

hp StorageWorks Continuous Access and Data Replication Manager SAN Extensions

Fifth Edition (February 2004)

Part Number: AA-RU5CE-TE

This guide describes the use of SAN extension technologies used to connect storage area network islands at distances greater than those typically associated with Fibre Channel. These technologies are specifically tested with two HP data replication products:

- HP StorageWorks Continuous Access EVA running Virtual Controller Software Version 3.0 or later on HSV110 controllers
- HP StorageWorks Data Replication Manager running Array Controller Software Version 8.6P or 8.7P on HSG80 controllers

This document also provides a list of third-party products that have passed certification testing.

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Continuous Access and Data Replication Manager SAN Extensions Reference Guide
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About This Guide

This reference guide provides information to help you:

- Become familiar with different types of SAN extension technologies supported by HP
- Know the approved third-party vendor products that were tested and approved for SAN extensions

“About this Guide” topics include:

- [Overview](#), page 7
- [Conventions](#), page 8
- [Getting Help](#), page 10

Overview

This section covers the following topics:

- [Intended Audience](#)
- [Prerequisites](#)
- [Related Documentation](#)

Intended Audience

This book is intended for use by customers who:

- Want to learn more about using SAN extensions
- Are experienced with Fibre Channel switches
- Have experience with SAN fabric configurations

Prerequisites

Before ordering SAN extension products, make sure you consider the items below.

- Review the related documents listed below.
- Review the products of HP or third-party vendors to decide on the most appropriate product for your needs.

Related Documentation

The following documents provide information on SAN design, and working with Continuous Access EVA (for HSV-based controllers) and Data Replication Manager (for HSG-based controllers). To obtain these and related documents, browse to the HP storage website at <http://h18006.www1.hp.com/storage/software.html>, and then navigate to the applicable storage product.

- For HP SANs: *HP StorageWorks SAN Design Reference Guide*, part number AA-RMPNH-TE
- For HP StorageWorks Continuous Access EVA:
 - *HP StorageWorks Continuous Access EVA Design Reference Guide*, part number AA-RS2YF-TE
 - *HP StorageWorks Continuous Access EVA Replication Performance Estimator Application Notes*, part number AA-RU5MC-TE
- For HP StorageWorks Data Replication Manager:
 - *HP StorageWorks HSG80 ACS Version 8.7P Data Replication Manager Design Guide Application Notes*, part number AA-RQ78B-TE

Conventions

Conventions consist of the following:

- [Document Conventions](#)
- [Text Symbols](#)

Document Conventions

The document conventions included in [Table 1](#) apply to this document.

Table 1: Document Conventions

Element	Convention
Cross-reference links	Blue text: Figure 1
Key and field names, menu items, buttons, and dialog box titles	Bold
File names, application names, and text emphasis	<i>Italics</i>
User input, command and directory names, and system responses (output and messages)	Monospace font COMMAND NAMES are uppercase monospace font unless they are case sensitive
Variables	<monospace, italic font>
Website addresses	Blue, underlined sans serif font text: http://www.hp.com

Text Symbols

The following 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 death.



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

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

Getting Help

If you still have a question after reading this guide, contact an HP authorized service provider or access our website: <http://www.hp.com>.

HP Technical Support

Telephone numbers for worldwide technical support are listed on the following HP website: <http://www.hp.com/support/>. From this website, select the country of origin.

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

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

HP Storage Website

The HP website has the latest information on this product, as well as the latest drivers. Access storage at <http://www.hp.com/country/us/eng/prodserv/storage.html>. From this website, select the appropriate product or solution.

HP Authorized Reseller

For the name of your nearest HP authorized reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the HP website for locations and telephone numbers: <http://www.hp.com>.

About SAN Extensions

1

In the global environment today, companies with storage area networks (SANs) cannot afford to be limited by distance. In fact, putting distance between your SAN islands is an important factor in creating a disaster-tolerant environment for your data. This document describes support for several technologies to overcome the distance limitations of typical Fibre Channel connections:

- Fibre Channel over IP
- Wavelength division multiplexing
- Fibre Channel over SONET
- Long-distance optical transceivers

These SAN extension technologies work closely with Fibre Channel switches because the switches are the transport mechanisms between elements of the SAN. Testing and certification of SAN extension products is usually across different switch product lines with associated data rates, and with the latest available version of switch firmware. Three types of HP Fibre Channel switch product lines are supported with SAN extensions:

- B-series
- C-series
- M-series

To see the list of models in these product lines, refer to the *HP StorageWorks SAN Design Reference Guide*.

Interswitch links (ISLs) using fiber optic cable can only achieve a distance of 10 kilometers at data rates of 1-gigabit per second (Gbps) or 2-Gbps. Any technology that allows a user to exceed this limitation is a SAN extension (see [Figure 1](#)).

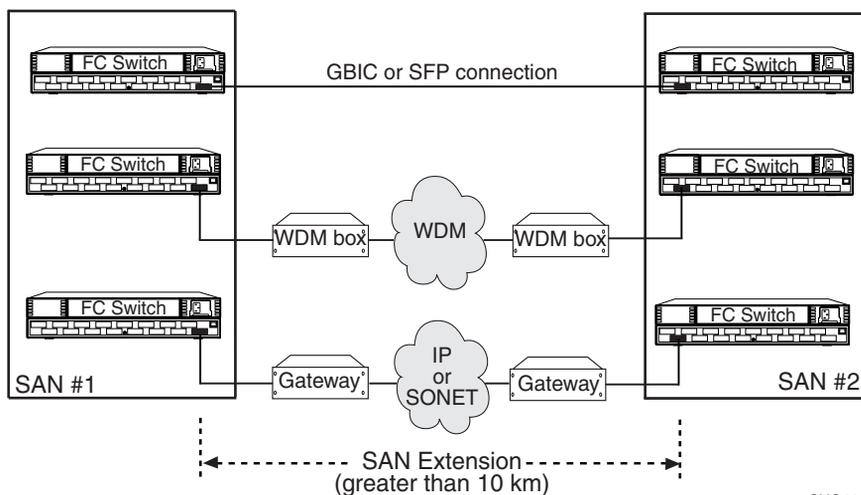


Figure 1: Types of SAN extensions

A SAN extension can be used with any Fibre Channel topology. Much of the extension testing performed by HP on third-party vendor equipment was done in environments running replication between extended SANs.

Two HP replication solutions are referenced in subsequent chapters. Both make use of Fibre Channel technology but differ in the controller architecture used. HP StorageWorks Continuous Access EVA uses the HSV100 or HSV110 controller with Virtual Controller Software (VCS) V3.0 or later to provide an easily customizable, virtualized storage environment. Data Replication Manager makes use of the HSG80 controller and Array Controller Software (ACS) V8.6P or V8.7P to provide disaster-tolerant data.

