TEST REPORT

Tolly.

#223125

July 2023

Commissioned by

Dell, Inc.

Dell PowerEdge R760 Rack Server & Emulex LPe36002 Host Bus Adapter

64G Fibre Channel Enables up to 4:1 Application Server Consolidation

EXECUTIVE SUMMARY

New generation technology can be expected to improve performance. There are times, however, when multiple technology advances can combine to provide an outsized advantage. Such is the case when the Dell PowerEdge R760 Rack Server is combined with the Broadcom Emulex LPe36002 64G Fibre Channel Host Bus Adapter.

Dell commissioned Tolly to benchmark the database performance of the Broadcom Emulex LPe36002 64G Fibre Channel dual-port host bus adapter (HBA) running in the Dell PowerEdge R760 Rack Server and compare that to the same combined workload performance running in four separate, R740-class servers each outfitted with a 16G FC HBA as was standard with that server generation.

Tests showed that the new R760 Intel Eagle Stream-based platform's increased CPU power and improved memory performance/capacity provide an environment where the database application can push the Emulex 64G FC HBA to full line rate performance of 64GFC thus matching the combined application throughput of four R740-class Purley platform servers using 16G FC HBAs. See Figure 1.

THE BOTTOM LINE

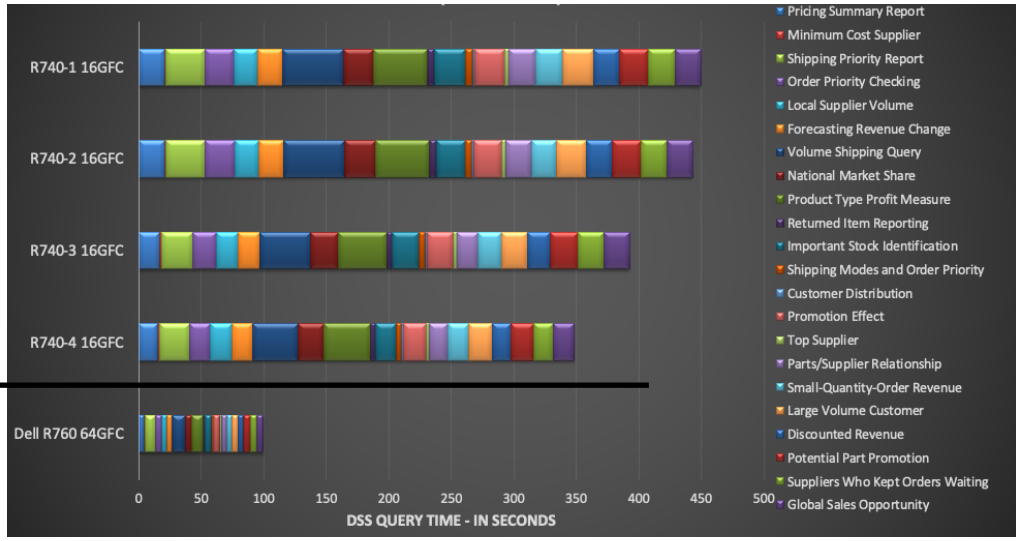
Dell PowerEdge R760 & Emulex LPe36002 64G HBA benefits over older generation with 16G HBAs:

1. 1x R760 with 64GFC HBA can achieve same TPROC-H query throughput compared to 4x R740-class servers with 16GFC HBA
2. Consolidating Oracle DSS workloads from 4 R740 servers with 16GFC HBA to a single R760 with 64GFC can significantly reduce I/O bound TPROC-H query time

Dell R760 & Emulex LPe36002 64G HBA Oracle Database 19c
Query Time Improvement: Dell PowerEdge R760 vs 4 Dell PowerEdge R740 Class Servers
(as reported by HammerDB TPROC-H v4.7)

Bars above the black line show the run times of four separate R740-class servers with 16G FC running against a single data store.

Bar below the black line shows the R760 with 64G FC running the same test against the same data store.



Notes: R740 servers were all "Purley-class" machines with the same generation Intel CPU and 16G Fibre Channel adapters.
Source: Tolly, June 2023

Figure 1

Overview

The goal of this test was to illustrate, simply, that a single Dell PowerEdge R760 Rack Server using a single port of a PCIe 4.0-based, dual-port Emulex 64G FC can equal the I/O throughput of four individual, older generation, R740-class servers each using a single port of a 16G FC HBA.

The R740-class servers use older, less powerful CPUs and use 16G FC HBAs that offer, at best, 25% of the 64G FC HBA's throughput. The HBAs are constrained by the bandwidth of the PCIe 3.0 bus architecture which would limit the benefits of using the higher FC speed HBAs in the older servers.

The broader point is that this significant performance improvement means that, for I/O-bound applications, a single Dell PowerEdge R760 Rack Server can be used to replace and consolidate the workloads and operating expenses of up to four older servers.

