Emulex® HBA Product Evaluation

Evaluation report prepared under contract with Emulex Corporation

Introduction

Due to increased interest in 8 Gb/s Fibre Channel host bus adapters, Emulex Corporation commissioned Demartek to update its previous evaluation (September 2008) of its 8 Gb/s Fibre Channel host bus adapters (HBAs) with recent 8 Gb/s HBA offerings from Brocade®. The evaluation includes the following topics:

- ♦ Customer Availability
- ♦ Model Variety
- ♦ Operating Environment Support
- ♦ Multipathing Support
- ♦ Installation Experience
- ♦ HBA Management
- ♦ HBA Performance
- ♦ Reliability and Support
- ♦ Brocade Switch Feature Support

This report includes actual steps taken to install and use the HBAs and the respective management software. This report also includes a basic performance evaluation of the respective HBAs.

The HBAs tested in this report are the Brocade 825 and the Emulex LightPulse® LPe12002 and LPe12000.

Evaluation Summary

As with our previous evaluation, we found that the Emulex LightPulse® HBA product family is more feature rich and provides a wider breadth of support for server hardware, operating systems, path management and storage hardware than the Brocade HBA. The current Emulex HBA product family is qualified and supported by all the major server, operating system and storage vendors. The current Brocade HBA products are much more limited with respect to industry support. Overall, the installation process for both the HBA and the management software was easier with the Emulex HBAs. The Emulex management software appears to be geared for efficient deployment and use in large environments, more so than the Brocade software.

The Emulex HBA performance was generally better than the Brocade HBA performance, especially for write operations, response time and overall CPU effectiveness.

In our opinion, the latest generation of 8 Gb/s Emulex HBA products are mature, robust, and well suited for large to small enterprise Fibre Channel deployments.

1 – Customer Availability

A common consideration regarding HBAs is their availability to customers. Customers can obtain HBAs through a variety of sales channels and HBAs are often bundled with SAN storage and servers from either the server vendor or the storage vendor.

The Emulex HBAs are widely available through many retail channels and are available through all the major server and storage vendors as part of a bundled SAN solution. The Brocade 815 and 825 HBAs are currently available through retail channels and a limited number of server and storage vendors.

Customer Availability	Emulex HBAs	Brocade HBAs
Retail Channels	Yes	Yes
Server Vendors	All Major	Limited
Storage Vendors	All Major	Limited

2 – Model Variety

Servers that use Fibre Channel HBAs have a variety of bus types. These bus types include PCI, PCI-X 1.0, PCI-X 2.0, PCI-Express 1.0a, PCI-Express 2.0, and older bus types such as cPCI and SBus. In addition to the form factor required for tower and rack servers, blade servers often have their own special form factor, requiring a somewhat specialized HBA.

Emulex offers many HBAs in a wide variety of bus-types and form factors as shown in the table below. Brocade's HBAs run only on PCI-Express 1.0 or 2.0.

The newest 8 Gb/s Fibre Channel HBAs from both Emulex and Brocade support 8, 4 and 2 Gb/s. These new 8 Gb/s HBAs run as "x8" on PCI-Express 1.0 or "x4" on PCI-Express 2.0 slots. The 8 Gb/s HBAs all require a PCI-Express bus.

Model Variety	Emulex HBAs	Brocade HBAs
SBus (25 MHz)	Yes	No
cPCI (66 MHz)	Yes	No
PCI (66 MHz)	Yes	No
PCI-X 1.0 (133 MHz)	Yes	No
PCI-X 2.0 (266 MHz)	Yes	No
PCI-Express 1.0a (2.5 GT/s)	Yes	Yes
PCI-Express 2.0 (5.0 GT/s)	Yes	Yes
Blade server: Dell	Yes	No
Blade server: Fujitsu	Yes	No
Blade server: HP	Yes	No
Blade server: IBM	Yes	No
Blade server: Sun	Yes	No

3 – Operating Environment Support

Fibre Channel HBAs are deployed in a number of operating environments and for many, a solution that is widely qualified is required. HBA operating environment support includes the

drivers required for that operating environment and the management software application including graphical user interface (GUI) and command-line (CLI) versions. The following tables compare the operating environment support for Emulex and Brocade HBAs.

Driver Support	Emulex HBAs	Brocade HBAs
HP-UX	Yes	No
Linux	Yes	Yes
NetWare	Yes	No
Solaris	Yes	Yes
Windows	Yes	Yes
VMware ESX Server 4.0	Yes	No
VMware ESX Server 3.5	Yes	Yes

4 – Multipathing Support

Multipathing is deployed in many Fibre Channel storage environments in order to provide more than one path between the server and the storage. This allows for failover in the event of a failure along one path and can provide load balancing across multiple paths. HBAs are a part of a complete multipathing solution and are typically qualified with various multipathing solutions from operating system vendors, file system vendors, storage vendors and others.

Some multipathing solutions, such as Microsoft MPIO, are qualified for various HBAs, including Brocade and Emulex HBAs, but require additional technology in the storage device to complete the multipathing solution.

Emulex HBAs are qualified to work with all of the major multipathing solutions from server, storage and file system vendors. There is limited multipathing support for Brocade HBAs as of this date.

5 – Installation Experience

Emulex and Brocade both use a single installation package that installs drivers and management software. The Emulex HBA management software is HBAnyware® and the Brocade HBA management software is Host Connectivity Manager (HCM).

In the installation test cases performed in our labs, the installation of the Emulex and Brocade HBA drivers and HBA management software was accomplished in under two minutes for each host server and no reboots were required. The Brocade HBA management software installation, however, required more interaction with the administrator. In our opinion, administrators in a large environment with many servers and HBAs will find that the Emulex approach is simpler and easier.

Emulex HBAnyware and Brocade HCM can be installed on hosts without HBAs. This allows the management software to be installed before installing HBAs or allows for remote management of the HBAs from a system that will not have HBAs installed in it. In addition, Emulex allows the HBA drivers to be pre-loaded. The Emulex technique of preloading of the entire HBA software

stack allows system images to be taken in preparation for batch deployment to a large number of servers. This provides a consistent process and scales well to large environments.

