MARVELL™

White Paper

QLogic/Lenovo 16Gb Gen 5 Fibre Channel for Database and Business Analytics

Assessment for Database and
Business Analytics

April 2022

Executive Summary

Fibre Channel SANs are a key component of most large data center storage environments. Large IT organizations have made huge investments in Fibre Channel storage technology to meet their high availability storage and reliability needs. The FCIA calculates that more than $10 billion has been invested in Fibre Channel technology over the last two decades. Fibre Channel continues to remain the dominant storage networking architecture for next-generation enterprise workloads, server virtualization, and cloud architectures. It is known for its ultra-reliability and mission-critical, high-performance capabilities in enterprise data centers.

The data center's ability to manage mixed workloads spanning real-time warehousing, storage, and bi-directional online transactional processing (OLTP) for consumer facing sites and social applications that require continual consumer dialogue helps to deliver digital executions. Enterprise data centers still have to offer traditional warehouse support, but being able to execute across all digital channels and having that capability in one environment has been extremely helpful in accelerating business as more and more digital executions are employed. Companies need stability underneath consumer-facing applications. There is a significant amount of social, retail, and point-of-sale (POS) data. And many companies produce Web blogs, which present these challenges:

- Large volumes of data must be interpreted into actionable insights for clients
- Tasks ranging from real-time consumer analytics scoring to consumer-specific text mining with Web blog data must be performed
- Raw data must be quickly interpreted and turned into actionable insight for clients in a timely manner

IT administrator managers need to quickly gain value from data warehousing, while supporting diverse analytical requirements and assisting with building future analytical applications. Fast, easy, and predictable implementations reduce risk and enable data centers to achieve rapid strategic value and allow customers to make optimized business decisions. Using the information from databases and business analytics helps business-line managers to understand their customer segments, build customer loyalty, and bring faster time to value. Best-in-class technology delivers the results that enterprise data centers demand.

This white paper analyzes the storage performance, reliability, and scalability of the QLogic®/Lenovo™ 6941942, 95Y2379, 8846370, 00Y3337, 00Y3341, 4XB0F286454, 4XB0F28651, 4XC0F28721 16Gb Gen 5 Fibre Channel Adapters from Cavium™ compared to the previous-generation QLogic 8Gb Fibre Channel adapter.

Key Findings

- QLogic 8Gb Fibre Channel Adapters and QLogic/Lenovo 16Gb Gen 5 Fibre Channel Adapters from Cavium continue to provide a high availability ASIC architecture with complete port isolation across its dual-port architecture. During testing, the architecture demonstrated deterministic, predictable, and scalable performance across both ports.

- The QLogic/Lenovo 16Gb Gen 5 Fibre Channel Adapter delivered three times the transactions—double the bandwidth—compared to the 8Gb adapter. In a real-life business analytics type environment (TPC-H), the QLogic/Lenovo 16Gb Fibre Channel Adapter completed the same analytical queries in 35 percent less time.

- The QLogic/Lenovo 16Gb Gen 5 Fibre Channel Adapter delivers double the transaction rate compared to 8Gb Fibre Channel for Oracle® OLTP applications..

QLogic/Lenovo 16GB Gen 5 Fibre Channel Adapter

The new QLogic/Lenovo Adapters provide several features that are designed for supporting enterprise I/O workloads:

- Up to 1.2 million IOPS reduce latency in high transaction intensive applications and virtualized environments

- 16Gbps Fibre Channel per port maximum throughput for high bandwidth SAN traffic

- Reduced hardware, cabling, and management costs by enabling more applications (VMs) to run on a single server and Fibre Channel port

- Decreased power and cooling costs by using the fewest PCI Express® lanes in PCIe® Gen3 environments

- Overlapping protection domains (OPD) to ensure a high level of reliability as data moves to and from the PCI bus and Fibre Channel network

- Complete investment protection for legacy 8Gb and 4Gb Fibre Channel infrastructure

- Future-proof design enables conversion to a 10GbE Converged Network Adapter

- Improved reliability and diagnostics with support for Brocade® ClearLink®

- Enhanced QoS (CS_CTL) prioritizes SAN traffic for end-to-end high performance

- Simplified deployment and management with fabric pre-provisioning.

Adapter Architecture and Design

The different brands of Fibre Channel Adapters tested have different designs for their dual-port adapters. The primary difference is that the QLogic design has separate processor, memory, and firmware for each port on the adapter, for both the 8Gb and 16Gb products. With these independent components in the QLogic design, activity such as high I/O loads, resets, and recoveries and errors that occur on one port do not impact the other port. Each port on the QLogic 16Gb Fibre Channel Adapter is able to achieve full line rate independent of the activity of the other port.