Test Background & Results

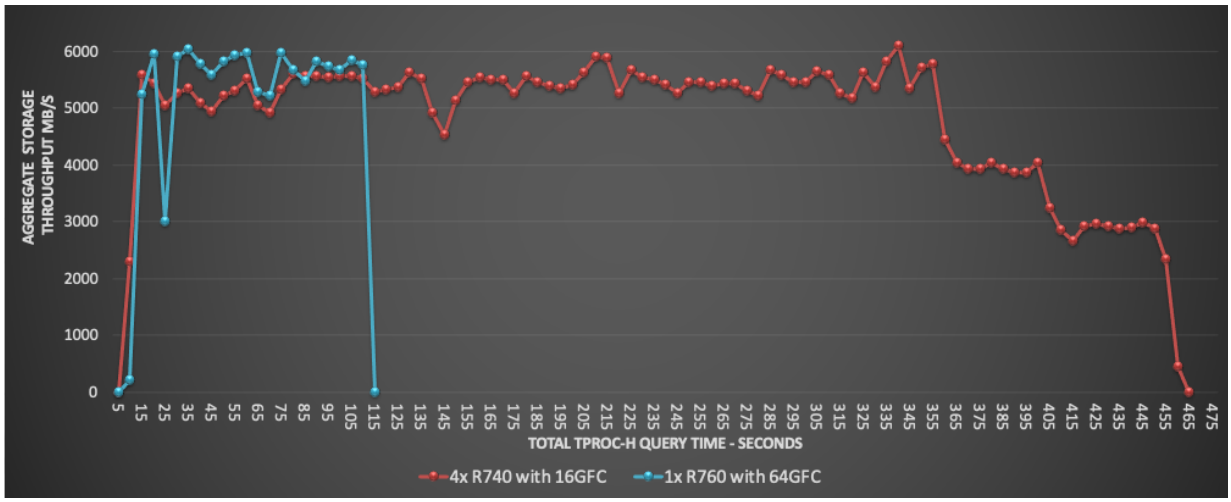
The same test was run on all of the servers and consisted of running the TPROC-H analytics workload of HammerDB.[1] The tests were run using the Oracle 19c database environment but the results are generally applicable to any database or other input/output intensive workload.

The TPROC-H workload measures how long it takes to run a series of 22 different types of decision support queries. This type of workload is "read only" with no database updates taking place.

The test was run using two different scenarios. In the first scenario, four of the older servers ran the HammerDB benchmark simultaneously against the same Dell data store. In the second scenario, the single Dell PowerEdge R760 ran the benchmark against the same data store.

Figure 1, above the horizontal dividing line, summarizes results of the first scenario. Because those servers were using 16G FC HBAs, 16G was the theoretical maximum for network I/O and, thus a potential bottleneck for each server. As each server finished the test, the reduced load on the target data store allowed subsequent server's tests to run more quickly. The fastest completion time was 335 seconds and

Dell R760 & Emulex LPe36002 64G HBA Performance Improvements
Query Time vs. Disk I/O: Dell PowerEdge R760 vs 4 Dell PowerEdge R740 Class Servers
(as reported by HammerDB TPROC-H v4.7)



Source: Tolly, June 2023

Figure 2

[1] https://www.hammerdb.com/docs/ch11.html

the slowest was 448 seconds with the average being 405.5 seconds.

Figure 1, below the horizontal dividing line, summarizes results of the second scenario. Here, a single Dell PowerEdge R760 Rack Server outfitted with an Emulex 64G FC HBA was able to complete the same test in 99 seconds. This illustrates that the R760 could take on the full load of four servers running this type of workload.

Figure 2 shows the results of the same two scenarios overlaid and measured in terms of disk I/O over the course of the tests. The red dots represent the combined disk I/O of all four older generation servers. The blue dots represent the single Dell PowerEdge R760 Rack Server. The disk throughput of the single R760 at 64G matches or exceeds the combined throughput of the four 16G servers.

Figure 3, below, illustrates the networking flow of the four older generation servers, in blue, and the Dell PowerEdge R760, in red, across the Broadcom Brocade 64G Fibre Channel switch

Test Setup & Methodology

The HBA under test used current production drivers that are publicly available. Default settings were used. Details of the test environment and systems under test are found in Tables 1-10. Figure 3 shows a composite test environment.

Dell, Inc.

