IBM TotalStorage SAN Switch

3534 Model F08 User's Guide

Read Before Using

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GC26-7454-01

IBM TotalStorage SAN Switch

3534 Model F08 User's Guide

GC26-7454-01

Note:
Before using this information and the product it supports, read the general information under “Notices” on page 23.

Second Edition (February 2003)

Contents

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Tables

Safety and environmental notices

This section contains information about:

- Safety notices used in this book
- Safety inspection for this product
- Environmental guidelines for this product

Safety notices and their translations

Safety notices are printed in English throughout this book.

- A *Danger* notice warns you of conditions or procedures that can result in death or severe personal injury.
- A *Caution* notice warns you of conditions or procedures that can cause personal injury that is neither lethal nor extremely hazardous.
- An *Attention* notice warns you of conditions or procedures that can cause damage to machines, equipment, or programs.

For translations of danger and caution notices, see *IBM TotalStorage SAN Fibre Channel Switch 3534 Model F08 Translated Safety Notices*, GC26-7459-00. The notices are listed in numeric order based on their IDs, which are displayed in parentheses at the end of each notice. See the following examples for the location of the ID numbers.

DANGER

An electrical outlet that is not correctly wired could place a hazardous voltage on metal parts of the system or the products that attach to the system. It is the customer's responsibility to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (1)

CAUTION:
The 3534 Model F08 switch is designed to be installed by the customer, and is certified as "customer setup". Make sure that the system or rack into which the switch will be installed is also designed and certified for customer setup; if it is not, then the switch must be installed by a CE. (1)

Safety inspection

Perform the following safety checks to identify unsafe conditions. Be cautious of potential safety hazards that are not covered in the safety checks. If unsafe conditions are present, determine how serious the hazards are and whether you should continue before correcting the problem.

CAUTION:
The 3534 Model F08 switch is designed to be installed by the customer, and is certified as "customer setup". Make sure that the system or rack into which the switch will be installed is also designed and certified for customer setup; if it is not, then the switch must be installed by a CE. (1)

Checking the machine

Perform the following external machine checks:

1. Verify that all external covers are present and are not damaged.

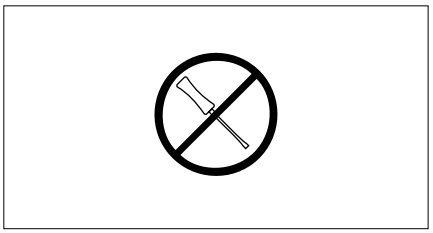
2. Ensure that all latches and hinges are in correct operating condition.
3. If the 3534 Model F08 is not installed in a rack cabinet, check for loose or broken feet.
4. Check the power cord for damage.
5. Check the external signal cable for damage.
6. Check the cover for sharp edges, damage, or alterations that expose the internal parts of the device.
7. Correct any problems that you find.

Checking the safety labels

Perform the following safety label checks:

1. Verify that the power supply cover caution label shown in Figure 1 is installed on the power supply of the 3534 Model F08.

   CAUTION:
   Do not remove cover, do not service, no serviceable parts. (2)



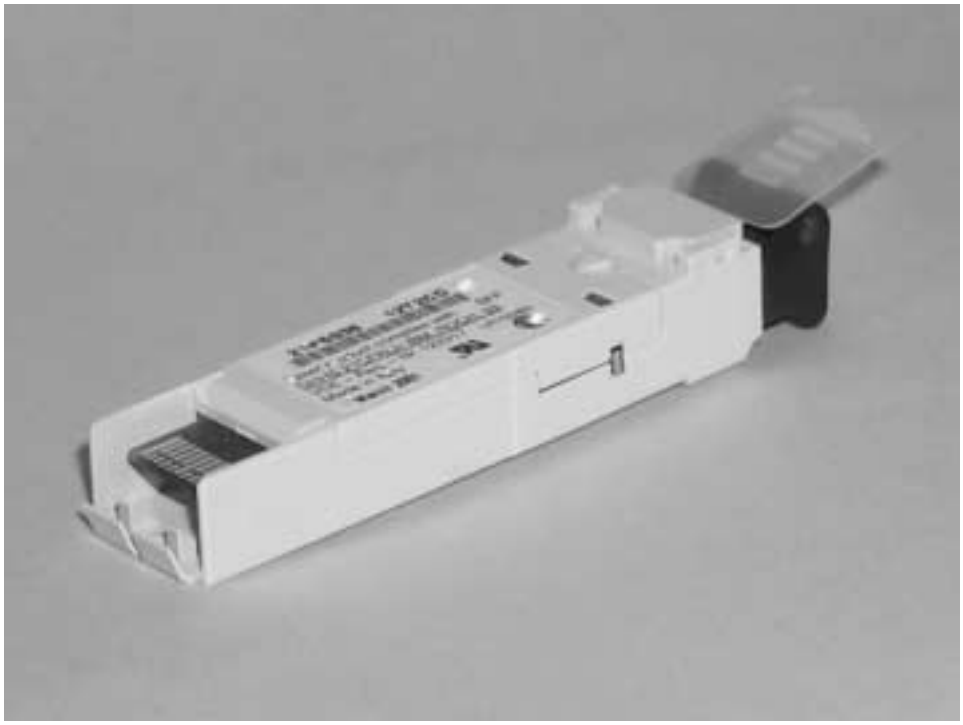
SJ000337

Figure 1. Power supply cover caution label

2. Verify that the small form-factor pluggable device (SFP) label shown in Figure 2 and Figure 3 on page xi is installed on the 3534 Model F08.

SJ000317

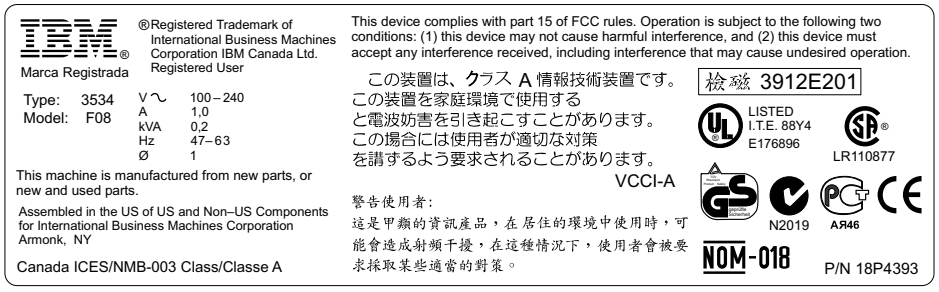
Figure 2. SFP label (front view)



SJ000314

Figure 3. SFP label (back view)

3. Verify that the safety label shown in Figure 4 is installed on the 3534 Model F08, and that the voltage specified on the label matches the voltage at the power source.



SJ000347

Figure 4. Safety label on the 3534 Model F08

Checking ac grounding

DANGER

An electrical outlet that is not correctly wired could place a hazardous voltage on the metal parts of the system or the products that attach to the system. It is the customer's responsibility to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (1)

Environmental notices and statements

This section describes the environmental notices and statements.

Battery notice

CAUTION:
A lithium battery can cause fire, explosion, or a severe burn. Do not recharge, disassemble, heat above 100°C (212°F), solder directly to the cell, incinerate, or expose cell contents to water. Keep away from children. Replace only with the part number specified for your system. Use of another battery may present a risk of fire or explosion. The battery connector is polarized; do not attempt to reverse the polarity. Dispose of the battery according to local regulations. (3)

Laser safety

CAUTION:
In the United States use only GBIC units or Fibre-Optic products that comply with FDA radiation performance standards, 21 CFR Subchapter J. Internationally use only GBIC units or Fibre-Optic products that comply with IEC standard 825-1. Optical products that do not comply with these standards may produce light that is hazardous to the eyes.  **(4)**

SJ000338

This unit might contain a single-mode or a multimode transceiver Class 1 laser product. The transceiver complies with IEC 825-1 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated under the recommended operating conditions.

This equipment contains Class 1 laser products, and complies with FDA radiation Performance Standards, 21 CFR Subchapter J and the international laser safety standard IEC 825-2.

Usage restrictions

The optical ports of the modules must be terminated with an optical connector or with a dust plug.

Fire suppression systems

A fire suppression system is the responsibility of the customer. The customer's own insurance underwriter, local fire marshal, or a local building inspector, or both, should be consulted in selecting a fire suppression system that provides the correct level of coverage and protection. IBM designs and manufactures equipment to internal and external standards that require certain environments for reliable operation. Because IBM does not test any equipment for compatibility with fire suppression systems, IBM does not make compatibility claims of any kind nor does IBM provide recommendations on fire suppression systems.

Product recycling

This unit contains recyclable materials. These materials should be recycled where processing sites are available and according to local regulations. In some areas,

IBM provides a product take-back program that ensures proper handling of the product. Contact your IBM representative for more information.

Product disposal

This unit might contain batteries. Remove and discard these batteries, or recycle them, according to local regulations.

About this document

This document introduces the IBM TotalStorage™ SAN Switch 3534 Model F08 (hereafter referred to as the 3534 Model F08).

Who should read this document

This document is intended for network and system administrators whose responsibility includes administration and management of a storage area network.

Throughout this document, the term *switch* applies to any IBM 3534 Model F08 switch, unless the reference is to a specific model.

Additional information

This section contains the following information:

- A list of the documents in the 3534 Model F08 library
- A list of the related documents
- The available Web sites
- Instructions on how to get help
- Instructions on how to get software updates
- Information about how to send your comments

3534 Model F08 library

The following documents contain information related to this product:

- *IBM TotalStorage SAN Switch 3534 Model F08 Installation Guide*, SY27-7631
- *IBM TotalStorage SAN Switch 3534 Model F08 User's Guide*, GC26-7454
- *IBM TotalStorage SAN Fibre Channel Switch 3534 Model F08 Translated Safety Notices*, GC26-7459

Related documents

Information related to the 3534 Model F08 software can be found in the following documents:

- *Brocade Advanced Performance Monitoring User's Guide*
- *Brocade Advanced Web Tools User's Guide*
- *Brocade Advanced Zoning User's Guide*
- *Brocade Diagnostic and System Error Message Reference*
- *Brocade Distributed Fabric User's Guide*
- *Brocade Fabric Manager User's Guide*
- *Brocade Fabric OS Procedures Guide*
- *Brocade Fabric OS Reference*
- *Brocade Fabric Watch User's Guide*
- *Brocade ISL Trunking User's Guide*
- *Brocade MIB Reference*
- *Brocade QuickLoop User's Guide*
- *Brocade SES User's Guide*
- *Building and Scaling Brocade SAN Fabrics: Design and Best Practices Guide*

When you use any of the Brocade documents, you will notice that the model numbers reflect the original Brocade switches. Table 1 provides a product matrix for you to use to correlate the Brocade model numbers to the IBM product and model numbers.

Table 1. Brocade and IBM product and model number matrix

Brocade model number	IBM product and model number
Silkworm 2010	3534 Model 1RU
Silkworm 2400	2109 Model S08
Silkworm 2800	2109 Model S16
Silkworm 3200	3534 Model F08
Silkworm 3800	2109 Model F16
Silkworm 3900	2109 Model F32
Silkworm 12000	2109 Model M12

Web sites

For detailed information about models and firmware that the switch supports, see the following Web site:

www.ibm.com/storage/fcswitch/

For detailed information about fibre-channel standards, see the fibre-channel Association Web site at:

www.fibrechannel.com/

For a directory of worldwide contact information, including technical support, see the following Web site:

www.ibm.com/contact/

Getting help

Contact your switch supplier for technical support. This includes support of hardware and of software, all product repairs, and ordering of spare components.

