EMC® Host Connectivity with Emulex Fibre Channel Host Bus Adapters (HBAs) and Fibre Channel over Ethernet Converged Network Adapters (CNAs) for the Linux Environments

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Contents

Preface 9

Chapter 1 Introduction

Purpose of this document 14
Host connectivity 14
Fibre Channel 14
Fibre Channel over Ethernet 14
Boot device support 15
Zoning 16
Useful Linux utilities and functions 17
EMC storage array-specific settings 18

Chapter 2 Installation Steps

Prerequisites for first-time installation 20
Summary of installation steps 22
Installing the adapter 24
Prerequisites 24
Installation procedure 24
Matching the adapter with the correct PCI slot 26

Chapter 3 Installing and Configuring the BIOS Settings

Verifying and updating the Emulex firmware and boot BIOS ... 32
Verifying the correct BIOS version 32
Updating the boot BIOS 33
Method One — Updating the adapter boot BIOS with hbacmd 34

Method Two – Booting from a DOS bootable diskette and using the lp6dutil utility 37
Method Three – Using lputil at the command line (for the Emulex 7.x driver) 38
Updating the HBA firmware with lputil 38
Updating the HBA boot BIOS with lputil 40

Chapter 4 Installing and Configuring the Linux Host with the Emulex Driver

Installation instructions for the Emulex v8.x-series driver 44
Downloading the Emulex v8.x-series adapter driver for the v2.6.x kernel 45
Installing the Emulex CNA v8.x-series driver on RHEL 5.2 and SLES 10 SP2 hosts 46
Installing the Emulex v8.x-series driver on SLES 9 SP1 hosts 47
Installing the Emulex v8.x-series driver on RHEL 4 hosts ... 49
Included Emulex driver on RHEL 4, RHEL 5, OEL 4, OEL 5, Asianux 2.0, Asianux 3.0, SLES 9, SLES 10, and SLES 11 52
Uninstalling the Emulex v8.x-series driver 56
Exercising the Emulex v8.x-series device driver 57
Loading and unloading the Emulex v8.x-series driver 57
Target information exported to the /proc filesystem 58
Dynamically modifying the driver and device information exported to the /sys filesystem 58
Installation instructions for the Emulex v7.x-Series driver 63
Enabling the Emulex v7.x-Series driver in RHEL 3.0 U4 and U5 63
Enabling the Emulex v7.x-Series driver in Asianux 1.0 U1 64
Installing the IOCTL Application Helper Module on RHEL 3.0 U4 65
Included Emulex driver in RHEL3.0 U6, RHEL3.0 U7, RHEL3.0 U8, and RHEL 3.9 67
Installing the Emulex v7.x-Series driver 68
Installing the Emulex applications kit 77
Uninstallation of the Emulex v7.x-Series driver 79
Uninstallation methods for the Emulex v7.x-Series driver 79
Installing the Emulex HBAnywhere applications kit 84
Editing the configuration files 87

Description of the Emulex lpfc driver parameters.....87
Descriptions of the Emulex parameters.....88
Editing the Emulex driver parameters on hosts with SLES 9, SLES 10, and SLES 11 90
Editing the Emulex driver parameters on hosts with RHEL 4 and RHEL 5.....91
Editing the Emulex driver parameters on hosts with Asianux 2.0 and Asianux 3.0 92
Editing the Emulex driver parameters on hosts with OEL 4 and OEL 5.....93
Using the Emulex lun_scan script 94

Chapter 5 Updating the Adapter and CEE/Menlo Firmware

Updating the adapter firmware with hbacmd..... 98
Updating Emulex CEE /Menlo firmware for LP21000-E/LP21002-E FCoE adapters..... 102
Updating Emulex BIOS/firmware for the OCe10102-FM-E/OCe10102-FX CNA adapters 104

Chapter 6 Connecting to the Storage

Zoning and connection planning in a fabric environment 110
Planning procedure 110
Establishing connectivity to the storage array.....110
Enabling persistent binding..... 111
Obtaining initiator and target information 111
Editing /usr/src/lpfc/lpfc.conf.....112
Editing /etc/modules.conf.....114
Configuring Emulex OCe10102-FM-E/OCe10102-FX iSCSI CNA for iSCSI connectivity 117

Chapter 7 Configuring a Boot Device on an EMC Storage Array

Cautions and restrictions booting from an EMC storage array 122
Symmetrix-specific cautions and restrictions 122
VNX series- and CLARiiON-specific cautions and restrictions.....123
Limitations 124
Common limitations.....124
Symmetrix-specific limitations 126
VNX series- and CLARiiON-specific limitations 126

Configuring a Symmetrix boot device 128
Preparing the Symmetrix system 128
Preparing the host 128
Configuring the Emulex boot BIOS for SAN boot 129
Configuring a VNX series or CLARiiON boot device 132
Preparing the VNX series or CLARiiON system 132
Preparing the host 132
Configuring the Emulex boot BIOS for SAN boot 133
Installing an operating system on a Symmetrix, VNX series, or CLARiiON 136
Installing supported RHEL 2.1 and 3.0 releases onto the EMC storage device with the Emulex v7.x-Series driver ... 136
Installing RHEL 2.1 and 3.0 onto the EMC storage device with the Emulex v7.x-Series driver diskette 137
Installing RHEL 3.0 U4 and U5 onto the EMC storage device with the Emulex v7.x-Series driver 138
Installing RHEL 3.0 U6 through RHEL 3.9 onto the EMC storage device with the Emulex v7.x-Series driver 138
Installing SLES 8 SP4 for the i386 architecture onto the EMC storage device with the Emulex v7.x-Series driver diskette 139
Installing supported RHEL 4, RHEL 5, OEL 4, OEL 5, Asianux 2.0, Asianux 3.0, SLES 9, SLES 10, and SLES 11 operating systems onto the boot device with the Emulex v8.x-series driver 141
Installing RHEL 5.2 and SLES 10 SP2 operating systems onto a boot device using FCoE Adapters 142
RHEL 5.2 OS SAN-boot installation with Emulex FCoE adapters 142
SLES 10 SP2 OS SAN-boot installation with Emulex FCoE adapters 143
Upgrading the Linux kernel 145

Chapter 8 Additional Notes

Ethernet connectivity over the CNA 148
Using the Emulex lun-scan script 149
Device reconfiguration procedures 151
Rebooting the host 151
Unloading and reloading the modular Emulex driver 151
Device reconfiguration: Device numbering 154
HPQ server-specific note 155
LUN 000 requirement for the Linux v2.6.x kernel 156

Linux device-naming convention 157
Block device file names 157
Red Hat distributions 158
SuSE distributions 158
PowerPath examples 159
Character device file names 159
Device reconfiguration procedures 161
Rebooting the host 161
Unloading and reloading the modular Emulex driver 161
Echoing the /proc filesystem 163
Rescanning the SCSI bus 164
Incorporating EMC Fibre Channel 165

Appendix A Special Instructions

CLARiiON "Ghost" LUN reported with the Emulex v7.1.14 and v7.3.2 drivers (PQB filter) 168
Enabling the lpfc_inq_pqb_filter parameter 169
(CLARiiON only): Required /etc/modules.conf edit for RHEL 2.1, RHEL 3.0, and SLES 8.0 default modular kernels ... 171
(CLARiiON only): Linux Navisphere Agent/CLI limitation with fdisk on CLARiiON 174
Disabling the Navisphere Agent service 175
Issuing a Navisphere Agent stop command 175
Removing the Naviagent/CLI RPM 175
(CLARiiON only): Linux Navisphere Naviagent/CLI limitation with VERITAS Volume Manager v3.2 on CLARiiON 177
(CLARiiON only): Linux Navisphere Agent requirement for RHEL 2.1 Intel Itanium systems 178
(CLARiiON Only): Linux Navisphere Agent requirement for RHEL 3.0 Intel Itanium systems 179

Index 181

Preface

As part of an effort to improve and enhance the performance and capabilities of its product line, EMC from time to time releases revisions of its hardware and software. Therefore, some functions described in this document may not be supported by all revisions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

If a product does not function properly or does not function as described in this document, contact your EMC representative.

This guide describes the features and setup procedures for Linux hosts with Emulex Host Bus Adapters (HBAs) and Converged Network Adapters (CNAs) to EMC Symmetrix, EMC VNX series, and EMC CLARiiON storage systems.

Audience

This guide is intended for use by storage administrators, system programmers, or operators who are involved in acquiring, managing, or operating Symmetrix, VNX series, and CLARiiON, and host devices.

Readers of this guide are expected to be familiar with the following topics:

- Symmetrix, VNX series, and CLARiiON system operation
- Linux operating environment
- Emulex adapters and drivers

EMC Support Matrix

Always consult the *EMC Support Matrix*, available through E-Lab Interoperability Navigator at: http://elabnavigator.EMC.com, under the **PDFs and Guides** tab, for the most up-to-date information.

Related documentation

The following documents are available on Powerlink:

- *EMC Host Connectivity Guide for Linux*
- *EMC Host Connectivity with QLogic Fibre Channel and iSCSI Host Bus Adapters (HBAs) and Converged Network Adapters (CNAs) for the Linux Environment*
- *EMC Linux iSCSI Attach Release Notes*
- The *EMC Networked Storage Topology Guide* has been divided into several TechBooks and reference manuals and are available through the E-Lab Interoperability Navigator, **Topology Resource Center** tab, at http://elabnavigator.EMC.com.
- For Emulex-specific documentation, refer to the Emulex website

Conventions used in this guide

EMC uses the following conventions for notes and cautions.

Note: A note presents information that is important, but not hazard-related.

CAUTION

A caution contains information essential to avoid data loss or damage to the system or equipment. The caution may apply to hardware or software.

Typographical Conventions

EMC uses the following type style conventions in this guide:

Normal	Used in running (nonprocedural) text for: • Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus) • Names of resources, attributes, pools, Boolean expressions, buttons, DQL statements, keywords, clauses, environment variables, filenames, functions, utilities • URLs, pathnames, filenames, directory names, computer names, links, groups, service keys, file systems, notifications
Bold	Used in running (nonprocedural) text for: • Names of commands, daemons, options, programs, processes, services, applications, utilities, kernels, notifications, system call, man pages Used in procedures for: • Names of interface elements (such as names of windows, dialog boxes, buttons, fields, and menus) • What user specifically selects, clicks, presses, or types

Italic	Used in all text (including procedures) for: • Full titles of publications referenced in text • Emphasis (for example a new term) • Variables
`Courier`	Used for: • System output, such as an error message or script • URLs, complete paths, filenames, prompts, and syntax when shown outside of running text
`Courier bold`	Used for: • Specific user input (such as commands)
`Courier italic`	Used in procedures for: • Variables on command line • User input variables
< >	Angle brackets enclose parameter or variable values supplied by the user
[ ]	Square brackets enclose optional values
|	Vertical bar indicates alternate selections - the bar means “or”
{ }	Braces indicate content that you must specify (that is, x or y or z)
...	Ellipses indicate nonessential information omitted from the example

Where to get help

EMC support, product, and licensing information can be obtained as follows.

Product information — For documentation, release notes, software updates, or for information about EMC products, licensing, and service, go to the EMC Powerlink website (registration required) at:

`http://Powerlink.EMC.com`

Technical support — For technical support, go to EMC Customer Service on Powerlink. To open a service request through Powerlink, you must have a valid support agreement. Please contact your EMC sales representative for details about obtaining a valid support agreement or to answer any questions about your account.

Your comments

Your suggestions will help us continue to improve the accuracy, organization, and overall quality of the user publications. Please send your opinion of this document to:

`techpub_comments@EMC.com`

1 Introduction

This document describes the procedures for installing an EMC-approved Emulex adapter into a Linux host environment and configuring the host for connection to an EMC storage array over Fibre Channel (FC) or Fibre Channel over Ethernet (FCoE).

Review the *EMC Support Matrix* for the latest information on approved adapters and drivers.

- Purpose of this document 14
- Host connectivity 14
- Boot device support 15
- Zoning 16
- Useful Linux utilities and functions 17
- EMC storage array-specific settings 18

Purpose of this document

This document is meant to assist in the installation and setup of Emulex Fibre Channel Host Bus Adapters (HBAs) and Fibre Channel Over Ethernet (FCoE) Converged Network Adapters (CNAs) and with the v7.x-series driver on the Linux v2.4.x hosts and the v8.x-series driver on Linux v2.6.x hosts. The focus of this document is to:

- Enable the integrated Emulex drivers in the Linux distributions
- Set up Linux hosts using the Emulex v7.x-series driver, which can be downloaded from the EMC®-approved section of the Emulex website
- Configure Linux hosts using the Emulex v8.x-series driver, downloadable from the EMC-approved section of the Emulex website at http://www.emulex.com.

Host connectivity

Review the *EMC Support Matrix* or contact your EMC representative for the latest information on qualified adapters, drivers, and Linux distributions.

Note: EMC does not support mixing different types of Fibre Channel adapter (including different types from the same vendor) in a server.

Fibre Channel

The Fibre Channel adapter driver functions as a device driver layer below the standard Linux SCSI adapter driver. The Fibre Channel interface therefore is transparent to the Linux disk administration system.

Fibre Channel over Ethernet

EMC supports the Emulex Fibre Channel over Ethernet (FCoE) Converged Network Adapter (CNA). FCoE adapters provide a method to converge both Fibre Channel and Ethernet traffic over a single physical link to a switch infrastructure which manages both storage (SAN) and network (IP) connectivity within a single unit.

The benefits of FCoE technology become apparent in large data centers:

- Where dense, rack-mounted and blade server chassis exist.
- Where physical cable topology simplification is a priority.
- In virtualization environments, where several physical storage and network links are commonly required.

The installation of the Emulex FCoE CNA provides the host with an Intel-based 10 gigabit Ethernet interface (using the existing in-box drivers), and an Emulex Fibre Channel adapter interface, which requires the installation of the supported driver revision.

Following installation of the proper driver for the FCoE CNA, the Fibre Channel interface will function identically to that of a standard Emulex Fibre Channel HBA. The FCoE CNA simply encapsulates Fibre Channel traffic within Ethernet frames. As such, FC-based content within this document also applies directly to the Emulex FCoE CNAs.

In-depth information about FCoE and its supported features and topologies can be found in the EMC *Fibre Channel over Ethernet (FCoE) TechBook* available at the Topology Resource tab in the E-Lab Interoperability Navigator at http://elabnavigator.EMC.com.

Boot device support

Linux hosts using Emulex adapters have been qualified for booting from EMC storage array devices interfaced through Fibre Channel as specified in the *EMC Support Matrix*.

The EMC Symmetrix®, EMC VNX™ series, and EMC CLARiiON® system that is to contain the Master Boot Record (MBR) for the host must have a lower logical unit number (LUN) than any other device visible to the host. This device must be mapped as `/dev/sda` by the Linux operating system for the boot to succeed from the device.

Refer to Chapter 7, "Configuring a Boot Device on an EMC Storage Array," for further information on booting from the SAN.

Zoning

When using Linux hosts in a fabric environment, the zoning must be set up as single-initiator and single-target zoning. A single initiator / target zone has one adapter port and one EMC storage array port. Storage arrays ports can be shared among adapters; however, each adapter port must be in its own zone.

Note: Multi-initiator zones are not supported in a Linux fabric environment.

Useful Linux utilities and functions

These utilities and functions can be helpful in performing configuration operations.

Table 1 Useful Linux utilities and functions

Utility/Function	Description
fdisk	Command used to create and manipulate partition tables.
grep	Command used to search through a file or files to find specific text.
fsck	Command used to check and repair a Linux filesystem.
mkfs	Command used to create a Linux filesystem on a device partition.
mount	Command used to attach the filesystem on a device to the file tree.
umount	Command used to detach a filesystem.
shutdown	Command used to shut down the system gracefully.
reboot	Command used to stop and restart the operating system.
insmod	Utility used to dynamically load a single module into a running kernel.
rmmod	Utility used to unload loadable modules from the running kernel if they are not in use and if other modules are not dependent upon those being removed.
modprobe	Utility used to load or remove a set of modules that can be either a single module or a stack of dependent modules.
lsmod	Utility used to list the currently loaded modules.
lspci	Utility used to display information about all of the PCI buses in the system and all of the devices connected to those buses.
scsiinfo	Utility to query information from a scsi device.

EMC storage array-specific settings

Refer to the *EMC Host Connectivity Guide for Linux*, available at http://Powerlink.EMC.com, for EMC storage array-specific settings.

2

Installation Steps

This chapter outlines the prerequisites for first-time installation, offers a summary of the installation steps with links to the appropriate sections, and provides information on installing the adapter.

Review the *EMC Support Matrix* for the latest information on approved adapters and drivers.

- Prerequisites for first-time installation 20
- Summary of installation steps 22
- Installing the adapter 24

Prerequisites for first-time installation

In order to complete a first-time installation of the Emulex adapter in your server, you will need the following:

- "Operating system" on page 20
- "HBAnyware and hbacmd utilities" on page 20
- "BIOS and firmware" on page 20
- "Linux driver" on page 21

Operating system

Before the Emulex adapter is installed, the Linux operating system must be installed and properly configured. Install the Linux kernel from the distribution installation CD by following the procedure provided in the distribution installation guide. Partition the boot drive, and select the packages and services necessary for the host.

IMPORTANT

Include the kernel source/development package and the gcc compiler tools during the installation. If these tools are not installed, then the out-of-kernel driver installation may fail and the driver will not be installed.

HBAnyware and hbacmd utilities

Emulex's HBAnyware program is a GUI-based utility. The hbacmd is a text-based utility. Both applications may be installed on any Linux system and used to manage, configure, and update the EMC-approved Emulex HBAs. The examples contained within this document use the hbacmd utility.

The EMC-qualified versions of HBAnyware and the hbacmd, along with complete documentation that includes the instructions for the installation of these utilities, are available for download from the EMC-approved section of the Emulex website at http://www.emulex.com/emc/support/index.jsp.

Follow the links to your adapter for the appropriate version.

BIOS and firmware

The version of BIOS and firmware (adapter firmware for your HBA or CNA, and CEE/Menlo firmware for your CNA) per the *EMC Support Matrix* for your supported configuration.

These are available for download from the EMC-approved section of the Emulex website at http://www.emulex.com/emc/support/index.jsp.

Follow the links to your adapter for the appropriate version.

Linux driver

The Linux driver for your HBA or CNA per the*EMC Support Matrix* for your supported configuration.

EMC supports both in-kernel and out-of-kernel drivers.

Note: The installation of the in-kernel driver occurs when you install your Linux distribution of choice.

Refer to the latest *EMC Support Matrix* for your specific Linux distribution, kernel version, and driver to determine whether or not you need to proceed with the following out-of-kernel instructions.

If your installation requires an out-of-kernel driver, download it from the EMC-approved section of the Emulex website at http://www.emulex.com/emc/support/index.jsp.

Follow the links to your adapter for the appropriate version.

Summary of installation steps

Table 2 describes the procedures for installing an EMC-approved Emulex adapters into a Linux host and configuring the host for connection to an EMC Storage Array over Fibre Channel (FC) or Fibre Channel over Ethernet (FCoE).

Table 2 Installation steps (page 1 of 2)

Step	Instructions	For Fibre Channel, refer to	For Fibre Channel over Ethernet, refer to
1	Install the HBA .	"Installing the adapter" on page 24	"Installing the adapter" on page 24
2	Verify the BIOS version	"Verifying the correct BIOS version" on page 32	"Verifying the correct BIOS version" on page 32
3	Install the BIOS. There are three states:		
	• If no version is installed	"Updating the boot BIOS" on page 33	"Updating the boot BIOS" on page 33
	• If wrong version is installed	"Updating the boot BIOS" on page 33	"Updating the boot BIOS" on page 33
	• If correct version is installed	Proceed to step 4.	Proceed to step 4.
4	Install the driver. There are two states:		
	• In kernel	For drivers listed in the *EMC Support Matrix* as in-kernel drivers, there is no need to install a driver since the process of installing the operating system has already included the driver. Table 5 on page 52 lists supported Emulex driver versions . If in kernel, proceed to Step 5.	For drivers listed in the *EMC Support Matrix* as in-kernel drivers, there is no need to install a driver since the process of installing the operating system has already included the driver. Table 5 on page 52 lists supported Emulex driver versions . If in kernel, proceed to Step 5.
	• Out of kernel	"Installation instructions for the Emulex v8.x-series driver" on page 44	"Installing the Emulex CNA v8.x-series driver on RHEL 5.2 and SLES 10 SP2 hosts" on page 46.

Table 2 Installation steps (page 2 of 2)

Step	Instructions	For Fibre Channel, refer to	For Fibre Channel over Ethernet, refer to
5	Install the HBanywhere applications kit.	"Installing the Emulex HBAnywhere applications kit" on page 84	"Installing the Emulex HBAnywhere applications kit" on page 84
6	Install the firmware. There are two states:		
	• Wrong firmware	"Updating the adapter firmware with hbacmd" on page 98 Once corrected, proceed to Step 7.	"Updating the adapter firmware with hbacmd" on page 98, and "Updating Emulex CEE /Menlo firmware for LP21000-E/LP21002-E FCoE adapters" on page 102 Once corrected, proceed to Step 7.
	• Correct firmware	Proceed to Step 7.	Proceed to Step 7.
7	Connect to the storage.	"Zoning and connection planning in a fabric environment" on page 110	"Zoning and connection planning in a fabric environment" on page 110
8	Reconfigure the device.	"Device reconfiguration procedures" on page 151	"Device reconfiguration procedures" on page 151

Installing the adapter

This section contains the following information needed for installing the adapter:

- "Prerequisites" on page 24
- "Installation procedure" on page 24
- "Matching the adapter with the correct PCI slot" on page 26

Prerequisites

Before the Emulex HBA is installed, the host must be configured with Linux. Install the Linux kernel (including sources) from the distribution installation CD, following the procedure provided in the distribution installation guide. Partition the boot drive and select the packages and services necessary for the host.

Installation procedure

Follow this procedure to install an adapter in your server.

Note: Newer adapters do not require this first jumper step. Proceed to Step 2.

1. For older adapter models, set the adapter jumpers as shown in Figure 1to enable it for use with the host.

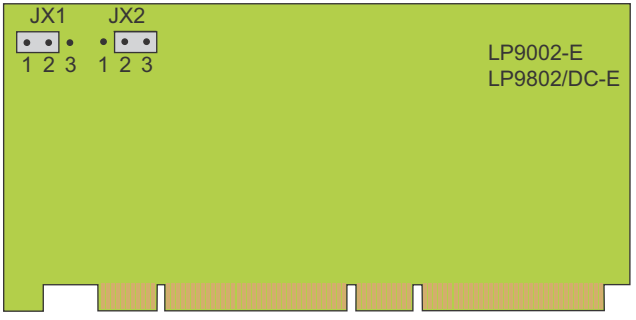
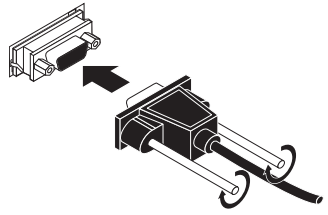
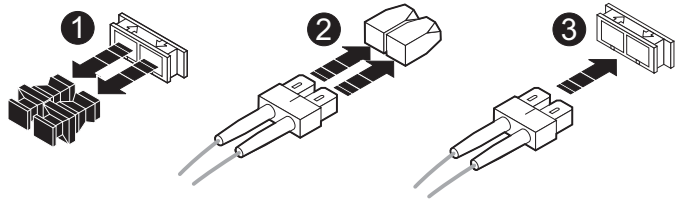


Figure 1 Jumpers on Emulex adapters

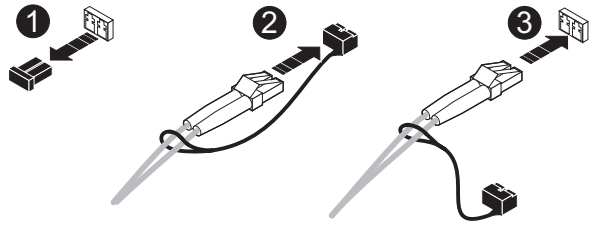
2. With host system power removed, install the adapter card and cables as instructed in the server documentation. The card installs into a single slot.
3. (Optical cable only.) Remove the protective covers on each fiber-optic cable.
4. Plug one end of the cable into the connector on the adapter as shown in the appropriate figure under this step. (The hardware might be rotated 90 degrees clockwise from the orientation shown.)
   - Fibre Channel adapter connectivity options include copper cable with DB9 connector, SC optical, and LC optical cable, as shown next.
     – Copper cable with DB9 connector:



     – SC optical cable:

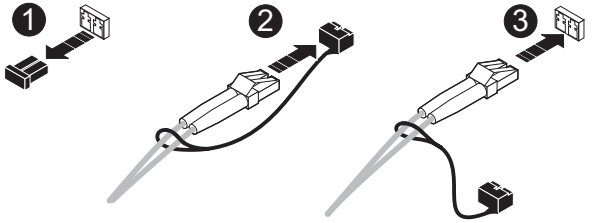


     – LC optical cable:



   - Fibre Channel over Ethernet converged network adapter (CNA) connectivity options include LC optical and Cisco SFP+, shown next.

– LC optical cable:



– Cisco SFP+ (Twinax cable)

5. Plug the other end of the cable into a connector on the storage system or a hub/switch port. For FCoE switch connections, do not connect cables to the switch port until the switch has been properly configured.
6. Label each cable to identify the adapter and the storage/switch/hub port to which it connects.
7. Reapply power and allow the system to boot normally.

Matching the adapter with the correct PCI slot

When choosing an adapter for your server, it is important to know which adapter is compatible with your server's PCI/PCI-X/PCI Express slots. Certain adapter models have specific voltage requirements or physical limitations that allow them to work only in specific slots.

Servers have several different bus slot types for accepting adapters:

- PCI

- PCI-X
- PCI-X 2.0
- PCI-Express

PCI slots can be 32-bit and 64-bit (denoted by their 124-pin or 188-pin connectors.) These slots have plastic "keys" that prevent certain adapters from fitting into them. These keys work with the cutout notches in the adapter edge connector so only compatible adapters will fit into them. This is done because of the voltage characteristics of the adapter. (For example, inserting a 3.3 V adapter into a 5 V slot will cause severe damage to both the adapter and the server.)

Figure 2 shows how PCI slots will appear with their keys and what type of voltage is provided for each slot type.

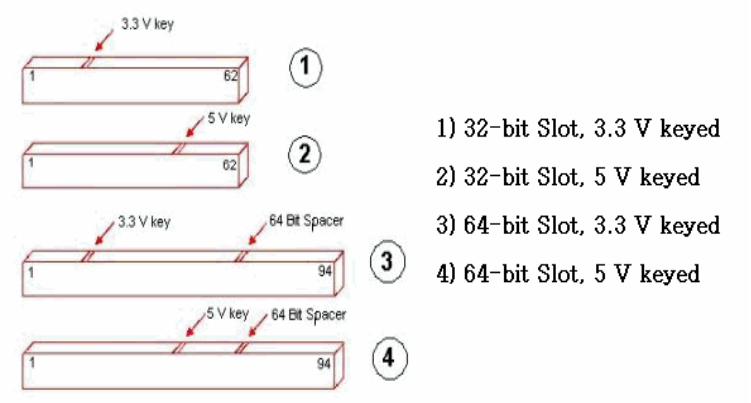


Figure 2 **PCI slot types and voltage key locations**

Figure 3 on page 28 shows the adapter edge connectors compatible with the PCI slots shown in Figure 2.

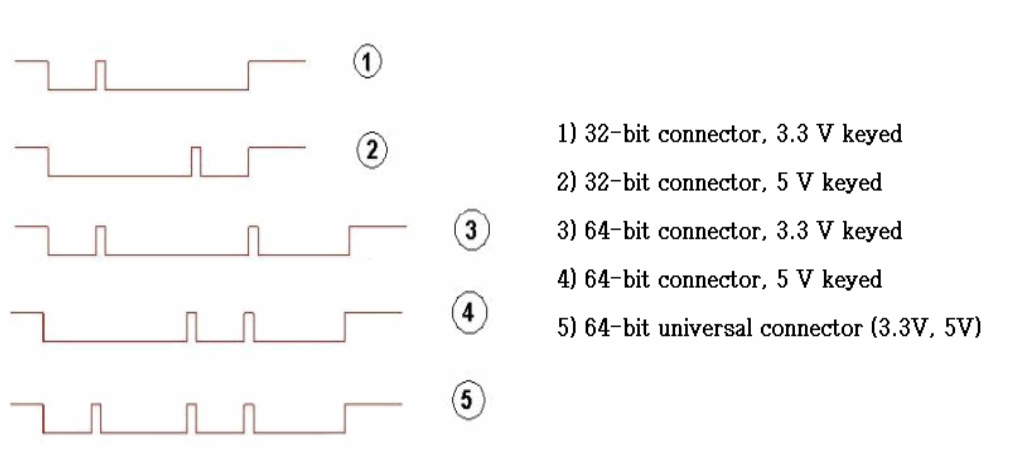


Figure 3 **Adapter edge connectors**

Note adapter 5, which shows a universal adapter edge connector. Universal adapters are compatible with both 3.3 V and 5 V PCI slots.

PCI-X (or PCI Extended) slots increase the speed with which data travels over the bus. PCI-X slots appear identical to a 64-bit PCI slot keyed for 3.3 V. (Refer to number 3 in Figure 2 on page 27 and Figure 3.) PCI-X slots are backwards compatible with 3.3 V PCI adapters and universal adapters. Inserting standard PCI adapters into PCI-X slots will lower the bus speed as they cannot take advantage of the improved performance.

PCI-X 2.0 is the next generation of PCI-X buses. PCI-X 2.0 increases the bus speed again, providing more performance for adapters. PCI-X 2.0 slots also appear identical to a 64-bit PCI slot keyed for 3.3 V. (Refer to number 3 in Figure 2 on page 27 and Figure 3.) PCI-X 2.0 is also fully backward compatible with 3.3 V PCI and PCI-X.

PCI Express (sometimes noted as PCIe) is a new bus type that uses the existing PCI model, but implements it in a faster, serial protocol. Because of the serial way it transmits data, the PCI Express bus slot can be different sizes depending on the throughput it supports. PCI Express slot speeds are expressed in "lanes" and are normally shown as x1, x4, x8, and x16. Each type of slot is a different length (as shown in Figure 4 on page 29) and adapter edge connectors will also be of varying lengths depending on how many lanes they require for throughput. Because of how PCI Express slots are keyed, an x1 adapter can be inserted in all four slot types, as the adapter will

negotiate with the slot to determine the highest mutually supported number of lanes. However, an adapter requiring x16 lanes will not fit into a smaller slot.

