



# **Fibre Channel and Converged Network Adapters for VMware ESX/ESXi 4.0**

User's Guide

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# Table of Contents

|          |  |      |
|----------|--|------|
|          | <b>Preface</b>   |      |
|          | Intended Audience . . . . .                                  | vii  |
|          | Related Materials . . . . .                                  | vii  |
|          | What's in This Guide . . . . .                               | viii |
|          | Documentation Conventions . . . . .                          | ix   |
|          | License Agreements . . . . .                                 | x    |
|          | Technical Support . . . . .                                  | x    |
|          | Availability . . . . .                                       | xi   |
|          | Training . . . . .   | xi   |
|          | Contact Information . . . . .                                | xi   |
|          | Knowledge Database . . . . .                                 | xi   |
| <b>1</b> | <b>Hardware and Software Components</b>                      |      |
|          | Hardware Components . . . . .                                | 1-1  |
|          | Software Components . . . . .                                | 1-3  |
|          | Boot Code . . . . .  | 1-3  |
|          | OS Driver . . . . .  | 1-3  |
|          | Firmware . . . . .   | 1-4  |
|          | Management Tools and Utilities . . . . .                     | 1-4  |
|          | Supported QLogic Adapters . . . . .                          | 1-4  |
| <b>2</b> | <b>Installation</b>  |      |
|          | Supported Features . . . . .                                 | 2-1  |
|          | Installing the Hardware . . . . .                            | 2-2  |
|          | Installing the Driver . . . . .                              | 2-3  |
|          | Installing SANsurfer Management Tools . . . . .              | 2-3  |
|          | Installing SANsurfer FC HBA Manager . . . . .                | 2-4  |
|          | Installing SANsurfer FC HBA CLI . . . . .                    | 2-7  |
| <b>3</b> | <b>Configuration</b>   |      |
|          | Identifying QLogic Adapters on VMware ESX/ESXi 4.0 . . . . . | 3-1  |
|          | Using vSphere™ Client . . . . .                              | 3-1  |
|          | Using Console OS . . . . .                                   | 3-2  |

|  |      |
|--|------|
| Using the QLogic <i>Fast!UTIL</i> BIOS Utility . . . . . | 3-5  |
| Verifying That the Driver is Loaded . . . . .            | 3-6  |
| Configuring the Driver Parameters. . . . .               | 3-7  |
| Deploying NPIV for VMware ESX/ESXi 4.0 . . . . .         | 3-9  |
| Monitoring NPIV Virtual Ports from SANsurfer. . . . .    | 3-10 |
| Configuring Boot from SAN . . . . .                      | 3-12 |

## A Troubleshooting

|  |      |
|--|------|
| Troubleshooting with LEDs. . . . .                   | A-1  |
| Dynamic Extended Logging . . . . .                   | A-3  |
| Troubleshooting with Driver Logs. . . . .            | A-4  |
| Debugging Using Proc Information . . . . .           | A-9  |
| Collecting System Logs for Troubleshooting . . . . . | A-10 |
| Frequently Seen Issues . . . . .                     | A-10 |

## Glossary

## Index

### List of Figures

| Figure |  | Page |
|--------|--|------|
| i      | Jagged-edged Screen Shots Depict Partial Interface . . . . . | x    |
| 1-1    | Adapter Components . . . . .                                 | 1-2  |
| 2-1    | Installing the Adapter . . . . .                             | 2-2  |
| 2-2    | Downloading SANsurfer FC HBA Manager—VMware. . . . .         | 2-5  |
| 2-3    | Downloading SANsurfer FC HBA Manager—Linux. . . . .          | 2-6  |
| 2-4    | Downloading SANsurfer FC HBA Manager—VMware. . . . .         | 2-7  |
| 3-1    | vSphere Client Configuration Page . . . . .                  | 3-2  |
| 3-2    | Finding Adapters on VMware ESX/ESXi 4.0 . . . . .            | 3-4  |
| 3-3    | Verifying That the Driver is Loaded . . . . .                | 3-7  |
| 3-4    | SANsurfer FC HBA Manager Showing NPIV. . . . .               | 3-11 |
| 3-5    | Virtual Port Information Page in SANsurfer . . . . .         | 3-12 |
| 3-6    | Starting Fast!UTIL from the BIOS Screen . . . . .            | 3-13 |

### List of Tables

| Table |   | Page |
|-------|---|------|
| 1-1   | Adapter Component Details . . . . .                     | 1-2  |
| 3-1   | Configurable Driver Parameters. . . . .                 | 3-8  |
| A-1   | QLA234x Adapter LED Scheme . . . . .                    | A-1  |
| A-2   | QLA24xx/QLE24xx/QEM2462 Adapter LED Scheme . . . . .    | A-2  |
| A-3   | QEM2462 Power and Attention Switch LED Scheme . . . . . | A-2  |
| A-4   | QLE25xx Adapter LED Scheme. . . . .                     | A-3  |
| A-5   | QLE8042 Converged Network Adapter LED Scheme . . . . .  | A-3  |

|     |                                      |      |
|-----|--------------------------------------|------|
| A-6 | Common Driver Log Messages . . . . . | A-6  |
| A-7 | Proc Output . . . . .                | A-9  |
| A-8 | Frequently Seen Issues . . . . .     | A-10 |

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## Notes

# Preface

QLogic provides a portfolio of Fibre Channel Adapters, Intelligent Ethernet Adapters, and Converged Network Adapters on the VMware<sup>®</sup> ESX/ESXi 4.0 platform:

- QLogic **Fibre Channel Adapters** include 2Gb, 4Gb, and 8Gb adapter offerings on VMware ESX/ESXi 4.0 in PCI-X<sup>™</sup>, PCI Express<sup>®</sup>, and PCI Express ExpressModule<sup>™</sup> form factors.
- QLogic **Intelligent Ethernet Adapters** include the 1/10Gb QLE3000 Series adapters in PCI Express form factors.
- QLogic **Converged Network Adapters** include the first-generation QLE8000 Series offering on VMware ESX/ESXi 4.0 in PCI Express form factors.

This guide provides detailed instructions on the installation, configuration, and troubleshooting of QLogic Fibre Channel and Converged Network Adapters (QLE8000 Series) on VMware ESX/ESXi 4.0. It also provides details on the use of QLogic adapter features to enhance the value of server virtualization using VMware ESX/ESXi 4.0. Such features include virtual adapter configuration using N\_Port ID Virtualization (NPIV) and “boot from SAN” configuration.

## Intended Audience

The *Fibre Channel and Converged Network Adapters for VMware ESX/ESXi 4.0 User's Guide* is intended for use by users deploying QLogic Fibre Channel and Converged Network Adapters on VMware ESX/ESXi 4.0: users ranging from end users, such as data center managers and system administrators, to the test and development community. This guide is primarily focused on VMware ESX. However, the Fibre Channel and Converged Network Adapters from QLogic offer the same functionality regardless of the ESX edition (that is, ESX or ESXi).

## Related Materials

For additional information, refer to the following QLogic and VMware documents.

### Related QLogic documentation:

- *SANsurfer FC HBA Manager User's Guide* (part number SN54651-00)
- SANsurfer FC HBA Manager release notes and ReadMe file

- *SANsurfer FC HBA CLI User's Guide* (part number SN0054614-00)
- SANsurfer FC HBA CLI release notes and ReadMe file

**Related VMware documentation:**

- Online *VMware Compatibility Guide* located here:  
<http://www.vmware.com/go/hcl>
- *VMware Fibre Channel SAN Configuration Guide* located here:  
[http://www.vmware.com/pdf/vsphere4/r40/vsp\\_40\\_san\\_cfg.pdf](http://www.vmware.com/pdf/vsphere4/r40/vsp_40_san_cfg.pdf)
- Other technical documentation for VMware products is located here:  
<http://www.vmware.com/support/pubs/>

## What's in This Guide

This user's guide provides a brief introduction to the Fibre Channel Adapter and Converged Network Adapter (QLE8000 Series) products from QLogic. The primary focus of this guide is to explain the adapter driver features, management tools available on VMware ESX/ESXi 4.0, and the supported features.

**NOTE:**

For Converged Network Adapters, this guide covers only the Fibre Channel over Ethernet (FCoE) functionality. FCoE drivers can be downloaded from the following URL:

[http://driverdownloads.qlogic.com/QLogicDriverDownloads\\_UI/SearchByProduct.aspx?ProductCategory=322&Product=1059&Os=167](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/SearchByProduct.aspx?ProductCategory=322&Product=1059&Os=167)

For additional information on the networking function of the QLE8000 Series Converged Network Adapters, visit the following URL:

[http://downloadcenter.intel.com/Product\\_Filter.aspx?ProductID=2925&lang=eng](http://downloadcenter.intel.com/Product_Filter.aspx?ProductID=2925&lang=eng)

The QLE8000 Series Converged Network Adapters use the Intel<sup>®</sup> 82598 10Gb Ethernet Controller. The drivers for this Ethernet controller for the QLE8000 Series adapters are in box in ESX/ESXi 4.0.

This preface covers the intended audience, related materials, document conventions used, license agreements, and technical support. The remainder of the guide is organized into the following chapters and appendices:

- [1 Hardware and Software Components](#) provides details about hardware components, software components, and the supported QLogic adapters.

- [2 Installation](#) details the supported features and covers installation of hardware, drivers, and SANsurfer® management tools.
- [3 Configuration](#) covers how to identify QLogic adapters, start *Fast!UTIL*, verify that the driver is loaded, configure driver parameters, deploy N\_Port ID virtualization (NPIV), monitor NPIV from the SANsurfer management tools, and configure the boot from SAN functionality.
- [A Troubleshooting](#) details troubleshooting methods, including LEDs and logs.

At the end of this user's guide you will find a glossary of terms and an index to help you quickly find information.

## Documentation Conventions

This guide uses the following typographic conventions:

### NOTE:

Notes provide additional information.

- Text in **bold font** indicates user interface elements such as a menu items, buttons, check boxes, or column headings. For example:

Under **Hardware**, click **Storage Adapters**.

- Text in a monospace font (*Courier New*) indicates file name, directory path, or command line text output. For example:

```
Enter an IP Address:
```

- Text in a bold monospace font (**Courier New**) indicates user input (what you type). For example:

```
# chkconfig firewall off
```

- Text in ALL CAPITALS indicates the name of a key that you press on the keyboard. For example:

On the QLogic BIOS banner screen, press CTRL+Q.

- Text in *italics* indicates emphasis, terms, document titles. For example:

Refer to the *VMware IO Compatibility Guide*.

- Italicized text within angle brackets indicates user-defined variables. For example:

```
cat /proc/scsi/qla2xxx/<adapter_number>
```

- Text within square brackets indicates optional parameters. For example

`iscli [optional parameters] [Command Variable]`

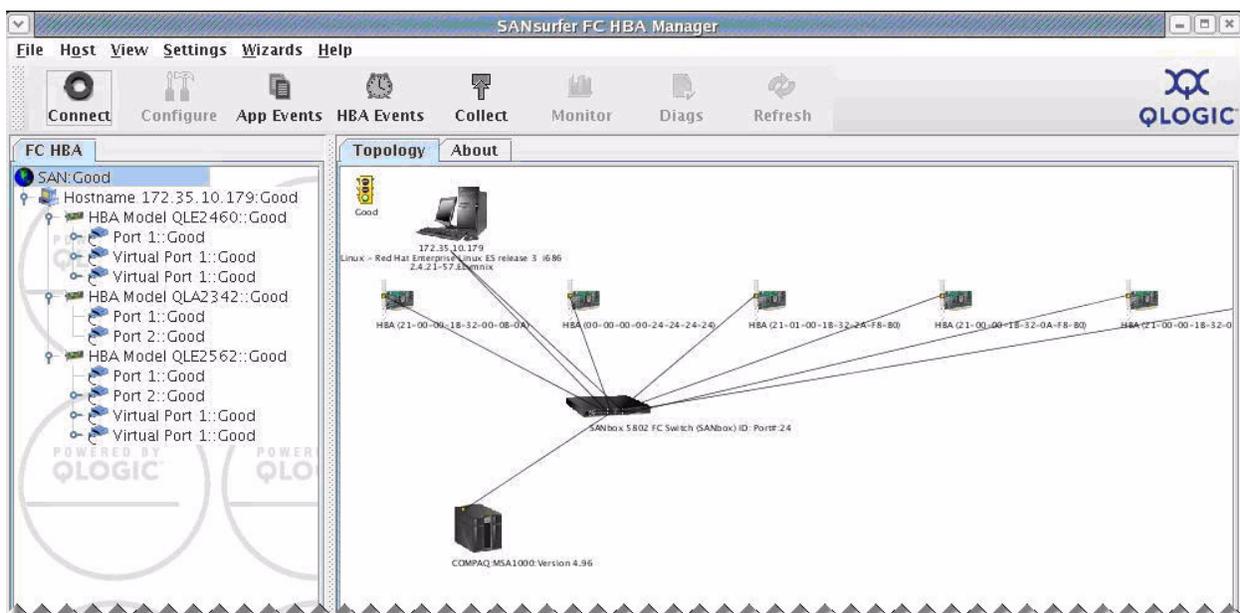
- Text in **blue** font indicates a hyperlink (jump) to a figure, table, chapter, or section in this guide, and links to Web sites are shown in underlined blue. For example:

[Table 4-1](#) lists the configurable driver parameters.

See “[Configuring Boot from SAN](#)” on page 4-10.

For more information, visit [www.qlogic.com](http://www.qlogic.com).

- Screen captures that depict only the essential portion of the user interface currently under discussion (rather than the entire dialog box or window) are shown with jagged edges, as shown in [Figure i](#).



**Figure i Jagged-edged Screen Shots Depict Partial Interface**

## License Agreements

Refer to the *QLogic Software End User License Agreement* for a complete listing of all license agreements affecting this product.

## Technical Support

QLogic-direct customers may contact QLogic Technical Support; others will be redirected to their authorized maintenance provider.

Visit the QLogic support Web site listed in [Contact Information](#) for the latest firmware and software updates.

## Availability

QLogic Technical Support for products under warranty is available during local standard working hours excluding QLogic Observed Holidays.

## Training

QLogic offers training for technical professionals for all iSCSI, InfiniBand, and Fibre Channel products. From the main QLogic Web page, [www.qlogic.com](http://www.qlogic.com), click the **Education and Resources** tab at the top, and then click the **Education & Training** tab at the left. The QLogic Global Training Portal offers online courses, certification exams, and scheduling of in-person training.

Technical certification courses include installation, maintenance, and troubleshooting QLogic products. Upon demonstrating knowledge using live equipment, QLogic awards a certificate identifying the student as a Certified Professional. The training professionals at QLogic may be reached by e-mail at [training@qlogic.com](mailto:training@qlogic.com).