Be prepared to provide the following information to the support personnel:

- The switch serial number
- The switch worldwide name
- The topology configuration
- Any output from the **supportShow** Telnet command
- A detailed description of the problem
- Any troubleshooting steps that were already performed

Getting software updates

Contact your switch supplier for software updates and maintenance releases.

For utility programs to facilitate loading firmware, sample Fabric Watch configurations, and management information base (MIB) files for switch management by simple network management protocol (SNMP), see the following Web site:

www.storage.ibm.com/ibmsan/products/sanfabric.htm

How to send your comments

Your feedback is important to help us provide the highest quality of information. If you have any comments about this document, you can submit them in one of the following ways:

- E-mail

  Submit your comments electronically to:

  starpubs@us.ibm.com

  Be sure to include the name and order number of the document and, if applicable, the specific location of the text that you are commenting on, such as a page number or table number.

- Mail or fax

  Fill out the Readers' Comments form (RCF) at the back of this document and return it by mail or fax (1-800-426-6209) or give it to an IBM representative. If the RCF has been removed, you can address your comments to:

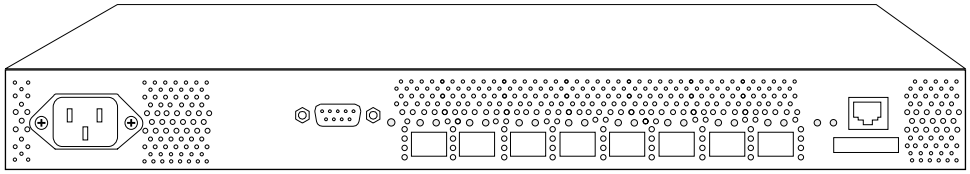
  International Business Machines Corporation
  RCF Processing Department
  Dept. M86/Bldg. 050-3
  5600 Cottle Road
  San Jose, CA 95193-0001
  U.S.A.

Introduction

This chapter describes the TotalStorage SAN Switch 3534 Model F08, hereafter referred to as the 3534 Model F08.

Product overview

Figure 5 shows the 3534 Model F08.



SJ000333

Figure 5. 3534 Model F08

The 3534 Model F08 is an 8-port, dual speed, auto-sensing fibre-channel switch, with one E_port. It is functionally compatible and interoperable with the current series of 2109 and 3534 switches. The 3534 Model F08 is an enterprise class switch that is designed to handle the large scale SAN requirements of an enterprise. You can use the 3534 Model F08 to address the SAN requirements of a small to medium-size workgroup. The 3534 Model F08 is a flexible switching platform that meets both low-latency and high-throughput demands. Based on Application Specific Integrated Circuit (ASIC) technology that is called the Bloom, the 3534 Model F08 provides high levels of reliability, availability, and port density.

The 3534 Model F08 provides the following:

- Nonblocking ports that provide full-duplex, throughput bandwidth at either 1.0625 Gbps or 2.125 Gbps.
- Fibre-channel autosensing ports that self-negotiate to the highest speed that the attached devices support.
- Universal ports that self-configure as F_ports or FL_ports.
- One port can be used as an E_port (the switch can be upgraded to eight E_port capability with an optional license).
- Trunking, which allows up to four ports to be grouped together to create high-performance 8 Gbps interswitch links (ISLs) between switches.
- Hardware zoning that permits or denies delivery of frames to any particular destination port address.
- Frame filtering, which augments the hardware zoning capabilities of the second-generation ASIC. The second-generation ASIC implements hardware zoning at the port level of the switch. The expanded capabilities of the third-generation ASICs include the following: worldwide name (WWN), device-level zoning, protocol-level zoning, and logical unit number (LUN)-level zoning. Thus third-generation ASICs provide the flexibility of second-generation software zoning with the enhanced security of hardware zoning.

  Note: Fabric OS version 3.1 is required for protocol-level and LUN-level zoning support.
- Phantom loop addressing that allows private 8-bit loop addresses to be treated as equivalent to public loop addresses.

- Support for unicast, multicast (up to 256 groups), and broadcast data traffic types.
- Extensive diagnostics, system monitoring capabilities, and dual redundant, hot-swappable power supplies and cooling units that provide high reliability, availability, and serviceability.
- A single system board design with a 100 MHz 80960VH reduced instruction set computer (RISC) CPU with integrated peripherals that provide high performance.
- Small form factor pluggable (SFP) media that supports short wavelength (SWL) optical, and long wavelength (LWL) optical.
- An operating system (Fabric OS) that delivers distributed intelligence throughout the network and enables a wide range of applications.
- A flexible topology that allows up to 239 switches to be interconnected to create a medium to large fibre-channel fabric. The topology can change dynamically as new switches or links are added to the fabric or as your needs change.
- Central memory architecture that maximizes switch throughput and guarantees full transmit and receive bandwidth to all fibre-channel ports at all times. It also enables a number of sophisticated queuing, messaging, and buffer pool management schemes to optimize switch performance characteristics in heavily loaded systems.
- Cut-through frame routing that minimizes port-to-port latency.

Hardware components

The 3534 Model F08 system board is a single-board design with a highly integrated CPU. The Intel® 80960VH CPU is a RISC core processor and is the top choice for this platform. It provides over 70% of the functionality for the digital section of the system board. The system uses three types of memory devices: DRAM, Flash File, and Boot Flash. On the fibre-channel section of the system board, the following three components provide high-speed data transfer:

- The Bloom ASICs
- The Serializer/Deserializer (SERDES)
- The SFP media. SFP media interfaces support SWL and LWL.

CPU subsystem

An Intel 80960VH CPU is used for management functions and switch initialization. The CPU runs the Fabric OS and is responsible for switch initialization, configuration, and management. Switching functionality is provided by the ASIC.

The following peripherals are supported as well:

- An Ethernet port
- A serial port
- Three digital thermometers
- A real-time clock
- General I/O

The CPU subsystem is a mixed voltage system using 1.8 V, 2.5 V, 3.3 V, and 5 V depending on the device. The maximum board power consumption is 50 W.

Features

The 3534 Model F08 CPU subsystem includes the following:

- A 80960VH-100 MHz CPU
- An SDRAM controller with parity check at 33 MHz
- A peripheral control interconnect (PCI) bus arbiter
- Main Memory (SDRAM): 32 MB
- Flash Memory: Dual 8 MB
- Boot flash; 512 bytes of 8–bit for system start
- 10BASE-T or 100BASE-T port for management connection with RJ45 connector
- One RS232 port with DB9 connector
- Eight LEDs to indicate the status for each port
- Eight LEDs to indicate the link speed for each port
- One LED on the front panel to indicate the overall switch status
- One LED on the back panel to indicate the overall switch status
- Two LEDs for the Ethernet port to indicate the port status and link speed information
- Three digital thermometers for temperature sensing
- One 3.3 V to 1.8 V dc/dc converter for the Bloom ASIC core supply
- One Bloom ASIC to support up to eight nonblocking ports
- Eight SERDES
- One real-time clock with a battery

Embedded processor

The embedded processor is an Intel 80960VH processor with a clock speed of 100 MHz. It contains the following:

- A high-performance RISC processor core (compatible with the 2109 and 3534 series of switches)
- An integrated EDO memory controller (for DRAM, SRAM, ROM, and Flash memory)
- A PCI bus interface
- A complex programmable logic device (CPLD) for SDRAM control
- Two direct memory access (DMA) channels
- An I2C interface
- General purpose I/O

You access system memory through the local bus. The external CPLD SDRAM device provides SDRAM controller functionality at 33 MHz. It supports parity checking to enhance the data integrity of the system. The CPU communicates with the ASIC and the 10BASE-T or 100BASE-T Ethernet media access controller (MAC) through the PCI interface. An external PCI bus arbiter enables the Ethernet device to be a bus master.

You can also access the RS232 Universal Asynchronous Receiver Transmitter (UART) serial port through the local bus. Other I/O peripherals, such as the real-time clock, the LEDs, the three digital thermometers, and miscellaneous I/O are handled by the I2C bus of the CPU. The CPU is the only I2C bus master in the system. The RS232 port and drivers, Ethernet MAC/PHY, and LEDs are external components to the CPU. An RJ45 connector provides Ethernet connection to external systems. The DB9 RS232 is a ribbon-cable connection through the on-board 10-pin header.

Bus operations

The interface between the embedded processor, the ASIC, and the 10BASE-T or 100BASE-T Ethernet MAC is implemented using a PCI bus. All PCI devices on the bus are PCI Revision 2.2 compliant. The PCI bus interface operates at 32-bit, up to 33 MHz and has a worldwide even parity bit. A slave-only PCI interface is provided by each ASIC to allow the processor to program various registers, routing tables, and so on within the chip. An external PCI bus arbiter enables the Ethernet device to be a bus master.

The local bus, a 32-bit multiplexed burst bus, provides the interface between the system memory and the I/O. Because the integrated EDO memory controller on the CPU allows only direct control for DRAM, SRAM, ROM, and Flash memory, the external CPLD controller is included to provide SDRAM controller functionality.

The I2C bus provides peripheral I/O control for the LEDs, the thermometers, and general I/O functions. The 80960VH CPU serves as the master on the I2C bus.

The Bloom ASIC is an eight-port fibre-channel switch controller. A proprietary 10-bit wide SSTL2 bus running at 106.25 MHz is used between the Bloom ASIC and the SERDES.

Memory

The system design uses three types of memory devices:

- DRAM
- Flash File
- Boot Flash

One on-board SDRAM chips provides up to 32 MB for system memory. One additional SDRAM chip provides data parity. The printed circuit board (PCB) SDRAM footprint is designed to be compatible with 64 MB, 128 MB, and 256 MB devices. An external CPLD device added to the local bus provides control functions for the 80960VH processor.

The system provides 4 MB of on-board redundant Flash File memory for software and data storage. The Boot Flash is an 8-bit Flash device socket that is used only for system start. The Boot Flash device contains a block area for startup code protection. The PLCC32 socket supports 3.3 V Boot Flash memory up to 512 KB.

Central memory: As with the 2019 series of switches and the 3534 1RU switch, the 3534 Model F08 is based on a central memory architecture. In this scheme, a set of buffers in the central memory is assigned to each port, to be used for receipt of frames. As an ASIC port receives and validates a frame, it stores the frame in one of its receive buffers in the central memory and forwards a routing request (a Put message) to the appropriate destination ports. When a destination port is capable of transmitting the frame, it reads the frame contents from central memory and forwards the frame to its transmit interface. It does not wait for the frame to be written in memory, unless the port is busy. After it has removed an entry for a frame from its internal transmit queue in preparation for transmitting a frame, the destination port sends a transmission complete message (a Finish message) to the port that received the frame. This allows the receiving port to reuse the buffer for subsequent frames received.

The central memory is also incorporated into the ASIC. Frames received on the ports in an ASIC are written into the portion of central memory.

