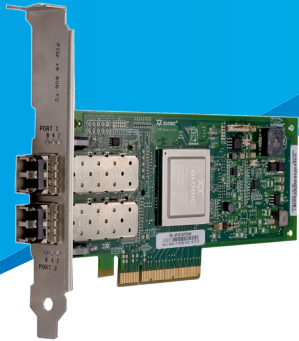


8Gb Fibre Channel Adapter of Choice in Microsoft Hyper-V Environments

QLogic 8Gb Adapter from Cavium Outperforms Emulex—QLogic Offers Best Performance and Scalability in Hyper-V Environments



Cavium's QLogic and the Emulex 8Gb Fibre Channel Adapters were tested with the most current software and firmware available. The test environment assessed IOPS, throughput performance, and scalability in a real-world Hyper-V environment.

EXECUTIVE SUMMARY

Server consolidation through virtualization of the enterprise data center improves server/processor utilization and lowers data center capital and operational cost. IT administrators must ensure that none of the subsystems become a bottleneck for successful deployment of a virtualized and consolidated data center. The evolution of consolidated server deployments and the move to 8Gb Fibre Channel infrastructure requires higher scalability in server connectivity to storage.

To meet the ever-growing demands of consolidated and virtualized environments, enterprise IT administrators must deploy a scalable, high-performance adapter architecture that can address the demands placed by multiple virtual machines (VMs) or guest operating systems (OSs), as well as applications, in virtualized environments running simultaneously on a single physical server.

Enterprise data centers are adopting server virtualization technologies to optimize and streamline the deployment of their enterprise applications. For those deploying a Windows environment, Microsoft® Windows Server® 2008 provides virtualization technology out-of-the box with Hyper-V™.

KEY FINDINGS

The QLogic® 8Gb Fibre Channel (FC) Adapters from Cavium™ and the Emulex® 8Gb FC Adapters were tested with the most current software and firmware available. The test environment provided an unconstrained assessment of IOPS, throughput performance, and scalability in a real-world Hyper-V environment.

The test results show that:

- In Hyper-V environments, the QLogic 2500 Series 8Gb Fibre Channel Adapter from Cavium offers up to 48 percent higher IOPS and throughput compared to the Emulex LightPulse 12000 Series Adapter.
 - QLogic 2500 Series Adapter IOPS are up to 48 percent higher than Emulex when performing sequential read operations.
 - QLogic 2500 Series Adapter IOPS are up to 18 percent higher than Emulex when performing sequential write operations.
 - QLogic 2500 Series Adapter IOPS are up to 40 percent higher than Emulex when performing sequential read/write operations.
- Cavium's QLogic 2500 Series Adapter demonstrates up to 44 percent superior VM scalability than the Emulex LightPulse 12000 Series Adapter. The QLogic adapter continues to scale as VM workloads are increased from two to eight.

MICROSOFT MICRO-BENCHMARK AND HYPER-V SCALABILITY

Configuration

The IOmeter tool benchmarked the QLogic 2500 Series Adapter versus the Emulex LightPulse LPe12002 8Gb Adapter in an exchange environment with minimum subsystem latency.

The IOmeter test setup (see Figure 1) consisted of the latest 8Gb adapters from QLogic and Emulex, running on current commercially available drivers, installed in a Intel® Tylersburg quad core (dual socket) server running Windows Server 2008 (64 bit) with the Hyper-V OS. The Tylersburg server was connected to a Texas Memory System RamSan®-400 through a QLogic 5802V 8Gb Switch to test sequential operation. RamSan-320 was added as part of the configuration to test scalability. Using a solid state disk allowed removing the latency introduced by a slower disk-drive, emulated a real world data-center configuration, and provided the performance benchmark expected from next-generation storage arrays.

As part of the sequential operation benchmark, one initiator and four target RamSan ports (with eight LUNs) were configured in a zone to the QLogic 5802V 8Gb Switch. For the scalability benchmark, eight LUNs (four LUNs per RamSan, one LUN per Hyper-V VM) were configured. Tests were performed to compare I/O performance of the QLogic and Emulex 8Gb Fibre Channel Adapters in a Microsoft Windows Hyper-V virtualized environment with Windows Server 2008 as a guest OS. IOmeter measured the IOPS and throughput values across a range of block sizes.

All measurements were made with out-of-the-box settings for the adapters from both companies, using the latest commercially available hardware and software.

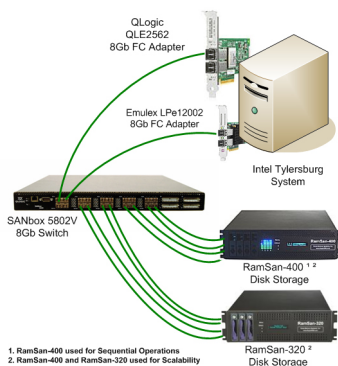


Figure 1. IOmeter Test Setup

Test Procedure

The tests were executed on the configuration shown in Figure 1 as follows:

1. A QLogic 8Gb single-channel PCI Express® to Fibre Channel Adapter (QLE2562) was installed on the test server using the Windows Server 2008 (64-bit) driver.
2. Workloads were created separately across a range of block sizes. Eight LUNs were created and mapped to four target ports.
3. Tests were run for one minute on this setup.
4. These steps were repeated for the Emulex 8Gb LPe12002 PCI Express to Fibre Channel Adapter (LPe12002).

