Fibre Channel XIO™ and PCI Option Board Owner's Guide

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CONTRIBUTORS

Written by Carolyn Curtis and Mark Schwenden
Illustrated by Dan Young, Carolyn Curtis, James Oliver, and Mark Schwenden
Edited by Christina Cary
Production by Obe Lynd
Engineering contributions by James Oliver
St Peter's Basilica image courtesy of ENEL SpA and InfoByte SpA. Disk Thrower image courtesy of Xavier Berenguer, Animatica.

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About This Guide

The Silicon Graphics® Fibre Channel XIO™ and Peripheral Component Interconnect (PCI) option boards provide fibre channel ports for the Origin™ family of Origin2000™, Origin200™, OCTANE™, and Onyx2™ servers and graphics workstations.

The Fibre Channel XIO board provides two ports; the Fibre Channel PCI board provides one port. These ports can be cabled to Silicon Graphics Fibre Channel storage options.

Audience

This guide is written for owners and users of a Fibre Channel XIO or PCI option board. It presumes general knowledge of fibre channel technology, knowledge of the host system in which the option board is installed, and knowledge of the fibre channel storage devices to which the option board ports are to be cabled.

Structure of This Document

This guide consists of the following chapters:

- Chapter 1, "Fibre Channel Option Board Features," describes both Fibre Channel option boards and the media interface adapter (MIA), which is required for an optical interface.
- Chapter 2, "Fibre Channel Basics," provides an overview of the fibre channel standard, architecture, and applications, with regard to Silicon Graphics fibre channel options.
- Chapter 3, "Fibre Channel Option Board Cabling," describes optional cables and those included with the boards.

Note: For information on installing the XIO or PCI board, see your workstation or server owner's or installation guide. For Origin2000 and Onyx2 systems, only qualified Silicon Graphics support personnel may install the boards and set up storage options.

Other Documentation

Besides this manual, have handy the owner's or installation guide for the server or workstation in which the Fibre Channel board is installed, and the owner's guide(s) for the peripheral device(s) with which the Fibre Channel board is to interface. If you don't have these guides handy, the information is also online in the following locations:

- IRIS InSight™ Library: from the Toolchest, choose Help > Online Books > SGI EndUser or SGI Admin, and select the applicable owner's or hardware guide.

  Once you are in the library, choose Catalogs > Hardware Catalog > and look under the Owner's Guides for the applicable owner's guide.

- Technical Publications Library: if you have access to the Internet, enter the following URL in your Web browser location window: http://techpubs.sgi.com/library/

Chapter 1

Fibre Channel Option Board Features

This chapter describes the Fibre Channel XIO and PCI option boards that interface between the host system and fibre channel peripherals:

- "Fibre Channel XIO Board" on page 2
- "Fibre Channel PCI Board" on page 4
- "Fibre Channel Board LEDs" on page 5
- "Fibre Channel Board Connectors" on page 5
- "Optional Media Interface Adapter (MIA)" on page 6
- "Fibre Channel Board Logic" on page 7

Note: For a full description of Silicon Graphics fibre channel storage options, see the *Origin FibreVault and Fibre Channel RAID Owner's Guide*. For information on installing the XIO or PCI board, see your workstation or server owner's guide. In the case of Origin2000 and Onyx2 systems, only qualified Silicon Graphics support personnel may install the boards.

Fibre Channel XIO Board

The Fibre Channel XIO board is a half-size XIO option board that provides the high-performance interface between an Origin family system, such as an Origin2000 or Onyx2 workstation or server, and two fibre channel arbitrated loop (FC-AL or FCAL) interfaces, which are used to connect to fibre channel disk enclosures. (See Chapter 2, "Fibre Channel Basics," for an explanation of fibre channel topology and architecture.)

The Fibre Channel XIO board is available in two versions:

- For Origin2000, Origin200, and Onyx2 servers and graphics workstations (marketing code XT-FC-2P, assembly part number 030-0927-00x): this version has the hook actuator for the compression connector.
- For OCTANE workstations (marketing code X9-FC-2P, assembly part number 013-2119-00x): this version lacks the hook actuator, which is not needed for this platform.

The two versions have identical functionality and differ only in mechanical aspects appropriate to the platforms for which they are intended.

Each Fibre Channel XIO board has two connectors, labeled **Channel 0** and **Channel 1**. Each channel can control up to 110 fibre channel disks. Figure 1-1 shows the Fibre Channel XIO board and connectors (version for Origin2000, Origin200, and Onyx2 servers and graphics workstations).

Board installation depends on the type of Silicon Graphics workstation or server you have.

- Origin2000 and Onyx2 workstations and servers: Contact your factory-authorized field service personnel.
- All other applicable Silicon Graphics workstations and servers: See the owner's guide or installation guide. If you don't have these guides handy, the information is also online; see "Other Documentation" on page xii in "About This Guide."