## Contact Information

Please feel free to contact your QLogic approved reseller or QLogic Technical Support at any phase of integration for assistance. QLogic Technical Support can be reached by the following methods:

**Web**            <http://support.qlogic.com>

**E-mail**        [support@qlogic.com](mailto:support@qlogic.com)

## Knowledge Database

The QLogic knowledge database is an extensive collection of QLogic product information that you can search for specific solutions. We are constantly adding to the collection of information in our database to provide answers to your most urgent questions. Access the database from the QLogic Support Center: <http://support.qlogic.com>.

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## Notes

# 1 Hardware and Software Components

This chapter provides details about QLogic Fibre Channel and Converged Network Adapters in VMware ESX/ESXi, including:

- [Hardware Components](#)
- [“Software Components” on page 1-3](#)
- [“Supported QLogic Adapters” on page 1-4](#)

## Hardware Components

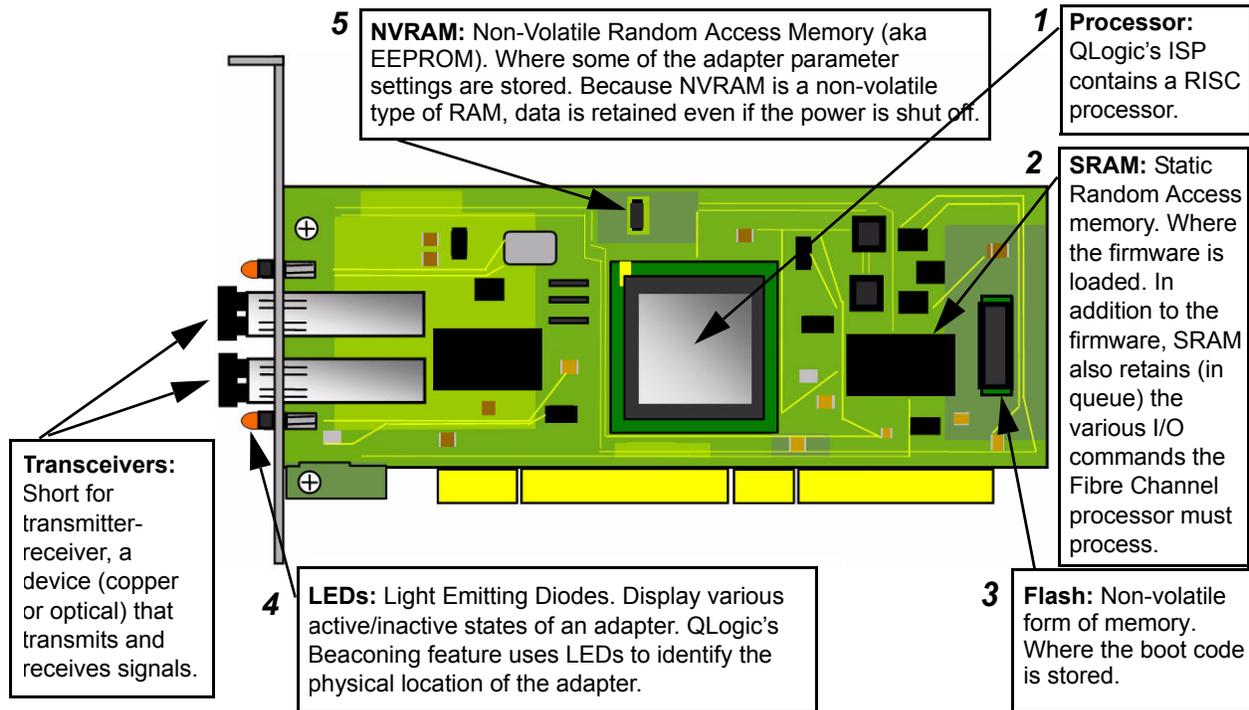
A typical QLogic Fibre Channel or Converged Network Adapter includes the following major components:

- RISC processor
- Static random access memory (SRAM)
- Non-volatile memory (Flash)
- Non-volatile random access memory (NVRAM) (On 8Gb Fibre Channel Adapters, NVRAM is built into the Flash.)
- Transceivers
- LEDs

**NOTE:**

QLE8000 Series Converged Network Adapters might have additional components not listed in the preceding list. This section is intended only to provide an overview of the key components on a typical Fibre Channel/Converged Network Adapter.

[Figure 1-1](#) shows the hardware components of a QLogic Fibre Channel or Converged Network Adapter and [Table 1-1](#) provides additional details of selected components.



**Figure 1-1 Adapter Components**

**Table 1-1. Adapter Component Details**

| Callout Number | Description  |
|----------------|--|
| <b>1</b>       | The reduced instruction set computer (RISC) processor, also known as the intelligent storage peripheral (ISP) controller, is the heart of the adapter. The RISC processor is a single integrated ASIC (application specific integrated circuit) that contains the processing power required to run the Fibre Channel and FCoE protocols. The RISC processor also interfaces the host bus (PCI-X or PCI Express) and controls the I/O operations. |
| <b>2</b>       | The static random access memory (SRAM) provides the runtime memory required for the adapter operations. The SRAM is where the firmware is downloaded when the adapter is powered up. The RISC processor (see <b>1</b> ) accesses the SRAM to process the firmware instructions. In addition, the SRAM stores the runtime context of various I/O operations in progress.  |
| <b>3</b>       | The non-volatile memory, also referred to as Flash memory, contains the boot code run by the RISC processor (see <b>1</b> ) when the adapter is powered up. On QLogic Fibre Channel Adapter 2400 series and later, the Flash memory contains multiple boot images—the FCode, x86 BIOS, and EFI—to support multi-boot capability on different platforms.  |

**Table 1-1. Adapter Component Details (Continued)**

| Callout Number | Description  |
|----------------|--|
| 4              | LEDs indicate the real-time status of the adapter, Fibre Channel or Ethernet link status, and link activity. LED patterns are described in detail in “ <a href="#">Troubleshooting with LEDs</a> ” on <a href="#">page A-1</a> .   |
| 5              | Non-volatile random access memory (NVRAM) is used to store the per-port adapter configuration parameters. These parameters are typically loaded at manufacturing and should not be modified except by those who have an expert level understanding of the functioning of QLogic Fibre Channel and Converged Network Adapters. During adapter initialization, the parameters are accessed and used to configure the adapter. Examples of adapter configuration parameters include Fibre Channel connection type (topology), Fibre Channel data rate, Fibre Channel tape support, and so on. |

## Software Components

This section describes the following QLogic adapter software components:

- [Boot Code](#)
- [OS Driver](#)
- [Firmware](#)
- [Management Tools and Utilities](#)

### Boot Code

Boot code resides on the Flash memory on the adapter. The primary function of the boot code is to communicate with an external boot device before the operating system takes the control over when booting from a storage device attached to the QLogic adapter. This type of configuration is referred to as *boot from SAN*.

### OS Driver

For all QLogic Fibre Channel Adapters currently supported on VMware ESX/ESXi 4.0, the driver is supported natively with ESX; that is, no separate driver installation is required for VMware ESX/ESXi 4.0 to recognize the QLogic Fibre Channel Adapters. QLogic Fibre Channel Adapters on VMware ESX/ESXi 4.0 require no additional driver installation steps to run the adapters. In some specific cases, you may need to download from the VMware Web site one of the following:

- A VMware Approved Driver CD ([http://driverdownloads.qlogic.com/QLogicDriverDownloads\\_UI/default.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/default.aspx))
- ESX/ESXi patches that might include specific fixes for adapters or enable new adapters.

**NOTE:**

All inbox drivers for ESX/ESXi are distributed by VMware.

## Firmware

The firmware module performs most of the Fibre Channel and FCoE protocol-related functions, thus freeing the system CPU and memory resources from protocol processing. This efficiency keeps the QLogic Fibre Channel and Converged Network Adapter drivers *thin*, which saves runtime system resources such as CPU and memory.

The QLogic Fibre Channel and Converged Network Adapter firmware is bundled with the driver. For the QLE8000 Series Converged Network Adapters, the FCoE Engine (framer) firmware is resident on the adapter. The FCoE firmware for the adapter is also bundled with the driver.

## Management Tools and Utilities

QLogic offers a comprehensive suite of management tools and utilities, including the following:

- **SANsurfer FC HBA Manager** provides a graphical user interface for simplified management.
- **SANsurfer FC HBA CLI** (command line interface) enables you to automate Fibre Channel Adapter management by means of scripting and interactive mode.

## Supported QLogic Adapters

For a complete list of QLogic Fibre Channel and Converged Network Adapters supported on VMware ESX/ESXi 4.0, refer to the online *VMware Hardware Compatibility Guide* located here:

<http://www.vmware.com/go/hcl>

For OEM-branded adapters manufactured by QLogic Corporation, click the OEM name in the **Partner Name** box.

# 2 Installation

This chapter provides the following installation information:

- [Supported Features](#)
- [“Installing the Hardware” on page 2-2](#)
- [“Installing the Driver” on page 2-3](#)
- [“Installing SANsurfer Management Tools” on page 2-3](#)

## Supported Features

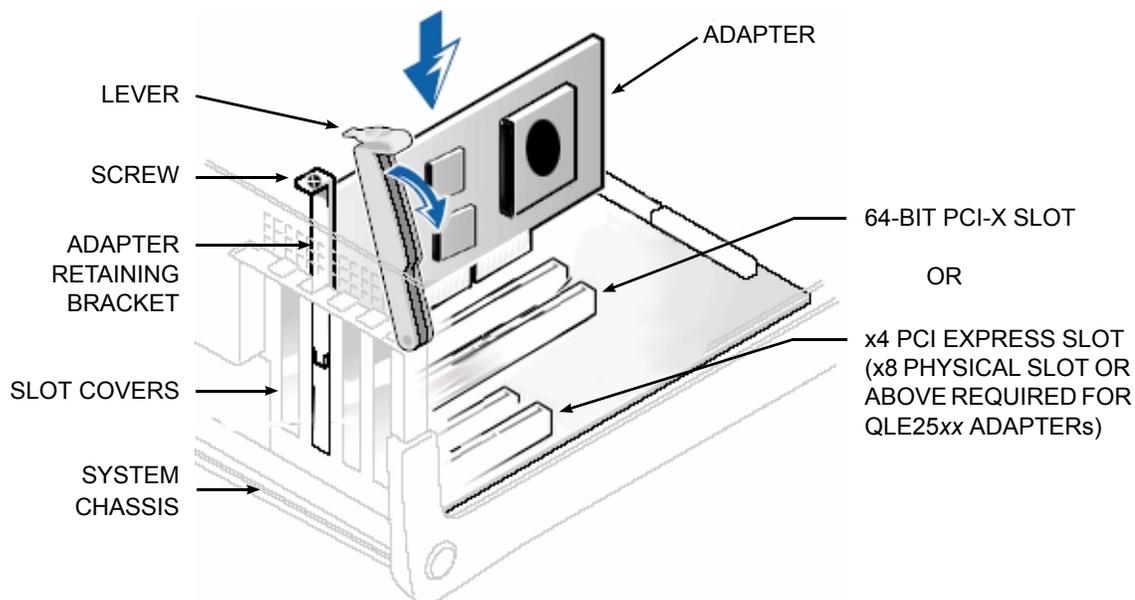
When properly installed, QLogic Fibre Channel and Converged Network Adapters for VMware ESX/ESXi 4.0 support the following features:

- **VMware ESX/ESXi Release Support**—4.0.
- **Topologies**—FC-AL, FC-AL2, point-to-point, and switched fabric.
- **Protocols**—FCP-3-SCSI, FC-tape (FCP-2).
- **Link Rate**
  - 2Gb, 4Gb, and 8Gb Fibre Channel Adapters with auto-rate negotiation
  - 10Gb Enhanced Ethernet for Converged Network Adapters
- **Single driver support**—for 2/4/8Gb Fibre Channel Adapters and 10Gb Enhanced Ethernet Converged Network Adapters.
- **SNIA Common Adapter API**—v1.x/v2.0 compliant.
- **QLogic CIM Providers for Adapter Management**—for ESXi 4.0 and later versions.
- **N\_Port ID virtualization**—driver supports virtual adapters as follows:
  - 4Gb Fibre Channel Adapters support 127 virtual adapters per port.
  - 8Gb Fibre Channel Adapters support 255 virtual adapters per port.
  - QLE8000 Series Converged Network Adapters support 63 virtual adapters per port.
- **Boot from SAN support**—enables servers on a network to boot their operating system from a Fibre Channel RAID unit on the SAN.

- **Support for MSI-X**—on 4/8Gb Fibre Channel and Converged Network Adapters.
- **Support for VMware SCSI path failover**—for Active/Active and Active/Passive storage devices.
- **Support for VMware VMotion™ and VMware Storage VMotion**
- **Remote SAN and adapter management**—using the SANsurfer FC HBA Manager tool (see “Installing SANsurfer FC HBA Manager” on page 2-4).
- **Automated local host management**—using the SANsurfer FC HBA CLI tool (see “Installing SANsurfer FC HBA CLI” on page 2-7).

## Installing the Hardware

Adapter hardware installation requires that you open the computer and locate the appropriate bus slot for housing the adapter, as detailed in the following steps. [Figure 2-1](#) shows the hardware placement.



**Figure 2-1 Installing the Adapter**

### To install the adapter:

1. Power off the computer, and then disconnect the power cable.
2. Remove the computer cover and find an appropriate empty bus slot.
3. Pull out the slot cover (if any) by removing the screw or releasing the lever.
4. Grasp the adapter by the top edge and seat it firmly into the appropriate slot.

5. Refasten the adapter's retaining bracket using the existing screw or lever.
6. Close the computer cover.
7. Plug the Fibre Channel or Ethernet cable into the adapter.
8. Plug in the power cable and turn on the computer.
9. Verify the LEDs on the adapter to ensure proper operation. The LED patterns are described in [“Troubleshooting with LEDs” on page A-1](#).

## Installing the Driver

The QLogic Fibre Channel driver ships “inbox” with VMware ESX/ESXi 4.0. However, in some specific cases, you may need to download the following:

- From the QLogic Web site, a VMware-approved Driver CD.
- From the VMware Web site, VMware ESX/ESXi 4.0 patches that might include specific fixes for adapters.

## Installing SANsurfer Management Tools

The QLogic Fibre Channel and Converged Network Adapter management tools include the SANsurfer FC HBA Manager (GUI) and the SANsurfer FC HBA CLI (command line interface). These management tools can be used only with VMware ESX 4.0. Because VMware ESXi 4.0 does not have a service console, the SANsurfer management tools cannot be installed in ESXi 4.0 for adapter management.

