

StorageWorks by Compaq

ISL Trunking User Guide

Part Number: AA-RR82A-TE

First Edition January 2002

Product Version: Version 3.0

This document contains the following topics: an overview of the ISL Trunking feature, instructions for installing an ISL Trunking license, information on how to use the ISL Trunking feature with telnet commands or Web Tools, and Frequently Asked Questions.

COMPAQ

© 2002 Compaq Information Technologies Group, L.P.

Compaq, the Compaq logo and StorageWorks are trademarks of Compaq Information Technologies Group, L.P. in the U.S. and/or other countries.

All other product names mentioned herein may be trademarks of their respective companies.

Confidential computer software. Valid license from Compaq required for possession, use or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer Software, Computer Software Documentation, and Technical Data for Commercial Items are licensed to the U.S. Government under vendor's standard commercial license.

Compaq shall not be liable for technical or editorial errors or omissions contained herein. The information is provided "as is" without warranty of any kind and is subject to change without notice. The warranties for Compaq products are set forth in the express limited warranty statements accompanying such products. Nothing herein should be construed as constituting an additional warranty.

Compaq service tool software, including associated documentation, is the property of and contains confidential technology of Compaq Computer Corporation or its affiliates. Service customer is hereby licensed to use the software only for activities directly relating to the delivery of, and only during the term of, the applicable services delivered by Compaq or its authorized service provider. Customer may not modify or reverse engineer, remove, or transfer the software or make the software or any resultant diagnosis or system management data available to other parties without Compaq's or its authorized service provider's consent. Upon termination of the services, customer will, at Compaq's or its service provider's option, destroy or return the software and associated documentation in its possession.

Printed in the U.S.A

ISL Trunking User Guide
First Edition January 2002
Part Number: AA-RR82A-TE

Contents

About this Guide

Intended Audience	v
Related Documentation	v
Prerequisites	vi
Document Conventions	vi
Symbols in Text	vi
Symbols on Equipment	vii
Rack Stability	viii
Getting Help	viii
Compaq Technical Support	viii
Compaq Website	ix
Compaq Authorized Reseller	ix

1 Introducing ISL Trunking

Overview	1-1
Advantages of ISL Trunking	1-2
Routing without the ISL Trunking Feature	1-2
Routing with the ISL Trunking Feature	1-3
Trunking Groups, Ports and Masters	1-4
Trunking Groups	1-4
Trunking Ports	1-4
Trunking Masters	1-5

2 Installing ISL Trunking

Overview	2-1
Installing ISL Trunking Using Telnet	2-1
Installing ISL Trunking Using Web Tools	2-2

3 Using ISL Trunking

Trunking Overview	3-1
-----------------------------	-----

Administering ISL Trunking	3-1
ISL Trunking Telnet Commands	3-1
Using Web Tools for ISL Trunking.....	3-2
Frequently Asked Questions about ISL Trunking	3-3

Glossary

Index

Figures

1-1	Routing without the ISL Trunking Feature	1-3
1-2	Routing with the ISL Trunking Feature	1-4

Tables

1	Document Conventions	vi
3-1	ISL Trunking Telnet Commands	3-1
3-2	Trunk Information Tab Description	3-2
3-3	Port Setting Tab Features	3-3
3-4	Frequently Asked Questions about ISL Trunking	3-3

About this Guide

This User Guide provides information to help you:

- Install an ISL Trunking license key.
- Use the ISL Trunking software using telnet commands or Web Tools.
- Contact technical support for additional assistance.

Intended Audience

This book is intended for use by System Administrators who are experienced with the following:

- *StorageWorks*™ Fibre Channel SAN Switches by Compaq.
- Fabric Operating System V3.0 or later

Related Documentation

In addition to this guide, Compaq provides corresponding information:

- Fabric Operating System Reference Guide—AA-RQ6FA-TE
- MIB Reference Guide—AA-RQ6HA-TE
- Zoning User guide—AA-RQ6YA-TE
- Fabric Operating System Procedures User Guide—AA-RQ6FA-TE
- Advanced Performance Monitor User Guide—AA-RR7UA-TE
- Web Tools User Guide—AA-RQ6GA-TE
- Quickloop User Guide—AA-RR7LA-TE
- Extended Fabric User Guide—AA-RR7QA-TE
- Fabric Watch User Guide—AA-RR7YA-TE

Prerequisites

Before you install or use the ISL Trunking software, make sure you consider the items in the Document Conventions section that follows.

Document Conventions

The conventions included in Table 1 apply in most cases.

Table 1: Document Conventions

Element	Convention
Key names, menu items, buttons, and dialog box titles	Bold
File names and application names	<i>Italics</i>
User input, command names, system responses (output and messages)	Monospace font COMMAND NAMES are uppercase unless they are case sensitive
Variables	<i>Monospace, italic font</i>
Website addresses	Sans serif font (http://www.compaq.com)

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.



WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.



CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Symbols on Equipment



Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.



Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.



Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.



Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

WARNING: To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.



Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

Rack Stability



WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
 - The full weight of the rack rests on the leveling jacks.
 - In single rack installations, the stabilizing feet are attached to the rack.
 - In multiple rack installations, the racks are coupled.
 - Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.
-

Getting Help

If you still have a question after reading this guide, contact service representatives or visit our website.

Compaq Technical Support

In North America, call Compaq technical support at 1-800-OK-COMPAQ, available 24 hours a day, 7 days a week.

NOTE: For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call Compaq technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the Compaq website: <http://www.compaq.com>.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

Compaq Website

The Compaq website has the latest information on this product, as well as the latest drivers. Access the Compaq website at: <http://www.compaq.com/storage>. From this website, select the appropriate product or solution.

Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Introducing ISL Trunking

This chapter provides the following information:

- Overview on page 1-1
- Advantages of ISL Trunking on page 1-2
- Trunking Groups, Ports and Masters on page 1-4

Overview

Interswitch Link (ISL) Trunking is an optional-licensed product available on the Compaq StorageWorks Fibre Channel SAN Switches with Fabric Operating System version 3.0. ISL Trunking is managed using telnet commands or the Web Tools interface.

The ISL Trunking feature allows up to four ISLs, connections between two switches through an Expansion Port (E_Port), to merge logically into a single link. When using ISL Trunking to aggregate bandwidth of up to four ports, the speed of the ISLs between switches in a fabric is quadrupled. For example, at 2 Gb/s speeds, ISL Trunking delivers ISL throughput of up to 8 Gb/s.

ISL Trunking also supports high-bandwidth, large-scale Storage Area Networks (SANs) which include core switches. The primary task of ISL Trunking is to route data and edge switches that aggregate connections to servers and storage. ISL Trunking simplifies network design and reduces the cost of storage management by optimizing bandwidth utilization and enabling load sharing of traffic at the frame-level.

For a list of frequently asked questions about the ISL Trunking Feature, refer to Frequently Asked Questions about ISL Trunking on page 3-3.

Advantages of ISL Trunking

The ISL Trunking feature enhances switch to switch performance in Storage Area Networks while simplifying management and improving reliability.

Advantages of the ISL Trunking feature include:

- Combining up to four ISLs into a single logical ISL
- Load sharing traffic across all ISLs in a trunk
- Maintaining in-order delivery of frames
- Avoiding rerouting if one of the server links between two switches fails
- Simplifying management by implementing fewer ISLs

Routing without the ISL Trunking Feature

Prior to the implementation of the ISL Trunking feature, device-level load sharing was done through Fibre Channel networks that created ISLs and operated with the Fibre Channel Shortest Path First (FSPF) routing protocol. The protocol established and communicated the shortest paths for data to be carried from source to destination. Load sharing multiple ISLs to connect two switches was established by a round robin algorithm that assigned the next available ISL as part of the link to connect a Host Bus Adapter (HBA) and storage. Depending on the fabric event sequences, multiple HBAs shared an individual ISL. This type of load sharing sometimes caused the fabric to have congested input/output traffic over the ISLs connecting two switches.

Although FSPF compliant switches ensure fixed routing paths, and guarantee that all frames are delivered in order, congestion occurs if the aggregation of the stream exceeds the capacity of one of the ISLs in the path.

For example, Figure 1–1 shows four untrunked ISLs with a maximum capacity of 2Gb/s each, for a maximum throughput of 8Gb/s. Due to traffic that is not trunked, the throughput of the four ISLs is:

$$1\text{Gb/s} + 1.5\text{Gb/s} + .5\text{G} + 1\text{Gb/s} + 1\text{Gb/s} = 5\text{Gb/s}.$$

NOTE: Two 2Gb/s data streams are competing for the same path.

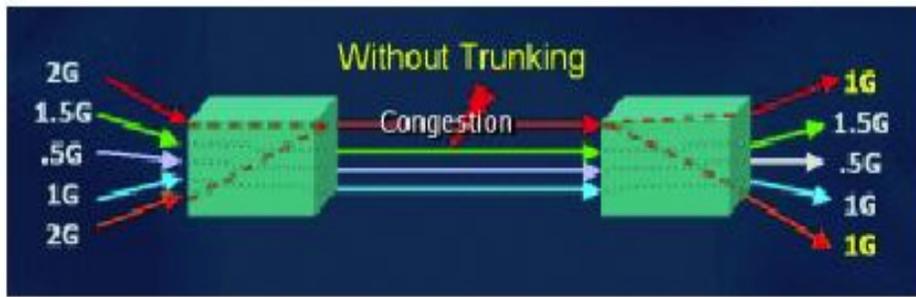


Figure 1–1: Routing without the ISL Trunking Feature

Routing with the ISL Trunking Feature

ISL Trunking ensures that all links are used efficiently, eliminating congestion on one link, while distributing the load of the links. This feature is designed to significantly reduce traffic congestion. As shown in Figure 1–2, four ISLs are combined into a single logical ISL with a total capacity of 8Gb/s.

The ISL Trunking feature distributes workload across all ISLs in a trunk. Each incoming frame is sent across the first available ISL. As a result, transient workload peaks for one system or application are much less likely to impact the performance of other parts of SAN fabric. Because the full bandwidth of each physical link is available, bandwidth is efficiently allocated.

In Figure 1–2, four ISLs provide 8Gb/s of total throughput. With the implementation of ISL Trunking, bandwidth is shared across the trunked ISLs, permitting a total throughput of:

$$2\text{Gb/s} + 1.5\text{Gb/s} + 0.5\text{Gb/s} + 1\text{Gb/s} + 2\text{Gb/s} = 7\text{Gb/s}$$

Because the trunk aggregates the four individual paths into one and preserves in-order deliver of frames, the total throughput is increased compared to a non-trunked group of ISLs.



Figure 1–2: Routing with the ISL Trunking Feature

Trunking Groups, Ports and Masters

ISL Trunking dynamically performs load sharing, at the frame level, across a set of available links between two adjacent switches to establish a trunking group. Ports that belong to a trunking group are called trunking ports. One port is used to assign traffic for the group, and is referred to as the trunking master.

