CROSSROADS

Crossroads® 4100
Fibre Channel/SCSI Storage Router

User Manual

P/N DS30084
Revision A

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Crossroads® 4100

Bi-Directional Fibre Channel/SCSI Storage Router
User Manual
Revision A
2/11/00

Crossroads Systems, Inc. is a member of the American National
Standards Institute (ANSI), Fibre Channel Working Group; the Fibre
Channel Industry Association (FCIA); the Storage Network Industry
Association (SNIA); and the InfiniBand Trade Association.

4100 Fibre Channel/SCSI Storage Router

Safety Instructions

WARNING	
⚠	*A WARNING denotes a hazard that can cause personal injury.*

CAUTION	
△	**A CAUTION denotes a hazard that can cause hardware or software damage.**

Grounding

This product is a Safety Class I product and has a protective grounding terminal. There must be an uninterruptible safety earth ground from the main power source to the product's input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, disconnect the power cord until the ground has been restored.

Servicing

Any servicing, adjustment, maintenance, or repair must be performed only by authorized service-trained personnel. There are no operator serviceable parts in this product.

Warranty

If you have any questions about the warranty of this product, contact a sales representative.

4100 User Manual

Regulatory Statements

Federal Communications Commission Notice (US Only)

The Federal Communications Commission (in 47 CFR 15.105) has specified that the following notice be brought to the attention of the users of this product.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

IEC Statement (Worldwide)

This is a Class B product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Canadian Notice (Avis Canadien)

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numerique de la classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

4100 Fibre Channel/SCSI Storage Router

European Union Notice

Products with the CE Marking comply with both the EMC directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission or the European Community. Compliance with these directives implies conformity to the following European Norms (in brackets are equivalent international standards):

EN55022 (CISPR 22) – Electromagnetic Interference
EN50082-1 (IEC801-2, IEC801-3, IEC801-4) – Electromagnetic
                                                    Immunity
EN60950 (IEC950) – Product Safety

VCCI Statement (Japan)

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＢ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

German Statements

Sicherheitshinweise

WARNUNG

Eine WARNUNG bezieht sich auf eine Gefahr, die zu Verletzung von Personen fuehren kann.

ACHTUNG

Ein ACHTUNG bezieht sich auf eine Gefahr, die zu Schaden am Geraet oder Verlust von Daten fuehren kann.

Schutzerdung

Dieses Produkt ist ein Schutzklasse I Geraet und hat einen Anschluss fuer Schutzerdung. Ein ununterbrochener Schutzleiter von der Stromquelle zum Schutzleiteranschluss des Geraetes oder dem Netzkabel ist unbedingt notwendig. Bei Anzeichen von Beeintraetigung dieser Schutzeinrichtung, trennen Sie die Netzzufuehrung bis die Schutzerdung wieder einwandfrei ist.

Wartung/Instandsetzung

Jegliche Wartung, Instandsetzung oder Einstellung muss durch einen qualifizierten, autorisierten Fachmann durchgefuehrt werden. Das Geraet enthaelt keinerlei zu wartende Teile fuer den Benutzer.

WARNUNG

Oeffnen Sie niemals das Gehaeuse ! Gefahr des Elektrischen Schlages !

4100 Fibre Channel/SCSI Storage Router

WARNUNG	
⚠	*Das Netzteil ist bestimmt und zertifiziert fuer einen Netzspannungsbereich von 100 – 240 V ~.*

WARNUNG	
⚠	*Die Geraetesicherung darf nur mit einer Sicherung des gleichen Typs und Nennwerten ersetzt werden.*

WARNUNG	
⚠	*Zur Vermeidung der Gefahr eines Elektrischen Schlages, oeffnen Sie das Gehaeuse unter keinen Umstaenden.*

Laser Safety

Certification and Classification Information

This product contains a laser internal to the Optical Link Card/Optical Link Module (OLC/OLM) for connection to the Fibre communications port. In the USA, all models of the OLC/OLM are certified as Class 1 laser product and conform to the requirements contained in the Department of Health and Human Services (DHHS) regulation 21 CFR Subchapter J. The certification is indicated by a label located on the plastic OLC/OLM housing.

Outside the USA, all models of the OLC/OLM are certified as Class 1 laser components that conform to the requirements contained in the International Electrotechnical Commission (IEC) standard 825 (1994) and Amendment 1 (1990) along with the CENELEC (European Committee for Electrotechnical Standardization) European Normalization Standard EN 60825 (1992)

Certifications include one or more of the following:

- Recognized Component by Underwriters Laboratories
- Certified by the Canadian Standards Association
- Certified by VDE (Germany) and/or Certified by Statens Provningsanstalt (SP) in Sweden.

4100 Fibre Channel/SCSI Storage Router

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The following shows the Class 1 information label specified in IEC 825 and CENELEC HD 482 51.

```
Class 1 Laser Product
Laser Klasse 1
Luckan 1 Laserlaite
```

Laser Information

Parameter	Shortwave	Longwave	
Nomenclature	100-M5-SN-I	100-SM-LL-L	100-SM-LC-L
Spectral Centre Wavelength	770-850nm	1300nm	770-850nm
Operating Range	2-500m	2-10km	2-10km
Launch Power Max	1.3 dBm	-3 dBm	-3 dBm
Launch Power Min	-7 dBm	-9 dBm	
Receive Power Min	-13 dBm	-25 dBm	-20 dBm
Receive Power Max	1.3 dBm	-3 dBm	-3 dBm
Extinction Ratio	6 dB	9 dB	9 dB
TX Deterministic Jitter	20 ps	20 ps	20 ps
Fiber Diameter	50um	9um	9um
Class	Multimode	Single-mode	Single-mode
Nominal Bit Rate	1062.5 Mbaud	1062.5 Mbaud	1062.5 Mbaud
OFC	none	none	none

Class 1 Laser Products are not considered hazardous.

Product Information

Each Fibre Channel communications port consists of a transmitter and receiver optical subassembly. The transmitter subassembly contains an internal semiconductor laser diode with a wavelength of 780 or 1300 nanometers.

WARNING

⚠️

There are no user maintenance or service operations or adjustments to be performed on any of the GBIC modules.

Usage Restrictions

Failure to comply with these usage restrictions may result in incorrect operation of the system and points of access may emit laser radiation above the Class 1 limits established by the IEC and U.S. DHHS.

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Crossroads 4100 User's Guide

Chapter 1

Introducing the Crossroads 4100 Storage Router

The Crossroads 4100 Storage Router provides bi-directional connectivity between a Fibre Channel Switched Fabric (FC-SW) or Fibre Channel Arbitrated Loop (FC-AL), and one Fast/Wide/Ultra SCSI bus.

Supported devices include:

- Initiator Devices – Fibre Channel and SCSI hosts
- Direct Access Devices – RAID Controllers, Disk drives, JBODs
- Sequential Access Devices – Tape drives
- Changer Devices – Tape and Magneto-Optical Libraries

1-2

How the 4100 Works

The 4100 is a storage router that translates the Fibre Channel Protocol (FCP) to and from the SCSI Protocol so that Fibre Channel and SCSI devices can communicate with each other. It attaches to either a Fibre Channel or SCSI host, and transfers the command, data, and status information to SCSI or Fibre Channel targets. Packets are transferred transparently by the 4100 from host to targets and vice versa.

The 4100 provides interconnection between one SCSI bus and a Fibre Channel Arbitrated Loop or Switched Fabric. It takes advantage of Fibre Channel's ability to encapsulate SCSI protocol packets to allow a host with a FC or SCSI adapter to access SCSI or FC peripheral devices transparently over a FC connection.

Figure 1-1. Typical Fibre Channel-to-SCSI configuration
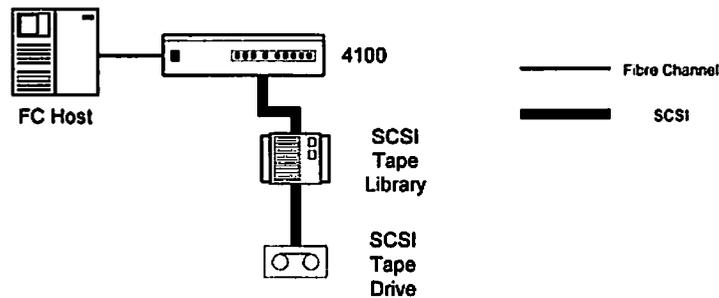
Figure 1-1 shows a typical Fibre Channel-to-SCSI configuration. Through the 4100, any host on the Fibre Channel loop can access the tape drive and library on the SCSI bus.

Figures 1-2 and 1-3 show the front and back panels of the 4100, respectively.

Figure 1-2. Front panel of the 4100
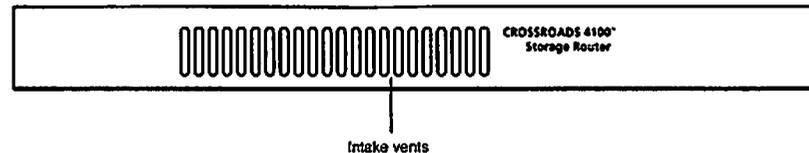
Intake vents

The air intake vents shown in Figure 1-2 provide cooling for the unit during operation and should always remain unobstructed. The exit vent for air is located on the back panel, shown in Figure 1-3.

Figure 1-3. Back panel of the 4100
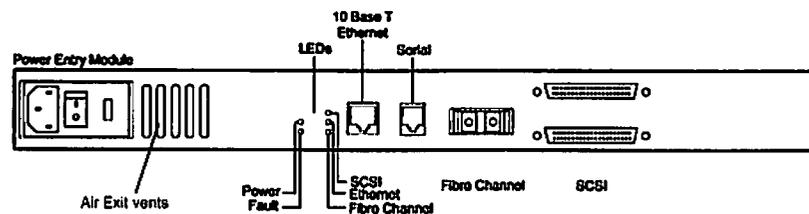
Besides the air vent, SCSI and Fibre Channel interfaces are found on the back panel. Ethernet and Serial interfaces provide the means for configuring and managing the unit. The LEDs (operation indicators) provide basic status information about the unit. Finally, a power connector and a power switch are located on the back panel. For proper operation of the 4100, cable connections on the back panel should remain securely in place.

Chapter 1

Operation Indicators

The 4100 is equipped with rear panel LED indicators (refer to
Figure 1-4) for monitoring overall unit status.

Figure 1-4. 4100 LEDs

```
                                    ETHERNET
                                    10 Base-T
                        SCSI O     ┌─────────┐
            Power O    Ethernet O  │  ████   │
            Fault O       FC O     │  ████   │
                                   └─────────┘
ANSLUTAS TILL JORDAT NÄTTUTAG)
```
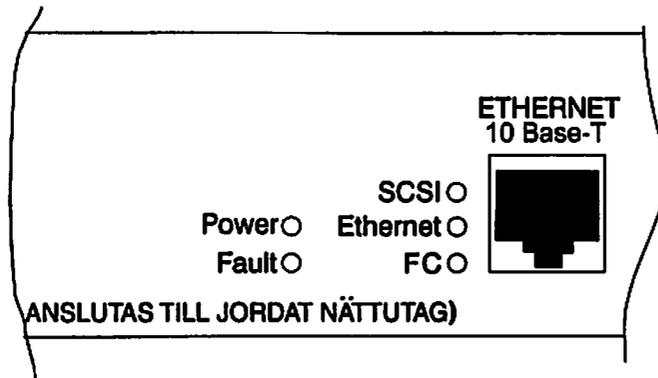
The LED functionality is detailed below:

- *Power* - This green indicator turns on when power is applied to
  the 4100.

- *Fault* - This amber indicator illuminates during POST, then
  remains dark unless the 4100 experiences a processor problem.

- *SCSI 1* - This green indicator signifies SCSI 1 activity when lit.

- *SCSI 0* - This green indicator signifies SCSI 0 activity when lit.

- *Ethernet* - This green indicator signifies Ethernet activity when
  lit.

- *FC* - This green indicator signifies Fibre Channel activity when
  lit.

Introducing the Crossroads 4100

Operating as Both a SCSI and Fibre Channel Device

The 4100 is both a SCSI and a Fibre Channel device operating on a SCSI bus and Fibre Channel network simultaneously.

The SCSI Side

On a SCSI bus, the 4100 acts as a SCSI initiator or target passing requests from hosts on the Fibre Channel network to target devices on the SCSI bus or from hosts on SCSI buses to targets on the Fibre Channel network. The 4100 SCSI bus uses one SCSI ID. The default Initiator ID is 7 and can be changed when configuring the 4100.

The Fibre Channel Side

In a Fibre Channel loop, the 4100 is identified by a single Arbitrated Loop Physical Address (AL_PA) or a fabric assigned Source ID. Once the address is acquired, any host on the Fibre Channel loop can access the devices on a SCSI bus transparently over a FC connection.

Mapping Devices

To allow Fibre Channel and SCSI devices to address each other, the 4100 creates tables mapping device identifiers for Fibre Channel to SCSI and for SCSI to Fibre Channel. During 4100 configuration, you can choose the mapping methods and, in certain cases, customize device mappings. See Chapter 3 for more information about address modes and their configurations.

Processing SCSI Information

The following section describes how the 4100 processes SCSI information when attached to FC hosts. Figure 1-5 illustrates steps 1 through 5 of the process.

1. A FC host issues a command. The FC host encapsulates the command in the FCP protocol and sends the packet to the 4100.

2. The FC controller in the 4100 receives the packet, interprets the FC information, and places the packet in buffer memory.

3. The 4100's processor interprets the information and programs a SCSI controller to process the transaction.

4. The SCSI controller sends the command to the SCSI device (target).

5. The SCSI target interprets the command and executes it.
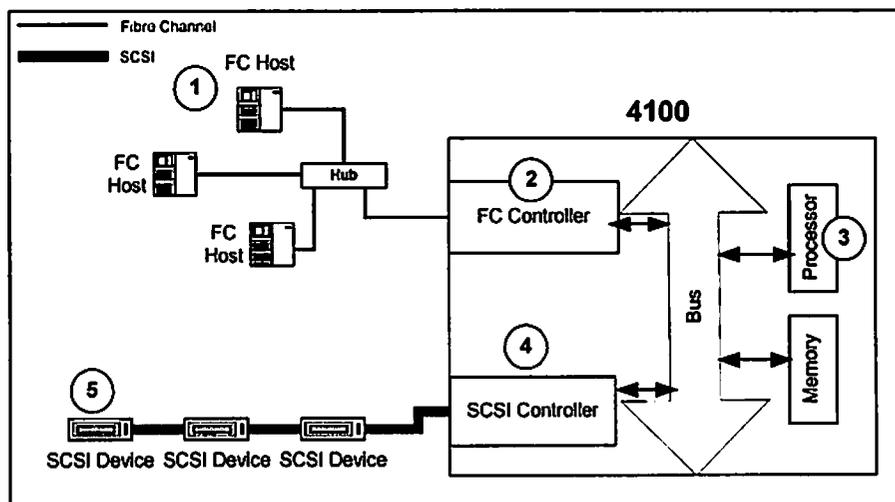
Figure 1-5. Information processing

Introducing the Crossroads 4100

6. Data flows between the FC host and SCSI target through payload buffers. See Figure 1-6.

7. Response information flows from the SCSI target back to the FC host. See Figure 1-6.

Figure 1-6: Flow of Data and Responses
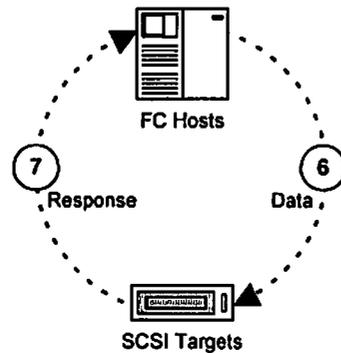
Processing Fibre Channel Information

Processing Fibre Channel information is the reverse of the process for processing SCSI information, described in the previous section. The 4100 processes information from the SCSI host by requesting operations of targets on a Fibre Channel Storage Area Network (FC SAN). The difference in this case is that an initiator on the SCSI side issues commands and the information is passed through the 4100 to the FC SAN.

Chapter 1

4100 Features

Fibre Channel Features

- Fibre Channel initiator and target modes
- Single 1.0625 Gbps FC port
- Fibre Channel Arbitrated Loop (FC-AL) and Switched Fabric (FC-SW) topologies
- Private Loop Direct Attach (PLDA) profile compliant
- Class 3 connection with SCSI-FCP protocol
- Copper and Optical GBIC support (Shortwave or Longwave)

SCSI Bus Features

- SCSI initiator and target modes
- One auto-negotiating SCSI bus (Narrow, Wide, Fast, Ultra)
- Ultra Wide SCSI for data transfer up to 40MB/s
- Simultaneous commands, tagged command queuing and disconnect/reconnect
- Middle of bus configuration with external termination
- SCSI-2 and SCSI-3 protocol
- Connection type is 68-pin D shell, P type connectors
- Differential or single-ended termination
- Disk, tape, optical and changer devices

Configuration Features

- Serial RJ-11 connector for terminal access
- Ethernet RJ-45 connector for FTP, Telnet and Web browser access
- Field-upgradable firmware
- SCC (SCSI only), Indexed, and Automatic addressing modes

Management Features

- Out-of-band Ethernet TCP/IP Management Access
- SNMP with private MIB support

Introducing the Crossroads 4100

4100 Benefits

<u>Bi-directional</u> – The 4100 allows Fibre Channel initiators to communicate with SCSI targets, as well as SCSI initiators to communicate with Fibre Channel targets, simultaneously.

<u>Centralization</u> – The 4100 enables existing storage to be moved to a central location to simplify management and maintenance, and to improve security.

<u>Connectivity</u> – SCSI devices may be attached to Fibre Channel storage networks to share data and increase address space.

<u>Consolidation</u> – The 4100 allows multiple servers to share storage resources, including tape drives, tape libraries, disk drives and disk arrays.