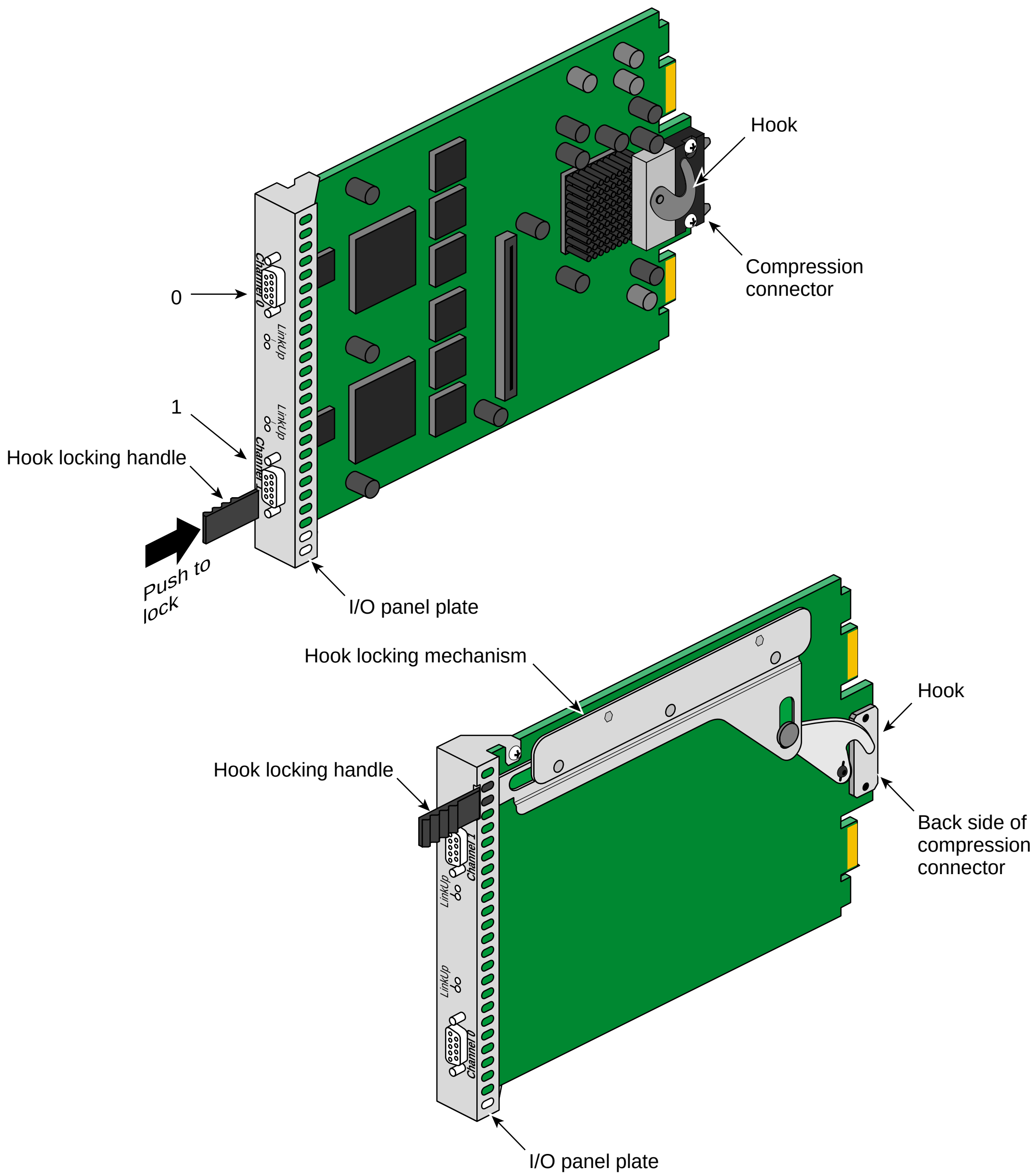

Figure 1-1 Fibre Channel XIO Board and Connectors (Origin2000, Origin200, and Onyx2)

Note: The board version for OCTANE workstations lacks the hook actuator, which would prevent installation of the board.

Fibre Channel PCI Board

The Fibre Channel PCI board (marketing code PCI-FC-1P, part number 9980953) is a half-size PCI option board that provides a high-performance interface between the host system and one FC-AL interface.

This board can be inserted into an Origin200 chassis, or into the PCI module of an Origin2000, Onyx2, or OCTANE chassis. The board I/O panel has one fibre channel connector, which can control up to 110 fibre channel disks. Figure 1-2 shows the Fibre Channel PCI board.

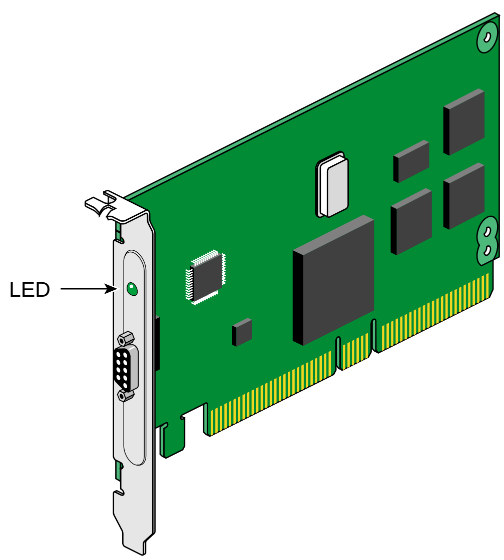

Figure 1-2 Fibre Channel PCI Board

To install the fibre Channel PCI board:

- If you have an Origin2000 or Onyx2 workstation or server, a qualified Silicon Graphics System Service Engineer must install the board.

- If you have an Origin200 workstation or server, follow installation instructions in the latest version of the *Origin200 Owner's Guide*.
- If you have an OCTANE workstation, follow installation instructions in the latest version of the *OCTANE PCI Module Installation Guide*.

Fibre Channel Board LEDs

LEDs on each type of Silicon Graphics Fibre Channel option board have these functions:

- Fibre Channel XIO board (see Figure 1-1):
  - The green LED (**LinkUp**) lights and remains on when the board is successfully initialized.
  - The orange LED lights and remains on when the loop is successfully initialized.

  Each connector on the board has a pair of LEDs.
- Fibre Channel PCI board (see Figure 1-2): The single green LED near the port lights and remains on when the board is successfully initialized.

Fibre Channel Board Connectors

Each Fibre Channel XIO board has two nine-pin (DB9) female connectors; each PCI board has one such connector. Figure 1-3 shows pin assignments.

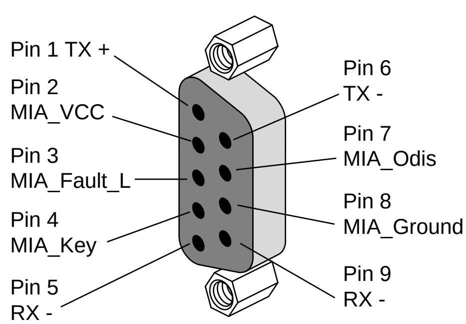

Figure 1-3 Fibre Channel Board Connector Pin Assignments

Both a copper and an optical interface are supported. The native interface is copper, as is standard for FC-AL. To use an optical cable, you must attach a media interface adapter, which is described in “Optional Media Interface Adapter (MIA)” on page 6.

You can cable a Fibre Channel XIO or PCI board to various Silicon Graphics Fibre Channel storage options. Fibre Channel enclosures can be RAID or JBOD (“just a bunch of disks”). For more information on Silicon Graphics Fibre Channel storage options, consult your Silicon Graphics sales representative or visit http://www.sgi.com/.