Installation Steps

**Emulex**   **Brocade**
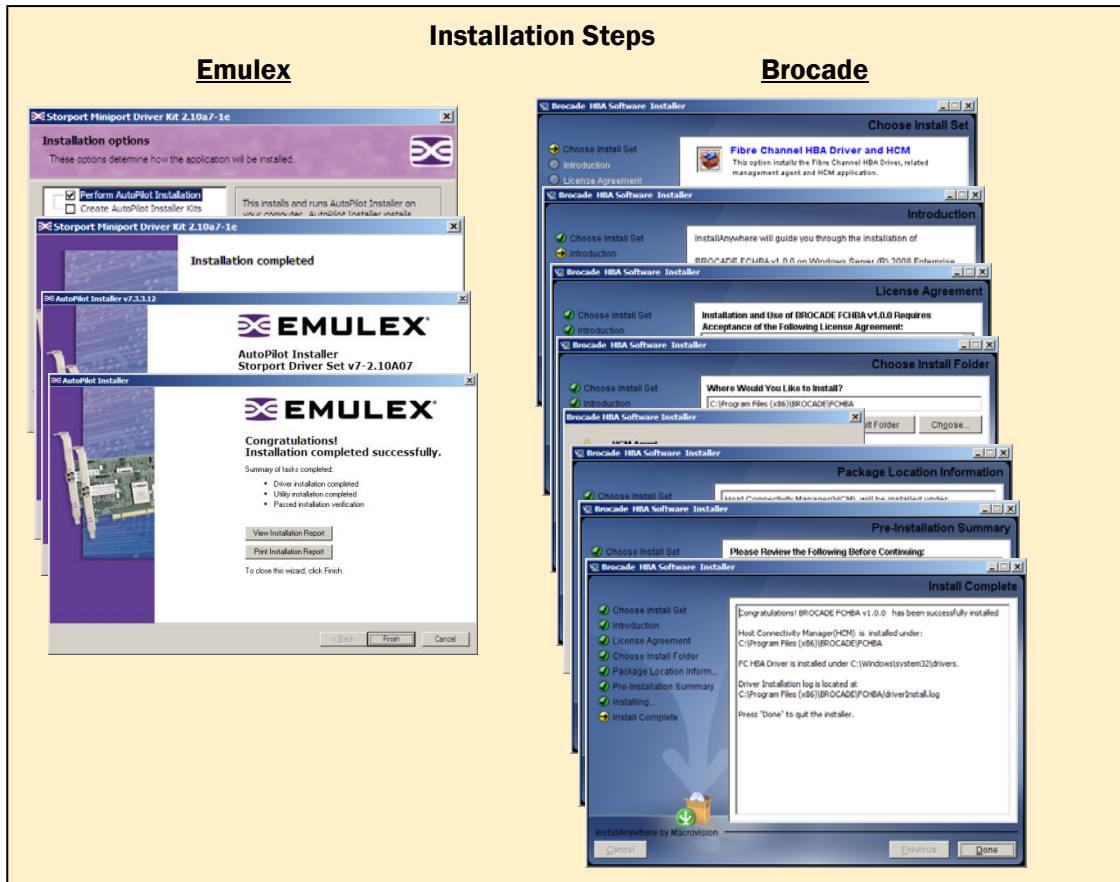
The first time HBAnyware was started, it could view the HBAs on the current host only. A management mode selection has three settings that restrict or expand the management scope:

♦ Strictly local - only manages Emulex adapters on this host
♦ Local management plus - manages Emulex adapters on this host and allows management of this adapter from remote hosts
♦ Full management - manages Emulex adapters on this host and others that allow it, and allows management of this adapter from remote hosts

If the full management mode is selected, HBAnyware discovers and manages all the Emulex adapters in the fabric that are visible to the host.

The Brocade HCM automatically discovers the Brocade HBAs in the local host. It can be set to discover and manage Brocade HBAs in other hosts, but can only manage adapters in one host at a time. This is particularly limiting for a medium to large data center. A combined view of the entire network is a key feature for effective SAN management.

Emulex Initial HBA Discovery	Brocade Initial HBA Discovery
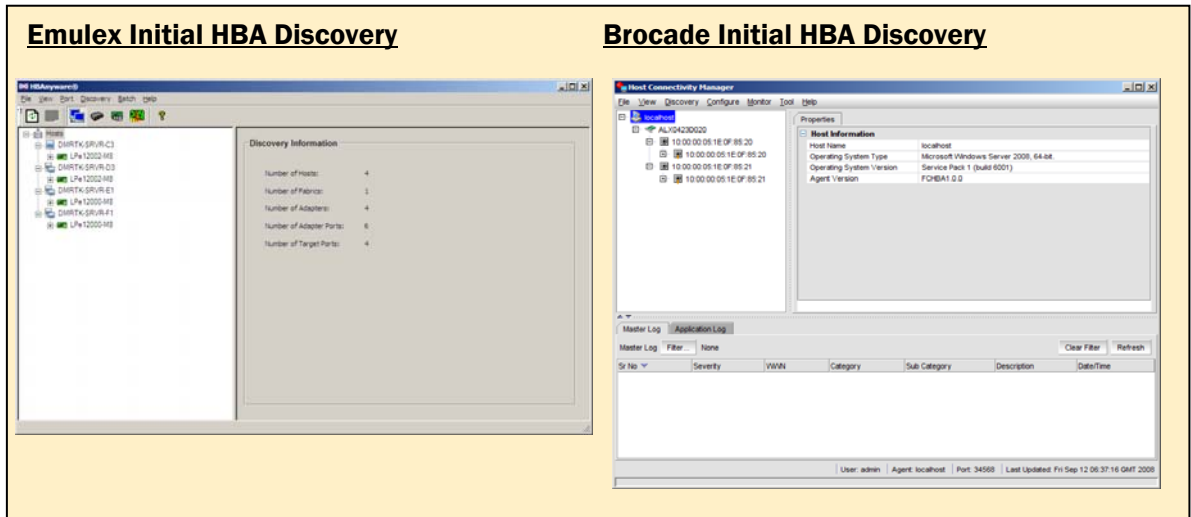
Emulex HBAnyware provides a Host View and a Fabric View, showing all Emulex HBAs visible in the SAN fabric. The Fabric View shows the host name associated with each HBA. A single click can switch between Host View and Fabric View as shown below.

Emulex HBAnyware

Host View	Fabric View
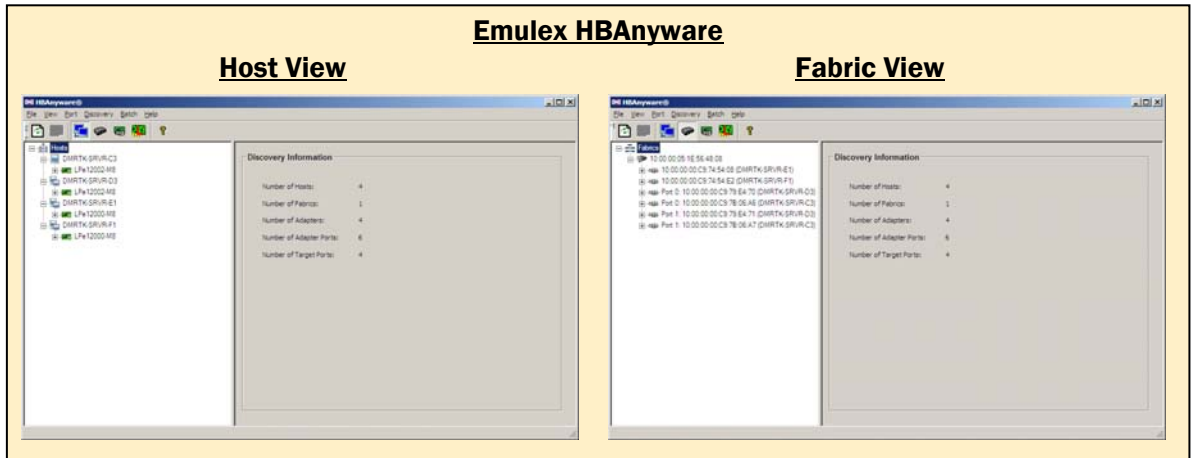
Brocade HCM can be installed on a host that does not have Brocade HBAs installed and but can only manage remote hosts by adding them manually as described previously.

