

# Emulex® HBA Product Evaluation

*Evaluation report prepared under contract with Emulex Corporation*

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## Introduction

Emulex Corporation commissioned Demartek to evaluate its Fibre Channel host bus adapters (HBAs) and compare them with recent 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 models 410 and 420 and the Emulex LPe11002.

## Evaluation Summary

Our general findings are 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 HBAs. 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 for 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. In addition, the Emulex LPe11002 HBA performed better than the Brocade 420 HBA in our basic performance tests.

In our opinion, the current Emulex HBA product family is mature, robust, and well suited for large to small enterprise Fibre Channel deployments.

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## 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 410 and 420 HBAs are available through retail channels only.

Customer Availability	Emulex HBAs	Brocade HBAs
Retail Channels	Yes	Yes
Server Vendors	Yes	No
Storage Vendors	Yes	No

## 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, 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 offers two HBA models – the 410 and 420, and these work with a PCI-Express 1.0a slot, either x4 or x8.

The Brocade Fibre Channel HBAs support 4 Gbps. The newest Emulex Fibre LightPulse Channel HBAs support 8 Gbps, and Emulex provides other HBAs that support 4 Gbps and 2 Gbps. Each of the Brocade and Emulex Fibre Channel HBAs are backward compatible with the slower speeds.

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	No
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 wide selection of certified solutions are required. HBA operating environment support includes the

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

<b>Driver Support</b>	<b>Emulex HBAs</b>	<b>Brocade HBAs</b>
HP-UX	Yes	No
Linux RHEL 4	Yes	Yes
Linux RHEL 5	Yes	Yes
Linux SLES 9	Yes	Yes
Linux SLES 10	Yes	Yes
NetWare	Yes	No
Solaris SPARC	Yes	Yes
Solaris x86	Yes	Yes (8, 9, 10)
Solaris SFS ("Leadville")	Yes	No
Windows Server 2003	Yes	Yes
Windows XP Pro	No	Yes
Windows Vista	Yes	No
VMware ESX Server 3.0.x	Yes	No
VMware ESX Server 3.5	Yes	No

Brocade's OEM manufacturer of its HBAs (LSI) supports additional platforms, but it remains to be seen when Brocade will adopt the newer versions of firmware and related software.

## 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 for load balancing across multiple paths. HBAs are a part of the complete multipathing solution and are typically certified to work with various multipathing solutions from operating system vendors, file system vendors, storage vendors and others.

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

The Emulex HBAs are certified to work with all the major multipathing solutions in the market today from server, storage and file system vendors. We did not find any major complete server-to-storage multipathing solution that has certified the Brocade HBAs as of this date.

## 5 – Installation Experience

Emulex and Brocade have apparently taken two somewhat different philosophies for the installation of HBA drivers and HBA management software. Emulex provides a single package, AutoPilot Installer<sup>®</sup> that installs the HBA drivers and the HBA management software, known as HBAnyware<sup>®</sup>. Brocade supplies the HBA drivers separately from their HBA management software, known as ESCM, and they are installed as two separate procedures.

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 and no reboots were required, however the Brocade HBA management software installation 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.

