

8Gb Fibre Channel Adapter of Choice in VMware[®] Environments

QLogic 8Gb Adapter Outperforms Emulex[®]—QLogic Offers Best Performance and Scalability in VMware Environments

Key Findings

The QLogic and the Emulex 8Gb Fibre Channel adapters were tested with the most current software and firmware available, in a test environment that enabled an unconstrained assessment of IOPS, throughput performance, and scalability in a VMware environment. QLogic's test results show that:

- For data centers deploying virtualization for server consolidation with VMware, the QLogic 2500 series 8Gb FC adapter offers up to 22 percent higher IOPS and throughput compared to the Emulex LightPulse 12000 series adapter.
 - Sequential Read Operations: QLogic 2500 series adapter IOPS are up to 22 percent higher than Emulex. Throughput is at parity.
 - Sequential Write Operations: QLogic 2500 series adapter IOPS are up to 13 percent higher than Emulex; throughput is up to 16 percent improved.
 - Sequential Read/Write Operations: QLogic 2500 series adapter IOPS are up to 14 percent higher than Emulex; throughput is up to 22 percent improved.
- Virtual Machine Scalability. The QLogic 2500 series 8Gb FC adapter is 54 percent faster than the Emulex LightPulse 12000 series adapter. The Emulex product I/O performance flattens out when the number of virtual machines increases above four.



Executive Summary

Server consolidation (through virtualization of the Enterprise data center) improves server/processor utilization and lowers data center capital and operational costs. 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 (FC) 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, as well as applications, in virtualized environments running simultaneously on a single physical server.

To help IT administrators make the best, most informed adapter choice, QLogic has performed a series of head-to-head performance benchmarks showing the I/O performance and scalability advantages of the QLogic 2500 series 8Gb FC adapter over the Emulex LightPulse® 12000 (LPe12000) series adapter. QLogic compared the overall performance of these 8Gb adapters when attached to an industry-leading, solid-state storage array to emulate real-world VMware environments.

VMware Micro-Benchmark and VMware Scalability Performance

Configuration

The IOmeter tool was used to benchmark the QLogic 2500 series 8Gb FC adapter versus the Emulex LightPulse LPe12000 8Gb adapter in an exchange environment with minimum subsystem latency.

The IOmeter test setup (Figure 1) consisted of the latest 8Gb adapters from QLogic and Emulex, running on current commercially available drivers, installed in a Dell® R900 quad core (dual socket) server running the VMware ESX 3.5 U2 operating system. The Dell R900 server was connected to a Texas Memory System RamSan®-400 (with 32GB total capacity) through a QLogic® 5802V series 8Gb switch. Using a solid state disk allows removing the latency introduced by a slower disk-driver, and provides the performance benchmark expected from next-generation storage arrays.

One initiator and four target RamSan ports were configured in a zone to the 8Gb QLogic 5802V. Eight LUNs on four target ports were configured for micro-benchmark. Eight LUNs (one LUN per VM) were configured for the scalability benchmark. Tests were performed to compare I/O performance of the QLogic and Emulex 8Gb FC adapters in a VMware ESX 3.5 virtualized environment with Windows Server® 2003 as a guest operating system. IOmeter measured the IOPS and throughput values across a range of block sizes.

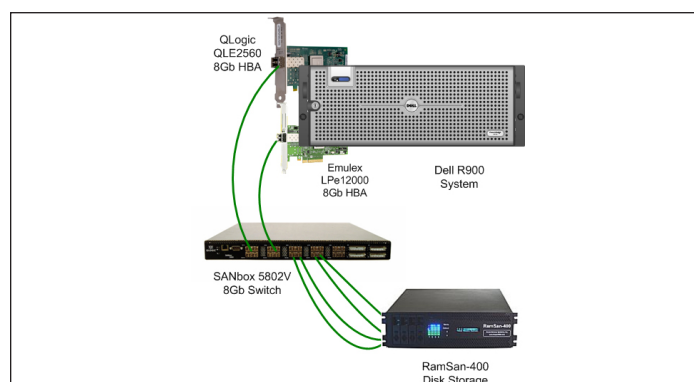


Figure 1. IOmeter Test Setup

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

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 (QLE2560) was installed on the test server using the VMware inbox ESX U2 driver.
2. Work loads 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 single-channel PCI Express to Fibre Channel adapter (LPe12000).

Test Results

The test results demonstrated increased performance of the QLogic 2500 series 8Gb FC adapter over the Emulex LPe12000 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 8Gb 2500 series adapter has a performance advantage over the Emulex LPe12000 8Gb adapter, especially at smaller block sizes supporting enterprise applications.

Sequential Read Operations

IOPS

At block sizes below 8KB, the QLogic 2500 series 8Gb FC adapter demonstrated up to 22 percent overall improvement of sequential read IOPS over the Emulex LPe12000 adapter, as shown in Figure 2.