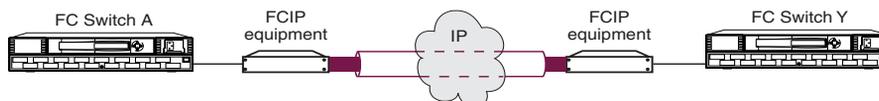
Fibre Channel Over IP

2

Using Internet Protocol over an IP-based network, HP can link sites over any extended distance. Local SANs are connected through an IP network to create an extended SAN. A Fibre Channel-over-Internet Protocol (FCIP) gateway is used at each end of the intersite link. Each FCIP gateway box encapsulates received Fibre Channel (FC) frames into IP packets for transmission over the IP network. Similarly, the FCIP box extracts the original FC frames from received IP packets and retransmits them to the destination FC node.

Single Link

The connection between switches linking two sites is called an *interswitch link* (ISL). A *fabric* is a network of one or more FC switches. [Figure 2](#) shows an FCIP gateway connection in a single-link fabric.



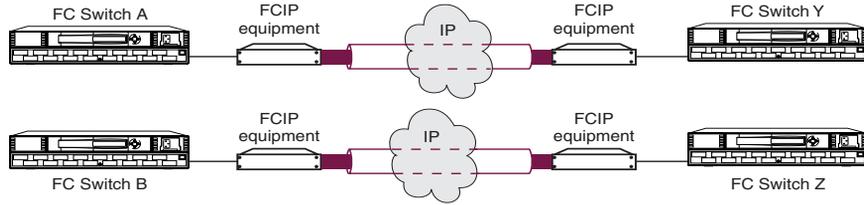
CX08181A

Figure 2: Single link IP configuration

Dual Links

Some configurations use two (dual) ISLs for redundancy. This configuration is common where high availability is a requirement. Two disaster-tolerant solutions that have been tested and are supported with this configuration are the HP StorageWorks Continuous Access EVA and Data Replication Manager (DRM). A dual link configuration (see [Figure 3](#)) is the benchmark for disaster protection, because if one link fails, the other link will temporarily handle all data replication.

For enhanced fault tolerance, a customer may choose to contract with two different providers for the two ISLs, including different entries into the data center.



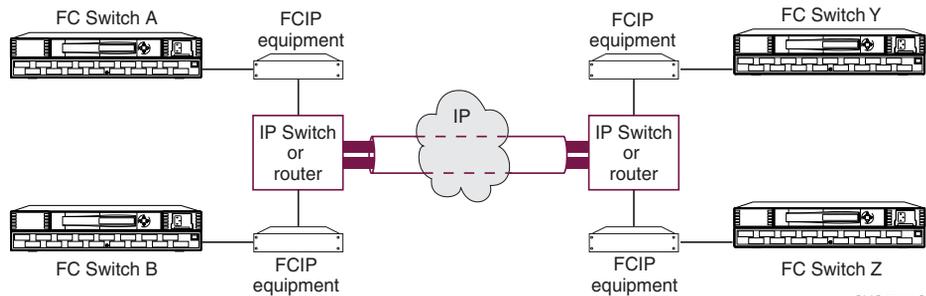
CXO7794B

Figure 3: Dual link IP configuration

In the dual link configuration, HP recommends that the maximum sustained I/O load be limited to 40% of the maximum available link bandwidth. This limit allows for instantaneous bursts of I/O activity, and it minimizes the performance effect of a single link failure, during which the entire I/O workload is carried by the surviving link.

Shared Link

A shared link configuration, as shown in Figure 4, uses only one ISL between the fabrics. While it is workable, this configuration is not recommended when high availability is necessary, because it does not allow redundancy between SANs. It may also decrease performance because the bandwidth available for storage is shared between the two fabrics.



CXO7795C

Figure 4: Shared link configuration

Network Considerations

The ability to use your existing network with FCIP depends on the type of storage replication you plan to do and the traffic already existing on your current network. The key consideration is whether you have enough unused/available bandwidth from your network to continue the current network load, accommodate future growth, and handle replication load demands. [Table 2](#) gives some recommendations for using an existing network, based on the purpose of the configuration being used.

Table 2: Network Considerations for Different Configuration Uses

Configuration Type	Use Existing Network?	Factors
Mirrored FCIP SAN	A separate network is recommended.	For peak performance of your current network, a separate network is recommended. A dedicated network is the benchmark for mirrored FCIP SAN systems.
Data Migration	The use of your existing network may be possible.	Data migration is a one-time movement of data for upgrade or maintenance purposes. During a migration it is possible to use your existing network, but the network performance may be significantly degraded.

In general, the FCIP equipment supports Ethernet connections of 10/100 Mbps, and 1 Gbps (Gigabit Ethernet). The network connection should be selected to match the amount of data to be transferred.

Two tools are available to help you make performance calculations:

- For Continuous Access EVA environments, use the Replication Performance Estimator. Its use is documented in the *HP StorageWorks Continuous Access EVA Replication Performance Estimator Application Notes*, part number AA-RU5MC-TE. The tool and the application notes are available at <http://h18006.www1.hp.com/products/storage/software/conaccesseva/index.html>.
- For DRM environments, use the DRM Performance Estimator. Its use is documented in the *Compaq SANworks Data Replication Manager Inter-site Link Performance Analyzer White Paper*, part number 142G-0100A-WWEN. The tool and white paper are located at <http://h18000.www1.hp.com/products/sanworks/drm/documentation.html>.

Worldwide FCIP Demonstration

In September 2001, as part of a technology demonstration, HP built a global multivendor SAN by linking three separate SAN islands on three continents—Australia, North America, and Europe—using FCIP technology in a DRM environment (see [Figure 5](#)). With Nijmegen, The Netherlands, as the local site, data was replicated to remote sites deployed in the United States and Australia. At that time, it was the longest distance ever spanned for a network using FCIP technology.

