Accelerating SQL Server 2016 with Dell PowerEdge R930 and Emulex Fibre Channel

32GFC provides performance boost for SQL Server 2016 data warehousing workloads.

Executive Summary

Large enterprises choose four-socket servers to power their most demanding workloads, including big data analytics and dense virtualization deployments. The latest Dell PowerEdge R930 four-socket server leverages the current Intel® Xeon® E7 v4 processor family to deliver the highest levels of performance.

Concurrently, datacenters are pairing their high-performance Dell 4-socket servers with solid-state (flash) storage systems to improve storage performance so that it matches the performance of the new servers. Fibre Channel is primarily selected as the host interface to meet their flash storage requirements. In many cases, however, deploying solid-state storage often moves the performance bottleneck to the storage network. This situation often drives users to seek higher performance from their storage network infrastructure.

Dell commissioned Demartek to evaluate its PowerEdge R930 server connected to a Dell Storage SC9000 all-flash storage array with 24 SSDs using three different generations of Emulex Fibre Channel (FC) adapters in a SQL Server 2016 database data warehousing environment.

We found that the combination of the new Dell PowerEdge R930 server, Dell Storage SC9000 all-flash array and Emulex Gen 6 (32GFC) HBAs provided the performance needed to alleviate network bottlenecks that can be caused by all-flash arrays and dramatically improve data warehousing application performance.

Key Findings

> The Dell PowerEdge R930 with Emulex LPe32000 32GFC adapter connected to the Dell SC9000 all-flash array completed the SQL Server 2016 decision support workload in 70% less time than with the legacy 8GFC adapter.

> The Dell PowerEdge R930 with Emulex LPe32000 32GFC adapter connected to the Dell SC9000 all-flash array completed the SQL Server 2016 decision support workload in 46% less time than with the 16GFC adapter.

> Using the Emulex LPe32000 32GFC adapter achieved an average of 285% greater throughput for the SQL Server 2016 decision support workload than the legacy 8GFC adapter.

> Using the Emulex LPe32000 32GFC adapter achieved an average of twice the throughput for the SQL Server 2016 decision support workload than the 16GFC adapter.

Dell PowerEdge R930 Server

The PowerEdge R930 with Microsoft SQL Server 2016, as well as its built-in high performing data warehouse, has the processing power required for virtualization and memory-intensive application workloads for databases. In order to scale performance to meet the demands of almost any workload, the PowerEdge R930 supports:

> Intel® Xeon® E7 v4 processor family with up to 24 cores per processor, totaling 96 processing cores with all four processors

> 96 DDR4 2400 MHz DIMM slots with up to 6 TB of available memory, or a lower total if lower-cost, smaller DIMMs are deployed

> Up to ten PCIe 3.0 slots, including up to six x16 slots

> Up to eight NVMe PCIe SSDs plus sixteen 2.5-inch hot-swappable hard disk drives or SSDs, or up to twenty-four hot-swappable hard disk drives or SSDs

> Up to four power supplies, either in non-redundant, redundant or fail-over configurations

Dell Storage SC9000 All-flash Array

The Dell Storage SC9000 all-flash array supports high-end workloads through its dual-controller design and scale-up capabilities. The SC9000 includes:

> 6 to 960 drives per array, 3 PB max capacity

> Up to 20 16Gb Fibre Channel host ports

> Up to 20 10GbE iSCSI host ports (SFP+/BASE-T)

> 12Gb SAS back-end expansion

> Intelligent compression, deduplication, RAID tiering and thin provisioning

> Multi-array federation and auto-failover

> Synchronous/Asynchronous replication

> Lifetime SSD warranty with comprehensive coverage against wear-out

> Optional FIPS-certified self-encrypting SSDs

Emulex 32Gb Fibre Channel Adapter Models

Emulex 32Gb Fibre Channel (FC) HBAs deliver 2x greater bandwidth than the previous generation – 12,800MBps (2 ports, 32G, full duplex) – as well as less than half the latency and up to 1.6 million IOPS on a single port. Emulex FC HBAs available from Dell include single and dual-port models.

The Emulex 32GFC and 16GFC adapters feature the Emulex Dynamic Multi-core Architecture that delivers optimum I/O performance by dynamically applying ASIC resources to either a single active port or across both active ports, as demanded by the workload. This ensures that performance is delivered when and where needed, to meet service level agreements (SLAs).

Supported Speeds

The Emulex LPe32000-series adapters support 32GFC, 16GFC and 8GFC link speeds, automatically negotiated.

The Emulex LPe31000-series adapters support 16GFC, 8GFC and 4GFC link speeds, automatically negotiated.