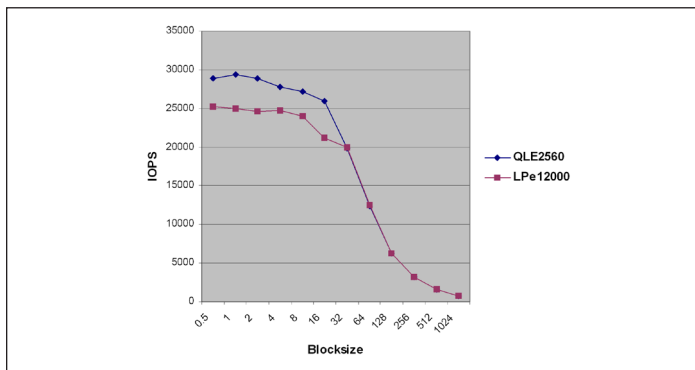


Figure 2. Sequential Read IOPS

Throughput

At block sizes above 64KB, the QLogic 2500 series 8Gb FC adapter and Emulex LPe12000 are at parity.

Sequential Write Operations

IOPS

At block sizes below 8KB, the QLogic 2500 series 8Gb FC adapter demonstrated up to 13 percent overall improvement of sequential write IOPS over the Emulex LPe12000 adapter, as shown in Figure 3.

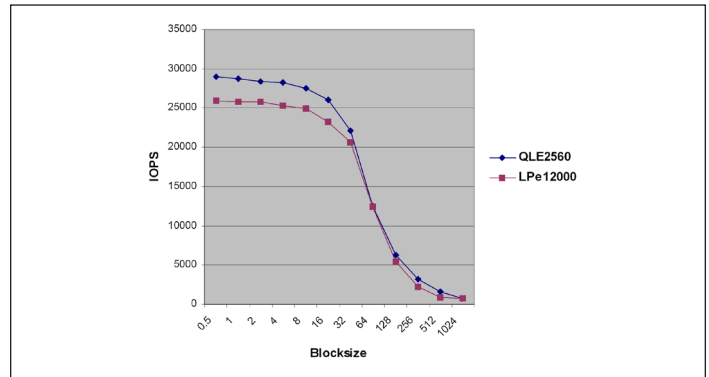


Figure 3. Sequential Write IOPS — Native

Throughput

At block sizes above 64KB, the QLogic 2500 series 8Gb FC adapter demonstrated up to 16 percent overall improvement of sequential write throughput over the Emulex LPe12000 adapter.

Sequential Read/Write Operations

IOPS

At block sizes below 8KB, the QLogic 2500 series 8Gb FC adapter demonstrated up to 14 percent overall improvement of sequential read/write IOPS over the Emulex LPe12000 adapter, as shown in Figure 4.

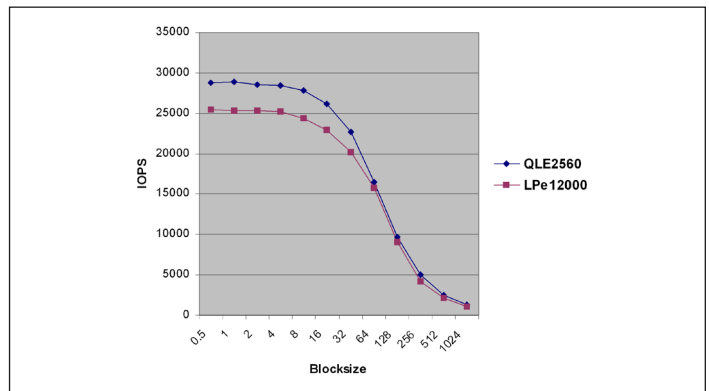


Figure 4. Sequential Read/Write IOPS

Throughput

At block sizes above 64KB, the QLogic 2500 series 8Gb FC adapter demonstrated up to 22 percent overall improvement of sequential read/write IOPS over the Emulex LPe12000 adapter.

Virtual Machine Scalability

QLogic 8Gb FC adapters meet the demand of today's data center (represented in this section of the white paper as virtual server workload). The following figures illustrate how QLogic FC adapter performance scaled higher than Emulex as the number of VMs increase from one to eight. Limitations in Emulex's adapter performance were observed between four and six VMs, beyond which their IOPS could not scale higher with the addition of more VMs.

- **Read IOPS Comparison with Eight VMs at 0.5K Block Size.** QLogic outperforms Emulex by 54 percent. In addition, the Emulex LPe12000 peaks out at 33,000 IOPS, as shown in Figure 6.

