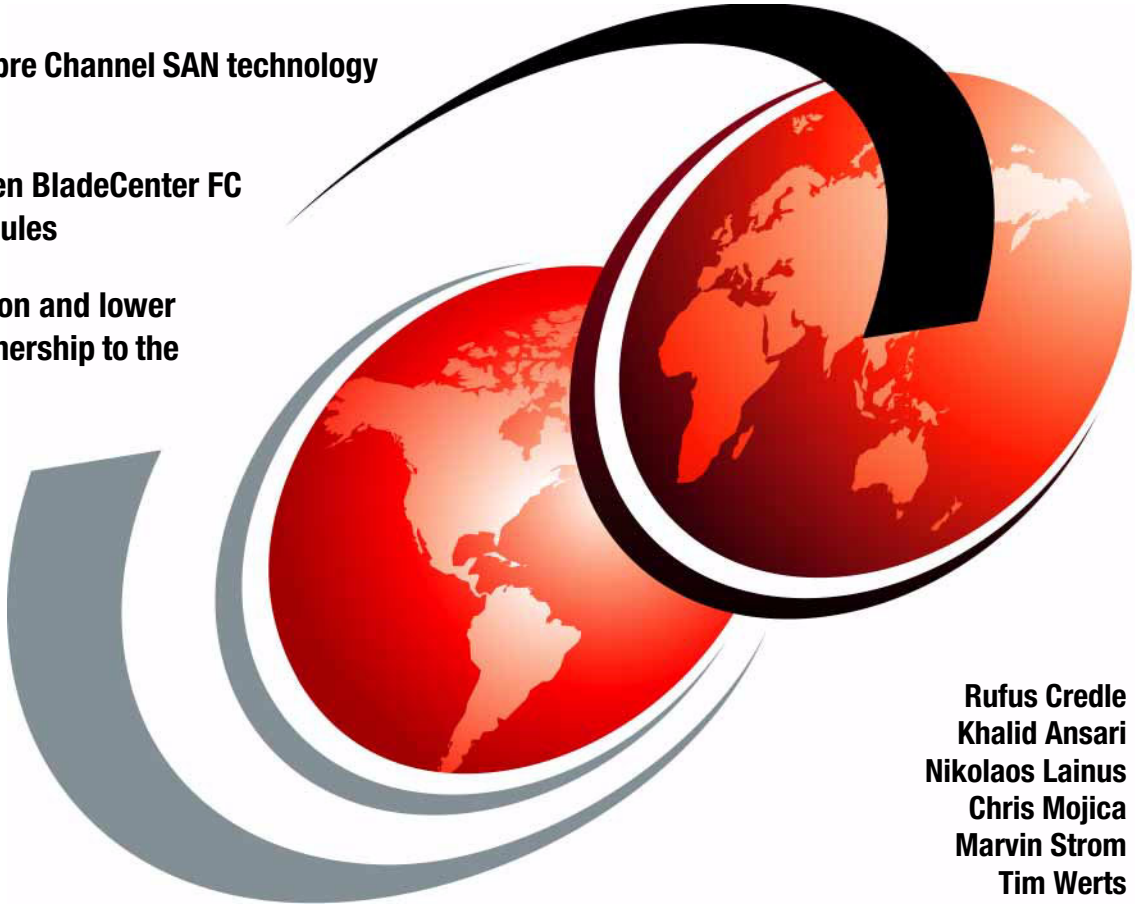
IBM

IBM BladeCenter 4Gb SAN Solution

- New 4Gb Fibre Channel SAN technology
- ServerProven BladeCenter FC switch modules
- Simplification and lower cost-of-ownership to the data center



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International Technical Support Organization

IBM BladeCenter 4Gb SAN Solution

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Note: Before using this information and the product it supports, read the information in “Notices” on page vii.

First Edition (September 2006)

This edition applies to IBM BladeCenter and IBM BladeCenter H.

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Preface

This IBM® Redbook focuses on the 4Gb end-to-end Fibre Channel (FC) SAN solution for the IBM BladeCenter® in the small to mid-sized businesses (SMB) and enterprise workgroup market.

In this IBM Redbook, we discuss the elements for constructing a BladeCenter SAN environment. We talk about the supported FC daughter cards, FC switch modules, external FC switches, and storage systems used in our lab environment. These items were used to construct an OEM environment to demonstrate the use of our storage vendor products and the interoperability of the IBM BladeCenter FC switch modules.

This IBM Redbook discusses the prerequisites, the installation, and the configuration of QLogic, McData, and Brocade switch modules in a homogeneous environment, as well as heterogeneous environments.

The team that wrote this IBM Redbook

This IBM Redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, Poughkeepsie Center.

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Thanks to the following people for their contributions to this project:

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1

Executive summary

This IBM Redbook provides you with solutions that incorporate the advanced features of the IBM BladeCenter. These solutions address the most common objectives of today's information technology (IT) departments for the small to mid-sized businesses (SMB) and enterprise workgroup market.

Efficiency and managing the bottom line continue to serve as the paramount to success. Your IT infrastructure is required to do more than ever before under tighter budgets. Your IT needs to do it in less time, with less space. You need to meet increasing user demands for greater availability and higher quality of services. And you need to get it all done with a smaller and less-skilled staff. The BladeCenter 4Gb SAN solution helps you address all of these issues.

The IBM BladeCenter 4Gb SAN solution offers new, powerful SAN technology that brings further simplification and lower cost-of-ownership to the data center. Strategic relationships with technology providers, such as Brocade, Cisco, EMC, Emulex, McDATA, and QLogic, are providing customers with unparalleled performance as they migrate to IBM BladeCenter.

You should understand the following about IBM BladeCenter SAN technology:

- IBM BladeCenter can help customers maximize server utilization with a wide range of cost-effective scale-out solutions.
- With over 400 leading ISV applications for customers to choose from, IBM's extensive network of Business Partners makes it easy for customers to meet all their business and IT solution needs.

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- Because IBM BladeCenter is designed with open standards in mind, servers can talk to servers that can talk to printers that can talk to storage, enabling end-to-end integration.
- IBM BladeCenter is affordably priced and offers small and mid-sized companies choice, outstanding performance, and revolutionary scalability to help build a flexible IT environment.
- The IBM BladeCenter 4Gb SAN solution provide an infrastructure for:
  a. Fully redundant storage connectivity
  b. Resilient storage requirements - hot pluggable and swappable
  c. Remote management
  d. Remote boot
  e. Homogeneous and heterogeneous operating environment
- The 4Gbps Fibre Channel technology will be rapidly deployed in environments with streaming video on demand applications, medical facilities that exchange imagery and data over long distances, and organizations that require data mining and data warehousing, thus providing complete return on investment.

If you are interested in deploying an IBM BladeCenter SAN solution, please contact IBM Customer Service.

Resources can be found at the following IBM Web sites:

- IBM BladeCenter

  http://www-03.ibm.com/systems/bladecenter/
- IBM BladeCenter Alliance Program

  http://www-03.ibm.com/servers/eserver/bladecenter/alliance/
- IBM Storage for IBM BladeCenter

  http://www-03.ibm.com/servers/eserver/bladecenter/storage/

2

IBM BladeCenter

In this chapter, we discuss the IBM BladeCenter and BladeCenter H chassis, shown in Figure 2-1 on page 4. Both units offer an extended range of storage and networking options integrated into the chassis to simplify infrastructure complexity and manageability. As you continue to explore this IBM Redbook, you will see that IBM delivers a wide range of easy-to-install, high-capacity, tested storage products that will meet your demanding business needs.

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Figure 2-1 IBM BladeCenter models

2.1 IBM BladeCenter

The BladeCenter provides the greatest density and common fabric support and is the *lowest* entry cost option. The other two members of the family, BladeCenter T and BladeCenter H, provide additional flexibility for difficult environmental needs and greater performance levels. All three chassis share a common set of blades and switches. For our SAN discussion, we will focus only the BladeCenter and BladeCenter H chassis.

The IBM BladeCenter include the following features:

- Rack-optimized, 7 U modular design enclosure for up to 14 hot-swap HS20, HS21, JS20, JS21, or LS20 blades and up to seven HS40 blades
- High-availability mid-plane that supports hot-swap of individual blades
- Two 2,000-watt, hot-swap power modules and support for two optional 2,000-watt power modules; redundancy and power for robust configurations
- Two hot-swap blowers
- A new Advanced Management Module (AMM) gives you control over the solutions at the chassis level, simplifying installation and management of everything in your installation
- Support for up to *four* network or storage switches or pass-through modules
- Light path diagnostic panel with DVD, diskette drive, and USB port
- IBM Director and Remote Deployment Manager for easy installation and management

For a complete look at the IBM BladeCenter chassis, visit this Web site:

http://www-306.ibm.com/common/ssi/rep_ca/7/897/ENUS106-117/ENUS106-117.PDF

2.2 IBM BladeCenter H

The BladeCenter H Chassis is slightly larger than the IBM BladeCenter. It is designed to support new high-speed fabrics and future Ethernet and InfiniBand technology. The BladeCenter H supports up to 10 switch modules.

The IBM BladeCenter H include the following features:

- The rack-optimized, 9 U modular design enclosure holds up to 14 blade servers.

- A high-availability, redundant midplane supports all current and future IBM blades.
- The chassis includes:
  - Two 2,900-watt, hot-swap, redundant power modules and support for two additional (optional) 2,900-watt, hot-swap, redundant power modules
  - Two hot-swap, redundant blowers and 6 or 12 supplemental fans
- The brand new Advanced Management Module (AMM) gives you control over the solutions at the chassis level, simplifying installation and management of everything in your installation.
- The chassis supports up to four traditional fabrics using networking switches, storage switches, or pass-through devices. The chassis also supports up to four new high-speed fabrics for future support of protocols like 4X Infiniband or 10 Gb Ethernet. The built-in media tray is client serviceable and includes light path diagnostics, front USB inputs, and a DVD drive.
- IBM Director and Remote Deployment Manager makes it easy to install and manage.

The blades servers supported by this new BladeCenter Chassis are:

- BladeCenter HS20, BladeCenter HS21, and BladeCenter HS40
- AMD Opteron LS20 for IBM BladeCenter
- BladeCenter JS20, BladeCenter JS21

These blades feature Xeon® DP, Xeon MP, PowerPC®, and Opteron capable models.

For a complete look at the IBM BladeCenter H chassis, visit this Web site:

http://www-306.ibm.com/common/ssi/rep_ca/1/897/ENUS106-161/ENUS106-161.PDF

2.3 The IBM ServerProven Program

The IBM ServerProven® Program is based on this simple idea: Give customers the confidence that all parts of their solution hardware, software, and middleware installs quickly, start up easily, and runs reliably. When you see the ServerProven emblem, you will know that the software application you are looking for is part of a complete business solution that has been identified, validated, optimized, and documented to run reliably on IBM servers.

The ServerProven program helps you easily identify a business application that has been validated on IBM servers. This includes non-IBM hardware devices, operating systems, and middleware, such as databases and systems management software and popular applications.

Therefore, take a minute to visit the IBM ServerProven Program Web site as you plan to implement your business solution on either IBM BladeCenter or BladeCenter H:

http://www-03.ibm.com/servers/eserver/serverproven/compat/us/

3

Elements of the IBM BladeCenter 4Gb SAN solution

This chapter discusses the elements to help you implement a successful BladeCenter SAN business solution.

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3.1 Fibre Channel 4Gb expansion cards

In this section, we review the supported 4Gb Fibre Channel expansion cards for the IBM BladeCenter.

3.1.1 QLogic 4Gb Standard and Small Form-Factor (SFF) Fibre Channel Expansion Cards for IBM BladeCenter

The QLogic 4Gb Fibre Channel expansion cards provide a higher bandwidth connection between BladeCenter server blades and SAN switches. These 4Gb expansion cards allow for a true *end-to-end* 4Gb Fibre Channel blade server to SAN solution. Both expansion cards are built with QLogic ISP2422 4Gb Fibre Channel dual port ASIC.

Available in two form factors, the SFF expansion card allows two drives and a card to coexist on the same blade server. The SFF adapter is available for the 8843 and 8850 Blade Servers.

The 4Gb adapter provides the ability to boot from a SAN attached drive on Intel, AMD Opteron, and PowerPC based blade servers. The firmware contained on the adapter is a multi-boot option ROM that consists of BIOS, Fcode, and Firmware for the ISP2422 ASIC. The BIOS software is used on the HS20, HS40, and LS20 blades to enable the Ctrl-Q utility available during initial boot up of the Blade. Open Firmware Fcode is used with the JS20 Blade family to provide remote boot capabilities

Expansion card features:

- The Boot from SAN capabilities within the FC expansion card minimizes server downtime and simplifies data backup and recovery processes, thus lowering TCO by completely separating the server from the storage.
- The 2-port PCI-X adapter provides a redundant connection via two independent FC channels from each server blade to the SAN fabric.
- Includes QLogic SANsurfer Management Suite that is used to manage both the FC expansion card and QLogic FC switch module for easy configuration and management of the SAN through a single management interface.
- Supports host-attachment to 2 and 4Gbs BladeCenter Fibre Channel Switch Modules. This includes all QLogic, McDATA, and Brocade switch modules.

Table 3-1 on page 11 shows the product and order information for these cards.

Table 3-1 Product and order information

Description	Order number
QLogic 4Gb Standard Fibre Channel Expansion Card	26R0884
QLogic 4Gb Standard and Small Form-Factor (SFF) Fibre Channel Expansion Card	26R0890

The BladeCenter switch module options shown in Table 3-2 are supported by this expansion card.

Table 3-2 Supported switch modules

Option part#	Product name	Speed support
32R1904/26R0081	QLogic 4Gb Fibre Channel Switch Modules	2 Gb, 4 Gb
32R1905/32R1833	McDATA 4Gb Fibre Channel Switch Modules	2 Gb, 4 Gb
32R1812/32R1813	Brocade 4Gb SAN Switch Modules	2 Gb, 4 Gb
48P7062	IBM BladeCenter 2-Port Fibre Channel Switch Module	2 Gb
26K6477	QLogic 6-Port Enterprise Fibre Channel Switch Module	2 Gb
32R1790	McDATA 6-Port Fibre Channel Switch Module	2 Gb
26K5601	Brocade Entry SAN Switch Module	2 Gb
90P1065	Brocade Enterprise SAN Switch Module	2 Gb
02R9080	IBM BladeCenter Optical Pass-through	2 Gb

The BladeCenter platforms shown in Table 3-3 are supported by this expansion card.

Table 3-3 Supported BladeCenter platforms

IBM BladeCenter	Machine type
HS20	8843
HS20	8678 (std HBA)
HS20	8832 (std HBA)
HS20	7981
HS21	8853
LS20	8850
JS21	8844
BladeCenter	8677
BladeCenter T	8720
BladeCenter T	8730
BladeCenter H	8852

Driver update disks

Refer to the IBM BladeCenter Support Web site to download files and for installation instructions.

The Fibre Channel Expansion Card Signed device driver for Microsoft® Windows® 2000 and Windows Server® 2003 - BladeCenter HS20, HS40 and LS20 can be found at:

http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-53295

The 4Gb Linux® Driver Update Disks for SAN boot can also be located at this Web site.

3.1.2 Emulex 4Gb SFF Fibre Channel Expansion Card

The Emulex 4Gb SFF Fibre Channel Expansion Card available for IBM BladeCenter is an addition to the family of IBM BladeCenter expansion cards that deliver a higher bandwidth connection between BladeCenter server blades and SAN switches, and allows for a *true end-to-end* 4Gb Fibre Channel blade server

to a storage area network (SAN) solution. It is built based on the Emulex Helios Fibre Channel controller.

The Emulex 4Gb 2-port SFF Fibre Channel Expansion Card is the latest Fibre Channel expansion card option for the BladeCenter.

Expansion card features:

- Universal boot provides multi-platform support for remote.
- Firmware-based architecture enables host bus adapters (HBAs) to be updated with new features and functionality, maintaining investment value.
- Includes Emulex HBAnyware management suite, which provides discovery, reporting, and management of local and remote HBAs.
- Sophisticated management capabilities, such as remote firmware upgrades and advanced diagnostics, are possible from a single console anywhere in the SAN.

Each server blade can be installed with one or more expansion cards to provide redundant connections to the switch modules within BladeCenter. The routing of the expansion card's two ports occurs through the BladeCenter's midplane to the switch modules. One port from the expansion card is wired via the midplane to one switch module bay, while the other port is wired to a second switch module bay to provide redundancy against a single point of failure. The expansion card provides support for 1Gb, 2Gb, and 4Gb data rates.

Table 3-4 shows the product and order information for this card.

Table 3-4 Product and order information

Description	Order Number	EAN Number
Emulex 4Gb SFF Fibre Channel Expansion Card	39Y9186	50-50689 for BladeCenter

For more information regarding the Emulex technology, visit the following Web site:

http://www.emulex.com/

Table 3-5 shows the BladeCenter switch module options supported by this expansion card.

Table 3-5 Supported switch modules

Option part#	Product name	Speed support
32R1904/26R0081	QLogic 4Gb Fibre Channel Switch Modules	2 Gb, 4 Gb
32R1905/32R1833	McDATA 4Gb Fibre Channel Switch Modules	2 Gb, 4 Gb
32R1812/32R1813	Brocade 4Gb SAN Switch Modules	2 Gb, 4 Gb
48P7062	IBM BladeCenter 2-Port Fibre Channel Switch Module	2 Gb
26K6477	QLogic 6-Port Enterprise Fibre Channel Switch Module	2 Gb
32R1790	McDATA 6-Port Fibre Channel Switch Module	2 Gb
26K5601	Brocade Entry SAN Switch Module	2 Gb
90P1065	Brocade Enterprise SAN Switch Module	2 Gb
02R9080	IBM BladeCenter Optical Pass-through	2 Gb

The BladeCenter platforms shown in Table 3-6 are supported by this expansion card.

Table 3-6 Supported BladeCenter platforms

IBM BladeCenter	Machine type
HS20	8843
HS20	7981
HS21	8853
LS20	8850
JS21	8844
BladeCenter	8677
BladeCenter T	8720

IBM BladeCenter	Machine type
BladeCenter T	8730
BladeCenter H	8852

Driver update disks

Refer to the IBM BladeCenter support Web site to download files and for installation instructions:

http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-63017

3.2 Integrated Fibre Channel switch modules

In this section, we discussed the supported integrated Fibre Channel switch modules for the IBM BladeCenter and BladeCenter H.

3.2.1 Brocade 10-Port and 20-Port 4Gb SAN Switch Module

The Brocade 4Gb SAN switch modules enable and enhance BladeCenter SAN infrastructures by building end-to-end 4Gb Fibre Channel SAN solutions with numerous advanced features to enhance the security, performance, availability, and management. The Brocade switch modules seamlessly integrate an IBM BladeCenter chassis into any Brocade SAN fabrics.

The 10-port switch module allows connection for up to seven internal blade servers and three external ports while the 20-port switch module allows connection to all 14 internal ports and six external ports. The 10-port switch module is upgradeable to the 20-port version with a simple pay-as-you-grow scalability via a license key.

Table 3-7 shows the product and order information for these modules.

Table 3-7 Product and order information

Description	Order number
Brocade 10-Port 4Gb SAN Switch Module	32R1813
Brocade 20-Port 4Gb SAN Switch Module	32R1812

Figure 3-1 shows the Brocade 10-Port and 20-Port 4Gb SAN Switch Module.

Figure 3-1 Brocade 10-Port and 20-Port 4Gb SAN Switch Module

Features

- Ports on Demand (POD) scaling from 10 to 20 ports on a pay-as-you-grow basis
  - Ports 0, 1-7, 15, and 16 are activated by default on the 10 Port Module.
  - Ports 8-14, 17-19 activated with a 10 Port Upgrade license for the 10 Port Module.
  - Ports 0-19 are activated by default on the 20 Port Module.
- 14 internal ports (ports 1 to 14) connect to IBM BladeCenter server blades
  - Auto-sensing at 2 Gbps or 4 Gbps and server blades log into the switch as F-ports (requires optional Fibre Channel Expansion Card installed on server blade).
- Six external ports (ports 0, 15, 16, 17, 18, and 19)
  - Connect to existing Fibre Channel SAN switches, other Brocade FC Switch modules, or directly to Fibre Channel Storage devices.
  - Auto-negotiate link speed (1Gbps, 2Gbps, or 4Gbps).
  - U-port initialization (E-port, F-port, or FL-port).
  - Can form up to two 12 Gbps ISL Trunks (requires ISL Trunking license).
  - Dynamic Path Selection (DPS) for improved load balancing the 24 Gbps of available external bandwidth between the two ISL Trunk groups.
- Two internal full-duplex 100Mbps Ethernet interfaces, terminated at a single MAC
- Hot code activation

- Frame-filtering technology that enables Advanced Zoning and Advanced Performance Monitoring capabilities
- Integrated security features, including SSH (secure shell), SSL/HTTPS, Radius Support, SNMPV3, Audit Logging, and Role Based Access Control (RBAC)
- Redundant power and cooling provided by IBM BladeCenter chassis

Standard and optional features

The Brocade 4Gb FC Switch Module is based on the Brocade Fabric Operating System (Fabric OS) Version 5.0.x. As with all Brocade products, the switch module is backward and forward compatible with the entire Brocade SilkWorm product family, including the IBM TotalStorage® *b-type* SAN switches and directors that are built on Brocade technology. As a member of the Brocade product line, the switch module offers numerous advanced features and functionality that typically are offered only on more expensive director products, such as:

- Advanced Web Tools (standard) provide a graphical interface that enables you to monitor and manage individual switches and ports from a standard workstation using a browser.
- Brocade Advanced Zoning (standard) ensures secure device connectivity through either domain/port or World Wide Node Name zoning enforced through hardware.
- Brocade 10-Port Upgrade (optional license feature 32R1822) upgrades the Brocade 10-port FC switch module to a 20-port module by nondisruptively adding 10 additional ports.
- Brocade Advanced Performance Monitoring (optional license feature 26K5612) allows very granular performance monitoring capabilities that include specific initiator-to-target traffic, SCSI Reads and Write per second, and CRC error tracking.
- Brocade ISL Trunking (optional license feature 26K5607) enhances SAN performance, increases availability, and simplifies management by creating up to two 12 Gb trunks to the external SAN that provide granular frame-level load balancing.
- Brocade Performance Bundle (optional license feature 26K5605) includes ISL Trunking and Advanced Performance Monitoring.
- Brocade Dynamic Path Selection (standard) also enhances performance by performing exchange-level load balancing across the ISL Trunks. ISL Trunking and DPS together ensure a balanced 24 Gb bandwidth to external SAN.

- Brocade Fabric Watch (optional license feature 32R1855) enhances SAN management and availability through client configurable monitors of critical security, statistics, and performance parameters, and sending alarms to the administrator to proactively catch potential problems.
- Brocade Extended Fabric (optional license feature 26K5613), when used with link extenders, enhances IBM Business Continuity solutions by allowing full FC bandwidth across extended distances up to 230 km.
- Brocade Advanced SAN Security (optional license feature 26K5617) provides flexible security and policy administration that protect data from unauthorized access and corruption, thus helping organizations meet specific security requirements.
- Brocade Fabric Manager 5.0 (software product sold separately) is a graphical interface for monitoring and managing numerous IBM BladeCenters in multiple fabrics comprised of Brocade switches from a standard workstation. The GUI simplifies task administration at the fabric, switch, and port levels in a medium-to-large size Brocade SAN environment.

For more information regarding integrated Fibre Channel switches for BladeCenter, visit the following Web site:

http://www-03.ibm.com/systems/bladecenter/switch/switch_fibrechannel_overview.html

3.2.2 McDATA 10-Port and 20-Port 4Gb Fibre Channel Switch Module

The McDATA 10-port and 20-port 4Gb Fibre Channel switches enable high-performing end-to-end SAN solutions using 4 Gbps Fibre Channel Technology. The McDATA switch modules provide a seamless integration of BladeCenter into McDATA Native SAN fabrics. The switches provide centralized McDATA management in McDATA fabrics and deliver McDATA-capable fabric services.

Available in two configurations, the 10-port switch provides the ability to connect up to seven internal blade server ports, and three external ports, while the 20-port switch provides all internal 14 ports and six external ports. The 10-port switch delivers pay-as-you-grow scalability via a license key update allowing all 20-ports to become active.

Table 3-8 on page 19 shows the description and order number for these modules.

Table 3-8 Product and order information

Description	Order Number
McData 10-port 4Gb Fibre Channel Switch Module for IBM eServer™ BladeCenter	32R1905
McData 20-port 4Gb Fibre Channel Switch Module for IBM eServer BladeCenter	32R1833

Figure 3-2 shows the McDATA 10-Port and 20-Port Fibre Channel Switch Module.

Figure 3-2 McDATA 10-Port and 20-Port Fibre Channel Switch Module

Switch features

- The 10-port model has seven internal auto-sensing 2/4Gb F-Ports and three external auto-sensing 1/2/4Gb E/F/FL ports (upgradeable to 20 ports with 10-port upgrade).
- The 20-port model has 14 internal auto-sensing 2/4Gb F-Ports and six external auto-sensing 1/2/4Gb E/F/FL ports.
- Includes McDATA SANBrowser Web application
- Supports McDATA equivalent HotCAT functionality, allowing firmware to be downloaded and activated while the fabric switch remains operational.
- Supports optional McDATA SANtegrity Security Suite software via a license key upgrade.
- Supported with QLogic 2Gb and 4Gb BladeCenter Fibre Channel expansion cards.

For more information regarding integrated Fibre Channel switches for BladeCenter, visit the following Web site:

http://www-03.ibm.com/systems/bladecenter/switch/switch_fibrechannel_overview.html

Standard and optional features

The following is a list of optional features for the switch module:

- McDATA SANtegrity Enhanced Activation (32R1797)
- QLogic/McDATA 10-port Upgrade (PN 32R1912)

3.2.3 QLogic 10-Port and 20-Port 4Gb Fibre Channel Switch Module

The QLogic 10-port and 20-port 4Gb Fibre Channel switch modules enable high-performing end-to-end SAN solutions using 4Gb Fibre Channel Technology. These standards-based switches are affordable 4Gb Fibre Channel Switch modules providing interoperability with FC-SW-2 and FC-SW-3 compliant SANs. Available in two configurations, the 10-port switch provides the ability to connect up to seven internal blade server ports, and three external ports, while the 20-port switch provides all 14 internal ports and six external ports. The 10-port switch delivers pay-as-you-grow scalability via a license key upgrade, allowing all 20-ports to become active.

Table 3-9 shows the product and order information for these modules.

Table 3-9 Product and order information

Description	Order number
QLogic 10-port 4Gb Fibre Channel Switch Module for IBM eServer BladeCenter	32R1904
QLogic 20-port 4Gb Fibre Channel Switch Module for IBM eServer BladeCenter	26R0881

Figure 3-3 on page 21 shows the QLogic 10-Port and 20-Port 4Gb Fibre Channel Switch Modules.

Figure 3-3 QLogic 10-Port & 20-Port Gb Fibre Channel Switch Module

Switch features

- The 10-port model has seven internal auto-sensing 2/4Gb F-Ports and three external auto-sensing 1/2/4Gb E/F/FL ports (upgradeable to 20 ports with 10-port upgrade).
- The 20-port model has 14 internal auto-sensing 2/4Gb F-Ports and six external auto-sensing 1/2/4Gb E/F/FL ports.
- Using FC SW-2 and FC SW-3 standards, this switch interoperates with other major SAN switch manufactures, such as Cisco and McDATA.
- Includes QLogic SANsurfer Management Suite for configuration and management of the SAN.
- Supports McDATA Mode Firmware Upgrade via an optional license key to provide seamless integration into McDATA fabrics.

Note: There are two operational modes for McDATA switches and directors: Open Fabric Mode and McDATA Fabric Mode.

McDATA Mode was developed prior to the existence of the FC-SW-2 standard allowing McDATA Switches. In McDATA Fabric Mode, the user can utilize a default zone set where any node in the fabric can see any other node in the fabric without initiating specific zones. Also, the user can perform zoning on a port number and a domain number basis instead of using worldwide port names.

Open Fabric Mode was introduced to allow McDATA devices to openly operate according to the rules ratified under the FC-SW-2 standard. In Open Fabric Mode, Default Zone Set and zoning by Domain number and port number are no longer enforced.

New switching devices to be seamlessly added to an existing McDATA fabric running in McDATA Fabric Mode or in Open Fabric Mode, as long as the setting of the switch being introduced match the operational mode of the existing fabric. Please be sure to check the operational mode of your existing fabric prior to introducing your new BladeCenter to the fabric.

- Supported with QLogic 2Gb and 4Gb BladeCenter Fibre Channel expansion cards

For more information regarding integrated Fibre Channel switches for BladeCenter, visit the following Web site:

http://www-03.ibm.com/systems/bladecenter/switch/switch_fibrechannel_overview.html

Optional features

The following is a list of optional features for the switch module:

- QLogic/McDATA 10-port Upgrade (PN 32R1912)
- McDATA Mode Firmware Key Upgrade (PN 32R1795)

3.3 External Fibre Channel SAN switches

In this section, we discuss some of the supported external Fibre Channel SAN switches we used during the implementation of the SAN environments mentioned in this IBM Redbook.

3.3.1 IBM System Storage SAN10Q

The 4Gb 10-port FC switch is a low cost, easy to use switch that extends 4Gb FC SAN connectivity in the SMB market. It offers both fabric and public loop modes of operation. This new 4Gb 10-Port Fibre Channel (FC) SAN switch option helps you meet the challenge of managing mission-critical data in a expanding, network environment.

With a small form factor of only 0.9 kg (2 lbs) and 1U deep, the IBM System Storage™ SAN10Q is a true spacesaver requiring only one-half a rack slot. This means two Fibre Channel switches can be racked in a single slot for a total of 20 ports. All ports are autodiscovering and self-configuring, which helps allow maximum port density and power with a minimum investment.

Highlights of this switch module are:

- Small and capable 1U 4 Gbps 10-port half-width rack.
- Flexible rackable or stand-alone form factor.
- Designed to improve manageability: No wait routing helps maximize performance independent of data traffic.
- Simple to use: Auto-sensing, self-configurating ports.
- Logical choice: Intuitive and affordable migration from direct attached storage to SAN.
- Complete package: SANsurfer Express software helps simplify switch installation, managing and fabric scaling.

Figure 3-4 shows the IBM System Storage SAN10Q switch.

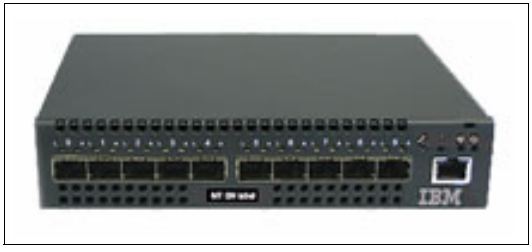

Figure 3-4 IBM System Storage SAN10Q

The IBM System Storage SAN10Q (type/model 6918-10X) offers:

- Fabric port speed: 4 Gbps, full-duplex, autonegotiating for compatibility with existing 2 Gbps and 1 Gbps devices
- Fabric latency: Fabric Point-to-Point Bandwidth: Up to 848 MBps full duplex per port
- Fabric Aggregate Bandwidth: Single chassis: Up to 80 Gbps (full duplex) end-to-end
- Maximum frame sizes: 2148 bytes (2112 byte payload)
- Per-port buffering: ASIC-embedded memory (nonshared) and 8-credit zero wait for each port

Table 3-10 shows the product information for the switch and rack kit.

Table 3-10 Product information

Description	Machine	Model	Number
IBM System Storage SAN10Q	6918	10X	691810X
IBM SAN10Q Rack Kit			39R6523

For more information, please visit the following Web site:
http://www-03.ibm.com/servers/storage/san/q_type/san10q/

3.3.2 QLogic SANbox 5600 Stackable Switch

The SANbox 5600 series of stackable switches delivers the seamless scalability and performance of a chassis switch, in an easy-to-manage, pay-as-you-grow solution. With sixteen 4Gb ports plus a four-pack of high-speed 10Gb ISL ports, and entry as low as eight ports with 4-port software-keyed increments and included graphical user interface (GUI) wizards, each SANbox 5600 stackable switch provides maximum flexibility for configuring, managing, and scaling SANs.

It is available in two power supply configurations: single integrated (SB5600) and dual hot-swappable (SB5602). For our example, see 7.2, “QLogic Fibre Channel Switch 5602 setup and configuration” on page 171.

Figure 3-5 on page 25 shows the switch.

Figure 3-5 SANbox 5600 Stackable Switch

The SANbox 5600 Stackable Switch provides the following:

- 8, 12, or 16 auto detecting 4Gb/2Gb/1Gb device ports
- Four 10Gb ports for high speed stacking links
- 4-port 4Gb/2Gb/1Gb or 10Gb field upgrade licenses are available
- Stacking of up to four units for 64 available user ports
- Non-Disruptive Code Load and Activation (NDCLA)
- Single and dual hot-swap power supply configurations available
- Configuration, Zoning, and Extended Distance wizards to simplify switch installation and fabric scaling
- Interoperable with all FC-SW-2 compliant Fibre Channel switches
- Full-fabric, public-loop, or switch-to-switch connectivity on 4Gb ports
- Full-fabric or switch-to-switch connectivity on 10Gb ports
- Auto-sensing, self-configuring ports
- Fabric Tracker tool for fabric-wide snapshots and detection of configuration changes
- Non-blocking full-bandwidth architecture
- I/O StreamGuard for RSCN suppression
- No-Wait routing: Guaranteed maximum performance independent of data traffic
- Industry's lowest latency for maximum performance
- SFP (small form-factor pluggable) connectivity: 16 front ports in a 1U full-width rack form-factor
- SANsurfer Switch Manager open management system: Designed for seamless operation with higher level third-party management applications
- In-band, out-of-band, Telnet and SNMP management access

- ASIC-embedded memory: Faster, more scalable, and more reliable than shared memory architecture

3.3.3 McDATA Sphereon 4400 Switch

The McDATA Sphereon 4400 is an 8- to- 16 port switch that delivers enterprise-level features with an entry-level price. It starts from a base of eight ports and grows in 4-port increments using McDATA's FlexPort technology. A full-featured Fibre Channel switch in a half-rack width configuration, the 4400 is designed to provide high performance with 4 Gbps non-blocking bandwidth on every port with the ability to auto-negotiate to 2 Gbps and 1 Gbps to protect existing investments.

Figure 3-6 shows the switch.

Figure 3-6 McDATA Sphereon 4400 Switch

The McDATA Sphereon 4400 offers the following:

- FlexPort connectivity-on-demand: Allows for affordable and nondisruptive additions to port capacity.
- HotCAT (Hot Code Activation Technology): Provides nondisruptive loading and activation of code upgrades and feature enhancements.
- EFCM Basic (formerly SANpilot) software: Offers an integrated, browser-based management tool for easy, intuitive control of Sphereon switches and small fabrics.
- Integration with the industry's broadest array of management applications, including Enterprise Fabric Connectivity Manager (EFCM).
- SANtegrity Security Suite software helps customers to protect data and securely manage access to their SANs.

3.3.4 IBM TotalStorage SAN32B-2 FC Switch (SilkWorm 4100)

The IBM TotalStorage SAN32B-2 (equivalent to the Brocade SilkWorm 4100) is a high-performance, high-availability Fibre Channel switch designed for rapidly growing storage requirements in mission-critical environments. With a flexible architecture that supports 1, 2, and 4 Gbps technology with 16, 24, or 32 ports in a 1U package, the SAN32B-2 provides excellent value at an affordable price point. As a result, even small organizations can achieve the levels of performance and availability typically available only to larger enterprises. These capabilities help make the SAN32B-2 ideal for branch offices and departments in large enterprises as well as for midsized organizations. It can be used as the foundation of small, stand-alone SANs or as an edge switch in larger core-to-edge SAN infrastructures for enterprise-class applications, such as ERP, MRP, data warehousing, billing, and e-mail.

Figure 3-7 shows the switch.

Figure 3-7 IBM TotalStorage SAN32B-2 FC Switch (SilkWorm 4100)

Highlights:

- Protects existing investments by providing 4 Gbps technology with auto-sensing capabilities to support earlier 1 and 2 Gbps devices
- Supports full 4 Gbps operations at distances up to 100 kilometers (or 500 kilometers at 1 Gbps) for cost-effective business continuance
- Increases network performance with enhanced Brocade Inter-Switch Link (ISL) Trunking, which enables a high speed data path up to 32 Gbps
- Utilizes Ports on Demand for fast, easy, and cost-effective scalability from 16 to 32 ports in 8-port increments
- Meets high-availability requirements with redundant, hot-pluggable components, and nondisruptive software
- Leverages intelligent Brocade SAN management and monitoring tools to increase operational efficiency and maximize SAN investments

For our example, see 5.4, “IBM TotalStorage SAN32B-2 Switch setup and configuration” on page 76.

Standard and optional features

As with the 4Gb SAN Switch Module, the SAN32B is based on the Brocade Fabric Operating System (Fabric OS) Version 5.0.x. and backward and forward compatible with the entire Brocade SilkWorm product family. The SAN32B offers the following advanced features and functionality:

- Advanced Web Tools (standard) provide a graphical interface that enables you to monitor and manage individual switches and ports from a standard workstation using a browser.
- Brocade Advanced Zoning (standard) ensures secure device connectivity through either domain/port or World Wide Node Name zoning enforced through hardware.
- Brocade 8 and 16-Port Upgrade (optional license feature FC7510/7513) nondisruptively adds eight or 16 additional ports to SAN32B.
- Brocade Advanced Performance Monitoring (optional license feature FC7556) allows very granular performance monitoring capabilities that include specific initiator-to-target traffic, SCSI Reads and Write per second, and CRC error tracking.
- Brocade ISL Trunking (optional license feature FC7557) enhances SAN performance, increases availability, and simplifies management by creating up to two 12 Gb trunks to the external SAN that provide granular frame-level load balancing.
- Brocade Performance Bundle (optional license feature FC7555) includes ISL Trunking and Advanced Performance Monitoring.
- Brocade Dynamic Path Selection (standard) also enhances performance by performing exchange-level load balancing across the ISL Trunks. ISL Trunking and DPS together ensure a balanced 24 Gb bandwidth to external SAN.
- Brocade Fabric Watch (standard) enhances SAN management and availability through client configurable monitors of critical security, statistics and performance parameters, and sending alarms to administrator to proactively catch potential problems.
- Brocade Extended Fabric (optional license feature FC7553) when used with link extenders, enhances IBM Business Continuity solutions by allowing full FC bandwidth across extended distances up to 230 km.
- Brocade Advanced SAN Security (optional license feature FC7554) provides flexible security and policy administration that protect data from unauthorized access and corruption, thus helping organizations meet specific security requirements.
- Brocade Fabric Manager 5.0 (software product sold separately) is a graphical interface for monitoring and managing multiple fabrics comprised of Brocade

switches from a standard workstation. The GUI simplifies task administration at the fabric, switch, and port levels in a medium-to-large size Brocade SAN environment.

More information regarding this product can be viewed at the following Web site:

ftp://ftp.software.ibm.com/common/ssi/rep_sp/n/TSD00742USEN/TSD00742USEN.PDF

3.4 External Storage Disk Arrays

In this section, we discuss some of the supported external Storage Disk Arrays we used during the implementation of the SAN environments mentioned in this Redbook.

3.4.1 IBM TotalStorage DS4100

The IBM TotalStorage DS4100 (formerly FAStT100) is designed to give cost-conscious enterprises an entry-level server that can help address storage consolidation and near-line application storage needs without undue expense, while leaving them room to grow. Single controller model supports up to 5.6 TB, while the dual controller model supports up to 44.8 TB of Serial ATA (SATA) physical disk storage with DS4000™ EXP100, provided by up to 14 internal 400GB disk drives inside the controller, the DS4100 can provide ample yet scalable storage without the cost of extra expansion units. This disk system is designed to help consolidate direct-attached storage into a centrally managed, shared, or storage area network (SAN) environment. With four Fibre Channel ports to attach to servers on dual controller, the need for additional switches is reduced or eliminated for additional potential cost savings.

The DS4100 was used during our lab implementation; however, since its replacement has come onto the scene to provide the end-to-end 4Gb storage technology required at this level. The replacement for the DS4100 is the DS4700 Express.

3.4.2 IBM System Storage DS4700 Express

The IBM System Storage DS4700 Express offering is geared toward small to midsize business and midrange enterprise customers.

The IBM System Storage DS4700 Express Model supports a high-performance 4Gb Fibre Channel interface designed for data-intensive applications that demand increased connectivity. The DS4700 Express supports eight 4 Gbps capable host channels that may be directly attached to host servers or connected

to a Fibre Channel storage area network (SAN). Four Gbps capable drives and IT infrastructure are required to achieve 4 Gbps throughput speeds.

There are two ways to measure the performance of a SAN device: megabytes per second (Mbps) and input/output per second (IOPS). The DS4700 Express 4 Gbps SAN solution is designed to provide up to 1600 Mbps throughput (assuming a 4 Gbps capable system) with up to 125,000 IOPS. A 2 Gbps storage array can require up to twice as many host ports as a 4 Gbps array to deliver the throughput of four 4 Gbps ports. The DS4700 Express can help you free up or eliminate the need for additional host ports in the SAN for each array.

The DS4700 Express storage system's four 4 Gbps drive connections are designed to support up to 112 disk drives with the attachment of six DS4000 EXP810 disk enclosures. This makes the DS4700 Express a good choice for performance-oriented or capacity-oriented storage requirements. Models 70 and 72 are designed to support over 33.6 TB of Fibre Channel physical storage capacity.

The DS4700 Express expands the DS4000's history of flexibility with another configuration option: cache size. The DS4700 Express is available in two models: Model 70 is designed to support up to 2 GB of physical cache memory (1 GB per controller) and the Model 72 can support up to 4 GB of physical cache memory (2 GB per controller).

The IBM System Storage DS4700 Express is designed to be an affordable, scalable storage server for storage consolidation and clustering applications. Its modular architecture, which includes Dynamic Capacity Addition and Dynamic Volume Expansion, can support on demand business environments by helping to enable storage to grow as demands increase. Autonomic features such as online firmware upgrades and DS4000 Service Alert also are designed to help enhance the system's usability.

The DS4700 Express features support the consolidation of direct-attached storage into a centrally managed, shared, or storage area network (SAN) environment. With built-in support for eight Fibre Channel–attached servers, the need for additional switches is reduced or eliminated, helping to make server clustering more cost-effective.

The 4 Gbps capable IBM System Storage EXP810 Storage Expansion Unit offers a new 16-bay disk enclosure for attachment to selected DS4000 mid-range disk systems, with up to 4.8 TB physical capacity per expansion unit using sixteen 300 GB disk drives. The EXP810 Storage Expansion Unit is designed to accommodate the new optional 2 Gbps Fibre Channel Enhanced Disk Drive Modules (E-DDM), as well as an intermix of 4 Gbps Fibre Channel Enhanced Disk Drive Modules (E-DDM), all within the same enclosure. The EXP810 contains redundant (AC or DC) power and cooling modules, and Environmental

Service Module (ESM) interfaces. The DS4000 EXP810 is available in a 19-inch rack-mount package.

Each ESM Customer Replacement Unit (CRU) contains two 2 Gbps/4 Gbps Fibre Channel host connections utilizing Small Form Factor Pluggable (SFP) connectors. The DS4000 EXP810 ESM designs support a 4 Gbps Fibre Channel loop. Both 2 Gbps and 4 Gbps Fibre Channel disk drives are supported. A switch on the front of the DS4000 EXP810 enclosure selects the speed of the entire enclosure—either 2 Gbps or 4 Gbps, but not both at the same time.

Table 3-11 shows the product and order information for these units.

Table 3-11 Product and order information

Description	Order Number
DS4700 Express Model 70	#181470H
DS4700 Express Model 72	#181472H

Please visit the following Web site for more on the features and benefits of this product:

http://www-03.ibm.com/servers/storage/disk/ds4000/ds4700/index.html

3.4.3 IBM System Storage DS4800

The IBM System Storage DS4800 is the very latest and most powerful in the highly successful IBM System Storage DS4000 Series. Designed as an integral component in the IBM storage solution portfolio, the DS4800 is a key component of IBM business continuity solutions portfolio delivering business resilience and continuity of operations. Also designed to accommodate the changing value of data over time while maintaining data availability, DS4800 can play a leading role in a hierarchical storage life cycle management strategy. The DS4800, when ordered in combination with IBM virtualization products (SAN File System or SAN Volume Controller), makes an outstanding solution to help simplify your I/T infrastructure.

The IBM System Storage DS4800 disk storage system supports a high-performance 4 Gb Fibre Channel interface for increased host connectivity to deliver necessary bandwidth for high-throughput applications. It is designed for data-intensive applications that demand increased connectivity provided by eight 4 Gbps host channels designed to provide up to 1600 MBps of sustained bandwidth for high-throughput applications through the eight channels directly attached to the host servers or connected to a Fibre Channel storage area network (SAN).

Models	1815-80A, 1815-82A, 1815-84A, and 1815-88A
RAID controller	Dual active
Cache	Model 80A: 4 GB battery-backed
	Model 82A: 4 GB battery-backed
	Model 84A: 8 GB battery-backed
	Model 88A: 16 GB battery-backed
Host interface	8 host ports: Fibre Channel (FC) Switched and FC Arbitrated Loop (FC-AL) standard, auto-sensing 1 GBps/2 GBps/4 GBps
Drive interface	8 drive ports: Fibre Channel (FC) Switched and FC Arbitrated Loop (FC-AL) standard, auto-sensing 2 GBps/4 GBps
Supported drives	36.4 GB, 73.4 GB, 146.8 GB, and 300 GB 10,000 rpm (Fibre Channel)
	36.4 GB, 73.4 GB, and 146.8 GB 15,000 rpm (Fibre Channel)
	400 GB and 250 GB 7,200 rpm (SATA)
	2 Gbps FC: 15K rpm, 146 GB/73 GB/36 GB (E-DDM)
	2 Gbps FC: 10K rpm, 300 GB/146 GB/73 GB (E-DDM)
	4 Gbps FC: 15K rpm, 146 GB/73 GB/36 GB (E-DDM)
RAID levels	0, 1, 3, 5, and 10
Storage partitions	8, 16, or 64 storage partitions; choice of 8, 16, or 64 required
	Upgrade: 8–16, 16–64
Maximum drives	Model 80A: 224 FC drives (using 14 DS4000 EXP810, or 16 EXP710 Expansion Units)
	Model 82A: 224 FC drives (using 14 DS4000 EXP810, or 16 EXP710 Expansion Units)

Model 84A: 224 FC drives (using 14 DS4000 EXP810, or 16 EXP710 Expansion Units)

Model 88A: 224 FC drives (using 14 DS4000 EXP810, or 16 EXP710 Expansion Units)

SAN Support Supported IBM FC switches and directors (product numbers 2005, 2006, 2109, 3534, 2031, 2032, 2034, 2042, 2061 and 2062, and BladeCenter)

Table 3-12 shows the product and order information for the system.

Table 3-12 Product and order information

Description	Order Number
IBM System Storage DS4800	Model 80 - 1815-80A Model 82 - 1815-82A Model 84 - 1815-84A Model 88 - 1815-88A

Please visit the following Web site for more on the features and benefits of this product:

http://www-03.ibm.com/servers/storage/disk/ds4000/ds4800/index.html

3.4.4 EMC CLARiiON CX3 UltraScale Series

The EMC CLARiiON CX3 UltraScale Series extends EMC's leadership in networked Storage with the third generation of CLARiiON CX Series Systems. The EMC CLARiiON CX3 UltraScale Series is the industry's only midrange storage solution designed from the ground up to deliver maximum business benefits, unprecedented application performance, the highest levels of scalability and reliability, and ease-of-use capabilities.

The UltraScale is a breakthrough architecture, as it is the only midrange storage architecture that sustains maximum throughput and performance for a wide variety of business applications. With a state-of-the-art I/O interconnect based on native PCI Express technology, UltraScale delivers high-bandwidth, low-latency characteristics that enable the CX3 UltraScale Series to capitalize on the industry's only full 4 Gbps capabilities throughout the entire system. Processing power improvements deliver significant performance increases in business applications and array-based replication software, such as EMC SnapView, SAN Copy, and MirrorView functionality.

The CLARiiON CX3 UltraScale series scales from the 365 GB capacity entry-point CX3 model 20 up to the 239 TB capacity CX3 model 80, the world's largest midrange storage platform. Customers can let their information grow as fast as their business, without the difficulties of data migrations of new management tools.

As application requirements change, CLARiiON's unique Virtual LUN technology can be used to nondisruptively move data from one tier of storage to a higher or lower tier and between 2 Gbps and 4Gbps drives within the same CLARiiON CX3 Series System to take advantage of the full UltraScale architecture. By matching performance and financial investment to the needs of the application or business process, information gets delivered as fast as it is needed, and budgets can go further than ever.

The EMC CLARiiON CX3 UltraScale Series includes:

- EMC CLARiiON CX3 model 80
- EMC CLARiiON CX3 model 40
- EMC CLARiiON CX3 model 20

The entry point into the CLARiiON CX series is the EMC CLARiiON CX300 networked storage system.

Please visit the following Web site for more on the features and benefits of the CLARiiON CX3 product line:

http://www.EMC.com/CX3

"EMC Corporation, Reprinted by Permission."

4

IBM BladeCenter setup and configuration

The IBM BladeCenter servers are designed to take less time to install, configure, and use fewer people to maintain. In this chapter, you will witness the preliminary tasks for setting up and configuring your IBM BladeCenter to support your SAN environment.

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4.1 Supported environments for Windows and Linux operating systems

Table 4-1 lists the hardware and operating systems with corresponding services packs that have been successfully tested in a Boot from SAN environment with a 4 Gbps solution. See the IBM Server Proven Web site for more information.

Table 4-1 Supported environments

Operating systems	8678	8832	8839	8843		8850	
				32 bit	64 bit	32 bit	64 bit
Windows 2000 SP4	X	X	X	X	N/A	X	N/A
Windows 2003 Standard	X	X	X	X	X	X	X
Windows 2003 Enterprise	X	X	X	X	X	X	X
SLES 9 SP1	X	X	X	X	X	X	X
RHEL 4 Update 1	X	X	X	X	X	X	X

4.1.1 Firmware and drivers

Once you have installed your QLogic or Emulex 4Gb Fibre Channel HBA, you should ensure that you have the appropriate firmware and drivers to configure them. The following firmware and drivers are available on the IBM BladeCenter Support Web site:

http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-45859#fibre

4.2 Blade server F1 setup

This step should be performed when you are prepared to configure a Boot from SAN environment. In the following steps, you will disable the use of the IDE drives that may be installed in the HS20, HS40, or LS20.

1. Power on the blade server and interrupt the boot sequence to enter the HS20 blade system BIOS by pressing the F1 key.
2. At the Configuration/Setup Utility menu, select **Devices and IO ports**.
3. Select **IDE Configuration Menu** and press Enter.

Note: On the HS20 (8832, 8678, and 8839; verify on all blades) blade servers

4. Set the Primary IDE Channel and Secondary IDE Channel option on the HS20 to Disabled (see Figure 4-1).

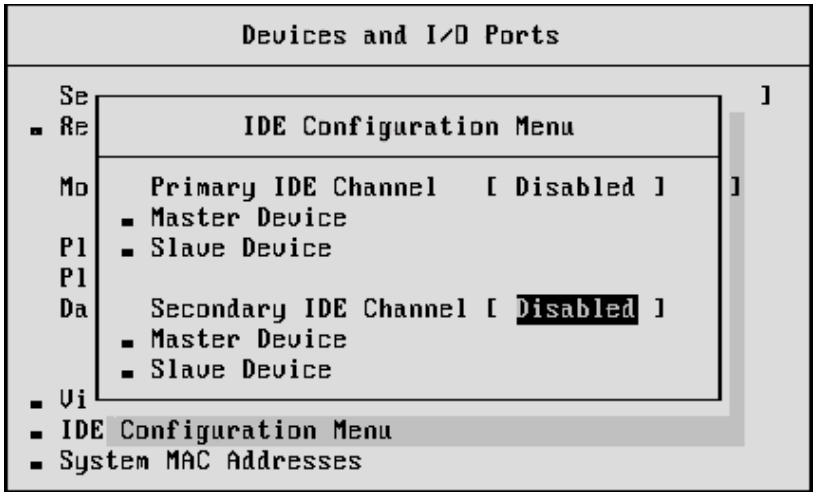

Figure 4-1 IDE Configuration Menu window

5. On the HS20 (8843 and 8850) blade servers with SCSI disks:
   a. Set the Planar SCSI option to Disabled on the HS20 (8843) and LS20 blade, as shown in Figure 4-2.

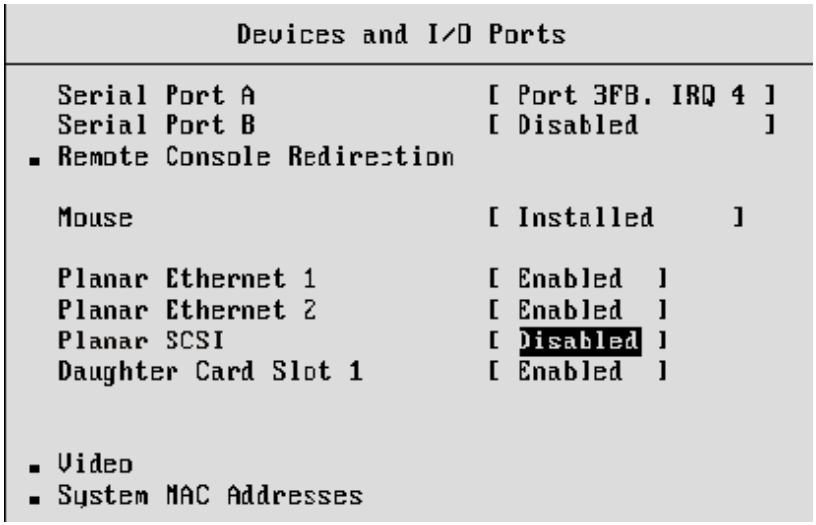

Figure 4-2 Devices and I/O Ports window

6. Press Esc to exit out of this menu and save the changes.

4.3 QLogic Fast!Util setup

This step should be performed when you are prepared to configure a Boot from SAN environment.

4.3.1 Configure the HS20 blade server Fibre Channel BIOS

In this section, you will follow the steps to configure your blade server FC HBA:

1. Power on or restart the HS20 Blade.

2. Press Ctrl-Q or Alt-Q to enter the FC BIOS configuration utility, as shown in Example 4-1.

Example 4-1 Ctrl-Q execute window

```
Broadcom NetXtreme Ethernet Boot Agent v3.1.15
Copyright (C) 2000-2002 Broadcom Corporation
All rights reserved.

Broadcom NetXtreme Ethernet Boot Agent v3.1.15
Copyright (C) 2000-2002 Broadcom Corporation
All rights reserved.

QLogic Corporation
QMC2462 PCI Fibre Channel ROM 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 0 is disabled
BIOS for Adapter 1 is disabled
ROM BIOS NOT INSTALLED

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

3. Select the first Fibre Channel adapter port (port 1 @ 4000 I/O address is internally connected to the top Fibre Channel Switch in slot 3 of the BladeCenter chassis), as shown in Figure 4-3.

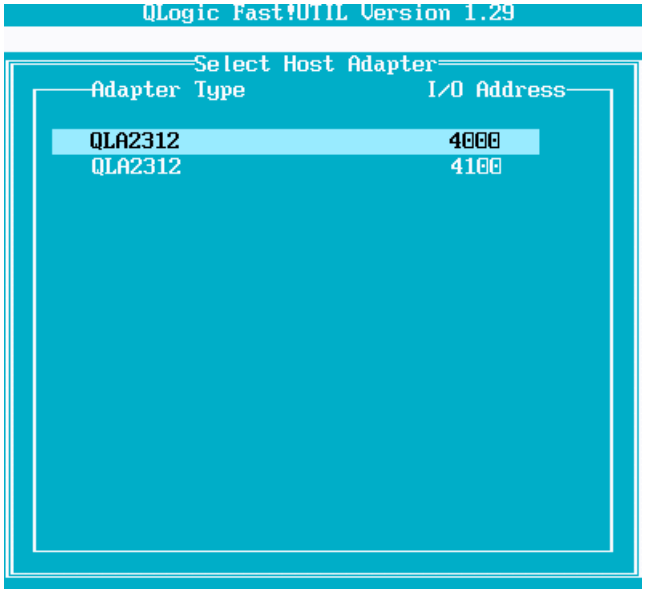

Figure 4-3 Select Host Adapter window

4. Select **Configuration Settings** → **Host Adapter Settings**.

5. Change the Host Adapter BIOS to Enabled (Figure 4-4); the default value is Disabled.
6. Record the World Wide Port Name (WWPN) of this host bus adapter. It will be needed to define the Storage Group, Host, and Host Port on the storage subsystem and also for fabric Zone configuration.

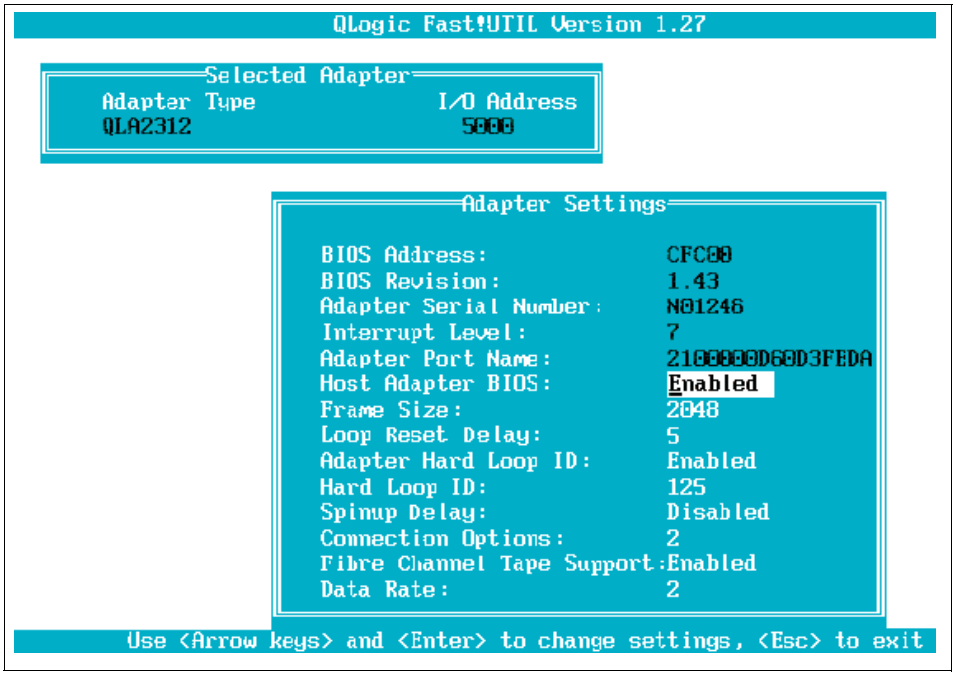

Figure 4-4 FC Host Bus Adapter BIOS menu

7. Verify and confirm that the following NVRAM definitions are applied on the HBA by selecting the Advance Adapter Settings, as shown in Figure 4-5.

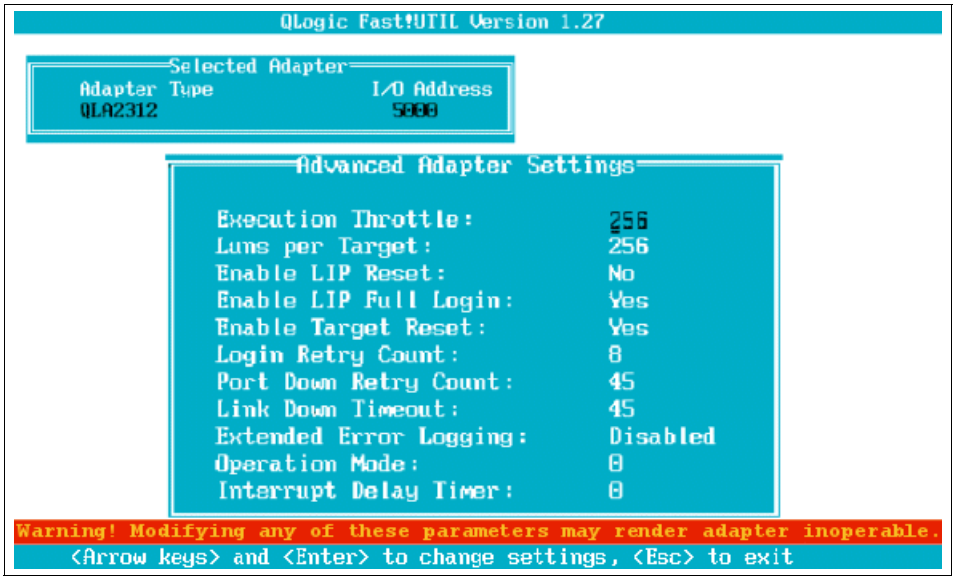

Figure 4-5 Advanced Adapter Settings window

4.4 4Gb Fibre Channel switch module implementation

To insert the switch module into a blade server chassis:

1. Unpack the switch module from its shipping box.
2. Verify that bay 3 or 4 in the BladeCenter chassis are empty. Note that Bay 3 and 4 locations are different for the IBM BladeCenter and BladeCenter H chassis.
3. Squeeze the release lever to release the insertion arm.
4. Pull the release lever away from the switch to completely open the lever.
5. Slide the switch module into the open slot, as shown in Figure 4-6 on page 43.

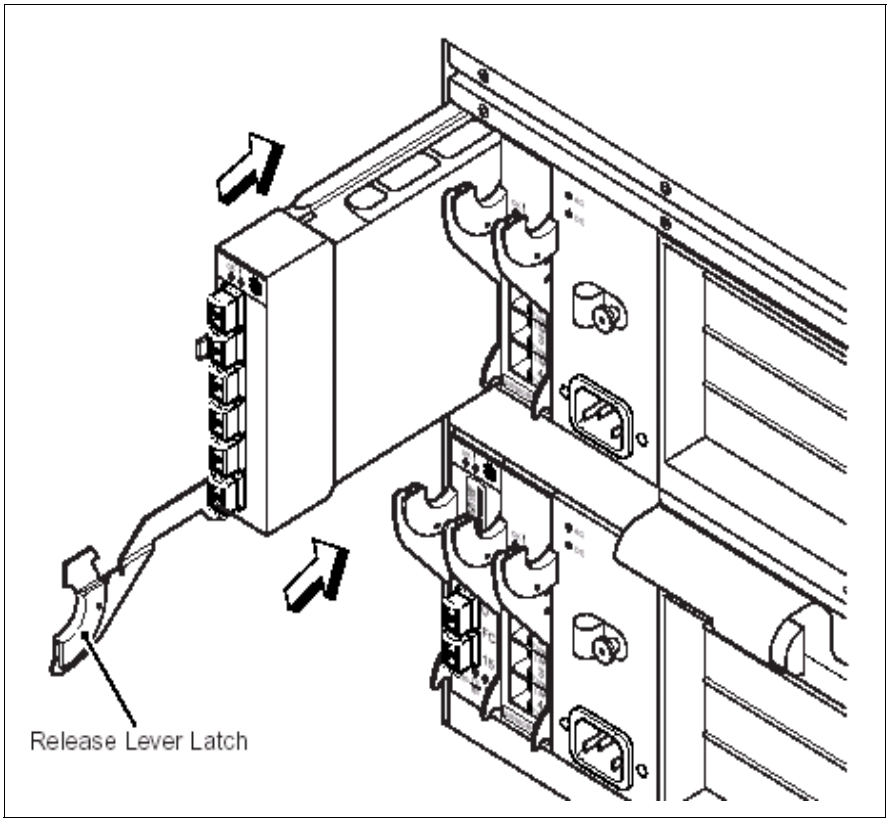

Figure 4-6 N-1

6. Raise the release lever until it moves from the lowered to the upright position. This locks the switch module into the chassis and automatically starts power up. The switch will run self-diagnostic tests (such as POST).
7. Wait until the diagnostics have completed and the LEDs are stable and then use the BladeCenter Management Module to configure the switch.

4.4.1 FC switch module configuration through the Management Module

Note: The new IBM BladeCenter Management Module firmware version that supports the Brocade, McDATA, and QLogic 4Gb SAN Switch Module is BRET82F.

To connect to the switch module using the BladeCenter Management Module:

1. On your workstation, open a supported browser window.
2. In the address field, type the IP address of the Management Module.
3. When prompted, enter the user name and password. By default, the IBM BladeCenter Management Module user name is USERID and the password is PASSW0RD. Note that a zero is used in place of the letter O. User names and passwords are case sensitive.

Figure 4-7 shows the initial AMM view.

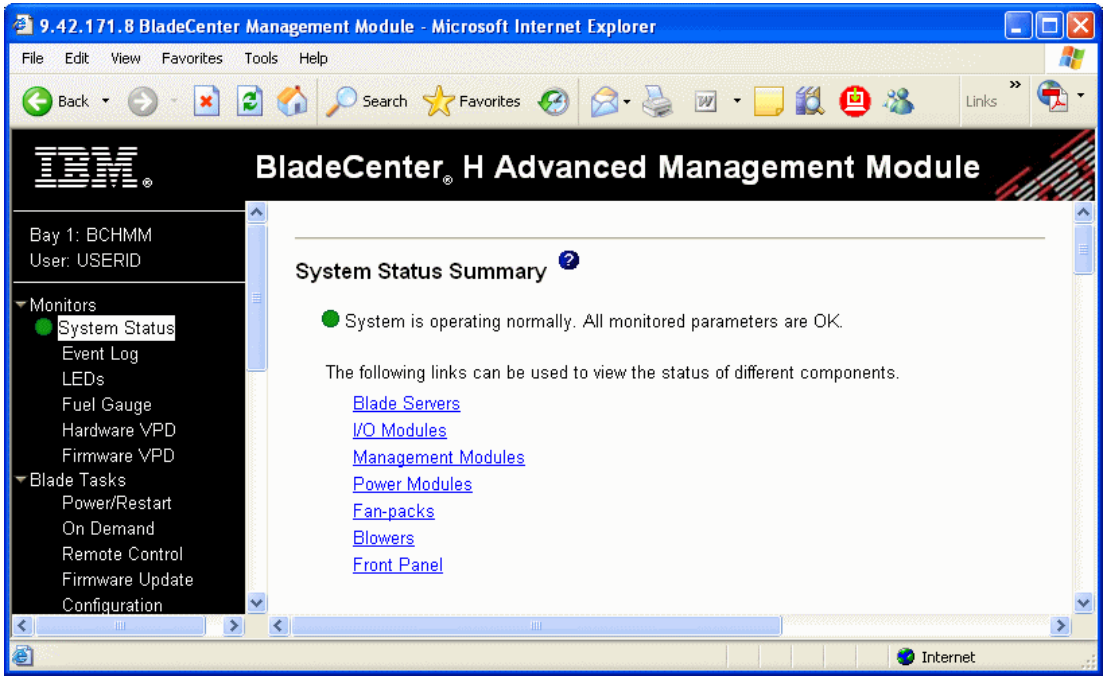

Figure 4-7 Initial BladeCenter H Advanced Management Module view

4.4.2 Setting the switch module IP Address and enabling external ports

The default IP address for the switch module is 192.168.70.129 (for Bay 3) or 192.168.70.130 (for Bay 4) of the BladeCenter chassis. To change the IP address, perform the following:

1. In the I/O Module Tasks tab, click **Configuration**. Select Bay 3 or 4.
2. Change the IP address and click **Save** (see Figure 4-8 on page 45).

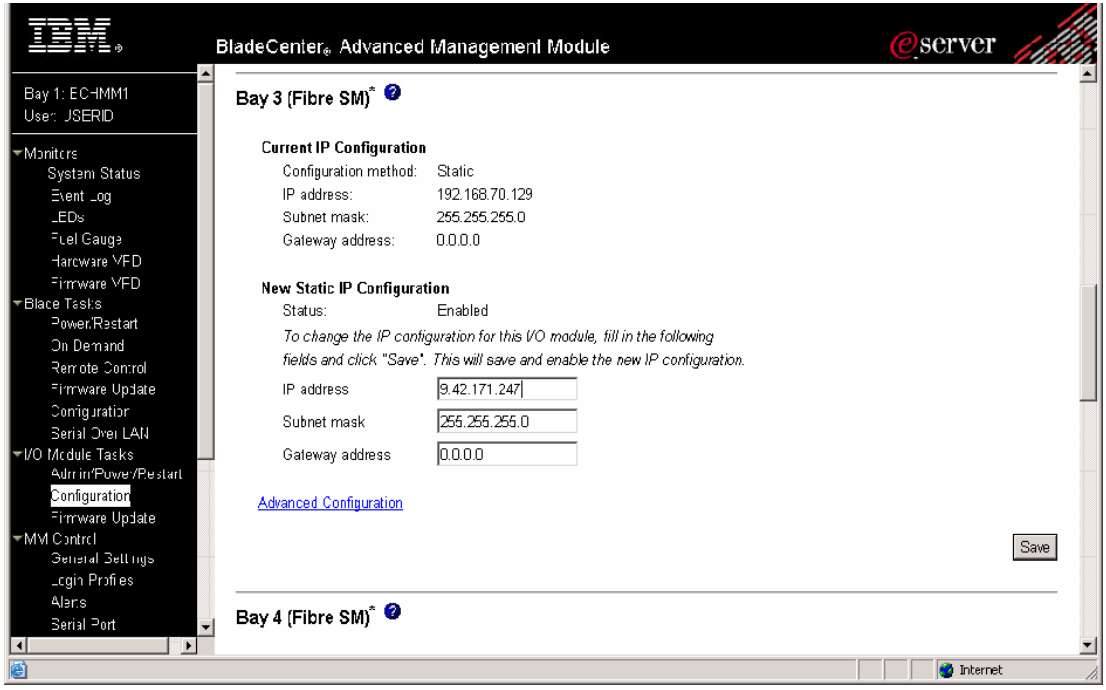

Figure 4-8 Setting Switch Module IP Address

Note: Use only the BladeCenter Management Module to set the switch module's IP address. Do not use the switch module's CLI or Web tools. Doing so may cause a loss of connectivity between the Management Module and switch module. The switch module's IP address must be on the same IP subnet to communicate.

3. While in the window shown in Figure 4-8 on page 45, locate and click **Advanced Configuration** for the switch module. You will see a window similar to Figure 4-9. Ensure that the external ports are enabled. Click **Save**.

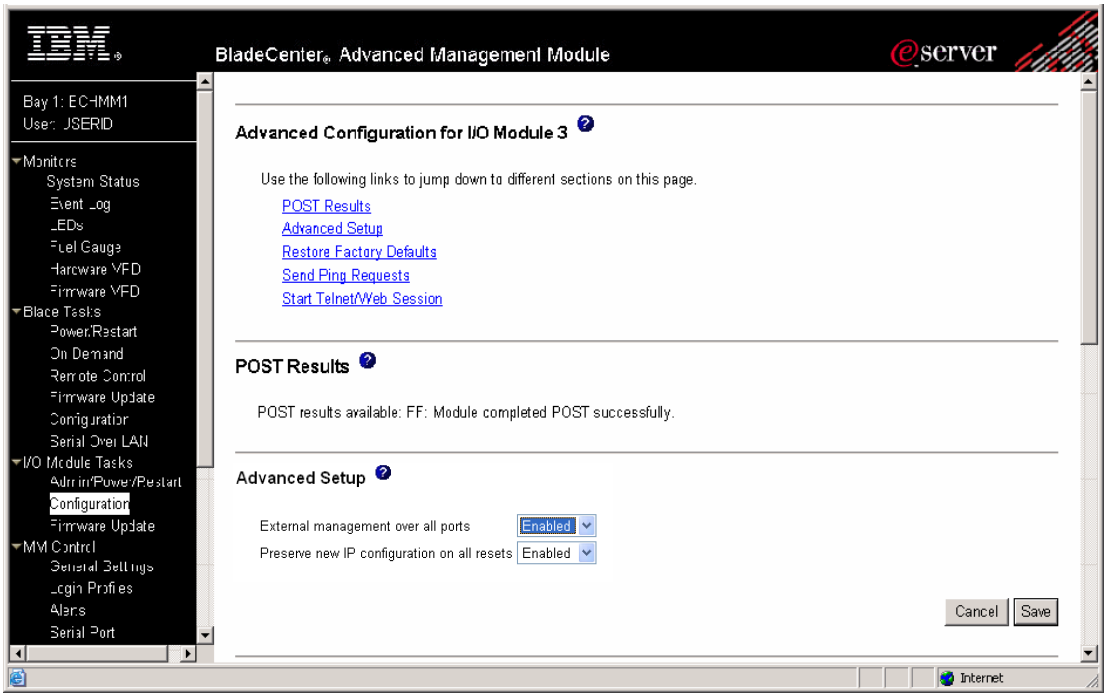

Figure 4-9 Enabling External Ports on switch module

4. The remaining steps for configuring the switch module are performed either through the command line interface (CLI) via telnet or Web tools (via Browser). Both methods are accessible from the Management Module window (see Figure 4-10) or you may access outside the Management Module by using the switch module's IP address.

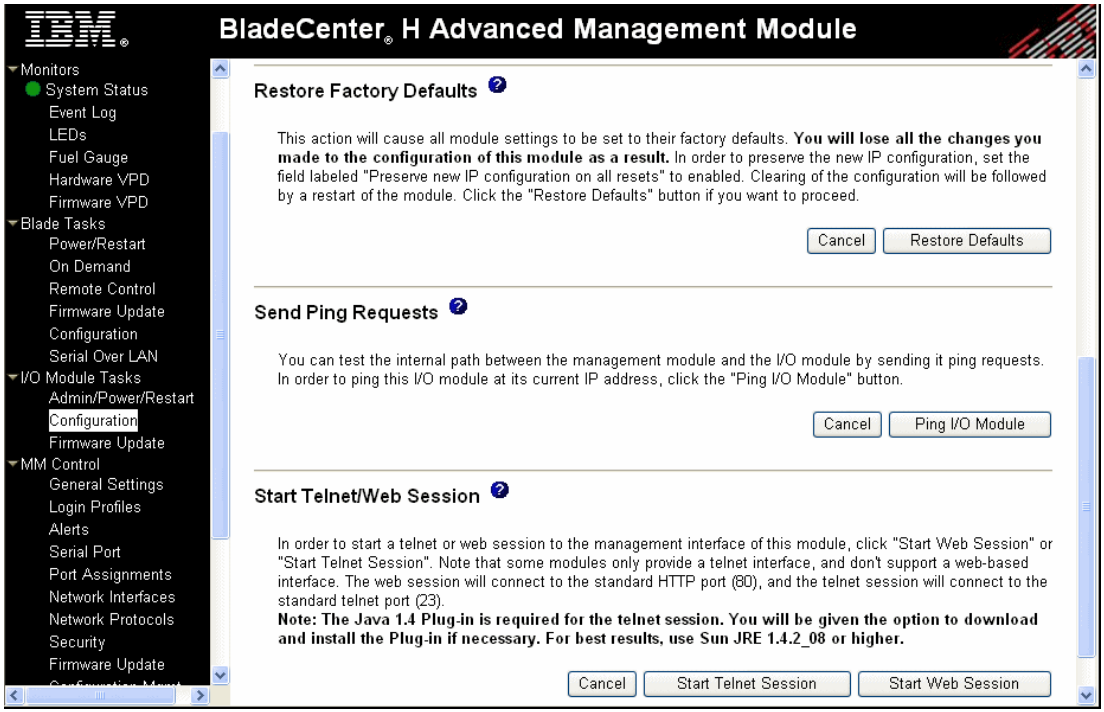

Figure 4-10 Launching Web or Telnet Session from the Management Module

5

Brocade SAN configuration

In this section, we discuss the 4Gb SAN solution presented by Brocade.

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5.1 Building an enhanced 4Gb SAN solution on Brocade technology

This section of the IBM Redbook provides you with the resources to build, manage, and maintain a SAN solution based on Brocade technology and offering these advanced features:

- Superior performance:
  - 4 Gbps end-to-end bandwidth from server to storage
  - Multiple 12 Gbps Inter Switch Link (ISL) Trunks connecting the BladeCenter to the external SAN fabric providing up to 48 Gb of total load balanced bandwidth
- Simple management:
  - Single point of SAN fabric management
  - Advanced performance monitoring capability
- High Availability:
  - Redundant SAN fabrics with no single point of failures
  - Multi-pathing software to the DS4800 disk array
  - Hot code load and activation for all switches
  - Health Monitoring tools to catch marginal components before they become hard failures
- Advanced SAN security:
  - Hardware Enforced Zoning for both ports and WWN
  - Using encryption, authentication, and access control lists to meet the strictest corporate security policies
- Scalability: Additional BladeCenter chassis and storage arrays may be connected to the core SAN32B switches without any disruption.

The solution built in this IBM Redbook consists of one BladeCenter H chassis, three blade servers, two Brocade 4Gb SAN Switch Modules, two TotalStorage SAN32B-2 FC switches, and one DS4800 (see Figure 5-1 on page 51).

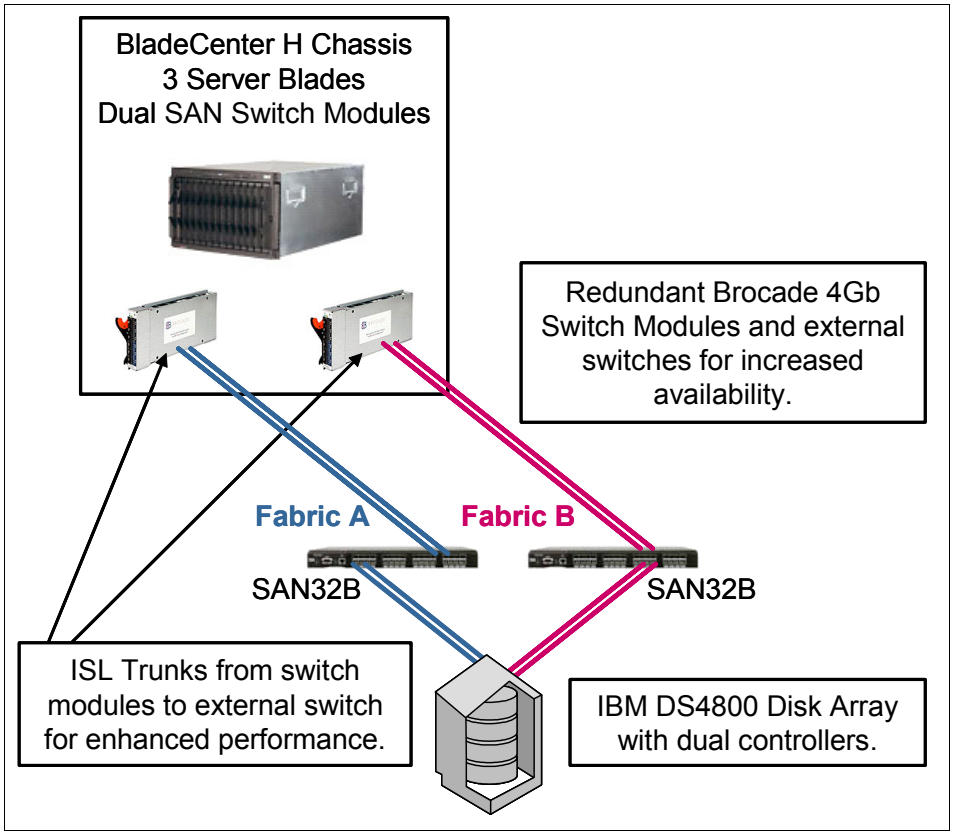

Figure 5-1 Solution diagrams

The Brocade portion of the Redbook includes these sections:

- "Brocade 10-Port and 20-Port 4Gb SAN Switch Module" on page 15
- "IBM TotalStorage SAN32B-2 FC Switch (SilkWorm 4100)" on page 27
- "Building an enhanced 4Gb SAN solution on Brocade technology" on page 50
- "SAN design with Brocade 4Gb SAN switch modules" on page 52
- Setup of the "Brocade 4Gb SAN Switch Module configuration" on page 55
- Setup of "IBM TotalStorage SAN32B-2 Switch setup and configuration" on page 76
- "Building the Brocade SAN fabric" on page 101
- "Connecting storage and servers to SAN fabric" on page 111
- "Zoning to control device connectivity" on page 115
- "Mapping a logical disk to server blades" on page 135

- “Documentation for Brocade 4Gb SAN switch module” on page 328

While this solution is using the IBM SAN32B external switch, the steps are very similar for other Brocade-based FC products from IBM, such as the SAN16B entry switch or SAN256B enterprise director.

5.2 SAN design with Brocade 4Gb SAN switch modules

In this section, we discuss the different SAN designs we are able to implement with the Brocade 4Gb SAN switch.

5.2.1 Small-to-medium SAN topologies

There are two huge benefits of the Brocade 4Gb SAN Switch Module compared to the previous 2Gb, two External Port switch module:

- Increased bandwidth up to 24 Gb
- Increased connectivity to other devices, switches, or switch modules

While the increased bandwidth will only be needed in extreme high-performance application environments, the improved connectivity will benefit all customers by building small-to-medium SAN fabrics without external switches. By using cascade, mesh, or core-to-edge SAN topologies, the BladeCenter chassis can be interconnected through the SAN switch modules to provide fabrics with redundancy and excellent performance. Figure 5-2 on page 53 demonstrates how 3, 4, 5, and 6 chassis may be connected.

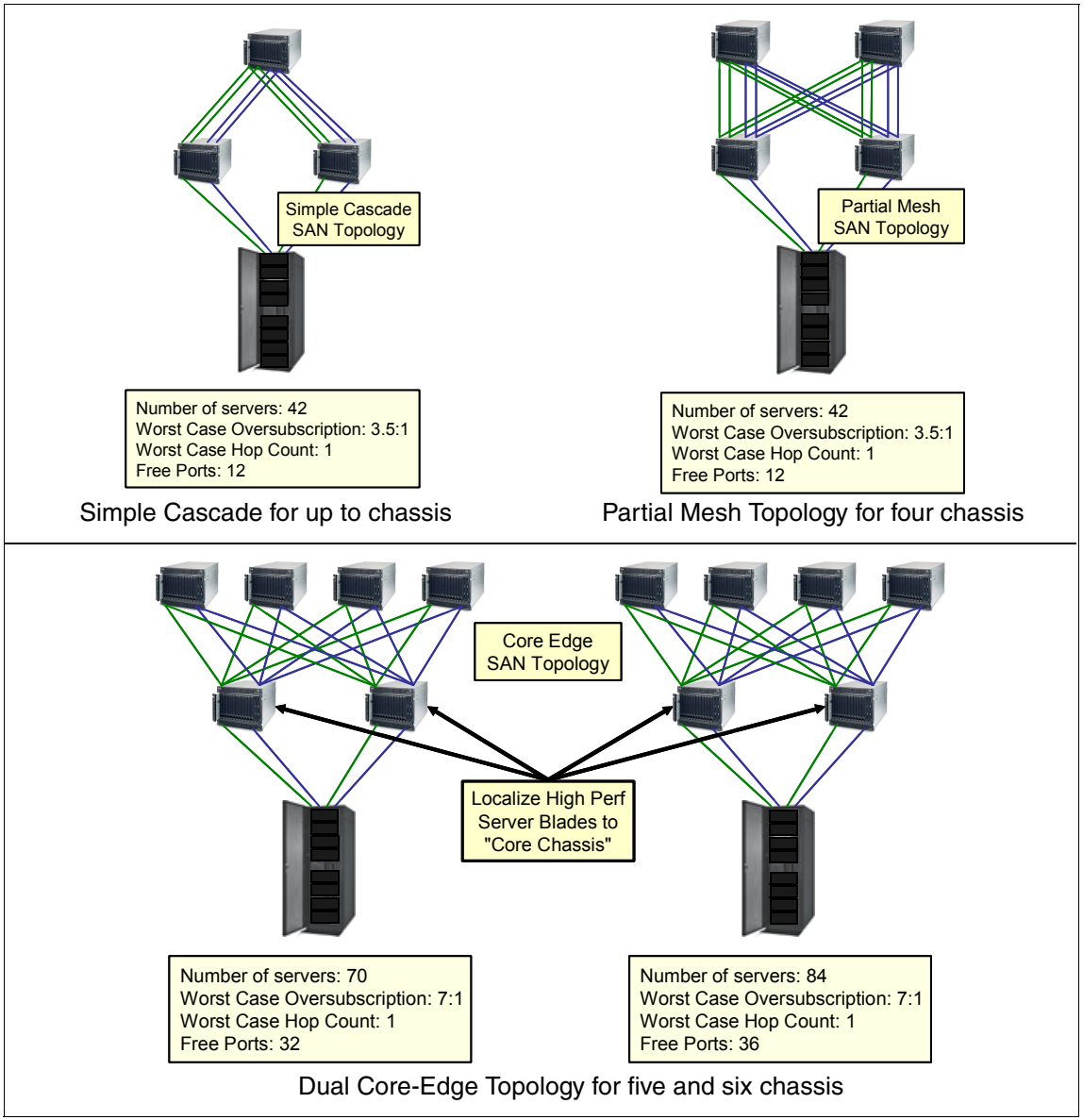

Figure 5-2 Dual Core-Edge Topology for five and six chassis

Each of the SAN designs above has free *unused* ports available on the switch modules that can connect to other devices, such as stand-alone servers, disk arrays, tapes, and virtualization engines. Note that connecting greater that six BladeCenter chassis increases fabric complexity and should be considered with care.

5.2.2 Building medium-to-large SAN topologies using the Brocade 4Gb SAN switch modules

Brocade products are designed with large scalability capabilities. Although the FC specification allows up to 239 domains (for example, switches) in a single fabric without routing, the practical and proven limits are lower. Brocade continuously tests and supports ever increasing SAN fabrics. As of 2005, Brocade has certified SAN fabrics of 56 domains and much greater number using the Brocade Multi-protocol Router. Therefore, by installing a Brocade fabric initially, you ensure seamless scalability to thousands of devices.

For more than six BladeCenter chassis in a SAN, using external switches at the core greatly simplifies the topology and future scalability. Use redundant external switches to ensure full redundancy and highest availability. When all the ports of the core switch are used, then further scalability can be accomplished without downtime by swapping the core for a larger core switch or director. Figure 5-3 shows two IBM TotalStorage SAN256B 4Gb directors as cores for numerous BladeCenter chassis.

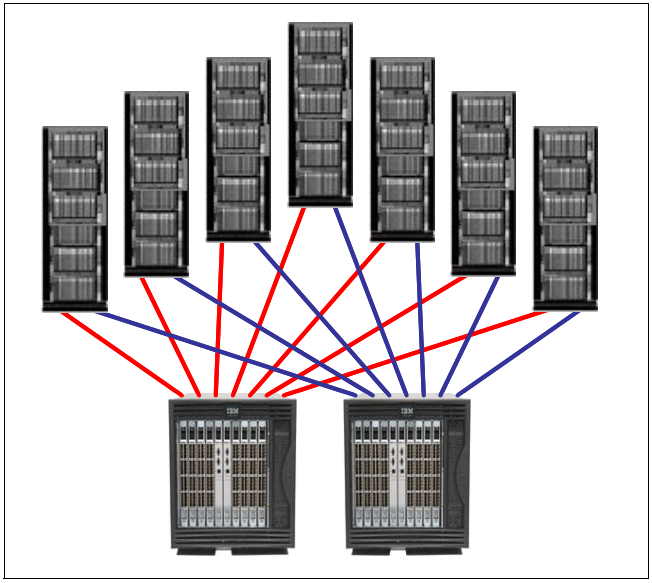

Figure 5-3 BladeCenter Chassis using two SAN256Bs

5.3 Brocade 4Gb SAN Switch Module configuration

Prior to completing the instructions in this section, please read Chapter 4, “IBM BladeCenter setup and configuration” on page 35 and complete the steps outlined there. Afterwards, return here to begin the implementation of your Brocade SAN environment. Figure 5-4 shows the SAN topology we used as our lab environment. It is assumed that LUN(s) have been created and assigned on the storage system prior to this SAN implementation.

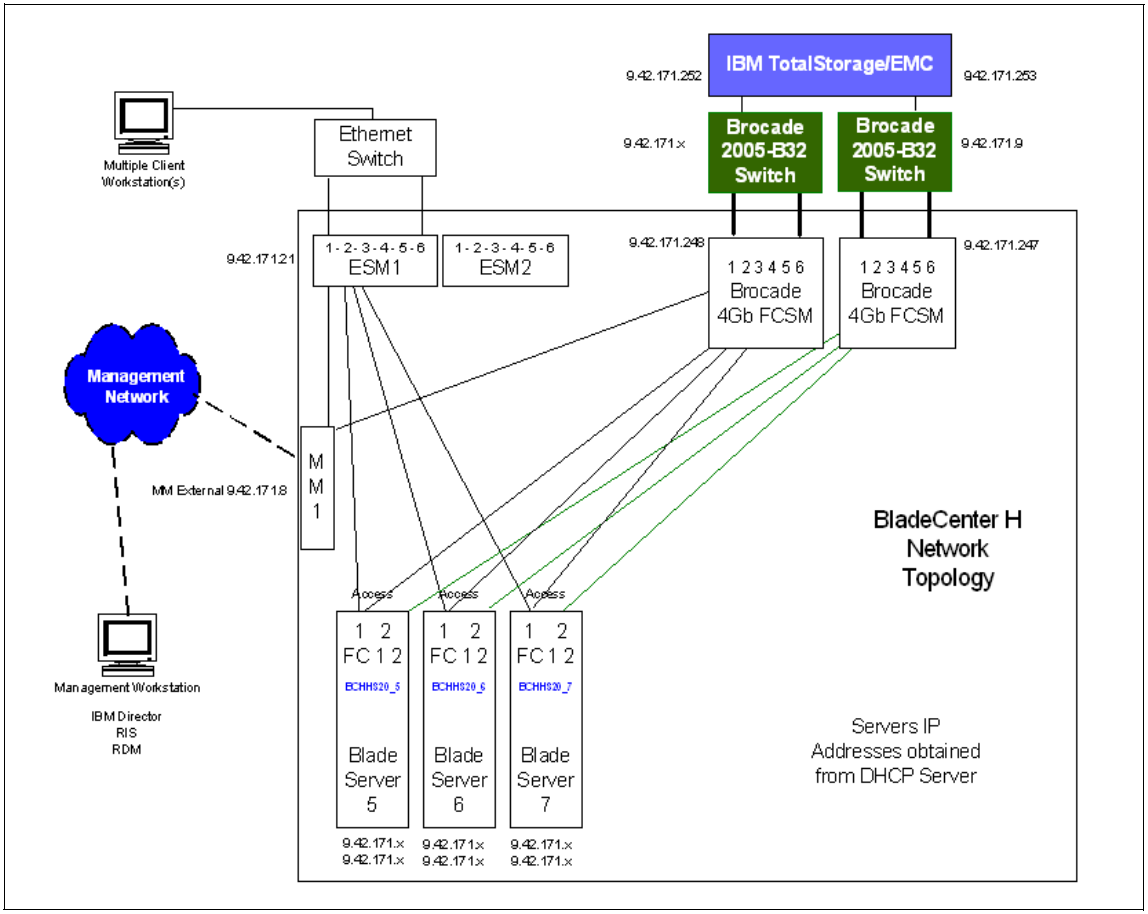

Figure 5-4 Brocade Fibre Channel SAN environment

5.3.1 Fabric OS requirements

At the time of its initial release, the Brocade 4Gb SAN Switch Module (SW4020) for IBM BladeCenter uses Fabric OS (FOS) Version 5.0.2 only. Attempts to load this software release on Brocade switches other than the Brocade 4Gb SAN Switch Module will result in `File Not Found` errors. Also, the SilkWorm 4020 is not supported by any previous versions of Brocade Fabric OS, including V5.0.1x. Attempts to load any release prior to Brocade Fabric OS V5.0.2 on a SilkWorm 4020 will result in `File Not Found` errors. Always check the IBM BladeCenter support site for the latest supported firmware for the switch module.

5.3.2 Launching Brocade Web tools for initial setup

As indicated previously, Web Tools management software can be launched from the Management Module or directly by using a browser and the switch's IP address. This section will describe how to set up the browser for best performance and launch Web Tools external to the Management Module.

Web Tools requires any browser that conforms to HTML Version 4.0, JavaScript™ Version 1.0, and Java™ Plug-in 1.4.2_06 or higher. You can launch Web Tools on any workstation with a compatible Web browser installed. Web Tools also supports the HTTPS protocol, if that protocol is enabled for the switch. For more information about enabling the HTTPS protocol on your switch, refer to the *Fabric OS v5.01 Administrator's Guide*.

1. Set browser for optimum performance.
   - The correct operation of Web Tools with Internet Explorer® requires specifying the appropriate settings for browser refresh frequency and process model. Browser pages should be refreshed frequently to ensure the correct operation of Web Tools.
   - To set the refresh frequency:
     i. Select **Tools** → **Internet Options** in the browser.
     ii. Click the **General** tab and click **Settings** (under Temporary Internet Files).
     iii. Click **Every visit to the page** under Check for newer versions of stored pages.
2. Begin your work by establishing a Web Tools session to your Brocade SSM (use the assigned IP address). To do so, follow the instructions listed below.

3. From the Internet Explorer (Windows) or Mozilla (Linux) browser, enter the IP address for your switch in the Address window box, then press the Enter key. You should see a Web Tools session open, similar to Figure 5-5. The Web Tools display for the SSM is somewhat different for external switches, since there are no Power Supply Fan buttons.

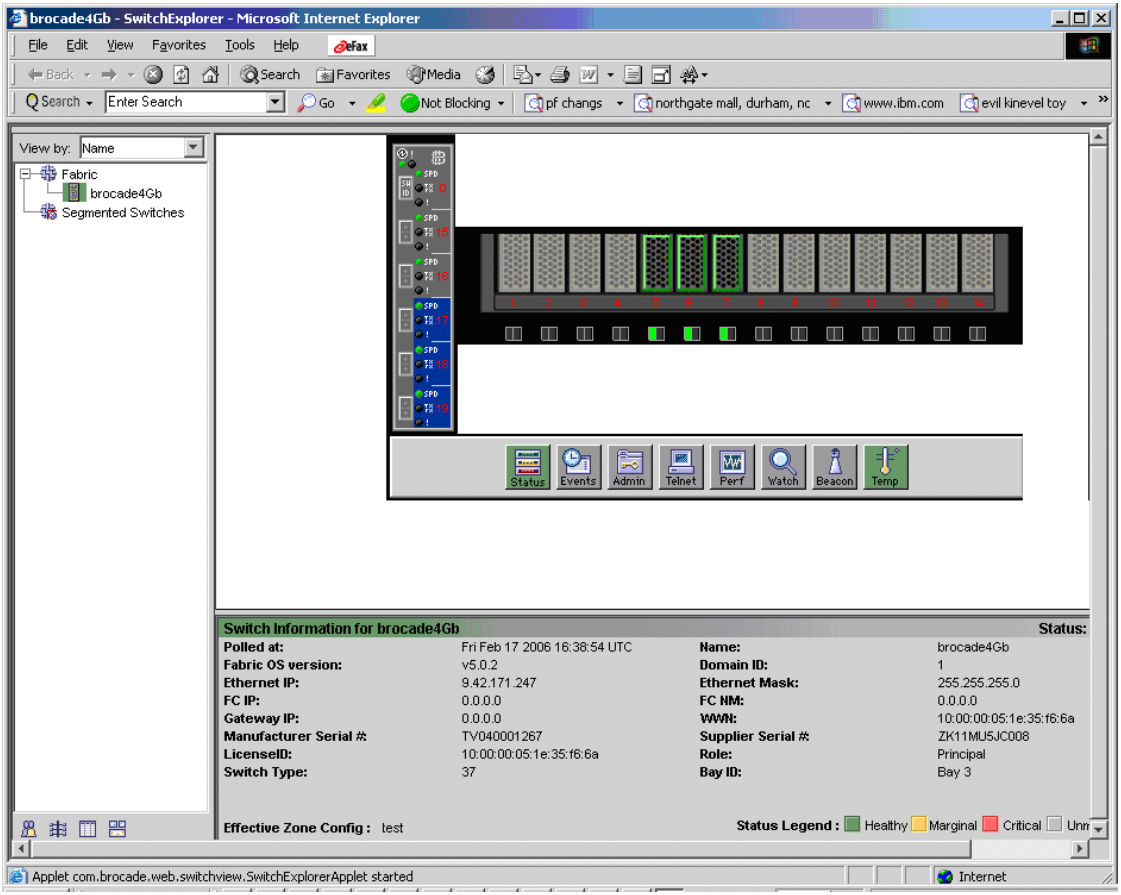

Figure 5-5 Web Tools for Brocade 4Gb SAN Switch Module

Figure 5-6 shows the different areas of Web Tools. Become familiar with the different areas to simplify your SAN administration.

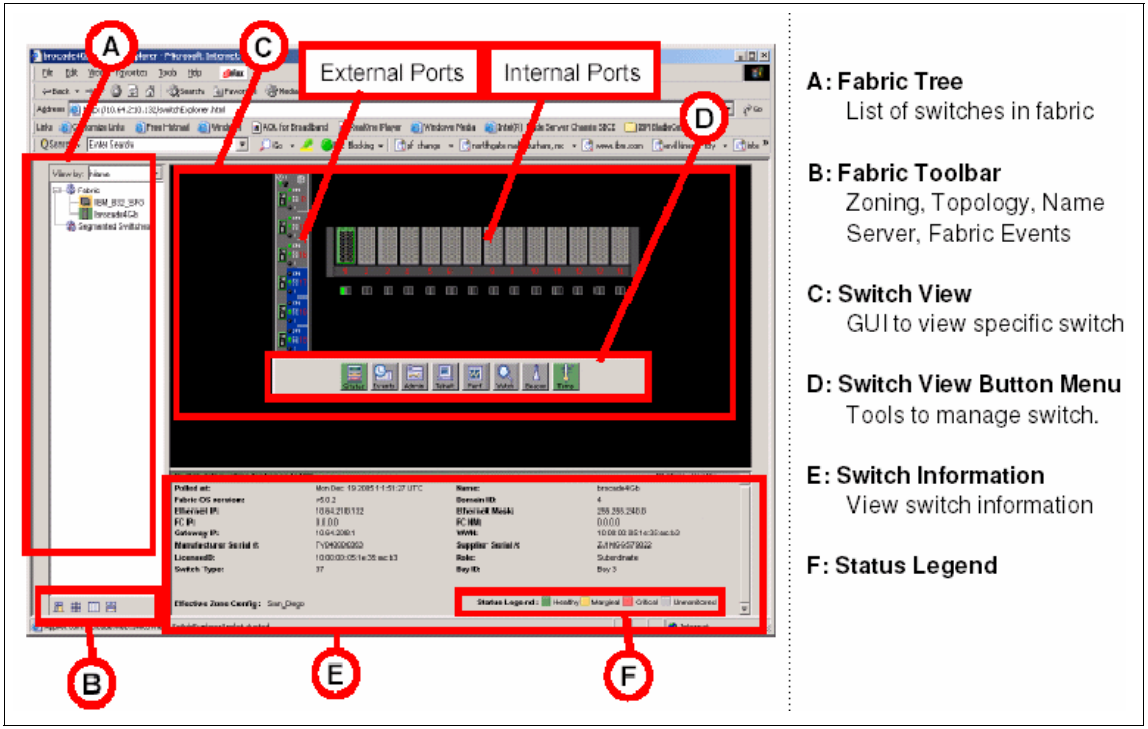

Figure 5-6 Brocade switch menu

4. From the Switch View Button Menu, click **Status** and verify that the switch module health is good (see Figure 5-7 on page 59).

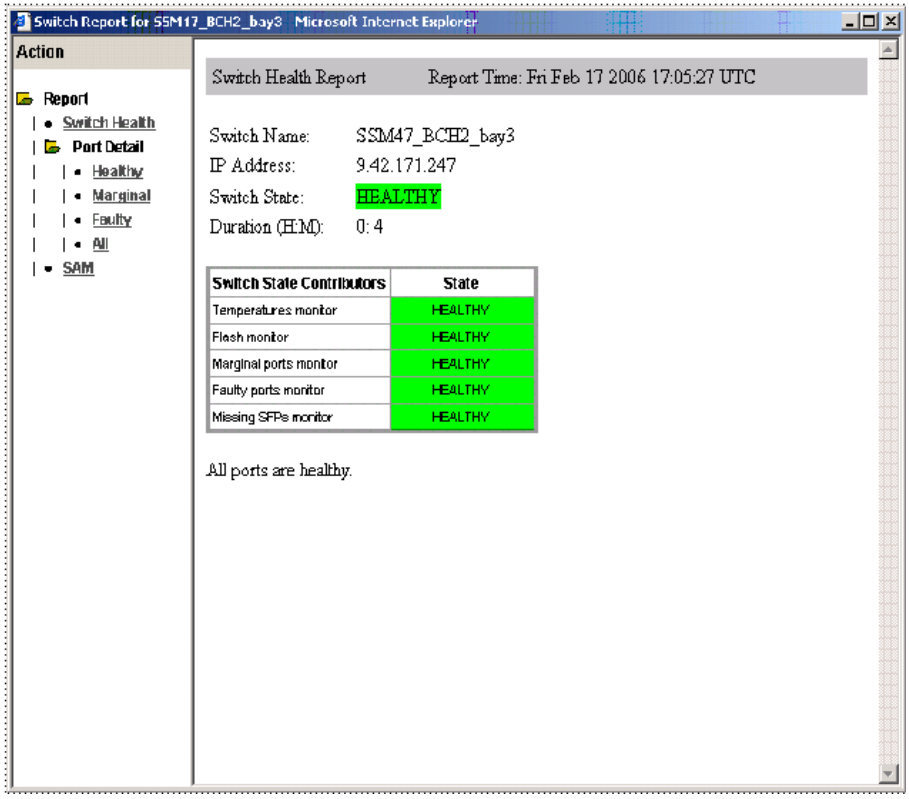

Figure 5-7 Switch Module Status Window

5. From the Switch View Button menu, select the **Admin** button. Log in to the switch using the following information:

   Login USERID

   Password PASSW0RD (note that 0 is a zero)

6. Set the Switch Status to **Disable**, as shown in Figure 5-8. You must disable a switch before changing Domain ID.

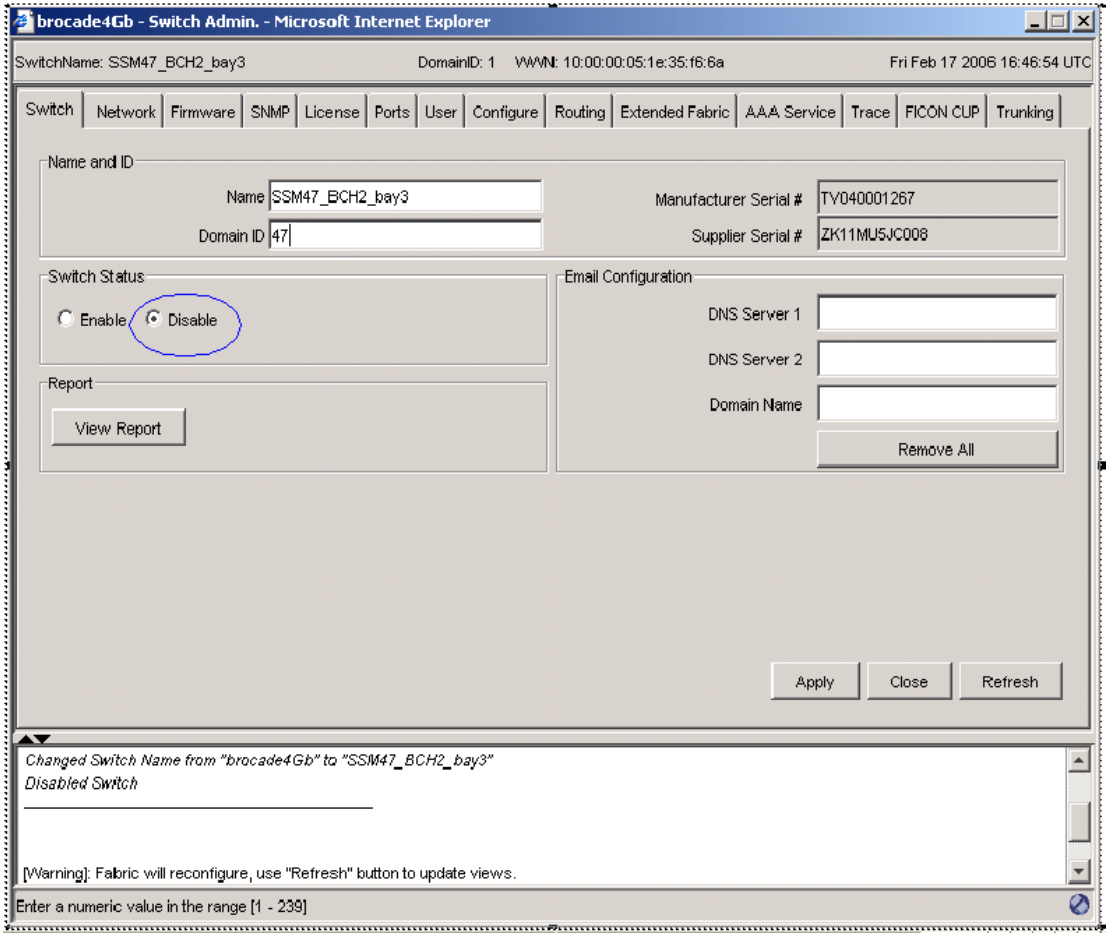

Figure 5-8 Admin window

7. Select the Domain ID of the switch.

   Guidelines for selecting Domain ID numbers:

   – Set unique domain numbers for each switch in the SAN. This allows for simpler merging of fabrics if needed in the future.

   – As a convention, consider setting the domain ID of each switch to the last octet of its IP address.

   – Be aware that the highest allowed domain number is 239.

– See Figure 5-9 as an example of both external switches and embedded switch modules.

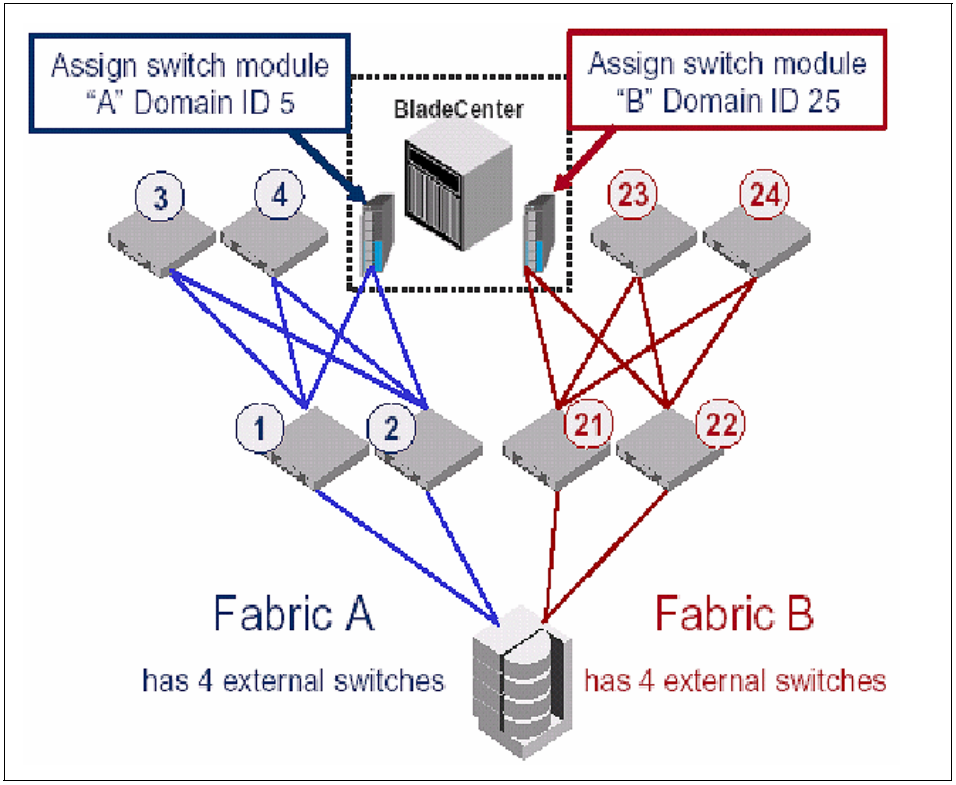

Figure 5-9 Selecting Domain ID numbers

8. Enter the selected number into the Domain ID field.
9. In this same window, set the switch's name to some unique and descriptive name. The switch name can include up to 15 characters, must begin with a letter, and must consist of letters, digits, and underscore characters, and no spaces. Setting the switch name is recommended to simplify locating switch module and fabric management. An example of a switch name is SSM47_BCH2_Bay3.

10. For new SAN installs, select the **Configure** tab (Figure 5-10) and verify that Switch PID Format is set to Format 1. Occasionally, when connecting to older external switches, you may need to change the Switch Port ID format. Refer to “Building the Brocade SAN fabric” on page 101 for more details.

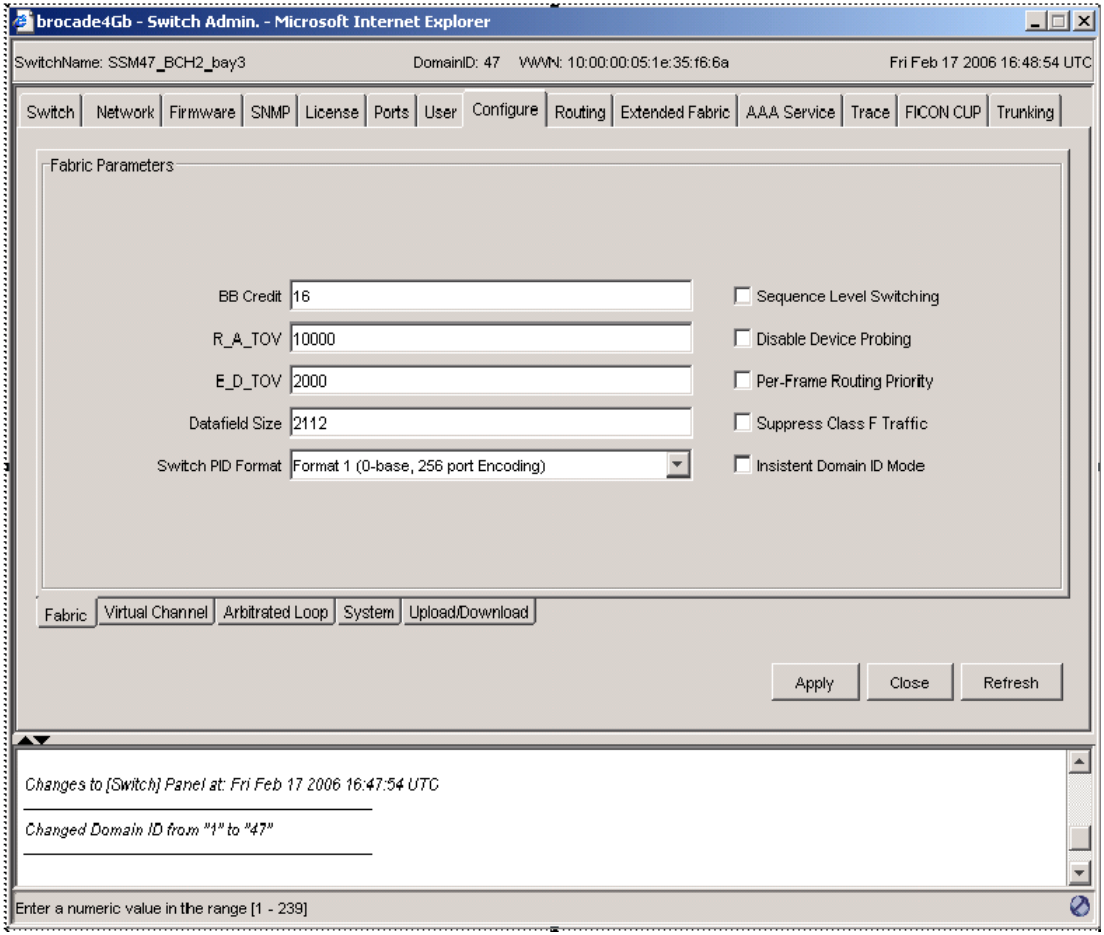

Figure 5-10 Verify Switch PID Format

Caution: Do not change the other configuration values unless instructed by your SAN supplier. They must match for every switch in the fabric and altering them may prevent the switch module from merging with other switches (called *segmentation*).

11. Set Switch Status to **Enable**. Click **Apply**.

12. Go to the Ports tab and ensure that the proper ports are licensed and have been enabled (see Figure 5-11).
    - For the 10-port module, ports 0-7, 15, and 16 should be both licensed and enabled.
    - For the 20-port module, all ports 0-19 are licensed and enabled.

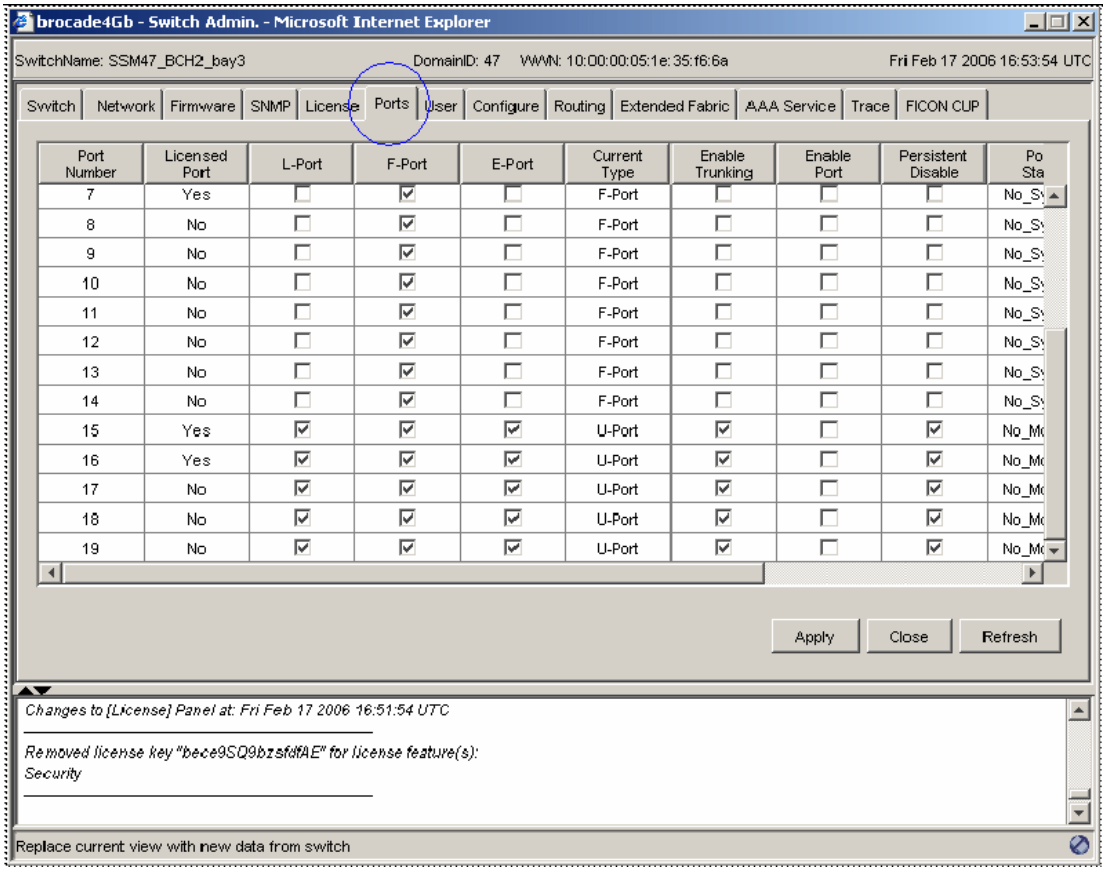

Figure 5-11 Brocade 4Gb Switch Admin window

13. Pay particular attention to the external port Enable Port setting. If the external ports 0, 15-19 are not enabled, then return to the Management Module GUI to enable them.

Note: If you enable/disable the externals the ports using Brocade Web Tools or CLI, then the ports will operate correctly until the next switch module reboot/power-cycle, while the external ports will default to the Management Module's setting. Therefore, it is important to enable/disable external ports using the BladeCenter Management Module.

14. Set the switch time and date using the command-line interface (CLI). Switches maintain the current date and time in flash memory and because the date and time are used for logging, you should set them correctly.
    a. From the Switch View Button Menu (Figure 5-6 on page 58), click the **Telnet** button.
    b. Log in as USERID with correct password.
    c. Enter the **`date`** command using this syntax:

       date *mmddHHMMyy*

       Where:

       mm: Month (01-12)

       dd: Day (01-31)

       HH: Hour (00-23)

       MM: Minute (00-59)

       yy: Year (00-99)

       For example:

       Brocade4Gb:USERID> **date**

       Fri Jan 29 17:01:48 UTC 2000

       Brocade4Gb:USERID > **date "0227123003"**

       Thu Feb 27 12:30:00 UTC 2003

       Brocade4Gb:USERID >

    d. Enter the **`tsTimeZone`** command to set the time zone using the syntax **`tsTimeZone [houroffset[,minuteoffset]]`**. The default time zone is Universal Time Conversion (UTC), which is eight hours ahead of Pacific Standard Time (PST). Determine your time zone offset. Below are some examples.
       - For Pacific Standard Time, enter **`tsTimeZone -8,0`**.
       - For Central Standard Time, enter **`tsTimeZone -6.0`**.
       - For Eastern Standard Time, enter **`tsTimeZone -5,0`**.

15. To synchronize your time with an external source such as an NTP server, enter the **tsclockserver** command using the syntax **tsclockserver *ipaddr***, where ipaddr is the IP address of the NTP server that the switch must be able to access.

Adding optional licenses to the Brocade Switch Module

This section shows you how to add optional licenses to the Brocade 4Gb SAN Switch Modules.

Brocade products in general offer several optional licensed features to improve performance, security, manageability, and availability. The Brocade 10 Port 4Gb SAN Switch Module for IBM BladeCenter (feature code 32R1813) is shipped with the following licenses:

- Advanced Web Tools (Web)
- Advanced Zoning (Zoning)
- Full Fabric License (Fabric)

The unlicensed ports can be activated by upgrading with a *10-Port (Ports-on-Demand) Upgrade* license (option 32R1822). This license may be purchased from your switch supplier.

The second Brocade 20 Port 4Gb SAN Switch Module for IBM BladeCenter (feature code 32R1812) is shipped with the following licenses:

- Advanced Web Tools (Web)
- Advanced Zoning (Zoning)
- Full Fabric License (Fabric)
- Full Ports on Demand license (additional 10 port upgrade)

The following software features are optional:

- Brocade Fabric Watch for IBM BladeCenter (option 32R1855)
- Brocade ISL Trunking for IBM BladeCenter (option 26K5607)
- Brocade Advanced Performance Monitoring for IBM BladeCenter (option 26K5612)
- Brocade Performance Bundle for IBM BladeCenter (includes ISL Trunking and Advanced Performance Monitoring) (option 26K5605)
- Brocade Extended Fabrics for IBM BladeCenter (option 26K5613)
- Brocade Advanced Security (Secure OS) for IBM BladeCenter (option 26K5617)

- Brocade Fabric Manager V5.x for IBM BladeCenter (stand-alone application, must be purchased separately)
- Brocade Fabric Watch for IBM BladeCenter (option 32R1855). See Figure 5-12 for optional software features.

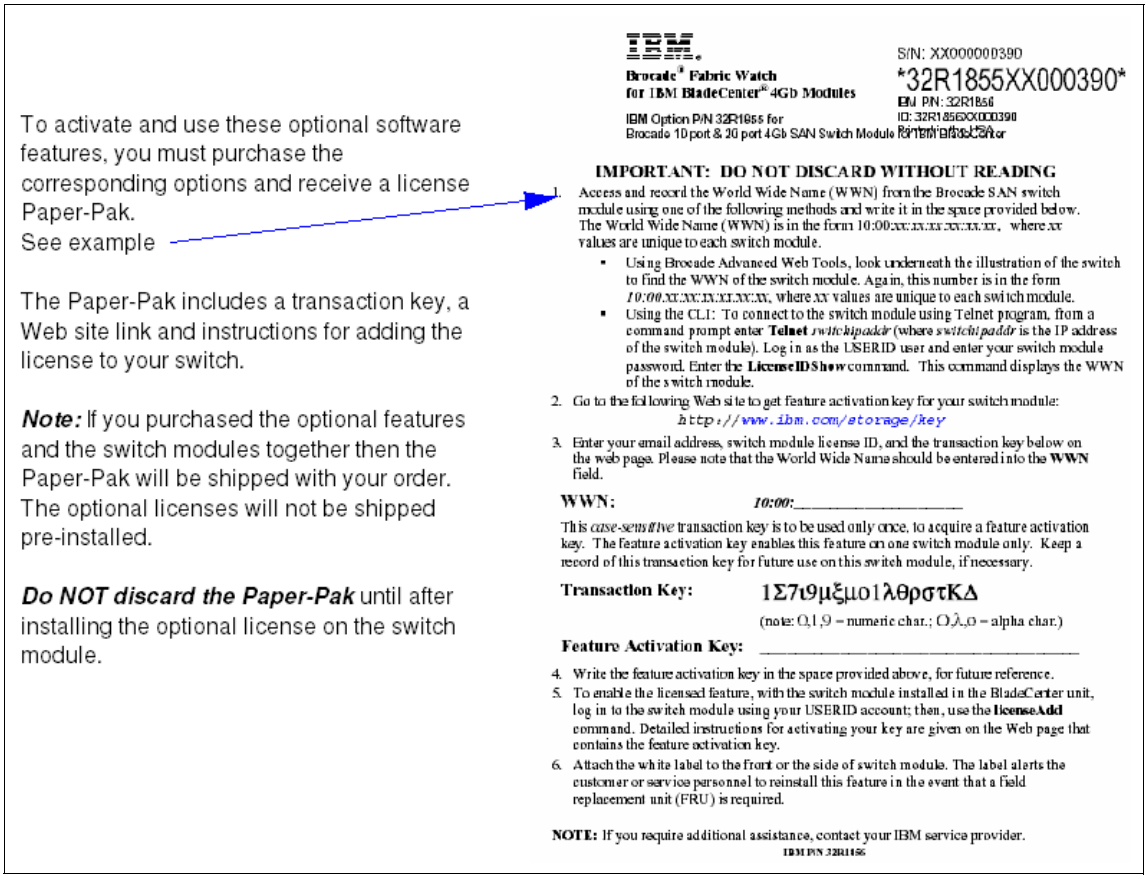

Figure 5-12 Option License Paper-Pak example

Do the following steps:

1. Access and record the LicenseID (same as the World Wide Name WWN) from the Brocade SAN switch module. The LicenseID is in the form 10:00:xx:xx:xx:xx:xx:xx, where xx values are unique to each switch module.
2. Using Brocade Advanced Web Tools, look underneath the illustration of the switch to find the LicenseID of the switch module (see Figure 5-13 on page 67).

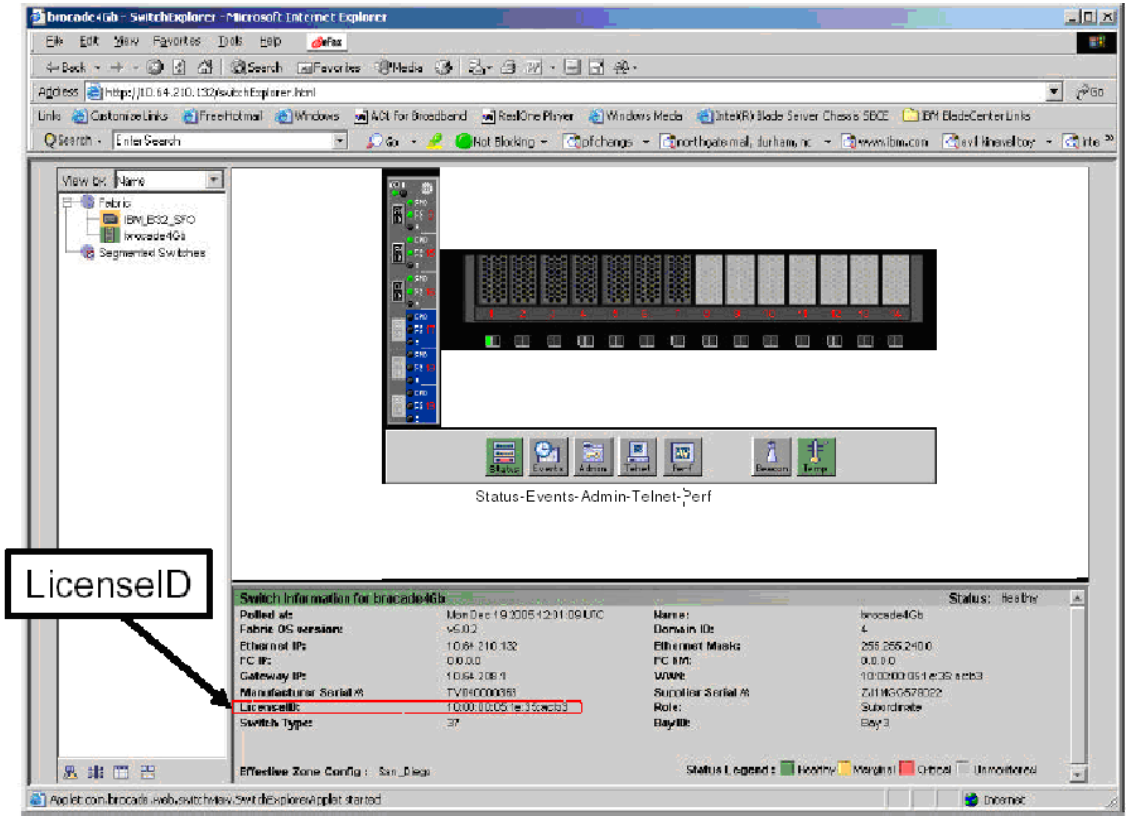

Figure 5-13 Locating License ID

3. Go to the following Web site to get feature activation key for your switch module:

   `http://www.ibm.com/storage/key`

4. Enter your e-mail address, switch module license ID, and the transaction key on the Web page shown in Figure 5-14. Please note that the LicenseID should be entered into the WWN field.

Figure 5-14 IBM License Key activation window

5. After submitting your information, the Web site will provide you a feature activation key and send you an e-mail with the information. Write the feature activation key in the space provided on your Paper-Pak for future reference.

6. Use Web Tools to enable the licensed feature. Under the Switch Admin Window (Figure 5-15), select the **License** tab and use the **Add** button to add the License Keys.

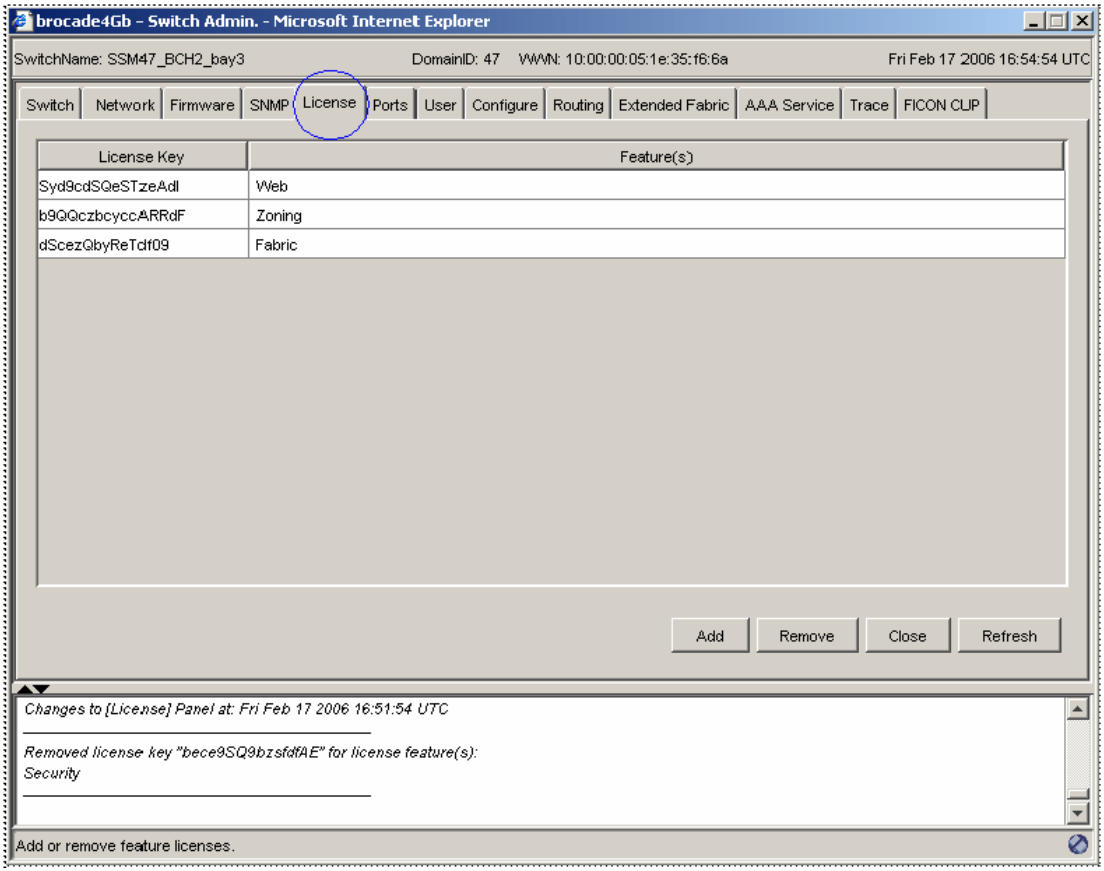

Figure 5-15 License management window

7. The Add License dialog box appears (Figure 5-16), and you should type or paste the Feature Activation License Key in the field. Next, click **Add License**.

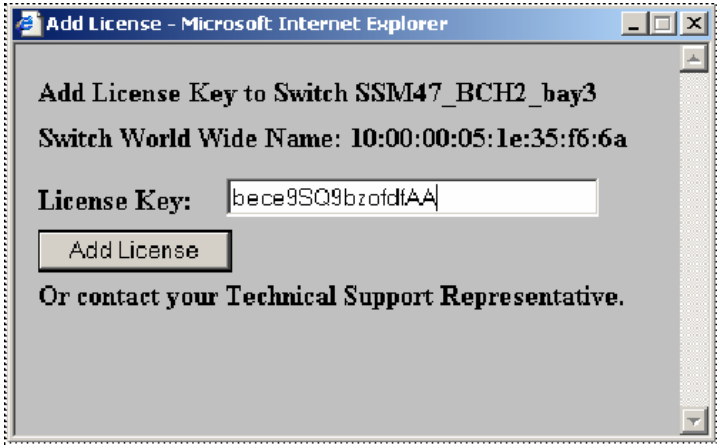

Figure 5-16 Add License dialog window

8. You will receive a confirmation dialog box (Figure 5-17). Click the appropriate option to either add more licenses or close the window.

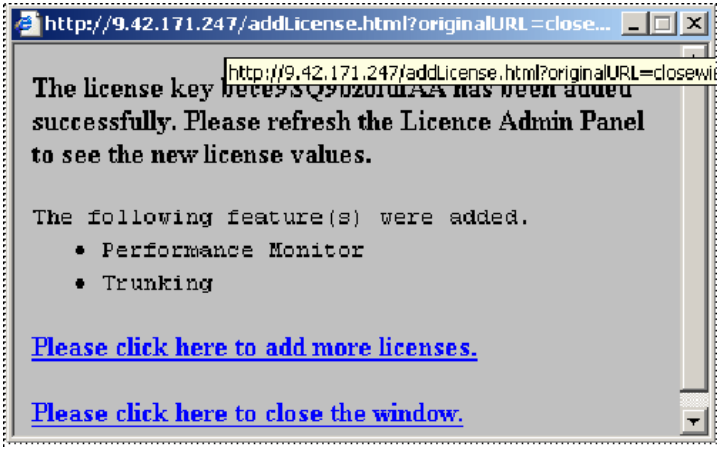

Figure 5-17 License Addition Confirmation window

9. Click **Refresh** (Figure 5-18 on page 71) and verify that all new Licenses have been added to the Feature List.

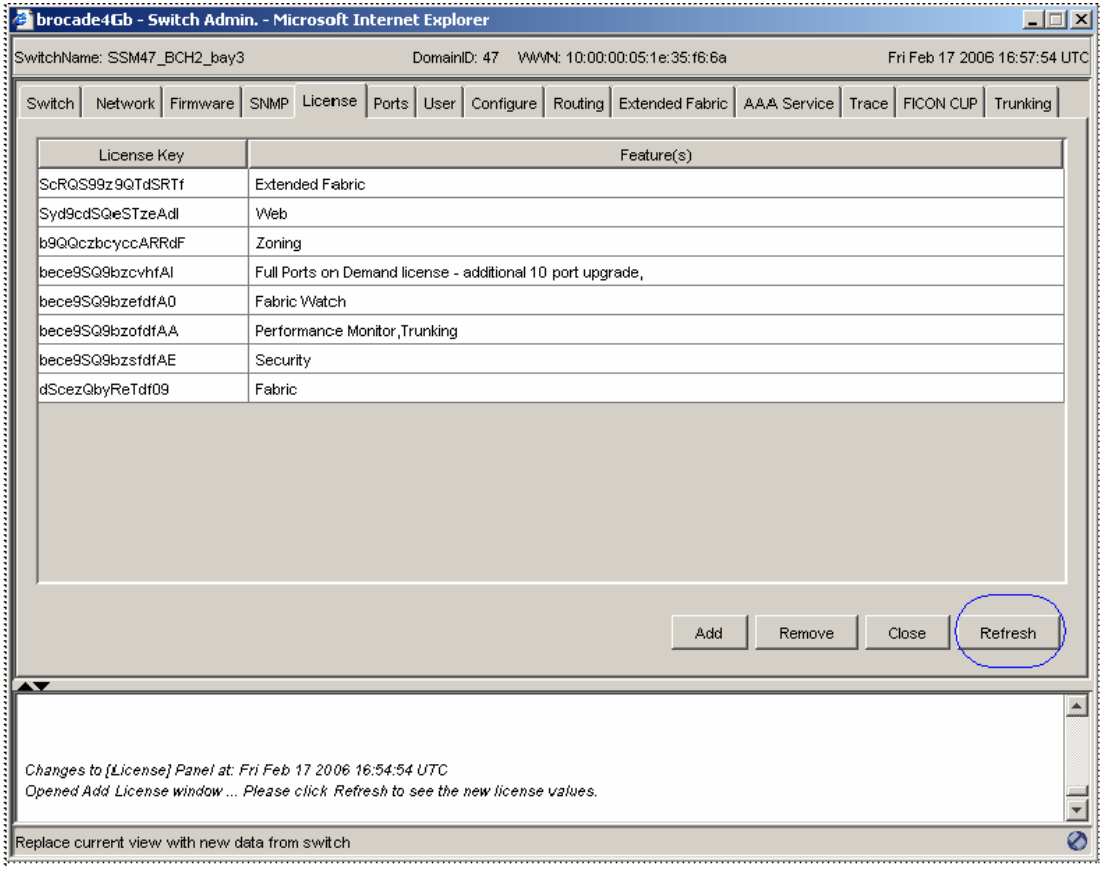

Figure 5-18 Confirm all licenses have been added

10. If installing the 10-Port (Ports-on-Demand) Upgrade license (option 32R1822) onto the 10-Port switch module, then you must take additional steps to enable the newly added ports.

    a. Verify that the Management Module Advanced IO setting for the External Ports is set to Enable.

b. Go to Brocade Web Tools and the Ports tab (Figure 5-19) under Admin.

c. Ports 8-14, 16-19 will not be enabled. Check all boxes under the Enable Port column for each new port that you wish to enable.

d. Click **Apply**.

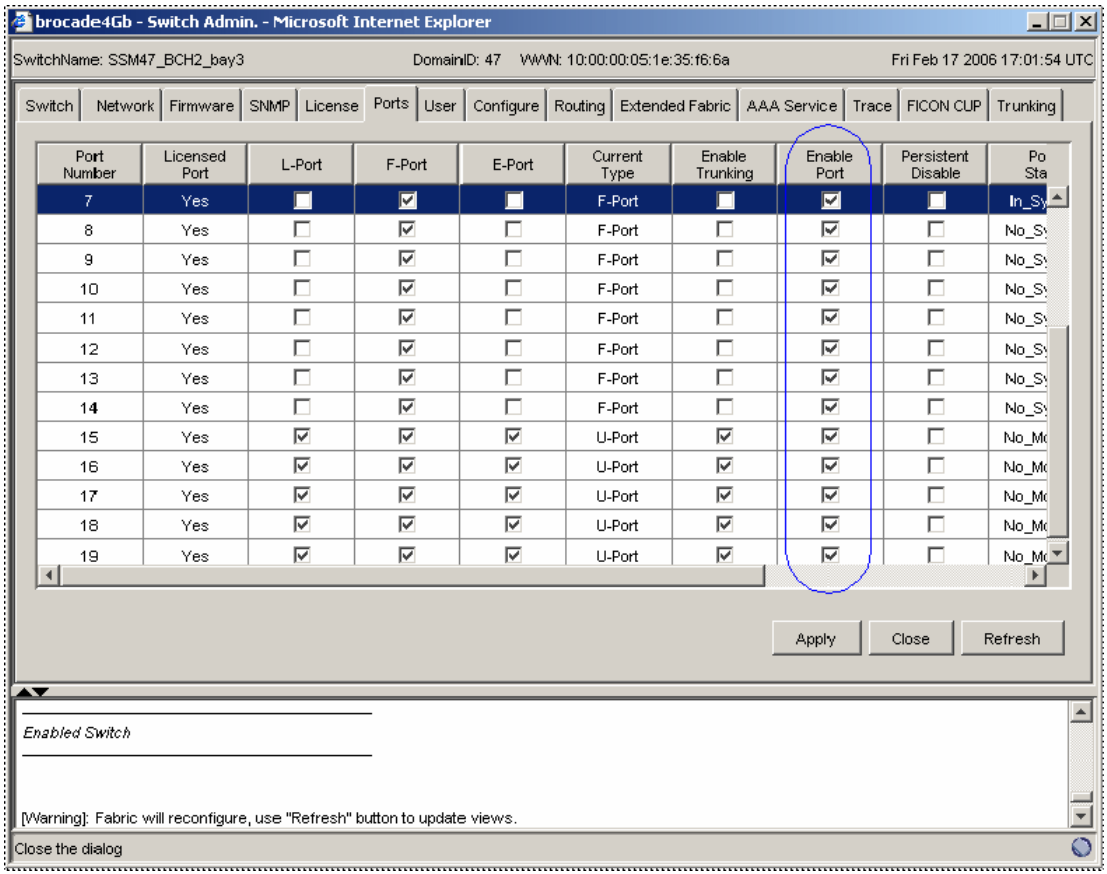

Figure 5-19 Enabling newly added Ports

Important: You should securely store the LicenseID and all the License Keys for every switch. This information helps recover licenses if licenses are accidentally removed. Also, you or service personnel will need the licenses to reinstall these features in the event that a field replacement unit (FRU) SHNS1C44 is required.

Below are the best practices for storing license information.

a. Keep hard copies of licenses and store them securely:
   i. Writing License Activation Keys on the original Paper-Pak forms.
   ii. Printing a screen capture of the licenses from Web Tools.
   iii. Telnet into the switch module and issue the **licenseShow** command and then print the results.
   iv. Remove the white labels from the Paper-Paks and add to the front or side of the switch module. Adding labels to the side of switch module requires a power down and should be performed before going into production.
   v. Print a copy of the switch configDownload file.

vi. Keep softcopy files of licenses and other critical switch information by using the configUpload/Download function found in the Configure tab (Figure 5-20). The configUpload option will save (upload) the switch information and settings to a config file on a server. The uconfigDownload option will restore (download) a previously save config file onto the switch module. Note that Figure 5-20 shows configDownload selected. To perform a configUpload, select the configUpload option.

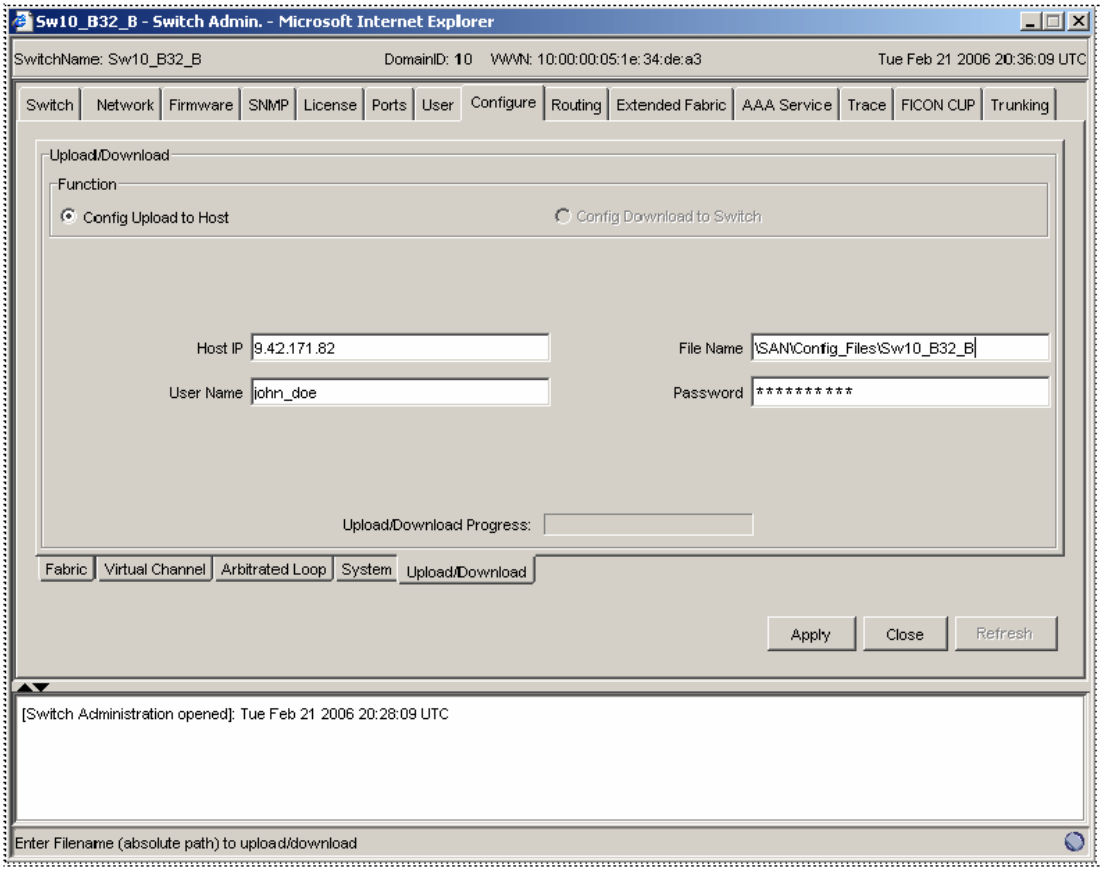

Figure 5-20 Perform Config Upload of switch information

Clear zone database

Zoning is a feature of FC switches that allow the SAN administrator to control device connectivity using zones (small private SAN groups). A single SAN fabric may contain none to many zones. Multiple zones may be grouped into a zone configuration (or zone config). Brocade switches allow multiple zone config

groups to be defined, but only one zone config group may be active within that SAN fabric.

Switches that have conflicting active zone configs or definitions will not merge to become one fabric. The switch modules are shipped with no zone definitions. However, if the switch module was used in a pre-production or lab SAN environment, then often there are zone definitions on the switch modules. Therefore, it is important to clear all zone data from switches before adding them to an existing SAN fabric.

1. Ensure that the switch module is not connected to any other switch. Otherwise, you may accidentally clear zone configuration for the entire fabric.
2. Open Web Tools and launch the Zone Administration module. Click the **Zoning** icon located in the Fabric Toolbar in the lower left corner of Web Tools window. You may need to log in to the switch if you are not already logged in.
3. Select **Actions** → **Clear All**.
4. The Disable Config warning displays. Click **Yes** to do all of the following:
   a. Disable the current configuration.
   b. Clear the entire contents of the current Web Tools Zone Admin buffer.
   c. Delete the entire persistent contents of the fabric zoning database.

Note: This action is not recoverable.

Brocade SAN Switch Module setup is complete

Repeat the setup process for all switch modules. For this solution, there are two switch modules in one BladeCenter chassis. Each switch module will connect to an external TotalStorage SAN32B-2 4Gb switch to provide full path redundancy.

Next, set up the external SAN32B, as described in 5.4, “IBM TotalStorage SAN32B-2 Switch setup and configuration” on page 76.

5.4 IBM TotalStorage SAN32B-2 Switch setup and configuration

In this section, we discuss the configuration of the external switch used in our lab environment. The switch is the IBM TotalStorage SAN32B-2 Switch, shown in Figure 5-21.

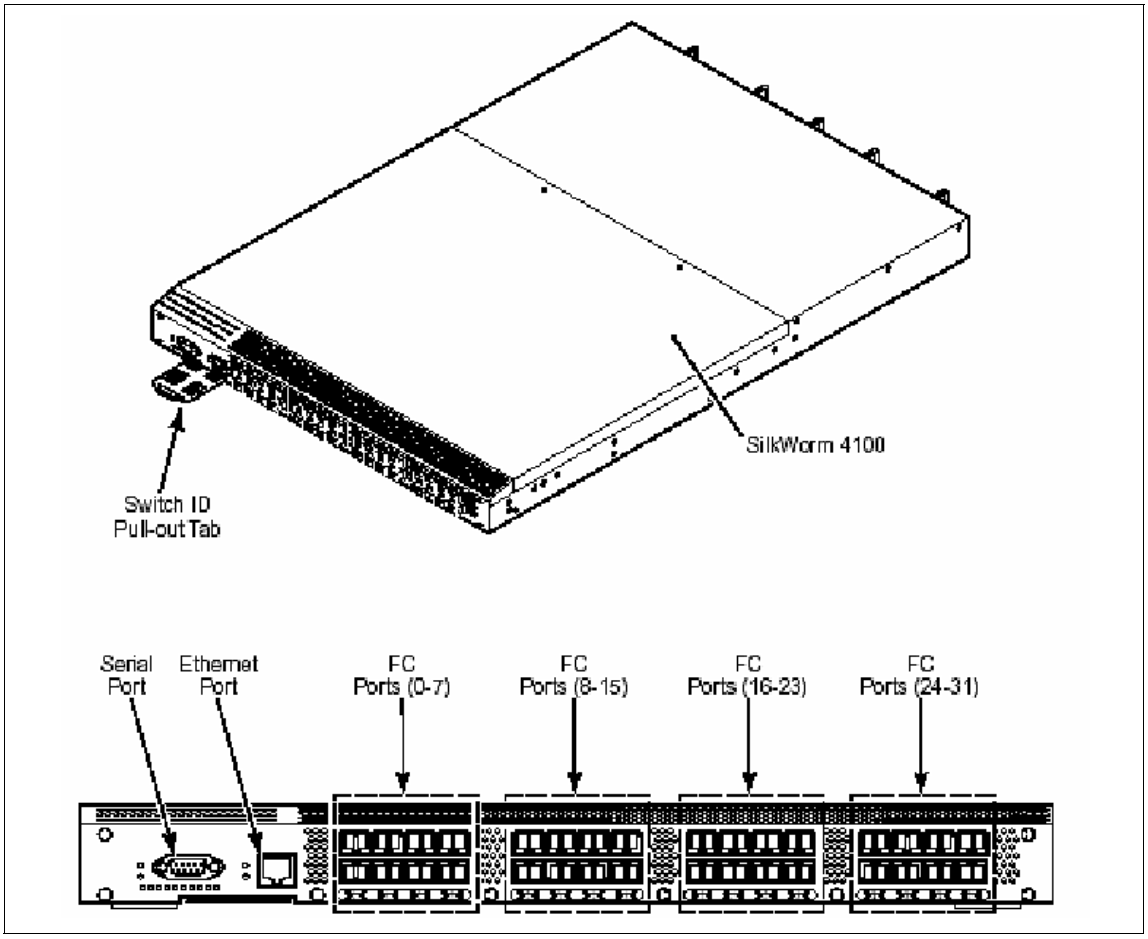

Figure 5-21 IBM TotalStorage SAN32B-2 Switch

5.4.1 Installing the SAN32B-2 in an EIA cabinet

Refer to the Fixed Rack Mount Kit Installation Procedure that shipped with your unit for instructions on installing the SilkWorm 4100 in a fixed rack.

5.4.2 Configuring the SAN32B-2

The SAN32B-2 must be configured correctly before it can operate within a network and fabric. The following items are required for configuring and connecting the switch for use in a network and fabric:

- The switch connected to a power source
- A workstation computer that has a terminal emulator application (such as HyperTerminal for Windows)
- An unused IP address and corresponding subnet mask and gateway address
- The serial cable provided with the switch
- An Ethernet cable
- SFP transceivers and compatible fibre cables, as required
- Access to an FTP server, for backing up the switch configuration

To configure the TotalStorage SAN32B-2, you must perform the following tasks:

1. “Providing power to the switch” on page 78
2. “Creating a serial connection” on page 78
3. “Connecting to the switch using the serial connection” on page 79
4. “Setting the switch IP address” on page 79
5. “Setting the SAN32B as the principal switch (optional)” on page 80
6. “Setting the time and date (optional)” on page 80
7. “Creating an Ethernet connection” on page 81
8. “Launching Brocade Web tools” on page 81
9. “Configuring SAN32B” on page 83
10. “Installing optional Feature Licenses” on page 85
11. “Clearing the zone database” on page 92
12. “Building a dummy zone (optional)” on page 93

Caution: Do not connect the switch to the network until the IP address is correctly set. For instructions on how to set the IP address, see “Setting the switch IP address” on page 79.

Providing power to the switch

To provide electrical power to the SAN32B-2, perform the following:

1. Connect the power cords to both power supplies and then to power sources on separate circuits to protect against AC failure. Ensure that the cords have a minimum service loop of six inches available and are routed to avoid stress.
2. Power on the power supplies by flipping both AC switches to 1. The power supply LED lights up green, and the switch begins running POST. The switch requires a minimum of three minutes to boot and complete POST.
3. After POST is complete, verify that the switch power and status LEDs on the left of the port side of the switch are green.

Note: Power is supplied to the switch as soon as the first power supply is connected and turned on.

Creating a serial connection

To create a serial connection to the SAN32B-2, perform the following:

1. Remove the plug from the serial port and insert the serial cable provided with the SAN32B-2.
2. Connect the serial cable to the serial port on the switch and to an RS-232 serial port on the workstation. If the serial port on the workstation is RJ-45 instead of RS-232, you can remove the adapter on the end of the serial cable and insert the exposed RJ-45 connector into the RJ-45 serial port on the workstation.
3. Disable any serial communication programs running on the workstation.
4. Open a terminal emulator application (such as HyperTerminal for Windows or TERM in a UNIX® environment) and configure the application as follows:
   - In a Windows 95, 98, 2000, or NT environment:
     - Bits per second: 9600
     - Data bits: 8
     - Parity: None
     - Stop bits: 1
     - Flow control: None
     - In a UNIX environment, enter the following string at the prompt:

       ```
       tip /dev/ttyyb -9600
       ```

Connecting to the switch using the serial connection

To log in to the switch through the serial connection:

1. Verify that the switch has completed POST. When POST is complete, the port status and switch power and status LEDs return to a standard healthy state; for information about LED signals, refer to the *SAN32B-2 Users Guide*.
2. When the terminal emulator application stops reporting information, press Enter to display the login prompt.
3. Log into the switch (Example 5-1) using admin with password password. You will be prompted to change all the default passwords, or you can hit Ctrl-C and escape to a prompt. If you do change the passwords, then please record the changes and store securely. Recovering lost passwords may be disruptive to operations.

Example 5-1 Serial connection login

```
Fabric OS (IBM_2005_B32)

IBM_2005_B32 console login: admin
Password:********
Please change your passwords now.
Use Control-C to exit or press 'Enter' key to proceed.

Password was not changed. Will prompt again at next login
until password is changed.
IBM_2005_B32:admin>
```

Setting the switch IP address

To replace the default IP address and related information:

1. Enter the **ipAddrSet** command (Example 5-2) at the terminal emulator application prompt, and enter the requested information at the prompts.

Example 5-2 ipAddrSet command

```
IBM_2005_B32:admin> ipaddrset
Ethernet IP Address [9.42.17.9]: 9.42.171.9
Ethernet Subnetmask [255.255.255.0]:
Fibre Channel IP Address [0.0.0.0]:
Fibre Channel Subnetmask [0.0.0.0]:
Gateway IP Address [9.42.171.3]:
Issuing gratuitous ARP...Done.
2006/02/17-15:12:03, [WEBD-1007], 1,, INFO, IBM_2005_B32, HTTP server will be
re
started due to change of IP Address
IP address is being changed...Done.
Committing configuration...Done.
```

```
IBM_2005_B32:admin>
```

2. Optionally, verify that the address was correctly set by typing the **ipAddrShow** command at the prompt.
3. Record the IP address on the pull out tab (see Figure 5-21 on page 76) provided for this purpose on the port side of the SAN32B-2.

Setting the SAN32B as the principal switch (optional)

When the SAN32B is used as the core switch for connecting multiple BladeCenter chassis and other external switches then an optional step is to set the SAN32B (or other core switch) as the *principal* switch. There is always one principal switch in a FC fabric and its primary responsibility is to manage domains IDs and rebuild the fabric when necessary. Typically, either the switch that is first powered up or (in the case where all switches are powered simultaneously) the switch with the lowest WWN will become the principal switch. Another best practice is to perform all fabric management activity (for example, zoning, and security changes when using the Advanced Secure option) from the core switch regardless if the core switch is principal one.

While logged into the SAN32B using the serial port, use the **fabricPrincipal** command (Example 5-3) to set the principal switch selection mode.

Example 5-3 fabricPrincipal command

```
IBM_2005_B32:admin> fabricprincipal 1
Principal Selection Mode enabled
IBM_2005_B32A:admin>
```

Setting the time and date (optional)

Set the switch time and date using the command-line interface (CLI). Switches maintain the current date and time in flash memory and because the date and time are used for logging, you should set them correctly.

1. Enter the **date** command using this syntax:

   ```
   date "mmddHHMMyy"
   ```

   Where:

   – mm: Month (01-12)
   – dd: Day (01-31)
   – HH: Hour (00-23)
   – MM: Minute (00-59)
   – yy: Year (00-99)

An example is shown in Example 5-4.

Example 5-4 date syntax