Test Results

The test results demonstrated superior performance of the QLogic 2500 Series 8Gb Fibre Channel Adapter over the Emulex LPe12002 8Gb Adapter. The following graphs provide a comparison of QLogic vs. Emulex 8Gb adapter IOPS while performing sequential read, write, and read/write operations.

The tests show that the QLogic 2500 Series Adapter has a performance advantage over the Emulex LPe12002 8Gb Adapter, especially at block sizes supporting enterprise applications.

SEQUENTIAL READ OPERATIONS

IOPS

At block sizes below 8KB, the QLogic 2500 Series Adapter from Cavium demonstrated up to 48 percent overall improvement of sequential read IOPS over the Emulex LPe12002 Adapter, as shown in Figure 2.

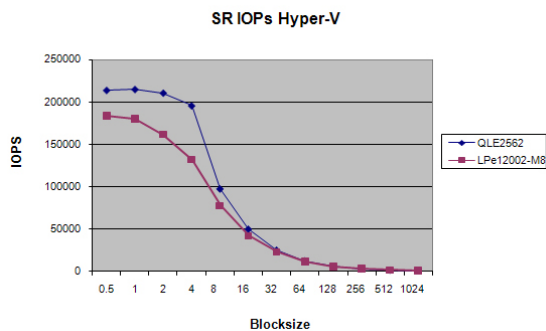


Figure 2. Sequential Read IOPS

Throughput

At block sizes above 64KB, the QLogic 2500 Series Adapter from Cavium showed a 4 percent advantage over the Emulex LPe12002 Adapter.

SEQUENTIAL WRITE OPERATIONS

IOPS

At block sizes below 8KB, the QLogic 2500 Series Adapter from Cavium demonstrated up to 18 percent overall improvement of sequential write IOPS over the Emulex LPe12002 Adapter, as shown in Figure 3.

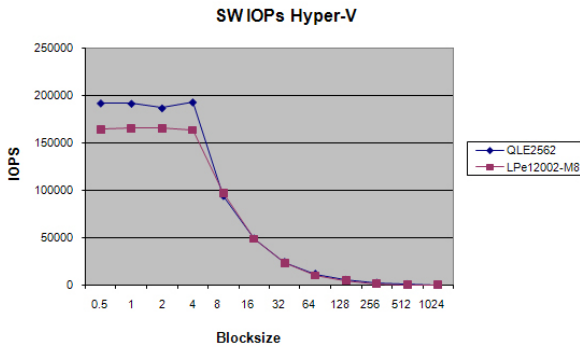


Figure 3. Sequential Write IOPS

Throughput

At block sizes above 64KB, the QLogic 2500 Series Adapter from Cavium demonstrated a 43 percent advantage over the Emulex LPe12002 Adapter.

SEQUENTIAL READ/WRITE OPERATIONS

IOPS

At block sizes below 8KB, the QLogic 2500 Series Adapter from Cavium demonstrated up to 40 percent overall improvement of sequential read/write IOPS over the Emulex LPe12002 Adapter, as shown in Figure 4.

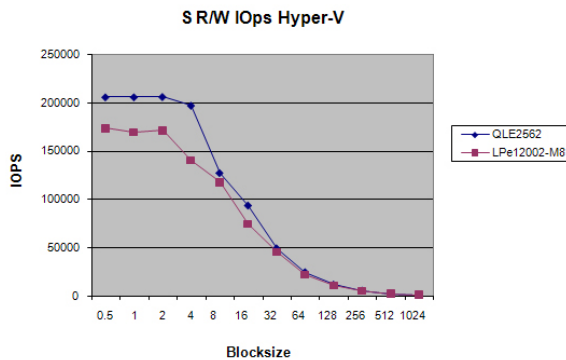


Figure 4. Sequential Read/Write IOPS

Throughput

At block sizes above 64KB, the QLogic 2500 Series Adapter from Cavium demonstrated a 7 percent advantage over the Emulex LPe12002 Adapter.

VIRTUAL MACHINE SCALABILITY

QLogic 2500 Series Adapters from Cavium meet the demand of today's data center (represented in this section of the white paper as virtual server workload). The figures in this section illustrate how QLogic Fibre Channel Adapter performance scaled higher than Emulex as the number of Hyper-V VMs increased from one to eight. The Emulex 8Gb adapter scaled from one to eight VMs, and demonstrated consistently lower performance (20 percent less than the QLogic 2500 Series Adapter). As the application scaled to eight VMs, the QLogic 2500 Series Adapter maintained high IOPS in support of Microsoft's Hyper-V applications.

Read IOPS

QLogic's IOPS, when running eight VMs at a 512K block size, were higher than Emulex by 20 percent. As shown in Figure 5, Emulex LPe12002 IOPS peaked at 108,000K.