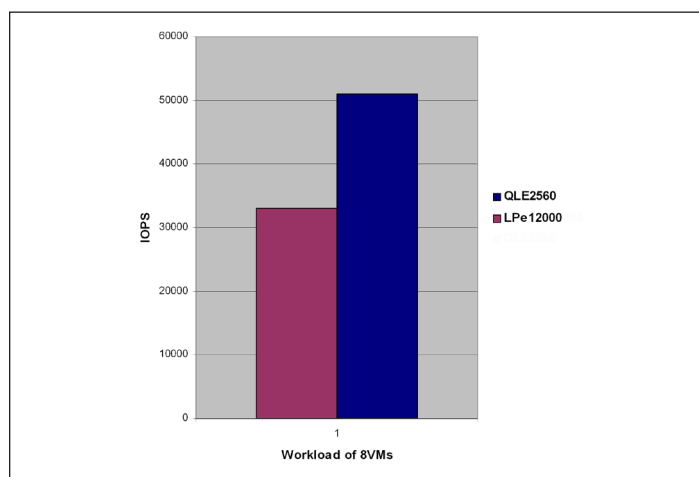


Figure 5. IOPS Comparison

- **Read IOPS Scalability at 4K Block Size.** As illustrated in Figure 6, Emulex and QLogic are at parity with one and two VMs. When there are more than four VMs, Emulex's IOPS flatten out to 33,000, but the QLogic FC adapter continues to scale.

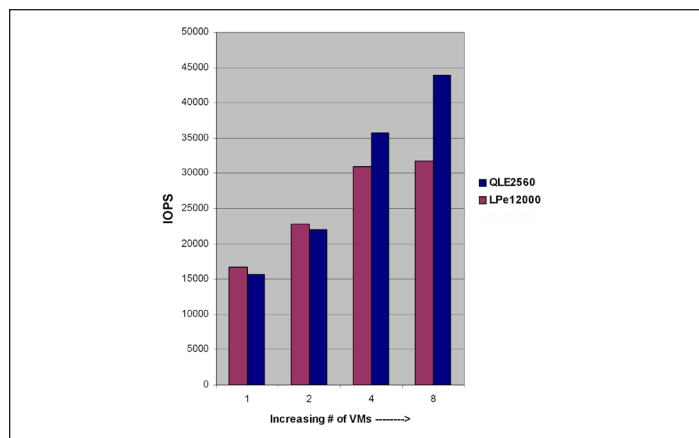


Figure 6. Scalability of Read Performance

- **Write Performance at 512 Block Size.** As identified in Figure 5 and Figure 6, the Emulex LPe12000 8Gb adapter cannot scale to support

the IOPS performance that is available with the increased number of VMs. Figure 7 shows that the Emulex LPe12000 maxed out at 33,000 IOPS at 4 VMs. Note that overall, QLogic has better write performance than Emulex.

The QLogic 2500 series 8Gb FC adapter continues 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 VMware environment. As customers purchase and integrate 8Gb adapter technology into 8Gb SANs and infrastructure, they expect optimum throughput and IOPS, as demonstrated by the QLogic 2500 series 8Gb FC adapter.

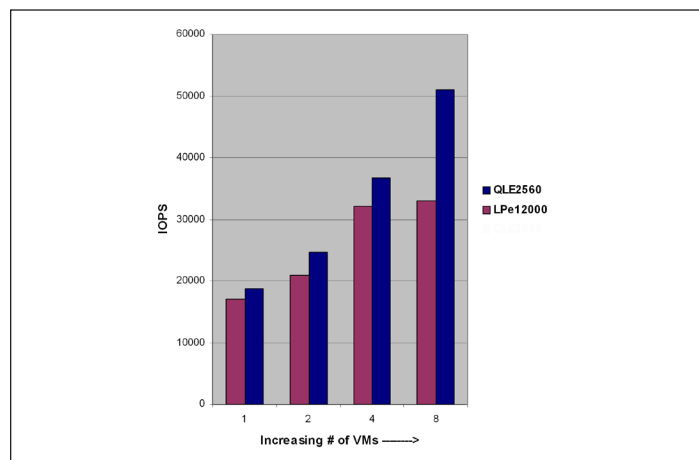


Figure 7. Scalability of Write Performance

Summary and Conclusion

QLogic 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 FC adapter 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 FC adapter over the Emulex LightPulse 12000 adapter in VMware virtualized environments.

Virtualization continues to become prevalent in enterprise data centers. 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 VMware, Microsoft®, and Linux®. The QLogic 2500 series 8Gb FC adapter technology provides extensive support and experience in server and adapter virtualization technology, making QLogic the clear choice to support the 8Gb FC and virtualization environments.

Appendix A

Server Configuration

Intel Server	
Processor type and speed	Dell R900 (quad socket, quad core) — total 16 cores
Memory	11 GB RAM
OS type	VMware
Version	ESX 3.5 U2
Guest OS	Windows Server 2003, SP1

FC Adapter Hardware

FC Adapters	
QLogic	QLE2560
Emulex	LPe12000

FC Adapter Configuration

QLogic and Emulex FC Adapters	
QLogic driver	VMware inbox ESX 3.5 U2
QLogic driver version	
Emulex driver	
Emulex driver version	

External Storage Configuration

Storage	
Solid state disk	RamSan-400 solid state storage
LUNs	8 LUNs, 4 target ports

FC Switch Hardware

Switch	
8Gb switch	QLogic 5802V

Disclaimer

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