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Improving Business Outcomes with HPE DL380 Gen9 Server, 3PAR StoreServ 8450 All-Flash Storage, StoreFabric SN6600B Switch and SN1600E HBA Gen 6 32GFC Technology

32GFC delivers faster time to insight for SQL Server 2016 data warehousing workloads.

Executive Summary

Large enterprises choose two-socket servers to power their most demanding workloads, including big data analytics and dense virtualization deployments. The latest HPE DL380 Gen9 two-socket server leverages the current Intel® Xeon® E5 v4 processor family to deliver the highest levels of performance.

Concurrently, datacenters are pairing their high-performance HPE dual-socket servers with Fibre Channel solid-state (flash) storage systems to improve storage performance so that it matches the performance of the new servers. In many cases, however, deploying solid-state storage often moves the performance bottleneck to the storage network, driving users to seek higher performance from their storage network infrastructure.

HPE commissioned Demartek to evaluate its DL380 Gen9 Server connected to an HPE 3PAR StoreServ 8450 All-Flash Storage with 48 SSDs using two different generations of HPE StoreFabric Fibre Channel Host Bus Adapters (16GFC and 32GFC) from Broadcom/Emulex and HPE StoreFabric B-series SN6600B Fibre Channel Switch (32GFC) from Brocade in a SQL Server 2016 database data warehousing environment.

We found that the combination of the new HPE DL380 Gen9 Server, HPE 3PAR StoreServ 8450 All-Flash Storage and HPE StoreFabric SN1600E 32Gb Fibre Channel Host Bus Adapter and StoreFabric B-series SN6600B Fibre Channel Switch supporting Gen 6 32GFC technology provided the performance needed to alleviate network bottlenecks that can be caused by all-flash arrays in slower speed FC SANs to dramatically improve data warehousing application performance.

Key Findings

> The HPE DL380 Gen9 with HPE StoreFabric SN6600B Fibre Channel Switch and SN1600E 32Gb Fibre Channel Host Bus Adapter connected to the HPE 3PAR StoreServ 8450 All-Flash Storage completed the SQL Server 2016 decision support workload in 37% less time than with the 16GFC adapter.

> The HPE StoreFabric SN6600B Fibre Channel Switch and SN1600E Fibre Channel Host Bus Adapter completed more than 54% of the large block I/Os for the data warehousing workload in less than two milliseconds, compared to only 3% of the large block I/Os using the 16GFC technology.

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HPE DL380 Gen9 Server

The DL380 Gen9 Server 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 DL380 Gen9 Server supports the following:

- Intel® Xeon® E5 v4 processor family with up to 22 cores per processor, totaling 44 processing cores with two processors
- 24 DDR4 2400 MHz DIMM slots supporting standard DIMM and up to 16 NVDIMM
- Up to six PCIe 3.0 slots, including up to two x16 slots
- Two 96 percent efficient (Titanium) power supplies

HPE 3PAR StoreServ 8450 All-Flash Storage

The HPE 3PAR StoreServ 8450 All-Flash Storage supports high-end workloads through its quad-controller design and scale-up capabilities. The 3PAR 8450 includes the following:

- Up to 480 SSDs and up to 1843 TB raw capacity
- Up to 24 16Gb Fibre Channel host ports
- Up to 8 10GbE iSCSI host ports
- Integration with VMware VAAI, VASA and Microsoft Offload Data Transfer (ODX)
- Federation with other models in the HPE 3PAR 8000 family
- Synchronous/Asynchronous replication
- Unconditional 5-year SSD warranty
- Optional FIPS-certified self-encrypting SSDs

HPE StoreFabric SN1600E 32Gb Fibre Channel Host Bus Adapter from Broadcom/Emulex

The HPE SN1600E 32Gb HBA from Broadcom/Emulex delivers the ultimate in high bandwidth, up to 12,800 MB/sec (2 ports, 32GFC, full duplex), and low latency (50% lower on-chip latency compared to the previous generation HPE StoreFabric SN1100E 16Gb HBA) performance.

The Broadcom/Emulex 32GFC and 16GFC adapters feature the Emulex Dynamic Multi-core Architecture that delivers optimum IO performance, up to 1.6 million IOPS, 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).

The new HPE SN1200E 16GFC HBA, built on the same platform as the new SN1600E 32GFC HBA, delivers many of the same features for portfolio consistency and interoperability.