The ASIC contains a RAM device plus data path crossbar logic that is used to implement the central memory. Memory blocks are accessed in a time-sliced fashion. The buffer pool can be split into 2112-byte buffers or into 312-byte mini-buffers. If frames that need to be buffered are smaller than the maximum 2112 bytes, using mini-buffers effectively expands the buffer pool and increases the efficiency of memory usage by providing more (but smaller) receive buffers.

Additionally, the Bloom ASIC provides a special memory interface (SMI). The SMI provides the firmware with a mechanism to read and write frame contents to and from the ASIC. It also supports higher throughput transfers. The SMI includes a set of two buffers that are large enough for an entire maximum-sized frame to be transferred in a single operation. Additionally, because there are two buffers available, the firmware can perform a read or write on a frame in one of the buffers while the ASIC streams another frame into the other buffer.

ASIC

The ASIC provides eight fibre-channel ports that can be used to connect to external N_ports (as an F_port) or external loop devices (as an FL_port). One port can be connected (as an E_port) to connect to another 3534 or 2109 series switch. With the fabric upgrade, you might have up to eight E_ports.

Each port can operate at either 1.0625 Gbps or 2.125 Gbps link speeds. The ASIC contains the fibre-channel interface logic, message and buffer queuing logic, receive buffer memory for the eight on-chip ports, and other support logic.

The Bloom ASIC is a PCI slave to the CPU. The ASIC interfaces through an inter-chip 10-bit SSLT2 bus connection clocked at 106.25 MHz. An 8-channel SERDES is used to support eight ports. The interface between ASIC and SERDES is also a 10-bit SSTL2 bus running at 106.25 MHz. The SERDES converts the 10-bit wide parallel data from the SSTL2 bus into high-speed serial data for the SFP media and vice versa. The SERDES supports single data rate (SDR) or double data rate (DDR) transfer between the SERDES and the SFP media. Implementing the SERDES external to the ASIC reduces the risk of silicon packaging as well as the risk of running 2.125 Gbps signals on a board with a long trace length.

The SFP media interfaces with external devices and enables support for shortwave laser and longwave laser. Two LEDs for each port provide port status and link speed information.

Control Message Interface (CMI): The 3534 Model F08 Control Message Interface (CMI) consists of a set of control signals that are used to pass hardware-level messages between ports. Recipient ports use these control signals to inform transmitting ports when a new frame needs to be added to the output queue of the transmitter. Transmitting ports also use the CMI to inform recipient ports that a frame transmission has been completed. A recipient port is free to reuse a receive buffer when it receives notification that the frame has been transmitted. In the case of multicast, multiple notifications are required to determine when a receive buffer is freed.

The CMI interface for the ASIC is connected inside the ASIC. Each chip time slices its output port to each possible destination chip in the switch. If it has a message to send to a particular destination during the corresponding time slot, the chip uses the time slot to send the message. Otherwise, the output port lines are driven to indicate that no message is present.

Ports

The 3534 Model F08 supports the following port types:

- Optical ports
- Ethernet port
- Serial port

The ASIC in the 3534 Model F08 connects up to eight SFP media. SFP devices are encased in metal to ensure low emissions and high thermal management. They are hot-swappable and use industry-standard local channel connectors. Each port provides ISL, loop, and fabric (E, F, and FL respectively) type connectivity that the 3534 Model F08 senses automatically; it requires no administration to identify the port type.

Optical ports

For optical ports, the 3534 Model F08 uses SFP fiber-optic transceivers that convert electrical signals to optical signals (and optical signals to electrical signals). Capable of transmitting at both 1 and 2 Gbps speeds, each SFP fiber-optic transceiver supports 850 nm SWL on multimode fiber-optic cable or 1310 nm LWL on single-mode fiber-optic cable. These miniature optical transceivers provide high port density and deliver twice the port density of standard removable GBIC transceivers.

Ethernet port

The 3534 Model F08 provides a fully IEEE-compliant 10BASE-T or 100BASE-T Ethernet port for switch management console interface. When a device is connected to the port, both ends negotiate to determine the optimal speed. The Ethernet port uses an RJ45 connector. There are two LEDs for the port. One LED indicates transmit and receive activity and one LED indicates speed (10 Mbps or 100 Mbps). The TCP/IP address for the port can be configured from the serial port.

Serial port

An RS232 serial port is provided on the 3534 Model F08. The serial port uses a DB9 connector. The connector is a header pin block on the system board. The parameters of the serial port are fixed at 9600 baud, 8 data bits, no parity, no hardware flow control, 1 start and 1 stop bit.

You use this connector to configure the internet protocol (IP) address and to recover the factory default settings of the switch should Flash memory contents be lost. The serial port connection should not be used to perform normal administration or maintenance functions. Accessible functions are limited to connecting a terminal to the port to reinitialize the switch defaults, which restores the switch to its factory configuration. This is required to restore the switch passwords to a known state and to allow you to set a specific switch IP address.

Enclosure

The 3534 Model F08 enclosure is designed to be mounted in a 19-in. rack, with a height of 1 RETMA unit, but it can also be used in a tabletop configuration.

The 3534 Model F08 enclosure has forced-air cooling. The fans push the air from the rear chassis intake through the enclosure and exhaust the air through venting holes in the front panel. The SFP media is hot-swappable so that it can be removed and replaced without interrupting the system power.

Other than SFP replacement, there are no user serviceable parts on the 3534 Model F08.

On the front of the unit, there are two port connections (an RS232 connection and an RJ45 connection). The RJ45 connection provides a 10BASE-T or 100BASE-T Ethernet port for a full system management console interface. The RS232 connection provides a serial port interface for setting the IP address of the switch and for resetting the switch to factory defaults

The fibre-optic cables, Ethernet cables, ac power input cables and serial port cables are located on the front of the switch.

Power supply

The 3534 Model F08 power supply is universal and capable of functioning worldwide without using voltage jumpers or switches. It meets IEC 61000-4-5 surge voltage requirements and is auto-ranging in terms of accommodating input voltages and line frequencies.

The power supply meets the following requirements:

Specification	**Value**
Outlet	Correctly wired and earth-grounded
Maximum output	75 watts
Maximum system power consumption	50 watts
Input voltage	90 – 264 V ac
Input line frequency	47 – 63 Hz
Harmonic distortion	Active power factor correction per IEC1000-3-2
BTU rating	60 watts x 3.412 BTU/Hr/watts = 204.72 BTU/hr
Inrush current	40 amps maximum, cold start at 25 celsius
Input line protection	Fused in hot line

LEDs

The 3534 Model F08 provides several LEDs to indicate status on the switch. Each of the eight ports has two status indicators. The first LED for the port is a two-color (green and yellow) LED, and indicates the status for the port. Green indicates normal status, and yellow indicates an error. The second LED is a single-color (green) LED and indicates the link speed for the port. Green indicates 2 Gbps. If the green LED is not lit (dark), it indicates 1 Gbps.

A single-color (green) LED is located on the front of the switch and indicates system power-on status. On the back of the switch, there is a two-color (green and yellow) LED driven by an I2C I/O expander that indicates the mode of the unit. Green indicates normal mode and yellow indicates diagnostic mode. All LEDs are surface mount components with on-board light pipe and are visible externally with full chassis enclosure.

There are two LEDs for the Ethernet port located on the front panel. One LED indicates the transmit and receive activity, and one LED indicates speed (10 Mbps or 100 Mbps).

Software components

The 3534 Model F08 is supported by the Fabric OS version 3.02 or later.

The Fabric OS is implemented in firmware and manages the operation of the 3534 Model F08. The switch firmware is designed to make a 3534 Model F08 easy to install and use while retaining the flexibility needed to accommodate your requirements. A fabric that is constructed with cascaded 3534 Model F08 switches automatically assigns individual switch addresses, establishes frame routes, configures the internal name server, and so on. You can access internal management functions using standard host-based Simple Network Management Protocol (SNMP) software or Web browsers. You can access these functions using network connectivity through the Ethernet port or using IP over the fibre-channel ports. Small computer systems interface (SCSI) Enclosure Services (SES) is also supported as a management method. The management functions of the switch allow you to monitor frame throughput, error statistics, fabric topology, fans, cooling, media type, port status, IDs, and other information to aid in system debugging and performance analysis.

The Fabric OS includes all basic switch and fabric support software as well as optionally licensed software that is enabled using license keys. The fabric license is preinstalled on the 3534 Model F08 to ensure fabric operation.

The Fabric OS is comprised of two major software components:

- Firmware that initializes and manages the switch hardware
- Diagnostics that perform component self-testing algorithms for fault isolation during the manufacturing process and in your installation

The internal firmware can be viewed as a set of embedded applications running on top of a proprietary real-time operating system.

Additionally, host-based software includes the drivers, utilities, and applications that use the switch. Obtain these components from your system vendor or fibre-channel component supplier.

For more information, see *Brocade Fabric OS Procedures Guide* and *Brocade Fabric OS Reference*.

3534 Model F08 software

The 3534 Model F08 software consists of a set of embedded applications running on top of a real-time operating system kernel. The set of applications include the following:

- Name server
- Alias server
- SNMP agent

The set of applications also includes several tasks to manage the following:

- Address assignment
- Routing
- Link initialization
- Fabric initialization
- Link shutdown
- Switch shutdown
- Frame filtering
- Fabric watch
- Auto speed negotiation
- The user interface

All embedded applications are written in C, except for the SNMP agent (included with the real-time operating system package) and the Web Server.

Figure 6 on page 10 shows a block diagram of the various elements that comprise the 3534 Model F08 firmware.

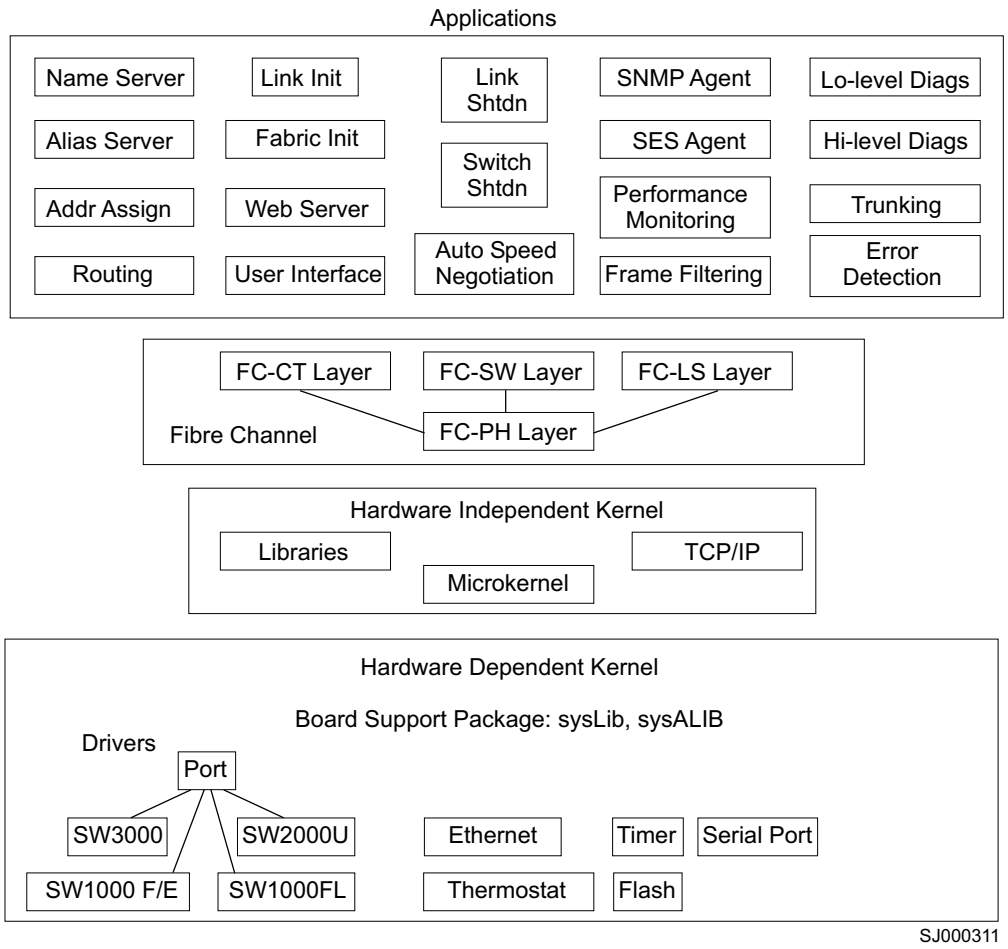


Figure 6. 3534 Model F08 firmware components

Applications

The 3534 Model F08 software applications implement a variety of functions. Switch applications exist to provide fabric services, such as name server and alias server functionality, to external devices. These particular applications process requests from fabric-attached external devices, and communicate with similar applications running on other switches within the fabric to obtain fabric-wide information to satisfy these requests. The applications present an interface to these standards-based services that provides access to information throughout the fabric while hiding the details of how the information is distributed across switches within the fabric from the external devices.

