

# The 4Gb HBA of Choice In Oracle Environments

## QLogic vs. Emulex 4Gb Fibre Channel HBA Performance Benchmarking with Oracle Workloads



### Executive Summary

Today's mission-critical Online Transaction Processing (OLTP), Online Analytical Processing (OLAP) and Web applications demand the highest levels of performance from their database servers and storage infrastructure. To satisfy this demand, organizations are making the transition to 4Gb Fibre Channel SANs, and IT decision makers are under pressure to select the right components in order to ensure a cost-effective and scalable solution.

A critical element of overall SAN performance is the selection and deployment of a Host Bus Adapter (HBA) with the right architecture. With the introduction of multi-processor CPUs coupled with virtualization technologies, high performance database solutions need to be complemented with high performance and scalable IO connectivity. A wrong choice can result in management complexity and limit an organization's overall business agility to meet continually evolving business needs.

To help IT decision makers make the best, most informed HBA choice, QLogic has performed a series of head-to-head performance benchmarks showing the I/O performance and scalability advantages of the QLogic SANblade™ Pro 2400 series HBAs over Emulex® LightPulse® HBAs in a variety of real-world OLTP, OLAP and Web scenarios using SAN-attached Oracle databases.

QLogic compared the overall performance of the 4Gb HBAs when attached to industry leading storage arrays and solid state drives to emulate a real-world SAN with maximum throughput workloads. Our tests highlight the advantage delivered by QLogic's SAN Pro architecture in Oracle environments.

### Key Findings

For demanding enterprise database applications, choosing QLogic 4Gb FC HBAs provides:

- **33% Higher Performance**
  - Using best-in-class Oracle™ and EMC™ components in OLTP, Web and OLAP workloads indicative of real-world storage configurations, QLogic HBAs demonstrated 33% better throughput than Emulex HBAs.
- **28% Superior Scalability**
  - In high-performance database applications, emulated with Oracle workloads, QLogic's SANblade 2400 series dual port HBAs deliver 28% higher IOPs compared to the Emulex's 11000 series HBAs.

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### Introduction

The objective of this exercise was to test and compare the I/O performance of QLogic and Emulex 4Gb Fibre Channel HBAs in a representative selection of database-driven workloads, a configuration arrived at through a combination of customer requests as well as common reference within Oracle user groups.

- An **OLTP workload** with a read:write ratio of 70:30
  - OLTP applications are high throughput, insert/update-intensive and typical for companies having large transaction processing applications, such as airline ticketing, large order-entry, and banking applications.
- A **Web workload** with read:write ratio of 90:10
  - Most database-backed Web applications have high throughput requirements and are read-intensive, but not exclusively so. Web workloads mix a variety of content and data-rich applications ranging from e-commerce and banking applications to CRM and self-service intranet applications.
- An **OLAP workload** with a read:write ratio of 100:0
  - The typical applications of OLAP are in business reporting for sales, marketing, business performance management (BPM), budgeting and forecasting, financial reporting and planning.

For our tests, the key measures of HBA I/O performance, especially when used in a database application, were one of the following:

- The ability to handle multiple data requests, and the volume of data or throughput as measured in megabytes per second (MBps) with an increase in the number of outstanding IOs.
- The ability of the HBA to scale across multiple ports.

In order to make the benchmarks relevant to today's businesses, we selected the market-leading **Oracle® RDBMS** running on Microsoft® Windows 2003™ Enterprise Edition with Service Pack 1. This is a very popular, highly scalable enterprise configuration in wide production use for all three workloads mentioned above. Selecting Oracle also allowed us to use ORION, a tool from Oracle used for predicting the performance of the Oracle database under load. ORION does this by simulating database I/O workloads using the same I/O software stack as the RDBMS. This tool gives users the capability to decide the kind and amount of load, varying from small sequential and random with user-defined data blocks.

**Testing performance** - To test the real-world performance of the HBAs, indicative of use within small or medium scale enterprises, we used a market-leading **EMC Clariion CX300™** storage array.

**Testing scalability** - To test the maximum throughput of the HBAs, we also conducted the test using a **Texas Memory Systems RamSan-400™** solid-state storage subsystem. Solid-state storage dramatically reduces the latency that comes from using disk-based storage, allowing us to measure the true horse-power of the HBA.

