

Accelerating Microsoft SQL Server 2016 Performance With Dell EMC PowerEdge R740

A performance study of 14th generation Dell EMC PowerEdge servers for Microsoft SQL Server

Dell EMC Engineering
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Revisions

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Executive summary

Online transaction processing (OLTP) is one of the most ubiquitous workloads. Rapid growth of data and business demand to process massive amount of data at accelerated speeds calls for new technology and systems that deliver higher performance, greater agility, and extensive scalability.

Dell EMC offers compelling end-to-end solutions for customers to incorporate new technologies and remain current. These solutions, based on Dell EMC's 14th generation of PowerEdge servers and Dell EMC storage, help customers improve performance, lower total cost of ownership, and accelerate time to value for their business critical applications. One recent addition to the Dell EMC Solutions portfolio is the Microsoft SQL Server 2016 solution that delivers a number of new capabilities and benefits.

The Dell EMC PowerEdge R740 is one of the 14th generation of PowerEdge servers. It is a 2-socket, 2U rack server designed to run complex workloads using highly scalable memory, I/O, and network options. It has the optimal balance of resources to power the most demanding environments.

To help customers evaluate the PowerEdge R740 servers for Microsoft SQL Server environment, the Dell EMC Enterprise Solutions team conducted a performance study. Our results demonstrate that the PowerEdge R740 server, when compared to PowerEdge R730, delivers a 41% increase in transactions per second, a 50% increase in user load, and a 50% reduction in average query response time.

1 Introduction

Many organizations are undergoing a rapid digital transformation. To help customers with this transformation, Dell EMC has introduced a new generation of servers that are designed for modern IT infrastructure. The scalable business architecture of the 14th generation of Dell PowerEdge servers enables customers to scale efficiently and adapt quickly to dynamic business and workload needs. The 14th generation servers also provide intelligent automation for routine tasks, freeing up skilled resources for business critical tasks. Moreover, the 14th generation of Dell EMC PowerEdge servers protect organizations and their customers with sophisticated and integrated security features built into the server platform.

With high scalability, advanced processing, and intelligent automation, Dell EMC PowerEdge R740 servers take the database workloads to a new level.

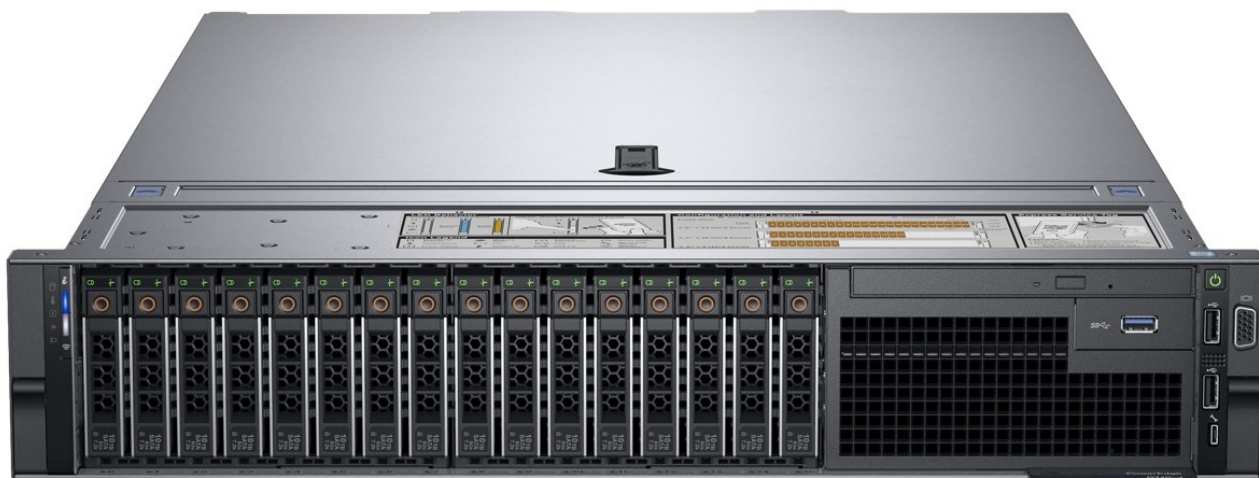


Figure 1 PowerEdge R740

Dell EMC Unity Storage systems are purpose built and available in all-flash and hybrid configurations. They are perfect for mid-sized deployments and high-performance environments.

To assist customers implementing Microsoft SQL Server 2016, the Dell EMC Enterprise Solutions team has designed and tested a solution consisting of Dell EMC PowerEdge R740, Dell EMC Networking S4048-ON, Brocade 6505 fiber-channel switch, and Dell EMC Unity 400 Storage.