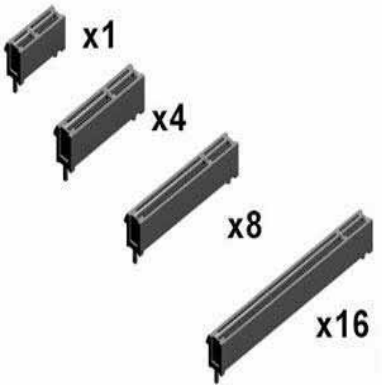


Figure 4 PCI Express slots

Figure 5 shows x1, x4, and x16 lane slots aligned on a mainboard. You can see how the slots are keyed so that low-lane adapters can fit into larger slots.

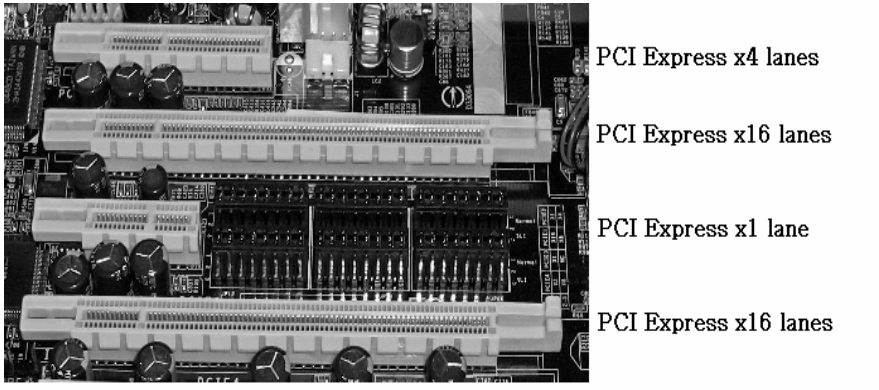


Figure 5 PCI Express slots aligned

Emulex offers adapters for each bus/slot type available. Table 3 on page 30 shows each of the EMC-supported Emulex adapters, and their respective slot requirements. Be sure to consult both your server user guide and Emulex to ensure that the adapter you want to use is compatible with your server's bus.

Table 3 Slot requirements of EMC-supported Emulex adapters

Adapter model	Protocol	PCI spec	BUS length	Power	Slot key
LP9002L	FC	PCI 2.2	64-bit	3.3V	Universal
LP9002DC	FC	PCI 2.2	64-bit	3.3V	Universal
LP982	FC	PCI-X 1.0a & PCI 2.2	64-bit	3.3V	Universal
LP9802	FC	PCI-X 1.0a & PCI 2.2	64-bit	3.3V	Universal
LP9802DC	FC	PCI-X 1.0a & PCI 2.2	64-bit	3.3V, 5V	3.3V
LP1050/LP1050DC	FC	PCI-X 1.0a & PCI 2.3	64-bit	3.3V, 5V	Universal
LP10000/LP10000DC	FC	PCI-X 1.0a & PCI 2.3	64-bit	3.3V, 5V	Universal
LP1050Ex/LP10000ExDC	FC	PCI Express	x4 lane	3.3v	n/a
LP1150/LP11000/LP11002	FC	PCI-X 2.0 & PCI 3.0	64-bit	3.3v	3.3v
LPe1150/LPe11000/LPe11002	FC	PCI Express	x4 lane	3.3v	n/a
LPe1250	FC	PCI Express	x4 lane	3.3v	n/a
LPe12000	FC	PCI Express	x4 lane	3.3v	n/a
LPe12002	FC	PCI Express	x4 lane	3.3v	n/a
LP21000	FCoE	PCI Express	x8 lane	3.3v	n/a
LP21002	FCoE	PCI Express	x8 lane	3.3v	n/a

Note that a few adapters are keyed universally, but require 5 V power (LP7000, LP8000, LP850.) They will fit into a 3.3 V PCI / PCI-X slot, but will not work unless the slot is capable of universal (3.3 V and 5 V) signaling. Consult your server user guide or manufacturer.

The LP9802DC, while capable of 3.3 V or 5 V signaling operation, fits only into a 3.3 V PCI / PCI-X slot. Remember, some of the older adapters are tall (also referred to as full-height) and may not fit into a server with a low-profile chassis. These factors must be considered before implementing your configuration to avoid unnecessary delays and possible equipment swaps or returns.

Currently, the Emulex FCoE converged network adapters (CNAs) require servers that can accommodate full-height, full-length PCI Express adapters. Always refer to the *EMC Support Matrix* for the most up-to-date information on which servers support these adapters.

3

Installing and Configuring the BIOS Settings

This chapter provides information on installing and configuring the BIOS settings.

- Verifying and updating the Emulex firmware and boot BIOS 32
- Method One — Updating the adapter boot BIOS with hbacmd..... 34
- Method Two – Booting from a DOS bootable diskette and using the lp6dutil utility 37
- Method Three – Using lputil at the command line (for the Emulex 7.x driver)..... 38

Verifying and updating the Emulex firmware and boot BIOS

Each Emulex Fibre Channel controller has a flash upgradable firmware and boot BIOS. In most instances, it is necessary to keep only the firmware up-to-date, because the BIOS is used only when using connected storage as a boot device. The latest supported firmware can be found on the Emulex website:

`http://www.emulex.com/ts/docoem/framemc.htm`

From this site, select the appropriate file for your adapter. The files are typically in a `.zip` file that contains different combinations of firmware and BIOS images. Extract the downloaded file to a diskette, and refer to `readme.txt` to determine which filename image to use.

If you are planning to boot from an EMC Storage Array, you need to use the file that includes the boot BIOS. Select the boot BIOS under the BootBIOS/FCode link listed for your adapter.

IMPORTANT

If you are upgrading the firmware and BIOS, you must upgrade the firmware first, because it might contain an older BIOS version, which you can update separately later.

For instructions on updating the firmware, refer to "Updating the Adapter and CEE/Menlo Firmware" on page 97.

Verifying the correct BIOS version

You can determine the BIOS version at boot time from the Emulex banner or from the Emulex BIOS Utility options menu.

- From the banner: Boot the host and watch for the banner, as shown in the LP11002 example in Figure 6.

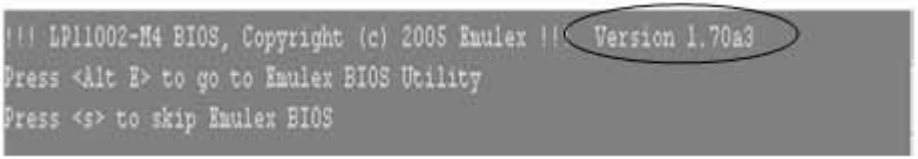


Figure 6 LP1102 Emulex banner

- If the banner does not display the required version, update the BIOS as described in "Updating the boot BIOS" on page 33.
- If the banner displays the required version, continue to the "Installation instructions for the Emulex v8.x-series driver" on page 44.

Updating the boot BIOS

Either of the following three methods can be used to update the boot BIOS:

- "Method One — Updating the adapter boot BIOS with hbacmd" on page 34
- "Method Two – Booting from a DOS bootable diskette and using the lp6dutil utility" on page 37

For the Emulex v7.x-Series driver, the lputil utility may be used, as described in:

- "Method Three – Using lputil at the command line (for the Emulex 7.x driver)" on page 38

Method One — Updating the adapter boot BIOS with hbacmd

To update the boot BIOS on the adapters, follow these steps:

1. Ensure that the firmware is updated prior to updating the boot BIOS.
2. Download the appropriate boot BIOS file from the EMC-approved section of the Emulex website and copy it to the appropriate directory, `/usr/sbin/lpfc`.:

Table 4 Adapter model and Boot BIOS file (page 1 of 2)

Adapter model	Boot BIOS file
LP982-E	lb*xxx*.prg (where *xxx* is the version) Example: lb170a3.prg
LP9002-E	cb*xxx*.prg (where *xxx* is the version) Example: cb170a3.prg
LP9802-E	hb*xxx*.prg (where *xxx* is the version) Example: hb170a3.prg
LP9802DC-E	hb*xxx*.prg (where *xxx* is the version) Example: hb170a3.prg
LP1050-E	mb*xxx*.prg (where *xxx* is the version) Example: mb170a3.prg
LP1050DC-E	mb*xxx*.prg (where *xxx* is the version) Example: mb170a3.prg
LP1050EX-E	mb*xxx*.prg (where *xxx* is the version) Example: mb170a3.prg
LP10000-E	tb*xxx*.prg (where *xxx* is the version) Example: tb170a3.prg
LP10000DC-E	tb*xxx*.prg (where *xxx* is the version) Example: tb170a3.prg
LP10000EXDC-E	tb*xxx*.prg (where *xxx* is the version) Example: tb170a3.prg
LP101-E	eb*xxx*.prg (where*xxx*. is the version) Example: eb170a3.prg

Table 4 Adapter model and Boot BIOS file (page 2 of 2)

Adapter model	Boot BIOS file
LPe111-E	yb*xx.x*..all (where *xxx*. is the version) Example: yb170a3.prg
LPe1150-E	wb*xxx*.prg (where *xxx* is the version) Example: wb170a3.prg
LPe11002-E	zb*xxx*.prg (where *xxx* is the version) Example: zb170a3.prg
LP11002-E	bb*xxx*..prg (where *xxx*. is the version) Example: bb170a3.prg
LP11250-E	ob*xxx*..prg (where *xxx*. is the version) Example: ob202a1.prg
LPe12000-E	ub*xxx*..prg (where *xxx*. is the version) Example: ub202a1.prg
LPe12002-E	ub*xxx*..prg (where *xxx*. is the version) Example: ub202a1.prg
LP21000-E	au*xxx*..prg (where *xxx*. is the version) Example: au501a5.prg
LP21002-E	mp*xxx*..prg (where *xxx*. is the version) Example: mp501a5.prg
LP1005-DC Mezzanine for HPQ Blade Servers	mp*xxx*.prg (where *xxx*. is the version) Example: mp501a5.prg
LP100-DC Mezzanine for IBM Blade Servers	mc*xxx*.prg (where *xxx* is the version) Example: mc501a3.prg
LP1005-BC Mezzanine for IBM Blade Servers	bu*xxx*..prg (where *xxx*. is the version) Example: bu502a1.prg
LPe1105-M Mezzanine for Dell Blade Servers	zb*xxx*..all (where *xxx* is the version) Example: zb202a1.all
LPe1105-M4 Mezzanine for Dell Blade Servers	zb*xxx* .all (where *xxx* is the version) Example: zb202a1.all
LPe1205-M Mezzanine for Dell Blade Servers	ud*xxx* .all (where *xxx* is the version) Example: ud110a5.all

3. Execute the command **/usr/sbin/hbanyware/hbacmd ListHBA**, and record the "Port WWN" information for all adapters within the host.
4. Execute the command **/usr/sbin/hbanyware/hbacmd Download <WWPN> <firmwarefile>**, where WWPN is the first Port WWN recorded from Step 2, and firmwarefile is the firmware file name determined in Step 1. The utility will report "Download Complete." when the firmware download has completed successfully.
5. If the installed adapter is a dual-ported model, then the boot BIOS does not need to be downloaded to each adapter port; downloading it to either port results in both ports being updated with the latest BIOS. Otherwise, for multiple single-port adapter models, repeat Step 4 for each adapter port WWN reported in Step 3, to ensure that all adapter instances within the host have been updated.
6. Reboot the system.

Method Two – Booting from a DOS bootable diskette and using the lp6dutil utility

This section discusses how to update the firmware and boot BIOS, using the Ip6util utility.

Follow these steps to upgrade the flash firmware from a MS-DOS bootable diskette:

1. Boot the computer using a DOS / WIN95 / WIN98 bootable diskette.
2. Insert the diskette containing the flash utility (`LP6DUTIL.EXE`).
3. At the `A:\>` prompt, type **lp6dutil** and press **ENTER** to start the utility.
4. The utility performs diagnostic tests on the installed adapter(s).

   You may be required to press **ENTER** after each test so the program can move on to the next. After the diagnostics are complete, the main menu appears.
5. Type **5** and press **ENTER** to select **Maintenance**.
6. Type **1** and press **ENTER** to select **Upgrade Firmware**.
7. Enter the range of adapters to flash; for example: **1–4** (for four adapters).

   Enter the Firmware Image filename, including the path. The firmware image file should be on the same disk as the `LP6DUTIL.EXE` program file.
8. When prompted, type **1** and press **ENTER** to proceed with the upgrade for the first controller.
9. When prompted, type **1** and press **ENTER** to reset the adapter after loading is complete.
10. Repeat steps 8 and 9 for each adapter in the range entered in step 6.
11. When all adapters have been loaded, type **0** and press **ENTER** at the **Maintenance** menu to return to the main menu.
12. Type **7** and press **ENTER** at the main menu to exit the flash utility.

Method Three – Using lputil at the command line (for the Emulex 7.x driver)

This section discusses how to update the firmware and boot BIOS, using the lputil utility.

Updating the HBA firmware with lputil

The `lputil` is dependent upon the existence of the Emulex driver. Therefore, the operating system and the Emulex driver must be installed prior to using the `lputil`. The `lputil` is included in the Emulex Application Kit along with the HBA API and HBAnyware.

Download the Emulex Application Kit from the EMC-approved section of the Emulex website. Follow the steps below to upgrade the flash firmware using the `lputil`.

To update the firmware on the HBAs:

1. Copy the appropriate firmware file from the CD-ROM or the EMC-approved section of the Emulex website to the appropriate directory, `/usr/sbin/lpfc`.

   The following table lists the HBA models and the name of the corresponding firmware files.

HBA model	Firmware file
LP982-E	`lfb`*`XXX`*`.all` (where *`XXX`* is the version) Example: `lfb1.91a5.all`
LP9002-E	`cdc`*`XXX`*`.all` (where *`XXX`* is the version) Example: `cdc3.92a2.all`
LP9802-E	`hd`*`XXX`*`.all` (where *`XXX`* is the version) Example: `hd1.91a5.all`
LP9802DC-E	`hf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `hf1.91a5.all`
LP1050-E	`mf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `mf1.91a5.all`
LP1050DC-E	`mf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `mf1.91a5.all`

HBA model	Firmware file
LP1050EX-E	`mf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `mf1.91a5.all`
LP10000-E	`td`*`XXX`*`.all` (where *`XXX`* is the version) Example: `td1.91a5.all`
LP10000DC-E	`td`*`XXX`*.all (where *`XXX`* is the version) Example: `td1.91a5.all`
LP10000EXDC-E	`td`*`XXX`*`.all` (where *`XXX`* is the version) Example: `td1.91a5.all`
LP101-E	`emb`*`XXX`*`.all` (where *`XXX`* is the version) Example: `emb1.91a5.all`
LPe1150-E	`wf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `wf2.50a6.all`
LPe11002-E	`zf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `zf2..10a10.all`
LP1150-E	`jf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `jf2.50a6.all`
LP11002-E	`bf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `bf2.50a6.all`
LP1005DC Mezzanine for HPQ Blade Servers	`mf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `mf1.91a2.all`
LP1005DC Mezzanine for IBM BladeServers	`mf`*`XXX`*`.all` (where *`XXX`* is the version) Example: `mf1.90a5.all`

Each firmware file contains four files. The naming schema of the files follows the format as shown in the example below for the LP9002 v3.92a2 firmware.

`cdc``3.92a2.`**`dwc`** = contains the firmware with combination boot

`cdc``3.92a2.`**`awc`** = contains the firmware with loader and combination boot

`cd``3.92a2.`**`dwc`** = contains the firmware with no boot code

`cd``3.92a2.`**`awc`** = contains the firmware with loader, no boot code

2. Start the firmware update utility:

```
cd /usr/sbin/lpfc
   ./lputil
```

3. Select Option **3 – Firmware Maintenance**.
4. Select the number of the adapter to update.
5. Select Option **1 – Load Firmware Update**.
6. Enter the full name of the image file (as shown in the table above; for example, `td190a4.all`) and press **ENTER**.
7. Select Option **0 – Return to Main Menu.**
8. Repeat steps 3 through 7 for each additional adapter in the system.
9. If you plan to update the BIOS on the system that will allow the system to boot from the EMC storage array, then update the Boot BIOS as described in *"Verifying and updating the Emulex firmware and boot BIOS" on page 32*.
10. If you do not plan to update the Boot BIOS, then reboot the system.

Note: If you are using the HBA to boot from the SAN, update the Boot BIOS immediately after updating the firmware as the firmware overwrites part of the Boot BIOS.

Updating the HBA boot BIOS with lputil

Follow these steps to upgrade the boot BIOS using the `lputil`:

To update the boot BIOS on the HBAs:

1. Ensure that the firmware has been updated prior to updating the boot BIOS.

2. Download the appropriate boot BIOS file from the EMC-approved section of the Emulex website and copy it to the appropriate directory, `/usr/sbin/lpfc`:

HBA model	Boot BIOS file
LP982-E	lb*xxx*.prg (where *xxx* is the version) Example: lb170a3.prg
LP9002-E	cb*xxx*.prg (where *xxx* is the version) Example: cb170a3.prg
LP9802-E	hb*xxx*.prg (where *xxx* is the version) Example: hb170a3.prg
LP9802DC-E	hb*xxx*.prg (where *xxx* is the version) Example: hb170a3.prg
LP1050-E	mb*xxx*.prg (where *xxx* is the version) Example: mb170a3.prg
LP1050DC-E	mb*xxx*.prg (where *xxx* is the version) Example: mb170a3.prg
LP1050EX-E	mb*xxx*.prg (where *xxx* is the version) Example: mb170a3.prg
LP10000-E	tb*xxx*.prg (where *xxx* is the version) Example: tb170a3.prg
LP10000DC-E	tb*xxx*.prg (where *xxx* is the version) Example: tb170a3.prg
LP10000EXDC-E	tb*xxx*.prg (where *xxx* is the version) Example: tb170a3.prg
LP101-E	eb*xxx*.prg (where *xxx* is the version) Example: eb170a3.prg
LPe1150-E	wb*xxx*.prg (where *xxx* is the version) Example: wb170a3.prg
LPe11002-E	zb*xxx*.prg (where *xxx* is the version) Example: zb170a3.prg
LP1150-E	jb*xxx*.prg (where *xxx* is the version) Example: jb170a3.prg

HBA model	Boot BIOS file
LP11002-E	bb*XXX*.prg (where *XXX* is the version) Example: bb170a3.prg
LP1005DC Mezzanine for HPQ Blade Servers	mp*XXX*.prg (where *XXX* is the version) Example: mp501a5.prg
LP1005DC Mezzanine for IBM BladeServers	mc*XXX*.prg (where *XXX* is the version) Example: mc501a3.prg

3. Copy the file for Open Boot support from the CD-ROM or the EMC-approved section of the Emulex website to the appropriate directory, `/usr/sbin/lpfc`.
4. Start the boot BIOS update utility:

```
cd /usr/sbin/lpfc
./lputil
```

5. Select Option **3 – Firmware Maintenance**.
6. Select the adapter number to update.
7. Select Option **1 – Load Firmware Update**.
8. Enter the full name of the image file (as shown in the table in item 1; for example, `cd190a4.awc`) and press **ENTER**.
9. Select Option **0 – Return to Main Menu.**
10. If desired, repeat steps 4 through 8 for each additional adapter in the system.
11. Using the lputil, choose the HBA that is to be used for booting from the fabric. Select Option **3** to enable the boot BIOS on the intended HBA.
12. Reboot the system.

Note: Booting from the SAN is not supported with EFI boot code.

4

Installing and Configuring the Linux Host with the Emulex Driver

This chapter describes the procedures for installing an EMC-approved Emulex host bus adapter (HBA) into a Linux host.

Refer to the *EMC Support Matrix* for the most up-to-date information on approved adapters and drivers.

- Installation instructions for the Emulex v8.x-series driver 44
- Uninstalling the Emulex v8.x-series driver 56
- Exercising the Emulex v8.x-series device driver 57
- Installation instructions for the Emulex v7.x-Series driver 63
- Uninstallation of the Emulex v7.x-Series driver 79
- Installing the Emulex HBAnywhere applications kit 84
- Editing the configuration files 87
- Using the Emulex lun_scan script 94

Installation instructions for the Emulex v8.x-series driver

Using the Emulex adapter with the Linux operating system requires adapter driver software. The driver functions at a layer below the Linux SCSI driver to present Fibre Channel devices to the operating system as if they were standard SCSI devices.

Refer to the latest *EMC Support Matrix* for specific qualified kernel versions and distributions.

Note: The support stated in the *EMC Support Matrix* supersedes versions listed in this document.

The Emulex v8.x-series lpfc and lpfcdfc drivers may be installed onto a Linux host using the installer script packaged along with the driver sources. However, for drivers listed in the *EMC Support Matrix* as in-kernel drivers, there is no need to perform the following installation since the process of installing the operating system has already included the driver.

Currently, the v2.6.x kernel does not allow scanning past a non-existent LUN 000. As a result, LUN 000 must exist on the EMC Storage Array in order for the SCSI layer to scan all devices.

This section includes the following information:

- "Downloading the Emulex v8.x-series adapter driver for the v2.6.x kernel" on page 45
- "Installing the Emulex CNA v8.x-series driver on RHEL 5.2 and SLES 10 SP2 hosts" on page 46
- "Installing the Emulex v8.x-series driver on SLES 9 SP1 hosts" on page 47
- "Installing the Emulex v8.x-series driver on RHEL 4 hosts" on page 49
- "Included Emulex driver on RHEL 4, RHEL 5, OEL 4, OEL 5, Asianux 2.0, Asianux 3.0, SLES 9, SLES 10, and SLES 11" on page 52

Downloading the Emulex v8.x-series adapter driver for the v2.6.x kernel

Note: This procedure is for both Fibre Channel and FCoE adapters.

Ensure that you have the latest qualified driver. Refer to the *EMC Support Matrix* for the latest driver revision.

Follow these steps to download the Emulex driver from the Emulex website:

1. Change to the directory to which you will save the driver.

   For example:

   ```
   mkdir /home/emulex
   cd /home/emulex
   ```

2. Use a web browser to access the Emulex website at the following url:

   http://www.emulex.com/emc/support/index.jsp

3. Select the link for the appropriate Emulex adapter in your system.
4. Find the listing for the Linux v8.x-Series driver listed:

   lpfc_2.6_driver_kit-8.2.0.29-1.tar.gz

5. In addition to the actual driver installation tar archive, the Emulex Application Kit tar archive may also be downloaded. The package name is:

   ElxLinuxApps-4.0a31-8.2.0.29-1-1.tar

What next?

Refer to the following sections, depending on your installation:

- "Installing the Emulex CNA v8.x-series driver on RHEL 5.2 and SLES 10 SP2 hosts" on page 46
- "Installing the Emulex v8.x-series driver on SLES 9 SP1 hosts" on page 47
- "Installing the Emulex v8.x-series driver on RHEL 4 hosts" on page 49

Installing the Emulex CNA v8.x-series driver on RHEL 5.2 and SLES 10 SP2 hosts

To install the Emulex FCoE v8.x-series driver on RHEL 5.2 and SLES 10 SP2 hosts using the installer script included in the package.

1. Boot into the qualified and supported kernel onto which the driver will be installed.
2. Obtain the `lpfc_2.6_driver_kit-8.2.0.29-1.tar.gz` from the Emulex website as instructed in "Downloading the Emulex v8.x-series adapter driver for the v2.6.x kernel" on page 45.
3. Uncompress and extract the source files from the tar archive:

   ```
   cd /home/emulex
   tar xzvf lpfc_2.6_driver_kit-8.2.0.29-1.tar.gz
   ```

   The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
lpfc_2.6_driver_kit-8.2.0.29-1/
lpfc_2.6_driver_kit-8.2.0.29-1/lpfcdriver_2.6-8.2.0.29-1.noarch.rpm
lpfc_2.6_driver_kit-8.2.0.29-1/lpfc-install
lpfc_2.6_driver_kit-8.2.0.29-1/README
```

   Contained within the newly created directory is the `lpfc-install` script.

4. Change to the directory that is extracted:

   ```
   cd lpfc_2.6_driver_kit-8.2.0.29-1
   ```

5. Uninstall the original driver before executing Step 6.

   a. Stop all applications using the Emulex 8.x-series driver and unload the lpfcdfc and the lpfc driver modules from the kernel.

   ```
   modprobe -r lpfcdfc
   modprobe -r lpfc
   ```

   b. The uninstallation of the driver may be performed using the `lpfc-install` script with the `-u` switch:

   ```
   ./lpfc-install -u

   Emulex LPFC Driver Installer Version 1.30.1.2
   Determining distribution type and kernel version ...
   Checking for Emulex driver packages ...
   Removing LPFC DFC Driver source RPM ...
   Removing LPFC Driver source RPM ...
   ```

```
Removing Emulex DFC driver startup script ...
Restoring old Emulex drivers...
Configuring /etc/modprobe.conf ...
Original saved as /etc/modprobe.elx
Original ramdisk image
/boot/initrd-2.6.9-5.0.3.ELsmp.img saved as
/boot/initrd-2.6.9-5.0.3.ELsmp.img.elx
Creating ramdisk ...
The ramdisk for this kernel has been updated.
Uninstallation complete
```

c. Reboot the host.

6. After the reboot, execute the `lpfc-install` script with no options to install the driver kit:

```
cd /home/emulex/lpfc_2.6_driver_kit-8.2.0.29-1
./lpfc-install
```

Upon completion of the `lpfc-install` script, the Emulex lpfc driver for the FCoE adapter is loaded and FC disks that are connected to the systemare accessible.

Note: The system must be rebooted so that the lpfc driver is loaded through the newly created ramdisk.

Installing the Emulex v8.x-series driver on SLES 9 SP1 hosts

The Emulex v2.10f driver (included by default in the SLES 9 SP1 distribution) is not supported by EMC. EMC requires the use of the v8.0.16.6_x2 driver when connecting to EMC storage.

Before installing the v8.0.16.6_x2 driver, the existing v2.x series driver must be uninstalled. The Emulex v8.0.16.6_x2 driver may then be compiled as a module and configured to load automatically at boot time. When the installer script is used, it creates a new RAM disk which includes the new driver.

This section describes the above-mentioned process using the installer script included in the package.

1. Boot into the qualified and supported kernel onto which the driver will be installed.
2. Obtain the `lpfc_2.6_driver_kit-8.0.16.6_x2-1.tar.gz` from the Emulex website as instructed in "Downloading the Emulex v8.x-series adapter driver for the v2.6.x kernel" on page 45.

3. Uncompress and extract the source files from the tar archive:

```
cd /home/emulex
tar xzvf lpfc_2.6_driver_kit-8.0.16.6_x2-1.tar.gz
```

The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
lpfc_2.6_driver_kit-8.0.16.6_x2-1/
lpfc_2.6_driver_kit-8.0.16.6_x2-1/lpfc_2.6_ioctl_module-2.0.2-1.noarch.rpm
lpfc_2.6_driver_kit-8.0.16.6_x2-1/lpfcdriver_2.6-8.0.16.6_x2-1.noarch.rpm
lpfc_2.6_driver_kit-8.0.16.6_x2-1/lpfc-install
lpfc_2.6_driver_kit-8.0.16.6_x2-1/README
lpfc_2.6_driver_kit-8.0.16.6_x2-1/elxlpfc
```

Contained within the newly created directory is the `lpfc-install` script. This script may be used to uninstall the existing v2.10f driver and will install both the lpfc and the lpfcdfc drivers.

4. Stop all applications using the Emulex driver and unload the currently running Emulex v2.10f driver in the system as follows:

```
modprobe -r lpfcdd
```

5. Uninstall the Emulex v2.10f driver by executing the `lpfc-install` script with the –u flag:

```
cd lpfc_2.6_driver_kit-8.0.16.6_x2-1/
./lpfc-install -u
```

```
The output from the running the script is as follows:
Emulex LPFC Driver Installer Version 1.30.1.2
Determining distribution type and kernel version ...
Checking for Emulex driver packages ...
Restoring old Emulex drivers...
Configuring /etc/modprobe.conf ...
Configuring /etc/sysconfig/kernel ...
Uninstallation complete.
```

6. The installer script will install both the `lpfc` and the `lpfcdfc` drivers. No options are needed when executing this script. The installer script unpacks the source RPMs included in the package in the `/usr/src/lpfc` directory and builds the driver using the sources for the currently running kernel. The script then modifies `/etc/modprobe.conf` and `/etc/sysconfig/kernel` to include changes for the v8.x driver. The `elxlpfc` is an initialization script for the Application Helper Module (lpfcdfc driver). The `elxlpfc` script is also installed so that the lpfcdfc driver is configured to start and stop during system boot up and shutdown. Finally, the installer script creates a backup of the existing RAM disk and creates a new RAM disk.

The output from running the installer script is as follows:

```
./lpfc-install
Emulex LPFC Driver Installer Version 1.30.1.2
Determining distribution type and kernel version ...
Checking for old Emulex driver ...
Looking for kernel source package ...
Looking for compilers ...
Searching for LPFC Driver source RPM from
/home/emulex/lpfc_2.6_driver_kit-8.0.16.6_x2-1/. ...
Installing package ...
Preparing...                ########################################### [100%]
   1:lpfcdriver_2.6          ########################################### [100%]
Building lpfc driver ...........
Loading LPFC Driver .....................
Searching for LPFC DFC Driver source RPM from
/home/emulex/lpfc_2.6_driver_kit-8.0.16.6_x2-1/. ...
Installing package ...
Preparing...                ########################################### [100%]
   1:lpfc_2.6_ioctl_module  ########################################### [100%]
Building lpfcdfc driver ...........
Loading LPFC DFC Driver ..
Installing Emulex DFC driver startup script ...
elxlpfc                   0:off  1:off  2:on   3:on   4:on   5:on   6:off
Package installation complete
Configuring ramdisk...
Configuring /etc/modprobe.conf ...
Original saved as /etc/modprobe.elx
Configuring /etc/sysconfig/kernel ...
Original saved as /etc/sysconfig/kernel.elx
Creating ramdisk ......

1 message generated during installation:

o The ramdisk for this kernel has been updated.
Please reboot this system to complete the installation
of the Emulex LPFC driver kit.
```

Note: The system must be rebooted so that the lpfc driver is loaded through the newly created ramdisk.