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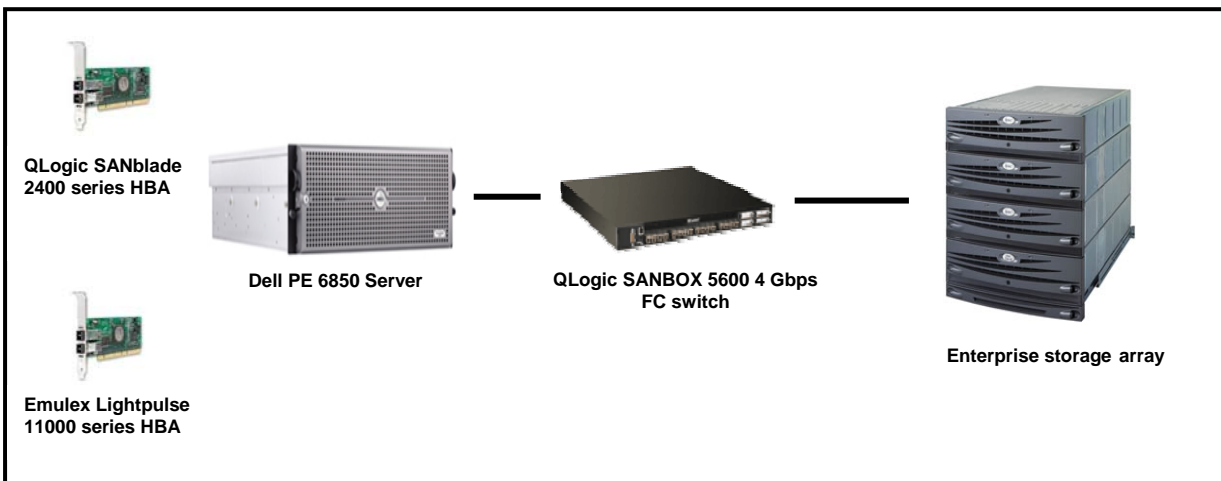
## Performance Scalability with Oracle Workloads

### Test Setup

The test setup consisted of the latest QLogic SANblade™ Pro 2400 series and Emulex® LightPulse® HBAs running on the latest commercially available drivers, housed in a Dell® PowerEdge™ 6850 server running Windows® Server™ 2003 operating system. The Dell server was connected to an enterprise storage array with 15 disks of 10,000 rpm total capacity through a QLogic® SANbox™ 5600 series 4Gbps switch.

The testing utilized one port on the enterprise storage array, accessing 8 of the total 15 LUNs created. Figure 1 depicts the test configuration setup.

Figure 1: Test Setup



All tests were run using the HBA default settings from both companies.

### Test Procedure

The test procedure using an enterprise storage array was as follows:

1. A QLogic 4Gb PCI Express to Fibre Channel HBA (QLE2460) was installed on the test server using the appropriate STORport miniport driver.
2. Eight LUNs of 60 GB each were created on the enterprise storage array and mapped to the first port.
3. The Windows device manager was used to verify that the LUN(s) were visible. Each LUN was then formatted and assigned a drive letter which could be used by the ORION tool.
4. The ORION commands were executed to simulate the three main workloads, using a standard block size of 1 megabyte:

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1. OLTP
2. Web application
3. OLAP
5. The same steps were repeated for the Emulex 4Gb PCI Express to FC HBA (LPe11000).

### Test Results

Performance of the QLogic and Emulex HBAs was measured based on a critical parameter - the rate at which the data is parsed by the HBAs (megabytes per second, or MBps). Higher MBps values denote greater throughput and a higher level of performance.

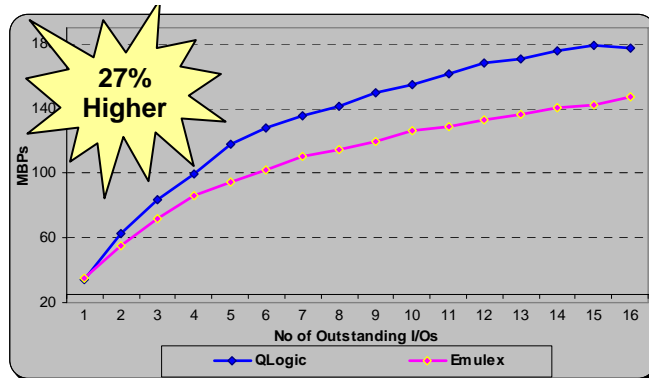
**The results demonstrate that across all three workloads—OLTP, OLAP, and Web—QLogic’s performance was an average 31% better than Emulex.**

The performance was measured against an increasing load on the HBAs determined by number of outstanding Input-Output (I/Os) requests. All tests used a standard block size of 1 megabyte.