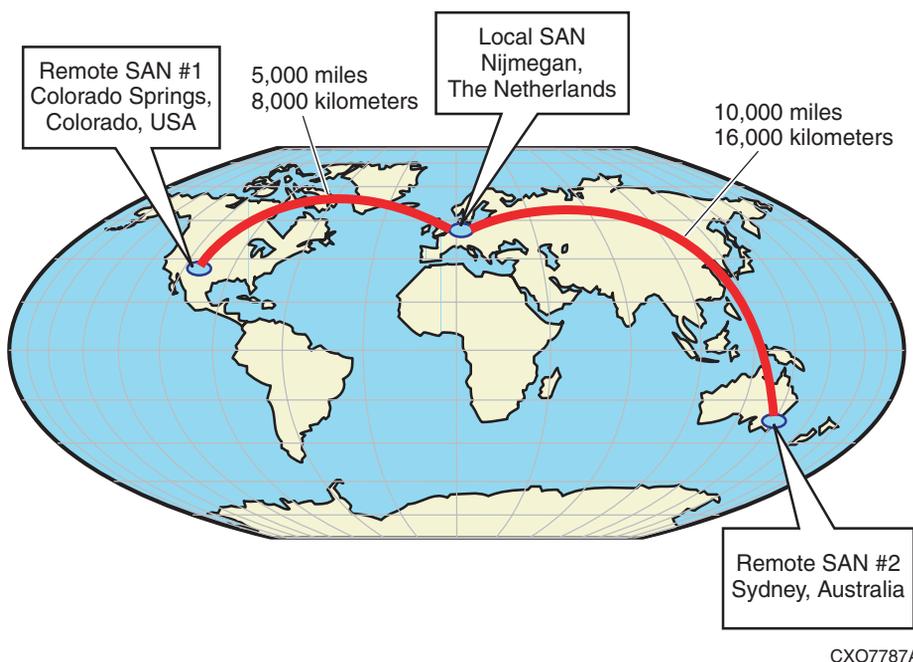


Figure 5: Global SAN spanning Europe, Australia, and North America

This demonstration shows how data can be managed around the world in a unified network. The advantages include significant improvements in IT operations and the replication of data within long-distance enterprises. With the FCIP technology, heterogeneous (defined here as using multiple operating systems) global SANs are capable of operating as one integrated unit. Data can be replicated in different places over any distance—in campus, metropolitan, and wide-area environments—while retaining data integrity. See [Table 3](#) for information on the types of ISLs used with the demonstration. Since this time, similar testing has been performed with Continuous Access EVA.

Table 3: Participant Locations and ISL Used

Location	ISL
Nijmegen, The Netherlands	E1 (2.0 Mbps)
Colorado Springs, Colorado USA	OC-3 (155 Mbps)
Sydney, Australia	T1 (1.5 Mbps)

The following features were demonstrated:

- Heterogeneous operating systems
- Multiple SANs
- A variety of lines and speeds

Bandwidth Considerations

When sites are located many miles apart, the speed of light through fiber can cause unacceptable delays in the completion of an I/O transaction. Increasing the amount of available bandwidth cannot solve this problem. Careful consideration must be given to these factors when matching your needs and wants to a particular application. For a discussion of distance and performance in design considerations, especially in relation to data replication, refer to the *HP StorageWorks Continuous Access EVA Design Reference Guide*, or the *HP StorageWorks HSG80 ACS Version 8.7P Data Replication Manager Design Guide Application Notes*.

Tips and Techniques

In a large SAN with multiple copy sets, accomplishing merges, full copies, or normalization can take an extremely long time. The following techniques can decrease the time involved in a DRM environment with HSG80 controllers:

- Set up and normalize all copy sets at the same location with direct Fibre Channel connections, and then move the remote hardware to the remote site for normal operations. Note that new copy sets will then normalize at the slower link speeds.
- Increase your link bandwidth while normalization is taking place.
- Determine what data must absolutely be available in a short time after a disaster, and put that data into a copy set. This applies not only to HSG80 controllers, but also with HSV controllers. Back up all other data using other non-realtime backup methods.

Currently most IP networks do not manage bandwidth to each individual connection. As traffic increases due to other demands on the network, bandwidth can be taken from the replication application. The following techniques can be used to minimize this effect:

- Create virtual private networks (VPNs) with Quality of Service (QoS) through your local routers for the replication circuit.
- Create separate physical networks.
- Guarantee the bandwidth using a third-party router/QoS vendor.

Distance has a dramatic effect on the amount of work that can be done across a link. Therefore, site planning should include the following best practices:

- Use the shortest possible distance between remote sites.
- Minimize the number of copy sets used.
- Design a plan to add additional copy sets that will not impact normal data traffic.
- Consider additional controller pairs to effectively use available bandwidth.

Certified Vendor Products for FCIP Gateway Devices

The vendor products listed in [Table 4](#) are certified for use as FCIP gateway devices. The vendors are listed in alphabetical order. Each certified device has a corresponding fact sheet, which can be seen in Appendix A. The fact sheet data was provided by the respective product manufacturer. HP does not rate the devices or make recommendations about these vendors. Users should make their own vendor product evaluations. This document will be revised as additional vendor products are certified.

Table 4: Vendor IP Devices Certified by HP for FCIP

Company Name	Device	Fact Sheet
Cisco Systems, Inc.	MDS 9000 IP services module	page 44
	PA-FC-1G (blade for 7200 & 7401 routers—IP interface, GbE only)	page 46
Computer Network Technology Corporation (CNT)	UltraNet Edge Storage Router Model 1000 (10/100 Mbps model)	page 48
	UltraNet Edge Storage Router Model 1001 (1000 Mbps model)	page 50
	UltraNet Edge Storage Router Model 1101 (1000 Mbps model)	page 52
Hewlett-Packard Company (HP product number 350074-B21)	IP Storage Router 2122-2	page 54
Lucent Technologies	OptiStar EdgeSwitch	page 57
Nishan Systems	IPS3300 Multiprotocol IP Storage Switch	page 65
SANcastle Technologies, Inc.	GFS-2 Gateway	page 70
	GFS-8 Global Data Fabric Switch	page 72
SAN Valley Systems, Inc. (HP product number QS-SN105-HK)	SL700-AC & SL700-DC IP-SAN Gateway	page 74
	SL1000-AC & SL1000-DC IP-SAN Gateway	page 76

Installation and Configuration

For installation and configuration information for qualified gateway devices, refer to the manufacturer's product documentation. Some replication-specific configuration settings are included with the vendor-specific data in Appendix A.

ACS V8.6P Switch Firmware and Maximum Transmission Rates

Table 5 lists the ACS Version 8.6P specifications for FC switch firmware revisions and the available maximum transmission rates (MTRs) for qualified gateway devices. The maximum transmission rate is a user-defined data transfer parameter that is used to govern the highest speed at which data may flow from a gateway device. The speeds listed in the table are the minimum and maximum speeds for the device, with the device being capable of speeds within the range.

