



Why Data Centers Choose Emulex for VMware Deployments

At a Glance

IT departments are implementing VMware® server virtualization to increase operating efficiencies and improve resource utilization. Many are choosing Emulex LightPulse and OneConnect adapters for network connectivity because of the Emulex advanced driver architecture, technology leadership in virtualization, security and networking connectivity, platform stability and performance.

Products

- Emulex® OneConnect™ Universal CNA
- Emulex LightPulse® Fibre Channel HBAs and FCoE CNAs
- Emulex OneCommand Manager® 5.0 (formerly HBAnyware®)

Applications

- Organizations deploying SAN-based VMware VI3 and vSphere™ 4
- Organizations deploying converged network solutions

“We looked at the capability of Emulex Fibre Channel HBAs and management tools and saw features that were not available from other suppliers. On the hardware side, there is the native support of VMware.

“Fibre Channel should just work, and that’s what we see with Emulex HBAs. With the HBA management tools, we get discovery and dynamic configuration capabilities that would otherwise require additional investment in tools running on other SAN components.”

— Steven Ham
Senior Windows System Administrator
Home Interiors & Gifts, Inc.

Eight Reasons Why Data Centers Choose Emulex

1 Converged networking framework to enable unified I/O (p.2)

Benefit—Reduce costs with Emulex LightPulse Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs) and OneConnect Universal CNAs (UCNAs) that support high-performance offload for TCP/IP (TOE), iSCSI and FCoE protocols

2 The most advanced VMware ESX and ESXi driver architecture (p.3)

Benefit—Highly stable server and storage area network (SAN) environment with minimal planned and unplanned downtime

3 Strong partnership with VMware and ESX Server expertise (p.4)

Benefit—Confidence that Emulex and VMware products and support will work well together to ensure that your data centers are operating at their best

4 High performance (p.4)

Benefit—Increase virtualization ratios to lower costs and reduce energy usage

5 Technology leadership in storage and network connectivity (p.4)

Benefit—Take advantage of new virtualization and security technology trends for Fibre Channel, FCoE, iSCSI and networking

6 Highly efficient and scalable enterprise management (p.5)

Benefit—Improve IT productivity by centrally managing larger networks, including iSCSI, without increasing administrative costs

7 “It Just Works” platform stability and interoperability (p.7)

Benefit—Lower cost of ownership

8 Broad product offering (p.7)

Benefit—Streamline training and administration by standardizing on Emulex adapters



OneConnect™



OneCommand™

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Introduction

Server virtualization has become one of the key technologies for increasing operating efficiencies and improving resource utilization. VMware Virtual Infrastructure 3 (VI3) leads the pack as the most popular virtualization platform. VMware vSphere 4 extends that leadership with improvements in performance and management, and the introduction of support for cloud computing. As VMware ESX and ESXi servers are deployed with a SAN, most IT organizations have made the choice to standardize on Emulex LightPulse Fibre Channel adapters. As converged networking becomes a reality, organizations now look to the Emulex OneConnect UCNA and LightPulse FCoE CNA to simplify data center networking operations.

Emulex understands the customer, from the enterprise down to mid-level and even small businesses, and has applied that knowledge to VMware enabled data centers. Why are these IT departments choosing Emulex? Because Emulex offers:

- A leading edge converged networking framework
- The most advanced VMware ESX and ESXi driver architecture
- Technology leadership in storage and network connectivity
- Highly efficient and scalable enterprise management
- Platform stability
- High performance and broad product offering

1. Converged Networking

Consolidation in the data center has typically meant improved operations and reduced costs (e.g., benefits of blade servers or virtualization). These same benefits are extended to I/O as data centers implement a new consolidated network technology for data and storage, called “converged networking.” Converged networking combines existing Local Area Network (LANs) and SANs into a single high-performance 10Gb/s Ethernet framework that intelligently connects every server, network and storage device within the data center, thereby enabling unified I/O.