Installation Experience	Emulex HBA & Software	Brocade HBA & Software
Combined driver and management software installation	Yes	Yes
Total number of steps to install	4	8
Total number of steps to discover HBAs	1	1x number of Hosts
In-band discovery	Yes	Yes
Host view of HBAs	Yes	No
Fabric view of HBAs	Yes	Yes

6 – HBA Management

Both Emulex and Brocade HBA management software provide online, searchable help within the software. When the Brocade HCM online help is on the screen, the user cannot toggle back and forth between the help screen and the main HCM interface. The user must close the help screen before attempting to work in the main HCM screen. When the Emulex HBAnyware online help is on the screen, the user can toggle back and forth between the help screen and the main HBAnyware screen as needed.

When clicking on an HBA on the left side of the menu structure, each product shows several tabs with various capabilities for daily or periodic management of HBA functions and parameters. Each product takes a different approach to many of the day-to-day HBA administrative tasks.


Detail HBA Functions and Parameters
Emulex HBAnyware — **Brocade HCM**
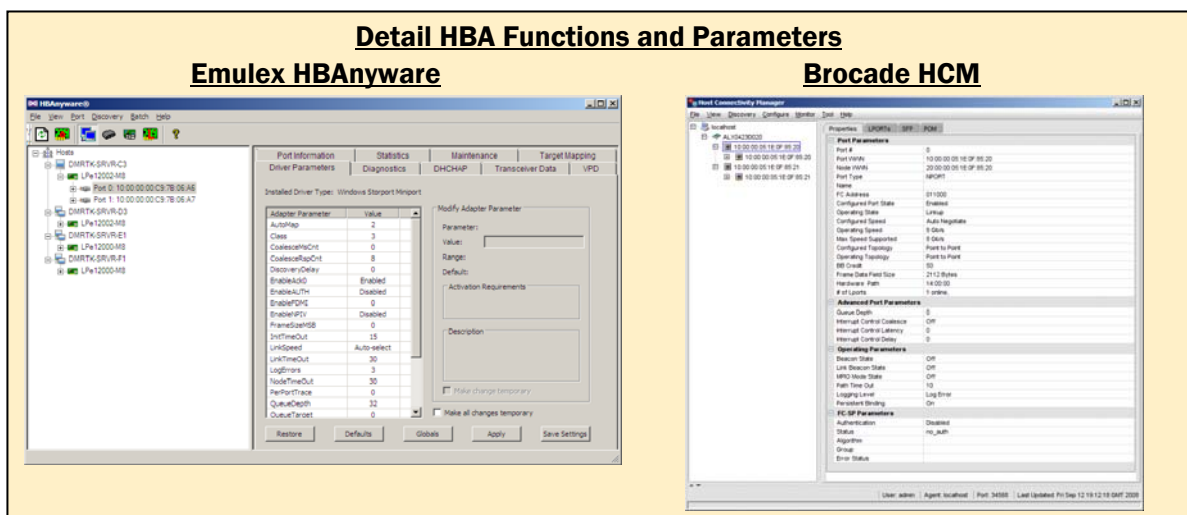
HBAnyware has twenty-three settings that can be changed under the "Driver Parameters" tab including queue depth and coalesce response count. HBAnyware provides a handy description of the feature and the range of allowable values, which is a benefit to administrators who might need a reminder for the many parameters that can be adjusted. In addition to the batch mode firmware updates, Emulex also provides a batch mode distribution of HBA parameter settings by distributing a parameter file for the HBAs to any or all of the servers with compatible Emulex HBAs that are visible in the fabric. This file remains on the server and in the event of a change of HBA, the parameter settings remain, so that the HBA automatically uses them and the administrator does not have to individually reset the HBA parameter settings. This is especially useful in large environments where the detailed settings need to be consistent across a large number of servers and HBAs.

Brocade's HCM allowed thirteen HBA port parameters to be changed within two groupings: "basic" and "advanced". These parameters can be changed for one HBA port at a time. The explanation of the parameters is available in the online help.

HBAnyware allows firmware updates to occur together for all similar HBA models in any or all hosts. The firmware is selected and HBAnyware provides a list of HBAs anywhere in the visible

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fabric that can use that firmware. The screenshots below show the start and finish of this process, including an event log. This process can be initiated from the local host or remote hosts.


Emulex HBA Firmware Update Process
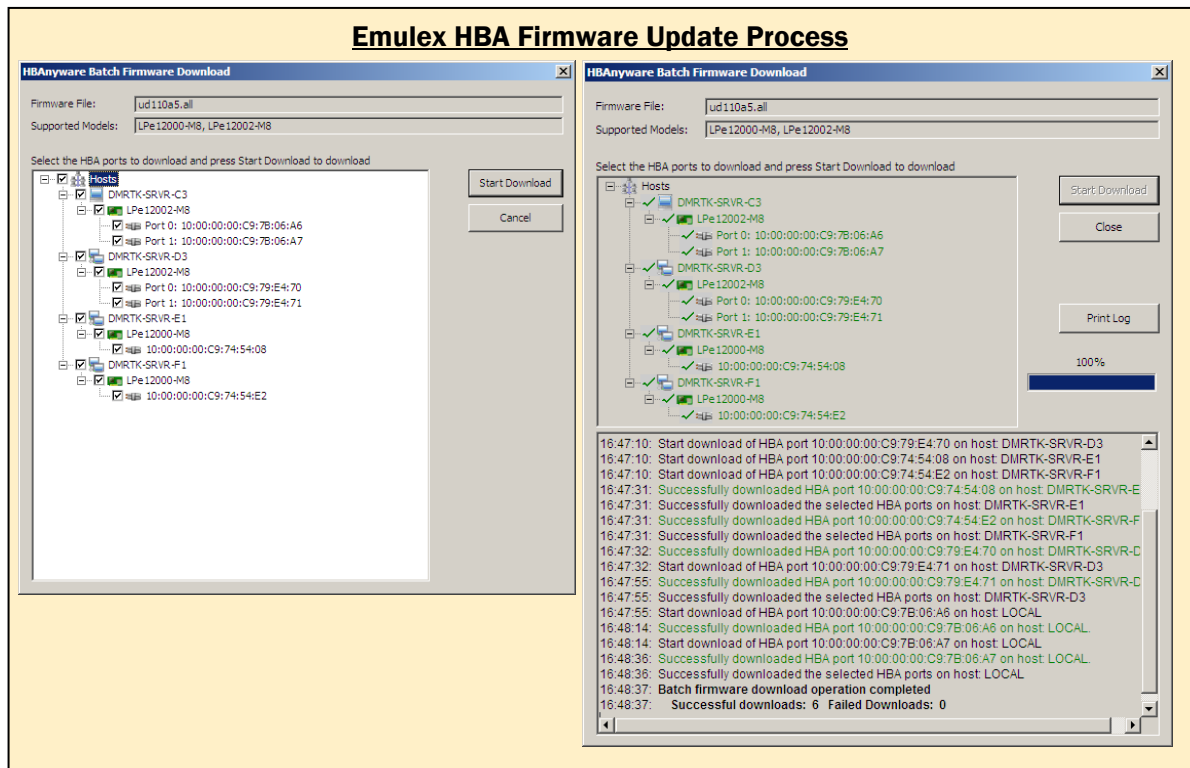
No reboots were required for Emulex HBA firmware updates. We found the event log to be quite useful, and would find it to be very valuable in managing large environments.