Other applications running in a switch implement functions used to manage internal fabric operation. One task allows for automatic address assignment throughout a fabric through a distributed algorithm run by participating switches. Another task, used to set up routes within the fabric, communicates with tasks that are running on other switches in the fabric to set up loop-free, lowest-cost routes.

The 3534 Model F08 provides an extensive set of diagnostics. A number of comprehensive low-level diagnostics can be used to detect failing switch hardware components by performing hardware-specific tests. In general, these diagnostics must be run when the switch is offline. However, an additional set of high-level

diagnostics can be used to exercise individual ports, passing data through external media interfaces and cables. These allow various media, cable, and port faults to be detected while normal switch operation continues on other ports.

New features

The 3534 Model F08 software includes some new features and functionality. The Fabric OS enables the 3534 Model F08 to support the following new functionality:

Auto-sensing speed negotiation

The 3534 Model F08 ASIC supports link operation at either 2 Gbps or 1 Gbps. Auto-sensing negotiation allows easy configuration. The link speed is negotiated to the highest speed that is supported by the device. Speed selection is auto-negotiated by the ASIC driver on a per-port basis. After the speed is determined, the transmitter and receiver for the port are automatically set. If multiple devices are connected to a port (for example on an FL_port), the driver auto-negotiates for the highest common speed and sets the transmitter and receiver accordingly.

Frame filtering

Zoning is a licensed fabric management service that can be used to create logical subsets of devices within a SAN and enable partitioning of resources for management and access control purposes. Frame filtering is a new feature of the 3534 Model F08 ASIC that enables it to provide zoning functions with finer granularity. Frame filtering can be used to set up port level zoning, worldwide name zoning, device level zoning, protocol level zoning, and LUN level zoning. After the filter is set up, the complicated function of zoning and filtering can be achieved at wire speed. .

For more information, see *Brocade Advanced Zoning User's Guide*.

Performance Monitoring

Performance Monitoring is a licensed feature that provides error and performance information to manage your storage environment. There are three types of monitoring:

- Arbitrated Loop Physical Address (AL_PA) monitoring: provides information about the number of cyclic redundancy check (CRC) errors.
- End-to-end monitoring: provides information about a configured source identifier to destination identifier (SID-DID) pair. Information includes the number of CRC errors for frames with the SID-DID pair, fibre-channel words transmitted from the port for the SID-DID pair, and fibre-channel words received for the port for the SID-DID pair.
- Filter-based monitoring: provides error information with a customer-determined threshold.

For more information, see *Brocade Advanced Performance Monitoring User's Guide*.

Trunking

Trunking is a licensed feature that enables traffic to be distributed across available ISLs while still preserving in-order delivery. On some fibre-channel protocol devices, frame traffic between a source device and destination device must be delivered in order within an exchange. This restriction forces current devices to fix a routing path within a fabric. Consequently, certain traffic patterns in a fabric can cause all active routes to be allocated to a single available path and leave other paths unused. The 3534 Model F08 ASIC creates a trunking group (a set of available paths linking two adjacent switches). Ports in the trunking group are called *trunking ports*. One

trunking port is designated as the trunking master port and is used to set up all routing paths for the entire trunking group. The trunk provides an 8 Gbps single-aggregate ISL pipe between switches.

For more information, see *Brocade ISL Trunking User's Guide*.

Real-time operating system

The 3534 Model F08 real-time operating system consists of a hardware-independent layer and a hardware-dependent section.

The hardware-independent portion of the operating system consists of a third-party real-time kernel plus a number of interfaces. The interfaces provide a structure for handling various layers in the fibre-channel protocol hierarchy.

In this collection of modules, the FC-PH layer provides FC-2 functionality, supporting reassembly of inbound frames into sequences. This layer also allows you to create a set of frames to transmit from an internal fibre channel sequence description.

The FC-LS layer handles various sorts of fibre-channel link services, including basic link services and extended link services.

Operations using the fibre-channel common transport interface, as defined in the FC-GS specification, use the interface provided by FC-CT code in the 3534 Model F08.

Switch-to-switch communications used to manage fabric initialization and routing use the services provided by the FC-SW layer to implement these functions.

Hardware-dependent functions of the real-time operating system contain a number of elements, including the Board Support package. This code is used to provide an interface between VxWorks and the 3534 Model F08-specific hardware related to supporting the 80960VH processor.

Drivers for specific hardware interfaces are also considered part of the hardware-dependent portion of the real-time operating system. A number of drivers support interface hardware that is used for fabric management purposes, such as the Ethernet port and serial port. Other drivers are used for miscellaneous internal functions, including temperature monitoring and power supply control.

Additional drivers, written for the fibre-channel interfaces of the switch, are managed through two layers. One of these, the port driver, creates a generic interface to the underlying switch hardware, and provides functions common to all switch implementations. Reporting to the port driver are the switch hardware-specific drivers, which handle the operations of individual types of switch ASICs. Three of these drivers, for the switch, flannel, and loom chips, are used for IBM's first and second-generation hardware. A fourth module implements the functionality required to drive the Bloom ASIC, which is used in the 3534 Model F08.

Initializing the switch

When the switch is started or restarted, the following operations are performed:

1. Early power-on self test (POST) diagnostics are run. POST is run before VxWorks is running.
2. VxWorks is initialized.
3. The hardware is initialized. The system is reset, the internal addresses are assigned to Loom chips, the Ethernet port is initialized, the serial port is initialized, and the front panel is initialized.
4. A full POST is run.
5. The links are initialized. Receiver and transmitter negotiation is run to bring the connected ports online.
6. A fabric exploration is run. This determines whether any ports are connected to other switches. If so, it determines the principal switch.
7. Addresses are assigned. After the principal switch is identified, port addresses are assigned. Each 3534 Model F08 tries to keep the same addresses that it used previously. Previous addresses are stored in the configuration Flash memory.
8. The routing table is constructed. After the addresses are assigned, the unicast routing tables are constructed.
9. Normal Nx_port operation is enabled.

Routing

The embedded processor maintains two routing tables, one for unicast and one for multicast. The unicast routing tables are constructed during fabric initialization. The multicast tables are initially empty, except for broadcast. After the tables have been constructed they are loaded into each ASIC.

The unicast tables change if ports or links come online or go offline, or if some other topology changes occur. When new paths become available, the embedded processor can change some routes in order to share the traffic load. The multicast tables change as ports register with the alias server to create, join, or leave a multicast group. Each time a table changes, it must be reloaded into the ASICs.

Service functions

The ASIC interrupts the embedded processor when a frame arrives that has an error (for example, incorrect source ID), when a frame times out, or when a frame arrives for a destination that is not in its routing tables. In the latter case, the frame might be addressed to an illegal destination ID, or it might be addressed to one of the service functions that are provided by the embedded processor such as SNMP, name server, or alias server.

SNMP

Simple Network Management Protocol (SNMP) allows network devices to be monitored, controlled, and configured remotely from a network management station running a network manager program.

SNMP agent code in the network device allows management by transferring data that is specified by a management information base (MIB).

The 3534 Model F08 agent supports the following:

- SNMPv1 manager
- Command-line utilities to access and command the agent
- MIB-II system group, interface group, and SNMP group
- Fabric-element MIB
- IBM-specific MIBs
- Standard generic traps
- IBM-specific traps

Diagnostics

The 3534 Model F08 supports a set of POSTs, as well as tests that can be invoked using Telnet commands. These diagnostics are used during the manufacturing process as well as for fault isolation of the product in your installation.

For more information, see *Brocade Diagnostic and System Error Message Reference*.

Diagnostic environment

Most diagnostics are written to run in the VxWorks environment. However, as VxWorks does not run without a working SDRAM, a SDRAM/boot EEPROM test is run as part of the pre-VxWorks startup code to verify that the basic processor-connected memories are functioning properly.

Hardware support

Loop-back paths for frame traffic are provided in the hardware for diagnostic purposes. A loop-back path within the ASIC, at the final stages of the fibre-channel interface, can be used to verify that the internal fibre-channel port logic is functioning properly, as well as paths between the interface and the central memory. Additionally, the SERIALLINK macro within the ASIC includes a serial data loop-back function that can be enabled through a register in the corresponding ASIC.

Diagnostics are provided to allow traffic to be circulated between two switch ports that are connected with an external cable. This allows the diagnostics to verify the integrity of the final stage of the SERDES interface, as well as the media interface module.

Diagnostic coverage

The POST and diagnostic commands concentrate on the fibre-channel ports and verify switch functionality of the 3534 Model F08.

Interoperability

This section includes information about interoperability.

Switch interoperability

The 3534 Model F08 supports both 1 Gbps and 2 Gbps transmit and receive rates with auto-negotiation. The actual data signaling rate that is used on a port is automatically sensed and is set to the rate that is supported by a device or devices that are attached to the port. The 3534 Model F08 has been tested and is compliant with the current FC standards. The 3534 Model F08 is compatible with most

current-generation switches N_ports, NL_ports, and E_ports, as well as host adapters, Redundant Array of Independent Disks (RAID) storage devices, hubs, and Fibre-SCSI bridge devices, including the 3534 and 2109 series of switches.

Implementation in existing environments

Because the 3534 Model F08 has a compatible 1 Gbps auto-negotiated signaling rate on each port, it can be used as a replacement for current 3534 and 2109 series switches. As newer technology is added to existing systems that support 2 Gbps signaling, the ports can accept these devices and interoperate with existing 1 Gbps devices. If the 3534 Model F08 is connected to a third-party device but is unable to negotiate the signaling rate, the 3534 Model F08 allows you to manually set the speed of each port through the management interfaces.