Data centers administrators face a major networking challenge from the combination of high bandwidth requirements, increasing network sprawl and the need for a more adaptive networking infrastructure. Most data centers today have:

- Multiple network fabrics, each dedicated to a specific type of traffic
- High numbers of adapters and switch port deployments
- Complex cabling infrastructure
- Complex management of switch and adapter firmware and associated service contracts

Converged networking solutions address these issues and transition the data center to a more dynamically provisioned network that is highly responsive and addresses the quality and service level requirements of business applications. Emulex offers two revolutionary converged networking options:

1. The Emulex LightPulse LP21000 is a first-generation CNA that leverages eight generations of advanced, field-proven Fibre Channel HBA technology to provide host LAN and Fibre Channel SAN connectivity over 10Gb/s Ethernet using FCoE and Enhanced Ethernet (EE).
2. The Emulex OneConnect Universal CNA is a second-generation design that supports multiple protocols, allowing data center administrators to consolidate to a single high performance, high bandwidth 10Gb Ethernet infrastructure. Based on a single-chip architecture, OneConnect UCNAs provide CPU offload for FCoE and iSCSI block storage, TOE and stateless offload for Networking, and NFS and CIFS for file based storage.

The decision to deploy iSCSI or FCoE is largely based on current deployments. Enterprise data centers with Fibre Channel SANs already in place typically choose FCoE, while smaller data centers with no Fibre Channel typically choose iSCSI. The flexibility offered by the OneConnect UCNA means that any size data center administrator need not make their final decision before purchasing, and in fact, once deployed, the protocol of choice can change. That is, the decision to use one protocol over another does not result in additional cost should the actual implementation change.

Emulex FCoE CNAs and UCNAs:

- Deliver optimized I/O performance, enabling more virtual machines per server
- Protect investments in existing storage infrastructure by leveraging existing storage management tools and processes for connected devices
- Enable seamless extension of Fibre Channel SANs
- Are supported by the Emulex OneCommand Manager application (previously HBAnyware) that provides management throughout the data center from a single console for OneConnect UCNAs and LightPulse Fibre Channel HBAs and FCoE CNAs

LightPulse FCoE CNAs

The LP21000 family of FCoE CNAs enables Fibre Channel traffic to be directly carried over Ethernet alongside networking traffic. FCoE eliminates the need to have two independent networks carrying storage and networking traffic—thereby easing bandwidth management and offering significant cost savings. The Emulex CNA architecture combines the functionality of industry-standard Network Interface Cards (NICs) with Emulex’s industry leading Fibre Channel HBAs, seamlessly converging the traffic over a shared lossless Ethernet network.

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Leveraging eight generations of advanced, field-proven Fibre Channel technology, the PCI Express-based LP21000 family meets the robust interoperability and reliability requirements of corporate data centers. The design leverages Emulex's proven enterprise class drivers, firmware and hardware architectures, while delivering the sophisticated capabilities required to manage multiple types of data flow concurrently without disrupting application performance.

OneConnect UCNAs

The Emulex OneConnect UCNA is designed to address the key challenges of evolving data center networks and improve the overall efficiency of data center operations. It enables compact form factors that meet the space constraints of all server platforms, including blade servers, and lowers power usage which reduces energy and cooling costs.

With the Emulex OneConnect UCNA, data center administrators can achieve lower total cost of ownership (TCO) through a simplified network infrastructure with the cost for network connections, cable and cable installation costs reduced by up to 85%. For virtualized servers, UCNAs will minimally reduce the number of Ethernet connections from five or more to two.

Convergence in your data center

Converged networking creates a new economic model for the data center which we call Convergenomics™. To analyze converged networking solutions for your data center, download your copy of Emulex's *Convergenomics—The Guide to Network Convergence Solutions* and go to the Convergenomics Calculator on www.emulex.com.