Optional Media Interface Adapter (MIA)

To support distances up to 300 meters, an optional fiber optic media interface adapter (MIA), is available; its marketing code is P-F-OE-KIT, which includes two modules (part number 9980952), one for each end of an optical cable. Silicon Graphics supports optical cabling distances of 25, 100, or 300 meters (between the host and the enclosure). The MIA is used with 62.5 µm optical cable.

The MIA uses a shortwave laser (CD-ROM laser) with a wavelength of 780 nm. A full-duplex module, it converts photons to electrons in one direction, and converts electrons to photons in the other direction.

An industry-standard duplex SC connection supplies the external fiber optic connection. This connection consists of two parts: the female part is in the MIA and the male part is on the fiber optic cable connector, as indicated in Figure 1-4. This connection is keyed.

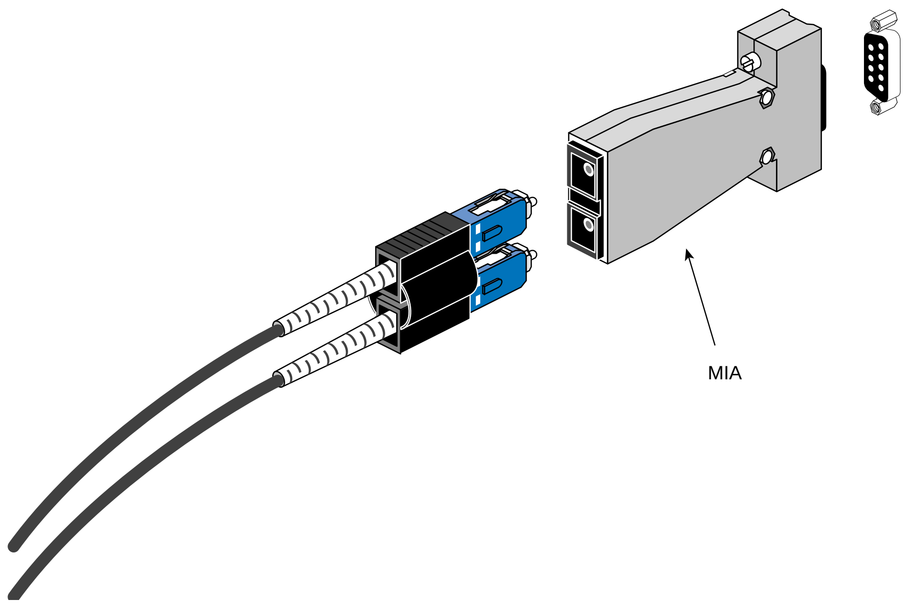

Figure 1-4 Media Interface Adapter (MIA) for Optical Cables

Fibre Channel Board Logic

Both types of board, XIO and PCI, provide conversion between a 1.062 gigabit fibre channel interface and a little-endian 64-bit PCI interface through the PCI-64 fibre channel ASIC. Each channel on each type of board has one of these components, as shown in Figure 1-5 and Figure 1-6, which are block diagrams of the boards.

Conversion from PCI to the 8-bit (400 MB per second) XIO interconnect link used in the Origin family of servers and graphics workstations and the OCTANE workstation is provided differently on the two boards:

- Fibre Channel XIO board: the board's PCI adapter provides this connection
- Fibre Channel PCI board: the PCI module containing the board, or the PCI backplane, provides this connection

Both boards support fibre channel Class 3 operations as a loop port (L_Port). The firmware supports Class 3 and FC-AL (arbitrated loop) transfers only. For details on ports, Class 3, and FC-AL, see Chapter 2.

Transceivers (SerDes) embedded on each board convert 8-bit parallel user data to 10-bit differential serial signals (8B10) and vice versa. They also provide frame synchronization, word alignment, and clock recovery for incoming serial data.

For incoming serial data, two recovered clocks at 53.125 MHz for odd or even bytes are provided as outputs on two pins, 180 degrees out of phase. Any required equalization to compensate for high-frequency losses for copper cables (by attenuating the lower frequencies to match) is supplied externally to the Fibre Channel option board. Serial data in both directions between the transformer and the external connector is AC-coupled via a capacitor.

If the Fibre Channel board loses power or the physical fibre channel connection is broken, the link that the board is attached to becomes inoperable. High-availability loop configurations require the use of a fibre channel hub (or switch).

Figure 1-5 is a Fibre Channel XIO board block diagram.