Heterogeneous interswitch operations

Fabric OS version 3.0 supports interoperability for the following functions:

- Basic switch functions
  - Link initialization
  - Principal switch selection
  - Routing fibre channel shortest path first (FSPF)
- Basic services
  - Simple name service
  - State change notification
  - WWN zoning (typically referred to as soft zoning or name server zoning)

The following facilities are switch-based facilities and will continue to function on any 3534 switch:

- SNMP facilities
- Simple QuickLoops with no zoning
- Translative mode (private target support on fabrics)
- Trunking (only functions between two IBM switches)
- Enhanced performance metrics

The following facilities are IBM value-added facilities that are not supported in a multi-vendor fabric. Use of these facilities causes the Fabric to segment.

- QuickLoop zones
- QuickLoop Fabric assist mode
- Port, protocol, or LUN zoning

IBM is not aware of any areas of noncompliance with any ratified standards at this time.

Host bus adapter interoperability

For a list of host bus adapters (HBAs) that have been tested and approved for use with the 3534 Model F08, go to the following Web site:
www.storage.ibm.com/ibmsan/products/2109/san_switch_solu.html

Operating system support

Fabric OS versions 2.x and 3.x have no specific OS dependencies. The Fabric OS in the switches allows for any fibre-channel-compliant device to attach to the switches as long as it conforms to the standards for device login, name service, and

related fibre-channel features. Regardless of the operating environment, proper interface to the fabric requires a fibre-channel HBA with a standards-compliant driver.

Reliability

The 3534 Model F08 provides the following features to ensure reliability:

- POST
- Error detection and fault isolation (internal and external CRC checking, parity checking, checksum, and illegal address checking)
- Continuous monitoring of environmental components (fan status and temperature)
- DC power in proper range monitoring
- Low component count

Because buffering is integrated into the ASICs in the 3534 Model F08, there is no need for external SRAM chips on the system board.

The 3534 Model F08 utilizes a highly integrated 80960VH processor that incorporates a memory controller, PCI bus arbiter, and I2C controller in the processor chip, reducing the parts count for the processor functions. Because a single system board contains all circuitry, the 3534 Model F08 requires no interboard connections.

Support services and documentation

IBM provides a wide array of support services for its products. This section provides information about how to report a problem.

Problem reporting procedures

To report problems about the machine, call IBM. In Canada, call IBM at 1-800-465-6666.

- In the United States, call IBM at 1-800-IBM-SERV (426-7378).
- You might be required to present proof of purchase.

To assist your support team with diagnosing a resolution, have the following data available when you call for support:

- Switch serial number
- Error codes
- Symptoms
- Topology configuration

Additionally, if you have a general switch question, have an open Telnet connection prior to placing your telephone call.

Specifications

The 3534 Model F08 is designed as a piece of network equipment. Its primary operating environments are server rooms, network equipment closets, and office environments. Table 2 on page 17 lists the performance, mechanical, environmental, and power specifications for the 3534 Model F08.

Table 2. Performance, mechanical, environmental, and power specifications for the 3534 Model F08

Performance specifications	
Routing capacity	A minimum aggregate routing capacity of 10 million frames per second is provided for Class 2, Class 3 and Class F frames in an 8-port switch.
Latency	The maximum latency for Class 2, Class 3 and Class F frames from input F_port to output F_port within a single switch is less than 2 microseconds when the destination port is free. Cut-through routing: transmission can begin as the frame arrives. Same latency as the 3534 and the 2109 series of switches.
Mechanical specifications	
Enclosure	1U, 48.26 cm (19 in.), EIA compliant Power from front Air flow back to front Height: 4.2 cm (1.69 in.) Width: 42.8 cm (16.9 in.) Depth: 26.4 cm (10.4 in.)
Weight	3.9 kg (8.5 lbs)
Environmental specifications	
Temperature (operating)	10° - 40°C (50° - 104°F)
Temperature (nonoperating)	10° - 50°C (50° - 126°F)
Vibration (operating)	0.5 G, 5–500–5 Hz
Vibration (nonoperating)	2.0 G, 5–500–5 Hz
Humidity (operating)	8% - 80% RH noncondensing at 40°C (104°F)
Humidity (nonoperating)	8% - 80% RH noncondensing at 40°C (104°F)
Altitude	Up to 3000 m (9800 ft) above sea level
Shock (operating)	150 G, 2.7 ms half-sine
Shock (nonoperating)	60 G, 13 ms trapezoid
Input voltage	90 – 264 V ac
Frequency	47 - 63 Hz
Power consumption	50 W maximum

Appendix A. Standards and protocol compliance

IBM is committed to providing products that comply with industry standards and protocols.

Standards

The 3534 Model F08 is compliant with the following standards:

- Fibre-Channel ANSI Specifications
  - FC-PH, version 4.3 (Fibre-Channel Physical)
  - FC-PH-2, version 7.4 (Fibre-Channel Physical, Enhanced) for Multicast and Broadcast functions
  - FC-PH-3, version 9.4
  - FC-SW-2, version 4.4 (Fibre-Channel Switched Fabric)
  - FC-FG Revision 3.5 (Fabric Generic Requirements)
  - FC-AL, version 4.5 (Arbitrated Loop)
  - FC-AL-2, version 5.7 (Arbitrated Loop Extensions)
  - FC-FLA, version 2.7 (Fabric Loop Attach)
  - FC-GS-2, version 5.3 (Generic Services)
  - FC-GS-3, version 6.42 or later (Generic Services)
  - FC-PLDA, version 2.1 (Private Loop Direct Attach)
  - FC-Tape Fibre-Channel Tape (FC-Tape)
  - FCP-2Rev4 (Fibre-Channel Protocol)
  - FC-FS Revision 0.2 or later
  - FC-IP
- SCSI Enclosure Services, Rev 8a
- EA/TIA RS-232 Serial Port specification
- Gigabit Interface Converter Definition Document, Sun, and so on
- IEEE 802.3 for Ethernet

Protocol compliance

The 3534 Model F08 complies with the following standards and protocols.

Support for fibre-channel ports

All ports on the 3534 Model F08 are universal ports and support F_port (point-to-point), FL_port (loop), and E_port (switch-to-switch) port connections.

Fibre-channel class operation

The 3534 Model F08 supports fibre-channel Class 2, Class 3, and Class F operations on all ports.

Auto-configuration

All ports support E_ports to allow for cascading switches to form larger fabrics. E_ports are auto-configuring. Linking ports from any two switches automatically configures an E_port connection to form the fabric. The 3534 Model F08 supports a trunking option that binds up to four ports together as a high-performance trunk group. In this trunking configuration, interswitch data transfers can occur at an

aggregate rate of 800 MBps in both directions. The trunk group is automatically configured on the ports of the switch as the links between the switches are connected.

In-order delivery

The 3534 Model F08 guarantees in-order delivery of frames between source F or FL and destination F or FL ports. In-order delivery is supported across any arbitrary switch configurations or fabric topologies.

Flexibility of fabric topology and operation

The 3534 Model F08 implements the FSPF routing protocol as specified in the T11 FC-SW-2 standard. Fabric topology and operation are automatically adjusted and dynamically distributed to the fabric as new switches and links are added to the fabric. This is completed with no operator intervention. When a link is added or removed, the routes are recalculated. The switch adopts a minimal disruption algorithm to minimize the impact of the route recalculation. To minimize disruption, the switch only reroutes traffic due to a new shortest path (if one has been established) or if new load sharing is required.

Fibre-channel simple name service

Fabric OS includes support for the fibre-channel simple name service as specified in FC-GS-3 version 6.42 or the latest published standard.

Fibre-channel state change notification service

Fabric OS supports the fibre-channel state change notification service as specified in FC-GS-3 version 6.42 or the latest published standard.

Fibre-channel alias and multicast services

Fabric OS supports the alias and multicast services as specified in FC-GS-3 version 6.42 or the latest published standard.

Support for fibre-channel protocol

The 3534 Model F08 supports the FCP-2Rev4 standard.

Support for FC-IP

Fabric OS supports FC-IP (as defined by IETF), including the address resolution protocol (ARP) service for IP nodes that are connected to the switch.

Appendix B. Safety certifications and regulatory compliance

The 3534 Model F08 switch complies with all the safety and regulatory standards listed in this chapter.

Safety

The 3534 Model F08 switch is certified to :

- UL1950/CSA950 binational
- IEC950/EN 60950 (Nemko & TUV; CE)

Additionally, the following Product Safety/Country or Region Testing/Certifications has been completed.

- Federal Communications Commission (FCC) statement (United States)
- Voluntary Control Council for Interference (VCCI) mark (Japan)
- BSMI (Taiwan)
- C-tick mark (Australia)
- CE Mark (Europe)
- Canada class number
- GOST approval (Russia)
- NOM mark (Mexico)

EMI/EMC

Radiated Electro-Magnetic Interference (EMI) emissions for the 3534 Model F08 power supply operating in a single or redundant power configuration comply with EMI levels specified by the following regulations:

- FCC Docket No. 20780, Part 15J, Class B level
- CISPR22 Class A
- EN55022 Class B
- VCCI Class A ITE

Additionally, the 3534 Model F08 power supply has received a CE Mark for susceptibility and complies with the following Electro-Magnetic Compatibility (EMC) regulations:

- EN 61000-3-2 (Harmonics)
- EN 61000-3-3 (Voltage Fluctuations)
- EN 55024 (Immunity)

Immunity

The 3534 Model F08 switch provides immunity 50% greater than the levels specified by EN 55024 and complies with the following specifications:

- EN 61000-4-2, Severity Level 3 for ESD
- EN 61000-4-3, Severity Level 3 for RF Fields
- EN 61000-4-4, Severity Level 3 for EFT/Burst
- EN 61000-4-5, Severity Level 3 for Surge Voltage
- EN 61000 4-11, Power, Sag, Dip, and Variations

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Federal Communications Commission (FCC) statement

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, 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 his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Industry Canada compliance statement

Avis de conformite a la reglementation d'Industrie Canada: Cet appareil numerique de la classe A est conform a la norme NMB-003 du Canada.

European Community compliance statement

This product is in conformity with the protection requirements of EC Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product is in conformity with the EU council directive 73/23/EEC on the approximation of the laws of the Member States relating to electrical equipment

designed for use within certain voltage limits. This conformity is based on compliance with the following harmonized standard: EN60950.

This product has been tested and found to comply with the limits for class A Information Technology Equipment according to European Standard EN 55022. The limits for class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Attention: This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Where shielded or special cables (for example, cables fitted with ferrites) are used in the test to make the product comply with the limits:

Properly shielded and grounded cables and connectors must be used in order to reduce the potential for causing interference to radio and TV communications and to other electrical or electronic equipment. Such cables and connectors are available from IBM authorized dealers. IBM cannot accept responsibility for any interference caused by using other than recommended cables and connectors.

Germany compliance statement

Zulassungsbescheinigung laut Gesetz ueber die elektromagnetische

Vertraeglichkeit von Geraeten (EMVG) vom 30. August 1995.

Dieses Geraet ist berechtigt, in Uebereinstimmung mit dem deutschen EMVG das

EG-Konformitaetszeichen - CE - zu fuehren.

Der Aussteller der Konformitaetserklaeung ist die IBM Deutschland.

Informationen in Hinsicht EMVG Paragraph 3 Abs. (2) 2:

Das Geraet erfuellt die Schutzanforderungen nach EN 50082-1 und EN 55022 Klasse A.