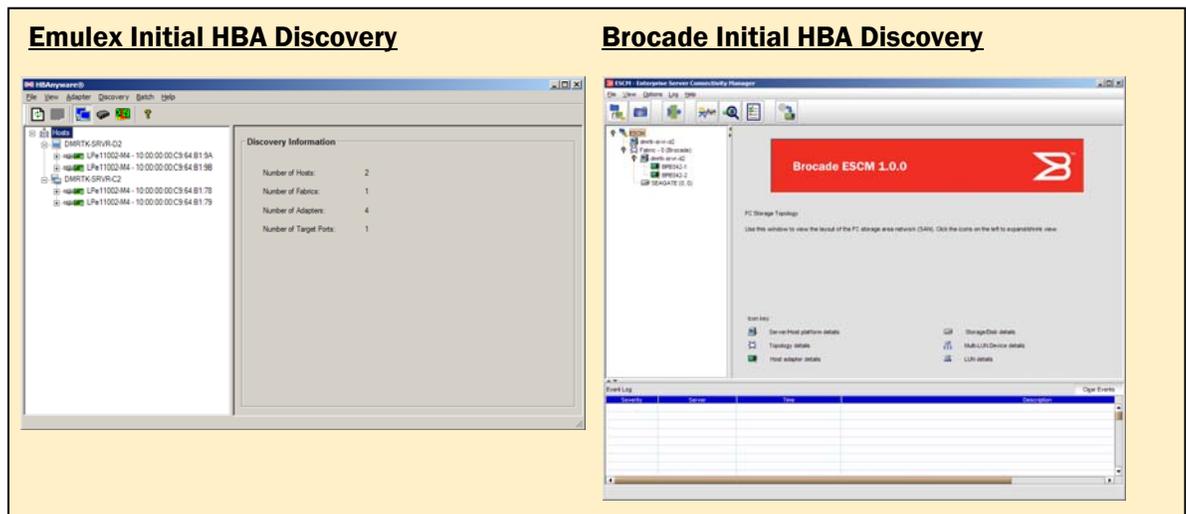
Emulex HBAnyware and Brocade ESCM can be installed on hosts without HBAs. This allows the management software to be installed before installing HBAs or allows for remote management of the HBAs from a system that will not have HBAs installed in it. In addition, Emulex allows the HBA drivers to also be 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 large numbers of servers. This provides a consistent process and scales well to large environments.

Emulex HBAnyware arrives prepackaged and is transparently deployed with the driver, in the span of a few mouse clicks. In contrast, the installation of Brocade ESCM required five steps. The drivers for the Brocade HBA are installed separately, and follow the standard process for installing drivers for the operating system.



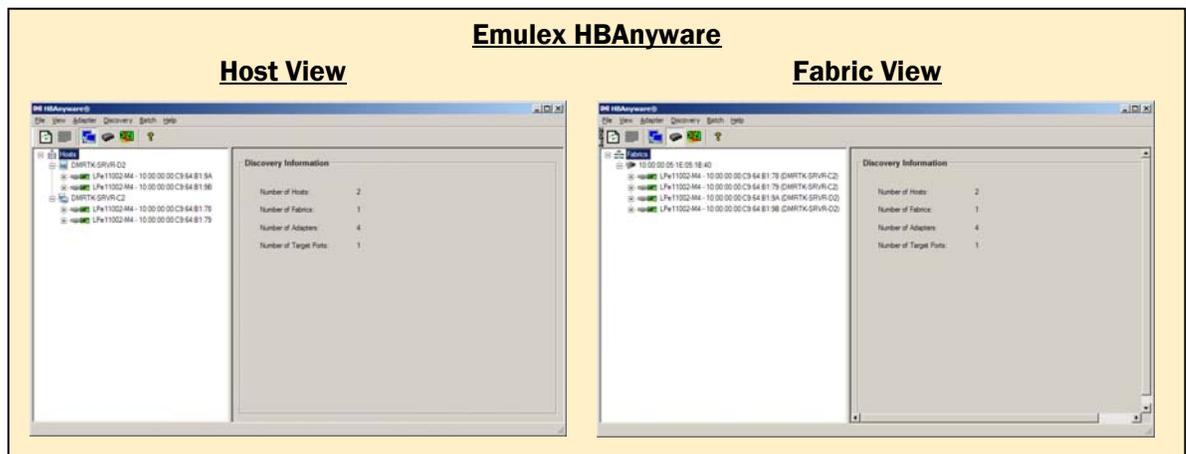
At first initialization, the Emulex HBAnyware software automatically and immediately discovered all the Emulex HBAs in the local server and those visible in the Fibre Channel SAN from that host, without any manual intervention or mouse clicks. This was a simple, one-step process.