SQL Server 2016

The total cost of ownership (TCO) advantages of Microsoft SQL Server 2016 include a number of built-in features that cost extra with other commercial database products. These built-in features include in-memory databases, end-to-end security, advanced analytics and complete mobile business intelligence.

The integrated, in-memory persistent Columnstore features of SQL Server 2016 reduce the storage footprint while delivering significantly higher analytics performance.

Always Encrypted is a feature designed to protect sensitive data in SQL Server databases. Data is protected transparently by automatically encrypting and decrypting sensitive data in the client application, limiting data access only to data owners, not system administrators.

Test Results

The primary workload used for these tests was a data warehousing application workload running on SQL Server 2016. This read-intensive data warehousing workload is also known as a decision support application because it gives answers to critical business questions. It consists of a fixed set of 22 queries of relatively high complexity presented to a large database that examines large volumes of data.

Because this is a fixed set of work, any improvements in infrastructure such as faster Fibre Channel host bus adapters (HBAs) will result in completion of the work in a smaller amount of time.

The business benefit of this is demonstrated in a faster time to extract business insights from the decision support application.

We compared the performance of this data warehousing workload with three Emulex adapters. The same operating system (Windows Server 2012 R2), the same database software (SQL Server 2016) and the same application workload settings were used for all three tests:
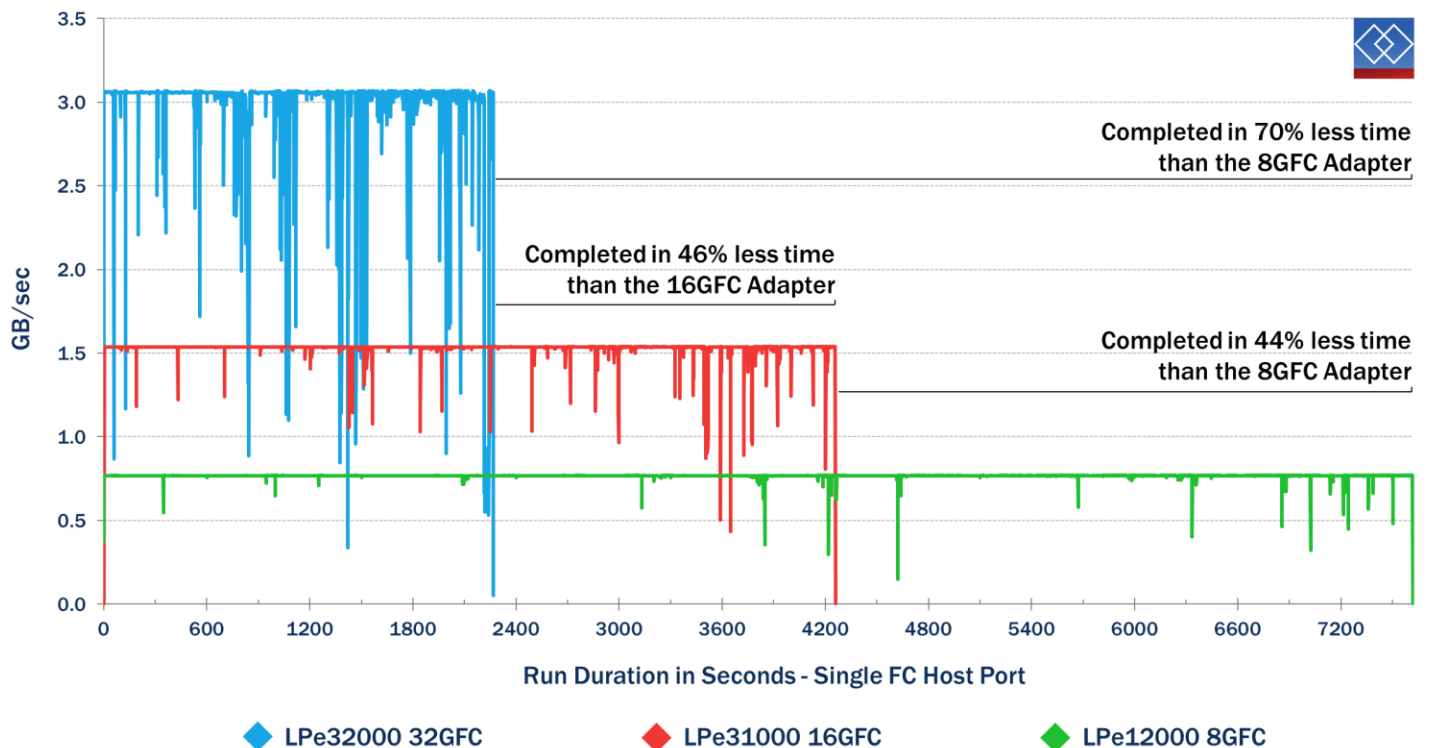
> Emulex LPe12002 – 8GFC

> Emulex LPe31002 – 16GFC

> Emulex LPe32002 – 32GFC

Throughput

When using real database workloads, the I/O rate varies as the workload progresses because the application is not only issuing I/O requests but is also consuming varying amounts of host CPU and memory resources.