EN 55022 Klasse A Geraete beduerfen folgender Hinweise:

Nach dem EMVG:_|t¹|

“Geraete duerfen an Orten, fuer die sie nicht ausreichend entstoert sind, nur mit besonderer Genehmigung des Bundesministeriums fuer Post und Telekommunikation oder des Bundesamtes fuer Post und Telekommunikation betrieben werden. Die Genehmigung wird erteilt, wenn keine elektromagnetischen Stoerungen zu erwarten sind.” (Auszug aus dem EMVG, Paragraph 3, Abs.4)

Dieses Genehmigungsverfahren ist nach Paragraph 9 EMVG in Verbindung mit der entsprechenden

Kostenverordnung (Amtsblatt 14/93) kostenpflichtig.

Nach der EN 55022:

“Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstoerungen verursachen. in diesem Fall kann vom Betreiber verlangt werden, angemessene Massnahmen durchzufuehren und dafuer aufzukommen.”

Anmerkung:

Um die Einhaltung des EMVG sicherzustellen, sind die Geraete wie in den Handbuechern angegeben zu installieren und zu betreiben.

Japanese Voluntary Control Council for Interference (VCCI) class 1 statement

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Ａ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。

Korean Government Ministry of Communication (MOC) statement

Please note that this device has been approved for business purposes with regard to electromagnetic interference. If you find that this is not suitable for your use, you may exchange it for one with a non-business use.

Taiwan class A compliance statement

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Glossary

This glossary provides definitions for the fibre-channel and switch terminology used for the IBM 3534 Model F08.

This glossary includes selected terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- The *IBM Glossary of Computing Terms*, available online at the following Web site:

  www.ibm.com/ibm/terminology/
- The *Storage Networking Dictionary*, available online at the Storage Networking Industry Association (SNIA) Web site:

  www.snia.org/education/dictionary/

The following cross-reference conventions are used in this glossary:

See Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also
Refers you to a related term.

8B/10B encoding. An algorithm for encoding data for transmission in which each 8-bit data byte is converted to a 10-bit transmission character. 8B/10B encoding supports continuous transmission with a balanced number of ones and zeros in the code stream and detects single bit transmission errors.

access control list (ACL). A list that specifies the users and groups allowed to access a particular file or directory.

ACL. See *access control list.*

address identifier. An address value used to identify the source (S_ID) or destination (D_ID) of a frame.

Address Resolution Protocol (ARP). In the Internet suite of protocols, the protocol that dynamically maps an Internet Protocol (IP) address to an address used by a supporting metropolitan or local area network such as Ethernet or token-ring.

alias address identifier. One or more address identifiers which can be recognized by a node port (N_port) in addition to its N_port identifier. Alias address identifiers are used to form groups of N_ports so that frames can be addressed to a group rather than to individual N_ports.

alias AL_PA. An arbitrated loop physical address (AL_PA) value recognized by a loop port (L_port) in addition to the AL_PA assigned to the port. See also *arbitrated loop physical address*.

alias server. A fabric software facility that supports multicast group management.

AL_PA. See *arbitrated loop physical address*.

American National Standards Institute (ANSI). An organization that establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States.

ANSI. See *American National Standards Institute*.

API. See *application programming interface*.

application programming interface (API). A set of run-time routines or system calls that allows an application program to use a particular service provided by either the operating system or another licensed program.

application-specific integrated circuit (ASIC). In computer chip design, an integrated circuit created by first mounting an array of unconnected logic gates on a substrate and later connecting these gates in a particular configuration for a specific application. This design approach allows chips for a variety of applications to be made from the same generic gate array, thereby reducing production costs.

ARB. See *arbitrate primitive signal*.

arbitrate primitive signal. A primitive signal that is transmitted as the fill word by a loop port (L_port) to indicate that the L_port is arbitrating to access to the loop. See also *arbitrated loop*.

arbitrated loop. A shared 100 MBps fibre-channel transport structured as a loop, and supporting up to 126 devices and one fabric attachment. A port must successfully arbitrate before a circuit can be established.

arbitrated loop physical address (AL_PA). An 8-bit value used to identify a participating device in an arbitrated loop.

arbitration wait timeout value (AW_TOV). The minimum time an arbitrating L_port waits for a response before beginning loop initialization.

ARP. See *Address Resolution Protocol*.

ASIC. See *application-specific integrated circuit*.

asynchronous transfer mode (ATM). A broadband technology for transmitting data over LANs or WANs, based on relaying cells of fixed size. Provides any-to-any connectivity, and nodes can transmit simultaneously.

ATM. See *asynchronous transfer mode*.

autoranging. A power supply that accommodates different input voltages and line frequencies.

AW_TOV. See *arbitration wait timeout value*.

bandwidth. (1) The capacity of a communications line, normally expressed in bits per second (bps). (2) The range of frequencies an electronic system can transmit or receive. The greater the bandwidth of a system, the more information the system can transfer in a given period of time. See also *throughput*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BB_credit. See *buffer-to-buffer credit*.

beginning running disparity. The disparity at the transmitter or receiver when the special character associated with an ordered set is encoded or decoded. See also *disparity*.

BER. See *bit error rate*.

BIOS. See *basic input/output system*.

BISR. Built-in self-repair.

bit error rate (BER). The probability that a transmitted bit will be erroneously received. The BER is measured by counting the number of bits in error at the output of a receiver and dividing by the total number of bits in the transmission. BER is typically expressed as a negative power of 10. See also *error*.

block. A unit of application data from a single information category that is transferred within a single sequence.

bloom. Application-specific integrated circuit (ASIC) technology on which the 3534 Model F08 is based.

British thermal unit (BTU). A measurement of heat produced in one hour.

broadcast. (1) The simultaneous transmission of the same data to all nodes connected to a network. (2) The simultaneous transmission of data to more than one destination. See also *multicast* and *unicast*.

BTU. See *British thermal unit.*

buffer-to-buffer credit (BB_credit). Used to determine how many frames can be sent to a recipient when buffer-to-buffer flow control is in use. See also *buffer-to-buffer flow control* and *end-to-end credit*.

buffer-to-buffer flow control. Management of the frame transmission rate in either a point-to-point topology or in an arbitrated loop. See also *buffer-to-buffer credit*.

cascading. The process of connecting two or more fibre-channel hubs or switches together to increase the number of ports or extend distances. See also *fabric* and *inter-switch link*.

cascading switches. Switches that are interconnected to build large fabrics.

central processing unit (CPU). A part of a computer that includes the circuits that control the interpretation and execution of instructions. A CPU in the circuitry and storage that executes instructions. Traditionally, the complete processing unit was often regarded as the CPU, whereas today the CPU is often a microchip. In either case, the centrality of a processor or processing unit depends on the configuration of the system or network in which it is used.

chassis. The metal frame in which the switch and switch components are mounted.

circuit. An established communication path between two ports, which consists of two virtual circuits capable of transmitting in opposite directions. See also *link*.

class F. Connectionless service for inter-switch control traffic, which provides notification of delivery or nondelivery between two expansion ports (E_ports).

class 1. Service that provides a dedicated connection between two ports (also called *connection-oriented service*), with notification of delivery or nondelivery.

class 2. Connectionless service between ports with notification of delivery or nondelivery.

class 3. Connectionless service between ports without notification of delivery. Other than notification, the transmission and routing of class 3 frames is identical to that of class 2 frames.

class of service. A specified set of delivery characteristics and attributes for frame delivery.

CMI. See *control message interface*.

comma. A unique pattern (either 1100000 or 0011111) used in 8B/10B encoding to specify character alignment within a data stream. See also *K28.5*.

community. The relationship between a Simple Network Management Protocol (SNMP) agent and one or more SNMP managers. The community describes which SNMP manager requests that the SNMP agent should honor.

control message interface (CMI). A set of control signals that are used to pass hardware-level messages between ports.

CPU. See *central processing unit*.

CRC. See *cyclic redundancy check*.

credit. The number of receive buffers allocated to a transmitting node port (N_port), node loop port (NL_port), or fabric port (F_port). The credit is the maximum number of outstanding frames that can be transmitted by that N_port, NL_port, or F_port without causing a buffer overrun condition at the receiver.

cut-through. A switching technique that allows a routing decision to be made and acted upon as soon as the destination address of a frame is received. See also *route*.

cyclic redundancy check (CRC). 1) A redundancy check in which the check key is generated by a cyclic algorithm. 2) An error detection technique performed at both the sending and receiving stations.

data word. A type of transmission word that occurs within frames. The frame header, data field, and CRC all consist of data words. See also *frame*, *ordered set*, and *transmission word*.

defined zone configuration. The complete set of all zone objects that are defined in the fabric. The defined configuration may include multiple zone configurations. See also *enabled zone configuration* and *zone configuration*.

destination ID (DID). The 3-byte destination ID of the destination device, in the 0xDomainAreaALPA format.

DID. See *destination ID*.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disparity. The relationship of ones and zeros in an encoded character. *Neutral disparity* indicates an equal number of ones and zeros, *positive disparity* indicates a majority of ones, and *negative disparity* indicates a majority of zeros.

DLS. See *dynamic load sharing*.

DMA. See *direct memory access*.

domain_ID. A unique identifier for the switch in a fabric. The domain_ID is usually automatically assigned by the switch, but can also be assigned manually. The value of domain_ID can be a value between 1- 239.

DRAM. See *dynamic random access memory*.

dynamic load sharing (DLS). A dynamic distribution of traffic over available paths that permits recomputing of routes when an Fx_port or expansion port (E_port) changes status.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

E_D_TOV. See *error detect timeout value*.

EE_credit. See *end-to-end credit*.

effective configuration. The particular zone configuration that is currently in effect. Only one configuration can be in effect at once. The effective configuration is built each time a zone configuration is enabled.

EIA. Electronic Industry Association.

EIA rack. A storage rack that meets the standards set by the Electronics Industry Association (EIA).

electromagnetic compatibility (EMC). The design and test of products to meet legal and corporate specifications dealing with the emissions and susceptibility of frequencies in the radio spectrum. Electromagnetic compatibility is the ability of various electronic equipment to operate properly in the intended electromagnetic environment.

electromagnetic interference (EMI). Waves of electromagnetic radiation, including but not limited to radio frequencies, generated by the flow of electric current.

electrostatic discharge (ESD). The flow of current that results when objects having a static charge come into close enough proximity to discharge.

ELP. Extended link parameters.

EMC. See *electromagnetic compatibility*.

EMI. See *electromagnetic interference*.

enabled zone configuration. The currently enabled configuration of zones. Only one configuration can be enabled at a time. See also *defined zone configuration* and *zone configuration*.

end-to-end credit (EE_credit). A credit scheme used to manage end-to-end flow control during the exchange

of frames between two communicating devices. See also *end-to-end flow control* and *buffer-to-buffer credit*.

end-to-end flow control. Flow control that occurs between two connected fibre-channel node ports (N_ports). See also *end-to-end credit*.

E_port. See *expansion port*.

error. In fibre-channel technology, a missing or corrupted frame, timeout, loss of synchronization, or loss of signal (link errors). See also *loop failure*.

error detect timeout value (E_D_TOV). The time that the switch waits for an expected response before declaring an error condition. Adjustable in 1 microsecond increments from 2 - 10 seconds.

