The science behind the report:

Gain business insights faster with new Dell EMC servers and Microsoft SQL Server 2017 software

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 Gain business insights faster with new Dell EMC servers and Microsoft SQL Server 2017 software.

On April 17, 2018, we finalized the hardware and software configurations we tested. Updates for current and recently released hardware and software appear often, so unavoidably these configurations may not represent the latest versions available when this report appears. For older systems, we chose configurations representative of typical purchases of those systems. We concluded hands-on testing on May 3, 2018.

Our results

The table below presents our findings in detail.

	Query time (hh:mm:ss)	Drive read latency (ms)	Drive read throughput (MB/s)
Dell EMC™ PowerEdge™ R740xd	00:16:56	0.3	254
Dell EMC PowerEdge R720xd	02:49:29	36.0	439
Improvement (percentage)	90%	99%	42%

System configuration information

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

Server configuration information	Dell EMC PowerEdge R740xd	Dell EMC PowerEdge R720xd
BIOS name and version	Dell 1.3.7	Dell 2.6.1
Non-default BIOS settings	None	Virtualization enabled
Operating system name and version/build number	Windows Server® 2016 Standard, Version 1607, Build 14393.2155	Windows Server 2012 R2 Datacenter, Version 6.3, Build 9600
Date of last OS updates/patches applied	03/19/18	03/21/18
Power management policy	Performance	Performance
Processor		
Number of processors	2	2
Vendor and model	Intel® Xeon® Gold 6130	Intel Xeon E5-2640
Core count (per processor)	16	6
Core frequency (GHz)	2.10	2.50
Stepping	H0	C2
Memory module(s)		
Total memory in system (GB)	192	192
Number of memory modules	12	12
Vendor and model	Hynix HMA82GR7AFR8N-VK	Hynix HMT42GR7MFR4C-PB
Size (GB)	16	16
Type	DDR4-2666	PC3-12800R
Speed (MHz)	2,666	1,333
Speed running in the server (MHz)	2,666	1,333
Storage controller		
Vendor and model	Dell PERC H730P Mini	Dell PERC H710P Mini
Cache size (GB)	1	1
Firmware version	25.5.4.0006	21.3.5-0002
Driver version	6.604.06.00	6.805.03.00
Local storage (type A)		
Number of drives	2	24
Drive vendor and model	Dell ST300MP0026	Dell ST9300653SS
Drive size (GB)	300	300
Drive information (speed, interface, type)	15K, 12Gbps, SAS, HDD	15K, 6Gbps, SAS, HDD

Server configuration information	Dell EMC PowerEdge R740xd	Dell EMC PowerEdge R720xd
Local storage (type B)		
Number of drives	12	N/A
Drive vendor and model	Dell THNSF8960CCSE	N/A
Drive size (GB)	960	N/A
Drive information (speed, interface, type)	6Gbps, SATA, SSD	N/A
Network adapter		
Vendor and model	QLogic BCM57800 10 GbE	Intel Gigabit 4P I350-t rNDC
Number and type of ports	2 x 1GbE, 2 x 10GbE	4 x 1GbE
Driver version	7.13.104.0	12.14.7.0
Cooling fans		
Vendor and model	Nidec UltraFlo 4VXP3-X30	San Ace 60 9GA0612P1J611
Number of cooling fans	6	6
Power supplies		
Vendor and model	Dell D1600E-S0	Dell E1100E-S0
Number of power supplies	2	2
Wattage of each (W)	1,600	1,100

How we tested

We ran the TPC-H-like test from the HammerDB suite on a Dell EMC PowerEdge R720xd with 24 15K SAS HDDs. We first began by splitting up the disks into three RAID10 volumes. We used two disks for our OS volume, 16 disks for our Data volume, and six disks for our Log volume. We then moved the TempDB and TempLog files to the Data and Log volumes, respectively. We started testing with the R720xd, tuning the MAXDOP until the solution achieved its fastest result.