In our tests, we achieved full line rate for each of the adapters, but the amount of time to complete the workload was much faster for the LPe32002 (32GFC) adapter than the other adapters, as shown in the chart.

HBA Throughput Profile - Data Warehousing Run
Dell R930, SQL Server 2016, 5 Concurrent Users

Completed in 70% less time than the 8GFC Adapter

Completed in 46% less time than the 16GFC Adapter

Completed in 44% less time than the 8GFC Adapter

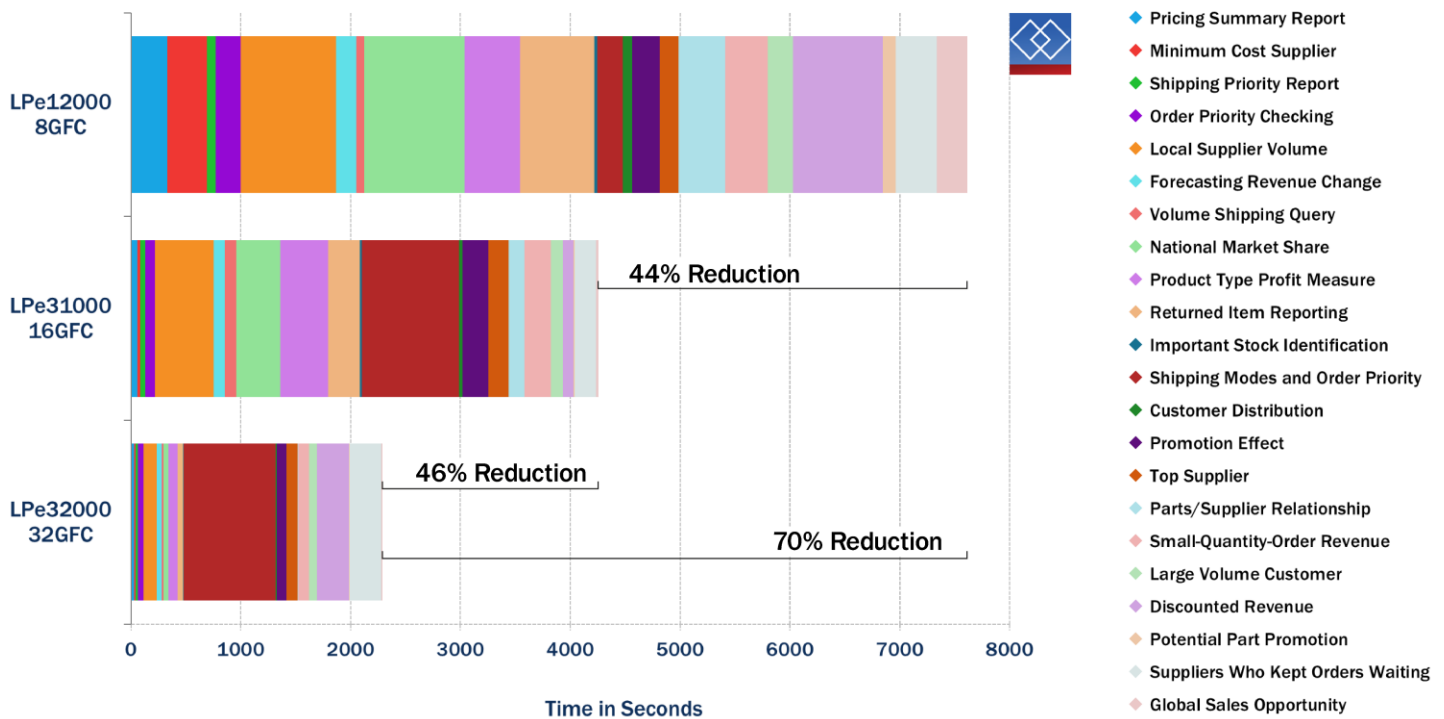◆ LPe32000 32GFC   ◆ LPe31000 16GFC   ◆ LPe12000 8GFC
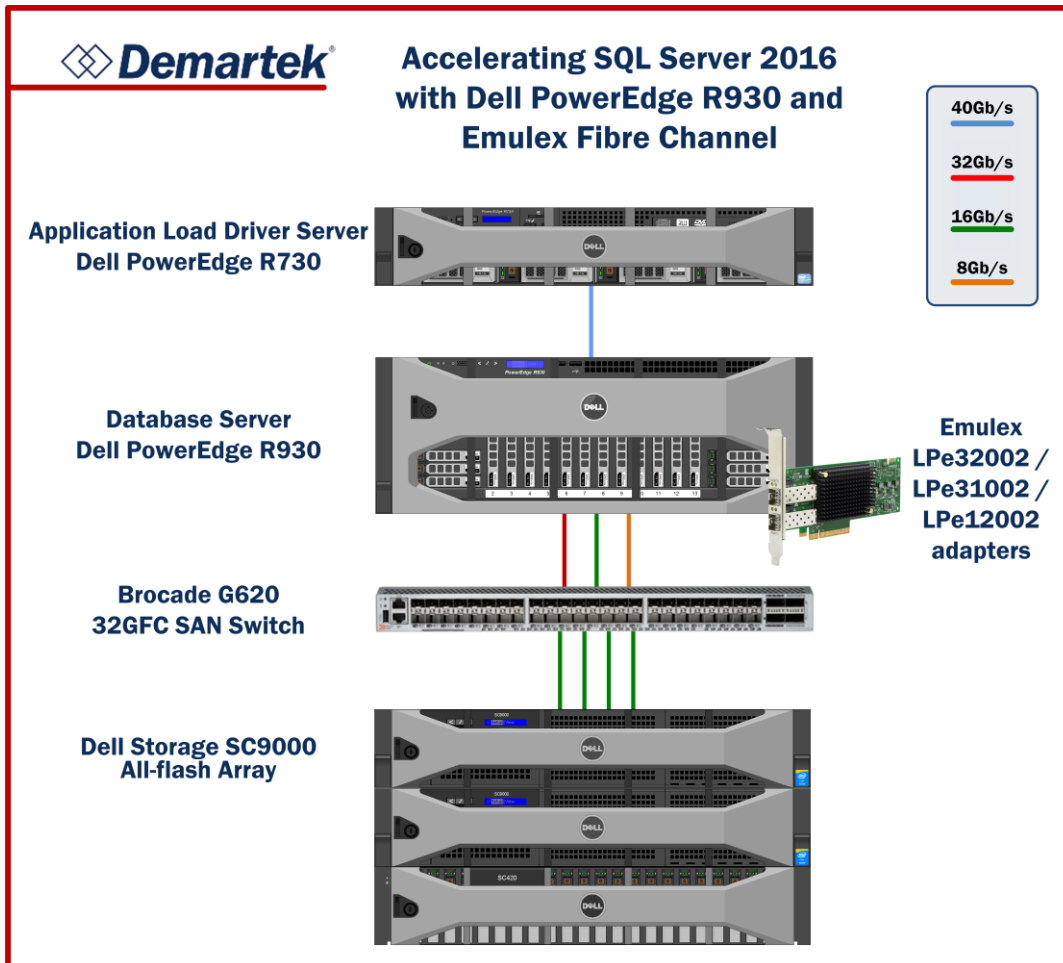
Query Response Time

