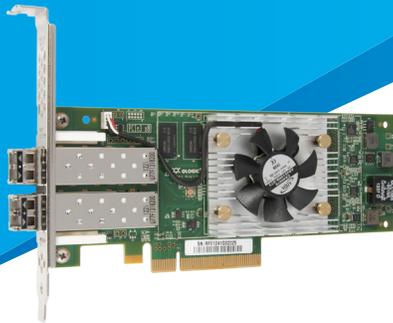


# QLogic Fibre Channel Advantages in VMware vSphere 5

QLogic Adapters Outperform Emulex, Providing Reduced CAPEX and OPEX



QLogic 16Gb Gen 5 Fibre Channel Adapters from Cavium—scalable performance for high-density virtualized environments.

## KEY FINDINGS

QLogic® adapters from Cavium™ are the clear choice for delivering scalable performance for vSphere® 5 environments. Extensive testing shows that for virtual machine scalability:

- The QLogic 2600 Series Adapters outperform the Emulex® LPe16000 Series in small block transactions—server capital expenditures (CAPEX) are reduced as much as 27 percent.
- The QLogic 2600 Series Adapters consume up to 42 percent less power than the Emulex LPe16000 Series, reducing operating expenses (OPEX).

## EXECUTIVE SUMMARY

Improving server processor utilization is a key component of server consolidation. Embracing virtualization to reduce server count delivers real savings in both capital and operational costs. IT professionals must plan and execute intelligently to minimize bottlenecks and implement Fibre Channel ecosystems that support required performance levels, growth plans, and economic challenges. To meet these collective challenges, Cavium provides scalable, high-performance QLogic adapter architectures that address the simultaneous demands placed by multiple virtual machines (VMs) and applications in virtualized vSphere environments.

To aid IT professionals in making the best adapter choice for migrating their Fibre Channel infrastructure from 4Gb or 8Gb to the latest 16Gb technology, Cavium performed a series of head-to-head performance benchmarks. The results showed the I/O performance, scalability, and power consumption advantages of QLogic Fibre Channel Adapters over Emulex. These advantages can be summarized in relationship to the data center budget's bottom line: lower server and cooling costs, reduced power bills, and decreased operational expenses associated with server management.

## INDUSTRY CHALLENGES

Underutilization of multi-core CPU hardware resources, the need to control overall hardware expenses, respond to green initiatives, and manage IT staffing levels are driving virtualization of physical server resources to new heights. Given the space consumption and power, cooling, procurement, and other ongoing costs associated with servers in the data center, IT professionals are trying to maximize the use of resources as efficiently as possible.

How many VMs can be run on a single physical server to maximize the server consolidation effort? The number can vary depending on the application type, where databases like Microsoft® SQL Server® and Oracle® will be much more resource intensive than less demanding application services like file or web. CPU, memory, and storage I/O all play important roles in answering questions surrounding ways to best maximize the server consolidation effort. This paper examines the impact of storage I/O in virtualizing a data center full of servers. Specifically, it covers how the scalability of storage I/O at the physical server level affects VM density.

## THE TEST CONFIGURATION

The test bed was comprised of an IBM® x3650 M4 server installed with ESXi 5.1. The server contained a QLogic QLE2672 16Gb Gen 5 Fibre Channel Adapter and an Emulex LPe16002B 16Gb Fibre Channel Adapter. Both were the latest dual-port 16Gb adapters available and were running on the latest commercially available drivers. All measurements were made using out-of-box settings. Each adapter was connected to dual Brocade DS-6505B 16Gb switches. Each fabric was connected to two active ports (one per controller) on an IBM Flash Array 820.