Trunking Groups

A trunking group is identified by the trunking master that represents the entire group. The rest of the group members are referred to as slave links that help the trunking master direct traffic across ISLs, allowing efficient and balanced in-order communication.

Trunking Ports

Trunking ports in a trunking group must meet the following criteria:

- Port must be configured as E_ports.
- Ports must reside in the same contiguous four-port groups. For example: 0-3, 4-7, 8-11, 12-15.
- Ports must be set to run at the 2G speed.
- The cable difference between all ports in a trunking group must be less than 400 meters, and should be kept to 30 meters or less within a trunk to ensure optimal performance and bandwidth utilization.

NOTE: Short Wave Length (SWL) and Long Wave Length (LWL) fiber optics can be intermixed within a trunking group.

Trunking Masters

The trunking master implicitly defines the trunking group. All ports with the same master are considered to be part of the same group. Each trunking group includes a single trunking master and from 1 to 3 trunking slave links. The first ISL found in any trunking group is assigned to be the trunking master, also known as the principal ISL. After the trunking group is fully established, all data packets intended for transmission across the trunk are dynamically distributed at the frame level across the ISLs in the trunking group, while preserving in-order delivery.

Installing ISL Trunking

Overview

Installing the ISL Trunking feature involves activating a license for each switch you want to enable for trunking. After the license is activated, ISL Trunking is automatically invoked as ISLs are added between two 2Gbit/s switches. A license may have been installed in the switch at the factory. If not, contact your switch supplier to obtain a license key.

The ISL Trunking feature requires a Compaq StorageWorks Fibre Channel SAN Switch with Fabric Operating System Version 3.0. A Trunking license can be installed using either telnet or Web Tools:

- Installing ISL Trunking Using Telnet on page 2–1
- Installing ISL Trunking Using Web Tools on page 2–2

Installing ISL Trunking Using Telnet

To use telnet to log on to the ISL Trunking feature, do the following:

1. From a command prompt screen, use the telnet command to log onto the switch (see the user guide provided with the hardware for details), using an account that has administrative privileges.
2. Determine whether a ISL Trunking license is already installed on the switch, type `licenseShow` on the telnet command line.

A list displays of all the licenses currently installed on the switch. For example:

```
admin> licenseShow
1A1AaAaaaaAAAA1a:
Release v3.0
Web license
Zoning license
SES license
Trunking license
```

If the Trunking license is not included in the list, or is incorrect, continue with step [3].

3. Enter the following on the command line:

```
licenseAdd "key"
```

where “*key*” is the license key provided to you, enclosed in double quotes. The license key is case sensitive and must be entered exactly as given.

4. Verify the license was added by entering the following on the command line:

```
licenseShow
```

If the ISL Trunking license is listed, the feature is installed and immediately available.

If the license is not listed, repeat step [3].

5. Disable the switch by entering the following command:

```
switchdisable
```

6. Enable the switch by entering the following command:

```
switchenable
```

Installing ISL Trunking Using Web Tools

To enter the ISL Trunking license key using the Web Tool user interface, do the following:

1. Launch the web browser, enter the switch name or IP address in the **Location/Address** field, and press **Enter**.

Web Tools launches, displaying the Fabric View.

2. Click the **Admin View** button on the relevant switch panel.

The logon window displays.

3. Enter a logon name and password with administrative privileges and press **Enter**.

The Switch Admin view displays.

4. Select the License Admin tab, enter the license key in the **License Key** field, and click **Add**.

The Trunking feature is available as soon as the license key is added.

5. Select Switch Settings tab, disable the switch by selecting **Disable**.
6. Enable the switch by selecting **Enable**.

Using ISL Trunking

This chapter provides the following information:

- Trunking Overview on page 3-1
- Administering ISL Trunking on page 3-1
- Frequently Asked Questions about ISL Trunking on page 3-3

Trunking Overview

The ISL Trunking feature is managed by performing some administration tasks. These tasks include: enabling or disabling the trunking, enabling and disabling ports of a switch, setting the speed of a port, and debugging a trunking link failure.

Administering ISL Trunking

The ISL Trunking feature is administered using telnet commands, or Web Tools (an optional-licensed product). You can also attach another cable to an additional port within a trunk group quad to establish a trunking group.

ISL Trunking Telnet Commands

Table 3–1 shows the telnet commands used to manage the ISL Trunking feature.

Table 3–1: ISL Trunking Telnet Commands

Telnet Command	Description	Example
portCfgTrunkport	Use this command to configure a port to be enabled or disabled for ISL Trunking.	To enable port 5 for ISL Trunking, enter: portCfgTrunkport 5, 1 To disable port 5 for ISL Trunking, enter: portCfgTrunkport 5, 0

Table 3–1: ISL Trunking Telnet Commands (Continued)

Telnet Command	Description	Example
switchCfgTrunk	Use this command to enable or disable trunking on all ports of a switch.	To enable ISL Trunking on all ports of a switch, enter: switchCfgTrunk 1 To disable ISL Trunking on all ports of a switch, enter: switchCfgTrunk 0
trunkDebug	Use this command to debug a trunk link failure.	To debug ports 1 and 2, enter: trunkDebug 1, 2
trunkshow	Use this command to display ISL Trunking membership information.	To display ISL Trunking membership information about users, enter: trunkshow

For detailed information on how to use these commands, refer to the *Fabric Operating System Reference Guide*.

Using Web Tools for ISL Trunking

Use Web Tools to view and modify ISL Trunking options through the Trunk Information Tab and the Port Settings Tab on the Switch Administration interface. For information on how to install and use Web Tools for the ISL Trunking feature, refer to the *Web Tools User Guide*.