1.1 Scope

This study examines:

- The performance of a SQL Server 2016 OLTP workload running on PowerEdge R740
- PowerEdge R740 as an appropriate computing platform for SQL Server 2016

1.2 Audience

This guide is intended for IT professionals, database administrators, and consultants interested in deploying SQL Server 2016 solutions using the latest Dell EMC PowerEdge R740 servers.

2 Solution overview

In this study, SQL Server 2016 was deployed on PowerEdge R740 server and Unity 400 storage. Figure 2 shows a logical diagram of the solution components.

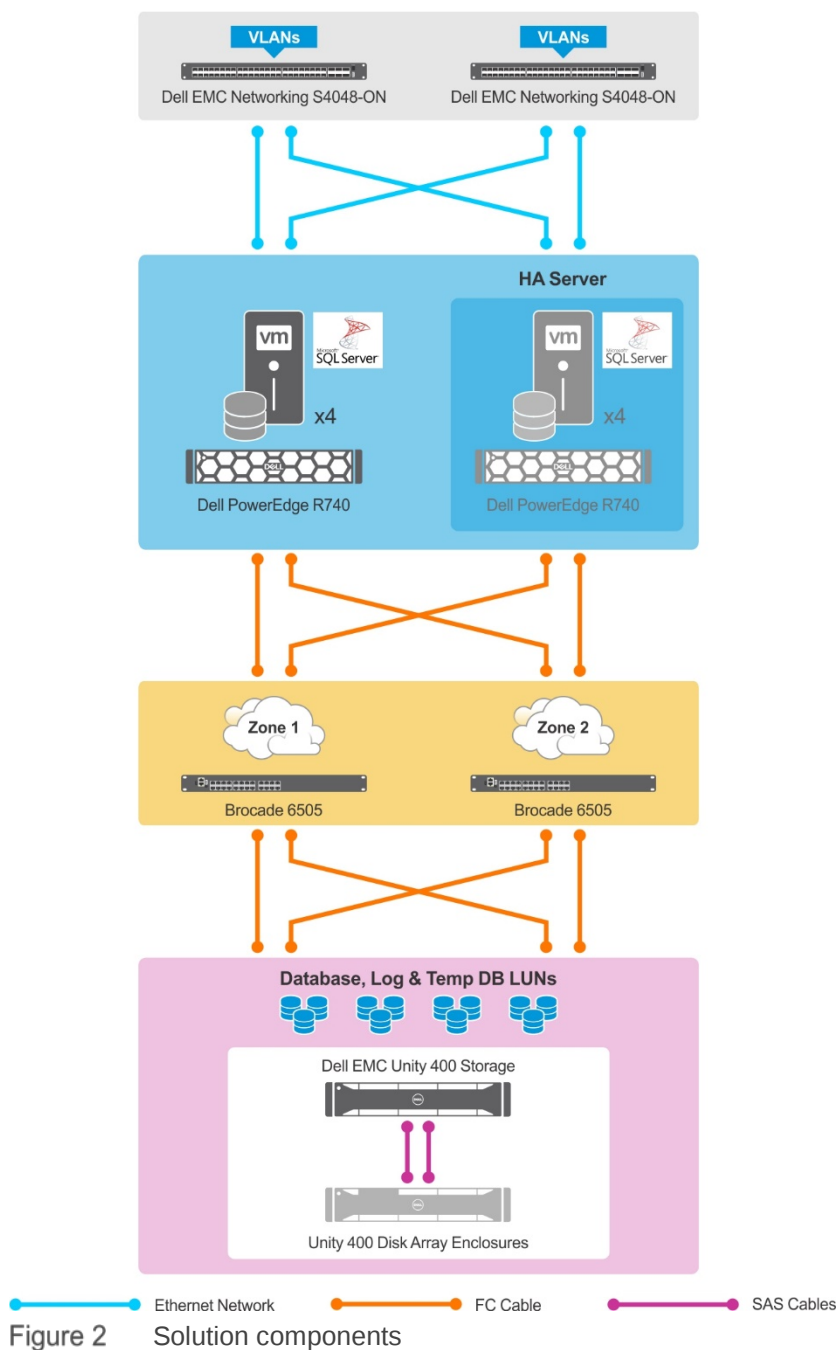


Table 1 Solution component details

Component	Description
BIOS	1.0.7
Processor	2 x Intel Xeon Platinum 8180 at 2.50 GHz, 28 cores
Memory	768 GB (24 x 32 GB 2666 MT/s DIMM)
Network interface	Broadcom 10Gb Ethernet BCM5720
FC HBA	2 X 16G Emulex LightPulse LPE31002 FC host bus adapter
Power supply units	2 x 1100 W
Operating system	Microsoft Windows 2016 Data Center Edition
Database	Microsoft SQL Server 2016 SP1 Enterprise Edition
Network switches	2 x Dell EMC Networking S4048-ON
FC switches	2 x Brocade 6505
External storage	1 x Dell EMC Unity 400 Storage 4 x Dell EMC Unity Storage Expansion Enclosures Drives: 18 x 6 TB NL-SAS 7.2K (performance tier) 25 x 400 GB SAS Flash 2 (extreme performance tier) 16 x 600 GB SAS 15K (capacity tier)