In the following chart, the time to complete each of the individual 22 queries is shown for each of the three adapters. Using the LPe12002 (8GFC) completion time as a baseline, we observed that the LPe32002 (32GFC) adapter achieved a 70% reduction in the time to

complete the workload, from approximately 127 minutes to approximately 38 minutes. We believe that this same rate of reduction in time to complete the work would scale to much larger databases.

HBA Query Time - Data Warehousing Run
Dell R930, SQL Server 2016, 5 Concurrent Users

Legend:
- ◆ Pricing Summary Report
- ◆ Minimum Cost Supplier
- ◆ Shipping Priority Report
- ◆ Order Priority Checking
- ◆ Local Supplier Volume
- ◆ Forecasting Revenue Change
- ◆ Volume Shipping Query
- ◆ National Market Share
- ◆ Product Type Profit Measure
- ◆ Returned Item Reporting
- ◆ Important Stock Identification
- ◆ Shipping Modes and Order Priority
- ◆ Customer Distribution
- ◆ Promotion Effect
- ◆ Top Supplier
- ◆ Parts/Supplier Relationship
- ◆ Small-Quantity-Order Revenue
- ◆ Large Volume Customer
- ◆ Discounted Revenue
- ◆ Potential Part Promotion
- ◆ Suppliers Who Kept Orders Waiting
- ◆ Global Sales Opportunity