Use the Web Tools Trunk Information tab to view a summary of trunk groups and associated master and member ports. Table 3–2 describes the headings displayed from the Trunk Information tab.

Table 3–2: Trunk Information Tab Description

Trunk Information Tab	Description
Trunk Group	A numerical number is displayed.
Master Port	The associated master port for the group is displayed.
Member Ports	Shows the member ports associated with the group, separated by a comma.

Table 3–3 describes the headings and the tasks you can perform using the Web Tools Port Setting tab.

Table 3–3: Port Setting Tab Features

Port Setting Tab Features	Description
Port Number	Each port is assigned a number. The port numbers are displayed under this heading.
Trunking Enable:Disable	This allows you to enable or disable ISL Trunking on a per port basis.
Port Enable:Disable	Use this to enable or disable a port.
Port Speed	Use this to set the speed of the port to 2Gb/s.

NOTE: Note: ISL Trunking ports always must operate at 2Gb/s, setting the speed to 1Gb/s prevents a port from participating in a trunk.

Frequently Asked Questions about ISL Trunking

Refer to Table 3–4 for the frequently asked questions about the ISL Trunking feature.

Table 3–4: Frequently Asked Questions about ISL Trunking

Frequently Asked Questions	Answers
Does ISL Trunking replace Dense Wavelength Digital Multiplexing (DWDM)?	No. DWDM is a ring, and if a failure occurs it reroutes the allocated wavelength over alternate routes, and therefore changes the effective cable lengths.
What happens if an ISL in the trunk slave port fails?	If one of the trunk slave ports fails, the logical ISL stays up, however, its capacity is reduced by 2Gb/s, and no route failure or re-routing of traffic occurs.
What happens if a trunk master fails?	If a trunk master fails, the ISL goes down, and FSFP perceives a momentary route failure. The trunk immediately re-forms without the failed ISL, and traffic resumes over the re-formed trunk with capacity reduced by 2Gb/s.
Are trunks automatically established when the trunking feature is enabled?	Yes. Trunks are automatically established on available ports when the trunking feature is enabled.

Table 3-4: Frequently Asked Questions about ISL Trunking (Continued)

Frequently Asked Questions	Answers
Is it possible to have more than one trunk between a pair of switches?	Yes.
Is there a limit on the number of trunks I can have on one switch?	No.
Is there a limit on the number of trunks I can have between a pair of switches?	No.
Is it possible to trunk between a switch and an edge devices host or storage?	No.
Should port statistics be the same across all participating ISLs within a trunk?	Not necessarily, it depends on the payload variations at the frame level. While optimal bandwidth utilization is the goal of the ISL Trunking feature, traffic might not be distributed exactly the same across all ISL links within a trunk.

Glossary

This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

8b/10b Encoding

An encoding scheme that converts each 8-bit byte into 10 bits. Used to balance ones and zeros in high-speed transports.

Address Identifier

A 24-bit or 8-bit value used to identify the source or destination of a frame.

AL_PA

Arbitrated Loop Physical Address; a unique 8-bit value assigned during loop initialization to a port in an arbitrated loop.

Alias Address Identifier

An address identifier recognized by a port in addition to its standard identifier. An alias address identifier may be shared by multiple ports.

Alias AL_PA

An AL_PA value recognized by an L_Port in addition to the AL_PA assigned to the port. See also *AL_PA*.

Alias Server

A fabric software facility that supports multicast group management.

API

Application Programming Interface; defined protocol that allows applications to interface with a set of services.

Arbitrated Loop

A shared 100 MBps Fibre Channel transport structured as a loop. Can support up to 126 devices and one fabric attachment. See also *Topology*.

ASIC

Application Specific Integrated Circuit.

ATM

Asynchronous Transfer Mode; a transport used for transmitting data over LANs or WANs that transmit fixed-length units of data. Provides any-to-any connectivity, and allows nodes to transmit simultaneously.

AW_TOV

Arbitration Wait Time-out Value; the minimum time an arbitrating L_Port waits for a response before beginning loop initialization.

Bandwidth

The total transmission capacity of a cable, link, or system. Usually measured in bps (bits per second). May also refer to the range of transmission frequencies available to a network. See also *Throughput*.

BB_Credit

Buffer-to-buffer credit; the number of frames that can be transmitted to a directly connected recipient or within an arbitrated loop. Determined by the number of receive buffers available. See also *Buffer-to-buffer Flow Control*, *EE_Credit*.

Beginning Run 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

Bit Error Rate; the rate at which bits are expected to be received in error. Expressed as the ratio of error bits to total bits transmitted. See also *Error*.

Block

As applies to Fibre Channel, upper-level application data that is transferred in a single sequence.

Bridge

Hardware that connects incompatible networks by providing translation for both hardware and software. For example, an ATM gateway can connect a Fibre Channel link to an ATM connection.

Broadcast

The transmission of data from a single source to all devices in the fabric, regardless of zoning. See also *Multicast*, *Unicast*.

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 *BB_Credit*.

Cascade

Two or more interconnected Fibre Channel switches. The recommended number of interswitch links is seven. See also *Fabric*, *ISL*.

Chassis

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

Circuit

An established communication path between two ports. Consists of two virtual circuits capable of transmitting in opposite directions. See also *Link*.

Class 1

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

Class 2

Service that provides multiplex and connection-less frame switching service between two ports, with notification of delivery or nondelivery.

Class 3

Service that provides a connection-less frame switching service between two ports, without notification of delivery or nondelivery of data. Can also be used to provide a multicast connection between the originator and recipients, with notification of delivery or nondelivery.