2. Advanced VMware Driver Architecture

Data center administrators know that a highly reliable software architecture is critical to the foundation of an enterprise SAN. The Emulex VMware ESX and ESXi software stack features:

- A single adapter driver model ensuring that one driver supports all generations of Emulex LightPulse HBAs, FCoE CNAs and OneConnect UCNAs. The single driver model preserves IT investment by taking advantage of new driver releases without requiring hardware replacement. A single driver simplifies management and reduces operating costs by eliminating the need to maintain complex driver/hardware compatibility matrices.
- Service Level Interface (SLI™), allowing new firmware releases to be deployed on one server or throughout the network without driver updates, and without rebooting. New firmware releases translate into new functionality and enhanced performance.
- Emulex 4Gb/s and 8Gb/s HBAs, FCoE CNAs, OneConnect UCNAs, VMware drivers and Emulex OneCommand Manager fully support N_Port ID Virtualization (NPIV) technology, enabling each HBA or CNA port to register multiple virtual ports (VPorts) identified by a virtual worldwide port name (WWPN) within the fabric.
- Emulex adapters are pre-loaded with boot code images for all major architectures. Emulex universal boot capability automatically recognizes and deploys the right boot code, allowing HBAs and CNAs to be seamlessly deployed in different server architectures without user intervention.
- Emulex HBAs, CNAs and VMware driver fully support boot from SAN for the ESX environment and uniquely enable up to eight alternate boot paths for greater continuity of service.
- Smaller memory requirement, with less than 50% of the memory used with other HBA vendors.

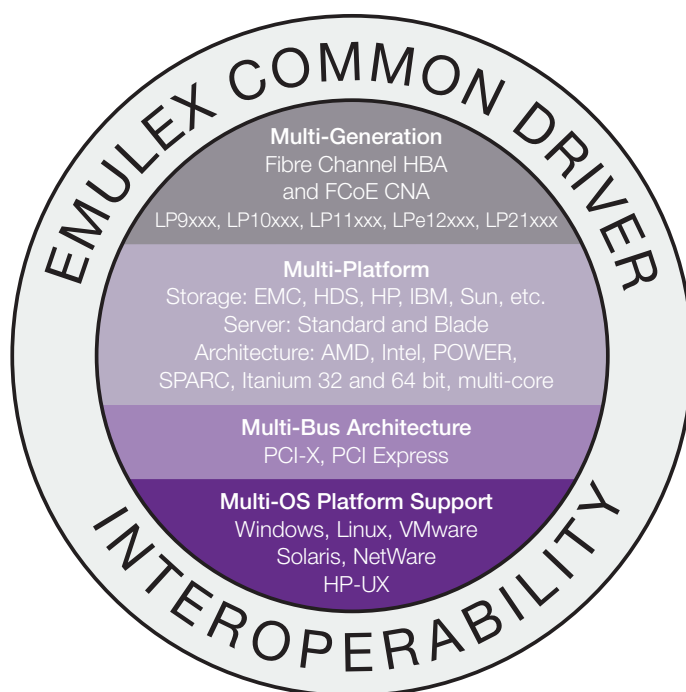


Figure 1 Emulex single driver model.

Emulex drivers are included with VMware ESX and ESXi distributions and work on all Emulex and OEM-branded LightPulse HBAs and FCoE CNAs. Support for iSCSI, FCoE, Ethernet and Fibre Channel by the OneConnect UCNA is continually progressing, with the latest support described on www.emulex.com. The Emulex software stack provides a solid framework today with investment protection for tomorrow.

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3. ESX Server Expertise

Based on a collaborative relationship with VMware, Emulex drivers are developed with an intimate understanding of the VMware ESX architecture, storage stack and memory management model. The result is a native driver designed and optimized for the VMware ESX platform and its I/O management architecture. For example, Emulex and VMware recently worked closely to deliver high performance I/O through VMDirectPath, described in detail below.

The partnership with Emulex and VMware can also be leveraged to resolve any issues and ensure that your data centers are operating at their very best.

VMDirectPath for high performance I/O

VMDirectPath provides a direct connection from a guest OS to an I/O device, bypassing hypervisor storage virtualization to deliver high-performance access to storage. An HBA port must be fully dedicated to a single VM, so VMDirectPath should be reserved for applications that require maximum I/O. VMDirectPath uses Virtualization Technology for Directed I/O (VT-d), which is implemented in the new Intel® Xeon® 5500 platform. Support is provided for Emulex LightPulse LPe12000 8Gb/s HBAs by VMware on an experimental basis with VMware vSphere 4.