There is no direct firmware update for the Brocade adapters tested. The documentation states that these new Brocade adapters (models 415, 425, 815 and 825) use a hardware-based stack. The firmware is bundled as part of the driver and will automatically be updated when the driver is updated.

Emulex and Brocade HBAs both have a "beacon" function which is accessible from the management software.

Both products provide a good set of diagnostics that can be run on the adapters, as shown below. Both have basic loopback tests and ping tests and log the number of tests and the test results. Emulex HBAs include a power-on self-test (POST). Brocade HBAs include protocol tests for FC ping and FC traceroute.
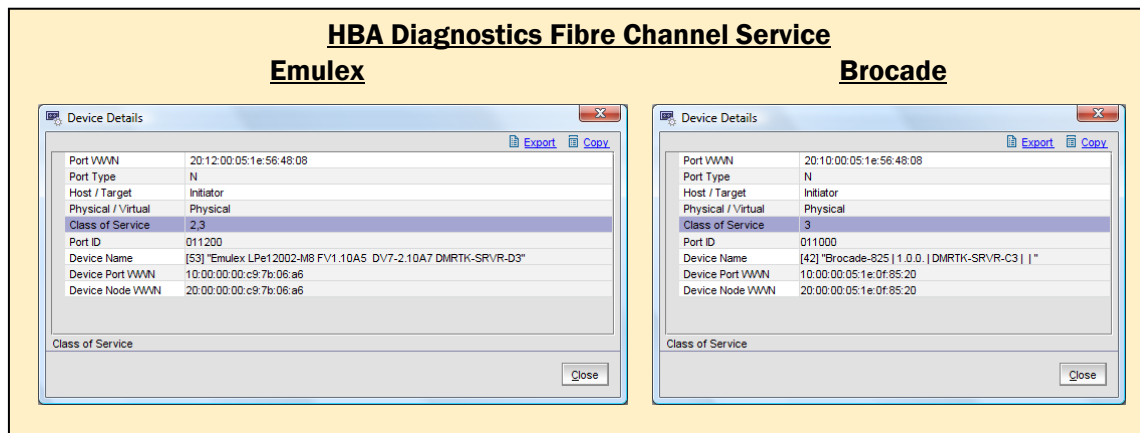
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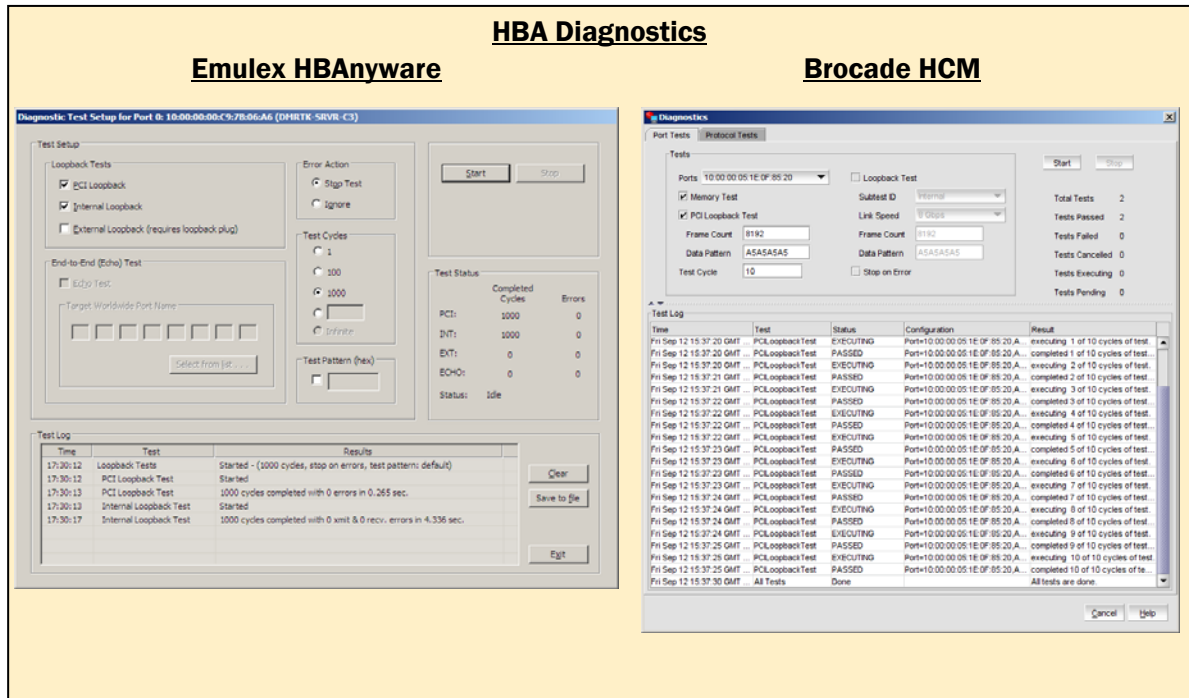
Server virtualization has created the need for virtual Fibre Channel ports that can be associated with virtual hosts. N-Port ID Virtualization (NPIV) has been established by the Fibre Channel technical community to address this need. Brocade and Emulex adapters both support NPIV.

Emulex supports NPIV for VMware ESX (and ESXi), Microsoft Hyper-V and System Center Virtual Machine Manager (SCVMM), Solaris 10 and Xen. In VMware ESX Server environments, HBAnyware can view VPorts, but creation and deletion of VPorts is done with VMware's Virtual Center application.

Emulex adapters support LUN masking through the HBA. We could find no equivalent function for Brocade adapters.

The Fibre Channel specifications allow for "Class 2" and "Class 3" service. The basic difference is that Class 2 sends delivery acknowledgement frames (guaranteed delivery) and Class 3 does not (best effort). Emulex adapters support Class 2 and 3, while Brocade adapters only support Class 3.