Supported Features

- NVMe over Fibre Channel enablement
- Secure firmware update
- ExpressLane LUN prioritization for write operations
- 10 million hour Mean Time Between Failure (MTBF) reliability
- HPE Smart SAN for 3PAR software for simplified and error-free target driven SAN deployment for All-Flash Storage

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HPE StoreFabric B-series SN6600B Fibre Channel Switch from Brocade

Gen 6 32GFC Fibre Channel connectivity maximizes the performance of flash storage, even when connecting at speeds less than 32 Gbps. In addition to faster throughput speeds and increased Inputs/Outputs per Second (IOPS), Gen 6 Fibre Channel provides enhanced monitoring and diagnostics capabilities that provide visibility into network latency levels and IOPS from the storage level all the way up to the Virtual Machine (VM) level.

HPE StoreFabric Fibre Channel solutions from Brocade provide the following benefits:

- Increased Performance for demanding workloads across 32GFC links
- Simplified end-to-end management of large-scale environments with automated monitoring and diagnostics
- Automatic detection of degraded application or device performance through network sensors
- Forward Error Correction (FEC) for increased data resiliency
- Significantly reduced latency in high-transaction applications compared with other offerings
- Seamless integration with emerging NVMe over Fabrics (NVMe-oF) technology without a disruptive “rip and replace”

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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) and/or Fibre Channel switches will result in completion of the work in a smaller amount of time even if the storage target is supporting slower FC speeds.

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 two generations of StoreFabric B-series Fibre Channel Switch technology.

The same operating system (Windows Server 2016), the same database software (SQL Server 2016) and the same application workload settings were used for these tests.

Fibre Channel switches:

> HPE SN6000B – 16GFC
> HPE SN6600B – 32GFC

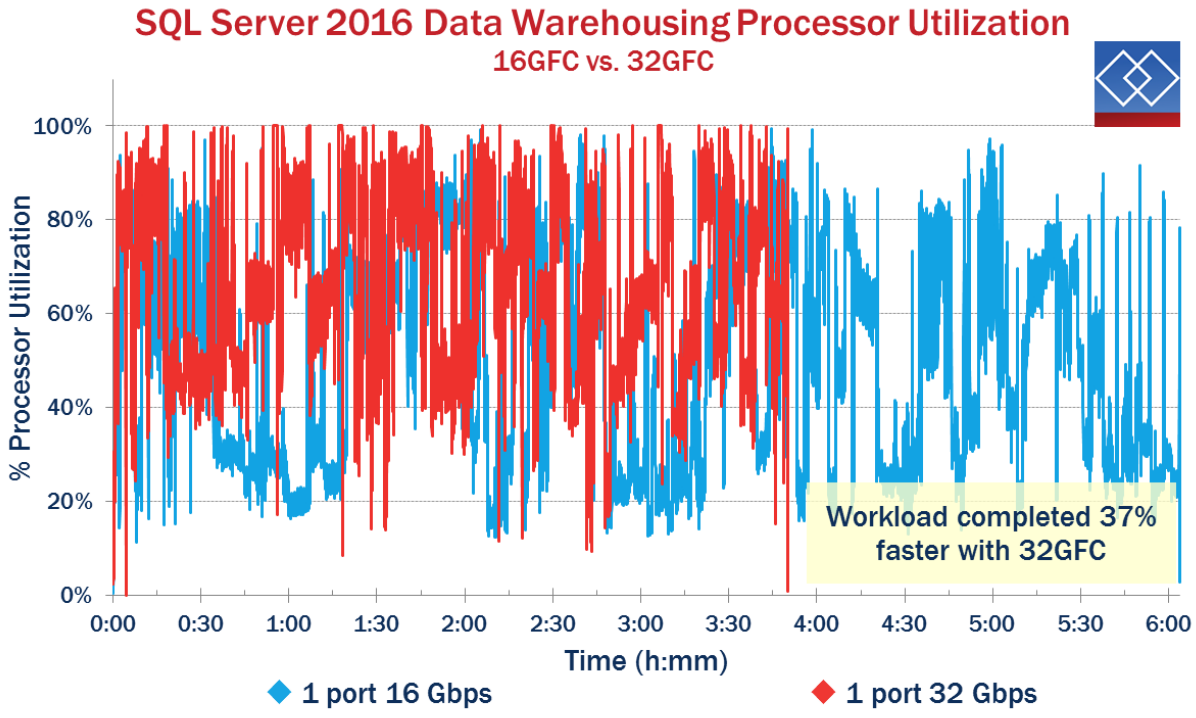
Fibre Channel host bus adapters (HBAs):

> HPE SN1200E – 16GFC
> HPE SN1600E – 32GFC

The results shown in this report used a single host Fibre Channel port for connectivity to the SAN fabric for each generation of technology.