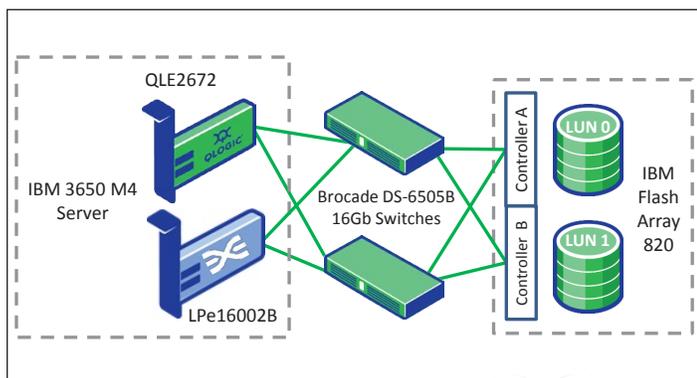


Figure 1. SQLIO Test Configuration

For each setup, the adapter and all storage array ports were zoned together via the switch. Two test LUNs were created on the array and configured so that one LUN was mapped to the QLogic adapter and one LUN was mapped to the Emulex adapter. Only the mapped through a given vendor's Host Bus Adapter were powered on during its portion of the test. Tests were performed to compare the I/O performance of the QLogic and Emulex Fibre Channel Adapters in an ESXi 5.1 virtualized environment.

SQLIO was used to simulate and benchmark OLTP-type workloads on up to 20 VMs; this is where higher IOPS performance is generally required. A batch script was used to launch SQLIO concurrently across all VMs and the sum of the performance from each individual VM was then calculated to provide aggregate performance. The VMs were running on Windows Server® 2008 R2.

## TEST PARAMETERS

- SQLIO v1.5.SG
- Thread count = 2
- Outstanding I/Os = 8
- Target DB size = 30GB
- Block sizes (bytes) = 1K, 2K, 4K, 8K

## TEST RESULTS: QLOGIC DELIVERS HIGHER LEVELS OF VM DENSITY

The test results indicate superior scalability of performance by the QLogic QLE2672 over the Emulex LPe16002B Adapter. Both adapters perform well at I/O sizes of 8K and above. But, when comparing the performance differences at the smaller I/O sizes popular with database and metadata accesses, there is an appreciable advantage for the QLogic QLE2672 adapter.

Figure 2 shows that the QLE2672 has up to a 27 percent advantage with 1KB, 2KB, and 4KB I/O random read data patterns.



Figure 2. Comparative Random Read Performance as Virtual Machines Scale

Similarly, with Random Write performance, the QLE2672 provides up to 19 percent better performance than Emulex.

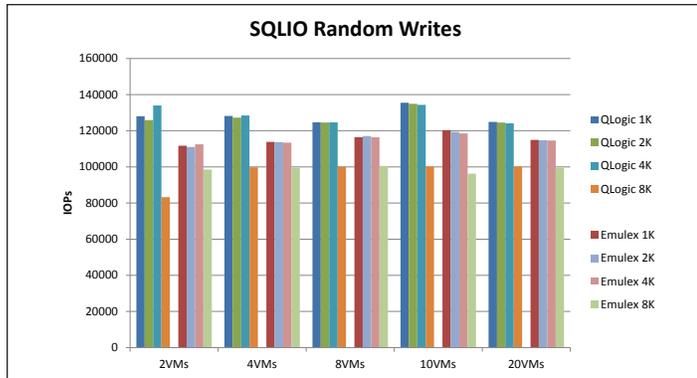


Figure 3. Comparative Random Write Performance as Virtual Machines Scale

**Note:** The performance captured in the above figures is limited due to the test environment and not indicative of each adapter's maximum performance.

### LOWER TOTAL COST OF OWNERSHIP – QLOGIC ADAPTERS REDUCE IT CAPEX AND OPEX

As IT professionals design and scale virtualized environments, scalable architectures are critical for maximum resource efficiency. Cavium delivers performance advantages that correlate to a reduction in the number of physical server resources required to meet the performance levels demanded by popular virtualized application workloads.

By using QLogic QLE2672 adapters from Cavium, IT administrators can meet their performance requirements and maintain quality of service (QoS) more efficiently, resulting in up to a 27 percent reduction in capital expenditures (CAPEX) for new server equipment.

### LOWER POWER CONSUMPTION

Dynamic Power Management techniques, such as Intelligent Link Training (ILT), save power on the QLogic 2600 Series 16Gb Fibre Channel Adapters. ILT forces the PCIe® bus to use the minimum number of lanes needed for maximum throughput. As an example, in PCIe Gen2 slots, the QLogic QLE2672 will use all 8 PCIe lanes; however, when the same adapter is plugged into a PCIe Gen3 slot, it uses only four lanes, thereby saving power.