```
IBM_2005_B32:USERID> date
Fri Jan 29 17:01:48 UTC 2000
Brocade4Gb:USERID > date "0227123003"
Thu Feb 27 12:30:00 UTC 2003
IBM_2005_B32:USERID >
```

2. Enter the **tsTimeZone** command to set the time zone using the syntax **tsTimeZone [houroffset[,minuteoffset]]**. The default time zone is Universal Time Conversion (UTC), which is 8 hours ahead of Pacific Standard Time (PST)
   - For Pacific Standard Time, enter **tsTimeZone -8,0**.
   - For Central Standard Time, enter **tsTimeZone -6.0**.
   - For Eastern Standard Time, enter **tsTimeZone -5,0**.
3. To synchronize time with an external source such as an NTP server:
   - Enter the **tsclockserver** command with the syntax **tsclockserver *ipaddr***, where ipaddr is the IP address of the NTP server that the switch must be able to access.
4. The serial port is no longer required. Log out of the serial console, remove the serial cable, and replace the plug in the serial port.

Creating an Ethernet connection

To create an Ethernet connection to the SAN32B:

1. Remove the plug from the Ethernet port.
2. Connect an Ethernet cable to the switch Ethernet port and to the workstation or to an Ethernet network containing the workstation.

Note: At this point, the switch can be accessed remotely, by command line, or by Brocade Advanced Web Tools. Ensure that the switch is not being modified from any other connections during the remaining tasks.

Launching Brocade Web tools

Web Tools requires any browser that conforms to HTML Version 4.0, JavaScript Version 1.0, and Java Plug-in 1.4.2_06 or higher. You can launch Web Tools on any workstation with a compatible Web browser installed. Web Tools also supports the HTTPS protocol, if that protocol is enabled for the switch. For more information about enabling the HTTPS protocol on your switch, refer to the *Fabric OS Administrator's Guide v5.0.1*.

1. Set the browser for optimum performance.
   - Correct operation of Web Tools with Internet Explorer requires specifying the appropriate settings for browser refresh frequency and process model. Browser pages should be refreshed frequently to ensure the correct operation of Web Tools.
   - To set the refresh frequency:
     i. Select **Tools** → **Internet Options** in the browser.
     ii. Click **General** tab and click **Settings** (under Temporary Internet Files).
     iii. Click **Every visit to the page** under Check for newer versions of stored pages.
2. From Internet Explorer (Windows) or Mozilla (Linux) browser, enter the IP address for your switch in the Address window box, then press the Enter key. You should see a Web Tools session open that is similar to Figure 5-22.

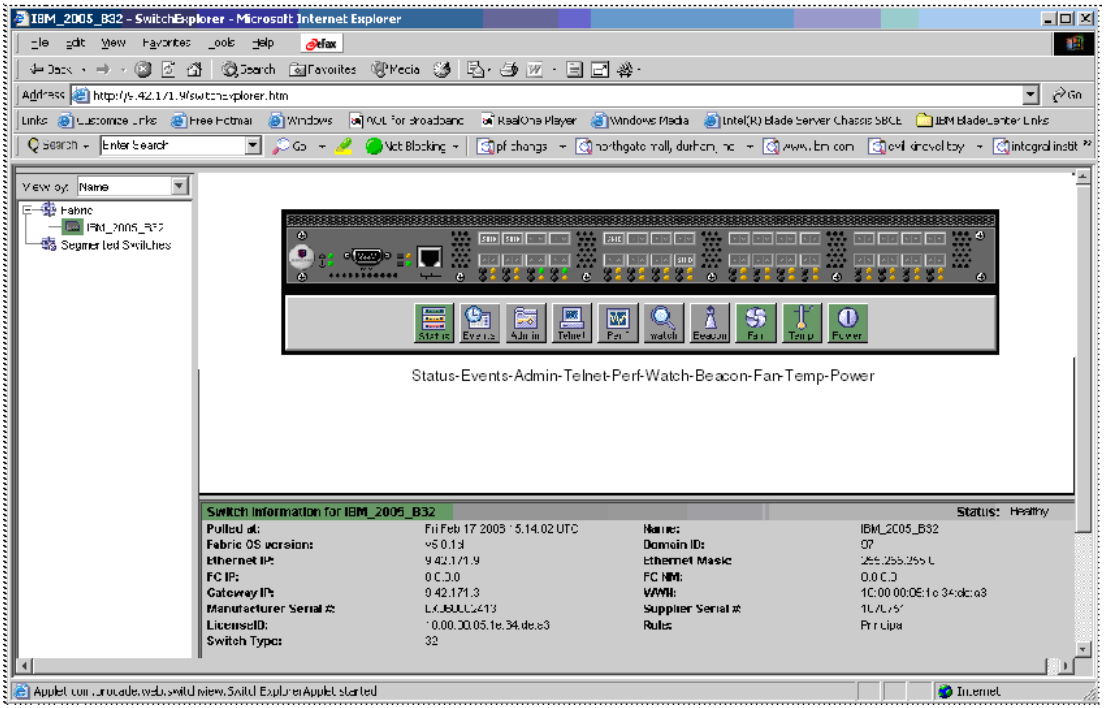

Figure 5-22 Web Tools initial window

Configuring SAN32B

The default domain ID for every switch is 1. All Domain IDs in a FC fabric must be different and range from 1-239. One naming convention is to use the last three digits of the switch's IP address as the domain ID (assuming the address is less that 239).

1. from the Switch View Button menu, select the **Admin** button. Log in to the switch using the following information:

   Login admin

   Password password

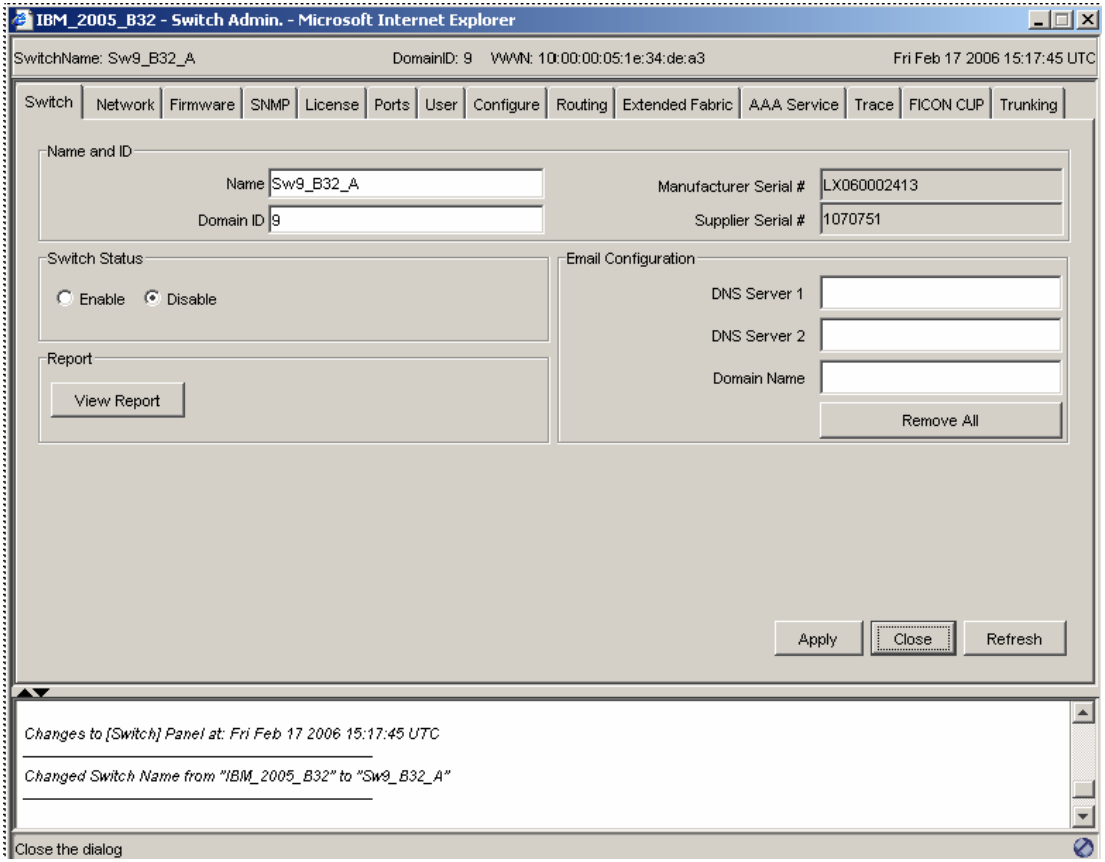

Figure 5-23 Setting Domain ID and Switch Name

2. Set Switch Status to **Disable** (Figure 5-23). You must disable a switch before changing the Domain ID.
3. Select the Domain ID of the switch.

Guidelines for selecting Domain ID Numbers:

- Set unique domain numbers for each switch in the SAN. This allows for simpler merging of fabrics if needed in the future.
- As a convention, consider setting the domain ID of each switch to the last octet of its IP address.
- Be aware that the highest allowed domain number is 239.
- See Figure 5-24 as an example of both external switches and embedded switch modules.

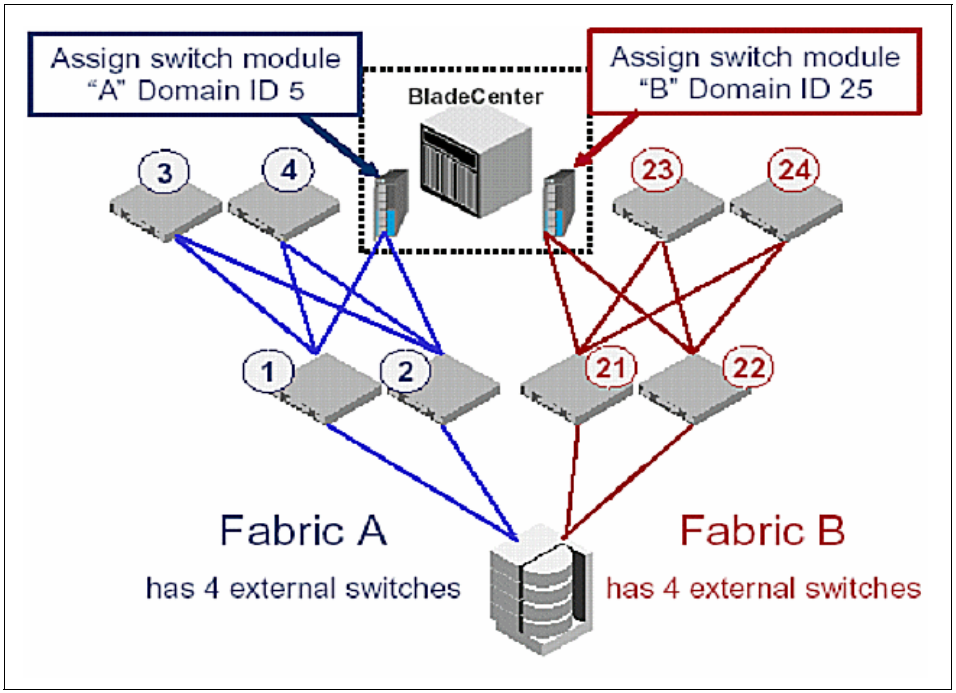

Figure 5-24 Selecting Domain ID numbers

4. Enter this new Domain ID into the Domain ID field.
5. Set the switch's name to some unique and descriptive name. The switch name will display in fabric views and event logs and simplify management. The name can include up to 15 characters, must begin with a letter, and must consist of letters, digits, and underscore characters, and no spaces. Setting the switch name is recommended to simplify locating switch module and fabric management. For example, the switch name Sw9_B32_A indicates Switch Domain 9 is a B32 in Fabric A.

6. Go to the Configure tab (Figure 5-25) and ensure that the Switch PID Format field is set to Format 1. Switch PID is the default setting for all Brocade products and is recommended for all new SAN installs. All switches in the SAN fabric must use the same Switch PID format. If the SAN32B is being connected to an existing SAN Fabric that is not using Switch PID 1, then see “Building the Brocade SAN fabric” on page 101".

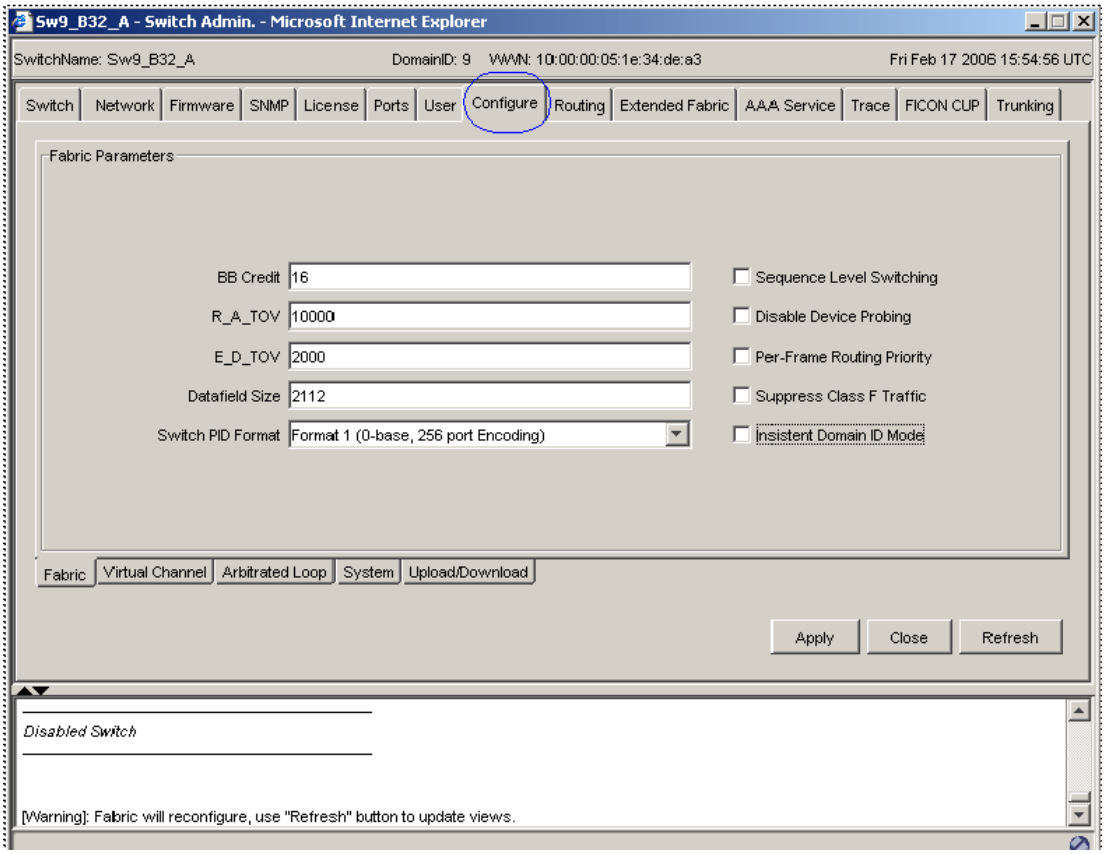

Figure 5-25 Verifying Switch PID Format window

7. Return to the Switch tab and set Switch Status to **Enable**. Click **Apply**.

Installing optional Feature Licenses

Install any additional Feature Licenses, if necessary. For the SAN32B the optional licensed features include Extended Fabrics, ISL Trunking, Advanced Performance Monitoring, Advanced SAN Security, and CUP (used for Mainframe environments only).

1. Access and record the LicenseID (Figure 5-26) (same as the World Wide Name (WWN) from the Brocade SAN32B switch module). The LicenseID is in the form 10:00:xx:xx:xx:xx:xx:xx, where xx values are unique to each switch module.

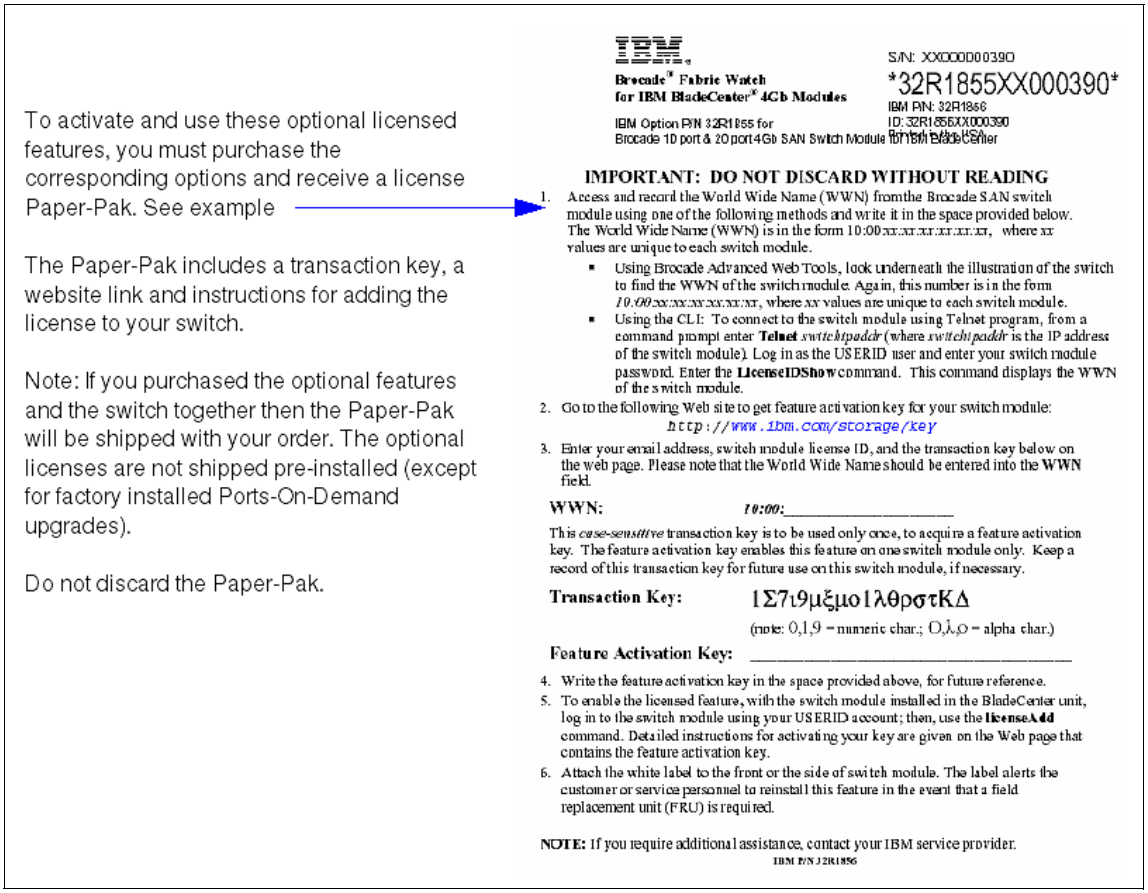

Figure 5-26 Option License Paper-Pak example

2. Using Brocade Advanced Web Tools, look in the switch information window to find the LicenseID (see Figure 5-22 on page 82).
3. Go to the following Web site to get feature activation key for your switch module:

   http://www.ibm.com/storage/key

   a. Enter your e-mail address, switch module license ID, and the transaction key below on the Web page. Please note that the LicenseID should be entered into the WWN field.

b. The Web site (Figure 5-27) will provide you a feature activation key and send you an e-mail with the information. Write the feature activation key in the space provided on your Paper-Pak for future reference. Store the Paper-Pak in a secure location.

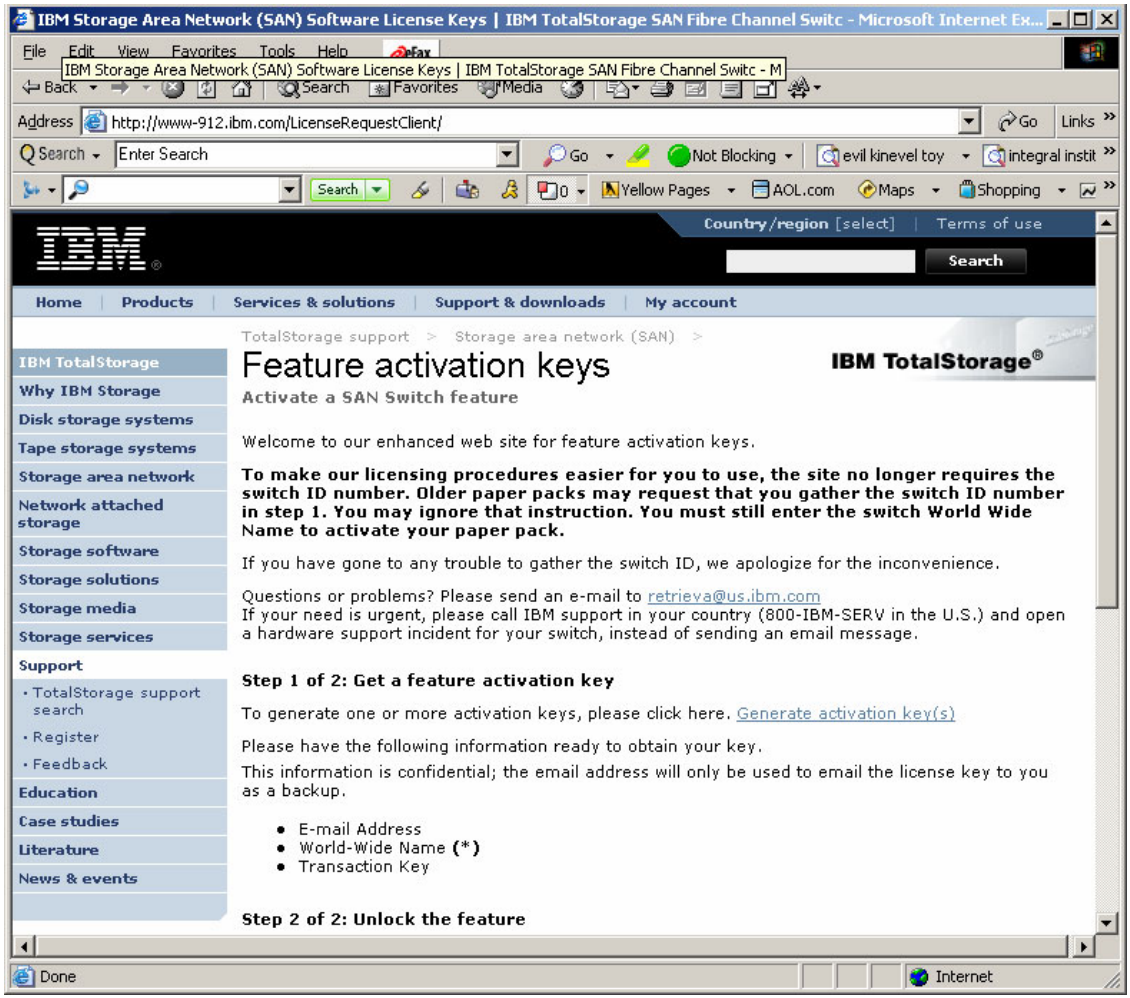

Figure 5-27 Brocade Feature Activation Web page

4. Use Web Tools to enable the licensed feature. Under the Admin Window, select the **License** tab and use the **Add** button to add the License Keys (see Figure 5-28).

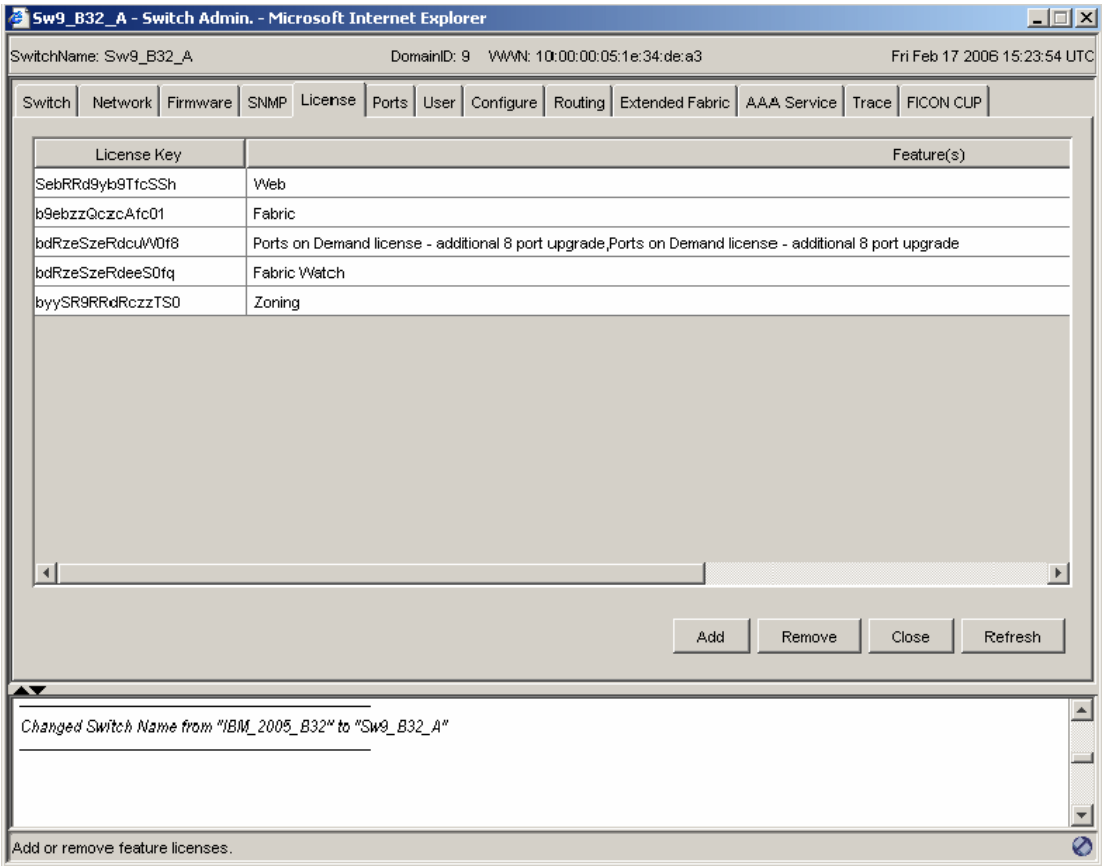

Figure 5-28 License Management window

5. The Add License dialog box appears and you should type or paste the Feature Activation License Key in the field (see Figure 5-29 on page 89).

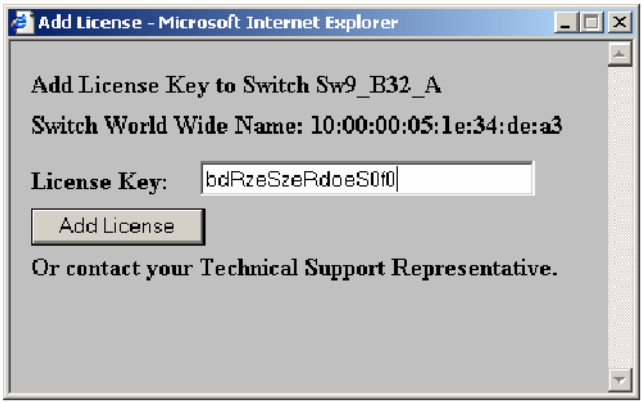

Figure 5-29 Adding a License Key

6. Select **Please click here to add more licenses** and continue adding licenses keys until complete (Figure 5-30).

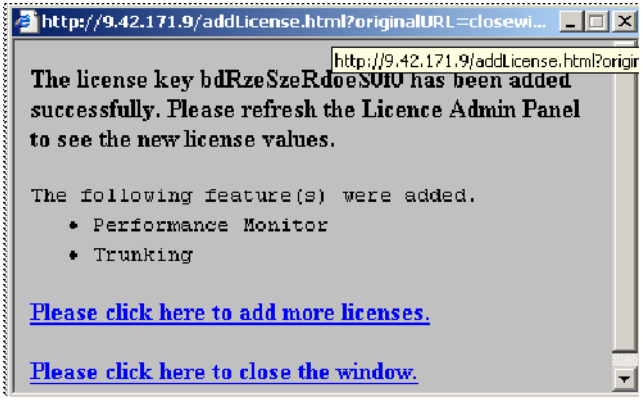

Figure 5-30 Adding more licenses

7.Click **Refresh** on License tab to verify that the new License has been added to the Feature List (see Figure 5-31).

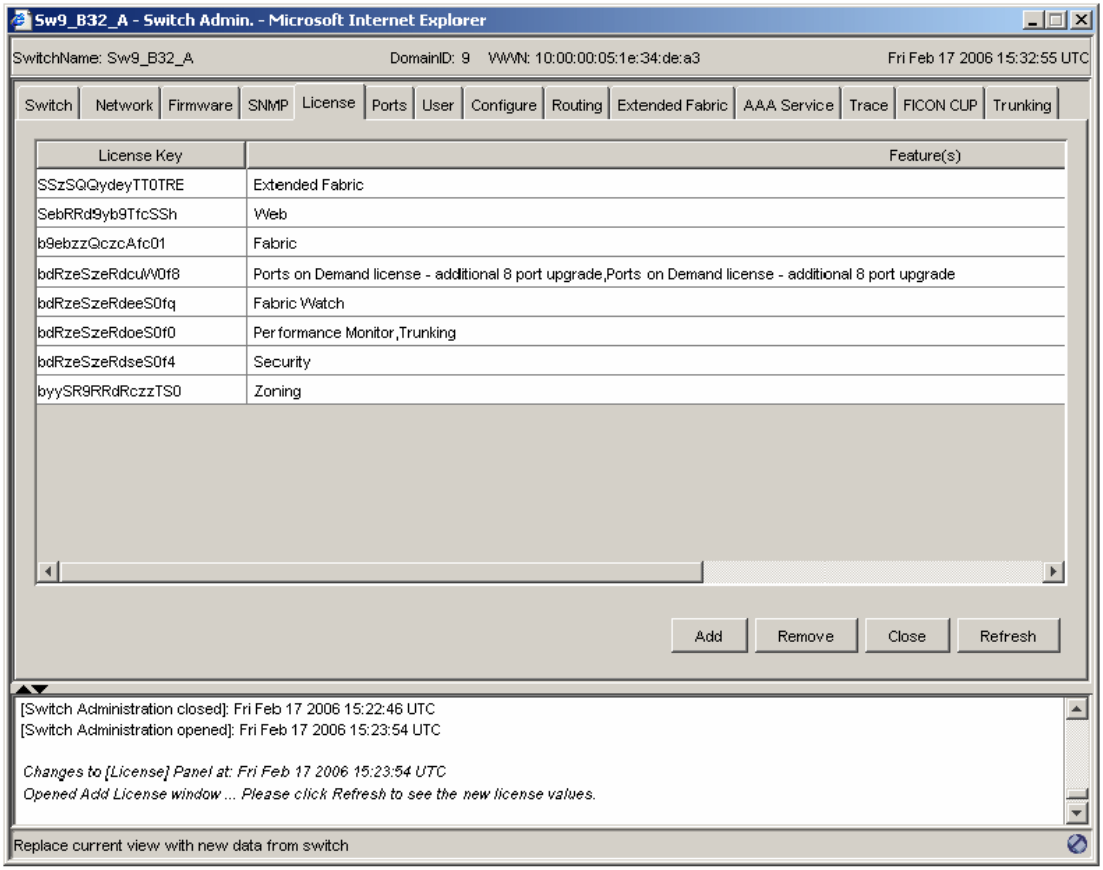

Figure 5-31 Verify licenses

7. If installing a Ports-on-Demand Upgrade license onto the B32 switch, then you must take additional steps to enable the newly added ports.
   a. Go to the Ports tab under Admin.
   b. The newly added ports will be licensed but not enabled. Check all boxes under the Enable Port column for each new port that you wish to enable.
   c. Click **Apply** (see Figure 5-32 on page 91).

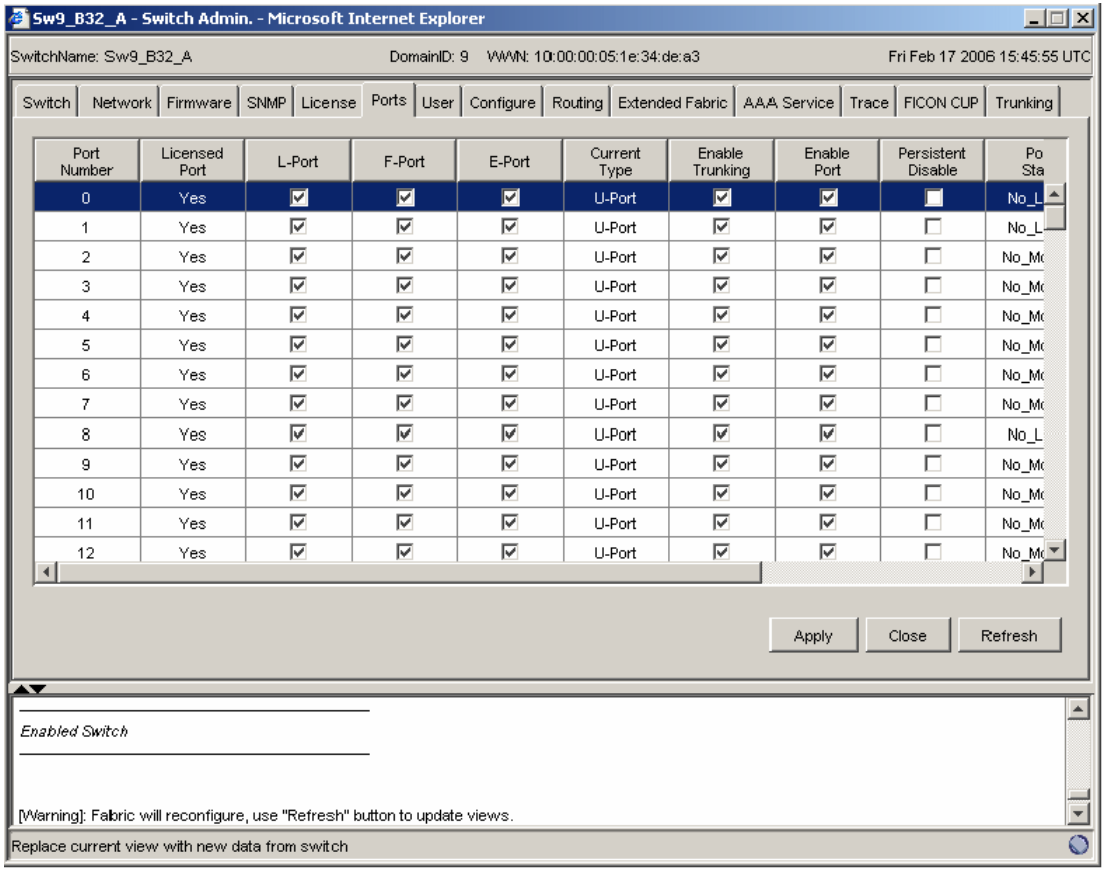

Figure 5-32 Enabling newly licensed ports

Important: You should securely store the LicenseID and all the License Keys for every switch. Keeping this information available helps recover licenses if licenses are accidentally removed. Also, you or service personnel will need the licenses to reinstall these features in the event that a field replacement unit (FRU) is required.

Below are the best practices for storing license information.

1. Keep hard copies of licenses and store them securely:
   a. Writing License Activation Keys on the original Paper-Pak forms.
   b. Printing a screen capture of the licenses from Web Tools.
   c. Telnet into the switch module and issue the **`licenseShow`** command and then print the results.

d. Remove the white labels from the Paper-Paks and add them to the front, side, top, or bottom of the switch. Adding labels to the side of switch module requires a power down and should be performed before going into production.

e. Print a copy of the switch configDownload file (see Figure 5-33).

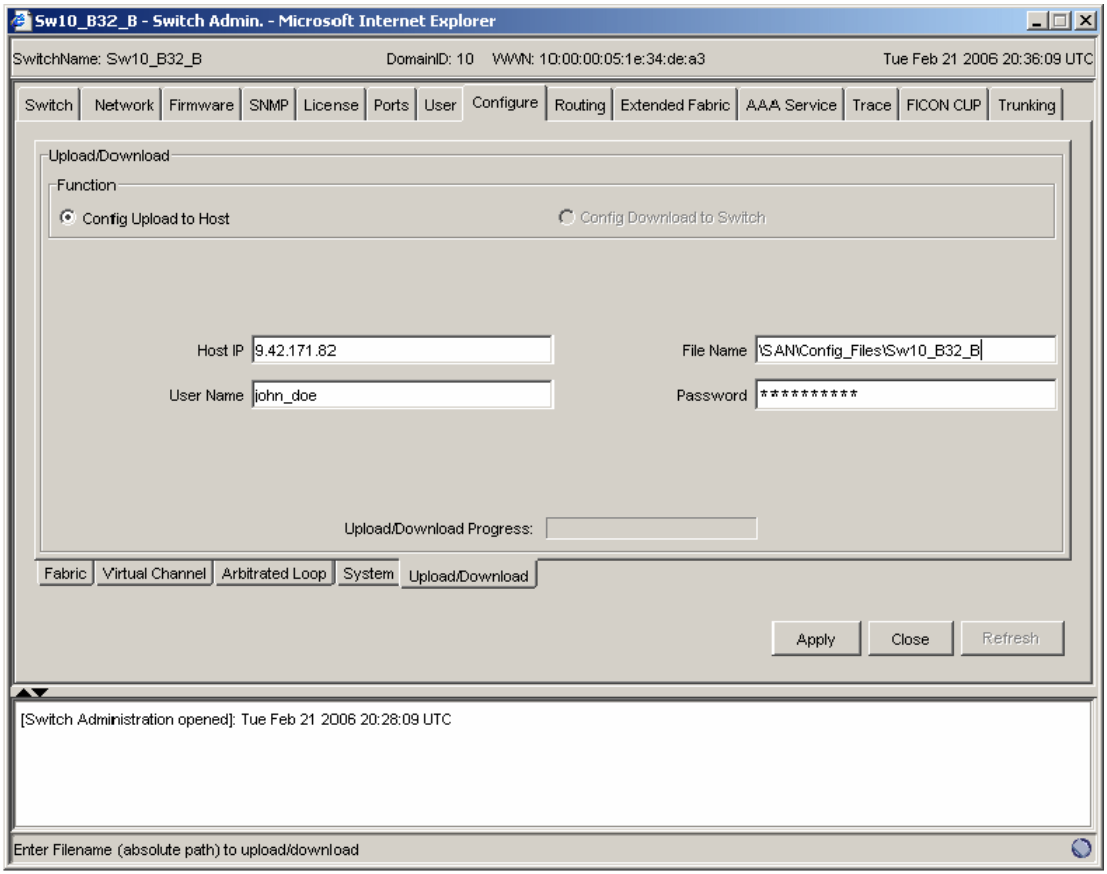

Figure 5-33 Downloading Switch configuration

f. Keep softcopy files of licenses and other critical switch information by using the configDownload function in the Configure tab under Admin.

Clearing the zone database

Zoning is a feature of FC switches that allow the SAN administrator to control device connectivity using zones (small private SAN groups). A single SAN fabric may contain none to many zones. Multiple zones may be grouped into a zone configuration (or zone config). Brocade switches allow multiple zone config

groups to be defined, but only one zone config group may be active within that SAN fabric.

Switches that have conflicting active zone configs or definitions will not merge to become one fabric. The SAN32B is shipped with no zone definitions. However, if the switch was used in a pre-production or lab SAN environment, then often zone definitions are on the switch. Therefore, it is important to clear all zone data from switches before adding them to an existing SAN fabric.

1. Ensure that the switch is *not* connected to any other switch. Otherwise, you may accidentally clear zone configuration for the entire fabric.
2. Open Web Tools and launch the Zone Administration module. Click the **Zoning** icon located in the Fabric Toolbar in the lower left corner of Web Tools window. You may need to log in to the switch if you are not already logged in.
3. Select **Actions** → **Clear All**.
4. The Disable Config warning displays. Click **Yes** to do all of the following:
   a. Disable the current configuration.
   b. Clear the entire contents of the current Web Tools Zone Admin buffer.
   c. Delete the entire persistent contents of the fabric zoning database.

   Note: This action is not recoverable.

5. Next, determine if you need to build a dummy zone on the SAN32B.

Building a dummy zone (optional)

Brocade products by default allow all devices full connectivity when there are no zone definitions. A good practice during the initial building of the SAN fabric is to create a dummy zone that prevents all device connectivity until you define the necessary zones. In our solution here, the SAN32B acts as the core switch for SAN switch modules. So we will create a *dummy zone* on the SAN32B before connecting the SAN switches modules or other devices. The dummy zone will consist only of the WWN of the SAN32B and thus preventing all other devices access until proper zones can be defined.

1. Open Web Tools and launch the Zone Administration module. Click the **Zoning** icon located in the Fabric Toolbar in the lower left corner of Web Tools window. You may need to log in to the switch if you are not already logged in.

2. While in the Alias tab (Figure 5-34), click **Create** to create an Alias with the name of the switch, for example, Sw9_B32_A. You will see the new Alias name in the window.

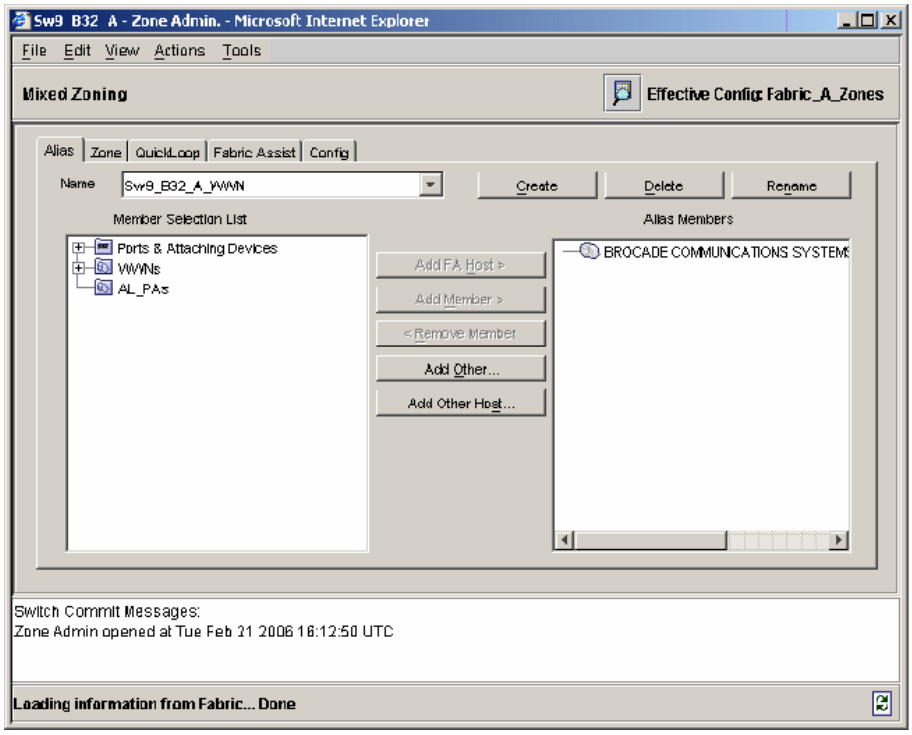

Figure 5-34 Zone Management window

3. Select the Alias you just created. It should be seen in the Name box. Then click the **Add Other** button.

4. Enter the WWN of the device and click **OK** (Figure 5-35). The window shown in Figure 5-36 should appear.

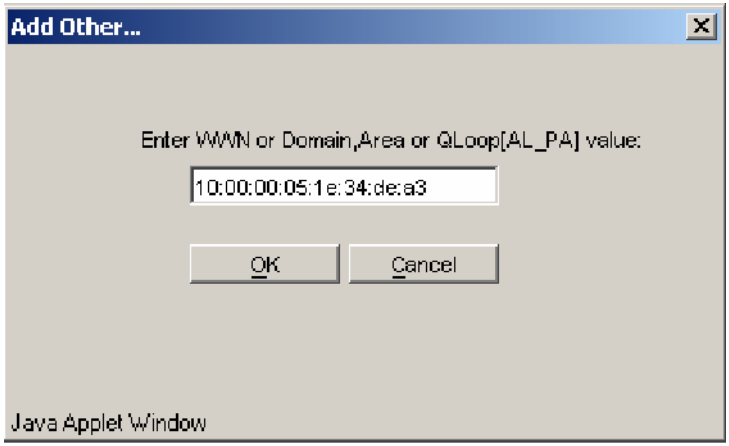

Figure 5-35 Creating an Alias

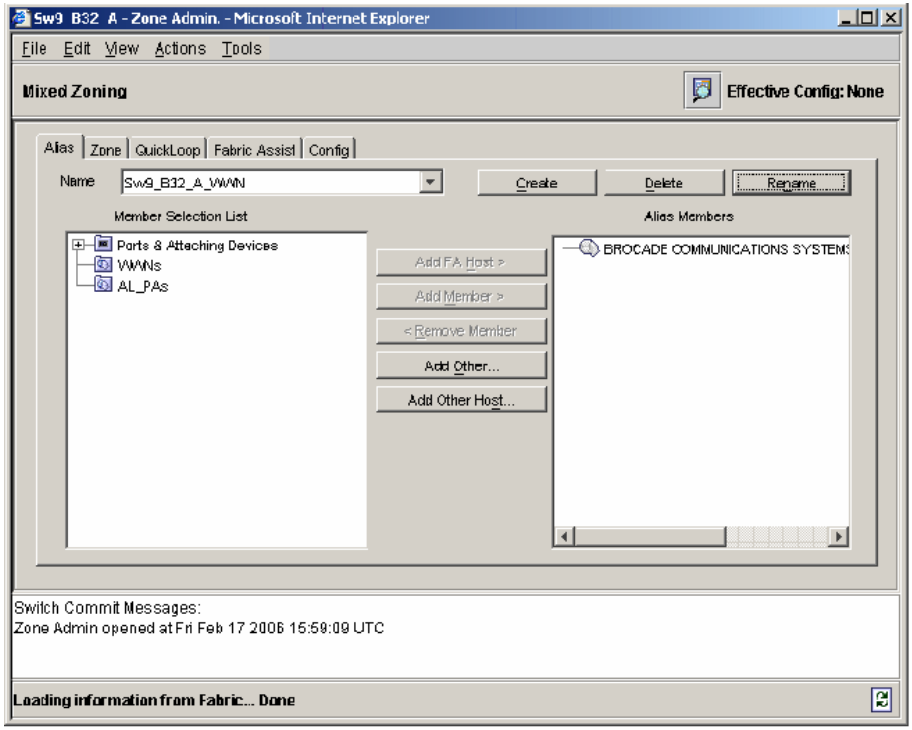

Figure 5-36 Defining the Alias

5. Enter the WWN (License ID) (Figure 5-37) of the SAN32B and click **OK**.

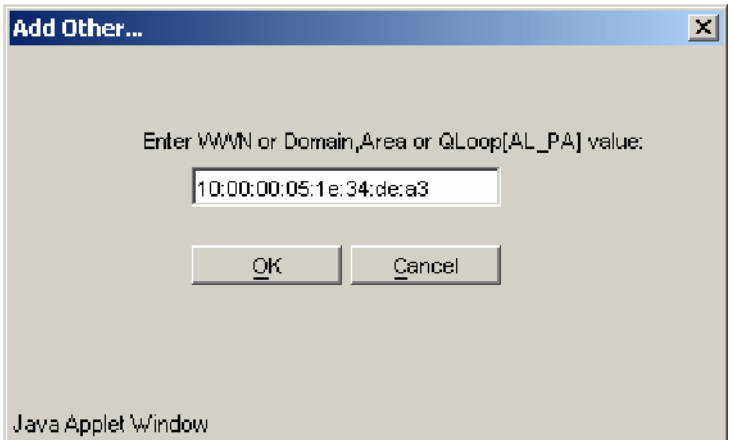

Figure 5-37 Entering the WWN of the switch to define the alias

6. Go to the Zone tab (Figure 5-38) and click **Create**. Name the zone Fabric_A Dummy Zone for Fabric A or Fabric_B_Dummy_Zone for fabric B.

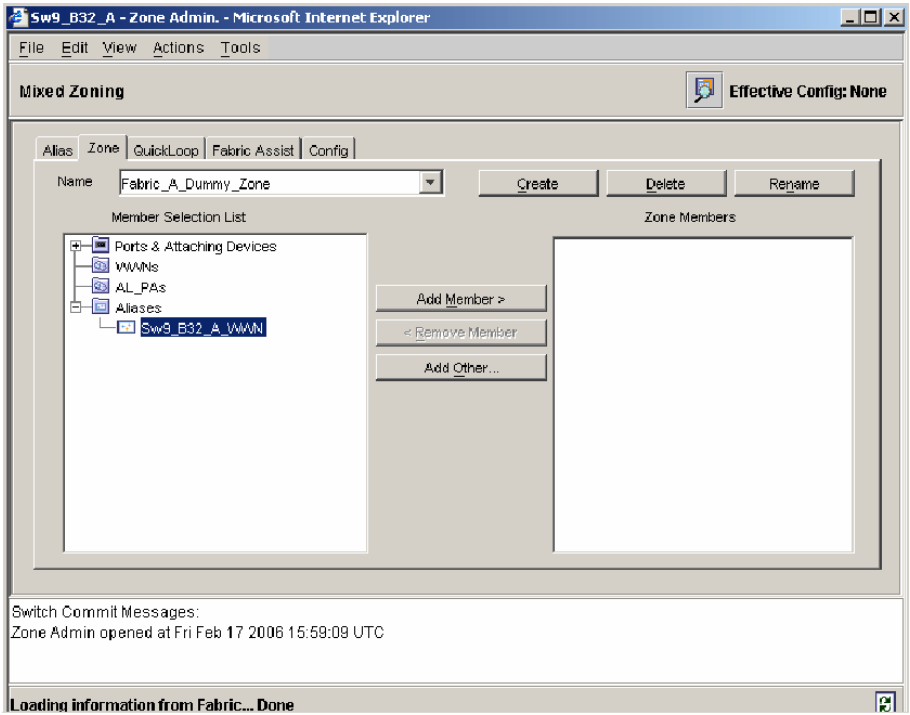

Figure 5-38 Creating a new zone

7. Expand the Aliases folder (Figure 5-39) in the left side of window. Find and highlight the alias with the switch WWN and click **Add Member**.

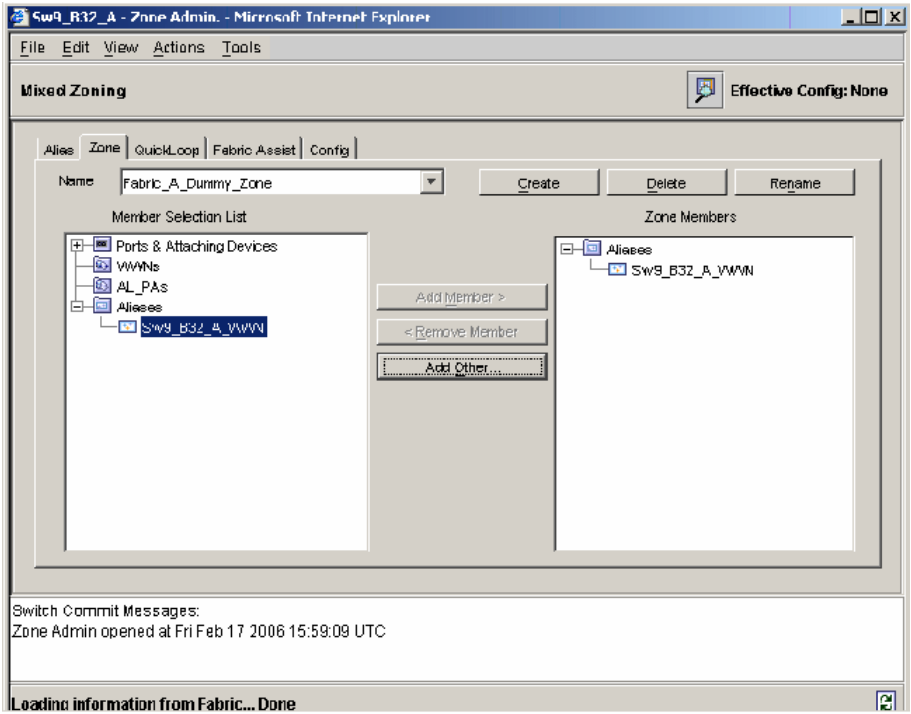

Figure 5-39 Mixed Zoning

8. Click the **Config** tab (Figure 5-40 on page 99) and create a new Config titled Fabric_A_Zones (or B).

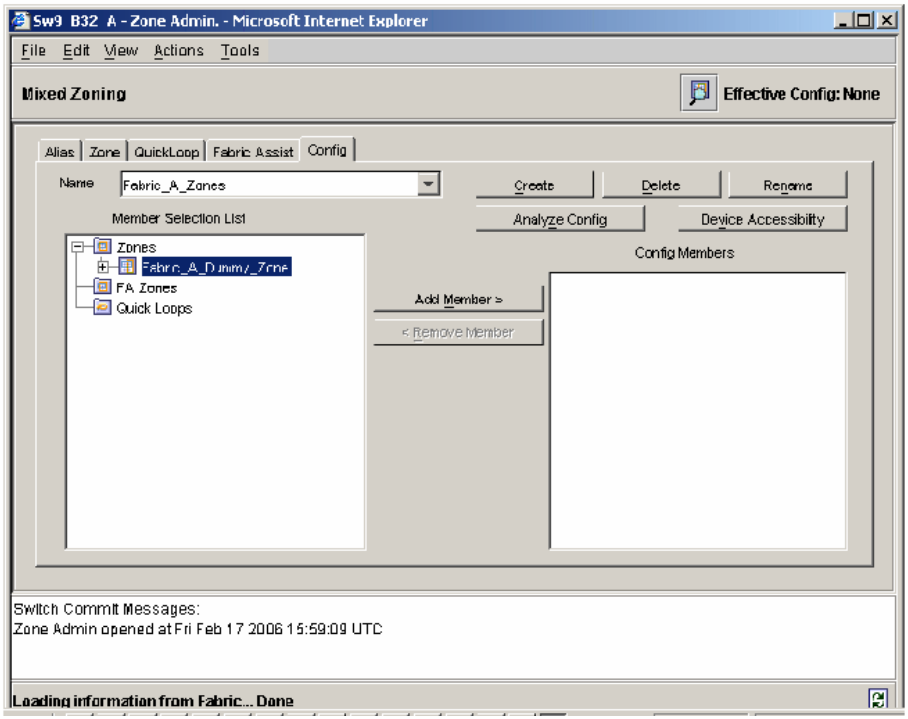

Figure 5-40 Creating a new zone config

9. Expand the Zones folder (Figure 5-40) on left side of window, highlight the dummy zone (Fabric_A_Dummy_Zone), and click **Add Member**.
10. Click **Action** in the top toolbar of the Zone Management window and select **Enable Config**. Then select **Fabric_A_Zones** (Figure 5-41) and click **OK**.

Figure 5-41 Enabling a zone config

11. Watch the window and wait for zone commit to complete. It may take several seconds. In the Zone window, verify that Fabric_A_Zones is the Effective Config (Figure 5-42).

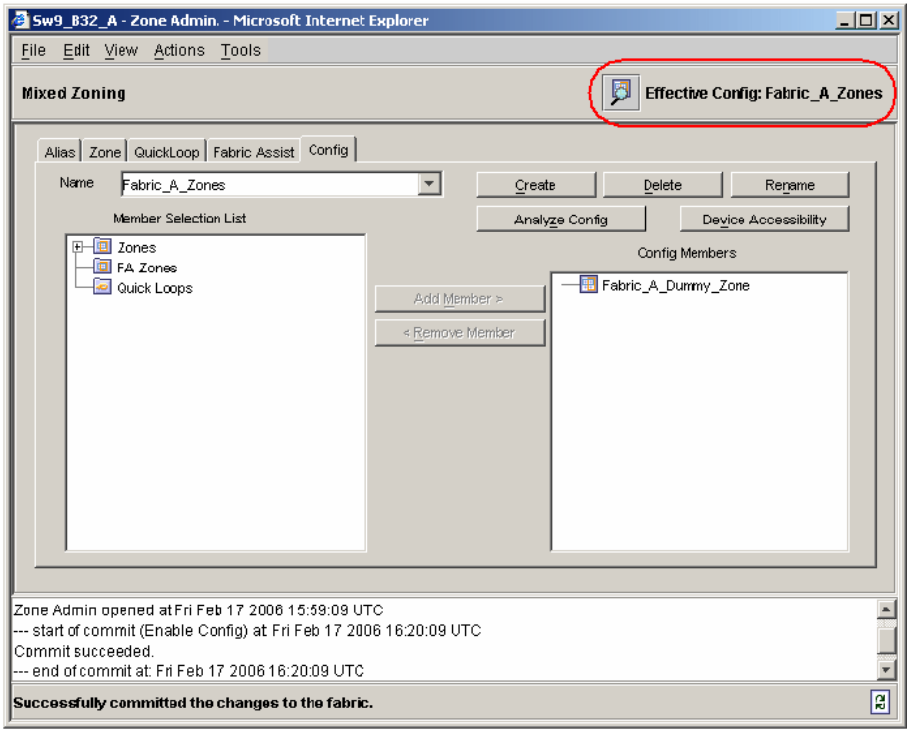

Figure 5-42 Viewing Effective Config

SAN32B setup is complete

Repeat the setup process for all external switches. For this solution, there are two SAN32B switches, one each for Fabric A and B.

Once the SAN32B switches are setup, connect the Brocade 4Gb SAN Switch Modules in the BladeCenter, as described in 5.5, “Building the Brocade SAN fabric” on page 101.

5.5 Building the Brocade SAN fabric

This section details steps for connecting the FC switches to build a SAN fabric. Since this solution has redundant SAN fabrics for increased availability, you must repeat the steps for the second fabric. No optional licenses are required to connect the Brocade switch module to the SAN32B. You may start with a single switch and then scale.

For this specific solution, we are using the optional advanced feature ISL Trunking and building 8Gb Trunks between the switch module to the SAN32B. Using ISL Trunking enhances the performance, availability, and manageability of the SAN fabric. However, ISL Trunking licenses are not required to build this or any SAN solution.

If you are not using ISL Trunking feature, then simply skip the Brocade ISL Trunking section and proceed to 5.5.4, “Connecting Brocade 4Gb SAN Switch Module to SAN32B” on page 105.

5.5.1 Brocade ISL Trunking

ISL Trunking optimizes network performance, availability, and manageability by merging multiple ISLs (inter-switch links) into a single logical entity called the trunk group. The trunk group offers these beneficial characteristics:

- *Enhanced Performance*: ISL Trunking distributes FC traffic at the frame level across the shared bandwidth of all member links with in-order delivery.
- *Simplified ISL Management*: ISL Trunking reduces or eliminates situations that require individual ISL configuration to achieve optimal performance and also simplifies fabric design and management (for example, one 12Gb Trunk is simpler to manage than three 4Gb ISLs).
- *Increased SAN Availability*: ISL Trunking enhances ISL availability by reducing the effects of ISL failures propagating within the SAN fabric. Since the trunk entity is comprised of multiple ISL links, then the failure of one member link does not cause a fabric re-route to occur.
- *Lower Total Cost of Ownership*: By improving SAN performance, availability, and manageability, ISL Trunking requires fewer ISLs, thus freeing FC ports and lowers the TCO of the SAN solution.

The Brocade 4Gb SAN Switch Module ISL Trunking feature allows for two trunk groups with up to three ISL connections each between itself and any other Brocade switch that has an ISL Trunking license installed. Each trunk group allows for three ISLs to merge logically into a single 12 Gbps link between switches (Figure 5-43). It is compatible with both short wavelength (SWL) and long wavelength (LWL) fiber optic cables and transceivers.

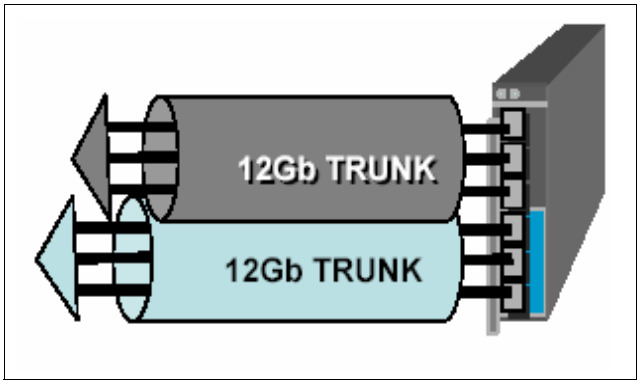

Figure 5-43 Six ISLs become two 12Gb ISL Trunks

5.5.2 Dynamic Path Selection (DPS)

The Brocade 4Gb SAN Switch Module also offers a performance enhancing feature called Dynamic Path Selection (DPS). DPS is a routing scheme that optimizes fabric-wide performance by automatically routing data to the most efficient available path in the fabric. While ISL Trunking can balance traffic at the most granular level (the FC frame) DPS balances loads at the FC Exchange level such as a SCSI read or write. DPS augments ISL Trunking to provide more effective load balancing in certain configurations, such as routing data between multiple trunk groups. As a result, a combination of DPS and ISL Trunking provides the greatest design flexibility and the highest degree of load balancing (see Figure 5-44 on page 103).

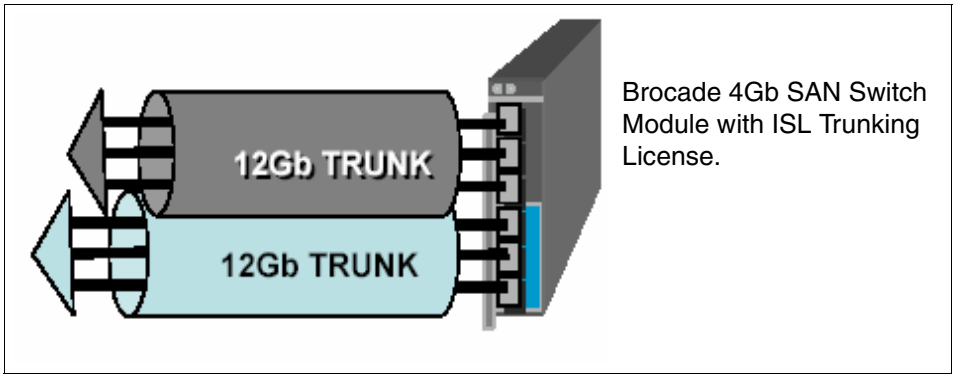

Figure 5-44 DPS with ISL Trunking offers 24 Gb of balanced performance

5.5.3 Trunking criteria

On the Brocade 4Gb SAN Switch Module, all trunking ports must meet the following criteria for standard distance trunking:

- There must be a direct connection between participating switches.
- Trunk ports must reside in the same port group (see Figure 5-45 on page 104 and Figure 5-46 on page 104).
- Trunk ports must run at the same speed (either 2 Gbps or 4 Gbps).
- Trunk ports must be E_Ports.
- Cable lengths for participating links should differ by no more than 550 meters.
- Trunk ports must be set to the same ISL mode (L0 is the default).
- This feature is not supported in interoperability mode.

For more information about ISL Trunking in general or Trunk Groups on other Brocade switch models, refer to the *Brocade Fabric OS Administrator's Guide*.

The diagrams in Figure 5-45 and Figure 5-46 shows the possible Trunk Groups on the Brocade 4Gb SAN Switch Module and the SAN32B.

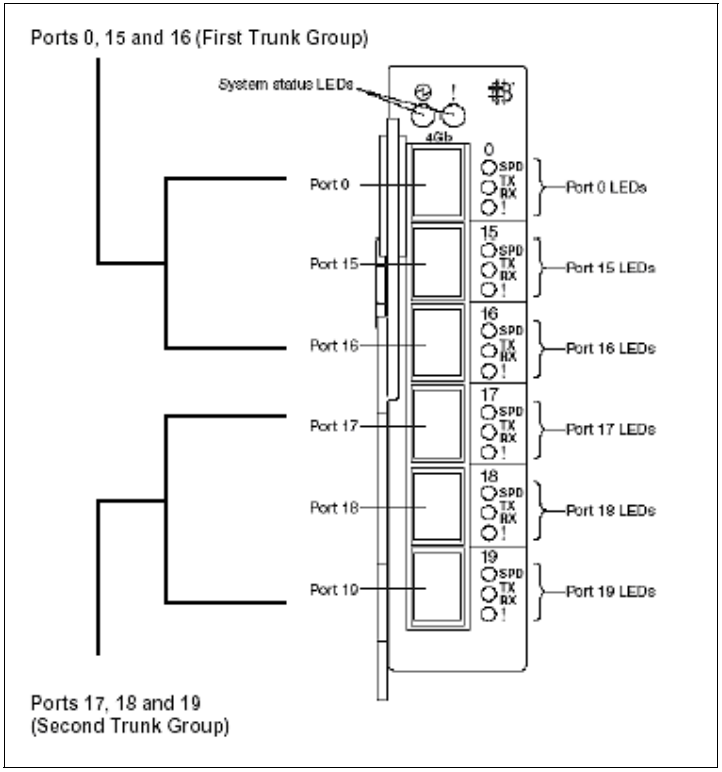

Figure 5-45 ISL Trunk Groups for 4Gb SAN Switch Module

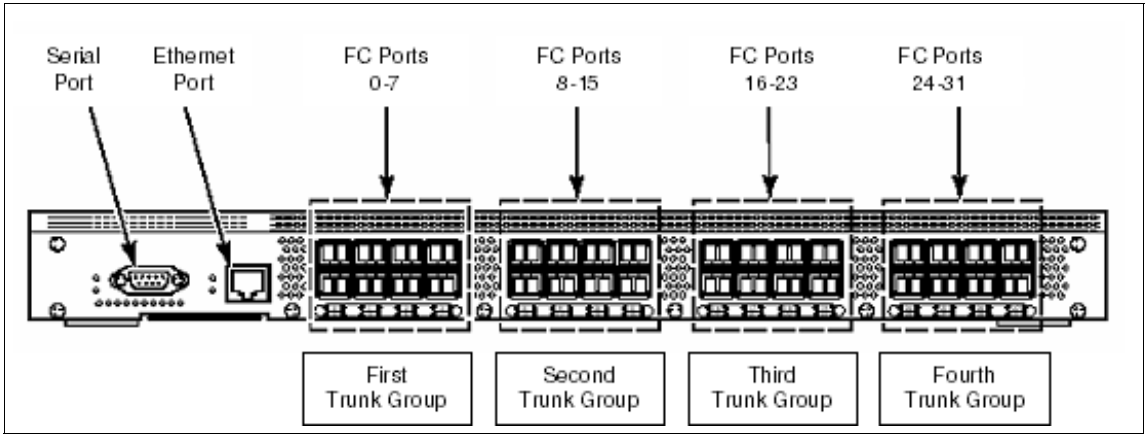

Figure 5-46 SL Trunk Groups for SAN32B

5.5.4 Connecting Brocade 4Gb SAN Switch Module to SAN32B

In this section, we will connect the 4Gb SAN switch module to the TotalStorage SAN32B.

1. Power off all server blades in BladeCenter before connecting the switch module to the external SAN Fabric to minimize port logins.
2. Install the SFP transceivers in the Fibre Channel ports, as required. All SFP transceivers must be 4Gb capable for 4Gb end-to-end bandwidth. Otherwise, the switches will negotiate to the highest, common supported speed (for example, 1Gb or 2Gb).

   You should connect the switches as though you are using the ISL Trunking feature. This allows you to add ISL Trunking in the future without rearranging the cables.

   Installing SFP transceivers:

   a. Remove the plugs from the FC ports to be used.
   b. Position a transceiver so that it is oriented correctly and insert it into a port until it is firmly seated and the latching mechanism clicks.
   c. Repeat steps a and b for the remaining ports, as required.

   Note: The transceivers are keyed to ensure correct orientation. If a transceiver does not install easily, ensure that it is correctly oriented.

   Orient a cable connector so that the key (the ridge on one side of connector) aligns with the slot in the transceiver. Then, insert the cable into the transceiver until the latching mechanism clicks.

3. Connect one fiber cable between the SAN switch module and the SAN32B.

   Caution: A 50 micron cable should not be bent to a radius less than 2 inches under full tensile load and 1.2 inches with no tensile load.

   Tie wraps are not recommended for optical cables because they are easily over-tightened.

4. Observe the LED to ensure the link initializes correctly. The Port Status LED should be solid green for both the SAN32B and switch module. Figure 5-47 on page 106 shows the LED definition for the switch module.

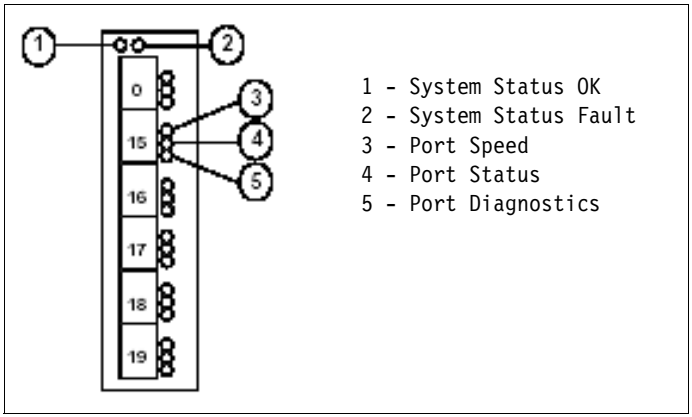

Figure 5-47 Brocade 4Gb Switch Module LED definitions

If the link does not come online, here are some simple steps to troubleshoot:

- Check the SFP transceiver and cable seating.
- Check that the switch modules external ports are enabled in the Management Module GUI.
- If that does not correct the issue, then disconnect the switch module and try the following steps:
  i. Using the Zone Management tool, clear the zone configuration.
  ii. Using the Admin tool under the Configure Fabric tab, verify the Switch PID formats for the switch module and SAN32B match (Format 1).
  iii. Using the Admin tool under the Switch tab, verify that the Switch Domain ID is different from the SAN32B match.
  iv. Using the Admin tool under the Ports tab and Speed column, ensure that the switch module and SAN32B ports are set for AN (auto-negotiate).
  v. Using the Admin tool under the Ports tab and Long Distance column, ensure that the switch module and SAN32B port settings match (the default is L0).
  vi. Open the Management Module GUI and Power Down switch module.
  vii. Reconnect the cable between the SAN32B and switch module.
  viii. In the Management Module GUI, power on the switch module.
- If these steps do not correct the problem, you can refer to the Troubleshooting chapter in the Brocade Fabric OS Administrator's Guide that is included on the SAN Switch Module Documentation CD.

– If you cannot determine the issue, then contact your SAN or BladeCenter supplier for support.

5. Once the first link is online, repeat the steps to connect the remaining links between the switch module and external switch.
6. Open Web Tools and click the **Topology** icon in the Fabric Toolbar in lower left of window. Verify that the switch module has merged with the external fabric.
7. For the switch module, go to the Web Tool Switch View and verify that the effective zone configuration transferred from the SAN32B. In our case, the effective zone configuration is Fabric_A_Zones.
8. This completes building Fabric A. Repeat these steps for building Fabric B.
9. Proceed to 5.6, “Connecting storage and servers to SAN fabric” on page 111.

5.5.5 Using ISL Trunking (optional)

If an ISL Trunking licenses is installed on both the switch module and external switch, then ISL Trunks should form when connecting the two switches. Review the criteria for building ISL Trunks at the beginning of this section and then use these steps to verify that the trunk groups form correctly.

Building ISL Trunks with an initial SAN setup

If ISL Trunking licenses are installed on switches before the SAN fabric is built, then follow these steps:

1. Follow steps 1-4 in “Connecting Brocade 4Gb SAN Switch Module to SAN32B” on page 105 to connect the initial link between the switch module and external switch.
2. Verify that a Trunk group has been formed. In Web Tools, click the **Admin** button and log in.
3. Select the **Trunking** tab and verify that the trunk group has formed (see Figure 5-48).

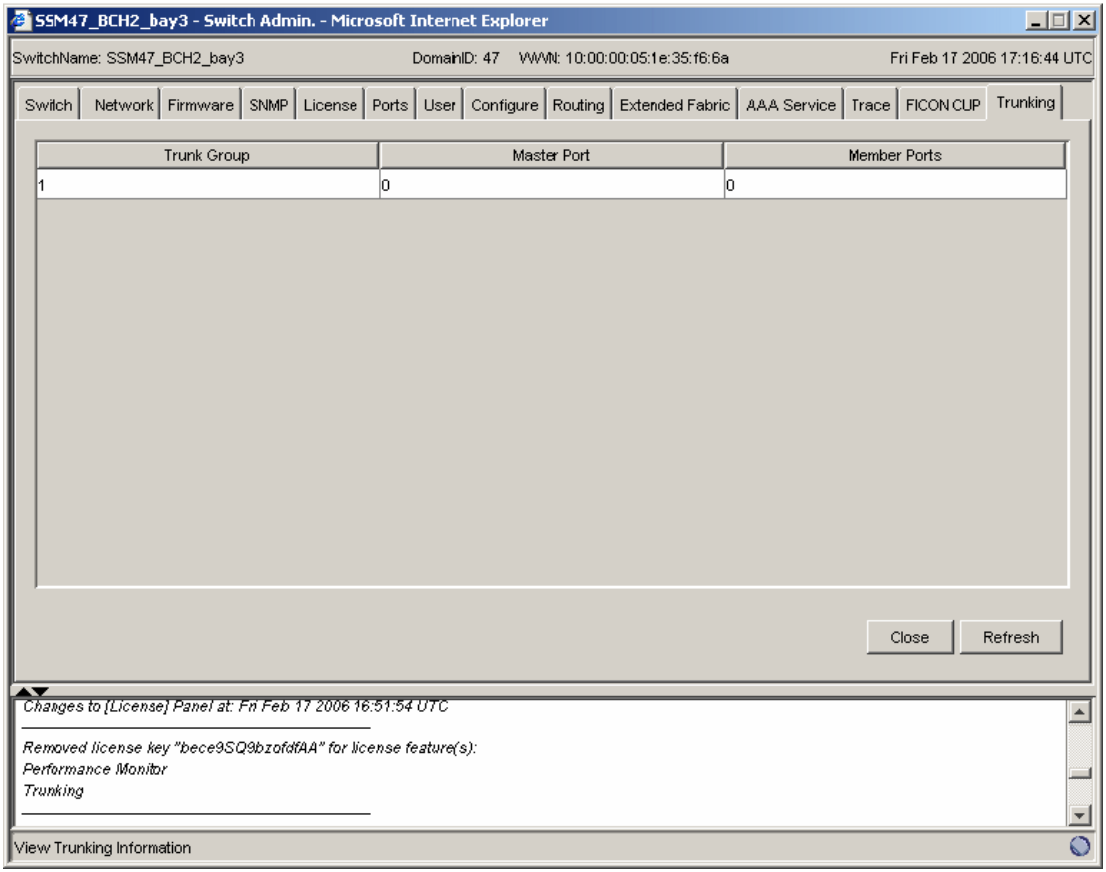

Figure 5-48 Viewing Trunk groups

4. Connect additional links between the switch module and external switch trunk port groups. Allow the links to establish.

5. On the Admin Trunking window, click the **Refresh** button and view the Member Ports column. Verify that the new link is now a member of the same Trunk group (see Figure 5-49).

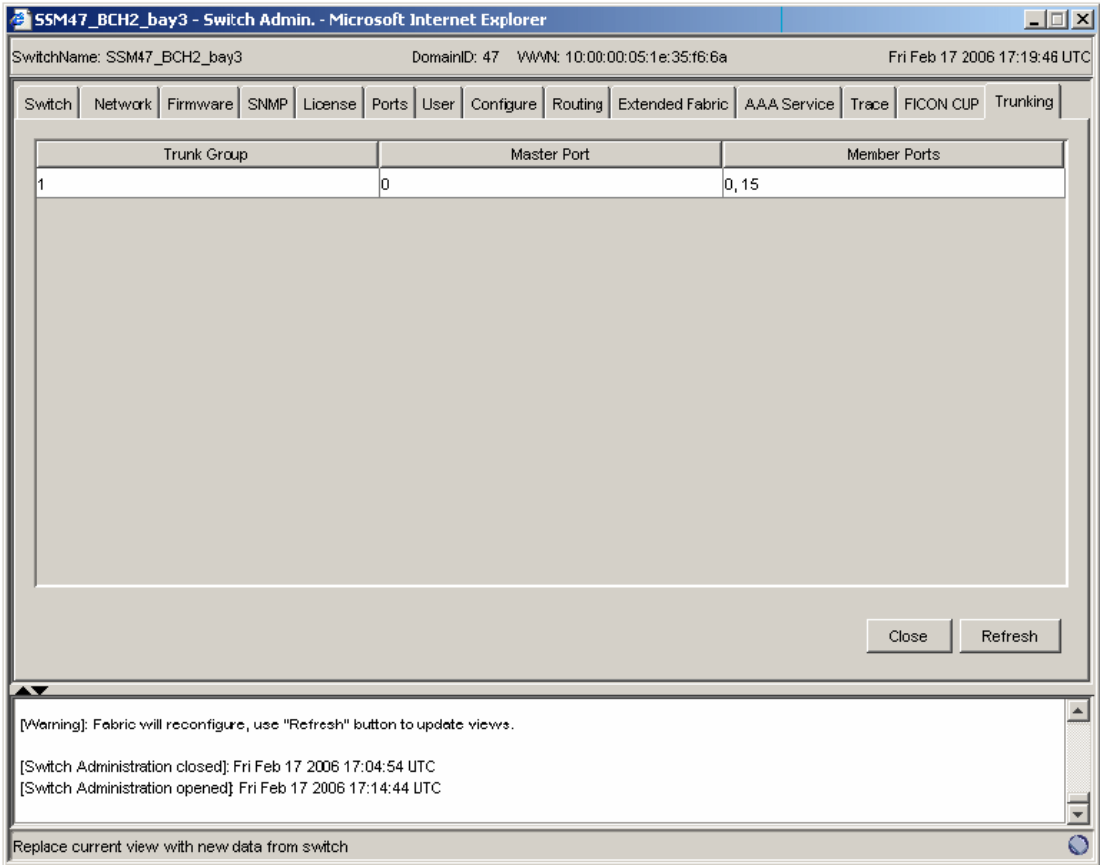

Figure 5-49 Viewing a two member trunk

6. Repeat, adding cables and verifying trunk members as necessary. The SAN 32B supports trunk groups up to eight members and up to 32 Gb of bandwidth. The Brocade 4Gb SAN Switch supports up to two three-member trunk groups of 12 Gb each.
7. This completes building Trunks for Fabric A. Repeat the steps for Fabric B.
8. Proceed to 5.6, “Connecting storage and servers to SAN fabric” on page 111.

Adding ISL Trunks to an existing SAN fabric

If ISL Trunking licenses are added to Brocade switches in an existing fabric (for example, the switches are already connected), then follow the following steps to enable ISL trunks groups:

1. Add ISL Trunking licenses to the switches.
2. Initialize the ports being used for ISLs so that they recognize that trunking is enabled. This procedure only needs to be performed one time from either the switch module or the external switch.

Enabling Trunk Groups from the 4Gb SAN switch module

1. Reinitialize the external ports from the Management Module GUI. Simply disable and then re-enable the External Ports (see Figure 5-50).

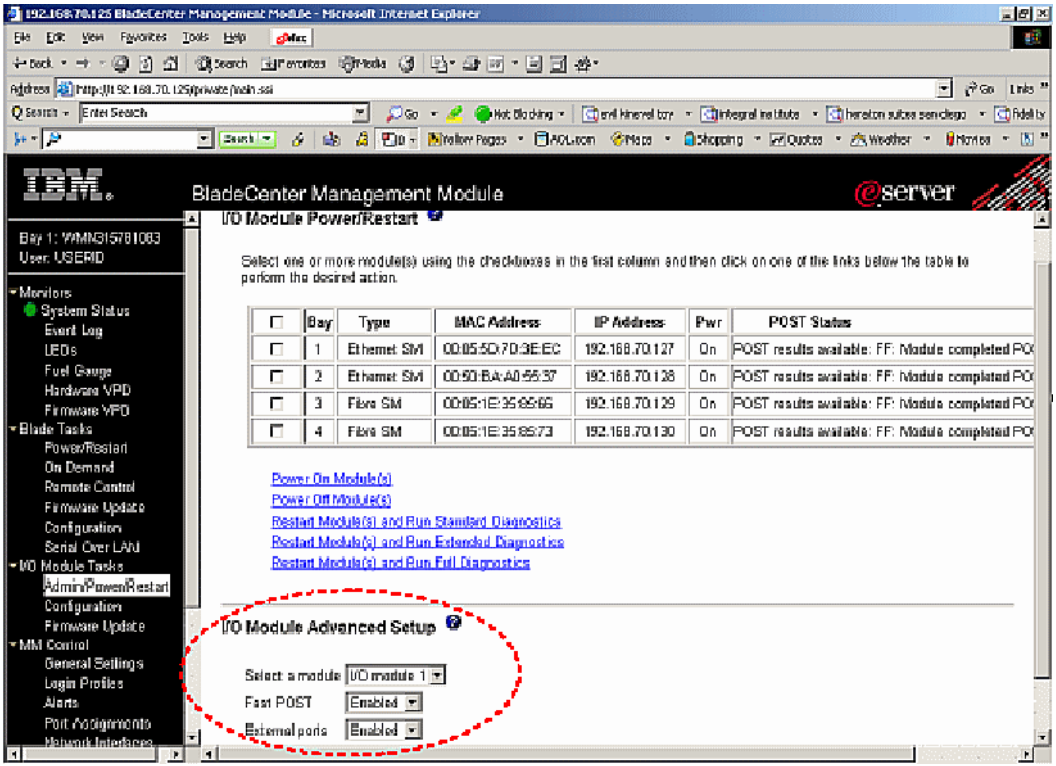

Figure 5-50 Disabling/Enabling External SAN Switch Module Ports

2. Verify that trunk members have been formed by viewing the Admin Trunking tab.

Enabling Trunk Groups from the external switch

1. Using Web Tools, go to the Admin Port window. Uncheck the **Enable Port** check box for all ports that are ISLs (E-Ports).
2. Click **Apply**. The ports are now disabled.
3. Check the **Enable Port** check boxes for these same ports and click **Apply**. The ports are now enabled.
4. Click the **Trunking** tab and verify that these ports have become members of the trunk groups.

This completes adding ISL Trunking for Fabric A. Repeat for Fabric B.

5.6 Connecting storage and servers to SAN fabric

This section details the recommended steps for connecting server and storage devices to your redundant SAN fabrics. Other than cabling the devices to the SAN fabric, all these steps are *best practice procedures* and not firm requirements.

5.6.1 Connecting DS4800 to SAN fabric

The DS4800 is configured with dual redundant controllers (A and B). Each controller has four channels to external servers or SAN fabrics. We recommend connecting at least two channels per controller to the redundant fabrics. This allows access to each controller if there is a link failure (see Figure 5-51).

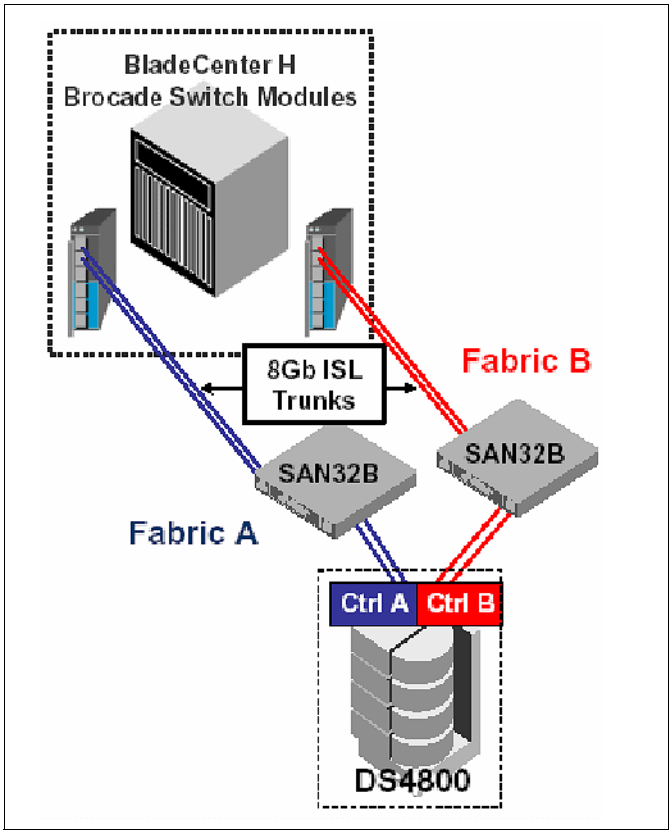

Figure 5-51 Fully redundant 4Gb SAN Solution

The ideal steps for connecting devices to SAN fabric are the following:

1. Ensure that proper SFP transceivers are firmly seated in the switch ports. For end-to-end 4Gb solutions, 4Gb SFP transceivers must be used and the connecting device must be 4Gb capable. Otherwise, the devices will negotiate to the highest, common supported speed (for example, 1Gb or 2Gb).

2. For the external switches, pre-assign ports to specific devices.

   An example for the SAN32B is shown in Figure 5-52. Here ports 0-7 are pre-assigned to Storage Devices. Ports 8-15 are pre-assigned for non-bladed servers. Ports 24-31 are pre-assigned for ISLs from other switches or switch modules. Ports 16-23 are unused and may be assigned as the SAN grows.

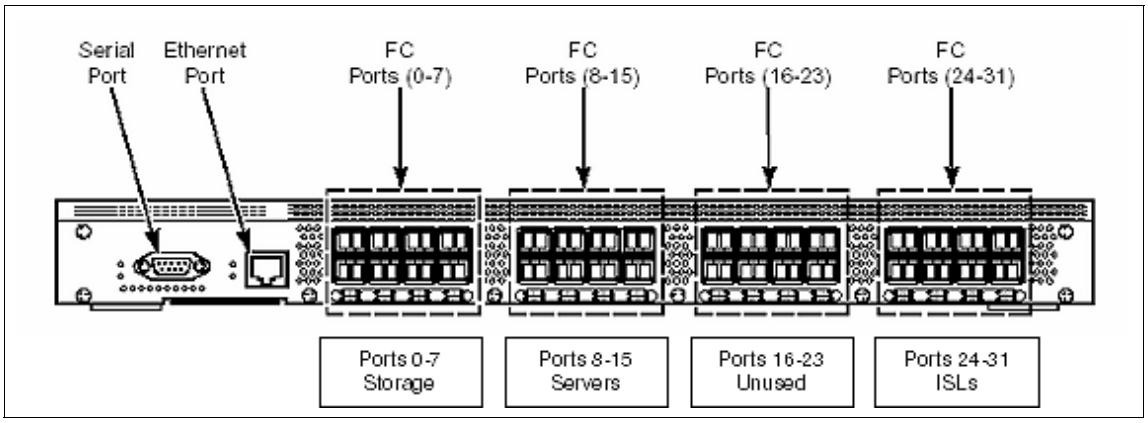

Figure 5-52 Port assignment for SAN32B

3. Power down the storage device (for example, the DS4800).

   Note: If powering down the storage device is not possible, then disable the switch ports assigned to the storage device.

4. Connect the fiber cables between the switch and the ports on the storage controller. Listen for the latching mechanism to click and lock into the transceiver.

   Note: Ensure that you connect cables from DS4800 Controller A to SAN32B in Fabric A and Controller B to SAN32B in Fabric B.

5. Power up the storage device to add one device.

   Note: Enable the switch port if the storage was connected while powered up.

6. Verify that the device successfully logged into the switch.
   a. The Port Status LED should be solid green.
   b. Check the Name Server table for the device information. The Name Server table is accessed by clicking on the Name Server icon at the bottom of the Fabric Toolbar area in Web Tools. The Name Server table will list the devices logged into the fabric, as shown in Figure 5-53.

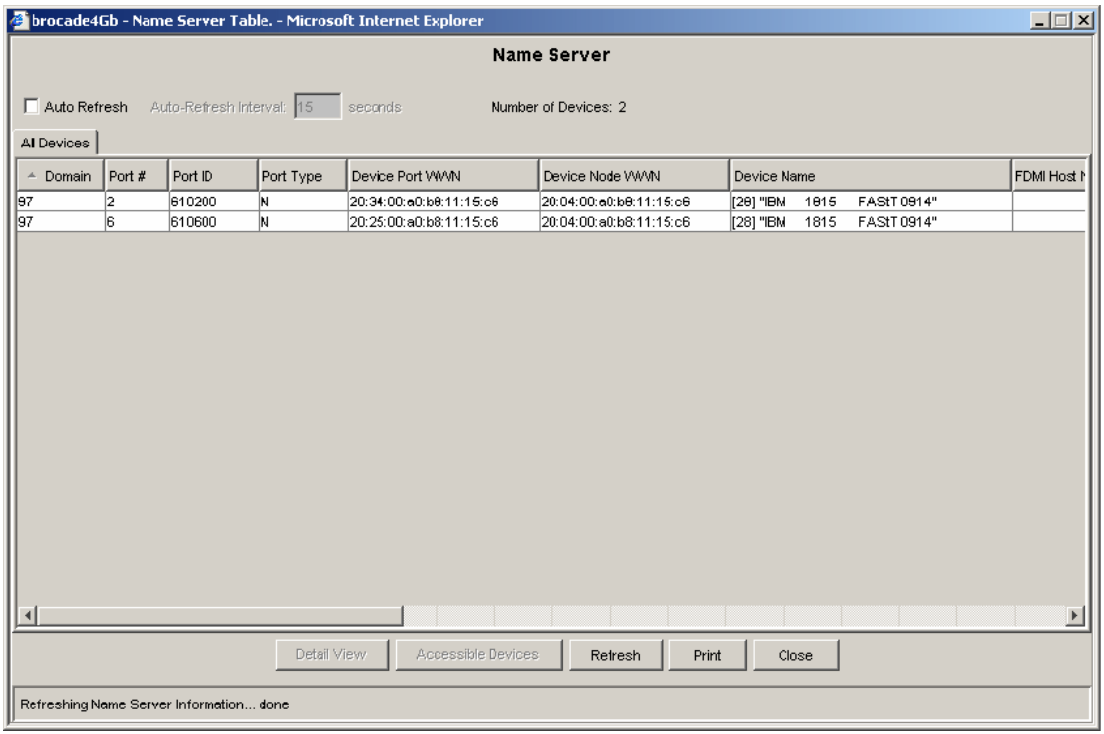

Figure 5-53 Viewing devices in the Name Server Table

7. Check proper device connectivity on both Fabric A and B.
8. The storage devices are now connected to the SAN fabric. Next, connect the server blades to the SAN fabric.

5.6.2 Connecting server blades to the SAN fabric

In this section, we discuss connecting the server blades to our SAN fabric.

1. Ensure that proper SFP transceivers are firmly seated in the switch ports. For end-to-end 4Gb solutions, 4Gb SFP transceivers and the FC daughter card must be used.

2. Install the 4Gb FC daughter card into the server blades if you have not done so.
3. Configure the daughter card.
4. Install and power up the server blade. Allow it to fully boot.
5. Check the switch modules Web Tools window to ensure that the server blade successfully logs into the switch module. The Port Status LED should be solid green to indicate a good connection.
6. Verify that it successfully logged into the switch module. From Web Tools, check the Name Server in the Fabric Toolbar and check that the blade server's FC daughter card WWN is listed. Repeat for switch modules A and B.