- **SANsurfer FC HBA Manager** provides:
  - ❑ A graphical user interface to easily install, configure, and deploy QLogic Fibre Channel and Converged Network Adapters.
  - ❑ Diagnostic and troubleshooting capabilities.
  - ❑ Statistical information required to optimize SAN performance.
  - ❑ Remote management capabilities.
- **SANsurfer FC HBA CLI** provides:
  - ❑ Management of QLogic Fibre Channel and Converged Network Adapters only on the local machine on which the tool is installed.
  - ❑ A non-interactive mode that can be used for scripting common and frequent operations.
  - ❑ Menu-driven mode for ease of use.

## Installing SANsurfer FC HBA Manager

To run SANsurfer FC HBA Manager on a VMware ESX 4.0 server requires a two-step installation process, whereby:

1. You must install the SANsurfer back end, commonly called the *qlremote agent*, on the ESX server.
2. You must download the SANsurfer FC HBA Manager GUI from the QLogic Web site and install it on a Windows® or Linux® system. SANsurfer FC HBA Manager allows you to remotely manage QLogic adapters.

After SANsurfer FC HBA Manager is installed, you must connect it to the qlremote agent using the IP address or host name of the ESX host on which the qlremote agent is installed. When SANsurfer FC HBA Manager is connected to the qlremote agent, you can use it to view and manage the QLogic adapters.

### NOTE:

- You must have the ESX agent from the ESX VMware downloaded package.
- The SANsurfer FC HBA Manager for Linux downloaded packages can be installed on any Windows or Linux box that has LAN access to the ESX server, depending on which server you want to manage the ESX server.

### NOTE:

The qlremote agent requires a service called *portmap* running on the ESX 4.0 host. To turn on the portmap service, execute the following commands on the ESX 4.0 Server Console:

```
# chkconfig firewall off
# esxcfg-firewall --allowIncoming --allowOutgoing
# chkconfig portmap on
# service portmap start
# service iptables stop
```

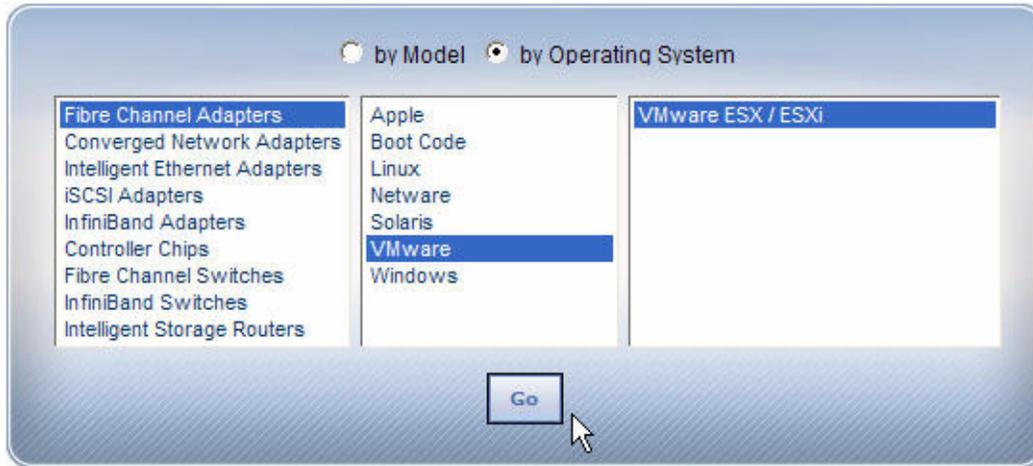
SANsurfer FC HBA Manager requires that you select the download link to the package for your operating system from the QLogic Web site.

### To install SANsurfer FC HBA Manager on VMware:

1. Go to the QLogic **Driver Downloads / Documentation** page at the following URL:

[http://driverdownloads.qlogic.com/QLogicDriverDownloads\\_UI/default.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/default.aspx)

2. Click the **by Operating System** button, and then select **Fibre Channel Adapters, VMware, and VMware ESX/ESXi**, as shown in [Figure 2-2](#).



**Figure 2-2 Downloading SANsurfer FC HBA Manager—VMware**

3. Click **Go**.
4. On the VMware ESX/ESXi download page under **Management Tools**, click **SANsurfer FC HBA Manager (x86/x64)**.
5. On the End User Software License Agreement page, click **Agree**.
6. Save the zipped file, and then use it to install SANsurfer FC HBA Manager by following the installation wizard.
7. Install the qlremote agent on your ESX host using silent mode as follows:

```
# ./standalone_sansurfer5.0.1b33_linux_install.bin -i silent
```

The qlremote agent and SANsurfer FC HBA Manager uses their respective system’s “hostname” to identify each other. When an asynchronous event occurs on the ESX Host, a notification is sent to the remote SANsurfer FC HBA Manager so that the GUI can refresh its information. For this to work, use root/admin privileges to complete the next steps.

8. Determine the system “hostname” based on the operating system:
  - For ESX/Linux, execute the following command:
 

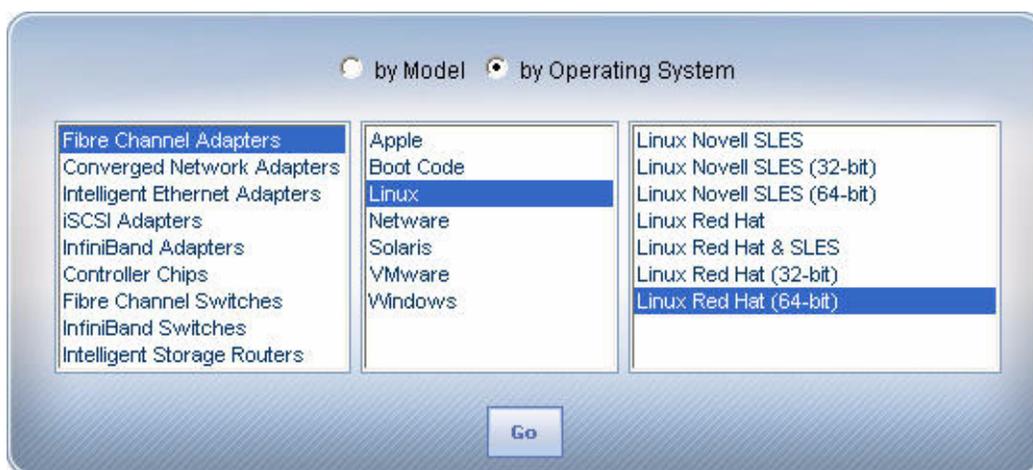
```
$ hostname
```
  - For Windows, follow these steps:
    - a. Click **Start**, and then click **Run**.
    - b. In the Run dialog box, type `cmd`, and then click **OK**.

- c. In the command window, type `hostname`, and then press ENTER.
9. On the ESX Host, add the IP address and the “hostname” of the remote system where you plan to run SANsurfer FC HBA Manager to the following files:  

```
/etc/hosts  
/etc/hosts.allow
```
10. On the remote system, add the IP address and “hostname” of the ESX Host, based on the operating system:
  - For Linux, modify the `/etc/hosts` file.
  - For Windows, modify the `C:\WINDOWS\system32\drivers\etc\hosts` file.
11. On both systems, restart the network services.
12. On the ESX Host, restart qlremote.
13. (Optional) Reboot both systems.

**To install SANsurfer FC HBA Manager on Linux or Windows:**

1. Go to the QLogic **Driver Downloads / Documentation** page at the following URL:  
[http://driverdownloads.qlogic.com/QLogicDriverDownloads\\_UI/default.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/default.aspx)
2. Click the **by Operating System** button, and then select **Fibre Channel Adapters, Linux** (or **Windows**) OS, and the specific OS version. [Figure 2-3](#) shows an example of selecting Linux Red Hat® 64-bit.



**Figure 2-3 Downloading SANsurfer FC HBA Manager—Linux**

3. Click **Go**.
4. Under **Management Tools**, click **SANsurfer FC HBA Manager (x86/x64)**.
5. On the End User Software License Agreement page, click **Agree**.
6. Save the zipped file and then use it to install SANsurfer FC HBA Manager by following the installation wizard.

After you complete the preceding installation steps, you must connect SANsurfer FC HBA Manager from the Linux or Windows host to the qlremote agent running on the ESX host.

The default password for SANsurfer FC HBA Manager is *config*. To ensure that security is not compromised, change this password as soon as possible after installing SANsurfer.

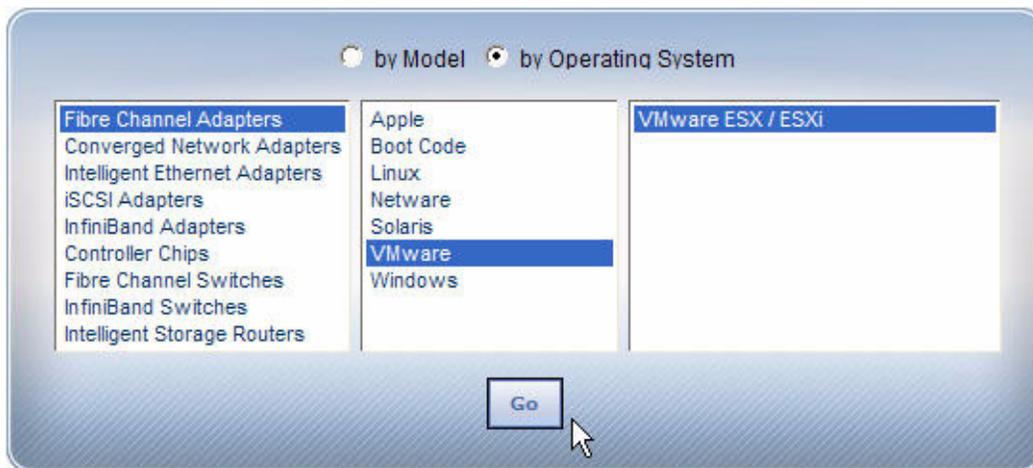
## Installing SANsurfer FC HBA CLI

Follow these steps to download and install the SANsurfer FC HBA CLI utility.

### To install SANsurfer FC HBA CLI:

SANsurfer FC HBA Manager requires that you select the download link to the package for your operating system from the QLogic Web site.

1. Go to the QLogic **Driver Downloads / Documentation** page at the following URL:  
[http://driverdownloads.qlogic.com/QLogicDriverDownloads\\_UI/default.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/default.aspx)
2. Click the **by Operating System** button, and then select **Fibre Channel Adapters**, **VMware**, and **VMware ESX/ESXi**, as shown in [Figure 2-2](#).



**Figure 2-4** Downloading SANsurfer FC HBA Manager—VMware

3. Click **Go**.

4. On the VMware ESX/ESXi download page under **Management Tools**, click **SANsurfer FC HBA CLI (x86/x64)**.
5. On the End User Software License Agreement page, click **Agree**.
6. Save the `scli-x.xx.xx-xx.i386.rpm.gz` file to your local machine. (In the file name, `x.xx.xx.xx` indicates the current version of SANsurfer FC HBA CLI). Then use it to install SANsurfer FC HBA CLI by following the installation wizard.

7. To uncompress the file, execute the following command:

```
# gunzip scli-x.xx.xx-xx.i386.rpm.gz
```

8. To install the package, enter the following command:

```
# rpm -iv scli-x.xx.xx-xx.i386.rpm
```

The new package is installed in the following directory:

```
/opt/QLogic_Corporation/SANsurferCLI
```

9. To query for the installed SANsurfer FC HBA CLI package name, enter the following command from the command line:

```
# rpm -q scli
```

# 3 Configuration

QLogic Fibre Channel and Converged Network Adapters on VMware ESX/ESXi 4.0 configuration procedures include the following:

- [Identifying QLogic Adapters on VMware ESX/ESXi 4.0](#)
- [“Using the QLogic Fast!UTIL BIOS Utility” on page 3-5](#)
- [“Verifying That the Driver is Loaded” on page 3-6](#)
- [“Configuring the Driver Parameters” on page 3-7](#)
- [“Deploying NPIV for VMware ESX/ESXi 4.0” on page 3-9](#)
- [“Monitoring NPIV Virtual Ports from SANsurfer” on page 3-10](#)
- [“Configuring Boot from SAN” on page 3-12](#)

## Identifying QLogic Adapters on VMware ESX/ESXi 4.0

On VMware ESX/ESXi 4.0, you can identify QLogic Fibre Channel and Converged Network Adapters in two ways:

- [Using vSphere™ Client](#)
- [Using Console OS](#)

**NOTE:**

You can also identify QLogic Fibre Channel and Converged Network Adapters when an ESX Server is managed using VMware vCenter™.

### Using vSphere™ Client

You can use the VMware vSphere™ Client to identify QLogic Fibre Channel and Converged Network Adapters on a VMware ESX/ESXi 4.0 system.

### To identify QLogic Fibre Channel and Converged Network Adapters using vSphere:

1. Start vSphere Client and select the host you want.
2. Click the **Configuration** tab to bring the Configuration page to the front.
3. Under **Hardware** on the left, click **Storage Adapters**.

A list of all storage adapters configured on the system appears, including QLogic Fibre Channel and Converged Network Adapters, as shown in Figure 3-1.