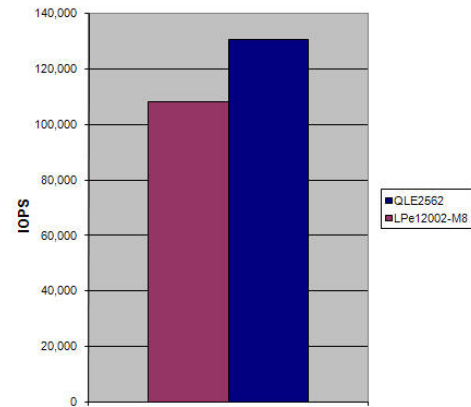


Figure 5. IOPS Comparison

As illustrated in Figure 6, Emulex and QLogic were parity with one VM, but as the workloads increased, Emulex IOPS lagged behind QLogic's performance by up to 44 percent, while the QLogic 2500 Series Adapter from Cavium continued to scale.

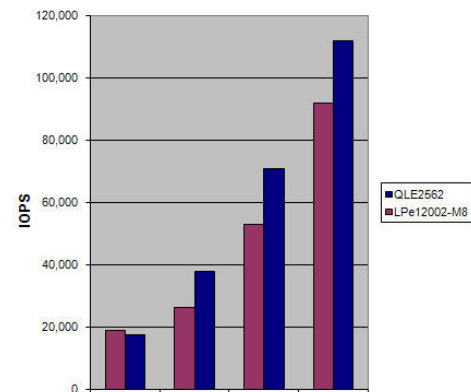


Figure 6. Scalability of Read IOPS

Write IOPS

Figure 7 shows that even though write IOPS was at parity at one VM adapter, the overall performance of the LPe12002 averaged 34 percent less than the QLogic 2500 Series Adapter from Cavium when the number of VMs scaled to eight.

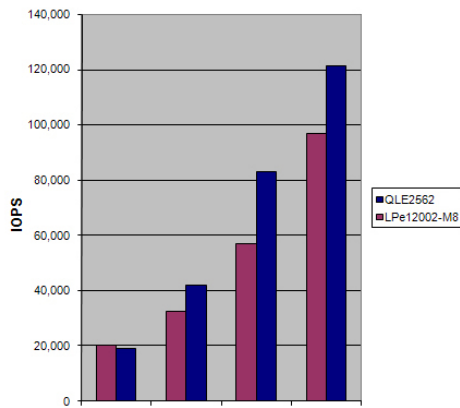


Figure 7. Scalability of Write IOPS

The QLogic 2500 Series Adapter from Cavium continued to provide scalability and performance as demonstrated in the aforementioned benchmarks. IOMeter was configured to place the maximum possible load on the QLogic and Emulex 8Gb adapters in the Windows Hyper-V environment. As customers purchase and integrate 8Gb adapter technology into 8Gb SANs and infrastructure, they expect the optimum throughput and IOPS, as demonstrated by the QLogic 2500 Series 8Gb Fibre Channel Adapters.

SUMMARY AND CONCLUSION

Cavium continues to be the industry leader in delivering high-performance I/O solutions to data center customers. The IOPS and throughput of the QLogic 2500 Series 8Gb Fibre Channel Adapter from Cavium is best in class and provides an unprecedented level of high performance, superior scalability, and enhanced reliability that exceeds the requirements for next-generation data centers. The results of the benchmark tests shown in this paper demonstrate the I/O performance and scalability advantages of the QLogic 2500 Series 8Gb Fibre Channel Adapter from Cavium over the Emulex LightPulse 12002 Adapter in Microsoft Hyper-V virtualized environments.

Virtualization continues to become prevalent in enterprise data centers and continues to grow with the introduction of Microsoft's Hyper-V product. A majority of today's virtualization deployments are based on software hypervisor-based solutions. Despite the benefits of these solutions, challenges remain with respect to I/O performance and system reliability. Virtualization is an important element of the data center. QLogic adapters support server virtualization platforms from Microsoft, Linux®, and VMware®. The QLogic 2500 Series 8Gb Fibre Channel Adapter technology provides better IOPS and throughput in virtualized servers, making QLogic the clear choice to support 8Gb Fibre Channel and virtualization environments.

APPENDIX

Server Configuration

Intel Server	
Processor type and speed	Tylersburg – 8 Core Xeon®, two sockets
Memory	11GB RAM
OS type	Microsoft 2008 Server (64 bit) with Hyper-V
Version	Windows Server 2008 (64 bit), SP1
Guest OS	Windows Server 2008

Fibre Channel Hardware Configuration

Adapters	
QLogic	QLE2562
Emulex	LPe12002-M8

Fibre Channel Driver Configuration

Drivers	
QLogic driver	9.1.8.16
Emulex driver	2.10a7, FW 1.10a5

External Storage Configuration

Storage — Sequential Operation Benchmark	
Solid state disk	RamSan-400 solid state storage
LUNs	8 LUNs, 4 target ports
Storage — Scalability Benchmark	
Solid state disk	RamSan-400 solid state storage RamSan-320 solid state storage
LUNs	4 LUNs, 4 target ports per RamSan

Fibre Channel Switch Hardware

Switch	
8Gb switch	QLogic 5802v

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.



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