Table 5: ACS Version 8.6P Specifications for Switch Firmware and Available MTRs

Gateway Devices	B-series FC Switch Firmware (1 Gbps)	Available MTRs	
		Min	Max
CNT UltraNet Edge Model 1000	2.1.9m, 2.4.1f	1.544 Mbps	100 Mbps
CNT UltraNet Edge Model 1001	2.1.9m, 2.4.1f	1.544 Mbps	1 Gbps
Nishan IPS3300	2.4.1f	1.544 Mbps	1 Gbps
SANcastle GFS-2	2.4.1f	10 Mbps	1 Gbps
SANcastle GFS-8	2.4.1f	10 Mbps	1 Gbps
SAN Valley SL1000	2.1.9m, 2.4.1f	1.544 Mbps	1 Gbps

ACS V8.7P Switch Firmware and Maximum Transmission Rates

Table 6 lists the ACS Version 8.7P specifications for FC switch firmware revisions and the available MTRs for qualified gateway devices. The speeds listed in the table are the minimum and maximum speeds for the device, with the device being capable of speeds within the range.

Table 6: ACS Version 8.7P Specifications for Switch Firmware and Available MTRs

Gateway Devices	B-series FC Switch Firmware (1 Gbps)	B-series FC Switch Firmware (2 Gbps)	C-series FC Switch Firmware (2 Gbps)	M-series FC Switch Firmware (1 and 2 Gbps)	Available MTRs	
					Min	Max
Cisco Model MDS 9000 IP	N/A	N/A	1.2(1b)	N/A	1.544 Mbps	1 Gbps
CNT UltraNet Edge Model 1000	2.6.0c	See note*	See note*	See note*	1.544 Mbps	100 Mbps
CNT UltraNet Edge Model 1001	2.6.0c	3.0.2f	See note*	See note*	1.544 Mbps	1 Gbps
HP Model SR2122-2	2.6.1	3.1.1 & 4.1.2b	See note*	See note*	10 Mbps	1 Gbps
Lucent OptiStar	2.6.0c	See note*	See note*	2.0.0 Build 33	1 Gbps	1 Gbps
Nishan IPS3300	2.6.0c	See note*	See note*	See note*	1.544 Mbps	1 Gbps
SANcastle GFS-2	2.6.0c	See note*	See note*	See note*	10 Mbps	1 Gbps
SANcastle GFS-8	2.6.0c	See note*	See note*	See note*	10 Mbps	1 Gbps
SAN Valley SL700	2.6.0c & 2.6.1	3.0.2f, 3.1.1, 4.0.2, & 4.1.2b	See note*	2.0.0 Build 33	1.544 Mbps	1 Gbps
SAN Valley SL1000	2.6.0c	3.0.2f, 3.1.1, 4.0.2, & 4.1.2b	See note*	2.0.0 Build 33	1.544 Mbps	1 Gbps

*Note: The gateway device was not tested with the listed switch.

VCS V3.0 and V3.010 Switch Firmware and Maximum Transmission Rates

Table 7 lists the VCS Versions 3.0 and 3.010 specifications for FC switch firmware revisions and the available MTRs for qualified gateway devices. The speeds listed in the table are the minimum and maximum speeds for the device, with the device being capable of speeds within the range.

Table 7: VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs

Gateway Devices	B-series FC Switch Firmware (1 Gbps)	B-series FC Switch Firmware (2 Gbps)	C-series FC Switch Firmware (2 Gbps)	M-series FC Switch Firmware (1 and 2 Gbps)	Available MTRs	
					Min	Max
Cisco Model MDS 9000 IP	N/A	N/A	1.2(1b)	N/A	1.544 Mbps	1 Gbps
Cisco Model PA-FC-1G	2.6.1c	3.1.1 & 4.1.2b	See note*	See note*	10 Mbps	1 Gbps
CNT Model 1001	2.6.0h	3.0.2k1 & 4.0.2b	See note*	See note*	1.544 Mbps	1 Gbps
CNT Model 1000	2.6.1c	3.1.1, & 4.1.2b	See note*	See note*	1.544 Mbps	100 Mbps
CNT Model 1101	2.6.0h	3.0.2k1 & 4.0.2b	See note*	See note*	1.544 Mbps	1 Gbps
HP Model SR2122-2	2.6.1c	3.1.1, & 4.1.2b	See note*	05.01.00 build 24	10 Mbps	1 Gbps
SAN Valley Model SL700	2.6.0h & 2.6.1c	3.0.2k1, 3.1.1, 4.0.2b, & 4.1.2b	See note*	04.01.02 build 4 & 05.01.00 build 24	1.544 Mbps	1 Gbps
SAN Valley Model SL1000	2.6.0h & 2.6.1c	3.0.2k1, 3.1.1, 4.0.2b, & 4.1.2b	See note*	04.01.02 build 4 & 05.01.00 build 24	1.544 Mbps	1 Gbps

*Note: The gateway device was not tested with the listed switch.

Continuous Access XP

Table 8 lists the Continuous Access XP specifications for FC switch firmware revisions for qualified gateway devices.

Table 8: Continuous Access XP Specifications for Switch Firmware

Gateway Devices	B-series FC Switch Firmware (1 Gbps)	B-series FC Switch Firmware (2 Gbps)	C-series FC Switch Firmware (2 Gbps)
Cisco Model MDS 9000 IP	N/A	N/A	1.2(1b)
Cisco Model PA-FC-1G	2.6.1c	3.1.1 & 4.1.2b	See note*
CNT Model 1000	2.6.1c	3.1.1	See note*
CNT Model 1001	2.6.1c	3.1.1	See note*
CNT Model 1100	2.6.1c	3.1.1	See note*
CNT Model 1101	2.6.1c	3.1.1	See note*
HP Model 2122-2	2.6.1c	3.1.1 & 4.1.2b	See note*
Inrange 9801 H	2.6.1c	3.1.1	See note*
Inrange 9801 L	2.6.1c	3.1.1	See note*
SAN Valley Model SL700	2.6.1c	3.1.1 & 4.1.2b	See note*
SAN Valley Model SL1000	2.6.1c	3.1.1 & 4.1.2b	See note*
*Note: The gateway device was not tested with the listed switch.			

Volume Shadowing for OpenVMS

The following are qualified vendor products for use with volume shadowing for HP OpenVMS:

- Cisco Model PA-FC-1G
- CNT UltraNet Edge Storage Router Model 1000
- CNT UltraNet Edge Storage Router Model 1001
- CNT UltraNet Edge Storage Router Model 1101
- HP StorageWorks IP Storage Router 2122-2
- SAN Valley Model SL700
- SAN Valley Model SL1000

Complementary Vendor Products

Two classes of hardware complement FCIP solutions: Quality of Service (QoS) devices and IP data encryption devices. Detailed information for the products mentioned below is available at the vendor websites.

Certified Quality of Service Products

Some customers may need additional hardware to improve the QoS of an existing IP network. Such hardware allows the shared use of the existing network with an FCIP solution. The QoS hardware listed in [Table 9](#) is certified for use with FCIP gateways.