At first initialization, Brocade ESCM automatically discovered the Brocade HBAs in the local host, but it did not discover the Brocade HBAs in other hosts. ESCM has a function to add remote hosts to its internal discovery list. Each host must be manually added by name or IP address, and ESCM must be installed on these hosts. After adding the remote hosts, they are automatically discovered and added to the topology. This process of manually adding the remote hosts must be performed on each host on which ESCM has been installed.



Brocade provides a topology view in its opening screen. After remote hosts have been added, it identifies the HBAs in the local and remote hosts, and identifies the remote host names in the topology.

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.



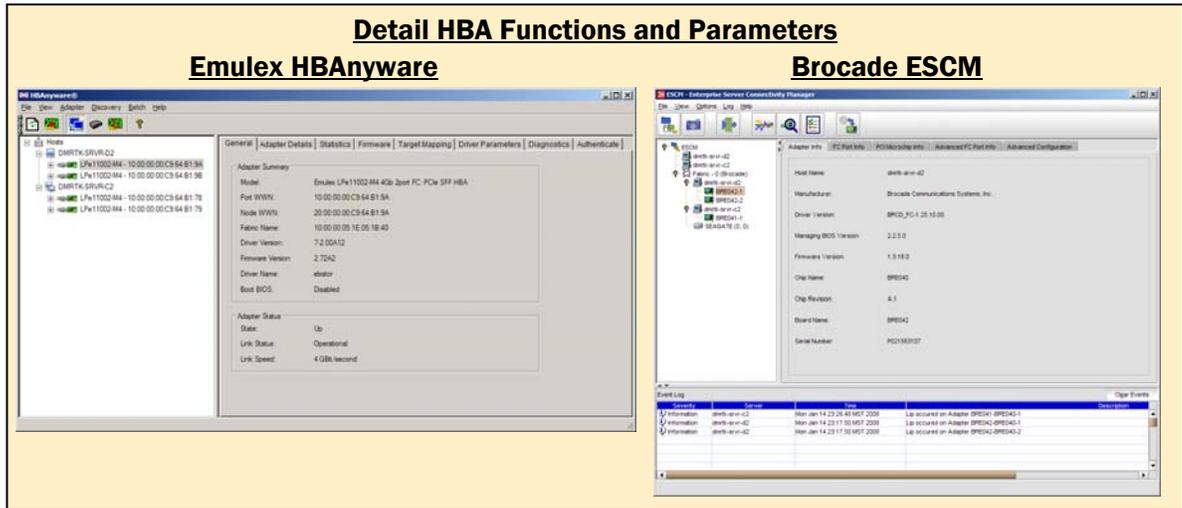
To discover and manage Emulex HBAs from a host that does not have Emulex HBAs installed, the out-of-band discovery option allows a range of IP addresses to be scanned for Emulex HBAs. Once discovered, the results are identical to the initial host view screen shown above.

Brocade ESCM can be installed on a host that does not have Brocade HBAs installed, and it can manage remote hosts by adding the remote hosts as described previously.