ESD. See *electrostatic discharge*.

exchange. A set of one or more non-concurrent related sequences passing between a pair of fibre-channel ports. An exchange encapsulates a “conversation” such as a small computer systems interface (SCSI) task or an Internet Protocol (IP) exchange. Exchanges can be bidirectional and can be short or long lived.

expansion port (E_port). In the building of a larger switch fabric, a port is designated an expansion port (E_port) when it is used as an inter-switch expansion port to connect to the E_port of another switch.

Extended Fabrics. A feature that runs on the Fabric operating system (OS) and allows creation of a fibre-channel fabric interconnected over distances of up to 100 km (62.14 mi).

fabric. A complex network using hubs, switches, and gateways.

Fabric Assist. A feature that enables private and public hosts to access public targets anywhere on the fabric, provided they are in the same Fabric Assist zone. This feature is available only when both QuickLoop and zoning are installed on the switch.

fabric login (FLOGI). The process by which a device gains access to the fabric.

fabric loop port (FL_port). A loop-capable fabric port that is used to connect node loop ports (NL_ports) to the switch in a loop configuration.

fabric name. The unique identifier assigned to a fabric and communicated during login and port discovery.

fabric port (F_port). A port that is part of a fibre-channel fabric. An F_port on a fibre-channel fabric connects to a node’s node port (N_port). See also *fabric loop port* and *Fx_port*.

Fabric Watch. A feature that runs on the Fabric operating system (OS) and allows monitoring and configuration of fabric and switch elements.

FC. See *fibre channel*.

FC-AL. See *Fibre Channel Arbitrated Loop*.

FCP. See *fibre-channel protocol*.

fibre channel (FC). A technology for transmitting data between computer devices at a data rate of up to 4 Gbps. It is especially suited for attaching computer servers to shared storage devices and for interconnecting storage controllers and drives.

Fibre Channel Arbitrated Loop (FC-AL). A form of fibre-channel network in which up to 126 nodes are connected in a loop topology, with each node’s loop port (L_port) transmitter connecting to the L_port receiver of the node to its logical right. Nodes connected to a Fibre Channel Arbitrated Loop arbitrate for the single transmission that can occur on the loop in any instant using a Fibre Channel Arbitrated Loop protocol that is different from fibre-channel switched and point-to-point protocols. An arbitrated loop can be private (no fabric connection) or public (attached to a fabric by a fabric loop port (FL_port)).

Fibre Channel Protocol (FCP). An evolving American National Standards Institute (ANSI) interconnection standard for high-speed data transfer among computers and storage devices defined by the Fibre Channel Protocol (FCP). At the physical level, data is transmitted serially over pairs of point-to-point links between fibre-channel (FC) ports. With appropriate components, data can be transferred at 100 MBps up over a distance of 10 km (6.2 mi) between FC ports. The ports can be configured in ring and switched interconnect topologies which allow each port to exchange data with any other port that is part of the same fabric.

fibre-channel service (FS). A service that is defined by fibre-channel standards and exists at a well-known address. For example, the Simple Name Server is a fibre-channel service. See also *Fibre Channel Service Protocol*.

Fibre Channel Service Protocol (FSP). The common protocol for all fabric services, transparent to the fabric type or topology. See also *fibre-channel service*.

fibre-channel shortest path first (FSPF). A routing protocol used by fibre-channel switches.

fibre-channel transport. A protocol service that supports communication between fibre-channel service providers. See also *Fibre Channel Service Protocol*.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit may contain other field replaceable units.

File Transfer Protocol (FTP). In TCP/IP, an application protocol used for transferring files to and from host computers.

fill word. A transmission word that is an IDLE or an ARBx primitive signal. Fill words are transmitted between frames, primitive signals, and primitive sequences to keep a fibre-channel network active.

firmware. Proprietary code that is usually delivered as microcode as part of an operating system. Firmware is more efficient than software loaded from an alterable medium and more adaptable to change than pure hardware circuitry. An example of firmware is the Basic Input/Output System (BIOS) in read-only memory (ROM) on a PC system board.

FLOGI. See *fabric login*.

FL_port. See *fabric loop port*.

F_port. See *fabric port*.

frame. In fibre-channel technology, the structure used to transmit data between ports. A frame consists of a start-of-frame delimiter, header, any optional headers, the data payload, a cyclic redundancy check (CRC), and an end-of-frame delimiter. There are two types of frames: link control frames (transmission acknowledgements, and so on) and data frames.

FRU. See *field replaceable unit*.

FS. See *fibre-channel service*.

FSP. See *Fibre Channel Service Protocol*.

FSPF. See *fibre-channel shortest path first*.

FTP. See *File Transfer Protocol*.

full-duplex. Describing a communications connection over which each device can transmit and receive simultaneously. See also *half-duplex*.

Fx_port. A fabric port that can operate as either a fabric port (F_port) or fabric loop port (FL_port). See also *fabric port* and *fabric loop port*.

gateway. A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architecture.

GBIC. See *gigabit interface converter*.

generic port (G_port). A port on a fibre-channel switch that can function either as a fabric port (F_port) or as an expansion port (E_port). The functionality of a G_port is determined during port login. A G_port functions as an F_port when connected to a node port (N_port), and as an E_port when connected to an E_port.

gigabit interface converter (GBIC). A transceiver that converts between electrical signals used by host bus adapters (and similar fibre-channel and Ethernet devices) and either electrical or optical signals suitable for transmission. Gigabit interface converters allow designers to design one type of device and adapt it for either copper or optical applications. Unlike gigabaud link modules, GBICs can be hot-swapped.

gigabit switch. A 16-port, fibre-channel gigabit switch.

G_port. See *generic port*.

half-duplex. Describing a communications connection over which only one device at a time can transmit data. See also *full-duplex*.

hard address. The arbitrated loop physical address (AL_PA) that a node loop port (NL_port) attempts to acquire during loop initialization.

hardware translative mode. A method for achieving address translation. Two hardware translative modes are available to a QuickLoop-enabled switch: Standard Translative Mode, which allows public devices to communicate with private devices across the fabric; and QuickLoop Mode, which allows private devices to communicate with other private devices across the fabric.

HBA. See *host bus adapter*.

host bus adapter (HBA). The interface card between a server or workstation bus and the fibre-channel network.

hub. A fibre-channel device that connects nodes into a logical loop by using a physical star topology. Hubs will automatically recognize an active node and insert the node into the loop. A node that fails or is powered off is automatically removed from the loop.

ID. See *identifier*.

identifier (ID). A sequence of bits or characters that identifies a user, program, device, or system to another user, program, device, or system.

IDLE. Continuous transmission of an ordered set over a fibre-channel link when no data is being transmitted for the purpose of keeping the link active and maintaining bit, byte, and word synchronization.

IETF. Internet Engineering Task Force.

information unit (IU). A set of information as defined by either upper-level process protocol definition or upper-lever protocol mapping.

initiator. The system component that originates an input/output (I/O) command over an I/O bus or network. I/O adapters, network interface cards, and intelligent

controller device I/O bus control application-specific integrated circuits (ASICs) are typical initiators. See also *target*.

in-order delivery (IOD). A parameter that, when set, guarantees that frames are either delivered in order or dropped.

integrated fabric. The fabric created by six switches that are cabled together and are configured to handle traffic as a seamless group.

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. Internet Protocol (IP) acts as an intermediary between the higher protocol layers and the physical network.

inter-switch link (ISL). A fibre link between two switches.

IOD. See *in-order delivery*.

IP. See *internet protocol*.

ISL. See *inter-switch link*.

ISL Trunking. A feature that enables distribution of traffic over the combined bandwidth of up to four inter-switch links (ISLs) between adjacent switches, while preserving in-order delivery. A set of trunked ISLs is called a *trunking group*; each port employed in a trunking group is called a *trunking port*. See also *master port*.

isolated E_port. An E_port that is online but not operational between switches due to overlapping domain ID or nonidentical parameters such as E_D_TOVs. See also *expansion port*.

IU. See *information unit*.

K28.5. A special 10-bit character used to indicate the beginning of a transmission word that performs fibre channel control and signaling functions. The first seven bits of the character are the comma pattern. See also *comma*.

LAN. See *local area network*.

latency. The time from the initiation of an operation until something actually starts happening (for example, data transmission begins).

LED. See *light-emitting diode*.

light-emitting diode (LED). A semiconductor chip that gives off visible or infrared light when activated.

link. In fibre-channel technology, two unidirectional fibers carrying data in opposite directions, along with their associated transmitters and receivers. See also *circuit*.

link services. A protocol for link-related actions.

LIP. See *loop initialization primitive*.

LM_TOV. See *loop master timeout value*.

local area network (LAN). A computer network located on a user's premises within a limited geographical area.

logical unit number (LUN). An identifier used on a small computer systems interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

long wavelength (LWL). A type of fiber-optic cabling that is based on 1300-mm lasers and supports link speeds of 1.0625 Gbps. LWL can also refer to the type of gigabit interface converter (GBIC) or small form-factor pluggable (SFP). See also *short wavelength*.

loop. A configuration of devices connected to the fabric by way of a fabric loop port (FL_port) interface card.

loop failure. Loss of signal within a loop for any period of time, or loss of synchronization for longer than the timeout value.

loop_ID. A hex value representing one of the 127 possible arbitrated loop physical address (AL_PA) values in an arbitrated loop.

loop initialization. The logical procedure used by a loop port (L_port) to discover its environment. Loop initialization can be used to assign arbitrated loop physical addresses (AL_PAs), detect loop failure, or reset a node.

loop initialization primitive (LIP). The signal used to begin initialization in a loop, which indicates either loop failure or resetting of a node.

looplet. A set of devices connected in a loop to a port that is a member of another loop.

loop master timeout value (LM_TOV). The minimum time that the loop master waits for a loop initialization sequence to return.

loop port (L_port). A port used to connect a node to a Fibre Channel Arbitrated Loop (FC-AL). See also *non-participating mode* and *participating mode*.

loop port state machine (LPSM). The logical entity that performs arbitrated loop protocols and defines the behavior of loop ports (L_ports) when they require access to an arbitrated loop.

L_port. See *loop port*.

LPSM. See *loop port state machine*.

LUN. See *logical unit number*.

LWL. See *long wavelength*.

MAC. See *media access control*.

management information base (MIB). A definition for management information that specifies the information available from a host or gateway and the operations allowed.

master port. As relates to trunking, the port that determines the routing paths for all traffic flowing through the trunking group. One of the ports in the first ISL in the trunking group is designated as the master port for that group. See also *ISL Trunking*.

media access control (MAC). Algorithms that control access to physical media, especially in shared media networks.

MIB. See *management information base*.

multicast. Transmission of the same data to a selected group of destinations. See also *broadcast* and *unicast*.

multimode. A type of optical fiber which incorporates shortwave lasers and which is used with gigabaud link modules. Typically, it is used for links of up to 500 m (1640.42 ft).

name server. In networking, the server that translates network names to addresses. See also *simple name server*.