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HBA Diagnostics Fibre Channel Service

Emulex	Brocade
Device Details	**Device Details**
📄 Export 📋 Copy	📄 Export 📋 Copy
Port WWN 20:12:00:05:1e:56:48:08	Port WWN 20:10:00:05:1e:56:48:08
Port Type N	Port Type N
Host / Target Initiator	Host / Target Initiator
Physical / Virtual Physical	Physical / Virtual Physical
Class of Service 2,3	Class of Service 3
Port ID 011200	Port ID 011000
Device Name [53] "Emulex LPe12002-M8 FV1.10A5 DV7-2.10A7 DMRTK-SRVR-D3"	Device Name [42] "Brocade-825	1.0.0.	DMRTK-SRVR-C3		"
Device Port WWN 10:00:00:00:c9:7b:06:a6	Device Port WWN 10:00:00:05:1e:0f:85:20
Device Node WWN 20:00:00:00:c9:7b:06:a6	Device Node WWN 20:00:00:05:1e:0f:85:20
Class of Service	Class of Service
Close	Close

HBA Management	Emulex HBA & Software	Brocade HBA & Software
Firmware update without server reboot	Yes	Yes
Batch mode selection of all HBAs for firmware update	Yes	No
Batch mode selection of all HBAs for driver parameter update	Yes	No
Description and value range of HBA driver parameters	Yes	No
HBA beaconing	Yes	Yes
Online, HBA POST	Yes	No
HBA driver/firmware diagnostic dump	Yes	No
LUN masking through the HBA	Yes	No

Management Software Support	Emulex HBAs	Brocade HBAs
Red Hat Enterprise Linux	Yes	Yes
SUSE Enterprise Linux	Yes	Yes
Oracle Enterprise Linux 4	Yes	No
Solaris 8 and 9	Yes	No
Solaris 10	Yes	Yes
Windows	Yes	Yes

NPIV Support	Emulex HBAs	Brocade HBAs
Linux (Xen)	Yes	No*
Microsoft Hyper-V	Yes	Yes
Solaris 10	Yes	No
VMware ESX	Yes	Yes

* The software and documentation do not agree for this item.
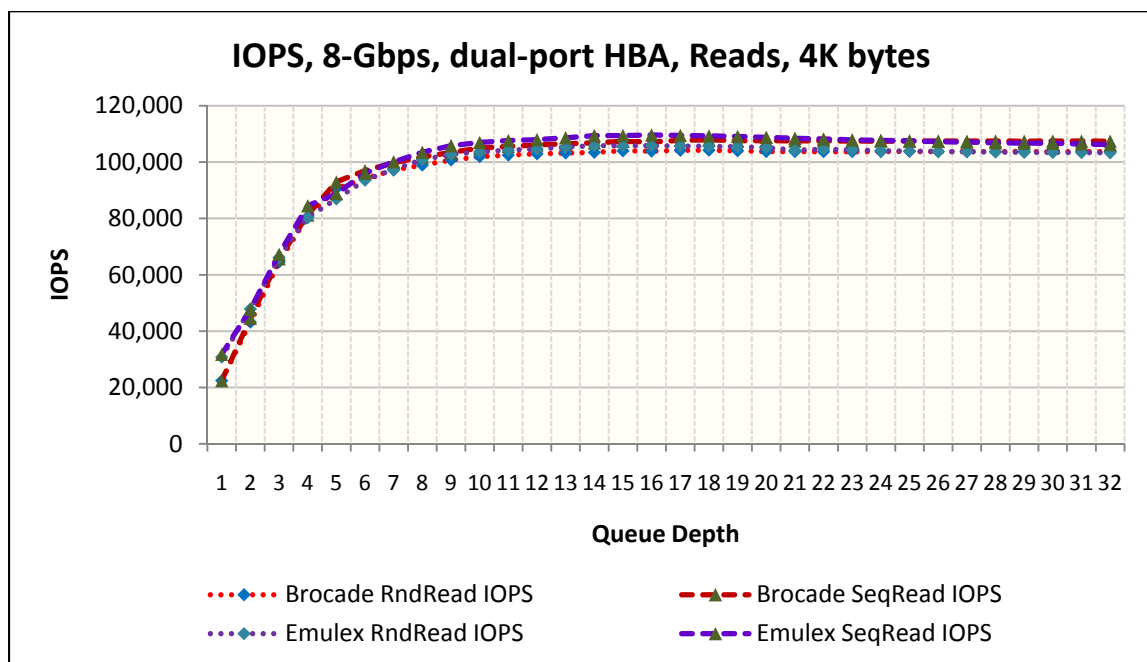
7 – HBA Performance

Vendors make various performance claims, so we ran some basic performance tests with Brocade and Emulex HBAs. A series of IOmeter tests were run spanning a wide range of block sizes and queue depths for reads and writes. The performance data is the same as in our September 2008 report.
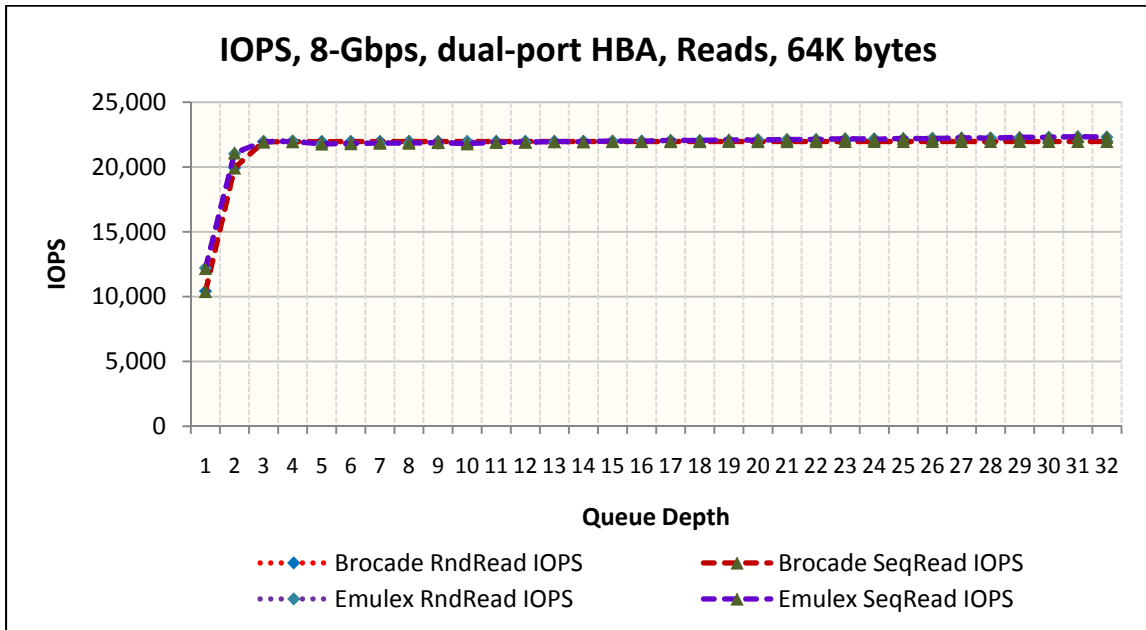
The performance test configuration included one server with a dual-port (both ports active) 8 Gb/s HBA connected to a Brocade 300 8 Gb/s Fibre Channel Switch. Also connected to the switch was a midrange storage subsystem with four active 4 Gb/s FC ports. The storage subsystem was configured with 48 300GB SAS 15K RPM disk drives. The tests were constructed so that each 8 Gb/s HBA port accessed two 4 Gb/s FC ports on the storage subsystem, with one LUN on each storage port. The tests were also constructed to access the storage subsystem cache as much as possible and the physical disk drives as little as possible, in order to highlight HBA performance.