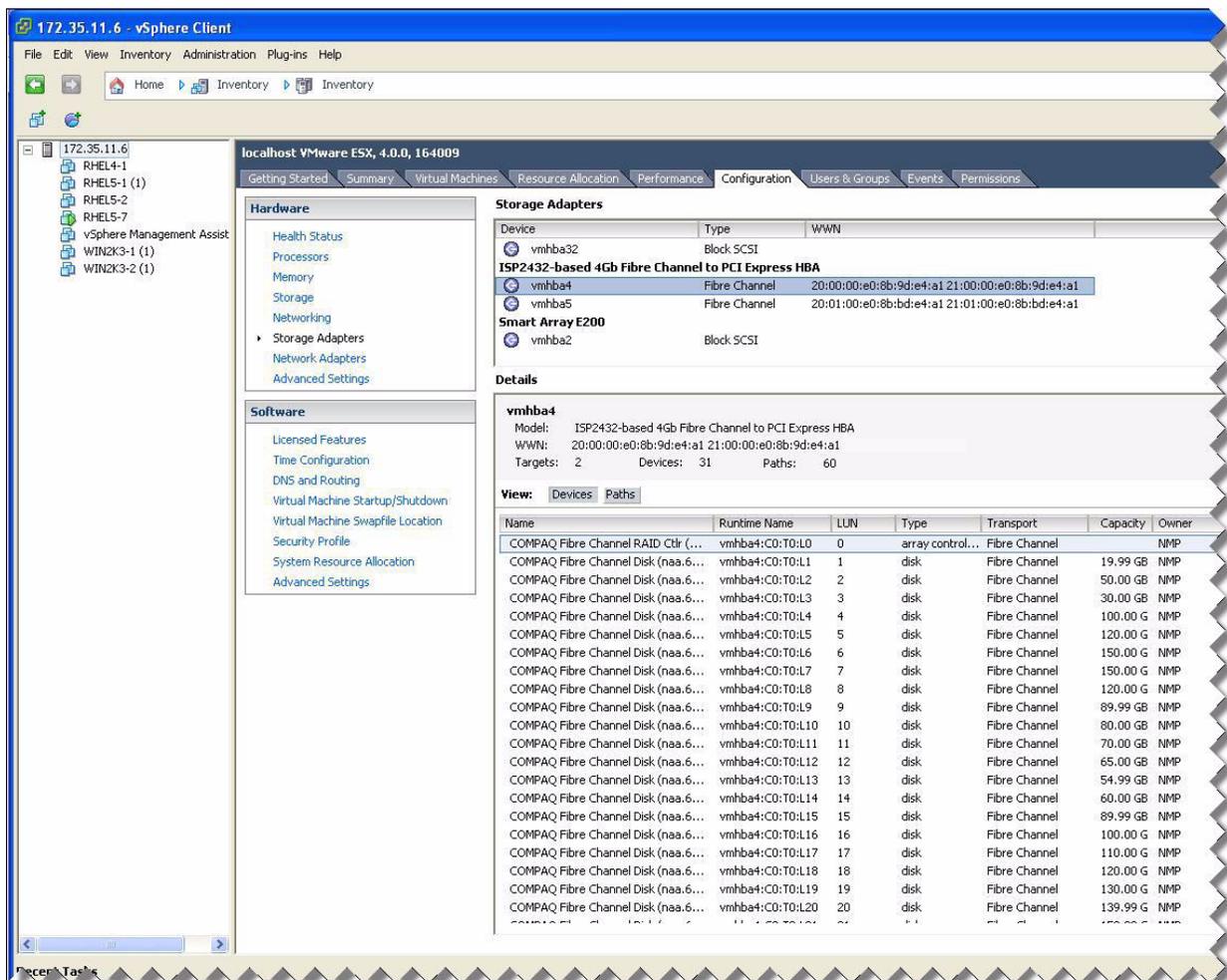


Figure 3-1 vSphere Client Configuration Page

## Using Console OS

You can use the console OS to identify QLogic Fibre Channel and Converged Network Adapters on a VMware ESX/ESXi 4.0 system.

**To identify QLogic Fibre Channel and Converged Network Adapters using console OS:**

1. Discover the device using `lspci`.
2. To list the subdirectories, run the following command:

```
ls /proc/scsi:
```

If the `qla2xxx` directory is present, QLogic adapters are installed on the VMware ESX/ESXi 4.0 system.

3. To list the QLogic storage adapters present on the system, run the following command:

```
ls /proc/scsi/qla2xxx
```

An example output may be:

```
# ls /proc/scsi/qla2xxx/  
1 2 3 4 5 6 HbaApiNode
```

4. To view additional details, run the following command:

```
cat /proc/scsi/qla2xxx/<adapter_number>
```

Where `<adapter_number>` is one of the adapter numbers shown in [Step 3](#).

This command lists the driver's supported features and its current state, in addition to its firmware/driver and boot code versions, as shown in [Figure 3-2](#).

```
172.35.10.234 - PuTTY
#0$ cat /proc/scsi/qla2xxx/8
000000 cat /proc/scsi/qla2xxx/8
QLogic PCI to Fibre Channel Host Adapter for QLE2562:
    Firmware version 4.04.09 [Class 2] [Multi-ID] , Driver version 8.02.01-kl-vmw38
BIOS version 2.10
FCODE version 2.04
EFI version 2.04
Flash FW version 4.06.02
ISP: ISP2532
Request Queue = 0x7d987000, Response Queue = 0x7da08000
Request Queue count = 4096, Response Queue count = 512
Total number of interrupts = 1086984
    Device queue depth = 0x20
Number of free request entries = 3352
Number of mailbox timeouts = 0
Number of ISP aborts = 0
Number of loop resyncs = 1
Host adapter:loop state = <READY>, flags = 0x145ac3
Dpc flags = 0x0
MBX flags = 0x0
Link down Timeout = 030
Port down retry = 005
Login retry count = 008
Execution throttle = 2048
ZIO mode = 0x6, ZIO timer = 1
Commands retried with dropped frame(s) = 0
Product ID = 0000 0000 0000 0000

NPIV Supported : Yes
Max Virtual Ports = 255

SCSI Device Information:
scsi-qla2-adapter-node=2000001b321667ee:020600:0;
scsi-qla2-adapter-port=2100001b321667ee:020600:0;

FC Target-Port List:
scsi-qla2-target-0=500508b300917771;
scsi-qla2-target-1=500508b300917779;

FC Port Information:
scsi-qla2-port-0=500508b300917770:500508b300917771:020800:81;
scsi-qla2-port-1=500508b300917770:500508b300917779:020900:82;
```

**Figure 3-2 Finding Adapters on VMware ESX/ESXi 4.0**

Driver information includes the following:

- Host adapter: loop state specifies the current state of the adapter port, including:
  - READY—Driver is ready to handle IO commands.
  - UPDATE—Driver is updating its target database because of a change in the fabric.
  - DEAD—No connection to a fabric or target.
- ZIO mode non-zero values indicate that the driver is operating in the Interrupt Coalescing mode, reducing the load on the CPU.

- `NPIV Supported` indicates whether the adapter port supports NPIV. If `Yes`, the maximum number of supported virtual ports on that specific adapter port is shown in the next line, `Max Virtual Ports`.
- `SCSI Device Information` lists the adapters' world wide names (WWNs) and Fibre Channel IDs.
- `FC Target-Port List` lists the target devices currently attached to the adapter port.
- `FC Port Information` lists all the devices that were connected to this port since power on. This field is used for debug purposes only, and may contain some redundant information.

## Using the QLogic *Fast!UTIL* BIOS Utility

QLogic Fibre Channel Adapters and Converged Network Adapters provide a BIOS utility, *Fast!UTIL*, which you can invoke at the BIOS. QLogic Fibre Channel Adapters support the *Fast!UTIL* BIOS utility on VMware ESX/ESXi 4.0 systems. *Fast!UTIL* does not require any installation.

Use *Fast!UTIL* to perform the following operations:

- Record BIOS, WWPN, and serial number information
- Restore factory defaults
- Scan for fibre devices
- Configure boot from SAN device
- Perform low-level disk commands
- Loopback test with loopback plug

To invoke *Fast!UTIL*, press the CTRL+Q keys at the QLogic BIOS banner screen, as described in steps 1 and 2 of [“Configuring Boot from SAN” on page 3-12](#).

The *Fast!UTIL* utility provides the following options:

- **Configuration Settings** provide options for Host Adapter Configuration, Boot Device Configuration, and an option to restore Default Configuration.
- **Scan Fibre Channel Devices** option scans the Fibre Channel loop and lists all the connected devices by loop ID. This option also displays device information such as vendor ID, product ID, and revision.
- **Fibre Disk Utility** scans the Fibre Channel loop and provides options to verify disk media, verify disk data, and format the Fibre Channel disk devices.
- **Loopback Data Test** runs a loopback test to ensure that the loop is up and to verify the health of the Fibre Channel loop.

- **Select Host Adapter** setting enables you to select a specific adapter, if you have multiple Fibre Channel or Converged Network Adapters in your system, and then configure or view the adapter's settings.

The *Fast!UTIL* BIOS utility is described in detail in the BIOS Readme file on the QLogic Driver Downloads / Documentation page (in the **Boot Code** section) for your adapter:

[http://driverdownloads.qlogic.com/QLogicDriverDownloads\\_UI/default.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/default.aspx)

## Verifying That the Driver is Loaded

Follow this procedure to ensure that the QLogic Fibre Channel or Converged Network Adapter driver is loaded on the VMware ESX/ESXi 4.0 system.

**To verify that the QLogic Fibre Channel or Converged Network Adapter driver is loaded:**

1. Log in to the service console as *root* user.
2. Execute the following command:

```
$ vmkload_mod -l
```

For proper operation, ensure that the Qlogic driver shows `Yes` in the `Loaded` column. [Figure 3-3](#) an example of the output.

| Name                | R/O | Addr           | Length   | R/W | Addr           | Length  | ID | Loaded |
|---------------------|-----|----------------|----------|-----|----------------|---------|----|--------|
| vmkernel            |     | 0x418017200000 | 0x296659 |     | 0x0            | 0x0     | 0  | Yes    |
| vmklinux            |     | 0x418017573000 | 0x63000  |     | 0x417fd8462ac0 | 0x30000 | 1  | Yes    |
| random              |     | 0x4180175d6000 | 0x3000   |     | 0x417fd849b380 | 0x4000  | 2  | Yes    |
| usb                 |     | 0x4180175a9000 | 0x17000  |     | 0x417fd849f4c0 | 0x2000  | 3  | Yes    |
| ehci-hcd            |     | 0x4180175f0000 | 0x8000   |     | 0x417fd84a14e0 | 0x1000  | 4  | Yes    |
| usb-ohci            |     | 0x4180175f8000 | 0x5000   |     | 0x417fd84a5200 | 0x1000  | 5  | Yes    |
| hid                 |     | 0x4180175fd000 | 0x5000   |     | 0x417fd84a6680 | 0x1000  | 6  | Yes    |
| dm                  |     | 0x418017602000 | 0x2000   |     | 0x417fd84a78d0 | 0x1000  | 7  | Yes    |
| nmp                 |     | 0x418017604000 | 0x16000  |     | 0x417fd84a88e0 | 0x2000  | 8  | Yes    |
| vmw_satp_local      |     | 0x41801761a000 | 0x1000   |     | 0x417fd84aa930 | 0x1000  | 9  | Yes    |
| vmw_satp_default_aa |     | 0x41801761b000 | 0x1000   |     | 0x417fd84ab940 | 0x1000  | a  | Yes    |
| vmw_psp_fixed       |     | 0x41801761c000 | 0x2000   |     | 0x417fd84ac950 | 0x1000  | b  | Yes    |
| libata              |     | 0x41801761e000 | 0x15000  |     | 0x417fd84ad960 | 0x2000  | c  | Yes    |
| usb-storage         |     | 0x418017633000 | 0xa000   |     | 0x417fd84af9a0 | 0x4000  | d  | Yes    |
| mask_path_plugin    |     | 0x41801763d000 | 0x1000   |     | 0x417fd84b41d0 | 0x1000  | e  | Yes    |
| vmw_satp_alua       |     | 0x41801763e000 | 0x4000   |     | 0x417fd84b51e0 | 0x1000  | f  | Yes    |
| vmw_satp_cx         |     | 0x418017642000 | 0x6000   |     | 0x417fd84b61f0 | 0x1000  | 10 | Yes    |
| vmw_satp_default_ap |     | 0x418017648000 | 0x2000   |     | 0x417fd84b7200 | 0x1000  | 11 | Yes    |
| vmw_satp_eva        |     | 0x41801764a000 | 0x2000   |     | 0x417fd84b8210 | 0x1000  | 12 | Yes    |
| vmw_satp_lsi        |     | 0x41801764c000 | 0x4000   |     | 0x417fd84b9220 | 0x1000  | 13 | Yes    |
| vmw_satp_symm       |     | 0x418017650000 | 0x1000   |     | 0x417fd84ba230 | 0x1000  | 14 | Yes    |
| vmw_satp_inv        |     | 0x418017651000 | 0x3000   |     | 0x417fd84bb240 | 0x1000  | 15 | Yes    |
| vmw_satp_eq1        |     | 0x418017654000 | 0x1000   |     | 0x417fd84bc250 | 0x1000  | 16 | Yes    |
| vmw_satp_msa        |     | 0x418017655000 | 0x1000   |     | 0x417fd84bd260 | 0x1000  | 17 | Yes    |
| vmw_satp_svc        |     | 0x418017656000 | 0x1000   |     | 0x417fd84be270 | 0x1000  | 18 | Yes    |
| vmw_satp_alua_cx    |     | 0x418017657000 | 0x3000   |     | 0x417fd84bf280 | 0x1000  | 19 | Yes    |
| vmw_psp_rr          |     | 0x41801765a000 | 0x3000   |     | 0x417fd84c02c0 | 0x1000  | 1a | Yes    |
| vmw_psp_mru         |     | 0x41801765d000 | 0x2000   |     | 0x417fd84c12e0 | 0x1000  | 1b | Yes    |
| bnx2                |     | 0x41801765f000 | 0xe000   |     | 0x417fd84c2320 | 0x15000 | 1c | Yes    |
| iscsi_trans         |     | 0x418017688000 | 0x7000   |     | 0x417fd84d9e40 | 0x2000  | 1e | Yes    |
| iscsi_linux         |     | 0x41801768f000 | 0x1000   |     | 0x417fd84dbe80 | 0x1000  | 1f | Yes    |
| sata_svw            |     | 0x418017690000 | 0x1000   |     | 0x417fd84dcea0 | 0x1000  | 20 | Yes    |
| megaraid_sas        |     | 0x418017691000 | 0x7000   |     | 0x417fd84de060 | 0x3000  | 21 | Yes    |
| qla2xxx             |     | 0x418017698000 | 0x38000  |     | 0x417fd84e31e0 | 0xda000 | 22 | Yes    |
| lvmdriver           |     | 0x4180176d0000 | 0x10000  |     | 0x417fd85c12c0 | 0x4000  | 23 | Yes    |
| filedriver          |     | 0x4180176e0000 | 0x1000   |     | 0x417fd85c5ae0 | 0x1000  | 24 | Yes    |
| deltadisk           |     | 0x4180176e1000 | 0x9000   |     | 0x417fd85c7e40 | 0x1000  | 25 | Yes    |
| multiextent         |     | 0x4180176ea000 | 0x2000   |     | 0x417fd85c8e80 | 0x1000  | 26 | Yes    |
| dvsdev              |     | 0x4180176ec000 | 0x2000   |     | 0x417fd85c9ea0 | 0x1000  | 27 | Yes    |
| etherswitch         |     | 0x4180176ee000 | 0x21000  |     | 0x417fd85caee0 | 0x9000  | 28 | Yes    |
| hub                 |     | 0x41801770f000 | 0x1000   |     | 0x417fd85d3f00 | 0x1000  | 29 | Yes    |
| shaper              |     | 0x418017710000 | 0x4000   |     | 0x417fd85d4f40 | 0x1000  | 2a | Yes    |
| sd                  |     | 0x418017714000 | 0xe000   |     | 0x417fd85d5f60 | 0x8000  | 2b | Yes    |

Figure 3-3 Verifying That the Driver is Loaded

## Configuring the Driver Parameters

Use the `esxcfg-module` command to configure the QLogic Fibre Channel and Converged Network Adapter driver parameters.