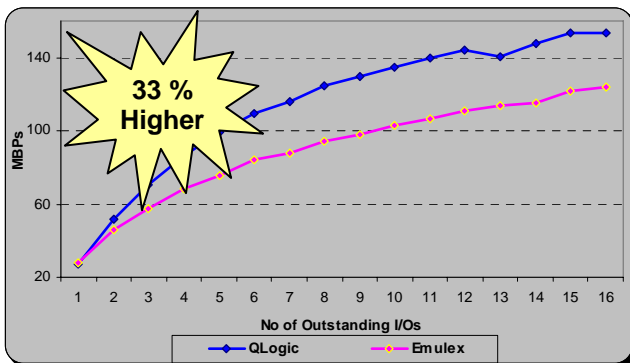
#### OLTP Workload

*Note that the performance gap between QLogic and Emulex increases as the number of Outstanding I/Os increases.*

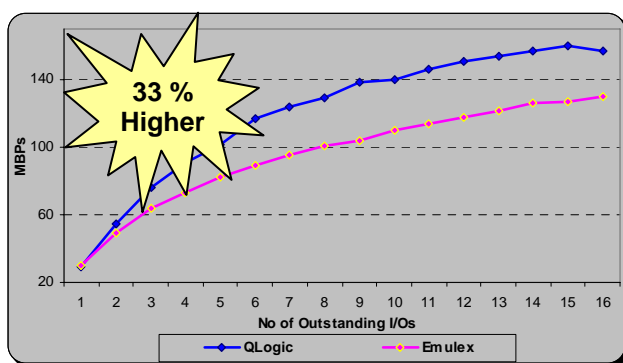
*(The # of Outstanding I/Os specifies the maximum number of outstanding asynchronous I/O operations active at one time).*



#### OLAP Workload



#### Web Workload



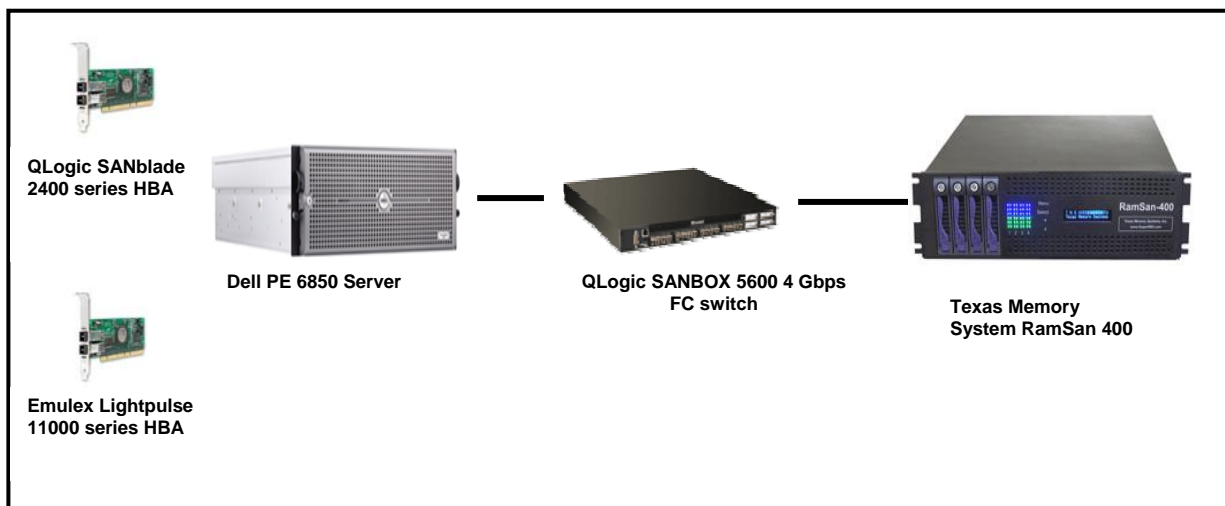
### Dual Port Scalability with Oracle Workloads