<u>Distance</u> – Length from SCSI hosts to SCSI devices is increased from 25m to 10,000m, facilitating remote or disaster tolerant sites.

<u>Flexibility</u> – The 4100 allows Fibre Channel initiators to communicate with SCSI targets, as well as SCSI initiators to communicate with Fibre Channel targets, simultaneously.

<u>Incremental Implementation (I^2)</u> – Multiple device connectivity and interoperability provides scalability and flexibility to satisfy growing storage requirements.

<u>Lower TCO</u> – Improving storage management, maintenance and security can lower Total Cost of Ownership (TCO) for enterprise storage.

<u>Rapid Field Deployment (RFD)</u> – A Crossroads exclusive feature that allows for quick, on-the-fly development and application enhancements.

<u>Reliability</u> – Low error rates, robust error recovery and flow control provide an enterprise with reliable data delivery.

<u>Scalability</u> – Point-to-point links can be expanded to multi-initiator links supporting interconnected servers, tape drives, tape libraries, disk drives and disk arrays.

Chapter 1

4100 Specifications

Physical Specifications
- Internal power supply with power switch and detachable power cord
- Fibre Channel activity LED
- SCSI Bus activity LED
- Ethernet activity LED
- Power LED
- Fault LED
- Airflow with internal fan
- Rack mount or desktop enclosure

Physical Dimensions
- Width 43.18cm (17.00 inches)
- Depth 22.82cm (8.98 inches)
- Height 4.31cm (1.70 inches, 1U)
- Weight 3.18 kg (7 lbs.)

Operating Environment
- 0 to 40 °C
- 5 to 80% Relative Humidity (non-condensing)

Non-operating Environment
- -40 to +55 °C
- 0 to 92% Relative Humidity (non-condensing)

Power
- 100 - 240 VAC, Auto Sensing
- 50/60 Hz, 1.0 Amps

This completes Chapter 1, *Introducing the Crossroads 4100 Storage Router.*

Chapter 2

Installing the 4100

This chapter describes how to install the 4100, including factors to consider when unpacking the unit for the first time. The 4100 can be setup as either a desktop or rack installation and can be connected to different types of devices. Read this chapter carefully and completely before working with the 4100.

Before physically installing the 4100, consider carefully the location for the unit installation, the intended use of the unit, and the type of devices to which the unit will be attached. Helpful information on the latter two items can be found in Chapter 3, *Overview of the 4100 Configuration.*

Location

The 4100 can be placed on a desktop or mounted in a standard 19-inch rack depending on the specific requirements of the installation.

The operating environment should meet the requirements found in the *Specifications* section of Chapter 1. If you plan to use the 4100 on a tabletop, attach the stick-on feet to the bottom of the unit to protect the surface of the table.

Note	The 4100 has a cooling fan mounted in the rear of the enclosure and air intake vents on the front of the enclosure. The rear fan vent and the front air intake vents should remain clear of obstructions to ensure proper airflow.

Unpacking the Box

Unpack the shipping container of the 4100 in an area clear of any clutter using the following instructions:

1. Remove all items from the shipping container. Check each one for damage. Keep the 4100 in the protective bag until you are ready to install it.

2. Refer to the packing slip or contents list to make sure you received all the equipment you ordered. If an item is missing, contact your sales representative immediately.

3. Select a location that ensures the front intake vents and rear fan vent are clear of obstructions so air can flow freely through the unit.

4. Do not connect any devices or cables to the 4100 until the 4100 is secured in a rack or placed securely on a flat, level surface.

Mounting the 4100 on a Desktop

Use the following instructions to mount the 4100 on a table or desktop.

1. Remove the 4100 from the protective bag.

2. Attach the stick-on feet to the bottom of the unit to protect the surface of the table.

3. Place the 4100 on the table or desktop. Be sure the air intake vents and rear fan vent are clear of any obstructions.

Installing the 4100

Mounting the 4100 in a Rack

There are two methods available to mount the 4100 into a standard 19"
rack. The standard method of installation uses ear brackets, described
below. An optional slide rail installation kit is also available
(http://www.crossroads.com/support/manuals/).

Read the entire installation procedure first, then begin the installation.
Use the following instructions to mount the 4100 in a standard 19" rack
using ear brackets.

Figure 2-1. Mounting materials
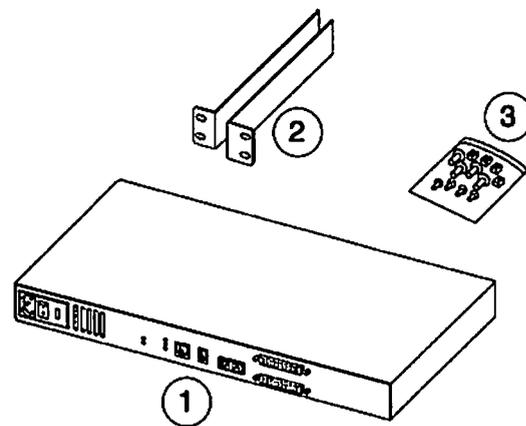
1. 4100

2. Left and right ear brackets

3. Mounting screws (4 large Phillips screws and 4 small Phillips
    screws) and cage nuts

Required tools:

*   Phillips screwdriver

Installation Procedure:

1. Remove the 4100 from the protective bag.

2. Determine where the 4100 will be mounted.

Note	Place the 4100 so the rear fan vent and the front intake vents remain clear of obstructions to ensure proper airflow.

3. Remove any blanking panels and other equipment from the chosen rack location.

4. Install the cage nuts on the vertical mounting rails of the rack cabinet.

Figure 2-2. Installing cage nuts
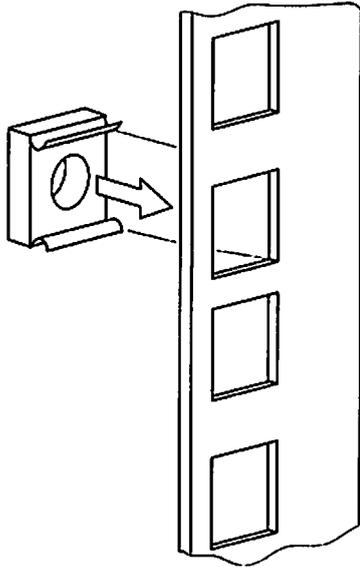
5. Locate the front of the ear brackets

Figure 2-3. Locating front of ear brackets
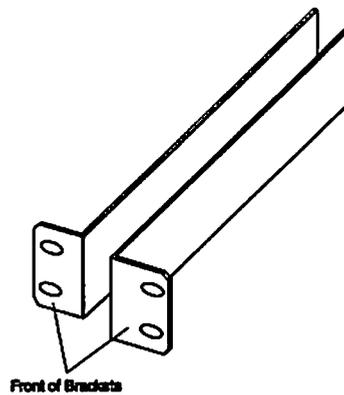
Front of Brackets

6. Attach the ear brackets to the 4100, using two small Phillips screws on each side. Position the front of each bracket next to the end of the 4100 that will be facing out of the rack (see Step 7 for more information). Tighten the screws securely.

Figure 2-4. Attaching ear brackets
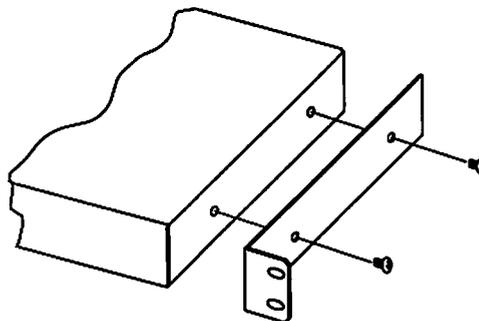
WARNING	To reduce injury or equipment damage, the mounting brackets must be level. If the brackets are not level, the 4100 cannot be installed correctly.

7. Attach the 4100 to the rack by using two large Phillips screws on each ear bracket. Be sure to use only the top and bottom holes in each ear bracket. (The middle holes will be used to attach the front cover panel after the unit is installed.) Tighten the screws securely.

    If you are mounting the 4100 in the front of the rack with the connectors facing the back (or in the back of the rack with the connectors facing the front), attach the front of the mounting brackets using the large Phillips screws as shown in Fig. 2-5.

Figure 2-5. Mounting at front of rack

Front of mounting bracket
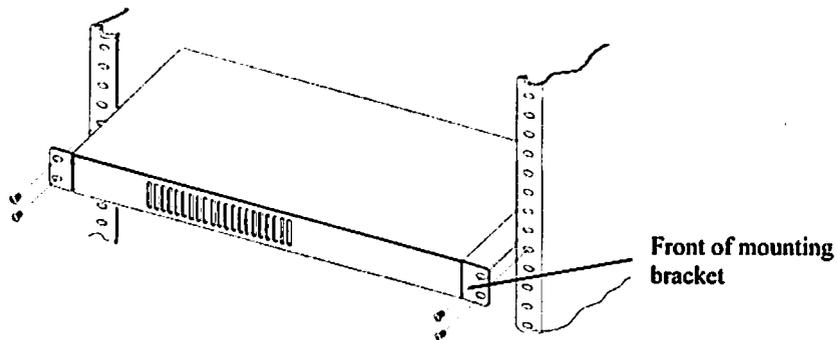
If you are mounting the 4100 in the front of the rack with the connectors facing the front (or in the back of the rack with the connectors facing the back), attach the front of the mounting brackets as shown in Fig. 2-6.

Figure 2-6. Mounting at back of rack

Front of
mounting
bracket
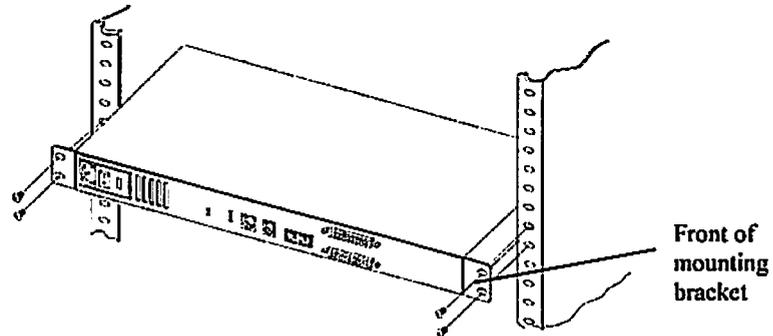
Once the 4100 is installed, you are ready to connect it to the other system
components.

Interfaces and Connections

There are four types of data interfaces to the 4100:

- Fibre Channel

- SCSI

- RS-232 (Serial port)

- Ethernet

The RS-232 and Ethernet ports are used primarily for 4100 configuration and management.

Figure 2-7. Port locations
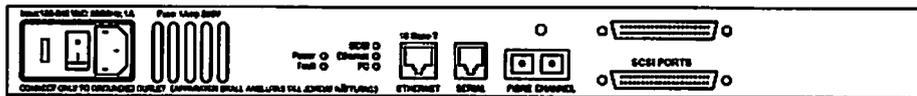
Fibre Channel Connection

Before connecting the 4100 to other Fibre Channel devices, it is important to understand the configuration requirements of the environment to which it will be connected. Failure to correctly configure a Fibre Channel device may impair the operation of the Storage Area Network to which it is attached.

Typical installations will have the 4100 connected to either an Arbitrated Loop or Switched Fabric environment. For an Arbitrated Loop, the unit can be directly attached to the Fibre Channel host bus adapter, in a point-to-point fashion. Arbitrated Loops also allow for the use of Fibre Channel hubs, to which the unit can be directly attached. In Fibre Channel switched environments, the switch is directly attached to the 4100.

Figure 2-8. Configuration with tape library in FC-AL
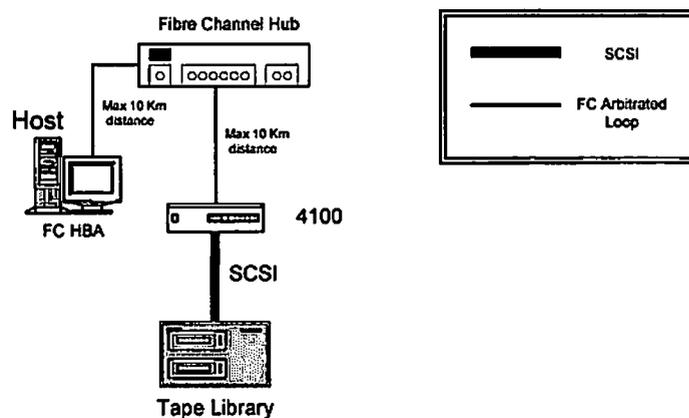
Both FC switches and hubs may allow for individual ports to be configured for different media types. The 4100 must be connected to the hub or switch port with the appropriate FC cabling for the media type in use on both the 4100 and the port to which it is connected.

The 4100 supports various Fibre Channel media types through the use of an internal Gigabaud Link Module (GLM). This module is factory installed and may be selected when ordering the unit.

Available media types include:

Copper Support - 1.0625 Gbaud DB-9 connector

Multi-Mode Fiber Support - 1.0625 Gbaud Dual SC connectors

Single-Mode Fiber Support - 1.0625 Gbaud Dual SC connectors

To connect the 4100 to the Fibre Channel Storage Area Network:

1. Locate the Fibre Channel port on the back of the 4100.

Figure 2-9. Fibre Channel port
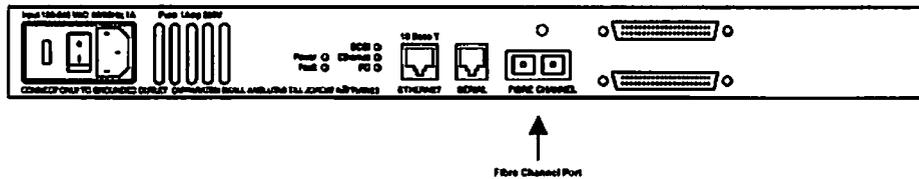
Fibre Channel Port

2. Remove the protective covers from the 4100's Fibre Channel connectors.

Note	A copper GLM will have no protective cover.

Installing the 4100

Figure 2-10. Removal of GLM protector

GBIC ──────▶
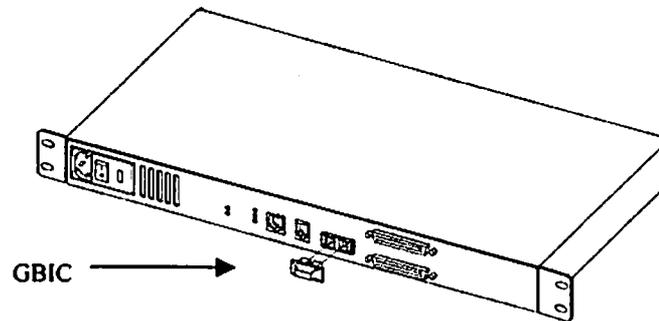
WARNING ⚠	*The 4100 has been qualified with a specific set of GLMs. Using a GLM that has not been qualified by Crossroads may cause the 4100 to operate improperly. See the Laser Safety section of this manual for more information.*

3. With the 4100 powered off, connect the 4100 into your Fibre Channel environment using the appropriate cabling. The FC optical connectors on the 4100 are keyed. Be sure to insert the cable connectors in the proper orientation.

SCSI Connection

The 4100 supports Fast/Ultra-2 Narrow/Wide SCSI. The 4100 is factory configured to support either a Single-Ended or Differential SCSI bus. Two 68-pin D-shell connectors are located on the rear panel of the unit, allowing the unit to be attached in the middle or at the end of a SCSI bus. If the 4100 is located at one end of the SCSI bus, an external terminator must be installed. One terminator is provided with the 4100.

SCSI / \ SE
< | -

Single-Ended SCSI support is indicated by this symbol on the rear of the 4100.

SCSI / \ DIFF
<< | -

Differential SCSI support is indicated by this symbol on the rear of the 4100.

The 4100 supplies termination power (TERMPWR) to the SCSI bus. An internal self-resetting fuse in the TERMPWR circuit is used that will reset after a fault is cleared.

To connect the 4100 to the SCSI bus:

1. Power off your SCSI devices.

2. Connect a SCSI cable to the SCSI connector on the back of the unit. If necessary, use a narrow-to-wide adapter, which should also incorporate "high-byte" termination.

3. Connect the other end of the SCSI cable to the next SCSI device on the bus.

4. If the 4100 is at the end of the SCSI bus, place the terminator provided with the unit on the 4100's other SCSI connector on the same bus. If the 4100 is not at the end of the bus, attach a second SCSI cable to the other SCSI connector. Use a narrow-to-wide adapter with "high byte" termination, if necessary. Connect this cable to the next device on the bus.

Figure 2-11. 4100 SCSI connection   BUS 0
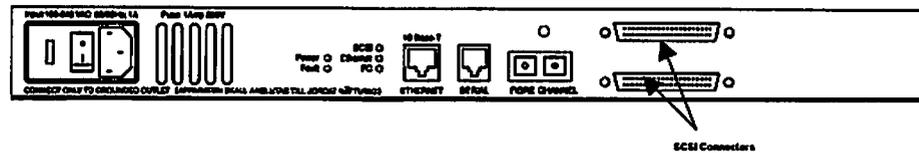
5. Make sure that the bus is terminated correctly. The devices at
   each end of the bus must be terminated.

Figure 2-12. SCSI terminator
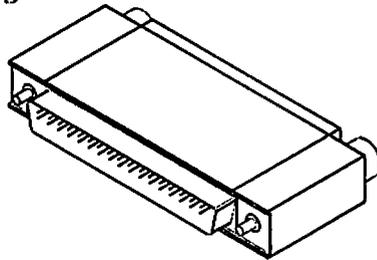
6. Power on your SCSI devices.

7. After all the SCSI devices have completed their individual POST
   (Power-On Self Test) processes, power on the 4100.

Ethernet Connection

10BaseT Ethernet connectivity is used to provide enhanced management
and configuration capabilities. The RJ-45 connector on the unit can be
directly connected to a standard 10BaseT Ethernet network.