NL_port. See *node loop port*.

node. A fibre-channel device that contains a node port (N_port) or node loop port (NL_port).

node loop port (NL_port). A port specific to Fibre Channel Arbitrated Loop (FC-AL). An NL_port has the same functional, logical, and message handling capability as a node port (N_port), but connects to an arbitrated loop rather than to a fabric. Some implementations can function either as N_ports or as NL_ports depending on the network to which they are connected. An NL_port must replicate frames and pass then on when in passive loop mode.

node name. The name assigned to a node during network definition.

node port (N_port). A port that connects a node to a fabric or to another node. N_ports connect to fabric ports (F_ports) or to other N_ports of other nodes. N_ports handle creation, detection, and flow of message units to and from the connected systems. N_ports are end points in point-to-point links.

non-participating mode. A mode in which a loop port (L_port) in a loop is inactive and cannot arbitrate or send frames, but can retransmit any received transmissions. This mode is entered if there are more than 127 devices in a loop and an arbitrated loop physical address (AL_PA) cannot be acquired. See also *participating mode*.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

NVS. See *nonvolatile storage*.

Nx_port. A node port that can operate as either a node port (N_port) or node loop port (NL_port). See also *node port* and *node loop port*.

ordered set. A transmission word that uses 8B/10B mapping and begins with the K28.5 character. Ordered sets occur outside of frames, and include: frame delimiters, which mark frame boundaries and describe frame contents; primitive signals, which indicate events; and primitive sequences, which indicate or initiate port states. Ordered sets are used to differentiate fibre-channel control information from data frames and to manage the transport of frames.

packet. In networking, a group of bits that has a defined format and fixed maximum size, sent as a unit across a network. See also *frame*.

participating mode. A mode in which a loop port (L_port) in a loop has a valid arbitrated loop physical address (AL_PA) and can arbitrate, send frames, and retransmit received transmissions. See also *non-participating mode*.

path selection. The selection of a transmission path through the fabric. Switches use the fibre-channel shortest path first (FSPF) protocol.

Performance Monitoring. A feature that provides error and performance information to the administrator and end user for use in storage management.

phantom address. An arbitrated loop physical address (AL_PA) value that is assigned to a device that is not physically in the loop. Also known as *phantom AL_PA*.

phantom device. A device that is not physically in an arbitrated loop but is logically included through the use of a phantom address.

PLDA. See *private loop direct attach*.

PLOGI. See *port login*.

point-to-point. A fibre-channel topology that employs direct links between each pair of communicating entities. See also *topology*.

port login (PLOGI). The port-to-port login process by which initiators establish sessions with targets. See also *fabric login*.

port_name. The unique identifier assigned to a fibre-channel port and communicated during login and port discovery.

POST. See *power-on self-test*.

power-on self-test (POST). A series of internal diagnostic tests that are activated each time the system power is turned on.

private device. A device that supports arbitrated loop protocol and can interpret 8-bit addresses, but cannot log into the fabric.

private loop. A Fibre Channel Arbitrated Loop (FC-AL) with no fabric attachment.

private loop direct attach (PLDA). A subset of fibre channel standards for the operation of peripheral devices.

private NL_port. A node loop port (NL_port) that communicates only with other private NL_ports in the same loop and does not log into the fabric.

protocol. A set of rules controlling the communication and transfer of data between two or more devices or systems in a communications network.

public device. A device that supports arbitrated loop protocol, can interpret 8-bit addresses, and can log into the fabric.

public loop. A Fibre Channel Arbitrated Loop (FC-AL) with an attachment to a fabric.

public NL_port. A node loop port (NL_port) that logs into the fabric, can function within either a public or a private loop, and can communicate with either private or public NL_ports.

QuickLoop. (1) A feature that makes it possible to allow private devices within loops to communicate with public and private devices across the fabric through the creation of a larger loop. (2) The arbitrated loop created using this software. A QuickLoop can contain a number of devices or looplets; all devices in the same QuickLoop share a single arbitrated loop physical address (AL_PA) space.

RAID. See *redundant array of independent disks*.

RAM. See *random access memory*.

random access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes.

R_A_TOV. See *resource allocation timeout value*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

reduced instruction set computer (RISC). A computer that uses a small, simplified set of frequently used instructions for rapid processing.

Redundant Array of Independent Disks (RAID). A collection of two or more disk drives that present the image of a single disk drive to the system. In the event of a single device failure, the data can be read or regenerated from the other disk drives in the array.

registered state change notification (RSCN). A switch function that allows notification of fabric changes to be sent from the switch to specified nodes.

remote procedure call (RPC). A facility that a client uses to request the execution of a procedure call from a server.

Remote Switch. A feature that runs on the Fabric operating system (OS) and enables two fabric switches to be connected over an asynchronous transfer mode (ATM) connection. Remote Switch requires a compatible fibre-channel-to-ATM gateway. The distance between each switch and the respective ATM gateway can be up to 10 km (6.214 mi).

request rate. The rate at which requests arrive at a servicing entity. See also *service rate*.

resource allocation timeout value (R_A_TOV). A value used to time out operations that depend on the maximum possible time that a frame can be delayed in a fabric and still be delivered. This value is adjustable in one microsecond increments from 10 - 120 seconds.

resource recovery timeout value (RR_TOV). The minimum time a target device in a loop waits after a loop initialization primitive (LIP) before logging out a small computer systems interface (SCSI) initiator. See also *error detect timeout value* and *resource allocation timeout value*.

RISC. See *reduced instruction set computer*.

ROM. See *read-only memory*.

route. The path that network traffic follows from its source to its destination. See also *fibre-channel shortest path first*.

routing. The assignment of the path by which a message is to reach its destination.

RPC. See *remote procedure call*.

RR_TOV. See *resource recovery timeout value*.

RSCN. See *registered state change notification*.

SAN. See *storage area network*.

SCSI. See *small computer systems interface*.

SCSI Enclosure Services (SES). A subset of the small computer systems interface (SCSI) protocol used to monitor temperature, power, and fan status for enclosure devices.

sequence. A group of related frames transmitted in the same direction between two node ports (N_ports).

service rate. The rate at which an entity can service requests. See also *request rate*.

SES. See *SCSI Enclosure Services*.

SFP. See *small form-factor pluggable*.

short wavelength (SWL). A type of fiber optic cabling that is based on 850-mm lasers and supports 1.0625 Gbps link speeds. SWL can also refer to the type of gigabit interface converter (GBIC) or small form-factor pluggable (SFP). See also *long wavelength*.

SID. See *source ID*.

simple name server (SNS). A switch service that stores names, addresses, and attributes for up to 15 minutes, and provides them as required to other devices in the fabric. SNS is defined by fibre channel standards and exists at a well-known address. See also *fibre-channel service*.

simple network management protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SMNP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

single mode. A type of optical fiber, typically used with gigabaud link modules incorporating longwave lasers. Typically used for long-distance links up to 10 km (6.21 mi).

small computer systems interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP). An optical transceiver used to convert signals between optical fiber cables and switches.

SNIA. Storage Network Industry Association.

SNMP. See *simple network management protocol*.

SNMPv1. The original standard for SNMP, now labeled v1.

SNS. See *simple name server*.

source ID (SID). The 3-byte source ID of the originator device, in the 0xDomainAreaALPA format.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

switch. A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have internal bandwidth that is a multiple of link bandwidth, and the ability to rapidly switch node connections from one to another. A typical switch can accommodate several simultaneous full-link bandwidth transmissions between different pairs of nodes.

switch name. The arbitrary name assigned to a switch.

switch port. A port on a switch. Switch ports can be expansion ports (E_ports), fabric ports (F_ports), or fabric loop ports (FL_ports).

SWL. See *short wavelength*.

target. A storage device on a fibre-channel network. See also *initiator*.

TCP. See *Transmission Control Protocol*.

tenancy. The time from when a port wins arbitration in a loop until the same port returns to the monitoring state. Also referred to as loop tenancy.

throughput. A measure of the amount of information transmitted over a network in a given period of time. For example, a network's data transfer rate is measured in bits per second (bps). Throughput is a measure of performance. It is also measured in Kbps or Mbps. See also *bandwidth*.

topology. In fibre-channel technology, the configuration of the fibre-channel network and the resulting communication paths allowed. There are three possible topologies: point-to-point, which allows a direct link between two communication ports; switched fabric, which allows multiple node ports (N_ports) to be linked to a switch by fabric ports (F_ports); and arbitrated loop, which allows multiple node loop ports (NL_ports) to be connected in a loop.

translative mode. A mode in which private devices can communicate with public devices across the fabric.

transmission character. A 10-bit character encoded according to the rules of the 8B/10B algorithm.

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. Transmission Control Protocol (TCP) provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

transmission word. A group of four transmission characters.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition. See also *simple network management protocol*.

tunneling. To treat a transport network as though it were a single communication link or local area network (LAN).

U. The unit of measure for rack-mounted equipment.

UDP. See *User Datagram Protocol*.

ULP. See *upper-layer protocol*.

ULP_TOV. See *upper-layer timeout value*.

unicast. Transmission of data to a single destination. See also *broadcast* and *multicast*.

universal port (U_port). A switch port that can operate as a generic port (G_port), expansion port (E_port), fabric port (F_port), or fabric loop port (FL_port). A port is defined as a U_port when it is not connected or has not yet assumed a specific function in the fabric.

U_port. See *universal port*.

upper-layer protocol (ULP). A protocol used on a fibre-channel network at or above the FC-4 level.

upper-layer timeout value (ULP_TOV). The minimum time that a SCSI ULP process waits for SCSI status before initiating ULP recovery.

User Datagram Protocol (UDP). In the Internet suite of protocols, a protocol that provides unreliable, connectionless datagram service. It enables an application program on one machine or process to send a datagram to an application program on another machine or process. UDP uses the Internet Protocol (IP) to deliver datagrams.

WAN. See *wide area network*.

well-known address. An address used to uniquely identify a particular node in the network to establish connections between nodes.

wide area network (WAN). A network that provides communication services to a geographic area larger than that served by a local area network or a metropolitan network, and that may use or provide public communications facilities. (T)

workstation. A powerful, single-user microcomputer, usually with a high-resolution display. Workstations are often used in conjunction with networked applications in which programs run on the workstation using data that resides on a server, which is connected to the workstation by a network.

worldwide name (WWN). A unique identifier for a switch on local and global networks.

World Wide Web (WWW). A network of servers that contain programs and files. Many of the files contain hypertext links to other documents available through the network.

WWN. See *worldwide name*.

WWW. See *World Wide Web*.

zone. A collection of fibre-channel node ports (N_ports) or node loop ports (NL_ports) (that is, device ports) that are permitted to communicate with each other using the fabric. Any two N_ports or NL_ports that are not members of at least one common zone are not permitted to communicate using the fabric. Zone membership can be specified by: 1) port location on a switch (that is, domain_ID and port number); or, 2) the N_port_name of the device; or, 3) the address identifier of the device; or, 4) the node name of the device. Well-known addresses are implicitly included in every zone. See also *zoning*.

zone alias. An alias for a set of port numbers or worldwide names (WWNs). Zone aliases can be used to simplify the entry of port numbers and WWNs. For example, “host” could be used as an alias for a WWN of 110:00:00:60:69:00:00:8a.

zone configuration. A set of zones designated as belonging to the same zone configuration. When a zone configuration is in effect, all valid zones in that configuration are also in effect.

zoning. In fibre-channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. See also *zone*.

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3534 Model F08 User's Guide

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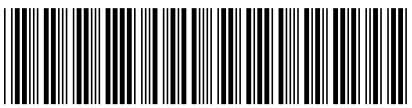

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