#### Test Setup

The test setup consisted of the latest 4Gb HBAs from QLogic and Emulex, running on current commercially available drivers, housed in a Dell® PowerEdge™ 6850 server running Windows® Server™ 2003 operating system. The Dell server was connected to a RamSan-400 with 32 GB total capacity through a QLogic® SANbox™ 5600 series 4Gbps switch. Using a solid state disk allows you to remove the latency introduced by slower disk-driver and future proof the performance benchmark expected from next-generation storage arrays.

Two LUNs of 16 GB each were created on the RamSan, visible through two different ports. The switch was zoned so that each LUN was visible through its respective port on the HBA.

**Figure 2:** Test Setup to Measure Scalability



The tests were performed using the latest hardware, software and drivers that were commercially available at the time of testing. All tests were run using the HBA default settings from both companies

#### Test Procedure

The test procedure using RamSan-400 solid state storage was as follows:

1. A QLogic 4Gb dual channel PCI Express to Fibre Channel HBA (QLE2462) was installed on the test server using the appropriate miniport driver.
2. Two LUNS of 16GB each were created and mapped to two different ports.
3. The Windows device manager was used to verify that the LUN(s) were visible. Each LUN was then formatted and assigned a drive letter which could be used by the ORION tool.
4. The ORION commands were executed to simulate an OLTP workload.

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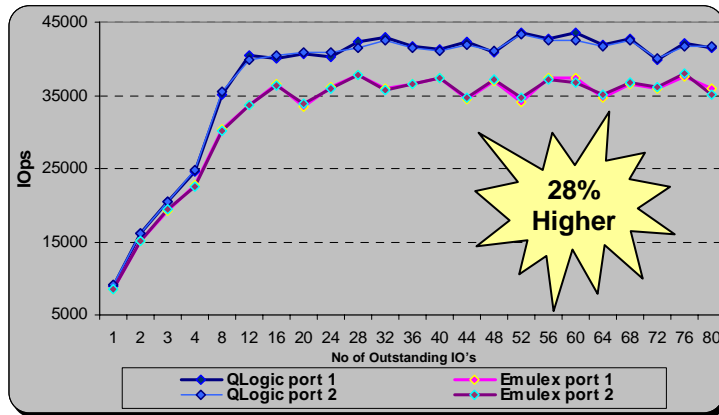
- The same steps were repeated for the Emulex 4gb dual channel PCI Express to Fibre Channel HBA (LPe11002).

### Test Results

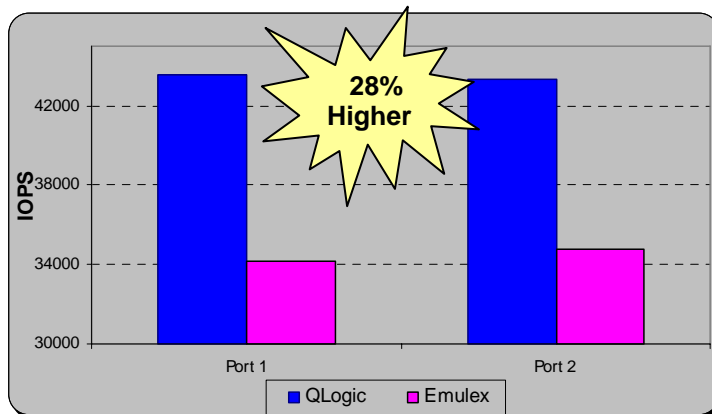
To test the scalability of QLogic and Emulex HBAs, a set of OLTP tests were run using the RamSan configuration as described above, using dual port HBAs. OLTP is the most common workload in the enterprise giving a good indication of the HBA's scalability in a production setting. Performance of the QLogic and Emulex HBAs was measured using a critical parameter - the rate at which I/O requests are serviced (IOPs). Higher IOP values denote greater throughput, and a higher level of performance.

*The performance difference between QLogic and Emulex HBA widens as the outstanding IO load increases, averaging 28%.*

Dual Port Scalability



Linear Scalability across Dual Ports



## Summary and Conclusion

IT managers know that choosing the right HBA for their SAN infrastructure can have a strong impact on the performance, agility and scalability of their enterprise storage environments.