Host CPU Utilization

The 32GFC technology allowed the host server to achieve a higher utilization rate, enabling it to complete the work in 37% less time, delivering better ROI on host CPU investment.



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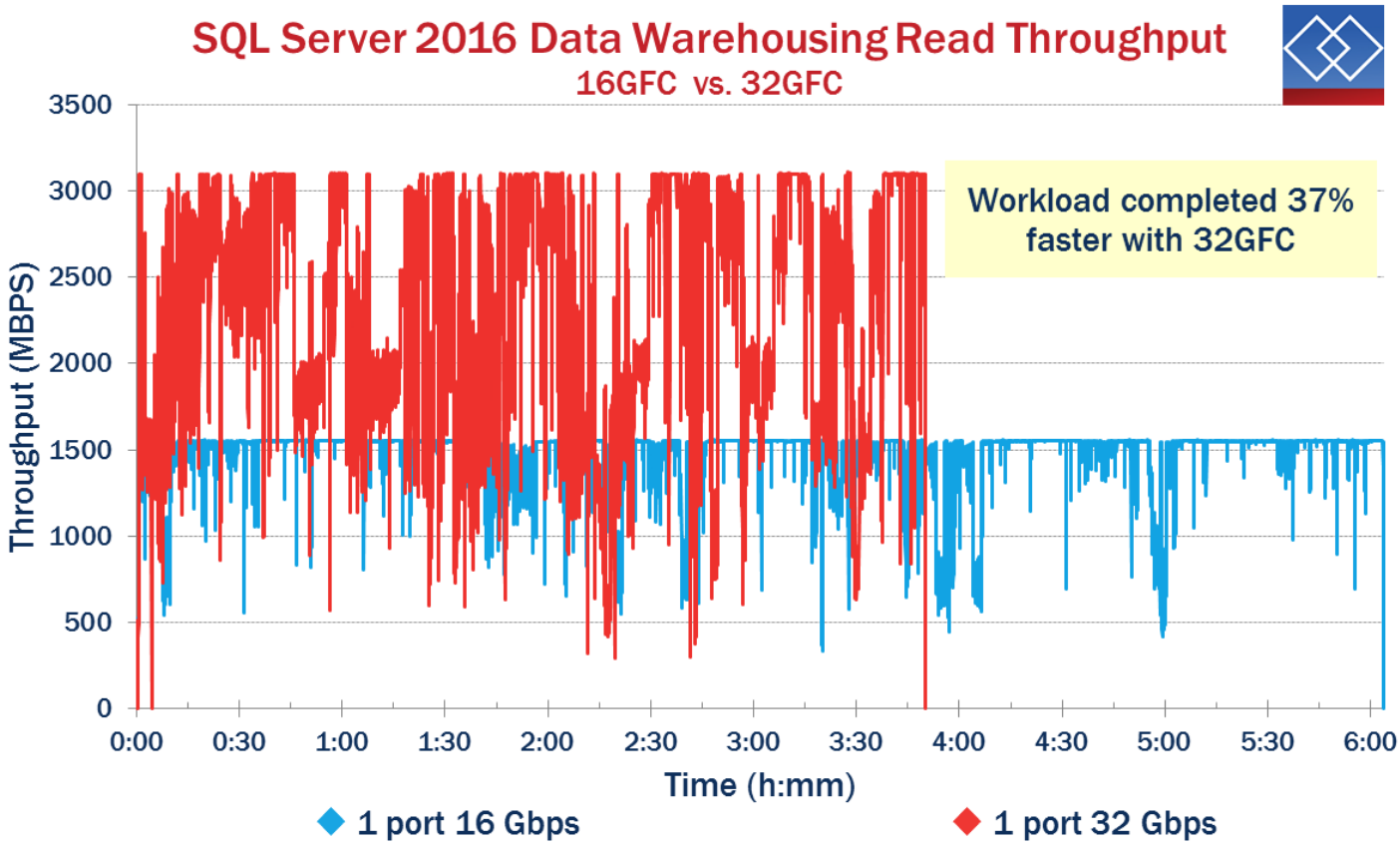
Higher Throughput

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 faster for the SN1600E (32GFC) adapter than the other adapter, as shown in the chart.