7. Power up and verify each blade server one at a time.
8. Once the blade servers and associated storage devices are powered up and connected to the SAN fabric, you may create zones to allow proper device connectivity. See “Zoning to control device connectivity” on page 115 for more information.

5.7 Zoning to control device connectivity

In this section, we establish zoning to control the fabric and storage connectivity.

5.7.1 Zoning overview

Advanced Zoning is a licensed Brocade product that allows partitioning of a storage area network (SAN) into logical groupings of devices that may access each other. These logical groupings are called zones. Zoning definition may be managed from any Brocade switch in the fabric and all changes are propagated to the rest of fabric. As a best practice, manage zones from the switch with the latest FOS version. If all switches have same FOS versions, then manage the zones from the core switch.

You can use Advanced Zoning to customize environments and optimize resources:

- Customize environments: You can use zones to create logical subsets of the fabric to accommodate environments, such as closed user groups or functional areas within the fabric. For example, you can identify selected devices within a zone for the exclusive use of zone members, or you can define a zone to create separate test or maintenance areas within the fabric.
- Optimize resources: You can use zones to logically consolidate equipment for efficiency or to facilitate time-sensitive functions; for example, to create a temporary zone to back up non-member devices.

A *zone* is a specified group of fabric-connected devices, also called *zone objects*, which communicate to one another. Any zone object connected to the fabric can be included in one or more zones.

Zones can overlap, that is, a zone object can belong to more than one zone and a fabric can have multiple zones.

Multiple zones may be grouped into a *zone configuration* (also called a *config*). A fabric can have any number of resident zone configurations; however, only one active configuration can be enabled at a time.

Individual zones cannot be enabled. Only one zone configuration may be enabled within a SAN fabric.

Note: After a zone configuration is enabled, if a device is not explicitly defined in a zone, that device is isolated and inaccessible by other devices in the fabric.

From previous steps in the SAN32B setup and configuration, there is an Effective Config called Fabric_A_Zones. This config consists only of a dummy zone that prevents all devices from seeing each other. The upcoming steps will add useful zones to this configuration so that the servers can access the storage.

5.7.2 Managing zones with Web Tools

You can monitor and manage zoning through the Web Tools Zone Admin module.

1. Ensure that server and storage devices are connected and logged into the SAN fabric.
2. From the SAN32B in Fabric A, click the **Zone Administration** icon in the Fabric Toolbar to access the Zone Admin module, as shown in Figure 5-54 on page 117.

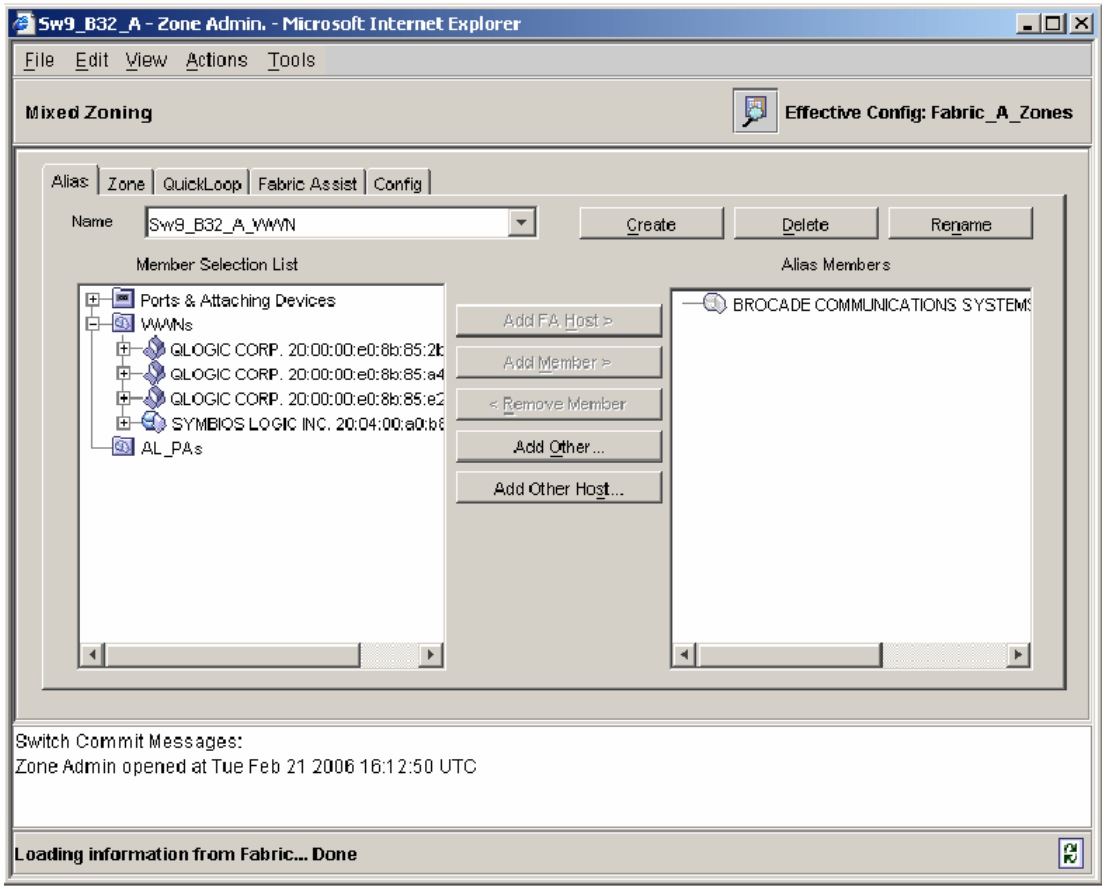

Figure 5-54 Zone Administration window

5.7.3 Building zone aliases

A zone alias is a name assigned to a device or a group of devices. By creating an alias, you can assign a familiar name to a device or group multiple devices into a single name. This simplifies cumbersome data entry and allows an intuitive naming structure for non-descriptive items, such as port numbers or a WWN. For example, you can use the name BC7_Blade3_Win2K_A as an alias for the FC daughter card port WWN 21:00:00:80:33:3f:aa:11.

1. Select the **Alias** tab and click **Create**.

2. Create a unique Alias name for port A of the FC daughter card server blade. Here we used BCH2_Blade7_FabricA (see Figure 5-55).

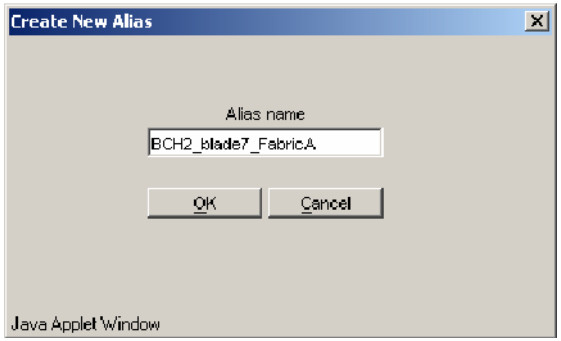

Figure 5-55 Creating an Alias name server blade 7

3. On the left hand side of window, fully expand the Port & Attaching Devices tree. All switches in the fabric will be shown. Find and expand the SAN Switch Module. If there are multiple switch modules, then they can be differentiated by their switch name (if you assigned them unique switch names) or domain IDs.
4. Find the correct port on the switch module. In this case, we are looking for port 7 that is connected to blade 7. Expand port 7 until the WW Port Name (WWPN) is shown. For each device, the WWPN will be the second (inner) WWN shown in the Port tree. The first (outer) WWN is called the WW Node Name (WWNN). Always use the WWPN for the most secure zoning (see Figure 5-56 on page 119).

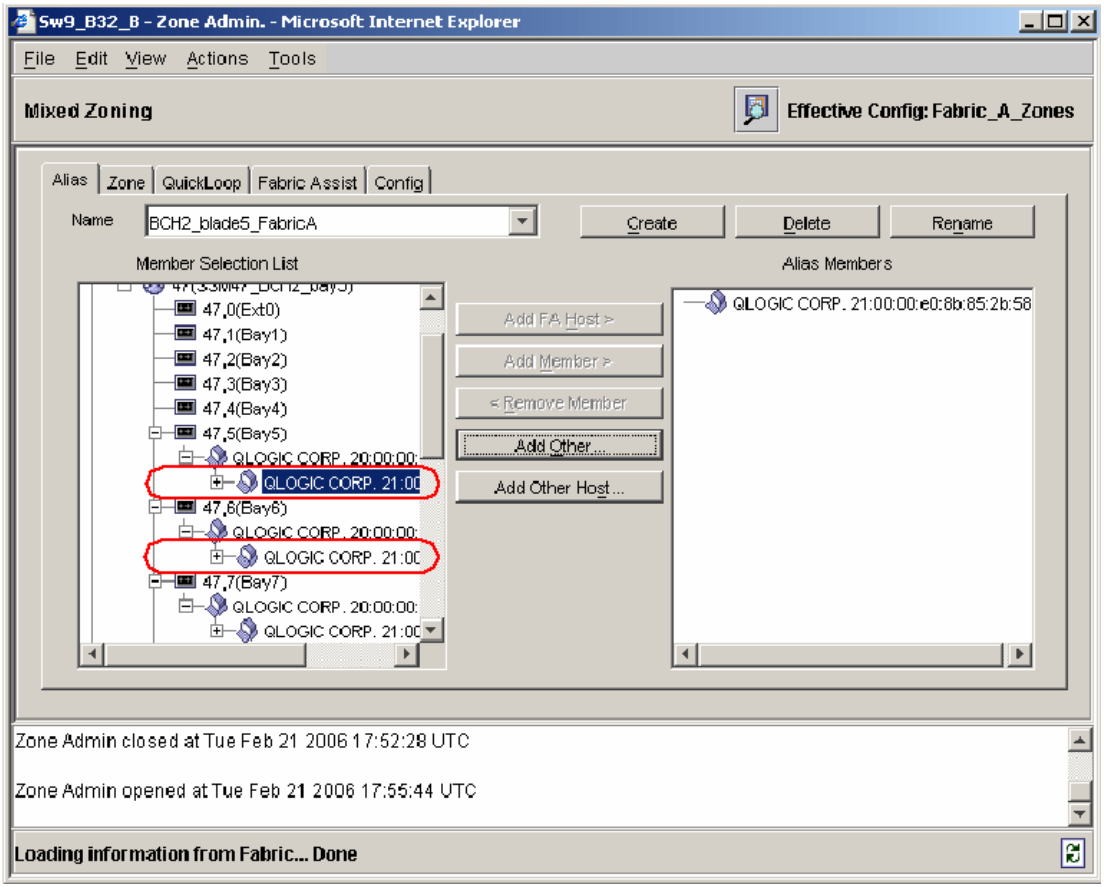

Figure 5-56 Finding WW Port Names of devices

5. Highlight the WWPN and click **Add Member**. Now the Alias is assigned the WWPN for the server blade.
6. Repeat these steps for all server blades in Fabric A. Assign each server port a unique and descriptive name.

7. Next, click **Create** to create Alias names for the storage ports. Here, we create the Alias name DS4800_Ctrl_A_Ch3 and will assign it the WWPN for channel 3 on the DS4800 controller A, as shown in Figure 5-57

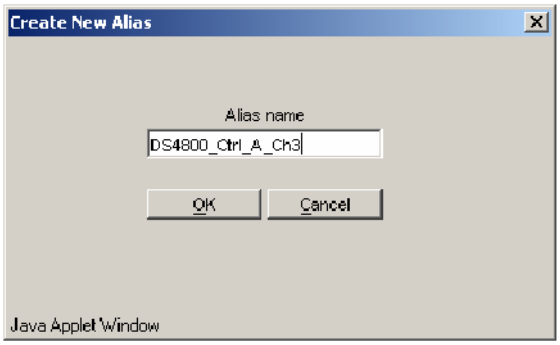

Figure 5-57 Creating the Alias name for the storage port

8. From the Zone Administration window under Ports and Attaching Devices, find the SAN32B and expand the port connected to Channel 3 of Controller A of the DS4800.
9. Highlight the WWPN for the storage port and click **Add Member** (see Figure 5-58 on page 121).

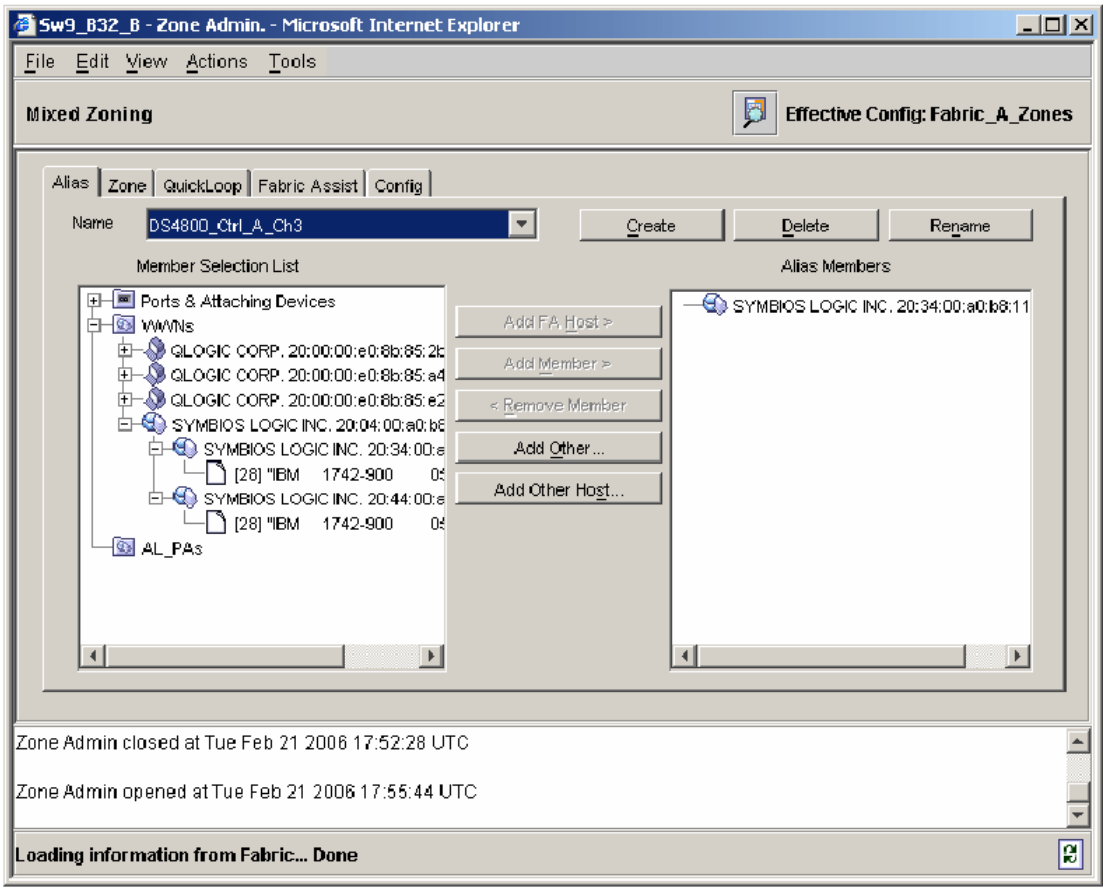

Figure 5-58 x-x. Assigning WWPN of storage port to Alias

10. Repeat assigning alias names for all storage ports in Fabric A.

5.7.4 Building zones

Once the alias are created, we can now build zones. Useful zones may be as small as two devices or as large as all the devices in the fabric. Zones may be based on operating systems, departments, applications, or any other scheme. The best zoning practice is building zones based on single FC adapter ports, commonly known as Host Bus Adapter (HBA) zones.

Zoning by single HBA most closely re-creates the original SCSI bus. Each zone created has only one HBA (initiator) in the zone; each of the target devices is added to the zone. Typically, a zone is created for the HBA and the disk storage ports are added. If the HBA also accesses tape devices, a second zone is

created with the HBA and associated tape devices in it. In the case of clustered systems, it could be appropriate to have an HBA from each of the cluster members included in the zone; this is equivalent to having a shared SCSI bus between the cluster members and presumes that the clustering software can manage access to the shared devices. In a large fabric, zoning by single HBA requires the creation of possibly hundreds of zones; however, each zone contains only a few members. Zone changes affect the smallest possible number of devices, minimizing the impact of an incorrect zone change. This zoning philosophy is the preferred method.

1. Select the **Zone** tab.
2. Click **Create** and enter a unique zone name for a specific server-storage combination (see Figure 5-59). Here we name the new zone Zn_ BCH2_Blade7_DS4800_A. We use the prefix Zn to designate that this name is a zone name. The BCH2 represents the specific BladeCenter chassis; Blade7 the blade server and DS4800 the storage device.

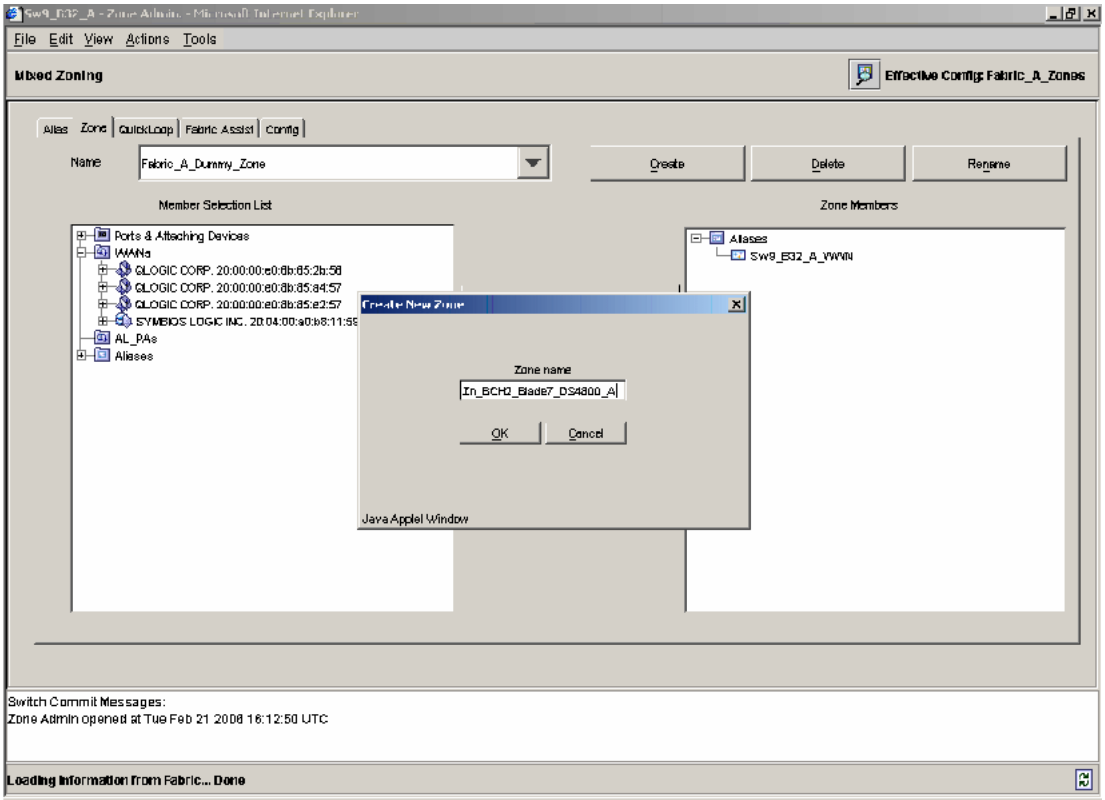

Figure 5-59 Creating a new zone name

3. Expand the Alias tree in the left hand side of the zone window. Highlight the Alias name for correct server blade and click **Add Member**. Also add to the zone the Alias names for the DS4800 ports (see Figure 5-60).

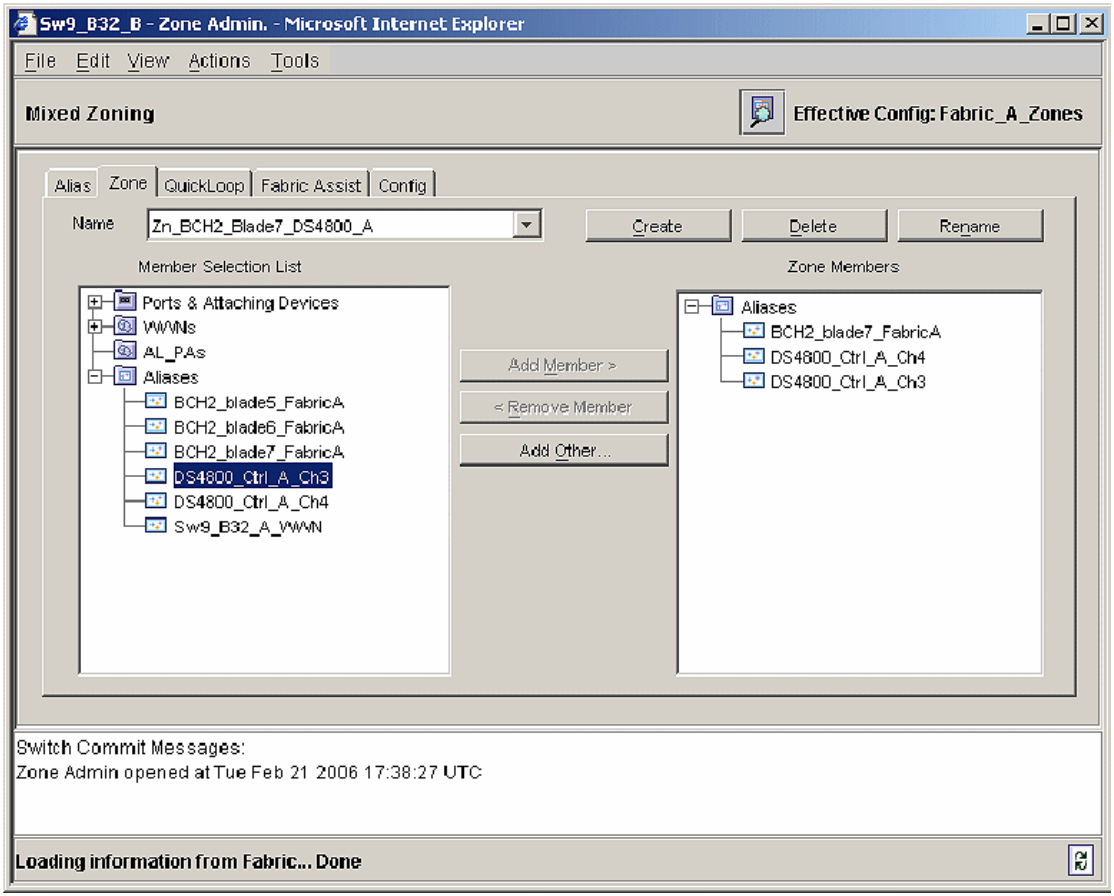

Figure 5-60 Adding Members to a zone

4. Repeat the steps to create and populate zones for each blade server. The DS4800 ports should be included in the zone if that server blade will need to access storage on the array.
5. Once all the zones are built, we need to create a zone configuration.

5.7.5 Building and enabling zone configurations

As discussed earlier, a zone configuration (also called a config) consists of zone definitions. There many be multiple zone definitions defined, but only one config may be enabled within the fabric. This enabled zone configuration is called the *effective config*. In this case, the Effective Config is Fabric_A_Zones, which currently consists only of the Fabric_A_Dummy_Zone. We will now add the newly created zones to this zone configuration.

1. Select the **Config** tab and ensure that Fabric_A_Zones is in the Name box. Then expand the Zones tree, as shown in Figure 5-61.

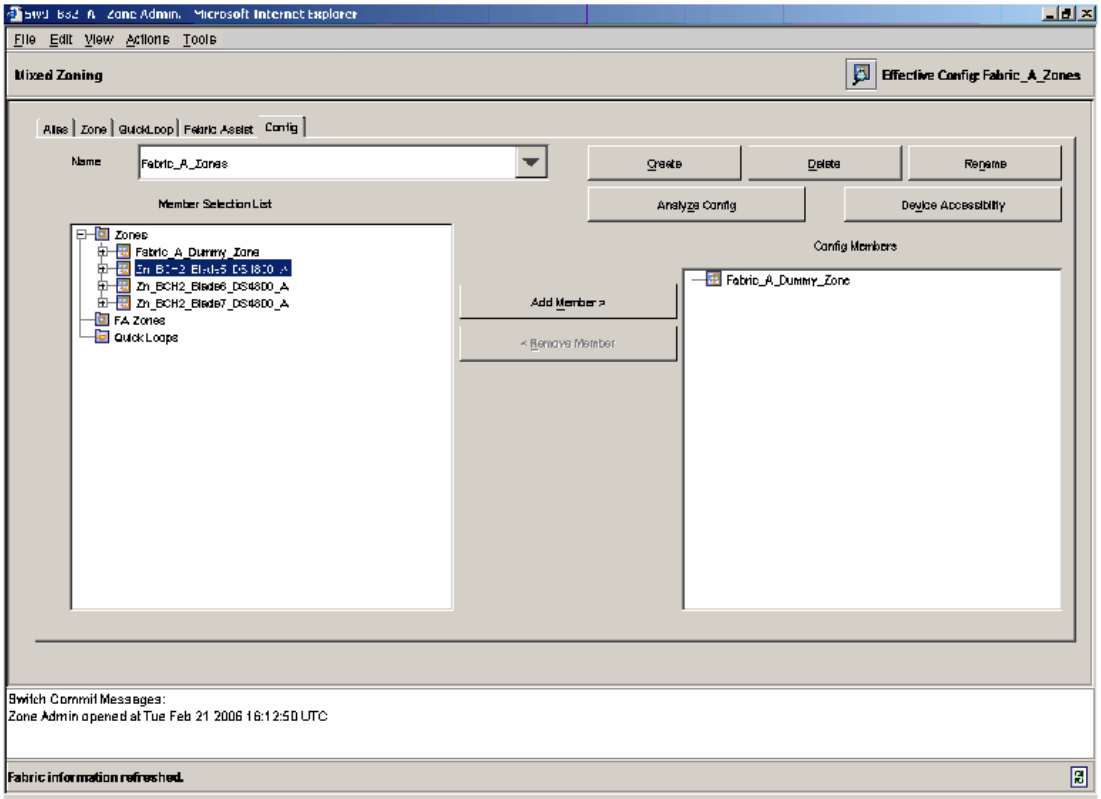

Figure 5-61 Zone config window

2. Highlight and add the server blade zones to the config (see Figure 5-62).

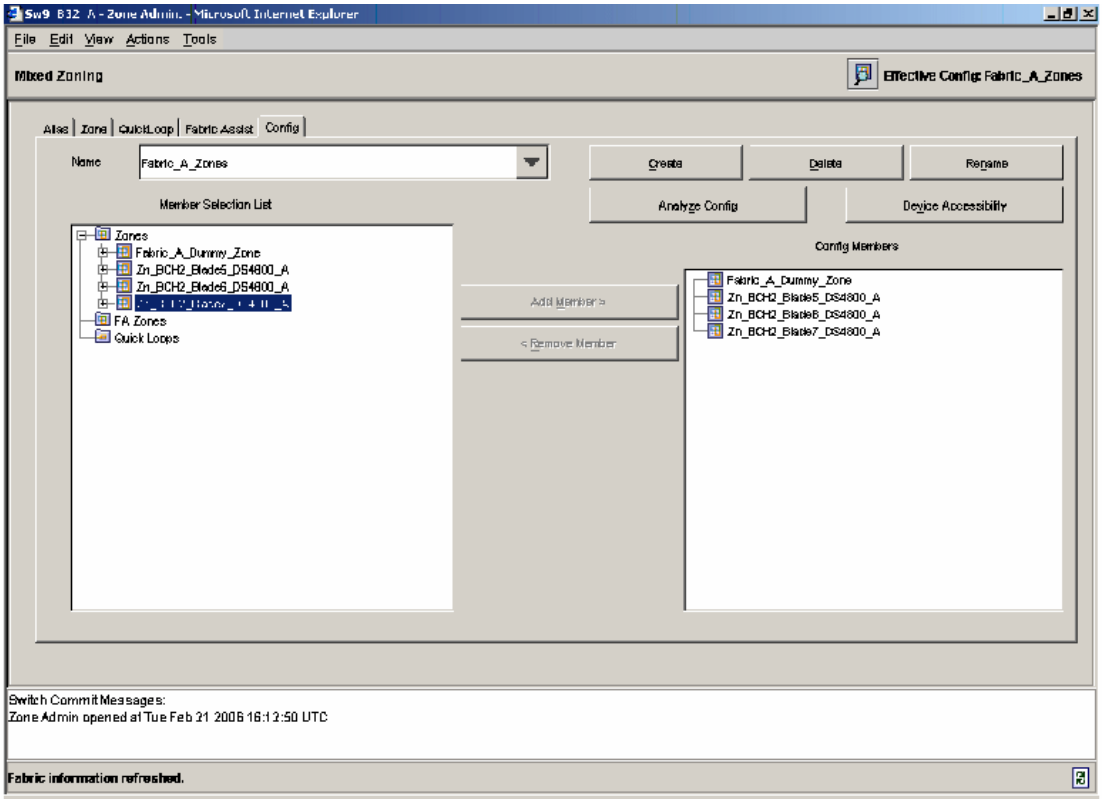

Figure 5-62 Adding members to a zone config

3. Enable the zone config with the new zone definitions. From the upper tool bar, select **Actions** and **Enable Config** (see Figure 5-63).

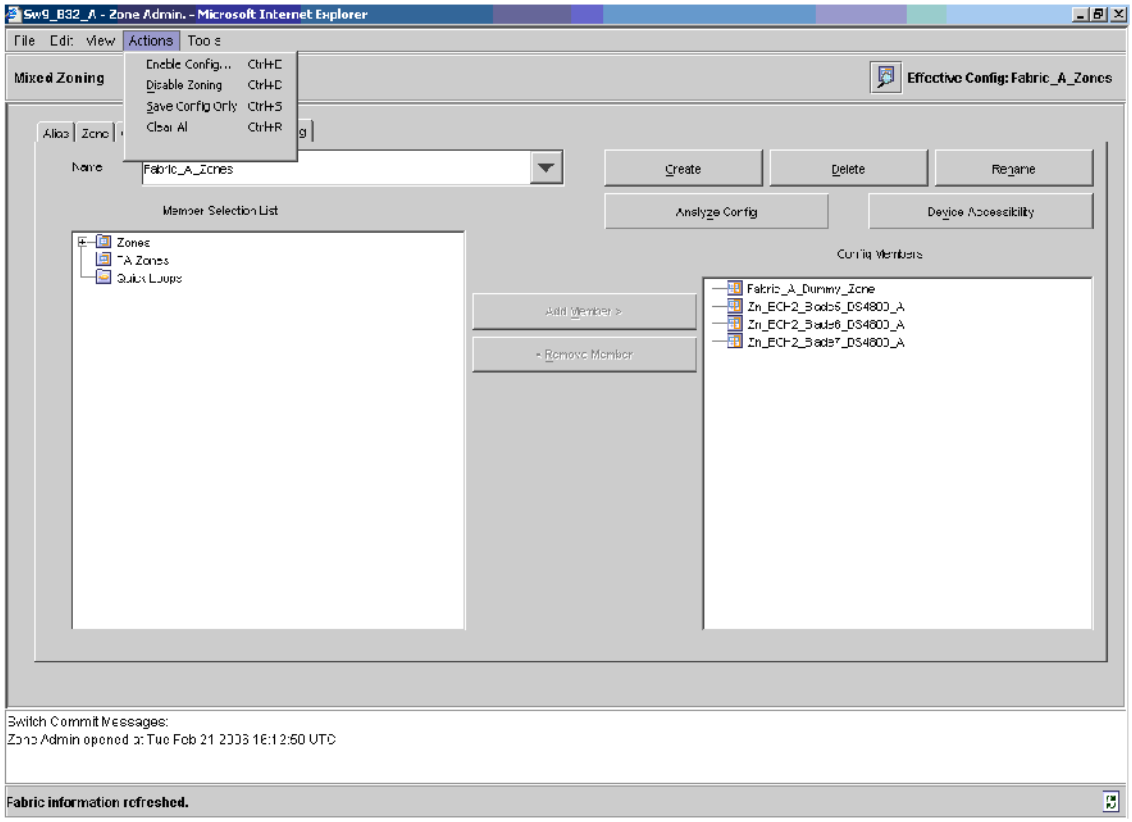

Figure 5-63 Options for zone actions

4. The Enable Config dialog box will appear. Select the proper zone config name and click **OK** (see Figure 5-64 on page 127).

Figure 5-64 Enable Config dialog box

5. A warning dialog box will appear. Click **Yes** (see Figure 5-65).

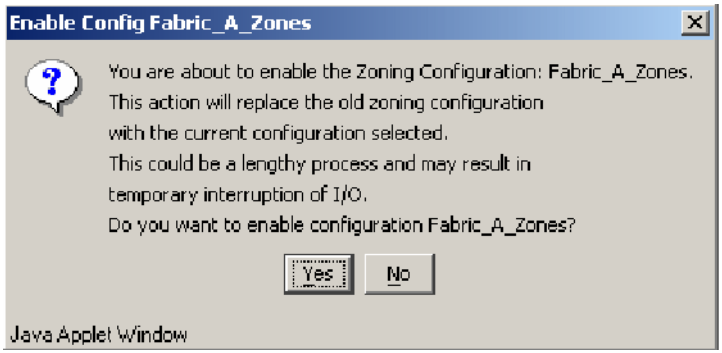

Figure 5-65 Enable Config warning

6. The activity window in the lower portion of window will inform you when the zone config commit is successful. Wait until the commit is complete before attempting other activities.
7. The new zone config is now effective.

> **Note:** If you do not enable the new config, then you should save the changes you have made. Any changes you make in the Zone Admin module are held in a buffered environment and does not update the zoning database until you save the changes. If you close the Zone Admin module without saving your changes, your changes are lost.

To save your changes, select **Actions** → **Save Config Only**.

8. Select **File** → **Print Summary** from the upper toolbar. Use the resulting printout to help the map server's WWNs to Storage Volumes (see Figure 5-66).

Note: You can also print out helpful device information from the switch Name Server window.

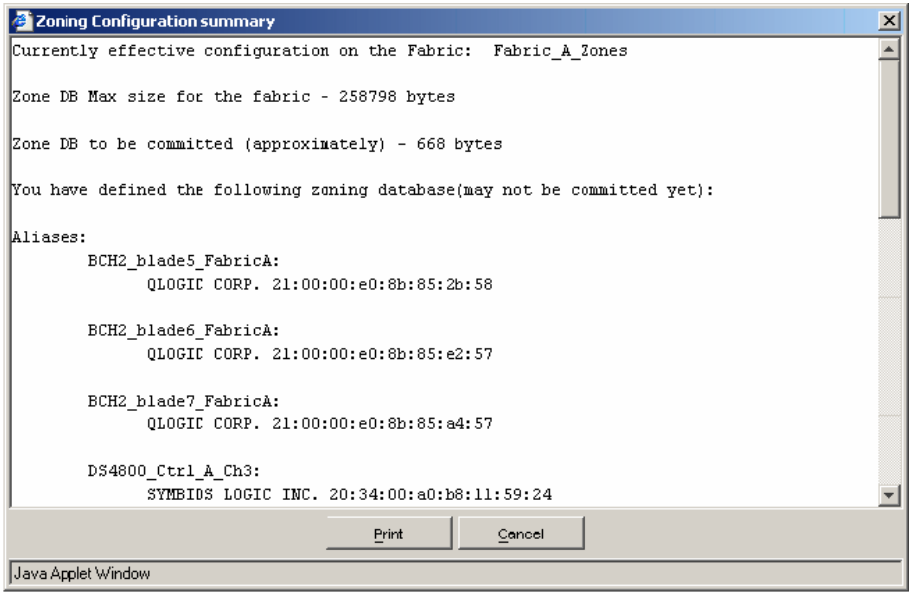

Figure 5-66 Zoning configuration summary

9. Repeat these steps for Fabric B.

Recommended: Back up each switch and switch module configuration.

a. Under Admin tools, select the **Configure** tab.
b. Select the **Upload/Download** subtab.
c. Insert the proper FTP server information.
d. Click **Apply** (see Figure 5-67 on page 129).

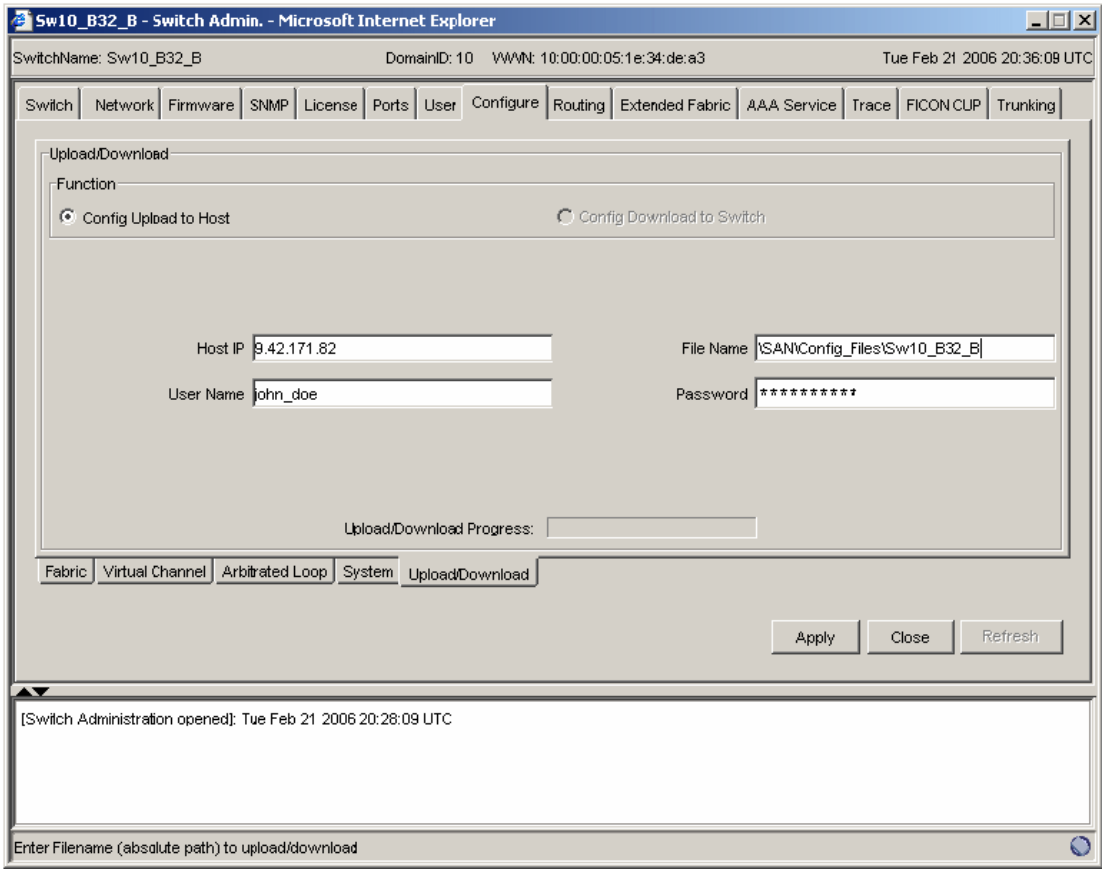

Figure 5-67 Download the switch information

10. Once you have completed Fabric A and B zoning, you can then use the storage management software to build and map storage volumes to specific servers. See “Mapping a logical disk to server blades” on page 135 for more information.

5.7.6 Using additional zoning tools

Brocade offers the administrator numerous tools to simplify the management of zones. Below are descriptions of some of these zoning management tools. Please reference *Brocade Web Tools Administrators Guide* for more detailed descriptions.

Zoning Wizards

There are several Zoning Wizards under the Tools menu in the upper tool bar that simplifies common zoning activities (see Figure 5-68). Often, SAN admins will forget to clean up the SAN database as devices are removed or replaced and the zone database will grow and include unnecessary definitions:

- Adding Un-zoned Devices to a zone. This is useful when you connect a new device to the SAN fabric.
- Removing Offline Devices from the zone database. This is useful when devices have been removed from the fabric due to failure or replacement.
- Replace Offline Devices simplifies replacing a device that may be included in many alias and zone definitions. An example would be when a FC Daughter card failed and was replaced.
- Define Device Alias steps an administrator through the steps to create new alias definitions.

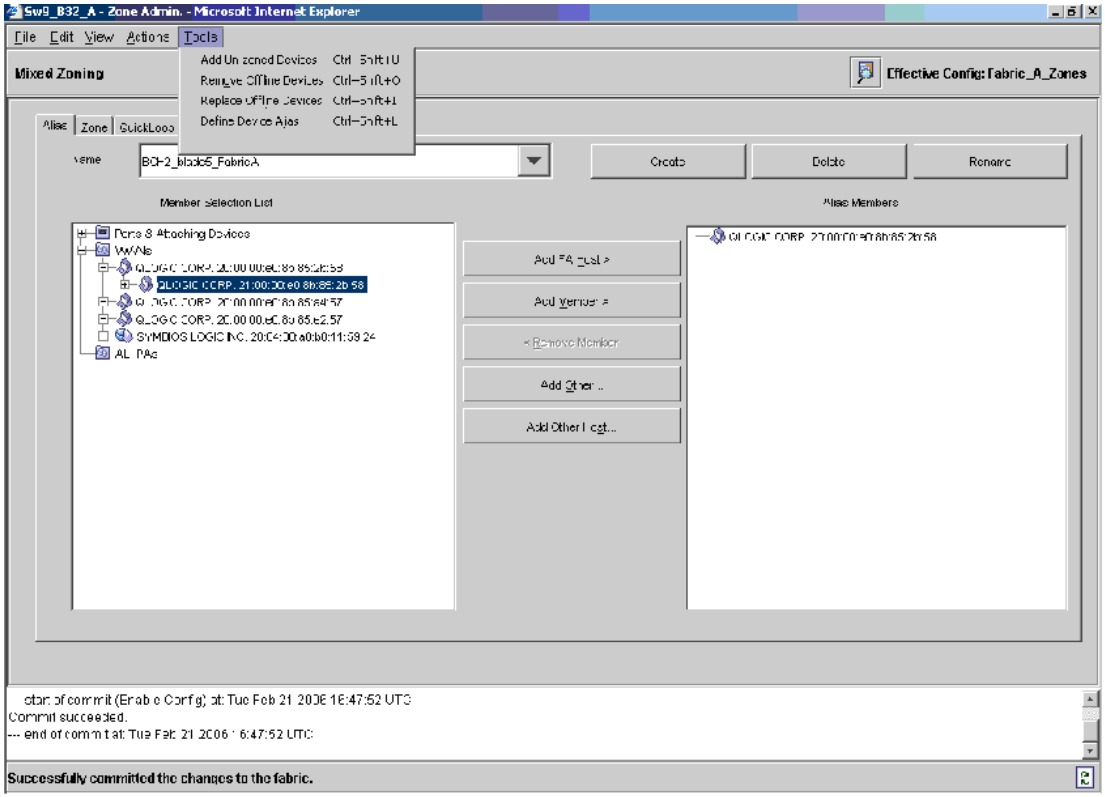

Figure 5-68 Wizards for common zone activities

Displaying an effective zone configuration

The enabled zone configuration window displays the actual content of the single zone configuration that is currently enabled on the fabric, whether it matches the configuration that was enabled when the current zone admin session was launched or last refreshed. The zones, QuickLoops, and FA zones are displayed, and their contents (ports, WWNs, and AL_PAs) are displayed next to them. Aliases are not displayed in the enabled zone configuration. If there is no active zone configuration enabled on the switch, a message is displayed to that effect.

To view detailed information about the enabled zone configuration:

11. Launch the Zone Admin module. The zone configuration in effect *at the time you launched the Zone Admin module* is identified in the top right corner. This information is automatically updated every 15 seconds. It is also updated if you manually refresh the Zone Admin module contents by clicking the refresh icon at the bottom right corner of the Zone Admin module, or when you enable a configuration through the Zone Admin module.
12. Use one of the following methods to identify the most recently effective zone configuration *without* saving or applying any changes you have made in the Zone Admin module:
    a. Select **File** → **View Effective Configuration** in the Zone Admin module.
    b. Click the enabled configuration button in the Zone Admin module.

Both of these actions display the Effective Configuration window (Figure 5-69). If no zone is enabled, a message is displayed, indicating that there is no active zoning configuration on the switch.

13. Optional: Click **Print** to print the enabled zone configuration details. This launches the print dialog.

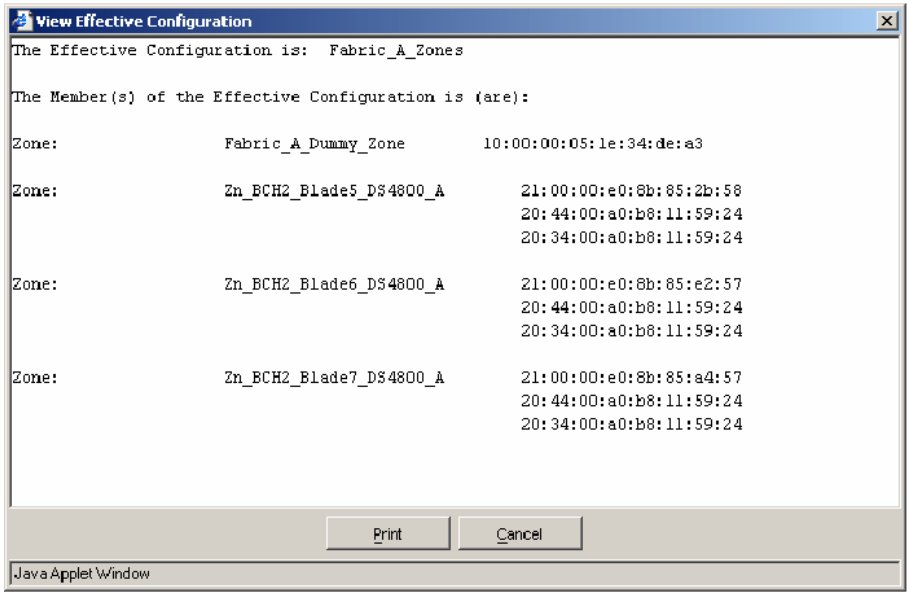

Figure 5-69 View Effective configuration window

Displaying the zone configuration summary

The zone configuration summary hierarchically lists all defined zoning elements known to the current Zone Admin session, whether any of the listed configurations has been enabled, and whether any of the lower level elements has been added as members of the higher level (aliases, zones, QuickLoops, and FA zones) structures. The zone configuration summary displays the entire contents of the fabric zoning database as it was at the time the Zone Admin session was launched, or the most recently saved or refreshed information, and any unsaved changes you make since the time the Zone Admin session is launched. It provides the name of the zone configuration that was enabled at the time you launched the Zone Admin session; however, keep in mind that the enabled configuration might have changed since then and that this window will not reflect those changes.

To view a zone configuration summary report:

1. Launch the Zone Admin module.
2. Select **File** → **Print Summary**.

   The Zone Configuration Summary window displays, as shown in Figure 5-70.

   It is important to note that the summary displays the information based on the changes just made. If current Zone Admin session changes have not yet been saved to the fabric, the information displayed here is different from what is seen from the switch.

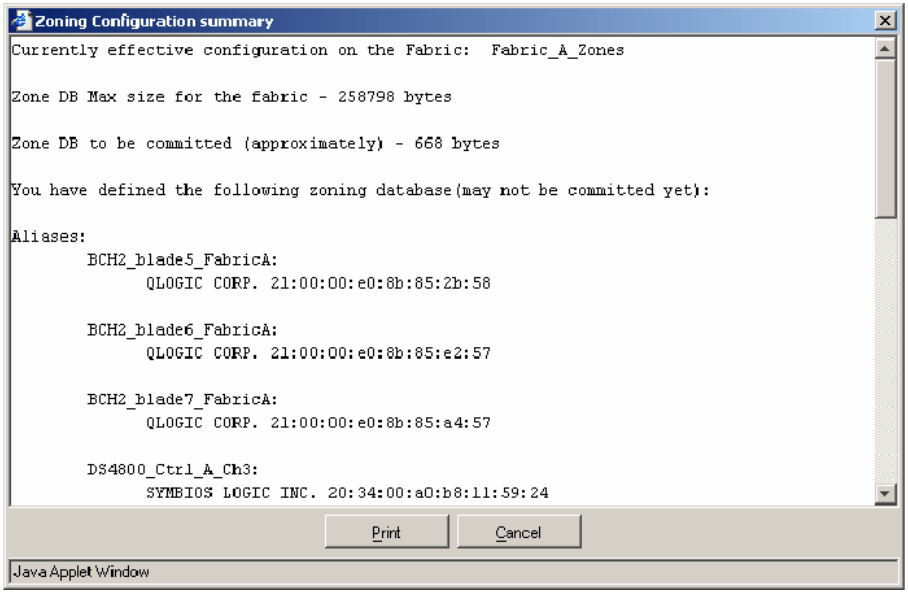

Figure 5-70 Zoning Configuration summary window

3. Optional: Click **Print** to print the zone configuration summary. This launches the print dialog.

Creating a configuration analysis report

The configuration analysis report lists the following:

- SAN components (ports, WWNs, and AL_PAs) that are not included in the configuration.
- SAN components (ports, WWNs, and AL_PAs) that are contained in the configuration but not in the fabric.

To create a configuration analysis report:

1. Launch the Zone Admin module.
2. Click the **Config** tab. Select a configuration to be analyzed from the Name drop-down list.
3. Click **Analyze Config**.

   A dialog displays, asking if you want to refresh the fabric before running the analysis. Click **Yes**.
4. The configuration analysis window displays.

Displaying the Initiator/Target Accessibility Matrix

The Initiator/Target Accessibility Matrix shows a list of initiators and a list of targets and indicates which initiator can access which target, as shown in Figure 5-71 on page 135.

To display an Initiator/Target Accessibility Matrix:

1. Launch the Zone Admin module, as described in “Zoning overview” on page 115.
2. Click the **Config** tab.

   Select a configuration to be analyzed for device accessibility from the Name drop-down list.
3. Click **Device Accessibility**.

   The Initiator/Target Accessibility Matrix for Config- Device Selection dialog displays.
4. Select the devices you want displayed in the accessibility matrix; click the radio button to select all devices in the fabric or to select a subset of the devices.

   If you select a subset, you must click the devices from the Select Devices list and click **Add** to move them to the Evaluate for Accessibility list.
5. Click **OK**.

   The Initiator/Target Accessibility Matrix displays (Figure 5-71 on page 135). You can *mouse over* a target to display the symbolic name of the device. In addition, you can right-click the device nodes and click **View Device Detail** to display detailed information about the selected device.

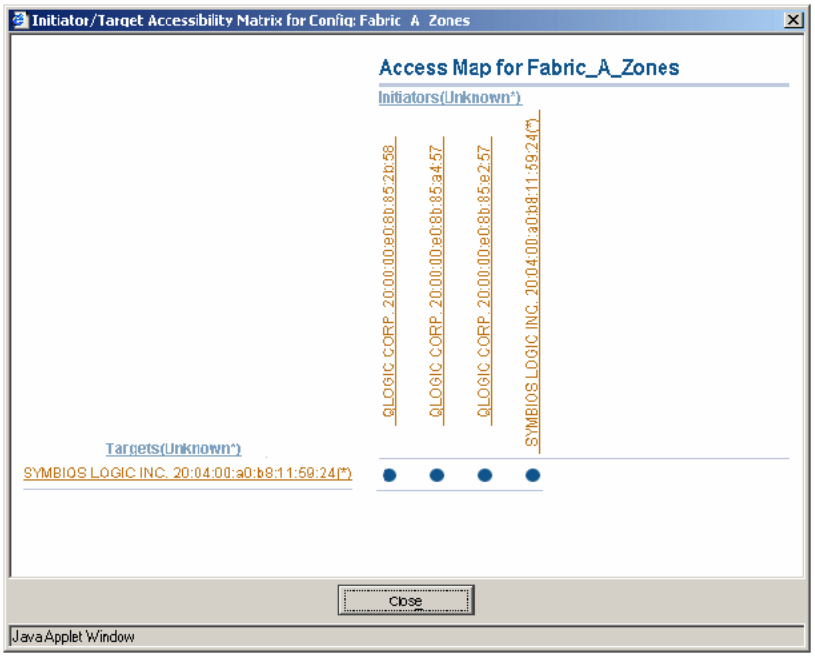

Figure 5-71 Initiator/Target Accessibility Matrix for Config: Fabric_A_Zones

5.8 Mapping a logical disk to server blades

The following section covers the host configuration procedure on the DS4800 storage subsystem. The DS4800 storage subsystem must be accessible out of band over the TCP/IP network; connect to the DS4800 storage subsystem using Storage Manager 9.15. The DS4800 software downloads are available at:

http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-62161

5.8.1 Host definition

Once the logical disks have been built using the storage management software, you must define host groups to represent the server blades and map these to their respective logical disks on the DS4800.

Figure 5-72 shows three logical disks that have been created, one for each blade server.

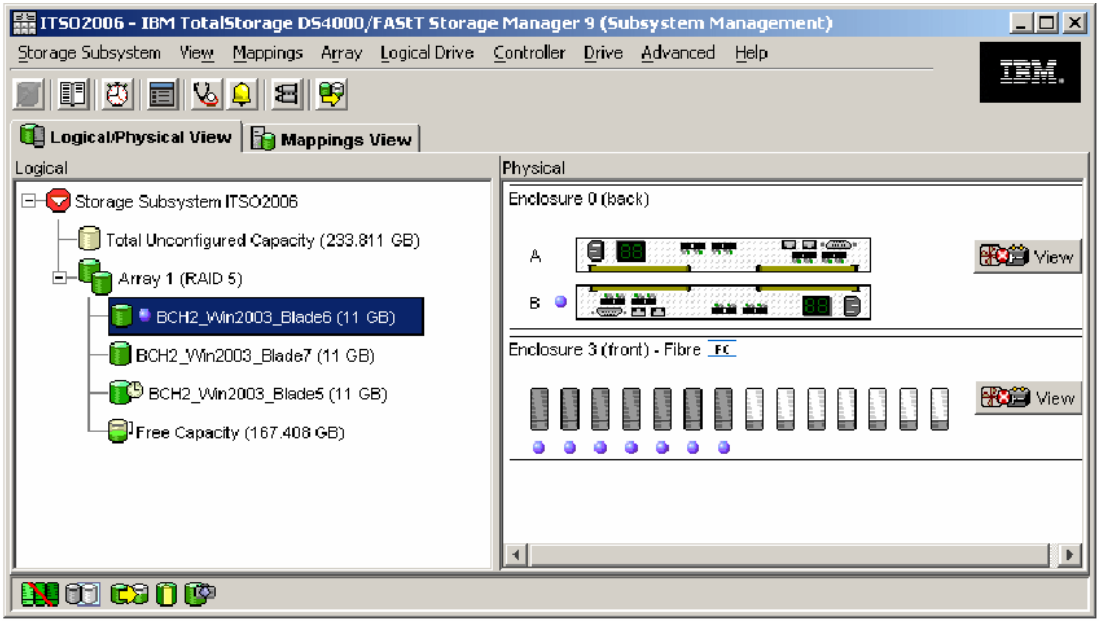

Figure 5-72 View of the storage volumes

For organizational purposes, we will create a group of servers called a host group. In our case, we will create a host group to represent all the blade severs in our specific BladeCenter chassis *BCH*. Select **Mappings** under the Host Group; we will create one host to represent each blade server within the BladeCenter chassis.

Note: Prior to defining your host definition, appropriate zoning should have been performed. See “Zoning” on page 275 or 5.7, “Zoning to control device connectivity” on page 115.

5.8.2 Defining a host group

In this section, perform the following steps to define a host group:

1. View and right-click the storage subsystem icon (Figure 5-73) to define a Host Group. The Host Group name and how you group are your choices.

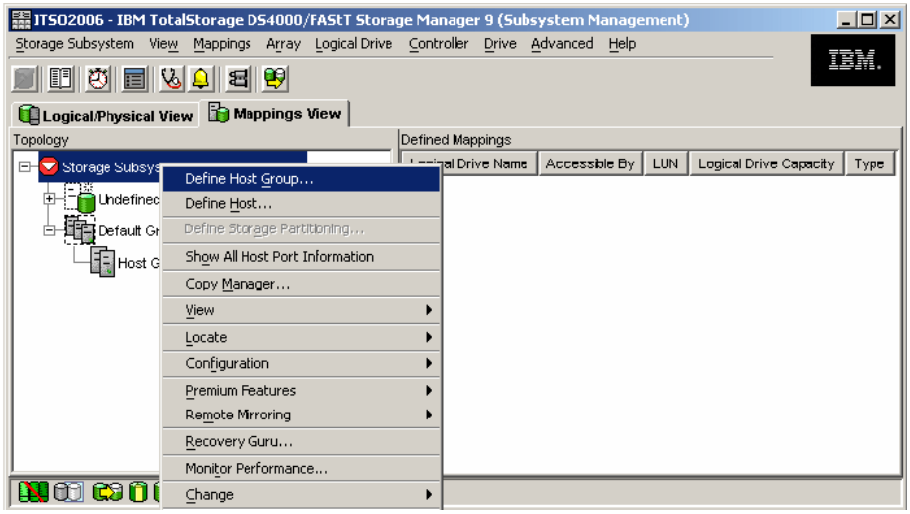

Figure 5-73 Define host group

5.8.3 Defining hosts

In this section, you will define a host:

1. Right-click the BladeCenter Host Group and select **Define Host**, as shown in Figure 5-74.

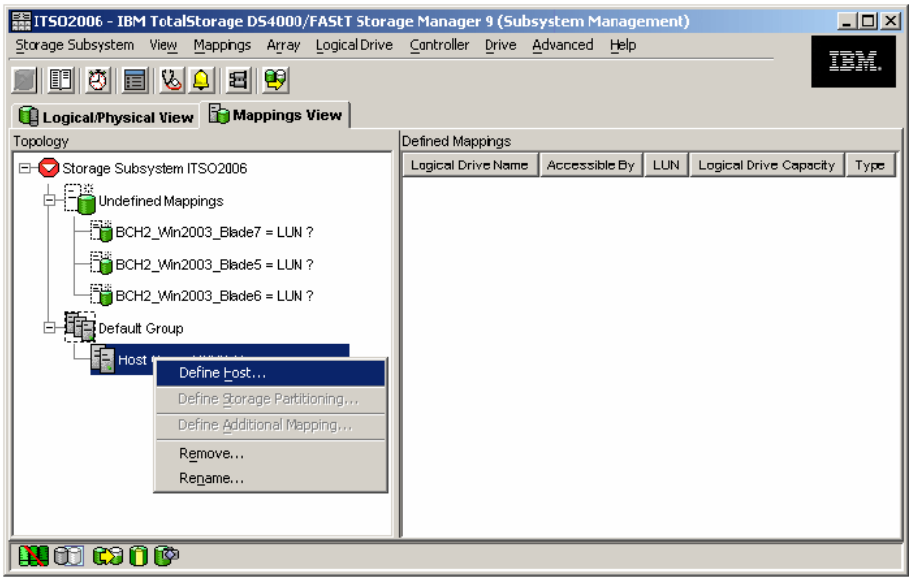

Figure 5-74 Define the host

2. Name the host to reflect one of the server blades, as shown in Figure 5-75 on page 139.

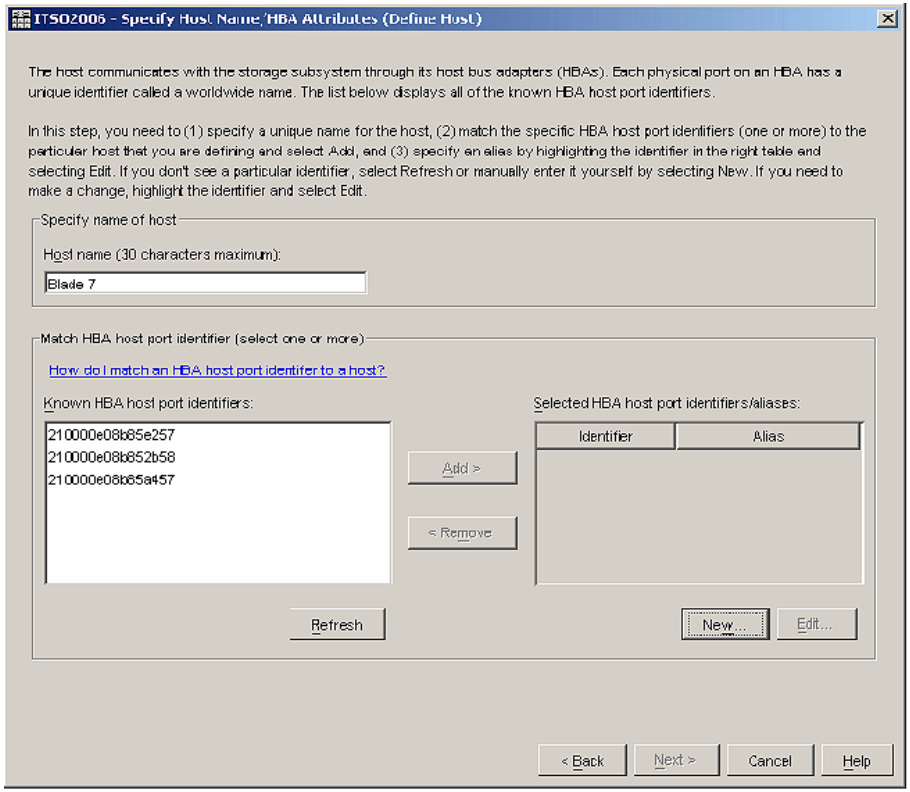

Figure 5-75 Naming the host

3. The server blades use dual ported FC daughter cards that have two WWPNs. Select the two WWPNs associated with the specific blade server and click **Add**.

4. Create a descriptive Alias for each WWPN. Make sure to differentiate between the two ports (for example, Port 1 and Port 2), as shown in Figure 5-76.

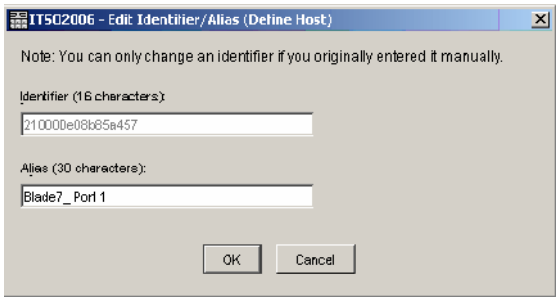

Figure 5-76 Naming the WWN for the server blades

5. Specify the host OS type and click **Next**, as shown in Figure 5-77.

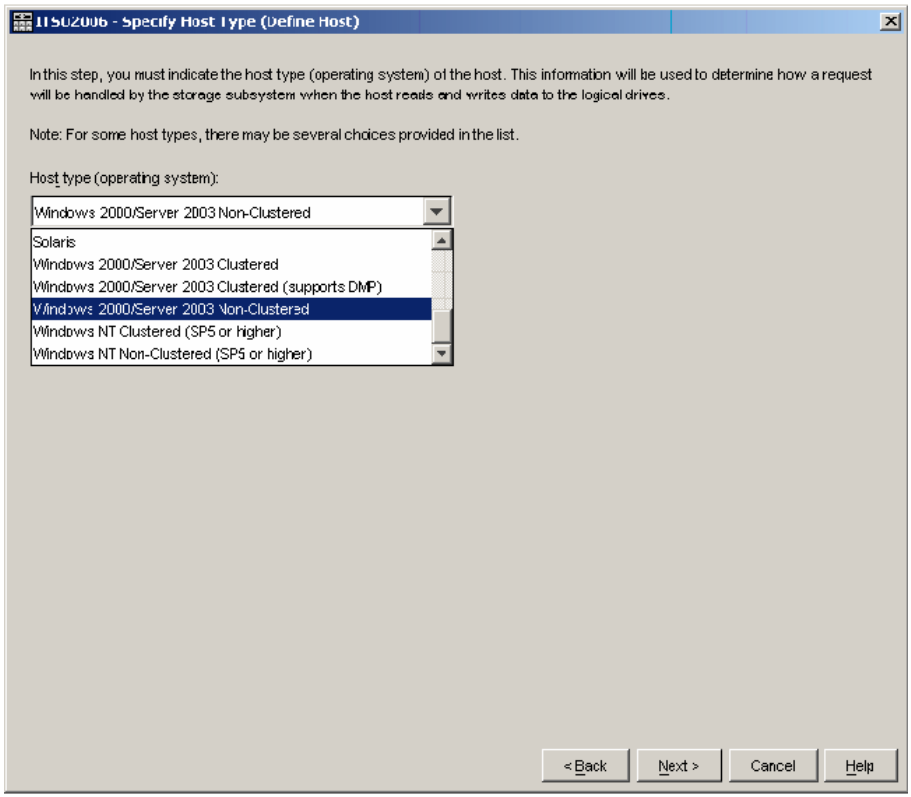

Figure 5-77 Define the Host OS Type

6. A dialog box will ask you if the host will share the logical drive with other hosts. Answer **Yes** or **No** depending on your solution. Typically, only clustered servers share logical drives.
7. Verify the final configuration and select **Finish** to complete the host definition, as shown in Figure 5-78.

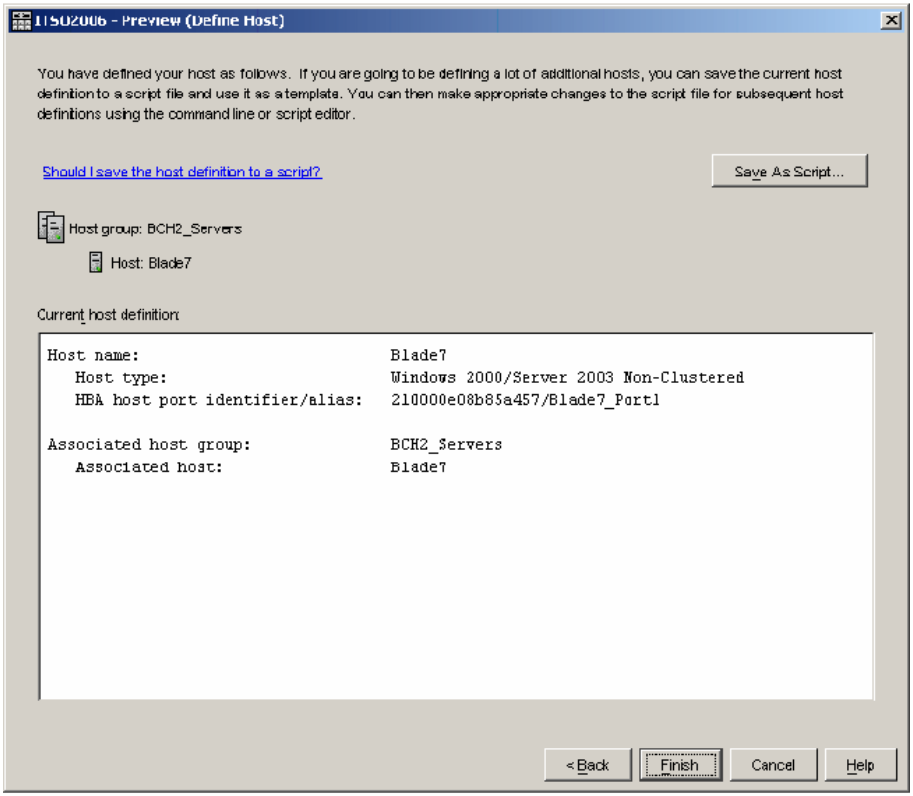

Figure 5-78 Finalizing the host configuration

8. Repeat the steps for both FC ports for each server blade. See Figure 5-79 for an example.

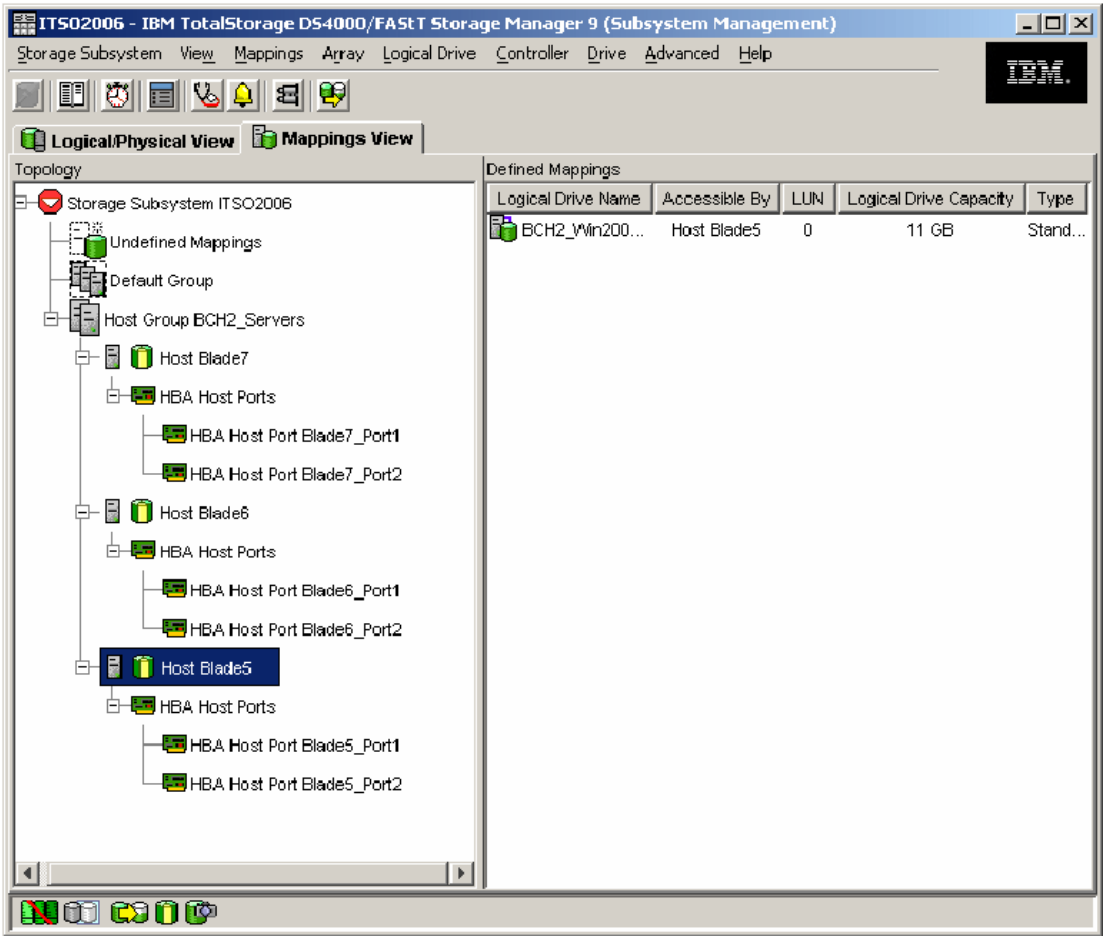

Figure 5-79 All host ports have been defined

5.8.4 Define storage partitioning

In this section, perform the following steps to define the storage partition:

1. Right-click one of the server blade hosts to define the Storage Partitioning, as shown in Figure 5-80.

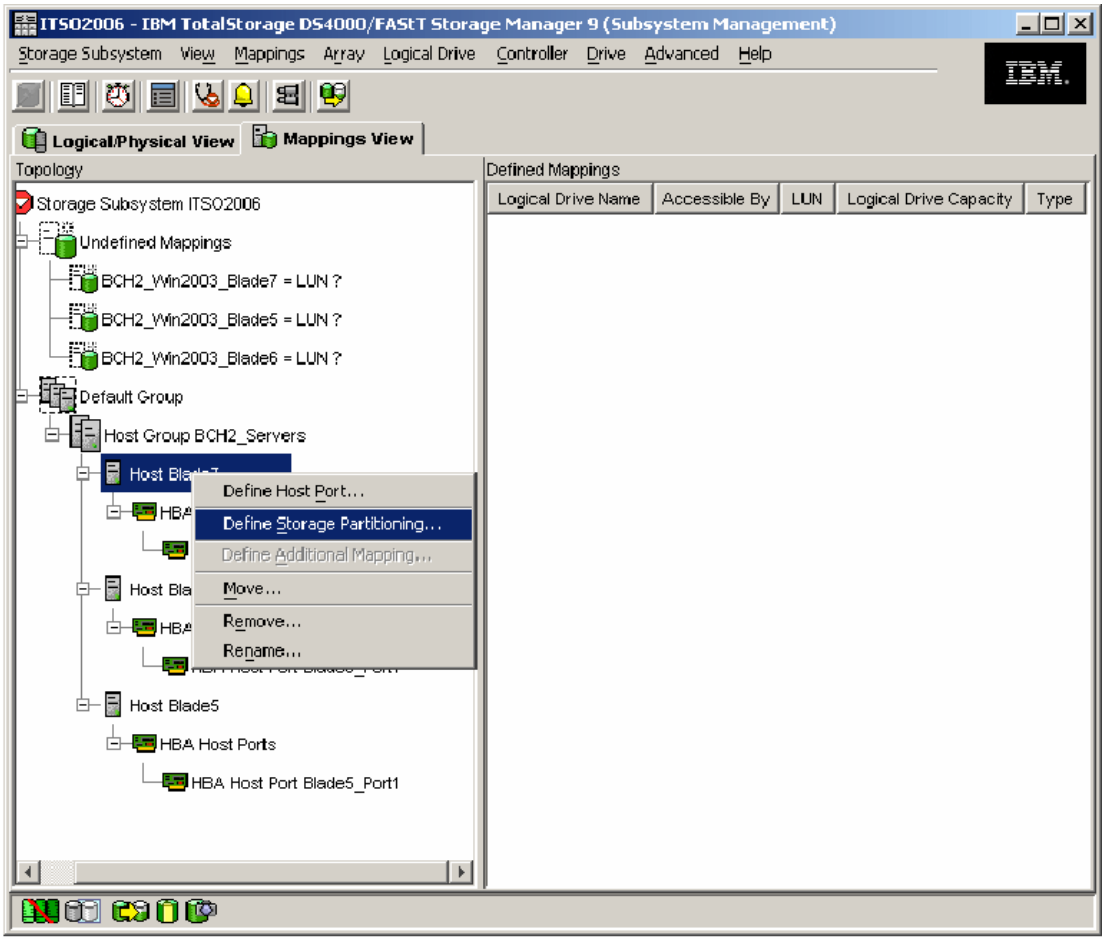

Figure 5-80 Defining storage partitions

2. Select the logical drive that is to be mapped to the server blade and click **Add**. Assign a LUN number to the logical drive. Then click **Finish** (see Figure 5-81).

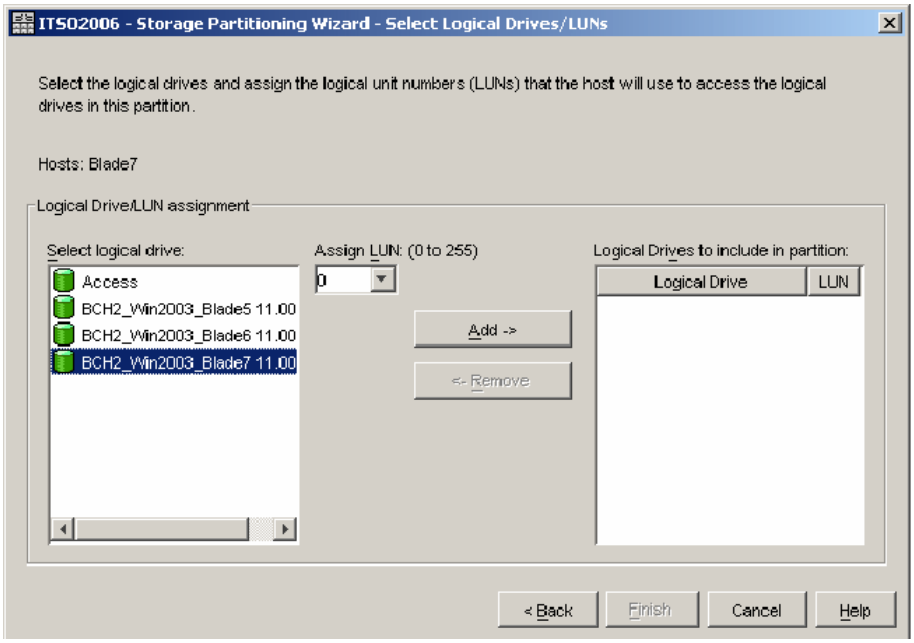

Figure 5-81 Mapping logical drives to Blade Server hosts

3. Repeat the steps to map the logical disks to each server blade.
4. Take the necessary steps within the blade server OS to discover and format the logical drives. Figure 5-82 on page 145 shows an example of a Windows 2003 server blade.

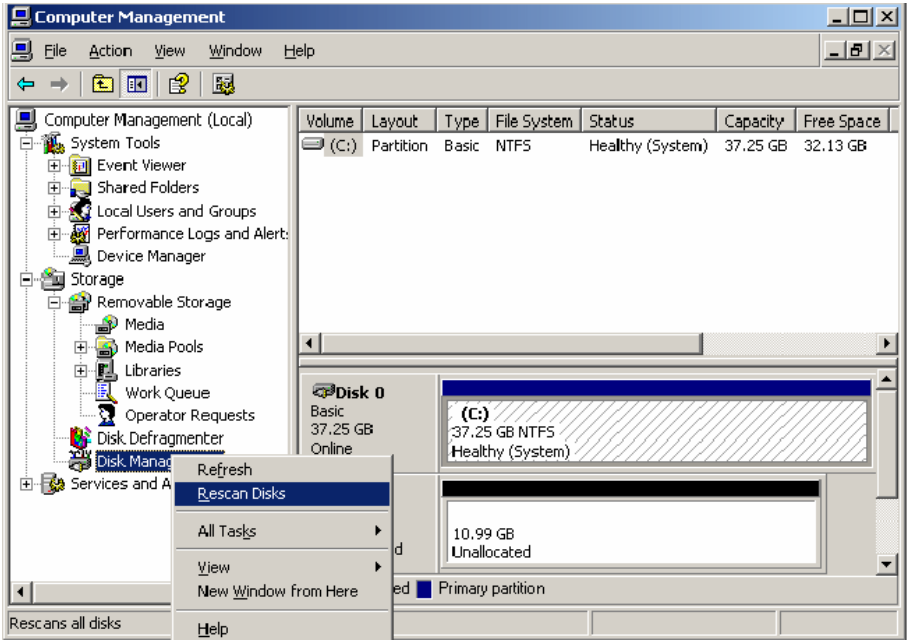

Figure 5-82 Discovering the logical drives

5. Repeat the mapping of the logical disks for each server blade.

6

McDATA SAN configuration

In this chapter, we discuss how to set up and configure the McDATA 4Gb Fibre Channel Switch Modules to attach to a SAN storage environment.

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6.1 IBM BladeCenter configuration

In this section, we begin with the setup and configuration of our IBM BladeCenter. To do so, please refer to Chapter 4, “IBM BladeCenter setup and configuration” on page 35 and follow the instructions prior to completing the steps in the following sections. Figure 6-1 shows the SAN topology we used in our lab environment. It is assumed that LUN(s) have been created and assigned on the storage system prior to this SAN implementation.

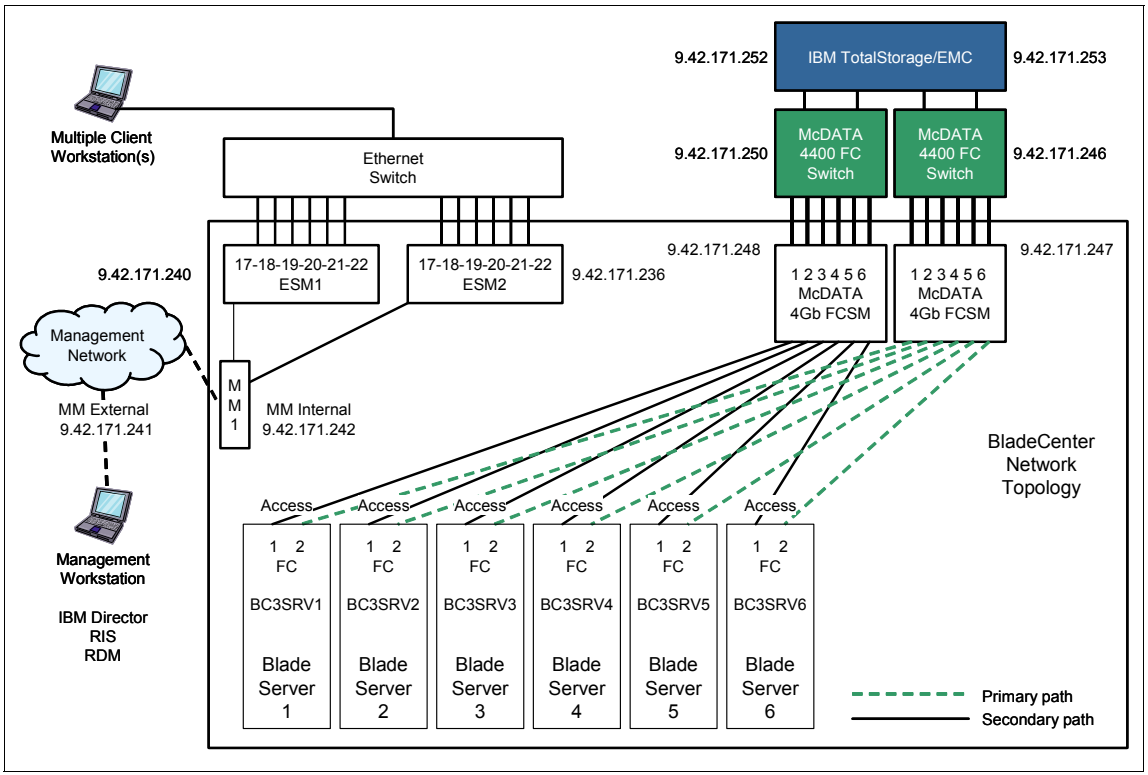

Figure 6-1 IBM BladeCenter utilizing McDATA 4Gb FCSM and McDATA 4400 Fabric attached DSxxxx

6.2 McDATA 4Gb Fibre Channel Switch Modules setup

In this section, we will configure our McDATA 4Gb Fibre Channel Switch Module.

1. Point your browser to the IP Address of the McDATA FCSM. You will need to make sure your current Java version is at or above 1.4.2.
2. Log in to the device.

3. Click **OK** to the Certificate dialog prompt to continue.
4. Click the **Add** button to display your fabric (see Figure 6-2).

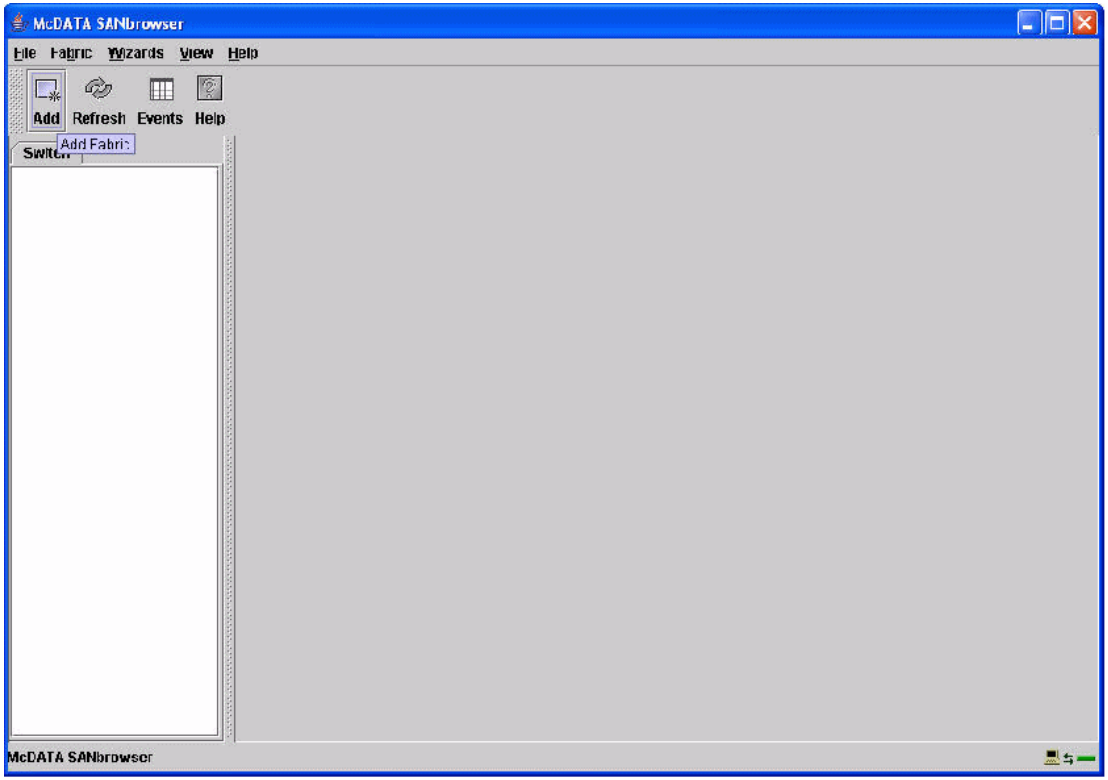

Figure 6-2 McDATA SANbrowser window

5. Enter the IP Address, Login Name, and Password. Click **Add Fabric** to continue (Figure 6-3).

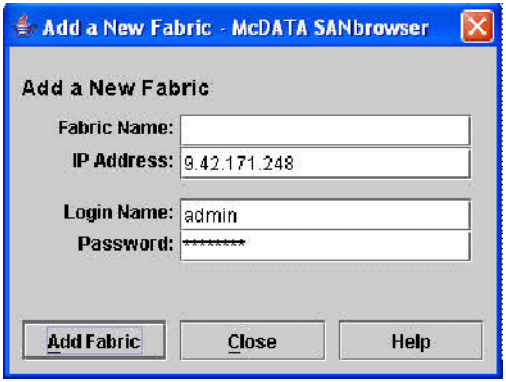

Figure 6-3 Add a New Fabric window

6. From the Topology window in the left pane, click the drop-down tree and double-click the IP address. Next, select your switch (in our example, McDATA4Gb). Select **Switch** → **Switch Properties...** (Figure 6-4).

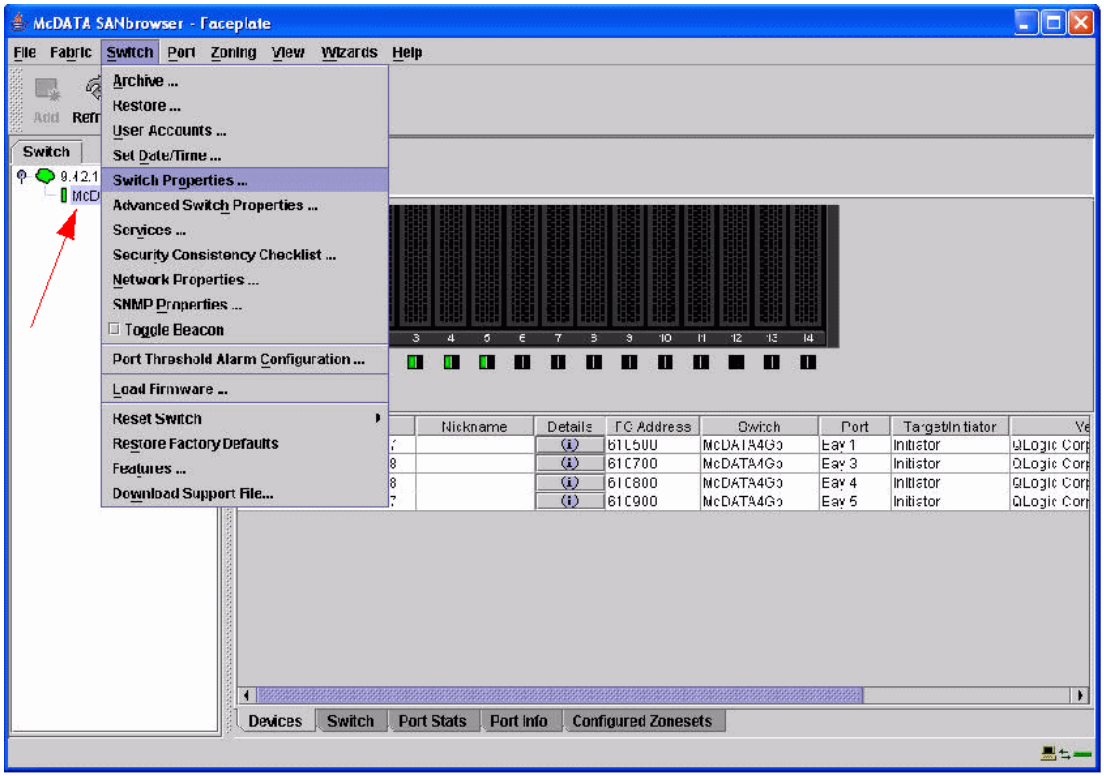

Figure 6-4 McDATA SANbrowser - Faceplate window

7. From the Switch Properties dialog (Figure 6-5), enter a symbolic name for your switch. Click the **Enable** radio button next to Domain ID lock (1). Enter a Unique Domain ID ranging from 1-31 (2). In our example, we selected 2 for the DID. Click **OK** to continue.

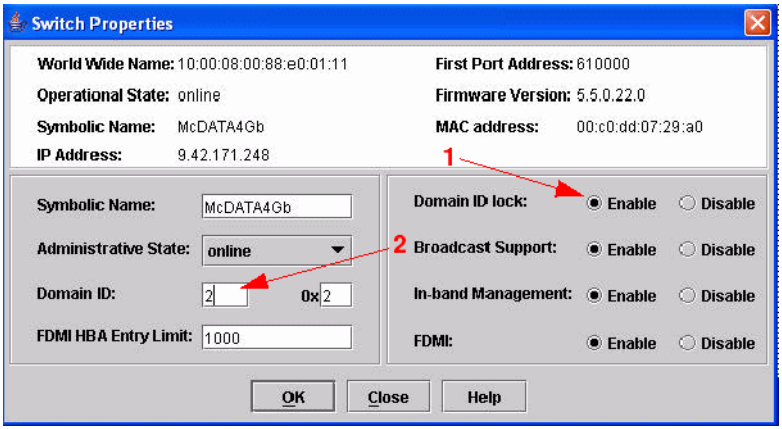

Figure 6-5 Switch Properties window

Note: Domain ID lock on a McDATA BladeCenter switch is the same as the Insistent Domain ID setting on McDATA Sphereon switches and Intrepid Directors. This setting will allow the switch to maintain its configured domain ID during a fabric merge or rebuild.

8. Click **OK** when the Updating Switch Properties dialog box appears.

9. From the McDATA SANbrowser - Faceplate window, select your desired E-Port. Next, select **Port** → **Port Properties** (Figure 6-6). In our example, we designated port 19.

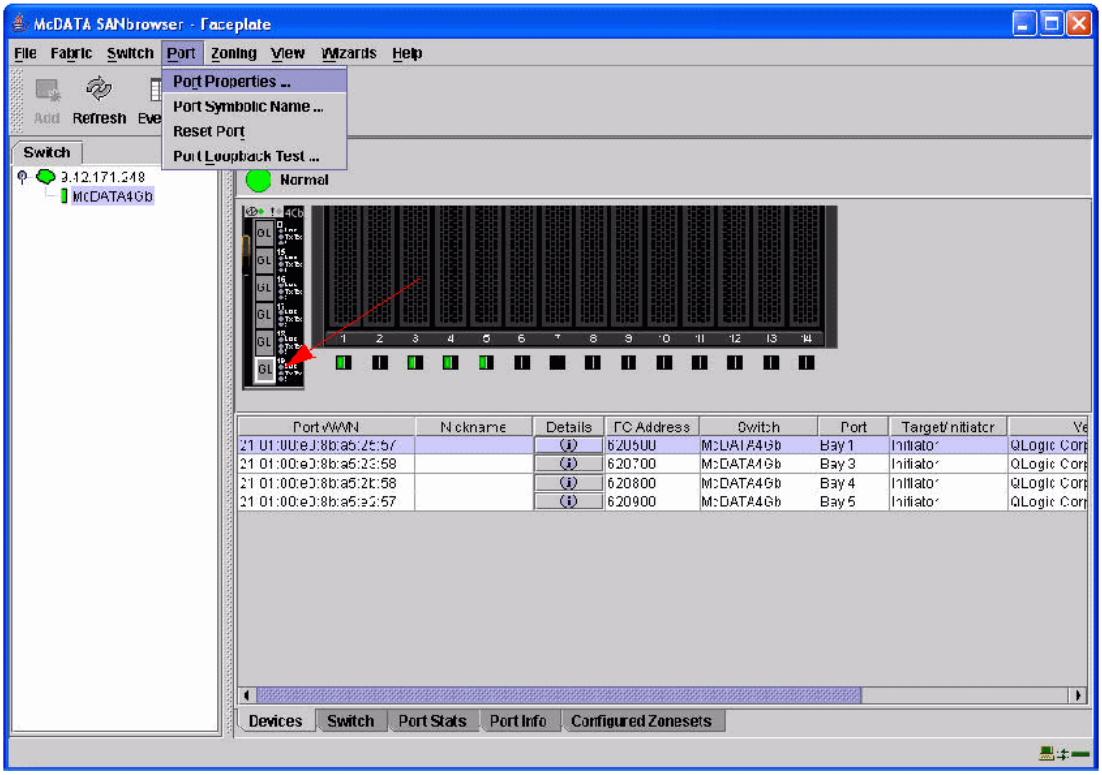

Figure 6-6 McDATA SANbrowser - Faceplate window

10. From the Port Properties dialog box (Figure 6-7), verify the following settings are true for port 19:
    a. Port State = Online
    b. Port Speed = Auto-detect
    c. Port Type = G-port
    d. I/O Stream Guard = Auto
    e. Device Scan = Enable
11. Click **OK**.

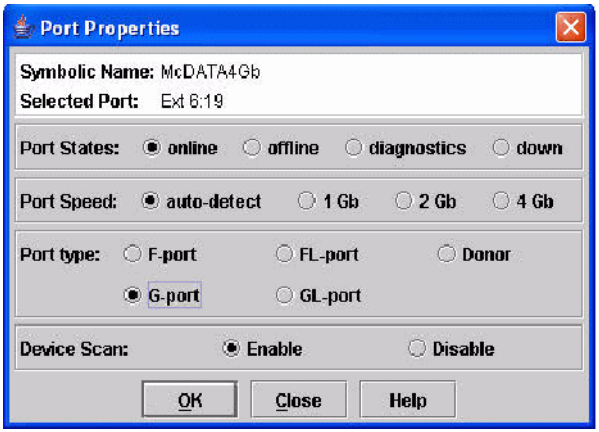

Figure 6-7 Port Properties window

12. From the Faceplate, select the **Configured Zoneset** tab (Figure 6-8). Verify there are no zones configured on the switch. If there are zones configured, see the manufacturer user's guide for instructions on how to remove the zone set and zones.

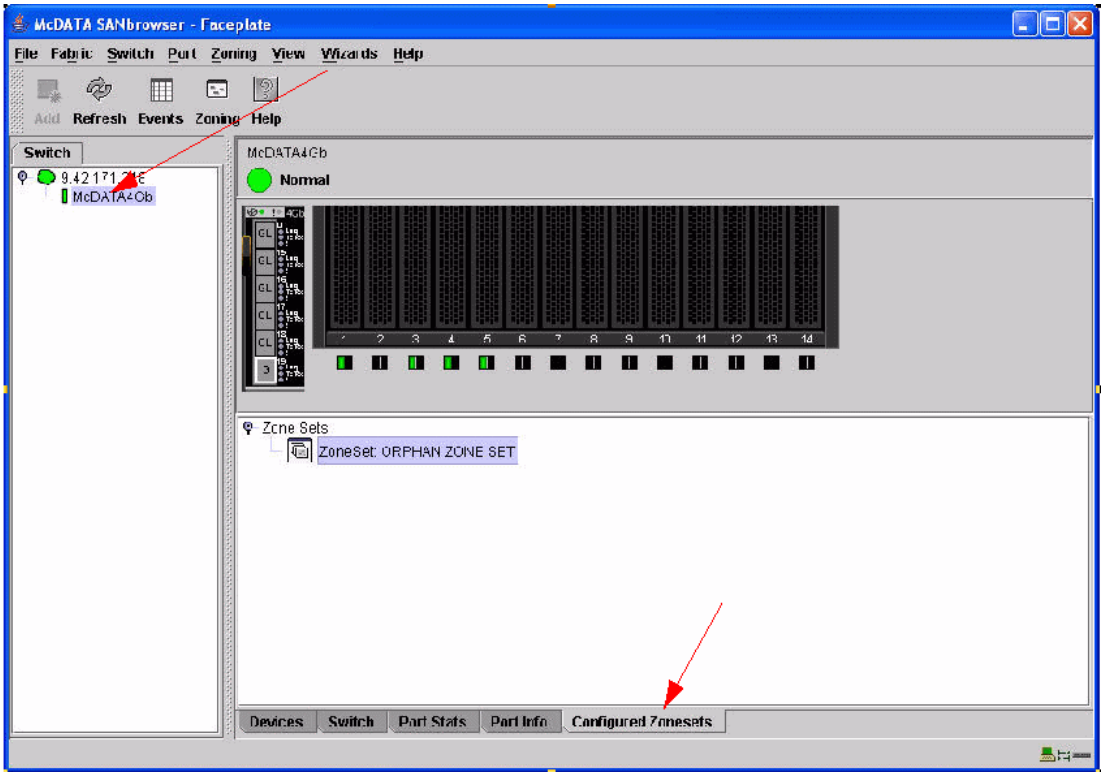

Figure 6-8 McDATA SANbrowser - Faceplate window

6.3 McDATA Edge Switch Sphereon 4400 configuration

In this section, we will perform the configuration for the Sphereon 4400. Please complete the following steps:

1. Launch your switch's IP address from your browser. Log in using your User ID and password (see Figure 6-9).

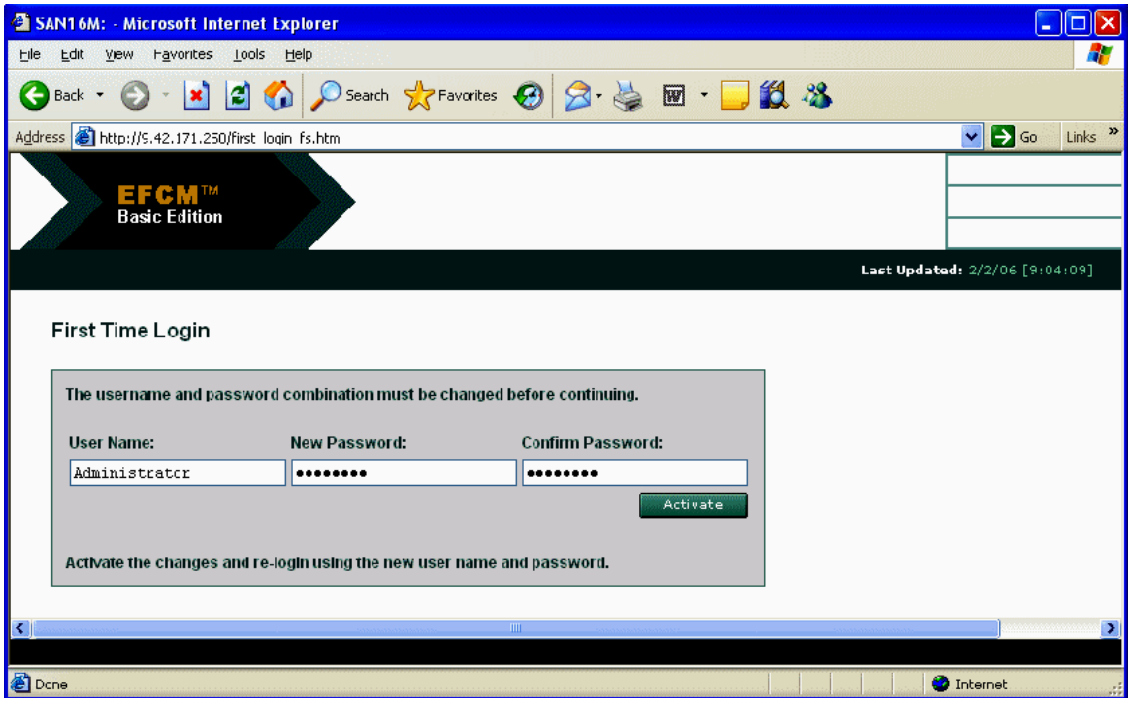

Figure 6-9 Edge Switch Sphereon 4400 login window

2. During the initial log-in to the switch, you will be required to change the password. Record your new password and store it. Click **Activate** to initiate new password.
3. From the initial window, click **View Details** to view the switch details.

Port configuration

4. From the action menu, select **Configure** → **Ports** → **Basic Info** (Figure 6-10).

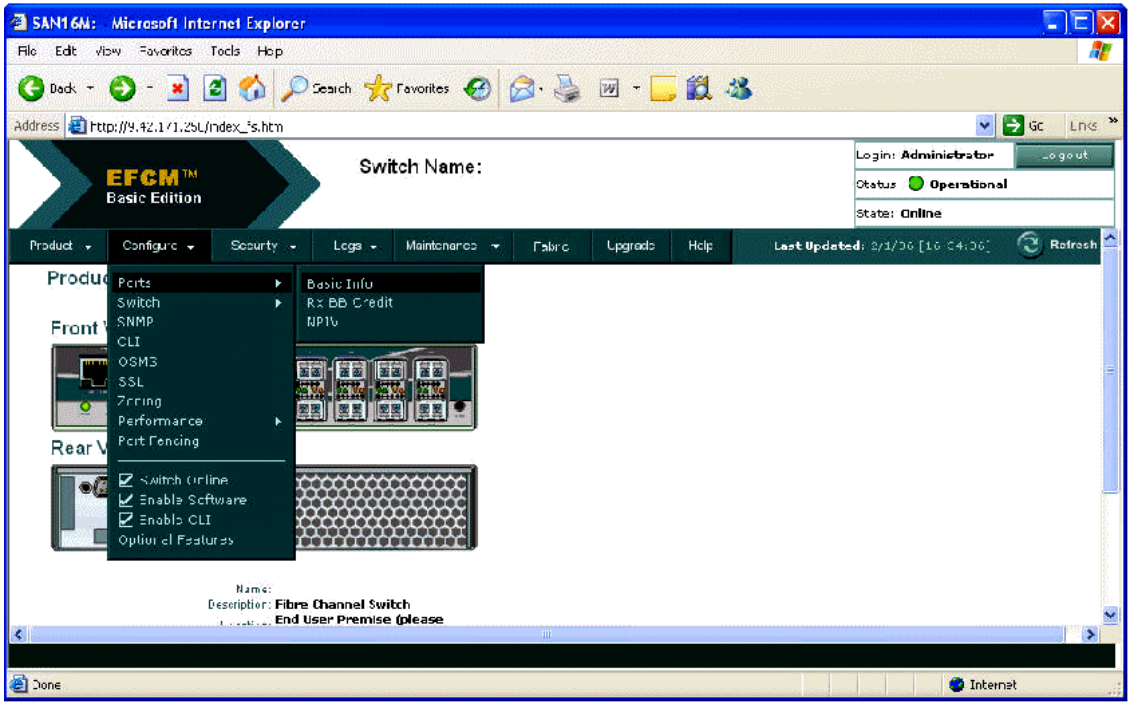

Figure 6-10 SAN16M window

5. In the port configuration dialog window, you may optionally assign a name to the port and define the connection type. In this example, we assigned port 0 to an E_Port type. By assigning the port type to be specifically an E_Port, no N_Ports are allowed to log in to the switch (see Figure 6-11).

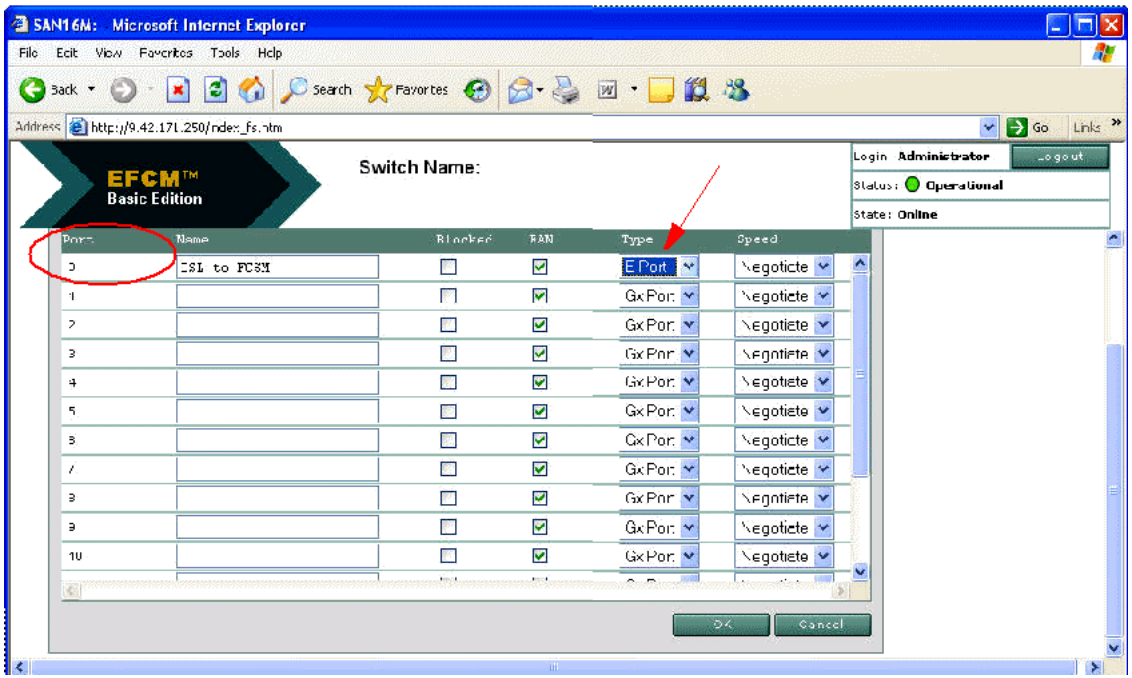

Figure 6-11 Port configuration dialog window

Domain ID configuration

6. Set the switch offline. Select **Configure** → **Switch Online**. Uncheck the check box (see Figure 6-12).

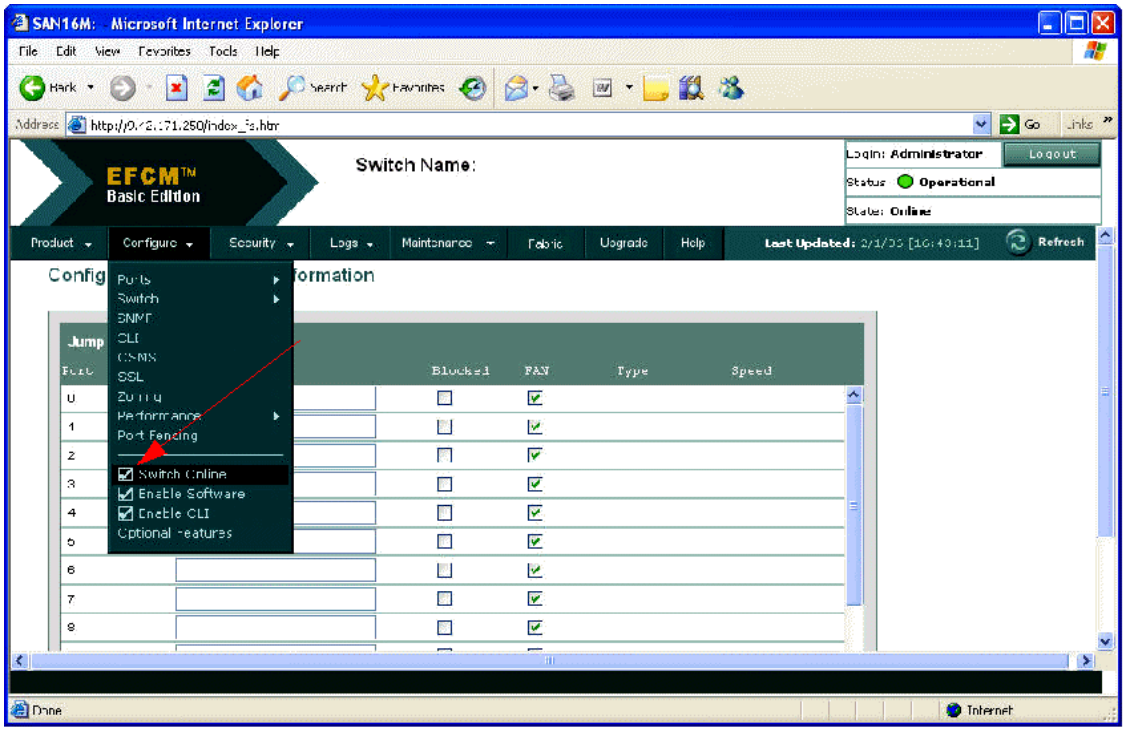

Figure 6-12 SAN16M window

7. Select **Configure** → **Switch** → **Parameters** (Figure 6-13).

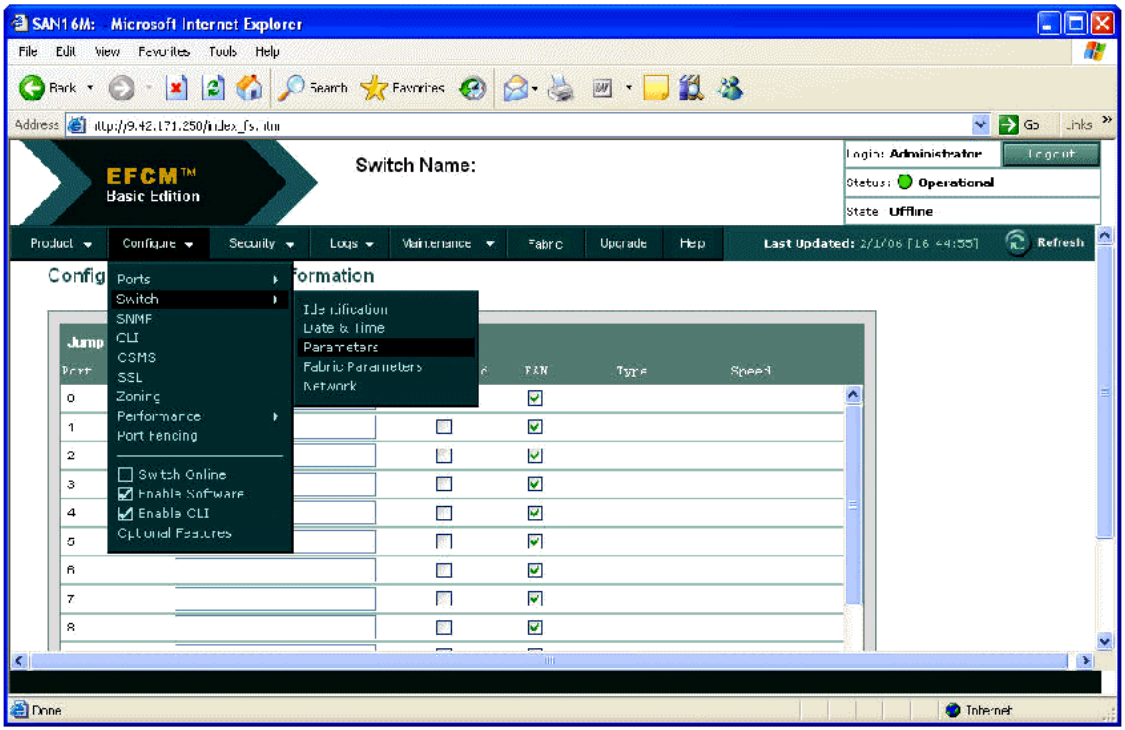

Figure 6-13 Configure dialog window

8. From the Configure → Switch → Parameters settings window (Figure 6-14), select **Insistent Domain ID** (1). Next, define a unique ID ranging between 1 and 31 (2). In our example, we use Domain ID 3. Click **OK**.

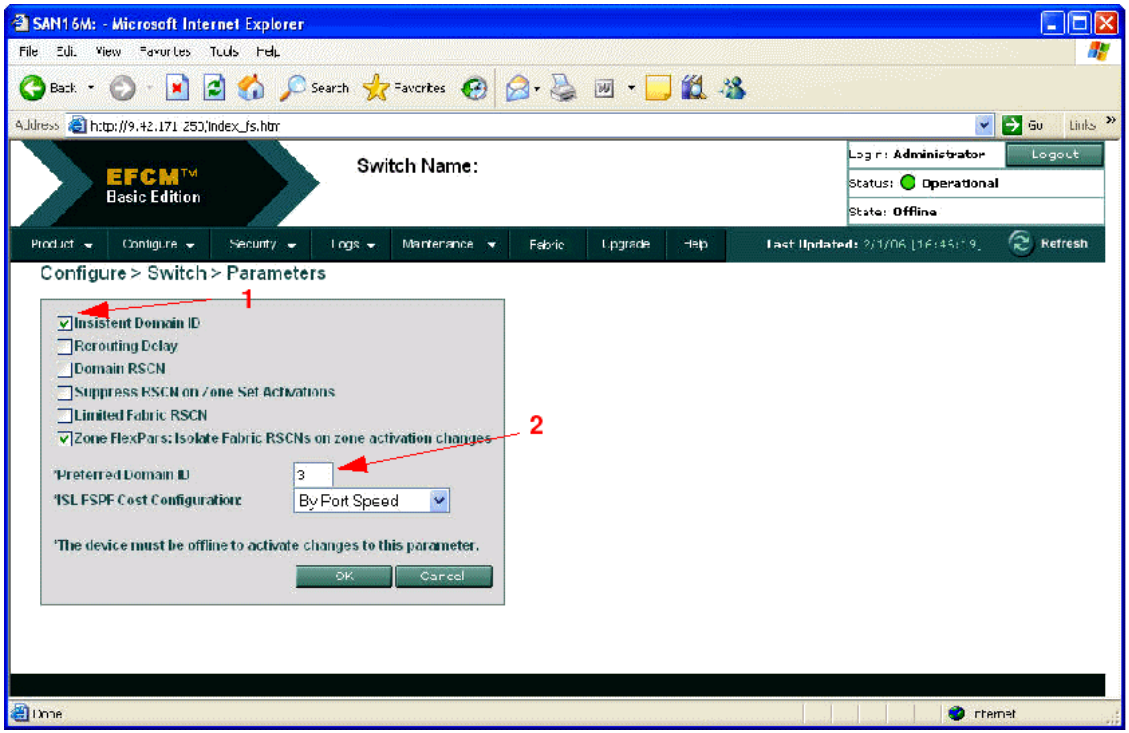

Figure 6-14 Configure → Switch → Parameters settings window

9. To set the switch back to an online state, select **Configure** → **Switch Online** and check the check box (Figure 6-15).

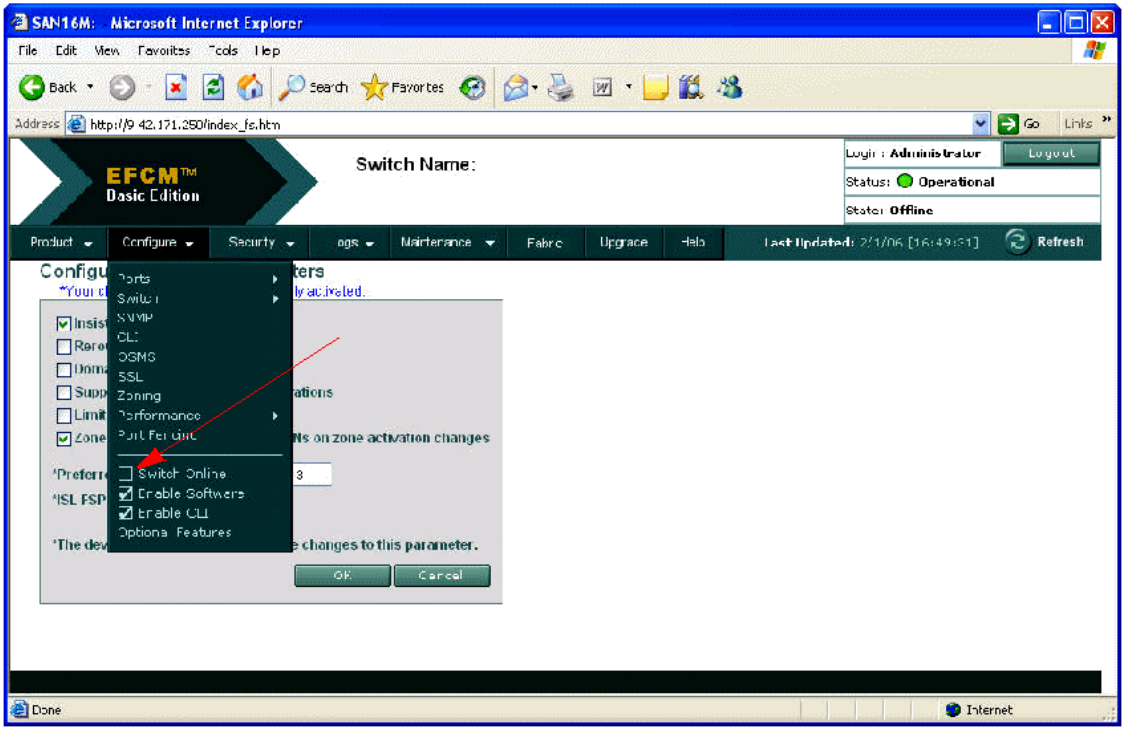

Figure 6-15 Configure window

Connect cables- ISL Verification

10. From the action menu, select **Fabric** → **Fabric View** (Figure 6-16).

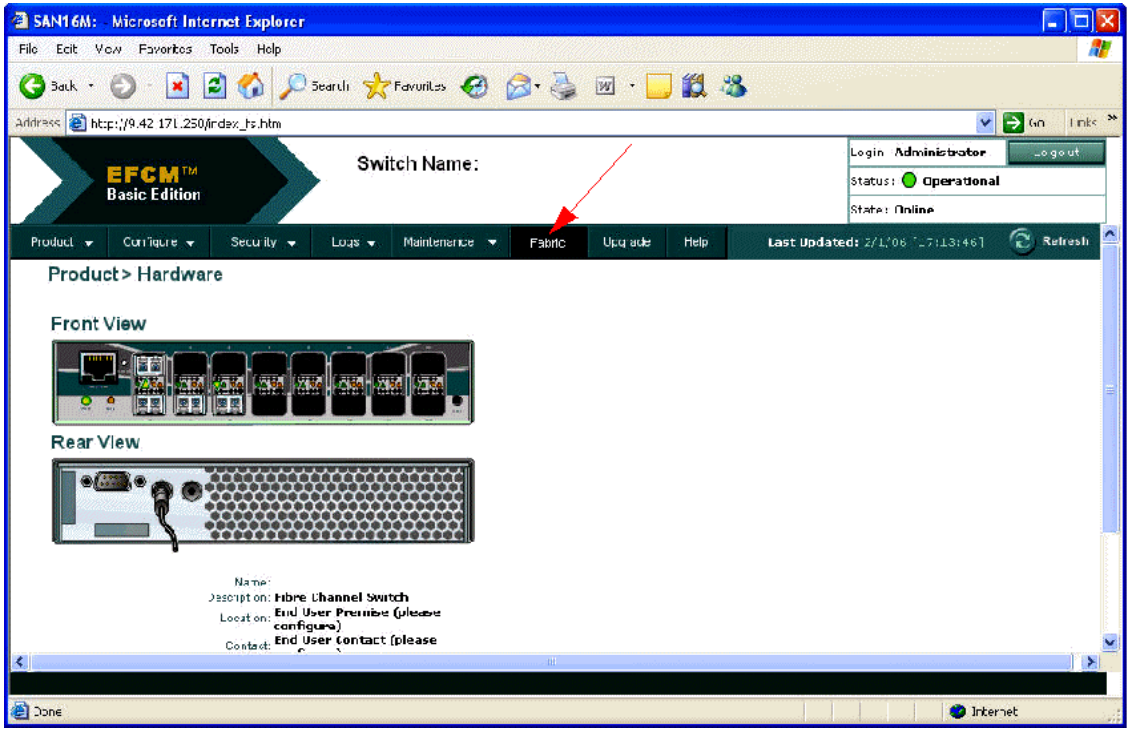

Figure 6-16 Fabric window

11. From the Fabric View windows, verify all switches are visible in the topology. Only switches that have successfully merged into the same fabric will be displayed on the Topology window (Figure 6-17).

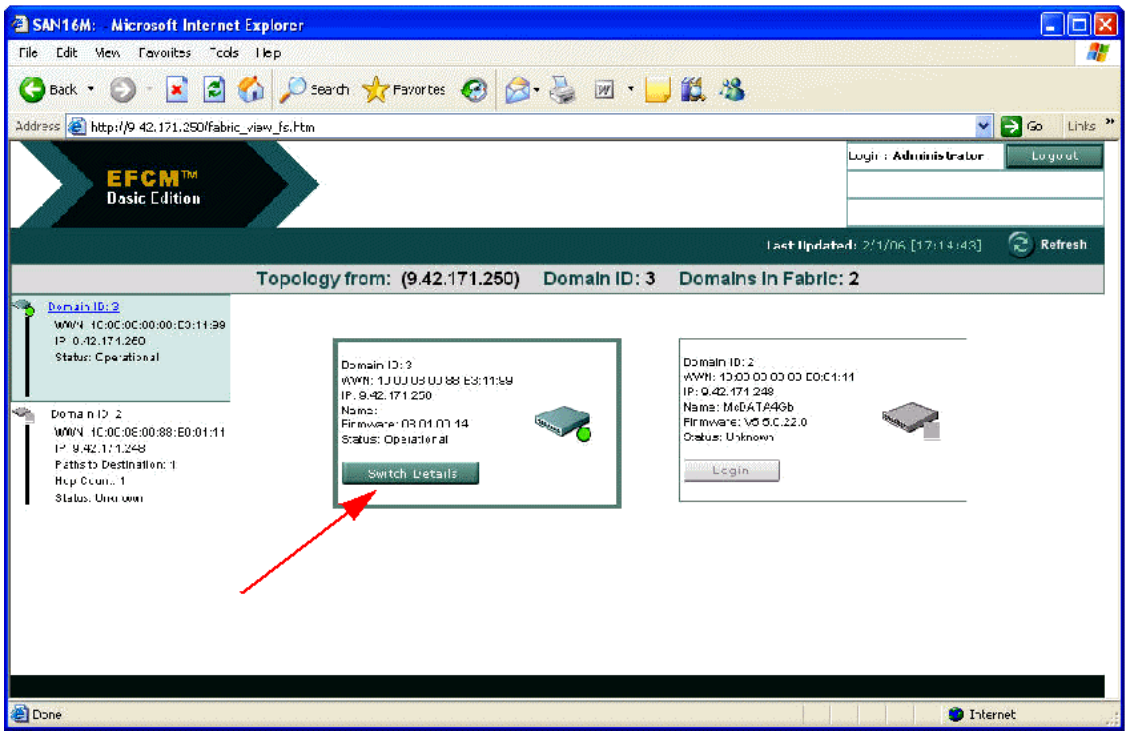

Figure 6-17 Topology window

12. From the Fabric View window, click **View Details** to view the switch details.

Zoning configuration

13. From the action menu, select **Configure** → **Zoning** (Figure 6-18).

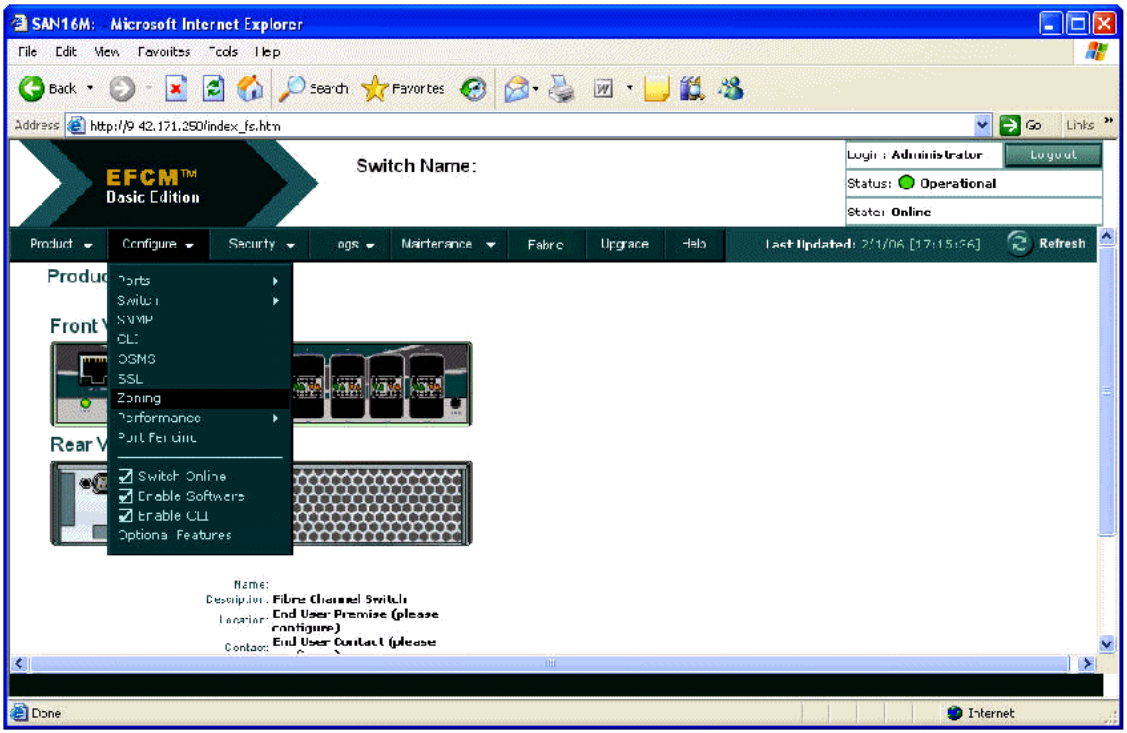

Figure 6-18 Configure window

14. Define a name for the zone set and select **Update** (Figure 6-19).

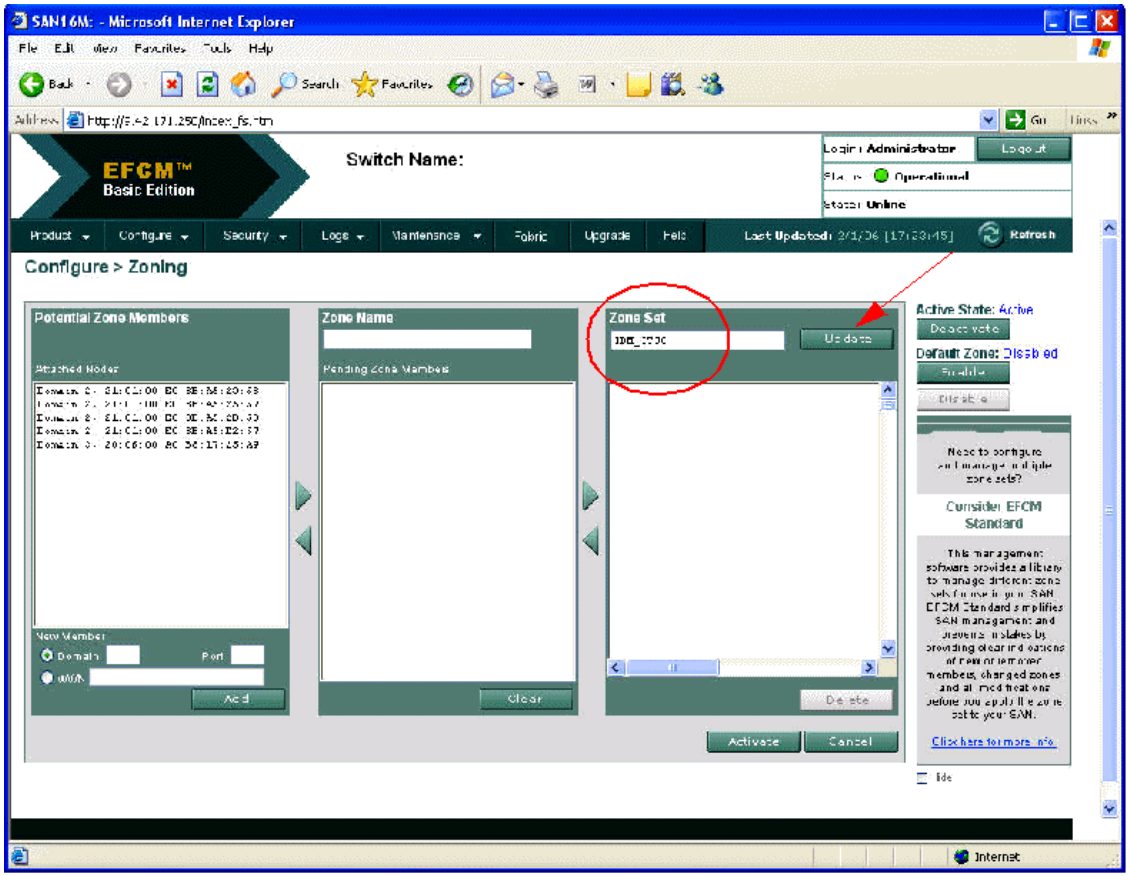

Figure 6-19 Configure → Zoning window

15. Define a zone name (1). Highlight the desired members (2) and click the right arrow button (3) to add the members to the zone and the zone to the zone set (see Figure 6-20).

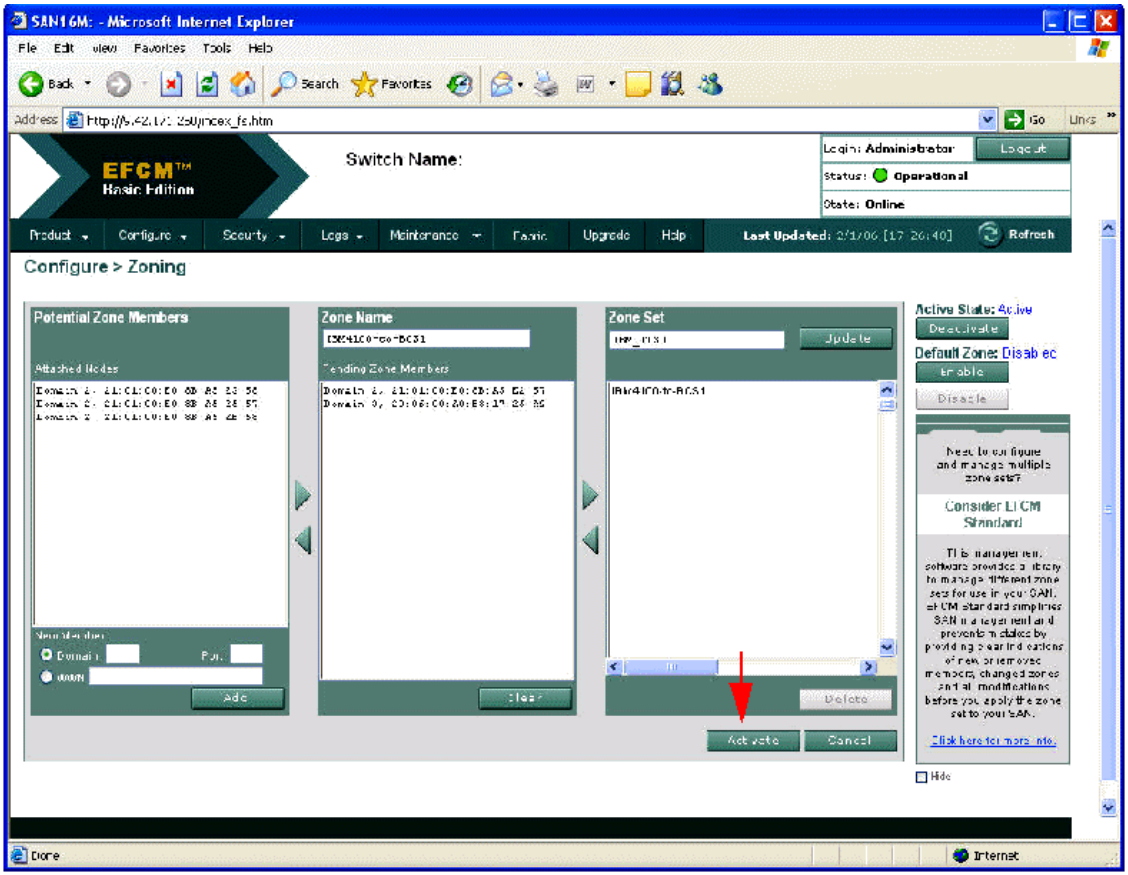

Figure 6-20 Configure → Zoning window

16. Once you have completed creating the desired zones with their members, click **Activate** to activate your zone set and zones, as shown in Figure 6-21.

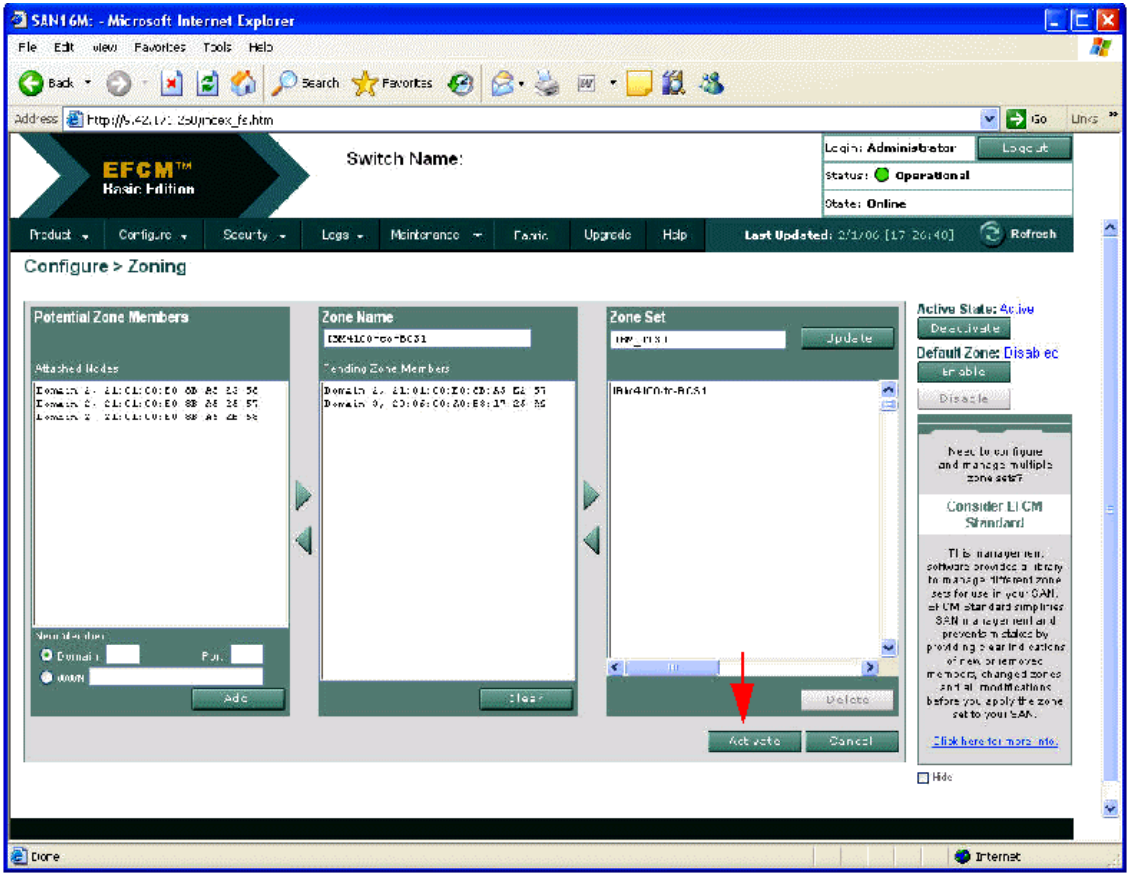

Figure 6-21 Configure → Zoning window

7

QLogic SAN configuration

In this chapter, we discuss how to set up and configure the QLogic 4Gb Fibre Channel Switch Modules to attach to a SAN storage environment. You will note that we have included the configuration of two QLogic external switch modules, the QLogic Fibre Channel 5602 and 1404. For more information about each switch, please visit the respective Web sites.

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7.1 IBM BladeCenter configuration