LPe12000 8GFC

LPe31000 16GFC — 44% Reduction

LPe32000 32GFC — 46% Reduction — 70% Reduction

Time in Seconds

Test Environment

◇◇ **Demartek**®

Accelerating SQL Server 2016 with Dell PowerEdge R930 and Emulex Fibre Channel

40Gb/s
32Gb/s
16Gb/s
8Gb/s

Application Load Driver Server
Dell PowerEdge R730

Database Server
Dell PowerEdge R930

Emulex LPe32002 / LPe31002 / LPe12002 adapters

Brocade G620 32GFC SAN Switch

Dell Storage SC9000 All-flash Array

Servers (application and database servers)

> 2x Intel Xeon E5-2643v3, 3.4GHz, 12 total cores, 24 total threads (load driver)

> 4x Intel Xeon E7-8890 v4, 2.2GHz, 96 total cores, 192 total threads (database server)

> 256 GB RAM, 2400 MHz (database server)

> 40 Gb Ethernet NIC (Dell OCe14401)

> Windows Server 2012 R2

> SQL Server 2016 (database server only)

Fibre Channel Switch

> Brocade G620 32GFC Switch

Fibre Channel Adapters

> Emulex LPe12002 (8GFC), firmware 2.02.A0

> Emulex LPe31002 (16GFC), firmware 11.0.235.14

> Emulex LPe32002 (32GFC), firmware 11.0.235.14

Storage System

> Dell Storage SC9000 all-flash array

> 24 SSDs, 2x 1TB volumes for databases

> 4x 16GFC target ports (2 active)

Summary and Conclusion

Combining the new Dell PowerEdge R930 server, the Dell Storage SC9000 all-flash array and the latest 32GFC adapters from Emulex provides a powerful solution for today's demanding enterprise workloads such as data warehousing with Microsoft SQL Server 2016.

> Using the LPe32000 32GFC Emulex adapter reduced the time to complete the data warehousing workload by 70% compared to the legacy 8GFC adapter.

> Using the LPe32000 32GFC Emulex adapter reduced the time to complete the data warehousing workload by 46% compared to the 16GFC adapter.

> Using the LPe31000 16GFC Emulex adapter reduced the time to complete the data warehousing workload by 44% compared to the legacy 8GFC adapter.

8GFC

16GFC — 2x the performance of 8GFC

32GFC — 4x the performance of 8GFC
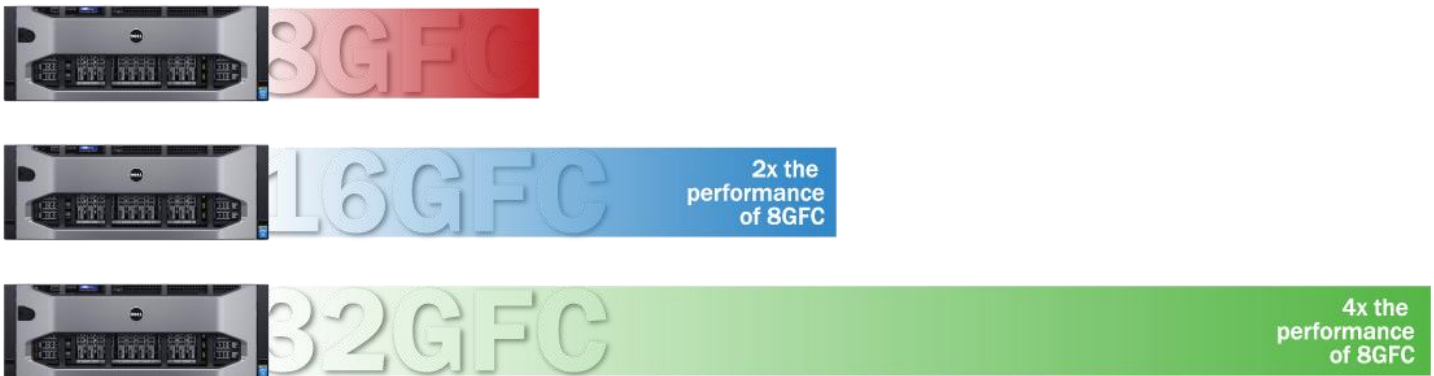
The most current version of this report is available at http://www.demartek.com/Demartek_Dell_R930_Emulex_32GFC_SQL_Server_2016_Evaluation_2016-06.html on the Demartek website.