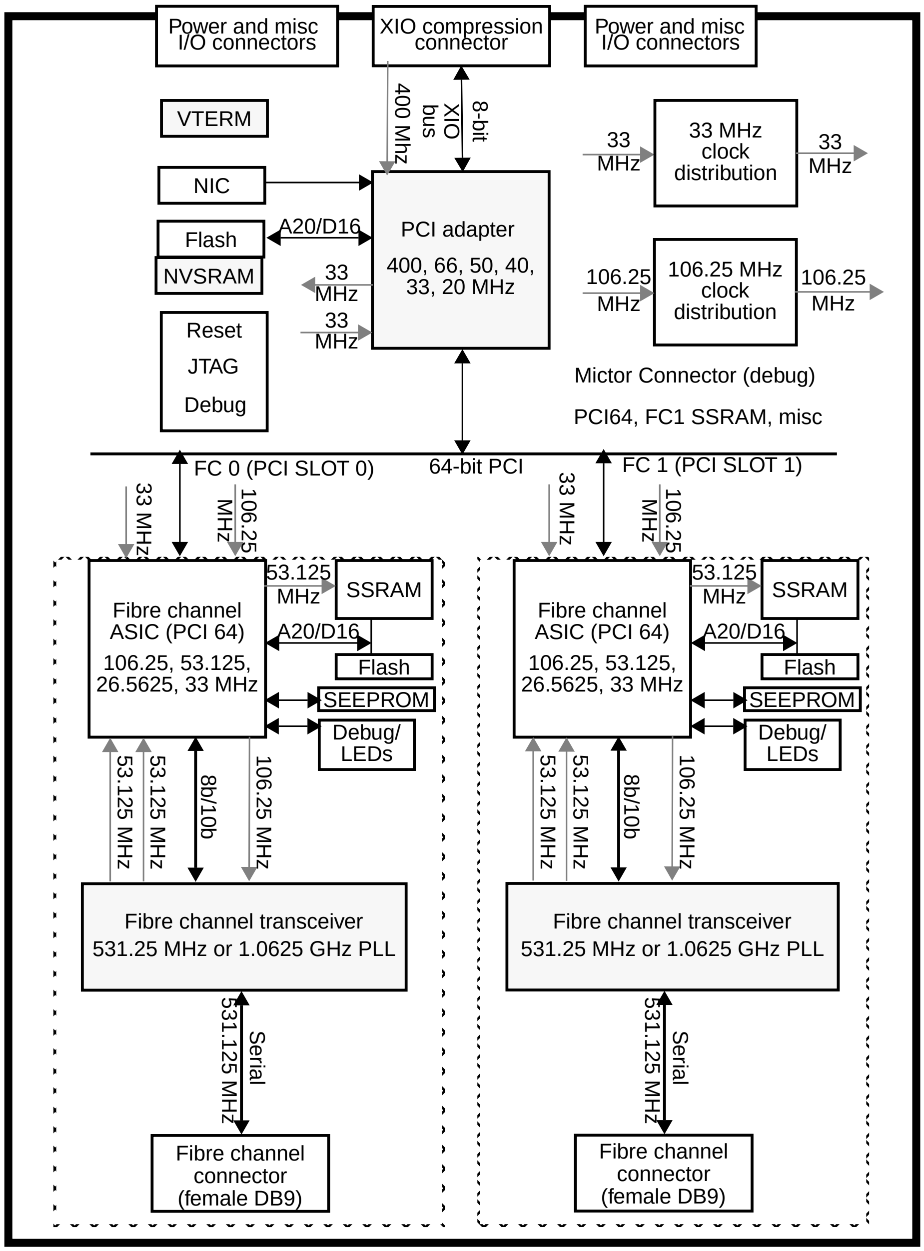

Figure 1-5 Fibre Channel XIO Board Block Diagram

Figure 1-6 is a Fibre Channel PCI board block diagram.

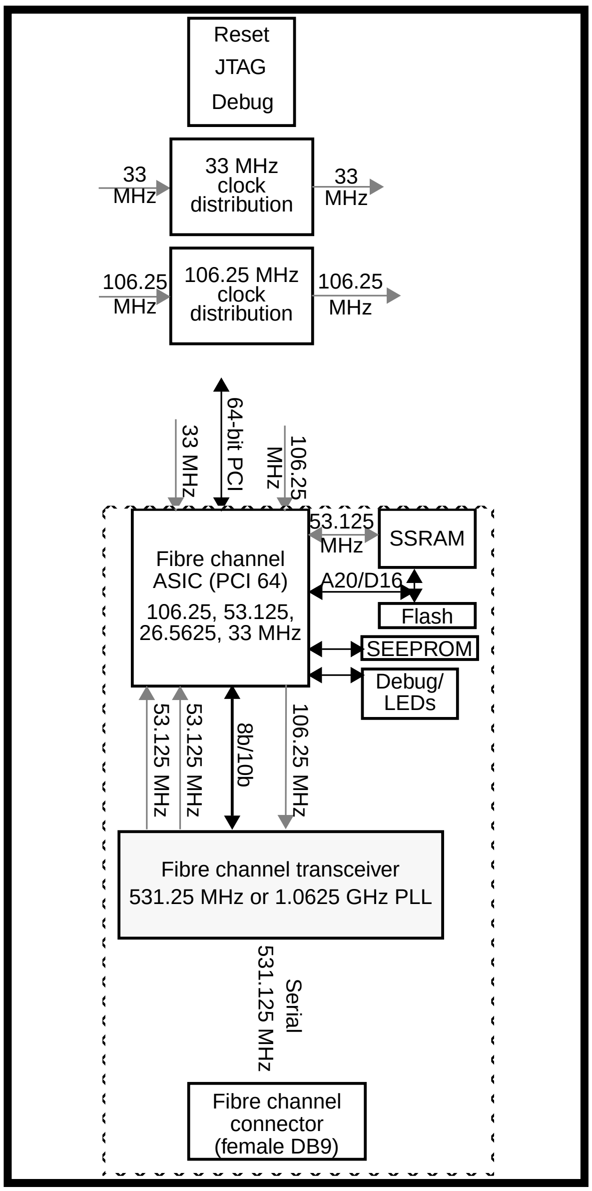

Figure 1-6 Fibre Channel PCI Board Block Diagram

Chapter 2

Fibre Channel Basics

This chapter provides an overview of fibre channel with regard to Silicon Graphics fibre channel options. It briefly explains

- "The Fibre Channel Standard" on page 11
- "Networks, Channels, and Fibre Channel" on page 12
- "Fibre Channel Applications" on page 14
- "Silicon Graphics Fibre Channel Ports and Topologies" on page 15
- "Fibre Channel Layers" on page 18

The Fibre Channel Standard

Fibre channel[1] is the general name of an integrated set of standards being developed by the American National Standards Institute (ANSI).[2] The fibre channel standard defines a high-speed data transfer interface that can be used to connect workstations, mainframes, supercomputers, storage devices, and displays. The fibre channel standard addresses the need for very fast transfers (up to 1 gigabit per second) of large amounts of information. Currently, fibre channel's main use is as an interface to storage.

Conceived as a generic, efficient physical transport system that can support multiple protocols, the standard also relieves system manufacturers of the burden of supporting the variety of channels and networks currently in place, because it provides one standard for networking, storage, and data transfer. Note that this Silicon Graphics implementation is for communication with mass storage systems only.

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1 Some information in this chapter was derived from the Fibre Channel Loop Community (FCLC) Web site, and the Fibre Channel Association (FCA) technical information Web site.

2 For information on the ANSI Fibre Channel standards, contact Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112 USA (303)-397-0271 or (800)-854-7179 (U.S. & Canada).