### To configure driver parameters:

1. To list the driver parameters, execute the following command:

```
# esxcfg-module -g qla2xxx
```

2. To set the driver parameters, execute the following command:

```
# esxcfg-module -s <options> qla2xxx
```

where *<options>* is one of the configurable parameters listed in [Table 3-1 on page 3-8](#).

For example, the following command sets the maximum device queue depth reported by the QLogic to a value of 32:

```
# esxcfg-module -s ql2xmaxqdepth=32 qla2xxx
```

- To update the ESX RAMdisk image, execute following command:

```
# esxcfg-boot -b
```

- For the preceding changes to take effect, reboot the server as follows:

```
# reboot
```

**NOTE:**

All configuration changes made using the `esxcfg-module -s` command are *persistent*, meaning that the configuration changes will be saved across system reboots.

[Table 3-1](#) lists alphabetically all the QLogic driver configurable parameters and provides a brief description of each.

**Table 3-1. Configurable Driver Parameters**

| Driver Parameter           | Description   |
|----------------------------|---|
| ql2xallocfwdump            | Option to enable allocation of memory for a firmware dump during adapter initialization. Memory allocation requirements vary by ISP type. 0 = memory not allocated (default). |
| ql2xcmdtimeout             | Timeout value in seconds for <code>scsi</code> command. Default is 20.  |
| ql2xenablemsi              | Enables MSI-X/MSI interrupt scheme. Default is 0 = disable MSI-X/MSI; 1 = enable MSI-X/MSI.   |
| ql2xexectuion_throttle     | IOCB exchange count for adapter. Default is 0; set intended value to override firmware defaults.  |
| ql2xextended_error_logging | Option to enable extended error logging. 0 = no logging (default); 1 = log errors.  |
| ql2xiidmaenable            | Enables iIDMA settings. Default is 1 = perform iIDMA; 0 = no iIDMA.   |
| ql2xintrdelaytimer         | Waiting time for firmware before it generates an interrupt to the host to notify completion of request.   |
| ql2xioctltimeout           | Ioctl timeout value in seconds for pass-through commands. Default is 66.  |

**Table 3-1. Configurable Driver Parameters (Continued)**

| Driver Parameter               | Description  |
|--------------------------------|--|
| ql2xloginretrycount            | Option to modify the login retry count.  |
| ql2xlogintimeout               | Login timeout value in seconds. Default is 20.   |
| ql2xmaxqdepth                  | Maximum queue depth to report for target devices. Default is 32.   |
| ql2xmaxsgs                     | Maximum scatter or gather entries per I/O request. Default is 32.  |
| ql2xoperationmode              | Option to enable operation mode for 2Gb or 4Gb Fibre Channel Adapters. For 2Gb Fibre Channel Adapters, set to 0x5 to enable zero input output (ZIO) mode. For 4Gb Fibre Channel Adapters, set to 0x5/0x6 to enable ZIO mode. |
| ql2xplogiabsentdevice          | Option to enable PLOGI (port login) to devices that are not present after a fabric scan. This workaround is required for some Fibre Channel switch defects. 0 = no PLOGI (default); 1 = perform PLOGI.                       |
| ql2xqfullrampup                | Number of seconds to wait to begin to ramp-up the queue depth for a device after a queue-full condition has been detected. Default is 120 seconds.   |
| ql2xusedefmaxrdreq             | Option to adjust PCIe™ Maximum Read Request Size. 1 = use system default; 0 = default.   |
| ql2xusedrivernaming            | Enables Consistent Device Naming feature. Default is 0 = disabled, 1 = enabled.  |
| qlport_down_retry <sup>a</sup> | Maximum number of command retries to a port that returns PORT-DOWN status. Default is 15. (This parameter is multiplied by a factor of 2 to determine the number of seconds driver holds the I/O request.)                   |

**Table Footnotes**

<sup>a</sup> This parameter determines how long the driver will internally queue I/O before returning the DID\_NO\_CONNECT status to the SCSI mid layer.

## Deploying NPIV for VMware ESX/ESXi 4.0

QLogic Fibre Channel and Converged Network Adapters support N\_Port ID virtualization (NPIV) for Fibre Channel and FCoE SANs. NPIV enables each virtual machine to have its own Fibre Channel-FCoE world wide port name (WWPN) by creating multiple virtual adapters on a single physical adapter.

VMware ESX/ESXi 4.0 enables NPIV support on QLogic 4Gb/8Gb Fibre Channel Adapters and QLE8000 Series Converged Network Adapters. No additional software or hardware installation is required to support NPIV. Note that VMware ESX/ESXi 4.0 supports NPIV only on RDM (Raw Device Mapping) devices.

To configure NPIV, the Fibre Channel-FCoE switch port must be configured to enable NPIV. The specific procedure to enable NPIV on the switch port depends on the switch itself. For details, refer to the Fibre Channel-FCoE switch documentation.

For more detailed NPIV information, refer to the following documents available from VMware:

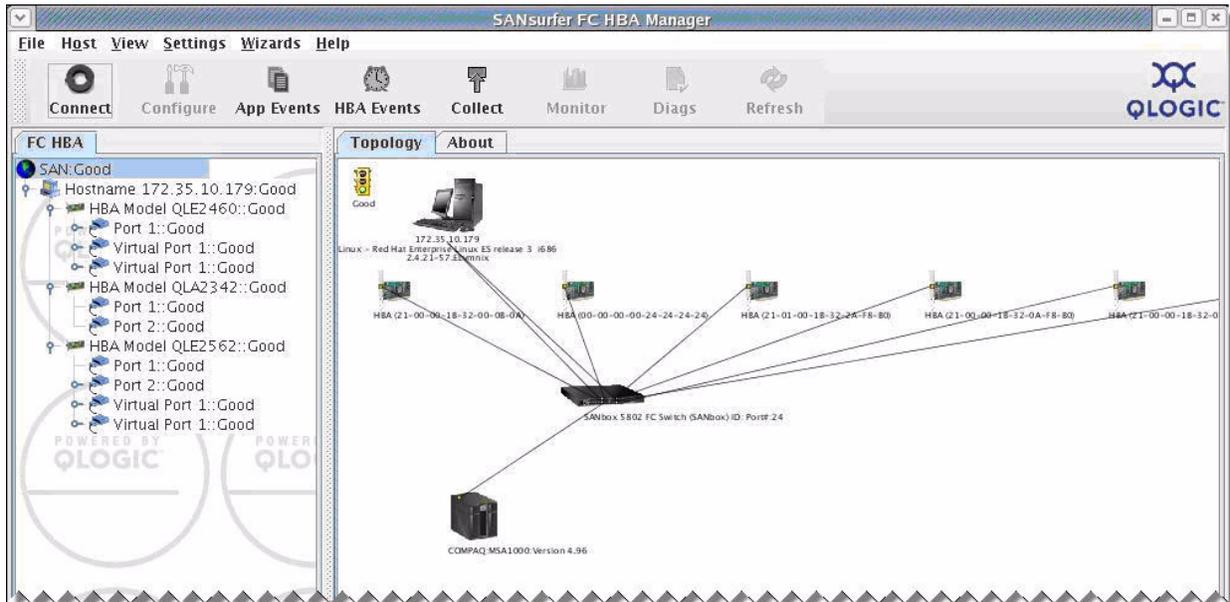
- *Fibre Channel SAN Configuration Guide*  
[http://www.vmware.com/pdf/vsphere4/r40/vsp\\_40\\_san\\_cfg.pdf](http://www.vmware.com/pdf/vsphere4/r40/vsp_40_san_cfg.pdf)
- *VMware Configuring and Troubleshooting N-Port ID Virtualization* technical note  
[http://www.vmware.com/pdf/vi3\\_35\\_25\\_npiv\\_config.pdf](http://www.vmware.com/pdf/vi3_35_25_npiv_config.pdf) (information is also applicable to ESX 4.0)

## Monitoring NPIV Virtual Ports from SANsurfer

QLogic's SANsurfer management tools also support the NPIV functionality in the drivers. SANsurfer FC HBA Manager (GUI) and SANsurfer FC HBA CLI (command line interface) both display the virtual ports configured on the system. SANsurfer management tools also provide additional information on the virtual ports, including diagnostics and monitoring information.

SANsurfer generates events and notifies the user of any change (such as virtual port creation and deletion) at the backend to the virtual ports.

Figure 3-4 shows a typical virtual environment in SANsurfer FC HBA Manager with physical and virtual ports. The proc node provides information on the number of virtual ports and their individual states, as well as the target devices with which they can communicate (see also “Using Console OS” on page 3-2).



**Figure 3-4 SANsurfer FC HBA Manager Showing NPIV**

When you select an individual virtual port on the Topology page, SANsurfer FC HBA Manager displays additional details about the selected virtual port on four tabbed pages. The Information page (see [Figure 3-5](#)) displays port attributes such as **Port ID**, **Firmware Version**, and **Actual Data Rate**.

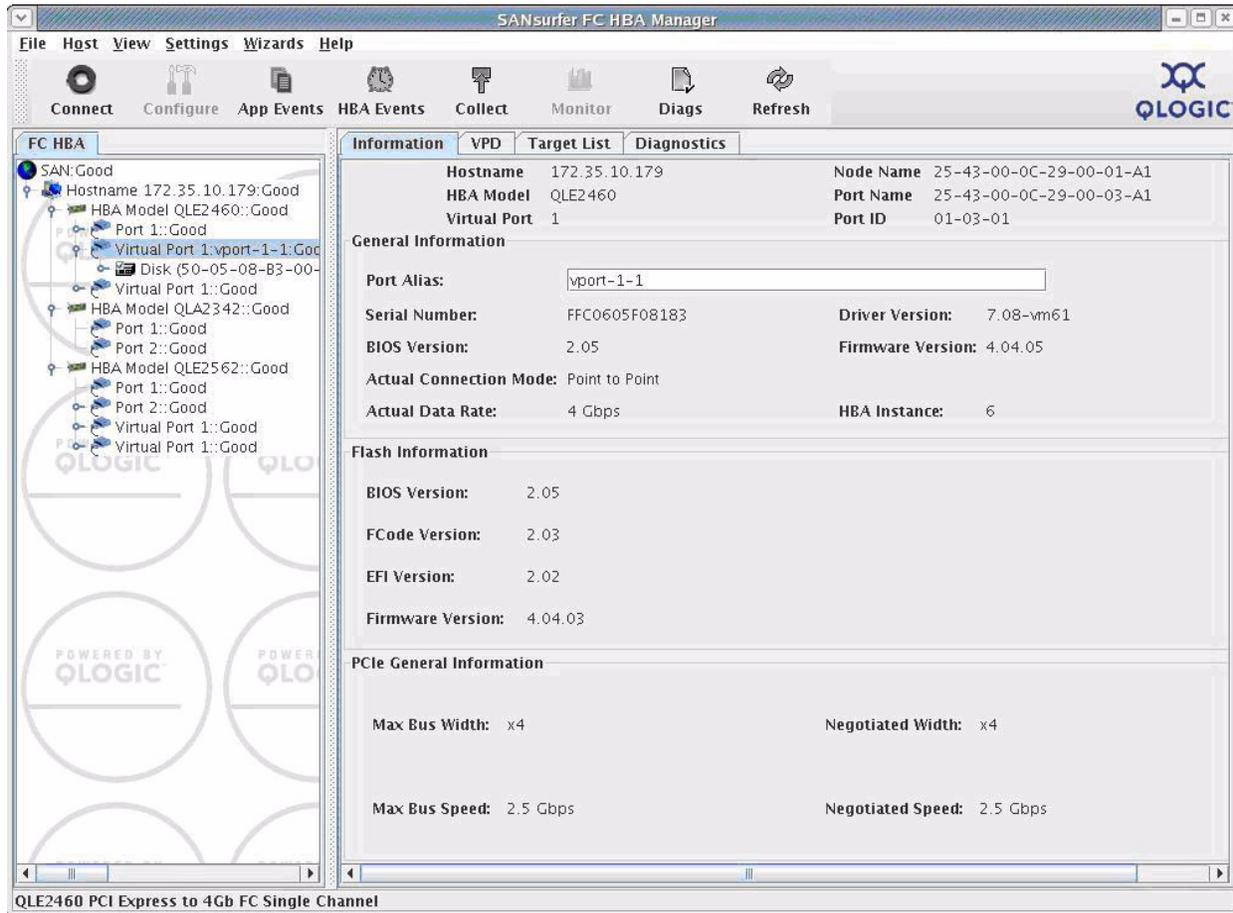


Figure 3-5 Virtual Port Information Page in SANsurfer

## Configuring Boot from SAN

*Boot from SAN* refers to installing and booting a server's operating system from a storage device attached to the SAN instead of from a locally attached storage device. The OS is installed on one or more LUNs in the SAN array and the Fibre Channel and Converged Network Adapters are configured to boot from the specified LUN. Boot from SAN provides several benefits including:

- Reducing server costs
- Ease of management
- Improved disaster tolerance
- Improved boot LUN availability

VMware ESX/ESXi 4.0 provides boot from SAN capability on QLogic Fibre Channel Adapters. For storage array and Fibre Channel switch configuration, refer to the appropriate user manual for the device. For VMware ESX/ESXi 4.0-specific configuration requirements, refer to the VMware *Fibre Channel SAN Configuration Guide* located at the following URL:

[http://www.vmware.com/pdf/vsphere4/r40/vsp\\_40\\_san\\_cfg.pdf](http://www.vmware.com/pdf/vsphere4/r40/vsp_40_san_cfg.pdf)

**To configure the QLogic Fibre Channel and Converged Network Adapter for boot from SAN:**

1. After installing the adapter, boot the server into BIOS.
2. At the QLogic BIOS banner screen (Figure 3-6), press the CTRL+Q keys.



```
QLogic Corporation
QMC2452 PCI Fibre Channel RDM BIOS Version 1.04
Copyright (C) QLogic Corporation 1993-2005. All rights reserved.
www.qlogic.com

Press <CTRL-Q> for Fast!UTIL

BIOS for Adapter B is disabled

BIOS for Adapter 1 is disabled
RDM BIOS NOT INSTALLED

<CTRL-Q> Detected, Initialization in progress, Please wait...
```

**Figure 3-6 Starting Fast!UTIL from the BIOS Screen**

The *Fast!UTIL* Fibre Channel Adapter configuration utility starts.

3. In *Fast!UTIL*, choose the appropriate Fibre Channel Adapter port to be configured.
4. On the *Fast!UTIL* Options page, select **Configuration Settings**, and then press ENTER.
5. On the Configuration Settings page, select **Host Adapter Settings**, and then press ENTER.
6. To set the BIOS to search for SCSI devices:
  - a. On the Host Adapter Settings page, select **Host Adapter BIOS**.
  - b. To toggle the value to **Enabled**, press the ENTER key.
  - c. To exit, press the ESC key.