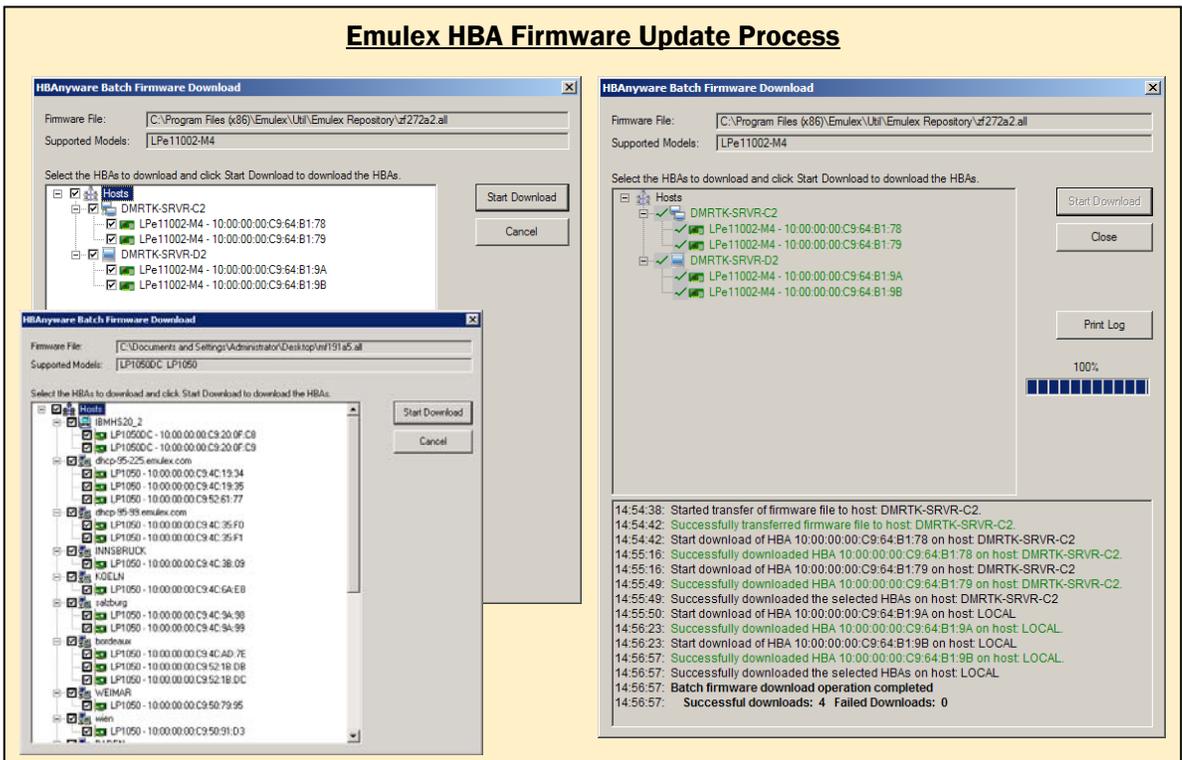
<b>Installation Experience</b>	<b>Emulex HBA &amp; Software</b>	<b>Brocade HBA &amp; Software</b>
Combined driver and management software installation	Yes	No
Total number of steps to install	2	5
Total number of steps to discover HBAs	1	1x number of Hosts
In-band discovery	Yes	Yes
Out-of-band discovery	Yes	Yes
Host view of HBAs	Yes	No
Fabric view of HBAs	Yes	Yes

## 6 – HBA Management

When clicking on an HBA on the left side of the menu structure, each product shows several tabs with various functions 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.

