

# Converged Network Adapter of Choice for FCoE in Virtualized Data Centers

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## QLogic QLE8152 Adapter Outperforms Emulex UCNA

### Key Findings

The QLogic QLE8152 Converged Network Adapter and the Emulex<sup>®</sup> OneConnect<sup>™</sup> Converged Network Adapters were compared in the same test environment, using the most current software and firmware available. The assessment focused on the FCoE performance required for real-world application environments and seamless integration with existing Fibre Channel infrastructure. QLogic's QLE8152 Converged Network Adapter delivers superior IOPS and CPU efficiency for workload scalability, compared to Emulex's UCNA, as itemized below:

- QLogic's QLE8152 Converged Network Adapter IOPS-CPU efficiency is up to 127 percent greater than Emulex's OneConnect Universal Converged Network Adapter (UCNA) performance for sequential read operations
- QLogic's QLE8152 Converged Network Adapter IOPS-CPU efficiency is up to 148 percent greater than Emulex's OneConnect UCNA performance for sequential read/write operations
- QLogic's QLE8152 Converged Network Adapter CPU utilization is at 11 percent across the range of typical block sizes. In contrast, Emulex's UCNA consumes up to 86 percent of the CPU cycles for sequential read operations at the smallest block size
- Evaluation of Emulex's driver source code demonstrated that Emulex has moved some of the FCoE functionality from the firmware to the driver to achieve higher IOPS at the smallest block size, at the expense of CPU efficiency

## Executive Summary

Organizations looking to consolidate their enterprise data centers to reduce capital and operational expenses need to implement high-performance products to support critical applications in the data center.

There are three crucial elements that influence server consolidation strategies. First, deploying virtualization helps increase the density of the operating systems (OSs) and the enterprise applications on a server, which reduces the number of physical servers. Second, implementing Fibre Channel over Ethernet (FCoE) technology consolidates storage and network I/O functions on a single adapter.

FCoE technology integrates with existing Fibre Channel infrastructure; and reduces cabling, switch, and management costs. Lastly, the more CPU cycles that are made available to the physical server the better, as this creates the headroom required to execute the increasing number of enterprise applications on multi-core servers running I/O-intensive tasks. Therefore, Converged Network Adapters in enterprise server environments must balance I/O performance while preserving CPU cycles for the data center to fully benefit from the implementation of virtualization and convergence.

## FCoE Performance and Scalability

When selecting a Converged Network Adapter for FCoE in a virtualized data center, an important benchmark is whether the product can deliver optimal balance between performance and CPU efficiency in line with the data center's consolidation requirements. This white paper shows that QLogic's QLE8152 Converged Network Adapter offers the right balance between IOPS and CPU efficiency to best support data center consolidation strategies such as virtualization and convergence to run most real-world enterprise applications. The tests also demonstrate the QLogic adapter's superior scalability for increasing workloads while preserving CPU cycles.

### Configuration

Tests were performed to compare the I/O performance of the QLogic and Emulex Converged Network Adapters.

IOmeter, an I/O subsystem measurement and characterization tool for single and clustered systems, benchmarked the QLogic QLE8152 Converged Network Adapter against the Emulex OneConnect UCNA in an enterprise-class, Intel® Nehalem server environment.

The IOmeter test setup (see Figure 1) consisted of the Converged Network Adapters from QLogic and Emulex running on current commercially available drivers, and installed in an Intel Nehalem quad-core (dual socket) server running Windows Server® 2008 R2 (64-bit) OS. The server was connected to a Texas Memory Systems RamSan-400 through a Cisco® Nexus 5020 FCoE switch to test sequential operations. Texas Memory Systems RamSan-325 was added as part of the configuration to test scalability. A solid state disk drive was used to prevent the latency that is typically introduced by slower disk drives, emulate a real-world data center configuration, and provide the performance benchmark expected from next-generation storage arrays.

