



Advantages of Dell PowerEdge R730 server over Dell PowerEdge R710 server—A statistical analysis & comparison after performing Database & Synthetic Benchmarks tests

This Dell technical white paper highlights the different tests performed (by simulating customer environment) to prove the advantages of Dell PowerEdge R730 server over Dell PowerEdge R710. Test results, data analysis, and implications are provided to showcase the advantages.

Dell Engineering
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Revisions

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Contents

- Revisions2
- Executive summary 4
- 1 Key findings.....5
 - 1.1 Database performance.....5
 - 1.2 Synthetic benchmarks5
- 2 Methodology 6
 - 2.1 Configurations 6
 - 2.2 Synthetic benchmarks..... 6
 - 2.3 Database testing 6
- 3 Synthetic benchmarks.....7
- 4 Database performance testing 9
 - 4.1 Online transaction processing (OLTP) workload 9
 - 4.2 OLTP Hardware configuration 10
 - 4.3 OLTP Database configuration 10
 - 4.4 OLTP results..... 11
- 5 Decision Support System (DSS) workload13
 - 5.1 DSS results13
- 6 Summary14



Executive summary

This Dell technical white paper compares the performance of the PowerEdge R710—the workhorse of many datacenters—against the PowerEdge R730 that uses the recently released E5-2600 v4 processors. Performance on synthetic benchmarks is first summarized, and then performance on OLTP and DSS database workloads is compared.