Class 4

Connection-oriented service that provides a virtual circuit between two ports, with notification of delivery or nondelivery. Allows fractional parts of the bandwidth to be used in a virtual circuit.

Class 6

Connection-oriented service that provides a multicast connection between the multicast originator and recipients, with notification of delivery or nondelivery.

Class F

Connection-less service for control traffic between switches, with notification of delivery or nondelivery of data between the E_Ports.

Class of Service

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

CLS

Close Primitive Signal. The protocol used by a port in an arbitrated loop to close a circuit.

Code Balance

The ratio of one bit to the total number of transmitted bits.

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*.

Command Line

Interface that depends entirely on the use of commands, such as through telnet or SNMP, and does not involve a GUI.

Community (SNMP)

A relationship between a group of SNMP managers and an SNMP agent, in which authentication, access control, and proxy characteristics are defined. See also *SNMP*.

Connection Initiator

A port that has originated a Class 1 dedicated connection and received a response from the recipient.

Connection Recipient

A port that has received a Class 1 dedicated connection request and transmitted a response to the originator.

CRC

Cyclic Redundancy Check; a check for transmission errors included in every data frame.

Credit

As applies to Fibre Channel, the number of receive buffers available for transmission of frames between ports. See also *BB_Credit*, *EE_Credit*.

CT_HDR

Common Transport Header. A header that conforms to the Fibre Channel Common Transport (FC_CT) protocol.

CT_IU

Common Transport Information Unit. An information unit that conforms to the Fibre Channel Common Transport (FC_CT) protocol.

Current Fill Word

The fill word currently selected by the LPSM (loop port state machine). See also *Fill Word*.

Cut-through

A switching technique that allows the route for a frame to be selected as soon as the destination address is received. See also *Route*.

Data Word

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*, *Transmission Word*.

Defined Zone Configuration

The set of all zone objects defined in the fabric. May include multiple zone configurations. See also *Enabled Configuration*, *Zone Configuration*.

Disparity

The relationship of ones and zeros in an encoded character. “Neutral disparity” means an equal number of each, “positive disparity” means a majority of ones, and “negative disparity” means a majority of zeros.

DLS

Dynamic Load Sharing; dynamic distribution of traffic over available paths. Allows for recomputing of routes when an Fx_Port or E_Port changes status.

Domain ID

As applies to SAN switches, a unique number between 1 and 239 that identifies the switch to the fabric and is used in routing frames. Usually automatically assigned by the switch, but can be manually assigned.

E_D_TOV

Error Detect Time-out Value; the minimum amount of time a target waits for a sequence to complete before initiating recovery. Can also be defined as the maximum time allowed for a round-trip transmission before an error condition is declared. See also *R_A_TOV*, *RR_TOV*.

E_Port

Expansion Port; a type of switch port that can be connected to an E_Port on another switch to create an ISL. See also *ISL*.

EE_Credit

End-to-end Credit; the number of receive buffers allocated by a recipient port to an originating port. Used by Class 1 and 2 services to manage the exchange of frames across the fabric between source and destination. See also *End-to-end Flow Control*, *BB_Credit*.

EIA Rack

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

Enabled Zone Configuration

The currently enabled configuration of zones. Only one configuration can be enabled at a time. See also *Defined Configuration*, *Zone Configuration*.

End-to-end Flow Control

Governs flow of class 1 and 2 frames between N_Ports. See also *EE_Credit*.

Error

As applies to Fibre Channel, a missing or corrupted frame, time-out, loss of synchronization, or loss of signal (link errors). See also *Loop Failure*.

Exchange

The highest level Fibre Channel mechanism used for communication between N_Ports. Composed of one or more related sequences, and can work in either one or both directions.

F_Port

Fabric Port; a port that is able to transmit under fabric protocol and interface over links. Can be used to connect an N_Port to a switch. See also *FL_Port*, *Fx_Port*.

Fabric Name

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

Fabric

A Fibre Channel network containing two or more switches in addition to hosts and devices. May also be referred to as a switched fabric. See also *Topology*, *SAN*, *Cascade*.

FC-AL-3

The Fibre Channel Arbitrated Loop standard defined by ANSI. Defined on top of the FC-PH standards.

FC-FLA

The Fibre Channel Fabric Loop Attach standard defined by ANSI.

FCIA

Fibre Channel Industry Association. An international organization of Fibre Channel industry professionals. Among other things, provides oversight of ANSI and industry developed standards

FCP

Fibre Channel Protocol; mapping of protocols onto the Fibre Channel standard protocols. For example, SCSI FCP maps SCSI-3 onto Fibre Channel.

FC-PH-1, 2, 3

The Fibre Channel Physical and Signalling Interface standards defined by ANSI.

FC-PI

The Fibre Channel Physical Interface standard defined by ANSI.

FC-PLDA

The Fibre Channel Private Loop Direct Attach standard defined by ANSI. Applies to the operation of peripheral devices on a private loop.

FC-SW-2

The second generation of the Fibre Channel Switch Fabric standard defined by ANSI. Specifies tools and algorithms for the interconnection and initialization of Fibre Channel switches in order to create a multi-switch Fibre Channel fabric.

Fibre Channel Transport

A protocol service that supports communication between Fibre Channel service providers. See also *FSP*.

Fill Word

An IDLE or ARB ordered set that is transmitted during breaks between data frames to keep the Fibre Channel link active.

FL_Port

Fabric Loop Port; a port that is able to transmit under fabric protocol and also has arbitrated loop capabilities. Can be used to connect an NL_Port to a switch. See also *F_Port*, *Fx_Port*.