Installing the Emulex v8.x-series driver on RHEL 4 hosts

By default, the Emulex v8.0.16 driver is integrated into the RHEL 4 kernel. EMC requires the use of the v8.0.16.6_x2 driver when connecting to EMC storage.

Before installing the v8.0.16.6_x2 driver, the existing v8.0.16 driver must be uninstalled. The Emulex v8.0.16.6_x2 driver will then be

compiled as a module and configured to load automatically on boot up. Also, a new RAM disk will be created for the system that includes the new driver in it.

This section describes the previously mentioned process using the installer script included in the package.

1. Boot into the qualified and supported kernel onto which the driver will be installed.
2. Obtain the `lpfc_2.6_driver_kit-8.0.16.6_x2-1.tar.gz` from the Emulex website as instructed under the "Downloading the Emulex v8.x-series adapter driver for the v2.6.x kernel" on page 45 section.
3. Uncompress and extract the source files from the tar archive:

   ```
   cd /home/emulex
   tar xzvf lpfc_2.6_driver_kit-8.0.16.6_x2-1.tar.gz
   ```

   The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
lpfc_2.6_driver_kit-8.0.16.6_x2-1/
lpfc_2.6_driver_kit-8.0.16.6_x2-1/lpfc_2.6_ioctl_module-2.0.2-1.noarch.rpm
lpfc_2.6_driver_kit-8.0.16.6_x2-1/lpfcdriver_2.6-8.0.16.6_x2-1.noarch.rpm
lpfc_2.6_driver_kit-8.0.16.6_x2-1/lpfc-install
lpfc_2.6_driver_kit-8.0.16.6_x2-1/README
lpfc_2.6_driver_kit-8.0.16.6_x2-1/elxlpfc
```

   Contained within the newly created directory is the `lpfc-install` script. This script may be used to uninstall the existing v8.0.16 driver and will install both the lpfc and the lpfcdfc drivers

4. Stop all applications using the Emulex driver and then unload the currently running Emulex v8.0.16 driver in the system as follows:

   ```
   modprobe -r lpfc
   ```

5. Uninstall the Emulex v8.0.16 driver by executing the `lpfc-install` script with the –u flag as follows:

   ```
   cd lpfc_2.6_driver_kit-8.0.16.6_x2-1/
   ./lpfc-install -u
   ```

   The output from the running the script is as follows:

   ```
   Emulex LPFC Driver Installer Version 1.30.1.2
   Determining distribution type and kernel version ...
   Checking for Emulex driver packages ...
   ```

```
Restoring old Emulex drivers...
Configuring /etc/modprobe.conf ...
Uninstallation complete.
```

6. The installer script will install both the `lpfc` and the `lpfcdfc` drivers. No options are needed when executing this script. The installer script unpacks the source RPMs included in the package in the `/usr/src/lpfc` directory and builds the driver using the sources for the currently running kernel. The script then modifies `/etc/modprobe.conf` to include `scsi_host_adapter` lines. The `elxlpfc` is an initialization script for the lpfcdfc driver. The `elxlpfc` script is also installed so that the `lpfcdfc` driver is configured to start and stop during system boot up and shutdown. Finally, the installer script creates a backup of the existing RAM disk and creates a new RAM disk.

   The output from running the installer script is as follows:

   `./lpfc-install`

```
Emulex LPFC Driver Installer Version 1.30.1.2
Determining distribution type and kernel version ...
Checking for old Emulex driver ...
Looking for kernel development package ...
Looking for compilers ...
Searching for LPFC Driver source RPM from
/home/emulex/lpfc_2.6_driver_kit-8.0.16.6_x2-1/. ...
Installing package ...
Preparing...
########################################### [100%]
   1:lpfcdriver_2.6
########################################### [100%]
Building lpfc driver .....
Loading LPFC Driver ........
Searching for LPFC DFC Driver source RPM from
/home/emulex/lpfc_2.6_driver_kit-8.0.16.6_x2-1/. ...
Installing package ...
Preparing...
########################################### [100%]
   1:lpfc_2.6_ioctl_module
########################################### [100%]
Building lpfcdfc driver .....
Loading LPFC DFC Driver ..
Installing Emulex DFC driver startup script ...
Package installation complete
Configuring ramdisk...
Configuring /etc/modprobe.conf ...
Original saved as /etc/modprobe.elx
```

```
Original ramdisk image
/boot/initrd-2.6.9-5.0.3.ELsmp.img saved as
/boot/initrd-2.6.9-5.0.3.ELsmp.img.elx
Creating ramdisk ...

1 message generated during installation:

o The ramdisk for this kernel has been updated.

Please reboot this system to complete the installation
of the Emulex LPFC driver kit.
```

Note: The system must be rebooted so that the `lpfc` driver is loaded through the newly created ramdisk.

Caveat

If the lpfcdfc driver is loaded, then it must be unloaded prior to the lpfc driver.

Use the following commands to unload the Emulex drivers:

```
modprobe -r lpfcdfc
modprobe -r lpfc
```

Included Emulex driver on RHEL 4, RHEL 5, OEL 4, OEL 5, Asianux 2.0, Asianux 3.0, SLES 9, SLES 10, and SLES 11

Table 5 lists the Emulex driver versions supported with the corresponding OS updates. These driver versions are included by default in the kernel and do not require any installation.

Table 5 Supported Emulex driver versions (page 1 of 4)

OS	Driver version	Supported adapters			
		1/2 Gb	4 Gb	8 Gb	CNA
Red Hat RHEL 4 U1 Asianux 2.0 Miracle Linux SE 4.0 RedFlag DC Server 5.0 Haansoft Linux 2006 Server	8.0.16.6_x2	√			
SuSe SLES 9 SP2	8.0.16.6_p3	√	√		

Table 5 Supported Emulex driver versions (page 2 of 4)

OS	Driver version	Supported adapters			
		1/2 Gb	4 Gb	8 Gb	CNA
Red Hat RHEL 4 U2 SuSe SLES 9 SP3	8.0.16.17	√	√		
Red Hat RHEL 4 U3 Asianux 2.0 SP1	8.0.16.18	√	√		
Red Hat RHEL 4 U4, RHEL 4.5, Oracle OEL 4 U4, OEL 4.5 Asianux 2.0 SP2	8.0.16.27	√	√		
Red Hat RHEL 4.6 SuSE SLES 9 SP4 Oracle OEL 4.6	8.0.16.34	√	√		
Red Hat RHEL 4.7 Oracle OEL 4.7 Asianux 2.0 SP3 SLES 9 SP4 (errata kernels equal to or greater than 2.6.5-7.316)	8.0.16.40	√	√	√	
Red Hat RHEL 4.8 Oracle OEL 4.8	8.0.16.46	√	√	√	√ [a]
Red Hat RHEL 4.9	8.0.16.47	√	√	√	√ [a]
SuSe SLES 10 GA	8.1.6	√	√		
Red Hat RHEL 5.0 Oracle OEL 5.0 Asianux 3.0 SuSE SLES 10 SP1 (errata kernels 2.6.16.46-0.12, 2.6.16.46-0.14)	8.1.10.3	√	√		
Red Hat RHEL 5.1 Oracle OEL 5.1 SuSE SLES 10 SP1 (errata kernels 2.6.16.53-0.8, 2.6.16.53-0.16)	8.1.10.9	√	√		

Table 5 Supported Emulex driver versions (page 3 of 4)

OS	Driver version	Supported adapters			
		1/2 Gb	4 Gb	8 Gb	CNA
SuSE SLES 10 SP1 (errata kernels equal to or greater than 2.6.16.54-0.2.3)	8.1.10.12-update	√	√		
Red Hat RHEL 5.2 SuSE SLES 10 SP2 Oracle OEL 5.2 Asianux 3.0 SP1	8.2.0.22	√	√	√	
RedHat RHEL 5.4 SuSE SLES 10 SP3	8.2.0.48.2p	√	√	√	√ a
RHEL 5.3 OEL 5.3	8.2.0.33.3p	√	√	√	√ a
RHEL 5.4 OEL 5.4	8.2.0.48.2p 8.2.0.48.3p (errata kernels 2.6.18-164.11.1.0.1.el5 and higher)	√	√	√	√ a
RHEL 5.5 OEL 5.5	8.2.0.63.3p	√	√	√	√ b
RHEL 5.6	8.2.0.87.1p	√	√	√	√ b
RHEL 5.7	8.2.0.96.2p	√	√	√	√ b
RHEL 5.8	8.2.0.108.4p	√	√	√	√ b
RHEL 6.0	8.3.5.17	√	√	√	√ b
SLES 10 SP4	8.2.0.92.1p	√	√	√	√
SuSE SLES 11 GA	8.2.8.14	√	√	√	√ a

Table 5 Supported Emulex driver versions (page 4 of 4)

OS	Driver version	Supported adapters			
		1/2 Gb	4 Gb	8 Gb	CNA
SuSE SLES 11 SP1	8.3.5.8.1p	√	√	√	√ [b]
SuSE SLES 11 SP2	8.3.5.48.2p	√	√	√	√ [b]
RHEL 6.1	8.3.5.30.1p	√	√	√	√
RHEL 6.2	8.3.5.45.4p	√	√	√	√

a. For models LP21000/LP21002 CNAs only.

b. For models LP21000/LP21002 and models OCe10102-FM-E/OCe10102-FX CNAs.

Note: Support of 8 Gb FC adapters begins with drivers 8.0.16.40 and 8.2.0.22. Please consult the *EMC Support Matrix* for supported configurations.

Table 6 Supported FC and FCoE out-of-kernel driver versions

OS	Driver version	Supported adapters			
		1/2 Gb	4 Gb	8 Gb	CNA
Red Hat RHEL 4.0	8.0.16.6_x2-2	√			
SUSE SLES 9 SP1	8.0.16.6_x2-2	√			
Red Hat RHEL 5.4	FCoE driver 8.2.0.71				√ [a]
SUSE SLES 10 SP3	FCoE driver 8.2.0.71				√ [a]
SUSE SLES 11	FCoE driver 8.2.8.40				√ [a]

a. For models OCe10102-FM-E/OCe10102-FX-E only.

Uninstalling the Emulex v8.x-series driver

This section guides you through the process of uninstalling the Emulex v8.x-series driver. The installer script contained within the tar archive may be used to remove the Emulex driver from both SLES 9 SP1 and RHEL 4 hosts. The installer script will restore the old Emulex driver.

1. Stop all applications using the Emulex 8.x-series driver and unload the lpfcdfc and the lpfc driver modules from the kernel.

   ```
   modprobe -r lpfcdfc
   modprobe -r lpfc
   ```

2. The uninstallation of the driver may be performed using the `lpfc-install` script with the `-u` switch:

   ```
   ./lpfc-install -u

   Emulex LPFC Driver Installer Version 1.30.1.2
   Determining distribution type and kernel version ...
   Checking for Emulex driver packages ...
   Removing LPFC DFC Driver source RPM ...
   Removing LPFC Driver source RPM ...
   Removing Emulex DFC driver startup script ...
   Restoring old Emulex drivers...
   Configuring /etc/modprobe.conf ...
   Original saved as /etc/modprobe.elx
   Original ramdisk image
   /boot/initrd-2.6.9-5.0.3.ELsmp.img saved as
   /boot/initrd-2.6.9-5.0.3.ELsmp.img.elx
   Creating ramdisk ...
   The ramdisk for this kernel has been updated.
   Uninstallation complete
   ```

3. Reboot the host.

Exercising the Emulex v8.x-series device driver

This section describes the following functionality available with the Emulex v8.x-Series driver:

- "Loading and unloading the Emulex v8.x-series driver", next
- "Target information exported to the /proc filesystem" on page 58
- "Dynamically modifying the driver and device information exported to the /sys filesystem" on page 58

Loading and unloading the Emulex v8.x-series driver

The preceding sections described the process of installing the Emulex driver, the supported Application Helper Module (lpfcdfc driver), and the Emulex Application Kit. The Emulex Application Kit and the Application Helper Module (lpfcdfc driver) utilize the base Emulex driver functionality. Hence, prior to unloading the Emulex driver, it is necessary to stop the application kit and to unload the Application Helper Module (lpfcdfc driver). Also, stop other applications that maybe using the Emulex driver to access the devices and unmount any mounted devices.

- Run the following commands to stop the Emulex application daemons:

```
cd /usr/sbin/hbanyware
./stop-hbanyware
```

- Run the following command to remove the Emulex Application Helper Module (lpfcdfc driver):

```
/etc/init.d/elxlpfc stop
```

- Finally, unload the Emulex driver:

```
modprobe -r lpfc
```

To reload the Emulex driver, the Application Helper Module (lpfcdfc driver), and the Application Kit use the following steps.

- Load the Emulex driver:

```
modprobe lpfc lpfc_log_verbose=0x10
```

- Reload the Emulex Application Helper Module (lpfcdfc driver):

```
/etc/init.d/elxlpfc start
```

- Start the Emulex Application daemons:

```
cd /usr/sbin/hbanyware
./start_elxdiscovery
./start_myserver
```

Note: While loading the Emulex driver using `modprobe`, it is possible to specify driver parameters. However, any parameters set in the `/etc/modprobe.conf` or `/etc/modprobe.conf.local` files will override the values specified on the command line.

Target information exported to the /proc filesystem

The Emulex driver populates the `/proc/lpfc/<host_adapter_number>` file with the WWPN and the WWNN of all targets for each adapter in the system. The `<host_adapter_number>` increments every time the driver is unloaded and reloaded.

For example:

```
cat /proc/scsi/lpfc/1
lpfc1t00 DID 491b00 WWPN 50:06:01:60:10:60:12:70 WWNN 50:06:01:60:90:60:12:70
lpfc1t01 DID 481b00 WWPN 50:06:01:68:10:60:12:70 WWNN 50:06:01:60:90:60:12:70
```

Dynamically modifying the driver and device information exported to the /sys filesystem

The Emulex driver exports the driver versions, parameters, and device information in `/sys/class/scsi_host/` directory. A new directory is dynamically created for each Emulex `scsi_host_adapter` in the system. Similar to the incrementing of the `<host_adapter_number>` in the `/proc` filesystem, the directory number will be incremented every time the driver is unloaded and reloaded.

The following is a listing of the directory contents:

```
cd /sys/class/scsi_host/host1
ls
.             events                lpfc_lun_queue_depth  outfcpio
..            fabric_name           lpfc_max_luns         port_name
board_online  fwrev                  lpfc_nodev_tmo        port_type
cmd_per_lun   hdw                    lpfc_scan_down        portfcid
ctlreg        host_busy              lpfc_topology         portnum
device        info                   lpfc_use_adisc        proc_name
```

```
disc_adisc     issue_lip              management_version    programtype
disc_map       lpfc_ack0              mbox                  scan
disc_npr       lpfc_drvr_version      modeldesc             serialnum
disc_plogi     lpfc_fcp_bind_method   modelname             sg_tablesize
disc_prli      lpfc_fcp_class         node_name             speed
disc_reglgn    lpfc_fdmi_on           nport_evt_cnt         state
disc_unmap     lpfc_link_speed        num_discovered_ports  unchecked_isa_dma
disc_unused    lpfc_log_verbose       option_rom_version    unique_id
```

This directory contains information regarding the driver and the various driver parameters available for manipulation. EMC recommends that the hbacmd utility be used to query and modify these values. The hbacmd utility is installed with the Emulex application kit and is available in the `/usr/sbin/hbanyware` directory. The hbacmd utility requires that both the Emulex driver and the Application Helper Module (lpfcdfc driver) be loaded.

The following is an example session of using the `hbacmd` utility.

For more information on how to use hbacmd, execute the command without any options.

```
host:/usr/sbin/hbanyware # ./hbacmd listhbas

Manageable HBA List

Port WWN    : 10:00:00:00:c9:3d:e3:3a
Node WWN    : 20:00:00:00:c9:3d:e3:3a
Fabric Name: 10:00:08:00:88:20:10:e9
Flags       : 8000fa0d
Host Name   : host
Mfg         : Emulex Corporation

Port WWN    : 10:00:00:00:c9:3d:e3:3b
Node WWN    : 20:00:00:00:c9:3d:e3:3b
Fabric Name: 10:00:08:00:88:60:d0:6b
Flags       : 8000fa0d
Host Name   : host
Mfg         : Emulex Corporation

host:/usr/sbin/hbanyware # ./hbacmd HBAAttrib  10:00:00:00:c9:3d:e3:3a

HBA Attributes for 10:00:00:00:c9:3d:e3:3a

Host Name       : host
Manufacturer    : Emulex Corporation
Serial Number   : MM42301231
Model           : LP10000
Model Desc      : Emulex LightPulse LP10000 2 Gigabit PCI Fibre Channel Adapter
Node WWN        : 20 00 00 00 c9 3d e3 3a
Node Symname    : Emulex LP10000 FV1.90A4 DV8.0.16.6_x2V8.0.16.6_x2
```

```
HW Version     : 1001206d
Opt ROM Version:
FW Version     : 1.90A4 (T2D1.90A4)
Vender Spec ID : 10DF
Number of Ports: 1
Driver Name    : lpfc
Device ID      : FA00
HBA Type       : LP10000DC
Operational FW : SLI-2 Overlay
SLI1 FW        : SLI-1 Overlay 1.90a4
SLI2 FW        : SLI-2 Overlay 1.90a4
IEEE Address   : 00 00 c9 3d e3 3a
Boot BIOS      : Disabled
Driver Version : 8.0.16.6; HBAAPI(I) v2.1.a, 11-04-04
```

host:/usr/sbin/hbanyware # ./hbacmd portstat 10:00:00:00:c9:3d:e3:3b

```
Port Statistics for 10:00:00:00:c9:3d:e3:3b

Secs Since Last Reset   :  121
Exchange Count          :  24
Responder Exchange Count:  0
TX Seq Count            :  52
RX Seq Count            :  52
TX Frame Count          :  52
RX Frame Count          :  52
TX Word Count           :  10496
RX Word Count           :  10496
TX KB Count             :  41
RX KB Count             :  41
LIP Count               :  -1
NOS Count               :  0
Error Frame Count       :  0
Dumped Frame Count      :  -1
Link Failure Count      :  0
Loss of Sync Count      :  7
Loss of Signal Count    :  0
Prim Seq Prot Err Count :  0
Invalid TX Word Count   :  8
Invalid RX Frame CRC Cnt:  0
```

host:/usr/sbin/hbanyware # ./hbacmd serverAttrib 10:00:00:00:c9:3d:e3:3b

```
Server Attributes for 10:00:00:00:c9:3d:e3:3b

Host Name       : host
FW Resource Path: /usr/sbin/hbanyware/RMRepository/
DR Resource Path: /usr/sbin/hbanyware/RMRepository/
HBAnyware Server Version: 2.1a8
```

```
host:/usr/sbin/hbanyware # ./hbacmd allnodeinfo 10:00:00:00:c9:3d:e3:3a

All Node Info for 10:00:00:00:c9:3d:e3:3a



Node Type      : READY
FCP ID         : 744E13
SCSI Bus Number: 0
SCSI Target Num: 0
Node WWN       : 50:06:04:8A:CB:37:C6:63
Port WWN       : 50:06:04:8A:CB:37:C6:63
OS Device Name : /sys/class/scsi_host/host0/00,0

host:/usr/sbin/hbanyware # ./hbacmd driverparams 10:00:00:00:c9:3d:e3:3a

Driver Params for 10:00:00:00:c9:3d:e3:3a
DX                    string      Low     High      Def      Cur  Exp  Dyn
00:               log-verbose        0     ffff        0        0    1    1
01:           lun-queue-depth        1       80       1e       1e    1    4
02:                 scan-down        0        1        1        1    1    4
03:                 nodev-tmo        0       ff       1e       1e    1    1
04:                  topology        0        6        0        2    1    4
05:                link-speed        0        2        0        2    1    4
06:                 fcp-class        2        3        3        3    1    4
07:                 use-adisc        0        1        0        0    1    1
08:                      ack0        0        1        0        0    1    4
09:           fcp-bind-method        1        4        2        2    1    4
0a:                 cr-delay        0       3f        0        0    1    4
0b:                 cr-count        1       ff        1        1    1    4
0c:                  fdmi-on        0        2        0        0    1    4
0d:        discovery-threads        1       40        1       20    1    4
0e:                 max-luns        1     8000      100      100    1    4
0f:              scsi-req-tmo        0       ff       1e       1e    1    1

host:/usr/sbin/hbanyware # ./hbacmd setdriverparam  10:00:00:00:c9:3d:e3:3a N
nodev-tmo 20

Set Driver Parameter nodev-tmo=20 (N) for 10:00:00:00:c9:3d:e3:3a

host:/usr/sbin/hbanyware # ./hbacmd setdriverparam  10:00:00:00:c9:3d:e3:3a N
log-verbose 20


Set Driver Parameter log-verbose=20 (N) for 10:00:00:00:c9:3d:e3:3a

host:/usr/sbin/hbanyware # ./hbacmd driverparams 10:00:00:00:c9:3d:e3:3a

Driver Params for 10:00:00:00:c9:3d:e3:3a
DX                    string      Low     High      Def      Cur  Exp  Dyn
00:               log-verbose        0     ffff        0       14    1    1
```

```
01:           lun-queue-depth        1       80       1e       1e    1    4
02:                 scan-down        0        1        1        1    1    4
03:                 nodev-tmo        0       ff       1e       14    1    1
04:                  topology        0        6        0        2    1    4
05:                link-speed        0        2        0        2    1    4
06:                 fcp-class        2        3        3        3    1    4
07:                 use-adisc        0        1        0        0    1    1
08:                      ack0        0        1        0        0    1    4
09:          fcp-bind-method        1        4        2        2    1    4
0a:                  cr-delay        0       3f        0        0    1    4
0b:                  cr-count        1       ff        1        1    1    4
0c:                   fdmi-on        0        2        0        0    1    4
0d:        discovery-threads        1       40        1       20    1    4
0e:                 max-luns        1     8000      100      100    1    4
0f:             scsi-req-tmo        0       ff       1e       1e    1    1
```

```
host:/usr/sbin/hbanyware # ./hbacmd portAttrib  10:00:00:00:c9:3d:e3:3b

Port Attributes for 10:00:00:00:c9:3d:e3:3b

Node WWN             : 20 00 00 00 c9 3d e3 3b
Port WWN             : 10 00 00 00 c9 3d e3 3b
Port Symname         :
Port FCID            : 611413
Port Type            : Fabric
Port State           : Operational
Port Service Type    : 12
Port Supported FC4   : 00 00 01 20 00 00 00 01
                       00 00 00 00 00 00 00 00
                       00 00 00 00 00 00 00 00
                       00 00 00 00 00 00 00 00
Port Active FC4      : 00 00 01 00 00 00 00 01
                       00 00 00 00 00 00 00 00
                       00 00 00 00 00 00 00 00
                       00 00 00 00 00 00 00 00
Port Supported Speed: 2 GBit/sec.
Port Speed           : 2 GBit/sec.
Max Frame Size       : 2048
OS Device Name       : /sys/class/scsi_host/host0/1
Num Discovered Ports: 2
Fabric Name          : 10 00 08 00 88 60 d0 6b
```

Installation instructions for the Emulex v7.x-Series driver

Using the Emulex adapter with the Linux operating system requires HBA driver software. The driver functions at a layer below the Linux SCSI driver to present fibre Channel devices to the operating system as if they were standard SCSI devices.

Refer to the latest *EMC Support Matrix* for specific qualified kernel versions and distributions.

Please note that the support stated in the *EMC Support Matrix* supersedes versions listed in this document.

Enabling the Emulex v7.x-Series driver in RHEL 3.0 U4 and U5

EMC supports the Emulex v7.1.14 driver included in RHEL 3.0 U4 and U5 distributions. In the RHEL 3.0 kernel v2.4.21-27.EL and later, the Emulex v7.1.14 driver is the default driver integrated into the kernel.

To enable the `lpfcdfc` driver in RHEL 3.0 U4, please refer to "Installing the IOCTL Application Helper Module on RHEL 3.0 U4" on page 65. By default, RHEL 3.0 U5 includes the `lpfcdfc` IOCTL Application Helper Module so no steps need to be taken in order to enable it.

The following procedure provides instructions for enabling the integrated v7.1.14 driver.

1. Ensure that the `/etc/modules.conf` file references an entry for each installed Emulex HBA.

   For each installed Emulex HBA, add an entry:

   `alias scsi_hostadapter`*`N`* `lpfc`

   where *`N`* is the sequential value of each Emulex HBA installed in the system, beginning with the number after the last host adapter number entry in the file. (The first host adapter entry begins with zero.)

   Example:

```
alias parport_lowlevel partport_pc
alias scsi_hostadapter mptbase
alias scsi_hostadapter1 mptscsi
alias scsi_hostadapter2 lpfc
alias scsi_hostadapter3 lpfc
```

```
alias eth0 tg3
options scsi_mod max_scsi_luns=255 scsi_allow_ghost_devices=1
```

2. If any modifications are made to the `/etc/modules.conf` file to include references to the Emulex HBAs, create a new ramdisk to reflect the changes made:

   `cd /boot`
   `mkinitrd -v initrd-`*`$1`*`.img` *`$1`*

   where *`$1`* is the currently running v2.4.x kernel version.

   Example:

   ```
   cd /boot
   cp initrd-2.4.21-27.ELsmp.img
   initrd-2.4.21-27.ELsmp.img.orig
   mkinitrd –v initrd-2.4.21-27.ELsmp.img 2.4.21-27.ELsmp
   ```

3. Reboot the host.

Note: When using RHEL 3.0 U4 and U5, it is required that parameter value modifications be made via an edit to `/etc/modules.conf`, not `lpfc.conf`.

Note: When attaching to a VNX series or CLARiiON storage system, the `lpfc_inq_pqb_filter` parameter must be enabled in the `/etc/modules.conf` file. Refer to "CLARiiON "Ghost" LUN reported with the Emulex v7.1.14 and v7.3.2 drivers (PQB filter)" on page 168.

Enabling the Emulex v7.x-Series driver in Asianux 1.0 U1

EMC supports the Emulex v7.1.14 driver integrated into the Asianux 1.0 U1 distribution. As with RHEL 3.0 U4, the Asianux 1.0 U1 kernel v2.4.21-20.19AX includes the Emulex v7.1.14 `lpfc` driver and the `lpfcdfc` IOCTL application helper driver by default in the kernel.

Follow the procedure used to enable the integrated v7.1.14 driver for RHEL 3.0 U4 for Asianux 1.0 U1 hosts. Refer to "Enabling the Emulex v7.x-Series driver in RHEL 3.0 U4 and U5" on page 63.

As with RHEL 3.0 U5, Asianux 1.0 U1 includes the `lpfcdfc` IOCTL Application Helper Module by default so no steps need to be taken in order to enable it.

Note: When attaching to a VNX series or CLARiiON storage array, the `lpfc_inq_pqb_filter` parameter must be enabled in the `/etc/modules.conf` file. Refer to "CLARiiON "Ghost" LUN reported with the Emulex v7.1.14 and v7.3.2 drivers (PQB filter)" on page 168.

Installing the IOCTL Application Helper Module on RHEL 3.0 U4

The Emulex IOCTL Application Helper Module allows Emulex applications to communicate with the driver itself. However, the IOCTL Application Helper Module is not included in the RHEL 3.0 U4 kernel. Therefore, if Emulex applications are to be used on the host, the IOCTL Application Helper Module must be downloaded and installed separately.

Follow these steps to install the IOCTL Application Helper Module on a RHEL 3.0 U4 host.

1. Verify that the correct version of the Emulex driver is loaded in the kernel. Run the lsmod command to ensure that the Emulex driver is loaded on the system.

   Example:

```
[root@l82bi250 /]# lsmod
Module                  Size  Used by    Not tainted
nfs                    97392   1  (autoclean)
lockd                  58256   1  (autoclean) [nfs]
sunrpc                 87804   1  (autoclean) [nfs lockd]
lpfc                  215568   0
ide-cd                 33728   0  (autoclean)
cdrom                  32064   0  (autoclean) [ide-cd]
lp                      8964   0  (autoclean)
parport                38560   0  (autoclean) [lp]
autofs4                16664   4  (autoclean)
audit                  90328   3
tg3                    64520   1
amd8111e               16144   1
mii                     4120   0  [amd8111e]
floppy                 56464   0  (autoclean)
sg                     36460   0  (autoclean)
keybdev                 2912   0  (unused)
mousedev                5528   1
hid                    21892   0  (unused)
input                   6048   0  [keybdev mousedev hid]
usb-ohci               21384   0  (unused)
usbcore                80352   1  [hid usb-ohci]
ext3                   88968   3
jbd                    54452   3  [ext3]
```

```
mptscsih               40944   4
mptbase                41888   3  [mptscsih]
diskdumplib             3808   0  [mptscsih mptbase]
sd_mod                 13744   8
scsi_mod              110312   4  [lpfc sg mptscsih sd_mod]
```

2. Review the files in `/proc/scsi/lpfc/` to verify the Emulex driver version.

   Example:

```
[root@l82bi250 /]# cat /proc/scsi/lpfc/*
Emulex LightPulse FC SCSI 7.1.14
Emulex LightPulse LP10000 2 Gigabit PCI Fibre Channel Adapter on PCI bus 09 device
08 irq 25
SerialNum: MM40706045
Firmware Version: 1.90A4 (T2D1.90A4)
Hdw: 1001206d
VendorId: 0xfa0010df
Portname: 10:00:00:00:c9:3d:30:a7   Nodename: 20:00:00:00:c9:3d:30:a7

Link Up - Ready:
   PortID 0x960c00
   Fabric
   Current speed 2G
lpfc0t00 DID 491200 WWPN 50:06:04:8a:cc:c8:31:7e WWNN 50:06:04:8a:cc:c8:31:7e
lpfc0t01 DID 481300 WWPN 50:06:04:8a:cc:c8:31:4f WWNN 50:06:04:8a:cc:c8:31:4f
Emulex LightPulse FC SCSI 7.1.14
Emulex LightPulse LP10000 2 Gigabit PCI Fibre Channel Adapter on PCI bus 09 device
10 irq 26
SerialNum: MM40706098
Firmware Version: 1.90A4 (T2D1.90A4)
Hdw: 1001206d
VendorId: 0xfa0010df
Portname: 10:00:00:00:c9:3d:30:6b   Nodename: 20:00:00:00:c9:3d:30:6b