Because there were few, if any, disk storage subsystems with 8 Gb/s ports at the time these tests were conducted, it's expected that a configuration with 8 Gb/s HBA ports and 4 Gb/s storage ports will be a common scenario.

In many cases, the read performance for both HBAs was very close. At the smaller block sizes, they were nearly identical. At the mid-range block sizes, the Brocade HBA was slightly faster, depending on queue depth. For the larger block sizes (128K and greater) the Emulex HBA was significantly faster.
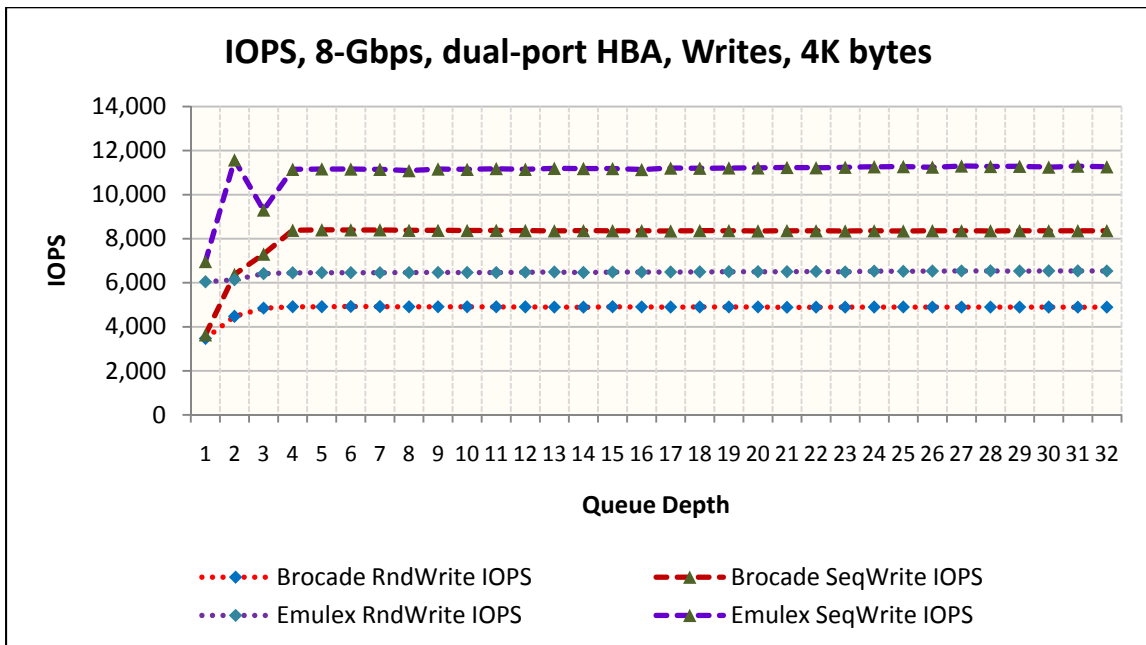
A few selected graphs follow:

IOPS, 8-Gbps, dual-port HBA, Reads, 64K bytes

Legend:
······◆······ Brocade RndRead IOPS   – –▲– – Brocade SeqRead IOPS
······◆······ Emulex RndRead IOPS   – –▲– – Emulex SeqRead IOPS
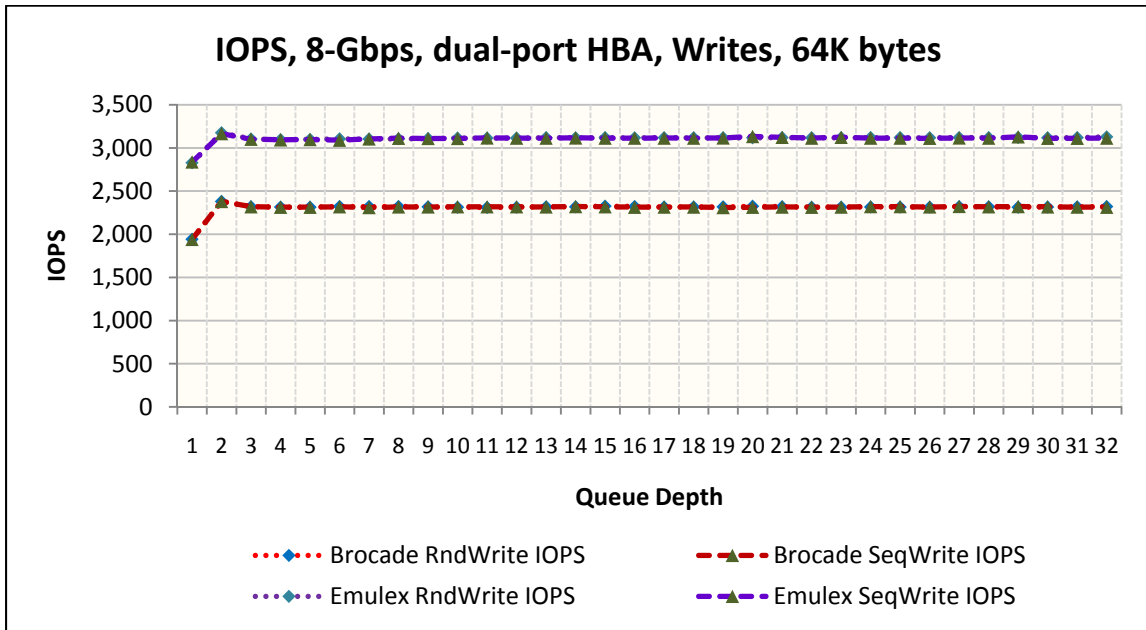
For write performance, the Emulex HBA was significantly faster than the Brocade HBA for all block sizes and queue depths up through the 64K block size. Above the 64K block size, the HBA write performance was nearly identical.
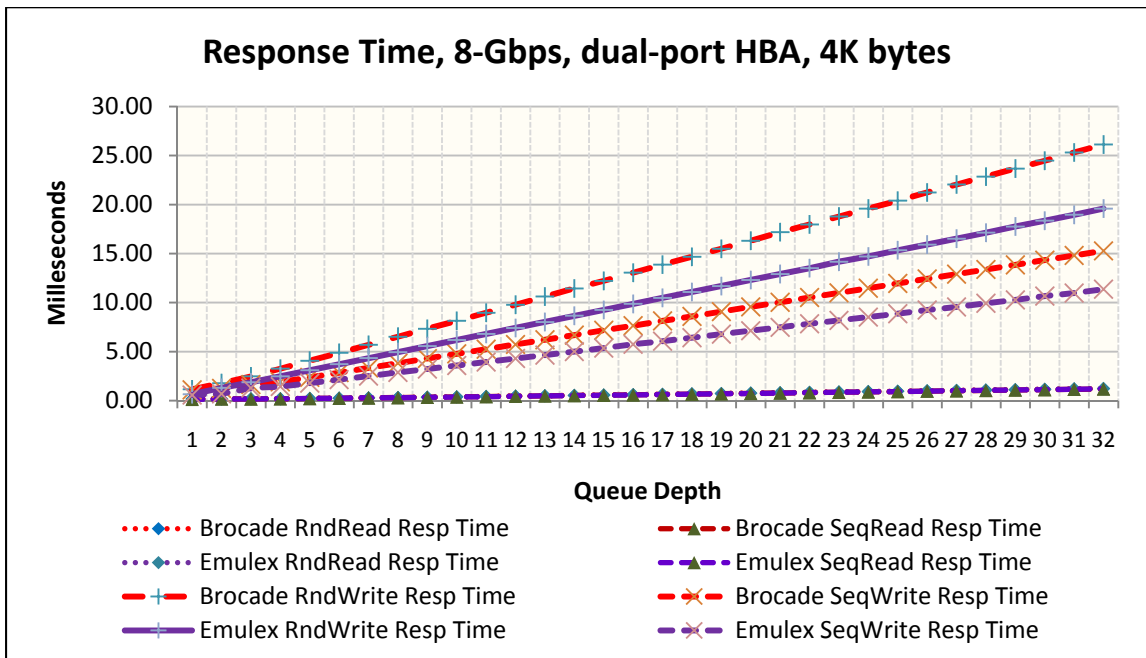
Results with two selected block sizes:

IOPS, 8-Gbps, dual-port HBA, Writes, 4K bytes

Legend:
······◆······ Brocade RndWrite IOPS   – –▲– – Brocade SeqWrite IOPS
······◆······ Emulex RndWrite IOPS   – –▲– – Emulex SeqWrite IOPS

IOPS, 8-Gbps, dual-port HBA, Writes, 64K bytes

Legend:
- ⋯◆⋯ Brocade RndWrite IOPS
- –▲– Brocade SeqWrite IOPS
- ⋯◆⋯ Emulex RndWrite IOPS
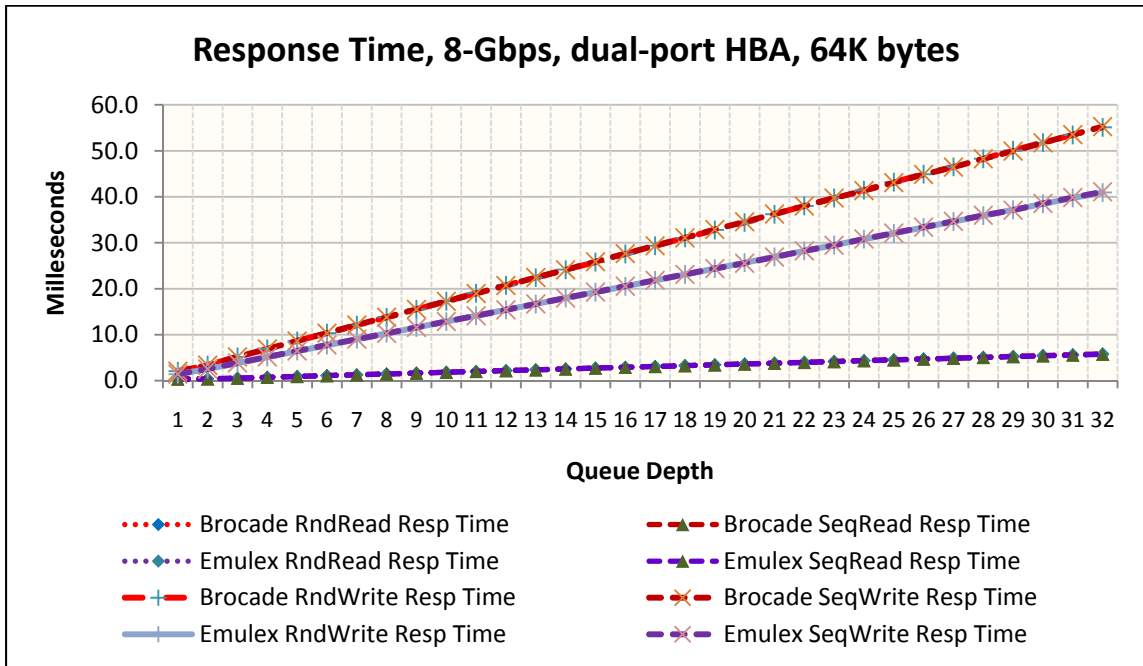- –▲– Emulex SeqWrite IOPS

Response time is a measure of the time it takes to get a response from an I/O request. The response time of the Emulex HBA was generally quicker than the Brocade HBA, especially for writes. The read response times were very close, with the Emulex HBA generally having a slightly faster response time.

Results with two selected block sizes:

Response Time, 8-Gbps, dual-port HBA, 4K bytes

Legend:
- ⋯◆⋯ Brocade RndRead Resp Time
- –▲– Brocade SeqRead Resp Time
- ⋯◆⋯ Emulex RndRead Resp Time
- –▲– Emulex SeqRead Resp Time
- –+– Brocade RndWrite Resp Time
- –✕– Brocade SeqWrite Resp Time
- —+— Emulex RndWrite Resp Time
- –✕– Emulex SeqWrite Resp Time

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Response Time, 8-Gbps, dual-port HBA, 64K bytes

Legend:
- ····◆···· Brocade RndRead Resp Time
- – –▲– – Brocade SeqRead Resp Time
- ····◆···· Emulex RndRead Resp Time
- – –▲– – Emulex SeqRead Resp Time
- – –+– – Brocade RndWrite Resp Time
- – –✕– – Brocade SeqWrite Resp Time
- —+— Emulex RndWrite Resp Time
- – –✕– – Emulex SeqWrite Resp Time

CPU effectiveness, a measure of CPU utilization for the work performed, was generally better for the Emulex HBA.