4. High Performance Fibre Channel Solution

Emulex LightPulse and OneConnect adapters deliver excellent performance across a wide range of application environments with varying server workloads. The latest Emulex vSphere 4 driver for Emulex LightPulse Fibre Channel HBAs and CNAs combines enhancements to the VMware vSphere 4 storage architecture with new Emulex-developed optimizations to provide dramatic improvements in I/O performance.

Emulex adapters and drivers are designed to leverage the enhanced storage stack in ESX/ESXi 4.0. IOMeter benchmarks using vSphere, LPe12000 and Emulex latest vSphere drivers with eight virtual machines achieved total I/O rates that were 98% of the performance capability for non-virtualized servers (see Figure 2).



Figure 2 Top IOPS performance.

Emulex integrated processors and dedicated hardware engines ensure maximum I/O processing speeds in transaction processing environments, while enabling sustained high bandwidth and CPU efficiency that maximizes application performance. Key technology innovations include:

- Dynamic interrupt coalescing optimizes I/O interrupt management for both heavy and light traffic
- Frame-level multiplexing continuously determines the optimum use of the Fibre Channel network to ensure maximum link utilization
- Out-of-order frame reassembly reorders data frames in the proper sequence, minimizing retransmissions and enhancing overall network performance
- A buffer credit pool that is 20-times larger than the leading competitor ensures uninterrupted link-rate performance during periods of high server I/O bus activity, including operations with remote storage
- Support for multiple concurrent direct-memory access (DMA) reads accelerates I/O performance for high transaction rate applications

5. Leadership in Storage and Network Connectivity

Whether it's virtualization, security, advanced adapter technology supporting converged networking or simplifying network administration, the Emulex strategy is to not only be first, but to engage with other ecosystem members to ensure that solutions are deployable in today's data centers.

Virtualization

Virtualization technologies are driving corporate IT disaster recovery, capital control and operating efficiency initiatives. Emulex is a principal contributor to developing technology that enables server virtualization in the SAN. The following are just some of the contributions:

- Co-developed NPIV technology with IBM. NPIV is a key feature of Emulex virtualization technology, enabling each Emulex adapter port to register multiple VPorts identified by a virtual WWPN within the fabric.
- Led the designation of NPIV as an American National Standards Institute (ANSI) T11 standard.
- Collaborated with Cisco, Brocade and other vendors to ensure seamless interoperability and provide data center administrators with greater flexibility for implementing server virtualization in SAN environments.

Emulex virtualization technology empowers administrators to deploy server virtualization, follow SAN best practices and seamlessly leverage popular storage management applications while implementing zoning and storage masking.

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NPIV - VM/VPport mapping

NPIV allows a physical adapter port to be logged into a fabric switch as multiple VPorts, with each VPort having a unique virtual WWPN address and identity on the SAN. VMs can be created and connected to SAN storage using an NPIV-based VPort. This allows each VM to have unique support for key SAN features, including zoning, LUN masking, backup, chargeback and quality of service (QoS) management. The OneCommand Manager management console provides details for VMs that are associated with VPorts, allowing administrators to readily see the relationship between VMs, VPorts and physical ports.

Security innovation

Storage security has often been overlooked as an area of concern but can have significant impact given how critical data assets are to every organization. Storage security ranks with server and network security as a top-of-mind issue for IT management.

Emulex has taken a leadership role in applying the latest in security standards into the Emulex LightPulse and OneConnect product lines.

- Emulex OneCommand Manager centralized management application addresses the security concerns for remote management of adapters with the support of Authenticated Common Transport (Authenticated CT) protocol as defined in Fibre Channel Global Services 3 (FC-GS-3) specification. Support of Authenticated CT satisfies the number one recommendation of the Storage Networking Industry Association's (SNIA) storage security initiative calling for securing of the management path.
- In 2007, Emulex continued to take the lead in enhanced security in the SAN by supporting the Fibre Channel Security Protocol (FC-SP), a standard that is now under the ANSI International Committee for Information Technology Standard (INCITS). FC-SP is a comprehensive approach to all aspects of data security. Support of adapter authentication helps data centers protect against WWN spoofing, host masquerading, non-malicious and administrator caused outages.