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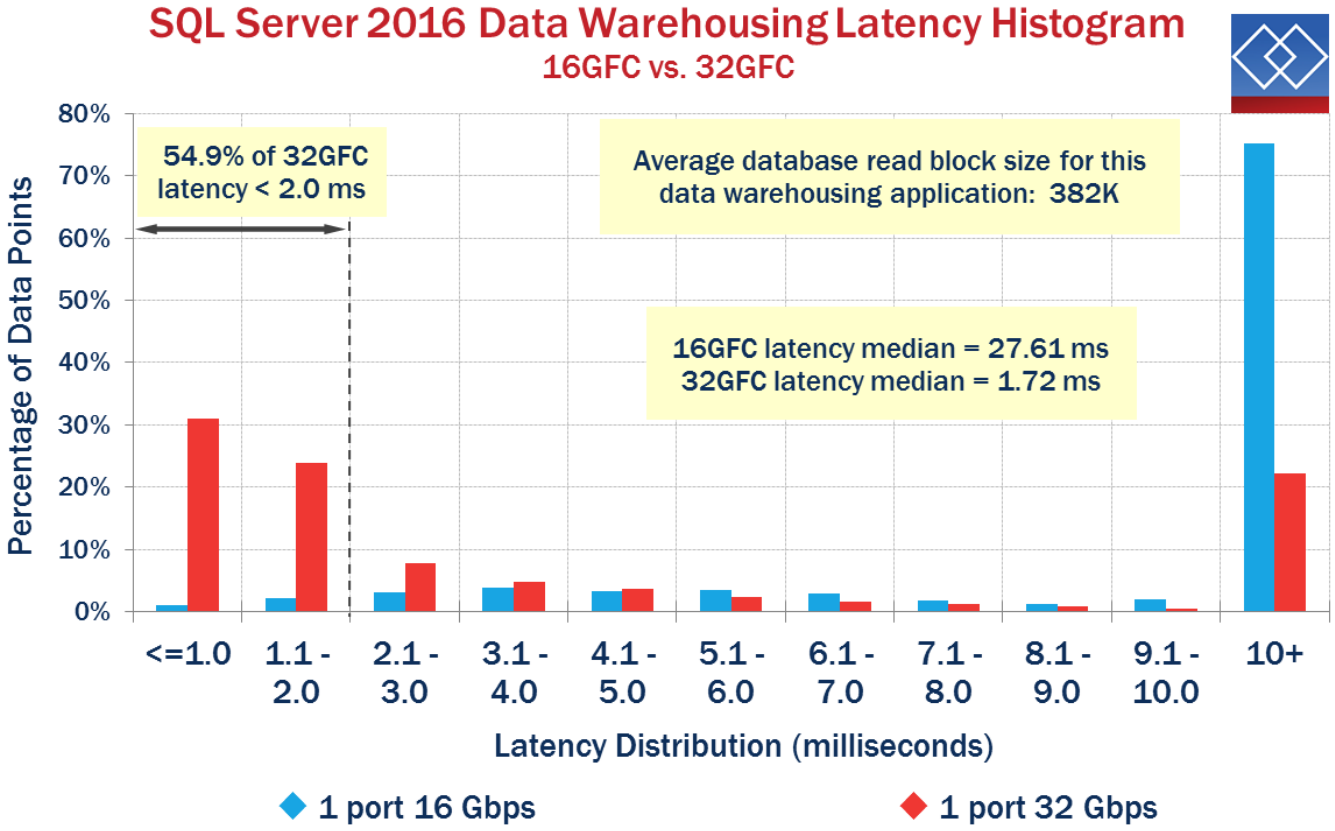
Faster Query Response Time

In the following chart, the time to complete each of the individual 22 queries is shown for each of the generations of adapters. Using the StoreFabric 16GFC technology completion time as a baseline, we observed that the StoreFabric 32GFC switch and adapter achieved a 37% reduction in the time to complete the workload, from approximately 363 minutes to approximately 230 minutes.

This particular data warehousing workload used large block sizes for its database read operations, averaging 382K, and reaching a peak of 512K.