Link Up - Ready:
   PortID 0x970c00
   Fabric
   Current speed 2G
lpfc1t00 DID 961b00 WWPN 50:06:04:8a:cc:c8:31:4e WWNN 50:06:04:8a:cc:c8:31:4e
lpfc1t01 DID 491400 WWPN 50:06:04:8a:cc:c8:31:7f WWNN 50:06:04:8a:cc:c8:31:7f
```

3. Change to the directory to which you will save the IOCTL Application Helper Module kit.

   Example:

```
[root@l82bi250 /]# mkdir /home/emulex
[root@l82bi250 /]# cd /home/emulex/
```

4. Download the IOCTL Application Helper Module from the Emulex website to a directory on the server. Refer to the instructions for downloading the driver as described in the "Downloading the Emulex v7.x-Series HBA driver for the v2.4.x kernel" on page 68. Select the link for the IOCTL Application Helper Module and download it to the system.

Note: The name of the package to be downloaded is `lpfc_2.4_ioctl_module_kit-1.0.13-1`

5. Uncompress and extract the source files from the tar archive:

```
[root@l82bi250 /]# cd /home/emulex/
[root@l82bi250 /]# tar zxvf lpfc_2.4_ioctl_module_kit-1.0.13-1.tar.gz
```

The uncompressing will create a new directory and will provide you with the following files within the new directory:

```
lpfc_2.4_ioctl_module_kit-1.0.13-1/
lpfc_2.4_ioctl_module_kit-1.0.13-1/elxlpfc
lpfc_2.4_ioctl_module_kit-1.0.13-1/ioctl-install
lpfc_2.4_ioctl_module_kit-1.0.13-1/lpfc_2.4_ioctl_module-1.0.13-1.noarch.rpm
lpfc_2.4_ioctl_module_kit-1.0.13-1/README
```

6. Change to the directory and install the IOCTL Application Helper Module using the installer script:

```
[root@l82bi250 /]# cd lpfc_2.4_ioctl_module_kit-1.0.13-1/
[root@l82bi250 /]# ./ioctl-install
```

7. For additional information on installing the Applications Kit, refer to "Installing the Emulex HBAnywhere applications kit" on page 84.

Included Emulex driver in RHEL3.0 U6, RHEL3.0 U7, RHEL3.0 U8, and RHEL 3.9

The following driver versions are included by default in the kernel and do not require any installation:

OS	Driver version
RHEL3.0 U6	7.3.2[a]
RHEL3.0 U7	7.3.3[a]
RHEL3.0 U8 and RHEL3.9	7.3.6[a]

a. Minimum required driver versions to support 4 GB HBAs.

Installing the Emulex v7.x-Series driver

Installation methods for the Emulex v7.x-Series driver

The Emulex v7.x-series `lpfc` and `lpfcdfc` drivers can be installed onto a Linux host using one of the two methods listed below.

- **Method one –** Run the installer script provided in the driver tar archive to compile and install the modular `lpfc` and `lpfcdfc` drivers on RHEL 2.1, RHEL 3.0, and SLES 8 systems.
- **Method two –** Use the DKMS RPM to compile and install the modular `lpfc` and `lpfcdfc` drivers on RHEL 2.1 and RHEL 3.0 sytems. By using the DKMS RPM, the necessary files will be edited and the drivers will be compiled and installed automatically.

Downloading the Emulex v7.x-Series HBA driver for the v2.4.x kernel

Ensure that you have the latest qualified driver. Refer to the *EMC Support Matrix* for the latest driver revision.

Follow these steps to download the Emulex driver from the Emulex website:

1. Change to the directory to which you will save the driver.

   For example:

   ```
   mkdir /home/emulex
   cd /home/emulex
   ```

2. Use a web browser to access the Emulex website at the following url:

   ```
   http://www.emulex.com
   ```

3. Select the link option **Drivers, Software, and Manuals**.
4. On the next page, select the **EMC** link from the **Select vendor** pull-down menu in the **HBAs installed in OEM equipment** section.
5. On the next page, select the link for the appropriate Emulex HBA in your system.
6. Find the listing for the Linux v7.x-series driver. There are two distinct tar archives for all of the Linux distributions supported:

   ```
   lpfc_2.4_dkms_kit-7.1.14-2.tar.gz
   lpfc_2.4_driver_kit-7.1.14-4.tar.gz
   ```

7. Select the appropriate link to download the desired tar archive for your distribution.
8. In addition to the actual driver installation tar archive, the IOCTL Application Helper Module and Emulex Applications Kit tar archives may also be downloaded. The file names for the kits are as follows:

```
lpfc_2.4_ioctl_module_kit-1.0.13-1.tar.gz
elxlinuxapps-2.1a24-7.3.2-1-2.tar
```

What next? Select a method to install the driver on a Linux host:

- Proceed to *"Installing the Emulex v7.x-Series driver, Method one"*, next, if you have selected the standard tar archive driver kit (`lpfc_2.4_driver_kit-7.1.14-4.tar.gz`).
- Proceed to *"Installing the Emulex v7.x Series driver, Method two" on page 72*, if you have selected the DKMS RPM tar archive (`lpfc_2.4_dkms_kit-7.1.14-2.tar.gz`).

Installing the Emulex v7.x-Series driver, Method one

This section guides you through the process of installing and utilizing the Emulex tar archive. The installer script contained within the tar archive will create the Emulex v7.x-series driver for RHEL 2.1, and RHEL 3.0, and SLES 8 distributions.

Note: Refer to the *EMC Support Matrix* for the specific kernel revisions qualified and supported.

1. Boot into the qualified and supported kernel onto which the driver will be installed.
2. Create a directory to which you will save the tar archive

```
mkdir /home/emulex
```

3. Obtain the `lpfc_2.4_driver_kit-7.1.14-4.tgz` from the Emulex website as instructed under "Downloading the Emulex v7.x-Series HBA driver for the v2.4.x kernel" on page 68.
4. Install the Emulex driver's tar archive onto your system with the following steps:

   a. Uncompress and extract the source files from the tar archive:

```
cd /home/emulex
tar zxvf lpfc_2.4_driver_kit-7.1.14-4.tgz
```

The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
lpfc_2.4_driver_kit-7.1.14-4/
lpfc_2.4_driver_kit-7.1.14-4/elxlpfc
lpfc_2.4_driver_kit-7.1.14-4/lpfcdfcdriver-1.0.13-1.noarch.rpm
lpfc_2.4_driver_kit-7.1.14-4/lpfc-install
lpfc_2.4_driver_kit-7.1.14-4/README
```

Contained within the newly created directory is the `lpfc-install` script. This script will install both the `lpfc` and the `lpfcdfc` drivers. These driver RPMs are installed in the `/usr/src/lpfc` directory. No options are needed when executing this script.

After the RPMs are installed into the `/usr/src/lpfc` directory, the RPMs then are executed so that the drivers will be built and installed into the currently running kernel. The script then modifies `/etc/modules.conf`. The lpfc driver host adapter line will be appended to the `/etc/modules.conf` file for each instance of an Emulex HBA.

The options line containing the addition of the `scsi_allow_ghost_devices` and `max_scsi_luns` parameters will also be appended to the file. This will allow the host to correctly identify the disconnected LUN 0 that is reported when attached to a VNX series or CLARiiON storage system, as well as allow the SCSI stack to scan up to 255 devices. The Unisphere™ / Navisphere® Host Agent requires that the disconnected LUN 0 be reported.

After modifying the `/etc/modules.conf` file, the last action performed by the installer is to create a new ramdisk.

The `elxlpfc` is an initialization script for the lpfcdfc driver. The elxlpfc script is also installed so that the `lpfcdfc` driver is configured to start and stop during system boot up and shutdown.

5. Install the Emulex driver.

```
cd /home/emulex/lpfc_2.4_driver_kit-7.1.14-4
./lpfc_install
```

The output from running the installer script is as follows:

```
Emulex LPFC Driver Installer Version 1.4.1.10
Determining distribution type and kernel version ...
Checking for old Emulex driver ...
```

```
Looking for kernel source ...
Looking for compilers ...
Searching for LPFC Driver source RPM from
/home/emulex/lpfc_2.4_driver_kit-7.1.14-4/. ...
Installing package ...
Preparing...                ########################################### [100%]
   1:lpfcdriver             ########################################### [100%]
***************
* Source Files are now available under /usr/src/lpfc
* RPM installer will now attempt to :
* Step 1: Install lpfc.conf file in /etc [ ln -s /usr/src/lpfc/lpfc.conf
/usr/src/lpfc/lpfc.conf ]
* Step 2: Build driver from sources and install under /lib/modules [ make -C
/usr/src/lpfc build install]
***************
* Action : Step 1: Installing lpfc.conf file ...
* Done   : Step 1: New lpfc.conf file has been installed in /etc
****************
* Action : Step 2: Building driver .........
* Done   : Step 2: The driver has been compiled and installed under /lib/modules
************************************************************
* The Emulex LPFC Driver has been installed on your system. *
************************************************************
Loading LPFC Driver ..........
Searching for LPFC DFC Driver source RPM from
/home/emulex/lpfc_2.4_driver_kit-7.1.14-4/. ...
Installing package ...
Preparing...                ########################################### [100%]
   1:lpfcdfcdriver          ########################################### [100%]
***************
* Source Files are now available under /usr/src/lpfc/ioctls
* RPM installer will now attempt to :
* Step 1: Build driver from sources and install under /lib/modules [ make -C
/usr/src/lpfc/ioctls build install]
***************
* Action : Step 1: Building driver ...
* Done   : Step 1: The driver has been compiled and installed under /lib/modules
************************************************************
* The Emulex DFC Driver has been installed on your system. *
************************************************************
Loading LPFC DFC Driver ..
Installing Emulex DFC driver startup script ...
Package installation complete
Configuring ramdisk...
Configuring /etc/modules.conf ...
Original saved as /etc/modules.elx
Original ramdisk image /boot/initrd-2.4.21-15.0.3.ELsmp.img saved as
/boot/initrd-2.4.21-15.0.3.ELsmp.img.elx
Creating ramdisk ..

1 message generated during installation:
```

```
o The ramdisk for this kernel has been updated.

Please reboot this system to complete the installation
of the Emulex LPFC driver kit.
```

An example of a newly modified `/etc/modules.conf` is shown below.

The last three lines of the file have been newly added by the installer script.

```
[root@l82bi250 /]# more /etc/modules.conf
alias eth0 tg3
alias eth1 tg3
alias eth2 tg3
alias scsi_hostadapter mptbase
alias scsi_hostadapter1 mptscsih
alias usb-controller usb-ohci
alias scsi_hostadapter2 lpfc
alias scsi_hostadapter3 lpfc
options scsi_mod max_scsi_luns=256 scsi_allow_ghost_devices=1
```

The `scsi_allow_ghost_devices` parameter is enabled by default in SLES 8 SP3. Therefore the installer script will not add the parameter to the `/etc/modules.conf` file for SLES 8 SP3 installations.

6. Reboot the host so that the lpfc driver can be loaded through the newly created ramdisk.

Installing the Emulex v7.x Series driver, Method two

This section guides you through the process of installing and utilizing the Emulex DKMS RPM for the Emulex v7.1.14 driver for RHEL 2.1 and 3.0 distributions.

Note: Please note that the DKMS RPM method does not function properly with SLES 8 distributions and may not be used.

The DKMS RPM will build and install the `lpfc` and `lpfcdfc` drivers and modify your `/etc/modules.conf` file.

The host adapter line will be appended to the `/etc/modules.conf` file for the `lpfc` driver.

The `options` line containing the addition of the `scsi_allow_ghost_devices` and `max_scsi_luns` parameters will also be appended to the file. This will allow the host to correctly identify the disconnected LUN 0 that is reported when attached to a

VNX series or CLARiiON storage system as well as allow the SCSI stack to scan up to 255 devices. The Unisphere / Navisphere Host Agent requires that the disconnected LUN 0 be reported.

The DKMS RPM will install the Emulex driver as a module.

Note: After the driver installation, the system should be rebooted so that the lpfc driver may be loaded through the newly created ramdisk.

1. Boot into the qualified and supported kernel into which the driver will be installed. Ensure that the kernel sources and the gcc compiler tools are installed.
2. Create a directory to which you will save the tar archive:

   `mkdir /home/emulex`

3. Obtain the `lpfc_2.4_dkms_kit-7.1.14-2.tar.gz` from the Emulex website as instructed under "Downloading the Emulex v7.x-Series HBA driver for the v2.4.x kernel" on page 68.

Install the Emulex driver's tar archive onto your system with the following steps:

1. Uncompress and extract the source files from the tar archive:

   ```
   cd /home/emulex
   tar zxvf lpfc_2.4_dkms_kit-7.1.14-2.tar.gz
   ```

   The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
lpfc_2.4_driver_kit-7.1.14-4/
lpfc_2.4_driver_kit-7.1.14-4/dkms-2.0.4-1.noarch.rpm
lpfc_2.4_driver_kit-7.1.14-4/lpfc_2.4_dkms_kit-7.1.14-2.tar.gz
lpfc_2.4_driver_kit-7.1.14-4/lpfc_2.4_driver_kit-7.1.14-4
lpfc_2.4_driver_kit-7.1.14-4/lpfc_2.4_driver_kit-7.1.14-4.tar.gz
lpfc_2.4_driver_kit-7.1.14-4/lpfcdfcdkms-1.0.13-2.noarch.rpm
lpfc_2.4_driver_kit-7.1.14-4/lpfcdkms-7.1.14-2.noarch.rpm
lpfc_2.4_driver_kit-7.1.14-4/README
```

2. If you do not already have DKMS installed on your system, then install the DKMS RPM contained within the newly created directory. If DKMS is already installed on the system, then skip to the next step to perform the Emulex driver installation.

   `rpm -ivh dkms-2.0.4-1.noarch.rpm`

The output from the installation of DKMS is as follows:

```
warning: dkms-2.0.4-1.noarch.rpm: V3 DSA signature: NOKEY, key ID 23b66a9d
Preparing...                ########################################### [100%]
   1:dkms                   ########################################### [100%]
```

3. Install the Emulex `lpfc` driver DKMS RPM:

   `rpm -ivh lpfcdkms-7.1.14-2.noarch.rpm`

   The output from the installation is as follows:

```
Preparing...                ########################################### [100%]
   1:lpfcdkms               ########################################### [100%]
***************
* Source Files are now available under /usr/src/lpfc-7.1.14
* RPM installer will now attempt to :
* Step 1: Install lpfc.conf file in /etc [ ln -s /usr/src/lpfc-7.1.14/lpfc.conf
/usr/src/lpfc/lpfc.conf ]
* Step 2: Build driver from sources and install under /lib/modules [ make -C
/usr/src/lpfc-7.1.14 build install]
***************
* Action : Step 1: Installing lpfc.conf file ...
* Done   : Step 1: New lpfc.conf file has been installed in /etc
****************
* Action : Step 2: Building driver .
Creating symlink /var/lib/dkms/lpfc/7.1.14/source ->
                 /usr/src/lpfc-7.1.14

DKMS: add Completed.

Preparing kernel 2.4.21-15.0.4.ELsmp for module build:
(This is not compiling a kernel, only just preparing kernel symbols)
Running Red Hat style preparation routine
make clean....
using
/lib/modules/2.4.21-15.0.4.ELsmp/build/configs/kernel-2.4.21-i686-smp.config
make oldconfig.....
running dkms_mkkerneldoth....

Building module:
cleaning build area....
make KERNELRELEASE=2.4.21-15.0.4.ELsmp
KERNELVERSION=2.4.21-15.0.4.ELsmp............
cleaning build area....
DKMS: build Completed.
Running module version sanity check.

lpfc.o:
- Original module
   - Found /lib/modules/2.4.21-15.0.4.ELsmp/kernel/drivers/addon/lpfc/lpfc.o
   - Storing in /var/lib/dkms/lpfc/original_module/2.4.21-15.0.4.ELsmp/i686/
   - Archiving for uninstallation purposes
```

```
 - Installation
   - Installing to /lib/modules/2.4.21-15.0.4.ELsmp/kernel/drivers/scsi/lpfc/

/etc/modules.conf: added alias reference for 'lpfc'
/etc/modules.conf: added 'options scsi_mod scsi_allow_ghost_devices=1
max_scsi_luns=255'
depmod....

Saving old initrd as /boot/initrd-2.4.21-15.0.4.ELsmp_old.img
Making new initrd as /boot/initrd-2.4.21-15.0.4.ELsmp.img
(If next boot fails, revert to the _old initrd image)
mkinitrd....

DKMS: install Completed.
* Done    : Step 2: The driver has been compiled and installed under /lib/modules
************************************************************
* The Emulex LPFC Driver has been installed on your system. *
************************************************************
```

An example of a newly modified `/etc/modules.conf` is shown below.

The last three lines of the file have been newly added by the installer script.

```
[root@l82bi250 /]# more /etc/modules.conf
alias eth0 tg3
alias eth1 tg3
alias eth2 tg3
alias scsi_hostadapter mptbase
alias scsi_hostadapter1 mptscsih
alias usb-controller usb-ohci
alias scsi_hostadapter2 lpfc
alias scsi_hostadapter3 lpfc
options scsi_mod max_scsi_luns=256 scsi_allow_ghost_devices=1
```

4. Install the Emulex DFC driver DKMS RPM:

   `rpm -ivh lpfcdfcdkms-1.0.13-2.noarch.rpm`

   The output is as follows:

```
[root@l82bi250 dkms]# rpm -ivh lpfcdfcdkms-1.0.13-2.noarch.rpm
Preparing...                ########################################### [100%]
   1:lpfcdfcdkms            ########################################### [100%]
***************
* Source Files are now available under /usr/src/lpfcdfc-1.0.13
* RPM installer will now attempt to :
* Step 1: Build ioctl module from sources and install under /lib/modules [ make
-C /usr/src/lpfcdfc-1.0.13 build install]
***************
* Action : Step 1: Building ioctl module .
```

```
Creating symlink /var/lib/dkms/lpfcdfc/1.0.13/source ->
                 /usr/src/lpfcdfc-1.0.13

DKMS: add Completed.

Preparing kernel 2.4.21-27.0.1.ELsmp for module build:
(This is not compiling a kernel, only just preparing kernel symbols)
Storing current .config to be restored when complete
Running Red Hat style preparation routine
make clean....
using
/lib/modules/2.4.21-27.0.1.ELsmp/build/configs/kernel-2.4.21-i686-smp.config
make oldconfig.....
running dkms_mkkerneldoth....

Building module:
cleaning build area....
make KERNELRELEASE=2.4.21-27.0.1.ELsmp INC_TOP=/usr/src/lpfc-7.1.14......
cleaning build area....

DKMS: build Completed.
Running module version sanity check.

lpfcdfc.o:
 - Original module
   - No original module exists within this kernel
 - Installation
   - Installing to /lib/modules/2.4.21-27.0.1.ELsmp/kernel/drivers/scsi/lpfc/

depmod....

DKMS: install Completed.
* Done   : Step 1: The ioctl module has been compiled and installed under
/lib/modules
************************************************************
* The Emulex DFC module has been installed on your system. *
************************************************************
```

5. Use the DKMS command to verify that the drivers have been built and installed successfully.

   For example:

```
[root@l82bi250 /]# dkms status
lpfc, 7.1.14, 2.4.21-27.0.1.ELsmp, i686: installed (original_module exists)
lpfcdfc, 1.0.13, 2.4.21-27.0.1.ELsmp, i686: installed
```

6. Reboot the host.

Caveat

If the `lpfcdfc` driver is loaded, then it must be unloaded prior to the `lpfc` driver.

Use the following to unload the lpfc driver:

```
modprobe -r lpfcdfc
modprobe -r lpfc
```

Installing the Emulex applications kit

The `lpfc` driver must be installed first because HBAnyware is dependent upon the existence of the `lpfc` driver.

1. Create a directory to which the application kit will be saved.

   ```
   mkdir /home/emulex_apps
   ```

2. Download the Applications Kit from the Emulex website and save it to the newly created directory. The name of the Application Kit is `elxlinuxapps-2.0a20-7.1.14-1.tar`.

3. Change to the newly created directory and uncompress and extract the source files from the tar archive:

   ```
   cd /home/emulex_apps
   tar xvf elxlinuxapps-2.0a20-7.1.14-1.tar
   ```

   The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
[root@l82bi250 /home/emulex_apps]# tar xvf elxlinuxapps-2.0a20-7.1.14-1.tar
enterprise_kitfiles/
install
uninstall
README.txt
README_SSC.txt
```

Contained within the existing directory is the `install` script.

Note: When the installation script is run, it will automatically install HBAnyware, the `lputil` utility, the HBAAPI libraries, and the `lpfcdfc` libraries and utility.

4. Within the newly created `enterprise_kitfiles/` directory are the applications to be installed.

```
[root@l82bi250 emulex_apps]# ls -la enterprise_kitfiles/
hbaapi_2.0.f.tgz
lputil_16a10.tgz
EmlxApps300a15.tgz
lpfcutil_2.4_lib_kit-1.0.13-1.tgz
scripts/
```

5. To install the application kit, change to the directory and run the installation script.

   cd /home/emulex_apps/enterprise_kitfiles
   ./install

   The output from running the installer script is as follows:

```
[root@l82bi250 emulex_apps]# ./install
Untarring EmlxApps tgz file...

Untarring lpfcutil tgz file...
Untarring hbaapi libs tgz file...
Untarring lputil tgz file...
Stopping HBAnyware Remote Management Server
Stopping HBAnyware Discovery Server
Starting HBAnyware Remote Management Server

Untarring HBAnyware local jre...

HBAnyware installation complete.

Cleaning up...
```

6. HBAnyware is a GUI-based application so the console may not be used. To start up the HBAnyware application, run the following commands:

   cd /usr/sbin/hbanyware
   ./hbanyware

Uninstallation of the Emulex v7.x-Series driver

This section describes how to successfully uninstall the Emulex v7.x-series driver from your Linux host.

Uninstallation methods for the Emulex v7.x-Series driver

The Emulex v7.x-series `lpfc` and `lpfcdfc` drivers can be uninstalled from a Linux host one of two methods:

- **Method one –** Using the installer script with the `–-uninstall` switch, remove the modular `lpfc` and `lpfcdfc` drivers.

  Note: See "Uninstalling the Emulex v7.x-Series driver, Method one," next.

- **Method two –** Use the DKMS RPM to uninstall the modular `lpfc` and `lpfcdfc` drivers on RHEL 2.1 and 3.0 systems.

  Note: See "Uninstalling the Emulex v7.x-Series driver, Method two" on page 81.

Uninstalling the Emulex v7.x-Series driver, Method one

This section guides you through the process of uninstalling and utilizing the Emulex tar archive. The installer script contained within the tar archive may be used to remove the Emulex driver as a module.

If you have used the tar archive method to install the Emulex driver, then the uninstallation of the driver may be performed using the `lpfc-install` script with the `–uninstall` switch.

1. Remove the Emulex tar archive driver:

   ```
   cd /home/emulex/lpfc_2.4_driver_kit-7.1.14-4
   ./lpfc-install --uninstall
   ```

   The output is as follows:

```
Emulex LPFC Driver Installer Version 1.4.1.10
Determining distribution type and kernel version ...
Checking for Emulex driver packages ...
Removing LPFC DFC Driver source RPM ...

The Emulex DFC Driver has been removed from your system.
```

```
Removing LPFC Driver source RPM ...
lpfc: Device or resource busy
/usr/src/lpfc/lpfc.conf saved as /usr/src/lpfc/lpfc.conf.backup

The Emulex LPFC Driver has been removed from your system.

Removing Emulex DFC driver startup script ...
Restoring old Emulex drivers...
```

2. Reboot the host.

Note: When using SLES 8 SP3, the uninstallation procedure does not fully remove all of the files. Therefore, the **lpfc --uninstall** command for the tar archive must be run twice.

Upgrading from the Emulex v2.x-Series driver to the v7.x-Series driver

To upgrade from the v2.x-series Emulex driver to the v7.x-series driver, the uninstallation procedure discussed above may be used to remove the previous installation of the v2.x-series driver.

1. Prior to upgrading the driver, all I/O being generated must be stopped and all applications currently using the Emulex HBAs and driver must be exited.
2. To remove the existing v2.x-series driver instance, run the command:

   ./lpfc-install --uninstall

   - This process will create a back up copy of the following files:
     - `/etc/modules.conf`
     - `/etc/lpfc.conf`
     - `/boot/initrd-$1.img`
   - If RPMs were used to install the v2.x-series driver, the uninstallation will attempt to remove those RPMs from the system.
   - A new ramdisk will be created with all references to Emulex drivers removed.
3. Reboot the host.

When the Emulex v2.x-series driver has been removed, refer to the "Installing the Emulex v7.x-Series driver" on page 68 for instructions to install the v7.x-series driver.

Uninstalling the Emulex v7.x-Series driver, Method two

If you have used the DKMS RPMs, then the RPMs should be removed from the system in order to uninstall the drivers.

Note: Please note that the DKMS RPM method does not function properly with SLES 8 distributions and may not be used.

The driver names may be verified by querying the RPMs.

For example:

```
[root@l82bi250 /]# rpm -qa | grep lpfc
lpfcdkms-7.1.14-2
lpfcdfcdkms-1.0.13-2
```

1. In order to successfully remove the `lpfc` and `lpfcdfc` drivers, the `lpfcdfc` driver RPM must be uninstalled first. If the attempt is made to uninstall the `lpfc` driver first, you will receive output similar to the following:

```
[root@l82bi250 /]# rpm -ev lpfcdkms-7.1.14-2
error: Failed dependencies:
        lpfcdkms >= 7 is needed by (installed) lpfcdfcdkms-1.0.13-2
```

2. To successfully remove the `lpfc` driver, first remove the `lpfcdfc` driver with the following command.

   rpm -ev lpfcdfcdkms-1.0.13-2

   The output of the command is as follows:

```
Uninstall of emulex lpfcdfc module (version 1.0.13) beginning:

-------- Uninstall Beginning --------
Module:  lpfcdfc
Version: 1.0.13
Kernel:  2.4.21-27.0.1.ELsmp (i686)
-------------------------------------

Status: Before uninstall, this module version was ACTIVE on this kernel.

lpfcdfc.o:
 - Uninstallation
   - Deleting from: /lib/modules/2.4.21-27.0.1.ELsmp/kernel/drivers/scsi/lpfc/
 - Original module
   - No original module was found for this module on this kernel.
   - Use the dkms install command to reinstall any previous module version.


DKMS: uninstall Completed.
```

```
------------------------------
Deleting module version: 1.0.13
completely from the DKMS tree.
------------------------------
Done.

The Emulex DFC module has been removed from your system.
```

3. With the successful uninstallation of the `lpfcdfc` driver RPM, the `lpfc` driver RPM may be removed from the system.

   To uninstall the `lpfc` driver, use the following command:

   rpm -ev lpfcdkms-7.1.14-2

   The output of the command is as follows:

```
Uninstall of emulex lpfc module (version 7.1.14) beginning:

-------- Uninstall Beginning --------
Module:  lpfc
Version: 7.1.14
Kernel:  2.4.21-27.0.1.ELsmp (i686)
-------------------------------------

Status: Before uninstall, this module version was ACTIVE on this kernel.

lpfc.o:
 - Uninstallation
   - Deleting from: /lib/modules/2.4.21-27.0.1.ELsmp/kernel/drivers/scsi/lpfc/
 - Original module
   - Archived original module found in the DKMS tree
   - Moving it to: /lib/modules/2.4.21-27.0.1.ELsmp/kernel/drivers/scsi/lpfc/

Saving old initrd as /boot/initrd-2.4.21-27.0.1.ELsmp_old.img
Making new initrd as /boot/initrd-2.4.21-27.0.1.ELsmp.img
(If next boot fails, revert to the _old initrd image)
mkinitrd....

Removing original_module from DKMS tree for kernel 2.4.21-27.0.1.ELsmp (i686)

DKMS: uninstall Completed.

------------------------------
Deleting module version: 7.1.14
completely from the DKMS tree.
------------------------------
Done.
/etc/lpfc.conf saved as /etc/lpfc.conf.backup
...Restoring - lib/modules/2.4.21-15.0.3.ELsmp/kernel/drivers/net/lpfndd.o
...Restoring - lib/modules/2.4.21-15.0.3.ELsmp/kernel/drivers/scsi/lpfcdd.o
...Restoring -
lib/modules/2.4.21-15.0.3.ELsmp/kernel/drivers/scsi/lpfc/lpfc_7114.o
```

```
...Restoring -
lib/modules/2.4.21-27.0.1.ELsmp/kernel/drivers/addon/lpfc_703/lpfc_703.o

The Emulex LPFC Driver has been removed from your system.
```

Installing the Emulex HBAnywhere applications kit

IMPORTANT

The lpfc driver must be installed first, because HBAnyware is dependent upon the existence of the lpfc driver.

Note: There is a one-to-one relationship between versions of the lpfc driver and the versions of the applications kit. For example, for the 8.0.16.6_x2 lpfc driver the application kit is ElxLinuxApps-2.1a8-8.0.16.4-1.tar. You will find the appropriate application kit located on the same page as the driver on the EMC-approved web page at the Emulex website.

Note: As of RHEL5, OEL 5, and Asianux 3.0, the Emulex 8.1.10.x driver / application combination requires the netlink library for event handling. RHEL5, OEL 5, and Asianux 3.0, by default, installs only the 64 bit netlink library on 64 bit architectures (IA64 and PPC64). HBAnyware provides both 32 and 64 bit libraries and on install will report a dependency error for the 32 bit library because the 32 bit netlink library is not present. The following message appears:

```
32-bit DFC library failed to install. Verify operating
system is configured with 32-bit development/library s/w
support. HBAnyware utilities not affected by this failure
as they are 64-bit applications.
```

32 bit applications, like SMI-S and others that rely on the HBA API component of HBAnyware, will need to install the 32 bit netlink library (available on the RHEL5, OEL 5, and Asianux 3.0 CDs) following the *Emulex ReadMe* notes.

To install the Emulex HBAnywhere applications kit:

1. Create a directory to which the application kit will be saved.

   ```
   mkdir /home/emulex_apps
   ```

2. Download the Applications Kit Applications Kit, and the associated *HBAnyware User Manual*, from the Emulex website and save it to the newly created directory. Refer to the *HBAnyware User Manual* for any operating system requirements needed to complete this installation.