EmulexSecure™ 8Gb/s Fibre Channel HBA technology provides strong host-based encryption to protect data throughout the enterprise, both in-flight on the SAN and at-rest on storage devices. Emulex has partnered with industry leader RSA for encryption key management. RSA's Key Manager is an easy-to-use, centrally administered, enterprise key management system that simplifies the deployment and ongoing use of encryption throughout the enterprise. EmulexSecure HBA technology provides data centers with maximum protection for the lowest cost. It off-loads encryption from the server CPU, providing a high-performance architecture that allows administrators to encrypt once and protect everywhere. Finally, EmulexSecure HBA enables VM-level encryption to enable security across all VMs with the ability to seamlessly support the secure transfer of a VM from one physical server to the next.

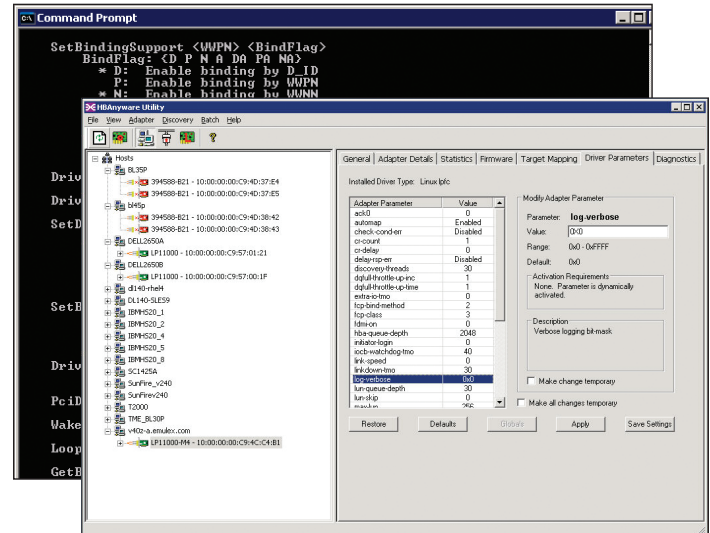
Emulex is an active and influential contributor to the FC-SP standard. As storage and networking security comes of age, Emulex is committed to delivering flexible and standards-based security technologies that will help mitigate data storage and networking security risks.

6. Efficient Management and Troubleshooting

Emulex OneCommand Manager application and HBAnyware HBA and CNA management software is designed for efficient, scalable administration of enterprise-class SANs and for converged network solutions. OneCommand Manager 5.0 now provides a multi-protocol management stack for the storage (Fibre Channel and iSCSI) and network connectivity solutions through a graphical (GUI) or scriptable command line interface (CLI).

OneCommand Manager is the only management application that delivers integrated iSCSI deployment and administration capabilities from a central console, eliminating the need to use tools within the BIOS or OS platform to configure the iSCSI adapter and then use a separate application for management.

Independent studies have found that HBAnyware is more intuitive, more scalable and offers greater functionality than the competitive management solutions (see Figure 3).



"...Our test concluded that Emulex's HBAnyware was an easier, more intuitive management application, lending itself to large SAN environments."

—Dennis Martin, President of **Demartek Testing Laboratory**

Figure 3 HBAnyware centralized HBA and CNA management.