The combination of 32GFC switch and adapter technology completed more than 54% of the I/O requests in less than two milliseconds, compared to only 3% of the I/O requests using the 16GFC technology. This shows the much improved latency capability of the 32GFC technology.



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Fibre Channel Technology Overview

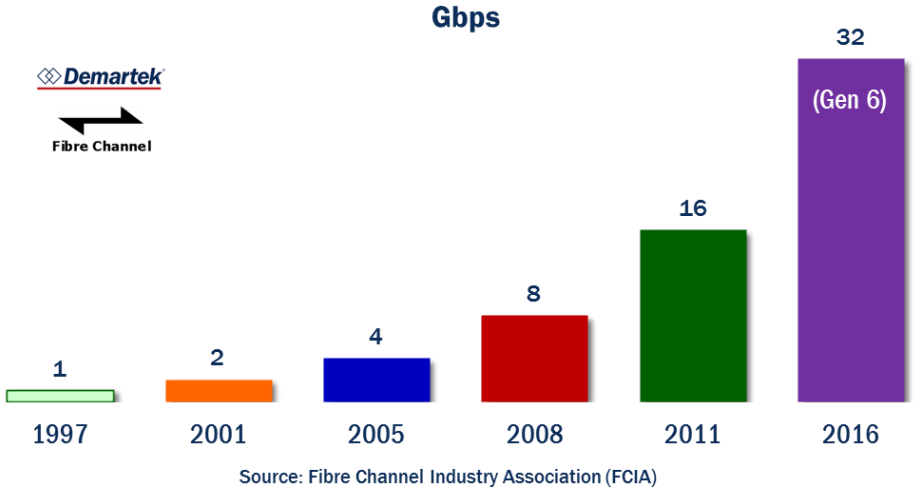
History

Fibre Channel is an industry standard storage solution. Development began in 1988, receiving ANSI standard approval in 1994. Fibre Channel technology was introduced to the market in 1997 at 1 gigabit per second (Gbps) and its single-lane speed has doubled every three to five years. With Gen 6 Fibre Channel, there is a single-lane (32GFC) and quad-lane (128GFC) specification.

Backward Compatibility

Fibre Channel technology is backward compatible with the two previous generations. This means that Gen 6 (32GFC) Fibre Channel switches, host bus adapters (HBAs) and optics (transceivers) are backward compatible with 16GFC and 8GFC equipment. This provides a smooth upgrade path for enterprises.

Fibre Channel Speed History



Source: Fibre Channel Industry Association (FCIA)

Fiber Optic Cable Lengths by Speed and Distance

Demartek	OM1	OM2	OM3	OM4
Cable Color	Orange	Orange	Aqua	Aqua
4GFC	70m	150m	380m	400m
8GFC	21m	50m	150m	190m
16GFC	15m	35m	100m	125m
32GFC	—	20m	70m	100m