In this section, we begin with the setup and configuration of our IBM BladeCenter. To do so, please visit Chapter 4, “IBM BladeCenter setup and configuration” on page 35 and follow the instructions outlined in the chapter. Afterwards, return to this section to begin the implementation of your QLogic SAN environment. Figure 7-1 shows the SAN topology we used as our lab environment. It is assumed that LUN(s) have been created and assigned on the storage system prior to this SAN implementation.

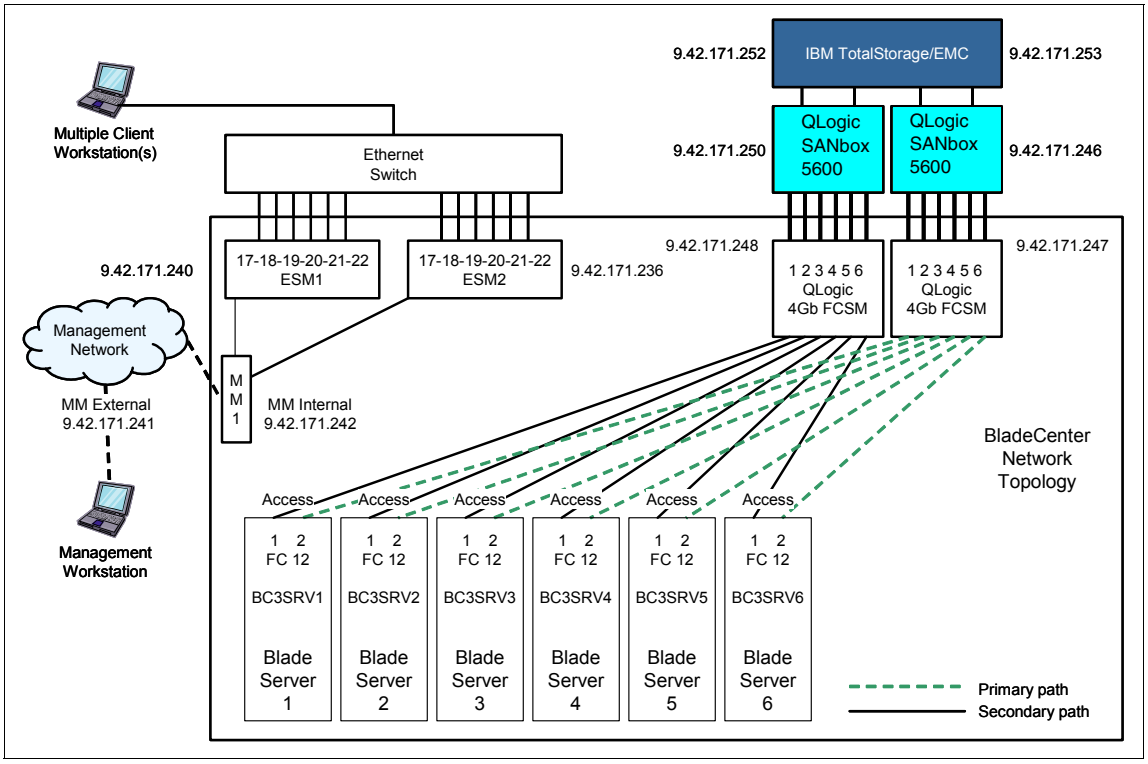

Figure 7-1 IBM BladeCenter utilizing QLogic 4Gb FCSM and QLogic 5602 Fabric attached DSxxxx

7.2 QLogic Fibre Channel Switch 5602 setup and configuration

To begin the setup of our QLogic Fibre Channel Switch 5602, we must install the SANsurfer Switch Manager on the server or workstation that will be managing the switch.

Note: There is an embedded GUI in the switch that one can use to manage the switch, so you do not have to install the SANsurfer switch manager application.

In our example, we installed on a workstation. Perform the following steps:

1. Once SANsurfer is installed, click **Start** → **Programs** → **SANsurfer_Switch_Manager** to launch the SANsurfer application.
2. The Initiate Start Dialog dialog box will appear. Click **Open Existing Fabric** and click **Proceed** to continue (see Figure 7-2).

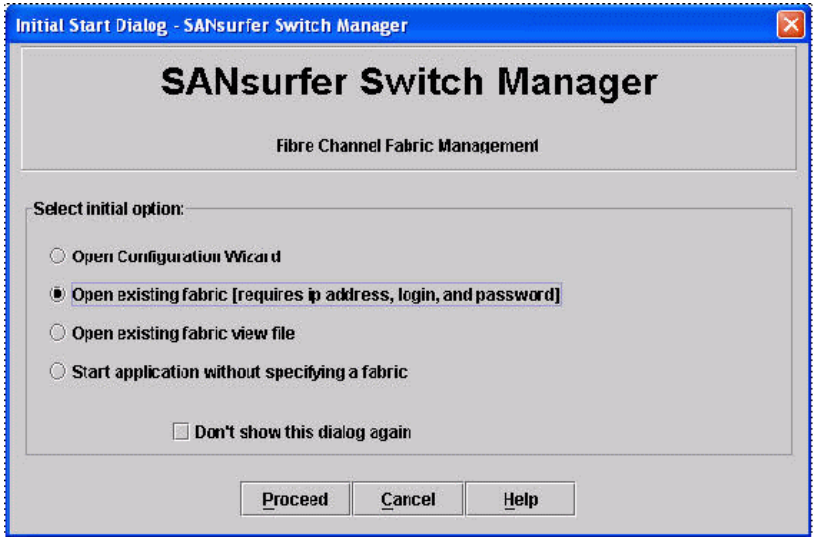

Figure 7-2 SANsurfer Switch Manager initial option window

3. Enter the IP Address for the switch in the IP Address field (Figure 7-3). Enter the user name and password and click **Add Fabric** to continue.

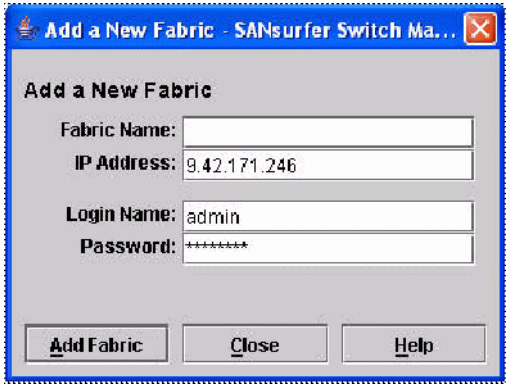

Figure 7-3 Add a New Fabric window

4. Click **OK** when the Non secure connection check dialog appears (Figure 7-4).

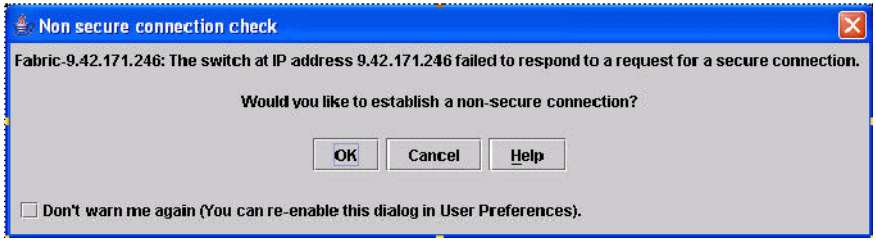

Figure 7-4 Non secure connection check window

Naming the switch and setting the Domain ID

5. From the Topology window in the left pane, click the drop-down tree. Click to select your switch (in our example, QL5602-1). Select **Switch** → **Switch Properties...** (Figure 7-5).

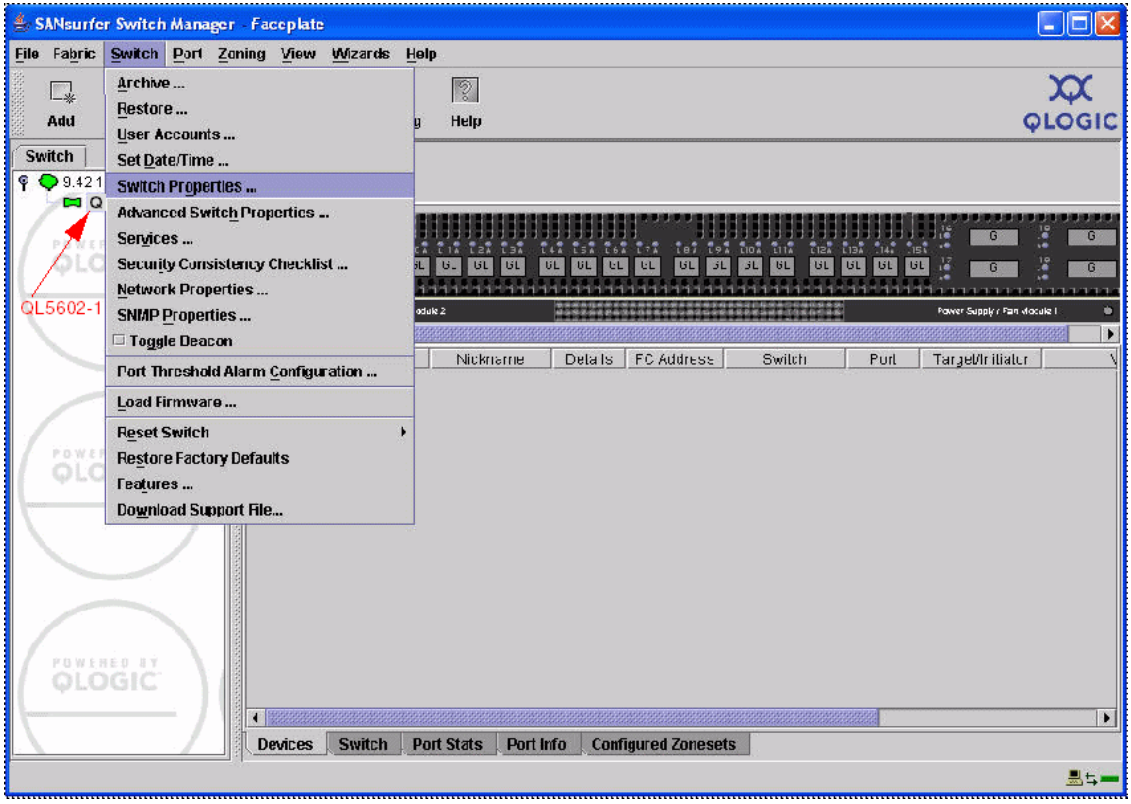

Figure 7-5 SANSurfer Switch Manager- Faceplate window

6. From the Switch Properties dialog (Figure 7-6), enter a symbolic name for your switch. Enter a Unique Domain ID ranging from 97-127 (1). Click the **Enable** radio button next to Domain ID lock (2). In our example, we selected 98 for the DID. Click **OK** to continue.

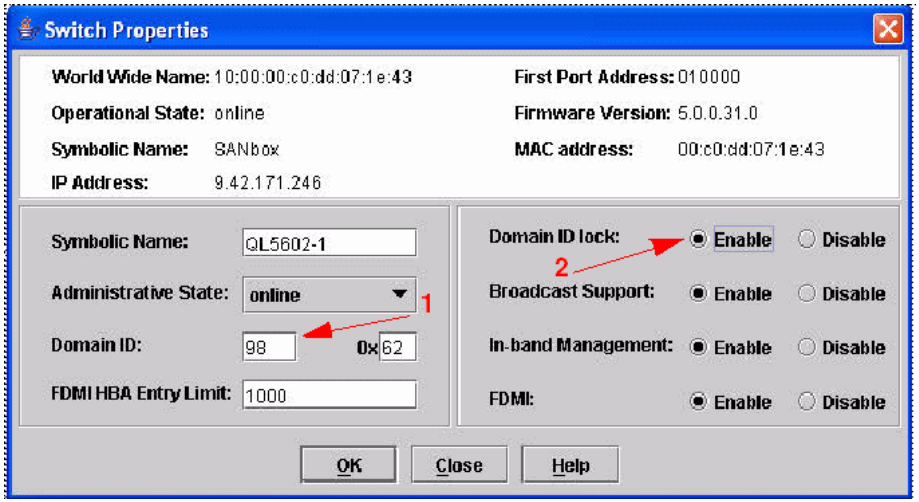

Figure 7-6 Switch Properties window

7. Click **OK** when the Updating Switch Properties dialog box appears.

Verify port settings

8. From the SANsurfer Switch Manager Faceplate, select your desired E-Port. Next, select **Port** → **Port Properties** (Figure 7-7). In our example, we designated port 7.

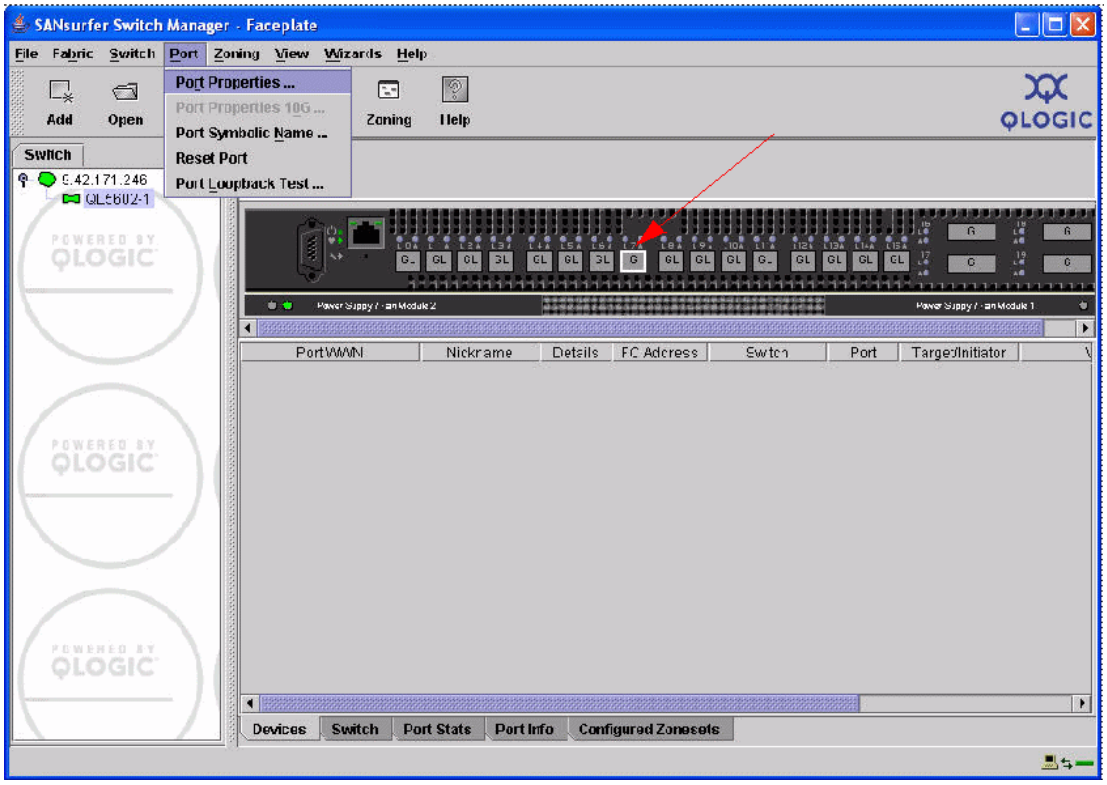

Figure 7-7 SANsurfer Switch Manager - Faceplate window

9. From the Port Properties dialog box (Figure 7-8), verify the following settings are true:
   a. Port State = Online
   b. Port Speed = Auto-detect
   c. Port Type = G-port
   d. I/O Stream Guard = Auto
   e. Device Scan = Enable
10. Click **OK**.

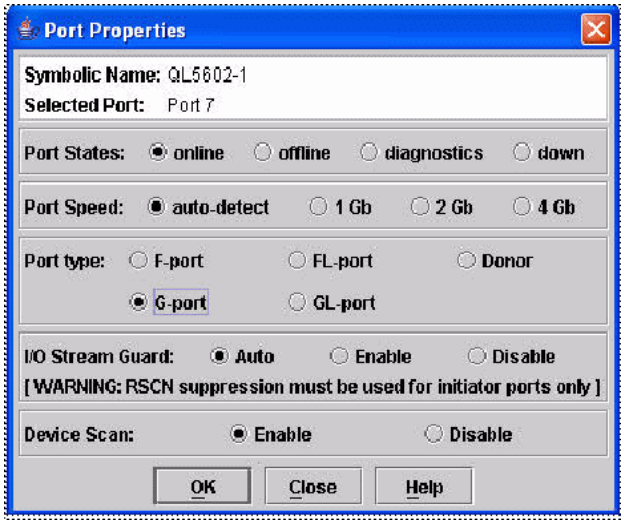

Figure 7-8 Port Properties window

Configure storage ports

11. On the Faceplate, select the port to which you will connect your storage. Select **Port** → **Port Properties** (Figure 7-9). In our example, we selected port 0.

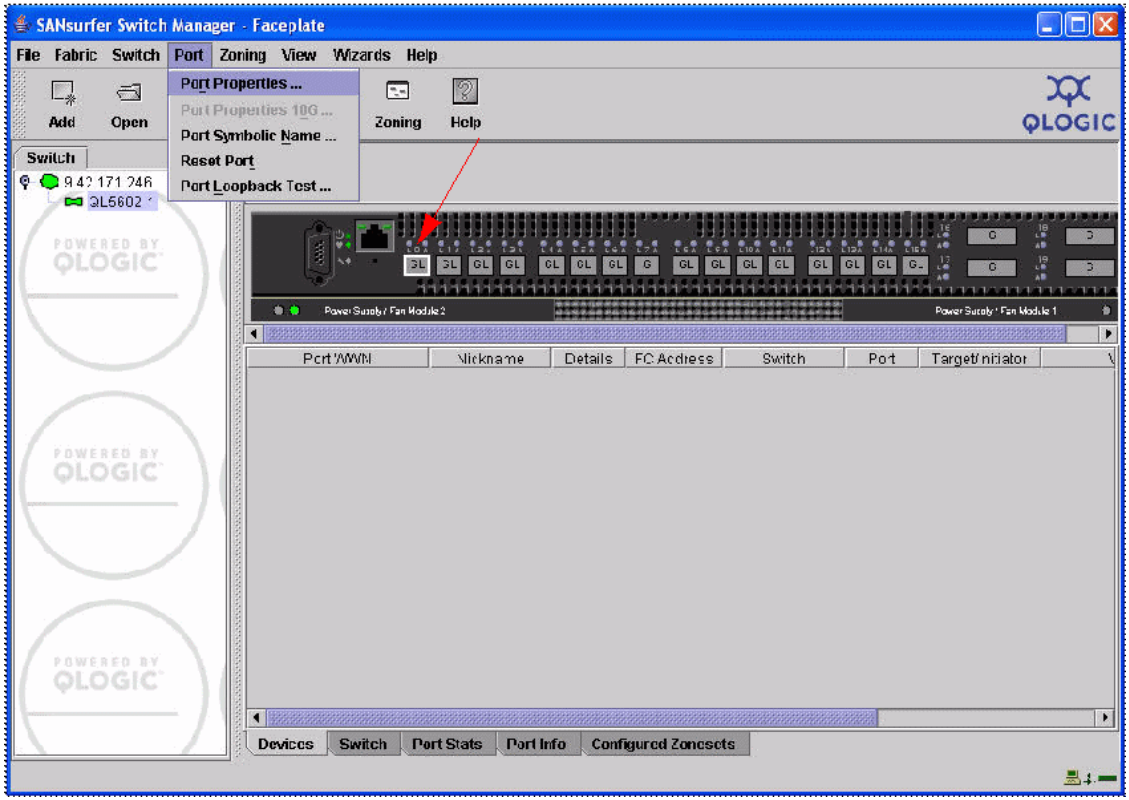

Figure 7-9 Port Properties window

12. Verify the following are true for port 0 (Figure 7-10):
    a. Port State = Online
    b. Port Speed = Auto-detect
    c. Port Type = GL-port
    d. I/O Stream Guard = Auto
    e. Device Scan = Enable
13. Click **OK**.

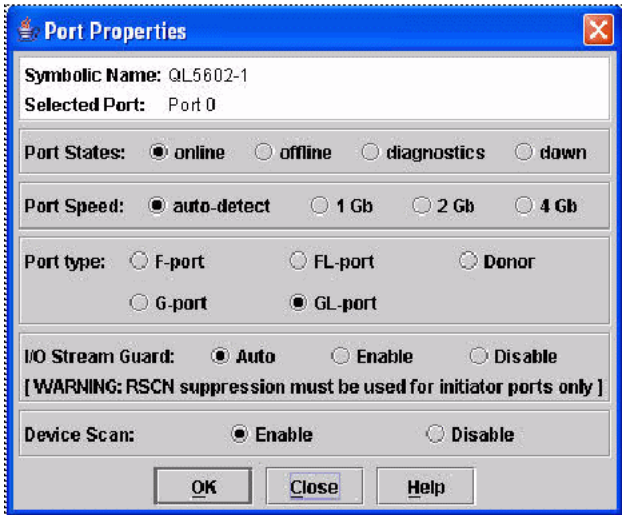

Figure 7-10 Port Properties settings window

14. Connect the storage to the port you configured in step 12.

15. Verify that a successful login occurs by checking for device registration in the *nameserver*. Observe that the port login indicator in the Faceplate image is green. Select the port and in the devices tab verify the PortWWN of the device appears (Figure 7-11).

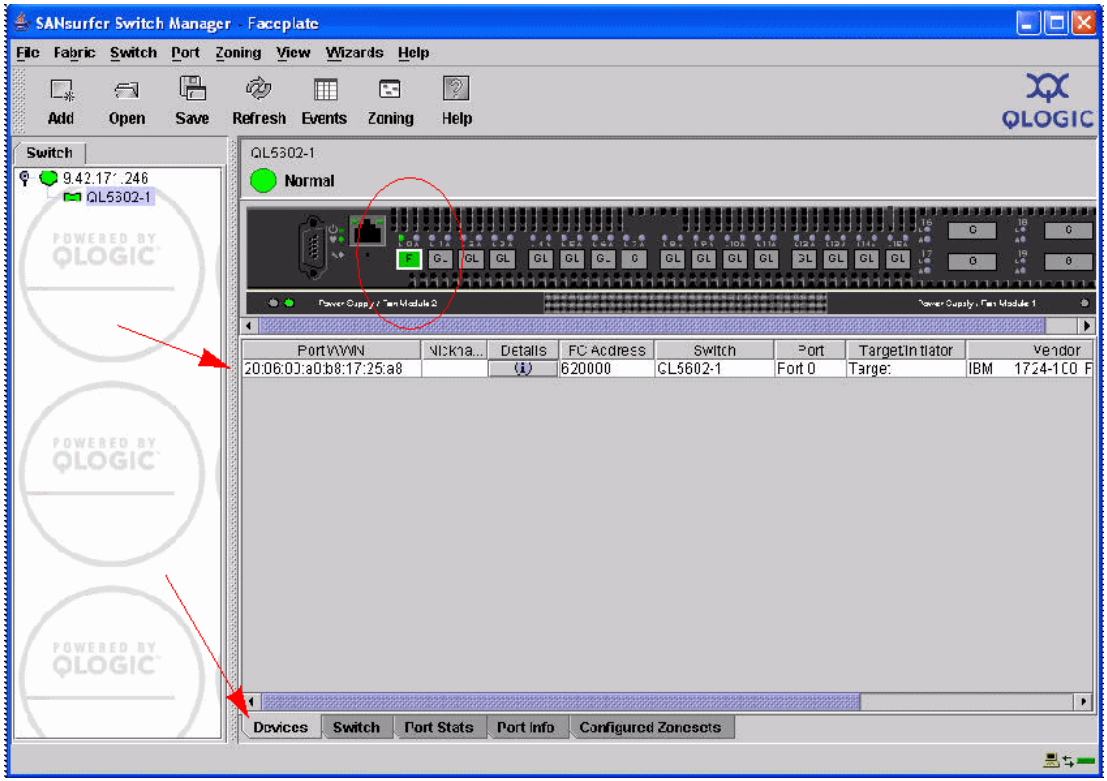

Figure 7-11 PortWWN window

16. From the Faceplate, select the **Configured Zoneset** tab (Figure 7-12). Verify there are no zones configured on the switch. If there are zones configured, see manufacturer user's guide for instructions on how to remove the zone set and zones.

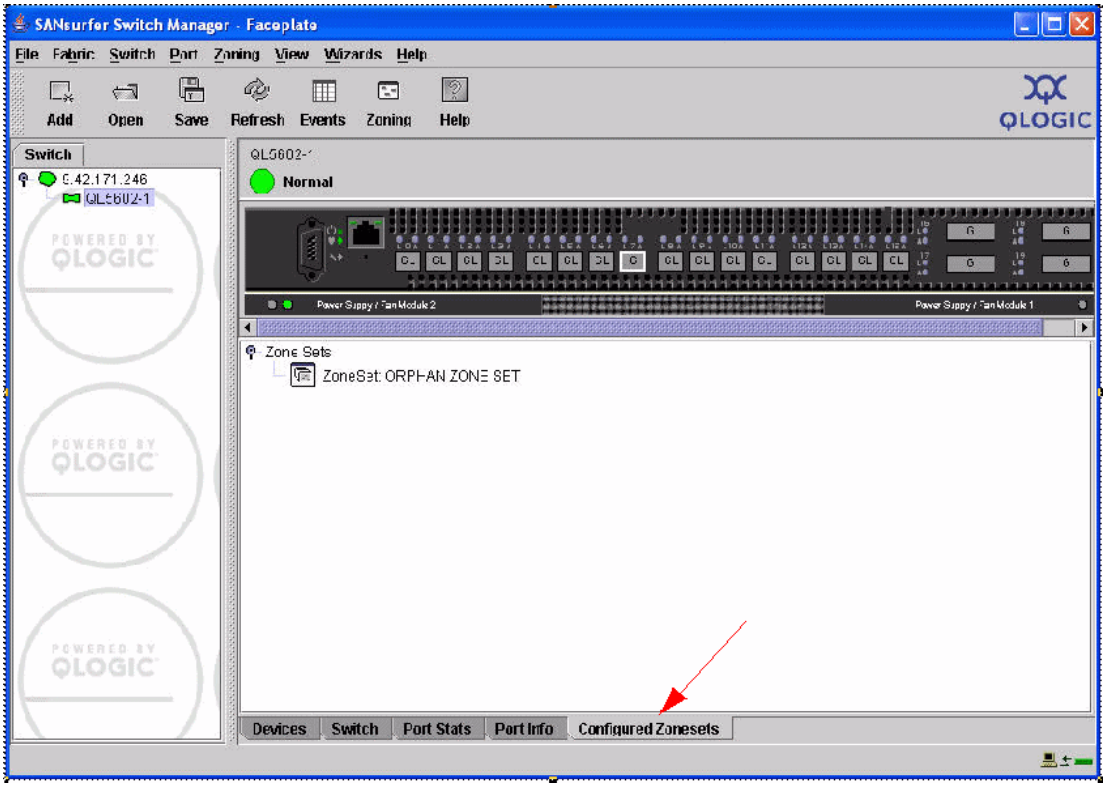

Figure 7-12 SANsurfer Switch Manager

This switch is now configured to work with other fabrics.

7.3 QLogic 4Gb FCSM connectivity to 5602 and SAN environment

In this section, we discuss the configuration of the QLogic 4Gb Fibre Channel Switch Module and establish connectivity to our SAN environment via the QLogic 5602. Perform the following steps:

1. Launch your switch's IP address from your browser. Enter the IP Address, Login Name, and Password. Click **Add Fabric** to continue (Figure 7-14 on page 182).

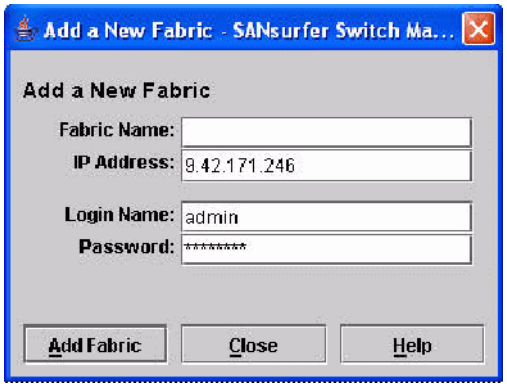

Figure 7-13 Add a New Fabric window

2. From the Topology window in the left pane, click the drop down tree and double-click the IP address. Next, select your switch (in our example, QL_FCSM4Gb). Select **Switch** → **Switch Properties...** (Figure 7-14).

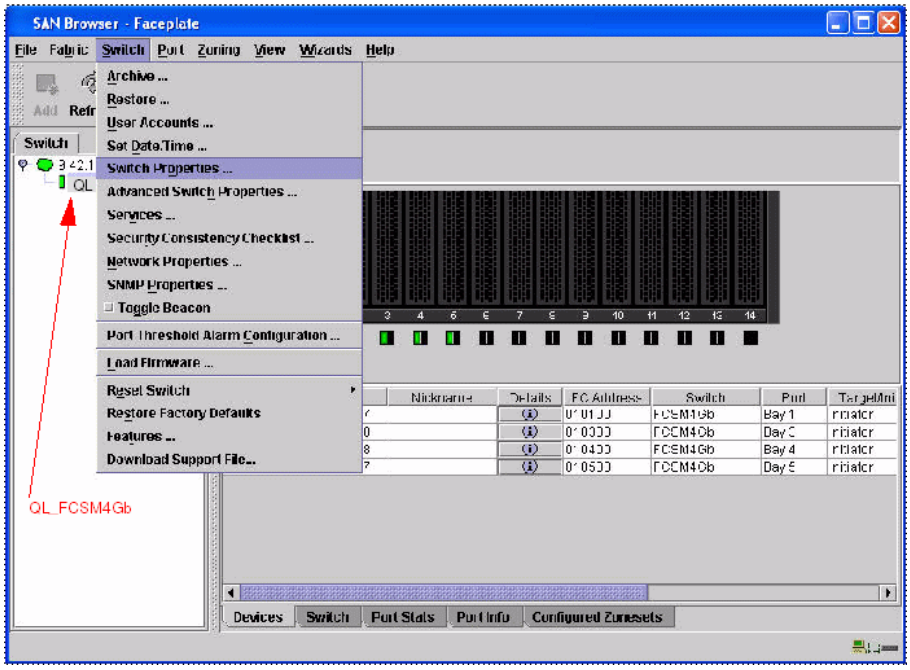

Figure 7-14 SAN Browser - Faceplate window

3. From the Switch Properties dialog (Figure 7-15 on page 183), enter a symbolic name for your switch. The Unique Domain ID ranges from 97-127 (1). Click the **Enable** radio button next to Domain ID lock (2). In our example, we selected 99 for the DID. Click **OK** to continue.

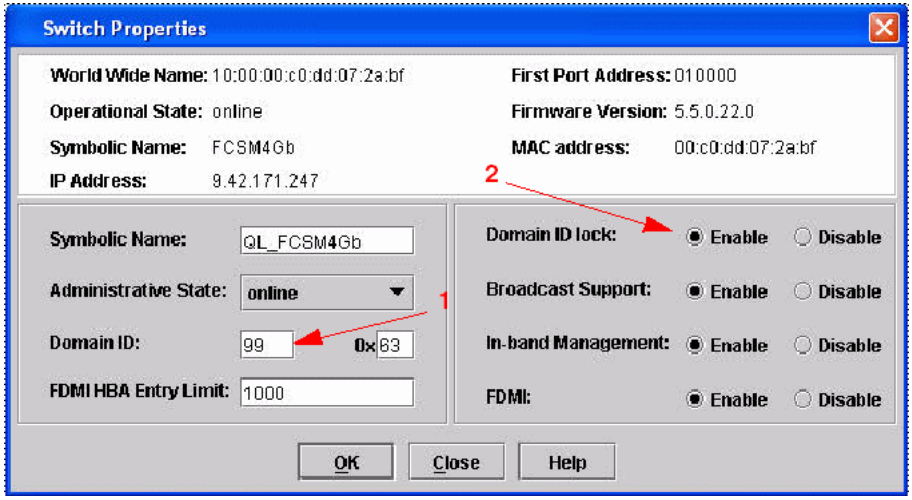

Figure 7-15 Switch Properties window

4. Click **OK** when the Updating Switch Properties dialog box appears.

5. From the Faceplate window, select your desired E-Port. Next, select **Port** → **Port Properties** (Figure 7-16). In our example, we designated port 19.

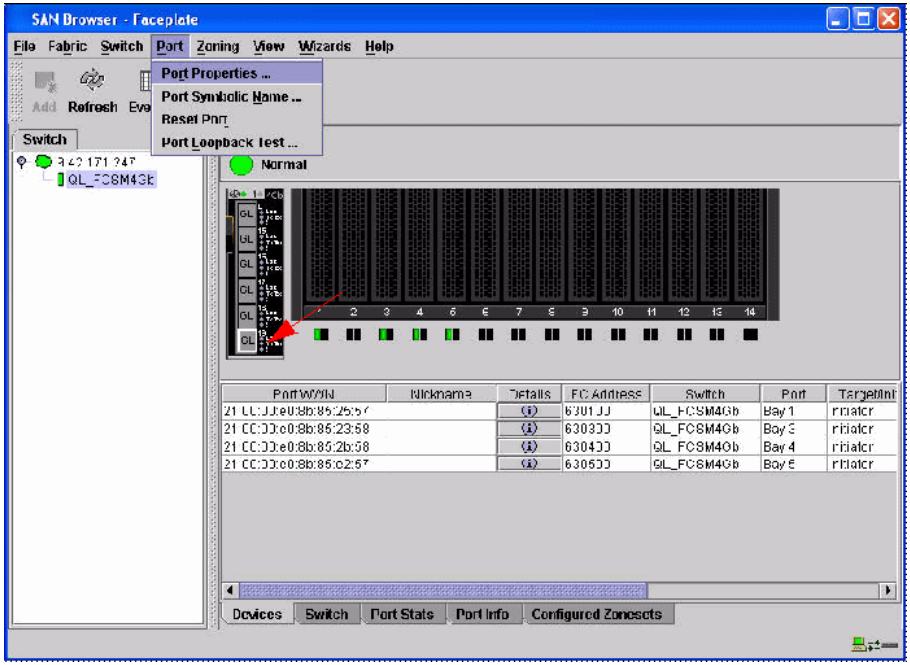

Figure 7-16 SANBrowser - Faceplate

6. From the Port Properties dialog box (Figure 7-17), verify the following settings are true for port 19:
   a. Port State = Online
   b. Port Speed = Auto-detect
   c. Port Type = G-port
   d. I/O Stream Guard = Auto
   e. Device Scan = Enable
7. Click **OK**.

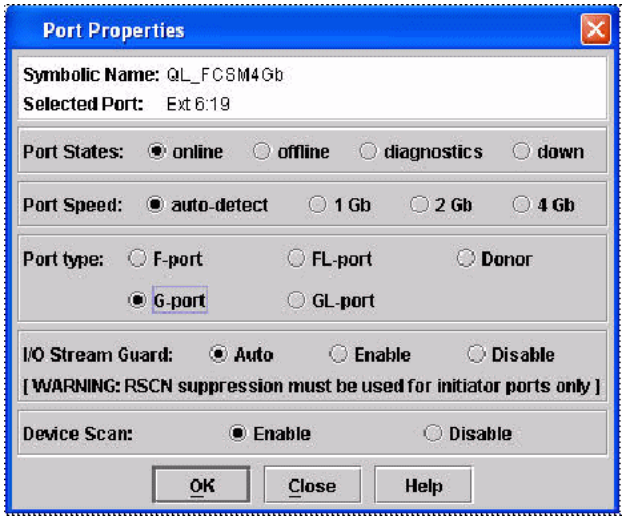

Figure 7-17 Port Properties window

8. From the Faceplate, select the **Configured Zoneset** tab (Figure 7-18). Verify there are not zones configured on the switch. If there are zones configured, see the manufacturer user's guide for instructions on how to remove the zone set and zones.

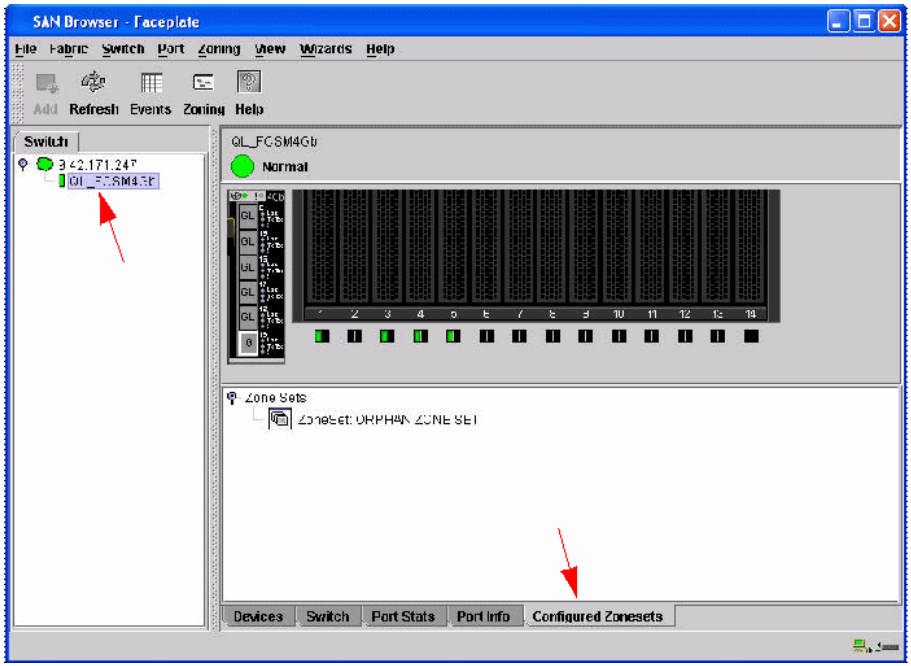

Figure 7-18 SAN Browser - Faceplate window

Connect FC cable from FCSM to 5602

9. Verify the E-Port (ISL) connection was successful. In the left panel, select the IP Address to obtain the Topology view window (Figure 7-19). Verify that both switches in the Topology viewing pane are visible. Optionally, you can telnet into the switch and type the command **`show fabric`** and verify that you can see both switches.

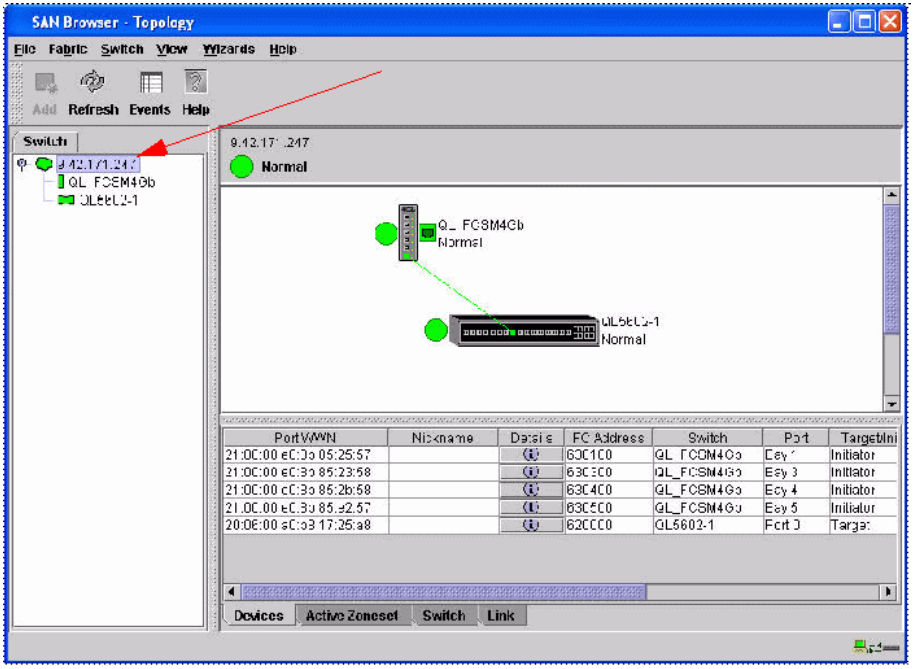

Figure 7-19 SAN Browser Topology window

Create a zone set and zone

10. From the Faceplate dialog window, select **Zoning** → **Edit Zoning** (Figure 7-20).

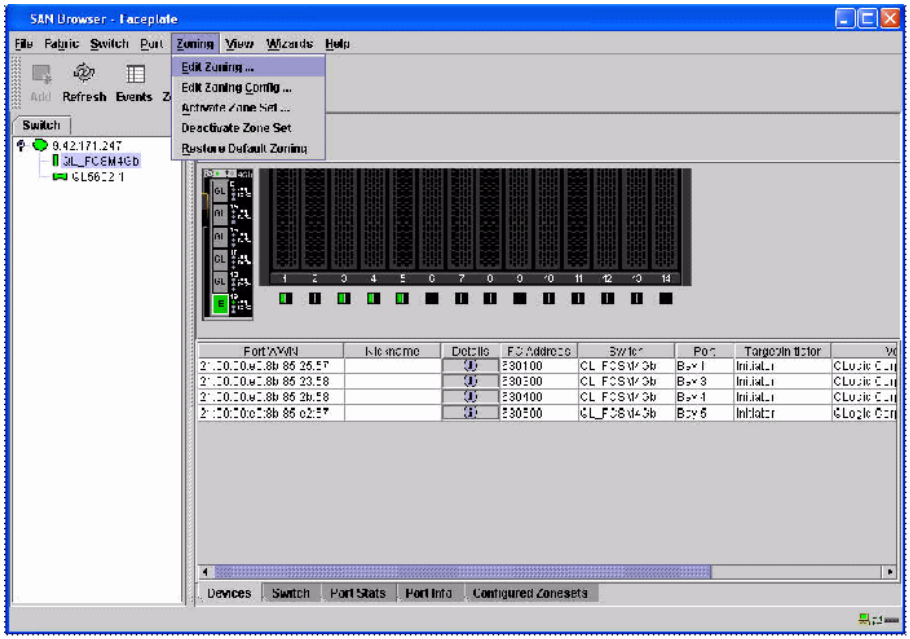

Figure 7-20 SAN Browser - Faceplate window

11. From the Edit Zoning dialog window, select **Edit** → **Create Zone Set** (Figure 7-21 on page 189).

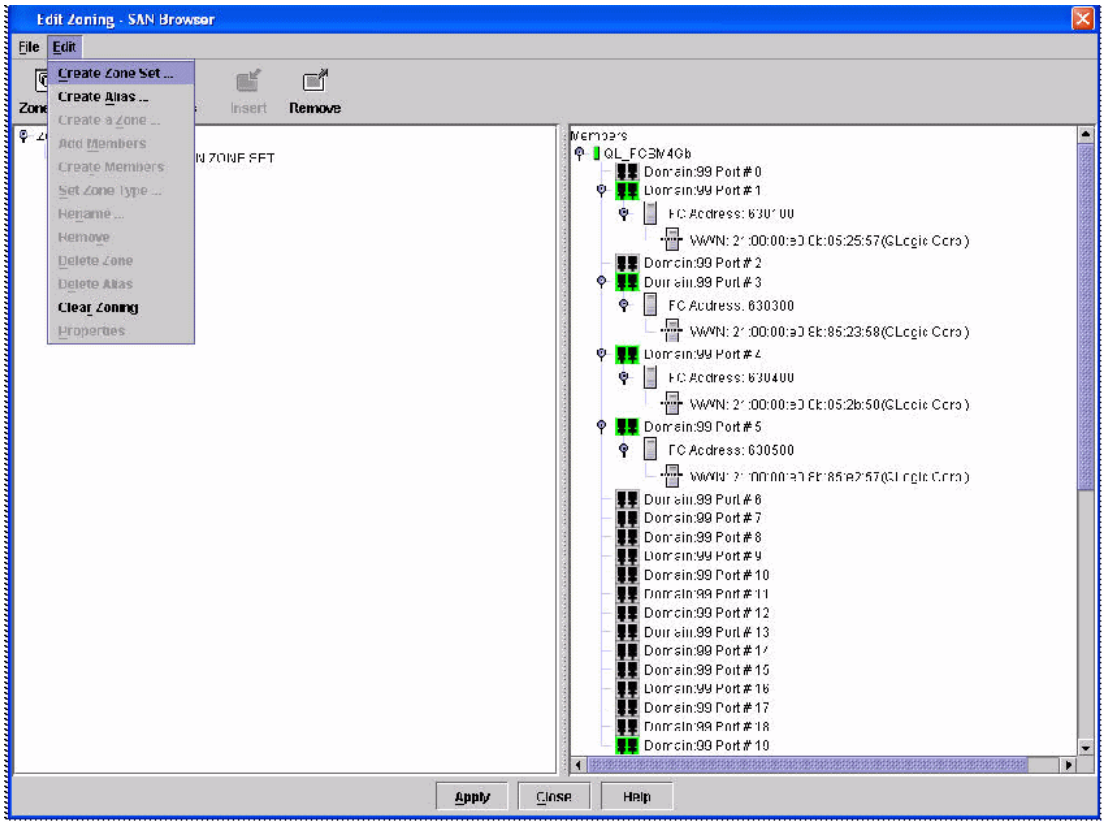

Figure 7-21 Edit Zoning - SAN Browser window

12. In the Create a zone set dialog box (Figure 7-22), enter a name in the Zone Set Name field and click **OK**.

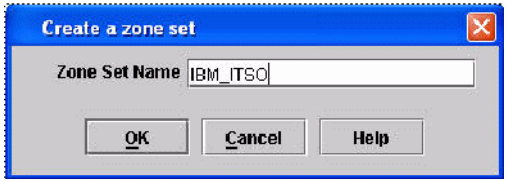

Figure 7-22 Create a zone set window

13. Highlight the Zone Set you just created. From the Edit Zoning - SAN Browser action menu (Figure 7-23), select **Edit** → **Create a Zone**.

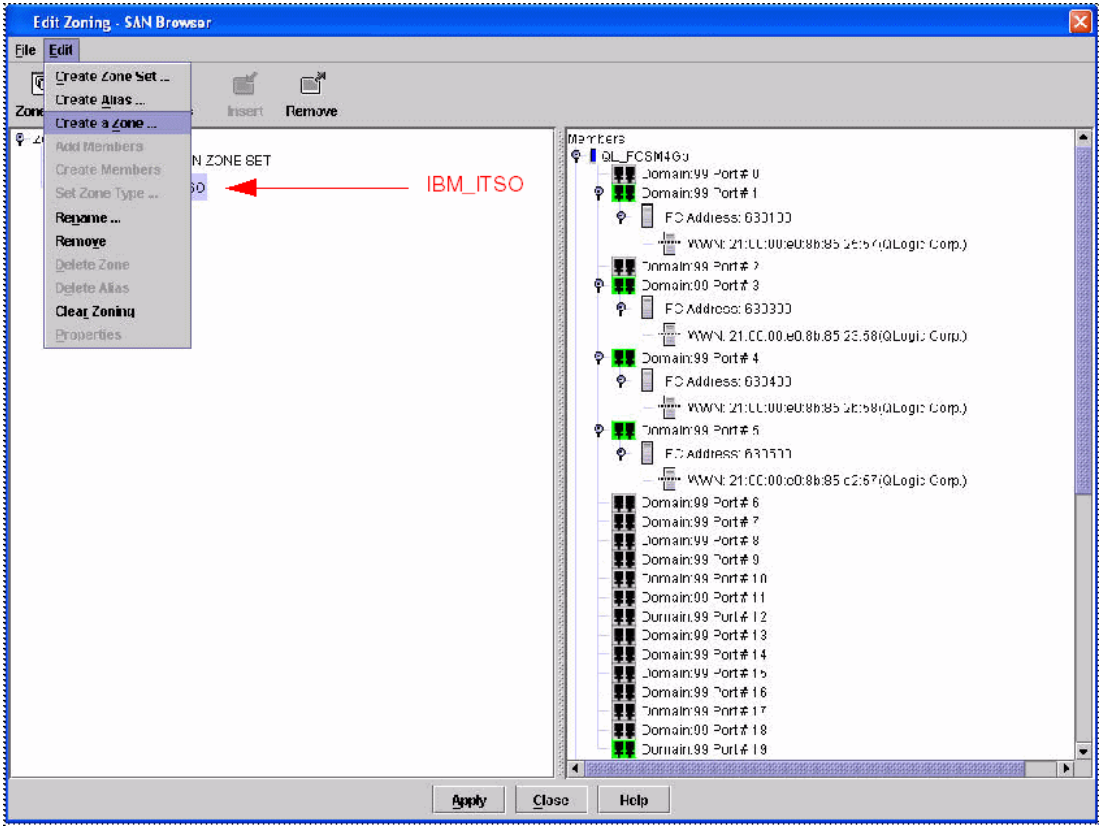

Figure 7-23 Edit Zoning - SAN Browser window

14. In the Create a zone dialog box (Figure 7-24), enter a name in the Zone Name field and click **OK**. In our example, we typed BCS_4100.

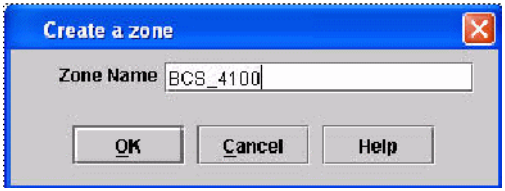

Figure 7-24 Create a zone window

15. In the Edit Zoning - SAN Browser window (Figure 7-25), highlight the zone you created. Select the members you want to be included in the zone. You may use the Control key to select more than one member. Select **Edit** → **Add Members**.

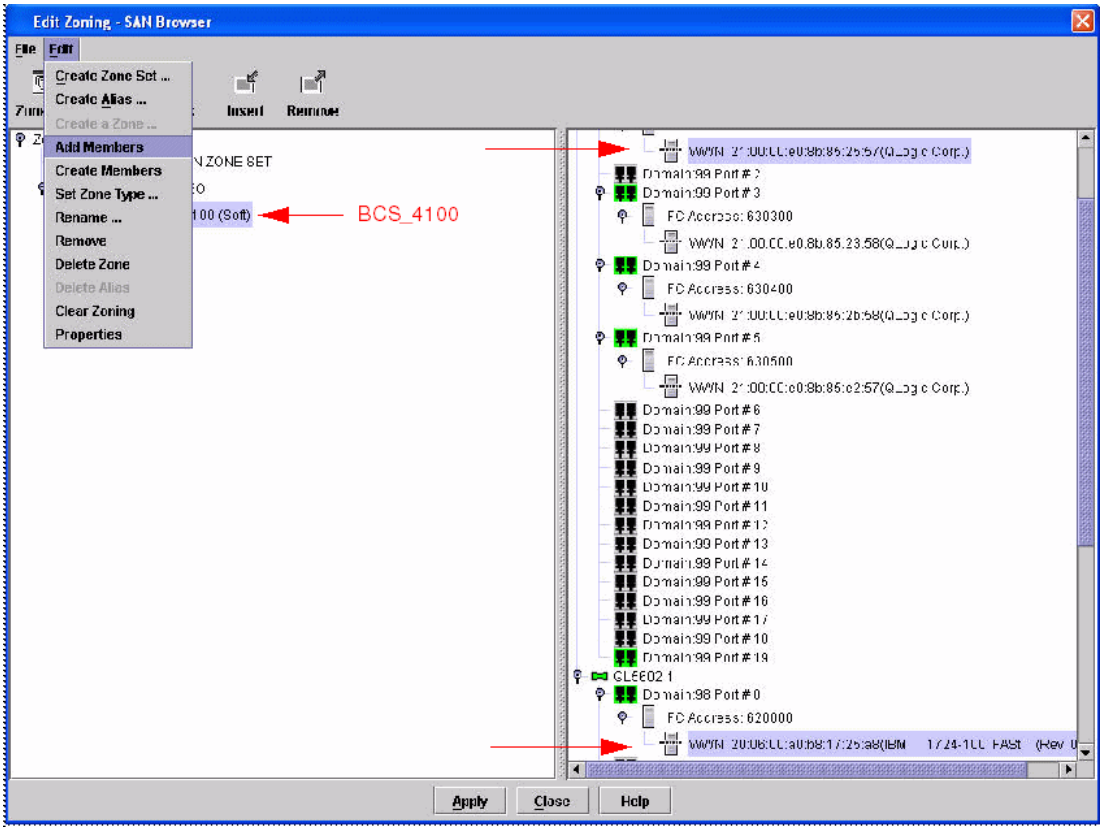

Figure 7-25 Edit Zoning - SAN Browser window

16. To create more zones, repeat steps 10 on page 188 through 12 on page 189.

17. Once your zones have been created (Figure 7-26), click **Apply** to save your configuration.

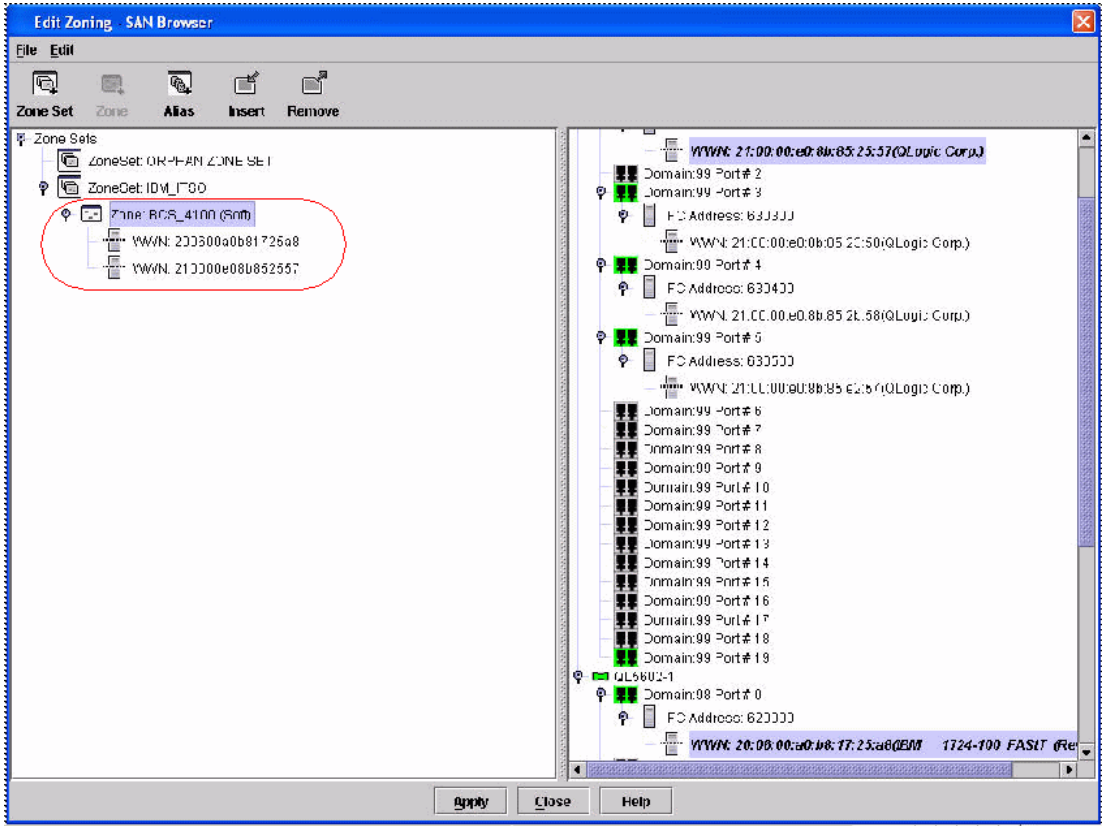

Figure 7-26 Edit Zoning - SAN Browser window

18. From the Save Zoning and Error Check dialog box (Figure 7-27 on page 193), select **Perform Error Check**.

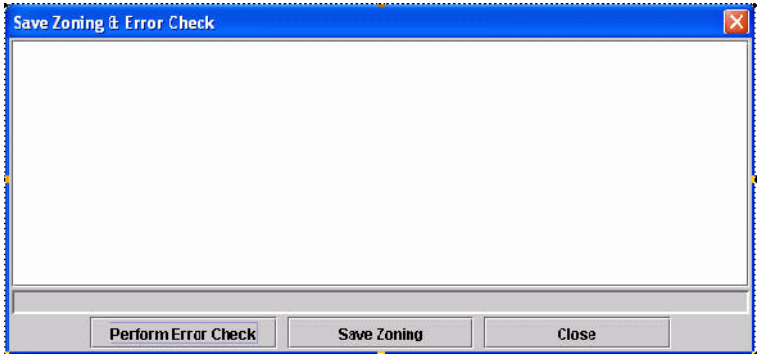

Figure 7-27 Save Zoning & Error Check window

19. Once the Error Check is complete and no errors appeared (Figure 7-28), click **Save Zoning**.

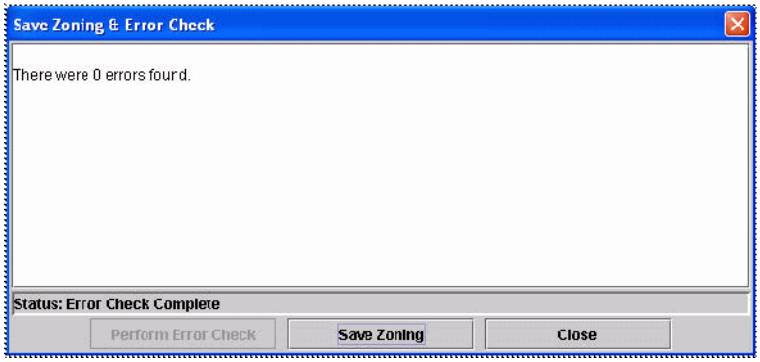

Figure 7-28 Save Zoning & Error Check window

20. Select **Yes** to activate your zone set(s) (Figure 7-29) once the save is complete. You should select **No** if you are not prepared to activate the zone set.

Figure 7-29 Zone set activation window

21. Select the zone set you want activated and click **OK**. In our example, we selected IBM ITSO (Figure 7-30).

Figure 7-30 Select Zone set to be activated window

22. Click the **Close** button to complete the saving and activation of your zone (see Figure 7-31).

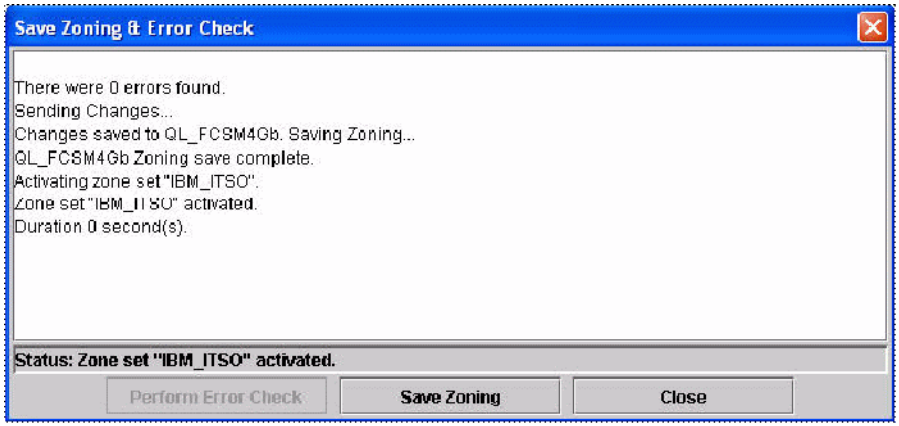

Figure 7-31 Save Zoning & Error Check window

23. Click the **Close** button to exit the Edit Zoning dialog window (Figure 7-32 on page 195).

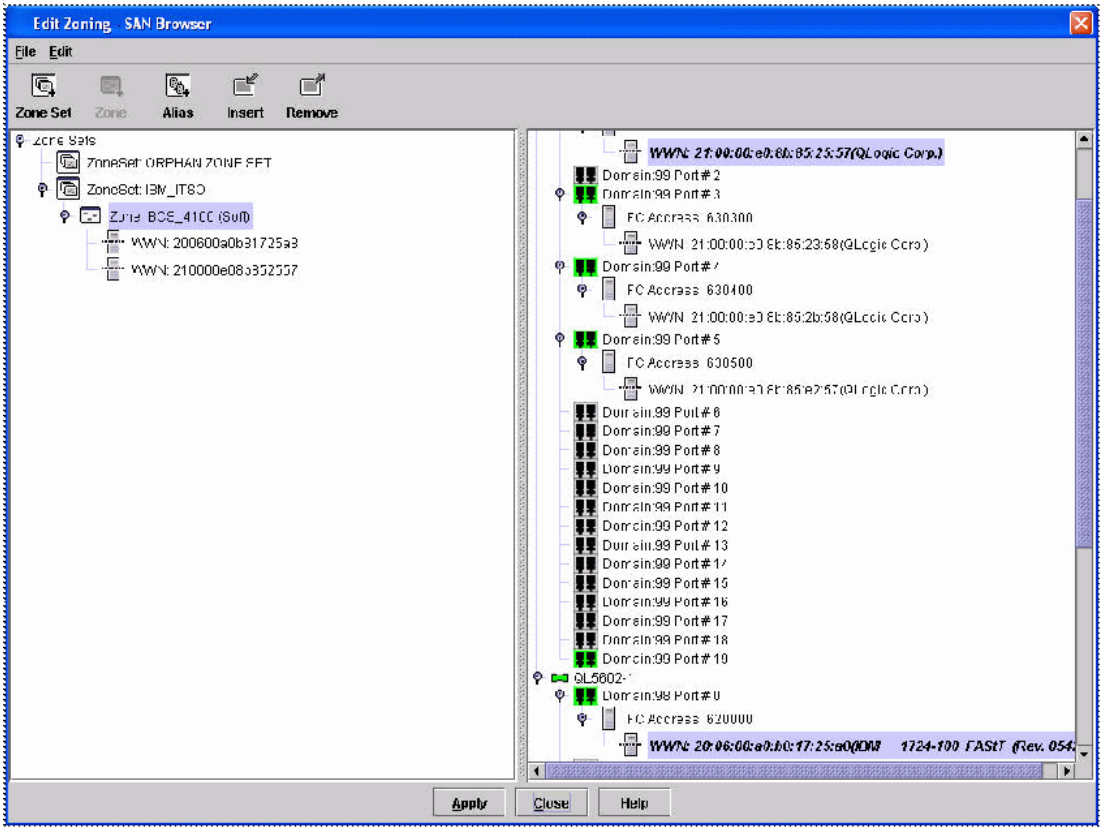

Figure 7-32 Edit Zoning - SAN Browser window

Perform a SAN check (referenced in the *Switch Interoperability Guide v6.0* and located at the following Web site: `http://qlogic.com/interopguide/info.asp`).

Note: The Successful Integration Checklist in the Switch Interoperability Guide v6.0 is located on page 44.

7.4 IBM System Storage SAN10Q (QLogic SB1404) setup/configuration

To begin the setup of our IBM System Storage SAN10Q (SB1404), we must install the SANsurfer Switch Manager on the server or workstation that will be managing the switch. In our example, we installed on a workstation.

Perform the following steps to configure the QLogic 1404:

Note: The 1404 is only allowed one ISL from the switch; however, the switch you connect to can be connected to many other switches. Thus, you can be in a larger than two switch fabric.

At this stage, we have assumed that you have all the upgrade licenses installed on the 1404.

1. Once SANsurfer is installed, select **Start** → **Programs** → **SANsurfer_Switch_Manager** to launch the SANsurfer application.
2. The Initiate Start Dialog dialog box will appear. Click **Open Existing Fabric** and click **Proceed** to continue (see Figure 7-33).

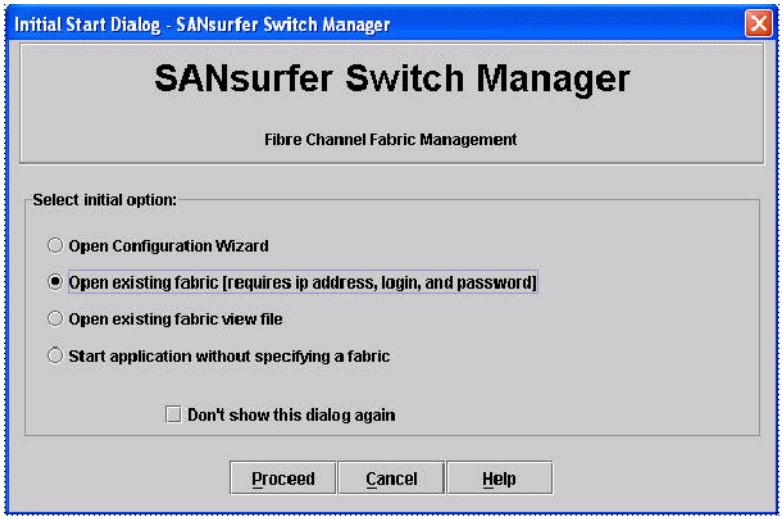

Figure 7-33 SANsurfer Switch Manager initial option window

3. Enter the IP Address for the switch in the IP Address field (Figure 7-34 on page 197). Enter the user name and password and click **Add Fabric** to continue.

Figure 7-34 Add a New Fabric window

4. Click **OK** when the Non secure connection check dialog appears.

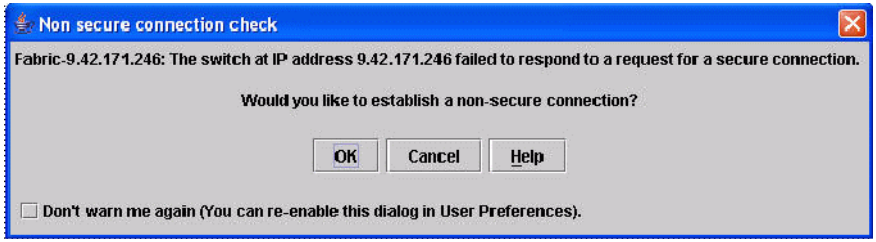

Figure 7-35 Non secure connection check window

Naming the switch and setting the Domain ID

5. From the Topology window in the left pane, click the drop down tree. Click to select your switch. Select **Switch** → **Switch Properties**... (Figure 7-36).

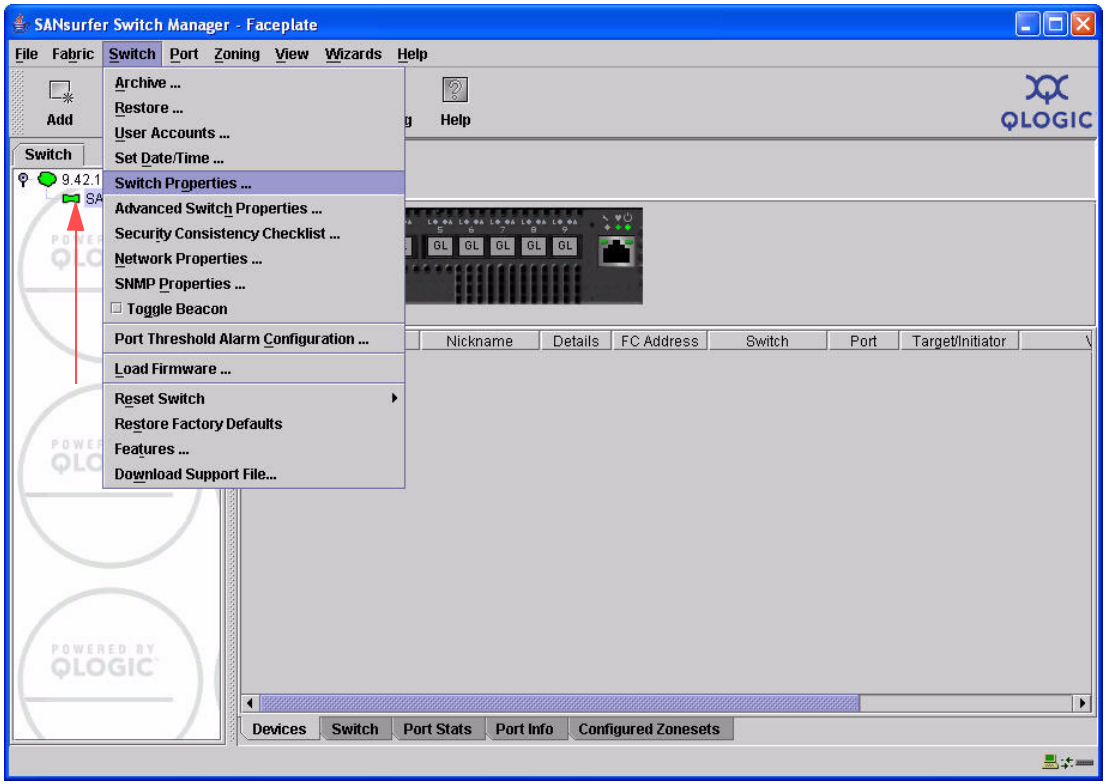

Figure 7-36 SANsurfer Switch Manager - Faceplate window

6. From the Switch Properties dialog (Figure 7-37 on page 199), enter a symbolic name for your switch (for example, QL_1400). Enter a Unique Domain ID ranging from 97-127 (1). Click the **Enable** radio button next to Domain ID lock (2). In our example, we selected 102 for the DID. Click **OK** to continue.

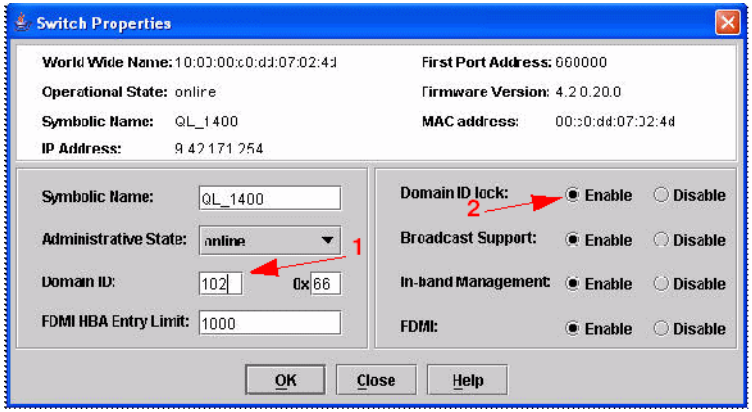

Figure 7-37 Switch Properties window

7. Click **OK** when the Updating Switch Properties dialog box appears.

Verify port settings

8. From the SANsurfer Switch Manager Faceplate, select your desired E-Port. Next, select **Port** → **Port Properties** (Figure 7-38). In our example, we designated port 0.

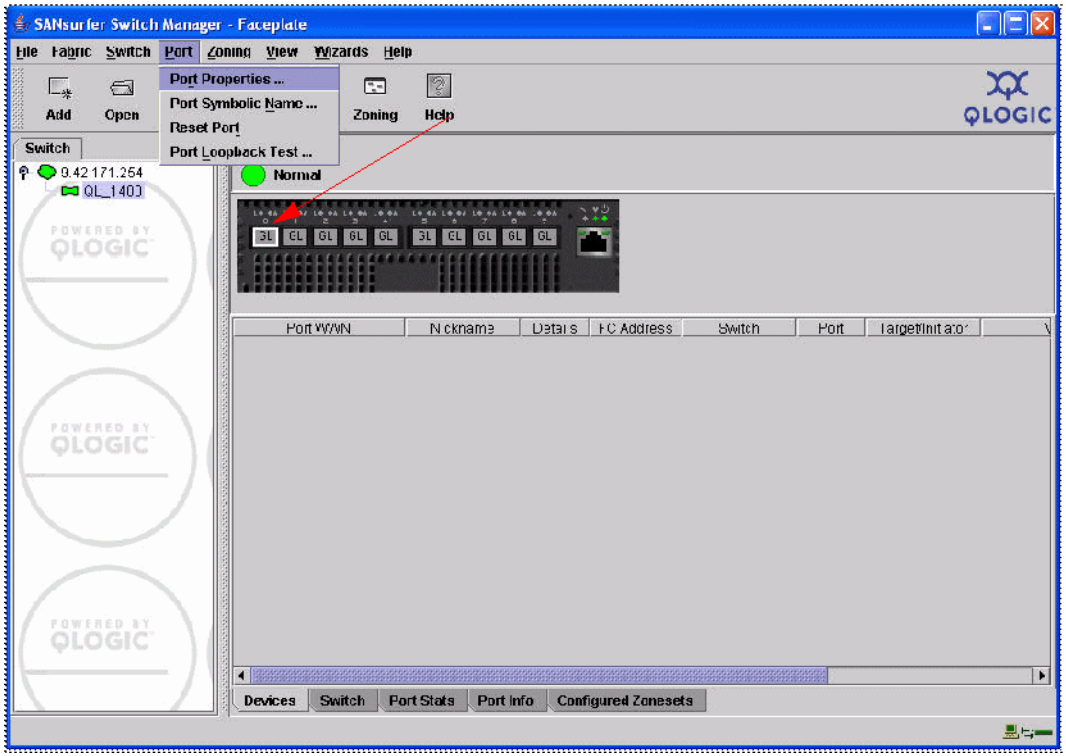

Figure 7-38 Port Properties window

9. From the Port Properties dialog box (Figure 7-39), verify the following settings are true:
   a. Port State = Online
   b. Port Speed = Auto-detect
   c. Port Type = G-port
   d. I/O Stream Guard = Auto
   e. Device Scan = Enable
10. Click **OK**.

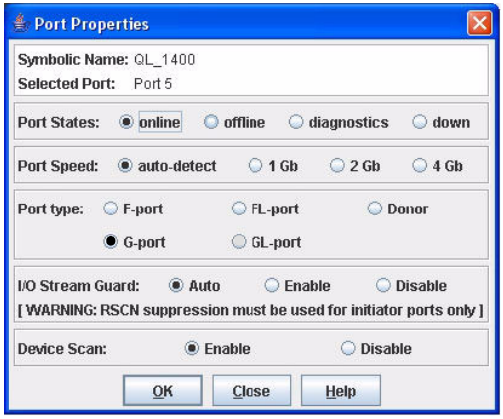

Figure 7-39 Port Properties window

Configure storage ports

11. On the Faceplate, select the port you will connect your storage. Select **Port** → **Port Properties** (Figure 7-40). In our example, we selected port 5.

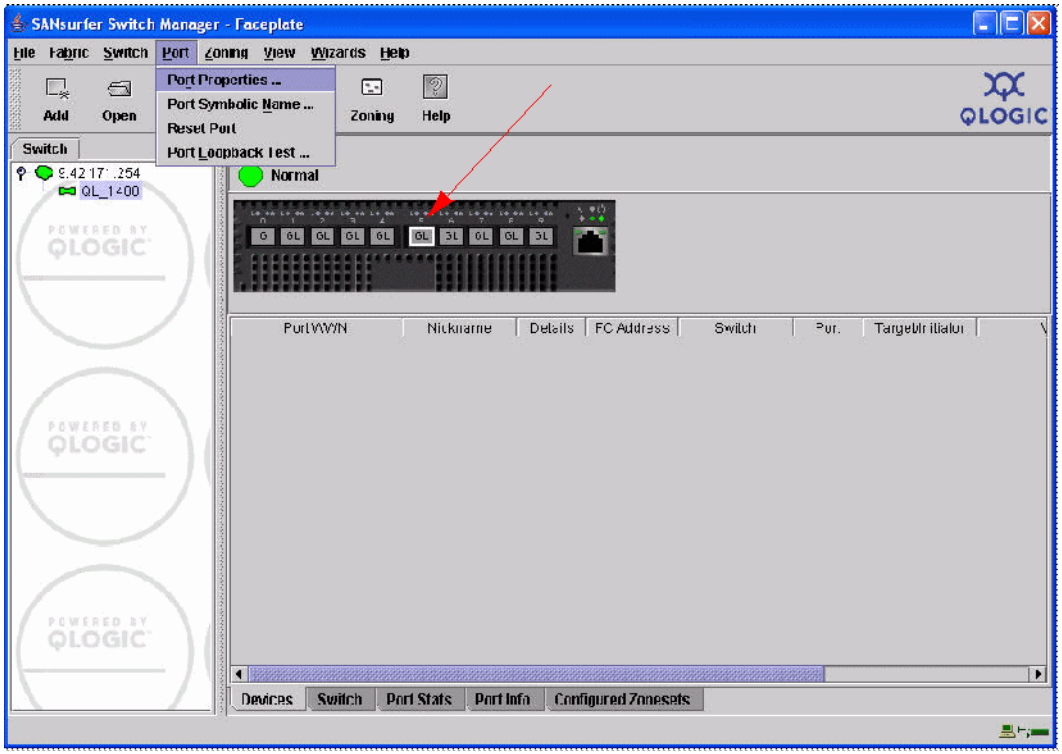

Figure 7-40 Port Properties window

12. Verify the following are true for port 5 (Figure 7-41 on page 203):
    a. Port State = Online
    b. Port Speed = Auto-detect
    c. Port Type = GL-port
    d. I/O Stream Guard = Auto
    e. Device Scan = Enable
13. Click **OK**.

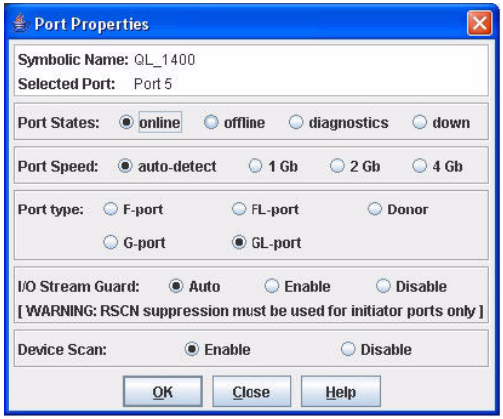

Figure 7-41 Port Properties settings window

14. Connect the storage to the port you configured in step 12 on page 202.

15. Verify that a successful login occurs by checking for device registration in the nameserver. See if the port login indicator in the Faceplate image is green. Select the port and, in the Devices tab, verify the PortWWN of the device appears. (Figure 7-42).

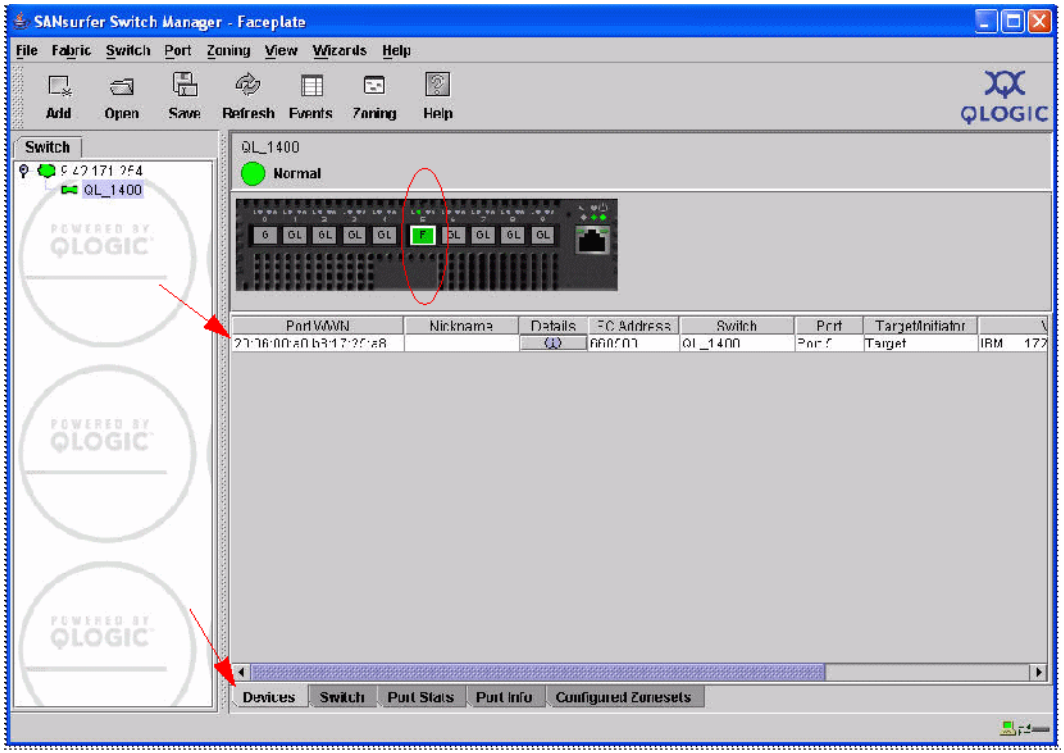

Figure 7-42 PortWNN window

16. From the Faceplate, select the **Configured Zoneset** tab. Verify there are no zones configured on the switch. If there are zones configured, see manufacturer user's guide for instructions on how to remove a zone set and zones.

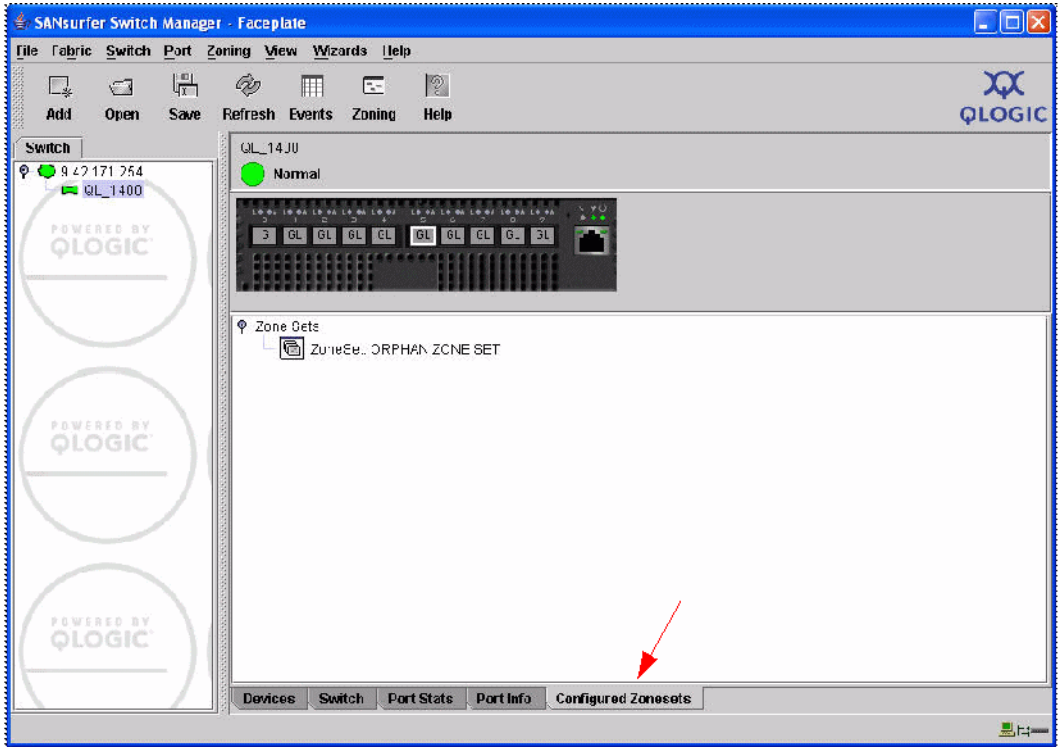

Figure 7-43 SANsurfer Switch Manager window

This switch is now configured to work with other fabrics.

7.5 QLogic 4Gb FCSM connectivity to 1404 and SAN environment

In this section, we discuss the configuration of the QLogic 4Gb Fibre Channel Switch Module and establish connectivity to our SAN environment via the QLogic 1404. Perform the following instructions:

1. Launch your switch's IP address from your browser. Enter the IP Address, Login Name, and Password. Click **Add Fabric** to continue (Figure 7-44).

Figure 7-44 Add a New Fabric window

1. From the Topology window in the left pane, click the drop-down tree and double-click the IP address. Next, select your switch (in our example, the default is FCSM4Gb). Select **Switch** → **Switch Properties**... (Figure 7-45 on page 207).

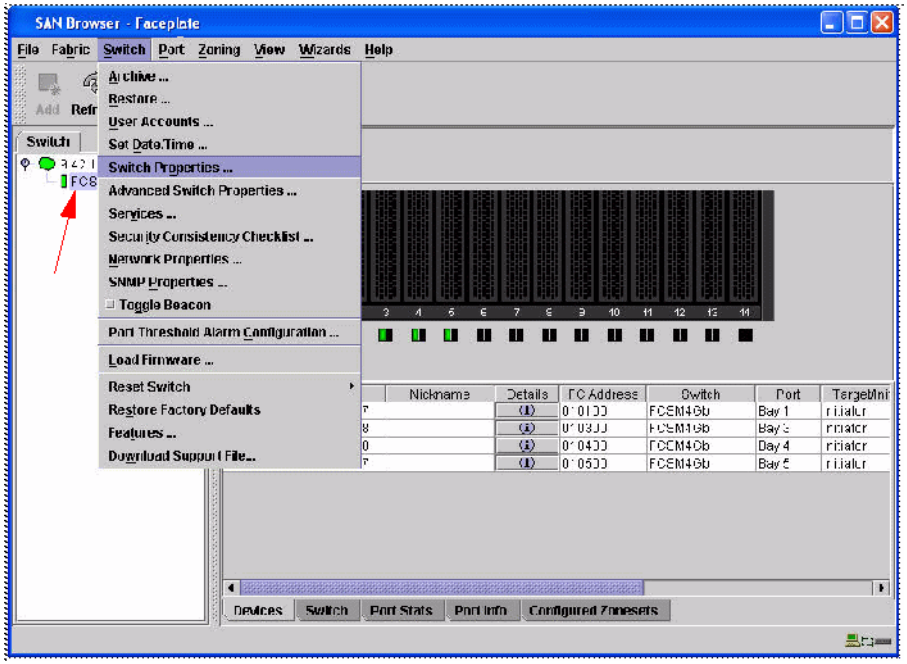

Figure 7-45 SAN Browser - Faceplate window

2. From the Switch Properties dialog (Figure 7-46), enter a symbolic name for your switch. Click the **Enable** radio button next to Domain ID lock (1). Enter a Unique Domain ID ranging from 97-127 (2). In our example, we selected 99 for the DID. Click **OK** to continue.

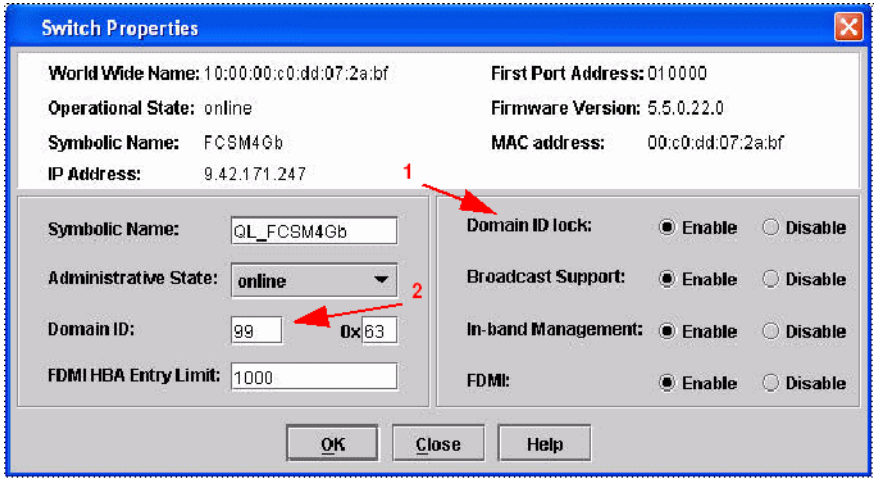

Figure 7-46 Switch Properties window

3. Click **OK** when the Updating Switch Properties dialog box appears.
4. From the Faceplate window, select your desired E-Port. Next, select **Port** → **Port Properties** (Figure 7-47). In our example, we designated port 19.

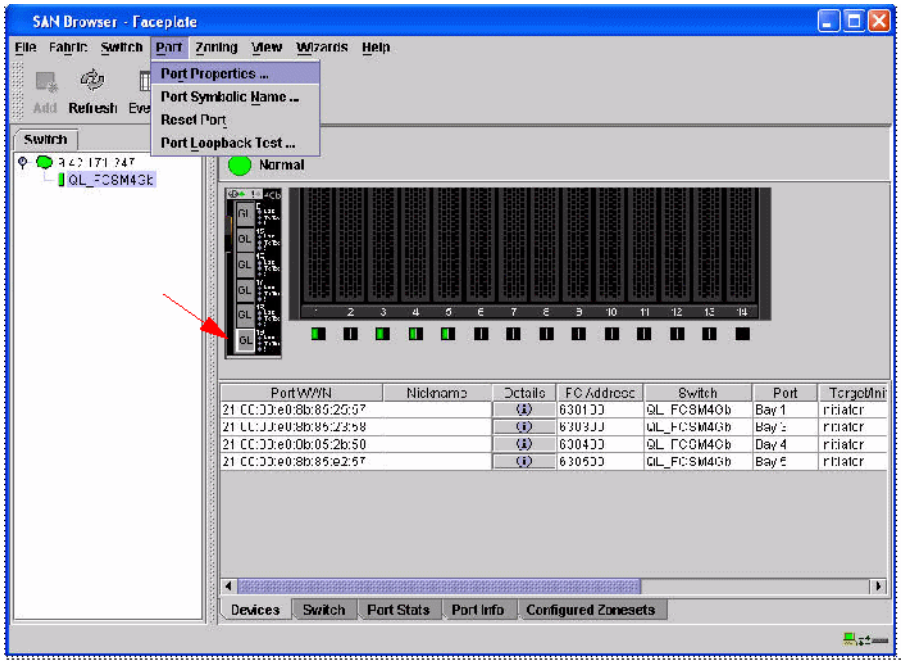

Figure 7-47 SAN Browser - Faceplate window

5. From the Port Properties dialog box (Figure 7-48 on page 209), verify the following settings are true for port 19:
   a. Port State = online
   b. Port Speed = auto-detect
   c. Port Type = G-port
   d. I/O Stream Guard = Auto
   e. Device Scan = Enable
6. Click **OK**.

7. When the Updating Port Properties - SAN Browser dialog box appears, click **OK** (see Figure 7-48).

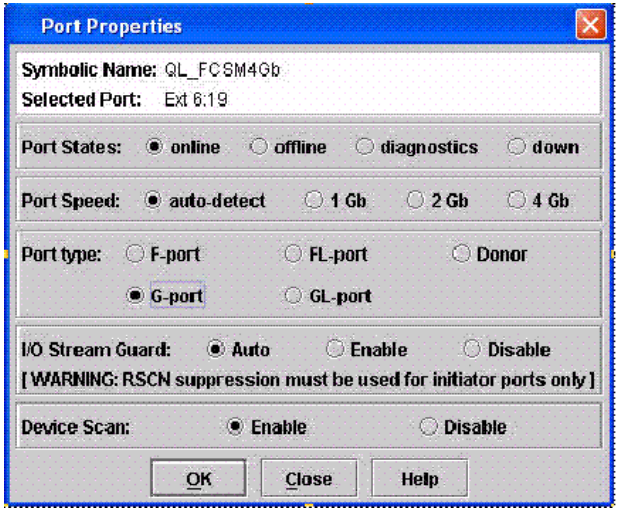

Figure 7-48 Port Properties window

8. From the Faceplate, select the **Configured Zoneset** tab (Figure 7-49). Verify there are no zones configured on the switch. If there are zones configured, see manufacturer user's guide for instructions on how to remove the zone set and zones.

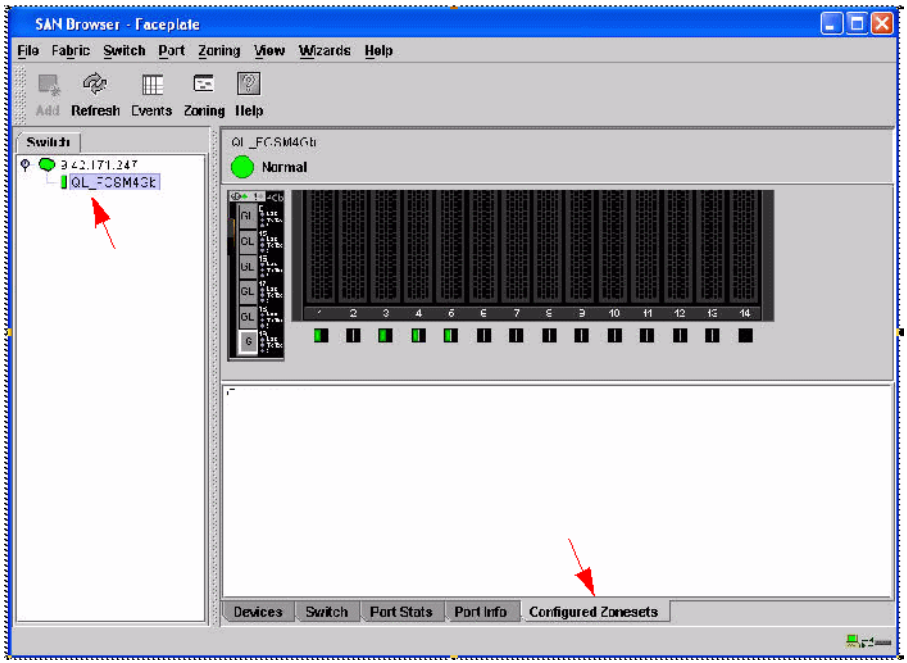

Figure 7-49 SAN Browser - Faceplate window

Connect FC cable from FCSM to 1404

9. Verify the E-Port (ISL) connection was successful. In the left panel, select the IP address to obtain the Topology view window (Figure 7-50). Verify both switches in the Topology viewing pane are visible. Optionally, you can telnet into the switch and type the command **`show fabric`** and verify that you see both switches.

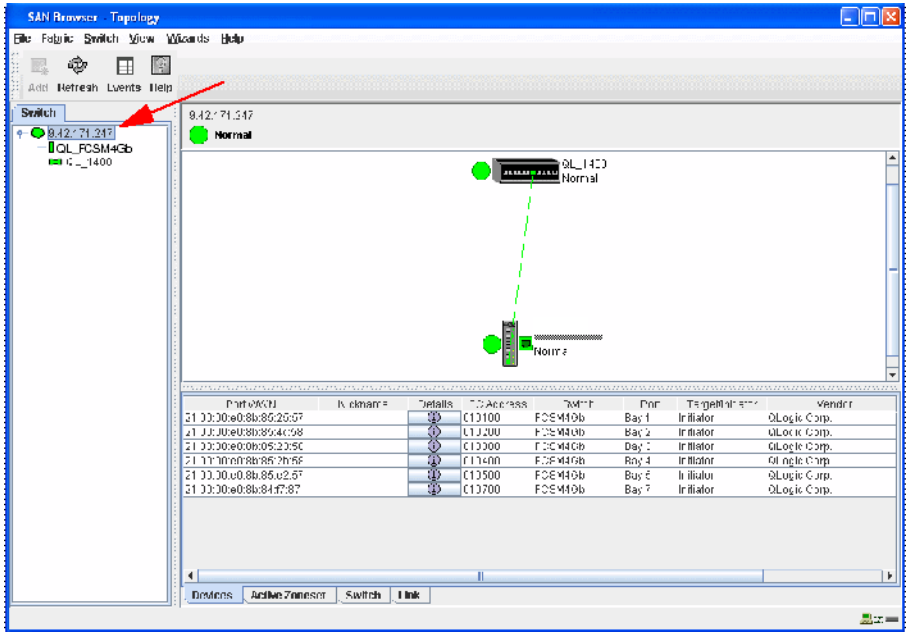

Figure 7-50 SAN Browser Topology window

Create a zone set and zone

10. In the left panel, highlight QL_FCSM4Gb. From the Faceplate dialog window, select **Zoning** → **Edit Zoning** (Figure 7-51).

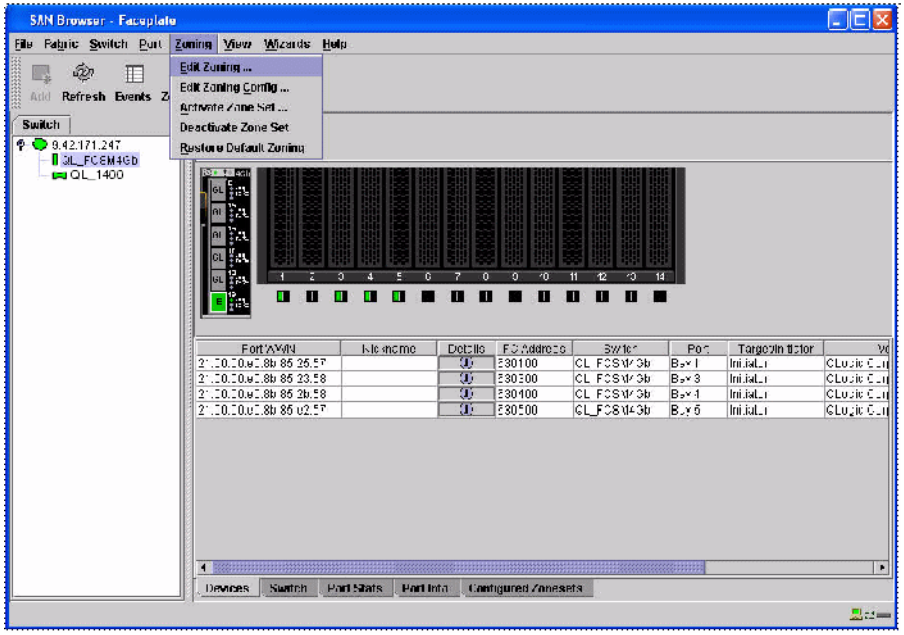

Figure 7-51 SAN Browser - Faceplate window

11. From the Edit Zoning dialog window, select **Edit** → **Create Zone Set** (Figure 7-52 on page 213).

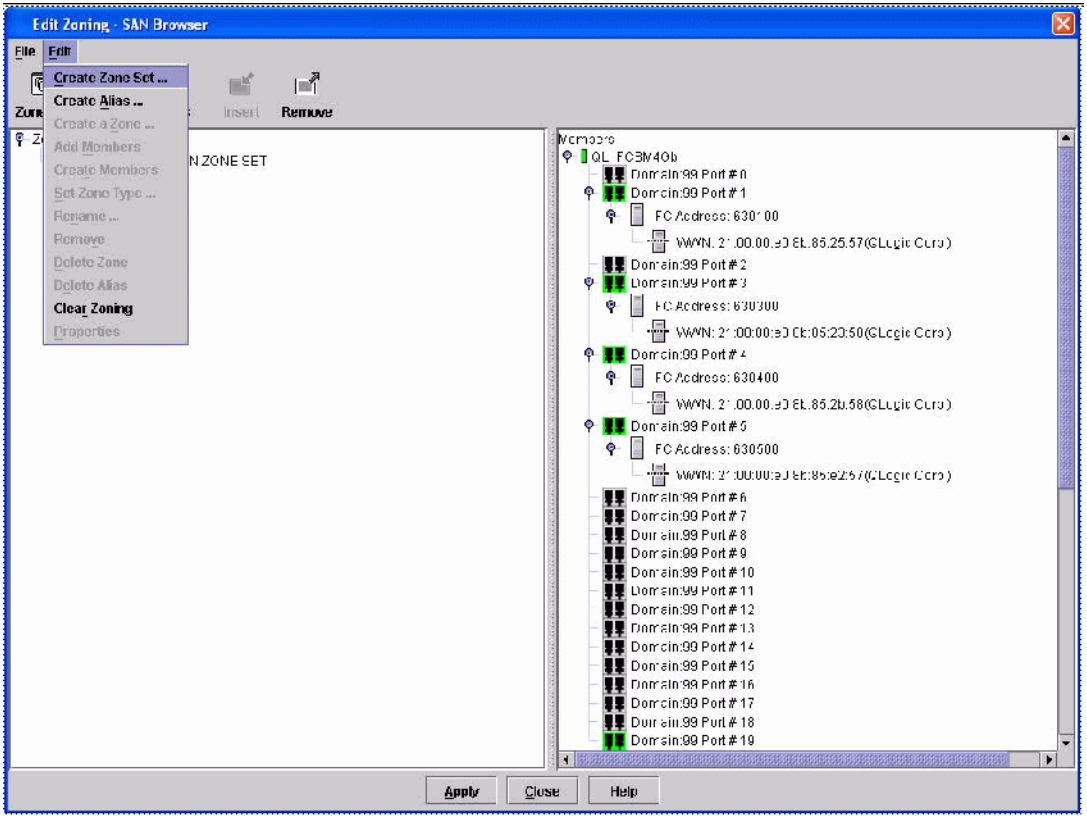

Figure 7-52 Edit Zoning- SAN Browser window

12. In the Create a zone set dialog box (Figure 7-53), enter a name for the Zone Set Name field and click **OK**. In our example, we typed IBM_ITSO.

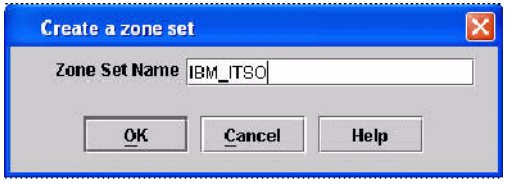

Figure 7-53 Create a zone set window

13. Highlight the Zone Set you just created. From the Edit Zoning - SAN Browser action menu (Figure 7-54), select **Edit** → **Edit Menu**.

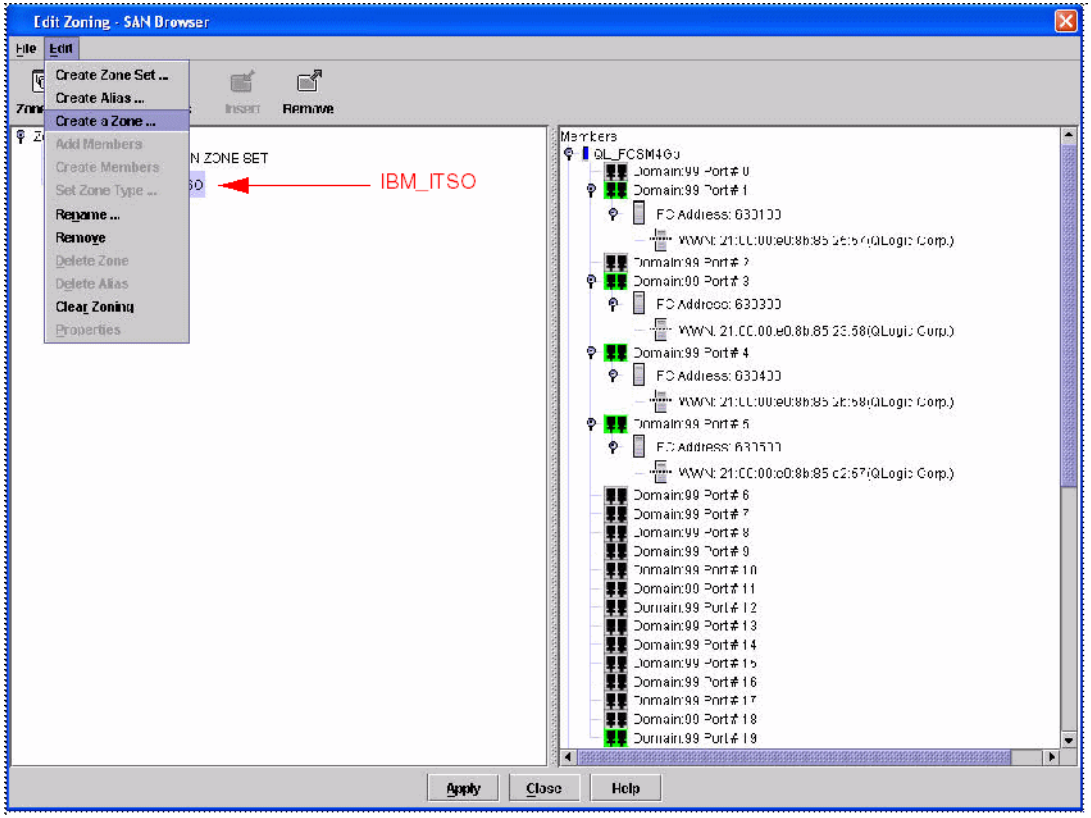

Figure 7-54 Edit Zoning - SAN Browser window

14. In the Create a zone dialog box (Figure 7-55), enter a name in the Zone Name field and click **OK**. In our example, we typed BCS_4100.

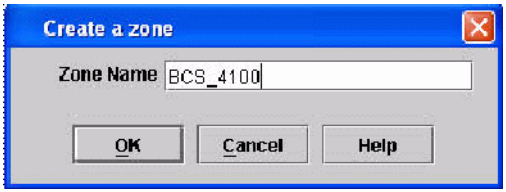

Figure 7-55 Create a zone window

15. In the Edit Zoning - SAN Browser window (Figure 7-56), highlight the zone you created. Select the members you want to be included in the zone. You may use the Control key to select more than one member. Select **Edit** → **Add Members**.

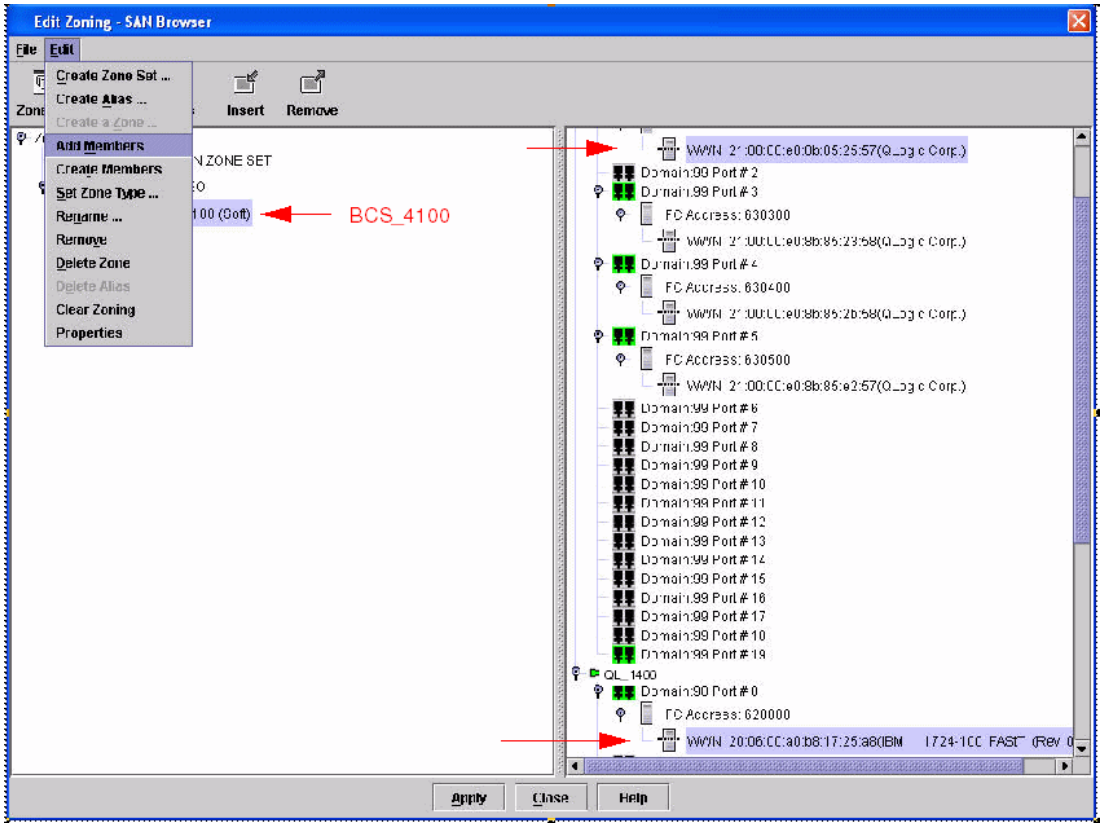

Figure 7-56 Edit Zoning - SAN Browser window

16. To create more zones, repeat steps 11 on page 212 through 13 on page 214.

17. Once your zones have been created (Figure 7-57), click **Apply** to save your configuration.

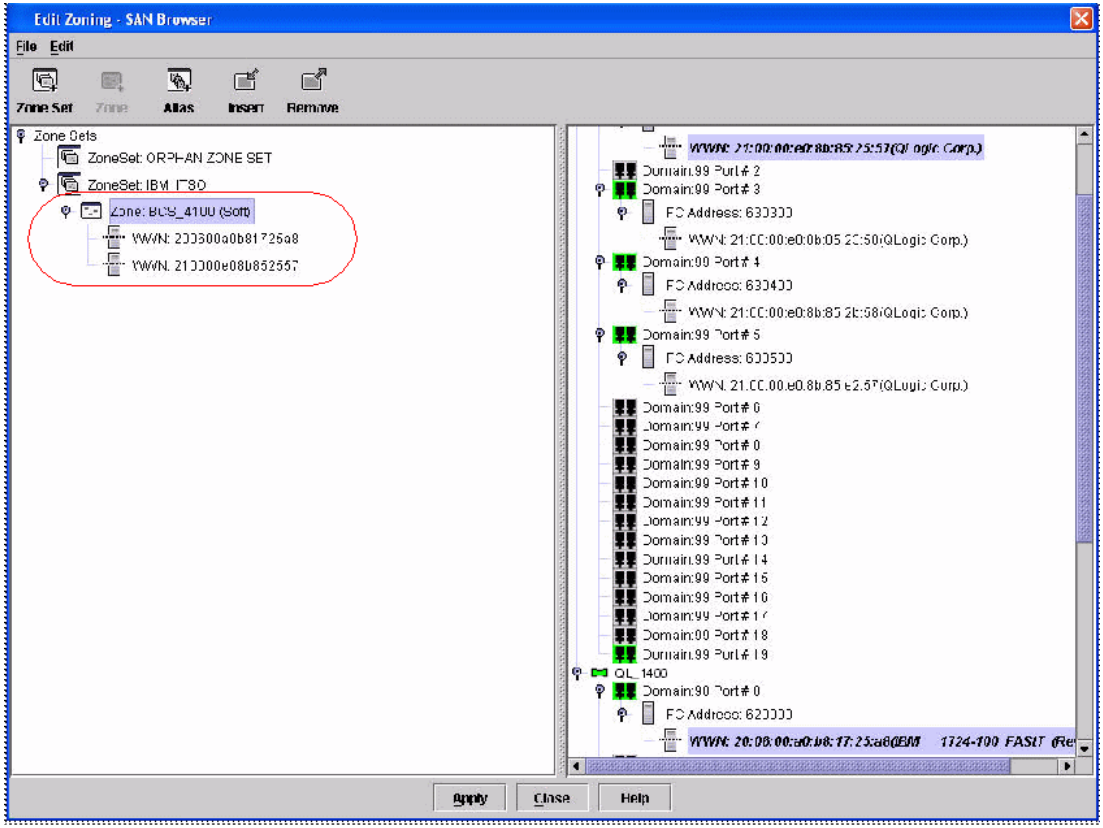

Figure 7-57 Edit Zoning - SAN Browser window

18. From the Save Zoning and Error Check dialog box (Figure 7-58 on page 217), select **Perform Error Check**.

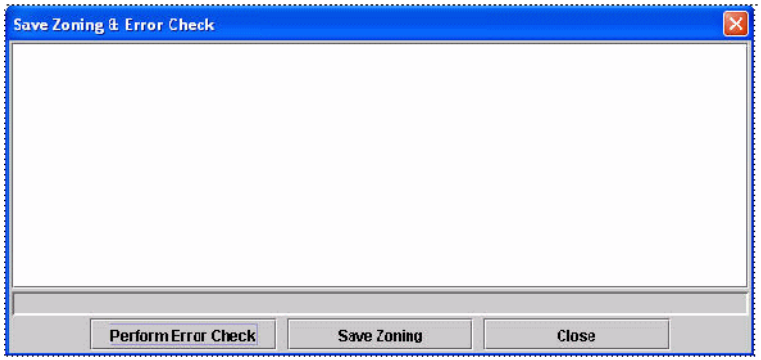

Figure 7-58 Save Zoning & Error Check window

19. Once the Error Check is complete and no errors appeared (Figure 7-59), select **Save Zoning**.

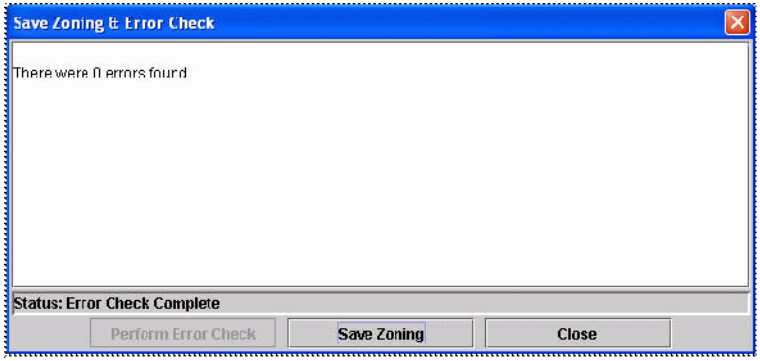

Figure 7-59 Save Zoning & Error Check window

20. Select **Yes** to activate your zone set(s) (Figure 7-60) once the save is complete. You should select **No** if you are not prepared to activate the zone set.

Figure 7-60 Zone set activation window

21. Select the zone set you want activated and click **OK** (Figure 7-61).

Figure 7-61 Select Zone set to be activated window

22. Click the **Close** button to complete your Zoning save (Figure 7-62).

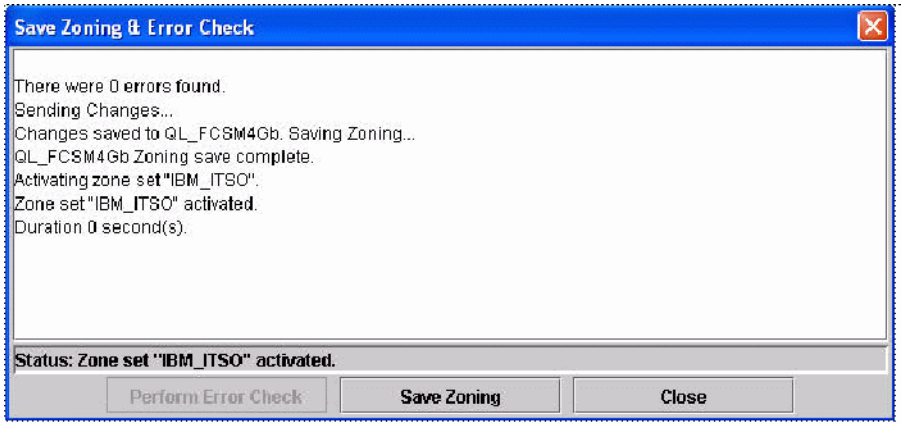

Figure 7-62 Save Zoning & Error Check window

23. Click the **Close** button to exit the Edit Zoning dialog window (Figure 7-63 on page 219).

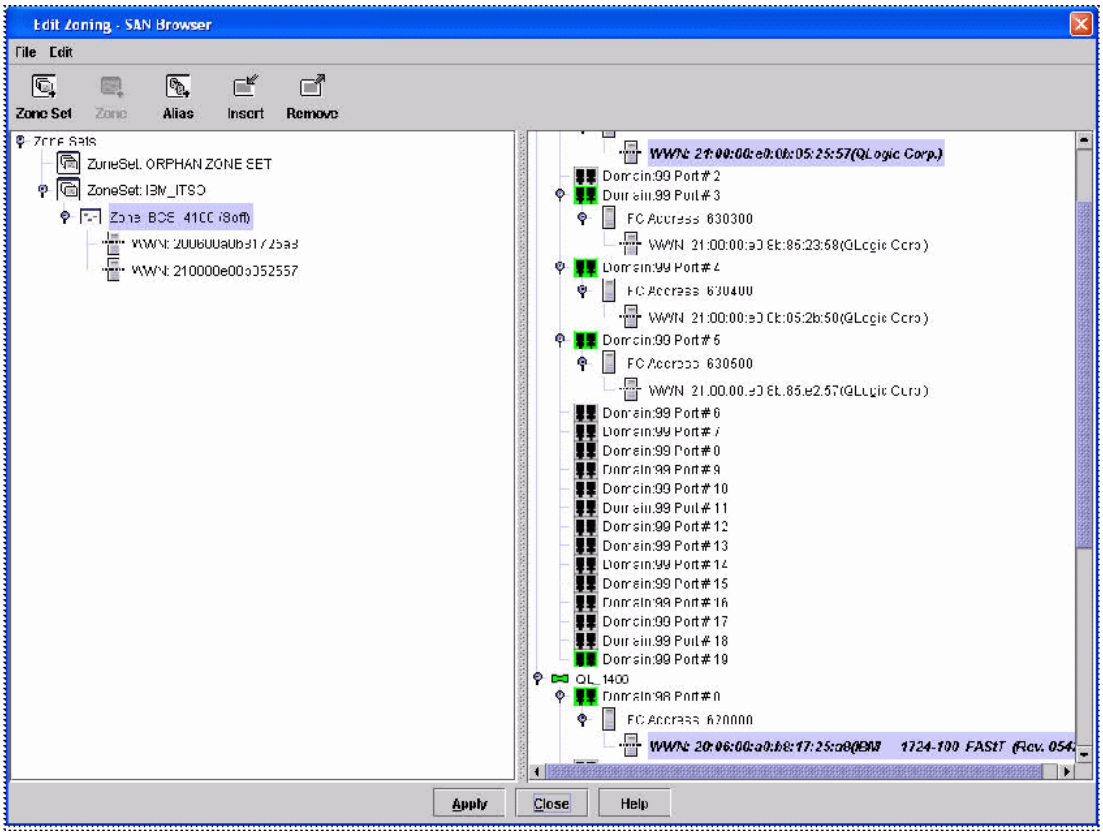

Figure 7-63 Edit Zoning - SAN Browser window

Perform a SAN check (referenced in the *Switch Interoperability Guide v6.0*, located at the following Web site: `http://qlogic.com/interopguide/info.asp`).

7.6 QLogic licenses

The following is the specific part numbers you should reference during purchase:

- QLogic 20-port 4Gb FC Switch Module (PN 26R0881)
- QLogic 10-port 4Gb FC Switch Module (PN 32R1904)
- QLogic/McDATA 10-port Upgrade (PN 32R1912)
- McDATA Mode Firmware Key Upgrade (PN 32R1795)

8

EMC Boot from SAN

This chapter illustrates the detailed configuration procedure necessary to implement the Boot from SAN (storage area network) solution using the IBM BladeCenter blade servers with Linux and Windows 2000/2003 operating systems, QLogic 4Gb FC HBAs, McDATA 4Gb Fibre Channel Switch Modules, ISL through McDATA 4700 and Intrepid, and the EMC CLARiiON CX700 storage subsystem. The Boot from SAN configuration procedure is similar for the HS20, LS20, and HS40 blade servers. The only exception is for the HS40 blade that requires the boot device to be selected under the startup sequence options in the setup menu (accessed by breaking the boot sequence using the F1 key). Thus, the procedure explained in this chapter can be applied to the HS20, LS20, and HS40 blade servers.

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8.1 Boot from SAN overview

Boot from SAN allows for the deployment of diskless servers in an environment where the boot disk is located on the RAID (redundant array of independent disks) capable storage server connected to the SAN. The server (Initiator) communicates with the storage device (target) through the SAN using the Fibre Channel host bus adapter (HBA). The software configuration parameters in FC BIOS of the HBA allow the server to identify and map the boot disk on the SAN. The Boot from SAN function allows for consolidation of the server and storage hardware and facilitates a central point of management.

The system downtime is greatly minimized in case a critical component such as a processor or host bus adapter fails and needs to be replaced. The system administrator only needs to swap the hardware and reconfigure the FC HBA BIOS, fabric zoning, plus change the host port definitions on the storage subsystem. The system image still exists on the logical drive and the server is operational once the hardware swap and configuration change is completed.

Because the EMC CLARiiON storage subsystem is configured with dual redundant Service Processors for fault tolerance, high availability, and load balancing, it is critical for the initial install of the operating system that only a single and unique path from the blade to the logical drive (boot LUN) on the storage subsystem is configured. As such, the secondary path via the second Service Processor must be disconnected or isolated by excluding the second port on the HS20 FC HBA card and the EMC CLARiiON Service Processor B in the initial zone configuration. The second path is included in the active zone configuration *after* the operating system is successfully installed and it has been verified that the HS20/HS40 blade successfully boots from the logical drive on the SAN.

Table 8-1 lists the hardware and software components used in implementing the lab setup to test Boot from SAN for Linux and Windows 2000/2003 operating systems.

Table 8-1 Hardware and software for SAN solution

Hardware configuration	Quantity	Software configuration
HS20 Blade (8832)	1	BIOS 1.10, FC BIOS 1.04.
HS40 Blade (8839)	1	BIOS 1.62, FC BIOS 1.04.
HS20 Blade (8843)	2	BIOS 1.08, FC BIOS 1.04.
LS20 Blade (8850)	1	BIOS 1.08, FC BIOS 1.04.

Hardware configuration	Quantity	Software configuration
McDATA Fibre Channel Switch Module	2	Firmware 5.5.0.22
EMC CLARiiON 700 Storage Server	1	Note: The EMC support matrix the HBA BIOS levels should be "1.13".

8.2 Pre-configuration checklist

Before proceeding to implement the Boot from SAN environment, ensure that the following tasks are completed:

1. Fibre Channel Switch Fabric
   - Refer to the *Switch User Guide* for configuration details.
   - Ensure that the unique Domain ID and IP address are configured on all the switches.
   - Verify the switch external port settings are enabled from the BladeCenter Management Module Advance setup menu. See “Setting the switch module IP Address and enabling external ports” on page 44.
   - Back up the switch fabric configuration.
   - Configure fabric Zoning using the McDATA SANbrowser.
2. CX700 Storage
   - Refer to the latest EMC CLARiiON Release Notes and *Installation and User Guide* for configuration details.
   - Obtain the IP addresses of the EMC CLARiiON storage subsystem.
   - Ensure that the EMC CLARiiON storage service processors and drives are cabled correctly.
   - Verify and create the new logical drive, if needed.
3. Remote Management Setup via TCP/IP
   - Verify and install the necessary Java plug-in 1.4.2_03 or above to access the McDATA Web Interface on the Remote Management workstation.
   - Install the Navisphere Management Agent and CLI application required to access the EMC CLARiiON storage server. Install it after the HBA has completed registration.

8.3 Configuring Boot from SAN

In this section, we begin discussing the specific activities necessary to implement a Boot from SAN using EMC technology.

8.3.1 Configure the Primary Boot Path from the HS20 blade BIOS

The following steps illustrate the procedure for booting an IBM BladeCenter blade server from an EMC CLARiiON storage device. Either Linux or the Windows 2000 and Windows 2003 Advance Server or Server Edition can be loaded once the environment is configured.

1. Perform the physical connectivity for the EMC CLARiiON storage subsystem and the switch fabric, as shown in the EMC CLARiiON CX700 and Fibre Channel Switch Installation and User Guides.
2. Perform the blade BIOS configuration, as shown in “Blade server F1 setup” on page 36.
3. Perform the Fibre Channel HBA configuration, as shown in “QLogic Fast!Util setup” on page 38.

8.3.2 Fabric Zoning configuration

The Fabric Zone configuration consists of the following tasks:

- Access the switch management interface and log in with Administrator privileges.
- Select the Zoning menu.
- Create a zone.
- Add member(s) to a zone.
- Create a new zone set if there no active zone set.
- Add zone(s) to a zone set
- Activate the zone set
- Verify the active zone set

Note: Notice in Figure 8-1 that there is only one path from the blade server to the EMC CLARiiON Service Processor A. This is essential to successfully installing the OS on the boot disk mounted on the EMC CLARiiON CX700. The second path to the Service Processor B is purposely excluded for OS installation through the single path.

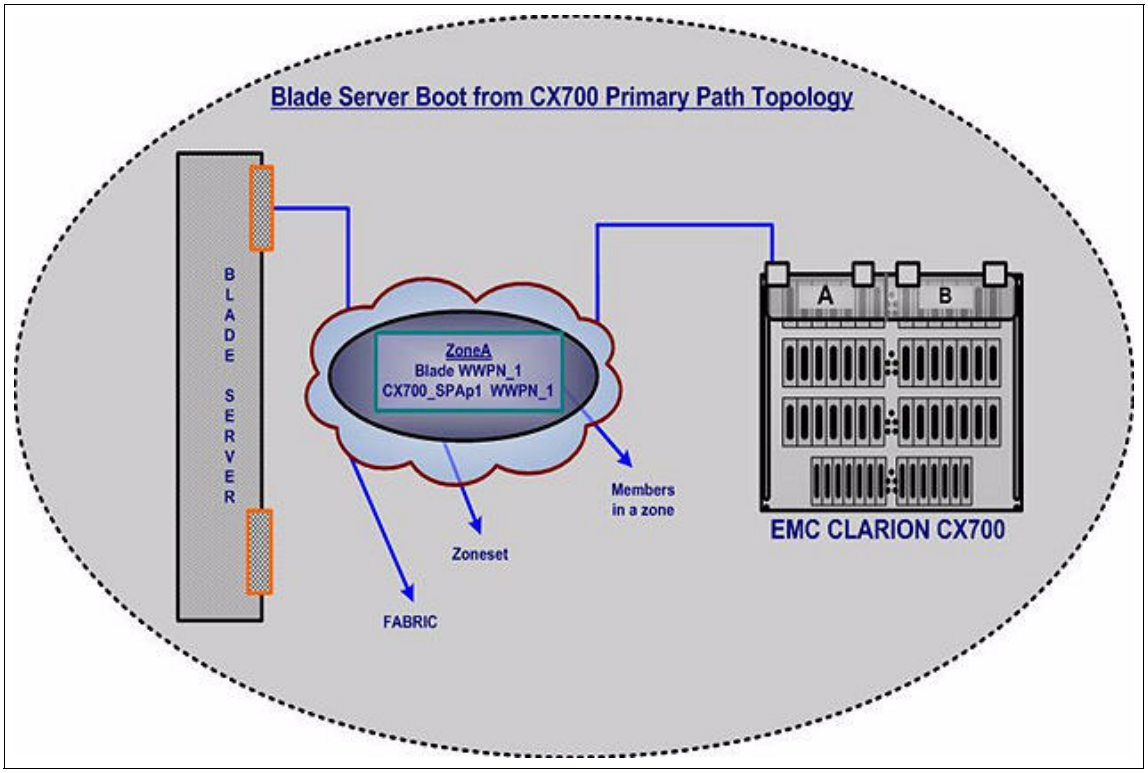

Figure 8-1 Blade server boot from CX700 primary path

The following steps illustrate the zone configuration for the primary path from the EMC CLARiiON Service Processor A and the first port on the HS20 blade host bus adapter, which corresponds to the IRQ address 2400.

1. Identify and record the WWNs of the EMC CLARiiON Service Processor A port 1 and the first FC port on the host to be used in the new active zone set. Verify the nameserver table for the hosts and storage ports login status.
2. Zoning.

> **Note:** For a detailed procedure to configure zoning, refer to the corresponding switches' (Brocade, Cisco, McDATA, or QLogic) User Guide.
>
> In an interoperable fabric, we highly recommend not using multiple Zone management interfaces. For example, in a intermix fabric with QLogic and McDATA; zone management can be done exclusively from McDATA tools, such as EFCM, QLogic SANpilot interface, or from the CLI.

Zoning configuration steps:

a. Create a Zone: I82bi46_qla1_CX3_4D_3_SPA0.

b. Add the WWNs of the HBA 0 and the CX700 SP-A port1.

c. Add the Zone: I82bi46_qla1_CX3_4D_3_SPA0 as a member of the active zone set or create a new zone set and insert the zone into the new zone set.

d. Activate the zone set.

8.4 Blade server F1 setup

This step should be performed when you are prepared to configure a Boot from SAN environment. Perform the instructions in 4.2, “Blade server F1 setup” on page 36 to disable the use of the IDE or SCSI drives that may be installed in the HS20, HS40, or LS20.

8.5 Configure a startup device for an HS40 blade only

Following the reboot initiated in the preceding step, you should carefully watch the boot sequence for the Setup menu,

a. Press the F1 key to enter the setup menu.

b. Select **Startup options**.

c. Select **Startup sequence options**.

d. Select **Second Startup Device** and press Enter to list all the startup devices, as shown in Figure 8-2 on page 227.

e. The Fibre device will be listed as one of the startup device, assuming the FC BIOS is enabled and the boot device is mapped correctly from Fast!UTIL menu.

f. Select the fibre device and press Enter. You will see a window similar to Figure 8-3 on page 227.

g. Save and exit.

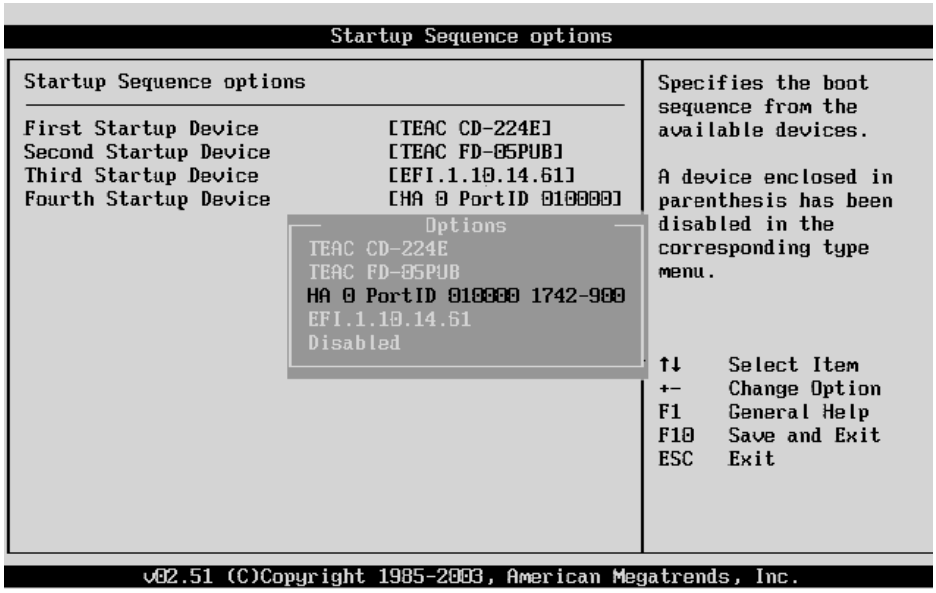

Figure 8-2 Startup Sequence options window

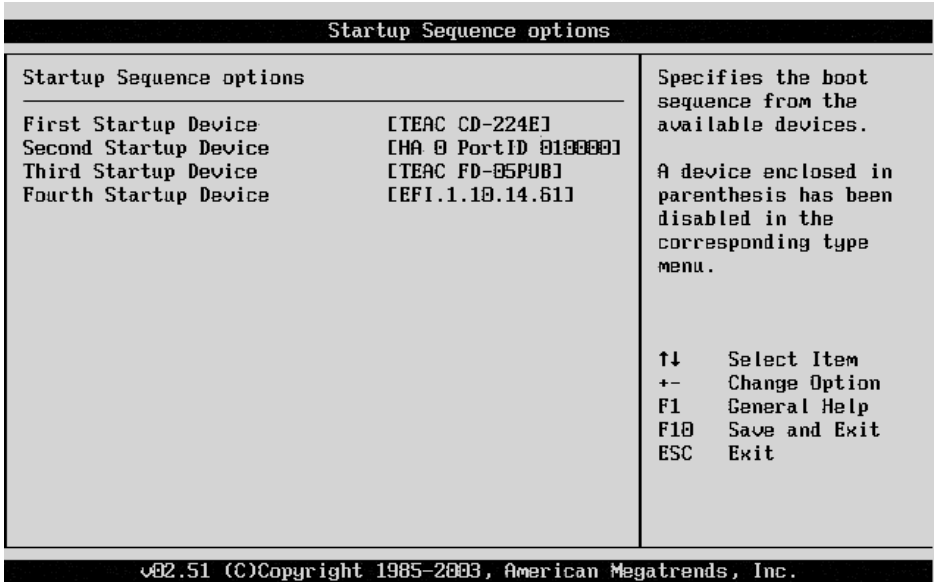

Figure 8-3 Startup Sequence options window

8.6 Blade server - QLogic HBA setup

This section discusses our setup of the QLogic Fibre Channel HBA establishing a connection with the EMC CLARiiON CX700 WWN (world wide name).

1. Start the BladeCenter HS20 to configure the QLogic HBA. When you reach the Ctrl-Q application (Example 8-1), type Ctrl-Q and press Enter to access the QLogic Fast!UTIL.

Example 8-1 Ctrl-Q execute window