7. After the **Host Adapter BIOS** is enabled, select the boot device as shown in the following table:

| Enable Selectable Boot | WWPN/LUN Boot List | Device Boot  |
|------------------------|--------------------|--|
| No                     | x                  | BIOS configures the first disk drive it finds as boot device.  |
| Yes                    | None specified     | BIOS configures the first disk drive it finds that is also a LUN 0 as boot device.   |
| Yes                    | Specified          | BIOS scans through the specified boot WWPN or LUN list until it finds a disk drive, and then configures it as the boot device. |

- a. Choose **Selectable Boot Settings**, and then press ENTER.
  - b. On the Selectable Boot Settings page, choose **Selectable Boot**.
  - c. To toggle the value to **Enabled**, press ENTER.
8. After the Selectable Boot is enabled, select the boot device. QLogic Fibre Channel Adapters allow the specification of up to four WWPN/LUNs as boot devices. To select up to three boot devices, follow these steps:
- a. To move to the **Primary** location of the **Selectable Boot List** menu, press the DOWN ARROW key.
  - b. To see a list of accessible devices in the **Select Fibre Channel Device** menu, press ENTER.
  - c. Press the DOWN ARROW key to scroll down to the device you want to put into your **Selectable Boot** menu list.
  - d. To select the requested device and load it into the **Selectable Boot** menu list, press ENTER.
  - e. (Optional) Repeat this step to specify up to three alternate boot devices.

Now the ESX system is ready to boot from SAN from the specified boot devices.

**NOTE:**

QLogic recommends that when both the adapter BIOS and the **Selectable Boot** option are enabled, you always select a device and put it in the **Primary** boot device location of the **Selectable Boot** menu list.

# A Troubleshooting

This appendix provides the following methods of determining the status of the adapters and finding solutions to common problems:

- [Troubleshooting with LEDs](#)
- [“Dynamic Extended Logging” on page A-3](#)
- [“Troubleshooting with Driver Logs” on page A-4](#)
- [“Debugging Using Proc Information” on page A-9](#)
- [“Collecting System Logs for Troubleshooting” on page A-10](#)
- [“Frequently Seen Issues” on page A-10](#)

## Troubleshooting with LEDs

QLogic Fibre Channel and Converged Network Adapters have LEDs that can help you diagnose problems. Typically, administrators observe the LED patterns to perform first-level troubleshooting that can indicate some obvious firmware or hardware issues.

Specific QLogic Fibre Channel and Converged Network Adapter families have unique LED patterns. The following tables describe the LED patterns for the various Fibre Channel and Converged Network Adapter series.

**Table A-1. QLA234x Adapter LED Scheme**

| Green LED          | Amber LED          | Activity                |
|--------------------|--------------------|-------------------------|
| ○                  | ○                  | Power off               |
| ●                  | ●                  | Power                   |
| ●                  | ○                  | Online                  |
| ○                  | ●                  | Link                    |
| ○                  | Flashing           | Loss of synchronization |
| Alternate flashing | Alternate flashing | Firmware error          |
| Flashing           | ○                  | Beacon                  |

**Table A-2. QLA24xx/QLE24xx/QEM2462 Adapter LED Scheme**

| Yellow LED   | Green LED  | Amber LED  | Activity                          |
|--|------------|------------|-----------------------------------|
| ○  | ○          | ○          | Power off                         |
| ●  | ●          | ●          | Power on (before firmware init)   |
| Flashing   | Flashing   | Flashing   | Power on (after firmware init)    |
| Yellow, green, and amber LEDs flashing alternately |            |            | Firmware error                    |
| ○  | ○          | ●/Flashing | Online, 1Gbps link / I/O activity |
| ○  | ●/Flashing | ○          | Online, 2Gbps link / I/O activity |
| ●/Flashing   | ○          | ○          | Online, 4Gbps link / I/O activity |
| Flashing   | ○          | Flashing   | Beacon                            |

**Table A-3. QEM2462 Power and Attention Switch LED Scheme**

| Green Power      | Activity  |
|------------------|---|
| ○                | Power off<br>Insertion or removal of the adapter is permitted                                     |
| ●                | Power<br>Insertion or removal of the adapter is <i>not</i> permitted                              |
| Blinking         | Hot-plug operation is in progress and insertion or removal of the adapter is <i>not</i> permitted |
| Yellow Attention | Activity  |
| ○                | Normal operation  |
| ●                | Operational problem at this slot  |
| Blinking         | Slot is being identified at the user's request  |

**Table A-4. QLE25xx Adapter LED Scheme**

| Yellow LED   | Green LED  | Amber LED  | Activity                          |
|--|------------|------------|-----------------------------------|
| ○  | ○          | ○          | Power off                         |
| ●  | ●          | ●          | Power on (before firmware init)   |
| Flashing   | Flashing   | Flashing   | Power on (after firmware init)    |
| Yellow, green, and amber LEDs flashing alternately |            |            | Firmware error                    |
| ○  | ○          | ●/Flashing | Online, 2Gbps link / I/O activity |
| ○  | ●/Flashing | ○          | Online, 4Gbps link / I/O activity |
| ●/Flashing   | ○          | ○          | Online, 8Gbps link / I/O activity |
| Flashing   | ○          | Flashing   | Beacon                            |

**Table A-5. QLE8042 Converged Network Adapter LED Scheme**

| Green LED (Link) | Green LED (Activity, TX/RX) | Activity                         |
|------------------|-----------------------------|----------------------------------|
| ○                | ○                           | Power on (no link)               |
| ●                | ○                           | Link established, no activity    |
| ●                | Flashing                    | Link established, TX/RX activity |

## Dynamic Extended Logging

The QLogic driver provides a mechanism to dynamically enable extended error logging about driver operation. These logs provide debugging and error information to help you understand driver behavior regarding issues related to the adapter. These logs are saved in a system log file named `vmkernel`, in the `/var/log/` directory.

To enable extended error logging, execute the following command:

```
# echo "scsi-qlaenable-log" > /proc/scsi/qla2xxx/<adapter_number>
```

To disable extended error logging, execute the following command:

```
# echo "scsi-qladisable-log" > /proc/scsi/qla2xxx/<adapter_number>
```

When the logging is enabled, the driver version in the `/proc/scsi/qla2xxx/<adapter number>` is appended with a `-debug` flag as shown below:

```
# cat /proc/scsi/qla2xxx/5
QLogic PCI to Fibre Channel Host Adapter for QLE2462:
    Firmware version 4.04.09 [IP] [Multi-ID] [84XX], Driver
version 8.02.01-k1-vmw41-debug
BIOS version 2.10
FCODE version 2.04
EFI version 2.04
Flash FW version 4.06.02
ISP: ISP2432
```

**NOTE:**

Although the driver logs provide debugging and error information, they also increase I/O latency. Therefore, QLogic does not recommend that you enable extended logging during normal operations.

## Troubleshooting with Driver Logs

All messages from the QLogic Fibre Channel Adapter driver are logged in `/var/log/vmkernel`. These messages provide additional information about the driver operation: both normal and driver warnings. Messages from the driver are usually preceded by `scsi(%d)`, where `%d` is the adapter instance number.

The following example shows a snippet from a `vmkernel` file:

```
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.220 cpu7:4109)<6>qla2xxx
0000:0a:00.0: Found an ISP2432, irq 113, iobase 0x0x4100b1a02000
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.220 cpu7:4109)<6>qla2xxx
0000:0a:00.0: Configuring PCI space...
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.220 cpu7:4109)VMK_PCI: 728:
device 010:00.0 capType 16 capIndex 76
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.220 cpu7:4109)VMK_PCI: 728:
device 010:00.0 capType 16 capIndex 76
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.253 cpu7:4109)<6>qla2xxx
0000:0a:00.0: Configure NVRAM parameters...
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.284 cpu7:4109)<6>qla2xxx
0000:0a:00.0: ZIO mode 6 enabled; timer delay (100 us).
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.284 cpu7:4109)<6>qla2xxx
0000:0a:00.0: Verifying loaded RISC code...
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.550 cpu6:4109)<6>qla2xxx
0000:0a:00.0: Allocated (64 KB) for EFT...
```

```
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.550 cpu6:4109)<6>qla2xxx
0000:0a:00.0: Allocated (1413 KB) for firmware dump...
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.572 cpu6:4109)IDT: 942: 0x71
<qla2xxx> sharable (entropy source), flags 0x10
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.572 cpu6:4109)VMK_VECTOR: 137:
Added handler for shared vector 113, flags 0x10
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.572 cpu6:4109)IDT: 1038: 0x71
for vmkernel
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.572 cpu6:4109)VMK_VECTOR: 225:
vector 113 enabled
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.572 cpu6:4109)LinPCI:
LinuxPCI_DeviceIsPAECapable: PAE capable device at 0000:0a:00.0
Aug 18 15:15:13 localhost vmkernel: 0:00:00:34.572 cpu6:4109)VMK_PCI: 627:
Device 010:00.0 name: vmhba4
Aug 18 15:15:13 localhost vmkernel: 0:00:00:35.112 cpu0:4096)<6>qla2xxx
0000:0a:00.0: LIP reset occurred (f8f7).
Aug 18 15:15:13 localhost vmkernel: 0:00:00:35.255 cpu0:4096)<6>qla2xxx
0000:0a:00.0: LIP occurred (f8f7).
Aug 18 15:15:13 localhost vmkernel: 0:00:00:35.255 cpu0:4096)<6>qla2xxx
0000:0a:00.0: LIP reset occurred (f7f7).
Aug 18 15:15:13 localhost vmkernel: 0:00:00:35.325 cpu0:4096)<6>qla2xxx
0000:0a:00.0: LOOP UP detected (4 Gbps).
```

Table A-6 lists the more common driver log messages and provides an explanation of each.

**Table A-6. Common Driver Log Messages**

|   |
|---|
| <code>"qla2xxx &lt;dev driver string&gt;: Found an ISPXXXX, irq yyy, iobase zzz"</code>   |
| Driver is reporting which adapter it has found during initialization.   |
| <code>"qla2xxx &lt;dev driver string&gt;: Verifying loaded RISC code..."</code>   |
| Driver is reporting that it has verified the RISC code and it is running.   |
| <code>"qla2xxx &lt;dev driver string&gt;: LIP reset occurred (f8f7)."</code>  |
| Driver received a LIP async event from the firmware.  |
| <code>"qla2xxx &lt;dev driver string&gt;: LOOP UP detected (4 Gbps)."</code>  |
| Driver received a loop up async event from the firmware.  |
| <code>"qla2xxx &lt;dev driver string&gt;: LOOP DOWN detected."</code>   |
| Driver received a loop down async event from the firmware.  |
| <code>"scsi(%d): Asynchronous P2P MODE received."</code>  |
| Driver received a point-to-point async event from the firmware.   |
| <code>"qla2xxx &lt;dev driver string&gt;:....QLogic Fibre Channel HBA Driver:<br/>8.02.01-k1-vmw41-debug.....QLogic QLExxxx - PCI-Express Dual Channel NGb<br/>Fibre Channel HBA..."</code>   |
| Driver is reporting information discovered during its initialization. This information includes the board ID, firmware version, and driver version.   |
| <code>"qla%d Loop Down - aborting ISP"</code>   |
| Indicates driver is attempting to restart the loop by resetting the adapter. Usually done by the driver when sync is not detected by the firmware for a long time (4+ minutes), and usually means that the adapter port is not connected to the switch or loop. |
| <code>"qla2xxx &lt;dev driver string&gt;: ISP System Error - mbx1=%x, mbx2=%x, mbx3=%x"</code>  |
| Driver received an async ISP system error event from the firmware. Additional information follows the message (that is, mailbox values from the firmware).  |
| <code>"qla2xxx &lt;dev driver string&gt;: Configuration change detected: value %d."</code>  |
| Driver received a change in connection async event from the firmware. Additional information follows the message (that is, mailbox 1 value from the firmware).  |
| <code>"scsi(%d): Port database changed"</code>  |
| Driver received a port database async event from the firmware.  |

**Table A-6. Common Driver Log Messages (Continued)**

|  |
|--|
| <code>"scsi(%d): RSCN,..."</code>  |
| Driver received a registered state change notification (RSCN) async event from the firmware. Additional information follows the message (that is, mailbox values from the firmware). |
| <code>"scsi(%d): Cannot get topology - retrying"</code>  |
| Firmware return status indicating it is busy.  |
| <code>"qla2x00: Status Entry invalid handle"</code>  |
| Driver detected an invalid entry in the ISP response queue from the firmware. %x indicates the queue index.  |
| <code>"scsi(%ld:%d:%d:%d): DEVICE RESET ISSUED.\n"</code>  |
| Indicates a device reset is being issued to (host:bus:target:lun).   |
| <code>"scsi(%ld:%d:%d:%d): BUS RESET ISSUED.\n"</code>   |
| Indicates a loop reset is being issued to (host:bus:target:lun).   |
| <code>"scsi(%ld:%d:%d:%d): ADAPTER RESET ISSUED.\n"</code>   |
| Indicates an adapter reset is being issued to (host:bus:target:lun).   |
| <code>"scsi(%d): Unknown status detected %x-%x"</code>   |
| Indicates the status returned from the firmware is not supported. %x-%x is the completion-scsi statuses.   |
| <code>"scsi(%d): Cable is unplugged..."</code>   |
| Indicates the firmware state is in LOSS OF SYNC; therefore, the cable must be missing.   |
| <code>"qla2x00: Performing ISP error recovery - ha=%p."</code>   |
| Indicates the driver has started performing an adapter reset.  |
| <code>"qla2x00_abort_isp(%d): **** FAILED ****"</code>   |
| Indicates the driver failed performing an adapter reset.   |
| <code>"qla2xxx &lt;dev driver string&gt;: RISC paused -- HCCR=%x, Dumping firmware!"</code>  |
| Indicates the driver has detected the RISC in the pause state.   |
| <code>"qla2xxx &lt;dev driver string&gt;: Mid-layer underflow detected (%x of %x bytes) wanted "%xbytes...returning error status!\n"</code>  |
| Indicates an underflow was detected.   |
| <code>"WARNING %s(%d):ERROR -- Unable to get host loop ID."</code>   |
| Firmware failed to return the adapter loop ID.   |

**Table A-6. Common Driver Log Messages (Continued)**

|   |
|---|
| <b>"WARNING qla2xxx: Couldn't allocate host from scsi layer!"</b>   |
| Indicates the driver could not register with the SCSI layer, usually because it could not allocate the memory required for the adapter. |
| <b>"WARNING scsi(%d): [ERROR] Failed to allocate memory for adapter\n"</b>  |
| Indicates the driver could not allocate all the kernel memory it needed.  |
| <b>"WARNING qla2xxx: Failed to initialize adapter"</b>  |
| Indicates that a previously occurring error is preventing the adapter instance from initializing normally.                              |
| <b>"WARNING qla2xxx: Failed to reserve interrupt %d already in use"</b>   |
| Indicates the driver could not register for the interrupt IRQ because another driver is using it.                                       |
| <b>"WARNING qla2xxx: ISP Request Transfer Error"</b>  |
| Driver received a Request Transfer Error async event from the firmware.   |
| <b>"WARNING qla2xxx: ISP Response Transfer Error"</b>   |
| Driver received a Response Transfer Error asynchronous event from the firmware.   |
| <b>"WARNING Error entry invalid handle"</b>   |
| Driver detected an invalid entry in the ISP response queue from the firmware. This error will cause an ISP reset to occur.              |
| <b>"WARNING scsi%d: MS entry - invalid handle"</b>  |
| Driver detected a management server command timeout.  |

## Debugging Using Proc Information

The driver `/proc/scsi/qla2xxx/<adapter_number>` provides debugging information that can help you troubleshoot problems with the driver. The `/proc` entry provides firsthand information about the current state of the driver.