Note: To install HBAnyware, you will need the rpm-build-xxxx package (e.g., rpm-build-4.2.1-4.2) and the gcc-xxx package (e.g., gcc-3.2.3-20).

Note: There is a one-to-one relationship between versions of the lpfc driver and the versions of the applications kit. For example, for the 8.0.16.6_x2 lpfc driver the application kit is ElxLinuxApps-2.1a8-8.0.16.4-1.tar. You will find the appropriate application kit located on the same page as the driver on the EMC-approved web page at the Emulex website.

3. Change to the newly created directory and uncompress and extract the source files from the tar archive:

```
cd /home/emulex_apps
tar xvf ElxLinuxApps-2.1a8-8.0.16.4-1.tar
```

The initial uncompression will create a new directory and will provide you with the following files within the new directory:

```
enterprise_kitfiles/
enterprise_kitfiles/hbaapi_2.1.a.tgz
enterprise_kitfiles/lputil_20a3.tgz
enterprise_kitfiles/EmlxApps300a28.tgz
enterprise_kitfiles/lpfcutil_2.6_lib_kit-80.161-2.tgz
install
uninstall
README.txt
README_SSC.txt
```

Contained within the existing directory is the `install` script.

Note: When the installation script is run, it will automatically install HBAnyware, the `lputil` utility, and the HBA API libraries.

4. To install the Application Kit, change to the newly created directory and run the installation script.

```
./install
```

The output from running the installer script is as follows:

```
Untarring EmlxApps tgz file...
Untarring lpfcutil tgz file...
Untarring hbaapi libs tgz file...
Untarring lputil tgz file...
Stopping HBAnyware Remote Management Server
Stopping HBAnyware Discovery Server
Starting HBAnyware Remote Management Server
```

```
Untarring HBAnyware local jre...
HBAnyware installation complete.
Cleaning up...
```

5. The installation utility will prompt for the "mode of operation" for HBAnyware to manage adapters. Select the desired mode of operation:
   - Option 1 (Local Mode) allows management of only the adapters within the host running HBAnyware.
   - Option 2 (Managed Mode) allows local adapters to be managed both by the local machine, as well as by remote machines running HBAnyware.
   - Option 3 (Remote Mode) is identical to Option 2, with the added feature that the local machine running HBAnyware can manage remote machines running HBAnyware (assuming they are running in "Managed Mode").
6. The installation utility will prompt to allow the user to change management mode (as described in Step 5). Select the desired answer.
7. **hbacmd** is a command-line program that can be used to modify and query Emulex adapter parameters. A sample session using **hbacmd** is described in the "Exercising the Emulex v8.x-series device driver" on page 57 of this document.
8. HBAnyware is a GUI-based application that is used to manage Emulex adapters on the host. To start up the HBAnyware application, run the following commands:

   ```
   cd /usr/sbin/hbanyware
   ./hbanyware
   ```

Editing the configuration files

This section contains information on editing the configuration files.

- "Description of the Emulex lpfc driver parameters", next
- "Descriptions of the Emulex parameters" on page 88
- "Editing the Emulex driver parameters on hosts with SLES 9, SLES 10, and SLES 11" on page 90
- "Editing the Emulex driver parameters on hosts with RHEL 4 and RHEL 5" on page 91
- "Editing the Emulex driver parameters on hosts with Asianux 2.0 and Asianux 3.0" on page 92
- "Editing the Emulex driver parameters on hosts with OEL 4 and OEL 5" on page 93

Description of the Emulex lpfc driver parameters

The Emulex driver exports certain parameters which may be used to modify the behavior of the driver. To obtain a listing of the parameters that have been exported, issue the **modinfo** command.

```
/sbin/modinfo lpfc | grep parm
parm:           lpfc_max_luns:Maximum number of LUNs per target driver will support (int)
parm:           lpfc_scsi_hotplug:Enables support of SCSI hotplug (int)
parm:           lpfc_discovery_threads:Maximum number of ELS commands during discovery (int)
parm:           lpfc_fdmi_on:Enable FDMI support (int)
parm:           lpfc_cr_count:A count of I/O completions after which aninterrupt response
                is generated (int)
parm:           lpfc_cr_delay:A count of milliseconds after which aninterrupt response is
                generated (int)
parm:           lpfc_fcp_bind_method:Select the bind method to be used (int)
parm:           lpfc_ack0:Enable ACK0 support (int)
parm:           lpfc_use_adisc:Use ADISC on rediscovery to authenticate FCP devices (int)
parm:           lpfc_fcp_class:Select Fibre Channel class of service for FCP sequences (int)
parm:           lpfc_link_speed:Select link speed (int)
parm:           lpfc_topology:Select Fibre Channel topology (int)
parm:           lpfc_nodev_tmo:Seconds driver will hold I/O waiting for a device to come
                back (int)
parm:           lpfc_scan_down:Start scanning for devices from highest ALPA to lowest (int)
parm:           lpfc_lun_queue_depth:Max number of FCP commands we can queue to a specific
                LUN (int)
parm:           lpfc_log_verbose:Verbose logging bit-mask (int)
```

Table 7 provides a listing of the EMC-recommended settings for the driver. These values will be used as default when installing the driver.

Table 7 Emulex parameters and settings

Emulex parameters	Emulex default settings	EMC recommended settings
lpfc_max_luns	256	256
lpfc_discovery_threads	32	32
lpfc_fdmi_on	0	0
lpfc_cr_delay	0	0
lpfc_cr_count	1	1
lpfc_fcp_bind_method	2	2
lpfc_ack0	0	0
lpfc_use_adisc	0	0
lpfc_fcp_class	3	3
lpfc_link_speed	0	0
lpfc_topology	0x00	0x00
lpfc_nodev_tmo	30	30 *
lpfc_scan_down	1	1
lpfc_lun_queue_depth	30	30
lpfc_log_verbose	0x0	0x0

* If PEMC owerPath,® Veritas DMP, or Linux native multipath (DM-MPIO) is installed, lpfc_nodev_tmo must be set to 10.

Descriptions of the Emulex parameters

`lpfc_link_speed` Specifies link speed selection for the initialization of the FC connection.

```
0 = auto negotiate
1 = 1 GB
2 = 2 GB
4 = 4 GB
```

The auto-negotiation feature may not be suitable in all environments. In such an environment, EMC recommends explicitly setting the link speed.

Note: For FCoE adapters, the FC link is virtualized within a 10 gigabit ethernet link. As such, modification of this setting will not affect the FC link speed.

`lpfc_topology` Specifies the link topology.

```
0x0 = attempt loop mode then point-to-point
0x02 = attempt point-to-point mode only
0x04 = attempt loop mode only
0x06 = attempt point-to-point mode then loop
```

In certain environments, attempting to log into a fabric in loop-mode may cause undesirable behavior. In such environments, EMC recommends explicitly setting the link topology. Explicitly setting the `lpfc_topology` parameter may reduce the time to complete the login to a target. Hence, if the host is connecting only to a FC-AL environment, this parameter should be set to 0x04. Similarly, if the host is connecting only to a FC-SW environment, this parameter should be set to 0x02.

`lpfc_nodev_tmo` Specifies the amount of time [0-255] that all I/O errors will be held on devices that disappear. EMC recommends that this value be set to 30.

In certain high-stress, non-production environments, a higher timeout value has helped recover over-exercised LUNS. In such environments, this value has been set to 60 seconds.

`lpfc_log_verbose` Specifies the bit mask to record specific types of verbose messages.

```
0x0 = No verbose logging
0x1 = ELS events
0x2 = Link Discover events
0x4 = Mailbox events
0x8 = Initialization events
0x10 = Link events
0x20 = IP traffic history
0x40 = FCP Traffic History
0x80 = Node Table events
0x400 = Miscellaneous events
0x800 = SLI events
0x1000 = FCP Check Condition Flag
0x2000 = LIBDFC events
0xffff = Log All Messages
```

The logging level may be increased by setting the desired flags.

What next?

Certain customization features are available in the form of driver parameter options. These options are read every time the driver is loaded and included in the newly created RAM disk that includes the Emulex v8.x driver.

- For editing the driver parameters on hosts with SLES 9 SP1 and newer service packs, and SLES 10 and newer service packs, proceed to "Editing the Emulex driver parameters on hosts with SLES 9, SLES 10, and SLES 11" on page 90.
- For editing the driver on hosts with RHEL 4 and newer updates, and RHEL 5, proceed to "Editing the Emulex driver parameters on hosts with RHEL 4 and RHEL 5" on page 91.

Editing the Emulex driver parameters on hosts with SLES 9, SLES 10, and SLES 11

On hosts with SLES 9 SP1 and newer service packs, SLES 10 and newer service packs, or SLES 11 and newer service packs, the values for the driver parameters are set in the file `/etc/modprobe.conf.local`..

Refer to "Description of the Emulex lpfc driver parameters" on page 87 for the description of the supported parameters and to identify parameters suited to your host.

The following is an example of a modified `/etc/modprobe.conf.local` file for a host that is connecting to a fabric in Point-to-Point at a 2 GB link speed and the log level set as verbose in order to capture all link events.

```
cat /etc/modprobe.conf.local
#
# please add local extensions to this file
#

## LPFC Module options ##
options lpfc lpfc_link_speed=2 lpfc_topology=0x02
lpfc_log_verbose=0x10
```

EMC recommends creating a new RAM disk after modifying the parameters in `/etc/modprobe.conf.local` and rebooting the host in order to use the new RAM disk.

To create a new RAM disk, use the script `lpfc-install` with the `--createramdisk` option as follows:

1. Change to the directory where the installation files are located.

   ```
   cd /home/emulex/lpfc_2.6_driver_kit-8.0.16.6_x2-1/
   ```

2. Run the install script with the `--createramdisk` option:

   ```
   ./lpfc-install --createramdisk
   Emulex LPFC Driver Installer Version 1.30.1.2
   Determining distribution type and kernel version ...
   Creating ramdisk .....
   The ramdisk for this kernel has been updated.
   ```

3. Reboot the host.

   Alternatively, a new ramdisk may be created using the **mkinitrd** command.

   For example:

   ```
   cd /boot
   mkinitrd -k vmlinuz -i initrd-2.6.5-7.139smp
   ```

Editing the Emulex driver parameters on hosts with RHEL 4 and RHEL 5

On hosts with RHEL 4 and newer updates, and RHEL 5, the values for the driver parameters are set in the file `/etc/modprobe.conf`. The following is an example of a modified `/etc/modprobe.conf` file for a host that is connecting to a fabric in Point-to-Point at a 2 GB link speed and the log level set as verbose in order to capture all link events.

Refer to the section "Description of the Emulex lpfc driver parameters" on page 87 for the description of the supported parameters and to identify parameters suited to your host.

For example:

```
cat /etc/modprobe.conf

alias eth0 tg3
alias eth1 tg3
alias scsi_hostadapter mptbase
alias scsi_hostadapter1 mptscsih
alias scsi_hostadapter3 lpfc
alias scsi_hostadapter4 lpfc
## LPFC Module options ##
options lpfc lpfc_link_speed=2 lpfc_topology=0x02
lpfc_log_verbose=0x10
```

Note: All options must be contained on a single line. The above example contains all options on a single line; however, because of line wrap, they appear to be on separate lines.

EMC recommends creating a new RAM disk after modifying the parameters in `/etc/modprobe.conf` and rebooting the host in order to use the new RAM disk.

To create a new RAM disk, use the script `lpfc-install` with the `--createramdisk` option as follows:

1. Change to the directory where the installation files are located.

   ```
   cd /home/emulex/lpfc_2.6_driver_kit-8.0.16.6_x2-1/
   ```

2. Run the install script with the `--createramdisk` option:

   ```
   ./lpfc-install --createramdisk
   Emulex LPFC Driver Installer Version 1.30.1.2
   Determining distribution type and kernel version ...
   Original ramdisk image /boot/initrd-2.6.9-5.EL.img
   saved as /boot/initrd-2.6.9-5.EL.img.elx
   Creating ramdisk ...
   The ramdisk for this kernel has been updated.
   ```

3. Reboot the host.

   Alternatively, a new ramdisk may be created using the **mkinitrd** command.

   For example:

   ```
   cd /boot
   mkinitrd –v initrd-2.6.9-5smp.EL.img 2.6.9-5smp.EL
   ```

Editing the Emulex driver parameters on hosts with Asianux 2.0 and Asianux 3.0

The following distributions are part of Asianux consortium and are based on Asianux 2.0 and Asianux 3.0:

- Miracle Linux v4.0
- RedFlag DC Server 5.0
- Haansoft Linux 2006 Server Asianux Inside

Refer to "Editing the Emulex driver parameters on hosts with RHEL 4 and RHEL 5" on page 91.

Editing the Emulex driver parameters on hosts with OEL 4 and OEL 5

Refer to "Editing the Emulex driver parameters on hosts with RHEL 4 and RHEL 5" on page 91.

Using the Emulex lun_scan script

Contained within the Emulex driver applications kit is a script, called `lun_scan`, which automates the SCSI scan requests for Emulex adapters. This script is located in the following applications kit directory:

```
enterprise_kitfiles/scripts/lun_scan
```

When the applications kit is installed, the `lun_scan` script is installed into the `/usr/sbin/lpfc` directory with the `dfc` and `lputil` utilities.

This script may be integrated into the system run-level transitions to ensure that all devices are fully detected.

The `lun_scan` script may be used to scan all of the Emulex HBAs or a specific Emulex HBA.

If the `lun_scan` script is run without specifying parameters, the output is as follows:

```
[root@l82bi250 /]# lun_scan

Usage: lun_scan [ <#> [<#>] | all ]
  where
    <#> : is a scsi host number of a specific lpfc HBA that is to
          be scanned. More than 1 host number can be specified.
    all : indicates that all lpfc HBAs are to be scanned.

  Example:
    lun_scan all  : Scans all lpfc HBAs
    lun_scan 2    : Scans the lpfc HBA with scsi host number 2
    lun_scan 2 4  : Scans the lpfc HBAs with scsi host number 2 and 4

  Warning: Scanning an adapter while performing a tape backup should
    be avoided.
```

Examples of the usage of the script are shown below.

1. To obtain the SCSI host number of the Emulex HBAs within the system, refer to the `/proc` filesystem:

```
[root@l82bi250 /]# ls /proc/scsi/lpfc/
2  3
In this particular system, the Emulex HBAs are listed as SCSI host numbers 2 and 3.
To scan on a single Emulex HBA, run the command plus the desired host number. For
example:
[root@l82bi250 /]# lun_scan 2
Scanning lpfc2, scsi host number : 2
```

2. If the system contained multiple Emulex HBAs, the command could be run with specific SCSI host numbers.

   For example, this system has four Emulex HBAs:

   ```
   [root@l82bi183 /]# ls /proc/scsi/lpfc/
   2  3  4  5
   ```

   To rescan the SCSI bus for LUNs on some of the HBAs, the SCSI host numbers for those HBAs may be specified:

   ```
   [root@l82bi250 /]# lun_scan 2 5
   Scanning lpfc2, scsi host number : 2
   Scanning lpfc5, scsi host number : 5
   ```

3. To rescan the LUNs on all of the Emulex HBAs within the system, execute the following:

   ```
   [root@l82bi183 /]# lun_scan all
   Scanning lpfc2, scsi host number : 2
   Scanning lpfc3, scsi host number : 3
   Scanning lpfc4, scsi host number : 4
   Scanning lpfc5, scsi host number : 5
   ```

5 Updating the Adapter and CEE/Menlo Firmware

This chapter provides information on updating the adapter and CEE/Menlo firmware for Fibre Channel over Ethernet adapters.

- Updating the adapter firmware with hbacmd 98
- Updating Emulex CEE /Menlo firmware for LP21000-E/ LP21002-E FCoE adapters 102

Updating the adapter firmware with hbacmd

The hbacmd utility is dependent upon the existence of the Emulex driver. Therefore, the operating system and the Emulex driver must be installed prior to using hbacmd. The hbacmd utility is included in the Emulex Application Kit along with the adapter API and HBAnyware.

Download the Emulex Application Kit from the EMC-approved section of the Emulex website, and follow the steps below to upgrade the flash firmware using hbacmd.

To update the firmware on the adapters:

1. Copy the appropriate firmware file from the CD-ROM or the EMC-approved section of the Emulex website to the appropriate directory, `/usr/sbin/lpfc`.

   Table 8 lists the adapter models and the name of the corresponding firmware files.

Table 8 HBA and CNA Fibre Channel firmware (page 1 of 3)

Adapter model	Firmware file
LP982-E	`lfb`*`XXX`*`.all` (where *XXX* is the version) Example: `lfb191a1.all`
LP9002-E	`cdc`*`XXX`*`.all` (where *XXX* is the version) Example: `cdc392a2.all`
LP9802-E	`hd`*`XXX`*`.all` (where *XXX* is the version) Example: `hd191a1.all`
LP9802DC-E	`hf`*`XXX`*`.all` (where *XXX* is the version) Example: `hf191a1.all`
LP1050-E	`mf`*`XXX`*`.all` (where *XXX* is the version) Example: `mf191a1.all`
LP1050DC-E	`mf`*`XXX`*`.all` (where *XXX* is the version) Example: `mf191a1.all`
LP1050EX-E	`mf`*`XXX`*`.all` (where *XXX* is the version) Example: `mf191a1.all`
LP10000-E	`td`*`XXX`*`.all` (where *XXX* is the version) Example: `td191a1.all`

Table 8 HBA and CNA Fibre Channel firmware (page 2 of 3)

Adapter model	Firmware file
LP10000DC-E	td*XXX*.all (where *XXX* is the version) Example: td191a1.all
LP10000EXDC-E	td*XXX*.all (where *XXX* is the version) Example: td191a1.all
LP101-E	emb*XXX*.all (where *XXX* is the version) Example: emb191a1.all
LPe111-E	ym*XXX*.all (where *XXX*is the version) Example: ym250a8.all
LPe1150-E	wf*XXX*.all (where *XXX* is the version) Example: wf250a4.all
LPe11002-E	zf*XXX*.all (where *XXX* is the version) Example: zf210a7.all
LP11002-E	bf*XXX*.all (where *XXX* is the version) Example: bf250a4.all
LP11250-E	of*XXX*.all (where *XXX* is the version) Example: of110a5.all
LPe12000-E	ud*XXX*.all (where *XXX* is the version) Example: ud110a5.all
LPe12002-E	ud*XXX*.all (where *XXX* is the version) Example: ud110a5.all
LP21000-E	ad*XXX*.all (where *XXX* is the version) Example: ad100a5.all
LP21002-E	af*XXX*.all (where *XXX* is the version) Example: af100a5.all
OCe10102-FM-E OCe10102-FX-E	XXXXXXXX.UFI(where XXXXXXXX is the version) Example: S2200017.UFI
LP1005-DC Mezzanine for HPQ Blade Servers	m*fXXX*.all (where *XXX* is the version) Example: mf191a2.all
LP1005-DC Mezzanine for IBM Blade Servers	mf*XXX*.all (where *XXX* is the version) Example: mf190a5.all

Table 8 **HBA and CNA Fibre Channel firmware (page 3 of 3)**

Adapter model	Firmware file
LP1005-BC Mezzanine for IBM Blade Servers	bf*xxx*.all (where *xxx* is the version) Example: bf210a10.all
LPe1105-M Mezzanine for Dell Blade Servers	zf*XXX*.all (where *XXX* is the version) Example: zf280a4.all
LPe1105-M4 Mezzanine for Dell Blade Servers	zf*XXX*.all (where *XXX* is the version) Example: zf280a4.all
LPe1205-M Mezzanine for Dell Blade Servers	ud*XXX*.all (where *XXX* is the version) Example: ud110a5.all

Each firmware file contains four files. The naming schema of the files follows the format as shown in the example below for the LP9002 v3.92a2 firmware.

cdc392a2.**dwc** = contains the firmware with combination boot

cdc392a2.**awc** = contains the firmware with loader and combination boot

cd392a2.**dwc** = contains the firmware with no boot code

cd392a2.**awc** = contains the firmware with loader, no boot code

2. Execute the command **/usr/sbin/hbanyware/hbacmd ListHBA**, and record the Port WWN information for all adapters within the host.
3. Execute the command **/usr/sbin/hbanyware/hbacmd Download <WWPN> <firmwarefile>**, where WWPN is the first Port WWN recorded from Step 2, and firmwarefile is the firmware file name determined in Step 1. The utility will report "Download Complete" when the firmware download has completed successfully.
4. Repeat Step 3 for each adapter port WWN reported in Step 2, to ensure that all adapter instances within the host have been updated.
5. If you do not plan to update the Boot BIOS, then reboot the system.

Note: If you are using the adapter to boot from the SAN, update the Boot BIOS immediately after updating the firmware as the firmware overwrites part of the Boot BIOS.

Updating Emulex CEE /Menlo firmware for LP21000-E/LP21002-E FCoE adapters

Each Emulex Fibre Channel controller has a flash upgradable firmware and boot BIOS. In most instances, it is necessary to keep only the firmware up-to-date, because the BIOS is applied only when using connected storage as a boot device. The latest supported firmware can be found on the Emulex website:

`http://www.emulex.com/ts/docoem/framemc.htm`

From this site, select the appropriate file for your adapter. The files are typically in a `.zip` file that contains different combinations of firmware and BIOS images. Extract the downloaded file to a diskette, and refer to `readme.txt` to determine which filename image to use.

IMPORTANT

If you are upgrading the firmware and BIOS, you must upgrade the firmware first, because it might contain an older BIOS version, which you can update separately later.

FCoE adapters include an additional chip component which requires the latest supported firmware. This chip is commonly referred to as a CEE (converged enhanced ethernet) or "Menlo" chip, the purpose of which is to handle the convergence of storage (FC) and network (IP) traffic over a single ethernet interface.

Note: To update the boot BIOS, refer to Chapter 3, "Installing and Configuring the BIOS Settings."

To update the CEE/Menlo firmware on the CNAs, follow these steps:

1. Copy the appropriate CEE/Menlo firmware file from the CD-ROM or the EMC-approved section of the Emulex website to the appropriate directory, /usr/sbin/hbanyware.
2. Execute the command **/usr/sbin/hbanyware/hbacmd ListHBA**, and record the "Port WWN" information for all adapters within the host.
3. Execute the command **/usr/sbin/hbanyware/hbacmd CEEdownload <WWPN> <CEEfirmwarefile>**, where WWPN is the first Port WWN recorded from Step 2, and CEEfirmwarefile is

the firmware file name determined in Step 1. The utility will report "Download Complete" when the firmware download has completed successfully.

4. If the installed adapter is a dual-ported model, then the CEE/Menlo firmware does not need to be downloaded to each adapter port; downloading it to either port results in both ports being updated. Otherwise, for multiple single-port adapter models, repeat Step 3 for each adapter port WWN reported in Step 2, to ensure that all adapter instances within the host have been updated.

Updating Emulex BIOS/firmware for the OCe10102-FM-E/OCe10102-FX CNA adapters

OneCommand Manager is the GUI software that is designed for administration of Emulex storage networking products, including both HBAs and CNAs. It can be used for retrieving card information, tuning of card parameters, and updating of firmware and BIOS. It is the upgraded version of previous HBAnyware GUI software offered by Emulex.

Before updating the OCe10102-FM-E / OCe10102-FX CNA firmware, download the latest firmware and Boot Code (BIOS) from the EMC-supported section of Emulex website at http://www.emulex.com/downloads/emc.html.

Prior to the release of OCe10102-FM-E / OCe10102-FX CNA, Emulex offered software packages for firmware and BIOS separately. The user needed to download both and update separately. After the release of the OCe10102-FM-E / OCe10102-FX CNA, a single unified software package, which is capable of updating both firmware and BIOS simultaneously, is available from Emulex.

The firmware updating process for the OCe10102-FM-E / OCe10102-FX CNA iSCSI CNA is different from updating the HBA or FCoE CNA, as follows:

- For HBA or FCoE CNA, the button to invoke a firmware update process is under the **Maintenance** tab on the right pane of each port interface, as shown in Figure 7 on page 105.

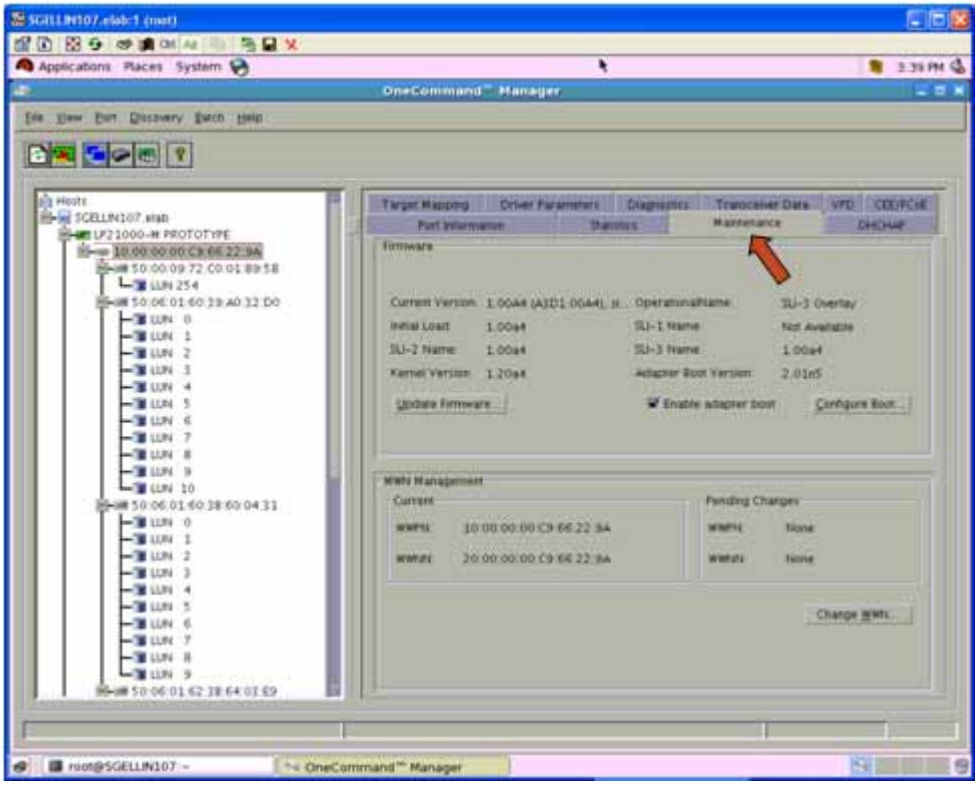


Figure 7 **Firmware update interface for Emulex FCoE CNA**

- However, the button for the OCe10102-FM-E / OCe10102-FX CNA iSCSI CNA is under the **Firmware** tab of the card entity, as shown in Figure 8 on page 106.

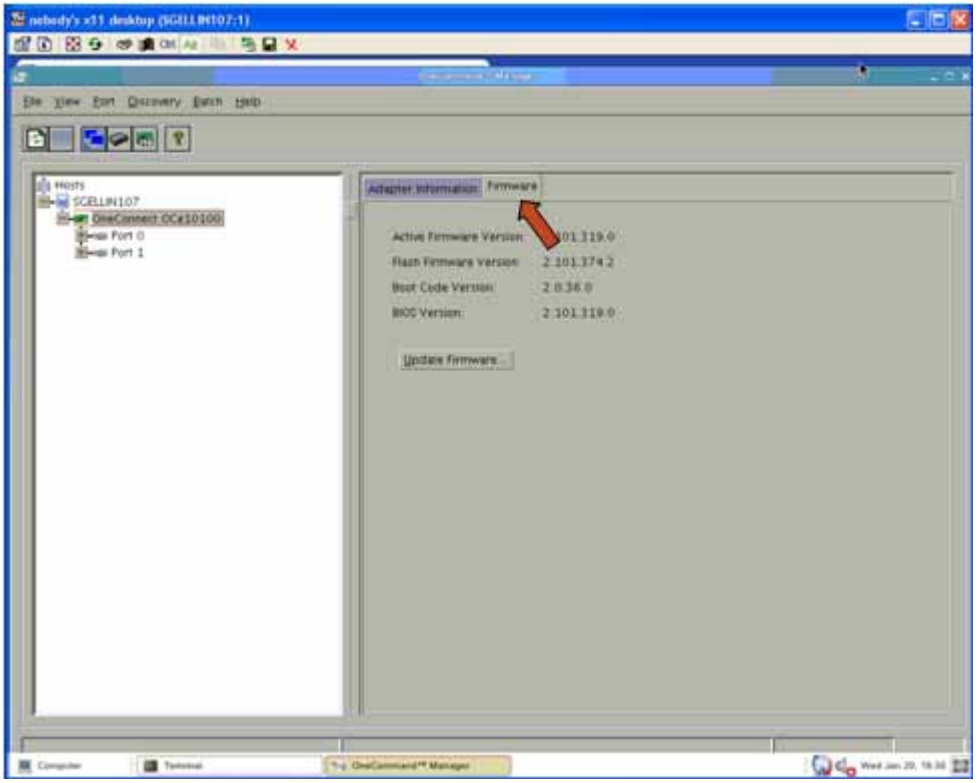


Figure 8 **Firmware update interface for Emulex OCe10102-FM-E/OCe10102-FX iSCSI CNA**

Since firmware and BIOS are offered in separate packages for HBAs and CNAs released before the OCe10102-FM-E / OCe10102-FX CNA, users need to update twice by clicking the **Update Firmware**… button and select appropriate packages for firmware and BIOS (firmware packages have .all as extension, while BIOS packages' extension is .PRG). However, for the OCe10102-FM-E / OCe10102-FX CNA cards, the user only needs to update once, using the unified package (with .all as extension).

To update the OCe10102-FM-E / OCe10102-FX CNA firmware and BIOS, complete the following steps.

1. Invoke the OneCommand Manager GUI client by issuing /usr/sbin/hbanyware/ocmanager in the Linux command prompt.
2. Click on the card entity with model name (such as "OneConnect OCe10100"; refer to Figure 8 on page 106);
3. Select the **Firmware** tab on the right pane of the interface and click **Update Firmware...** to invoke the firmware download window.
4. Click **Browse...** to open file browser and navigate to the directory with the firmware package stored.
5. Select the appropriate package and click **Start Download** to start the download process.
6. After the download process is completed, switch to the **Adapter Information** tab, and verify both the firmware and BIOS versions are updated. Figure 9 shows an example of the Adapter Information tab prior to the firmware upate.