Configuration is required to set the IP network address to allow for use
of the configuration capabilities of this port. Refer to Chapter 4 for
details on setting the IP network address.

Note	The 4100 contains a unique Ethernet MAC address that is assigned during the manufacturing process.

Chapter 2

Ethernet capabilities include Telnet, SNMP, and a Web Interface for configuration and management. FTP and TFTP are also supported for firmware upgrades.

Figure 2-13. 4100 Ethernet port

Serial Port Connection

The RJ11 connector on the rear panel of the 4100 provides an RS-232 connection that can be used to configure the 4100, monitor diagnostic status, or to update the program stored in the 4100's Flash memory. A cable is provided with the unit to connect to a DB-9 serial connection. Further information on the operations allowed via the RS-232 port is provided in Chapter 4.

The Serial port operates with the following settings:

Baud Rate:	Autobaud (9600, 19200, 38400, 57600, or 115200)
Data Bits:	8
Stop Bits:	1
Parity:	None
Flow Control:	None or XON/XOFF

Installing the 4100

Figure 2-14. 4100 Serial port
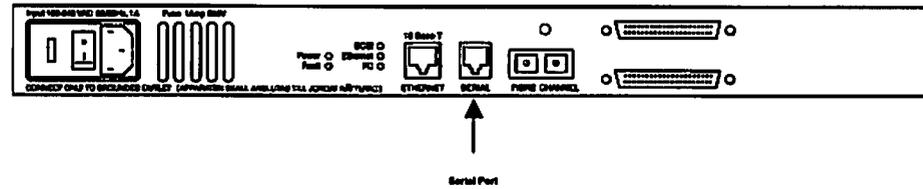
Autobaud Feature

The autobaud feature automatically configures the baud rate on the 4100. Once you set the baud rate in the terminal emulation program, wait until the 4100 completes the Power-On Self Test (POST) and then the Firmware Initialization process. This can take up to 90 seconds. Then press the **Enter** key slowly 7 or 8 times and the 4100 will automatically detect the baud rate. The baud rate is then saved in the 4100's configuration and will be retained through future power cycles.

Note	Pressing the Enter key before the POST has completed has no effect on the autobaud feature. Wait until both the POST and the Firmware Initialization processes have completed before pressing the ENTER key. This may take up to 90 seconds.

The baud rate in the terminal emulation program must be set at 9600, 19200, 38400, 57600, or 115200 for the autobaud feature to recognize it. The 4100 will not function properly at any other baud rate.

Connecting the Power Cord

The power cord shipped with the 4100 is a 120 VAC three-conductor power cord for use in the United States or Canada. If you are planning to use another input voltage or if you plan to use the 4100 outside of the U.S. or Canada, you must supply your own power cord.

To connect the power cord to the 4100:

1. Make sure the 4100's power is switched off. See Fig. 2-15 for the location of the power switch on the back of the unit.

2. Connect the female end of the power cord to the power connector on the back of the 4100.

3. Plug the male end of the power cord into the power source.

Figure 2-15. 4100 power switch and connector
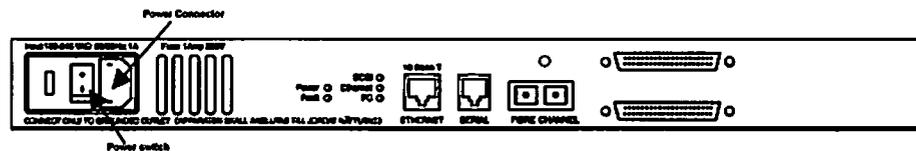
This completes Chapter 2, *Installing the 4100.*

Installing the 4100

Chapter 3

Overview of the 4100 Configuration

The 4100 can be configured either through the serial port or over Ethernet via a Telnet, Web Management Interface, or SNMP management tool.

Before attempting to configure the 4100, a basic understanding of Fibre Channel and SCSI devices is recommended.

Note	For information on SCSI standards, refer to publications from the X3T10 committee of ANSI (American National Standards Institute). For information on Fibre Channel standards, refer to publications from the X3T11 committee of ANSI. Approved American National Standards and Technical Reports may be purchased from: ANSI 11 West 42nd Street 13th Floor New York, NY 10036 Sales Dept: (212) 642-4900

Choosing the Right Configuration

The factory default settings of the 4100 permit the configuration shown in Figure 3-1 to work without any initial changes to settings in the 4100. However, with more complex configurations or certain application requirements, changes to the 4100 settings may be required.

Figure 3-1. Configuration with tape library

Fibre Channel Hub

Host

Max 10 Km distance

Max 10 Km distance

FC HBA

4100

SCSI

Tape Library

SCSI

FC
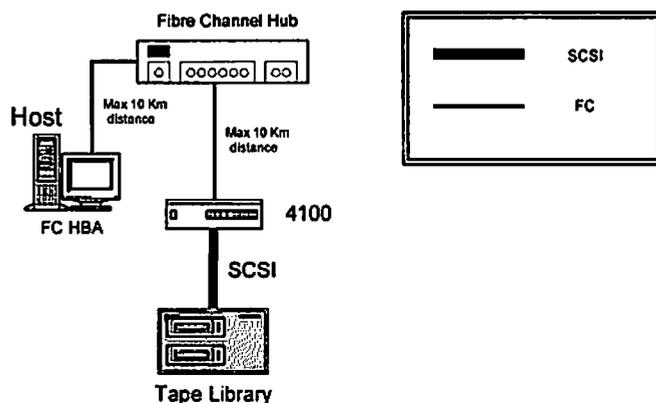
The first step in configuring the 4100 is to determine the mode of operation required. The 4100 can support Fibre Channel hosts communicating with SCSI targets, called Initiator Mode, or SCSI hosts communicating with Fibre Channel targets, called Target Mode. The default configuration of the 4100 is Initiator Mode.

A typical configuration could involve a Fibre Channel host connecting via an Arbitrated Loop to the 4100, with SCSI target devices also attached to the 4100. An example of this configuration, using a tape library and drives, is represented in Figure 3-1.

Overview of the 4100 Configuration

Hint: Answers to the following questions can facilitate the choice of a configuration:

1. Will host(s), or server(s), connect to the 4100 via SCSI or Fibre Channel?

2. Will the target device(s) connect to the 4100 via SCSI or Fibre Channel?

3. What is the physical distance between the host(s) and target device(s)?

The answers to these questions will help determine the optimal configuration for specific host systems and devices.

Assistance in choosing compatible software and devices for use with the 4100 is available at http://www.crossroads.com/solutions/configurator/default.asp on the Internet where an online configuration guide lists compatible products from various manufacturers. Products listed here have all been successfully tested for use with the 4100.

The following symbols for SCSI and Fibre Channel (FC) connections are used by this manual for illustrations of Initiator and Target Modes.

FC Switched Fabric

FC Arbitrated Loop

SCSI

3-4
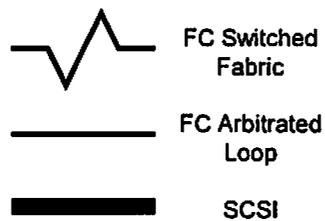
Initiator Mode Configurations

Point-to-Point Single FC host to single SCSI device. Uses Arbitrated Loop.
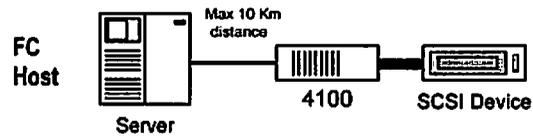
Single Initiator Single FC host to multiple SCSI devices.
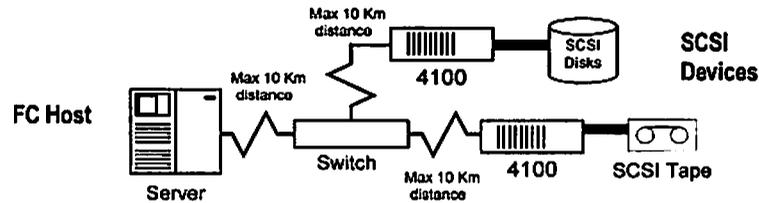
Multi-Initiator Multiple FC hosts to single SCSI device.

Overview of the 4100 Configuration
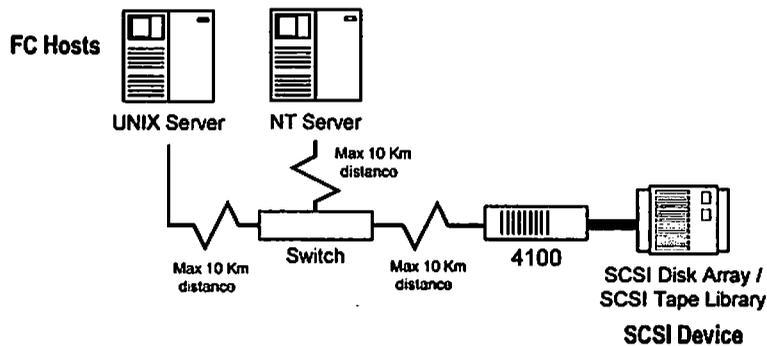
Target Mode Configurations

Point-to-Point Single SCSI host to single FC device over Arbitrated Loop.

SCSI Host

Max 10 Km distance

4100
Server

FC Disk/RAID
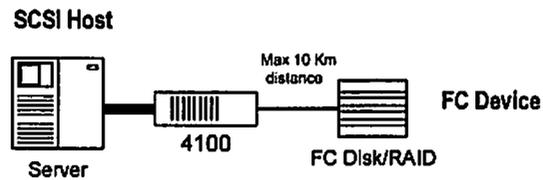
FC Device

Single-Initiator Single SCSI host to single FC device over Arbitrated Loop. Range can be extended using a hub.

Max 10 Km distance

FC Device

Max 10 Km distance

FC Disk/RAID

SCSI Host

Hub
(Optional)

4100
Server
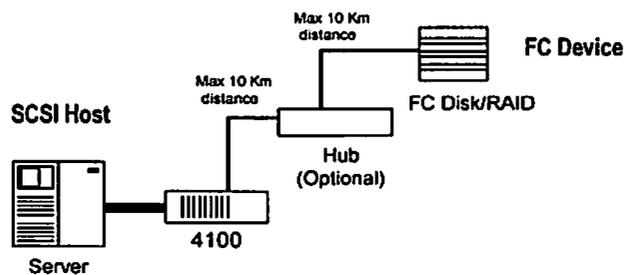
Multi-Initiator Multiple SCSI hosts to single FC device over Switched Fabric.

4100
Server

Max 10 Km distance

Max 10 Km distance

FC Device

FC Disk/RAID

Max 10 Km distance

4100
Server
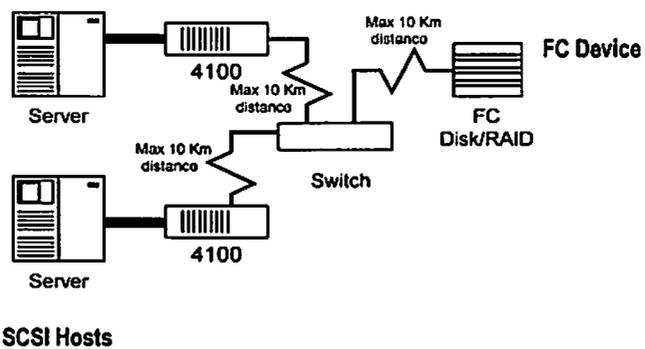
Switch

SCSI Hosts

Router-to-Router Configurations

Router-to-Router (R2R) Single SCSI host to single SCSI device. Range can be extended using a hub.
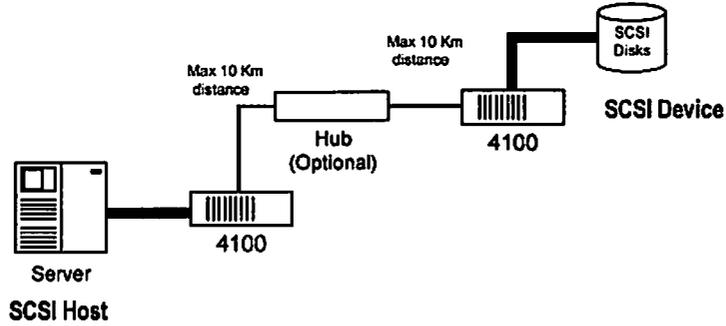
Router-to-Router (R2R) Multiple SCSI hosts to multiple SCSI devices. Routers communicate over Switched Fabric.

Overview of the 4100 Configuration
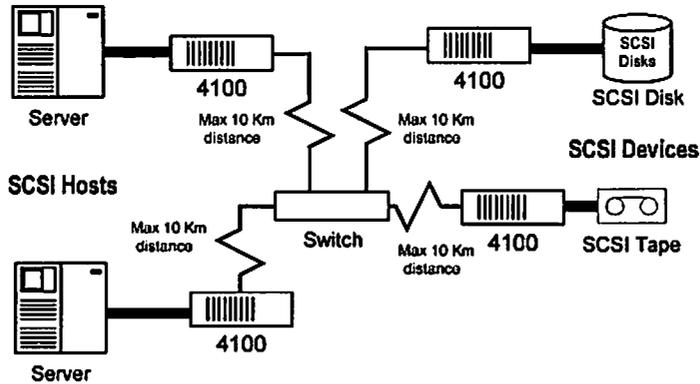
FC Arbitrated Loop Addressing

On a Fibre Channel Arbitrated Loop, each device appears as an Arbitrated Loop Physical Address (AL_PA). To obtain an AL_PA, two methods, called 'soft' and 'hard' addressing, can be used by the 4100. The 4100 can be configured to use either method. Soft addressing is the default setting. For hard addressing, the user specifies the AL_PA of the 4100.

Soft Addressing

When acquiring a soft address, the 4100 acquires the first available loop address starting from address 01 and moving up the list of available ALPAs in the chart from 01 to EF. In this mode, the 4100 automatically obtains an available address and participates on the FC loop, as long as there is at least one address available on the loop that is connected to the 4100. Fibre Channel supports up to 126 devices on an Arbitrated Loop.

Hard Addressing

When acquiring a hard address, the 4100 attempts to acquire the AL_PA value that was specified by user configuration. If the desired address is not available at loop initialization time, the 4100 comes up on the FC loop using an available soft address. This allows both the loop and the unit to continue to operate. This situation would occur when another device on the Arbitrated Loop has acquired the same address as that configured on the 4100.

Hard addressing is recommended for FC Arbitrated Loop environments where it is important that the FC device addresses do not change. Device address changes can affect the mapping represented by the host operating system to the application, and have adverse effects. An example of such an environment would be a tape library installation, where the application configuration requires fixed device identification for proper operation. Hard addressing ensures that the device identification to the application remains constant.

When connected to a Fibre Channel switch, the 4100 is identified to the switch as a unique device by the factory programmed World Wide Name (WWN).

Host Device Configuration

The host system using a Fibre Channel Host Bus Adapter (HBA) will typically map Fibre Channel devices into the existing device mapping scheme used by that operating system. Refer to the HBA manual for the mapping table. This usually results in the Fibre Channel HBA mapping Fibre Channel AL_PAs to SCSI target addresses. The HBA will claim enough SCSI bus entries to allow for 125 Fibre Channel targets to map to SCSI Bus:Target entries. This is usually done by a fixed mapping of AL_PA to Bus:Target. In such a configuration, the 4100 corresponds to a Bus:Target identifier, with the SCSI devices attached to the 4100 appearing as logical units (LUNs). In addition, operating systems can extend the available SCSI limit of 15 per bus.

Although this is not an issue for the operating system or most applications, there are cases where older applications can have expectations about what are valid SCSI IDs, and not deal correctly with certain mappings. In particular, applications have been seen to exhibit difficulties addressing target IDs greater than 15 (e.g. 16 and up). This problem can be resolved by configuring the 4100 to use hard addressing, and setting the AL_PA used by the unit to a value that the HBA will map to an ID with a value less than 16.

For example, depending on the FC HBA, if the hard AL_PA selection is 1, the address is 1. If the selection is 125, the AL_PA address is 0xEF. Some FC HBA's will configure differently, so verify the AL_PA by reviewing the documentation for the HBA.

SCSI Addressing

In Initiator Mode, the 4100 appears on the SCSI bus as a single initiator. The default Initiator ID is 7, but it can be set via configuration to any valid SCSI address. No other devices on the SCSI bus may use this address. Note that the FC host itself is not connected to the bus.

In Target Mode, the 4100 appears on the SCSI bus as an initiator ID and one or more Target IDs. By the default, no Target IDs are setup. Target IDs can be setup from the SCSI Configuration menu described in Chapter 4.

The 4100 provides the capability to reset the SCSI bus during the 4100 boot cycle. This allows the devices on the SCSI bus to be in a known state. Configuration provides for the SCSI bus reset feature to be enabled or disabled. The feature is enabled in the default configuration but should be disabled for configurations using multiple initiators, tape changers, or other devices that have long reset cycles, or are adversely affected by bus resets.

The 4100 negotiates for the maximum values for transfer rates and bandwidth on the SCSI bus. If an attached SCSI device does not allow the full rates, the 4100 will use the best rates it can negotiate for that device. Negotiation is on a device specific basis, so the unit can support a mix of SCSI device types on the SCSI bus.

Initiator Mode: Fibre Channel-to-SCSI

This section describes the configuration of the 4100 when in Initiator Mode – acting as a target to a Fibre Channel Initiator, passing Fibre Channel Protocol (FCP) requests through to SCSI target devices.

By default, the 4100 is in Initiator Mode. The unit uses soft addressing on the Fibre Channel loop and auto addressing for the target device mapping. Auto addressing is described in more detail later in this chapter.

The 4100 automatically detects if it is connected to a FC loop or a switch, and will use the appropriate addressing scheme without further configuration.