FLOGI

Fabric Login; the process by which an N_Port determines whether a fabric is present, and if so, exchanges service parameters with it. See also *PLOGI*.

Frame

The Fibre Channel structure used to transmit data between ports. 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, etc.) and data frames.

FS_ACC

Fibre Channel Services Accept. The information unit used to indicate acceptance of a request for a Fibre Channel service.

FS_IU

Fibre Channel Services Information Unit. An information unit that has been defined by a specific Fibre Channel service.

FS_REQ

Fibre Channel Services Request. A request for a Fibre Channel services function, or notification of a fabric condition or event.

FS_RJT

Fibre Channel Services Reject. An indication that a request for Fibre Channel services could not be processed.

FS

Fibre Channel Service; 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 *FSP*.

FSP

Fibre Channel Service Protocol; the common protocol for all fabric services, transparent to the fabric type or topology. See also *FS*.

FSPF

Fabric Shortest Path First; the routing protocol for Fibre Channel switches.

Full Fabric

The licensing that allows multiple E_Ports on a switch, making it possible to create multiple ISL links.

Full-duplex

A mode of communication that allows the same port to simultaneously transmit and receive frames. See also *Half-duplex*.

Fx_Port

A fabric port that can operate as either an F_Port or FL_Port. See also *F_Port*, *FL_Port*.

G_Port

Generic Port; a port that can operate as either an E_Port or F_Port. A port is defined as a G_Port when it is not yet connected or has not yet assumed a specific function in the fabric.

Gateway

A device such as a switch that connects different subnets together. A switch can be used as a gateway from the Ethernet to the Fibre Channel. Set the gateway address on one switch to the Fibre Channel IP address of another switch to enable the other switch to forward IP traffic to the ethernet port on the second switch.

GBIC

Gigabit Interface Converter; a removable serial transceiver module that allows gigabaud physical-level transport for Fibre Channel and gigabit ethernet. Also known as Optical Transceiver.

Gbps

Gigabits per second (1,062,500,000 bits/second).

GBps

GigaBytes per second (1,062,500,000 bytes/second).

Half-duplex

A mode of communication that allows a port to either transmit or receive frames at any time, but not simultaneously (with the exception of link control frames, which can be transmitted at any time). See also *Full-duplex*.

Hard Address

The AL_PA that an NL_Port attempts to acquire during loop initialization.

Hardware Translative Mode

A method for achieving address translation. The following two hardware translative modes are available to a QuickLoop enabled switch:

- Standard Translative Mode: Allows public devices to communicate with private devices that are directly connected to the fabric.
- QuickLoop Mode: Allows initiator devices to communicate with private or public devices that are not in the same loop.

HBA

Host Bus Adapter; the interface card between a server or workstation bus and the Fibre Channel network.

Hub

A Fibre Channel wiring concentrator that collapses a loop topology into a physical star topology. Nodes are automatically added to the loop when active and removed when inactive.

Idle

Continuous transmission of an ordered set over a Fibre Channel link when no data is being transmitted, to keep the link active and maintain bit, byte, and word synchronization.

IN_ID

Initial Identifier. The field in the CT_HDR where the port ID of the client originator of a Fibre Channel Services request.

Initiator

A server or workstation on a Fibre Channel network that initiates communications with storage devices. See also *Target*.

Integrated Fabric

The fabric created by a Compaq StorageWorks Fibre Channel SAN Switch IS/32 or IS/64, or SAN Switches 16-EL/8-EL switches cabled together and configured to handle traffic as a seamless group.

IOD

In-order Delivery; a parameter that, when set, guarantees that frames are either delivered in order or dropped.

IPA

Initial Process Associator. An identifier associated with a process at an N_Port.

ISL

Interswitch Link; a Fibre Channel link from the E_Port of one switch to the E_Port of another. See also *E_Port*, *Cascade*.

Isolated E_Port

An E_Port that is online but not operational due to overlapping domain IDs or nonidentical parameters (such as E_D_TOVs). See also *E_Port*.

IU

Information Unit; a set of information as defined by either upper-level process protocol definition or upper-level protocol mapping.

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*.

L_Port

Loop Port; a node port (NL_Port) or fabric port (FL_Port) that has arbitrated loop capabilities. An L_Port can be in one of two modes:

- *Fabric mode* Connected to a port that is not loop capable, and using fabric protocol.
- *Loop mode* In an arbitrated loop and using loop protocol. An L_Port in loop mode can also be in participating mode or non-participating mode.

See also *Non-participating Mode*, *Participating Mode*.

Latency

The period of time required to transmit a frame, from the time it is sent until it arrives.

Link Services

A protocol for link-related actions.

Link

As applies to Fibre Channel, a physical connection between two ports, consisting of both transmit and receive fibres. See also *Circuit*.

LIP

Loop Initialization Primitive; the signal used to begin initialization in a loop. Indicates either loop failure or resetting of a node.

LIS_HOLD_TIME

Loop Initialization Sequence Hold Time. The maximum period of time for a node to forward a loop initialization sequence.

LM_TOV

Loop Master Time-out Value; the minimum time that the loop master waits for a loop initialization sequence to return.

Login BB_Credit

The number of receive buffers a receiving L_Port has available when a circuit is first established. Communicated through PLOGI, PDISC link services, or FLOGI.

Loop Circuit

A temporary bidirectional communication path established between L_Ports.

Loop Failure

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

Loop Initialization

The logical procedure used by an L_Port to discover its environment. Can be used to assign AL_PA addresses, detect loop failure, or reset a node.