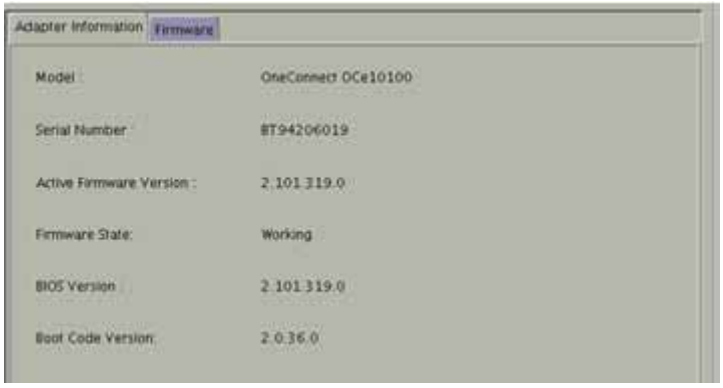


Figure 9 Adapter information prior to firmware update

The updating process is completed once the latest versions are verified, as shown in Figure 10.

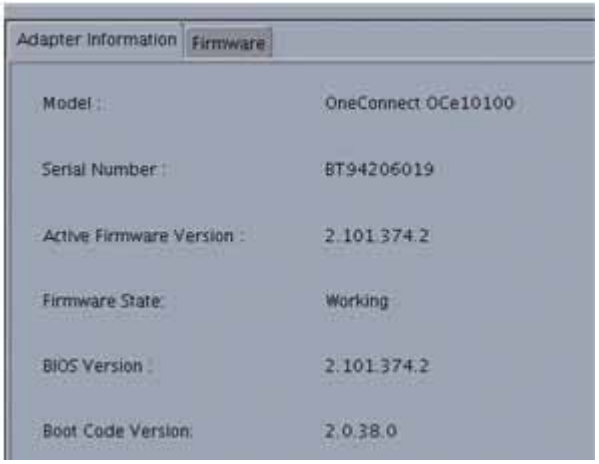


Figure 10 Adapter information after firmware update

6 Connecting to the Storage

This chapter provides information on connecting to the storage.

- Zoning and connection planning in a fabric environment 110
- Enabling persistent binding 111
- Configuring Emulex OCe10102-FM-E / OCe10102-FX iSCSI CNA for iSCSI connectivity 117

Zoning and connection planning in a fabric environment

In a fabric environment, the user should plan for the switch topology, target-to-hosts mapping, and the zone.

Planning procedure

The recommended procedure is as follows:

1. Draw the connectivity among the hosts, switch, and storage array to verify the correct fabric configuration.
2. Configure the zone capability in the switch. If connecting to EMC Connectrix, refer to the *Connectrix Enterprise Storage Network System Planning Guide* for information on the zone configuration.

Establishing connectivity to the storage array

Once the adapter has been properly configured, connectivity will need to be established between the adapter and the storage array. In the case, where the adapter will be directly connected to the storage array, the cable can just be attached. However, when attaching to an FC or FCoE switch, several additional configuration steps are needed.

These include zoning the port on the adapter to the correct port on the storage array, as well as configuring LUN Masking on the array.

For additional information on how to perform these additional installation steps, refer to the *Fibre Channel over Ethernet (FCoE) TechBook*, located at http://elabnavigator.EMC.com, **Topology Resource Center** tab.

Note: You will need to reload the driver or reboot the server so the new targets and LUNs may be scanned and acquired by the Linux SCSI subsystem.

What next:
Follow the instructions in "Device reconfiguration procedures" on page 151.

Enabling persistent binding

In a fabric environment, EMC recommends, but does not require, enabling persistent binding in the driver. When using persistent binding, EMC strongly recommends the use of binding via WWPN.

Without a persistent binding mechanism, the host will be unable maintain persistent logical routing of the communication from a storage device object across the fabric to an EMC storage array volume. If the physical configuration of the switch is changed (for example, cables are swapped or the host is rebooted), the logical route becomes inconsistent, which could cause data corruption.

Please note that the persistent binding mechanism in the Emulex driver is target-based only, not LUN-based.

Obtaining initiator and target information

The initiator and target information necessary for persistent binding is logged in `/proc/scsi/lpfc/N` (where *N* indicates the file for each adapter in the system) when the driver is loaded. The initiator and target information is used to assign the persistent binding information in `/usr/src/lpfc/lpfc.conf` or `/etc/modules.conf`.

You can obtain the initiator and target information by grep'ing the `/proc/scsi/lpfc/N` file for each adapter in the system.

For example:

```
cd /proc/scsi/lpfc
grep WWPN *
```

This example produces output similar to the following:

```
2:lpfc0t05 DID 6c0b13 WWPN 50:06:01:61:10:60:12:70 WWNN 50:06:01:60:90:60:12:70
2:lpfc0t06 DID 6c1713 WWPN 50:06:01:69:10:60:12:70 WWNN 50:06:01:60:90:60:12:70
3:lpfc2t02 DID 6c0b13 WWPN 50:06:01:61:10:60:12:70 WWNN 50:06:01:60:90:60:12:70
3:lpfc2t04 DID 6c1713 WWPN 50:06:01:69:10:60:12:70 WWNN 50:06:01:60:90:60:12:70
```

What next?

To enable persistent binding for the modular driver, you must edit either `/usr/src/lpfc/lpfc.conf` or `/etc/modules.conf`.

To edit one of these files, proceed to the appropriate section:

- *"Editing /usr/src/lpfc/lpfc.conf" on page 112*
- *"Editing /etc/modules.conf" on page 114*

Editing /usr/src/lpfc/lpfc.conf

The Emulex v7.1.14 driver uses the `lpfc_fcp_bind_method` parameter. When using the `lpfc_fcp_bind_method` parameter, the following values will force a particular type of binding:

- A value of 1 forces WWNN binding.
- A value of 2 forces WWPN binding.
- A value of 3 forces DID binding.
- A value of 4 forces the driver to derive the binding from ALPA.

EMC recommends enabling persistent binding via WWPN; therefore, the default value of 2 should be used.

To edit `/usr/src/lpfc/lpfc.conf` and compile the persistent binding parameters into the driver, follow these steps:

1. Please note the following requirements when enabling persistent binding:
   - Only one persistent binding method can be used.
   - The `lpfc_automap` parameter must be set to 0.
   - The `lpfc_scan_down` parameter must be set to 0.
2. As stated previously, the `lpfc_scan_down` parameter must be set to 0 when using persistent binding. Search for the `lpfc_scan_down` parameter in `/usr/src/lpfc/lpfc.conf` and change the value from:

   ```
   int lpfc_scan_down = 1;
   ```

   to

   ```
   int lpfc_scan_down = 0;
   ```

3. Next, the `lpfc_automap` parameter must be set to 0 when using persistent binding. Search for the `lpfc_automap` parameter in `/usr/src/lpfc/lpfc.conf` and change the value from:

   ```
   int lpfc_automap = 1;
   ```

   to

   ```
   int lpfc_automap = 0;
   ```

4. Add the WWPN and SCSI ID information to the `lpfc_fcp_bind_WWPN` parameter. The SCSI ID consists of the lpfc interface to bind with and the target number for that lpfc interface.

   For example, `lpfc0t1` would reference target 1 on interface `lpfc0`.

   Example:

```
char
*lpfc_fcp_bind_WWPN[MAX_FC_BINDINGS]={"50060482cadfe242:lpfc0t1","50
060482cadfe243:lpfc0t2", 0};
```

   Note: The entry must be all on one line; the length of the line forces it to wrap to multiples lines in this document.

5. Save your changes to the `/usr/src/lpfc/lpfc.conf` file.
6. Recompile the driver:

   `make build`

7. Install the driver in the currently running kernel:

   `make install`

   The `make install` parameter copies the driver to the appropriate `/lib/modules/ $1/kernel/drivers/scsi` directory (where *$1* is the kernel version).

8. Create a new ramdisk to reflect the changes made. This may be done by using the `lpfc-install` script or by manually creating a new ramdisk.

   - When using the `lpfc-install` script, you will need to use the `-configramdisk` option.

   For example:

```
/home/emulex/lpfc_2.4_driver_kit-7.1.14-4/lpfc-instal
l -configramdisk
```

   The output from this command will be similar to the following:

```
Emulex LPFC Driver Installer Version 1.4.1.10
Determining distribution type and kernel version ...
Configuring ramdisk...
Configuring /etc/modules.conf ...
Original saved as /etc/modules.elx
```

```
Original ramdisk image /boot/initrd-2.4.21-27.0.1.ELsmp.img saved as
/boot/initrd-2.4.21-27.0.1.ELsmp.img.elx
Creating ramdisk ..
The ramdisk for this kernel has been updated.
```

- Depending upon your distribution, use one of the following instruction sets when manually creating a new ramdisk.
  - For Red Hat distributions, use:

    ```
    cd /boot
    mkinitrd -v initrd-$1.img $1
    ```

    where *$1* is the currently running v2.4.x kernel version.

    Example:

```
cd /boot
cp initrd-2.4.21-15.0.4.ELsmp.img initrd-2.4.21-15.0.4.ELsmp.img.orig
mkinitrd –v initrd-2.4.21-15.0.4.ELsmp.img 2.4.21-15.0.4.ELsmp
```

  - For SuSE distributions use:

    ```
    cd /boot
    mkinitrd –k vmlinuz-$1 –i initrd-$1
    ```

    Example:

```
cd /boot
cp initrd-2.4.21-266 initrd-2.4.21-266.orig
mkinitrd –k vmlinuz-2.4.21-266 –i initrd-2.4.21-266
```

9. Reboot the host.

What next? Proceed to “Additional Notes” on page 147.

Editing /etc/modules.conf

Instead of editing `/usr/src/lpfc/lpfc.conf` to compile the persistent binding parameters into the driver, you may use the options parameter in `/etc/modules.conf` to specify those settings:

1. Obtain the initiator and target information for each adapter in the system as instructed under “Obtaining initiator and target information” on page 111.
2. Change to the appropriate directory and append the persistent binding information to the bottom of the `modules.conf` file:

   ```
   cd /etc
   vi modules.conf
   ```

3. Set the `lpfc_scan_down` parameter as follows:

   The default setting is:

   ```
   lpfc_scan_down=1
   ```

   Change it to zero:

   ```
   lpfc_scan_down=0
   ```

4. Set the `lpfc_automap` parameter as follows:

   The default setting is:

   ```
   lpfc_automap=1
   ```

   Change it to zero:

   ```
   lpfc_automap=0
   ```

5. Set the `lpfc_fcp_bind_WWPN` parameter to the required number of persistent binding entries.

   Example:

   ```
   lpfc_fcp_bind_WWPN=50060160006000ed:lpfc0t1,500601680
   06000ed:lpfc0t2,50060160006000ed:lpfc1t1,500601680060
   00ed:lpfc1t2
   ```

   Note: The entry must be all on one line; the length of the line forces it to wrap to multiples lines in this document.

6. Save the changes to `/etc/modules.conf`.

   The following is an example of `/etc/modules.conf` for a v2.4.x system using the Emulex driver with persistent binding enabled:

```
alias parport_lowlevel parport_pc
alias scsi_hostadapter sym53c8xx
alias scsi_hostadapter1 lpfc
alias scsi_hostadapter2 lpfc
alias eth0 tlan
options scsi_mod max_scsi_luns=255 scsi_allow_ghost_devices=1
options lpfc lpfc_topology=0x02 lpfc_automap=0 lpfc_scan_down=0
lpfc_fcp_bind_WWPN=50060160006000ed:lpfc0t1,50060168006000ed:lpfc0t2,50060160060
00ed:lpfc1t1,50060168006000ed:lpfc1t2
```

Note: The last three lines of the example are actually all one line; however, the length of the line forces it to wrap to multiples lines in the display.

7. Create a new ramdisk to reflect the changes made. This may be done by using the lpfc-install script or by manually creating a new ramdisk.

   - When using the `lpfc-install` script, use the `-configramdisk` option.

     For example:

     ```
     cd /home/emulex/lpfc_2.4_driver_kit-7.1.14-4/
     ./lpfc-install -configramdisk
     ```

     The output will be similar to the following:

```
Emulex LPFC Driver Installer Version 1.4.1.10
Determining distribution type and kernel version ...
Configuring ramdisk...
Configuring /etc/modules.conf ...
Original saved as /etc/modules.elx
Original ramdisk image /boot/initrd-2.4.21-27.0.1.ELsmp.img saved as
/boot/initrd-2.4.21-27.0.1.ELsmp.img.elx
Creating ramdisk ..
The ramdisk for this kernel has been updated.
```

   - Depending upon your distribution, use one of the following instruction sets when manually creating a new ramdisk.
     - For Red Hat distributions, use:

       ```
       cd /boot
       mkinitrd -v initrd-$1.img $1
       ```

       where *$1* is the currently running v2.4.x kernel version.

       For example:

```
cd /boot
cp initrd-2.4.21-15.0.4.ELsmp.img initrd-2.4.21-15.0.4.ELsmp.img.orig
mkinitrd -v initrd-2.4.21-15.0.4.ELsmp.img 2.4.21-15.0.4.ELsmp
```

     - For SuSE distributions use:

       ```
       cd /boot
       mkinitrd -k vmlinuz-$1 -i initrd-$1
       ```

       For example:

```
cd /boot
cp initrd-2.4.21-266 initrd-2.4.21-266.orig
mkinitrd -k vmlinuz-2.4.21-266 -i initrd-2.4.21-266
```

8. Reboot the host.

What next? Proceed to "Additional Notes" on page 147.

Configuring Emulex OCe10102-FM-E/OCe10102-FX iSCSI CNA for iSCSI connectivity

If OCM is not available for a particular OS, iSCSI connectivity can still be configured for the OCe10102-FM-E / OCe10102-FX iSCSI CNA by using the iscsiadm utility. Iscsiadm creates an interface (iface) for each OCe10102-FM-E / OCe10102-FX iSCSI CNA port and uses such structure to bind sessions and support iSCSI offload.

First, ensure the be2iscsi driver is already available as an in-kernel driver. It can be checked using 'modinfo be2iscsi'. If an in-kernel be2iscsi driver is not available, an out-of-box driver needs to be installed. This out-of-box driver is provided by Emulex.

Next, the initiator name and network settings must be configured. An example of an initiator name and network setting is shown in Figure 11.

```
SGELLIN103:/etc/iscsi # cat initiatorname.iscsi
InitiatorName=iqn.1990-07.com.emulex.sgellin121
```

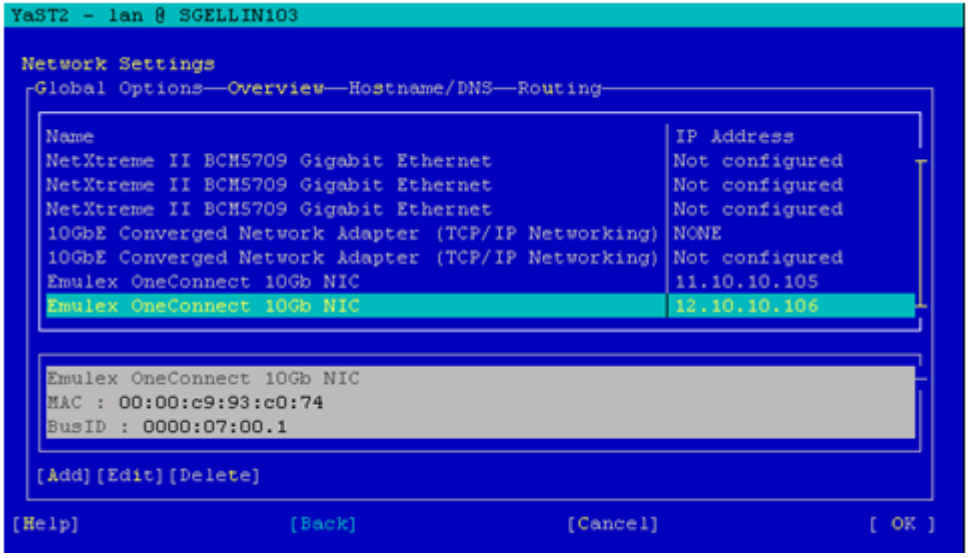


Figure 11 **Network Settings window**

An IP must be configured on the OCe10102-FM-E / OCe10102-FX port to ensure the host can ping each target port without any issues. If you cannot ping the portal, then you will not be able to bind a session to the portal.

The open-iscsi package needs to be installed and started to use the iscsiadm utility.

```
SGELLIN103:~ # rpm -qa | grep iscsi
yast2-iscsi-server-2.17.8-0.1.108
yast2-iscsi-client-2.17.20-0.2.23
open-iscsi-2.0.871-0.20.3
SGELLIN103:~ # /etc/init.d/open-iscsi start
Starting iSCSI initiator service:  tcp                                    done
Setting up iSCSI targets:                                                 unused
SGELLIN103:~ # iscsiadm -m session
iscsiadm: No active sessions.
```

When iscsiadm is run for the first time, it creates a default iface config file under the /etc/iscsi/ifaces directory for each of your OCe10102-FM-E / OCe10102-FX CNA portals. You can check the ifaces created by issuing `iscsiadm -m host`.

```
SGELLIN103:/etc/iscsi/ifaces # ls
be2iscsi.00:00:c9:93:c0:73  be2iscsi.00:00:c9:93:c0:75  iface.example

SGELLIN103:/etc/iscsi/ifaces # iscsiadm -m host
be2iscsi: [0] <empty>,[00:00:c9:93:c0:73],<empty> <empty>
be2iscsi: [1] <empty>,[00:00:c9:93:c0:75],<empty> <empty>
```

For each port, you can view the detailed configurations in the iface config file. An example of the default iface config file content is shown next.

```
SGELLIN103:/etc/iscsi/ifaces # cat be2iscsi.00:00:c9:93:c0:73
# BEGIN RECORD 2.0-871
iface.iscsi_ifacename = be2iscsi.00:00:c9:93:c0:73
iface.hwaddress = 00:00:c9:93:c0:73
iface.transport_name = be2iscsi
# END RECORD
```

Table 9 lists a description for each field in the iface config file.

Table 9 iface config file fields

Setting	Description
Ifacename	Iface configuration name
Iface.hwaddress	MAC address of the port
Ip_address	IP address to use for this port
Iface.transport_name	Name of driver

You can update the value of any of the fields above by using `iscsiadm -m iface -o update -I <ifacename>` to set up the interface you require. It will update the iface config file automatically and will be persistent across host reboots.

```
SGELLIN103: # iscsiadm -m iface -I be2iscsi.00:00:c9:93:c0:73
-o update -n iface.transport_name -v be2iscsi -n iface hwaddress
-v 00:00:c9:93:c0:73 -n iface.ipaddress -v 11.10.10.105
be2iscsi.00:00:c9:93:c0:73 updated.

SGELLIN103:/etc/iscsi/ifaces # cat be2iscsi.00:00:c9:93:c0:73
# BEGIN RECORD 2.0-871
iface.iscsi_ifacename = be2iscsi.00:00:c9:93:c0:73
iface.ipaddress = 11.10.10.105
iface.hwaddress = 00:00:c9:93:c0:73
iface.transport_name = be2iscsi
# END RECORD
SGELLIN103:/etc/iscsi/ifaces #
```

With iface configured successfully, you can further discover and log in to target portals and manually bind them to ifaces. To discover a target portal and bind it to a particular iface, using `iscsiadm -m discovery -t -st -p <target ip:port> -I <iface>`, and then log in using `iscsiadm -m node -L all`.

You can check active login sessions by issuing `iscsiadm -m session`. An example is shown next.

```
SGELLIN103:~ # iscsiadm -m discovery -t st -p 11.10.10.100
-I be2iscsi.00:00:c9:93:c0:73
11.10.10.46:3260,3 iqn.1992-04.com.emc:cx.fcntr080600029.b2
12.10.10.99:3260,6 iqn.1992-04.com.emc:cx.fcntr080600029.b8
12.10.10.47:3260,4 iqn.1992-04.com.emc:cx.fcntr080600029.b3
11.10.10.44:3260,1 iqn.1992-04.com.emc:cx.fcntr080600029.a2
12.10.10.45:3260,2 iqn.1992-04.com.emc:cx.fcntr080600029.a3
11.10.10.100:3260,5 iqn.1992-04.com.emc:cx.fcntr080600029.a8

SGELLIN103:~ # iscsiadm -m node -L all
Logging in to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.b2, portal: 11.10.10.46,3260]
Logging in to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.b8, portal: 12.10.10.99,3260]
Logging in to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.b3, portal: 12.10.10.47,3260]
Logging in to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.a2, portal: 11.10.10.44,3260]
Logging in to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.a3, portal: 12.10.10.45,3260]
Logging in to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.a8, portal: 11.10.10.100,3260]
iscsiadm: Could not login to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.b2, portal: 11.10.10.46,3260]:
iscsiadm: initiator reported error (4 - encountered connection failure)
iscsiadm: Could not login to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.b8, portal: 12.10.10.99,3260]:
iscsiadm: initiator reported error (4 - encountered connection failure)
iscsiadm: Could not login to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.b3, portal: 12.10.10.47,3260]:
iscsiadm: initiator reported error (4 - encountered connection failure)
iscsiadm: Could not login to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.a2, portal: 11.10.10.44,3260]:
iscsiadm: initiator reported error (4 - encountered connection failure)
iscsiadm: Could not login to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.a3, portal: 12.10.10.45,3260]:
iscsiadm: initiator reported error (4 - encountered connection failure)
Login to [iface: be2iscsi.00:00:c9:93:c0:73, target: iqn.1992-04.com.emc:cx.fcntr080600029.a8, portal: 11.10.10.100,3260]: successful
iscsiadm: Could not log into all portals. Err 4.

SGELLIN103:~ # iscsiadm -m session
be2iscsi: [1] 11.10.10.100:3260,5 iqn.1992-04.com.emc:cx.fcntr080600029.a8
```

7

Configuring a Boot Device on an EMC Storage Array

With the introduction of the Emulex v7.x-series driver, EMC supports booting RHEL 2.1 and 3.0 hosts from an EMC storage array through an EMC-qualified Emulex Fibre Channel HBA.

With the introduction of the Emulex v8.x-series driver in the kernel, EMC supports hosts booting from EMC storage arrays through an EMC-qualified Emulex Fibre Channel adapter with RHEL 4 and newer updates, RHEL 5 and newer updates, OEL 4 U4 and newer updates, OEL 5 and newer updates, Asianux 2.0 and newer service packs, Asianux 3.0, SLES 9 SP1 and newer service packs, SLES 10 and newer service packs, and SLES 11.

- Cautions and restrictions booting from an EMC storage array 110
- Limitations 124
- Configuring a Symmetrix boot device 128
- Configuring a VNX series or CLARiiON boot device 132
- Installing an operating system on a Symmetrix or CLARiiON 136
- Installing supported RHEL 4, RHEL 5, OEL 4, OEL 5, Asianux 2.0, Asianux 3.0, SLES 9, SLES 10, and SLES 11 operating systems onto the boot device with the Emulex v8.x-series driver 141
- Installing RHEL 5.2 and SLES 10 SP2 operating systems onto a boot device using FCoE Adapters 142
- Upgrading the Linux kernel 145

Cautions and restrictions booting from an EMC storage array

Note the following cautions and restructions when booting from an EMC storage array:

CAUTION

If the Linux host booting from the SAN loses connectivity long enough, the disks will disappear from the system. To prevent further data from being lost in a situation like this, EMC recommends that the error behavior be changed from continue to remount read-only. To make this change, consult the man page for tune2fs. A hard reboot is required to bring the system back to a usable state.

CAUTION

You should configure the host with enough memory to eliminate the need for a swap partition. EMC cannot recommend an amount of memory as this varies greatly depending upon the environment.

EMC recommends shutting down the host server during any maintenance procedures that could make the boot disk unavailable to the host.

Any of these events have the potential to crash a system booting from an EMC storage array:

Symmetrix-specific cautions and restrictions

The following are Symmetrix-specific restrictions:

- Lost connection to Symmetrix system (pulled or damaged cable connection).
- Symmetrix service and upgrade procedures, such as online Symmetrix microcode upgrades and/or configuration changes.
- Symmetrix director failures, including failed lasers.
- Symmetrix system power failure.
- Storage area network service and upgrade procedures, such as firmware upgrades or hardware replacements.

VNX series- and CLARiiON-specific cautions and restrictions

The following are VNX series and CLARiiON-specific restrictions:

- Lost connection to VNX series and CLARiiON array (pulled or damaged cable connection).
- VNX series service and upgrade procedures.
- CLARiiON service and upgrade procedures, such as online CLARiiON FLARE® upgrades and / or configuration changes.
- VNX series and CLARiiON SP failures, including failed lasers.
- VNX series and CLARiiON system power failure.
- Storage area network failures, such as failures in Fibre Channel switches, switch components, or switch power.
- Storage area network service and upgrade procedures, such as firmware upgrades or hardware replacements.
- Trespass of a VNX series and CLARiiON LUN from one SP to the other.

Limitations

This section contains the following limitation information:

- "Common limitations" on page 124
- "Symmetrix-specific limitations" on page 126
- "VNX series- and CLARiiON-specific limitations" on page 126

Common limitations

Boot configurations must not deviate from the following limitations established by EMC:

- LUN 000 must exist on the EMC storage array in order for the SCSI layer to scan all devices on RHEL 4 (all releases), SLES 9 SP1, and Asianux 2.0. In these distributions, the v2.6.x kernel does not allow scanning past a nonexistent LUN 000.

  Note: This issue has been resolved with SLES 9 SP2 and RHEL 4 U3.

  Note: It is recommended that SPC-2 and the SC3 bit be set on the Symmetrix FA ports attached to the host.

- The EMC Storage device must have enough disk space to hold the Linux operating system.
- A maximum of 32 volumes may be configured on the EMC storage array port that will be used to boot Linux.
- EMC recommends that you install, rather than upgrade, the kernel-source and kernel UP, SMP, and enterprise RPMs.
- Linux hosts booting from an EMC storage array are limited to the use of one HBA.
- Hosts booting from an EMC storage array must use the Emulex driver as a module, not statically linked into the kernel.
- Only 32-bit SLES 8 hosts are supported booting from an EMC storage array. 64-bit architectures are not supported.

- The Symmetrix, VNX series, or CLARiiON device that is to contain the Master Boot Record (MBR) for the host must have a lower logical unit number (LUN) than any other device visible to the host. This device must be mapped as `/dev/sda` by the Linux operating system for the boot to succeed from the device.

  Note that this includes the following cases:

  - Volume Logix database device when using Volume Logix in a Symmetrix environment — The installer will fail to write the MBR to this device, as it is write-protected.
    - To force the installer to avoid an attempt to write to this device, EMC recommends masking the LUN. The administrative host must first initialize the Volume Logix database. The LUN may then be masked by modifying the active configuration file to enable the 'fba flag2' to restrict access to the Volume Logix database.
    - An alternative to masking the VCM DB, is to map the Volume Logix database device so that it is the highest LUN presented to the host However, please be aware that the LUN number should not be higher than 254 (FE) if it is to be used by Solutions Enabler or EMC ControlCenter® running on a Microsoft host.

      Note: The EMC-recommended method is to use LUN masking.

  - VNX series or CLARiiON ghost LUN — If no LUN 0 exists in the storage group, a phantom device (LUNZ) will be presented by the array in its place. Additionally, a valid LUN 0 presented via an inactive path acts as a not-ready device. Always ensure that a valid LUN 0 is present in the storage group and that it is owned by the SP connected to the boot HBA. If the boot LUN trespasses, a system crash may result.
- When attaching the Linux host to an EMC storage array, use the adapter in the lowest-numbered PCI slot in the server. To keep the configuration and installation simple, it is recommended that only that single HBA be cabled to the array. Ensure that the boot BIOS or firmware has been applied to your HBA.
- The installer installs the boot block onto only the first disk it sees. This includes SCSI and IDE drives in your system. If only EMC storage array devices are attached to the system, the boot BIOS should be set to the first LUN the HBA sees. If there are other

local disks in the system, you may be forced (depending on how Linux discovers the drives) to put your boot block onto a local disk.

- Some servers present the option of disabling the local drive. If the local drive is disabled, then verify that the boot block is installed on the first EMC storage array device seen by the Linux host.

Symmetrix-specific limitations

The following are Symmetrix-specific limitations:

- When attached to a Symmetrix, the physical-to-logical split must be such that you meet the minimum required disk space required to install the Linux operating system. Refer to your Linux distribution guide for these requirements.
- Prior to the installation on a Symmetrix LUN, the Linux host HBA must have successfully logged into the array. Using Solutions Enabler from another host, at least one LUN must be assigned to the host.
- During the installation procedure, it is recommended, but not required, that only one LUN be allocated to the host for ease of use. Once the installation has completed, additional LUNs may be assigned to the host.
- For RHEL 4.5, boot from a LUN with the VCM gatekeeper existing on a Symmetrix, you may receive an "unhandled exception with ZeroDivisionError" message when partitioning the boot LUN. Remove the VCM gatekeeper from the FA port and the installation will be successful.

VNX series- and CLARiiON-specific limitations

The folloiwng are VNX series- and VNX series- or CLARiiON-specific limitations:

- Prior to the installation on a VNX series or CLARiiON LUN, the Linux host must have been manually registered on the array and assigned to a Storage Group. At least one LUN must be bound to the host's Storage Group and owned by the SP connected to the HBA being used for the fabric boot. The lowest-numbered path to the boot LUN must be the active path.
- It is required that the boot LUN be assigned Host LUN ID 0.

- During the installation procedure, it is recommended that only one LUN be assigned to the Storage Group for ease of use. Once the installation has completed, additional LUNs may be added to the Storage Group.
- Booting from the SAN requires the use a Unisphere / Navisphere Management station with the Unisphere / Navisphere Manager or NaviCLI. The station must be separate from the boot server, but networked to the VNX series or CLARiiON system.

Configuring a Symmetrix boot device

This section describes how to install an EMC-qualified version of Linux onto a Symmetrix system connected to an Intel-based x86 and x86_64 class systems and AMD Opteron-based x86_64 class systems.

Preparing the Symmetrix system

- It is recommended that Volume Logix be enabled on the Symmetrix system for LUN-masking purposes.
- During the installation procedure, only one LUN should be allocated to the host, so that the boot LUN may be identified easily. After the OS installation, additional LUNs may be allocated.
- Create a zone that includes the WWPN of the HBA to be used and one Symmetrix FA port. Add the newly created zone to the zone configuration in the fabric and enable the zone configuration.