Address Mapping

The 4100 supports three addressing methods for mapping SCSI targets to Fibre Channel Initiators (Hosts):

- *Indexed Addressing* – Allows editing and maintenance of a static address mapping table.

- *Auto Addressing* – Automatically creates a new address mapping table every time the 4100 is power cycled.

- *SCC Addressing* – Implements the SCSI-3 Controller Commands SCSI storage array addressing to address SCSI devices attached to the 4100.

SCSI Targets are selected by mapping the appropriate values into the FCP LUN field, and correlating a Fibre Channel LUN value to a SCSI Bus:Target:LUN value. The 4100 acts as a single initiator on the SCSI bus, defaulting to ID 7. All commands passed through to the SCSI bus originate from this SCSI ID.

Note	The SCSI bus number corresponds to the physical SCSI port on the back of the 4100. For example, SCSI bus 0 corresponds to SCSI port 0 on the rear of the 4100.

Indexed Addressing

Indexed Addressing allows for Fibre Channel host bus adapters (HBAs) to access SCSI devices attached to the 4100. This is done by use of a

Overview of the 4100 Configuration

table, which is indexed by sequential FCP LUN values, indicating selected BUS:TARGET:LUN devices.

Table 3-1. Example of Indexed Addressing Table*

FCP LUN Value	SCSI BUS:TARGET:LUN
0x00	0:0:0
0x01	0:1:0
0x02	0:2:0
0x03	0:3:0
0x04	0:4:0
0x05	0:5:0
0x06	0:6:0
0x08	0:8:0
(...)	(...)
0x0E	0:15:0
0x0F	0:0:1
0x10	0:1:1
(...)	(...)

* *FCP LUN Value 0x07 is not shown because the associated SCSI BUS:TARGET:LUN is reserved for the default Initiator ID.*

The indexed addressing table has the structure shown in Table 3-1. The 4100 will allow up to 80 device entries to be mapped. The index table can be manually edited, and is then saved to the 4100 FLASH memory. The configuration menu has options allowing the table to be filled in order of increasing Target ID, or LUN, as may be desired for the specific requirements needed. Options are also provided to perform SCSI device discovery, and fill the table in the order that devices are discovered on a SCSI bus.

Indexed Addressing mode is recommended for environments where SCSI device configuration may change, and a fixed mapping from the application to the target devices is required. That is, if a SCSI device is removed from the SCSI bus, and the 4100 is power cycled, then the FC-to-SCSI addressing for the remaining SCSI devices will not change and the SCSI devices can be replaced at the same address. An example of such an environment is where hot pluggable devices may be used, thereby changing the order of devices on the SCSI bus.

Auto Addressing

The Auto Addressing option is similar to Indexed Addressing, but with the distinction that the table used is created each time through SCSI device discovery upon power up (or other router initialization process), and not otherwise retained. As the 4100 performs device discovery on the SCSI bus, the table is filled with adjacent FCP LUNs referencing each subsequent SCSI device. The host system then detects every attached device without voids, allowing full device discovery to the host. This allows easy configuration in environments where device ordering is not important, and hot plugging of SCSI devices will not occur. Configuration allows for discovery to be performed in order of Bus, Target ID, or LUN, as desired for the specific environment.

In Auto Addressing, Bus Number order is configured as the default mode of the 4100.

SCC Addressing

The 4100 also implements the SCSI-3 Controller Commands (SCC) (X3T10 Project 1047D Revision 6b 01-July-96) SCSI storage array addressing to address SCSI devices attached to the 4100. The Access Method used is the SCC Logical Unit Addressing method.

In SCC Addressing mode, the 4100 will respond to FCP commands as a SCC controller device. A subset of the SCC behavior is implemented. Commands may be addressed to the 4100 directly, or to attached SCSI devices, depending on the Fibre Channel LUN specified.

Further description of the 4100 implementation of SCC addressing is in Appendix D.

Overview of the 4100 Configuration

Target Mode: SCSI-to-Fibre Channel

This section describes the configuration of the 4100 when it is in Target Mode – acting as a target to a SCSI Initiator, passing requests through to Fibre Channel targets.

The 4100 responds to commands issued to a set of configured SCSI IDs, and maps these to Fibre Channel Device/LUN values. The following table indicates a possible mapping for SCSI LUN to Fibre Channel WWN:LUN.

Table 3-2. SCSI-to-Fibre Target:Channel Address Mapping example

SCSI	Fibre Channel			
Bus:Target:LUN	Port No.	FC_LUN	WWN	STAT
00:09:00	0x210213	0x00000000 0x00000000	0x100000E0 0x02021306	UP
00:09:01	0x210213	0x00010000 0x00000000	0x100000E0 0x02021307	UP

The table can be edited to represent the desired mapping, and saved to FLASH memory, which is retained even through power cycles.

In addition to configuring address mapping, Target Mode requires a SCSI interface on the 4100 be configured to respond to specified SCSI IDs – accomplished through the SCSI Configuration Menu. Target IDs enabled for the 4100 must be unique on the SCSI bus, with the exception that the Initiator ID used on the 4100 must also be used as one of the enabled Target IDs. Specifically, in Target Mode, one of the targets must have the same ID as the Initiator ID used by the 4100.

Note	The Initiator and Target IDs must be assigned before the address table can be configured.

Configuration Methods

The 4100 can be configured either through the serial port or over Ethernet via a Telnet, Web Management Interface, or SNMP management tool. FTP and TFTP are also supported on Ethernet to upgrade firmware revisions.

Serial

The serial port allows for configuration of device characteristics from an attached terminal or terminal emulator. For instructions on use of the serial interface, refer to Chapter 4, *Configuring the 4100.*

Ethernet

The 10BaseT Ethernet port must first be configured via the serial port with an appropriate IP address, subnet mask, and gateway prior to use unless the default values are to be used. The factory default values that are used by the 4100 are IP address 1.1.1.1, and a subnet mask of 255.255.255.0.

Telnet

The 4100 is capable of holding Telnet sessions for configuration purposes. The configuration menus accessed via the serial port will be disabled when a Telnet session is connected. To open a Telnet session, the IP address of the 4100 and a Telnet client utility are required.

From most Windows 9x and NT systems, users can start a Telnet session from the DOS (or Command) prompt using the following steps:

1. From the Windows Start menu, open the DOS (or Command) prompt window.

2. At the '>' prompt, enter the following command

    TELNET <IP address>

Overview of the 4100 Configuration

where <IP address> is the IP address of the 4100. This will start a Telnet session window for the 4100.

3. Enter 'root' for the default user name and 'password' for the default password. It is recommended that you change the user name and password as soon as possible. See *Ethernet Configuration* in Chapter 4 for more information on setting up user names and passwords.

4. Access configuration options in the same way used for the serial interface.

5. To exit the Telnet session, select the **Disconnect** option from your Telnet client utility. In most Telnet utilities, this option is available as a menu item.

Web Management Interface

The 4100 allows any standard web browser to view and change the 4100's configuration. Information is dynamically generated in an HTML format by the 4100 so that web browsers can access it.

To access the Web interface, enter the IP address of the 4100 into the Address field of a Web browser. Or, you can enter a URL using a host name defined by the user – for instance, http://CP4100. But, the user must define the host name on the DNS server first.

To make changes to settings, use standard keyboard and mouse controls to input information and then select the **Submit** button to send the changes to the 4100.

A user name and password are required before any changes can be submitted. The default user name is "root" and the default password is "password."

Changes will not take effect until the next time the 4100 reboots but the unit can be forced to reboot by selecting the **Reboot** option from the Diagnostics menu.

Chapter 3

SNMP

The 4100 includes SNMP management support. SNMP commands are transported via Ethernet. SNMP support allows configuration and management using standard SNMP management tools. Available data for SNMP is defined in the 4100's MIB.

Crossroads provides a private MIB for the configuration of the 4100. The Crossroads private MIB includes all objects configurable from the serial interface. The Crossroads private MIB also includes some Fibre Channel and SCSI statistics that are not accessible via the serial interface. SNMP support also includes Traps, which are used to notify a SNMP management console of various conditions.

The objects defined in the Crossroads private MIB are specific to Crossroads products. For a copy of the Crossroads private MIB, contact a service representative.

This completes Chapter 3, *Overview of the 4100 Configuration.*

Chapter 4

Configuring the 4100

Because the various configuration methods of the 4100 (described in Chapter 3, *Overview of the 4100 Configuration*) offer such similar functionality, this chapter will describe specific configuration options from the perspective of the serial interface only. For an overview of using the other configuration methods available, see Chapter 3.

The 4100 allows the user to access many configuration settings through the serial interface. Among these settings are:
- Baud rate of the serial port
- Fibre Channel address
- SCSI Initiator and Target IDs
- Ethernet IP and MAC addresses
- Fibre Channel-to-SCSI mapping
- SCSI-to-Fibre Channel mapping
- Trace level settings

All of the above settings may be changed and saved.

Note	Unless otherwise indicated, configuration changes take effect when the unit next powers on or reboots.

Communicating with the 4100

The 4100 is designed to communicate with a terminal or any operating system utilizing a terminal emulator. For example, Windows 9x and NT 4.0 operating systems can use Hyperterminal. Be sure the baud rate, data bits, stop bits, parity, and flow control are set as specified in Table 4-1.

Table 4-1. Connection properties

Type	Setting
Baud rate	*9600, 19200, 38400, 57600, or 115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None or XON/XOFF

*See information on the Autobaud feature in Chapter 2.

Setting Up Serial Port Communications

Leave the 4100 turned off until you have set up serial port communications with your host computer, unless of course serial I/O was previously established and is currently running.

Configuring the 4100

To set up serial communications with the 4100:

1. Plug the serial cable provided with the 4100 into one of your computer's serial ports (for example, COM1 or COM2) and the 4100's serial port.

2. Start your terminal interface program.

3. Set the terminal interface program to use the appropriate COM port.

4. Specify the following settings for the port:

Baud rate:	9600, 19200, 38400, 57600, or 115200
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None or XON/XOFF

Note	Before powering on the 4100, make sure all the devices on the SCSI bus are powered on and have finished performing their self tests. The devices on your Fibre Channel Storage Area Network should be powered on also.

5. Power on the 4100.

Power Up Messages

When you press the 4100's power switch to the on position (marked with a 'I' symbol), a series of messages similar to the following appear on the terminal or terminal emulation program:

```
Performing Power-on Self Test ...
 Monitor-flash Check-sum.............................. passed
 Program-store Main RAM .............................. passed
 Trace Buffer in Main RAM ............................ passed
 PCI Protocol RAM (16Mb) ............................. passed
 SCSI Script RAM (I) ................................. passed
 Initializing Ports ..
 Fibre-channel Port Single-frame Sequence Loopback... passed
 Fibre-channel Port Multi-frame Sequence Loopback.... passed
 Ethernet Port Loopback .............................. passed
 SCSI Port (I) Loopback .............................. passed
Self test completed successfully


Select which mode to boot :
 1. Fibre Channel/SCSI Router
 2. Diagnostics Monitor
```

The default boot mode is 1) Fibre Channel/SCSI Router and will be automatically selected if you wait three seconds.

The illustrations in this chapter use Xs to represent numeric values for certain data fields, such as the product release version and the revision of firmware.

Note	If you do not see messages on your screen, re-check your computer's serial port settings and press Enter five or six times. In particular, make sure the baud rate is set to one of the values listed in Table 4-1.

The main menu appears as follows:

```
        Crossroads Systems 4100
           Version X.X XXXX

1) Perform Configuration
2) System Utilities
3) Display Trace and Assertion History
4) Reboot
5) Download a New Revision of The Firmware


Command >
```

The main menu allows for various operations to be performed on the 4100.

Option 1) is described below. For information on selections 2) through 5), see Chapter 5, *Managing the 4100*.

Perform Configuration

The Perform Configuration menu allows the administrator to configure the various.options on the 4100. For most configuration changes to take effect, you must reboot the 4100 (see System Reboot under the System Utilities menu described in Chapter 5).

Note	Menus are not case sensitive. You can enter uppercase and lowercase characters interchangeably whenever menus indicate letters as choices.

```
                    Configuration Menu
                    Version X.X XXXX

 1) Baud Rate Configuration
 2) Fibre Channel Configuration
 3) SCSI Configuration
 4) Ethernet Configuration
 5) Fibre Channel to SCSI Mapping Configuration
 6) SCSI to Fibre Channel Mapping Configuration
 7) Trace Settings Configuration
 8) Real-Time Clock Configuration

 A) Save Configuration
 B) Restore Last Saved Configuration
 C) Reset and Save Configuration to Factory Defaults

 X) Return to main menu
```

Baud Rate Configuration

This menu changes the baud rate used on the serial port. Select 1) – 5) for appropriate baud rate setting. If you are using the Autobaud feature, it may not be necessary to set a baud rate. See Chapter 2 for more information on using the Autobaud feature.

```
               Baud Rate Configuration Menu        .
                    Version X.X XXXX

 1) * 9600    2)    19200
 3)    38400  4)    57600
 5)   115200

 X) Return to previous menu
```
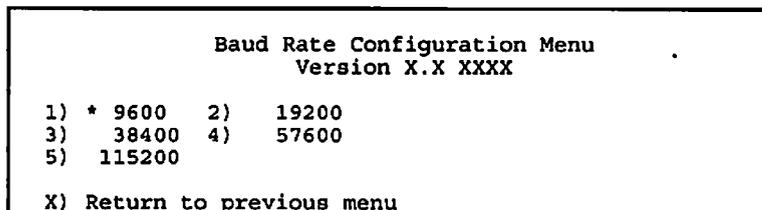
The asterisk (*) symbol indicates the current setting for the baud rate.

Configuring the 4100

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Fibre Channel Configuration

This menu allows for setting the Fibre Channel Address method, Hard Address value, discovery mode, and WWN overrides.

```
            Fibre Channel Configuration Menu
                  Version X.X XXXX

Current Fibre Channel Configuration:

World Wide Name High: XxXXXXXXXX
World Wide Name Low: XxXXXXXXXX
Discovery Mode: Auto Discovery on Reboot Events
Use Hard ALPA: Yes
     Hard ALPA Value: 0x00000055

   1) Change World Wide Name High
   2) Change World Wide Name Low
   3) Toggle Discovery Mode
   4) Toggle Hard ALPA Usage
   5) Change ALPA Value

   X) Return to previous menu
```

- Select 1) to enter a new value for the World Wide Name High.

- Select 2) to enter a new value for the World Wide Name Low.

- Select 3) to toggle the Discovery Mode among the following options:

```
Manual Discovery Only
Auto Discovery on Reboot Events
Auto Discovery on Link Up Events
```

Discovery Mode determines how the 4100 will discover new Fibre Channel devices.

Manual Discovery sets discovery of new devices to only occur after the user selects the **Initiate FC Discovery** option from the SCSI to Fibre Channel Configuration Menu. With this option, the ports are discovered but the devices behind the ports are not discovered.

Auto Discovery allows the 4100 to automatically discover all Fibre Channel devices when the router reboots or whenever link-up events occur, such as connecting cables or rebooting network hubs.

Reboot Events is the default selection. Both the ports and the devices behind the ports are discovered.

Link-up Events discovers both the ports and the devices behind the ports for the first link-up event. Subsequent link-up events will only discover the ports and not the devices behind the ports.

Select **4)** to set the Hard AL_PA Usage to **Yes** or **No**. If set to **Yes**, a unique one-byte valid value (derived from an Arbitrated Loop Topology as defined in ANSI specification FC_AL ver 4.5) is used for the Fibre Channel configuration. When configuring the Fibre Channel AL_PA, the 4100 will present a list of loop addresses along with the corresponding AL_PA. From here, the user can select the loop address desired. If set to **No**, the router will use a soft AL_PA value, which means the router will negotiate on the arbitrated loop for a valid ALPA. This setting has no affect on SCSI-to-FC or FC-to-SCSI mapping modes or mapping tables.

- Select **5)** to set the Hard AL_PA Value by entering a node number from the ALPA lookup table that appears when this option is selected. For more information, see Table D-5 in Appendix D, *Addressing, Structures and Operations*.

SCSI Configuration

This menu allows for setting the SCSI Initiator ID, adding and removing SCSI Target IDs, setting the SCSI bus reset behavior, and changing the Discovery delay time.

```
┌─────────────────────────────────────────────────┐
│              SCSI Configuration Menu              │
│                Version X.X XXXX                   │
│ Bus 0, Current SCSI Configuration:                │
│                                                   │
│     Initiator SCSI ID:  7                         │
│     Target SCSI ID(s):                            │
│                                                   │
│     Reset SCSI Bus on Boot      : Yes             │
│     SCSI Initial Discovery Delay : 2000 ms        │
│                                                   │
│         1) Change Initiator SCSI ID               │
│         2) Add Target SCSI ID                     │
│         3) Remove Target SCSI ID                  │
│         4) Toggle SCSI Reset Operation            │
│         5) Change Discovery Delay Time            │
│                                                   │
│         X) Return to previous menu                │
└─────────────────────────────────────────────────┘
```

- Select **1)** to change the Initiator SCSI ID. This is the ID for the SCSI device that requests operations from other SCSI devices known as targets. This should be a unique ID on the bus. Default is 7.

- Select **2)** to add a Target SCSI ID. This adds an ID for a SCSI device that responds to operation requests from the SCSI initiator. This must be setup before users can access **SCSI to Fibre Channel mapping** (from the SCSI to Fibre Channel Mapping Configuration menu).

- Select **3)** to remove a Target SCSI ID. This option eliminates target IDs previously added.

- Select **4)** to toggle the SCSI reset operation between **Yes** and **No**. When set to **Yes**, the 4100 will automatically discover SCSI devices after initial power up and after reboots.