```
Broadcom NetXtreme Ethernet Boot Agent v3.1.15
Copyright (C) 2000-2002 Broadcom Corporation
All rights reserved.

Broadcom NetXtreme Ethernet Boot Agent v3.1.15
Copyright (C) 2000-2002 Broadcom Corporation
All rights reserved.

QLogic Corporation
QMC2462 PCI Fibre Channel ROM 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 0 is disabled
BIOS for Adapter 1 is disabled
ROM BIOS NOT INSTALLED

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

The window shown in Figure 8-4 should then appear.

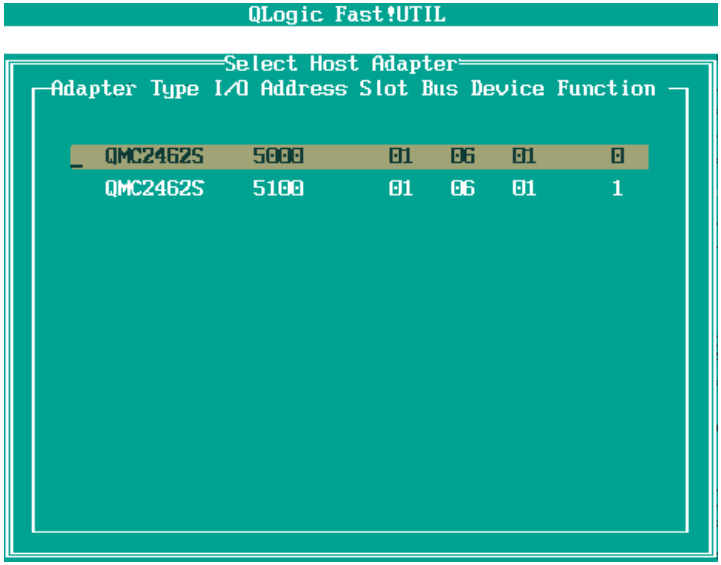

Figure 8-4 Select I/O Address window

2. Select the 0 ID and press Enter. You will see a window similar to Figure 8-5.

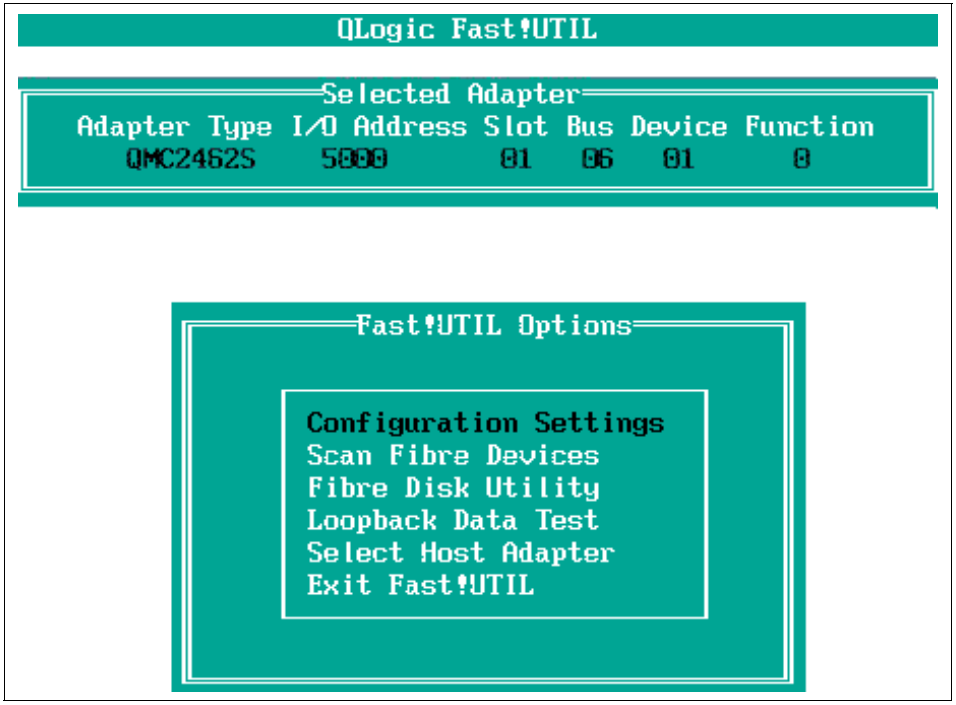

Figure 8-5 Fast!UTIL Options window

3. Select **Configuration Settings**. You will see a window similar to Figure 8-6.

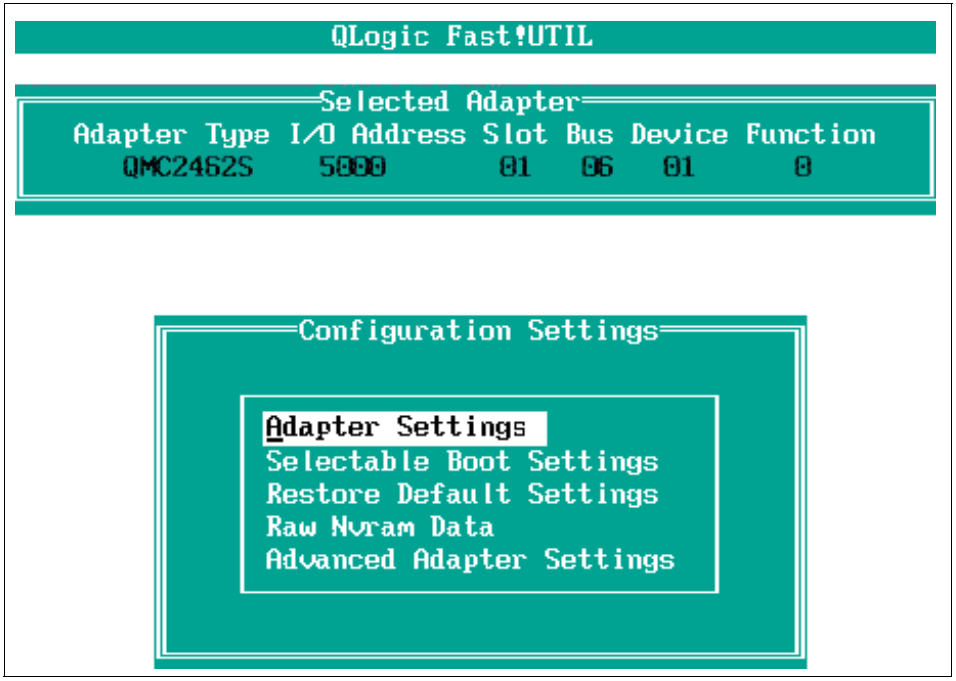

Figure 8-6 Configuration Settings window

4. Under Configuration Settings, click **Adapter Settings**. You will see a window similar to Figure 8-7.

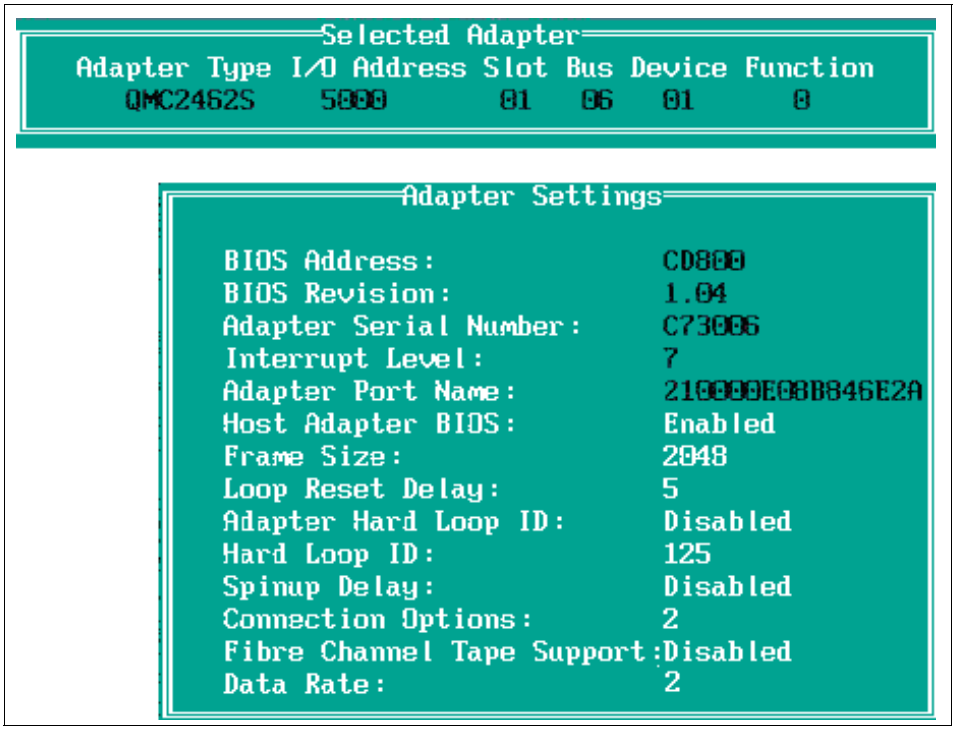

Figure 8-7 Adapter Settings WWN info and enable BIOS window

5. Ensure that the Host Adapter BIOS is Enabled, the Hard Loop ID is set to 125, and the Data Rate is set to 2 (auto detect). Press Enter to change settings and Esc to exit. Next, you will see a window similar to Figure 8-8.

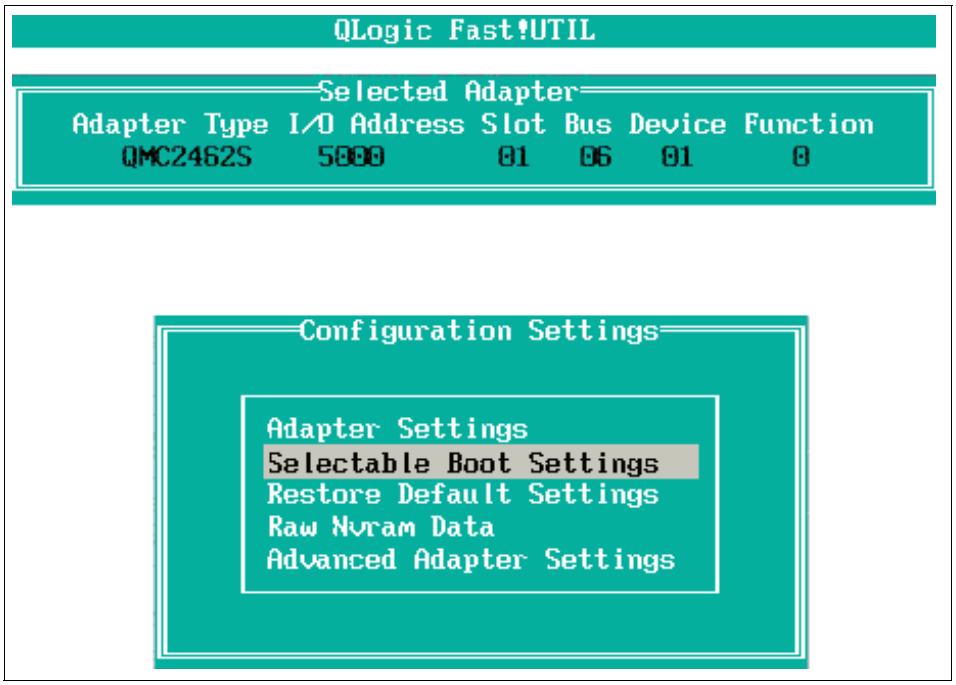

Figure 8-8 Configuration Settings window

6. Select **Selectable Boot Settings** and press Enter. You will see a window similar to Figure 8-9.

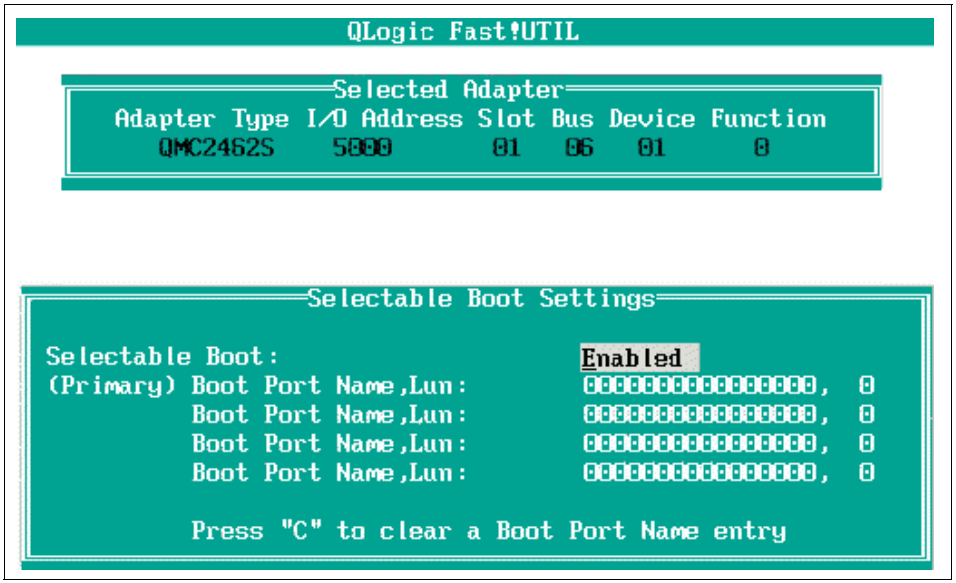

Figure 8-9 Selectable Boot Settings window

7. In the Selectable Boot Settings window, ensure Selectable Boot is set to Enabled (*Do not press Enter*). *Stop at this point*. Go to Configure McDATA Fibre Channel Switch Module. You will resume this step in “Blade server - QLogic HBA setup continuation” on page 262.

8.7 Configure McDATA Fibre Channel Switch Module

In this section, we will access the McDATA SANbrowser to begin the configuring of zones for accessing storage LUNs on the EMC CLARiiON CX700.

1. To begin, enter the IP address of the McDATA Fibre Channel Switch Module for the IBM eServer BladeCenter into your favorite Web browser. You will see the Java Plug-in Version Check and after several seconds a window similar to Figure 8-10 on page 235.

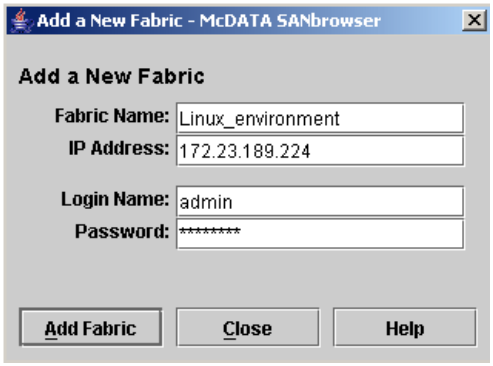

Figure 8-10 Add a New Fabric window

2. Enter a Fabric Name, then proceed with typing in the login name and password and click **Add Fabric**. You will see a window similar to Figure 8-11.

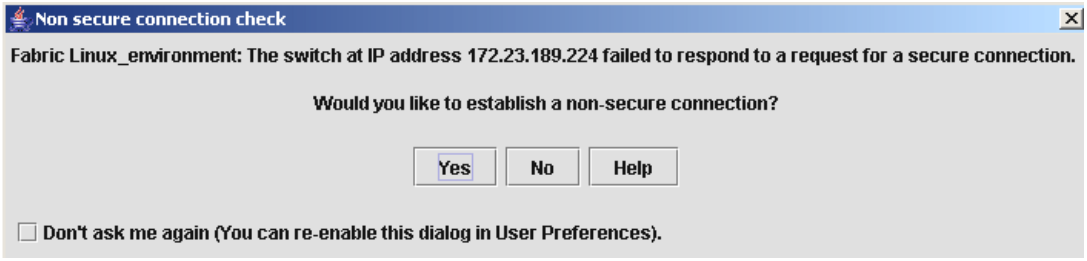

Figure 8-11 Non-secure connection verification window

3. Select **Yes** to establish a non-secure connection. You will see a window similar to Figure 8-12.

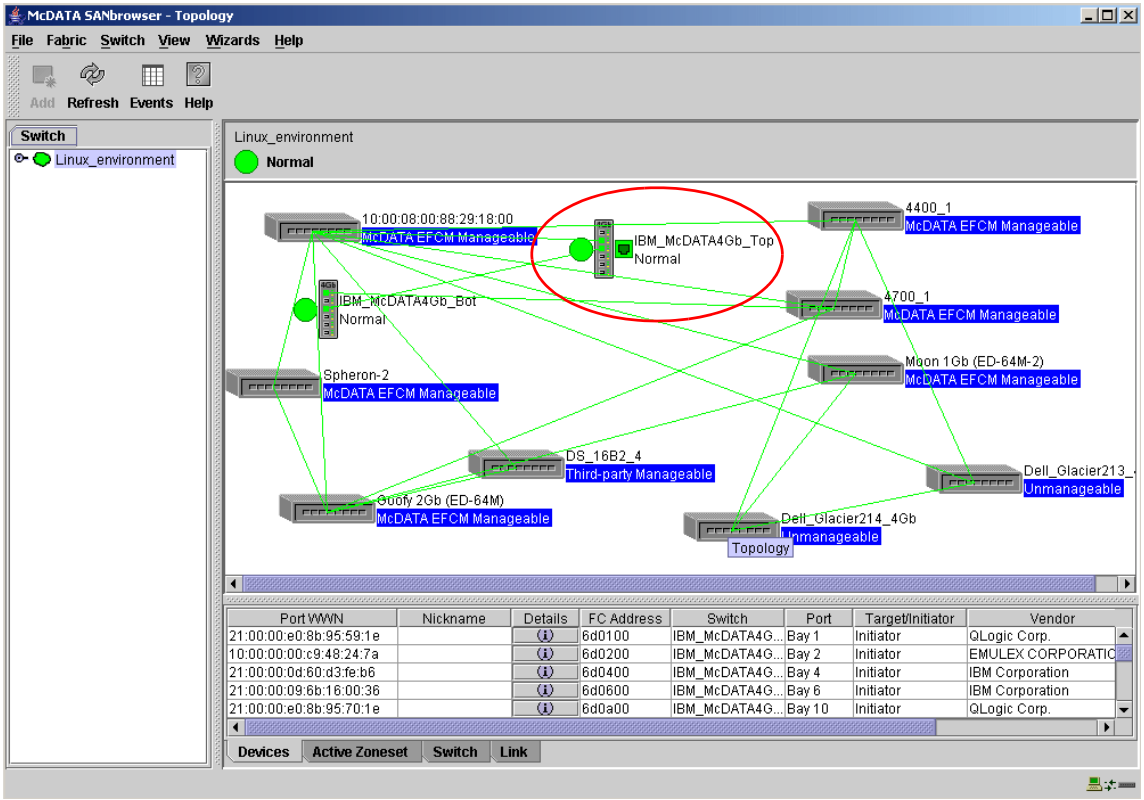

Figure 8-12 Topology window - Linux environment

In this topology, a large Fibre Channel SAN environment is displayed. The McDATA Fibre Channel Switch Module for IBM BladeCenter is circled. This is the switch module we utilize to create our zone sets. In the left panel, double-click Linux_environment to see the IBM_McDATA4Gb_Top settings.

Note: Depending on your fabric environment, there are other products you can use to configure your zones, for example, Connectrix Management.

The window shown in Figure 8-13 should appear.

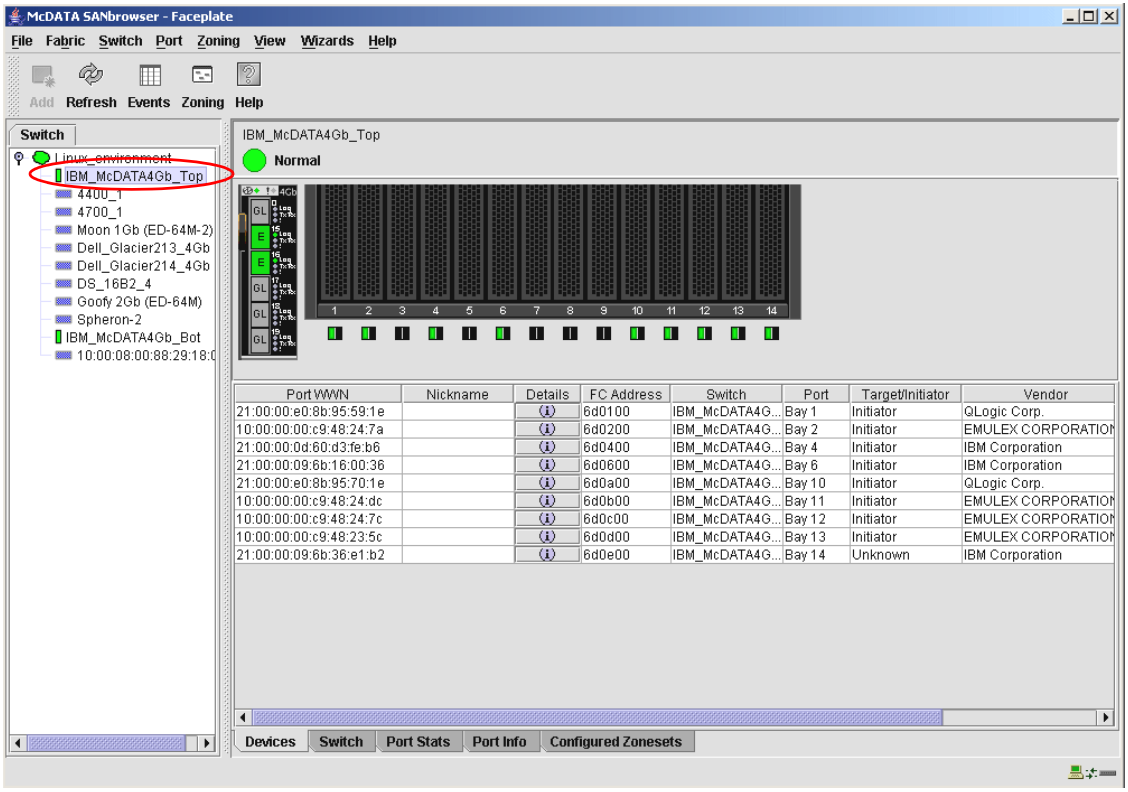

Figure 8-13 Switch faceplate window

4. Highlight **IBM_McDATA4Gb_Top**. You will see a window similar to Figure 8-14.

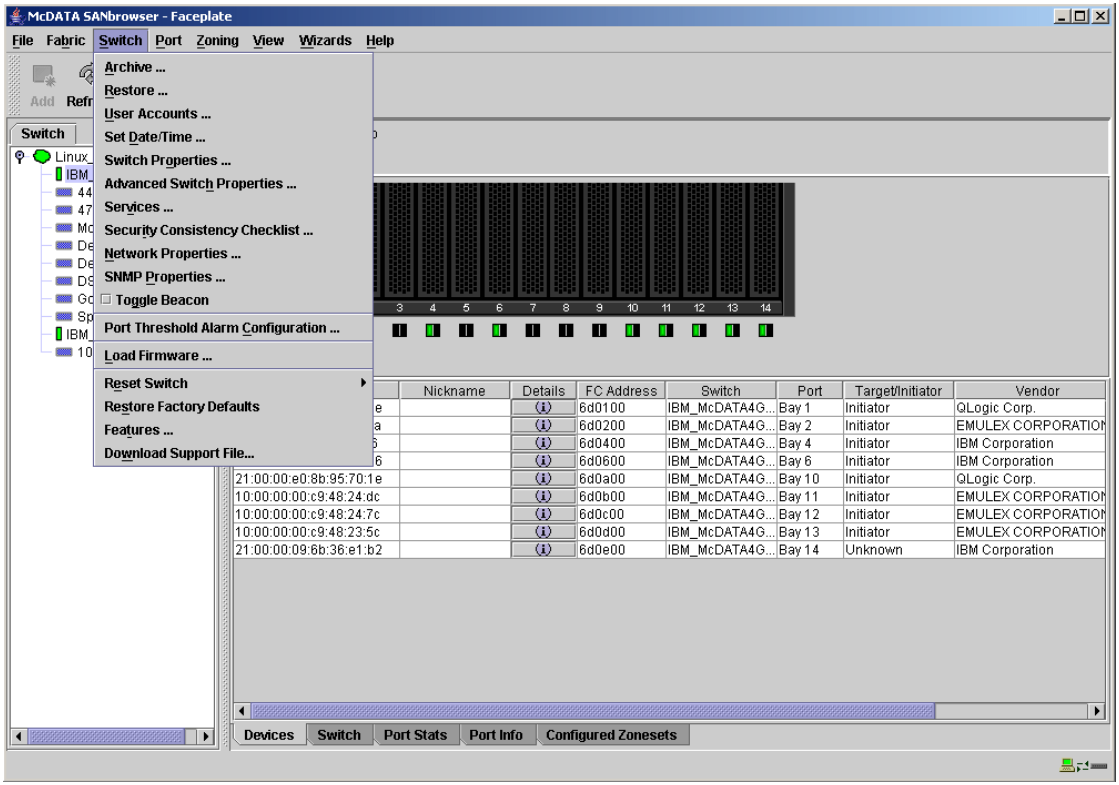

Figure 8-14 McDATA SAN Browser - Faceplate window

5. Select **Switch** → **Advanced Switch Properties**. You will see a window similar to Figure 8-15 on page 239.

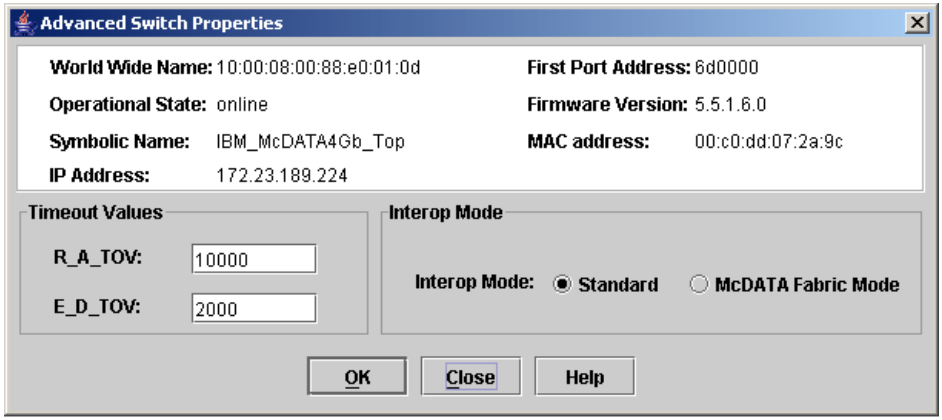

Figure 8-15 Advanced Switch Properties window

The McData Switch Module defaults to the McDATA Fabric Mode when originally configured. For our environment, we must be in Standard mode.

Note: Default mode: Select this mode if the fabric contains only McData switches and directors operating in McData Fabric 1.0 mode.

If the switch is in McDATA Fabric Mode and you change the Default Zone setting, the new setting is propagated to all switches in the fabric. If the switch is in Standard mode and you change the Default Zone setting, the new setting is not propagated to any other switches in the fabric.

In our example, we have different types of switches in our fabric. Ensure Standard mode has been selected and click **OK**. Next, select **Switch** → **Switch Properties**. You will see a window similar to Figure 8-16.

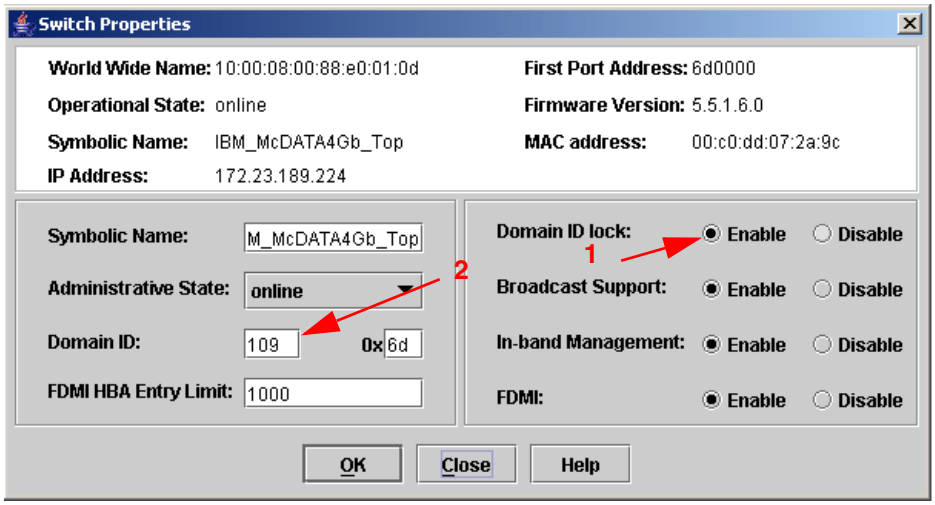

Figure 8-16 Switch Properties window

6. From the Switch Properties dialog (Figure 8-16), enter a symbolic name for your switch. For our example, the name is IBM_McDATA4Gb_Top. Click **Enable** for the Domain ID lock radio button to ensure that the switch always has that Domain ID. In the Domain ID box, type a unique Domain ID in the 97-127 range for the switch (2). In our example, we selected 109 for the DID. Click **OK** to continue.

The window shown Figure 8-17 in should appear.

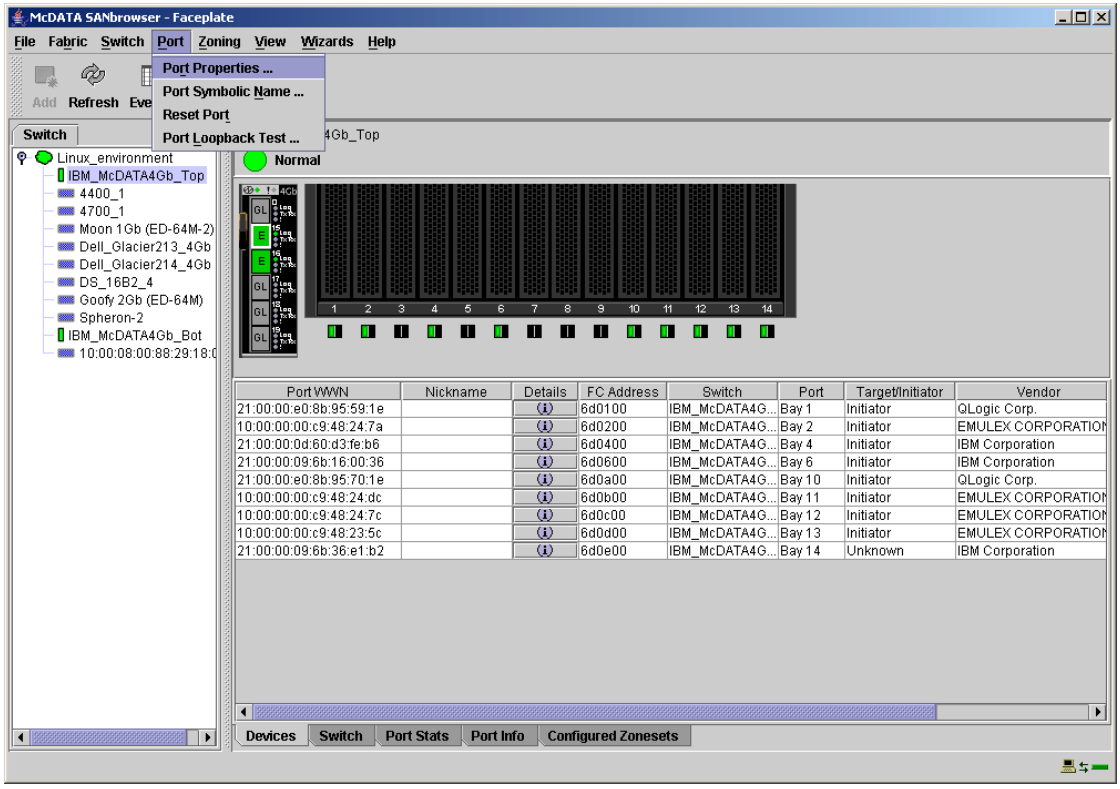

Figure 8-17 McDATA SANbrowser Faceplate window

7. At this stage, we need to configure our ports. Select **Port** → **Port Properties**. You will see a window similar to Figure 8-18.

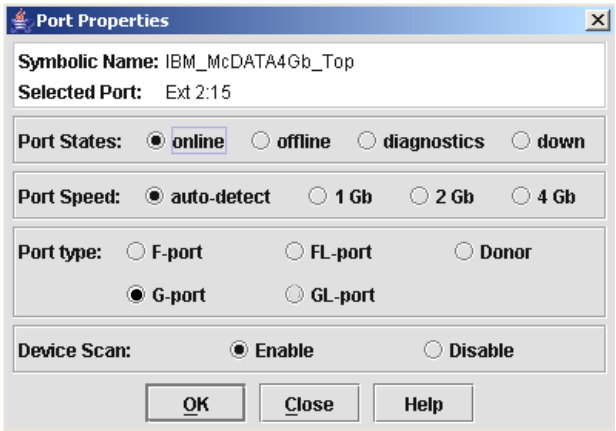

Figure 8-18 Port Properties window

8. From the Port Properties dialog box, verify the following settings are true for port 2:15:
   a. Port States = online
   b. Port Speed = auto-detect
   c. Port type = G - port
   d. Device Scan = Enable

   Note: G-Ports (General ports): Automatically configured to E or F ports to support switches or fabric devices. All switch ports should be set to G-port, except for tape libraries that do not support F-port; see GL ports below.

9. Click **OK**.
10. From the McDATA SANbrowser Faceplate window, select **Zoning** → **Edit Zoning**. You will see a window similar to Figure 8-19 on page 243.

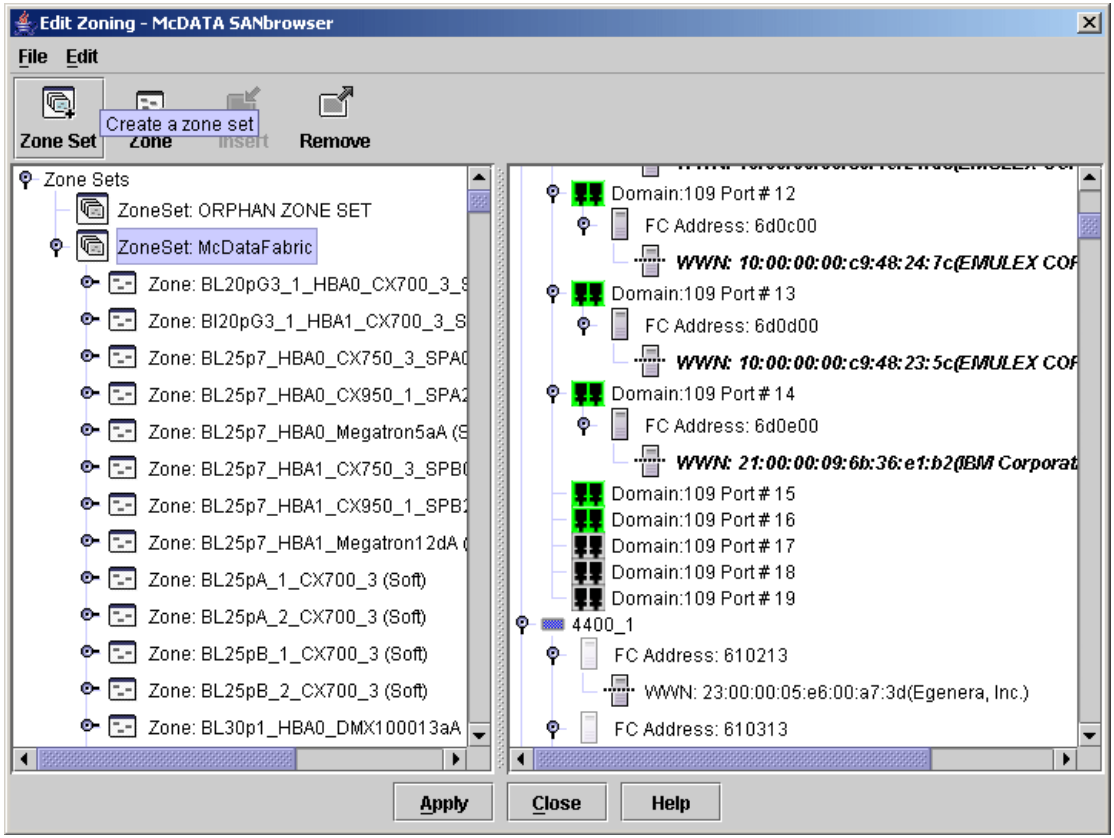

Figure 8-19 Edit Zoning - McDATA SANbrowser window

11. Click the **Zone Set** icon to create a zone set. You will see a window similar to Figure 8-21 on page 244.

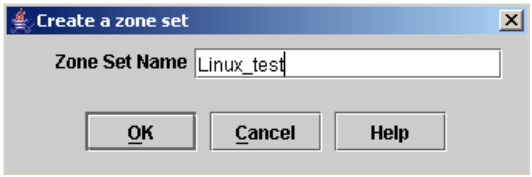

Figure 8-20 Create a zone set window

12. Type in a zone set name. For our example, we typed Linux_text. Click **OK**. The window shown in Figure 8-21 should appear.

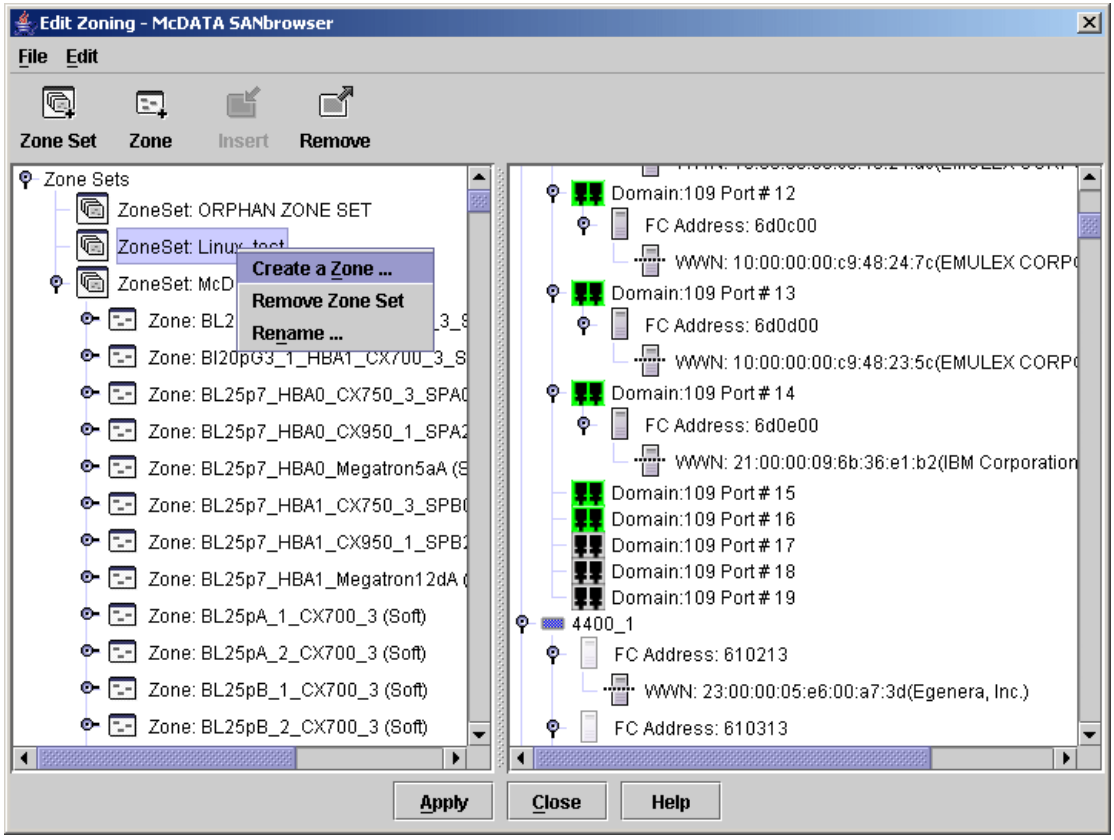

Figure 8-21 Zoning switches listed window

13. In the left panel, right-click **ZoneSet: Linux_text** and select **Create a Zone...**. You will then see a window similar to Figure 8-22.

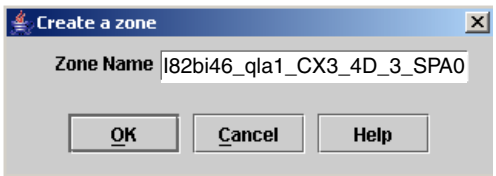

Figure 8-22 Create a zone window

14. in the Create a zone dialog box, enter a name in the Zone Name field. In our example, we typed I82bi46_qla1_CX3_4D_3_SPA0. Click **OK**. You will then see a window similar to Figure 8-23.

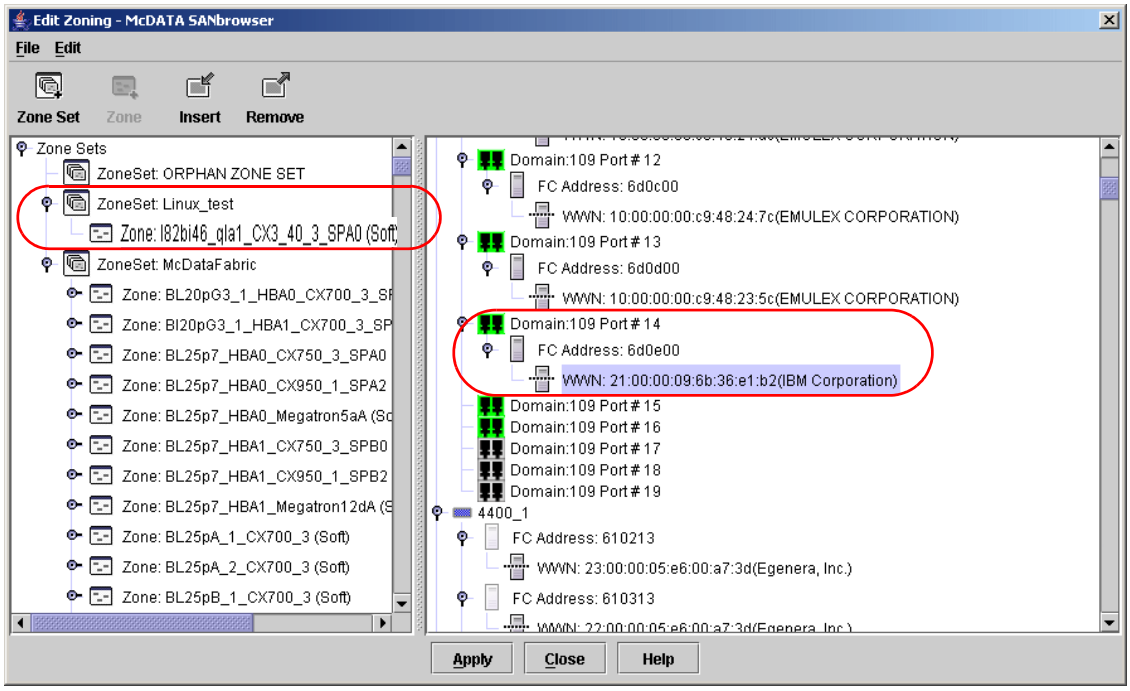

Figure 8-23 Creating I82bi46_qla1_CX3_4D_3_SPA0 zone window

15. In the right panel, add the QLogic HBA to Zone: I82bi46_qla1_CX3_4D_3_SPA0. Hold down mouse button and drag the member to the zone. In our example, this is WWN: 21:00:00:09:6b:36:e1:b2(IBM Corporation).You will see a window similar to Figure 8-24.

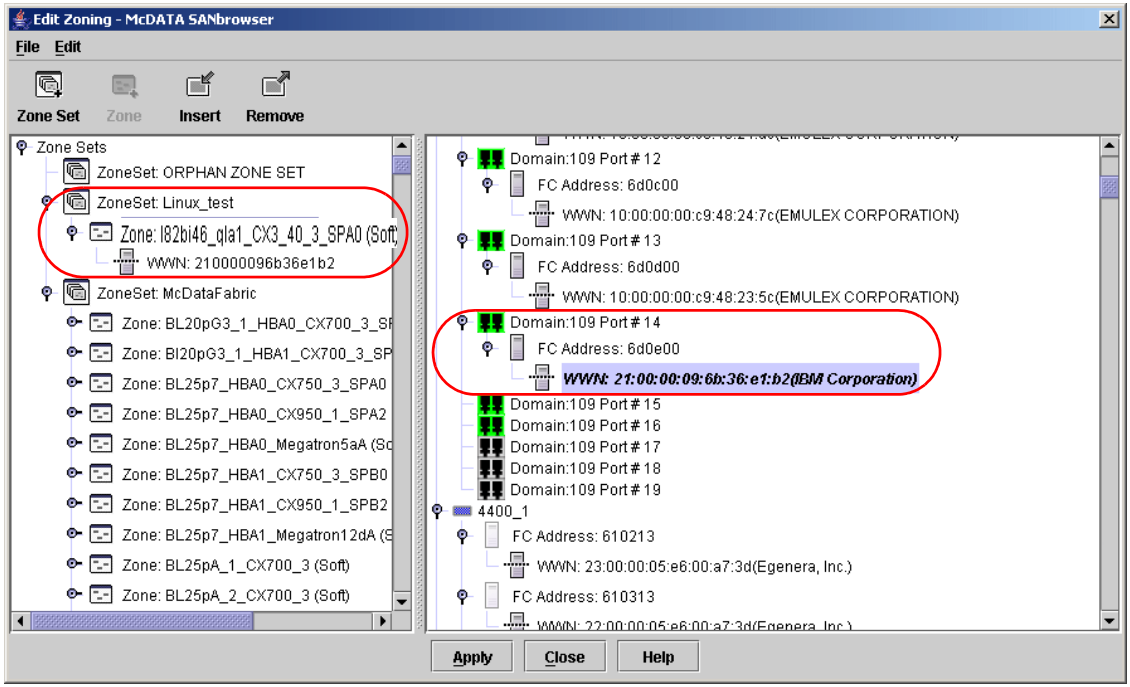

Figure 8-24 I82bi46_qla1_CX3_4D_3_SPA0 zone window

16. In the right panel, locate the Storage WWN that will be utilized for the Boot from SAN configuration (see Figure 8-26 on page 248).

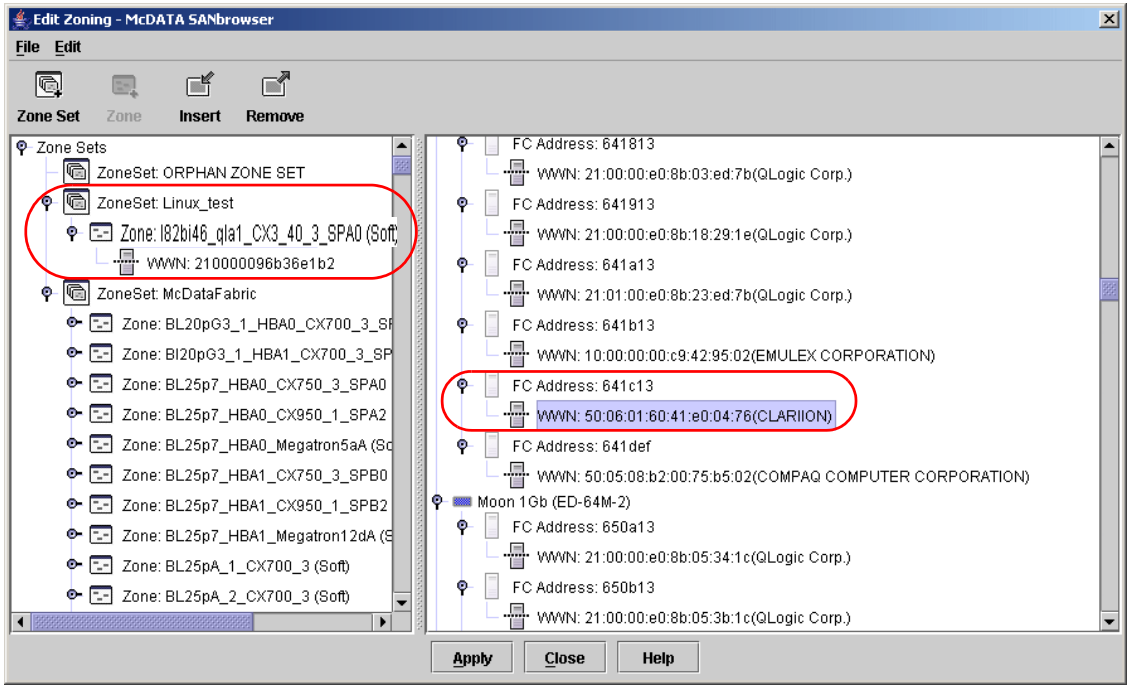

Figure 8-25 I82bi46_qla1_CX3_4D_3_SPA0 zone window

17. From the right panel, add the Storage WWN to the I82bi46_qla1_CX3_4D_3_SPA0 zone. Hold down the mouse button and drag the member to the zone. In our example, this is WWN: 50:06:01:60:41:e0:04:76 (CLARIION). You will see a window similar to Figure 8-26.

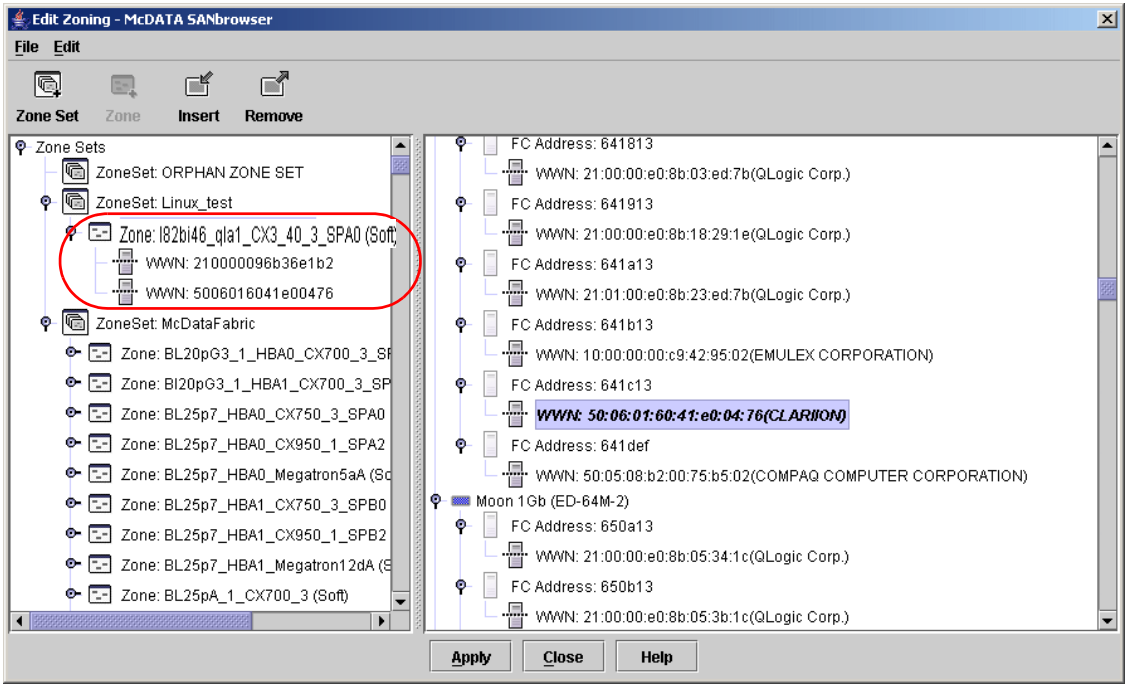

Figure 8-26 I82bi46_qla1_CX3_4D_3_SPA0 zone window

18. Both HBA and Storage WWN are within the I82bi46_qla1_CX3_4D_3_SPA0 zone. Click **Apply**.

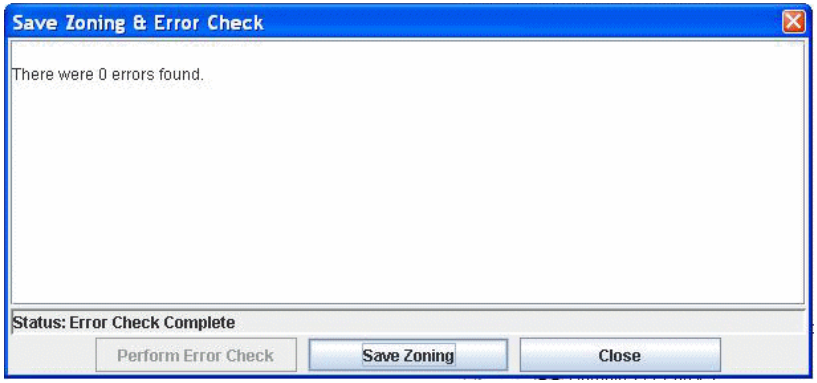

Figure 8-27 Perform error check and save zoning

19. Click **Save Zoning**. You will see a window similar to Figure 8-28.

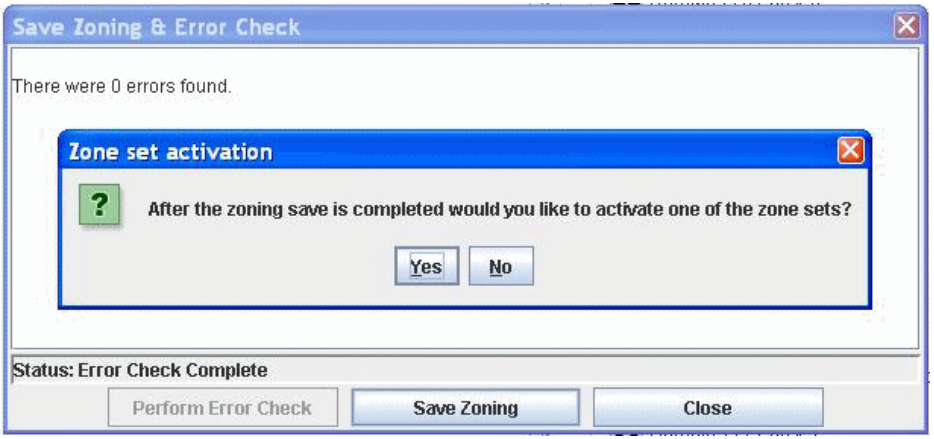

Figure 8-28 Zone set activation window

20. Click **Yes** to activate the zone set. You will see a window similar to Figure 8-29.

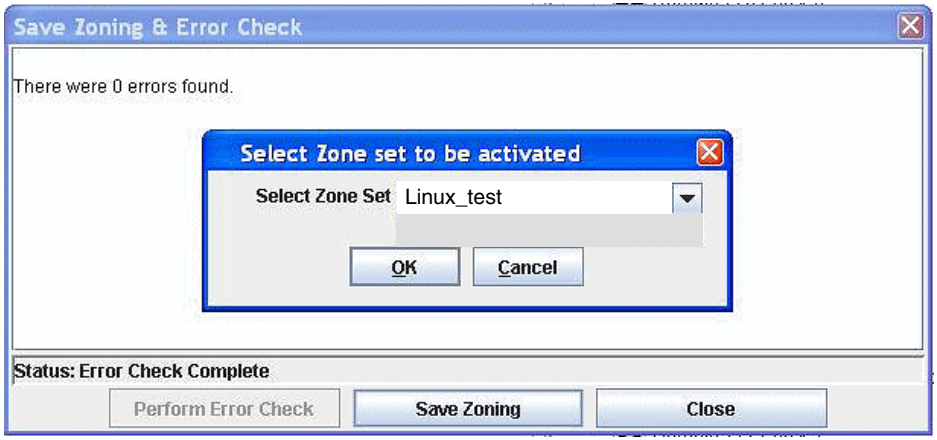

Figure 8-29 Select Zone set to be activated window

21. Select the zone set. In our example, we select Linux_test. Click **OK**. Click **Save Zoning** and then **Close**.

8.8 EMC CLARiiON storage configuration

In this section, we discuss the configuration of our storage device and making LUNs available for our boot system. In this example, we used the CLARiiON CX700 (the top-of-the-line CX series model). The CX700 scales up to 117 TB. For more information regarding the CLARiiON products, visit `http://www.emc.com/CX3`.

Configure storage group

The EMC CLARiiON storage configuration should be performed from the Remote Management workstation using the EMC CLARiiON Storage Manager Client utility. The EMC CLARiiON Storage server is accessed from the Out-of-Band Ethernet over TCP/IP connection.

1. Launch the Web browser (Internet Explorer 6.0 or higher) and point to the IP address of the EMC CLARiiON CX700 Storage device. The menu in Figure 8-30 on page 251 is displayed.

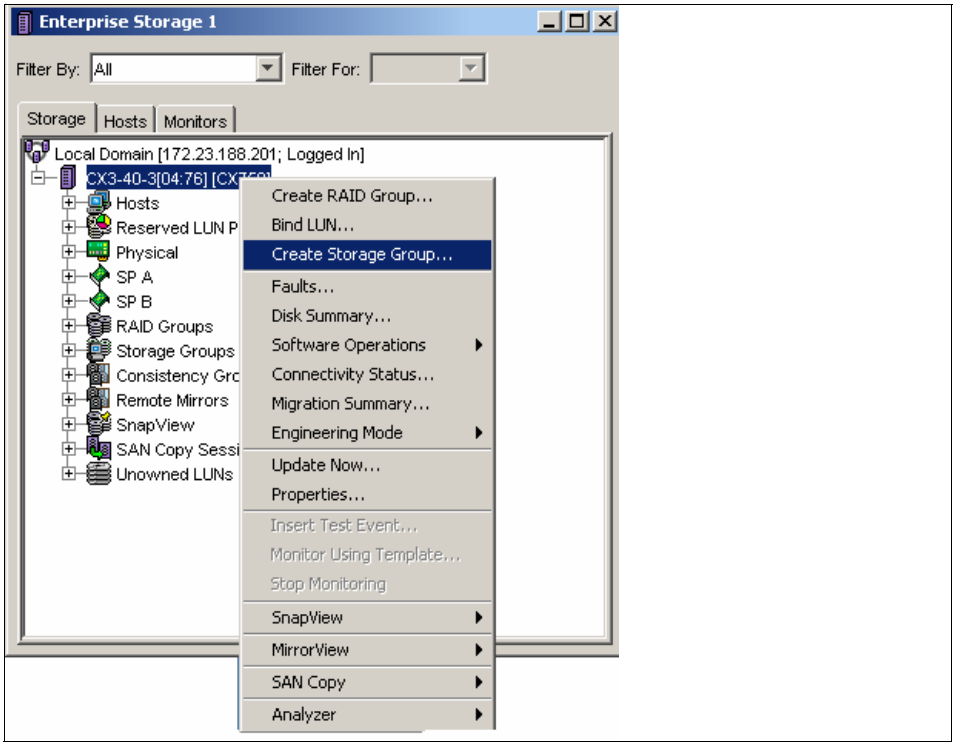

Figure 8-30 Enterprise Storage 1 window

2. From the Enterprise Storage menu, right-click the CX3-40-3[04:76][CX700] device. Next, click **Create Storage Group**. You will see a window similar to Figure 8-31.

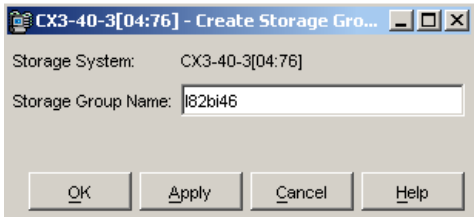

Figure 8-31 Create Storage Group window

3. From the Create Storage Group menu, define the name of the group and click **Apply** and **OK**. In our example, we typed I82bi46. You will see a window similar to Figure 8-32.