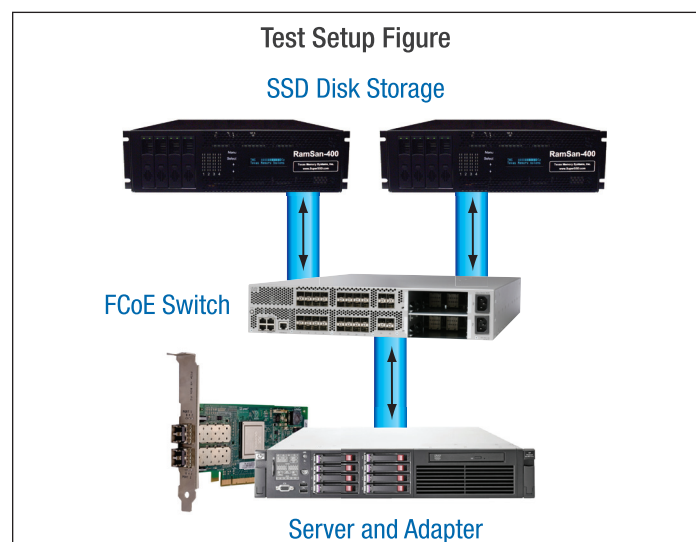


Figure 1. IOmeter Test Setup for Microbenchmark

## Test Results

The results of the performance benchmarks are described in the following sections. IOPS, CPU utilization, and IOPS scalability metrics were evaluated. While smaller block sizes (such as 512 bytes) are often used by companies in product tests to maximize the published peak IOPS, typical transfer sizes for real-world applications are 4KB and 8KB. The metrics for IOPS-over-CPU utilization provide meaningful data for the host server, indicating the number of IOPS performed by the device for a given CPU percentage utilized as a result of the workload.

### Sequential Read Operations

For block sizes of 8KB and below, the QLogic QLE8152 Converged Network Adapter's sequential read IOPS, normalized by CPU utilization, are up to 127

percent greater than the Emulex UCNA's IOPS, as shown in Figure 2.

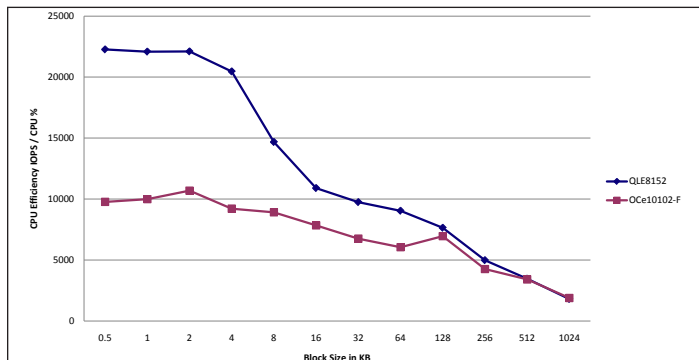


Figure 2. Sequential Read IOPS/CPU

The Emulex UCNA was capable of approximately 900K IOPS at the 512B block size, a number consistent with the company's previously published results. **However, at the 512B block size, almost all of the Intel Nehalem quad core (dual socket) CPUs were consumed (as discussed in the next section), leaving no room for applications.**

CPU Usage and UCNA Driver Modifications

QLogic's QLE8152 Converged Network Adapter shows consistent, very low CPU utilization and efficiency across block sizes with increasing workloads over Emulex OneConnect. As seen in Figure 3, on a consistent basis, the QLogic adapter uses only about 11 percent of the CPU across block sizes for FCoE read operations, preserving adequate headroom for server virtualization and scalability.

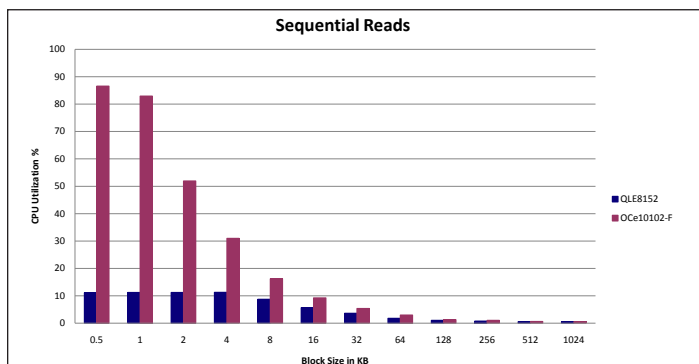


Figure 3. CPU Utilization Across Block Sizes

Sequential Read/Write Operations

While QLogic's Converged Network Adapter again outperformed Emulex across a range of block sizes for the sequential read/write test, this section of the white paper will only demonstrate the advantage of using QLogic at a 4KB block size. For the 4KB block size typically used in Oracle® database applications, the QLogic QLE8152 Converged Network Adapter's sequential read/write IOPS, normalized by CPU utilization, are up to 148 percent greater than the Emulex UCNA's IOPS, as shown in Figure 4.