Loop_ID

A hex value representing one of the 127 possible AL_PA values in an arbitrated loop.

Looplet

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

LPSM

Loop Port State Machine; the logical entity that performs arbitrated loop protocols and defines the behavior of L_Ports when they require access to an arbitrated loop.

LWL

Long Wavelength; a type of fiber optic cabling that is based on 1300-nm lasers and supports link speeds of 1.0625 Gbps. May also refer to the type of GBIC or SFP. See also *SWL*.

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*.

MIB

Management Information Base; an SNMP structure to help with device management, providing configuration and device information.

Monitoring State

The state in which a port is monitoring the flow of information for data relevant to the port.

Multicast

The transmission of data from a single source to multiple specified N_Ports (as opposed to all the ports on the network). See also *Broadcast*, *Unicast*.

Multimode

A fiber optic cabling specification that allows up to 500 meters between devices.

N_Port

Node Port; a port on a node that can connect to a Fibre Channel port or to another N_Port in a point-to-point connection. See also *NL_Port*, *Nx_Port*.

NAA

Network Address Authority. An identifier that indicates the format of a network address.

Name Server

Frequently used to indicate Simple Name Server. See also *SNS*.

NL_Port

Node Loop Port; a node port that has arbitrated loop capabilities. Used to connect an equipment port to the fabric in a loop configuration through an FL_Port. See also *N_Port*, *Nx_Port*.

Node Name

The unique identifier for a node, communicated during login and port discovery.

Node

A Fibre Channel device that contains an N_Port or NL_Port.

Non-participating Mode

A mode in which an 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 AL_PA cannot be acquired. See also *L_Port*, *Participating Mode*.

Nx_Port

A node port that can operate as either an N_Port or NL_Port.

Open Originator

The L_Port that wins arbitration in an arbitrated loop and sends an OPN ordered set to the destination port, then enters the Open state.

Open Recipient

The L_Port that receives the OPN ordered set from the open originator, and then enters the Open state.

Open State

The state in which a port can establish a circuit with another port. A port must be in the Open state before it can arbitrate.

OPN

Open Primitive Signal. The protocol used by a port that has won arbitration in an arbitrated loop to establish a circuit.

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 the following items:

- *Frame delimiters* Mark frame boundaries and describe frame contents.
- *Primitive signals* Indicate events.
- *Primitive sequences* 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

A set of information transmitted across a network. See also *Frame*.

Participating Mode

A mode in which an L_Port in a loop has a valid AL_PA and can arbitrate, send frames, and retransmit received transmissions. See also *L_Port, Non-participating Mode*.

Path Selection

The selection of a transmission path through the fabric. The Compaq switches use the FSPF protocol.

Phantom Address

An AL_PA value that is assigned to a device that is not physically in the loop. Also known as phantom AL_PA.

A twenty-bit public address created for an 8-bit loop device to allow public devices to access it.

Phantom Device

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

PLOGI

Port Login; the port-to-port login process by which initiators establish sessions with targets. See also *FLOGI*.

Point-to-point

A Fibre Channel topology that employs direct links between each pair of communicating entities. See also *Topology*.

Port Cage

The metal casing extending out of the optical port on the switch, and in which the SFP can be inserted.

Port_Name

The unique identifier assigned to a Fibre Channel port. Communicated during login and port discovery.

POST

Power On Self-Test; a series of tests run by a switch after it 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

An arbitrated loop that does not include a participating FL_Port.

Private NL_Port

An NL_Port that communicates only with other private NL_Ports in the same loop and does not log into the fabric.

Protocol

A defined method and a set of standards for communication.

Public NL_Port

An 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.

Public Device

A device that can log into the fabric and support 20-bit addresses (or has 20-bit phantom addresses created for it by the switch). See also *Phantom Addresses*

Public Loop

An arbitrated loop that includes a participating FL_Port, and may contain both public and private NL_Ports.

QuickLoop

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.

May also refer to 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 AL_PA space.

R_A_TOV

Resource Allocation Time-out Value; the maximum time a frame can be delayed in the fabric and still be delivered. See also *E_D_TOV*, *RR_TOV*.

Route

As applies to a fabric, the communication path between two switches. May also apply to the specific path taken by an individual frame, from source to destination. See also *FSPF*.

Routing

The assignment of frames to specific switch ports, according to frame destination.

RR_TOV

Resource Recovery Time-out Value; the minimum time a target device in a loop waits after a LIP before logging out a SCSI initiator. See also *E_D_TOV*, *R_A_TOV*.

RSCN

Registered State Change Notification; a switch function that allows notification of fabric changes to be sent from the switch to specified nodes.

RX_ID

Responder Exchange Identifier. A 2-byte field in the frame header used by the responder of the Exchange to identify frames as being part of a particular exchange.

SAN

Storage Area Network; a network of systems and storage devices that communicate using Fibre Channel protocols. See also *Fabric*.

Sequence

A group of related frames transmitted in the same direction between two N_Ports.

Service Rate

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

Single Mode

The fiber optic cabling standard that corresponds to distances of up to 10 km between devices.

SI

Sequence Initiative.

SNMP

Simple Network Management Protocol. An internet management protocol that uses either IP for network-level functions and UDP for transport-level functions, or TCP/IP for both. Can be made available over other protocols, such as UDP/IP, because it does not rely on the underlying communication protocols. See also *Community (SNMP)*.

SNMPv1

The original SNMP protocol, now labeled v1.

SNS

Simple Name Server; 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. May also be referred to as directory service. See also *FS*.

Switch Name

The arbitrary name assigned to a switch.