The results of this study demonstrate that QLogic SANblade™ Pro 2400 series HBAs consistently out-perform Emulex® LightPulse® HBAs in today's real-world environments and provide significant head-room for future scalability.

- **Higher Performance:** Using best-in-class Oracle™ and EMC™ components in OLTP, Web and OLAP workloads indicative of real-world storage configurations, QLogic HBAs demonstrated 31% better throughput than Emulex HBAs.
- **Superior Scalability:** QLogic's dual port HBAs scale better in OLTP tests with higher work-loads and deliver 28% higher IOPs compared to Emulex HBAs.

The key to the increased performance advantage can be attributed to the SAN Pro architecture that is designed into QLogic 4Gb FC ASICs and HBAs. Some of the key Performance Foundation Foundations of the SAN Pro architecture include:

**Intelligent Interleaved Direct Memory Access (iiDMA)** – ensures maximum bandwidth utilization between end nodes that have different link rates.

**Dual Read Direct Memory Access (DRDMA)** – optimizes DMA read request processing by allowing multiple DMA read requests to be serviced.

**Out of Order Frame Reassembly (OoOFR)** – reassembles the frames within an exchange in the correct order, even though they may have been received out of order

Please refer to the URL below for Technical Briefs on the foundations of the SAN Pro architecture.

[http://www.qlogic.com/knowledgecenter/briefs\\_papers.asp](http://www.qlogic.com/knowledgecenter/briefs_papers.asp)

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The superior scalability advantages demonstrated in this testing delivers practical benefits in real-life applications used by enterprise IT users:

- **Lower the hardware total cost of ownership (TCO)** especially with emerging, high-performance database applications that will be used in conjunction with emerging server virtualization technologies and high-performance Grid-computing. QLogic HBAs provide higher IOPs and throughput to account for high bandwidth requirements to meet the needs of enterprise SANs.
- **Investment protection.** Future proof SAN infrastructure in the data center with higher performance 4Gb QLogic HBAs. Higher performance and scalability, backward and forward compatibility are being delivered at the price of 2Gb FC HBA technology.
- **Deliver true performance advantages** in enterprise email and database applications such as Microsoft Exchange and Oracle. For more information on QLogic 4Gb FC HBA performance advantages in a Microsoft Exchange environment, please check out the following URL.  
[http://www.qlogic.com/products/indep\\_test\\_results.asp](http://www.qlogic.com/products/indep_test_results.asp)

Standardizing on and deploying QLogic 4Gb HBAs translates to a clear performance benefit, enabling enterprises to do more with less and drive more value from their SAN infrastructure investments.

## Appendix

### Server Configuration

Intel Server	
Type and Speed of Processor	X86 Family Intel Xeon quad processor running at 3.6 GHz
Memory	8Gb SDRAM
Internal Hard Disk	140 GB
Operating System (OS)	MS Windows Server 2003 Enterprise Edition
OS Version	5.2.3790 Service Pack 1
System Model	Dell Power Edge 6850

### FC HBA Configuration

QLogic and Emulex FC HBA	
QLogic Driver	STOR miniport
QLogic Driver Version	9.1.2.16
Emulex Driver	STOR miniport
Emulex Driver Version	1.11a3

### External Storage Configuration

EMC Storage	
Disk Array	EMC Clariion CX300
Number of Drives	15 10K rpm
Number of LUN's	15
Drives per LUN	1
Number of Ports Used	2

RamSan Storage	
Model	RamSan 400
Total Storage Capacity	32 GB
Number of Ports Used	1/2 Port

### Switch Configuration

Switch Configuration	
Switch	SANbox 5600
Vendor	QLogic
Total Number/Speed of Ports	16 4Gb
Firmware Version	V5.0.0.17.0

### References

- 1) ORION download and documentation is available at:  
<http://www.oracle.com/technology/software/tech/orion/index.html>
- 2) QLogic drivers are available at:  
[http://support.QLogic.com/support/os\\_detail.asp?productid=935&osid=85](http://support.QLogic.com/support/os_detail.asp?productid=935&osid=85)
- 3) Emulex drivers are available at:  
<http://www.emulex.com/ts/downloads/stor/storport.html>

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