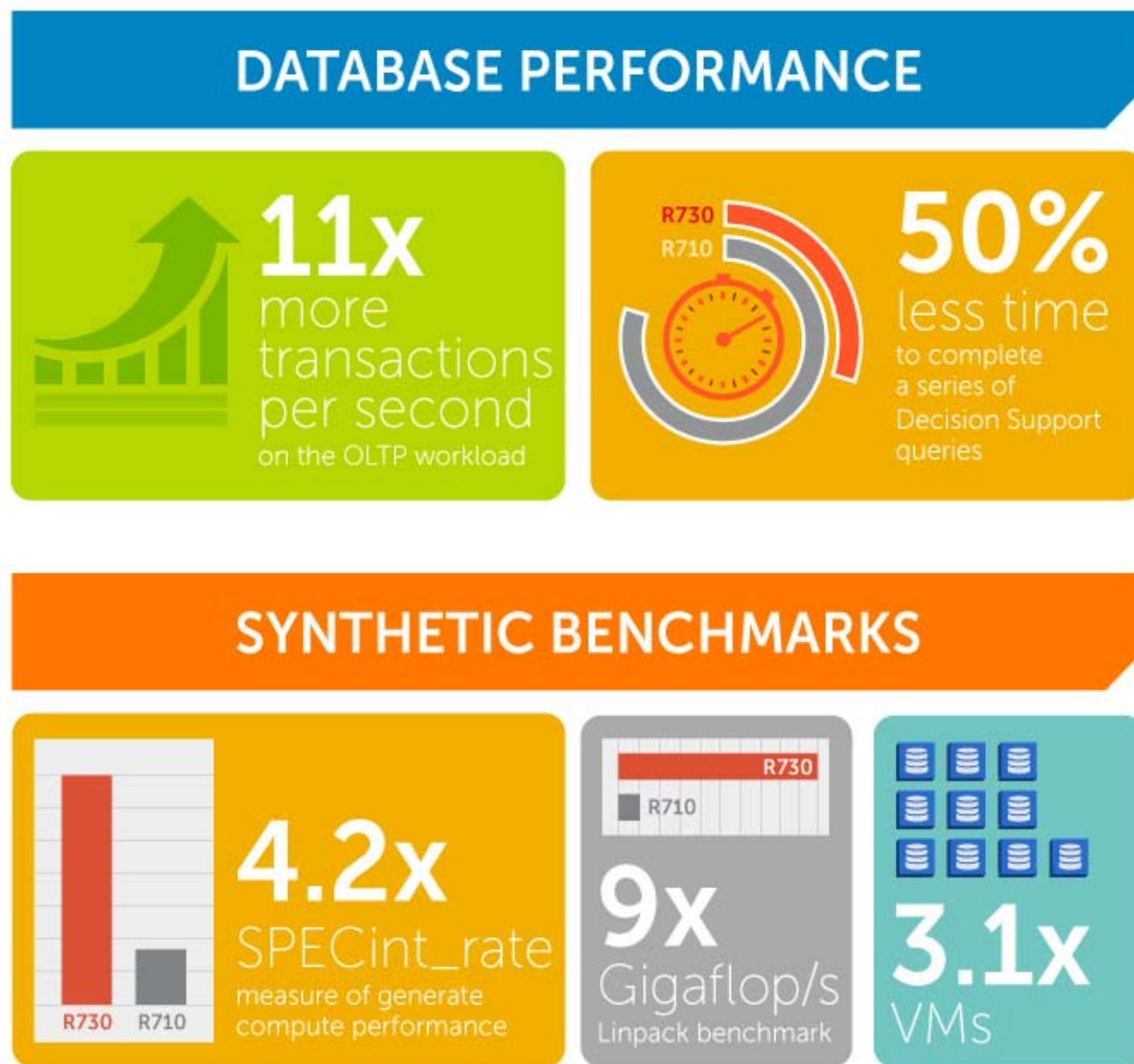


Figure 1 Advantages of Dell R730 PowerEdge Servers over Dell R710 PowerEdge Servers

1 Key findings

1.1 Database performance

- The PowerEdge R730 can complete 11 times as many transactions per second as the R710 on the OLTP workload.
- The PowerEdge R730 can complete a series of Decision Support queries in half the time that is taken by a R710 server.

1.2 Synthetic benchmarks

- The R730 scores 4.2 times higher than R710 in the SPECint_rate measure of generate compute performance.
- The R730 completes effectively 9 times more Gigaflops than R710 on the Linpack benchmark.
- The R730 can support 3.1 times as many virtual machines as the R710 as measured by the VMmark 2.x benchmark.



2 Methodology

The results of several industry standard benchmarks are compared between R710 and R730, highlighting the impressive performance improvements across the 11th and 13th generation PowerEdge servers. The systems were configured in a typical customer configuration where the performance of two additional database workloads are compared.

2.1 Configurations

2.2 Synthetic benchmarks

For the summary of synthetic benchmarks, the highest available published score for each platform was used to highlight the maximum score increase on each benchmark.

2.3 Database testing

For some server comparisons, it is a good practice to compare apples-to-Apples configurations, with equal number of CPU cores, equal memory capacity, and so on. For the database testing outlined in this white paper, an attempt was made to configure the test systems because they might be configured by a customer. For example, relatively low core count processors that are common in database installations were installed. The availability of low-cost solid state drives (SSDs) and automated tiering by using SanDisk DAS Cache software made the inclusion of an SSD on the R730 configuration an efficient option.



3 Synthetic benchmarks

The first comparison is the best available Benchmark results for a number of industry standard Benchmarks from both R710 and R730.