Preparing the host

- Create a zone that includes the WWPN of the HBA to be used and one FA port. Add the newly created zone to the zone configuration in the fabric and enable the zone configuration.
- The PCI Fibre Channel HBA must be the lowest-numbered PCI slot in the server. For example, if there are three adapters in the system in slots 2, 4, and 5, connect the cable to the adapter in slot 2. Do not connect cables to other adapters until the installation is complete and the host rebooted.
- SCSI hard disks are allowed in SAN boot configurations. However, the BIOS for the disk's SCSI adapters must be disabled. Any SCSI disks attached to the host should be disconnected during the operating system installation.
- For servers with SCSI CD-ROM drives, ensure that the BIOS is enabled on the SCSI channel that includes the CD-ROM. Disable the BIOS on any other integrated SCSI channels.
- For servers with IDE CD-ROM drivers, disable the BIOS on the server's integrated SCSI adapter(s). The SCSI BIOS is not required to boot from the CD-ROM.

- Disable the BIOS on any other HBAs in the system other than the Emulex HBA designated for booting.

Configuring the Emulex boot BIOS for SAN boot

After the boot BIOS is installed and enabled, it must be configured for use for booting from the SAN. The following procedure describes how to configure the boot BIOS:

1. Connect the Symmetrix Fibre Channel port to the adapter in the lowest-numbered PCI slot in the server. For example, if there are three adapters in the system in slots 2, 4, and 5, connect the cable to the adapter in slot 2. Do not connect cables to the other adapters at this time.
2. Boot the server, and press **ALT-E** when the Emulex banner appears.
3. The first screen of the BIOS setup utility contains a list of all the adapters with the boot BIOS installed. Select **Option 1** from the list, and press **ENTER**.
4. On the next screen, select **Option 2 - Configure This Adapter's Parameters**, and press **ENTER**.
5. Select **Option 4 - Topology** and press **ENTER**.
6. Select **Option 1 - Auto Topology: Loop First (default)** and press **ENTER**.
7. Press **ESC** to return to the **Parameters** menu.

   Select **Option 1 - Enable/Disable Boot BIOS**, and press **ENTER**.
8. If the BIOS is listed as **Disabled**, select **1** to enable it, and press **ENTER**.
9. Press **ESC** to return to the **Parameters** menu.
10. Press **ESC** twice to return to the list of installed adapters.

    Note: It is recommended, but not required, that the boot BIOS be disabled on the other adapters in the system.
11. From the adapter list, select **1** for the adapter to be used for boot, and press **ENTER**.
12. From the **Options** menu, select **Option 1 - Configure Boot Devices**, and press **ENTER**.

13. The next screen displays a list of devices available for use as a boot LUN. Initially, the values are set to 0. However, once the information regarding the boot LUN is obtained, it is logged in this field.

    At the prompt, select the boot entry of **1**. This entry will be used to fill in the information regarding the target boot device.

14. On the next screen, select **00** to clear the selected priority slot, or select the device from which the host will boot. Select the boot device (for example, **01**). This list also provides the LUN number of the first LUN visible on that device.

15. The system prompts you to enter the boot LUN. Type the number of the device from which the system will boot, and press **ENTER**.

16. A list of all available LUNs appears, beginning with the desired boot LUN number. Type the two-digit number next to the desired boot LUN, and press **ENTER**.

    Note: On Symmetrix systems, the LUN number of the first visible device to that port should be used.

17. When prompted to select the option to boot via WWPN or DID, select **1** for **WWPN**, and press **ENTER**.

18. Press **X** to exit from the menu, and select **y** to reboot the system.

19. Reboot the host.

The HBA is now configured to boot from the desired LUN on the Symmetrix system.

What next?

Proceed to the appropriate section, depending upon the Linux operating system to be installed:

- If the OS to be installed is any version of RHEL 2.1 or RHEL 3.0 U2 and U3, proceed to "Installing supported RHEL 2.1 and 3.0 releases onto the EMC storage device with the Emulex v7.x-Series driver" on page 136.
- If the OS to be installed is 3.0 U4 or U5, proceed to "Installing RHEL 3.0 U4 and U5 onto the EMC storage device with the Emulex v7.x-Series driver" on page 138.

- If the OS to be installed is RHEL 3.0 U6, U7, U8, or RHEL 3.9, proceed to "Installing RHEL 3.0 U6 through RHEL 3.9 onto the EMC storage device with the Emulex v7.x-Series driver" on page 138.
- If the OS to be installed is SLES 8 SP4 (32-bit only), proceed to "Installing SLES 8 SP4 for the i386 architecture onto the EMC storage device with the Emulex v7.x-Series driver diskette" on page 139.

Configuring a VNX series or CLARiiON boot device

This section describes how to install an EMC-qualified version of Linux onto an EMC VNX series or CLARiiON storage system connected to an Intel-based x86 and x86_64 class systems and AMD Opteron-based x86_64 class systems.

Preparing the VNX series or CLARiiON system

- It is recommended that Access Logix be enabled on the VNX series or CLARiiON system for LUN masking purposes.
- Boot device support requires a Unisphere / Navisphere Management station with Unisphere / Navisphere Manager or CLI installed. The station must be separate from the server being installed and must be networked to the VNX series or CLARiiON system.
- Before installing Linux onto a VNX series or CLARiiON system, the array must have one bound LUN allocated to the Storage Group for the server being installed. The LUN must be owned by the SP connected to the boot HBA.
- During the installation procedure, only one LUN should be in the boot Storage Group, so that the boot LUN may be identified easily. After the installation, additional LUNs may be added to the host's Storage Group.

Note: If LUNs need to be created, refer to the Unisphere / Navisphere Management software documentation for the array type.

Preparing the host

- Create a zone that includes the WWPN of the HBA to be used and one SP port. Add the newly created zone to the zone configuration in the fabric and enable the zone configuration.
- EMC recommends using port 0 on the SP for consistency.
- The PCI Fibre Channel HBA must be the lowest-numbered PCI slot in the server. For example, if there are three adapters in the system in slots 2, 4, and 5, connect the cable to the adapter in slot 2. Do not connect cables to other adapters until the installation is complete and the host rebooted.

- SCSI hard disks are allowed in SAN boot configurations. However, the BIOS for the disk's SCSI adapters must be disabled. Any SCSI disks attached to the host should be disconnected during the operating system installation.
- For servers with SCSI CD-ROM drives, ensure that the BIOS is enabled on the SCSI channel that includes the CD-ROM. Disable the BIOS on any other integrated SCSI channels.
- For servers with IDE CD-ROM drivers, disable the BIOS on the server's integrated SCSI adapter(s). The SCSI BIOS is not required to boot from the CD-ROM.
- Disable the BIOS on any other HBAs in the system other than the Emulex HBA designated for booting.

Configuring the Emulex boot BIOS for SAN boot

After the boot BIOS is installed and enabled, it must be configured for use for booting from the SAN. The following procedure describes how to configure the boot BIOS:

1. Connect the VNX series or CLARiiON SP Fibre Channel port to the adapter in the lowest-numbered PCI slot in the server. For example, if there are three adapters in the system in slots 2, 4, and 5, connect the cable to the adapter in slot 2. Do not connect cables to the other adapters at this time.
2. Boot the server, and press **ALT-E** when the Emulex banner appears.
3. The first screen of the BIOS setup utility contains a list of all the adapters with the boot BIOS installed. Select **Option 1** from the list, and press **ENTER**.
4. On the next screen, select **Option 2 - Configure This Adapter's Parameters**, and press **ENTER**.
5. Select **Option 4 - Topology** and press **ENTER**.
6. Select **Option 1 - Auto Topology: Loop First (default)** and press **ENTER**.
7. Press **ESC** to return to the **Parameters** menu.

   Select **Option 1 - Enable/Disable Boot BIOS**, and press **ENTER**.
8. If the BIOS is listed as **Disabled**, select **1** to enable it, and press **ENTER**.

9. Press **ESC** to return to the **Parameters** menu.
10. Press **ESC** twice to return to the list of installed adapters.

Note: It is recommended, but not required, that the boot BIOS be disabled on the other adapters in the system.

11. From the adapter list, select **1** for the adapter to be used for boot, and press **ENTER**.
12. From the **Options** menu, select **Option 1 - Configure Boot Devices**, and press **ENTER**.
13. The next screen displays a list of devices available for use as a boot LUN. Initially, the values are set to 0. However, once the information regarding the boot LUN is obtained, it is logged in this field.

    At the prompt, select the boot entry of **1**. This entry will be used to fill in the information regarding the target boot device.
14. On the next screen, select **00** to clear the selected priority slot, or select the device from which the host will boot. Select the boot device (for example, **01**). This list also provides the LUN number of the first LUN visible on that device.
15. The system prompts you to enter the boot LUN. Type the number of the device from which the system will boot, and press **ENTER**.
16. A list of all available LUNs appears, beginning with the desired boot LUN number. Type the two-digit number next to the desired boot LUN, and press **ENTER**.

Note: On VNX series or CLARiiON systems, the desired boot LUN is 00. On Symmetrix storage arrays, the LUN number of the first visible device to that port should be used.

17. When prompted to select the option to boot via WWPN or DID, select **1** for **WWPN**, and press **ENTER**.
18. Press X to exit from the menu, and select **y** to reboot the system.
19. Reboot the host.

The HBA is now configured to boot from the desired LUN on the VNX series or CLARiiON system.

What next? Select the appropriate section depending upon the Linux operating system to be installed:

- If the OS to be installed is any version of RHEL 2.1 or RHEL 3.0 U2 and U3, proceed to "Installing supported RHEL 2.1 and 3.0 releases onto the EMC storage device with the Emulex v7.x-Series driver" on page 136.
- If the OS to be installed is 3.0 U4 or U5, proceed to "Installing RHEL 3.0 U4 and U5 onto the EMC storage device with the Emulex v7.x-Series driver" on page 138.
- If the OS to be installed is RHEL 3.0 U6, proceed to "Installing RHEL 3.0 U6 through RHEL 3.9 onto the EMC storage device with the Emulex v7.x-Series driver" on page 138.
- If the OS to be installed is SLES 8 SP4 (32-bit only), proceed to "Installing SLES 8 SP4 for the i386 architecture onto the EMC storage device with the Emulex v7.x-Series driver diskette" on page 139.

Installing an operating system on a Symmetrix, VNX series, or CLARiiON

This section includes the following information for installing an operating system on a Symmetrix, VNX series, or CLARiiON:

- "Installing supported RHEL 2.1 and 3.0 releases onto the EMC storage device with the Emulex v7.x-Series driver," next
- "Installing RHEL 2.1 and 3.0 onto the EMC storage device with the Emulex v7.x-Series driver diskette" on page 137
- "Installing RHEL 3.0 U4 and U5 onto the EMC storage device with the Emulex v7.x-Series driver" on page 138
- "Installing RHEL 3.0 U6 through RHEL 3.9 onto the EMC storage device with the Emulex v7.x-Series driver" on page 138
- "Installing SLES 8 SP4 for the i386 architecture onto the EMC storage device with the Emulex v7.x-Series driver diskette" on page 139

Installing supported RHEL 2.1 and 3.0 releases onto the EMC storage device with the Emulex v7.x-Series driver

EMC supports specific kernel revisions of both RHEL 2.1 and 3.0 booting from the SAN. Currently, RHEL AS/ES 2.1 v2.4.9-e.49 and v2.4.9-e.57 and RHEL 3.0 v2.4.21-15.EL through v2.4.21-20.EL are supported. Please refer to the *EMC Support Matrix* for the most recent information.

The kernel versions listed above for RHEL 2.1 and 3.0 do not include any Emulex driver. Therefore, in order to boot from the SAN, a driver diskette image must be created for these kernel revisions.

The driver diskette will provide the correct driver and information necessary for the Red Hat Installer to access the EMC storage array devices presented over the fabric. The driver diskette installation method allows devices to be discovered at installation time, for which the device drivers are not part of the standard distribution.

The process of building a driver diskette for RHEL is described in detail on several websites. The following website provides details and supplementary information on the build process: http://people.redhat.com/dledford. Doug Ledford's website

contains the necessary kit to build driver diskettes, as well as detailed information on the function and development of driver diskettes.

The entire build process must be performed on a Red Hat host that contains the kernel source tree for the target version of RHEL for which the driver diskette is being built. To ensure that the necessary source tree exists, the most straightforward method is to install the kernel source RPMs from the RHEL 2.1 or 3.0 distributions.

Follow the instructions as specified on Doug Ledford's website to build the driver diskette image. Once the driver diskette has been successfully created, the installation may be performed.

Installing RHEL 2.1 and 3.0 onto the EMC storage device with the Emulex v7.x-Series driver diskette

Using the driver diskette created in the previous section, the installation of RHEL 2.1 or 3.0 may be performed. Before beginning the installation, performs the steps described under the Configuring the Boot BIOS section.

To install RHEL with a driver diskette onto the EMC storage array device, use the following steps:

1. Boot the server to be installed.
2. At the `boot:` prompt, type the command **`linux dd`** (Linux driver diskette), and press **ENTER**.
3. You will be prompted with the question:

   Do you have a device driver disk?

   Select **YES**.
4. You are then prompted to perform the following:

   `Insert your driver disk and press OK to continue.`

   Insert the device driver diskette as instructed, and select **OK**.
5. When asked for the type of installation to perform, select **Custom**.

   By selecting the **Custom** installation option, you will have complete control of the boot device selection and manipulation.

   From this point, follow the normal installation process.

Although EMC does not make recommendations on the installation selections, it is worthwhile to create a boot diskette for the installation to aid in troubleshooting possible connectivity problems.

On completion of the installation, the system will boot into the RHEL OS selected.

Installing RHEL 3.0 U4 and U5 onto the EMC storage device with the Emulex v7.x-Series driver

The Emulex v7.1.14 driver ships as the default in both RHEL 3.0 U4 (v2.4.21-27.EL kernel) and U5 (v2.4.21-32.EL kernel).

As of the date this document was written, booting from the SAN is supported with RHEL 3.0 U4 and U5 for 32-bit, AMD64, and EM64T architectures, but not Itanium. Refer to the *EMC Support Matrix* for the latest information on supported distributions, kernels, and architectures.

Since the Emulex v7.1.14 driver is integrated into the RHEL 3.0 U4 and U5 kernels, there is no need to create a driver diskette image.

Before beginning the installation, performs the steps described in the appropriate section for the EMC storage array being used:

- "Configuring a Symmetrix boot device" on page 128
- "Configuring a VNX series or CLARiiON boot device" on page 132

Using the RHEL 3.0 U4 CDs, boot the server to be installed. The installation may now be performed as it would when using an internal disk drive.

Installing RHEL 3.0 U6 through RHEL 3.9 onto the EMC storage device with the Emulex v7.x-Series driver

RHEL 3.0 U6 through RHEL 3.9 ship with the Emulex v7.3.x driver as the default driver in the kernel, refer to Table 5 on page 52 for the appropriate version.

As of the date this document was written, booting from the SAN is supported with RHEL 3.0 U6 through RHEL 3.9 for 32-bit, AMD64, and EM64T architectures, but not Itanium. Refer to the *EMC Support Matrix* for the latest information on supported distributions and architectures.

Since the Emulex v7.3.x driver is integrated into the kernel of RHEL 3.0 U6 through RHEL 3.9, there is no need to create a driver diskette image.

Before beginning the installation, perform the steps described in the appropriate section for the EMC storage array being used:

- "Configuring a Symmetrix boot device" on page 128
- "Configuring a VNX series or CLARiiON boot device" on page 132

Using the CDs for your Red Hat Enterprise Linux 3.0 install, boot the server to be installed. The installation may now be performed as it would when using an internal disk drive.

Installing SLES 8 SP4 for the i386 architecture onto the EMC storage device with the Emulex v7.x-Series driver diskette

EMC supports specific kernel revisions of SLES 8 SP4 for the i386 architecture booting from the SAN. Please refer to the *EMC Support Matrix* for the most recent information.

The Emulex v1.23a driver included in the SLES 8 SP4 distribution is not supported and must be replaced with the v7.x series driver. Since the v7.x series driver is not integrated into the SLES 8 SP4 kernel, a driver diskette image is required for the Emulex 7.x-series driver when booting from the SAN.

The driver diskette image for SLES 8 SP4 may be downloaded from the Linux Tools section on the Emulex website.

1. Download the driver diskette image, and save it to a local directory on a host other than the host that is to boot from the SAN.
2. Uncompress the driver diskette image:

   ```
   gunzip dd-emulex-20050517.img.gz
   ```

3. Write the driver diskette image to a floppy diskette:

   ```
   dd if=dd-emulex-20050517.img of=/dev/fd0
   ```

4. Boot the host system from the SLES 8 SP4 CD with the driver diskette floppy in the floppy drive, and begin the installation. The SLES 8 SP4 installation automatically searches the floppy and will load the lpfc driver during the installation.

Do not remove the SLES 8 SP4 CD from the CD-ROM driver until the installation program prompts for the SLES 8 CD 1.

Note: A separate /boot partition should be created during the installation.

When the SLES 8 SP4 kernel is upgraded to a newer kernel version, the Emulex driver will revert to the default 1.23a driver that is integrated into the kernel. As a result, the Emulex v7.x-series driver must be reinstalled.

Using YaST2, perform the Online Update to update the system kernel to the desired revision.

Rename, or if desired, delete, the existing v1.23a driver modules. To rename the driver modules, run the following commands:

cd /lib/modules/2.4.21-292-smp/kernel/drivers/scsi/lpfc

mv lpfcdd.o lpfcdd_123a.o

mv lpfndd.o lpfndd_123a.o

After the v1.23a drivers are renamed, the installer script provided in the Emulex v7.x-series driver tar archive should be used to compile the v 7.x-series driver. Refer to "Installing the Emulex v7.x-Series driver" on page 68 for further instructions.

Installing supported RHEL 4, RHEL 5, OEL 4, OEL 5, Asianux 2.0, Asianux 3.0, SLES 9, SLES 10, and SLES 11 operating systems onto the boot device with the Emulex v8.x-series driver

RHEL 4 or newer updates, RHEL 5, and newer updates, OEL 4 U4 and newer updates, OEL 5 and newer updates, Asianux 2.0 and newer service packs, Asianux 3.0, SLES 9 SP1or newer service packs, SLES 10 or newer service packs, , and SLES 11 or newer service packs, include Emulex device drivers as part of their distribution. EMC recommends that these drivers be used during the initial OS installation. After completing the installation, it may be required that the driver be upgraded to the latest supported Emulex driver and corresponding Application Helper Module (lpfcdfc driver) as posted in the *EMC Support Matrix*.

Note: EMC recommends, but does not require, installing the Emulex Application Kit.

Installing RHEL 5.2 and SLES 10 SP2 operating systems onto a boot device using FCoE Adapters

EMC supports booting from an array device in FCoE environments with RHEL 5.2 and SLES 10 SP2 operating systems.

Because RHEL 5.2 and SLES 10 SP2 distributions do not have in-kernel support for the Emulex FCoE adapters, Emulex provides a special "DD" driver package to allow loading of the FCoE adapter driver at install time, which allows for installing to an array device. These driver packages are available from the EMC-supported section of the Emulex website.

The DD driver package is available as a floppy disk image and a CD image, which can be copied to the respective media, based on the removable storage options in the host platform.

RHEL 5.2 OS SAN-boot installation with Emulex FCoE adapters

To install RHEL 5.2 SAN-boot with Emulex FCoE adapters:

1. Obtain the appropriate "DD" driver kit for the Emlux FCoE adapter from the EMC-supported section of the Emulex website, and copy it to the appropriate media (floppy disk or CD).
2. Insert RHEL 5.2 product CD #1 in the CD drive and boot the system.

   The system boots from the CD and stops at the boot prompt.
3. At the boot prompt, type:

   linux dd

   and then press **ENTER**.

   The **Driver Disk** message box displays the prompt:

   ```
   Do you have a driver disk
   ```

   Select **YES**, then press **ENTER**.
4. From the **Driver Disk Source** window, select the driver source:

   - If the driver file is on a disk, select fd0, then press **ENTER**.
   - If the driver file is on a CD, select **hd*x*** (where *x*=CD drive letter), then press **ENTER**.

   The **Insert Driver Disk window** displays.

5. Insert the disk (described in Step 1) into either the floppy disk drive or the CD drive, depending on the option selected in Step 4.
6. Click **OK**, then press **ENTER**.

   The SCSI driver is loaded automatically.
7. The **Disk Driver** window displays, prompting for more drivers to install. Click **NO**, then press **ENTER**.
8. Insert the current Linux Red Hat product CD #1 in the CD drive (remove the iso-dd-kit CD first if necessary), then press **ENTER**.
9. Follow the on-screen instructions to complete the installation.

SLES 10 SP2 OS SAN-boot installation with Emulex FCoE adapters

To install SLES 10 SP2 SAN-boot with Emulex FCoE adapters:

1. Obtain the appropriate "DD" driver kit for the Emulex FCoE adapter from the EMC-supported section of the Emulex website, and copy it to the appropriate media (floppy disk or CD).
2. Insert the SLES 10 CD #1 in CD drive and boot the system.
3. On the main installation screen, press **F5**.
4. The system prompts you to select **Yes**, **No**, or **File**.

   Select **Yes**.
5. Select the installation option, then press **ENTER**

   In response to the following prompt:

   ```
   Please choose the driver update medium.
   ```

   b. Make sure the dd-kit is inserted in proper drive (i.e., CD-ROM or Floppy).

   c. Select appropriate drive, then press **ENTER**. This loads the driver update to the system.
6. If the driver update was successful, the following message displays:

   ```
   Driver Update OK.
   ```

   Press **ENTER**.
7. If the system prompts you to update another driver, click **BACK**, then press **ENTER**.

The following message displays:

```
Make sure that CD number 1 is in your drive.
```

8. Put SLES 10 CD 1 in the drive and press **OK**.
9. Follow the on-screen instructions to complete the installation.

Upgrading the Linux kernel

After successfully completing the installation and rebooting your host, you may want to upgrade the kernel to newer errata to take advantage of fixes and features incorporated into the kernel errata.

EMC recommends installing the kernel packages, rather than upgrading, so that either kernel version may be used for boot. Also, if you have created a boot diskette, an updated diskette should be created after the upgrade.

After upgrading the kernel, however, it is required that the supported Emulex driver be installed and included as part of the RAM disk.

8 Additional Notes

This chapter provides additional notes to consider.

- Ethernet connectivity over the CNA 148
- Using the Emulex lun-scan script 149
- Device reconfiguration procedures 151
- Device reconfiguration: Device numbering 154
- HPQ server-specific note 155
- LUN 000 requirement for the Linux v2.6.x kernel 156
- Linux device-naming convention 157
- Device reconfiguration procedures 161
- Rescanning the SCSI bus 164
- Incorporating EMC Fibre Channel 165

Ethernet connectivity over the CNA

The Emulex FCoE CNA delivers lossless 10 Gb/s Enhanced Ethernet support with dynamic allocation of networking and storage bandwidth that may be used for either system ethernet or iSCSI traffic, as well as FCoE. The Linux driver that supports the ethernet and iSCSI traffic for this device is ixgbe. The driver will automatically be installed and loaded by your supported Linux distribution.

To configure the network capabilities of your Emulex CNA, refer to your Linux distributor's network administrator's guide for more details. If you are configuring your CNA for iSCSI traffic, refer to the *EMC Linux iSCSI Attach Release Notes* found on http://powerlink.emc.com for the iSCSI configuration after configuring the network first.

Using the Emulex lun-scan script

Contained on the EMC approved web page of the Emulex website is a script called `lun_scan.sh`, which allow you to dynamically (without a reboot or driver unload/reload) discover new targets and LUNs (on new or existing targets) that have come online. This script is located at the following URL:

`http://www.emulex.com/ts/downloads/linuxfc/linux_tools.html`

This script may be integrated into the system run-level transitions to ensure that all devices are fully detected.

Note: It is highly recommended that a rescan of the SCSI bus should not be conducted while you are running IO. The dynamic discovery and insertion of LUNs while IO is running on applications may cause unforeseen errors to occur on the IO in flight. The benefit of the dynamic scanning of the SCSI bus is to reduce the need to reboot the server.

The `lun_scan.sh` script may be used to scan all of the Emulex adapters or a specific Emulex adapter. If the `lun_scan.sh` script is run without specifying parameters, the output is as follows:

```
[root@l82bi250 /]# lun_scan.sh
Usage: lun_scan [ <#> [<#>] | all ]
```

where

is a SCSI host number of a specific lpfc HBA that is to be scanned. More than 1 host number can be specified.

all indicates that all lpfc HBAs are to be scanned.

Example:

```
lun_scan all : Scans all lpfc HBAs
lun_scan 2 : Scans the lpfc HBA with scsi host number 2
lun_scan 2 4 : Scans the lpfc HBAs with scsi host number 2 and 4
Warning: Scanning an adapter while performing a tape backup should
be avoided.
```

Examples of the usage of the script are:

- To obtain the SCSI host number of the Emulex adapters within the system, refer to the /proc filesystem:

  ```
  [root@l82bi250 /]# ls /proc/scsi/lpfc/
  2 3
  ```

  In this particular system, the Emulex adapters are listed as SCSI host numbers 2 and 3.

To scan on a single Emulex adapter, run the command plus the desired host number. For example:

```
[root@l82bi250 /]# lun_scan.sh 2
Scanning lpfc2, scsi host number : 2
```

- If the system contained multiple Emulex adapters, the command could be run with specific SCSI host numbers.

  For example, this system has four Emulex adapters:

  ```
  [root@l82bi183 /]# ls /proc/scsi/lpfc/
  2 3 4 5
  ```

  To rescan the SCSI bus for LUNs on some of the adapters, the SCSI host numbers for those adapters may be specified:

  ```
  [root@l82bi250 /]# lun_scan.sh 2 5
  Scanning lpfc2, scsi host number : 2
  Scanning lpfc5, scsi host number : 5
  ```

- To rescan the LUNs on all of the Emulex adapters within the system, execute the following:

  ```
  [root@l82bi183 /]# lun_scan.sh all
  Scanning lpfc2, scsi host number : 2
  Scanning lpfc3, scsi host number : 3
  Scanning lpfc4, scsi host number : 4
  Scanning lpfc5, scsi host number : 5
  ```

Device reconfiguration procedures

The Linux v2.6.x kernel lacks a command built into the kernel that allows for a dynamic SCSI bus reconfiguration such as `drvconfig` or `ioscan`.

The SCSI bus may be rescanned with a system reboot, or with a removal and reinsertion of the modular driver. In either case, all I/O must be stopped and all other mounted filesystems must be unmounted before rebooting or removing the modular driver.

Note: In the Linux v2.6.x kernel, the adapter numbers will increment in the `/proc` filesystem with each reinsertion of the Emulex driver.

Rebooting the host

Rebooting the host allows for the reliable detection of newly added devices. The host may be rebooted after all I/O has been stopped.

Unloading and reloading the modular Emulex driver

Depending upon the hardware configuration, it is possible to unload and reload the modular Emulex driver. This driver removal from and reinsertion into the kernel causes a scan of the SCSI bus and causes the driver to detect any newly added device(s).

If the driver is to be removed from and then reinserted into the kernel, perform the following before removing the driver:

1. Stop all I/O.
2. Unmount all filesystems attached to the Emulex driver.
3. If the Unisphere Host Agent or Navisphere Agent/CLI is installed and enabled on the host, stop the Unisphere Host Agent or Navisphere Agent service by typing one of the following commands:
   - For the Unisphere Host Agent:

     /etc/init.d/hostagent stop

     or

     service hostagent stop

- For the Navisphere Host Agent:

  /etc/init.d/naviagent stop

  or

  service naviagent stop

4. If PowerPath is installed and enabled on the host, stop the PowerPath service by typing one of the following commands:

   /etc/init.d/PowerPath stop

   or

   service PowerPath stop

5. If the Emulex Applications Helper Module is installed and enabled on the host, remove the `lpfcdfc` module from the currently running kernel prior to the `lpfc` driver.

   To unload the Emulex drivers, type both of the following commands:

   modprobe -r lpfcdfc

   modprobe -r lpfc

   The **modprobe** command is a wrapper or an extension to the `insmod` and `rmmod` commands. The **modprobe** command uses and maintains a set of files that describe all the modules that are available for the current kernel in `/lib/modules`.

   The **modprobe** command may be used to load and unload an entire set of modules. (A set of modules can be a single module or a stack of dependent modules.) The **modprobe** command automatically loads all of the dependent modules needed in a module stack based on the information in `modules.dep`.

   Note: EMC recommends using **modprobe** to load and unload the Emulex modular drivers.

   The loading of the module is accomplished with either **modprobe** or **insmod**. These commands are used to install loadable kernel modules into a running kernel. The commands will attempt to link a module into the running kernel by resolving the symbols from the kernel's exported symbol table.

The unloading of the module can be accomplished with the **modprobe** (with the `-r` switch) command or the **rmmod** command. These commands are used to unload the loadable modules from the running kernel if they are not in use and if other modules are not dependent upon them.

As mentioned previously, if the Emulex Application Helper Module is installed and loaded, you must remove it before the standard Emulex lpfc driver.

- lpfcdfc — The Application Helper Module (lpfcdfc driver) that is used to communicate with the Emulex adapters and to query information and perform maintenance on the Emulex adapters.
- lpfc — The low-level Emulex Linux adapter driver module.

Device reconfiguration: Device numbering

In the Linux v2.6.x kernel, SCSI addresses are not used in the device file names as they are in other types of UNIX (Sun, SGI, HP-UX, and BSD, for example). Block device filenames take the form `/dev/sd`*`l`*`n`, where *l* is the letter denoting the physical drive and *n* is the number denoting the partition on that physical drive. Disk device file names and major and minor numbers are assigned dynamically at boot time or device loading time in the order of discovery.

Depending upon the hardware configuration, if a device is added and the system rebooted, the device numbering might change, possibly rendering the host's mount table inaccurate. For the most consistent results and to reduce the possibility of mount table inaccuracies, new devices should be appended (if possible) to the list of already attached devices. For example, if the host contains multiple adapters, it is best to append the new device to the last adapter and to the end of the device list attached to that adapter. This would eliminate the need to alter the preexisting entries in the mount table, since the new device could be appended to that as well.