Table 9: Certified QoS Products

Company Name	Device	Purpose	Website
Allot Communications	NetEnforcer	Application traffic and bandwidth management system	http://www.allot.com
Packeteer	PacketShaper Model: 6500	Application traffic and bandwidth management system	http://www.packeteer.com
Riverstone Networks, Inc.	Model: RS8000 Model: RS3000	MPLS Gigabit Ethernet routers	http://www.riverstonenet.com

Certified IP Data Encryption Devices

Customers who need additional security for their data over the ISL can purchase a third-party encryption device. The devices in [Table 10](#) are currently certified to work only with the CNT, SANcastle, and SAN Valley gateways listed in [Table 4](#).

Table 10: Additional Certified Hardware

Company Name	Device	Purpose	Website
SAFENET	High Assurance Gateways	IP link encryption	http://www.safenet-inc.com
General Dynamics (For U.S. Government use only)	TACLANE KG-175	IP link encryption	http://www.generaldynamics.com

Warranty Information

HP does not warrant third-party products. Consult the original equipment manufacturer for warranty information.

Wavelength Division Multiplexing

3

Wavelength division multiplexing (WDM) is an optical technology used to add connection capacity over an existing fiber optic network. It works by combining and transmitting multiple optical signals simultaneously at different wavelengths down a single fiber. In effect, one fiber is transformed into multiple virtual fibers. This allows WDM to multiply the effective bandwidth capacity of the optical fiber.

For example, by multiplexing eight 1-Gbps signals into a single fiber, the data-carrying capacity of that fiber increases from 1 Gbps to 8 Gbps in aggregate.

The maximum data-carrying capacity that can be designed into a WDM system is strongly dependent on the spacing between the wavelengths being used. For fused silica fiber, the range of usable wavelengths lies within two spectral windows that are each approximately 30 nm wide. One is nominally centered around 1300 nm and the other around 1550 nm.

The spectral windows occur within the infrared spectrum where the optical scattering and absorption losses associated with fused silica fiber are minimal and transmission is maximized. Fiber optic systems in general are currently designed to operate within these two transmission windows. WDM systems typically combine multiple channels within either window where channel separations are on the order of the window width divided by the number of channels. The following is an example:

$$(30 \text{ nm window width}) / (8 \text{ channels}) = 3.75\text{-nm channel spacing}$$

The most demanding of WDM configurations combine up to 128 channels within a single transmission window. When adjacent wavelengths are separated in the fiber by less than 1 nm it is considered dense-WDM (DWDM). When wavelengths in the fiber are separated by more than 1 nm it is considered coarse-WDM (CWDM).

A key advantage to WDM is that most architectures are protocol and bit-rate independent. WDM-based networks can simultaneously transmit data in Fibre Channel, Internet Protocol (IP), Asynchronous Transfer Mode (ATM), Synchronous Optical Network (SONET)/Synchronous Digital Hierarchy (SDH), and Ethernet protocols, and can simultaneously handle multiple bit rates.

Commercial Applications

From a Quality of Service (QoS) viewpoint, WDM-based networks create a lower-cost way to respond quickly to customers' bandwidth demands and protocol changes. This is because each new wavelength is a new, full bandwidth communications pipe. In many areas of the world it is much cheaper to deploy WDM technology on existing fiber than it is to install new fiber.

After WDM has been implemented, service providers can establish a grow-as-you-go infrastructure. WDM gives service providers the flexibility to expand capacity in any portion of their networks—an advantage no other technology can offer. Carriers can address specific problem areas that are congested because of high capacity demands. This is especially helpful where multiple rings intersect between two nodes, resulting in *fiber exhaust*. (Fiber exhaust means that the traffic volume on the Internet and other networks has exhausted collective bandwidth available through installed optical fiber lines.)

By partitioning and maintaining different dedicated wavelengths for different customers, service providers, for example, can lease individual wavelengths—as opposed to an entire fiber—to their high-use business customers.

WDM Product Variations

WDM vendors currently offer at least three variations of the products described in this guide. WDM system architectures can be delineated in the most general sense as being:

- Passive (optically and with respect to transmission protocol)
- Active with respect to signal amplification
- Active with respect to protocol handling

Most WDM products on the market today fit uniquely into one of these categories, or have been designed to combine attributes of each.

Passive Systems

These WDM systems are transparent to transmission protocol and data rate. As such, they establish open interfaces that give operators the flexibility to provide Fibre Channel, SONET/SDH, asynchronous, ATM, Frame Relay, and other protocols over the same fiber. A truly passive optical system also passes the optical signal without any form of signal conditioning such as amplification or attenuation (beyond the levels inherent to the system components).

Active Signal Amplification

Certain WDM products are offered with line amplifiers and attenuators. These features are included primarily to facilitate interfacing via fiber optic links to other telecommunications hardware. Line amplifiers allow the boosting of weak signals received from peripheral network components, as well as boosting the signals being transmitted that might otherwise fall below the threshold sensitivities of receiving equipment.

Similarly, incoming and outgoing signals can be attenuated if they are sensed as being above receiver saturation levels. These active systems typically monitor power levels to ensure that operation is maintained within the power budget of the hardware. Power monitoring capability is usually accomplished with hardware/software control loops, which can add significantly to the cost of the product.

Active Protocol Handling

While most WDM systems are designed to be protocol independent, products are available that offer a system with protocol-specific capabilities for Fibre Channel. This design enables digital time division multiplexing (TDM) on top of existing optical multiplexing to support multiple channels per wavelength.

This design also allows for network monitoring, digital retiming (to reduce jitter), link integrity monitoring, and distance buffering. Considering the added sensitivity to protocols, this WDM variant seems straightforward in point-to-point configurations but may require additional and potentially costly transmission hardware when deployed in meshed networks.

System Characteristics

Acceptable and optimal WDM systems have certain key characteristics. These characteristics are recommended for any WDM system in order for carriers to realize the full potential of this technology:

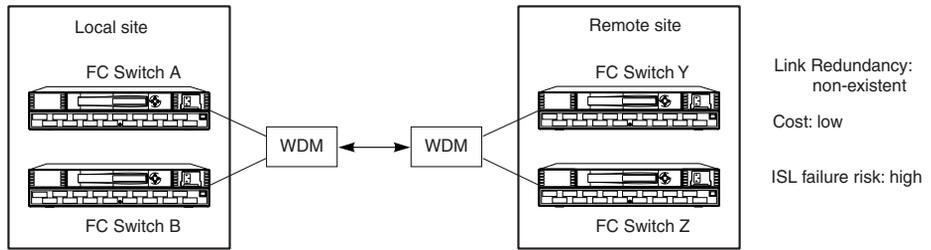
- Use the full capacity of the customers' existing dark fiber
- Offer component reliability, 24x7 availability, and expandability
- Provide optical signal amplification and attenuation. This is desirable on the client side and long-haul side interfaces to increase the transmitted/received signal-to-noise ratio.
- Provide signal conditioning (that is, the retiming and reshaping of the optical data-carrying signal) for optimization of the bit error rate
- Offer channel add/drop capability (the ability to change the number of data channels by adding or dropping optical wavelengths at any network node location)
- Allow compensation of power levels (preferably automatic or without manual intervention), especially to facilitate adding (or dropping) channels
- Provide upgradable channel capacity and/or bit rate.
- Allow interoperability which requires standards-compliant interfaces such as Fibre Channel, SONET, ATM, and so on
- The wavelength at each customer's interface channel is converted to a longer wavelength prior to multiplexing with other channels for transmission over the long haul.