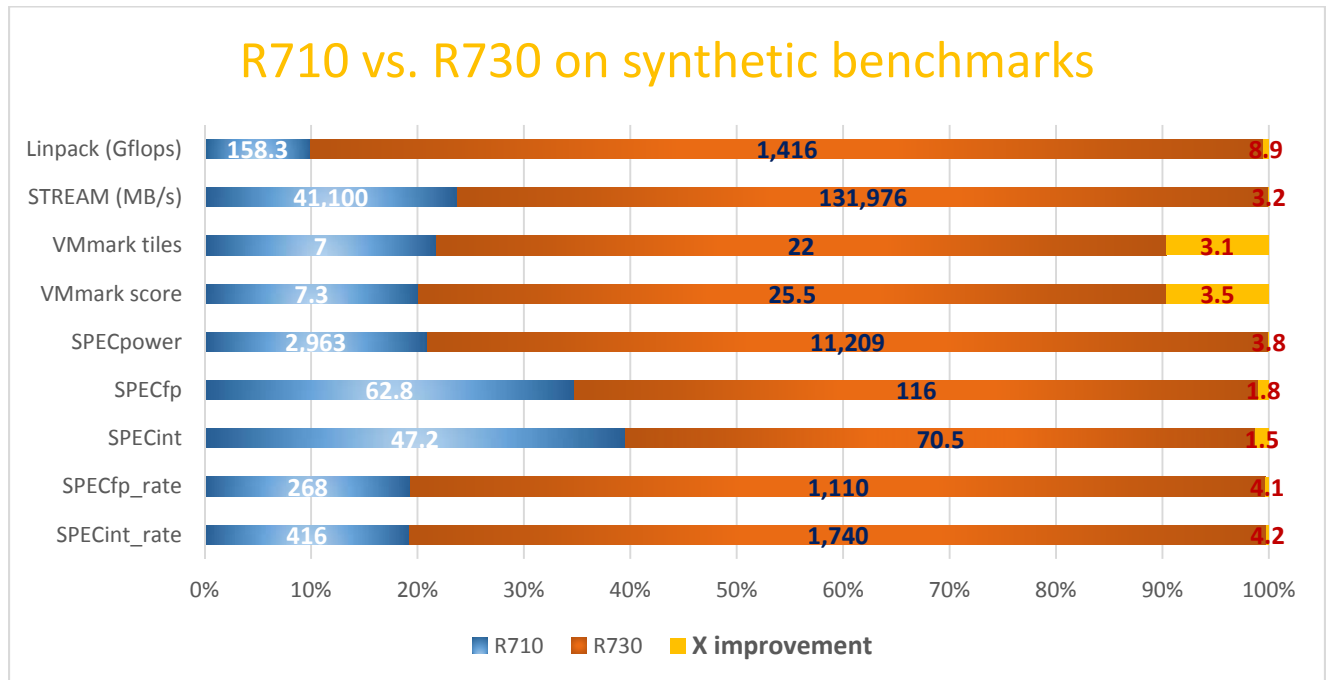


Figure 2 R710 vs. R730 on synthetic benchmarks

As shown in the table, improvements vary from 1.5 times higher score for the largely single-threaded SPECint benchmark to 4.2 times higher for the fully multithreaded SPECint_rate benchmark. The addition of AVX2 instructions that allow a single instruction to operate on multiple floating point data, result in an impressive almost 9X improvement in Linpack score.

R710			R730		
Benchmark	Processor	Result	Processor	Result	X improvement
SPECint_rate	Intel Xeon X5690	416	E5-2699 v4	1,740	4.2
SPECfp_rate	Intel Xeon X5690	268	E5-2699 v4	1,110	4.1
SPECint	Intel Xeon X5690	47.2	E5-2667 v4	70.5	1.5
SPECfp	Intel Xeon X5690	62.8	E5-2667 v4	116.0	1.8
SPECpower	Intel Xeon X5670	2,963	E5-2699 v4	11,209	3.8
VMmark score	Intel Xeon X5690	7.3	E5-2699 v3	25.5	3.5
VMmark tiles	Intel Xeon X5690	7	E5-2699 v3	22	3.1
STREAM (MB/s)	Intel Xeon X5690	41,100	E5-2699 v4	131,976	3.2
Linpack (Gflops)	Intel Xeon X5690	158.3	E5-2699 v4	1,416	8.9

The VMmark 2.x benchmark runs its workloads against a set of tiles, which are groups of eight virtual machines (VMs) running common applications such as a mail server, web 2.0 server and database, and an e-commerce system. The R730 server scores 3.5 times higher overall VMmark score, and the R730 can support 22 tiles (176 VMs) compared to only 7 tiles (56 VMs) on the R710.