- Select **5)** to change the discovery delay time for SCSI devices. This is the time that the 4100 waits after a power-up or reboot before starting to discover SCSI devices. This value should be set to no less than 250ms, according to the SCSI standard for Reset-to-Selection Time. Crossroads recommends you set the value to at least 2 seconds to ensure all SCSI devices complete their individual power-ups.

Chapter 4

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Ethernet Configuration

This option allows for setting up all Ethernet network settings including IP address, Subnet mask, IP gateway, SNMP and security settings, physical address, and hostname.

```
                    Ethernet Configuration Menu
                        Version X.X XXXX


Ethernet Physical Address      : 08:06:07:05:03:09
IP Address                     : 1.1.1.1
Subnet Mask                    : 255.255.255.0
Hostname                       :
IP Gateway                     : 0.0.0.0

    1) Change Ethernet Physical Address
    2) Change IP Address
    3) Change IP Subnet Mask
    4) Change SNMP Settings
    5) Change Security Settings
    6) Change IP Gateway
    7) Change Hostname

    X) Return to previous menu
```

- Select 1) to change the Ethernet Physical Address, or MAC address, of the 4100. Ethernet physical addresses are always assigned to Ethernet adapters by the manufacturers.

- Select 2) to change the IP address of the 4100. The default for this setting is 1.1.1.1.

- Select 3) to change the IP Subnet mask for the 4100. The default for this setting is 255.255.255.0.

- Select 4) to access the SNMP Settings for the 4100, including the community names for GET and SET as well as SNMP Trap settings. For Trap settings, select the IP address of the device to send the SNMP trap notifications. SNMP Settings will be covered in more detail later in this chapter.

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- Select 5) to change security settings, including the user name and password. User names and passwords should be unique and kept confidential and it is recommended to use a combination of letters and numbers when creating user names and passwords.

- Select 6) to change the IP gateway for the Ethernet network of the 4100. The default setting is blank.

- Select 7) to change the hostname. This is an alphanumeric entry of one word up to 8 characters long. The default setting is "CP4100".

Fibre Channel-to-SCSI Mapping Configuration

This option allows selecting the addressing mode of the 4100, as well as displaying attached devices when using the 4100 in Initiator Mode. The menu to modify the Indexed addressing table is also accessed through this menu.

```
            Fibre Channel to SCSI Configuration Menu
                        Version X.X XXXX

           Current Fibre Channel to SCSI Mapping Mode is Indexed

       1)  Display Attached SCSI Devices, LUN Priority
       2)  Display Attached SCSI Devices, Target ID Priority
       3)  Display Attached SCSI Devices, Bus Number Priority
       4)  Change the Fibre Channel to SCSI Mapping Mode
       5)  Show/Edit Fibre Channel to SCSI Mapping Table


       X)  Return to Previous Menu
```

- Select 1) to display attached SCSI devices according to ascending LUN order.

- Select 2) to display attached SCSI devices according to ascending SCSI Target ID (SCSI device address ID) order.

- Select 3) to display attached SCSI devices in ascending SCSI Bus Number (SCSI port ID number) order.

- Select **4)** to change the mode of Fibre Channel to SCSI Mapping to one of the following options:

```
1) Set to SCC
2) Set to Indexed
3) Set to Auto-assigned, LUN priority
4) Set to Auto-assigned, target ID priority
5) Set to Auto-assigned, bus number priority
```

SCC addressing is used to address SCSI devices attached to the 4100 using the SCSI-3 Controller Commands method of logical unit addressing. In this mode, the 4100 will respond to FCP commands as in a SCC controller device. The FC HBA must support this addressing method.

Indexed addressing presents the user a table with the current mappings. The user can then select a table entry by FCP LUN and specify the associated BUS:TARGET:LUN.

Auto-assigned addressing fills the table with one of multiple prioritizing schemes, or with the currently attached SCSI devices.

LUN priority – fills the table according to ascending LUN order.

Target ID priority – Fills the table according to ascending SCSI Target ID (SCSI device address ID) order.

Bus Number priority – Fills the table in ascending SCSI Bus Number (SCSI port ID number) order.

The current mode for address mapping appears when you select **5)** from the Fibre Channel to SCSI Configuration menu.

Changes to these settings must be saved in FLASH memory using option **A** from the Configuration menu, where they are retained across future device resets or power cycles.

- Select **5)** to view or edit the Fibre Channel to SCSI Mapping table used for Indexed addressing. This option only appears (see below) if you previously set address mapping to Indexed.

Configuring the 4100

```
Fibre Channel to SCSI Mapping Table
     Version: x.x  xxxx    Link Up

          FC_LUN      BUS TGT LUN
          0x00  ->  0   0   0
          0x01  ->  0   1   0
          0x02  ->  -   -   -
          0x03  ->  -   -   -
          0x04  ->  -   -   -
          0x05  ->  -   -   -
          0x06  ->  -   -   -
          0x07  ->  -   -   -
          0x08  ->  -   -   -
          0x09  ->  -   -   -
          0x0A  ->  -   -   -
          0x0B  ->  -   -   -
          0x0C  ->  -   -   -
          0x0D  ->  -   -   -
          0x0E  ->  -   -   -
          0x0F  ->  -   -   -

Enter LUN entry to change, F to fill, X to return, <enter> for more >
```

Existing LUN entries can be edited by specifying the LUN numbers to be changed. The LUN numbers are entered as two-digit values.

The Mapping Table can also be filled by entering an 'F' at the command prompt. The following menu will appear.

```
Fill Fibre Channel to SCSI Mapping Table
          Version X.X    XXXX

1) Flat, LUN Priority
2) Flat, Target ID Priority
3) Flat, Bus Number Priority
4) Ordered, LUN Priority
5) Ordered, Target ID Priority
6) Ordered, Bus Number Priority

X) Return to Previous Menu
```

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Flat – This option sets all Fibre Channel LUN values in ascending order. Use this option when you have multiple devices using different D_IDs.

> *LUN priority* – Fills the table according to ascending LUN order.
>
> *Target ID priority* – Fills the table according to ascending SCSI Target ID (SCSI device address ID) order.
>
> *Bus Number priority* – Fills the table in ascending SCSI Bus Number (SCSI port ID number) order.

Ordered – This option maps only SCSI Target IDs that are responding.

> *LUN priority* – Fills the table according to ascending LUN order.
>
> *Target ID priority* – Fills the table according to ascending SCSI Target ID (SCSI device address ID) order.
>
> *Bus Number priority* – Fills the table in ascending SCSI Bus Number (SCSI port ID number) order.

SCSI-to-Fibre Channel Mapping Configuration

This option allows modification of the table mapping SCSI Target:LUN values to Fibre Channel Node:LUN values when using the 4100 in Target Mode. Prior to configuring these tables, the user must enable the SCSI target and initiator addresses desired to enable the mapping for that SCSI device. The SCSI-to-FC Mapping Configuration menu similar to the following appears:

```
SCSI to Fibre Channel Configuration Menu
   Version: X.X XXXX    Link Up

1) Initiate FC Discovery
2) Display Attached FC Devices
3) Fill, One Device/Target
4) Fill, Sequential FC Devices
5) Show/Edit SCSI to Fibre Channel Mapping Table

X) Return to Previous Menu
```

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Choose from the following Options:

- Select 1) to discover FC devices and SCSI ports. FC devices with no associated LUNs are ignored, but will appear in a trace history report. This option is automatically performed at Power Up but results are printed to the screen only when you select the option from this menu. It is not recommended that you use this option for fabric environments.

- Select 2) to view all discovered FC devices. A table is displayed with the following information:

  Port No.:   D_ID (for Point-to-Point configurations), AL_PA (for Arbitrated Loop), or the Port Number (for Fabric)

  WWN: World Wide Port Name

  LUN: SCSI devices, or LUNs of SCSI devices

  STAT: UP, DOWN, or OFFL status

  VENDOR: Vendor name from SCSI inquiry data

  PRODUCT: Product name from SCSI inquiry data

- Select 3) to fill the mapping table with one SCSI Target per FC device. If there are more targets defined than FC devices, the extra targets receive blank entries in the mapping table. Conversely, if there are more FC devices than targets, an error message appears. Return to the SCSI Configuration Menu to add more targets.

- Select 4) to fill the mapping table with up to eight LUNs to a SCSI Target, starting with the first Target ID, and going through each Target ID afterwards in sequential order. This is the only option that allows mapping of FC devices with more than eight LUNs. If there are not enough targets (eight LUNs to a target) to map all the LUNs of all FC devices, a warning message appears. Return to the SCSI Configuration Menu to add more targets.

- Select 5) to view or edit the mapping table.

A table similar to the following will appear:

```
SCSI to Fibre Channel Mapping Table
Version: X.X XXXX    Link Up


SCSI Bus/Tgt/Lun = 0/0/XX
+------------+----------+-------------------------+------------------------+----+
| BUS TGT LUN | PORT NO. | FC_LUN                  | WWN                    |STAT|
+------------+----------+-------------------------+------------------------+----+
   00 00 00    0x210213   0x00000000 0x00000000     0x100000E0 0x020001ED   UP
   00 00 01    0x210E13   0x00000000 0x00000000     0x20000060 0x1631E4C1   UP
   00 00 02    0x210E13   0x00010000 0x00000000     0x20000060 0x1631E4C1   UP
   00 00 03    0x210E13   0x00020000 0x00000000     0x20000060 0x1631E4C1   UP
   00 00 04    0x210E13   0x00030000 0x00000000     0x20000060 0x1631E4C1   UP
   00 00 05    0x210E13   0x00040000 0x00000000     0x20000060 0x1631E4C1   UP
   00 00 06    0x210E13   0x00050000 0x00000000     0x20000060 0x1631E4C1   UP
   00 00 07    0x210E13   0x00060000 0x00000000     0x20000060 0x1631E4C1   UP
+------------+----------+-------------------------+------------------------+----+

Enter LUN entry to change, X to exit, <enter> for more > 0
```

Press the **Enter** key to toggle through the available mapped targets.

Enter a LUN entry to modify that entry in the table currently shown. For example, to modify the first entry shown above, type **0**.

The following screen would appear:

```
Please select device for SCSI 00/00/00:
+-----+----------+-------------------------+-----+----------+-------------------+
| ID  | PORT NO. | WWN                     | LUN | VENDOR   | PRODUCT           |
+-----+----------+-------------------------+-----+----------+-------------------+
| 000 | 0x210213 | 0x100000E0 0x020001ED   | 000 | SEAGATE  | ST34501W          |
+-----+----------+-------------------------+-----+----------+-------------------+
  001   0x210e13   0x20000060 0x1631E4C1     000   DGC        DISK
  002   0x210e13   0x20000060 0x1631E4C1     001   DGC        DISK
  003   0x210e13   0x20000060 0x1631E4C1     002   DGC        DISK
  004   0x210e13   0x20000060 0x1631E4C1     003   DGC        DISK
  005   0x210e13   0x20000060 0x1631E4C1     004   DGC        RAID 1
  006   0x210e13   0x20000060 0x1631E4C1     005   DGC        DISK
  007   0x210e13   0x20000060 0x1631E4C1     006   DGC        RAID 5
+-----+----------+-------------------------+-----+----------+-------------------+

Enter ID number of device, E to edit manually, - to delete:
```

Enter an ID number to assign a device to the current SCSI BUS:TARGET:LUN. If there are more than 16 available FC devices, the

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user can scroll through the available devices by pressing the **Enter** key after each screen is displayed.

Select **E** to edit the assigned value for SCSI BUS:TARGET:LUN manually. This option hard codes the Port Number and is not recommended. However, the user could enter a number in the form:

XXXXXX Y Z

> where **XXXXXX** is an AL_PA, D_ID, or Port number
> and **Y Z** is the FC_LUN

Select '—' to delete the currently selected entry from the mapping table.

Trace Settings Configuration

This option allows trace levels to be set. This should not be modified in normal operation, as performance degradation may result.

```
                     Trace Settings
                   Version X.X XXXX

     Level 0 : ON         Level 1 : OFF
     Level 2 : OFF        Level 3 : OFF
     Level 4 : OFF        Level 5 : OFF
     Level 6 : OFF        Level 7 : OFF

        U) Update Current Operating Trace Levels
        X) Return to previous menu

 Enter trace level to change >
```

Enter a level number from the Trace Settings that are shown. This toggles the current setting to either **ON** or **OFF**.

Level 0 is for Errors and Exceptions
Level 1 is for Fibre Channel Events
Level 2 is for Bridge Events
Level 3 is for SCSI Events
Levels 4-7 are reserved.

Select U) to update current operating trace levels. This option forces the currently displayed trace settings to become effective immediately, without requiring a reboot or power cycle.

Real-Time Clock Configuration

When this option is selected from the Perform Configuration menu, the System Clock Setup Menu appears.

```
            System Clock Setup Menu
               Version X.X XXXX


FRIDAY, Date: 06/11/00, Time: 12:43:13

1) Set clock


X) Return to previous menu
```

Select 1) to set the clock. A series of three prompts will appear allowing setup of 24 hour time (hh:mm:ss), current date (mm/dd/yy), and the day of week (SUN, MON, TUE, WED, THU, FRI, SAT). All digits must be entered, i.e. 12:37:00.

Save Configuration

This option saves the current configuration state in FLASH, which updates the saved previous configuration state.

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Restore Last Saved Configuration

This option restores the most recently saved configuration. This can be useful when configuration changes are made, but the user wishes to return to the previously saved configured state.

Reset and Save Configuration to Factory Defaults

This option resets all current configuration options to the factory defaults and saves those options to FLASH memory as the current configuration.

SNMP Configuration

The SNMP Configuration menu allows for various SNMP options to be configured. This includes the Trap Manager IP address, community names, and the Trap priority.

Current SNMP Configuration indicates the community names for GET and SET and indicates trap status, including the Manager IP Address for enabled traps.

```
                    SNMP Configuration
                     Version X.X XXXX

Current SNMP Configuration:

Community Name for GET: public
Community Name for SET: private

Traps are disabled

1) Change Community Name for GET
2) Change Community Name for SET
3) Toggle Trap


X) Return to previous menu
```

The SNMP GET community name is checked for each GET request received by the 4100. The community name in the SNMP packet must

---

match the community name configured here for the SNMP GET request to be successfully completed. Configure your SNMP manager to have the same GET and SET community names as the 4100.

- Select **1)** to change the Community Name for GET.

- Select **2)** to change the Community Name for SET.

- Select **3)** to toggle traps on or off.

If SNMP Traps are disabled, no Trap events are sent.

SNMP configuration with traps enabled:

```
                    SNMP Configuration
                   Version: X.X XXXX

Current SNMP Configuration:

Community Name for GET: public
Community Name for SET: private
Manager IP Address for Traps: 1.1.1.1

Traps are enabled for events of any priority

1) Change Community Name for GET
2) Change Community Name for SET
3) Toggle Trap
4) Change Manager IP Address for Traps
5) Decrease Trap Priority
6) Increase Trap Priority

X) Return to previous menu
```

- Select **4)** to change the Manager IP Address for Traps. The Trap Manager IP address is the address used for sending Trap notifications. Typically, this is the IP address of the machine using the Network Management Program and/or a MIB browser.

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- Select 5) to decrease Trap Priority.

- Select 6) to increase Trap Priority.

The SNMP Trap Priority determines which traps will be sent to the specified Trap IP Address. Events having a priority equal to or higher than the configured priority will be sent first.

This completes Chapter 4, *Configuring the 4100.*

Chapter 5

Managing the 4100

The 4100 can be managed either through the serial port or over Ethernet via a Telnet session, Web Management Interface, or SNMP management tool.

Note	Menus are not case sensitive. You can enter uppercase and lowercase characters interchangeably whenever menus offer letters as choices.

For information on accessing a management interface with the 4100, see the *Configuration Methods* section of Chapter 3.

For information on setting up serial communications with the 4100 or for how to configure specific settings of the 4100, see Chapter 4.

Management Operations

The screens shown in this chapter are available through the serial interface or the Ethernet interface when a telnet session is used. In either of these cases, the menu structure is the same. A Web Management Interface is also available, or the 4100 may also be configured using an SNMP management tool.

From the serial interface, access the main menu.

```
                  Crossroads 4100 Configuration
                  Version: x.x xxxx    Link Up

  1) Perform Configuration
  2) Display Status of Power-on Self Test
  3) Display Trace and Assertion History
  4) Reboot
  5) Download a New Revision of the Firmware

Command >
```

For information on selection 1), see Chapter 4, *Configuring the 4100.*

Select 2) to display the status of the Power-On Self Test (POST). This option is described in detail later in this chapter.

Select 3) to display trace and assertion history. This option is described in detail later in this chapter.

Select 4) to reboot the 4100. This option is described in detail later in this chapter.

Select 5) to download a new revision of the firmware to the 4100. This option only appears on the RS-232 serial interface. To download new firmware via Ethernet, use an FTP or TFTP session, as described in Chapter 5.

Managing the 4100

Display Status of Power-On Self Test

This option displays the results of the most recent Power-On Self Test (POST). The POST test results are shown below.

```
                    Status of Power-on Self Test
                    Version: x.x xxxx    Link Up

Serial Port Loopback ................................... passed
Monitor-flash Checksum ................................. passed
Program-store Main RAM ................................. passed
Trace Buffer in Main RAM ............................... passed
PCI Protocol RAM ....................................... passed
SCSI Script RAM (I) .................................... passed
SCSI Script RAM (II) ................................... passed
Fibre-channel Port Single-frame Sequence Loopback ...... passed
Fibre-channel Port Multi-frame Sequence Loopback ....... passed
Ethernet Port Loopback ................................. passed
SCSI Port (I) Loopback ................................. passed
SCSI Port (II) Loopback ................................ passed

Press Any Key to Continue...
```

Display Trace and Assertion History

This option allows for internal trace state information to be dumped and captured. This is useful to debug installation issues, and can be provided to Crossroads for failure analysis. Further information on using this interface is in the troubleshooting section of this manual.

```
                        Trace Dump Menu
                    Version: x.x xxxx    Link Up

1) Display trace for current boot cycle
2) Display trace from previous boot cycle
3) Display trace from last assertion failure
4) Display history of assertion failures
5) Clear current trace buffer
6) Arm assert buffer lock
7) Clear assert buffer lock

X) Return to previous menu
```

Select 1) to display trace history for the current boot cycle. This option displays trace information from the current boot cycle in accordance with the trace level settings specified in the configuration.