Fibre channel can provide a general transport vehicle for Upper Level Protocols (ULPs), including the Intelligent Peripheral Interface (IPI) and Small Computer System Interface (SCSI) command sets, high-performance parallel interface (HIPPI) data framing, Internet Protocol (IP), and IEEE 802.2. Proprietary and other command sets can also use and share the fibre channel, although such use is not defined as part of the fibre channel standard and is not supported by Silicon Graphics host systems. The Silicon Graphics implementation currently supports only the SCSI fibre channel protocol.

Note: For a description of Silicon Graphics fibre channel storage options, see the *Origin FibreVault and Fibre Channel RAID Owner's Guide*.

Networks, Channels, and Fibre Channel

The two most common peripheral protocols for device communication in the computer industry are networks and channels.

Networks

- involve I/O interfaces that usually support many small transactions with relatively high overhead due to software involvement in the flow of information
- allow a host or device in the network to communicate with any other device
- operate in an open, unstructured, and unpredictable environment

Channels

- supply peripheral I/O interface to a host and transport large amounts of data between the host and peripherals
- keep data processing overhead to a minimum by handling data transfer in hardware, with little or no software involvement once an I/O operation begins
- operate in a closed, structured, and predictable environment where all devices that can communicate with a host are known in advance and any change requires host software or configuration table changes

Fibre channel technology attempts to combine the best of these two methods into an I/O interface that meets the needs of both channel users and network users. Fibre channel communications can be conducted over copper coax, twisted pair, or optical fiber. Note that Silicon Graphics currently supports only copper coax, with optical cable and a media interface adapter (MIA) as an option.

Fibre Channel technology provides three different interconnect topologies to serve the combined needs of channel and network usages. These three topologies are:

- fabric
- point-to-point
- arbitrated loop

Currently, Silicon Graphics supports only arbitrated loop technology, (see "Silicon Graphics Fibre Channel Ports and Topologies" on page 15).

Fabric Topology

A fabric topology permits dynamic interconnections between nodes through ports connected to the fabric. This is a standard network configuration. In the future, it may be possible to carry both network traffic and disk I/O over the same wire.

Point-to-Point Topology

In point-to-point host applications, two ports are connected to a link. The transmitter of each port is connected directly to the receiver of the opposite port. This topology limits the number of connections that can be made across the wire.

Arbitrated Loop Topology

The arbitrated loop topology used by Silicon Graphics is called fibre channel arbitrated loop (FC-AL or FCAL). In this topology, each port arbitrates for access to the loop. Ports that "lose" the arbitration act as repeaters of all traffic on the loop. The loop is a dedicated transmit channel and a dedicated receive channel that are clad together into one cable to form a loop out and back. This protocol allows up to 127 ports connected in a serial loop (one FL_Port and 126 NL_Ports). Silicon Graphics supports a maximum of 110 disks in a single rack.

Ports are called Node Ports (N_Ports), Node_Loop Ports (NL_Ports), Fabric_Ports (F_Ports), or Fabric_Loop Ports (FL_Ports).

An NL_Port represents each disk in a disk array. Each NL_Port sees all messages and passes messages not addressed to that port. Ports passing messages are said to be in "repeat mode."

Fibre Channel Applications

Figure 2-1 shows fibre channel in the overall Origin2000 and Onyx2 I/O structure.

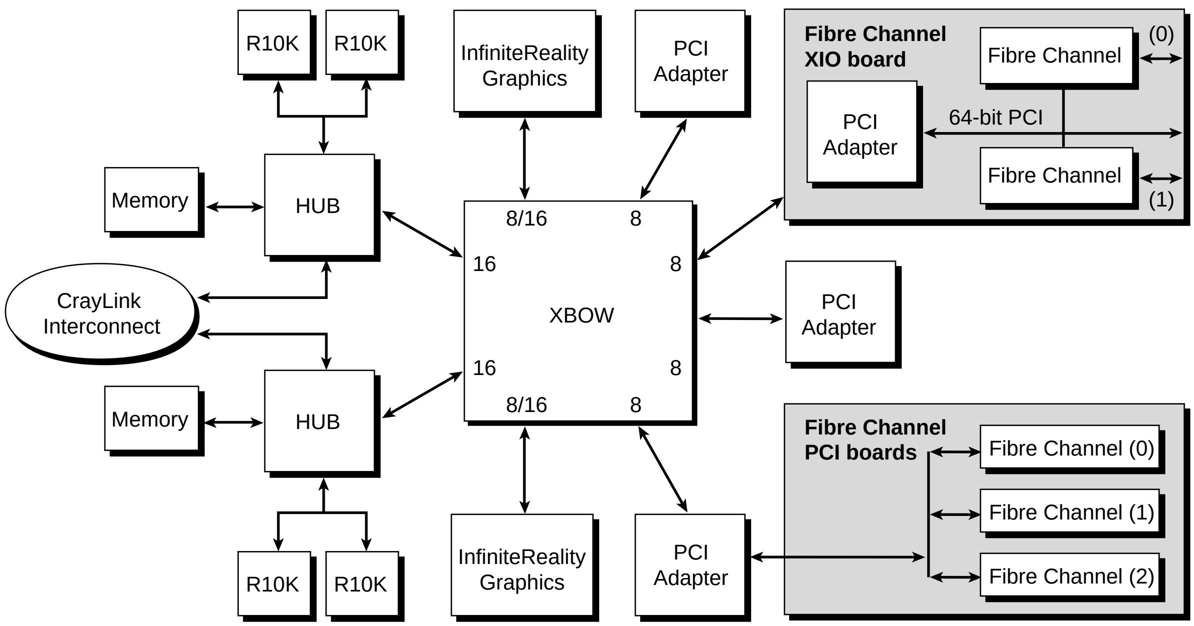

Figure 2-1 Fibre Channel in the Origin2000 and Onyx2 I/O Structure

Fibre channel is useful for a variety of applications:

- scientific graphics and video markets, which use high bandwidth rates with large I/O requests
- file server and database markets, which must support large amounts of I/Os per second (IOPS) with relatively small random I/Os
- the emerging video-on-demand market, which must provide many random data streams at a guaranteed data rate (which may or may not include disk failure)

High-availability RAID is also a requirement for this market. Fibre channel RAID addresses the needs of this market by supporting several disks in a well-balanced access pattern on a single arbitrated loop. The arbitrated loop also provides an arbitration fairness scheme that prevents high-priority requests from starving low-priority requests. For more information on high availability and RAID within fibre channel options, see the *Origin FibreVault and Fibre Channel RAID Owner's Guide*.