The SPECpower score of the R730 is 3.8 times more than the R710, indicating that system energy efficiency has been improving right along with outright performance. This enables further datacenter capacity growth, infrastructure reduction, and reduces electricity and cooling costs during the lifespan of a server.



4 Database performance testing

The systems were configured (by using the two systems) in typical customer configurations to measure the performance improvement on database workloads.

4.1 Online transaction processing (OLTP) workload

Quest Software Benchmark Factory for Databases version 7.3 was used to generate a TPC-E database and test its performance. The definition of TPC-E from the Benchmark Factory for Databases User Guide:

The Transaction Processing Council is an organization that establishes transaction processing and database benchmark standards. For a complete overview and detailed explanation of the TPC-E Benchmark, refer to: TPC-E Benchmark. Transaction Processing Council testing results cannot be published as certified unless the testing procedure is audited and approved by the TPC organization. If not certified, the testing results can be published as a "TPC-E like" test.

The Benchmark page for the TPC-E Benchmark contains the following additional information about this workload:

The TPC-E benchmark simulates the OLTP workload of a brokerage firm. The focus of the benchmark is the central database that executes transactions related to the firm's customer accounts. Although the underlying business model of TPC-E is a brokerage firm, the database schema, data population, transactions, and implementation rules have been designed to be broadly representative of modern OLTP systems.

4.2 OLTP Hardware configuration

Detailed configuration for server nodes used in the OLTP comparisons

	Dell PowerEdge R710	Dell PowerEdge R730
Sockets/form factor	2 / 2U	2 / 2U
Processors	2 x Intel Xeon E5620 (4 cores, 8 threads)	2 x Intel Xeon E5-2620 v4 (8 cores, 16 threads)
Processor Frequency	2.4 GHz base / 2.66 GHz turbo	2.1 GHz base / 3.0 GHz turbo
Physical/logical cores	8 / 16	16 / 32
Processor TDP	80 W	85 W
Memory	8 x 2GB Dual Ranked DDR3 @ 1066 MT/s	8 x 4GB Single Ranked DDR4 @ 2133 MT/s
Hard drives	7 x 15K 300 GB SAS HDD	7 x 15K 300 GB SAS HDD 1 x 120 GB SATA SSD
Virtual disks on PERC	2 x HDD in RAID 1 (OS) 2 x HDD in RAID 1 (database) 2 x HDD in RAID 1 (DB logs) 1 x HDD hot spare	2 x HDD in RAID 1 (OS) 2 x HDD in RAID 1 (database) 2 x HDD in RAID 1 (DB logs) 1 x HDD hot spare 1 x SSD dedicated to SanDisk DAS Cache caching
Network	Quad port Broadcom Netxtreme BCM5709C (4 x 1 Gb)	Quad port Broadcom Netxtreme II BCM57800 (2 x 10 Gb, 2 x 1 Gb)
Storage controller	Dell PERC H700 with 512 MB cache	Dell PERC H730 with 1 GB cache
Operating system	Windows Server 2008 R2 SP2	Windows Server 2012 R2
Database	SQL Server 2012	SQL Server 2012

4.3 OLTP Database configuration

For the OLTP testing, a 50 GB SQL Server test database was used. This size database fits within the capacity of the 120 GB SSD used for SanDisk DAS Cache, which contributes to the large performance gains described later in this white paper. Customers with larger databases must increase the number and/or capacity of SSDs to achieve similar performance improvement.

To ensure the disk subsystem was being properly exercised in this test, SQL Server was limited to 2 GB of memory for its caching.