Select 2) to display trace history from the previous boot cycle. This option displays trace information from the previous boot cycle in accordance with the trace level settings specified in the configuration.

Select 3) to display trace history from the last assertion failure. This option displays assertion data in the trace buffer for the most recent assertion. If the assert buffer has been locked (see 6) below), then this option displays the first assertion event since the trace buffer was locked.

Select 4) to display the history of assertion failures. This option displays a list of assertion failures but does not provide detailed information about the assertions. '->' identifies which assertion is stored in the assertion trace buffer.

Select 5) to clear the current trace buffer. If this option is selected, none of the options from the Display Trace and Assertion History menu will display any data.

Select 6) to arm the assert buffer lock. When selected, the Trace Dump Menu indicates 'Assert buffer is armed.' When an assertion occurs while this feature is armed, the Trace Dump Menu will indicate 'Assert buffer is locked.' This option is used to prevent subsequent assertions from overwriting an original assertion in the trace buffer. All assertions will appear in the history of assertion failures (see 4) above).

Select 7) to clear, or disarm, the assert buffer lock. This feature effectively turns off the lock for the assert buffer.

Reboot

The reboot function restarts the 4100. This will cause selected configuration options to take effect.

Managing the 4100

WARNING	All current operations will be interrupted. Do not reboot the unit during normal operation.

Download a New Revision of the Firmware

When this option is selected from the main menu, a confirmation message will appear to verify the selection. If a response of Y(yes) is given to the confirmation message, the 4100 starts to accept a new firmware image.

Note	Be sure the SCSI bus is terminated. Even if no SCSI cables are currently connected, the SCSI bus on the back of the router must be terminated. See Chapter 2.

Upgrade Firmware

The 4100 can use FTP, TFTP or serial communications to update the firmware. In order to update the firmware via the serial connection, the 4100 must be connected to a terminal or terminal emulation program supporting XMODEM transfers. The Download Firmware menu item does not appear when accessing the configuration menus through Telnet, SNMP, or the Web Management Interface.

Note	For quicker downloading, configure the 4100 and the terminal emulator utility session connected to it (such as Hyperterminal) to run at 115200. Download time is approximately 3 minutes at 115200 baud.

To upgrade firmware using FTP:

1. Connect the 4100 to the Ethernet network used by your computer.

2. Start your FTP program using the 4100's IP address:

   ftp <IP address>

The default IP address is 1.1.1.1. See the "Change IP Address" section of Chapter 4 for information on changing the 4100 IP address.

3. Use "root" as the default user name and "password" as the default password.

   To change the user name and password, see the *Change Security Settings* section of Chapter 4.

4. Specify binary mode:

   bin

5. Specify the firmware's path and filename with the "put" command:

   put <*path:filename*>

   The file will transfer and the 4100 will reboot. The 4100 will then be using the new firmware.

Note	You may want to confirm the new firmware level by checking the 4100's reboot messages through the serial interface.

To upgrade firmware using TFTP:

1. Connect the 4100 to the Ethernet network used by your computer.

2. At the command line, type the following command:

   tftp –i <IP address> put <path:filename>

   The file will transfer and the 4100 will reboot. The 4100 will then be using the new firmware.

Note	You may want to confirm the new firmware level by checking the 4100's reboot messages through the serial interface.

To upgrade firmware using a terminal or terminal emulator connected to the serial port of the 4100:

1. From the main menu, select the **Download a New Revision of The Firmware** option to start the download procedure.

2. When the download is confirmed, the 4100 will start the download process.

3. Use the **Transfer→Send File** option in the terminal emulator utility.

4. Select the location of the firmware. Use the **Browse** button, if you need help finding it.

5. Make sure to select XMODEM as the transfer protocol.

6. Press the **Send** button.

7. The firmware will begin to download to the 4100.

   When the download process is complete, the system verifies that the firmware image was successfully written to the FLASH memory and then reboots the 4100. Upon reboot, the 4100 detects that there is a newly downloaded firmware image and copies that image to the boot sector of the FLASH and then boots with that image. At that point the 4100 is using the new firmware.

Note	Be sure the SCSI bus is terminated. Even if no SCSI cables are currently connected, the SCSI bus on the back of the router must be terminated. See Chapter 2.

Chapter 5

Figure 5-1. Downloading a new revision of the firmware

```
                    Download Firmware Menu
This will replace the current revision of the firmware.
A reboot will also be performed as part of this process.
Are you sure (Y/N)? y

Please begin xmodem firmware transfer ...

_____ (transmit Firmware image via XMODEM)

Performing Power-on Self Test ...
 (...)
Self test completed successfully

Select which mode to boot :
 1. Fibre Channel/SCSI Router
 2. Diagnostics Monitor

 seconds left 1 : 1
Verifying firmware checksum ...
Updating firmware ...
Target Name: Crosspoint
Attaching network interface lnPci0... done.
Attaching network interface lo0... done.
NFS client support not included.
Initializing sioc...
SCRIPTS start @ 0x88002000 (3520)
Initialized Successfully
Build Level: XXXX
```

Web Management Interface

The 4100 allows any standard web browser to view and change the
4100's current configuration and operating status. Although the menu
structure is different than the serial and SNMP interfaces, the
functionality of the Web Management Interface is the same. In many
cases, the Web Management Interface replaces the menu screens of the
serial and SNMP interfaces with drop-down menu options.

Information is presented in HTML format in accordance with the W3C
specification for HTML 3.2. Current W3C Recommendations and other
technical documents can be found at http://www.w3.org/pub/WWW/TR/.

Managing the 4100

Accessing the Web Management Interface

1. Connect a 10baseT Ethernet cable to the back of the 4100. See Chapter 4, *Configuring the 4100*, of the User Manual for more information on configuring Ethernet access.

2. Apply power to connected SCSI and Fibre Channel devices.

3. After all the devices have gone through their power up routines, boot up the 4100.

4. Turn on the host computer.

5. If you know the IP address for the 4100, open the host computer's web browser and enter the IP address into the Address field of the Web browser. The factory default for the IP address of the 4100 is 1.1.1.1.

If you do not know the 4100's IP address (or need to change the IP address), connect to the 4100 using the RS-232 (serial) connection. Current information can be seen and changed from the Ethernet/SNMP Configuration menu. See Chapter 4, *Configuring the 4100*, of the User Manual for more information on making changes to the IP address.

Note	To access the Web Management Interface, the 4100 must be assigned an IP address. The factory default setting for the IP address allows access on a local area network only. If the factory default for the IP address is already used by another device on the local network, the IP address must be changed.
	For remote access from WAN or Internet locations, the IP address must be changed to a valid IP address. Valid IP addresses have the form *x.x.x.x* where each *x* is an integer in the range of 1 to 255.

6. When selecting a menu item for the first time (except for the Display SCSI Devices option), the user will be prompted to log

in with a user name and password. The defaults are "root" for user name and "password" for password. This information is required only once per session.

7. After entering the user name and password, full access is gained to the configuration menus for as long as a session lasts. A session ends when the user exits the Web browser or navigates the browser to a new web address. Log-in will be required again the next time a session is opened.

Making Changes via the Web Interface

To make changes to settings, use a standard keyboard and mouse to enter new information. Select the **Submit** button to send changes from the web browser to the 4100. Changes will not take effect until the next time the 4100 reboots. The unit can be forced to reboot right away by selecting the **Reboot** option from the Diagnostics menu.

For instructions on specific settings, see Chapter 4, for descriptions of the equivalent settings available from the serial interface of the router.

Note	It is recommended <u>not</u> to bookmark Web Interface pages with a Web browser. Because configuration information is transmitted via URLs, there is the possibility of the 4100 being configured with information present at the time a page was bookmarked.
	For similar reasons, it is also recommended <u>not</u> to use navigation features of the Web browser (such as the BACK button) to navigate the Web Interface.
	It is recommended to navigate only using the Web page links contained in the Web interface itself. Depending on the Web browser used, these links will often appear as highlighted text. By clicking on the text links, the Web Interface can be safely navigated.

This completes Chapter 5, *Managing the 4100.*

Chapter 6

Troubleshooting

Various problems can arise when configuring and using the 4100. This section is provided to help guide the user through some of the basic methods of identifying faults in the setup and configuration of the unit.

Most problems are found in the initial installation. In general, it is wise to check all connections and review the configuration before proceeding with further trouble analysis. Simplify the installation if possible, reducing it to the most basic configuration then adding elements one at a time and verifying the operation at each step.

Indicators

The LED indicators on the 4100 are useful for diagnosing various problems.
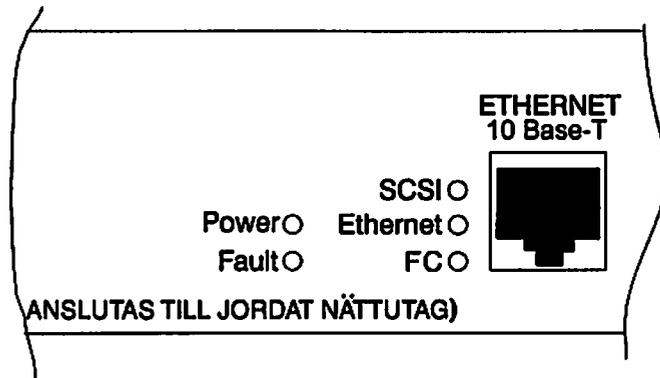
- The *Power* indicator turns on when power is applied to the unit. Lack of power indication suggests the unit being turned off, a problem with the power supplied to the unit, or an internal problem with the unit.

- The *Fault* indicator is lit when the 4100 detects a fault condition. Faults can occur as a result of Power-On Self Test (POST) failure or operational failures. It is normal for this indicator to flash on when the unit is powered up or reset. If the fault indicator stays lit, contact Crossroads support.

- The *SCSI* indicator shows SCSI activity when lit. This should only occur briefly during power up or configuration, and relatively often when the unit is transferring data. If the SCSI indicator stays continually lit without corresponding Fibre Channel device activity, it may indicate a problem with the SCSI bus configuration. Verify the SCSI bus configuration.

Troubleshooting

- The *Ethernet* indicator signifies Ethernet activity when lit. If the light fails to flicker, or if it stays continually lit, it may indicate a problem with the network connection. Verify the network connection. The port must be connected to a 10BaseT Ethernet network to function properly.

- The *FC* indicator shows Fibre Channel activity when lit. If this indicator fails to light at all, or stays continually lit without corresponding SCSI bus activity, it may indicate a problem with the Fibre Channel link. Verify the Fibre Channel configuration.

Chapter 6

Basic Verification

Verify SCSI Bus Configuration

Problems with SCSI bus configuration are common. Basic operation of a SCSI bus can be checked by using the configuration menu to view attached SCSI devices. See Chapter 4 for more information. Other conditions to look for include:

- Termination – Problems with termination can cause intermittent or hard failure. The SCSI bus must be terminated on both ends, and only both ends. Termination issues when both narrow and wide devices are on the same bus are common.

- Bus Type – Single-Ended devices cannot be mixed with Differential devices on the same bus. Similarly, Single-Ended terminators cannot be used on Differential buses, and Differential terminators cannot be used on a Single-Ended bus.

- Device ID – Each device on the SCSI bus must have a unique ID. Also check the configured IDs for the 4100 to verify these are not in use by other devices on the SCSI bus.

- Cabling – Check SCSI cables to verify they are functional. SCSI rules for total length, distance between devices, and stub length must be adhered to. Connections should also be checked and reseated if necessary.

- SCSI Devices – Verify that the SCSI devices on a particular SCSI bus can be seen in the configuration menu of the 4100. **Select Perform Configuration** from the first menu. Then select **Fibre Channel to SCSI Mapping Configuration.** You must then enter a '1' for LUN priority, '2' for Bus priority, or a '3' for Target, in order to view the list of SCSI devices. If the 4100 cannot see the devices, verify SCSI configuration, cabling, and termination.

Troubleshooting

Even if the SCSI devices are displayed, they are not accessible unless the mapping mode is auto-assigned or the mapping table has been filled when using Indexed addressing.

Verify Fibre Channel Connection

If SCSI devices are recognized on the SCSI bus but do not appear to the Fibre Channel host, it may be that the Fibre Channel link is not properly established. Most hubs and switches have link indicators, showing link status. When the 4100 is connected and powered on, this link indicator should show a good link. If it does not, check the cabling or connections. As a means of verifying link integrity when connected to a functional host, disconnecting then reconnecting the Fibre Channel cable should cause momentary activity of this indicator as the link itself reinitializes. Also verify that the media type of the 4100 and attached hub, HBA, or switch are of corresponding types. When using optical media, verify that the attached device is using non-OFC type optical devices.

Verify SCSI Devices in NT

If running FC-to-SCSI mapping mode, open the NT Control Panel, select "SCSI Adapters," and double click on the FC HBA. The SCSI devices should be listed.

If no devices are listed, verify the 4100 configuration, FC HBA configuration, and cabling.

If devices are listed, verify FC HBA mapping mode or the ALPA on the 4100.

If running SCSI-to-FC mapping mode, open the NT Control Panel, select **SCSI adapters**, and double click on the SCSI controller.

If no devices are listed, verify the 4100 configuration, SCSI Controller configuration, and cabling.

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Sometimes NT may need to be rebooted with all SCSI devices and the 4100 left on before NT will recognize the devices.

Verify Configuration

A number of configuration changes may result in an invalid configuration. If you are in doubt about the configuration, restore the 4100 to the factory default configuration and proceed to configure the unit a step at a time, verifying the functionality of the configuration as changes are made.

Verify Addressing

If working in FC-to-SCSI Initiator Mode and using Indexed or SCC Addressing, try swapping to Auto Addressing to see if this solves the problem.

Verify Devices

It may be useful to connect the SCSI target devices you are attempting to use to the native SCSI interface to verify that the devices are functional. SCSI target devices can be connected to a host SCSI bus to verify they are functional.

Verify Host Configuration

In some cases, it may be that the FC host bus adapter or host device driver may not be working properly. Check the configuration of these elements. It may be useful to check the release notes for the driver provided to see if there are any specific issues or required configuration. It may also be useful to ensure that you are using a current version of the host bus adapter driver.

Verify HBA Device Driver Information

Check the HBA device driver Readme file for configuration specifics. An HBA may require a different configuration,

Troubleshooting

depending on whether it is connected to a loop or a switch. HBAs typically come with utility programs that can be used to view or change their configuration.

Serial Port Problems

If you experience trouble communicating with the serial port, verify the configuration of the host terminal or terminal emulation program. The 4100 requires the baud rate to be set correctly, 8 data bits, 1 stop bit, and no parity. Flow control should be disabled, and may cause problems if set to 'hardware'. Some terminal programs may not support baud rates higher than 19200, so a lower baud rate may be required. If problems persist, you may want to check the cabling or try a different host. If a valid Ethernet IP address is configured, serial configuration settings can also be set via SNMP and telnet.

Note	When using the serial connection to update the router firmware, be sure the SCSI bus is terminated. Even if no SCSI cables are currently connected, the SCSI bus on the back of the router must be terminated. See Chapter 2.

Running Diagnostics

For further diagnostic testing, a Diagnostic Cable Kit can be purchased. Instructions for running a diagnostics wrap test are included with the kit. Contact your service representative for information on purchasing and using the Diagnostic Cable Kit.

Customer Support

If you are unable to resolve an issue, contact your service
representative and ask for customer support.

This completes Chapter 6, *Troubleshooting.*

Troubleshooting

Appendix A

RJ-11 Serial and RJ-45 Ethernet Pin Assignments

The pin assignments given for the RJ-11 serial connection are in reference to the serial receptacle on the back panel of the 4100. Use an RS-232 null modem cable to connect the 4100 to the host system.

Figure A-1. RJ-11 pin assignments

RJ-11 modular receptacle

Pin assignments

Pin No.	Function
Pin 1	No Connection
Pin 2	Ground
Pin 3	Transmit Data from 4100
Pin 4	Receive Data to 4100
Pin 5	RTS (Ready to Send)
Pin 6	CTS (Clear to Send)
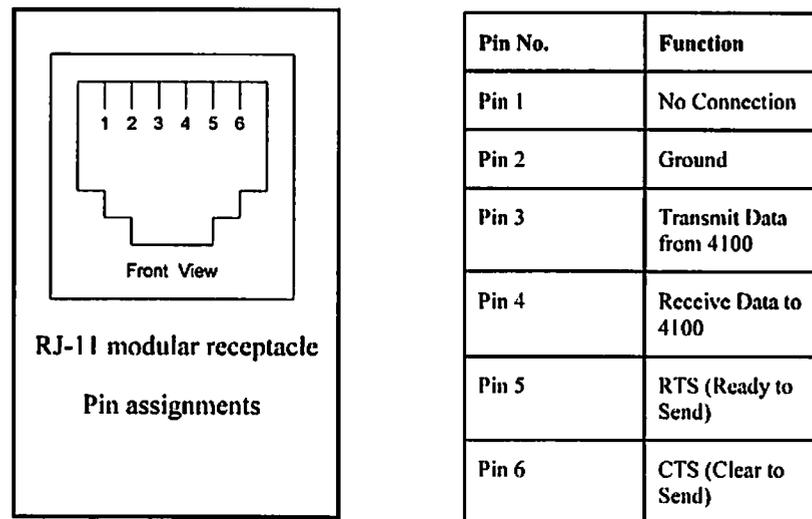
Appendix A

In conjunction with the pin assignments provided for the RJ-11 receptacle on the back panel of the 4100, below are the corresponding pin out assignments for a DB-9 serial connector used to connect the other end of the serial cable to a terminal, or a computer running terminal emulation software.