Qualified Vendor Products for WDM

HP supports the use of all WDM-enabled intersite Fibre Channel provided the WDM equipment is configurable to 1- or 2-gigabits per second data rates. Both CWDM and DWDM systems are supported. The maximum end-to-end distance supported is 100 kilometers of total latency for DRM.

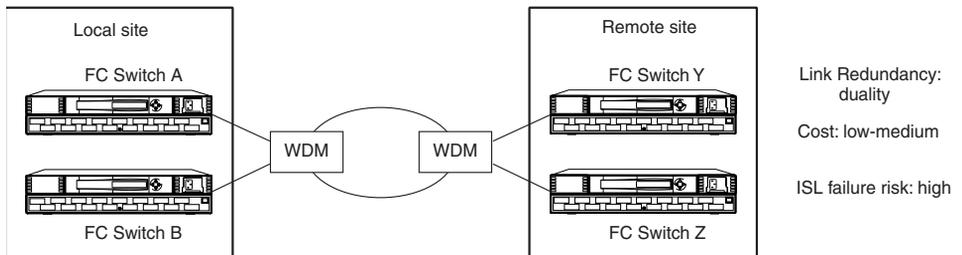
HP support for all WDM products has been the result of extensive and successful testing of many systems over a wide range of StorageWorks product versions. Based on the experience gained during certification efforts, combined with the maturity of current WDM technology, HP has high confidence in the interoperability of current and future WDM products with HP storage products.

Figures 5, 6, and 7 show a comparison of configuration options for DRM systems.



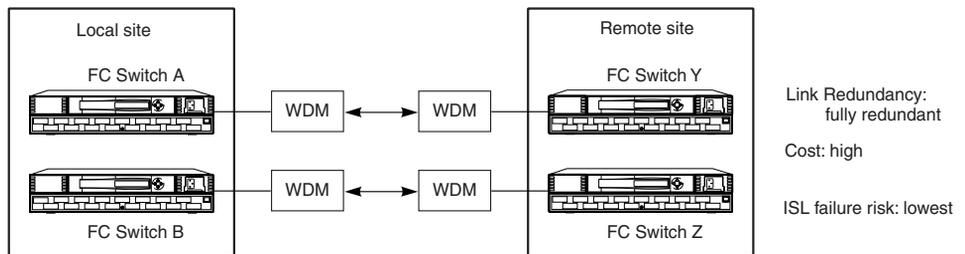
CXO7205B

Figure 6: Simple point-to-point configuration using one long-haul fiber link



CXO7206C

Figure 7: Redundant WDM loop configuration using two (or more) long-haul fiber links



CXO7207B

Figure 8: Fully Redundant WDM loop configuration using two (or more) long-haul fiber links

Fibre Channel Over SONET (FC-SONET)



Local SANs can be connected with Synchronous Optical Network (SONET) to create an extended SAN. An FC-SONET gateway is used at each end of an intersite link. Each FC-SONET gateway box encapsulates received Fibre Channel frames into SONET packets for transmission over the network. Similarly, each FC-SONET box extracts the original FC frames from received SONET packets and retransmits them to the destination Fibre Channel node. The FC-SONET boxes also handle SONET-level error recovery. [Figure 9](#) shows a fully redundant SONET configuration using HP StorageWorks Continuous Access EVA.

Dual Links

A dual-link configuration is the benchmark for disaster protection, because if one link fails, the other link will temporarily handle all data replication. A dual link configuration that is only partially redundant is shown in [Figure 10](#).

For enhanced fault tolerance, a customer may choose to contract with two different providers for the two interswitch links (ISLs), including different entries into the data center.

In the dual-link configuration, HP recommends that the maximum sustained I/O load be limited to 40 percent of the maximum available link bandwidth. This limit allows for instantaneous bursts of I/O activity as well as minimizing the performance effect of a single link failure, during which the entire I/O workload is carried by the surviving link.

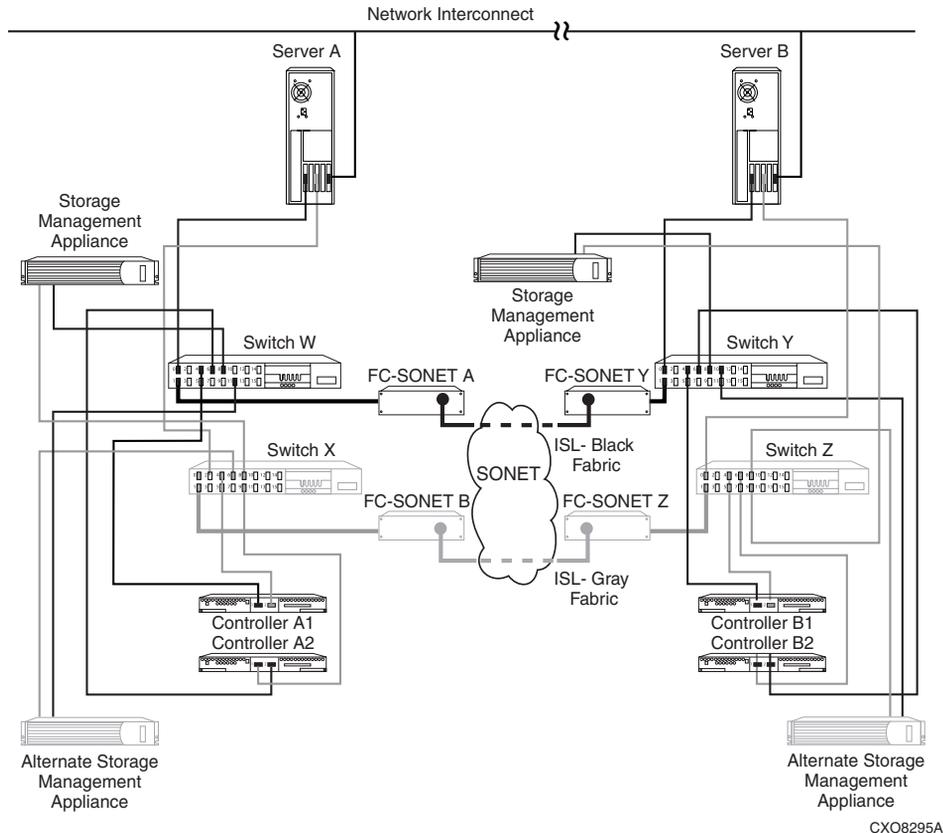


Figure 9: Continuous Access EVA-over-SONET configuration (fully redundant)