If a new device were added to the first out of two adapters and the system rebooted, the device file names will shift by one number and the mount table entries will also shift by one device file name. If there is only one adapter, the new device can more easily be appended to the list of the regularly attached devices and the mount table altered accordingly.

HPQ server-specific note

When using Compaq systems, it is highly recommended that the Compaq SmartStart CD be run to configure the Compaq server prior to installing the Linux operating system. The SmartStart CD is shipped by Compaq with their systems, and is a bootable CD that is used to configure Compaq servers. If another operating system is selected other than Linux, there may be problems installing the operating system or using the drivers installed in the kernel.

Follow these steps to select Linux as the primary operating system from the Compaq SmartStart CD:

1. Boot the Compaq server using the SmartStart CD.
2. Select the **System Configuration Utility**.
3. Once the System Configuration Utility has started, a window titled **Steps in Configuring Your Computer** appears, with the following options listed:
   - **Step 1: Important System Configuration Information**
   - **Step 2: Add or Remove Boards**
   - **Step 3: View or Edit Details**
   - **Step 4: Examine Switches or Print Report**
   - **Step 5: Save and Exit**

   Select **Step 3: View or Edit Details**.
4. In the new window, select **Primary Operating System** (the first item in the list); then select **Unix** from the list of possibilities.
5. Another list of UNIXes appears; select **Linux** from this list.
6. Select **ENTER**; then select **<F10> Done**.
7. The console returns to the **Steps in Configuring Your Computer** window. Select **Step 5: Save and Exit**.

   When prompted, select **Save the configuration and restart the computer**.
8. When prompted again to save your configuration and reboot, press **ENTER** to reboot the system.
9. You may then proceed with installing your operating system.

LUN 000 requirement for the Linux v2.6.x kernel

LUN 000 must exist on the EMC storage array in order for the SCSI layer to scan all devices on RHEL 4 (all releases), SLES 9 SP1, and Asianux 2.0. In these distributions, the v2.6.x kernel does not allow scanning past a nonexistent LUN 000.

Note: This issue has been resolved with SLES 9 SP2 and RHEL 4 U3.

Note: It is recommended that SPC-2 and the SC3 bit be set on the Symmetrix FA ports attached to the host.

Linux device-naming convention

The four high-level device drivers in Linux are:

- `sd` – Direct access (disks)
- `sg` – SCSI generic interface
- `sr` – Data CD-ROMs
- `st` – Tapes

The `sg` driver is a character-based device while the other three drivers are block-based devices. The `sg` driver is used primarily for scanners, CD writers, and printers. The `sg` device files are dynamically mapped to SCSI IDs/LUNs on the SCSI bus starting with the first SCSI controller.

Block device file names

A native device file name for block devices takes the following form:

`/dev/sd`*`LN`*

where:

- *`L`* is a letter denoting the physical drive.and Configuring the HBA and Driver.
- *`N`* is a number denoting the partition on that physical drive.

Note: Usually, the partition number is not included when referring to the entire drive.

Following this format, the filenames are as follows:

```
/dev/sd[a-d][a-z][1-15]
```

The Linux kernel reserves 16 major numbers for SCSI devices. Each major number can have zero to 255 minor numbers. These minor numbers include the partitions for a SCSI device. Linux supports one to 15 partitions per disk device. Partitions 1 through 4 are the primary partitions, while partitions 5 and greater are the logical or extended partitions. These limitations are specific to the Intel platform. By default, slices are not used in Linux.

Therefore, the product of 16 major numbers and 16 minor numbers yields 256 SCSI devices. As a result, the kernel is able to scan logical devices ranging from 0 through 255. Red Hat Linux distributions and

SuSE SLES 7 support a maximum of 128 SCSI devices as opposed to the SuSE SLES 8 distribution, which supports all 256 SCSI devices. The 256 total of SCSI devices includes any non-EMC storage array devices, such as local disks.

Red Hat distributions

Red Hat Linux distributions can scan LUN numbers from 0 through 255; however, only the first 128 SCSI devices discovered by the system will be mapped to an `sd` device. Any gaps in devices presented to the system will not result in gaps in the `sd` device names.

Note: The first device may be a non-zero LUN.

Examples:

- If you have allocated devices 0 through 255 to the Linux host, it will be able to scan up to 255; however, only the first 128 devices (0 through 127) will be usable and accessible by the host.
- If you have LUNs 128 through 255 assigned to a Linux host, you will be able to scan through and use all of them.
- If you have LUNs 256 or above exported to a Linux host, the Linux hosts will neither see nor be able to access those devices with an address over 256.

In total, a Red Hat host could support disk devices from /dev/sda through /dev/sddx.

SuSE distributions

For SuSE distributions prior to SLES 8, the limitations are the same as for Red Hat distributions. SuSE SLES 8 is different in that it supports up to 256 devices by default as it reserves 16 major numbers for SCSI devices.

Each major number is allocated 0 to 255 minor numbers that are used to denote the partitions for a SCSI device. Therefore, a product of 16 major numbers and 16 minor numbers yields up to 256 SCSI devices. As a result, the kernel is able to scan logical devices ranging from 0 through 255. These disk devices would be reported as `/dev/sda` through `/dev/sdiu`.

Therefore, if you have allocated LUNs from 0 through 255 to the SLES 8 Linux host, the host can scan and use all 256 logical units. However, just as with Red Hat distributions, if you present logical units over 256 to a Linux host, the host will neither see nor be able to access those devices with an address of over 256.

PowerPath examples

When EMC PowerPath® is installed, keep in mind that there is a limitation of 128 SCSI devices total per system, *not* per adapter.

- Example without PowerPath — If you have two HBAs or a dual channel HBA and you want both ports / HBAs to see and access devices; you must split the 128 devices between the two HBAs. For example, 64 devices would be allocated to each HBA. If you allocate 128 devices to the first HBA, the second HBA will not be able to access any devices. The limitation of 128 SCSI devices is in the Linux SCSI subsystem and is per system, *not* per adapter.
- Example with PowerPath — Keep in mind that if you present 128 LUNs to a Linux host to one HBA, then only that one HBA will be able to see and access devices.

  In the case of PowerPath, if you have eight HBAs in a server and plan to have two paths per HBA, you will be left with only eight devices per HBA:

  ```
  128 LUNs/ (8 HBAs * 2 paths) = 8 devices
  ```

Character device file names

The corresponding character device file names take the following form:

```
/dev/sgN
```

where *N* begins with zero and increments by one.

The use of the alphabetic sg device file names

```
/dev/sg[a-d][a-z]
```

are now deprecated and are used as links to the sg numeric device filenames.

Current versions of the Solutions Enabler and the included inquiry utility require the existence of the deprecated alphabetic SCSI generic

device file names. Not all Linux distributions provide corresponding sg device file names for the sd device file names. Additionally, since the alphabetic sg device file names are deprecated, some distributions, such as SuSE SLES 8 do not provide them at all. For example, on Red Hat releases there are generally 128 sd device file names, 16 sg numeric file names, and 16 sg alphabetic file names. On SuSE SLES 8, there are 256 sd device file names, 64 sg numeric file names, and no sg alphabetic device file names.

In order for `inquiry` and other Solutions Enabler commands to complete successfully, the sg alphabetic file names must exist and be linked to the sg numeric. You can use mknod to create any sg numeric file names needed and use ln to create the link from the sg numeric to the SG alphabetic.

Note: The Linux kernel assigns minor SCSI device numbers dynamically by assigning them only to devices that are actually connected to the host in the order of their SCSI IDs. This means that connecting an external SCSI device can change the minor numbers of all the internal SCSI devices with a higher SCSI ID.

Device reconfiguration procedures

Linux currently lacks an actual kernel command that allows for a dynamic SCSI channel reconfiguration like `drvconfig` or `ioscan`.

The three methods of reconfiguring devices on a Linux host are:

- Rebooting the host
- Unloading and reloading the modular Emulex driver
- Echoing the `/proc` filesystem

Rebooting the host

Rebooting the host allows reliable detection of newly added devices. The host may be rebooted after all I/O has stopped, whether the driver is modular or statically linked.

Unloading and reloading the modular Emulex driver

Depending upon the hardware configuration and on whether the Emulex driver has been loaded into the kernel as a module, the Emulex driver may be unloaded and then reloaded. If the Emulex driver has been loaded as a module, this unloading and reloading will cause a scan of the SCSI bus. The driver should detect the newly added device(s).

If, however, the modular driver is to be removed from and then reinserted into the kernel, the following must be done before removing the driver:

1. Stop all I/O.
2. Unmount all filesystems attached to the Emulex driver.
3. If the Unisphere Host Agent or Navisphere Agent/CLI is installed and enabled on the host, stop the Unisphere Host Agent or Navisphere Agent service by typing one of the following commands:
   - For the Unisphere Host Agent:

     /etc/init.d/hostagent stop

     or

     service hostagent stop

- For the Navisphere Host Agent:

  /etc/init.d/naviagent stop

  or

  service naviagent stop

4. If PowerPath is installed and enabled on the host, stop the PowerPath service with one of the following commands:

   /etc/init.d/PowerPath stop

   or

   service PowerPath stop

5. If the Emulex Application Kit has been installed, stop the Discovery Server and Remote Management Server processes with the following commands:

   /etc/init.d/ElxDiscSrv stop

   /etc/init.d/ElxRMSrv stop

6. Unload the lpfcdfc driver before unloading the lpfc driver.

   Use the **modprobe** command to remove the drivers:

   ```
   modprobe -r lpfcdfc
   modprobe -r lpfc
   ```

   The **modprobe** command is a wrapper or an extension to `insmod` and **rmmod**. The command uses and maintains a set of files that describe all the modules that are available for the current kernel in `/lib/modules`. The **modprobe** command can be used to load and unload an entire set of modules. (A set of modules can be a single module or a stack of dependent modules.) When **modprobe** is used, it automatically loads all of the modules needed in a module stack based on the information in `modules.dep`. EMC recommends using **modprobe** to load and unload the Emulex modular drivers.

   The loading of the module is accomplished with either **modprobe** or **insmod**. These commands are used to install loadable kernel modules into a running kernel. The commands will attempt to link a module into the running kernel by resolving the symbols from the kernel's exported symbol table.

The unloading of the module can be done with either the **modprobe** (with the -r switch) or **rmmod** command. These commands are used to unload the loadable modules from the running kernel if they are not in use and if other modules are not dependent on them.

Echoing the /proc filesystem

If the `/proc` filesystem is enabled in the kernel, echoing the `/proc` can be used to add and/or remove single SCSI devices. To add a device, you must first identify the host, channel, target ID and LUN numbers for the device to be added to `/proc/scsi/scsi`.

The command to be run follows this format:

echo "scsi add-single-device 0 1 2 3" > /proc/scsi/scsi

where:

0 is the host ID.
1 is the channel ID.
2 is the target ID.
3 is the LUN.

This command will add the new device to the file `/proc/scsi/scsi`. If one does not already exist, a device file name may need to be created via for this newly added device in the `/dev` directory.

To remove a device, use the appropriate host, channel, target ID, and LUN numbers and issue a command similar to the following:

echo "scsi remove-single-device 0 1 2 3" > /proc/scsi/scsi

where:

0 is the host ID.
1 is the channel ID.
2 is the target ID.
3 is the LUN.

Rescanning the SCSI bus

The SCSI bus may be rescanned with a system reboot, or with a removal and reinsertion of the modular driver. In either case, all I/O must be stopped and all other mounted file systems must be unmounted before rebooting or removing the modular driver.

If the SCSI bus is not rescanned or the Unisphere/Navisphere Agent service not stopped, attempts to make a new filesystem with `mkfs` on the newly created partition will fail.

Incorporating EMC Fibre Channel

After the EMC storage array has devices assigned with device addresses and the directors have been switched on line, the host can see all the target EMC devices assigned to that host interface. Devices are presented to the host in the same manner as devices accessed through a standard SCSI interface.

A

Special Instructions

This appendix contains special instructions for the following:

- CLARiiON “Ghost” LUN reported with the Emulex v7.1.14 and v7.3.2 drivers (PQB filter) 168
- (CLARiiON only): Required /etc/modules.conf edit for RHEL 2.1, RHEL 3.0, and SLES 8.0 default modular kernels 171
- (CLARiiON only): Linux Navisphere Agent/CLI limitation with fdisk on CLARiiON 174
- (CLARiiON only): Linux Navisphere Naviagent/CLI limitation with VERITAS Volume Manager v3.2 on CLARiiON 177
- (CLARiiON only): Linux Navisphere Agent requirement for RHEL 2.1 Intel Itanium systems 178
- (CLARiiON Only): Linux Navisphere Agent requirement for RHEL 3.0 Intel Itanium systems 179

CLARiiON “Ghost” LUN reported with the Emulex v7.1.14 and v7.3.2 drivers (PQB filter)

EMC supports the Emulex v7.1.14 driver that is integrated into the RHEL 3.0 U4 (v2.4.21-27.EL) and U5 (v2.4.21-32.EL) kernels and the Emulex v7.3.2 driver that is integrated into RHEL: 3.0 U6. When using these quarterly updates and the integrated Emulex driver, parameter value modifications must be made via an edit to `/etc/modules.conf`, rather than `lpfc.conf`.

When running these RHEL 3.0 quarterly updates in CLARiiON environments, it is highly recommended that the **lpfc_inq_pqb_filter** parameter be enabled. In certain environments, there have been cases where the SCSI mid-layer exits a SCSI disk scan incorrectly or prematurely due to a mishandling of the response from the `INQUIRY` command.

The following are symptoms of this issue:

1. When an initiator is zoned to multiple targets on the same CLARiiON storage system, the scan of the SCSI bus will succeed and the list of devices on the first initiator-target pair will be enumerated. However, the SCSI bus scan is not issued on any targets, other than the first. The premature exit of the SCSI bus scan results in the reporting of a “ghost” LUN for each instance of a failed initiator-target pair, as well as an incomplete enumeration of the available disks using the failed initiator-target pairs, and the unavailability of target-side failover.
2. If a SCSI host initiator is zoned to only one target on a CLARiiON storage system, the initiator incorrectly enumerates a "ghost" LUN in addition to the actual devices in the host Storage Group.

The CLARiiON “ghost” LUN is reported in the `/proc/scsi/scsi` file as a DGC Direct-Access device, but no Model type is displayed.

An example of this incorrect reporting is shown below:

```
more /proc/scsi/scsi
Host: scsi2 Channel: 00 Id: 00 Lun: 00
  Vendor: DGC      Model: RAID 5           Rev: 0207
  Type:   Direct-Access                    ANSI SCSI revision: 04

Host: scsi2 Channel: 00 Id: 00 Lun: 01
  Vendor: DGC      Model: RAID 5           Rev: 0207
  Type:   Direct-Access                    ANSI SCSI revision: 04
```

```
Host: scsi2 Channel: 00 Id: 00 Lun: 02
  Vendor: DGC      Model: RAID 5           Rev: 0207
  Type:   Direct-Access                    ANSI SCSI revision: 04
Host: scsi2 Channel: 00 Id: 00 Lun: 03
  Vendor: DGC      Model: RAID 5           Rev: 0207
  Type:   Direct-Access                    ANSI SCSI revision: 04
Host: scsi2 Channel: 00 Id: 00 Lun: 04
  Vendor: DGC      Model: RAID 5           Rev: 0207
  Type:   Direct-Access                    ANSI SCSI revision: 04
Host: scsi2 Channel: 00 Id: 01 Lun: 00
  Vendor: DGC      Model:                  Rev: 0207
  Type:   Direct-Access                    ANSI SCSI revision: 04
```

Due to the existence of the "ghost" LUN, PowerPath failover does not function properly and can result in an all paths down scenario. By enabling the parameter, the driver is instructed to change the peripheral qualifier bit from 1 to 3 for an INQUIRY response. As a result, the SCSI mid-layer will handle the INQUIRY response correctly and, subsequently, will enumerate the disks for each initiator-target pair correctly.

This behavior has not occurred in Symmetrix environments and, therefore, enabling the `lpfc_inq_pqb_filter` parameter is not required in said environments.

Enabling the `lpfc_inq_pqb_filter` parameter

1. In order to enable this parameter, the `options` line for the `lpfc` driver should be appended to the `/etc/modules.conf` file.

   The following is an example of `/etc/modules.conf` file for a RHEL 3.0 U4, U5, or U6 system using the integrated Emulex driver with the `lpfc_inq_pqb_filter` parameter enabled:

```
alias parport_lowlevel parport_pc
alias scsi_hostadapter sym53c8xx
alias scsi_hostadapter1 lpfc
alias scsi_hostadapter2 lpfc
alias eth0 tlan
options scsi_mod max_scsi_luns=255 scsi_allow_ghost_devices=1
options lpfc lpfc_topology=0x02 lpfc_inq_pqb_filter=1
```

2. Create a new ramdisk to reflect the changes made.

   ```
   cd /boot
   mkinitrd -v initrd-$1.img $1
   ```

   where *$1* is the currently running v2.4.x kernel version.

For example:

```
cd /boot
cp initrd-2.4.21-27.0.4.ELsmp.img initrd-2.4.21-27.0.4.ELsmp.img.orig
mkinitrd –v initrd-2.4.21-27.0.4.ELsmp.img 2.4.21-27.0.4.ELsmp
```

3. Reboot the host.

   After the host reboots, the Emulex driver should report all devices accurately.

(CLARiiON only): Required /etc/modules.conf edit for RHEL 2.1, RHEL 3.0, and SLES 8.0 default modular kernels

When a Linux host is attached to both SPs in a CLARiiON storage system, the driver will report a disconnected LUN 0 on SPB and a failure to read the capacity of the device. The Unisphere/Navisphere Host Agent requires that disconnected LUN 0 be reported properly.-39Instal

A device file name is allocated to the disconnected LUN 0 in the /dev filesystem, but the device cannot be mounted, partitioned, or otherwise accessed.

An example of a disconnected LUN 0 being reported in `/var/log/messages`:

```
Jul 17 14:35:57 182bi134 kernel: sdb : READ CAPACITY failed.
Jul 17 14:35:57 182bi134 kernel: sdb : status = 1, message = 00, host = 0,
   drivr = 28
Jul 17 14:35:57 182bi134 kernel: Current sd00:00: sense key Illegal Request
Jul 17 14:35:57 182bi134 kernel: Additional sense indicates Logical unit not re
dy,cause not reportable
Jul 17 14:35:57 182bi134 kernel: sdb : block size assumed to be 512 bytes, disk
size 1GB.
Jul 17 14:35:57 182bi134 kernel: sdb: I/O error: dev 08:10, sector 0
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 2
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 4
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 6
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 0
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 2
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 4
Jul 17 14:35:58 182bi134 kernel: I/O error: dev 08:10, sector 6
Jul 17 14:35:58 182bi134 kernel: unable to read partition table
```

Red Hat and SuSE have added a parameter to the SCSI stack (`scsi_scan.c` file) to allow access to devices marked as *offline*.

For RHEL, the `max_scsi_luns` parameter must be enabled in `/etc/modules.conf`. In the default Red Hat kernels, `CONFIG_SCSI_MULTI_LUN` is disabled. As a result, if the target 0 LUN 0 disappears from the storage group and the host is rebooted or the driver unloaded and reloaded, the host will see only the ghost LUNs (with **ArrayCommPath** disabled) or the LUNZ (with **ArrayCommPath** enabled).

By default, the SuSE SLES 8 kernel has enabled the `CONFIG_SCSI_MULTI_LUN` parameter. Therefore, there is no need to add the `max_scsi_luns` parameter to the `/etc/modules.conf` file on SLES 8 SP3.

A kernel compilation is not required when appending the `scsi_allow_ghost_devices` parameter to `/etc/modules.conf`.

Follow these steps to enable the new parameter in `/etc/modules.conf`:

1. Change to the appropriate directory and edit the file:

   `vi /etc/modules.conf`

2. Append the following line to the file:

   - For Red Hat distributions use:

`options scsi_mod max_scsi_luns=255 scsi_allow_ghost_devices=1`

Example:

```
alias parport_lowlevel parport_pc
alias scsi_hostadapter sym53c8xx
alias scsi_hostadapter1 lpfc
alias eth0 tlan
alias scsi_hostadapter2 lpfc
options scsi_mod max_scsi_luns=255 scsi_allow_ghost_devices=1
```

   - For SuSE distributions use:

`options scsi_mod scsi_allow_ghost_devices=1`

Example:

```
alias parport_lowlevel parport_pc
alias scsi_hostadapter sym53c8xx
alias scsi_hostadapter1 lpfc
alias scsi_hostadapter2 lpfc
alias eth0 tlan
options scsi_mod max_scsi_luns=255 scsi_allow_ghost_devices=1
options lpfc lpfc_topology=0x02 lpfc_automap=0 lpfc_scan_down=0
lpfc_fcp_bind_WWPN=50060160006000ed:lpfc0t1,50060168006000ed:lpfc0t2,5006016006000ed:lpfc1t1,50060168006000ed:lpfc1t2
```

3. Create a new ramdisk to reflect the changes made:

   - For Red Hat distributions, use:

```
cd /boot
cp initrd-$1.img initrd-$1.img.orig
mkinitrd -v initrd-$1.img $1
```

   where *`$1`* is the currently running v2.4.x kernel version.

   Example:

```
cd /boot
cp initrd-2.4.21-15.0.4.ELsmp.img initrd-2.4.21-15.0.4.ELsmp.img.orig
mkinitrd –v initrd-2.4.21-15.0.4.ELsmp.img 2.4.21-15.0.4.ELsmp
```

- For SuSE distributions use:

```
cd /boot
cp initrd-$1 initrd-$1.orig
mkinitrd -k vmlinuz-$1 -i initrd-$1
```

Example:

```
cd /boot
cp initrd-2.4.21-266 initrd-2.4.21-266.orig
mkinitrd –k vmlinuz-2.4.21-266 –i initrd-2.4.21-266
```

4. Reboot the host.

(CLARiiON only): Linux Navisphere Agent/CLI limitation with fdisk on CLARiiON

There is a known issue with the Linux Naviagent/CLI in which the Naviagent does not close the sd devices before becoming a daemon and, as a result, the devices remain open. This may cause issues when attempting to access devices.

For example, if the Naviagent service is left running and someone runs `fdisk` to create new partitions on CLARiiON storage devices, any attempt to make a new filesystem with `mkfs` on the newly created partition(s) will fail.

An example of a warning issued when `fdisk` is run is:

```
WARNING: Re-reading the partition table failed with
error 16. Device or resource busy.  The kernel still
uses the old table.  The new table will be used at next
reboot.
```

If, after receiving the above warning, the user attempts to run `mkfs` on a newly created filesystem, `mkfs` will also fail with an error similar to the following:

```
mke2fs.ext2: No such device or address while trying to
determine filesystem size
```

This problem may be resolved in on of the ways described in detail in the following list:

- Disable the Naviagent/CLI service.
- Issue a Naviagent stop command:
  - On RHEL, issue the command:

    `service naviagent stop`
  - On SLES , issue the command:

    `/etc/init.d/naviagent stop`
- Remove the Naviagent/CLI RPM.
- Rescan the SCSI bus.

Disabling the Navisphere Agent service

After the Naviagent registers the host with the CLARiiON system, the service may be disabled so that it does not start upon reboot. This may be performed manually or by using the curses-based setup tool.

To peform this manually:

If the Unisphere Host Agent or Navisphere Agent/CLI is installed and enabled on the host, stop the Unisphere Host Agent or Navisphere Agent service by typing one of the following commands:

- For the Unisphere Host Agent:

  /etc/init.d/hostagent stop

  or

  service hostagent stop

- For the Navisphere Host Agent:

  /etc/init.d/naviagent stop

  or

  service naviagent stop

Issuing a Navisphere Agent stop command

On RHEL, the Naviagent service may be stopped with one of the two following commands and then the fdisk/mkfs commands may be rerun:

service naviagent stop

/etc/rc.d/init.d/naviagent stop

On SLES, the Naviagent service may be stopped with the following command and then the fdisk/mkfs commands may be rerun:

/etc/init.d/naviagent stop

Removing the Naviagent/CLI RPM

The Naviagent/CLI RPM may be removed from the system after it has been used for the initial set-up and registration of the host on the CLARiiON system.

In order to remove the RPM, stop the Naviagent service and then remove the RPM package.

Example:

```
/etc/init.d/naviagent stop
rpm -ev naviagentcli-6.20.0.2.59-1
```

(CLARiiON only): Linux Navisphere Naviagent/CLI limitation with VERITAS Volume Manager v3.2 on CLARiiON

The Linux Navisphere Agent holds open the devices to be used by VERITAS Volume Manager v3.2 during the initialization and installation of the CLARiiON devices. When this occurs, the message `Devices busy or in use` is reported.

The issue with the Navisphere Agent and VERITAS Volume Manager v3.2 can occur on initialization and installation of the VxVM, as well as on subsequent reboots.

Here is an example of the error reported during **vxinstall**:

```
  The Volume Manager is now reconfiguring (partition phase)...
  Volume Manager: Partitioning sdq as a new disk.
Device /dev/sdq : does not exist or is in use
ERROR: partition modification failed
Device /dev/sdq : does not exist or is in use
ERROR: partition modification failed
  The Volume Manager is now reconfiguring (initialization phase)...
  Volume Manager: Adding disk01 (sdq) as a new disk.
vxvm:vxdisk: ERROR: Device sdq: online failed:
       Disk is not usable
  Definition of sdq failed. /etc/rc.d/init.d/vxvm-reconfig rootdg sdq
disk01
  The following disks failed initialization:
sdq
```

If the devices were successfully partitioned during the installation, you might also run into an issue after subsequent reboots where the VxVM's `rootdg` becomes unavailable. You will receive errors when trying to issue VxVM commands; this is a result of the configuration daemon (`vxconfigd`) not running, and can happen if the Navisphere host agent is running. To resolve the problem:

The Naviagent/CLI RPM may be removed from the system after it has been used for the initial set-up and registration of the host on the CLARiiON system.

In order to remove the RPM, stop the Naviagent service and then remove the RPM package. For example:

```
/etc/init.d/naviagent stop
```

```
rpm -ev naviagentcli-6.20.0.2.59-1
```

(CLARiiON only): Linux Navisphere Agent requirement for RHEL 2.1 Intel Itanium systems

The Navisphere Agent/CLI RPM for Linux is a 32-bit executable. Therefore, for RHEL 2.1 Itanium-based systems, the x86-compat-libs RPM package must be installed in order for the Linux Navisphere Agent/CLI RPM to install properly.

(CLARiiON Only): Linux Navisphere Agent requirement for RHEL 3.0 Intel Itanium systems

The Navisphere Agent/CLI RPM is supported on RHEL 3.0 IA64 hosts. However, `glibc-2.3.2-95.27` or later must be installed on the system in order for the Navisphere Agent/CLI RPM pkacage to install successfully on RHEL 3.0 IA64.

Note that the `x86-compat-libs` RPM package that was required for RHEL 2.1 [IA64] is not available or necessary for RHEL 3.0 [IA64].

The following is RPM query and installation output from a RHEL 3.0 [IA64] host:

```
[root@l82bi021 /]# rpm -q compat-glibc
package compat-glibc is not installed
[root@l82bi021 /]# rpm -q x86-compat-libs
package x86-compat-libs is not installed
[root@l82bi021 /]# rpm -q compat-glibc.7x
package compat-glibc.7x is not installed
[root@l82bi021 /]# rpm -qa | grep compat
compat-libstdc++-7.3-2.96.128
[root@l82bi021 /]# rpm -qa | grep glibc
glibc-2.3.2-95.30
glibc-devel-2.3.2-95.30
glibc-2.3.2-95.30
glibc-headers-2.3.2-95.30
glibc-profile-2.3.2-95.30
glibc-common-2.3.2-95.30
glibc-kernheaders-2.4-8.34.1
glibc-utils-2.3.2-95.30
[root@l82bi021 /]# ls /emul
ia32-linux ia32-Linux
[root@l82bi021 /]# rpm -ivh Navisphere Agentcli-6.7.0.4.7-1.i386.rpm
Preparing... ########################################### [100%]
1:Navisphere Agentcli ########################################### [100%]

[root@l82bi021 /]# rpm -ivh Navisphere Agentcli-6.16.0.4.63-1.i386.rpm
Preparing... ########################################### [100%]
1:Navisphere Agentcli ########################################### [100%]
```

Index

A

Asianux 1.0 64
Asianux 2.0 hosts, editing Emulex driver parameters on 92

B

binding, persistent 111
BIOS, boot 32, 102
boot
    BIOS 32, 102
    device support 15
boot BIOS
    update 32
boot device, Symmetrix, configuring 128
boot device, VNX/CLARiiON, configuring 132

C

cable, HBA, connecting 25
CEE/Menlo firmware 102
CNA 14
CNA, Ethernet connectivity 148
converged network adapter 14

D

device drivers 157

E

edit /usr/src/lpfc/lpfc.conf 112
Emulex
    Fibre Channel controller 32, 102
    v7.1.14 driver 63
    website 32, 102
Emulex Application Kit 84, 98
    tar archive 45
Emulex v2.10f driver 47
Emulex v8.0.16.6_x2 driver 47
Emulex website 32, 102
Ethernet connectivity 148

F

FCoE 14
FCoE adapters 102
Fibre Channel controller, Emulex 32, 102
Fibre Channel over Ethernet 14
firmware files 98
firmware, upgradable 32, 102
firmware/BIOS (flash), updating 32, 102
flash firmware/BIOS, updating 32, 102
functions, Linux 17

H

HBA API 98
HBA, installing 24
hbacmd 34, 86
HBAnyware 98
HBAnywhere
    applications kit 84
host connectivity 14
hosts, booting 15

L

Linux
    functions 17

utilities 17
LP6DUTIL 37
lp6dutil 37
lpfc_2.6_driver_kit-8.0.16.6_x2-1.tar.gz 50
lpfc-install script 46, 48, 56, 113

M

Master Boot Record (MBR) 15
Menlo (CEE) firmware 102
message url http
//www.emulex.com/emc/support/index.jsp 20, 21, 45
modules.conf 114

P

persistent binding 111

S

single-initiator/target zone 16

U

uninstall, drivers 56
upgradable firmware 32, 102
utilities, Linux 17

V

v2.10f driver, Emulex 47
v8.0.16.6_x2 driver, Emulex 47

W

website, Emulex 32, 102

Z

zoning 16