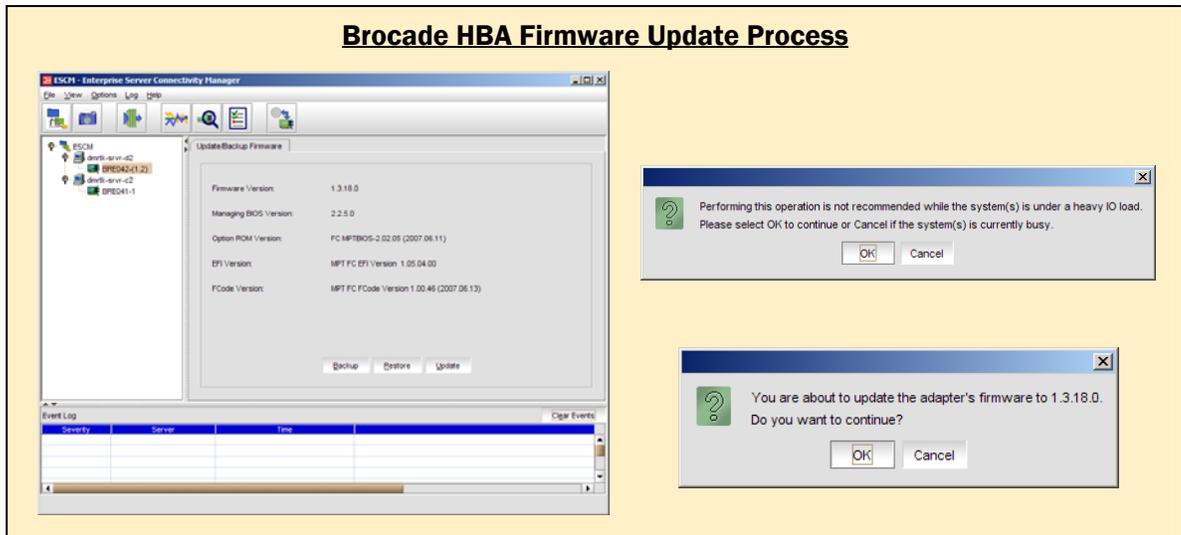


HBAnyware allows firmware updates to occur together for all similar HBA models in any or all hosts. The firmware is selected, and then HBAnyware provides a list of those HBAs anywhere in the visible fabric that can use that firmware. The screenshots below show the start and finish of this process, including an event log. This process can be initiated from the local host or remote hosts.

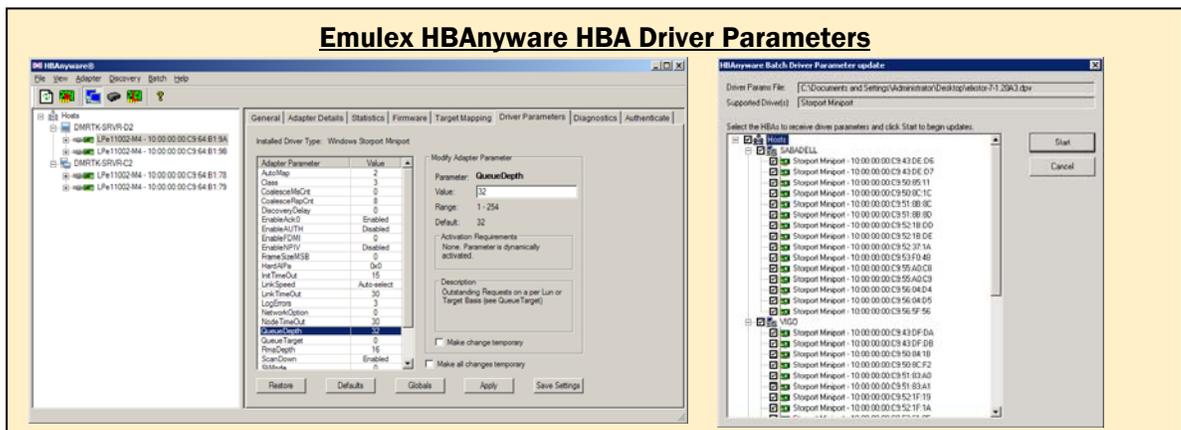


No reboots were required for Emulex HBA firmware updates. We found the event log to be quite useful, and would find it to be very valuable in managing large environments.

Updates to the Brocade HBAs are performed through the Backup/Restore/Update Adapter Firmware button in ESCM. Firmware, BIOS and Fcode can be updated for one or more adapters. No reboots are required. There is no progress indicator for any of these updates. No event log entries were noted when any firmware, BIOS or Fcode updates were made.



Both brands of HBAs have a “beacon” function, but the Brocade beacon function is only accessible in the ESCM Command Line Interface (CLI), not from the standard ESCM. HBAnyware has a “Beacon On” and “Beacon Off” radio button on the diagnostics tab.