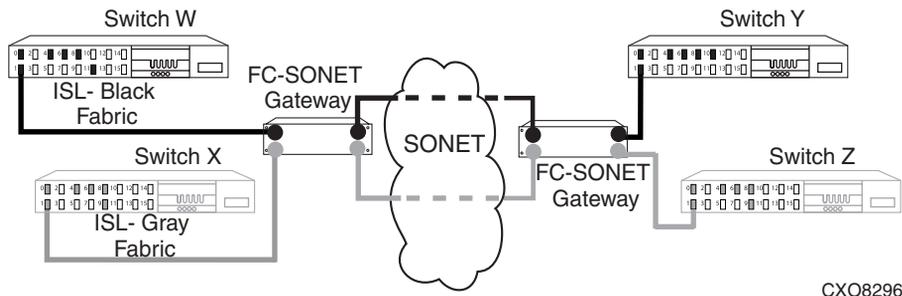


Figure 10: Dual-link SONET configuration (partially redundant)

Shared SONET Link for Dual ISLs

A shared SONET-link configuration, as shown in [Figure 11](#), uses one ISL between each of the fabrics. While it is workable, this configuration is not recommended because it does not allow redundancy between SAN islands. Performance is similar to the dual-link configuration due to the ability of SONET to completely isolate bandwidth on a single network interface.

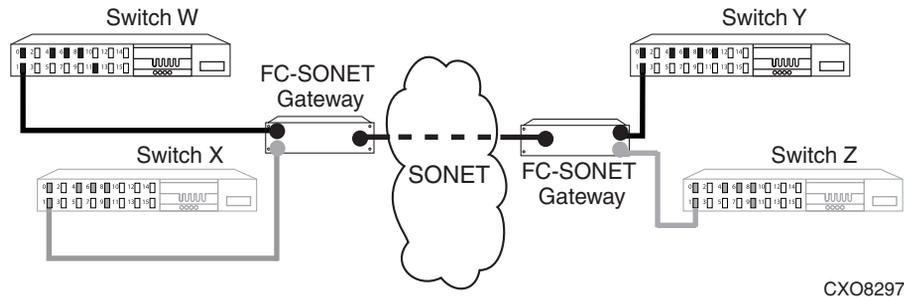


Figure 11: Shared-link SONET minimum configuration

Considerations Relevant to Using the Existing SONET Network

The ability to use your existing network with FC-SONET depends on the type of storage replication you plan to do, and the existing network traffic. The key consideration is whether you have enough unused or available bandwidth from your network to continue the current network load, accommodate future growth, and handle replication load demands.

Network Speeds

In general, FC-SONET equipment supports speeds up to full rate Fibre Channel. The network connection should be selected to match the amount of data to be replicated. SONET provides WAN interfaces of OC-3 (155 Mbps), OC-12 (622 Mbps), and OC-48 (2.5 Gbps).

Performance in a WAN Environment

When planning for replication across distances, the bandwidth and speed of the link may not be the determining factor in performance of the system. Careful consideration must be given to size of the storage configurations with regard to the ability to manage them over distance. For information on management versus distance, refer to the *HP StorageWorks Continuous Access EVA Design Reference Guide*.

Certified Vendor Products for SONET Gateway Devices

The vendor product listed in [Table 11](#) is certified for use as a SONET gateway device. Each certified device has a corresponding fact sheet located in Appendix B.

Table 11: Vendor SONET Devices Certified by HP

Company Name	Device	Fact Sheet Location
Ciena Corporation	Optical Utility Services Platform (Ousp) 2048	page 80

VCS V3.010 Switch Firmware and Maximum Transmission Rates

Table 12 lists the VCS Version 3.010 specifications for FC switch firmware revisions and the available MTRs for the qualified gateway device. The speeds listed in the table are the minimum and maximum speeds for the device, with the device being capable of speeds within the range.

Table 12: VCS Version 3.010 Specifications for Switch Firmware and Available MTRs

Gateway Device	B-series FC Switch Firmware (1 Gbps)	B-series FC Switch Firmware (2 Gbps)	B-series Core 2/64 Switch Firmware	M-series FC Switch Firmware (1 and 2 Gbps)	Available MTRs	
					Min	Max
Ciena OUSP 2048	2.6.1c	3.1.1	4.1.2b	See note*	OC-3	OC-48
*Note: The gateway device was not tested with the listed switch.						

Long-Distance Optical Transceivers

5

This chapter provides an overview of long-distance optical transceivers.

The older type of 1-gigabit-per-second (Gbps) transceivers, which use the SC-style connectors, are known as gigabit interface converters (GBICs) and shown in [Figure 12](#). The newer 2-Gbps transceivers, which use the smaller LC-style connectors, are known as small form factor pluggables (SFPs) and shown in [Figure 13](#).

Long-distance transceivers are supported on all Fibre Channel switch product lines.

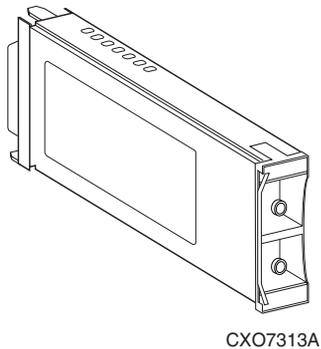


Figure 12: GBIC

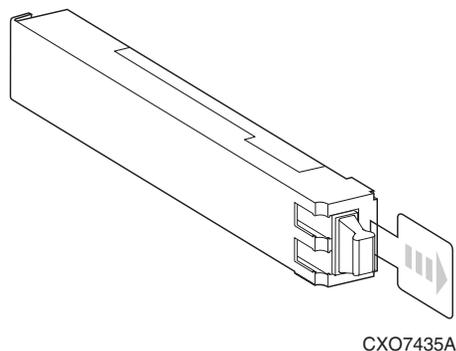


Figure 13: SFP

Long-Distance Optical Transceiver Product Features

Refer to [Table 13](#) for a comparison of features among several types of optical transceivers.

Note: The transceiver distances listed below are not exact. You need to determine the link power budget of your fiber before purchasing any of the part numbers below.