Table 2 Detailed specifications

Component	Specifications
PowerEdge R740 server	The PowerEdge R740 server is designed to run complex workloads in mid-sized and large enterprises, all in a 2U footprint. The R740 server: • Is a 2-socket server featuring the Intel Xeon Processor Scalable family with up to 28 cores • Uses highly scalable memory, I/O, and network options • Provides up to 80 TB of internal storage with sixteen 2.5" drives or eight 3.5" drives, ideal for database and business intelligence applications
Dell EMC Networking S4048-ON	10/40 GbE is a top-of-rack, high-density 1U switch with forty eight 10 GbE uplinks.
Brocade 6505	It supports a maximum of 24 ports and operates at a maximum speed of 16 Gbps, all in a 1U footprint. It comes with Gen 5 Fiber Channel and Brocade Fabric Vision technology.
Dell EMC Unity 400 Storage	Based on the powerful new family of Intel E5-2600 processors, Dell EMC Unity hybrid and all-flash storage systems implement an integrated architecture for block, file with concurrent support for native NAS, iSCSI, and Fibre Channel protocols. Each system leverages dual storage processors, full 12 Gb SAS back-end connectivity, and multicore architected operating environment to deliver unparalleled performance and efficiency. Additional storage capacity is added via Disk Array Enclosures (DAEs).

3 Performance benchmarking

This section talks about the benchmarking tool, performance metrics, and methodology used for the solution testing.

The overall testing process was divided into the following phases:

1. Finding the maximum OLTP performance delivered by SQL Server 2016 on the PowerEdge R740 server.
2. Conducting a comparative performance analysis of the PowerEdge R740 server and PowerEdge R730 server.

3.1 Performance benchmarking tool

Benchmark Factory is a simplified database benchmarking tool that allows users to verify database performance. Benchmark Factory can be used to conduct the following:

- Database workload generation
- Database code scalability testing
- Virtual user and transaction load simulation
- Industry standard benchmark testing

In this study, the TPC-E benchmark was used.

3.2 Performance metrics

For an OLTP environment, the most commonly used metrics are transactions per second (TPS) and average query response time (AQRT). Along with TPS and AQRT, CPU utilization and memory utilization data were also collected during the testing.

For an OLTP environment, it is important to define acceptable ranges for the above mentioned metrics. The acceptable values are:

Table 3 Acceptable ranges

Field	Range
TPS	Increasing TPS graph
AQRT	Lower than 25 milliseconds
CPU utilization	70%-80%

3.3 Test methodology

PowerEdge R740 and PowerEdge R730 were tested in a virtualized environment. Different combinations for number of VMs, vCPUs, and amount of memory per VM were tested. The highest performance was found with four VMs running simultaneously with 24 vCPUs and 160 GB memory per VM on PowerEdge R740.

The configuration details used in the benchmark testing are listed in the following table:

Table 4 Test configuration details for PowerEdge R740 and R730

Component	R740	R730
Logical CPUs	24 cores	18 cores
Memory for OS	160 GB	192 GB
Memory for SQL Server instance	128 GB	160 GB
Database size	600 GB	
Temp DB drives	100 GB LUN	
Database + log drives	800 GB LUN	
Virtual network interface	1	
Virtual FC channel ports	2	
Test workload	Quest Benchmark Factory TPC-E	
Scale factor	41	
User load	100-400	
Inter-arrival time	40 ms	

Note: During the testing, it was ensured that there were no storage bottlenecks.

4 Performance benchmarking results and analysis

This section talks about the performance results of PowerEdge R740 and performance comparison with PowerEdge R730.

4.1 Performance results of PowerEdge R740

The best performing test cases for PowerEdge R740 were explored and the metrics at saturated user loads for these environments were recorded.