4.4 OLTP results

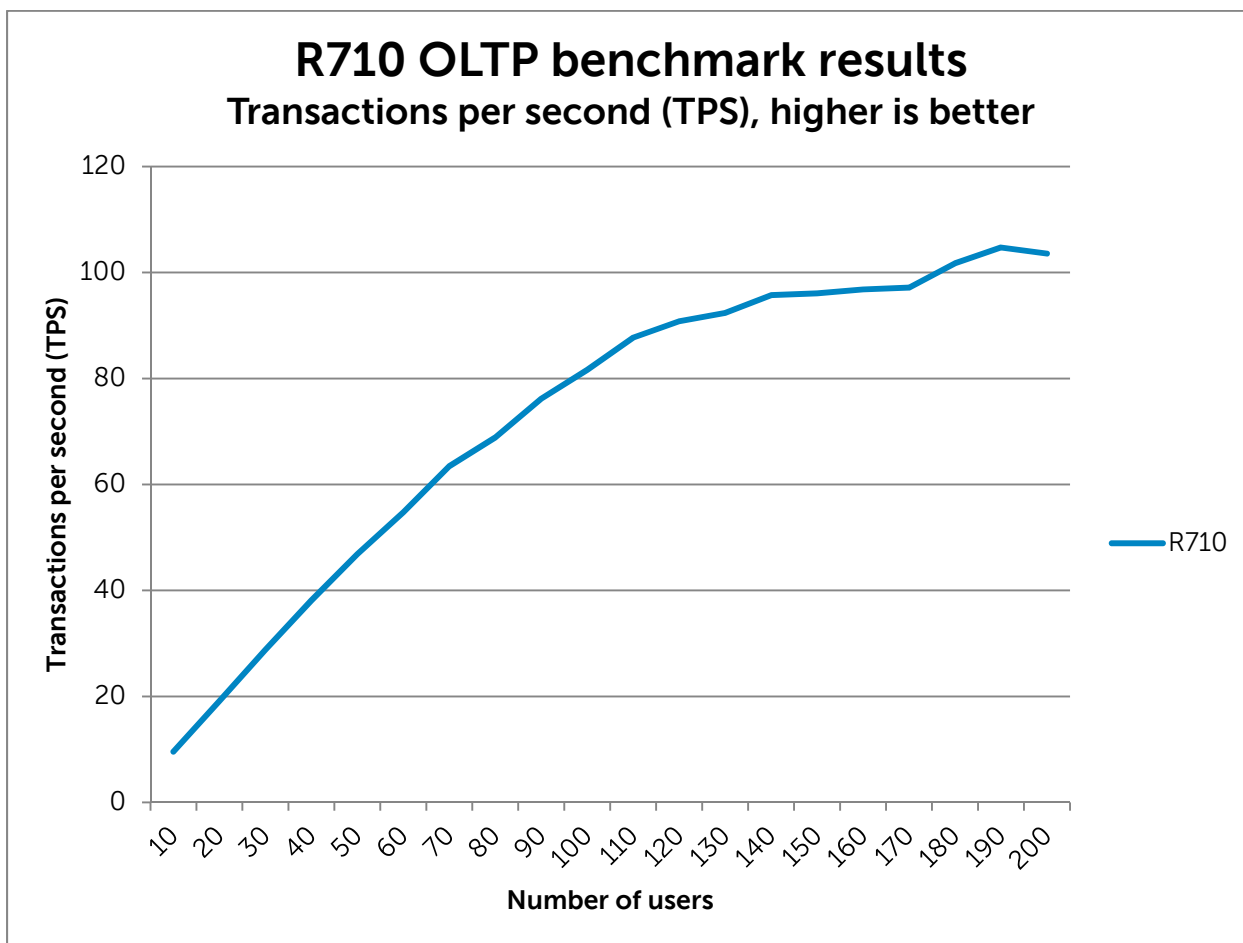


Figure 3 R710 OLTP OLTP Benchmark results

Benchmark Factory iterates through higher and higher number of benchmark users. Additional users generate increasingly higher number of Transactions per Second (TPS) to the database, and also generate increasing stress on the disk subsystem. Finally, the disk subsystem is saturated, and TPS from more users levels off or even reduces in its value.