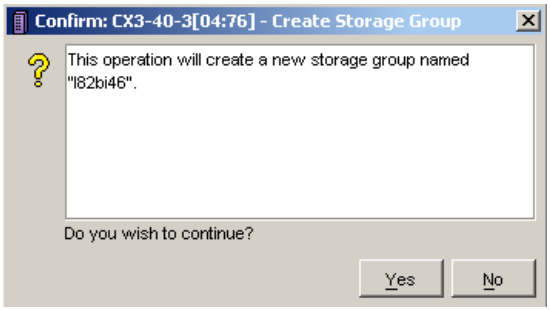

Figure 8-32 Create Storage Group window

4. Click **Yes** to create the storage group.

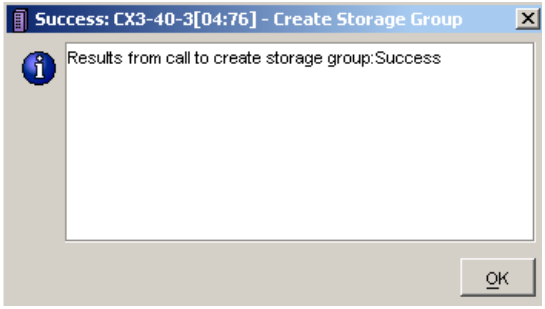

Figure 8-33 Create Storage Group window

5. Click **OK**. You will see a window similar to Figure 8-34.

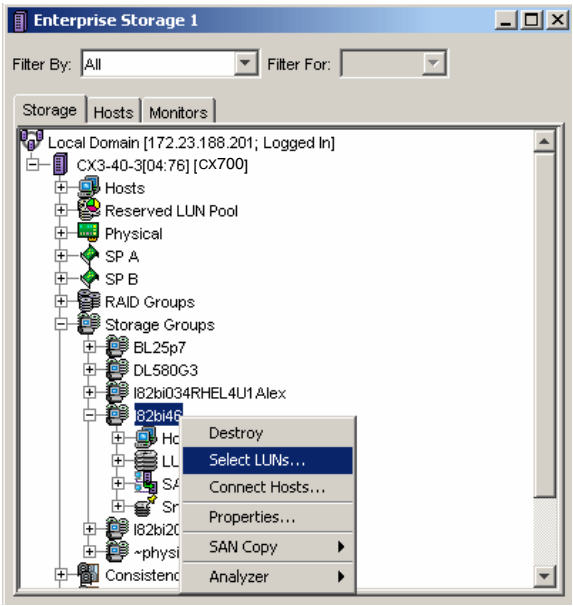

Figure 8-34 Enterprise Storage 1 window

6. Define the devices for the first Fibre Channel port on the blade server by selecting the Storage Group created. Right-click the group (I82bi46) and click **Select LUNs**. You will see a window similar to Figure 8-35.

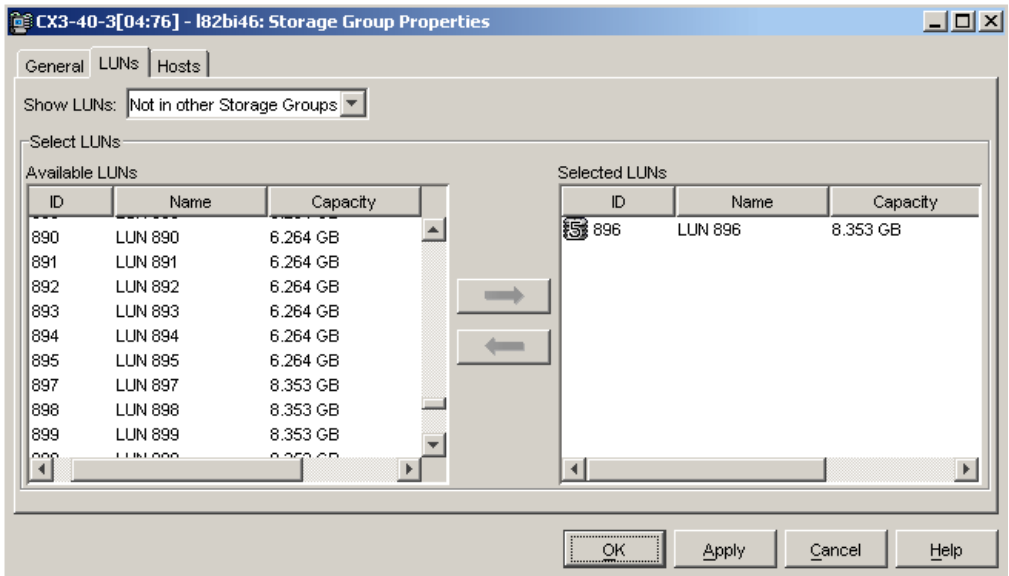

Figure 8-35 I82bi46: Storage Group Properties window

7. Search and select the LUN to be mapped to the host and press the right arrow key to move it under Selected LUNs.

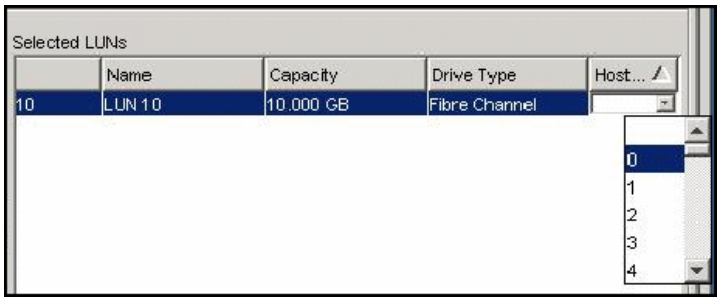

Figure 8-36 Selected LUNs window

8. Under Selected LUNs, scroll to the right of the Capacity column until you see the Host column. Assign the Offset value of zero (0) to the boot LUN (Figure 8-36). It is required that the boot LUN gets the lowest LUN ID value and additional LUNs can have values higher than the boot LUN. Click **Apply** and **OK**. You will see a window similar to Figure 8-37 on page 255.

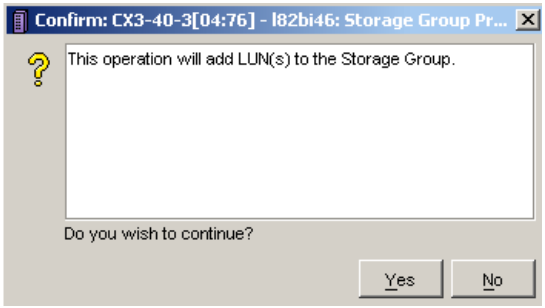

Figure 8-37 l82bi46:Storage Group Properties window

9. Click **Yes** to continue.
10. Once the LUNs has been successfully added to storage group, click **OK**. You will see a window similar to Figure 8-38.

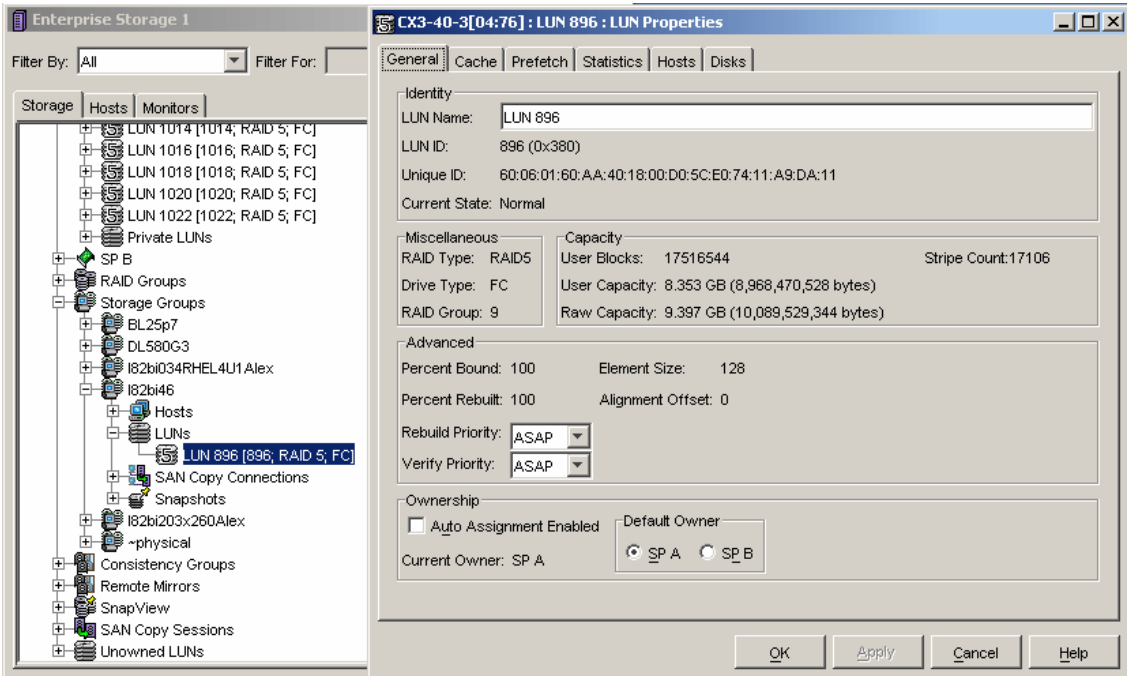

Figure 8-38 l82bi46: LUN Properties window

11. Right-click **LUN 896[896, RAID 5,FC]** and select **Properties**. Ensure the LUN Name is correct and that you are set on the correct SP. In our example, we use SP A. Click **OK**. The window shown in Figure 8-39 should appear.

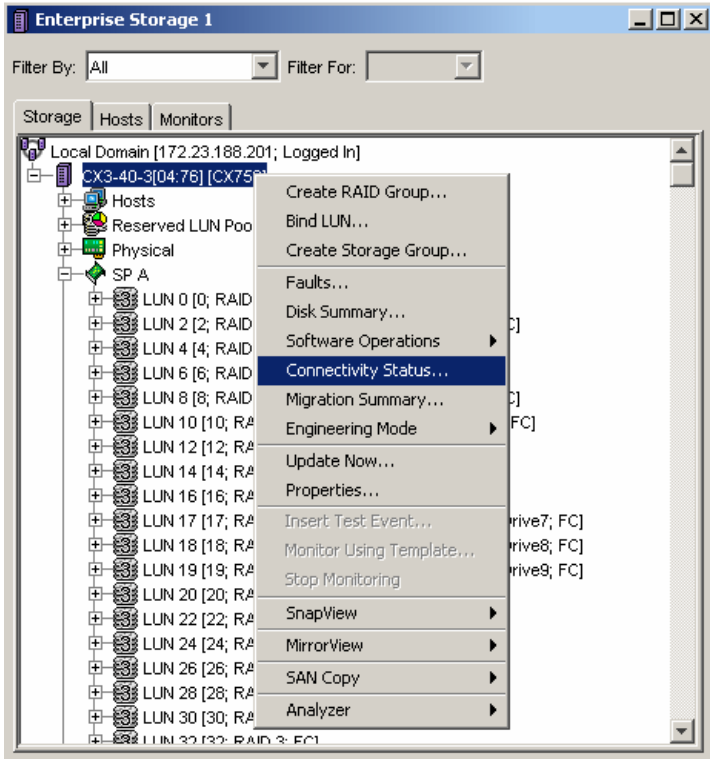

Figure 8-39 Connectivity Status window

12. From the Enterprise Storage 1 window, right-click CX3-40-3[04:76][CX700] and click **Connectivity Status**. You will see a window similar to Figure 8-40.

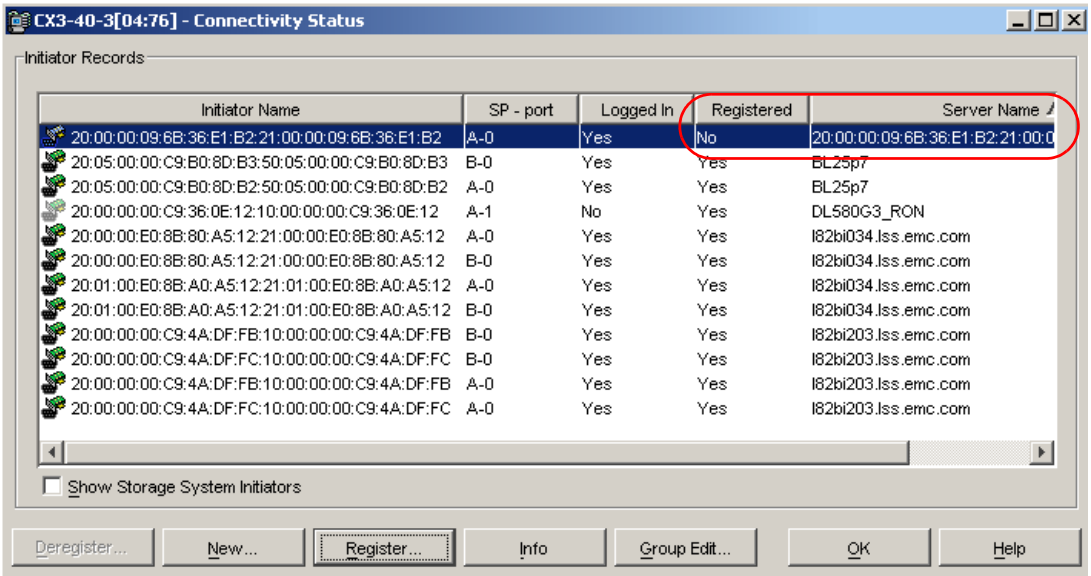

Figure 8-40 Connectivity Status window

13. From the Connectivity Status window, click **Register** to register your initiator record. You will see a window similar to Figure 8-41. In our example, 20:00:00:09:6B:36:E1:B2:21:00:00:09:6B:36:E1:B2.

    Notice in the Registered column the initiator record displays No and the hexadecimal Server Name.

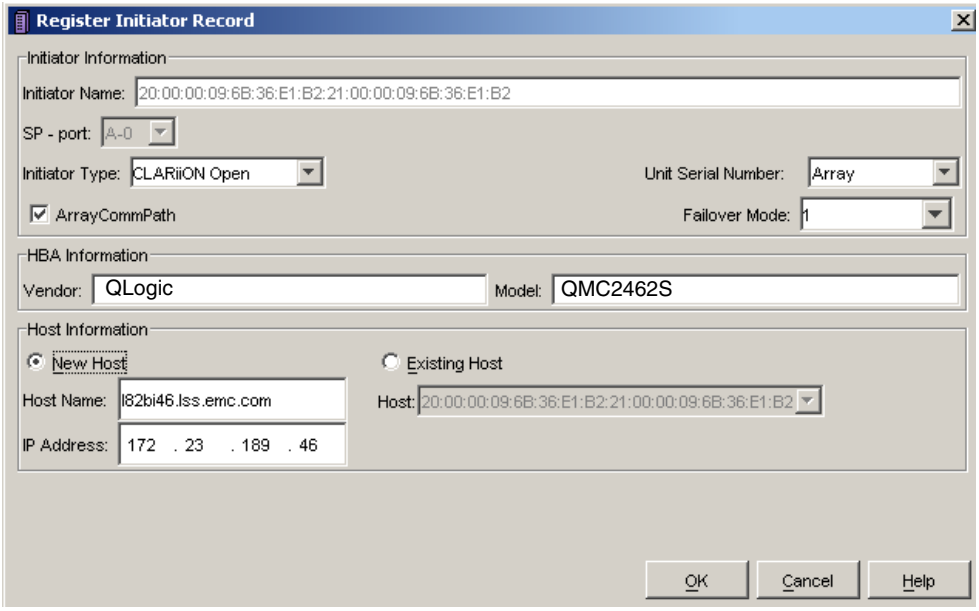

Figure 8-41 Register Initiator Record window

14. Ensure the Initiator Type, CLARiiON Open, is displayed. In the new Host Name field, type in the fully-qualified domain name and IP Address; in our example, they are l82bi46.lss.emc.com and 172.23.189.46. Click **OK**. You will see a window similar to Figure 8-42 on page 259.

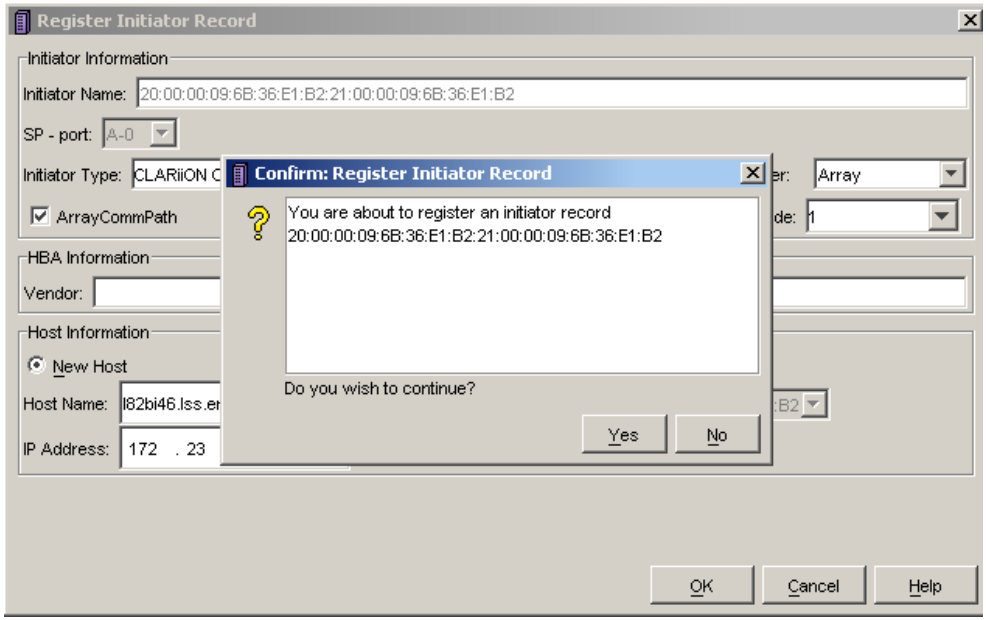

Figure 8-42 Register Initiator Record window

15. Click **Yes** to continue with registration. You will see a window similar to Figure 8-43.

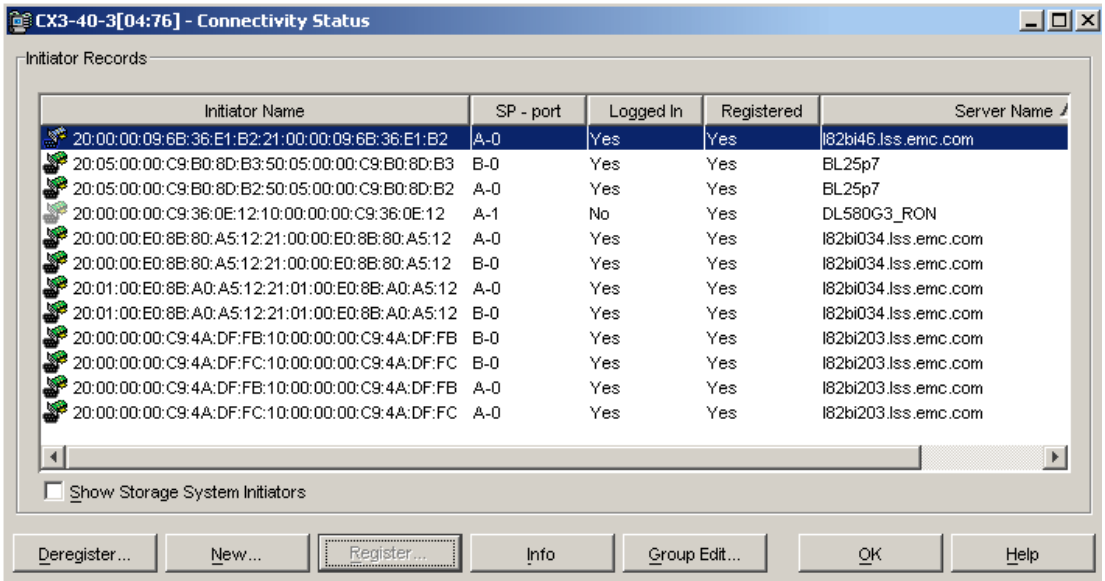

Figure 8-43 Connectivity Status window

16. Notice the change in the Registered and Server Name columns once the record has been registered. Click **OK** and return to Enterprise Storage 1 window (Figure 8-44).

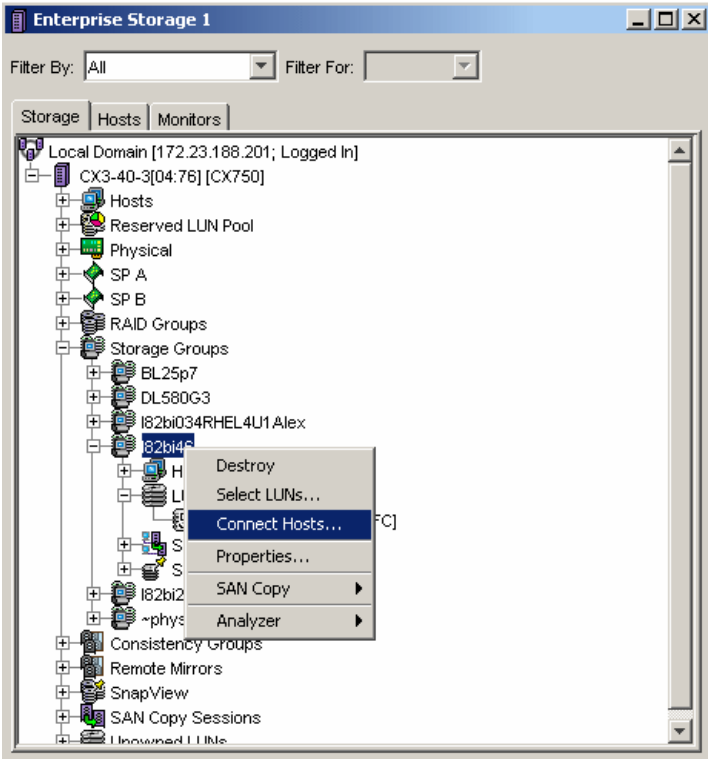

Figure 8-44 Enterprise Storage 1 window

17. Right-click the I82bi46 group and select **Connect Hosts**. You will see a window similar to Figure 8-45 on page 261.

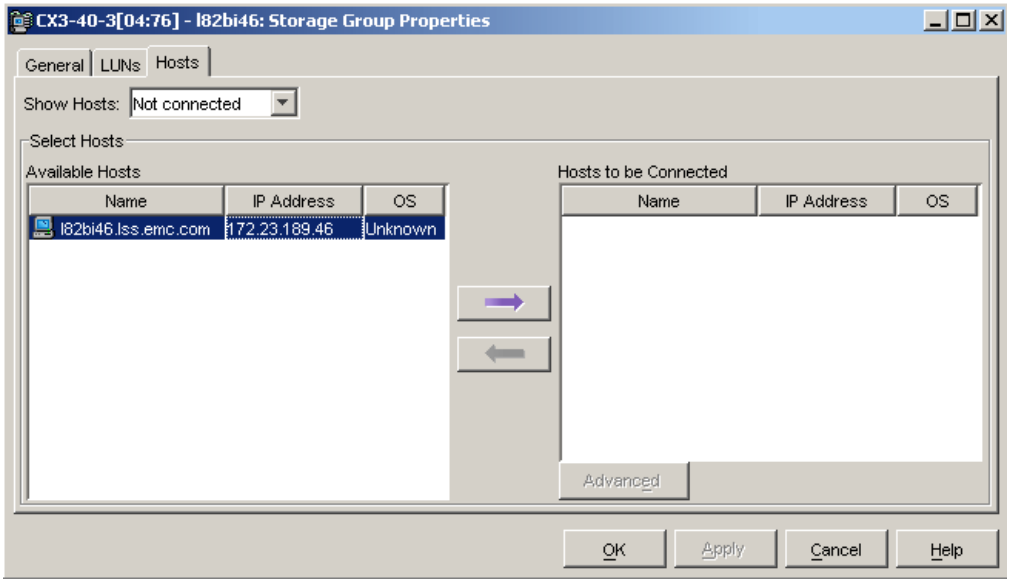

Figure 8-45 l82bi46: Storage Group Properties window

18. Under the Host tab, select the available hosts you created and move it to the Host to be Connected window. You will see a window similar to Figure 8-45.

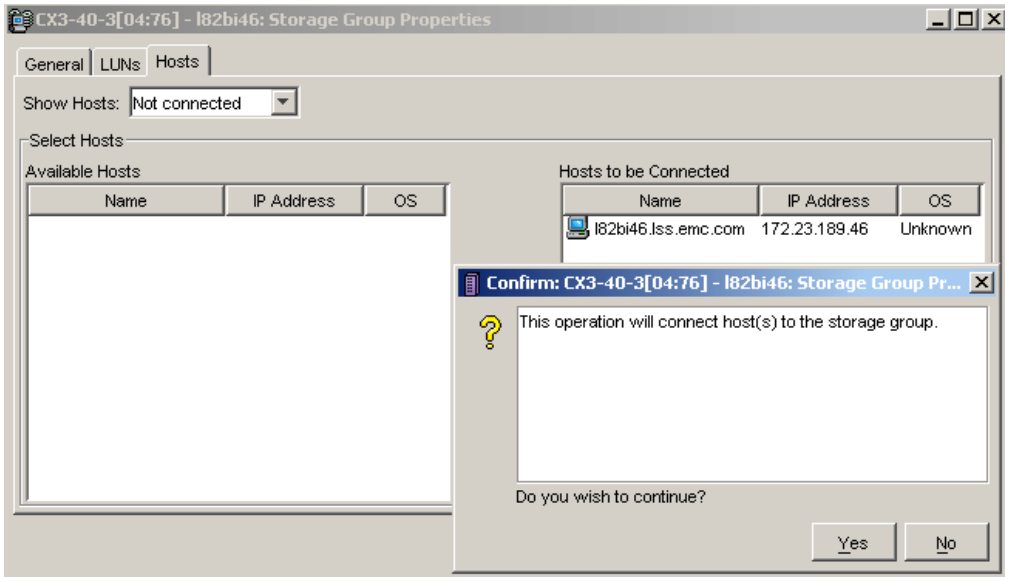

Figure 8-46 l82bi46: Storage Group Properties window

19. Click **Apply** and then click **Yes**. You will see a window similar to Figure 8-47.

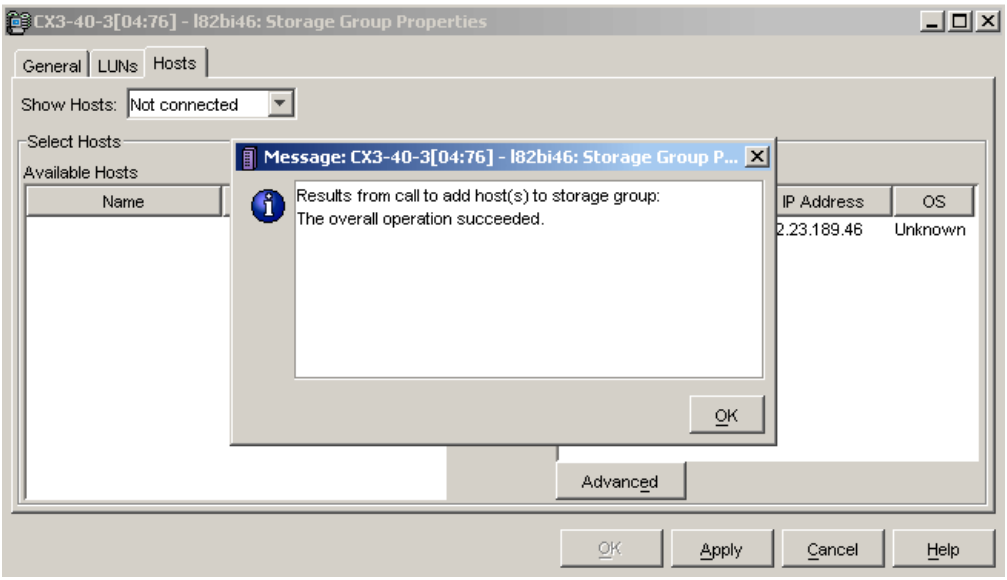

Figure 8-47 l82bi46: Storage Group Properties window

20. Once the operation is successful, click **OK**. At this time, refer to 8.9, “Blade server - QLogic HBA setup continuation” on page 262 and resume the setup of the QLogic HBA.

8.9 Blade server - QLogic HBA setup continuation

This section resumes the steps you begin in 8.6, “Blade server - QLogic HBA setup” on page 228. Complete the following instructions:

1. In Figure 8-48 on page 263, cursor down to (Primary) Boot Port Name, LUN: and press Enter. You will see a window similar to Figure 8-49 on page 263.

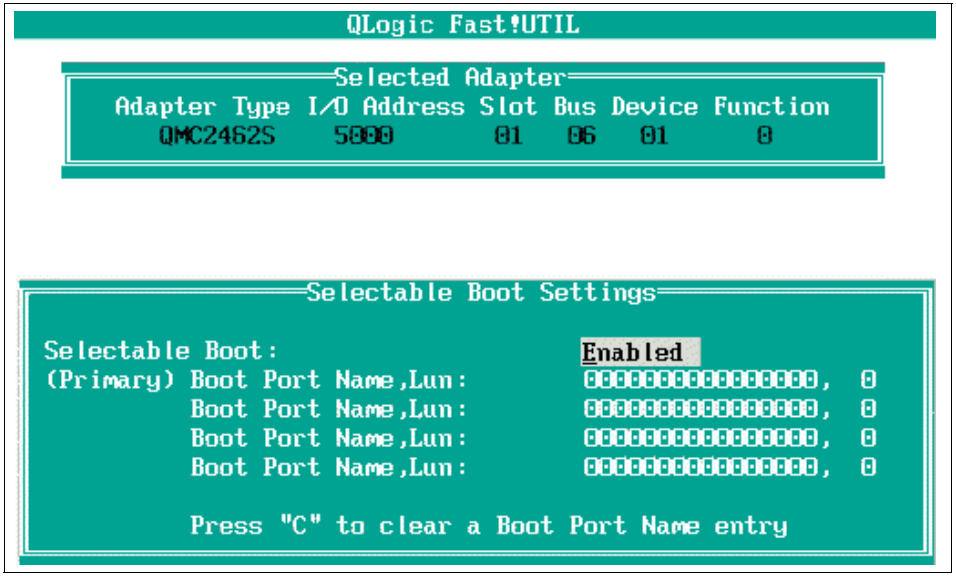

Figure 8-48 Selectable Boot Settings window

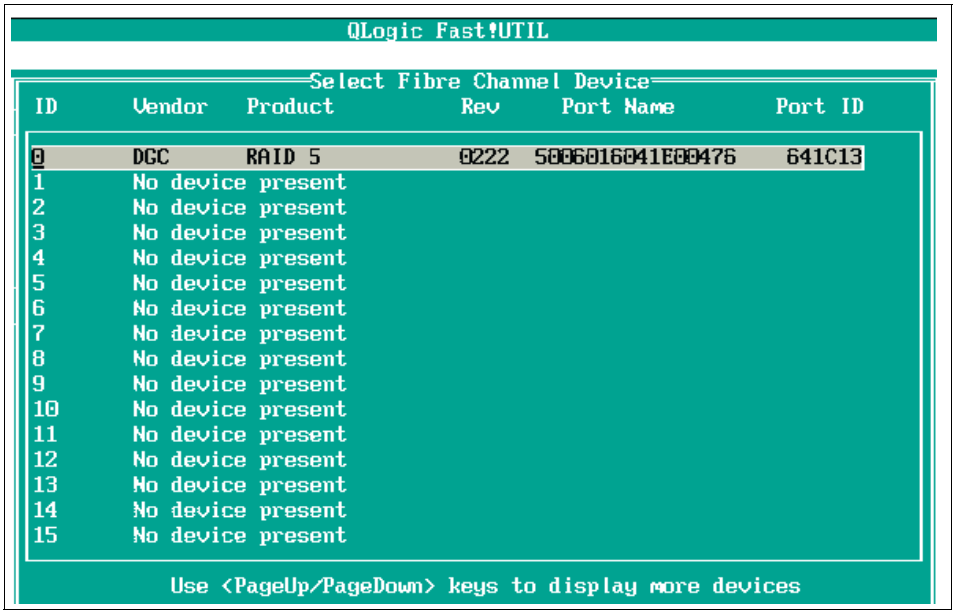

Figure 8-49 Select Fibre Channel Device windows

2. The CLARiiON Storage WWN is identified under Port Name. Highlight it and press Enter. You will see a window similar to Figure 8-50.

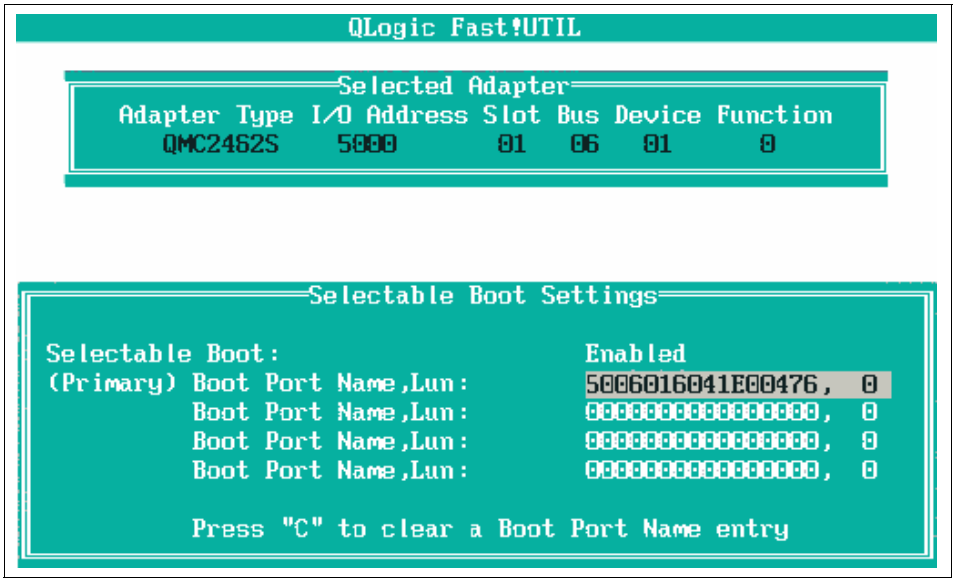

Figure 8-50 Selectable Boot Settings window

3. Highlight (Primary) Boot Port Name, Lun to ensure the CLARiiON Storage WWN bootable device appears. Press Esc twice to exit. Click **Save changes**.

8.10 Linux operating system install

There are no special instructions for the Linux operating system installation. Therefore, you may commence with installing the operating system at this time.

8.11 Windows 2000/2003 operating system install

In this section, we discuss the special instructions you will need to perform when loading the Windows 2000/2003 operating system. Complete the following steps:

1. Boot the blade server using the Windows 2000 or Windows 2003 installation CD and get ready to Press F6 immediately, as shown in Example 8-2.

Example 8-2 Windows Setup window

```
Press F6 if you need to install a third party SCSI or RAID driver.
```

2. Install the FC HBA device driver using the diskette. The EMC compatible FC device driver is available at the following URL:

   http://support.qlogic.com/support/oem_product_list.asp?oemid=65

Figure 8-51 shows that the FC HBA device driver was correctly recognized for the HS20.

Figure 8-51 QLogic Fibre Channel Adapter window

Once the FC device driver and the operating system installation process completes, perform the following tasks:

1. Install the recommended service packs and reboot.
2. Install the EMC PowerPath driver, host agent, and other utilities. Refer to the EMC CLARiiON Installation and Setup documentation for more information.
3. Power down the HS20 blade server.

8.12 Failover and multipath configuration

In this section, we discuss the failover and multipath configuration from the blade server to the EMC CLARiiON CX700 Storage Subsystem.

Figure 8-52 on page 266 illustrates the logical topology depicting the secondary path as well as additional paths from the host to the storage in order to achieve failover and multipathing.

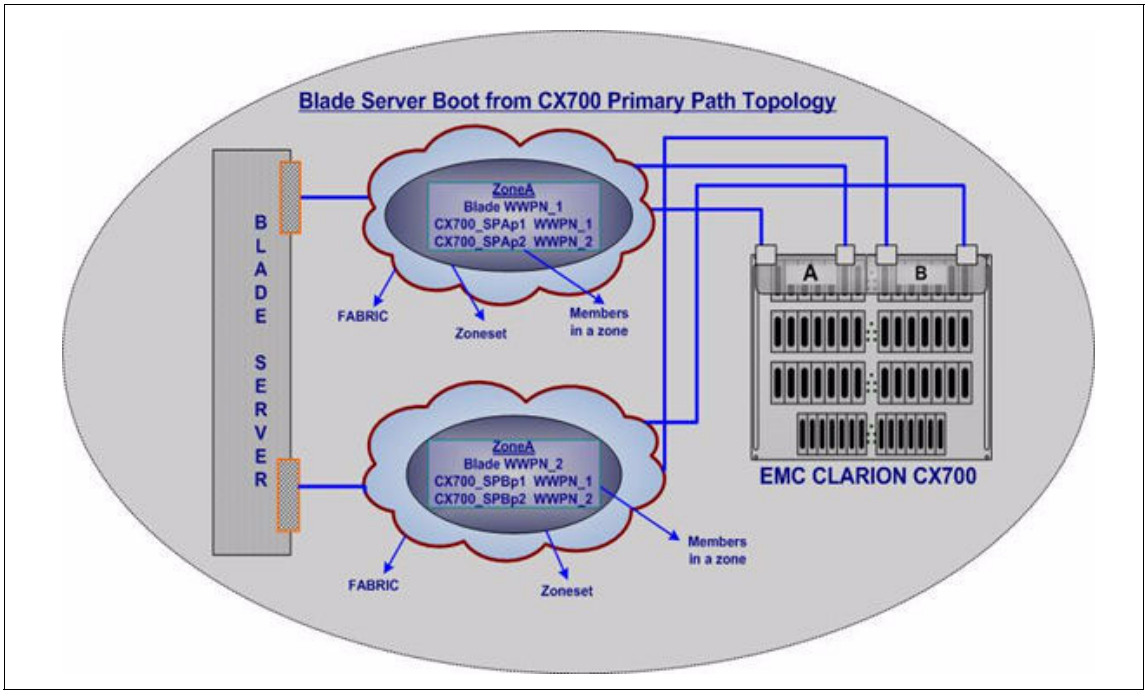

Figure 8-52 Blade server boot from CX700 primary-multi path

Notice that in Figure 8-52, the second link from EMC CLARiiON Service Processor B is connected to the fabric. In order to achieve load balancing from the host to the storage, one additional path is added from service processors A and B.

8.13 Configuration steps to enable additional paths

Here are the configuration steps to enable additional paths from the Blade Server to the EMC CX700 Storage:

1. Verify, from the switch, that the second port on the Blade Server and the ports to be used on CX700 are logged into the fabric.
2. Create a zone for the secondary path:
   a. WWN of the second HBA port on the blade server
   b. WWNs of one or more ports from the CX700 Service Processor B
3. Add one or more ports from the CX700 Service Processor A to the zone created initially for the primary path to install the operating system.

4. Add the zone(s) to the corresponding zone set.
5. Activate the zone set.

8.14 Re-register of the Storage Group on CX700

Note: In this section, the host (the WWN of the first HBA port) registered initially on CX700 with the WWN of the storage group device will be unregistered temporarily. The new host registration process requires both ports from the Blade Server to be registered simultaneously and can be done automatically, provided the EMC's Navisphere agent is installed on the blade server.

The de-registration of the Storage Group requires the host to be shut down. The following section illustrates the steps to de-register the host and automatically register the two host HBA FC ports by installing the agent software:

1. Install the agent software.
2. From the CX700 Enterprise Storage menu, select **Storage Group** and de-register the host.
3. Reboot the blade server.
4. Verify the login and registration status of the blade server FC ports by selecting the CX700 **Enterprise Storage** → **Connectivity Status** menu.

8.15 QLogic Fibre Channel HBA BIOS configuration

This section references those steps you need to perform your setup on the second FC HBA port. Complete the following:

1. Reboot the host to interrupt the boot sequence and enter the Fibre Channel BIOS by pressing the Ctrl-Q keys.
2. Enable the BIOS setting for the second port on the HBA to be zoned with the EMC CLARiiON Service Processor B.
3. Add the additional paths under the Selectable Boot Settings menu for both Fibre Channel ports
4. Save and exit.

8.16 Failover test with EMC CX700 Storage

In this section, we discuss the failover of our multipath EMC CX700 environment.

Note: It is assumed that the PowerPath software is already installed on the host and the following steps illustrate the host availability by disconnecting the primary path. The Load Balancing over multiple paths on the same Service Processor is also demonstrated.

1. Launch the PowerPath Administrator. Select **Start** → **Programs** → **EMC** → **PowerPath** → **PowerPath Administrator**.

   Figure 8-53 displays the single active path topology from the blade server to the CX700 Service Processor A.

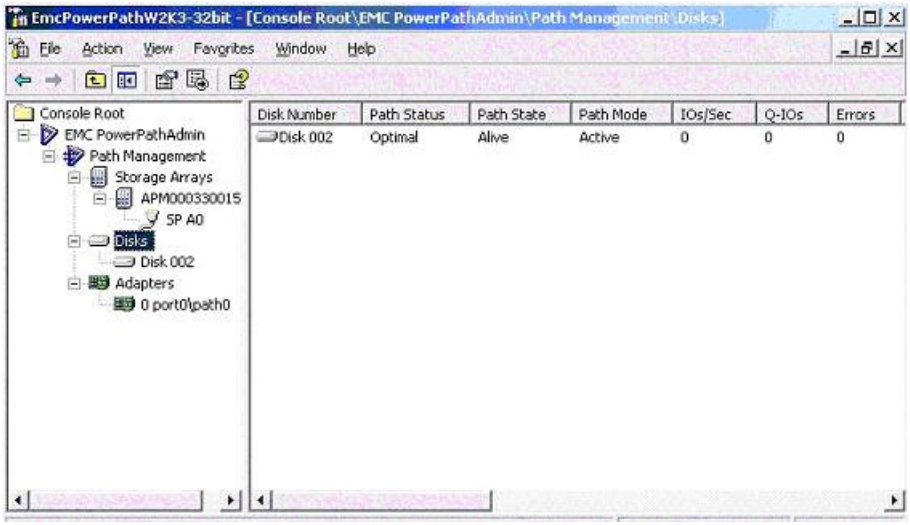

Figure 8-53 EMC PowerPathW2K3-32-bit window

2. In Figure 8-54 on page 269, the second path is added with active status from the Blade Server to the CX700 Storage. At this point, both paths are active and in optimal state, as shown in Figure 8-54 on page 269:

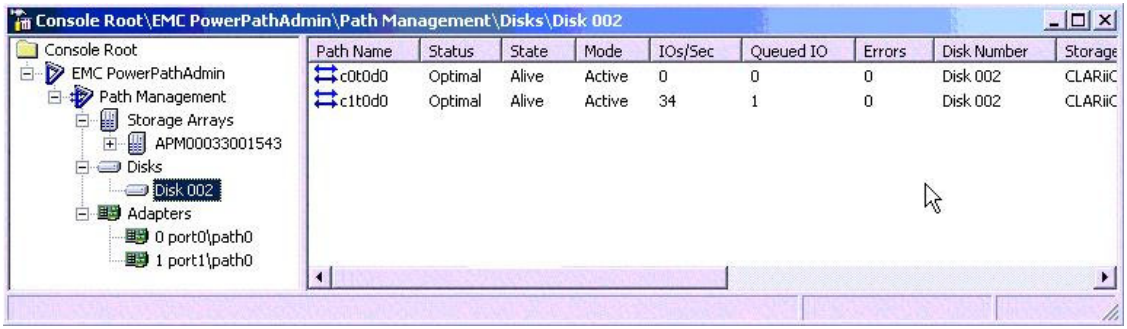

Figure 8-54 EMC PowerPath Management window

3. Figure 8-55 illustrates the primary path down due to the link failure injected by disabling the first HBA port on the blade server at the switch. The IO is rerouted via the alternate path (second HBA port on the blade server) with minimum delay, so high availability is achieved.

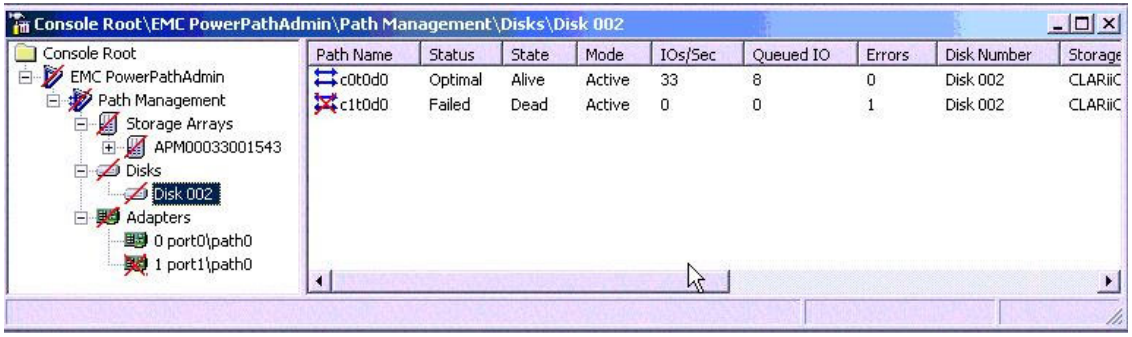

Figure 8-55 EMC PowerPath Management window

8.16.1 EMC PowerPath Path Management via Linux

In the section above, you see an example of how EMC PowerPath Path Management is performed via a Windows interface. The following images provide a similar view of how path management is performed via Linux.

Figure 8-56 displays the paths and activity of blade server HBAs to Symmetrix and CLARiiON Storage Systems. In Figure 8-57, this is an example of a failure occurring (under the Summary column) with an HBA path connected to the CLARiiON subsystem. After resolving the error, the path is returned to an optimal status.

```
[root@l82bi034 ~]# powermt display paths
Symmetrix logical device count=5
============================================================================
----- Host Bus Adapters --------- ------ Storage System -----    - I/O Paths -
### HW Path                           ID          Interface     Total    Dead
============================================================================
  1 qla2xxx                      000190100501      FA  5dA          5       0
  2 qla2xxx                      000190100501      FA  5dA          5       0

CLARiiON logical device count=20
============================================================================
----- Host Bus Adapters --------- ------ Storage System -----    - I/O Paths -
### HW Path                           ID          Interface     Total    Dead
============================================================================
  1 qla2xxx                      HK192200803         SP A0         20       0
  1 qla2xxx                      HK192200803         SP B0         20       0
  2 qla2xxx                      HK192200803         SP B0         20       0
  2 qla2xxx                      HK192200803         SP A0         20       0


[root@l82bi034 ~]#
```

Figure 8-56 EMC PowerPath Management window

```
Symmetrix logical device count=5
CLARiiON logical device count=20
============================================================================
----- Host Bus Adapters ---------  ------ I/O Paths -----  ------ Stats ------
### HW Path                        Summary   Total   Dead  IO/Sec Q-IOs Errors
============================================================================
  1 qla2xxx                      optimal      45      0    3215   259      0
  2 qla2xxx                      failed       45     45       0     0     45
```

Figure 8-57 EMC PowerPath Management window

8.17 Conclusion

This concludes the step by step procedure for blade server Boot from SAN attached EMC CLARiiON CX700 Storage.

9

TotalStorage DS4100, DS4700, and DS4800 Boot from SAN

In this chapter, we discuss the benefits of a TotalStorage Boot from SAN solution and how to properly implement this environment. The steps to implement the TotalStorage Boot from SAN solution can be used to configure the DS4100, DS4700 and DS4800.

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9.1 Overview of IBM BladeCenter Boot from SAN

The following sections discuss the benefits and best practices procedures for the Boot from SAN technology on the IBM BladeCenter blade servers connected to any IBM or OEM storage subsystems.

The Boot from a SAN (storage area network) attached storage feature on the IBM BladeCenter Blade servers provides high availability, reduces cabling complexity, minimizes the downtime windows, and helps consolidate the IT infrastructure.

9.1.1 Cost reduction

The BladeCenter architecture helps cut the equipment costs by reducing the number of moving parts such as fans, power supply, and internal disk drives when compared with the stand-alone servers. The BladeCenter architecture provides the capability to share the resources such as power, cooling, cabling, and IO paths among all the servers within the chassis and facilitates centralized management.

9.1.2 High availability

The system downtime is greatly minimized in situations where a critical component such as a processor, memory, or the system planar fails and needs to be replaced. The system administrator only needs to swap the hardware with similar hardware and install the same Fibre Channel Host Bus Adapter (HBA) on the blade server, thus making the system quickly available for production. In case of the HBA failure, the system administrator must replace the failed HBA and modify the zoning to include the WWPN of the new HBA in the active zone set and update the host configuration on the storage subsystem to make the system operational. Additionally, the user must update the HBA's BIOS boot configuration, via the Alt-Q utility, to point the HBA's boot LUN to the correct logical drive on the storage subsystem. The system image resides on the logical drive hosted by the storage subsystem connected to the SAN.

9.1.3 Centralized management

Centralized management can be achieved with a single blade server within the same chassis with management applications, such as IBM Director/RDM installed for remote deployment of the OS, or firmware updates for device peripherals over the local area network (LAN).

9.1.4 Redundancy

End-to-end redundancy is established across the Fibre Channel path from the host to the storage. The dual port HBA, redundant switch modules in the chassis, and a maximum of four paths on each DS4800 storage controller gives you the ability to route IO across the redundant paths. The RDAC multipath driver on the host and the Auto Volume Transfer feature on the storage subsystems both contribute to detecting path failures and rerouting the IO down an alternate path.

In addition to the redundant architecture of the solution, the RAID (redundant array of inexpensive disks) technology, for example, RAID 10 (mirroring + striping), RAID 3 (striping and all parity stored on one disk per array), and RAID 5 (striping and parity on all disks in an array) protect against data loss if only one disk per array has failed. Thus, RAID 5 plus a spare drive per array provides adequate protection against data loss and drive failures.

Enhanced performance can be achieved by exploiting the existing Fibre Channel bandwidth, a maximum speed of 4 Gbps end-to-end in conjunction with load balancing, using RDAC for Windows or Linux operating systems or the built-in failover/load balancing capabilities of the Linux device driver across four host channels per DS4800 storage controller. At a LUN level, the DS4800 storage subsystem operates in an active passive configuration, which means a LUN is always available via single or multiple paths on the active controller (preferred owner of that LUN), if the primary path fails, then the LUN is moved to the backup path regardless of the failing point, for example, the host, fabric, or the storage. At a controller level, both controllers may be active.

9.1.5 Implementing Boot from SAN

The following sections briefly cover the workings of a Boot from SAN solution and the best practice procedures that ensure seamless integration of various components in addition to a clean deployment of the solution.

The architectural view in Figure 9-1 illustrates a most common software stack installed on the host in order for it to successfully boot from the DS4000 storage. The preliminary configuration is performed at the FC BIOS on the Fibre Channel HBA installed on the host to enable it to boot from the SAN attached storage. Once the connectivity to the fabric is established, storage is mapped to the host and selected as the boot device, and then the operating system is installed through the single path on the boot disk mounted from the DS4800 subsystem.

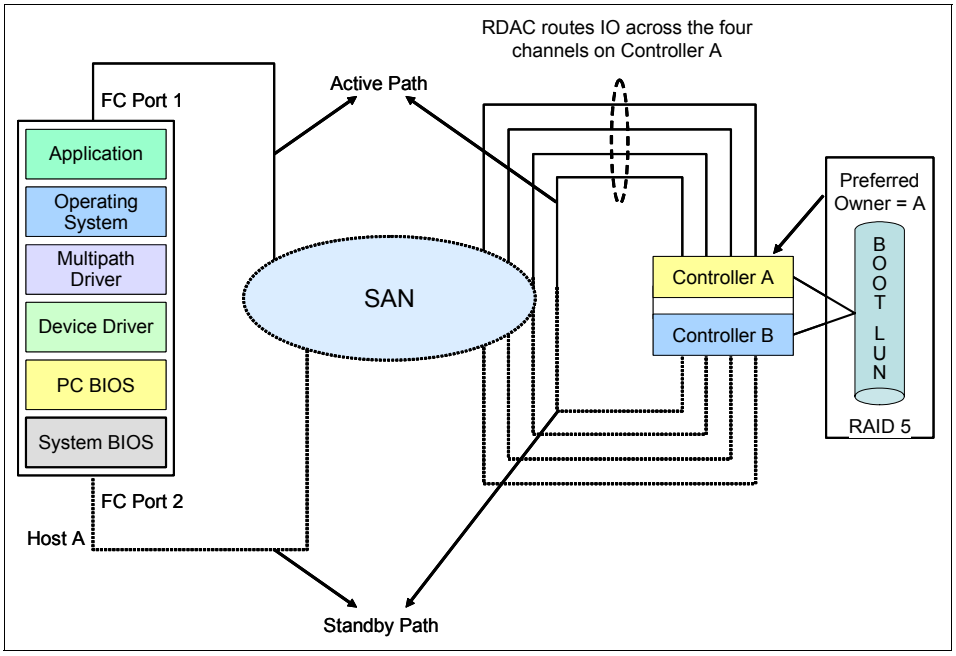

Figure 9-1 Blade Server Boot from DS4800 Storage Architecture

The RDAC multipath driver is installed once the OS has been installed and prior to introducing alternate paths to storage. It maintains the path information and so if a link failure is detected on the active path, it notifies the storage controller to move the LUN(s) to the alternate path. This link failure detection and notification occurs with minimum delay before the IO is rerouted through the alternate path and the system becomes available to the user. The RDAC driver resides between the HBA's device driver and the OS managing the path that is presented to the OS, as shown in Figure 9-1. If the link failure is detected during the system

initialization, for example, when the OS is not loaded on the host, then Auto Volume Transfer (AVT) or Auto Disk Transfer (ADT) feature must be enabled on the storage subsystem and the boot LUN configured on both HBA ports to detect the link failure on the preferred path and move the LUN to the backup path. Table 9-1 shows the default and configured ADT status on the DS4800 storage subsystem.

Table 9-1 NVSRAM Host Type Index definitions

INDEX	ADT STATUS	TYPE
0	Disabled	Default
1 (Default)	Disabled	Windows 2000/Server 2003 Non-Clustered
2	Enabled	Windows 2000/Server 2003 Non-Clustered
3	Disabled	Windows 2000/Server 2003 Clustered
4	Disabled	AIX®
5	Enabled	Linux
6	Disabled	AIX
7	Enabled	HP-UX
8	Disabled	Solaris™
9	Enabled	Windows 2000/Server 2003 Non-Clustered (supports DMP)
10	Disabled	Irix
11	Enabled	NetWare Failover
12	Enabled	IBM TS SAN VCE
13	Disabled	LNXCL
14	Enabled	Solaris (with VERITAS DMP)
15	Enabled	Windows 2000/Server 2003 Clustered (supports DMP)

Zoning

Zoning provides the segregation of devices at the fabric level by creating smaller virtual SANs within the fabric. Zoning logically manages access between devices within the same physical Fibre Channel fabric. In order for a host to gain access to the storage subsystem port, its host port(s) must be placed in the same zone as the corresponding target port(s) and this zone should be a member of the active zone set. Thus, zoning is a tool to permit or deny access to the devices

connected to the fabric, but it does not have the intelligence to apply controls beyond the fabric, for example, to present or hide the LUN to certain hosts.

LUN masking

The data integrity is ensured by applying the LUN level security; the DS4100, DS4700 and DS4800 storage provides the storage partitioning feature used to permit or deny a device access to the storage. Storage partitioning is independent of Fibre Channel zoning. Additionally, LUN masking capabilities are available within the SANSurfer management GUI to allow further control over a host's access to its storage LUNs. This is one example of LUN masking, at the controller level, while products such QLogic SANSurfer can do masking at the host level, and so on.

9.2 Boot from SAN configuration best practices

The best practices considerations shown in Table 9-2 are specified for the QLogic Fibre Channel 4 Gb Switch Module, McDATA 4 Gb Fibre Channel Switch Module, and the DS4000 storage subsystem.

Table 9-2 Minimum hardware configuration for setting up the Boot from SAN FC SAN

Hardware list	Quantity
BladeCenter chassis	1
Blade server	1
FC expansion card	1
FC SAN switch module	2
Storage Array Controller	1
External FC SAN switch <optional>	1

9.3 Configuring Boot from SAN on TotalStorage DS4100

In this section, we discuss and actually perform the Boot from SAN on the TotalStorage DS4100. However, you should note that these steps can be use to implement Boot from SAN on the DS4700 and DS4800 as well.

9.3.1 Blade server F1 setup

This step should be performed when you are prepared to configure a Boot from SAN environment. Perform the instructions in 4.2, “Blade server F1 setup” on page 36 to disable the use of the IDE or SCSI drives that may be installed in the HS20, HS21, HS40, or LS20.

9.3.2 Blade server - QLogic HBA setup

This section discusses our setup of the QLogic Fibre Channel HBA establishing a connection with the TotalStorage DS4100 world wide name (WWN).

1. Start the BladeCenter HS20 to configure QLogic HBA. When you reach the Ctrl-Q application (Example 9-1), type Ctrl-Q and press Enter to access the QLogic Fast!UTIL.