Dell PowerEdge R760 & Emulex LPe36002 HBA

64G FC Application Server Consolidation

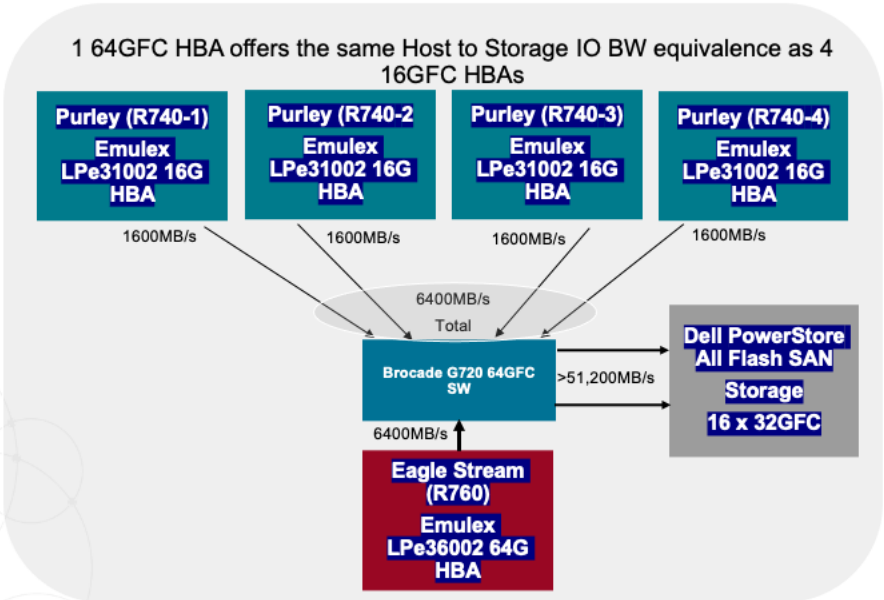
Tested June 2023

Server systems were all VMware ESXi 8 hosts running ESXi-8.0U1-21495797 (8U2 GA). Storage volumes mapped to each VM were configured as thick provisioned, eagerly zeroed. PVSCSI controller was used.

Each VM was assigned 100GB of memory and 40 vCPUs. Each VM was running RHEL 8.8

Details of the HammerDB tests are found in the "Test Background & Results" section above.

Application Server Consolidation Test Bed Topology



Source: Tolly, June 2023

Figure 3

Test Configuration Summary - 1 of 2

64G HBA Under Test

Vendor	Product Name	Bus Architecture	Firmware	Driver
Broadcom	Emulex LPe36002	PCIe 4.0	14.2.455.15	14.2.560.8

Table 1

R760 Server Configuration

Vendor/System	Dell PowerEdge R760
CPU	2 socket Intel(R) Xeon(R) Platinum 8468 @ 2.1 GHz
Number of CPUs	96
Memory (RAM)	512 GB
OS	Red Hat Ent. Linux 8.7 (RHEL8)
Kernel	4.18.0-425.3.1

Table 2

Database Test Tool

Vendor	Open Source
Application	HammerDB 4.7
TPROC-H settings	Degree of parallelism = 32 Scale factor = 3 Virtual users = 1 Ramp-up time: 2 minutes Run time: 5 minutes

Table 3

Oracle Database Configuration

Database	Oracle Database 19c (19.3)
Storage	Oracle Grid 19c, ASM disk group with external redundancy, 1 namespace for data
Dataset Size	40GB
Database Settings	SGA = 12000 MB PGA = 4000 MB Block size = 8 KB

Table 4

Storage Configuration

Vendor/Device	Dell PowerStore 7000T v3.2.0.1
Ports	16 x 32G FC
Volumes	2 x NVMe: 200 GB and 1 TB
Performance Policy	High
Namespace/LUN	8 x 32G Target ports per Namespace
Network Fabric	Brocade G720 64G FC Switch v9.1.1

Table 5

Source: Tolly, June 2023

Test Configuration Summary - 2 of 2

16G HBA Under Test

Vendor	Product Name	Bus Architecture	Firmware	Driver
Broadcom	LPe31002	PCIe 3.0	14.2.455.11	14.2.560.8

Table 6

R740 Class Server Configuration	Host 1
CPU	2 socket Intel(R) Xeon(R) Gold 6146 @ 3.2GHz
Number of CPUs	24
Memory (RAM)	128 GB

Table 7

R740 Class Server Configuration	Host 2
CPU	2 socket Intel(R) Xeon(R) Platinum 8176 @ 2.10GHz
Number of CPUs	56
Memory (RAM)	128 GB

Table 8

R740 Class Server Configuration	Host 3
CPU	2 socket Intel(R) Xeon(R) Platinum 8176 @ 2.10GHz
Number of CPUs	56
Memory (RAM)	128 GB

Table 9

R740 Class Server Configuration	Host 4
CPU	2 socket Intel(R) Xeon(R) Gold 6148 @ 2.40GHz
Number of CPUs	40
Memory (RAM)	128 GB

Table 10

Source: Tolly, June 2023

About Tolly

The Tolly Group companies have been delivering world-class IT services for over 30 years. Tolly is a leading global provider of third-party validation services for vendors of IT products, components and services.

You can reach the company by E-mail at sales@tolly.com, or by telephone at +1 561.391.5610.

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Broadcom Emulex LPe36002

The Broadcom Emulex LPe36000-series Gen 7 Fibre Channel HBAs are designed for demanding mission-critical workloads and emerging applications. The family of adapters features Silicon Root of Trust security, designed to thwart firmware attacks aimed at enterprises and governments.

Gen 7 64G provides seamless backward compatibility to 32G and 16G networks.

Dell sells the LPe36002 64G HBA for the same price as the 32G model.

Terms of Usage

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