This can be seen in Figure 3, where maximum TPS is achieved at 190 benchmark users, with a TPS of 105. While this performance meets expectations for a 5 year old server, Figure 2 below shows that running the same workload on R730 results in dramatically improved performance.

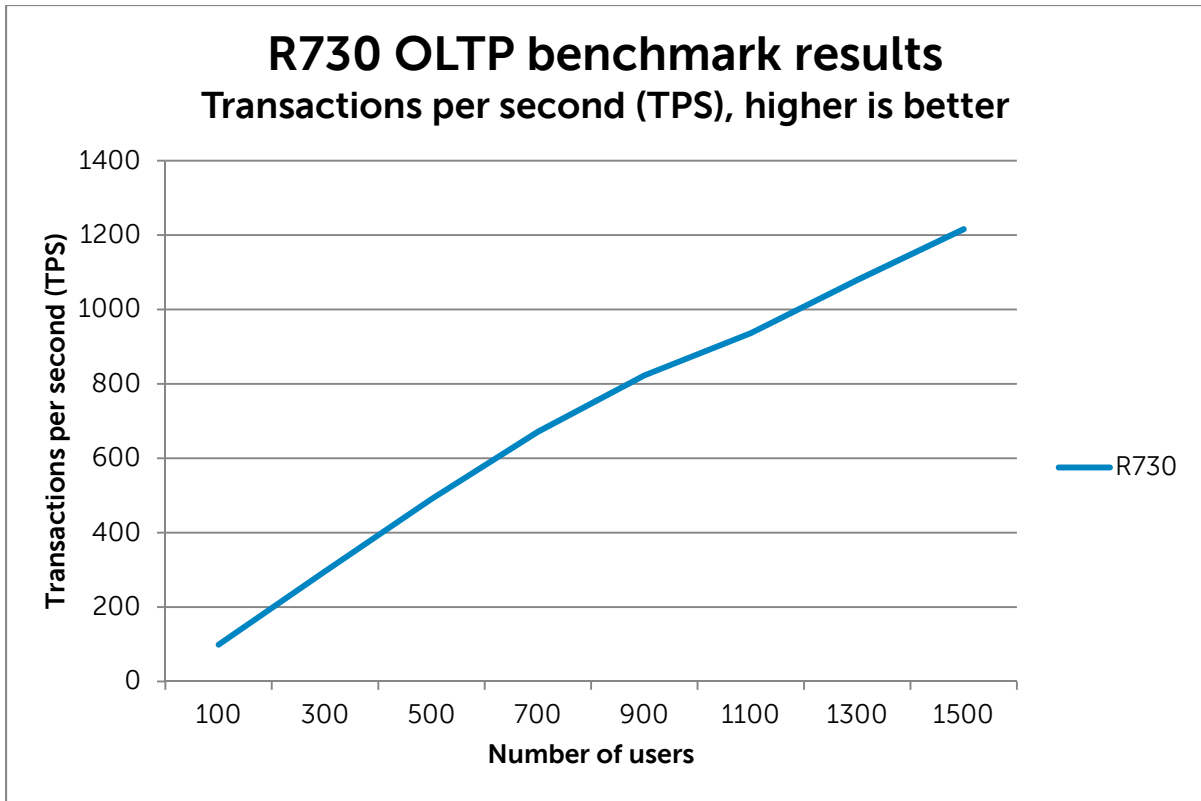


Figure 4 R730 OLTP Benchmark results

The R730 server can complete 1,216 TPS before its performance levels off—more than 11X improvement over 105 TPS recorded by R710. Also, this performance was achieved with 1500 Benchmark users, compared to 190 benchmark users for R710, for greater than 13X improvement.

Also, at these maximum TPS levels, the R730 server had an Average Response Time of 37 milliseconds, compared to 97 milliseconds of R710.