OneCommand Manager provides comprehensive control of Emulex LightPulse and OneConnect adapters within a centralized, cross-platform framework, combining flexible remote-management options with secure access control. The OneCommand Manager application delivers:

- State-of-the-art, powerful management capabilities, no matter where the HBAs and CNAs are located or what platform they are running on
- Exclusive online management of ESXi servers using the Common Interface Model (CIM), described in detail below
- Support for IBM BladeCenter® Virtual Fabric, described in detail below
- Tools for offline, online and different protocols for OneConnect-enabled servers (using either a OneConnect UCNA or a OneConnect LAN on Motherboard [LOM])
- Automation of management tasks for unparalleled HBA and CNA configuration and management efficiency. Batch mode propagation of firmware versions deployed effortlessly across the SAN
- Scriptable CLI giving storage administrators the flexibility to tailor or automate their HBA and CNA management actions using customized scripts
- Discovery and management of VPorts residing on Emulex Fibre Channel HBAs, FCoE CNAs and UCNAs (see Figure 4)
- Export of HBA/CNA data using an open, flexible XML format, which IT administrators can import into commonly used data analysis tools, such as Excel, to create custom reports

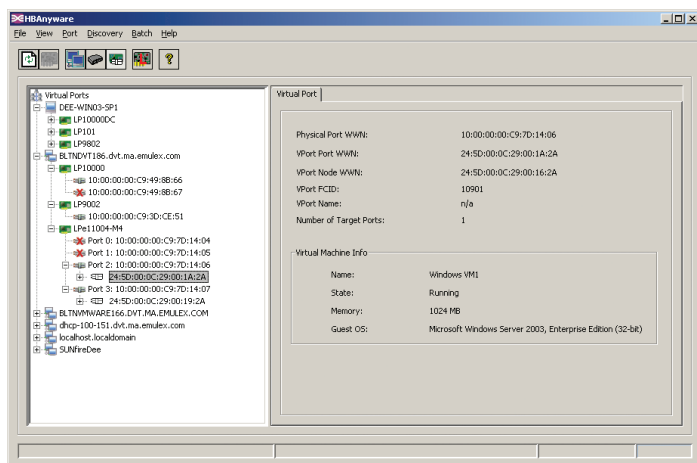


Figure 4 OneCommand Manager provides discovery and management of vPorts.

Emulex LightPulse HBAs, CNAs and OneConnect UCNAs are designed to assist with troubleshooting and minimize the impact of field upgrades. For example, streamlined replacement helps avoid configuration errors when replacing Emulex adapters. Port parameters are stored on the host so parameters associated with the previous adapter can be applied to a replacement without user intervention.

Leveraging the Storage Management Initiative Specification (SMI-S) for which it was a principal architect, Emulex offers open, standards-based interfaces and components, enabling integration with enterprise storage and server management solutions.

This architecture has allowed Emulex to partner with IBM to automate adapter provisioning and management with IBM Remote Deployment Manager Software (RDM), and with HP on Rapid Deployment Pack (RDP) software supporting seamless Emulex adapter installation and deployment. Additional provisioning capabilities have been developed with other major blade and traditional server vendors.

CIM delivers improved storage management

The in-box Emulex CIM provider communicates with a CIM client in the new OneCommand Manager 5.0 management application update to provide first-time online management of HBAs, CNAs and UCNAs for ESXi servers. This results in higher availability as there is no need to bring down the adapter for configuration and management. OneCommand Manager provides comprehensive reporting, optimizing and troubleshooting, enabling management of Emulex adapters for servers throughout the network from a single console.

The OneCommand Manager application also provides detail for VPorts and VMs, showing the relationship between physical ports, VPorts and VMs. VMware vCenter 4.0 provides added visibility to shared storage through customizable reports and topology maps, and improves storage management with new per-virtual machine and datastore reporting.

IBM BladeCenter virtual fabric

With the new Emulex Virtual Fabric Adapter, IBM users have the ability to carve up two 10Gb Ethernet pipes into 2 through 8 virtual Ethernet NICs. The BLADE Network Technologies (BNT) 10-port 10Gb Ethernet Switch Module offers the flexibility to tailor bandwidth in increments of 100Mb up to a maximum of 10Gb in addition to dedicated bandwidth, physical separation of data and high availability. Emulex OneCommand Manager provides intelligent support for this solution. This bandwidth allocation is provisioned at system boot time with no online configuration required, and OneCommand Manager reports them as discrete NIC functions in the device discovery tree. By collaborating with IBM and BNT, Emulex delivers a leading edge solution that delivers instant results.