The pin assignments given for the DB-9 serial connection are in reference to the serial connector at the end of the cable. Use an RS-232 null modem cable to connect the 4100 to the host system.

Figure A-2. Corresponding pin out of DB-9 connector

1	2	3	4	5
6	7	8	9	

DB-9 modular connector

Pin assignments

Pin No.	Function
Pin 1	No Connection
Pin 2	RX data (Receive)
Pin 3	TX data (Transmit)
Pin 4	No Connection
Pin 5	Signal Ground
Pin 6	No Conection
Pin 7	RTS (Request to Send), not used
Pin 8	CTS (Clear to Send), not used
Pin 9	No Connection

RJ-11 Serial and RJ-45 Ethernet Pin Assignments
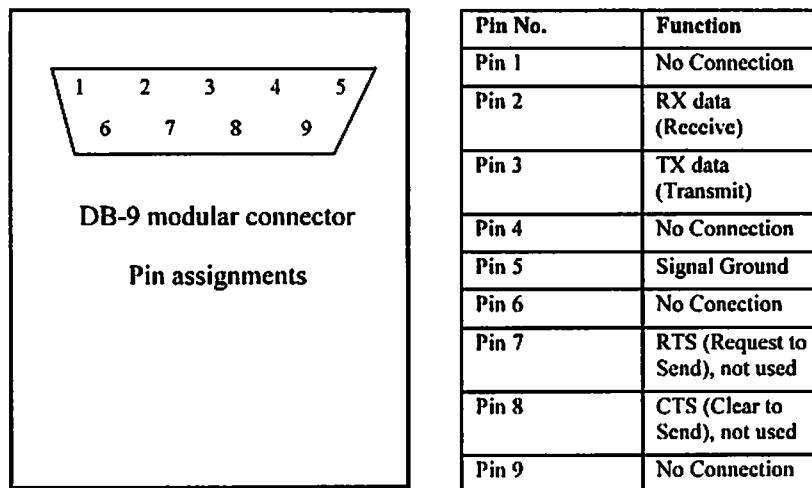
The pin assignments given for the RJ-45 Ethernet connection are in reference to the Ethernet receptacle on the back panel of the 4100. The 4100 Ethernet connection supports the IEEE specifications for the 10BASE-T Ethernet standard.

Figure A-3. RJ-45 pin assignments

RJ-45 modular receptacle

Pin assignments

1 2 3 4 5 6 7 8

Front View

Pin No.	Function
Pin 1	Transmit Out +
Pin 2	Transmit Out -
Pin 3	Receive In +
Pin 4	No Connection
Pin 5	No Connection
Pin 6	Receive In -
Pin 7	No Connection
Pin 8	No Connection
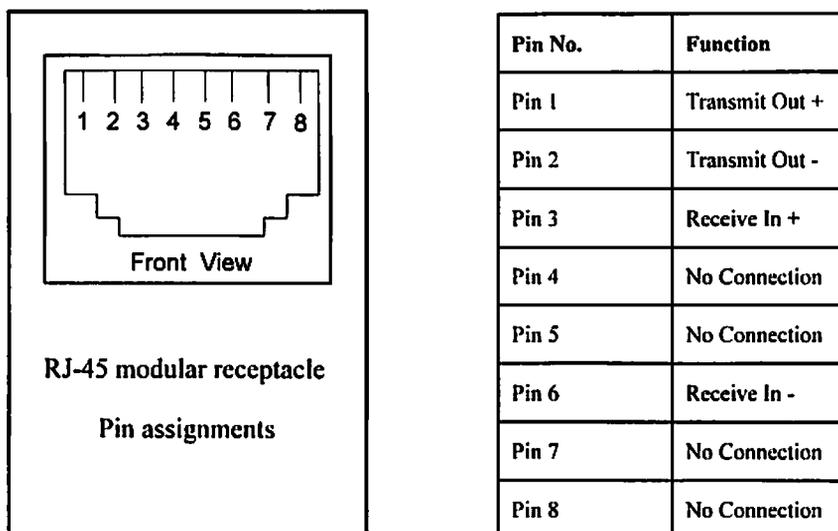
This completes Appendix A, RJ-11 Serial and RJ-45 Ethernet Pin Assignments.

RJ-11 Serial and RJ-45 Ethernet Pin Assignments

Appendix B

Fibre Channel Interface and Commands

Download Command

The Update Firmware command is used to download firmware to the Fibre Channel 4100 over Fibre Channel. Multiple Update Firmware Write Buffer commands will be required to accomplish the total transfer. All write commands except the final write will have the 3-bit Mode field set to 0x06. The last write command in the sequence will have the Mode field bits set to 0x07 to signify the end of transfer. Each Update Firmware write buffer command will return an FCP response. Update Firmware is successful when the FCP response returns 0x00 (success). When the download process is complete and the firmware image has been successfully written to FLASH, the 4100 will respond to the last transfer with 0x00, then re-boot with the updated firmware. If any errors occur, the Controller will return an FCP_RSP response RC value other than 0x00 and the 4100 will abort the update. In this case, the 4100 will not re-boot and the previous version of firmware will remain intact. The host will issue a Write Buffer command with:

Table B-1. Download command write buffer

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0x3B)							
1	Reserved					Mode		
2	Buffer ID							
3	(MSB)							
4	Buffer Offset							
5								(LSB)
6	(MSB)							
7	Parameter List Length							
8								(LSB)
9	Control							

- Byte 2 set to 0xFA,
- Bytes 6-8 set to the length of the outbound data length (maximum transfer length is 64K (0x10000)).
- The mode will be set to 0x06 for the first & middle Write Buffers and 0x07 for the last.

Note:

- Multiple Update Firmware commands will generally be required to transfer the entire program image from the host to the 4100 DRAM. When the last data block is transferred (mode = 0x07) the 4100 terminates data transfer and performs a CRC checksum on data received.
- It is required that the FC initiator sends sequentially from the beginning of the firmware image to the end. No out of sequence Write Buffers are allowed.
- If the CRC test is successful, the Controller will reboot. The 4100 will use the newly updated firmware. The previous firmware image is discarded. If the CRC test fails, the image transferred to DRAM is discarded, and the controller continues to use the previous firmware image.

Fibre Channel Interface and Commands

- Multi-frame sequences are allowed. Transfer Length for each write must be less than or equal to 64KB (65536 bytes).
- It is required that the Parameter list length be the same as the FCP_DL field in the FCP_CMND IU.

Report LUNs Command

The 4100 supports the FC Report LUNs command. The Report LUNs command will return a list of Logical Unit Numbers that can receive commands. The format of the report LUNs command is as follows:

Table B-2. Report LUNs command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0xA0)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	(MSB)							
7	Allocation Length							
8								
9	(LSB)							
10	Reserved							
11	Control Byte							

Table B-3. Report LUNs parameter list

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				LUN list length				
2								
3								(LSB)
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
LUN list								
0-7	First LUN							
	:							
0-7	Last LUN							

Note	The LUN list length is the number of LUNs times 8.

PRLI Data

The 4100 supports the discovery mechanism as described in the standard "Private Loop SCSI Direct Attach Rev. (section 10.3 - Target Discovery)". The 4100 returns the PRLI response data as specified in Table B-4.

Fibre Channel Interface and Commands

Table B-4. 4100 PRLI response data

Item	Value
PRLI Command Code	0x20
Page Length	0x10
Payload Length	0x10
Type Code	0x8
Type Code Extension	0x0
OPA	0x0
RPA	0x0
IPE	0x1
Response Code	0x1
Originator Process Associator	0x0
Responder Process Associator	0x0
Initiator Function	0x1
Target Function	0x1
Command/Data Mixed Allowed	0x0
Data/Response Mixed Allowed	0x0
Read XFER_RDY Disabled	0x1
Write XFER_RDY Disabled	0x0

This completes Appendix B, *Fibre Channel Interface and Commands.*

Appendix B

Fibre Channel Interface and Commands

Appendix C

SCSI Interface and Commands

SCSI Inquiry Data

The 4100 returns the inquiry data as defined in Table C-1 when a SCSI Inquiry Command is received. The 4100 rejects all other SCSI commands that are addressed to the 4100.

Table C-1. 4100 inquiry data

Peripheral Qualifier	0x00
Peripheral Device Type	0x0C - Indicates Bridge/Router function
RMB	0x00
Device Type Qualifier	0x00
ISO Version	0x00
AENC	0x00
TrmIOP	0x00
Response Data Format	0x02 - SCSI-2 Inquiry Data Format
Additional Length	0x20
RelAdr	0x00
Wbus32	0x00
Wbus16	0x00
Sync	0x00
Linked	0x00
CmdQue	0x00
SftRe	0x00
Vendor ID	"CROSSRDS"
Product ID	"4100"
Revision Level	"0.01"

The 4100 will only reply to a SCSI Inquiry when using 8-byte LUN field of 0x00's. Once the 4100 has been detected, then the devices on the SCSI-2 can be detected using the SCC logical unit addressing.

This completes Appendix C, *SCSI Interface and Commands*.

SCSI Interface and Commands

Appendix D

Addressing, Structures and Operation

Fibre Channel and SCSI systems employ different methods of addressing devices. The inclusion of a storage router requires that a method of translating device IDs be implemented so that each SCSI device is mapped to the appropriate Fibre Channel LUN. The SCSI buses establish bus connections between devices. Targets on a SCSI bus may internally address logical units. The addressing of a specific SCSI device is represented by the BUS:TARGET:LUN triplet.

When a Fibre Channel initiator initializes on a loop, the host must first determine what devices exist on the loop. Device discovery is performed, and an FCP target device list is built. Each device is queried for FCP logical units. The logical units are the actual devices that the operating system will address. When an initiator addresses a logical unit, the LUN field used is consistent in form with the SCC defined fields. All current Fibre Channel host bus adapter drivers are consistent with these methods. The addressing used is the SCC Logical Unit Addressing and Peripheral Device Addressing methods, shown in Table D-1 and Table D-2. First level addressing is supported, so only the first 2 bytes of the 8 byte FCP LUN are used.

Bit Byte	7	6	5	4	3	2	1	0
N	Address Method		Address Method Specific					
N+1	Address Method Specific							

Table D-1. SCC Addressing Structure

Codes	Description
00	Peripheral Device Addressing Method
01	Volume Set Addressing Method
10	Logical Unit Addressing Method
11	Reserved

Table D-2. Address Method Definitions

Bit Byte	7	6	5	4	3	2	1	0
N	1	0	Target					
N+1	Bus			LUN				

Table D-3. SCC Logical Unit Addressing

Bit Byte	7	6	5	4	3	2	1	0
N	0	0	Bus					
N+1	Target/LUN							

Table D-4. Peripheral Device Addressing

The 4100 supports the Peripheral Device Addressing Method and the Logical Unit Addressing Method, depending on the configuration.

Addressing, Structures and Operation

0:0x01	21:0x2E	42:0x52	63:0x74	84:0xA6	105:0xC9
1:0x02	22:0x31	43:0x53	64:0x75	85:0xA7	106:0xCA
2:0x04	23:0x32	44:0x54	65:0x76	86:0xA9	107:0xCB
3:0x08	24:0x33	45:0x55	66:0x79	87:0xAA	108:0xCC
4:0x0F	25:0x34	46:0x56	67:0x7A	88:0xAB	109:0xCD
5:0x10	26:0x35	47:0x59	68:0x7C	89:0xAC	110:0xCE
6:0x17	27:0x36	48:0x5A	69:0x80	90:0xAD	111:0xD1
7:0x18	28:0x39	49:0x5C	70:0x81	91:0xAE	112:0xD2
8:0x1B	29:0x3A	50:0x63	71:0x82	92:0xB1	113:0xD3
9:0x1D	30:0x3C	51:0x65	72:0x84	93:0xB2	114:0xD4
10:0x1E	31:0x43	52:0x66	73:0x88	94:0xB3	115:0xD5
11:0x1F	32:0x45	53:0x67	74:0x8F	95:0xB4	116:0xD6
12:0x23	33:0x46	54:0x69	75:0x90	96:0xB5	117:0xD9
13:0x25	34:0x47	55:0x6A	76:0x97	97:0xB6	118:0xDA
14:0x26	35:0x49	56:0x6B	77:0x98	98:0xB9	119:0xDC
15:0x27	36:0x4A	57:0x6C	78:0x9B	99:0xBA	120:0xE0
16:0x29	37:0x4B	58:0x6D	79:0x9D	100:0xBC	121:0xE1
17:0x2A	38:0x4C	59:0x6E	80:0x9E	101:0xC3	122:0xE2
18:0x2B	39:0x4D	60:0x71	81:0x9F	102:0xC5	123:0xE4
19:0x2C	40:0x4E	61:0x72	82:0xA3	103:0xC6	124:0xE8
20:0x2D	41:0x51	62:0x73	83:0xA5	104:0xC7	125:0xEF

Table D-5. Arbitrated Loop Node number to ALPA lookup table

The data shown in Table D-5 comes from the Fibre Channel Configuration Menu (setting the ALPA value) on the 4100 storage router. The user enters the node number (number to the left of the colon from Table D-5) and the router translates the node number into the corresponding ALPA value (number to the right of the colon in Table D-5).

Auto Assigned Addressing Option

The Auto Assigned option is similar to the Indexed addressing, but with the distinction that the table used is created through SCSI device discovery on power up or reset, and not otherwise retained. As the unit performs device discovery on the SCSI bus, the Index table FCP LUN values are filled with adjacent FCP LUNs referencing each subsequent SCSI device. The host system will then detect every attached SCSI device without voids, allowing full device discovery to the host. This allows easy configuration in environments where SCSI device ordering is not important, and where hot plugging of SCSI devices will not occur.

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Tape libraries are excellent candidates for using Auto Assigned Addressing. Configuration options provide for the SCSI discovery to be performed in order of bus, target, or LUN as desired for the specific environment.

Indexed Addressing Option

Indexed Addressing allows for host bus adapter (HBA) drivers that only use Peripheral Device addressing to access SCSI devices attached to the 4100. This is done by use of a table, which is indexed by sequential LUN values, indicating selected BUS:TARGET:LUN devices. It is not possible in this mode to address the 4100 as a controller unit directly. The table has the structure as shown in Table D-6.

The maximum size of the table is equal to the number of buses times the number of targets per bus, less one initiator ID per bus, times the number of LUNs per target.

The index table can be manually edited. Configuration tools allow for the table to be filled in order of increasing bus, target, or LUN, as may be desired for the specific requirements needed. A method is also provided to perform SCSI device discovery, and fill the table in the order that SCSI devices are discovered on the SCSI busses.

Addressing, Structures and Operation

FCP LUN Value	SCSI BUS:TARGET:LUN
0	0:0:0
1	0:1:0
2	0:2:0
3	0:3:0
4	0:4:0
5	0:5:0
6	0:6:0
	(0:7:0 occupied by Initiator ID)
7	0:8:0
(...)	(...)
13	0:14:0
14	0:15:0
15	1:0:0
16	1:1:0
17	1:2:0
(...)	(...)

Table D-6. Indexed Addressing Table

SCC Addressing Option

When a 4100 device is configured to use SCC addressing, the unit is capable of responding as a controller device to the FCP Initiator, or routing the FCP request to a specified BUS:TARGET:LUN. When a request using the Peripheral Device Addressing Method is received (An FCP command with the LUN field with bits 7 and 6 of byte 0 are set to 0), the unit routes the request to the internal processor, which acts on the command directly. When a request using the Logical Unit Addressing Method is received (bits 7 and 6 set to 10b), the request is routed to the BUS:TARGET:LUN as specified in the defined field.

Host systems using SCC addressing will typically do initial device discovery using the Peripheral Device Addressing method. On issuing an INQUIRY command to the 4100, the host will receive the 4100 Inquiry data, indicating the device type as a controller device (Inquiry data indicates device type is 0xC). The host will then know, on this

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basis, that subsequent commands to 4100 attached devices will use the Logical Unit Addressing method.

The host can perform discovery by either walking through the BUS:TARGET:LUN values as would a standard SCSI driver, or by issuing a REPORT LUNS command. This command is sent to the 4100 (using the Peripheral Device Addressing Method), and the 4100 returns a table indicating attached devices. The host can then perform actions on these 4100 attached devices directly without having to perform discovery by issuing commands through all possible combinations.

SCSI Initiators to Fibre Channel Targets

SCSI Initiators addressing Fibre Channel targets require that the Bus:Target:LUN selected be associated with a given Fibre Channel destination ID and FCP LUN field. When a command is received on the SCSI bus, the routing table for that unit is accessed to determine what destination ID, and thus, what FCP target device to which the command is routed. When the FCP_CMD is issued, the LUN field associated with that entry is used, to provide the additional LUN addressing behind the FCP target. Further identification in the later phases of the command processing is by the exchange identifier. The table used is shown in Table D-8. The table can be manually edited, for both the Loop ID (AL_PA) and LUN field. Two bytes are provided for the LUN field, so that devices using SCC addressing can be used. In these cases, the bit fields used must be manually configured.

For example, it may be desirable to address a FCP RAID controller using SCC Volume set addressing. In this case, LUN 0 would be addressed by using the LUN value 0x4000. Using Logical Unit Addressing, the LUN value would be 0x8000. Similarly, Bus 1, Target 2, LUN 3 would be represented as 0x8243.