We then ran the same test using the same method on a PowerEdge R740xd server configured with two 300GB 12Gbps 15K SAS HDDs and 12 960GB 6Gbps SATA SSDs. We used the two HDDs in a RAID1 configuration for our OS volume, 10 SSDs in RAID10 for our Data volume, and the remaining two SSDs in RAID1 for our Log volume.

Installing Microsoft Windows Server 2012 R2 on the Dell EMC PowerEdge R720xd server

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. When prompted to boot from DVD, press any key.
6. When the installation screen appears, click My language is English (United States).
7. Leave the 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. Windows will begin and restart automatically.
14. At the Settings page, fill in the Password and Reenter Password fields with the same password.
15. Log in with the password you set up in the previous step.

Configuring Windows Update on the PowerEdge R720xd server

1. In the left pane of the Server Manager window, click Local Server.
2. Next to Windows Update in the main frame, click Not configured.
3. In the main pane of the Windows Update window, 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.

Disabling the Windows Update Service on the PowerEdge R720xd server

1. After you have installed all updates, press Start Menu, and type `Services`.
2. Scroll down, and right-click the Windows Update service.
3. Click Properties.
4. For the startup type, choose Disabled. If the service is running, stop it.
5. Click Apply.
6. Click OK to close the window.

Formatting a Windows NTFS volume for SQL Server® on the PowerEdge R720xd server

1. Right-click the start icon, and click Disk Management.
2. Right-click the disk, and click Online.
3. Right-click the disk again, and click Initialize.
4. Right-click an unallocated area, and select New Simple Volume.
5. Click Next.
6. Click Next.
7. Assign a letter path, and click Next.
8. Set the Allocation Unit Size to 64K, and name the volume `Label`.
9. Click Next.
10. Click Finish.
11. Repeat steps 1-10 on all Data and Log volumes.

Installing SQL Server 2008 R2 Standard on the PowerEdge R720xd

1. Mount the installation DVD for SQL Server 2008 R2 Standard.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, double-click on SQL Server 2008 R2 Standard DVD.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. Select Enter the product key, and enter the product key. Click Next.
6. Click to accept the license terms, and click Next.
7. Click Use Microsoft Update to check for updates, and click Next.
8. To install the setup support files, click Install.
9. If no failures appear, 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 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. In our tests, 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 to ensure 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.

Moving and expanding TempDB on the PowerEdge R720xd server

1. Open SQL Server Management Studio.
2. Expand Databases→System Databases
3. Right-click tempdb, and choose Properties.
4. Set location of tempdev to Data volume and templog to Log volume.
5. Click Files, and enter a new Initial Size (MB) for both files. The size required will depend on the scale of your TPC-H database. We set tempdev to 50 GB and templog to 20 GB to ensure ample space.
6. When the files have finished expanding, click OK.

Installing Windows Server 2016 on the PowerEdge R740xd server

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 UEFI Boot Menu.
4. Select the boot media, and press Enter.
5. When prompted to boot from DVD, press any key.
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 2016 Standard Edition (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. Windows will begin and restart automatically.
13. When the Settings page appears, fill in the Password and Re-enter Password fields with the same password.
14. Log in with the password you set up in the previous step.

Formatting a Windows NTFS volume for SQL Server on the PowerEdge R740xd

1. Right-click the start icon, and click Disk Management.
2. Right-click the disk, and click Online.
3. Right-click the disk again, and click Initialize.
4. Right-click an unallocated area, and select New Simple Volume.
5. Click Next.
6. Click Next.
7. Assign a letter path, and click Next.
8. Set the Allocation Unit Size to 64K, and name the Volume Label.
9. Click Next.
10. Click Finish.
11. Repeat steps 1-10 on all Data and Log volumes.