Switch Port

A port on a switch. Switch ports can be E_Ports, F_Ports, or FL_Ports.

Switch

Hardware that routes frames according to Fibre Channel protocol and is controlled by software.

SWL

Short Wavelength; a type of fiber optic cabling that is based on 850-nm lasers and supports 1.0625-Gbps link speeds. May also refer to the type of GBIC or SFP. See also *LWL*.

Target

A storage device on a Fibre Channel network. See also *Initiator*.

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

The rate of data flow achieved within a cable, link, or system. Usually measured in bps (bits per second). See also *Bandwidth*.

Topology

As applies to Fibre Channel, the configuration of the Fibre Channel network and the resulting communication paths allowed. There are three possible topologies:

- Point to point - A direct link between two communication ports.
- Switched fabric - Multiple N_Ports linked to a switch by F_Ports.
- Arbitrated loop - Multiple NL_Ports connected in a loop.

Transfer State

The state in which a port can establish circuits with multiple ports without reentering the arbitration cycle for each circuit. This state can only be accessed by an L_Port in the Open state.

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 Word

A group of four transmission characters.

Trap (SNMP)

The message sent by an SNMP agent to inform the SNMP management station of a critical error. See also *SNMP*.

Tunneling

A technique for enabling two networks to communicate when the source and destination hosts are both on the same type of network, but are connected by a different type of network.

U_Port

Universal Port; a switch port that can operate as a G_Port, E_Port, F_Port, or 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.

UDP

User Datagram Protocol; a protocol that runs on top of IP and provides port multiplexing for upper-level protocols.

ULP_TOV

Upper-level Time-out Value; the minimum time that a SCSI ULP process waits for SCSI status before initiating ULP recovery.

ULP

Upper-level Protocol; the protocol that runs on top of Fibre Channel. Typical upper-level protocols are SCSI, IP, HIPPI, and IPI.

Unicast

The transmission of data from a single source to a single destination. See also *Broadcast*, *Multicast*.

Well-known Address

As pertaining to Fibre Channel, a logical address defined by the Fibre Channel standards as assigned to a specific function, and stored on the switch.

Workstation

A computer used to access and manage the fabric. May also be referred to as a management station or host.

WWN

Worldwide Name; an identifier that is unique worldwide. Each entity in a fabric has a separate WWN.

Xmitted Close State

The state in which an L_Port cannot send messages, but can retransmit messages within the loop. A port in the XMITTED CLOSE state cannot attempt to arbitrate.

Zone Configuration

A specified set of zones. Enabling a configuration enables all zones in that configuration. See also *Defined Configuration*, *Enabled Configuration*.

Zone

A set of devices and hosts attached to the same fabric and configured as being in the same zone. Devices and hosts within the same zone have access permission to others in the zone, but are not visible to any outside the zone. See also *Zoning*.

Zoning

A feature that runs on Fabric OS and allows partitioning of the fabric into logical groupings of devices. Devices in a zone can only access and be accessed by devices in the same zone. See also *Zone*.

Index

A

advantages of trunking 1–2
applications names, convention defined vi
authorized reseller, Compaq ix

B

button names, convention defined vi

C

caution, symbol and definition vi
command names, convention defined vi
Compaq
 authorized reseller ix
 technical support viii
 website ix

conventions

 application names, defined vi
 button names, defined vi
 command names, defined vi
 dialog box names, defined vi
 document vi
 file names, defined vi
 keyboard keys, defined vi
 menu items, defined vi
 menu sequences, defined vi
 system responses, defined vi
 user input, defined vi
 variables vi
 website addresses vi

D

dialog box names, convention defined vi
document
 conventions vi

 prerequisites vi
 documentation, related v

E

electrical shock hazard, symbol and definition vii
equipment symbols vii
excessive weight, symbol and definition vii

F

Fibre Channel Shortest Path First (FSPF) 1–2
file names, convention defined vi
four-port groups 1–4

G

getting help viii
 Compaq technical support viii
 Compaq website ix

group

 members 1–4
 trunking 1–4

H

help, obtaining viii
hot surface, symbol and definition vii

I

important, defined vi
installation
 telnet 2–1
 Web Tools 2–2

Intended v

Interswitch Link (ISL) 1–1

K

keyboard keys, convention defined vi

L

load balancing 1–3

M

manage trunking 3–2

master 1–5

members, group 1–4

menu items, convention defined vi

menu sequences, convention defined vi

multiple power source, symbol and definition vii

N

network interface connection, symbol and
definition vii

note, defined vi

O

overview

trunking 1–1

P

port

speed 1–4

trunking 1–4

prerequisites vi

R

rack stability, warning viii

related documentation v

routing

with trunking 1–3

without trunking 1–3

S

switch 2–1

switch administration 3–2

switchCfgTrunk 3–1

symbols

in text vi

on equipment vii

system responses, convention defined vi

T

technical support, Compaq viii

telnet commands

administering 3–1

installation 2–1

portCfgTrunkport 3–1

trunkDebug 3–1

trunkshow 3–1

text symbols vi

trunking

administration 3–2

advantages 1–2

groups 1–4

management 3–2

masters 1–5

overview 1–1

port 1–4

U

user input, convention defined vi

V

variables, convention defined vi

W

warning

electrical shock hazard symbol, defined vii

excessive weight symbol, defined vii

hot surface symbol, defined vii

multiple power source symbol, defined vii

network interface connection symbol,
defined vii

rack stability viii

symbol and definition vi

Web Tools

installation license key 2–2

tabs 3–2

website addresses, convention defined vi

websites

Compaq storage ix

Compaq technical support viii