For many of the advanced functions, HBAnyware has a number of settings that can be changed under the “Driver Parameters” tab including queue depth, coalesce response count, and many others. 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. A screen shot of these parameters can be seen on the lower left side of page 8. In addition to the batch mode firmware updates, Emulex also provides a batch mode distribution of

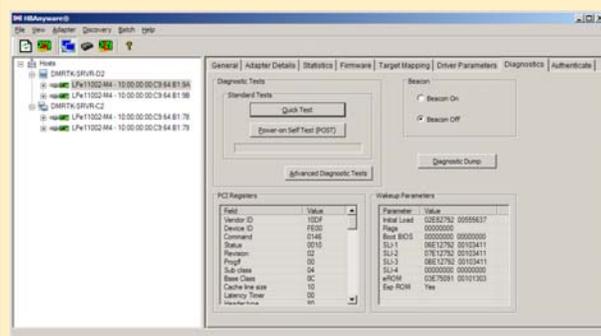
HBA parameter settings by distributing a parameter file for the HBAs to any or all of the servers with those HBAs, which can be seen in the screen shot on the lower right side of page 8. This file remains on the server and in the event of a change of HBA, the parameter settings remain, so that the HBA 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.

There were very few HBA parameters that could be changed using Brocade’s ESCM.

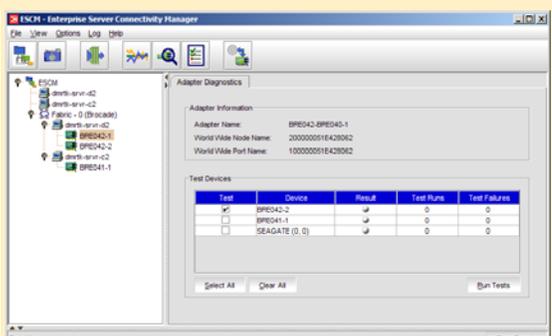
Both products provide a diagnostics function that allows the administrator to diagnose possible problems with the HBAs, but Emulex’s HBAnyware provides more diagnostic functions including a quick test and non-disruptive Power-On Self Test (POST) and logs the various diagnostic tests, which can be seen in the screen shots below. The POST function allows the administrator to quickly test the HBA without rebooting the server. This is critical in large environments where server reboots are not tolerated in certain circumstances. HBAnyware also provides an HBA driver/firmware diagnostic dump feature, not found in the Brocade product. This is an extremely useful capability to expedite root cause analysis by Tech Support. Brocade ESCM provides a “run tests” function, but does not indicate what the tests are nor does it provide any progress indication.

### HBA Diagnostics

#### Emulex HBAnyware



#### Brocade ESCM



#### Emulex HBAnyware - Test Setup

Test Setup:  PCI Loopback,  Internal Loopback,  External Loopback (requires loopback plug)

End-to-End (Echo) Test:  Echo Test, Target Worldwide Port Name: [ ]

Error Action:  Stop Test,  Ignore

Test Cycles:  1,  100,  1000,  Infinite

Test Pattern (hex):

Test	Completed Cycles	Errors
PCI:	1000	0
INT:	1000	0
EXT:	0	0
ECHO:	0	0
Status:	Idle	

Time	Test	Results
15:10:24	Loopback Tests	Started - (1000 cycles, stop on errors, test pattern: default)
15:10:24	PCI Loopback Test	Started
15:10:24	PCI Loopback Test	1000 cycles completed with 0 errors in 0.110 sec.
15:10:24	Internal Loopback Test	Started
15:10:30	Internal Loopback Test	1000 cycles completed with 0 xmit & 0 recv. errors in 5.328 sec.

<b>HBA Management</b>	<b>Emulex HBA &amp; Software</b>	<b>Brocade HBA &amp; Software</b>
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	No
Online, HBA POST	Yes	No
HBA driver/firmware diagnostic dump	Yes	No