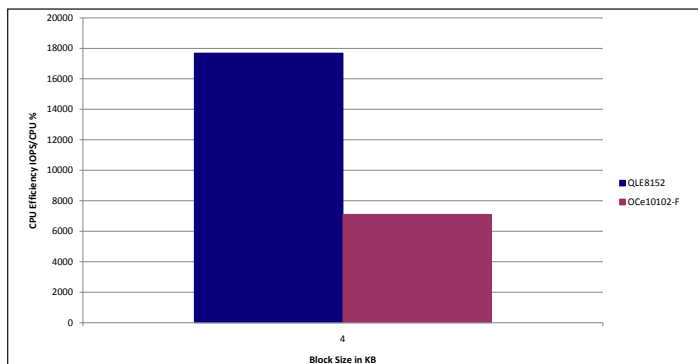


Figure 4. Sequential Read/Write IOPS/CPU

Workload Efficiency

Workload scalability is defined by increasing outstanding I/Os for selected workers. Observing high-efficiency results as the workload increases identifies the ability of the adapter to scale when additional virtual machine (VM) hosts are added to the physical server. For block sizes below 8KB and an increasing workload of 32 outstanding I/Os, the sequential read operations of the QLogic QLE8152 Converged Network Adapter are up to 145 percent greater than the Emulex UCNA (as shown in Figure 5). The QLogic QLE8152 adapter outperformed the Emulex UCNA across block sizes.

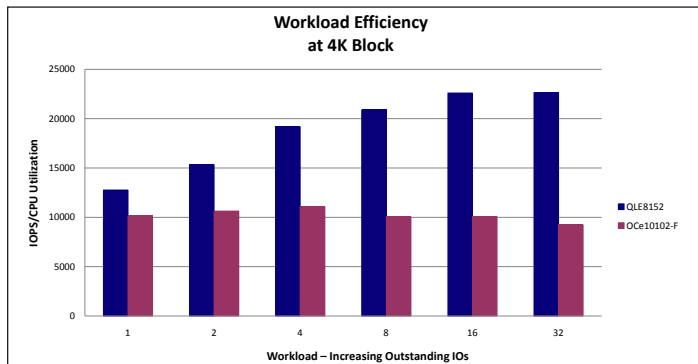


Figure 5. Scalability of IOPS/CPU

To better understand why the Emulex UCNA consumes much of the CPU, which is not the case for their 8Gb Fibre Channel adapter, QLogic examined the Emulex GPL driver submitted to the Linux community. The analysis found that a large part of the work to support the high number of I/Os was completed in the driver instead of the firmware, unlike Emulex's own Fibre Channel Implementation. The Emulex UCNA does not offload key Fibre Channel functions to the adapter, driving CPU usage higher on the host.

Users expect to use the same, proven Fibre Channel stack when using FCoE functionality on Converged Network Adapters. The Emulex UCNA appears to leverage a different driver stack, with several key functions running on the host: Fibre Channel frame header information, scatter/gather maintenance, exchange creation and maintenance, and most error

handling. Modifications to the Fibre Channel/FCoE driver stack that affect all OSs are likely to make the UCNA less than ideal for deployments in virtualized data centers, where preserving CPU and memory is paramount.

## Summary and Conclusion

One of the key strategies for data center server consolidation and virtualization involves the deployment of multi-core servers. CPU efficiency and workload scalability impact data center density. An adequate number of CPU cores and cycles must be preserved for enterprise applications to run on multiple virtualized hosts. QLogic's QLE8152 Converged Network Adapter outperforms Emulex's UCNA by delivering optimal IOPS and CPU efficiency.

QLogic continues to be the industry leader in delivering high-performance I/O solutions to data center customers. The QLogic 8100 Series of Converged Network Adapters provide best-in-class performance for server consolidation and workload scalability in enterprise data centers.

## Appendix—Test Configuration

Server Configuration	
Processor	2.8GHz Intel Nehalem Dual Socket Quad Core Processor
Memory	24GB RAM
Operating System	Windows 2008 R2 (64-bit)
Benchmark Tool	IOMeter

FCoE Adapters	
QLogic	QLE8152
Emulex	0Ce10102-F

Driver Configuration Version	
QLE8152	9.1.8.19
OneConnect UCNA	7.2.30.016

Storage Configuration	
Targets	SSD RAMSAN 400 SSD RAMSAN 325
LUNs	Four per port
Ports	Four ports per target

Switch Hardware	
FCoE Switch	Cisco Nexus 5020

#### Disclaimer

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