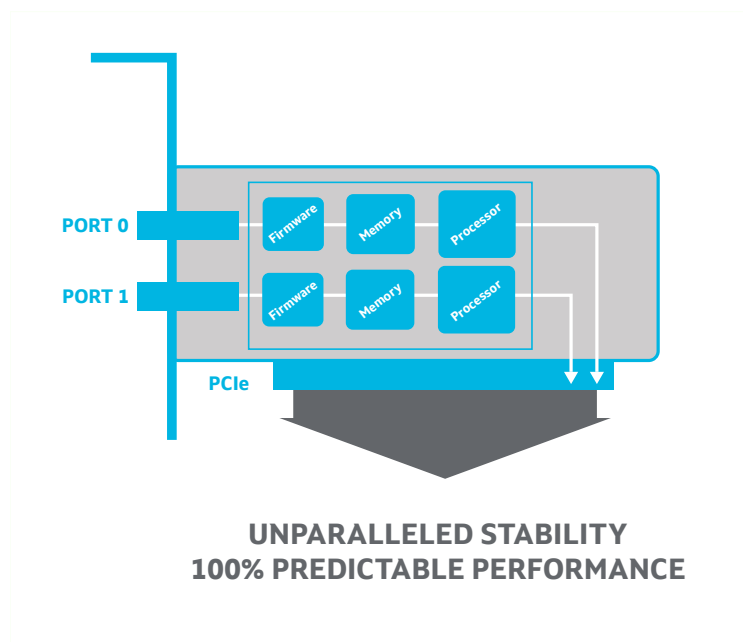**UNPARALLELED STABILITY**
100% PREDICTABLE PERFORMANCE

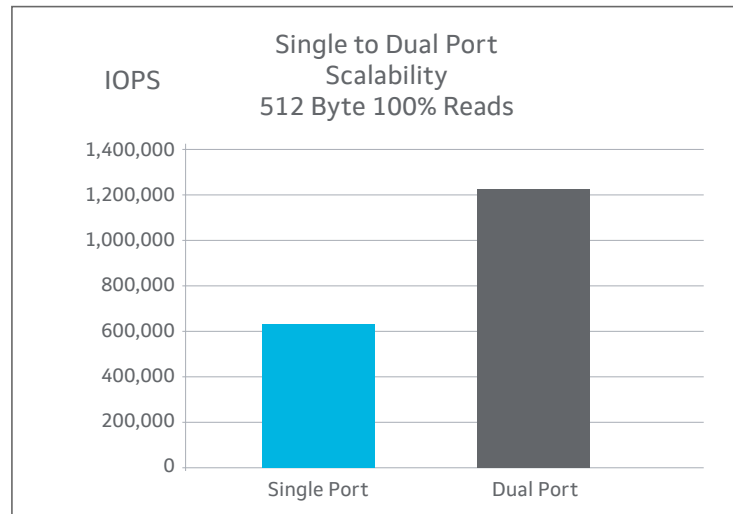Figure 1. Port-Level Traffic Isolation

Figure 2. Scalability Across Ports for the QLogic/Lenovo Adapter

A series of Iometer runs were performed, first using one port and then both ports. The QLogic adapter scaled linearly as the second port was added to the workload.

QLogic's isolated ASIC design architecture provides the following benefits, which are key requirements for enterprise deployments of Fibre Channel SAN infrastructures:

- **Independent Functionality**– Reset or error recovery on one port does not impact the performance of the other port.

- **High Reliability**– A firmware crash on one port does not crash the other port.

- **Best-in-Class Security**– Isolation at the physical level: Physical Function (PF) for one port cannot access state information (registers, memory info, etc.) of another PF due to physical isolation.

- **Predictable Performance**– I/O spikes on one port do not affect the performance of the other port.

- **Enhanced Scalability** – The QLogic dual-port adapter has better scalability than competitive offerings when traffic on the second port is added

Real-World Enterprise Workload Analysis

To test the performance of the QLogic/Lenovo 8Gb and QLogic/Lenovo 16Gb Fibre Channel Adapters in a real-world environment, QLogic ran a data warehousing (TPC-H) workload, not for the purpose of publishing official benchmark results, using Microsoft® SQL Server® in a Microsoft Windows Server® 2012 environment.

Workload Overview

The read-intensive database workload consisted of a suite of business oriented ad-hoc queries and concurrent data modifications. The queries and the data populating the database had broad, industry-wide relevance. The workload illustrated decision support systems and business analytics that examine large volumes of data, execute queries with a high degree of complexity, and provide answers to critical business questions.

Workload Database Queries

The workload consisted of a series of twenty-two unique queries that exercised different sections of the database. Each query placed a different load on the combined CPU, memory, and storage resources. Because each repetition of the workload performed the same work, the time to complete the process was shorter fovr faster configurations of CPU, memory, and storage.