Installing SQL Server 2017 Standard on the PowerEdge R740xd

1. Attach the installation media ISO for SQL Server 2017 Standard to the host.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2017 Standard 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. Enter the SQL Standard license key, and click Next.
6. Click to accept the license terms, 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, 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 the TempDB tab.
16. Change the number of TempDB files to eight, and change its location to the Data volume.
17. Change the location of the TempLog file to the Log volume.
18. Click Next.
19. At the Ready to Install screen, click Install.
20. Close the installation window.
21. Download and install SQL Server Management Studio.

Expanding TempDB & TempLog files on the PowerEdge R740xd server

1. Open SQL Server Management Studio.
2. Expand Databases→System Databases.
3. Right-click tempdb, and choose Properties.
4. Click Files, and enter a new Initial Size (MB) for both files. The size required will depend on the scale of your TPC-H database. We set tempdev to 50 GB and templog to 20 GB to ensure ample space.
5. When the files are finished expanding, click OK.

Enabling Lock Pages in Memory

1. Click the Start menu, type `gpedit.msc`, and press Enter.
2. Once the Group Policy console opens, expand Computer Configuration→Windows Settings→Security Settings→Local Policies.
3. Select User Rights Assignment.
4. In the right-hand pane, double-click Lock pages in memory.
5. Click Add user or group.
6. Add the NT SERVICE\MSSQLSERVER account, and click OK.

Creating a TPC-H-like Database

1. Open SQL Server Management Studio.
2. Right-click Databases→New Database.
3. Name the database. We named ours tpch.
4. To add seven more database files, click Add.
5. Name the database files, and click OK.

Installing HammerDB

1. Download the latest version of HammerDB from www.hammerdb.com/download.html.
2. Double-click the .exe file, choose English, and click OK.
3. Click Yes.
4. Click Next.
5. Choose a destination location, and click Next.
6. Click Next.
7. Click Finish.

Generating the HammerDB TPC-H-like 300-scale database

We used the following steps to generate a 300-scale TPC-H-like database using HammerDB. For both solutions, we generated the data locally.

1. Open HammerDB, and click Options→Benchmark.
2. Choose MSSQL Server and TPC-H.
3. Expand SQL Server→TPC-H→Schema Build.
4. Double-click Options.
5. Choose 300 scale and the number of virtual users corresponding to the number of CPU cores. Click OK.
6. For the R740xd dataset, check the box for Clustered Columnstore.
7. Double-click Build. This build could take several hours to complete.
8. Using SQL Server Management Studio, perform a full backup of the database for restoring between test runs.

Performing the test

Using the legacy server as our base system, we ran the TPC-H-like test while increasing the degree of parallelism (DOP) on each run by one until the time to finish increased. We determined that a DOP of six was the ideal performance point on the legacy system, and MAXDOP of 24 was the ideal for the R740xd solution. Open HammerDB.

1. Select Options→Benchmark.
2. Choose MSSQL Server and TPC-H.
3. Expand SQL Server→TPC-H→Schema Build.
4. Double-click Options, and set the scale to 300.
5. If using the Legacy system, change the SQL Server ODBC Driver to SQL Server Native Client 10.0.
6. Click OK.
7. Expand Driver Script, and double-click Options.
8. Set MAXDOP to six (24 if running R740xd tests), and enable Refresh Function.
9. Click OK.
10. Double-click Load.
11. Expand Virtual User, and double-click Options.
12. Choose 1 Virtual User, and enable Show Output, Log Output to Temp, and Use Unique Log Name.
13. Click OK.
14. Double-click Create users.
15. Start a custom Perfmon data collector set to capture CPU, RAM, and disk performance counters.
16. To begin the Power Test run, click Start.
17. When the run finishes, stop Perfmon.
18. Save the HammerDB results text file and Perfmon output.
19. Open SQL Manager, delete the TPC-H-like database, and restore the database from the backup file.
20. Reboot the server.

Read the report at http://facts.pt/rviwgy ▶

This project was commissioned by Dell Technologies.

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