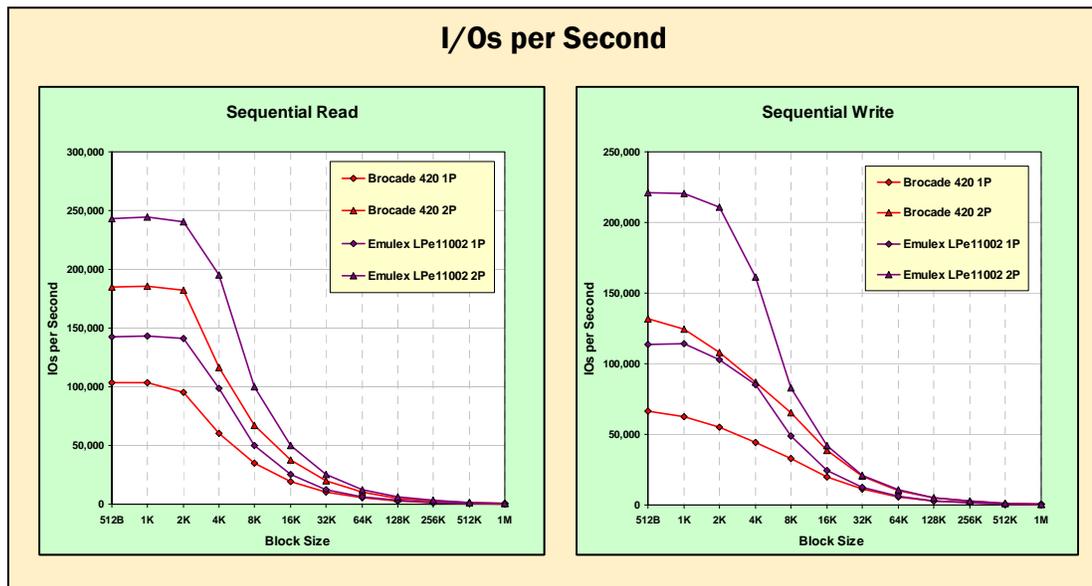
<b>Management Software (GUI) Support</b>	<b>Emulex HBAs</b>	<b>Brocade HBAs</b>
Linux RHEL 4	Yes	No
Linux RHEL 5	Yes	No
Linux SLES 9	Yes	No
Linux SLES 10	Yes	No
Oracle Enterprise Linux 4	Yes	No
Solaris 8	Yes	No
Solaris 9	Yes	No
Solaris 10	Yes	No
Windows 2000 Server	Yes	No
Windows 2003 Server	Yes	Yes

<b>Management Software (CLI) Support</b>	<b>Emulex HBAs</b>	<b>Brocade HBAs</b>
Linux RHEL 4	Yes	Yes
Linux RHEL 5	Yes	Yes
Linux SLES 9	Yes	Yes
Linux SLES 10	Yes	Yes
Oracle Enterprise Linux 4	Yes	No
Solaris 8	Yes	Yes
Solaris 9	Yes	Yes
Solaris 10	Yes	Yes
Windows 2000 Server	Yes	No
Windows 2003 Server	Yes	Yes