5 Decision Support System (DSS) workload

To compare performance on a DSS workload, the freely available HammerDB database testing application was used. HammerDB can generate a series of ad-hoc queries on the database that are intended to mimic the workload used in the TPC-H Benchmark—although the results are not directly comparable to the officially published TPC-H results.

To ensure that the 30 GB database would fit entirely in memory, both systems were upgraded to 64 GB of system memory for this test. SQL Server was allowed to use all available system memory for this test.

5.1 DSS results

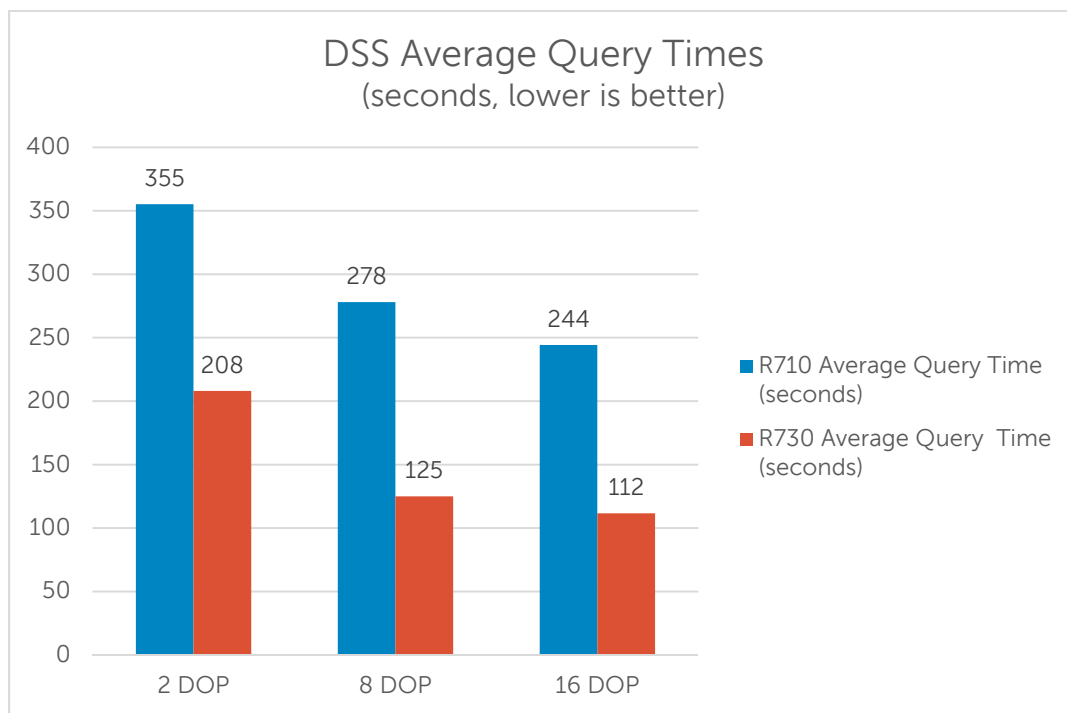


Figure 5 DSS Average Query Time (AQT)

The DSS workload can increase the number of concurrent queries by increasing the Degree of Parallelism (DOP) value. Testing started at 2 DOP, increased to 8, and then to 16.

As shown in figure 6, at the baseline 2 Degrees of Parallelism (DOP), the R730 executes the set of queries in an average of 208 seconds, or 41% less time than the 355 seconds required by the R710. As the DOP is increased to 8, the workload completes in 55% less time than the R710, or less than half the time. With a DOP of 16, R730 still executes the workload in half the time.

This processor-bound in-memory database shows the benefits that can be achieved by the E5-2600 v4 processors, providing twice as many processor cores while still fitting within a similar 85W TDP envelope.

6 Summary

The synthetic Benchmarks all indicate impressive improvements across server generations. SPECint_rate, commonly used to stand for general business compute power, is 4.2 times higher on the R730 than on the R710, and the addition of AVX 2 instructions on the E5-2600 v4 processors lead to an impressive improvement of almost 9 times higher on Linpack. The VMmark results show that an R730 can accommodate as much as 3 times as many heavily loaded virtual machines.