Table A-8 lists the `/proc` output fields and provides a description of each.

**Table A-7. Proc Output**

| Output Field               | Description   |
|----------------------------|---|
| Boot Code Version          | Provides the version of the boot code present on the adapter. A version of 0.00 indicates that the boot code is corrupted or not present, and must be updated to perform a <i>boot from SAN</i> (see “Configuring Boot from SAN” on page 3-12).   |
| Number of ISP aborts       | Provides the number of times the system chip has been reset. Typically, whenever the system NVRAM or Flash is updated, the chip is reset to use the updated information. Otherwise, the chip is reset only if an error occurs. This number thus provides a close approximation of whether the chip has been operating properly. |
| Host adapter FC link state | Provides the connection state of the specified adapter. Possible values include the following:<br>READY: Ready to perform I/Os.<br>UPDATE: The topology is being re-discovered.<br>DEAD: No connection.<br>DOWN: Intermittent state, link temporarily down.   |
| NPIV Supported             | Indicates whether the given adapter node supports NPIV. If <i>yes</i> , the subsection provides the maximum number of virtual ports supported.  |
| SCSI Device Information    | Provides the WWN of the given adapter.  |
| FC Port Information        | Lists all Fibre Channel ports to which the specified adapter is connected. The last entry in this field indicates the login status of the port and whether the port is operating in <i>target</i> or <i>initiator</i> mode.   |
| SCSI LUN Information       | Lists all the LUNs visible to the specified adapter.  |

## Collecting System Logs for Troubleshooting

To collect all relevant data on the running system into one `tar` file, execute the following command:

```
# vm-support
```

## Frequently Seen Issues

Table A-8 lists some common issues and questions and provides tips for their resolution.

**Table A-8. Frequently Seen Issues**

| Issue   | Troubleshooting Tip  |
|---|--|
| What is the SANsurfer FC HBA Manager password?  | The password is <i>config</i> .  |
| One specific adapter in the system has performance issues, while all other adapters in the system are okay.   | Ensure that the adapter is plugged into a slot that allows the adapter to use the full bandwidth available. Also check that the bus the adapter is on is not shared by other high bandwidth PCI cards.   |
| <p>Errors similar to the following occur when the system is booted up. In addition, the ALT+Q QLogic BIOS banner is not shown; or FlashUTIL! is hanging when trying to flash the adapters.</p> <ul style="list-style-type: none"> <li>■ 00180101 10772422 PCID device resource allocation failure</li> <li>■ 00180101 10772422 PCID device resource allocation failure</li> </ul> | There are too many devices taking up extended BIOS data area (EBDA) memory resources. To free up enough resources to allow the adapters to work properly, you can disable unused onboard services such as Wake on LAN, PXE boot, and so on.  |
| Different target numbers can be assigned to the various storage devices for the adapters on the SAN. What is the correct method to assign persistent bindings?  | QLogic recommends that you assign the target numbers of the devices in the same order on multiple adapters. For example, if controller A of an array is assigned to target 0 on HBA0, you should assign controller B of an array to target 0 on HBA1, and then continue this same methodology for all targets and adapters. Note that the driver and OS must be reloaded for the changes to take effect. |
| Rescanning an adapter port for target/LUN discovery.  | <pre># esxcfg-rescan vmhba&lt;X&gt;</pre> <p>You can find the <code>vmhba</code> value corresponding to an adapter port by examining the <code>/var/log/vmkernel</code> log, where the adapter is assigned a <code>vmhba&lt;X&gt;</code> vector.</p>   |

# Glossary

## adapter

The board that interfaces between the host system and the target devices. Adapter is synonymous with *host bus adapter (HBA)*, *host channel adapter (HCA)*, *host adapter*, and *adapter board*.

## arbitrated loop

A circular (ring) topology (versus point-to-point) where two or more [ports](#) can be interconnected, but only two ports can communicate at a time. All communication passes through all ports connected to the loop.

## adapter port

A port on the adapter board.

## adapter port beacon

An LED on the adapter. Flashing it enables you to locate the adapter.

## basic input output system

See [BIOS](#).

## BIOS

Basic input output system (typically in Flash PROM). The program (or utility) that serves as an interface between the hardware and the operating system and allows booting from the adapter at startup.

## boot code

The program that initializes a system or an adapter. Boot code is the first program to run when a system or a device within a system, such as an adapter, is powered on. [FCode](#), [BIOS](#), and EFI (enhanced firmware interface) are all forms of boot code for specific hardware/operating system environments.

Boot code for QLogic Fibre Channel Adapters is required if the computer system is booting from a storage device (disk drive) attached to the adapter. The primary function of the boot code is communication with the external boot device before the operating system is up and running. Boot code can also perform secondary functions, including managing the setup for the adapter and initializing and testing the adapter's [ISP](#).

## boot device

The device, usually a the hard disk, that contains the operating system the [BIOS](#) uses to boot from when the computer is started.

## boot from SAN

The ability for each server on a network to boot their operating system from a Fibre Channel RAID unit located on the SAN, rather than from a local disk or direct-attached storage (DAS). This enables easier SAN management because you can replace a server and boot it from the Fibre Channel RAID unit.

## cache

A temporary high-speed storage (memory) area where recently used or frequently accessed data is stored for rapid access, thus increasing the efficiency of processor operations.

Cache contents duplicate recently-used values stored on disk or elsewhere. Cache is quick to access relative to the original data which either takes more time due to slow disc-access time, or is slow to compute. After data is stored in the cache, future use can be made by accessing the cached copy rather than re-finding or recomputing the original data, so that the average access time is lower.

- **L1 cache**—Primary (smallest) cache on the same chip as the processor.
- **L2 cache**—Secondary (larger) cache. Either on the processor chip or external to the processor.

## Converged Network Adapter

QLogic Converged Network Adapters support both data networking (TCP/IP) and storage networking (FC) traffic on a single I/O adapter using two new technologies: Enhanced Ethernet and Fibre Channel over Ethernet (FCoE).

## device

A [target](#), typically a disk drive. Hardware such as a disk drive, tape drive, printer, or keyboard that is installed in or connected to a system. In [FC](#), a *target* device.

## driver

The software that interfaces between the file system and a physical data storage device or network media.

## E\_Port

Expansion port. A port in a Fibre Channel switch that connects to another Fibre Channel switch or bridge device by an inter-switch link (ISL). E\_Ports are used to link Fibre Channel switches to form a multi-switch fabric.

## Enhanced Ethernet

Also called *data center Ethernet* or *converged enhanced Ethernet*. Refers to new enhancements to the existing [Ethernet](#) standard that eliminate Ethernet's inherent lossy nature and make 10Gb Ethernet a viable storage networking transport.

## Ethernet

The most widely used [LAN](#) technology that transmits information between computers, typically at speeds of 10 and 100 million bits per second (Mbps).

## expansion port

See [E\\_Port](#).

## F\_Port

Fabric port. The "fabric" port in a Fibre Channel [fabric switch](#) provides a point-to-point link attachment to a single [N\\_Port](#). F\_Ports are intermediate ports in virtual point-to-point links between end ports, for example N\_Port to F\_Port to F\_Port to N\_Port using a single Fibre Channel fabric switch.

## fabric

A fabric consists of cross-connected Fibre Channel devices and switches.

## fabric loop port

See [FL\\_Port](#).

## fabric port

See [F\\_Port](#).

## **fabric switch**

Also, switched fabric. Connects multiple devices from independent Fibre Channel-arbitrated loops (FC-ALs) and point-to-point topologies into a fabric using Fibre Channel switches.

## **Fast/UTIL**

QLogic *Fast/UTIL*™ Fibre Channel Adapter BIOS utility.

## **FC**

Fibre Channel is a high-speed serial interface technology that supports other higher layer protocols such as SCSI and IP.

## **FCode**

Forth code. A type of boot code for use on Sun®'s SPARC® or Macintosh® hardware platforms. See also [boot code](#) and [Flash](#).

## **FCoE**

Fibre Channel over Ethernet. A new technology defined by the T11 standards body that allows traditional Fibre Channel storage networking traffic to travel over an Ethernet link by encapsulating Fibre Channel frames inside Layer 2 Ethernet frames. For more information, visit [www.fcoe.com](http://www.fcoe.com).

## **Fibre Channel**

See [FC](#).

## **Fibre Channel over Ethernet**

See [FCoE](#).

## **FL\_Port**

Fabric loop port. In a Fibre Channel, the fabric switch is capable of Fibre Channel Arbitrated Loop operations and is connected to one or more NL\_Ports by a Fibre Channel Arbitrated Loop. An FL\_Port becomes a shared entry point for public NL\_Port devices to a Fibre Channel

fabric. FL\_Ports are intermediate ports in virtual point-to-point links between end ports that do not reside on the same loop, for example NL\_Port to FL\_Port to F\_Port to N\_Port through a single Fibre Channel fabric switch.

## **Flash**

Non-volatile memory where the [boot code](#) is saved. At times, Flash and boot code are used interchangeably.

## **generic port**

See [G\\_Port](#).

## **G\_Port**

Generic port. A port that can operate as either an E\_Port or an F\_Port. A G\_Port can determine operating mode at switch port initialization, F\_Port when an N\_Port attachment is determined, E\_Port when an E\_Port attachment is determined. See [E\\_Port](#), [F\\_Port](#), [FL\\_Port](#), [L\\_Port](#), [N\\_Port](#), [NL\\_Port](#)

## **HBA**

Host bus adapter. See [adapter](#).

## **input/output control**

See [ioctl](#).

## **intelligent storage peripheral**

See [ISP](#).

## **inter-switch link**

See [ISL](#).

## **ioctl**

Input/output control. A system call in Unix/Linux systems. Allows an application to control or communicate with a device driver outside usual read/write operations.

## ISL

Inter-switch link. The connection between two switches using E\_Ports.

## ISP

Intelligent storage peripheral. QLogic trademark and family of Fibre Channel and SCSI controller chips that replace network interface chips in network adapters, servers, and storage.

## LAN

Local area network. Network typically with transmissions less than 5 km.

## L\_Port

Loop port. Does arbitrated loop functions and protocols. NL\_Ports and FL\_Ports are examples of loop-capable ports. See [E\\_Port](#), [F\\_Port](#), [FL\\_Port](#), [G\\_Port](#), [N\\_Port](#), [NL\\_Port](#).

## LIP

Loop initialization process. The initialization process in an arbitrated loop that occurs when the loop is powered up or a new device is added. One function of a LIP is to assign addresses. All data transmission on the loop is suspended during a LIP.

## local area network

See [LAN](#).

## loop initialization process

See [LIP](#).

## logical unit number

See [LUN](#).

## loopback

Diagnostic tool that routes transmit data through a loopback connector back to the same adapter.

## LUN

Logical unit number, a subdivision of a SCSI target. It is the small integer handle that differentiates an individual disk drive or partition (volume) within a common SCSI target device such as a disk array.

Technically, a LUN can be a single physical disk drive, multiple physical disk drives, or a portion (volume) of a single physical disk drive. However, LUNs are typically not entire disk drives but rather virtual partitions (volumes) of a RAID set.

Using LUNs, the Fibre Channel host can address multiple peripheral devices that may share a common controller.

## media

Physical-layer information carriers. Fibre Channel supports several different physical media: copper, multimode optical, and single-mode optical. All Fibre Channel protocols are supported on all media.

## message signaled interrupts

See

## MSI/MSI-X

Message signaled interrupts. An alternate way of generating an interrupts with special messages to allow PCI to emulate a pin assertion or deassertion. Message signaled interrupts allow the device to write a small amount of data to a special address in memory space. The chipset will deliver the corresponding interrupt to a CPU. MSI-X (defined in PCI 3.0) allows a larger number of interrupts (up to 2048), and gives each one a separate target address and data word.

## N\_Port

Node port. A port that connects by a point-to-point link to either a single N\_Port or a single F\_Port. N\_Ports handle creation, detection, and flow of message units to and from the connected systems. N\_Ports are end ports in virtual point-to-point links through a fabric, for example N\_Port to F\_Port to F\_Port to N\_Port using a single Fibre Channel fabric switch. See also [FL\\_Port](#).

## N\_Port ID virtualization

See [NPIV](#).

## NIC

Network interface card or network interface controller. A computer circuit board or card that is installed in a computer so that it can be connected to a network.

## NL\_Port

Node loop port. A port capable of arbitrated loop functions and protocols. An NL\_Port connects through an arbitrated loop to other NL\_Port and at most a single FL\_Port. NL\_Ports handle creation, detection, and flow of message units to and from the connected systems. NL\_Ports are end ports in virtual point-to-point links through a fabric, for example NL\_Port to F\_Port to F\_Port to N\_Port using a single Fibre Channel fabric switch. In the absence of a fabric switch FL\_Port, NL\_Ports can communicate with other NL\_Ports in virtual point-to-point links through a FC\_AL open loop circuit often through FC\_AL (arbitrated Loop) hub or loop switch devices. See: [E\\_Port](#), [F\\_Port](#), [FL\\_Port](#), [G\\_Port](#), [N\\_Port](#).

## node loop port

See [NL\\_Port](#).

## node port

See [N\\_Port](#).

## NPIV

The ability for a single physical Fibre Channel end point (N\_Port) to support multiple, uniquely addressable, logical end points. With NPIV, a host Fibre Channel Adapter is shared in such a way that each virtual adapter is assigned to a virtual server and is separately identifiable within the fabric. Connectivity and access privileges within the fabric are controlled by identification of each virtual adapter and, hence, the virtual server using each virtual adapter.