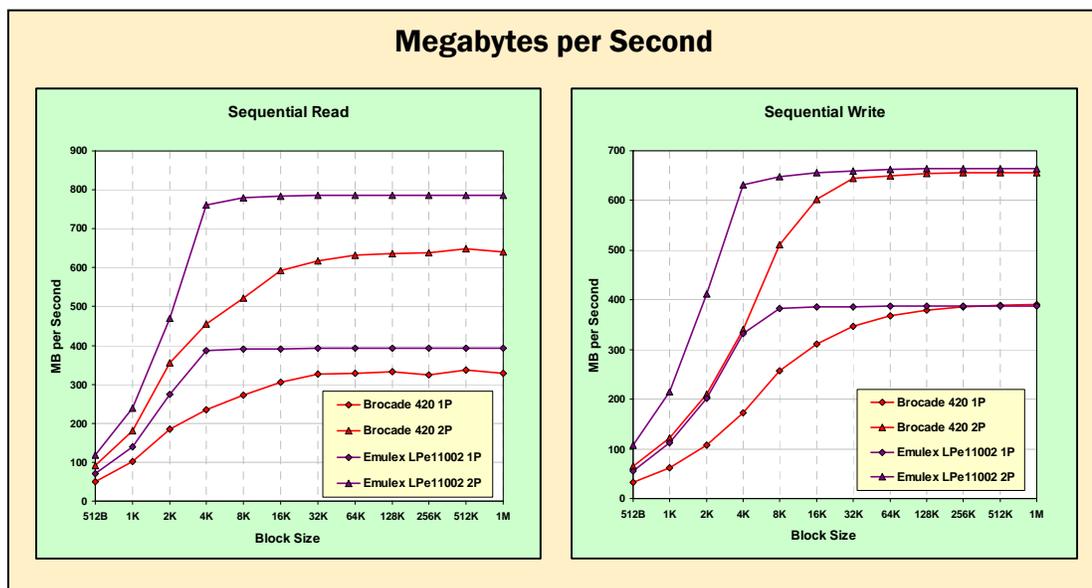
## 7 - HBA Performance

Vendors make various performance claims, so we ran some basic performance tests with the Brocade and Emulex HBAs. A series of IOMeter tests were run spanning a wide range of block sizes for reads and writes. An HP DL585G2 server was connected to a Texas Memory Systems RAMSAN storage device through a Brocade Silkworm<sup>®</sup> 4100 Fibre Channel switch. The series of tests was run with one HBA, and then repeated for the other HBA. The Emulex HBA outperformed the Brocade HBA for one port and two port activity for all block sizes in our tests.

### IOPS



### MBPS



## **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 for other types of products.

Both Emulex and Brocade provide reliable HBAs. Emulex manufactures its HBAs and maintains a high level of proven quality. The Brocade HBA is manufactured by a well-known OEM manufacturer that provides high-quality components.

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.

On September 17, 2007, Brocade announced that its HBAs were available through its channel partners. In its February 14, 2008 quarterly financial report, Brocade announced that two OEM partners have committed to qualify and resell Brocade's future HBA products. We could find no public Brocade statements regarding qualification or support of its current HBAs by any major server or storage vendor. Also, we found no public Brocade claims of deployed port count or MTBF for its current HBAs.

## **9 – Brocade Switch Feature Support**

The Emulex HBAs support the Brocade Fabric Device Management Interface (FDMI). The Brocade HBAs do not currently support FDMI on Brocade Fibre Channel switches.

The newest Emulex HBAs support the 8 Gbps link speed of the Brocade 48000 director. The current Brocade HBAs do not support 8 Gbps link speed.

## Appendix A – Evaluation Environment

The installation tests were conducted at the Demartek facilities, using two identical Dell PowerEdge 2900 servers running Windows Server 2003 R2 Enterprise x64 Edition, each with dual-processor, quad-core Intel Xeon E5345 processors and 4 GB RAM. The tests were run with the 64-bit version (x64) of Windows Server on both servers.

The Emulex HBAs were model LPe11002 in each server. These are dual-port, 4 Gbps Fibre Channel using PCI-Express (x4) slots in the servers. They were connected into an existing Fibre Channel storage infrastructure at the Demartek facilities. Emulex HBAnyware version 3.0a16 was used for these tests.

The Brocade HBAs included a Brocade 420 and Brocade 410 HBA, one in each server. The model 420 is dual-port and the model 410 is single-port. Both are 4 Gbps Fibre Channel using PCI-Express (x8) slots in the servers. Brocade ESCM version 1.0.0 was used for these tests.

The dual-port tests were run with the Emulex and Brocade dual-port cards with both ports active. The single-port tests were run with only one port active on the Emulex card and the single-port Brocade card.

For the performance tests, an HP DL585G2 server with 4 GB RAM and PCI-Express x4 slots was loaded with Windows Server 2003 R2 Enterprise x64 Edition and 4 GB RAM. It was connected to a Texas Memory Systems RAMSAN storage device which does not have the physical motion characteristics of a storage array with spinning disk drives. IOMeter was used to drive the I/O workload. IOMeter is an industry standard, open source I/O load generator, available from Source Forge at <http://sourceforge.net/projects/iometer/>. Version 2006.07.27 was used for all the IOMeter tests.

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