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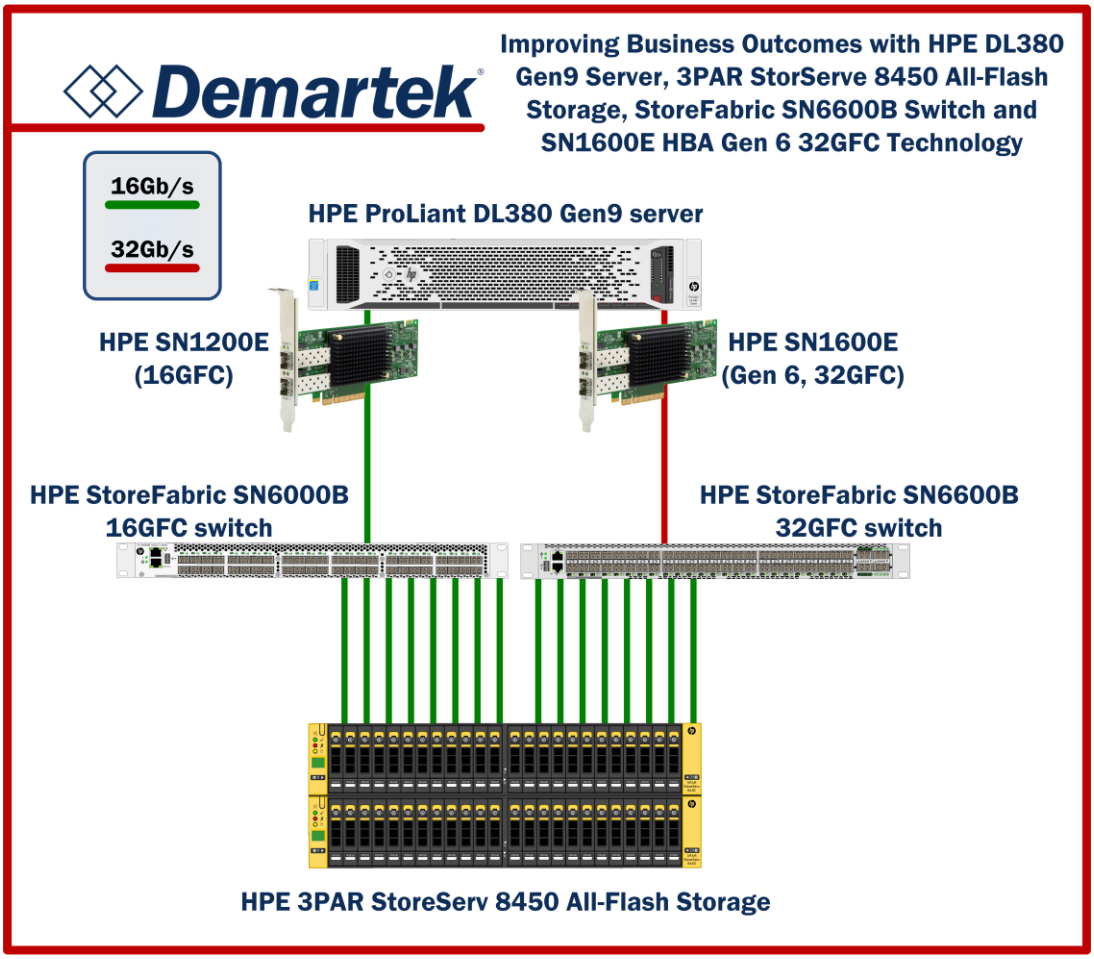
Test Environment



Servers (application and database servers)

> 2x Intel Xeon E5-2690v4, 2.6GHz, 28 total cores, 56 total threads
> 64 GB RAM, 2400 MHz
> 10Gb Ethernet NIC
> Windows Server 2016
> SQL Server 2016 Developer Edition

Fibre Channel Switch

> HPE StoreFabric SN6000B 16Gb 48/24 Fibre Channel Switch (Brocade)
> HPE StoreFabric SN6600B 32Gb 48/24 Fibre Channel Switch (Brocade)

Fibre Channel Adapters

> HPE SN1200E 16Gb Dual Port Fibre Channel Host Bus Adapter (Broadcom/Emulex)
> HPE SN1600E 32Gb Dual Port Host Bus Adapter (Broadcom/Emulex)

Storage System

> HPE 3PAR StoreServ 8450 All-Flash Storage
> 48x 480GB SSDs
> 8x 16GFC target ports

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Summary and Conclusion

Combining the new HPE DL380 Gen9 Server, the HPE 3PAR StoreServ 8450 All-Flash Storage and the latest 32GFC HBAs and switches from HPE StoreFabric (Storage Networking) utilizing Broadcom/Emulex and Brocade technology provides a powerful solution for today's demanding enterprise workloads that are latency and I/O sensitive. *Workloads such as data warehousing with Microsoft SQL Server 2016, which are taking advantage of storage with All-Flash technology while supporting the latest FC technology for their infrastructure will see immediate performance outcomes even if the entire SAN end-to-end is not all the same FC speeds.*

Gen 6 Fibre Channel technology from Brocade and Emulex will help Information Technology to immediately experience the benefits of application performance and I/O insight not seen previously on slower FC technologies, in addition to having access to a broader Gen 6 32GFC feature-set and investment protection.

> Using the HPE StoreFabric 32Gb Fibre Channel switch and adapter reduced the time to complete the data warehousing workload by 37% compared to the 16GFC switch and adapter.

> The HPE StoreFabric 32GFC switch and adapter completed more than 54% of the large block I/Os for the data warehousing workload in less than two milliseconds, compared to only 3% of the large block I/Os using the 16GFC technology. This shows the much improved latency characteristics of the new 32GFC technology.

The most current version of this report is available at www.demartek.com/Demartek_HPEStoreFabric_Gen6 on the Demartek website.