Silicon Graphics Fibre Channel Ports and Topologies

Figure 2-2 diagrams the Silicon Graphics fibre channel arbitrated loop topology.

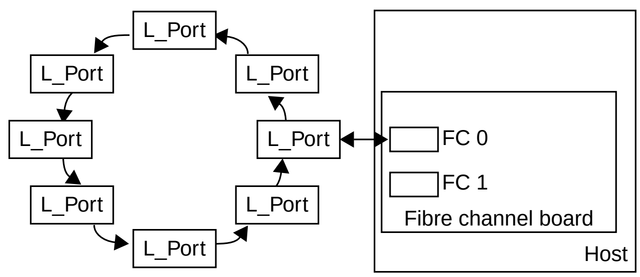

Figure 2-2 Fibre Channel Arbitrated Loop (FC-AL)

FC-AL is a shared-bandwidth distributed topology with arbitration fairness. Although the Silicon Graphics FC-AL option potentially supports 126 active L_Ports, current support is limited to a maximum of 110 disks within a single rack. Communication on a loop is between two devices at a time. All nonactive FC-AL ports act as repeaters; all devices on the loop run at the same interface speed.

The arbitrated loop topology is a distributed topology in which each port includes the minimum necessary function to establish a circuit. The ports are all L_Ports.

Disk L_Ports use the Point-to-Point Protocol (create a point-to-point circuit between two L_Ports).

Figure 2-3 diagrams an example of port arbitration.

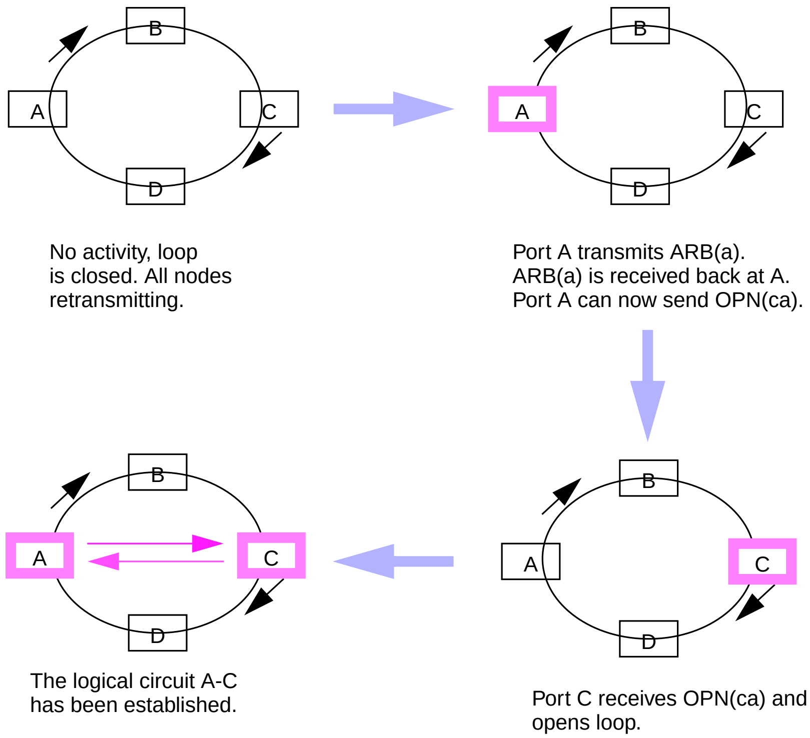

Figure 2-3 Port Arbitration Example

Port arbitration begins with one port replacing fill words between frames with an arbitration primitive called “ARBx.” If it goes completely around the loop and returns to the sending port, then that port has won arbitration.

A port that wins arbitration stops retransmitting received data and opens the loop between its receiver and transmitter by sending out the open primitive, OPNyx, where “y” represents the physical address of the destination port (also known as Arbitrated Loop Physical Destination, AL_PD) and “x” represents the sending port. See Figure 2-3 for an example of loop functions.

Closing a loop is done by transmitting the close primitive (CLS). The partner port finishes its work and retransmits the CLS and then the loop is available for arbitration again.

The FC-AL loop interface is an implementation of SCSI-3 architecture that provides higher performance, greater connectivity, and high-availability features. FC-AL was designed as a low-cost method of connecting multiple hosts and storage devices without requiring the use of switches and fabrics. Note that multi-host configurations require the use of special optional software and hardware; ask your Silicon Graphics sales or service representative for information.

Data Transfer in Fibre Channel

Data transfers in fibre channel use the following parameters:

- DC-balanced 8-bit/10-bit (8B10) signals with odd or even disparity
- variable-length data frames (maximum 2 KB)
- 32-bit CRC on frames

Combining channel and LAN characteristics, fibre channel uses buffers, one at the source node (port) and one at the destination. Each buffer can be any size.

FC layers 0, 1, and 2 (see “Fibre Channel Layers” on page 18 for an explanation of FC layers) move data from one buffer to another without regard to the format or meaning of data, thus avoiding the overhead required for handling different network communications protocols. FC layers 0, 1, and 2 provide only control of the transfer and simple error detection, relying on the content of the message header to trigger actions such as routing data to the proper buffer. Except for how FC formats serial data for transmission, protocols are irrelevant; communication protocols between devices can be whatever those devices require. The Silicon Graphics fibre implementation uses SCSI Framing Protocol for FC-AL communications between devices and the host system.

Information can flow between two ports—actually between their buffers—in both directions simultaneously. The mechanism coordinating the flow of information between two N_Ports is an *exchange*.

Data transfer takes place in units called *frames*, each a maximum of 2048 bytes of data. The frame contains the information to be transmitted, the address of the source and destination ports, and link control information. Frames are of two types, Data frames and Link_Control frames. Data frames can be used as Link_Data frames and Device_Data frames. A set of related frames for one operation is called a *sequence*.

There are no limits on the size of a transfer. Frame sizes are transparent to upper-level software because the unit of transfer is a sequence. A specific layer of fibre channel (FC-2, described in "FC-2" later in this chapter) is responsible for breaking a sequence into the frame size that was negotiated between ports. This layer of FC also detects transmission errors using 32-bit cyclic redundancy checking (CRC).