Real-world Variable I/O Rates vs. Synthetic Workloads

Synthetic workloads, such as those produced by the Iometer, serve a useful purpose and are designed primarily to exercise the storage system and its interface, with the ability to place a steady workload on the storage system. However, a real database application workload requires varying amounts of CPU, memory, and storage throughout the normal course of activity, depending on the particular transactions being processed. As a result, the I/O activity will vary during the progression of the workload. The TPC-H benchmark provides a more accurate and real-life determination of how choosing the right Fibre Channel Adapter can significantly improve real-world database analytical performance.

Performance Results

For the TPC-H tests, the time to complete the workloads and the I/O bandwidth rates were measured during the tests. The data was captured using the standard Performance Monitor (PerfMon) tool provided in the Windows Server operating system.

As there are large, existing investments in 8Gb Fibre Channel infrastructure today and 16Gb Gen 5 Fibre Channel technology is being adopted, this analysis includes various combinations of performance tests using 8Gb and 16Gb Gen 5 Fibre Channel technology.

Qlogic 16gb Gen 5 Fibre Channel vs. Qlogic 8gb Fibre Channel

QLOGIC 16GB GEN 5 FIBRE CHANNEL VS. QLOGIC 8GB FIBRE CHANNEL One of the key comparisons between 16Gb and 8Gb Fibre Channel is the difference in performance. The following charts show the performance improvements provided by the QLogic/Lenovo 16Gb Gen 5 Fibre Channel Adapter.

In Figure 3, throughput limiting is shown by the flat spots on the graph, but there is the potential for additional performance beyond the capability of the adapter. The 8Gb Fibre Channel results show this limited throughput in several places, which extends the time required to complete the task. On the other hand, specific queries of the workload in the 16Gb environment completed up to 82 percent faster compared to the 8Gb environment. As shown in Figure 4, the total time to complete a workload is noticeably less using the 16Gb Gen 5 Fibre Channel Adapter.
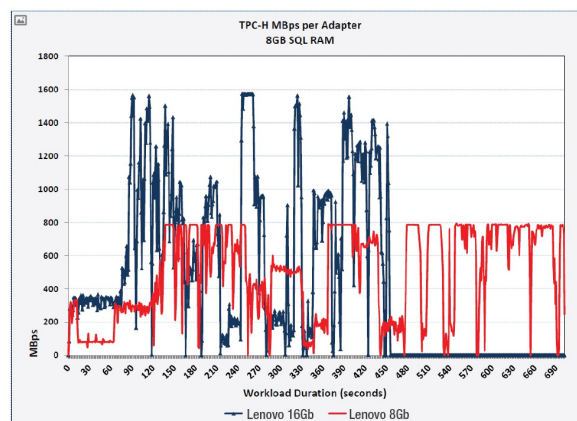

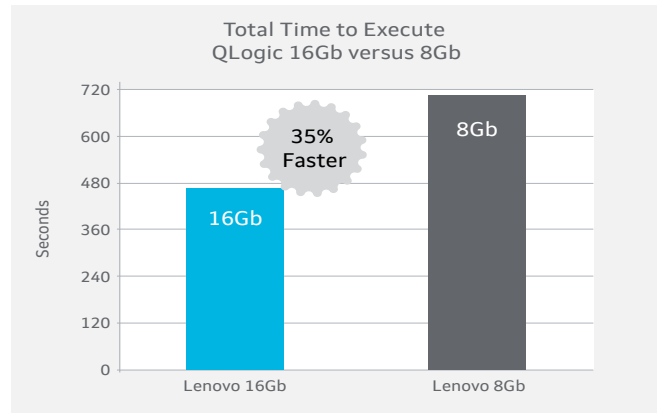Figure 3. Throughput Performance Comparison

Figure 4. Total Time to Execute is Faster Using 16Gb Gen 5 Fibre Channel

16Gb Gen 5 Fibre Channel provides additional bandwidth that can be used by mission-critical database applications to improve performance over 8Gb Fibre Channel. It also supports other I/O-intensive applications, such as increased numbers of VMs running on physical servers, cloud applications, and more.