Results with two selected block sizes:

CPU Effectiveness, 8-Gbps, dual-port HBA, 4K bytes
Queue depth=8

CPU Effectiveness, 8-Gbps, dual-port HBA, 64K bytes
Queue depth=8
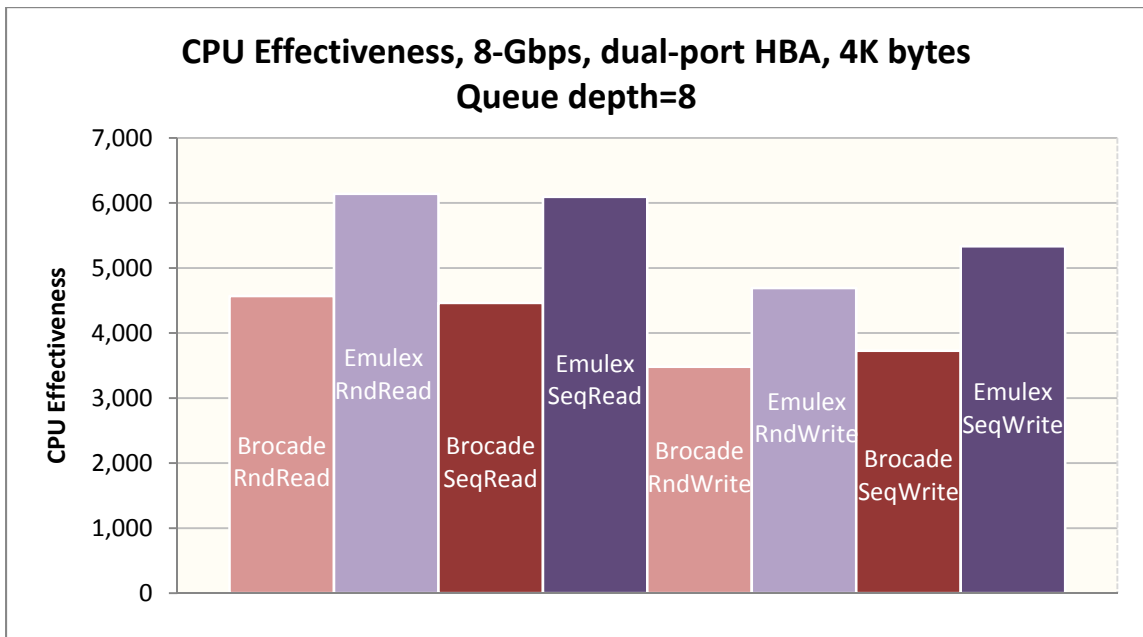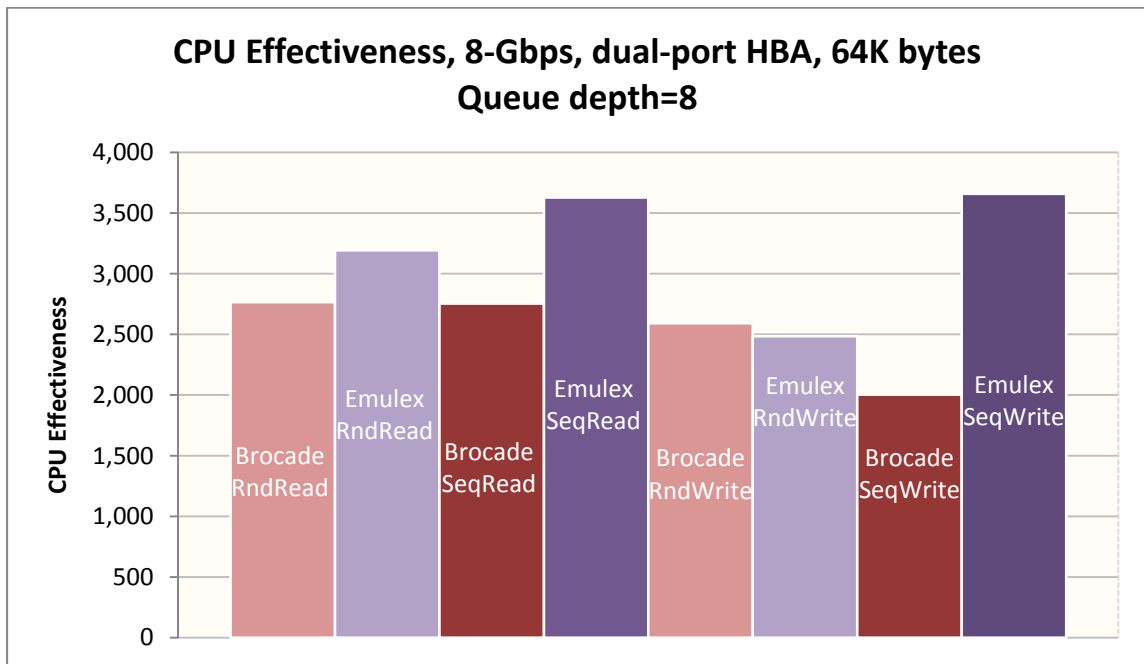
8 – Reliability and Support

Emulex has a proven HBA customer support center with a great deal of expertise and history. Brocade is fairly new in providing HBA customer support, as their traditional market has been other types of products.

Both Emulex and Brocade manufacture their own HBAs and offer a three-year warranty. Previous models of the Brocade HBA were manufactured by an OEM manufacturer.

In its January 24, 2008 quarterly financial report, Emulex claimed an installed base of more than five million host server ports from its HBA product family. Emulex currently claims more than ten million hours of field mean time between failures (MTBF) for its HBA family, based on field reliability data. Emulex HBAs have been qualified, sold and supported by every major server and storage vendor.

Brocade HBAs are available through channel partners and a limited number of server and storage vendors. We found no public Brocade claims of deployed port count or MTBF for its current HBAs.

9 – Brocade Switch Feature Support

The Emulex HBAs and the new Brocade HBAs claim to support the Brocade Fabric Device Management Interface (FDMI).

The Emulex and Brocade HBAs tested here support the host-to-fabric FC-SP authentication.

The online help for the Brocade HBA indicates a port-trunking feature where two HBA ports can be trunked together to form a single logical port. However, neither the online help nor any of the Brocade manuals available at the time of testing describe how to create such a port. This feature works with, and requires, a compatible Brocade switch in the fabric.

Appendix A – Evaluation Environment

The installation tests were conducted at the Demartek facilities, using four Dell PowerEdge 2900 servers. Two were running Windows Server 2003 R2 Enterprise x86 Edition and two were running Windows Server 2008 Enterprise x64 Edition. Each server has dual-processor, quad-core Intel Xeon E5345 processors. The servers running Windows Server 2003 had 8GB RAM. The servers running Windows Server 2008 had 32GB RAM.

A total of four 8 Gb/s HBAs from each company were tested, one in each of the four servers. Each HBA was installed into the PCI-Express 1.0 x8 slot of the server.

The servers and storage used were connected to a Brocade 300 24-port, 8 Gb/s Fibre Channel switch.

The Emulex HBAs were two each of models LPe12002 (dual-port) and LPe12000 (single-port). Emulex HBAnyware version 4.0a32 was used for these tests.

The Brocade HBAs were four of the model 825 (dual-port). Brocade HCM version 1.0.0 was used for these tests.