## NVRAM

Non-volatile random access memory. A type of memory that retains data (configuration settings) even when power is removed. You can manually configure NVRAM settings or restore them from a file.

## path

A path to a device is a combination of a adapter [port instance](#) and a target port as distinct from internal paths in the fabric network. A fabric network appears to the operating system as an opaque network between the adapter (initiator) and the target.

Because a path is a combination of an adapter and a target port, it is distinct from another path if it is accessed through a different adapter and/or it is accessing a different target port. Consequently, when switching from one path to another, the driver might be selecting a different adapter (initiator), a different target port, or both.

This is important to the driver when selecting the proper method of failover notification. It can make a difference to the target device, which might have to take different actions when receiving retries of the request from another initiator or on a different port.

## **PLOGI**

Port login. A port login occurs in a Fibre Channel SAN when two node ports establish a connection between each other (typically a device such as a Fibre Channel Adapter connecting to a switch).

## **point-to-point**

Also FC-P2P. Two Fibre Channel nodes directly connected (not in a loop).

## **port**

Access points in a device where a link attaches. The most common port types are:

- **N\_Port**—a Fibre Channel port that supports point-to-point topology.
- **NL\_Port**—a Fibre Channel port that supports loop topology.
- **F\_Port**—a port in a fabric where an N\_Port can attach.
- **FL\_Port**—a port in a fabric where an NL\_Port can attach.

## **port instance**

The number of the port in the system. Each adapter may have one or multiple ports, identified with regard to the adapter as port 0, port 1 and so forth. to avoid confusion when dealing with a system containing numerous ports, each port is assigned a port instance number when the system boots up. So Port 0 on an adapter might have a port instance number of, for example, 8 if it is the eighth port discovered by the system.

## **port login**

See [PLOGI](#).

## **reduced instruction set computer**

See [RISC](#).

## **registered state change notification**

See [RSCN](#).

## **RISC**

Reduced instruction set computer. A computer microprocessor that performs fewer types of computer instructions, thereby operating at higher speeds.

## **RSCN**

Registered state change notification (RSCN) is a Fibre Channel fabric notification sent to all specified nodes when any major fabric changes occur. This notification allows nodes to immediately gain knowledge about the fabric and react accordingly.

## **SAN**

Storage area network. Multiple storage units (disk drives) and servers connected by networking topology.

## **SCSI**

Small computer system interface. A high-speed interface used to connect devices—such as hard drives, CD drives, printers, and scanners—to a computer. The SCSI can connect many devices using a single controller. Each device is accessed by an individual identification number on the SCSI controller bus.

## **small computer system interface**

See [SCSI](#).

## target

The storage-device endpoint of a [SCSI](#) session. Initiators request data from targets (usually disk-drives, tape-drives, or other media devices). Typically, a SCSI peripheral device is the target but an adapter may, in some cases, be a target. A target can contain many [LUNs](#).

A target is a device that responds to a request by an initiator (the host system). Peripherals are targets, but for some commands (for example, a SCSI COPY command), the peripheral may act as an initiator.

## TCP/IP

Transmission control protocol/Internet protocol. Basic communication language of the Internet.

## world wide port name

See [WWPN](#).

## WWPN

World wide port name. Unique 64-bit address assigned to each port on a device. One WWNN may contain multiple WWPN addresses.

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## Notes

# Index

## A

acronyms, definitions of [Glossary-1](#)  
 adapter port beacon, definition of [Glossary-1](#)  
 adapter port, definition of [Glossary-1](#)  
 adapters  
   definition of [Glossary-1](#)  
   identifying on VMware ESX [3-1](#)  
   installing hardware [2-2](#)  
   supported [1-4](#)  
 agreements, license [x](#)  
 arbitrated loop, definition of [Glossary-1](#)  
 audience, intended [vii](#)  
 automated local host management, supported [2-2](#)

## B

basic input output system, *See* BIOS  
 BIOS  
   definition of [Glossary-1](#)  
   searching for SCSI devices [3-13](#)  
   utility, *Fast!UTIL* [3-5](#)  
 blue text, meaning of [x](#)  
 bold text, meaning of [ix](#)  
 boot code  
   definition of [Glossary-1](#)  
   software component [1-3](#)  
   version, viewing [3-3](#)  
   version viewing, with proc [A-9](#)  
   version, viewing with dynamic logging [A-4](#)  
 boot device  
   configuring with *Fast!UTIL* [3-5](#)  
   definition of [Glossary-1](#)  
   primary, specifying [3-14](#)  
   selecting [3-14](#)

boot from SAN  
   boot code, debugging [A-9](#)  
   configuration description [1-3](#)  
   configuring [3-12–3-14](#)  
   definition of [Glossary-1](#)  
   feature, support for [2-1](#)  
 booting server's OS from SAN [3-12](#)

## C

cache, definition of [Glossary-2](#)  
 certification training [xi](#)  
 CIM providers, supported [2-1](#)  
 collecting system logs [A-10](#)  
 components  
   hardware [1-1](#)  
   software [1-3](#)  
 configuration [3-1](#)  
 configuring  
   boot from SAN [3-12](#)  
   driver parameters [3-7](#)  
 console OS, identifying adapters with [3-2](#)  
 contact information [xi](#)  
 contacting Technical Support [x](#)  
 contents of this guide [viii](#)  
 Converged Network Adapter, definition of [Glossary-2](#)  
 Courier New font, meaning of [ix](#)

## D

debugging using proc information [A-9](#)  
 definitions of terms [Glossary-1](#)  
 deploying NPIV [3-9](#)

device

- boot, configuring [3-5](#)
- definition of [Glossary-2](#)
- external boot [1-3](#)
- fibre, scanning for [3-5](#)

documentation

- conventions used in guide [ix](#)
- related [vii](#)

driver

- definition of [Glossary-2](#)
  - installing [2-3](#)
  - logs, troubleshooting with [A-4](#)
  - OS [1-3](#)
  - parameters, configuring [3-7](#)
  - verifying that it is loaded [3-6](#)
- dynamic extended logging [A-3](#)

FCode

- boot image [1-2](#)
- definition of [Glossary-3](#)

FCoE, definition of [Glossary-3](#)

FC-P2P, See point-to-point

features, supported [2-1](#)

Fibre Channel over Ethernet, definition of [Glossary-3](#)

Fibre Channel, definition of [Glossary-3](#)

firmware module [1-4](#)

FL\_Port, definition of [Glossary-3](#)

Flash

- component of adapter [1-2](#)
- definition of [Glossary-3](#)

Forth code, definition of [Glossary-3](#)

frequently seen issues [A-10](#)

## E

- E\_Port, definition of [Glossary-2](#)
- e-mailing QLogic support [xi](#)
- end user license agreements [x](#)
- Enhanced Ethernet, definition of [Glossary-2](#)
- esxcfg-module command [3-7](#)
- Ethernet, definition of [Glossary-2](#)
- expansion port, definition of [Glossary-2](#)
- extended BIOS data area (EBDA) [A-10](#)
- extended error logging [A-3](#)

## F

- F\_Port, definition of [Glossary-2](#)
- fabric loop port, definition of [Glossary-3](#)
- fabric port, definition of [Glossary-2](#)
- fabric switch, definition of [Glossary-3](#)
- fabric, definition of [Glossary-2](#)
- Fast!*UTIL
  - definition of [Glossary-3](#)
  - management tool, features [3-5](#)
- FC, definition of [Glossary-3](#)

## G

- G\_Port, definition of [Glossary-3](#)
- generic port, definition of [Glossary-3](#)
- glossary of terms [Glossary-1](#)
- guide, typographic conventions [ix](#)

## H

- hardware
  - components [1-1](#)
  - installing [2-2](#)
- HBA, definition of [Glossary-3](#)
- host bus adapter, See adapter

## I

- identifying adapters on VMware ESX [3-1](#)
- initiator mode, port [A-9](#)
- input/output control, See ioctl

installing [2-1](#)  
  driver [2-3](#)  
  hardware [2-2](#)  
  SANsurfer FC HBA CLI [2-7](#)  
  SANsurfer FC HBA Manager [2-4](#)  
  SANsurfer management tools [2-3](#)  
instance (port), definition of [Glossary-6](#)  
intelligent storage peripheral, *See* [ISP](#)  
intended audience [vii](#)  
inter-switch link, definition of [Glossary-4](#)  
introduction to product [vii](#)  
ioctl  
  definition of [Glossary-3](#)  
  timeout value [3-8](#)  
ISL, definition of [Glossary-4](#)  
ISP  
  aborting [A-6](#)  
  aborts, number of [A-9](#)  
  definition of [Glossary-4](#)  
  request transfer error [A-8](#)  
  response queue, invalid entry [A-7, A-8](#)  
  response transfer error [A-8](#)  
  system error [A-6](#)  
ISP controller [1-2](#)  
ISP type [3-8](#)  
ISP25xx [1-1](#)  
italicized text, meaning of [ix](#)

## K

knowledge database, searching [xi](#)

## L

L\_Port, definition of [Glossary-4](#)  
L1 cache [Glossary-2](#)  
L2 cache [Glossary-2](#)  
LAN, definition of [Glossary-4](#)  
LED indicators [A-1](#)  
license agreements [x](#)  
link rate, supported [2-1](#)  
Linux, SANsurfer, installing on [2-4](#)

LIP  
  async event (driver log message) [A-6](#)  
  definition of [Glossary-4](#)  
local area network, definition of [Glossary-4](#)  
logging, dynamic extended [A-3](#)  
logical unit number, definition of [Glossary-4](#)  
loop (arbitrated), definition of [Glossary-1](#)  
loop initialization process, *See* [LIP](#)  
loop port, definition of [Glossary-4](#)  
loopback, definition of [Glossary-4](#)  
LUNs  
  definition of [Glossary-4](#)  
  OS installed on [3-12](#)

## M

management tools and utilities [1-4](#)  
materials, related [vii](#)  
media, definition of [Glossary-4](#)  
message signaled interrupts, *See* [MSI/MSI-X](#)  
messages, driver log [A-4](#)  
monitoring NPIV virtual ports [3-10](#)  
monospace font, meaning of [ix](#)  
MSI/MSI-X  
  definition of [Glossary-4](#)  
  enabling/disabling [3-8](#)  
  support for [2-2](#)

## N

N\_Port ID virtualization  
  definition of [Glossary-5](#)  
  deploying [3-9](#)  
  supported [2-1](#)  
N\_Port, definition of [Glossary-5](#)  
network interface controller/card, definition of [Glossary-5](#)  
NIC, definition of [Glossary-5](#)  
NL\_Port, definition of [Glossary-5](#)  
node loop port, definition of [Glossary-5](#)  
node port, definition of [Glossary-5](#)  
non-volatile random access memory, definition of [Glossary-5](#)

## NPIV

- definition of [Glossary-5](#)
- deploying [3-9](#)
- virtual ports, monitoring [3-10](#)

## NVRAM

- definition of [Glossary-5](#)
- description of [1-3](#)

## O

- OS driver [1-3](#)

## P

- parameters, configuring driver [3-7](#)
- path, definition of [Glossary-5](#)
- phoning QLogic support [xi](#)
- PLOGI
  - definition of [Glossary-6](#)
  - enabling port login [3-9](#)
- point-to-point
  - definition of [Glossary-6](#)
  - supported topology [2-1](#)
- port
  - definition of [Glossary-6](#)
  - instance, definition of [Glossary-6](#)
- port login
  - definition of [Glossary-6](#)
  - enabling PLOGI [3-9](#)
- preface to guide [vii](#)
- proc entry, debugging with [A-9](#)
- proc output fields [A-9](#)
- protocols, supported [2-1](#)

## Q

- QLogic Technical Support, contacting [x](#)
- qlremote agent
  - portmap service, enabling [2-4](#)
  - requirement for [2-4](#)

## R

- reduced instruction set computer, [See](#) RISC
- registered state change notification, [See](#) RSCN
- related materials [vii](#)
- remote SAN and adapter management [2-2](#)
- RISC
  - definition of [Glossary-6](#)
  - processor, description of [1-2](#)
- RSCN
  - definition of [Glossary-6](#)
  - firmware async event [A-7](#)

## S

- SAN
  - booting from [3-12](#)
  - definition of [Glossary-6](#)
- SANsurfer
  - management tools, installing [2-3](#)
  - NPIV, monitoring [3-10](#)
- SANsurfer FC HBA CLI
  - description of [1-4](#)
  - features of [2-3](#)
  - installing [2-7](#)
- SANsurfer FC HBA Manager
  - description of [1-4](#)
  - features of [2-3](#)
  - installing [2-4](#)
- SCSI path failover, support for [2-2](#)
- SCSI, definition of [Glossary-6](#)
- small computer system interface, definition of [Glossary-6](#)
- SNIA Common HBA API, supported [2-1](#)
- software components [1-3](#)
  - boot code [1-3](#)
  - firmware [1-4](#)
  - management tools and utilities [1-4](#)
  - OS driver [1-3](#)
- storage area network, [See](#) SAN
- Storage VMotion, support for [2-2](#)
- support, technical [x](#)

supported  
adapters [1-4](#)  
features [2-1](#)  
system logs, collecting [A-10](#)

## T

target  
definition of [Glossary-7](#)  
devices, max queue depth [3-9](#)  
discovery, rescanning for [A-10](#)  
mode, port [A-9](#)  
numbers, different assigned [A-10](#)  
TCP/IP, definition of [Glossary-7](#)  
technical support  
knowledge database [xi](#)  
technical support, obtaining [x](#)  
telephoning QLogic support [xi](#)  
terms, definitions of [Glossary-1](#)  
topologies, supported [2-1](#)  
training from QLogic [xi](#)  
transmission control protocol/Internet protocol,  
definition of [Glossary-7](#)  
troubleshooting [A-1](#)  
driver logs [A-4](#)  
dynamic extended logging [A-3](#)  
frequently seen issues [A-10](#)  
LED indicators [A-1](#)  
proc information for debugging [A-9](#)  
QLogic knowledge database [xi](#)  
system logs [A-10](#)  
typographic conventions in guide [ix](#)

## V

vCenter, identifying adapters with [3-1](#)  
verifying that driver is loaded [3-6](#)  
virtual ports (NPIV), monitoring [3-10](#)  
vmkernel, driver logs [A-4](#)  
VMotion, support for [2-2](#)  
vSphere Client, identifying adapters on [3-1](#)

## W

what's in this guide [viii](#)  
Windows, SANsurfer, installing on [2-4](#)  
world wide port name, See WWPN  
WWPN  
definition of [Glossary-7](#)  
enabling with NPIV [3-9](#)

## Z

zero input output (ZIO) mode [3-9](#)



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