In more database scenarios, the additional processor power and the addition of a single low-cost SSD for tiering provided an 11 times improvement in Transactions per Second on the OLTP workload. The additional cores on the R730 let it complete the DSS workload in 55% less time than the R710.

These measurements will be helpful to customers with a fleet of PowerEdge R710 or similar servers, and will help them understand the additional performance and improved power efficiency that can be achieved by migrating their data centers to the Dell PowerEdge R730 server.

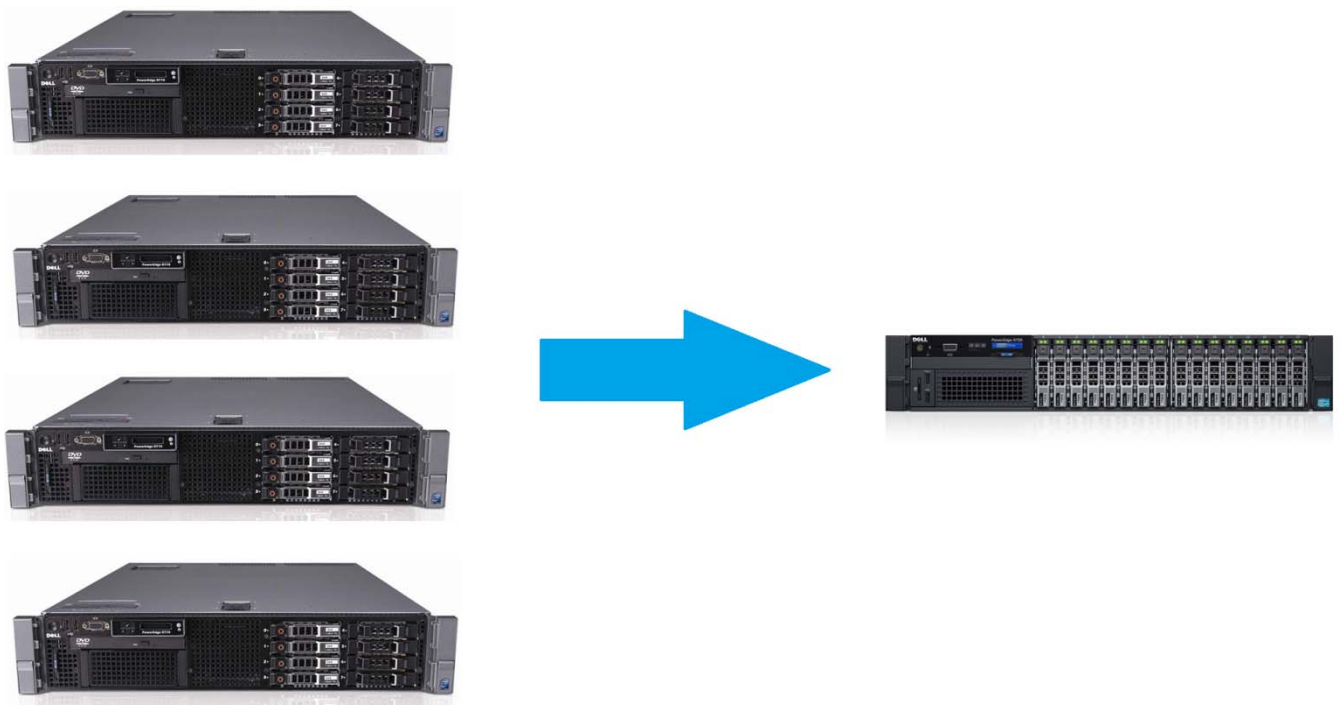


Figure 6 For the same workloads, the compute power of four PowerEdge R710 can be handled by a single PowerEdge R730 server.