Fibre Channel Layers

Fibre channel is a layered architecture with five layers: FC-0, FC-1, FC-2, FC-3, and FC-4. Figure 2-4 diagrams the relationship between FC layers and open system interconnection (OSI) layers.

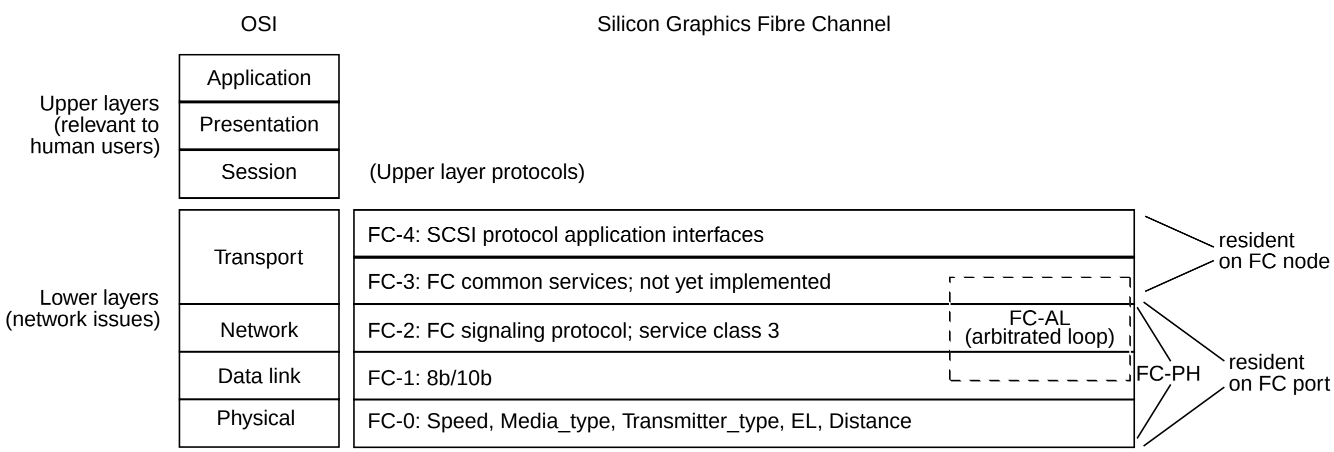

Figure 2-4 Fibre Channel Layers and OSI Layers

FC-PH is the FC Physical and Signaling Interface, revision 4.1, defined in the FC-PH standard (ANSI X4.3). FC-PH is made up of FC0, FC1, and FC2.

Each FC layer is described and explained in the following separate sections:

- "FC-0" on page 19
- "FC-1" on page 19
- "FC-2" on page 19
- "FC-3" on page 22
- "FC-4" on page 22

FC-0

FC-0 defines the physical interface (media), or link, encompassing a wide variety of media, speed, and distance combinations. It defines the physical link in the system, including the fiber, connectors, and optical and electrical parameters for a variety of data rates. For characteristics of Silicon Graphics FC copper and fiber optic cables, see "Cable Characteristics" on page 24 in Chapter 3.

Note: In FC, there is no change in protocol between copper and fiber.

FC-1

FC-1 defines the transmission protocol, including serial encoding and decoding rules, special characters, and error control. The information transmitted over a fiber is encoded 8 bits at a time into a 10-bit transmission character. The transmission code, which must be DC-balanced to support the electrical requirements of the receiving units, improves the transmission characteristic of information. The transmission characters ensure that short-run lengths and enough transitions are present in the serial bitstream to make clock recovery possible.

FC-2

FC-2, the signaling protocol, is the transport mechanism of fibre channel. It defines the framing rules of the data to be transferred between ports, the different mechanisms for controlling service classes, and the means of managing the sequence of a data transfer. The standard defines these building blocks to aid in the transport of data across the link:

- "Ordered Set" on page 20
- "Frame" on page 20
- "Sequence" on page 21
- "Exchange" on page 21
- "Protocol" on page 21

Ordered Set

An ordered set is a four-byte transmission word containing data and special characters that have a special meaning. Ordered sets provide the ability to obtain bit and word synchronization, which also establishes word boundary alignment. An ordered set always begins with the special character K28.5. Three major types of ordered sets are defined by the signaling protocol:

- frame delimiters: Start-of-Frame (SOF) and End-of-Frame (EOF), which immediately precede or follow the contents of a frame.
- two primitive signals (primitives), Idle and Receiver Ready (R_RDY):
  - Idle indicates an operational port facility ready for frame transmission and reception.
  - R_RDY indicates that the interface buffer is available for receiving further frames.

  The primitives are transmitted and repeated continuously to indicate specific conditions within a port or conditions encountered by the receiver logic of a port.
- four primitive sequences:
  - Offline (OLS)
  - Not Operational (NOS)
  - Link Reset (LR)
  - Link Reset Response (LRR)

When a primitive sequence is received and recognized, a corresponding primitive sequence or Idle is transmitted in response. Recognition of a primitive sequence requires consecutive detection of three instances of the same ordered set.

Frame

The basic building block of an FC connection is the frame, which contains the information to be transmitted (payload), the address of the source and destination ports, and link control information. Frames are broadly categorized as data frames and Link_control frames. Data frames can be used as Link_Data frames and Device_Data frames. Link_control frames are classified as Acknowledge (ACK) and Link_Response (Busy and Reject) frames.

Each frame begins and ends with a frame delimiter. The frame header immediately follows the SOF delimiter. The frame header controls link applications and device protocol transfers, and detects missing or out-of-order frames. An optional header can contain additional link control information. A field up to 2112 bytes (payload) contains the information to be transferred from a source N_Port to a destination N_Port. The four-byte CRC, which precedes the EOF delimiter, detects transmission errors.

Sequence

A sequence is formed by a set of one or more related frames transmitted unidirectionally from one port to another. Each frame in a sequence is uniquely numbered with a sequence count. Error recovery, controlled by an upper protocol layer is usually performed at sequence boundaries. For more detail, see "Data Transfer in Fibre Channel" on page 17 in this chapter.