Addressing, Structures and Operation

SCSI Address	FC Address
SCSI Bus 0, Target 0, LUN 0	Loop ID 0, LUN 0x0000
SCSI Bus 0, Target 1, LUN 0	Loop ID 1 LUN 0x0000
SCSI Bus 0, Target 2, LUN 0	Loop ID 2 LUN 0x0000
(...)	(...)
SCSI Bus 0, Target 0, LUN 1	Loop ID 16 LUN 0x0000
SCSI Bus 0, Target 1, LUN 1	Loop ID 17 LUN 0x0000
SCSI Bus 0, Target 2, LUN 1	Loop ID 18 LUN 0x0000
(...)	(...)
SCSI Target 7 Unavailable (Router Initiator ID)	

Table D-7. SCSI to FCP Routing Table

This completes Appendix D, *Addressing, Structures and Operations.*

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Addressing, Structures and Operation

Appendix E

Management Information Base (MIB)

A MIB (Management Information Base) is an element used in network management with SNMP (Simple Network Management Protocol) and a management station running a management application, such as Hewlett Packard's Open View. The management application uses GET and SET commands to get system information and set system environment variables.

Fibre Alliance MIB

Crossroads Systems supports the Fibre Alliance MIB. The Fibre Alliance is an industry consortium dedicated to implementing standard methods of management for SANs. The Fibre Alliance MIB has been submitted to the IETF for review as of September 14, 1999. As of this writing it has not yet been adopted as an IETF standard. For further information contact Crossroads Systems or go to the Fibre Alliance or IETF on the web.

Fibre Alliance: www.fibrealliance.org   **IETF: www.ietf.org**

Crossroads MIB

Crossroads Systems also supports a private MIB that can be accessed via Ethernet and is both a diagnostic and a configuration tool for the 4100. The following sections outline what MIB information is available for each interface type on the Crossroads Private MIB. For more information on accessing the Crossroads Private MIB, contact a Crossroads Systems services representative.

MIB Fibre Channel Interface Information

Fibre Channel data reported includes frame and packet information, upper layer protocol (ULP) type (FCP or IP), and other Fibre Channel specific information. Draft MIBs for Fibre Channel N_Ports and F_Ports are in the public domain.

The Crossroads Systems private MIB includes:
- Groups for Fibre Channel configuration
- Fibre Channel port physical table
- Fibre Channel port statistics
- SCSI-to-Fibre Channel mapping
- Fibre Channel-to-SCSI mapping

MIB SCSI Interface Information

The Crossroads Systems MIB gathers SCSI information for management purposes. This Crossroads Systems specific MIB provides information about the following:
- Number of I/O operations per bus
- Number of disconnects
- Abort count
- Number of bus resets
- Vital Product Data (VPD) from Inquiry command for each SCSI device
- SCSI configuration information

Management Information Base (MIB)

This information can be found in the SCSI Statistics Table, SCSI Config Group, and the SCSI Product Data Groups of the Crossroads Systems private MIB.

MIB Ethernet and Serial Interfaces Information

The Ethernet interface is used for configuration and management, so total traffic flow is relatively low. The basic Ethernet configuration items are found in the Management Interfaces (MI) Table. The serial port is provided for user configuration. The serial port baud rate will be kept in the MI Table.

This completes Appendix E, *Management Information Base (MIB)*.

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Management Information Base (MIB)

Appendix F

Reference Standards

- *Fibre Channel Physical and Signaling Interface (FC-PH)*, ANSI X3T9.3/Project 755D/Rev. 4.3, Contact: Global Engineering, 1-800-854-7179
- Fibre Channel Protocol for SCSI (FCP) Rev 12
- Fibre Channel Private Loop Direct Attach (FC-PLDA)
- *Fibre Channel Arbitrated Loop (FC-AL)*, ANSI X3T11/Project 960D/Rev. 4.54, Contact: Globe Engineering, 1-800-854-7179
- *GigaBaud Link Module (GLM) Family*, Fibre Channel System Initiative, FCSI-301-Revision 1.0
- *Common FC-PH Feature Sets Profiles*, Fibre Channel Systems Initiative, FCSI-101-Rev. 3.1
- *SCSI Profile*, Fibre Channel System Initiative, FCSI-201-Rev. 2.2
- *FCSI IP Profile*, Fibre Channel System Initiative, FCSI-202-Rev. 2.1

This completes Appendix F, *Reference Standards*.

Appendix F

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Reference Standards

Glossary

Adapter

A printed circuit assembly that translates data between the FC host processor's internal bus and a different bus, such as SCSI.

Address

See SCSI Addressing.

Addressing Mode

Used to create a mapping table that maps devices on the SCSI bus to Fibre Channel logical units.

AL_PA

Arbitrated Loop Physical Address. A unique one-byte valid value, derived and used in an Arbitrated Loop Topology as defined in ANSI specification FC_AL ver 4.5.

Arbitrated Loop

See Fibre Channel - Arbitrated Loop. (ANSI specification FC_AL ver 4.5)

Area

The second byte of the N_Port Identifier.

Auto-Assigned Mapping

A menu item. The auto-addressing option creates a mapping table using devices discovered upon powering up or resetting the 4100, that is not otherwise retained by the 4100.

Baud

A unit of signaling speed, expressed as the maximum number of times per second the signal can change the state of the transmission line or other medium (units of baud are sec^{-1}). Note: With Fibre Channel scheme, a signal event represents a single transmission bit.

Bus

A means of transferring data between modules and adapters or between an adapter and SCSI devices. For a SCSI bus definition, see SCSI Bus.

Channel

A general term for a path on which electronic signals travel.

Clusters

Two or more computers sharing the same resources on a communication link.

Device

See FC Device or SCSI Device.

Differential

An electrical signal configuration using a pair of lines for data transfer. The advantage of differential compared to single-ended configuration is a relative high tolerance for common-mode noise and crosstalk when used with twisted pair cables. In layman's terms, this means longer distance.

Domain

A FC term describing the most significant byte in the N_Port Identifier for the FC device. It is not used in the FC-SCSI

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hardware path ID. It is required to be the same for all SCSI targets logically connected to a FC adapter.

Exchange

A FC term for the basic mechanism used for managing an operation. An exchange identifies information transfers consisting of one or more related nonconcurrent sequences that may flow in the same or opposite directions, but always in half duplex mode. An exchange is identified by an OX_ID and an RX_ID.

Fabric

AN FC term that includes FC Arbitrated Loop, Switched Fabric, and Point-to-Point.

Fault LED

During power up and self test, the 4100 Fault LED comes on. After self test, if this LED remains on or comes on, the 4100 has a problem with one of its components. During normal operation, this LED should be off.

FC

See Fibre Channel.

FC Adapter

A printed circuit assembly that translates data between the FC host processor's internal bus and the FC link. This is also known as an HBA, or Host Bus Adapter.

FC-AL

See Fibre Channel - Arbitrated Loop.

FC Device

A device that uses Fibre Channel communications.

FC Port

An opening at the back of the 4100 that provides a fiber optic connection between the FC adapter and the FC host.

FC-SCSI Hardware Path ID

A FC term describing a list of values showing the physical hardware path of the FC host to the target device.

Format:
Bus_Converter/Adapter_Address.Protocol_Type.Area.Port.Bus.Target.LUN

Example: 8/4.8.0.0.2.4.0

Fiber

A fiber optic cable made from thin strands of glass through which data in the form of light pulses is transmitted (LASER, LED). It is often used for high-speed transmission over medium (200m) to long (10km)distances but it can be used for short distances (<200m).

Fibre

A generic FC term used to cover all transmission media types specified in the Fibre Channel Physical Layer standard (FC-PH), such as optical fiber, copper twisted pair, and copper coaxial cable.

Fibre Channel (FC)

Logically, the Fibre Channel is a bidirectional, full-duplex, point-to-point, serial data channel structured for high performance data communication. Physically, the Fibre Channel is an interconnection of multiple communication ports, called N_Ports, interconnected by a switching network, called a fabric, a point-to-point link, or an arbitrated loop. Fibre Channel is a generalized transport mechanism that has no protocol of its own or native input/output command set, but can transport any existing Upper Level Protocols (ULPs) such as SCSI and IP.

Fibre Channel - Arbitrated Loop (FC-AL)

One of three existing Fibre Channel topologies, in which 2 to 126 devices are interconnected serially in a single loop circuit. The arbitrated loop topology supports all classes of service and

guarantees in order delivery of frames when the source and destination are on the same loop.

Fibre Channel Protocol for SCSI (FCP)

FCP defines a Fibre Channel mapping layer (FC-4) that uses FC-PH services to transmit SCSI command, data, and status information between a SCSI initiator and a SCSI target. Using FCP enables transmission and receipt of SCSI commands, data and status, across the Fibre Channel using the standard Fibre Channel frame and sequence formats.

Frame

The smallest, indivisible unit of information transfer used by Fibre Channel. Frames are used for transferring data associated with a sequence. Frame size depends on the hardware implementation and is independent of the ULP or the application software.

FTP

File Transfer Protocol

GigaBit Interface Connector (GBIC)

A physical component that manages the functions of the FC-0 layer, which is the physical characteristic of the media and interface, including drivers, transceivers, connectors, and cables. Mounts on a FC adapter card and connects the 4100 to a FC host. Also referred to as a Physical Link Module (PLM).

Hardware Path

See FC-SCSI Hardware Path ID.

Host Bus Adapter (HBA)

See FC Adapter.

ID

Numerical identifier

Indexed Addressing

> A menu name. It allows for generic Fibre Channel host bus adapters to access SCSI devices attached to the 4100 using a table which is indexed by sequential LUN values.

Initiator

> A device (usually a host system) that requests an operation to be performed by another device known as a target (usually a peripheral).

Initiator Mode

> Configuration mode of the storage router in which a Fibre Channel initiator requests operations to be performed by a SCSI target device.

IP

> Internet Protocol

Link

> For Fibre Channel, it is a connection between two nodes, each having at least one N_Port (or the other end could be an F-Port), interconnected by a pair of optical or copper links, one inbound and one outbound.

Longwave

> Lasers or LEDs that emit light with wave lengths around 1300 nm. When using single mode (9 nm) fibre, longwave lasers can be used to achieve lengths greater than 2Km.

Loop Address

> A FC term indicating the unique ID of a node in Fibre Channel loop topology, sometimes referred to as a Loop ID. Also a status type in the FC Status Menu, showing the FC Loop Address of the 4100.

Loop Port (L_Port)

> A FC port that supports loops.

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LUN

> Logical Unit Number or Logical Unit; a subdivision of a SCSI target. For SCSI-3, each SCSI target supports up to sixteen LUNs (LUN-0 to LUN-16). Using LUNs, the FC host can address multiple peripheral devices that may share a common controller.

Management Information Base (MIB)

> A structured set of data variables, called objects, in which each variable represents some resource to be managed. A related collection of resources to be managed.

Mapping Table

> A table which is indexed by sequential LUN values, indicating selected BUS:TARGET:LUN devices. It is used by the 4100 to perform Fibre Channel-to-SCSI operations by default.

Mb

> Megabit.

MB

> Megabyte. (There are 8 bits in a byte.)

MIB

> See Management Information Base.

Motherboard

> The main PCA of the 4100 that provides a physical and logical connection between Fibre Channel and SCSI devices.

Multiplexer

> A device that allows two or more signals to be transmitted simultaneously on a single channel.

Node Name

> A field value under the FC Status Menu. The unique FC
> identifier, a 64-bit value, the factory assigns to the 4100.

N_Port

> A FC term defining a "Node" port. A FC-defined hardware
> entity that performs data communication over the FC link. It is
> identifiable by a unique Worldwide Name. It can act as an
> originator or a responder.

N_Port Identifier

> A FC term indicating a unique address identifier by which an
> N_Port is uniquely known. It consists of a Domain (most
> significant byte), an Area, and a Port, each 1 byte long. The
> N_Port identifier is used in the Source Identifier (S_ID) and
> Destination Identifier (D_ID) fields of a FC frame.

Offline

> Taking the 4100 offline indicates that all SCSI and FC adapters
> in the 4100 are offline.

> Taking a SCSI adapter offline means ending inputs/outputs and
> suspending all transactions going from the 4100 to the specified
> SCSI devices. The SCSI adapter is no longer active or available
> for access.

> Taking a FC adapter offline means ending inputs/outputs and
> suspending all transactions going from the 4100 to the specified
> FC device.

Online

> For the 4100, online indicates that at least one adapter in the
> 4100 is active and available for access.

> For a SCSI adapter, online indicates the SCSI adapter is active
> and available for access and input/output processing.

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For a FC adapter, online indicates the FC adapter is active and available for access and input/output processing.

Originator

The Fibre Channel N_Port responsible for starting an exchange. A FC originator is comparable to a SCSI initiator.

Point-to-Point

One of three existing FC topologies, in which two ports are directly connected by a link with no fabric, loop, or switching elements present. The 4100 which uses FC-AL to support Point-to-Point configurations.

Port Name

A field value under the FC Status Menu; the FC port identifier; a 64-bit value the factory assigns to each FC adapter.

POST

See Power On Self Test.

Power On Self Test (POST)

A group of tests run when the 4100 is powered on.

Processor

Contains the arithmetic and logic, control, and internal memory units that control the 4100.

Reset SCSI

For a specific SCSI bus, the host clears all inputs and outputs and then resets the bus and all the devices connected to it.

Responder

The logical function in an N_Port responsible for supporting the exchange initiated by the originator in another N_Port. A FC responder is comparable to a SCSI target. The 4100 is often the responder.

Router

A device which selectively forwards data between networks based on administratively defined preferences. The forwarding decision is based on paths between address mappings among dispersed devices. Storage Routers focus on the SAN environment. See **Storage Router**.

Router-to-Router

Configuration involving at least two storage routers where one router is in Initiator Mode and another in Target Mode.

SAN

Storage Area Network

SCC Addressing

A menu name. SCSI-3 Controller Commands (SCC) addressing is used to address SCSI devices attached to the 4100 using the SCC logical unit addressing method. In SCC addressing mode, the 4100 will respond to FCP commands as a SCC controller device.

SCSI

Small Computer System Interface. An industry standard for connecting peripheral devices and their controllers to an initiator.

SCSI Adapter

A 16-bit fast/wide differential or 8-bit narrow single-ended physical connection between the 4100 and the SCSI devices. Each SCSI adapter supports up to sixteen (for fast/wide) or eight (for narrow) SCSI devices, including itself.

SCSI Addressing

A SCSI adapter supports up to 16 devices, including itself. Each device has its own unique SCSI address. The SCSI address of a device dictates the device's priority when arbitrating for the SCSI bus. SCSI address "7" has the highest priority. The next

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highest priority address is "6" followed by 5, 4, 3, 2, 1, 0, 15, 14, 13, 12, 11, 10, 9, 8, with "8" being the lowest priority address.

The narrow SCSI adapter is factory set to address 7. A narrow SCSI adapter supports up to eight devices, including itself. SCSI address "7" has the highest priority followed by 6, 5, 4, 3, 2, 1, and 0.

SCSI Bus

The means of transferring SCSI data between SCSI devices. It is an 8-bit or 16-bit bus that supports up to eight or sixteen devices (including itself), in any mix of initiators and targets, with the limitation that at least one initiator and one target must be present.

SCSI Device

A single unit on the SCSI bus, identifiable by a unique SCSI address. A SCSI device can act as an initiator or target. For SCSI-3, each SCSI device supports up to sixteen LUNs.

SCSI Port

An opening at the back of the 4100 providing connection between the SCSI adapter and the SCSI bus.

SCSI Status

A menu name used to show the number of SCSI devices on the bus.

Shortwave

Lasers or LEDs that emit light with wavelengths around 780 nm or 850 nm. When using multimode fibre (50 nm), shortwave lasers can be used with FC links less than 500m. To achieve longer lengths, single-mode fibre is required. The preferred fibre core size is 50 micron as this fibre has large bandwidth so that the distance is limited by the fibre attenuation. A 62.5 micron core size is also supported for compatibility with existing FDDI installations. Fibre of this type has smaller bandwidth and, in this case, the distance is limited by the fibre bandwidth.

Glossary

SNMP

> Simple Network Management Protocol.

Speed

> A status type in the FC Status Menu showing the speed (1063 Mbps) of the FC adapter.

Storage Router

> An intelligent device within the SAN (storage area network) infrastructure that can handle multiple protocols, such as Fibre Channel and SCSI. The routing decision is based on paths between address mappings among dispersed initiators and targets.

Switched Fabric

> A FC term describing a switched topology, which is one of the three existing FC topologies. Fabric elements interconnect various N_Ports or NL_Ports and are responsible for frame routing.

TCP

> Transmission Control Protocol

Target

> A device (usually a peripheral) that responds to an operation requested by an initiator (usually a host system). Peripherals are targets, but for some commands (for example, a SCSI COPY command), the peripheral may need to act temporarily as an initiator.

Target Mode

> Configuration mode of the storage router in which a SCSI initiator requests operations to be performed by a Fibre Channel target device.

Terminator Block/Termination

An electrical connection at each end of the SCSI bus composed of a set of resistors (or possibly other components). Its function is to provide a pull-up for open collector drivers on the bus, and also impedance matching to prevent signal reflections at the ends of the cable.

The SCSI bus requires termination at both ends of the bus. One end of the SCSI bus is terminated by the SCSI adapter's internal termination. The other end should have a terminator placed on the 68-pin high density SCSI connector on the last SCSI peripheral. If this device is not terminated, data errors may occur.

TFTP

Trivial File Transfer Protocol

Topology

The physical or logical layout of nodes on a network. FC topologies include Point-to-Point, FC-AL, and Fabric.

Trap

In the context of SNMP, an unsolicited message sent by an agent to a management station. The purpose is to notify the management station of some unusual event.

View Node Name

A status type in the FC Status Menu showing the identification of the node.

View Port Name

A status type in the FC Status Menu showing the identification of the port.

World Wide Name (WWN)

A Name_Identifier which is worldwide unique, and represented by a 64-bit unsigned binary value.

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