Example 9-1 Ctrl-Q execute window

```
Broadcom NetXtreme Ethernet Boot Agent v3.1.15
Copyright (C) 2000-2002 Broadcom Corporation
All rights reserved.

Broadcom NetXtreme Ethernet Boot Agent v3.1.15
Copyright (C) 2000-2002 Broadcom Corporation
All rights reserved.

QLogic Corporation
QMC2462 PCI Fibre Channel ROM 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 0 is disabled
BIOS for Adapter 1 is disabled
ROM BIOS NOT INSTALLED

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

The window shown in Figure 9-2 should appear.

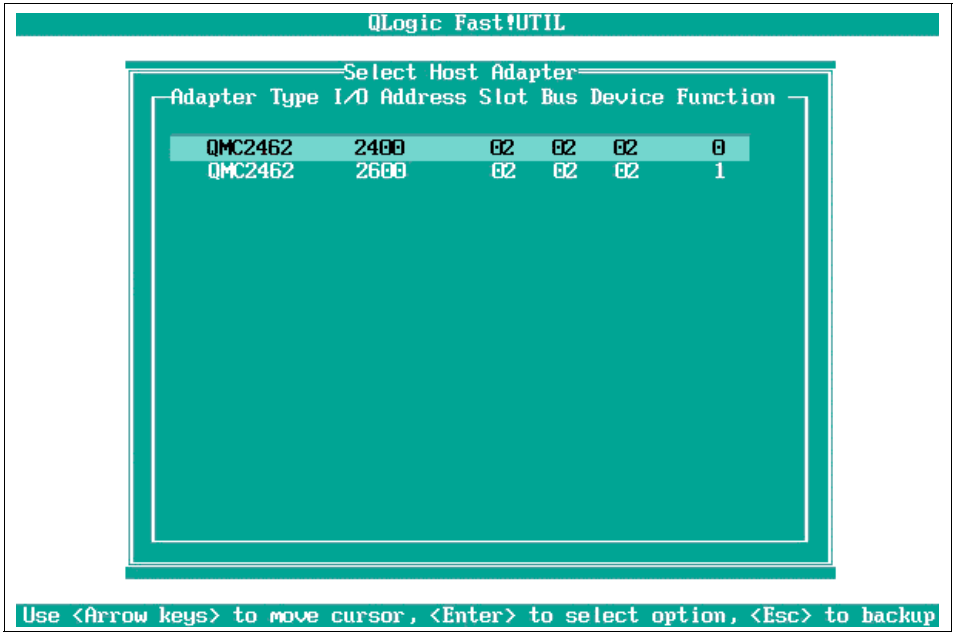

Figure 9-2 Select I/O Address window

1. Select 0 ID and press Enter. You will see a window similar to Figure 9-3.

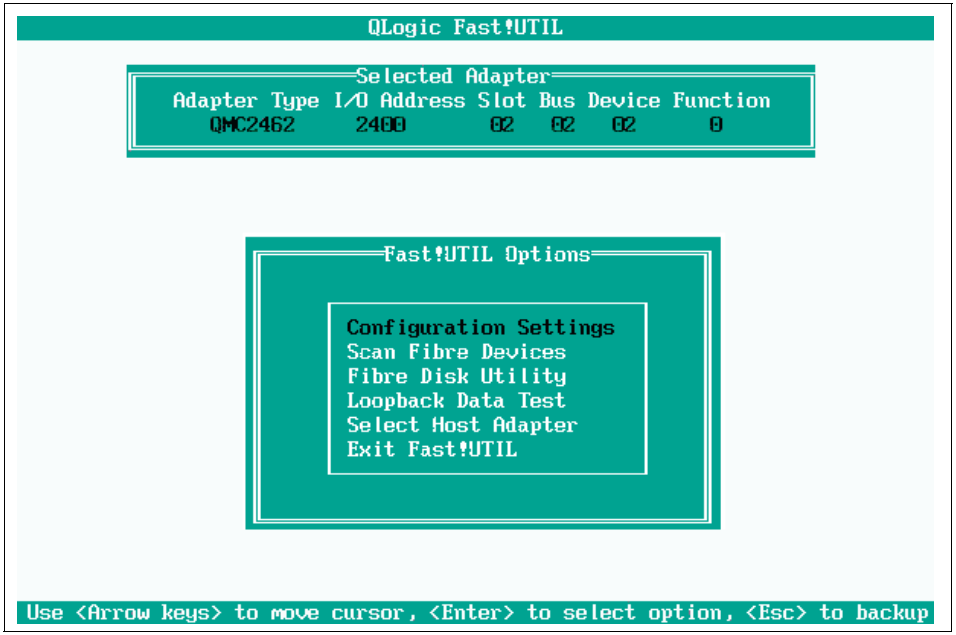

Figure 9-3 Configuration Settings window

2. Select **Configuration Settings**. You will see a window similar to Figure 9-4.

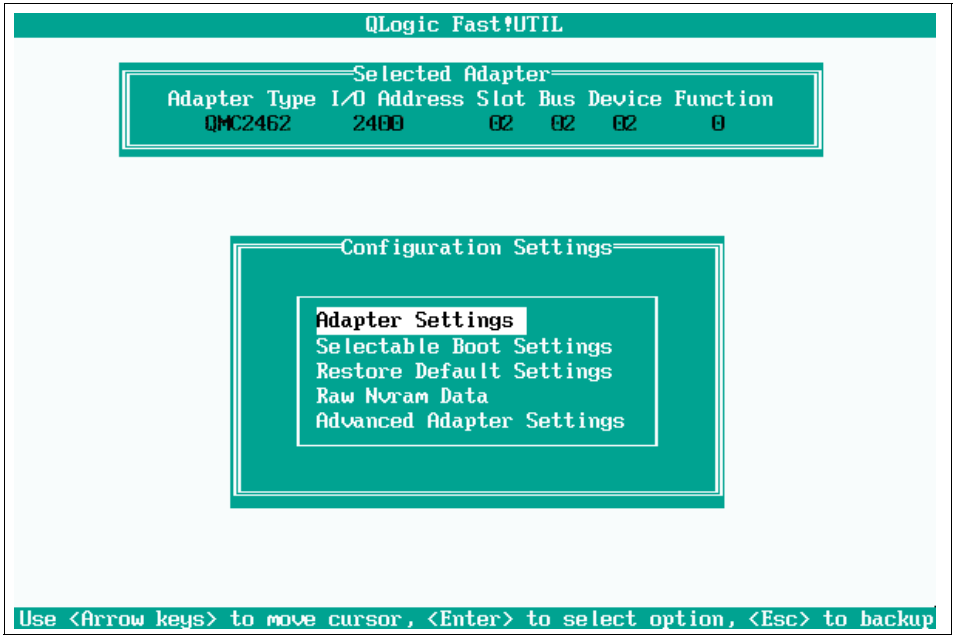

Figure 9-4 Adapter Settings window

3. Under Configuration Settings, click **Adapter Settings**. You will see a window similar to Figure 9-5 on page 281.

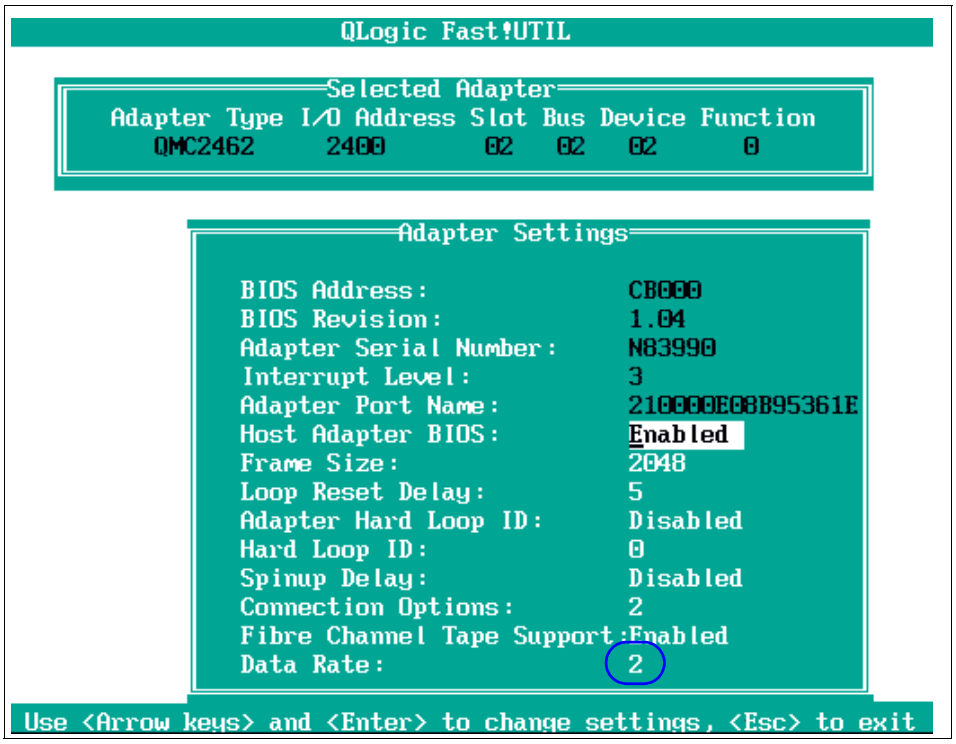

Figure 9-5 5 - Adapter Settings WWPN info and enable BIOS window

4. Ensure that the Host Adapter BIOS is Enabled, the Hard Loop ID is set to 125, and Data Rate is set to 2 (auto detect). Press Enter to change settings and Esc to exit. Next, you will see a window similar to Figure 9-6 on page 282.

Note: You should make a note of the adapter port name (otherwise known as the world wide port name), so that it corresponds to the ID on the storage subsystem.

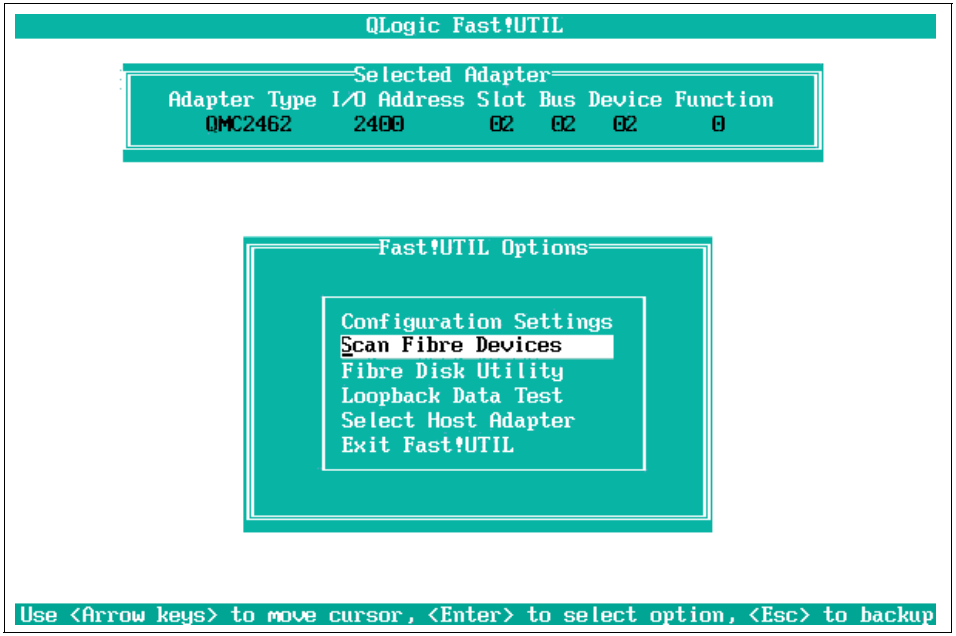

Figure 9-6 Scan Fibre Devices window

5. Hit Esc (Figure 9-6), then scan the Fibre Channel devices to register it with the switch name server for zoning and with storage.

   At this step, we are scanning the Fibre Channel SAN so that the HBA registers with the fabric to allow for zoning, since the device should be listed in the switches name server database (this is part of the scan FC devices process) so that the user does not have to manually enter its WWPN. You are now able to perform the zoning (assuming all equipment was wired/powered up before any of this was started). Also, this process registers the HBAs WWPN with the storage device so that the user does not have to manually enter this information when defining host partitions.

   At this point, you should see the window shown in Figure 9-7 on page 283.

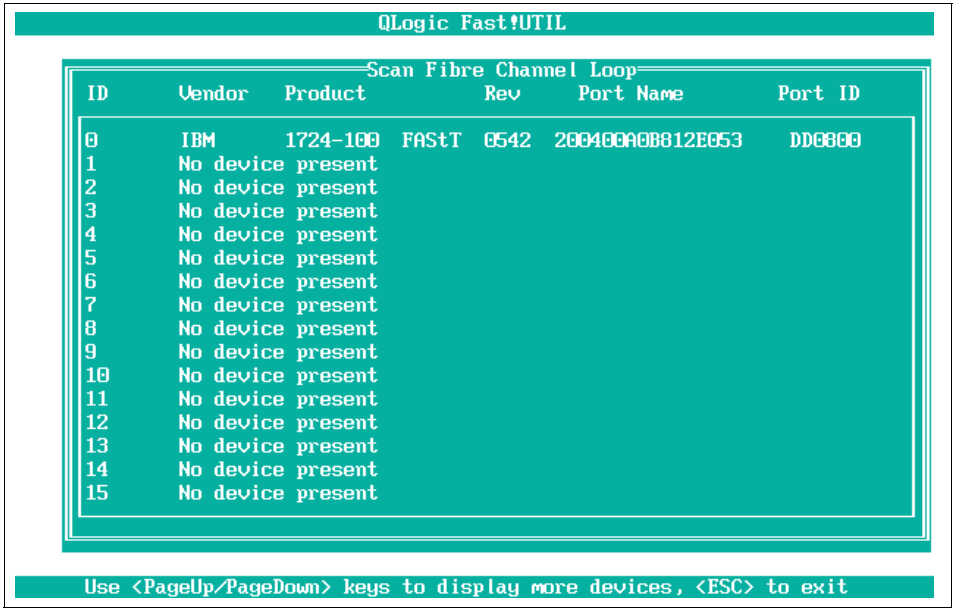

Figure 9-7 DS4100 storage listed

6. Select **WWN 200400A0B812E053** and press Esc. You will see a window similar to Figure 9-8. The WWPN will not be the user's, as it depends on the WWPN of their storage; think of WWPN as the serial number of the storage devices, thus it is unique to each storage port.

Note: The point of this step is to register the HBA with the fabric so that we can configure zoning and host partitioning without having to enter the WWPNs of the devices by hand.

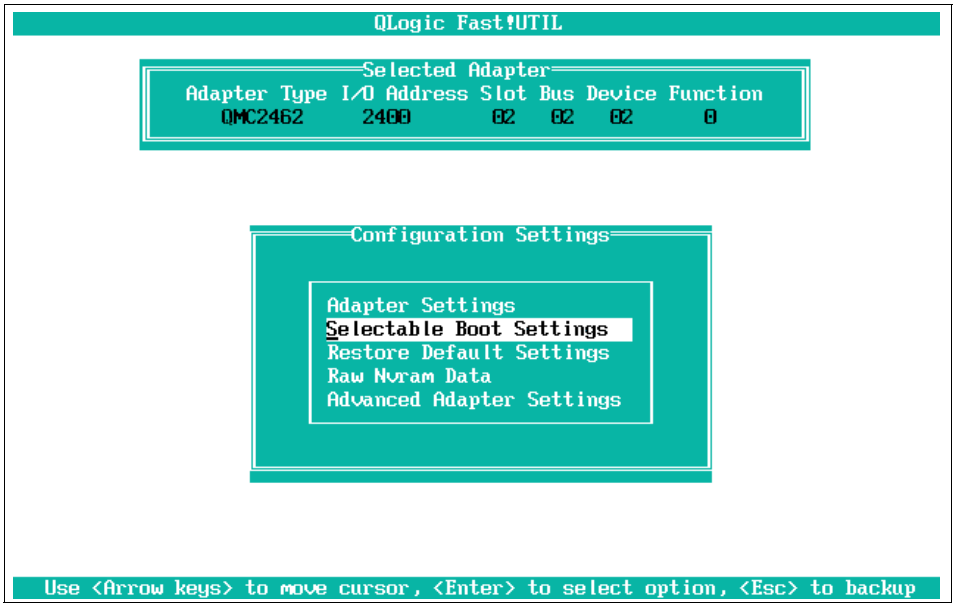

Figure 9-8 Configuration Settings window

7. Select "Selectable boot settings" and press Enter. You will see a window similar to Figure 9-9 on page 285.

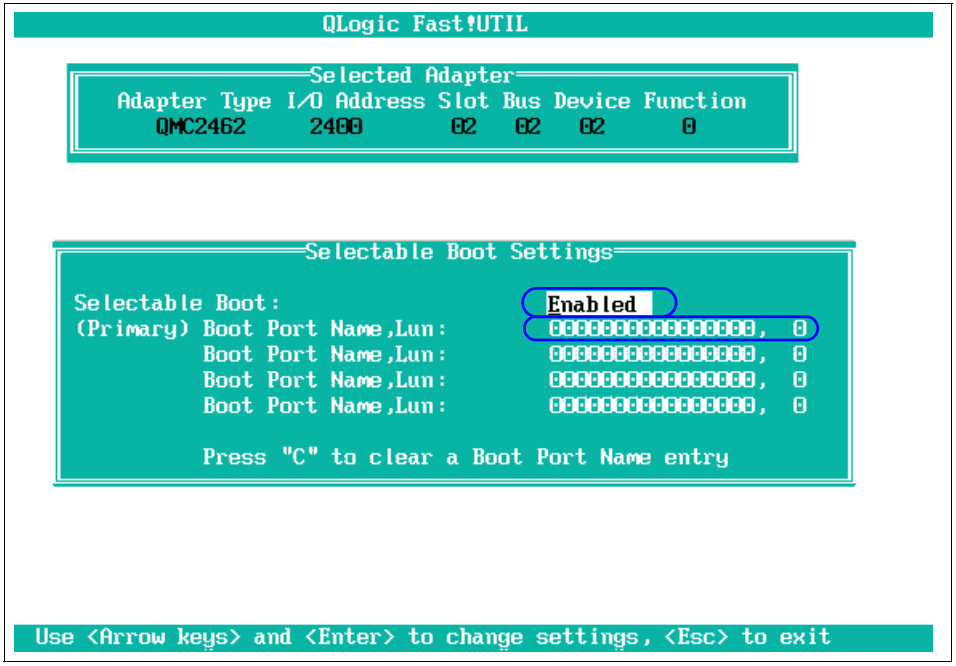

Figure 9-9 QLogic Fast!UTIL window

8. In the Selectable Boot Settings window, ensure Selectable Boot is set to Enabled (*Do not press Enter*). *Stop at this point*. Go to “Configure the QLogic Fibre Channel Switch Module” on page 288.

STOP: At this point, go to the zoning instructions now before proceeding to step 9. The point of this step is not to select the boot LUN quite yet; rather, it is just to register the HBA with the fabric. We will select the boot LUN later since we have not defined it yet. Now, you should start and complete the steps in 9.3.3, “Configure the QLogic Fibre Channel Switch Module” on page 288, at which point you will continue with the window shown in Figure 9-10.

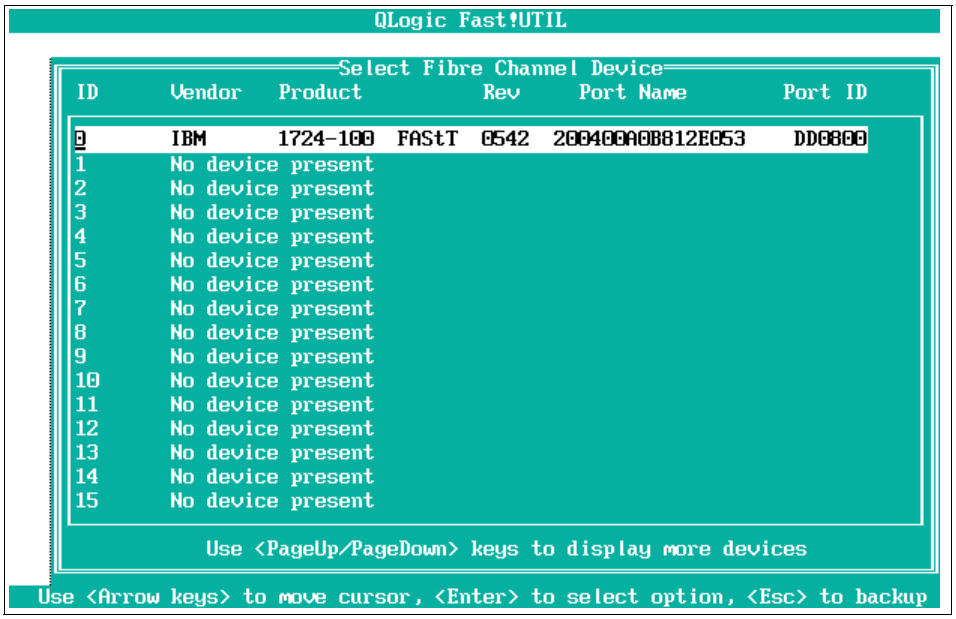

Figure 9-10 Select the boot device

9. Once you have completed your Zoning steps in “Configure the QLogic Fibre Channel Switch Module” on page 288 and “Storage” on page 303, you will return here. You should see the window shown in Figure 9-9 on page 285. Select **Primary Boot Port Name, Lun** and press Enter. You will see a window similar to Figure 9-10. Select the boot storage device’s WWPN and press Enter. Now, you are allowed to select a specific boot LUN.

   You will see a window similar to Figure 9-11 on page 287. In our example, we selected 200400A0B812E053.

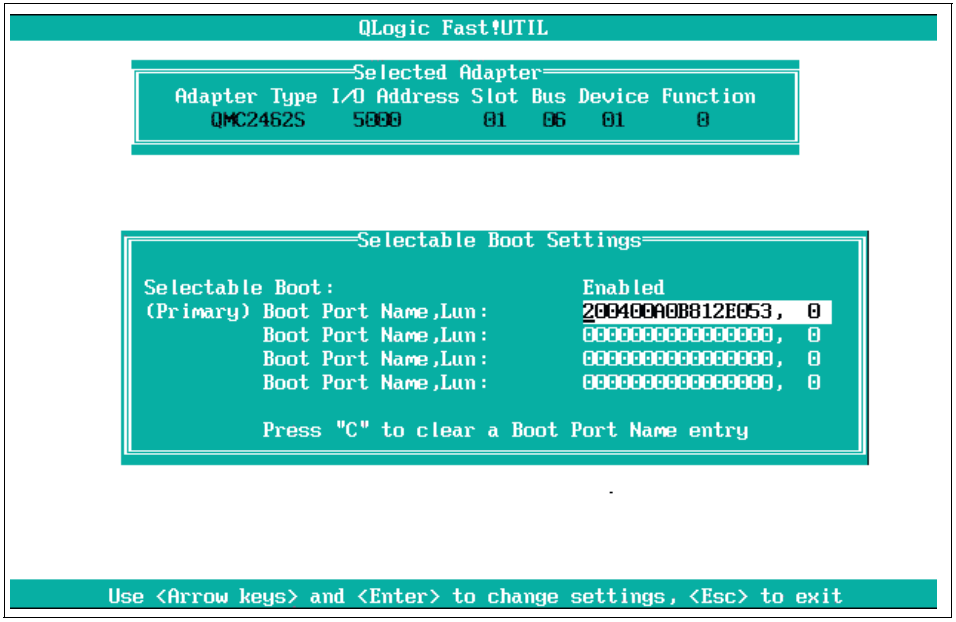

Figure 9-11 Selectable Boot Settings window

10. Press Esc and you will see a window similar to Figure 9-12.

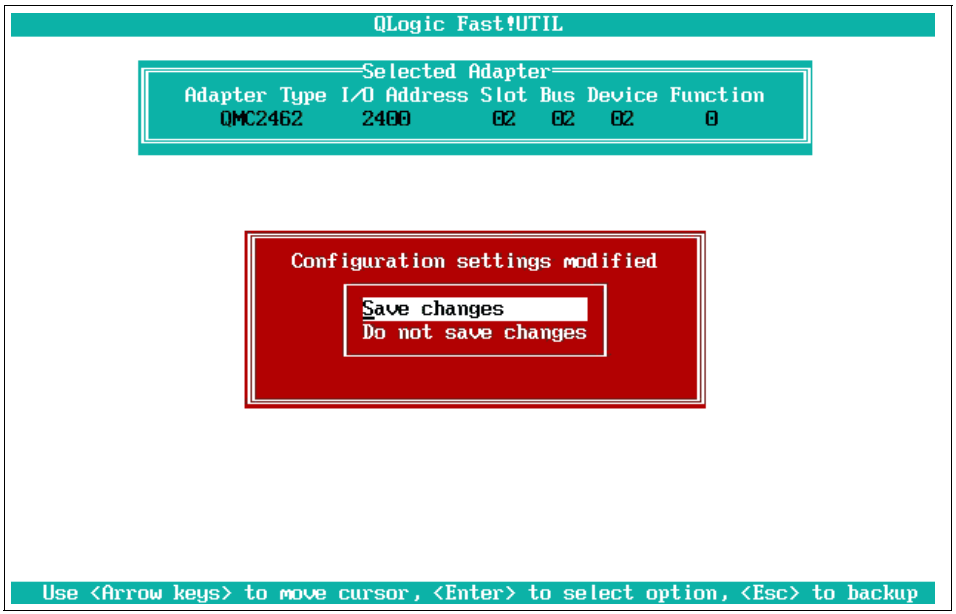

Figure 9-12 QLogic Fast!UTIL window

11. Press Enter to save your changes. You can begin the installation of your operating system once you have confirmed there is only one logical path from the server to the storage.

9.3.3 Configure the QLogic Fibre Channel Switch Module

In this section, we will access the QLogic SANbrowser to begin the configuring of zones for accessing storage LUNs on the TotalStorage DS4100.

1. To begin, enter the IP address of the QLogic Fibre Channel Switch Module for IBM BladeCenter into your Internet Explorer Web browser. You will see the Java Plug-in Version Check and after several seconds a window similar to Figure 9-13.

> **Note:** If the Java JRE™ is not installed, you will get a warning when you try to connect to the switch via a Web browser.

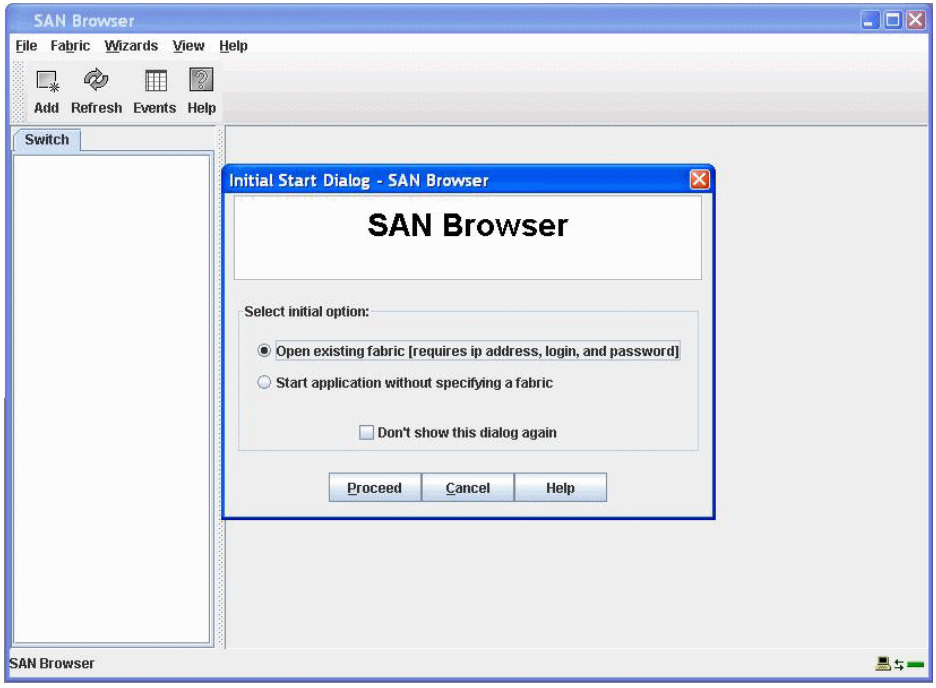

Figure 9-13 SAN browser window

2. Select **Open existing fabric [requires IP address, login, and password]** and click **Proceed**. You will see a window similar to Figure 9-14 on page 289.

Figure 9-14 Add a New Fabric window

3. Enter a name in the Fabric Name field. Continue to insert the IP address of the switch module and then your user ID and password. The default user ID and password is USERID and PASSW0RD (use all caps, and, in the password, insert 0 for O). In our example, we enter a fabric name of BladeCenter SAN 1. Click **Add Fabric**. You will see a window similar to Figure 9-15.

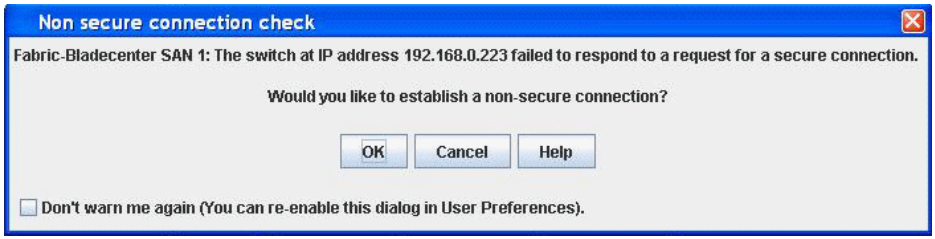

Figure 9-15 Fabric specified window

4. Click **OK**. You will see a window similar to Figure 9-16.

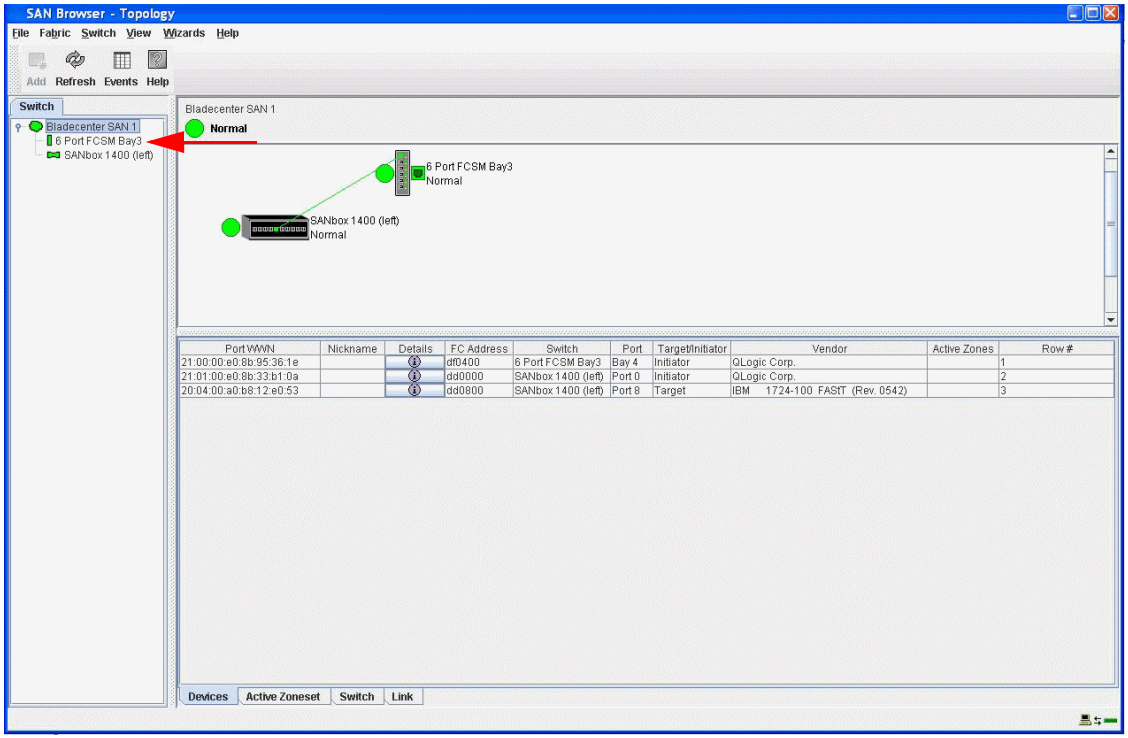

Figure 9-16 Topology window

5. This is the topology window that includes the 4Gb QLogic Fibre Channel Switch Module and the QLogic SANBox 1404. Double-click **6 Port FCSM Bay 3** and you will see a window similar to Figure 9-17.

> **Note:** In this example, 6 Port FCSM Bay 3 is a logical name for the switch that we defined. This could be named something more significant for your environment. Also, the switch could reside in Bay 3 or Bay 4, which are both valid bays for the FCSMs.

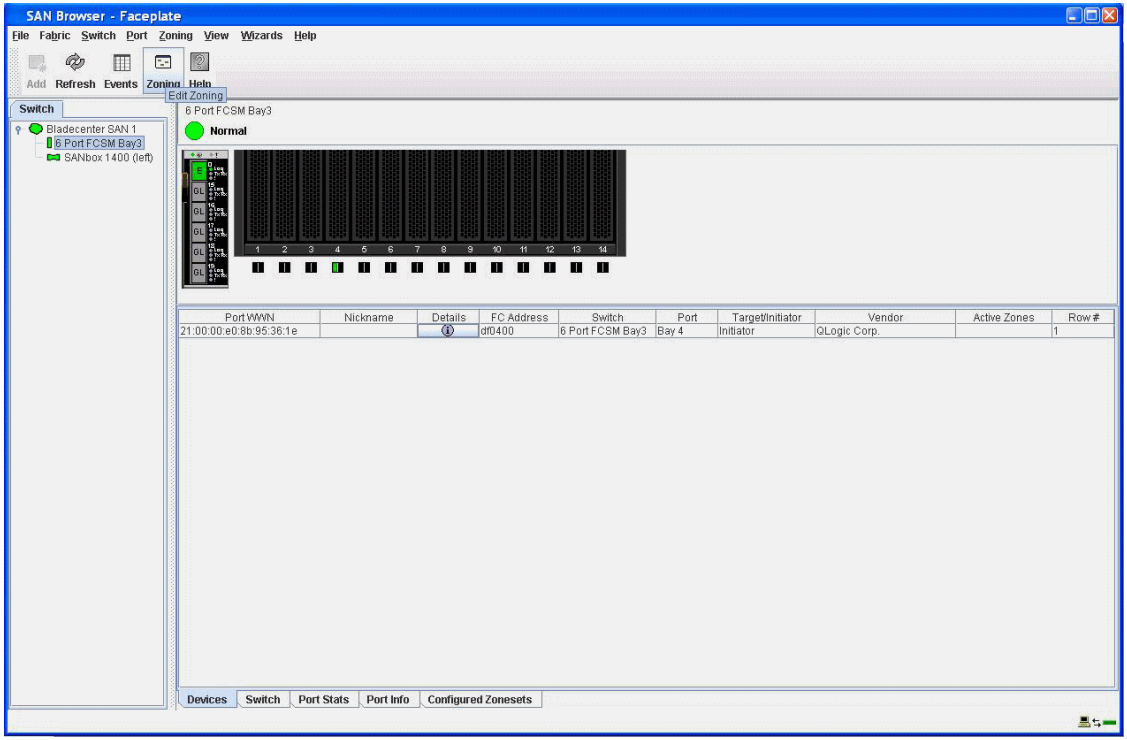

Figure 9-17 Edit zoning window

6. From the Edit Zoning dialog window, click the **Zoning** icon and then click **Edit Zoning.** You will see a window similar to Figure 9-18.

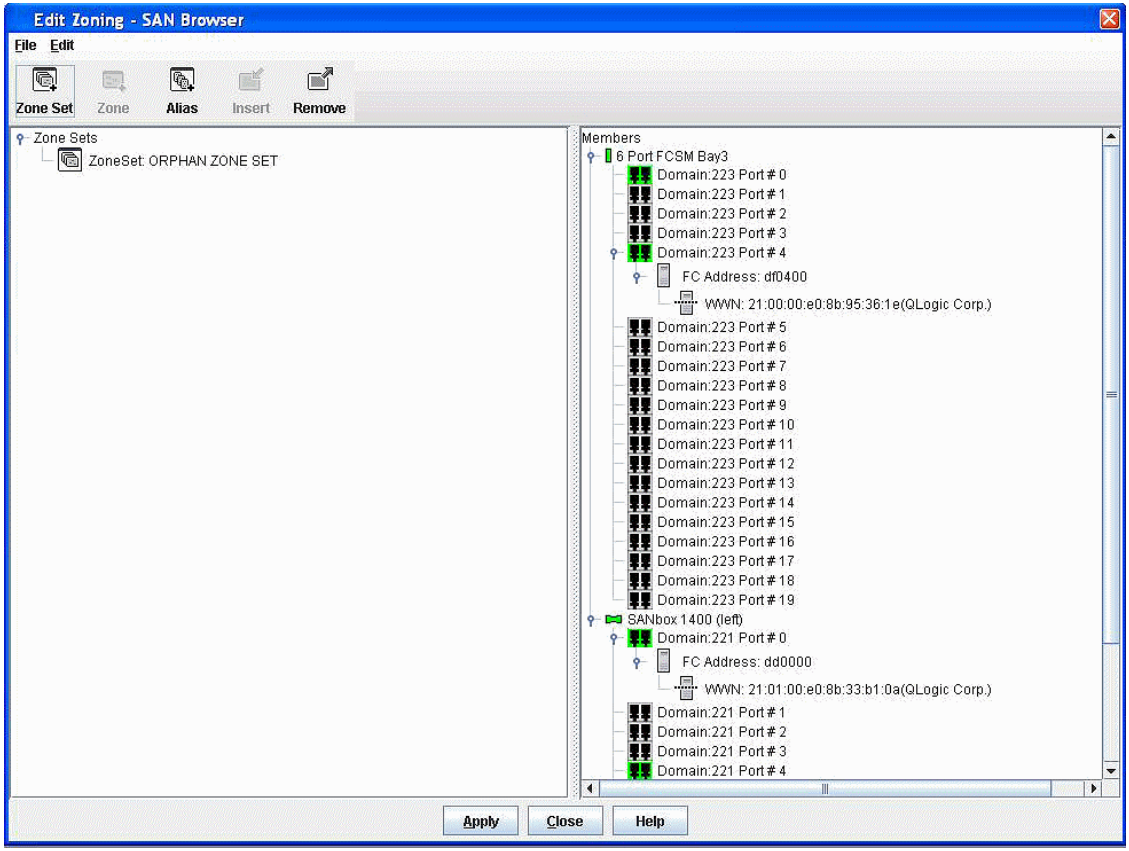

Figure 9-18 Zoning switches listed window

7. From the Edit Zoning dialog window (Figure 9-19), click **Zone Set** → **Create a zone set**. You will see a window similar to Figure 9-20 on page 294.

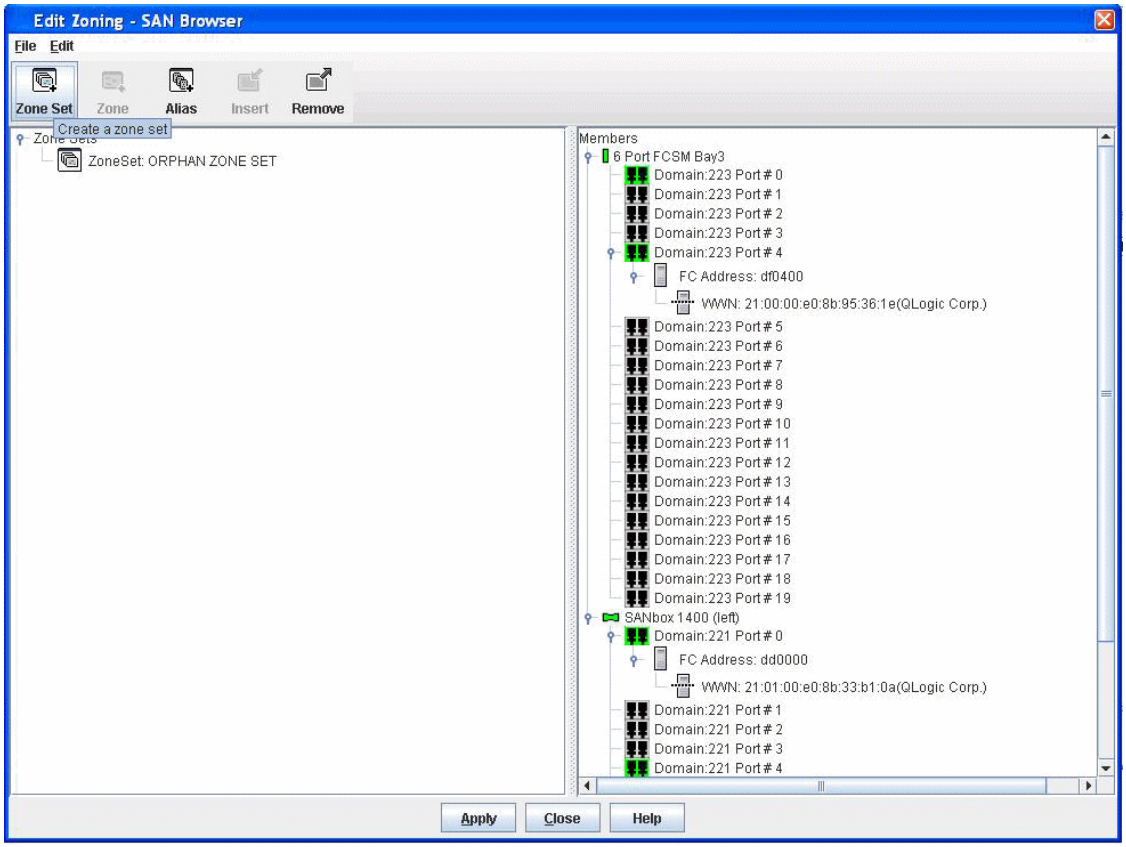

Figure 9-19 Create zone set window

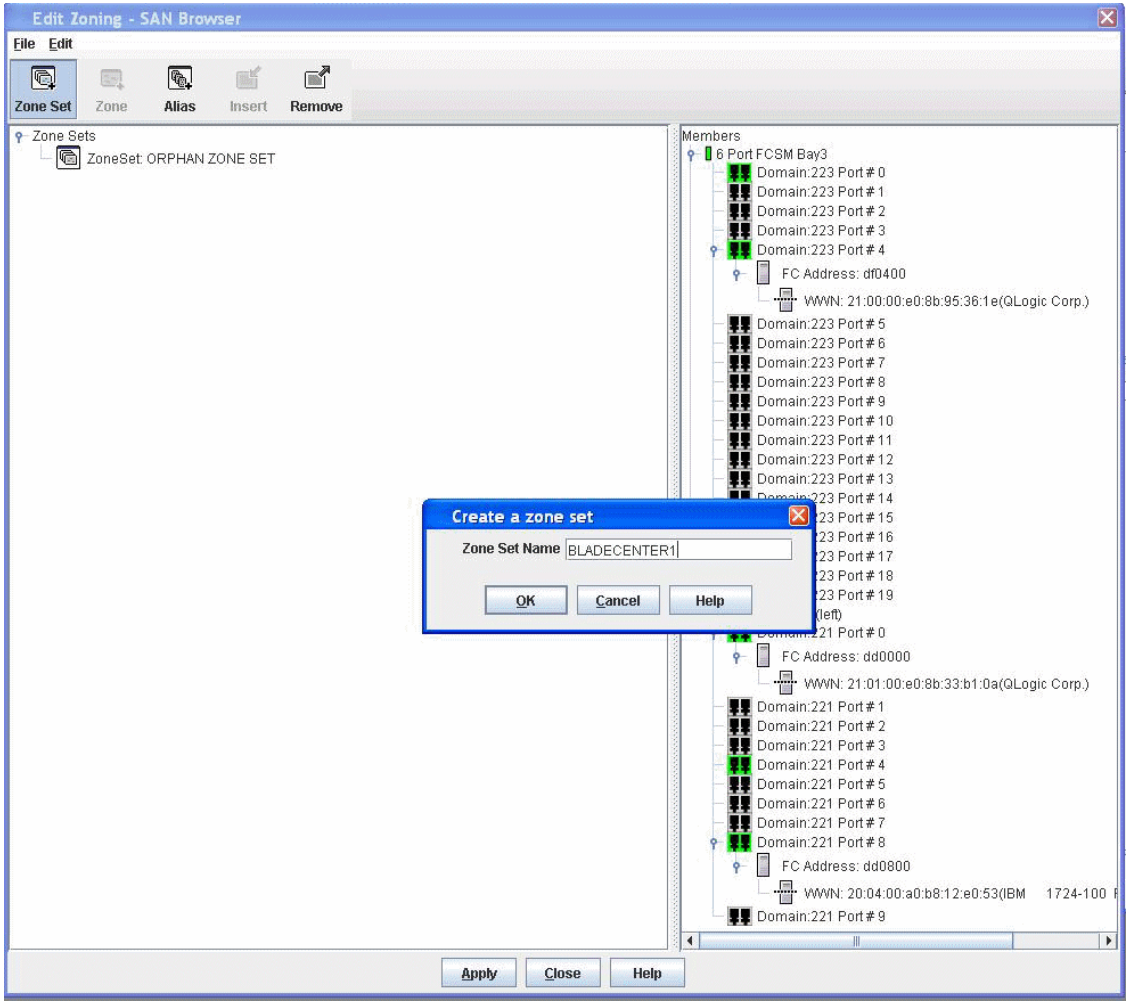

Figure 9-20 Creating BladeCenter1 zone set window

8. In the Create a zone set dialog box, enter a name for the Zone Set Name field and click **OK**. In our example, we typed BLADECENTER1.

9. Once the zone set has been created, you should create a zone. Right-click **ZoneSet: BLADECENTER1** and select **Create a Zone...** (Figure 9-21). You will see a window similar to Figure 9-22 on page 296.

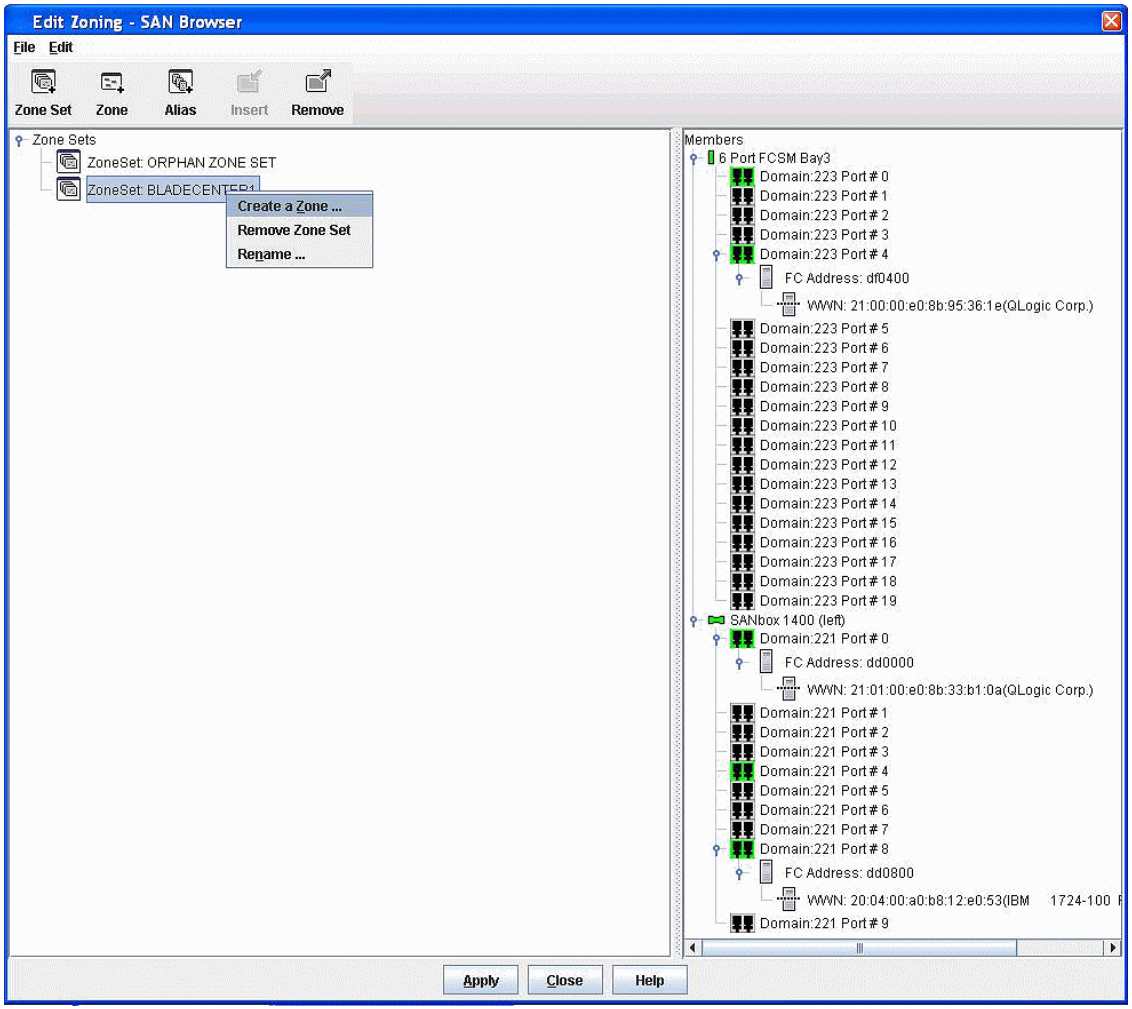

Figure 9-21 BladeCenter1 zone set created window

10. In the Create a zone dialog box, enter a name in the Zone Name field and click **OK** (Figure 9-22). In our example, we typed BLADE4PORT0BOOT. Next, you will see a window similar to Figure 9-23 on page 297.

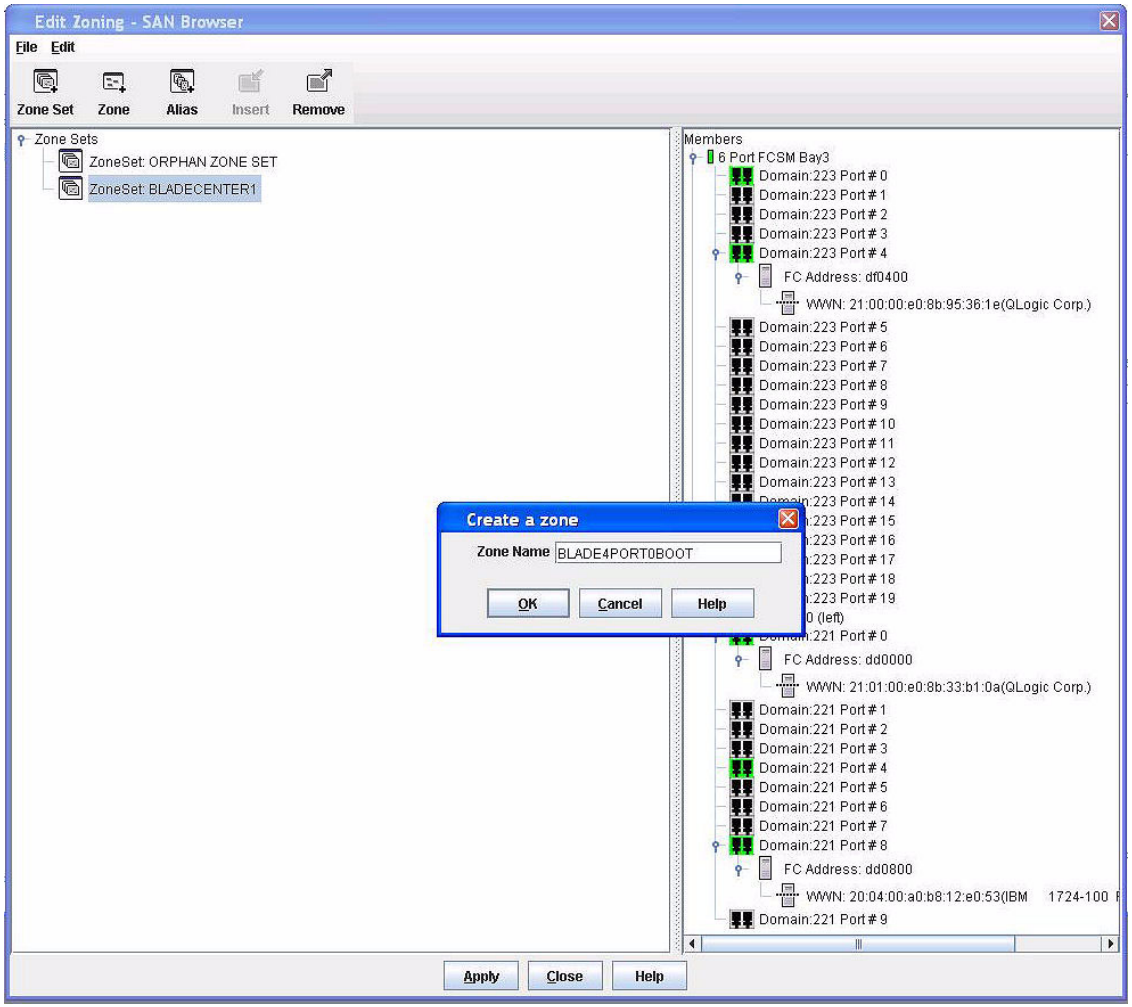

Figure 9-22 Creating blade4port0boot zone window

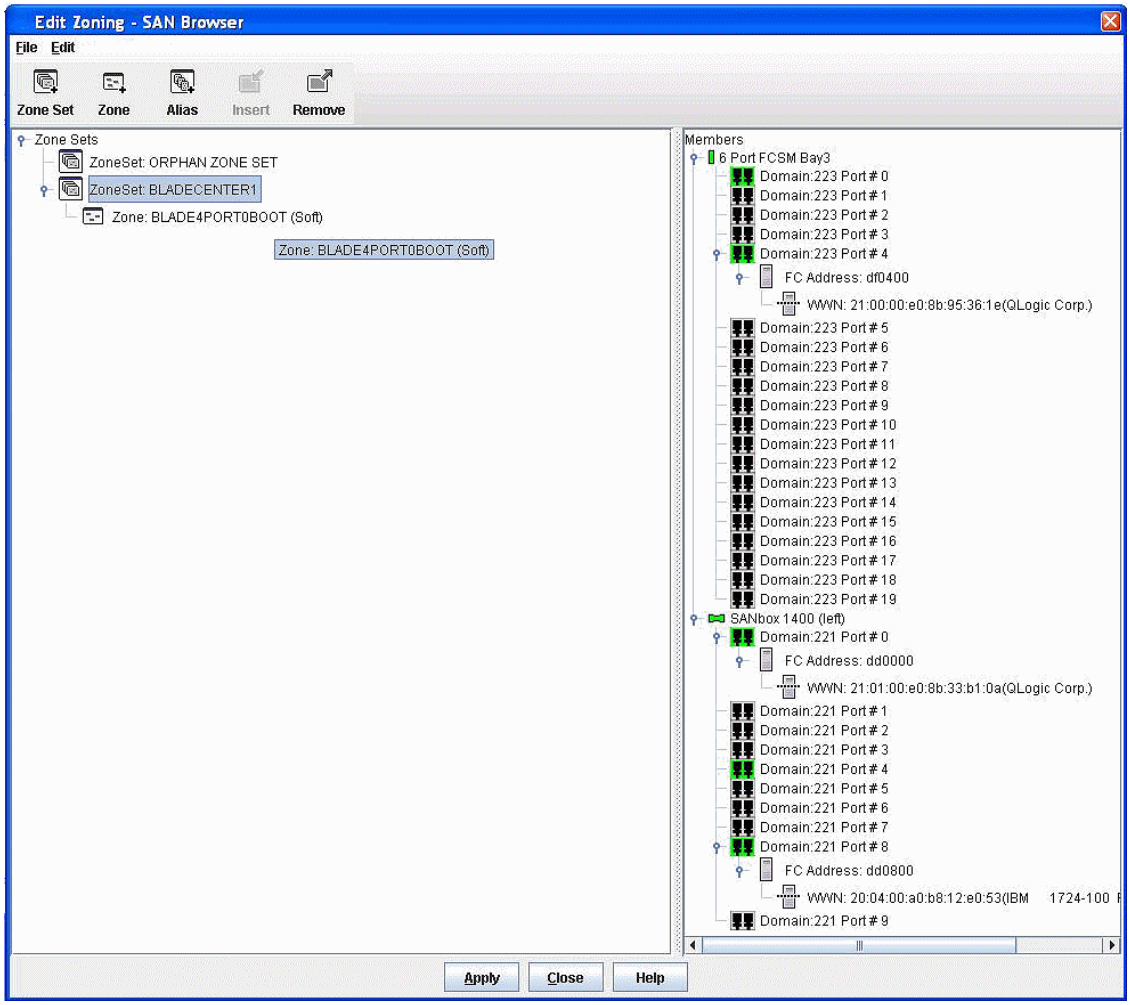

Figure 9-23 blade4port0bootzone created window

11. Hold Ctrl and select the devices meant for the zone with the left mouse button. In our example, we selected the FCSM WWN: 21:00:00:e0:8b:95:36:1e (QLogic Corp.) and the storage path WWN: 20:04:00:a0:b8:12:e0:53 (IBM 1724-100 FAStT (Rev. 0542) (Figure 9-24). Continue holding down the mouse button and drag the members to the zone. You will then see a window similar to Figure 9-25 on page 299.

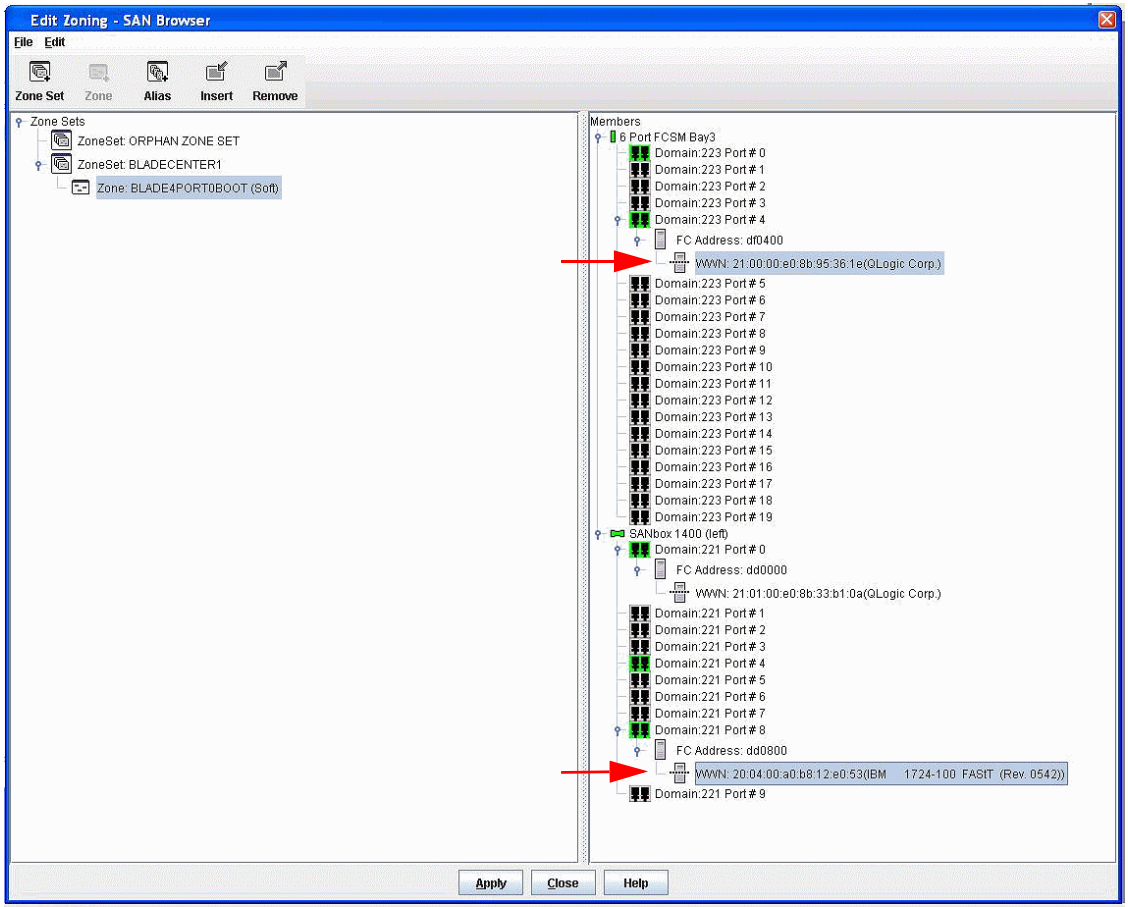

Figure 9-24 Edit Zoning - SAN Browser window

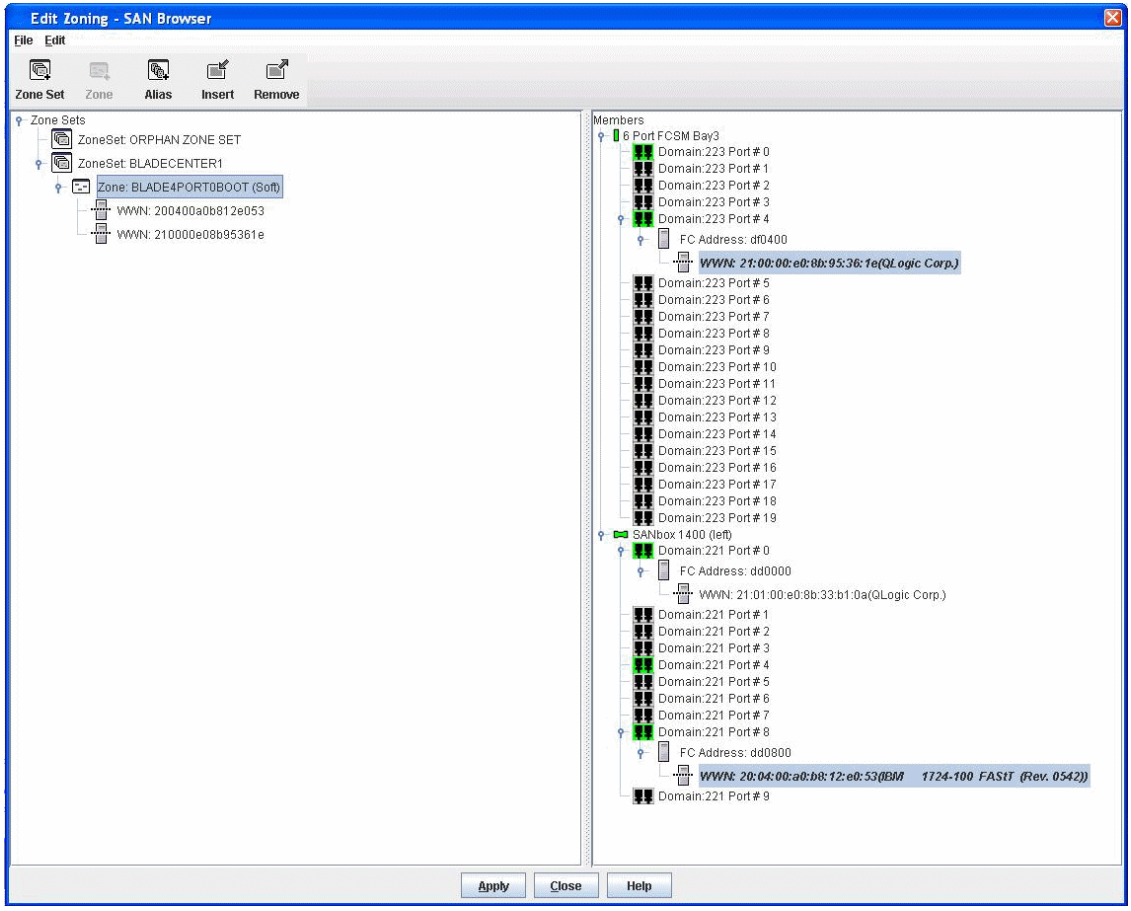

Figure 9-25 Edit Zoning - SAN Browser window

12. Members were added to the zone. Click **Apply** to apply zoning changes. You will see a window similar to Figure 9-26.

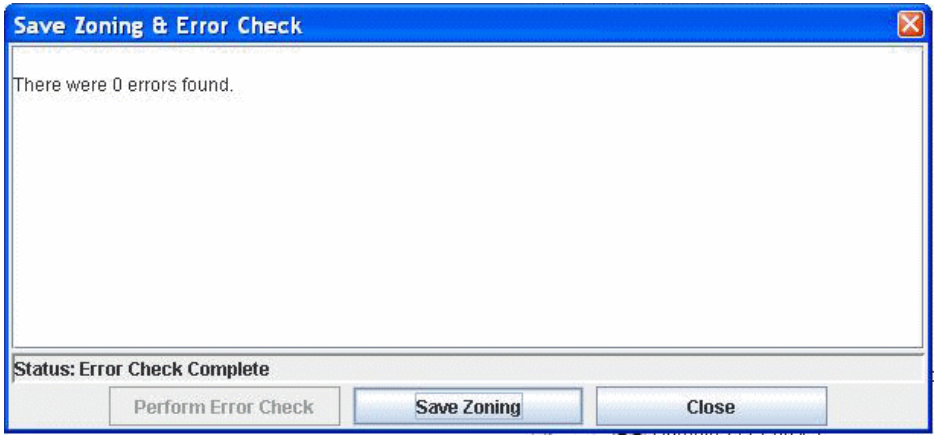

Figure 9-26 Perform error check and save zoning

13. From the Save Zoning and Error Check dialog box (Figure 9-26), select **Perform Error Check**. Once the Error Check is complete and no errors appeared, select **Save Zoning**. You will see a window similar to Figure 9-27.

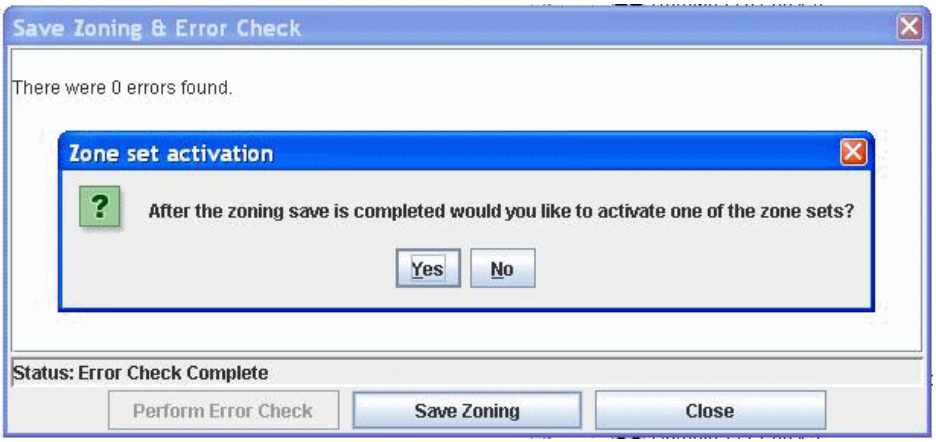

Figure 9-27 Zone set activation window

14. Select **Yes** to activate your zone set(s) once the save is complete. You will see a window similar to Figure 9-28 on page 301.

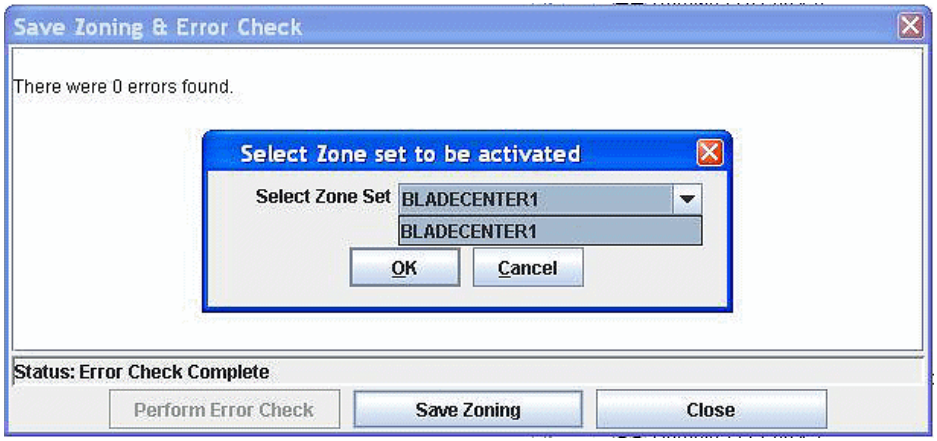

Figure 9-28 Select zone set to activate

15. Select the zone set to be activated and click **OK**. You will see a window similar to Figure 9-29.

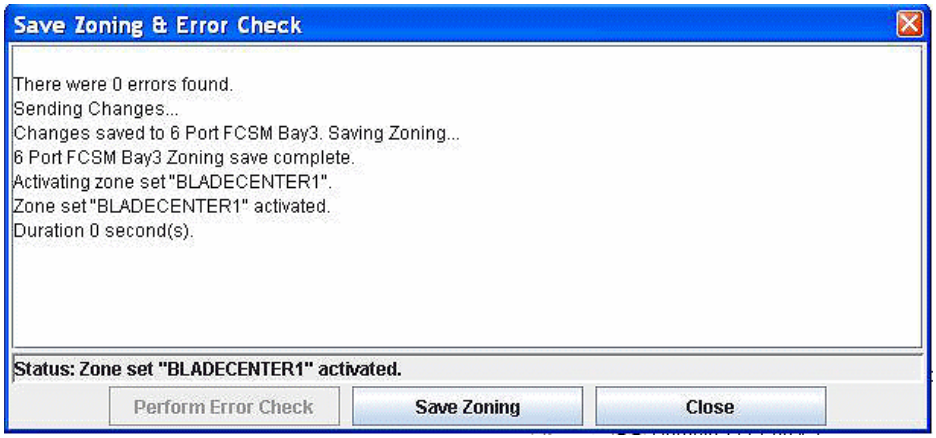

Figure 9-29 Zone set activated

16. Click the **Close** button to complete saving your zone. You are returned to a window that is similar to Figure 9-30.

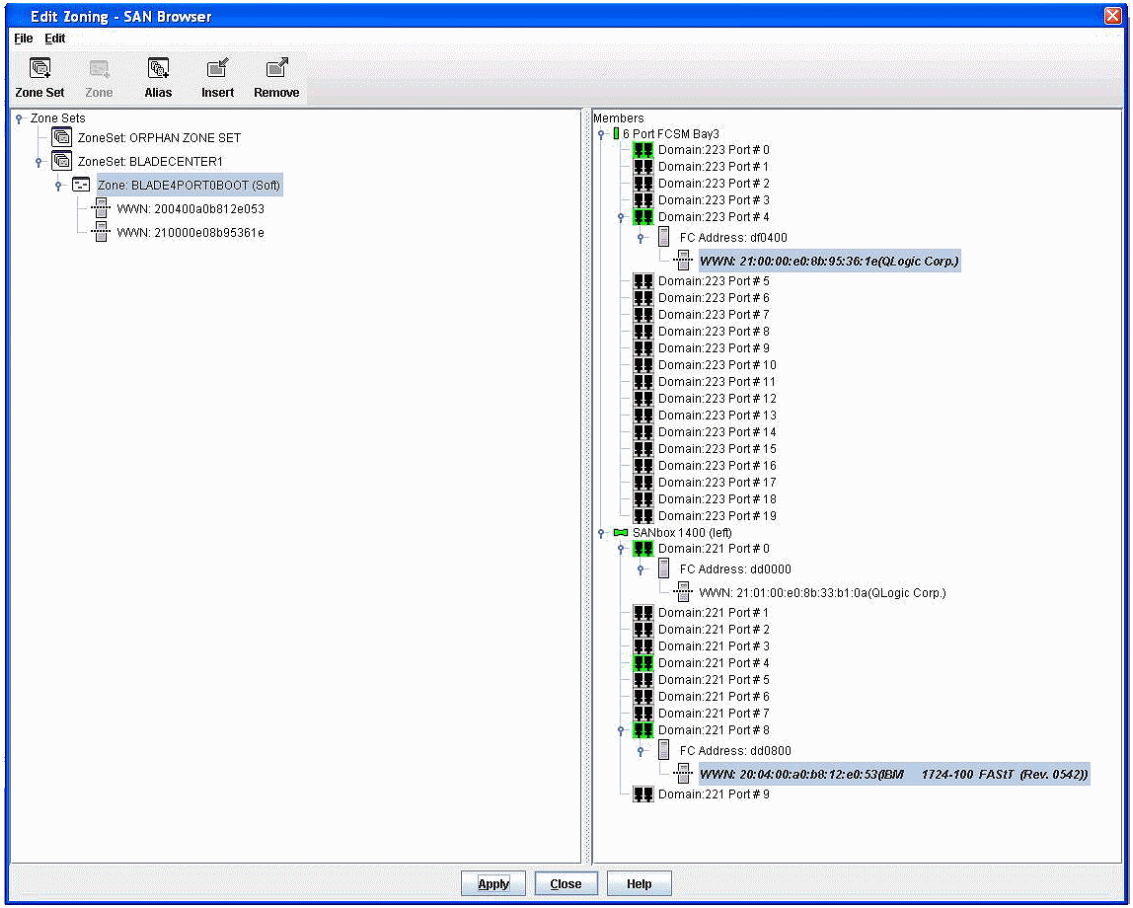

Figure 9-30 Close edit zoning

9.3.4 Storage

In this section, we will complete the necessary steps to access our storage server. Perform the following instructions:

1. Click **Start** → **All Programs** → **Storage Manager 9 Client** to launch Storage Manager (Figure 9-31). You will see a window similar to Figure 9-32 on page 304.

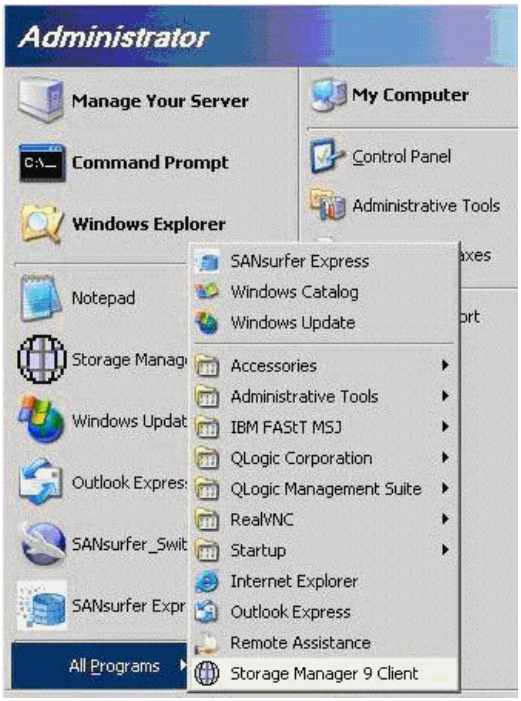

Figure 9-31 Start Storage Manager 9 client

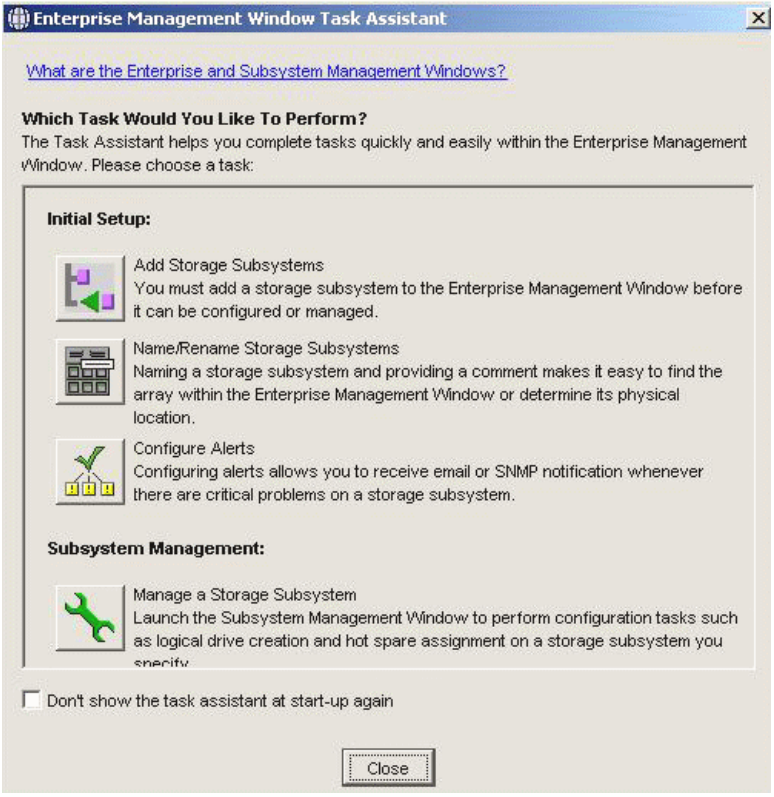

Figure 9-32 Load Storage Manager

2. Under Initial Setup, click **Add Storage Subsystems**. You will see a window similar to Figure 9-33.

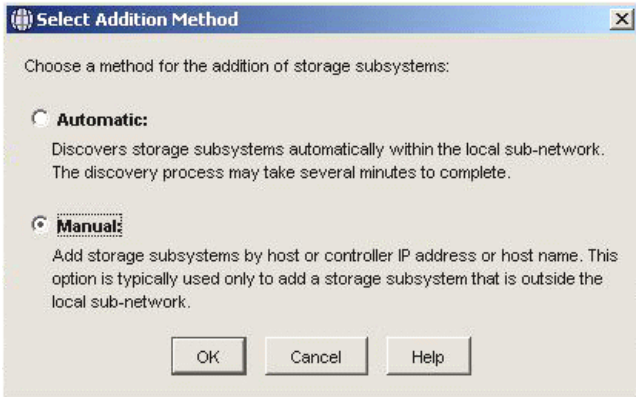

Figure 9-33 Select Addition Method window

3. Select **Manual** to specify storage subsystems and click **OK**. You will see a window similar to Figure 9-34.

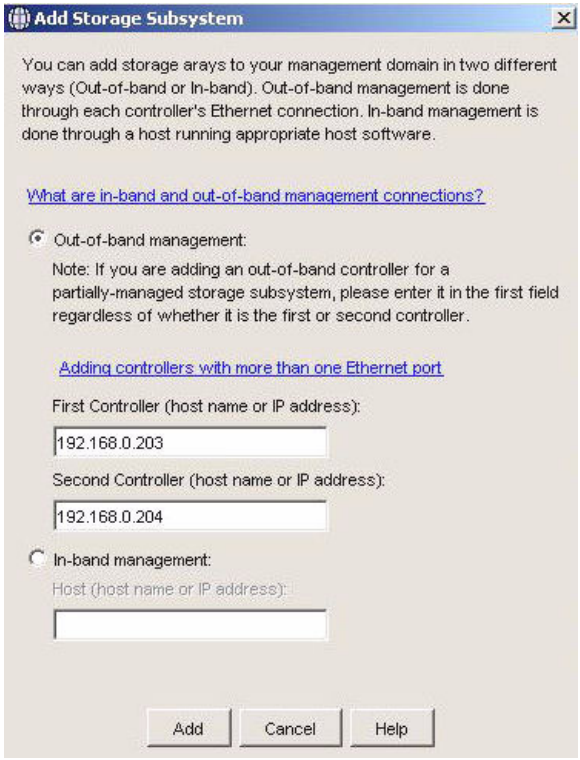

Figure 9-34 Add Storage Subsystem

4. Enter the controller IP addresses of the storage server and click **Add**. You will see the connecting status. Afterwards, you will see a window similar to Figure 9-35.

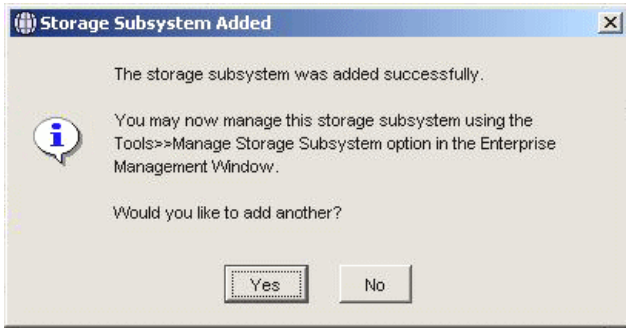

Figure 9-35 Storage Subsystem Added window

5. Click **No**. You do not want to add any more storage at this time. You will see a window similar to Figure 9-36.

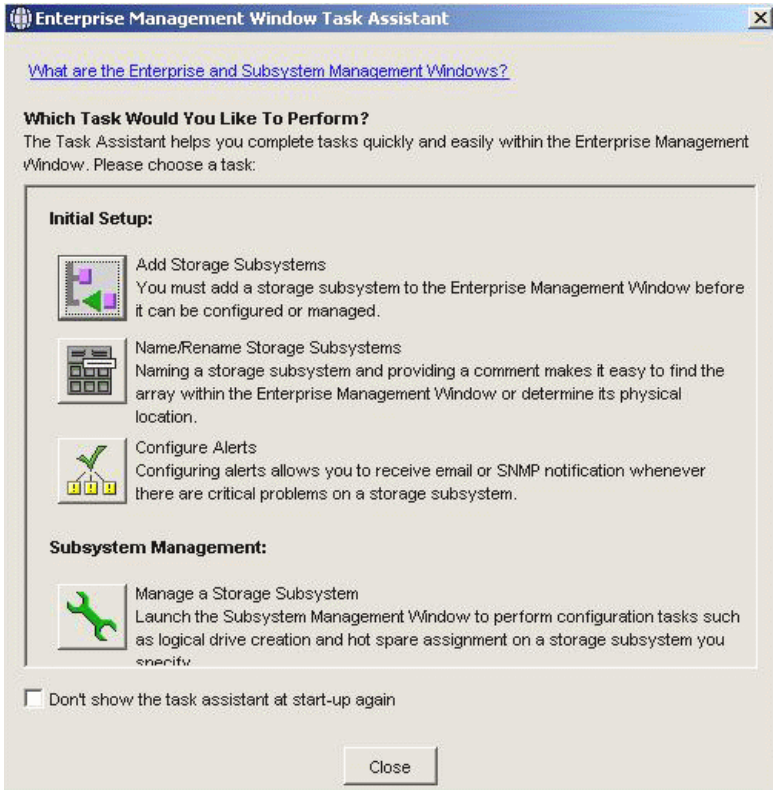

Figure 9-36 Enterprise Management Window Task Assistant

6. Click **Manage a Storage Subsystem**. You will see a window similar to Figure 9-37.

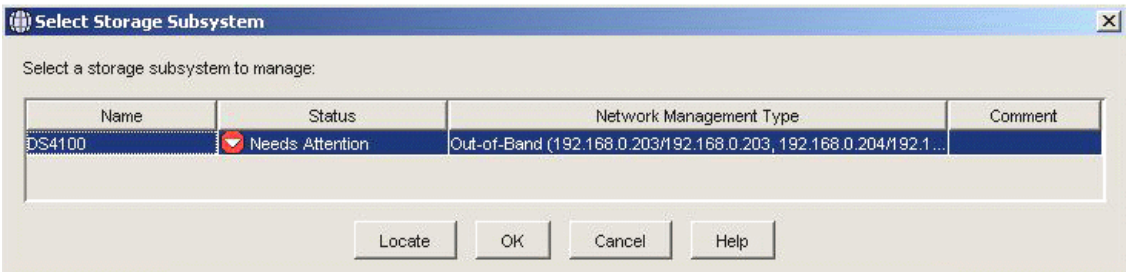

Figure 9-37 Select Storage Subsystem window

7. Specify which storage subsystem you plan to manage. In our example, it is the DS4100. Click **OK**. You will see a window similar to Figure 9-38.

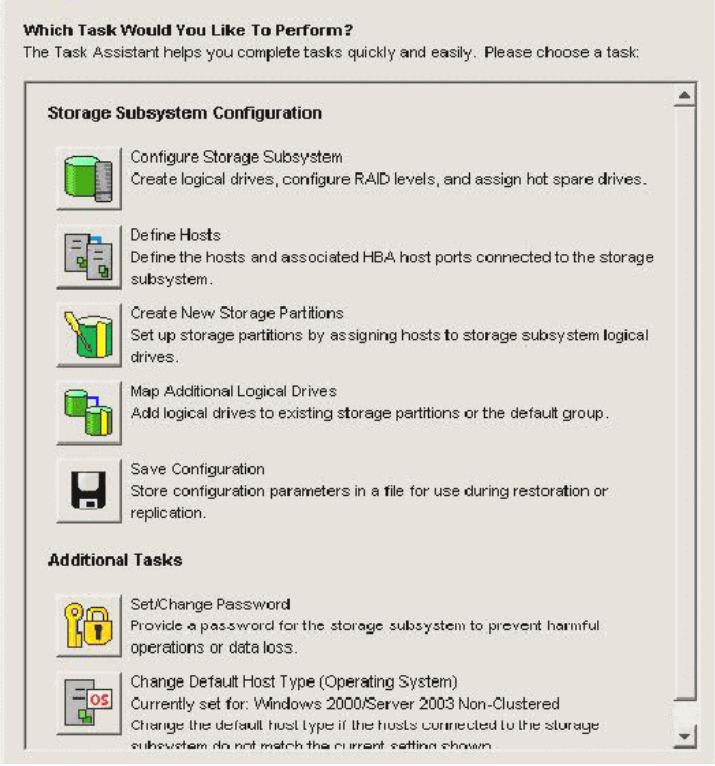

Figure 9-38 Storage Subsystem Configuration window

8. Click **Configure Storage Subsystem**. You will see a window similar to Figure 9-39.

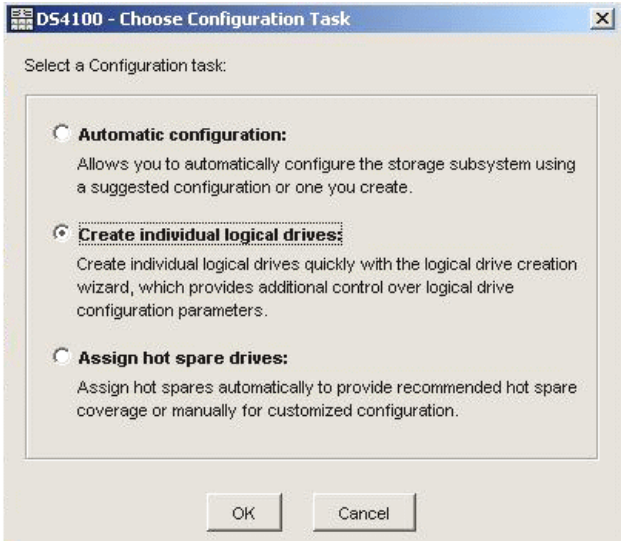

Figure 9-39 Choose Configuration Task window

9. Select **Create individual logical drives** and click **OK**. You will see a window similar to Figure 9-40.

Figure 9-40 Allocate Capacity for Logical Drive window

10. Specify what space to use for LUN. In our example, we selected the RAID 0 array. You will see a window similar to Figure 9-41.

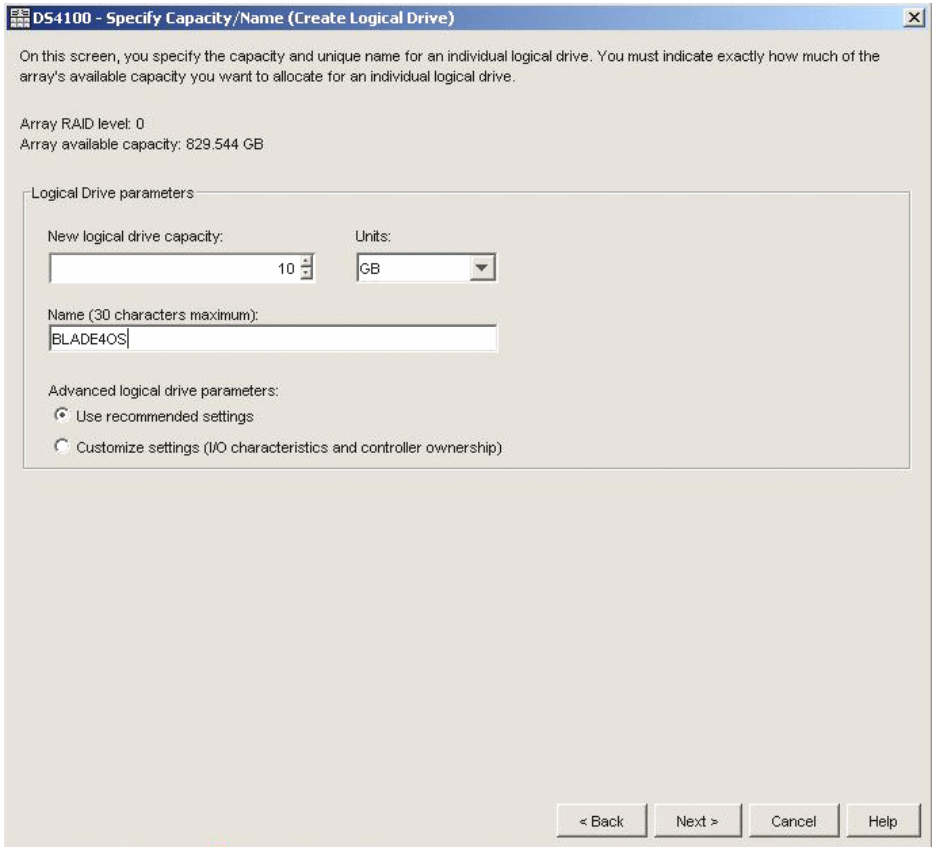

Figure 9-41 specify lun capacity and lun name

11. Specify the LUN capacity and LUN name. In our example, the LUN capacity is 10 GB and the LUN name is BLADE4OS. Under Advanced logical drive parameters, make sure **User recommended settings** is selected. Click **Next** and you will see a window similar to Figure 9-42 on page 311.

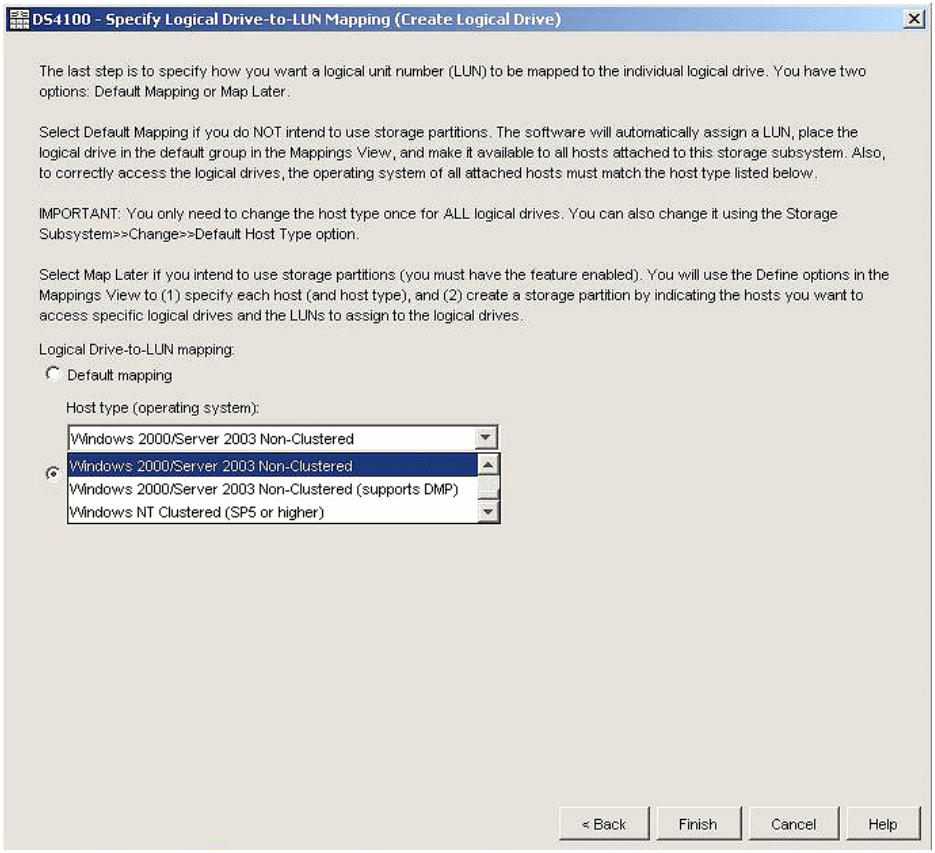

Figure 9-42 Specify Logical Drive-to-LUN Mapping (Create Logical Drive) window

12. Specify the logical drive to LUN mapping, insuring you pick a type where AVT/ADT is enabled (see Table 9-1 on page 275). In our example, we selected Windows 2000/Server 2003 Non-Clustered. Click **Finish** to created the LUN. Next, you will see a window similar to Figure 9-43.

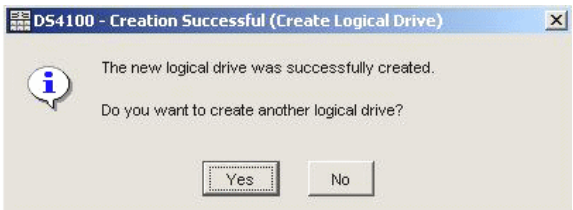

Figure 9-43 Creation Successful (Create Logical Drive) window

13. Click **No**. You do not want to create any additional LUNs at this time. Next, you will see a window similar to Figure 9-44.

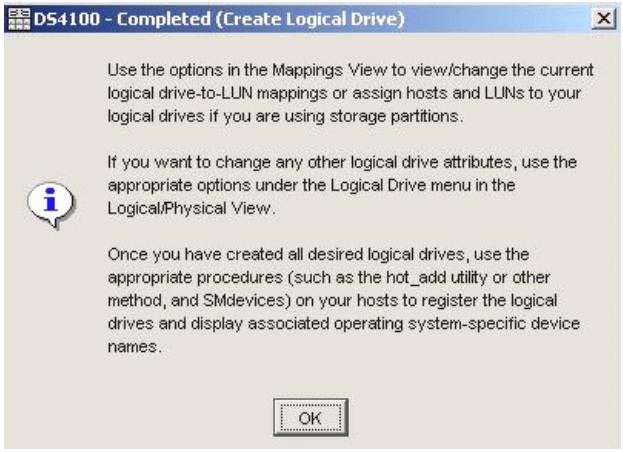

Figure 9-44 Completed (Create Logical Drive) window

14. Review the information in the window and click **OK**. You will see a window similar to Figure 9-45.

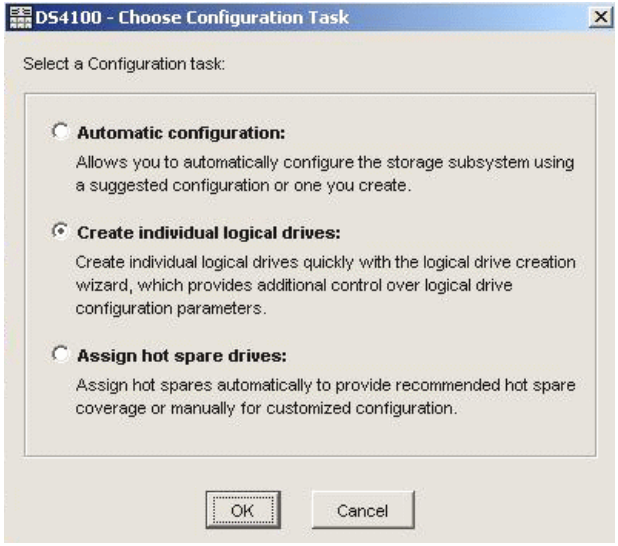

Figure 9-45 Cancel out to get out of configuration

15. Click **Cancel** to exit configuration task. You will see a window similar to Figure 9-46.

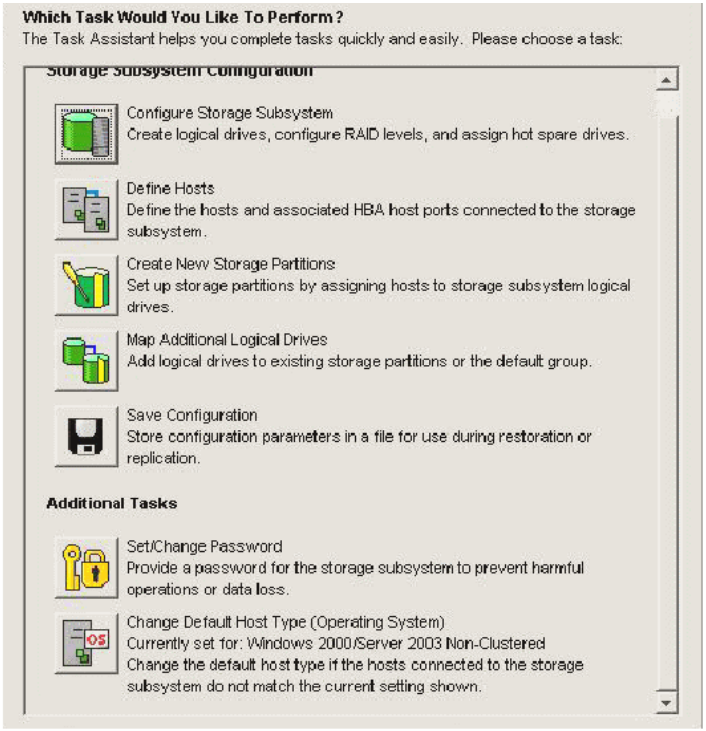

Figure 9-46 Click on define hosts

16. Click **Define Hosts**. Here you will define your host to your storage subsystem. You will see a window similar to Figure 9-47.

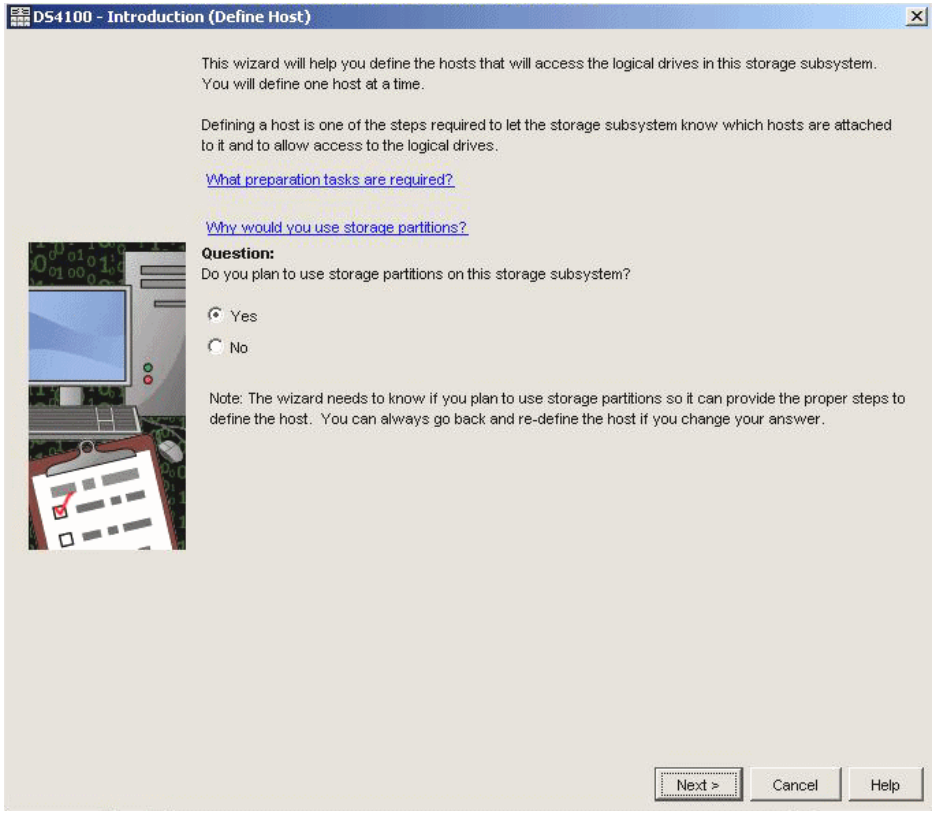

Figure 9-47 Introduction (Define Host) window

17. Select **Yes** and click **Next** to use the storage partition on the selected subsystem. You will see a window similar to Figure 9-48.

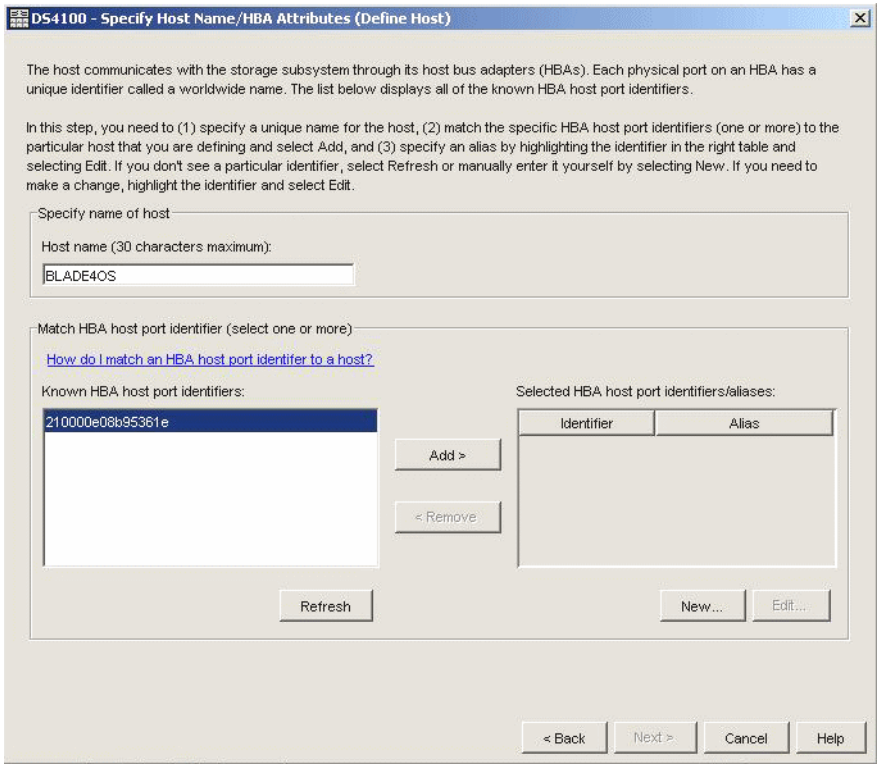

Figure 9-48 Specify Host Name/HBA Attributes (Define Host) window

18. Specify the name of your host. In our example, we selected BLADE4OS. Next, you will specify the WWPN of the HBA you intend to use. In our example, we selected 210000e08b95361e. Click **Add**. You will see a window similar to Figure 9-49.

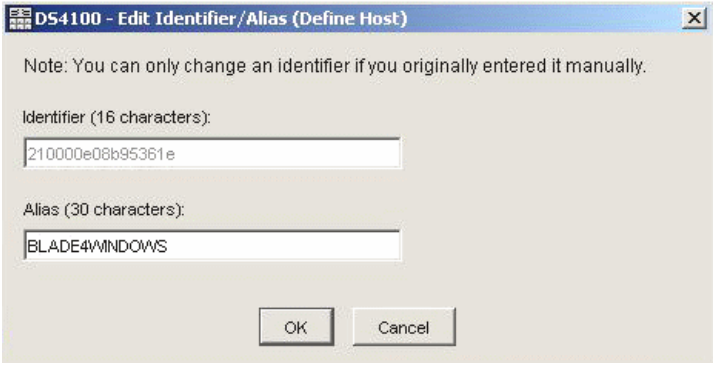

Figure 9-49 Edit Identifier/Alias (Define Host) window

19. In the Alias field, specify an alias for mapping. In our example, we typed BLADE4WINDOWS. Click **OK** to continue. You will see a window similar to Figure 9-50.

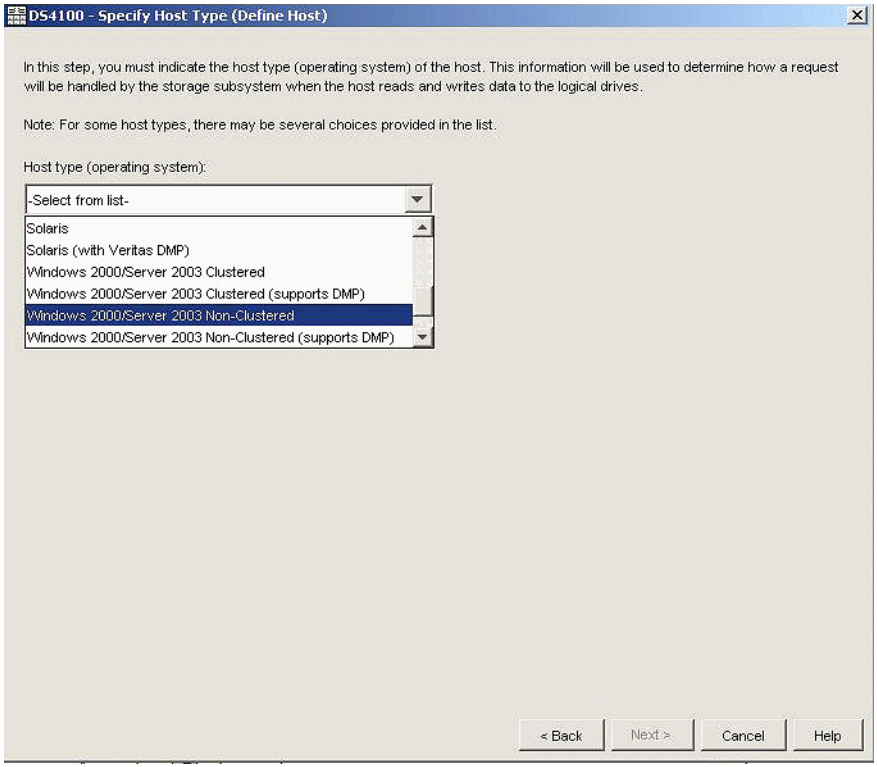

Figure 9-50 Specify Host Type (Define Host) window

20. In this step, specify the host type (or the operating system) of your host. In our example, we specified Windows 2000/Server 2003 Non-Clustered. Click **Next** to continue. You will see a window similar to Figure 9-51.

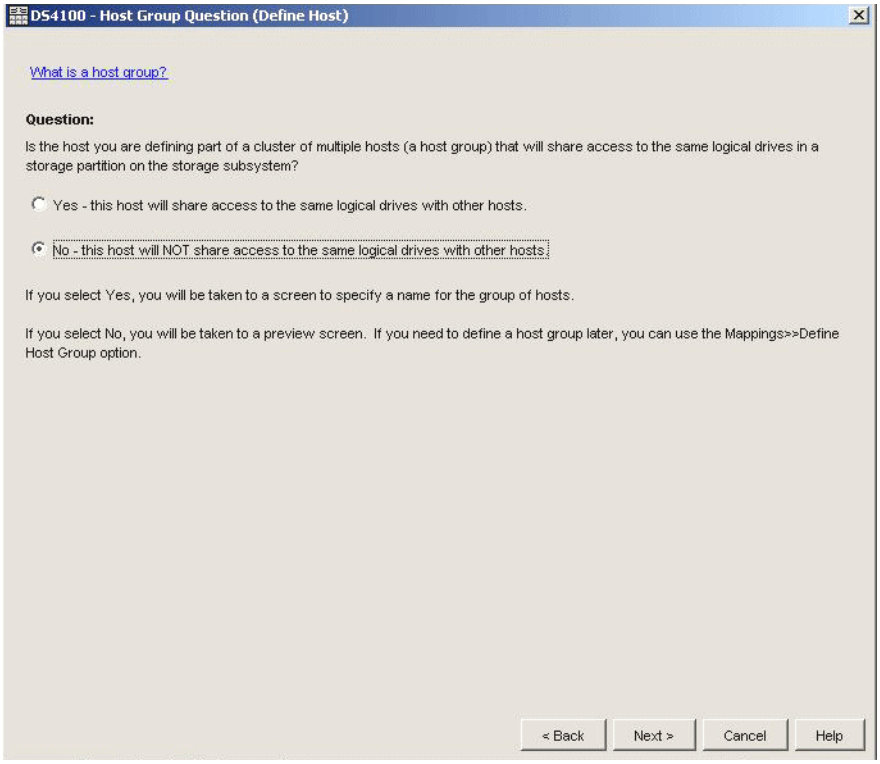

Figure 9-51 Host Group Question (Define Host) window

21. Select **No - this host will NOT share access to the same logical drives with other hosts**. Click **Next** and you will see a window similar to Figure 9-52 on page 319.

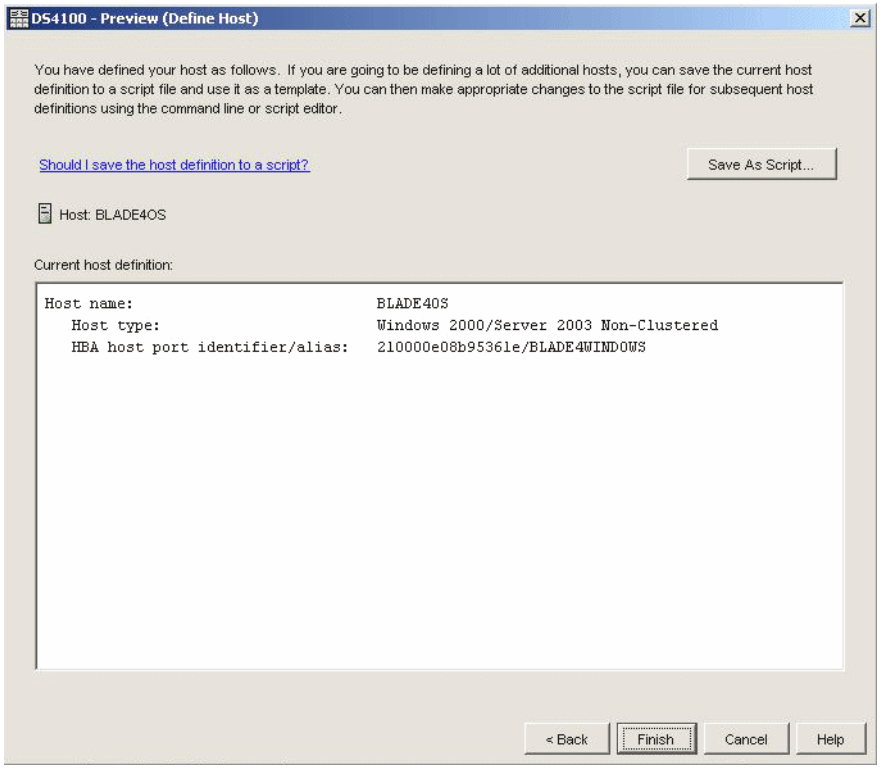

Figure 9-52 Preview (Define Host) window

22. In Figure 9-52, you are able to verify the host information you have defined. Click **Finish**. You will see a window similar to Figure 9-53.

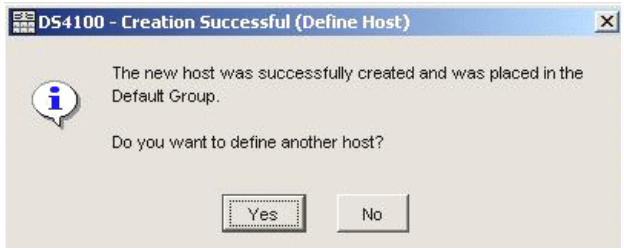

Figure 9-53 Creation Successful (Define Host) window

23. After your host has been successfully created, click **No** to return the Subsystem Management Window Task Assistant window (Figure 9-54).

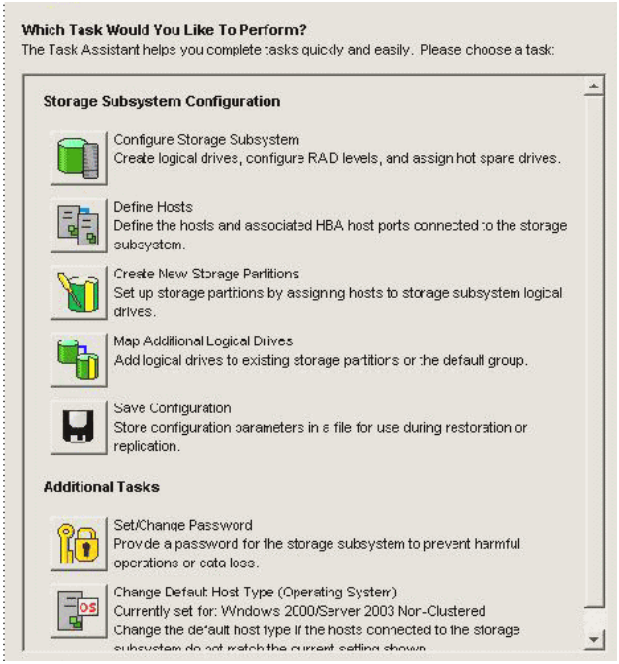

Figure 9-54 Subsystem Management Window Task Assistant window

24. Select **Create New Storage Partitions**. You will see a window similar to Figure 9-55.

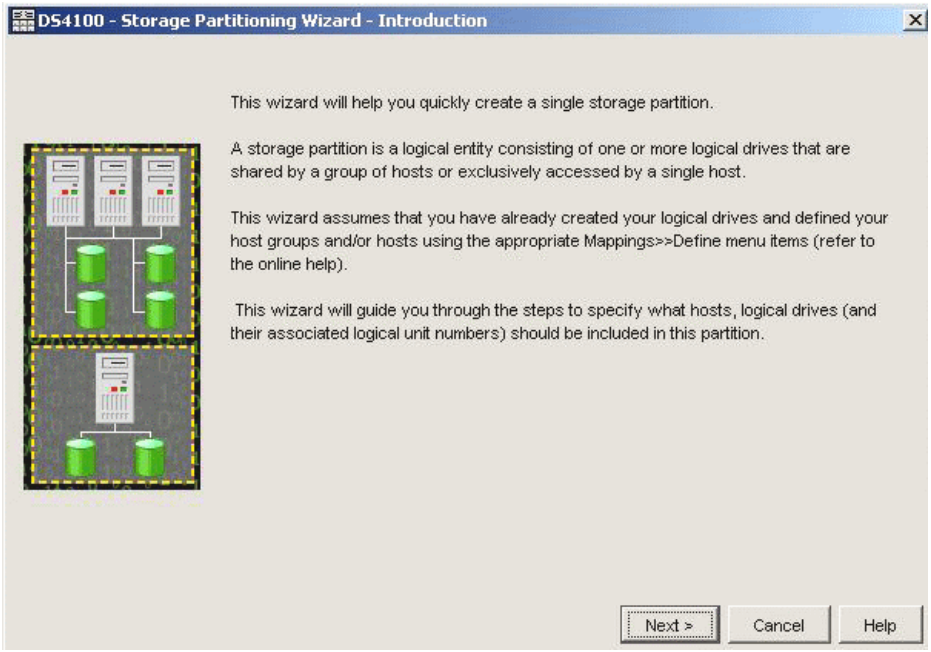

Figure 9-55 Storage Partitioning Wizard window

25. Click **Next** to enter the wizard. You will see a window similar to Figure 9-56.

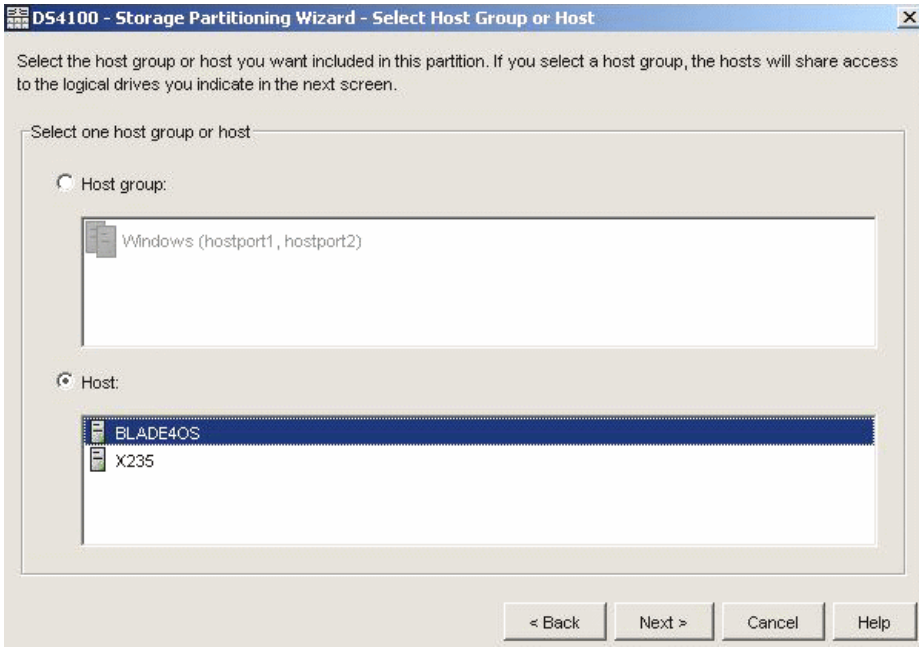

Figure 9-56 Storage Partitioning Wizard - Select Host Group or Host window

26. In this step, we will select the Host we have created for our configuration. First, select **Host** and then select **BLADE4OS**. Click **Next**. You will see a window similar to Figure 9-57 on page 323.

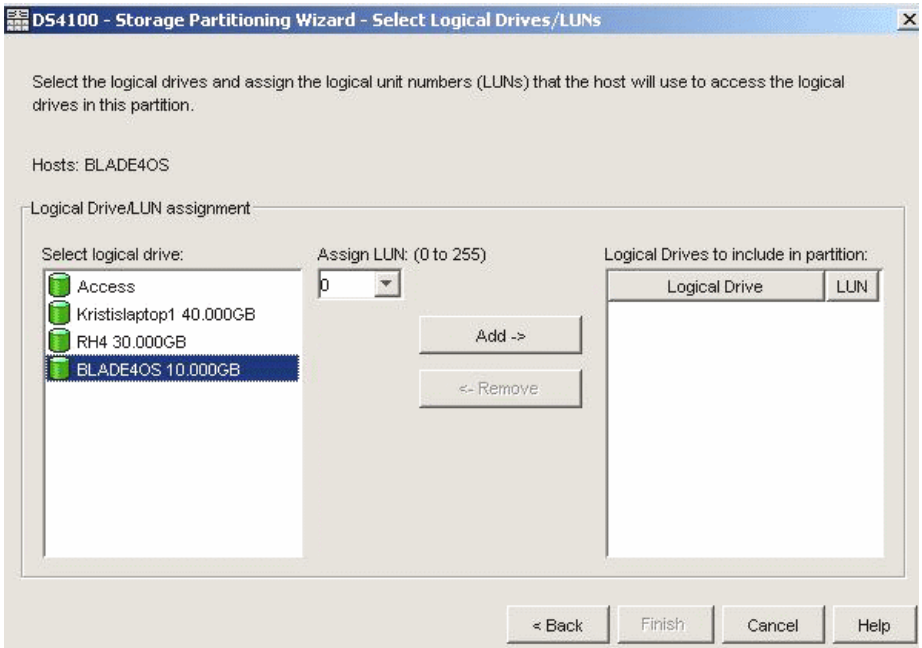

Figure 9-57 Storage Partitioning Wizard - Select Logical Drives/LUNs window

27. In the Logical Drive/LUN assignment view, select **BLADE4OS 10.000GB** as our logical drive. Assign LUN 0 and click **Add**. You will see a window similar to Figure 9-58. Listed in Table 9-3 are valid boot LUNs you may use.

Table 9-3 Operating system valid boot LUN

Operating system	Valid Boot LUN
Linux 2.6 kernel (for example, RH4, SLES9)	LUNs 0-7
Linux 2.4 kernel (for example, RH3, SLES8)	LUN 0
Windows 2000/2003	LUN 0-15

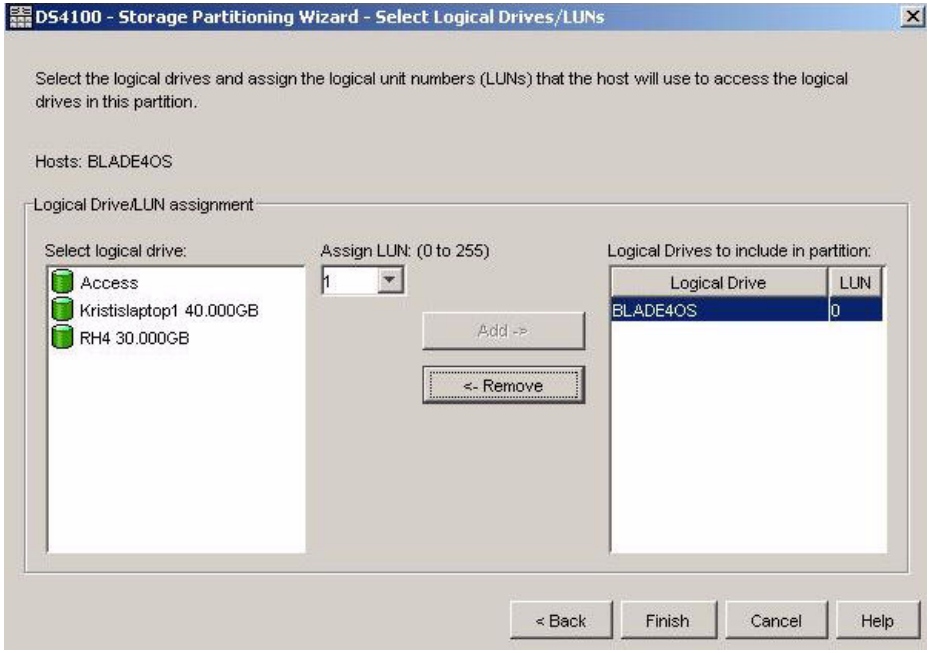

Figure 9-58 Storage Partitioning Wizard window

28. Click **Finish** to complete the logical drive mapping. You will see a window similar to Figure 9-59.

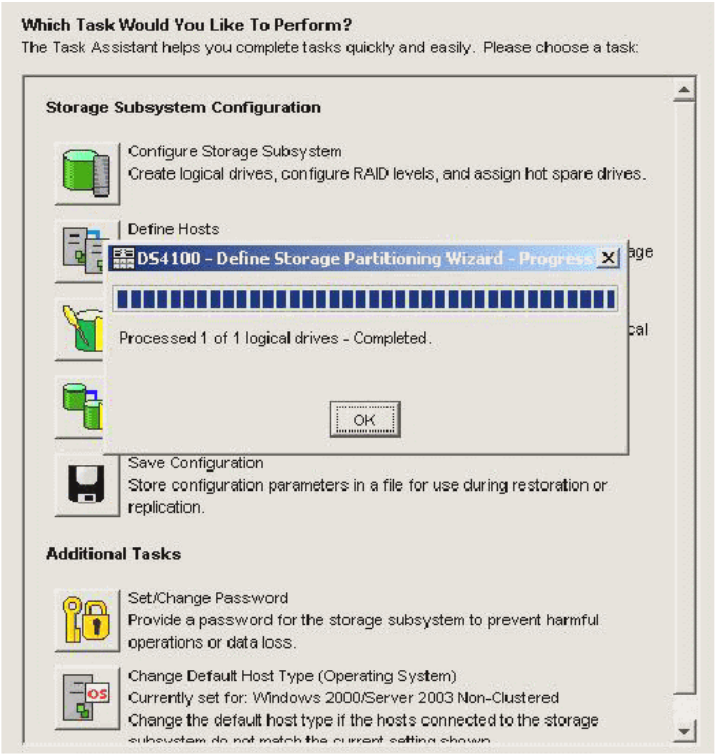

Figure 9-59 Define Storage Partitioning Wizard - Processing window

29. Click **OK**. Next, you will see a window similar to Figure 9-60.

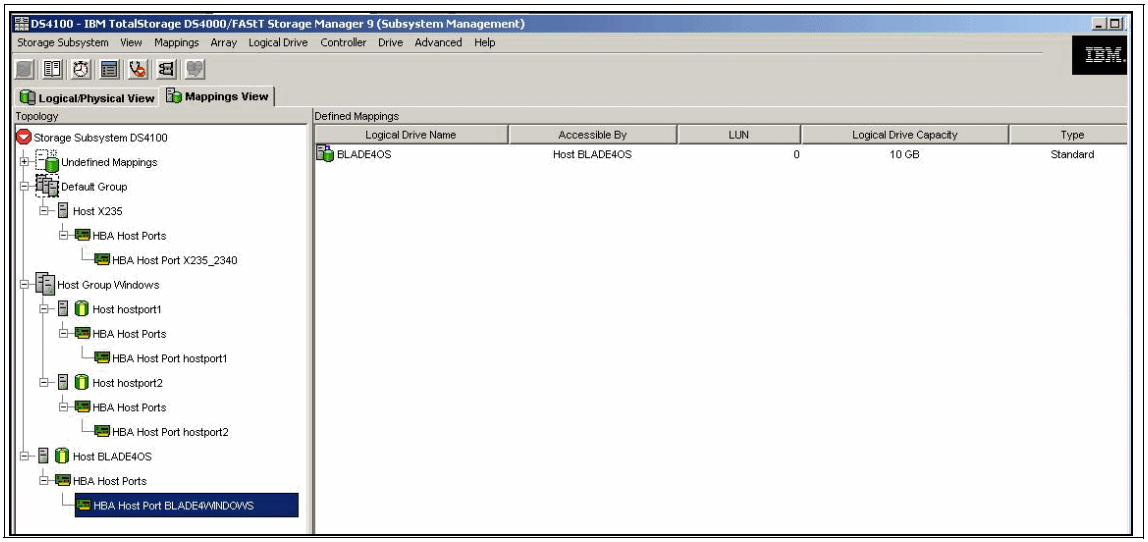

Figure 9-60 DS4100 - IBM TotalStorage DS4000/FAStT Storage Manager 9 (Subsystem Management)

This step completes the storage configuration for blade4port0. After completing the steps in this section, you should return to step 9 on page 286 to configure the boot storage device's WWPN for installing the operating system.

9.3.5 Configuring Boot from SAN on DS400

If you seek to implement a BladeCenter Boot from SAN utilizing the DS400, please review the QLogic white paper:

Boot from SAN Part III: Technology update QLA4010/QMC4052/QLA234x/IBM FCEC/QMC2462 DS300/400/4x00 Configuration Guide

found at:

http://www.qlogic.com/documents/datasheets/knowledge_data/whitepapers/boot_from_SAN_pt3.pdf

A

Brocade documentation and technical help

This appendix lists the Brocade documentation and technical help that you can access on the Web and other sources.

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Documentation for Brocade 4Gb SAN switch module

The following are included on the Brocade 4Gb SAN Switch Module for IBM BladeCenter Documentation CD-ROM, the IBM BladeCenter Web Site, the IBM TotalStorage SAN Switch Web site, or on the Brocade Web site, through the Brocade Connect site.

Fabric OS

The following are Brocade Fabric OS documents:

- *Brocade Fabric OS Administrator's Guide*
- *Brocade Fabric OS Command Reference Manual*
- *Brocade Fabric OS System Error Message Reference Manual*
- *Brocade Fabric OS MIB Reference Manual*
- *Brocade Fabric OS v5.0.2 Release Notes*

Fabric OS Features

The following are Brocade advanced features documents:

- *Brocade Web Tools Administrator's Guide*
- *Brocade Fabric Watch Administrator's Guide*
- *Brocade Secure Fabric OS Administrator's Guide*

Fabric Management Software

The *Brocade Fabric Manager Administrator's Guide* describes the setup and implementation of the Fabric Manager SAN software.

Brocade 4Gb SAN Switch Module for IBM BladeCenter (SilkWorm 4020)

The following are Brocade documents for the 4Gb SAN Switch Module (SilkWorm 4020):

- *SilkWorm 4020 Hardware Reference Manual*
- *SilkWorm 4020 QuickStart Guide*

Additional resource information

For related information about very specific features or features, refer to the documents posted through the Brocade portal link on the IBM TotalStorage SAN Switch Support Web site:

Go to http://www.ibm.com/servers/storage/san/b_type/library.html and click the **Fabric Operating System (FOS) Version 5.x Product Manuals** link at the bottom of the page. At the redirected site, select **Home** → **Technical Resource Center** → **Documentation Library** → **Best Practice Guides**.

Current relevant titles include:

- *1 Gbit/sec to 2 and/or 4 Gbit/sec SAN Migration Diagram Version 1.3*
- *Cable Management Guidelines Version 1.0*
- *Firmware Downloads Best Practice Notes Version 2.0*
- *IBM BladeCenter Design, Deployment and Management Guide Version 1.0*
- *LAN Guidelines For Brocade SilkWorm Switches Version 1.4*
- *SAN Administrator's Bookshelf*
- *SAN Migration Guide Version 1.1*
- *SAN Security Best Practices Guide*

The guides can also be obtained through the Brocade Connect Web site:

http://www.brocadeconnect.com

There are also white papers for Server and SAN Administrators provided on the Brocade Web site, which are an excellent resource for additional information:

http://www.brocade.com/san/white_papers.jsp

Relevant titles on the topics of SAN Basics, SAN Design, SAN Management, and SAN Solutions include:

- *Brocade SAN Solutions: A More Effective Approach to Information Storage and Management*
- *Connecting SANs Over Metropolitan and Wide Area Networks*
- *Designing Next-Generation SANs with Brocade 4Gbit/sec Fibre Channel Solutions*
- *Benefits of Upgrading to 4 Gbit/sec Brocade SAN Infrastructure*
- *The Benefits of Upgrading a SAN Infrastructure Using Brocade Technology*
- *Zoning Implementation Strategies for Brocade SAN Fabrics*
- *Improving Business Continuity and Data Availability Using Brocade SAN*

For practical discussions about SAN design, implementation, and maintenance, you can obtain *The Principles of SAN Design* through:

http://www.brocade.com/products/sanadmin_bookshelf/index.jsp

For additional Brocade documentation, visit the Brocade SAN Info Center and click the Resource Library location at http://www.brocade.com.

Release notes are bundled with the Fabric OS.

Getting technical help for Brocade 4Gb SAN switch module

Contact IBM Support for hardware, firmware, and software support.

For support calls, have the following information available:

1. General Information
   - Technical Support contract number, if applicable
   - Switch model
   - Switch operating system version
   - Error numbers and messages received
   - **supportSave** command output
   - Detailed description of the problem and specific questions
   - Description of any troubleshooting steps already performed and results
2. Switch Serial Number

   The switch serial number and corresponding bar code are provided on the serial number label, on the side of the unit. The serial number is 12 characters long and looks something similar to this:

   SN: ZXXXXX3WA069

   The serial number label is located as follows:

   SilkWorm 4020 switch: Side of switch module

   It can also be obtained:

   - From a telnet session to the switch by using the **chassisshow** command. It is located in the Serial Num: field.
   - From a Web Tools session, where it is located in the Supplier Serial # field.
   - From Fabric Manager, click the **Switches** tab. It is located in a column titled Supplier Serial Number.

- From the IBM BladeCenter Management Module, click the **Hardware VPD** tab. It is located in a column titled FRU Serial No.

3. License ID Information (required to obtain or replace licenses)
   - From a telnet session to the switch, use the **`licenseidshow`** command to display the license ID.
   - In a Web Tools session, where is located in the LicenseID field.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this IBM Redbook.

IBM Redbooks

For information about ordering these publications, see “How to get IBM Redbooks” on page 336. Note that some of the documents referenced here may be available in softcopy only.

- *IBM BladeCenter iSCSI SAN Solution*, REDP-4153
- *IBM eServer BladeCenter and Topspin InfiniBand Switch Technology*, REDP-3949
- *IBM TotalStorage DS300 and DS400 Best Practices Guide*, SG24-7121
- *IBM TotalStorage: SAN Product, Design, and Optimization Guide*, SG24-6384

Other publications

These publications are also relevant as further information sources:

- *McDATA 4Gb Fibre Channel Switch Module for IBM eServer BladeCenter Installation Guide*
- *McDATA 4Gb Fibre Channel Switch Module for IBM eServer BladeCenter Management Guide*
- *QLogic 4Gb Expansion Card for IBM eServer BladeCenter Installation Guide*
- *QLogic 4Gb Fibre Channel Switch Module for IBM eServer BladeCenter Installation Guide*
- *QLogic Fibre Channel Switch Module for IBM eServer BladeCenter Management Guide*

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Online resources

These Web sites and URLs are also relevant as further information sources:

- *Boot from SAN Part III: Technology update QLA4010/QMC4052/QLA234x/IBM FCEC/QMC2462 DS300/400/4x00 Configuration Guide*, found at:

  http://www.qlogic.com/documents/datasheets/knowledge_data/whitepapers/boot_from_SAN_pt3.pdf

- Brocade Connect Web site.

  http://www.brocadeconnect.com

- For additional Brocade documentation, visit the Brocade SAN Info Center and click the Resource Library location.

  http://www.brocade.com

- Brocade Fabric Manager 5.0 (software product sold separately). More information regarding this product can be viewed at:

  ftp://ftp.software.ibm.com/common/ssi/rep_sp/n/TSD00742USEN/TSD00742USEN.PDF

- Brocade Web site - White papers for Server and SAN Administrators.

  http://www.brocade.com/san/white_papers.jsp

- CLARiiON products.

  http://www.emc.com/CX3

- DS4800 software downloads.

  http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-62161

- DS4700 Storage Web site.

  http://www-03.ibm.com/servers/storage/disk/ds4000/ds4700/index.html

- DS4800 Storage Web site.

  http://www-03.ibm.com/servers/storage/disk/ds4000/ds4800/index.html

- EMC Approved Software: Symmetrix and CLARiiON.

  http://support.qlogic.com/support/oem_product_list.asp?oemid=65

- EMC CLARiiON Support Services.

  http://www.emc.com/global_services/support/clariion_support/index.jsp

- EMC Powerlink.

  https://powerlink.emc.com/

- EMC Topology Guide: This guide is available via Powerlink. Visit the following Web link to gain access to this material.

  https://powerlink.emc.com/

- For more information regarding the Emulex technology, visit the following Web site:

  http://www.emulex.com/

- Feature activation keys (Activate a SAN Switch feature).

  http://www.ibm.com/storage/key

- Fibre Channel Expansion Card Signed device driver for Microsoft Windows 2000 and Windows Server 2003 - BladeCenter HS20, HS40 and LS20.

  http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-53295

- Fibre Channel switches for BladeCenter.

  http://www-03.ibm.com/systems/bladecenter/switch/switch_fibrechannel_overview.html

- Web site to download files and for installation instructions for software and device drivers for IBM BladeCenter.

  http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-63017

- IBM BladeCenter.

  http://www-03.ibm.com/systems/bladecenter/

- IBM BladeCenter Alliance Program.

  http://www-03.ibm.com/servers/eserver/bladecenter/alliance/

- IBM BladeCenter Chassis.

  http://www-306.ibm.com/common/ssi/rep_ca/7/897/ENUS106-117/ENUS106-117.PDF

- IBM BladeCenter H Chassis.

  http://www-306.ibm.com/common/ssi/rep_ca/1/897/ENUS106-161/ENUS106-161.PDF

- IBM ServerProven Program Web site.
  http://www-03.ibm.com/servers/eserver/serverproven/compat/us/

- IBM Storage for IBM BladeCenter.

  http://www-03.ibm.com/servers/eserver/bladecenter/storage/

- IBM System Storage SAN10Q Web site.
  http://www-03.ibm.com/servers/storage/san/q_type/san10q/

- IBM TotalStorage SAN Switch Support Web site.

  http://www.ibm.com/servers/storage/san/b_type/library.html
- *The Principles of SAN Design*, found at:

  http://www.brocade.com/products/sanadmin_bookshelf/index.jsp
- *QLogic Switch Interoperability Guide v6.0*, found at:

  http://qlogic.com/interopguide/info.asp

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