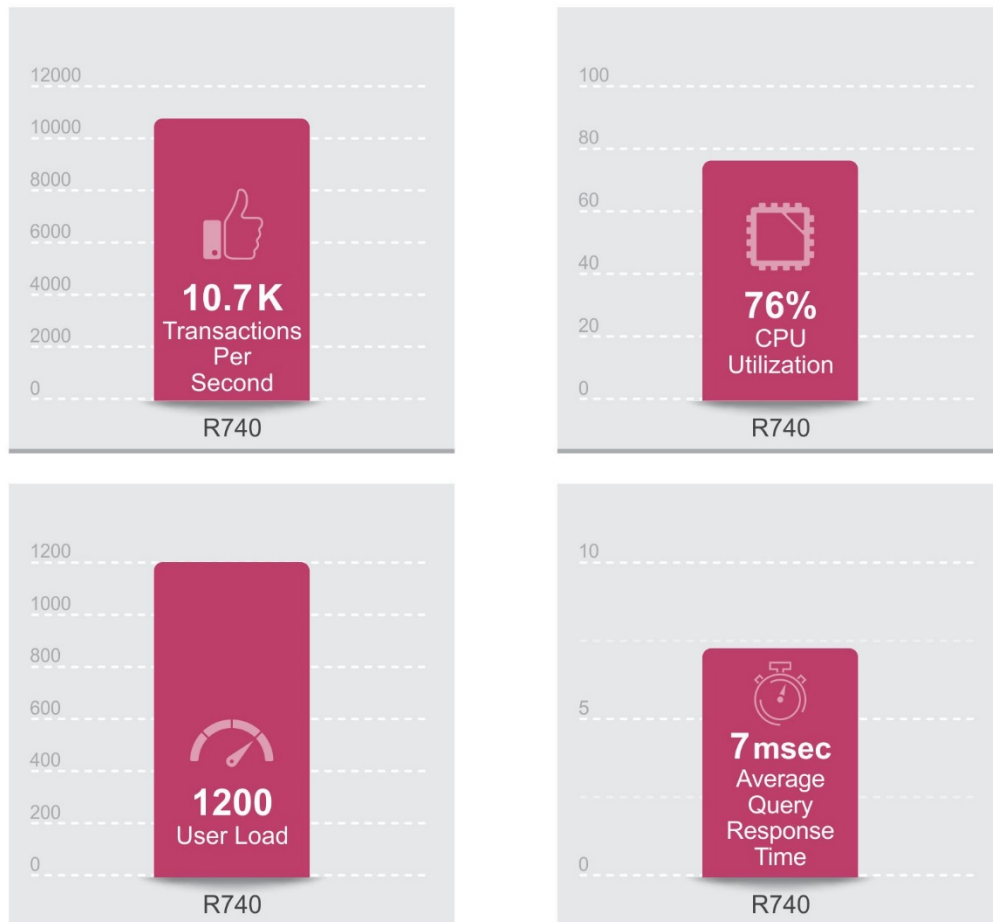


Figure 3 PowerEdge R740 performance results

4.2 Performance comparison between PowerEdge R740 and PowerEdge R730

PowerEdge R740 is the next generation successor of PowerEdge R730. PowerEdge R740 provides optimized performance for a multitude of workloads for small and medium-sized businesses.

The study compared the OLTP performance of SQL Server 2016 on PowerEdge R740 and PowerEdge R730. PowerEdge R740 shows a 41% increase in transactions per second, 50% increase in the user load, and a 50% reduction in the average query response time.



Figure 4 Performance comparison – SQL Server 2016 on PowerEdge R740 and PowerEdge R730

5 Conclusion

In this study, the performance of PowerEdge R740 running SQL Server 2016 OLTP workload was analyzed. The test environment was powered by Intel Xeon processor family and consisted of Dell EMC 14th generation PowerEdge R740 server, best-in-class Dell EMC Unity 400 Storage, Brocade 6505 fiber-channel switch, and Dell EMC Networking S4048-ON.

As shown in the results of the study, PowerEdge R740 supports up to 10,700 transactions per second with an average query response time (AQRT) of 7 milliseconds.

The study demonstrates significant performance improvements delivered by the latest generation of the Dell EMC PowerEdge servers. Our results indicate that the PowerEdge R740 server, when compared to PowerEdge R730, delivers a 41% increase in transactions per second, a 50% increase in user load, and a 50% reduction in average query response time.

Offering high performance and scalability, PowerEdge R740 is an ideal platform for OLTP workload with SQL Server 2016.

6 References

The following are resources referenced or recommended related to this study:

[TPC-E Standard Specification](#)

[Benchmark Factory User Guide](#)

[What's New in SQL Server 2016](#)

[Windows Server 2016](#)

[Dell EMC PowerEdge R740](#)

[Dell EMC Unity 400 Storage](#)