In a PCI Express® Gen3 slot, the QLogic Dynamic Power Management feature demonstrates 42 percent greater power savings over the Emulex adapter, as shown in Table 1.

| Dual-Port Adapter | Power Consumption: Idle State | Power Consumption: Active State (with I/O) |
|-------------------|-------------------------------|--|
| LPe16002B         | 10.85W                        | 11.64W                                     |
| QLE2672           | 7.63W                         | 8.20W                                      |
| QLogic Advantage  | 3.2W (42%)                    | 3.4W (42%)                                 |

<sup>1</sup> For a detailed description of the power testing methodology, see the technology brief, "QLogic Platform and Methodology for Product Evaluations."

In a PCI Express Gen3 slot, Dynamic Power Management automatically reduces power consumption, without IT administrator interaction, by using the minimum number of PCI Express lanes to accommodate the maximum Fibre Channel bandwidth.

Table 2. Example of Number of Physical Servers Required to Achieve 2 Million IOPS Using a Random Read Workload

| Virtual Machines | I/O Size | QLogic IOPS | Emulex IOPS | Server Requirements using QLogic | Server Requirements using Emulex | QLogic Advantage |
|------------------|----------|-------------|-------------|----------------------------------|----------------------------------|------------------|
| 4                | 1K       | 133,108     | 106,102     | 16                               | 19                               | 25%              |
|                  | 2K       | 132,881     | 104,968     | 16                               | 20                               | 27%              |
|                  | 4K       | 130,623     | 102,916     | 16                               | 20                               | 27%              |
| 10               | 1K       | 128,865     | 117,015     | 16                               | 18                               | 10%              |
|                  | 2K       | 127,601     | 119,879     | 16                               | 17                               | 6%               |
|                  | 4K       | 125,072     | 116,553     | 16                               | 18                               | 7%               |

**Table 3. Example of Number of Physical Servers Required to Achieve 2 Million IOPS Using a Random Write Workload**

| Virtual Machines | I/O Size | QLogic IOPS | Emulex IOPS | Server Requirements using QLogic | Server Requirements using Emulex | QLogic Advantage |
|------------------|----------|-------------|-------------|----------------------------------|----------------------------------|------------------|
| 4                | 1K       | 128,231     | 113,851     | 16                               | 18                               | 13%              |
|                  | 2K       | 127,293     | 113,641     | 16                               | 18                               | 12%              |
|                  | 4K       | 128,428     | 113,426     | 16                               | 18                               | 13%              |
| 10               | 1K       | 135,505     | 120,283     | 15                               | 17                               | 13%              |
|                  | 2K       | 134,920     | 119,358     | 15                               | 17                               | 13%              |
|                  | 4K       | 134,327     | 118,521     | 15                               | 17                               | 13%              |

**Note:** The performance captured in the above tables is limited due to the test environment and not indicative of each adapter's maximum performance.

### REAL CAPEX BENEFITS

- **Lower Server Costs.** QLogic Fibre Channel Adapters from Cavium achieve the same level of performance and VM density as Emulex while requiring up to 27 percent less physical servers.

### REAL OPEX BENEFITS

- **Reduced Power Bills.** QLogic Fibre Channel Adapters from Cavium consume 42 percent less power for significant cost savings.
- **Lower Cooling Costs.** Reduced power consumption results in generating less heat.
- **Reduced Operating Expenses.** Fewer servers and software licenses to purchase and maintain.

### SUMMARY AND CONCLUSION

With the current trajectory of multi-core processor progression and the continued evolution of virtualization software by VMware®, the drive for greater VM density and application performance will continue with an unquenchable thirst. IT professionals are continuously challenged on a cost/performance model required to get the best performance for the smallest investment, both with initial capital expenditure and after the sale when operating expenses are under the microscope.

IT professionals have a choice when migrating their Fibre Channel infrastructure from 4Gb or 8Gb to the latest 16Gb Gen 5 technology. The comparisons made in this paper show that QLogic Fibre Channel Adapters from Cavium are the right choice when customers want superior, scalable performance and the lowest power consumption available to achieve the highest density vSphere environment.

### 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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