In addition, the deployment of 16Gb Gen 5 Fibre Channel provides the opportunity to reduce the number of cables required within server racks. It can also play a role in consolidating the total number of Fibre Channel Switch ports required in a SAN, because of the increased bandwidth available.
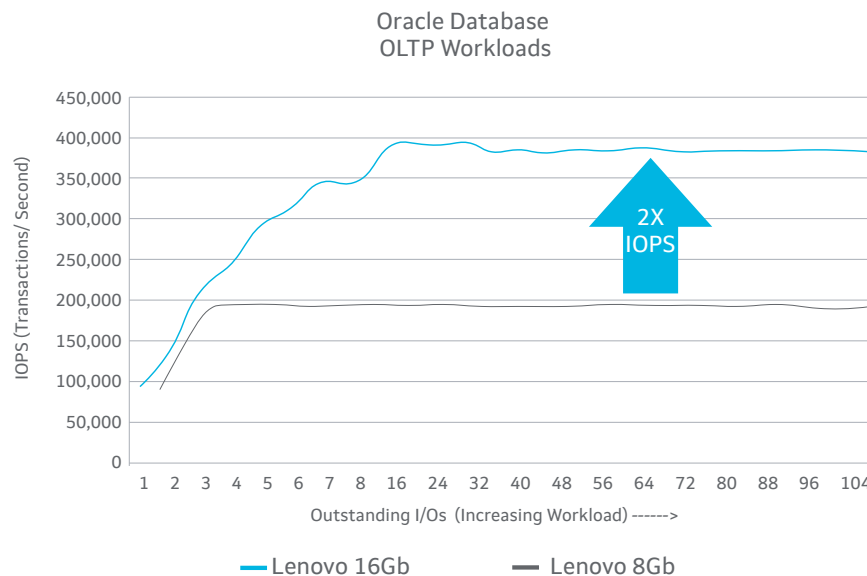

Figure 5. Oracle Database OLTP Performance Comparison

Oracle OLTP Workloads

OLTP applications are highly transactional, and insert and update intensive. This workload is typical for companies that have large transaction processing applications, such as airline ticketing, large order-entry, and banking applications. To make the benchmarks relevant to today's businesses, QLogic selected the market-leading Oracle Relational Database Management System (RDBMS), running on RHEL® 5.8 and simulated using the Oracle-supplied ORION benchmark tool.

Figure 5 shows the two-fold performance advantage of QLogic 16Gb Fibre Channel Adapters over QLogic/Lenovo 8Gb Fibre Channel Adapters in the OLTP application environment.

Summary and Conclusion

QLogic/Lenovo 16Gb Fibre Channel infrastructure removes bottlenecks by providing higher bandwidth capability for environments with growing performance requirements, such as from virtualized servers, database applications, and Solid State Drives.

True enterprise reliability is ensured by port-level isolation, which fully segregates the Gen 5 Fibre Channel functions of each port on the adapter. QLogic's dual-port design has isolated the functionality for the processor, memory, and firmware for each port on the adapter. The QLogic design incorporates independent components, allowing activity such as high I/O loads, resets, recoveries, and errors that occur on one port to not impact the other port. Each port on the QLogic Host Bus Adapter is able to achieve full line-rate independent of the activity of the other port, unlike competitive offerings.

QLogic's Gen 5 Fibre Channel isolated dual-port designed architecture delivers:

- **Independent Functionality** – Reset or error recovery on one port does not impact performance of the other port

- **Higher Reliability** – Firmware crash on one port does not crash the other port

- **Better Security** – Isolation at the physical level; Physical Function (PF) for one port cannot access state information (registers, memory info, etc.) of another PF due to physical isolation

- **Predictable Performance** – I/O spikes on one port do not affect the performance of the other port

- **Enhanced Scalability** – The QLogic dual-port adapter has better scalability than competitive offerings when traffic on the second port is added

Test results show that the QLogic adapters outperformed the competitor's adapters; the QLogic adapters provided higher bandwidth and faster completion of database workloads, as well as secure, predictable, and scalable dual-port architecture.

The QLogic/Lenovo 16Gb dual-port adapter scales linearly and delivers twice the performance compared to its own single-port adapter. The competition's shared architecture does not have the capacity to scale its dual-port adapter compared to its single-port adapter.

The tests found that for the TPC-H workload:

- Moving from QLogic 8Gb to QLogic 16Gb Gen 5 Fibre Channel improves TPC-H performance by up to 82 percent for some queries and increases the overall TPC-H full run by 35 percent.

- The QLogic 16Gb adapter delivers double the transactional performance for Oracle OLTP environments.

About Cavium

Cavium, Inc. (NASDAQ: CAVM), offers a broad portfolio of infrastructure solutions for compute, security, storage, switching, connectivity and baseband processing. Cavium's highly integrated multi-core SoC products deliver software compatible solutions across low to high performance points enabling secure and intelligent functionality in Enterprise, Data Center and Service Provider Equipment. Cavium processors and solutions are supported by an extensive ecosystem of operating systems, tools, application stacks, hardware reference designs and other products. Cavium is headquartered in San Jose, CA with design centers in California, Massachusetts, India, Israel, China and Taiwan.