Exchange

An exchange is composed of one or more nonconcurrent sequences for a single operation. The exchanges can be unidirectional or bidirectional between two ports. Within a single exchange, only one sequence can be active at any one time, but sequences of different exchanges can be active concurrently.

Protocol

The protocols are related to the services offered by

- primitive sequence protocols for link failure
- N_Port login protocol: before performing data transfer, an N_Port interchanges its service parameters with another N_Port
- N_Port logout protocol: performed when an N_Port requests removal of its service parameters from the other N_Port (used to free resources at the connected N_Port)
- data transfer protocol: methods of transferring upper-layer protocol (ULP) data using FC flow control management

Flow control paces the flow of frames between N_Ports and between an N_Port and the fabric to prevent overrun at the receiver. Class 3 uses only buffer-to-buffer flow control. Flow control is managed by the sequence initiator (source) and sequence recipient (destination) Ports using Credit and Credit_CNT:

- Credit is the number of buffers allocated to a transmitting Port.
- Credit_CNT represents the number of data frames that have not been acknowledged by the sequence recipient.

Buffer-to-buffer flow control is managed between an N_Port and an F_Port or between N_Ports in point-to-point topology. Each port is responsible for managing BB_Credit_CNT. BB_Credit is established during the fabric login. The Sequence recipient (destination) port signals by sending a Receiver_Ready primitive signal to the transmitting port when it has free receive buffers for the incoming frames. Frame delivery is not confirmed.

Silicon Graphics fibre channel provides for service class 3. A connectionless service ("hopeful" or "datagram"), Class 3 is the most practical for connections requiring a lot of time. Class 3 has no end-to-end flow control or delivery acknowledgments. A datagram is the transfer of data without first establishing that data will be delivered. Timeouts are used to decide whether information is lost and retransmission is required.

FC-3

FC-3 defines the common services provided by FC-PH to the ULPs. These services, which include striping, hunt groups, and multicast, are not implemented yet.

FC-4

FC-4, the upper-layer protocol (ULP) interface, defines the ULP-specific mapping protocols that provide interfaces between FC-PH and the ULPs. Silicon Graphics FC supports only the SCSI-3 packetized protocol for SCSI.

Fibre Channel Option Board Cabling

The storage options use either copper or optical cable of various lengths, as summarized in Table 3-1.

Table 3-1 Cables for Fibre Channel Storage Options

Material	Length	Marketing Code	Part Number	Included/Optional	Use
Copper	10 m (32.8 feet)	X-F-COP-10M	018-0570-001	Included in option; one per port	Option board to enclosure
Copper	25 m (82 feet)	X-F-COP-25M	018-0571-001	Optional	Option board to enclosure
Optical	25 m (82 feet)	X-F-OPT-25M	018-0656-201	Optional	Option board to enclosure
Optical	100 m (328 feet)	X-F-OPT-100M	018-0656-301	Optional	Option board to enclosure
Optical	300 m (984 feet)	X-F-OPT-300M	018-0656-401	Optional	Option board to enclosure

In the Silicon Graphics fibre storage implementation, copper cable is standard and optical is optional. Two 10-meter copper cables are shipped with the Fibre Channel XIO option board; one is shipped with the Fibre channel PCI option board.

Note: Copper cables longer than 10 meters must be equalized.

This chapter describes cables for the Fibre Channel XIO and PCI option board, both optional and those included in the shipment:

- “Cable Characteristics” on page 24
- “Cable Distances and Shielding” on page 25
- “Cable Labels” on page 25

Cable Characteristics

Table 3-2 summarizes characteristics for the copper twinax and fiber optic cables.

Table 3-2 Cable Characteristics

Characteristic	Copper Twinax	Fibre Optic
Variant	100-TW-EL-S full-duplex (quad conductor)	100-M5-SL/N-I
Range	25 meters maximum; > 10 meters requires equalization	300 meters maximum
Transmitter	PECL	Optical laser 780 nm
Medium	150 ohm	62.5 micron
Range	25 meters	300 meters
Connector	Male DB9	SC duplex connector
Maximum length	Enclosure to server: 25 m	Enclosure to server: 300 m

Caution: To maintain acceptable quality and signal integrity, use only Silicon Graphics-supplied copper and optical cables with your fibre enclosures.

Cable Distances and Shielding

This section discusses each type of FC cable in more detail, including allowable distances.

For information on cabling Silicon Graphics fibre channel storage options to the Fibre Channel XIO or PCI board, see the *Origin FibreVault and Fibre Channel RAID Owner's Guide*. In the case of Origin2000 and Onyx2 systems, only qualified Silicon Graphics support personnel install the boards and cable the options.

Caution: If a host system and a fibre channel enclosure are on separate building grounds, grounding problems may arise when this cabling is connected with a copper cable utilizing a DC ground shield on both ends. In this case, use the optional fibre optical cabling to link host and enclosure.

Copper Cable Distances and Shielding

The copper twinax cable is a fully shielded, full-duplex, balanced cable capable of supporting distances of 25 meters at the 1.0625 Gbaud transfer rate. The connectors for both ends of the twinax cable are male DB9 connectors that plug in at the host and enclosure. The shield on each end of the cable connects directly to the connector shield, providing a DC ground on both ends.

Note: Copper cables longer than 10 meters must be equalized.

Fibre Optic Cable Distances

Silicon Graphics fibre channel products support 62.5 µm optical cable and a maximum distance of 300 meters.

Cable Labels

Included in the Fibre Channel XIO board shipment is a label kit for identifying fibre channel cable connectors. Use these labels to identify which controller on which option board is supporting a particular fibre channel storage enclosure, fibre rack, or loop.

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  Technical Publications
  Silicon Graphics, Inc.
  2011 North Shoreline Boulevard, M/S 535
  Mountain View, California 94043-1389

Fibre Channel XIO™ and PCI Option Board Owner's Guide

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CONTRIBUTORS

Written by Carolyn Curtis and Mark Schwenden
Illustrated by Dan Young, Carolyn Curtis, James Oliver, and Mark Schwenden
Edited by Christina Cary
Production by Obe Lynd
Engineering contributions by James Oliver
St Peter's Basilica image courtesy of ENEL SpA and InfoByte SpA. Disk Thrower image courtesy of Xavier Berenguer, Animatica.

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