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7. Reliability and Data Integrity

Emulex provides “It Just Works” stability—delivering reliability, data integrity and interoperability to large enterprise SANs.

- Emulex LightPulse 2Gb/s and 4Gb/s Fibre Channel HBAs provide the greatest reliability, averaging more than 10 million hours of field Mean Time Between Failures (MTBF)
- Since 1996, Emulex has used a combination of parity, cyclic redundancy check (CRC), error correcting code (ECC) and other advanced error-checking and recovery algorithms to verify that data blocks being passed from the host interface through Emulex adapters are protected from any form of data corruption

Emulex has established one of the industry’s most comprehensive interoperability labs. An extensive collection of servers, storage subsystems and test equipment are used to test and re-test LightPulse Fibre Channel HBAs and FCoE CNAs and OneConnect UCNAs to ensure interoperability in real world environments and common customer configurations (see Figure 5 for a view of Emulex’s compatibility database which is accessible from the Emulex website).

Manufacturer	Model Type	Manufacturer Model	Emulex HBA	Data Rate	Bus Type	Operating System
VMware	Software	ESX Server	LPe12000	8Gb/s	PCI Express 2.0	VMware ESX 3.x VMware ESXi
VMware	Software	ESX Server	LPe12002	8Gb/s	PCI Express 2.0	VMware ESX 3.x VMware ESXi
VMware	Software	ESX Server	LPe1250	8Gb/s	PCI Express 2.0	VMware ESX 3.x VMware ESXi

Figure 5 Emulex interoperability database provides compatibility information: www.emulex.com/interop.

8. Choice for Enterprise VMware SANs

Emulex is the recognized Fibre Channel HBA and CNA leader for customers ranging from large enterprises down to small businesses with just as pressing data center needs. Emulex offers a broad family of HBAs and CNAs supporting all major bus architectures with single channel and dual-channel I/O connectivity. Emulex has also partnered with major system suppliers to provide Fibre Channel connectivity for leading blade solutions.

Emulex LightPulse and OneConnect adapters are supported by leading server, storage and software companies so that data center administrators can standardize on Emulex knowing they will have support and accompanying products from their preferred vendor.

Companies who have already standardized on Emulex for their Windows, Solaris, HP-UX, Linux or AIX solutions are now achieving the same scalability, performance, manageability and investment protection with Emulex Fibre Channel HBA, FCoE CNA and UCNA solutions for VMware VI3 and vSphere 4.

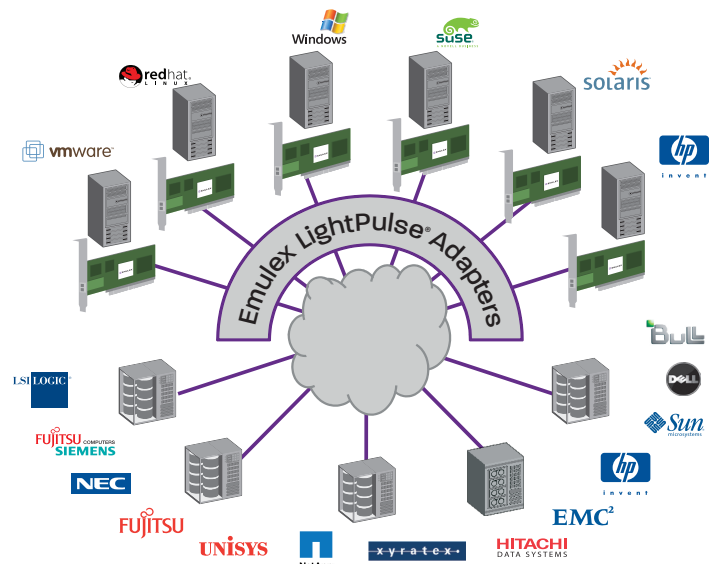


Figure 6 Emulex HBAs and CNAs are fully supported throughout the SAN.



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