Table 13: Long-Distance Optical Transceiver Product Features

Transceiver	Part Number	Max. Data Rate	Optical Connector	Optical Wave-length	1-Gbps Power Budget Min.	2-Gbps Power Budget Min.
10-km GBIC	127508-B21	1 Gbps	SC	1310 nm	11 dB	N/A
100-km GBIC	230800-B21	1 Gbps	SC	1550 nm	24 dB	N/A
10-km SFP	300835-B21	2 Gbps	LC	1310 nm	13.5 dB	11.5 dB
35-km SFP	300836-B21	2 Gbps	LC	1310 nm	19 dB	19 dB

Link Power Budget

The link power budget is the difference between the minimum optical power launched from the transmitter and the minimum acceptable optical power at the receiver input. A link power budget is usually specified in decibels (dBs), and the sum of all losses in an optical line must be less than this number.

If the fiber cable between the two sites is leased, have your carrier provide you with the loss in your circuit. If the fiber cable is owned, check the installation records to ensure that the fiber cable meets the power budget.

Table 14 provides recommendations on how to optimize your long-distance link.

Table 14: Configuration Recommendations

Recommendations	Implication
Use low-attenuation 9-micron fiber.	Best for long distances (preferably less than 0.3 dB loss per km).
Minimize number of connectors.	Connectors account for 0.3 dB, or greater, of signal loss.
Use fusion splices.	Minimizes attenuation.
For fibers, from any point of the optical link, the minimum bending radius is 3.1 inches during installation and 2.0 inches long-term.	Exceeding these bend radius limitations can result in fracture of the fiber and in further attenuation losses.
During installation, avoid extreme environments, such as excessive temperature and vibration.	Avoids possible damage to the fiber cable.
During installation, ensure that the fiber cable is not pinched or pulled.	Prevents compression and stretch to the fiber cable.
Use measurement tools such as calibrated light sources, power meters, and an optical time domain reflectometer (OTDR).	Verifies optical link losses.

Performance Considerations

The very-long-distance optical transceiver extends the distance between the Fibre Channel switch E_ports. Using credit-based flow control, the credit given to the E_port is eight buffer-to-buffer (bb) credits, and Figure 14 shows how throughput with these credits diminishes over distance. (This loss applies to any transmission media, whether you are using long-distance transceivers, IP, ATM, or WDM.)

With both WDM and long-distance transceivers you can increase the performance by increasing the buffer-to-buffer credits in the Fibre Channel switches. By increasing the buffer-to-buffer credits to 48 bb the performance at 180 km will be close to the same as that obtained using a 500-m fiber.

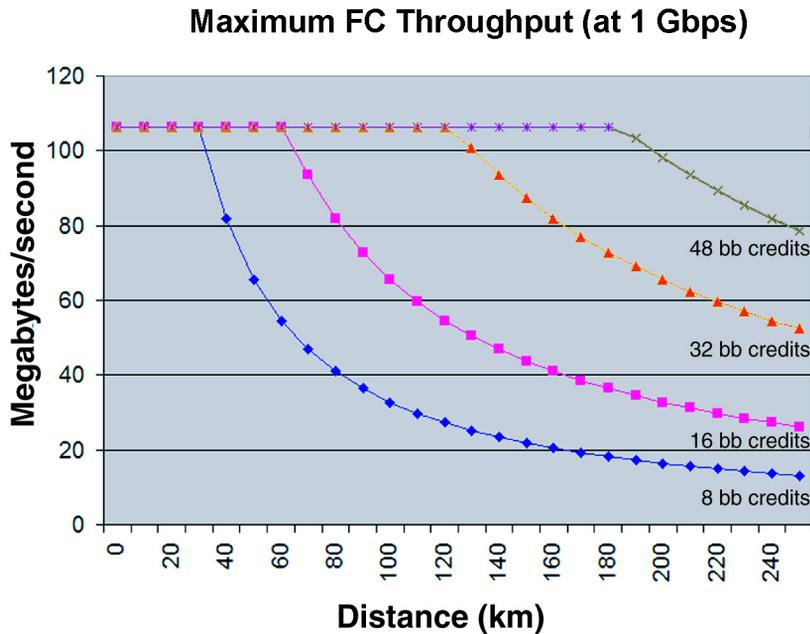


Figure 14: Effects of distance on throughput with various buffer-to-buffer credits

Certified FCIP Vendor Products



The fact sheets in this appendix list third-party FCIP gateways that have been approved for use in Continuous Access EVA and Data Replication Manager environments. Fact sheets are provided on the listed pages for the following vendor equipment:

- Cisco MDS 9000 IP Fact Sheet, on page 44
- Cisco PA-FC-1G Fact Sheet (10/100 Mbps), on page 46
- CNT FCIP Gateway Model 1000 Fact Sheet (10/100 Mbps), on page 48
- CNT FCIP Gateway Model 1001 Fact Sheet (1000 Mbps), on page 50
- CNT FCIP Gateway Model 1101 Fact Sheet (1000 Mbps), on page 52
- HP StorageWorks IP Storage Router 2122-2 Fact Sheet, on page 54
- Lucent FC Gateway Equipment Fact Sheet (1000 Mbps), on page 57
- Nishan Systems FCIP Gateway Equipment Fact Sheet, on page 65
- SANcastle FCIP Gateway Equipment Fact Sheet (GFS-2), on page 70
- SANcastle FCIP Gateway Equipment Fact Sheet (GFS-8), on page 72
- SAN Valley Systems FCIP Gateway (SL700) Equipment Fact Sheet, on page 74
- SAN Valley Systems FCIP Gateway (SL1000) Equipment Fact Sheet, on page 76

Cisco MDS 9000 IP Fact Sheet

Vendor: Cisco Systems, Inc.

<http://www.cisco.com>

Cisco MDS 9000 8-Port, 1 GbE IP Services Module

Original Certification Date:
11/10/2003

Feature	Specification
Supported hardware revision	N/A (depends on MDS switch)
Supported firmware revision	Requires MDS 9000 family v1.2(a) firmware
Product function	1 GbE and FCIP interface to MDS 9000 family of FC switches
Fibre Channel speed	2 Gbps
Number of FC ports	8
FC buffer-to-buffer credits	Depends on MDS 9000 family switch
FC optical interface	1470 nm CWDM FC SFP, also 1490, 1510, 1530, 1550, 1570, 1590, and 1610 SFPs
FC optical connector	1 GbE to 1- or 2-Gb Fibre Channel short wave optical transceiver SFP (336223-B21) and long wave (336224-B21)
IP interface	1 GbE
IP protocol	Fibre Channel protocols (FC-PH, rev 4.3; FC-PH-2, rev 7.4; FC-PH-3, rev 9.4; FC-GS-2, rev 5.3; FC-GS-3, rev 7.01; FC-FLA, rev 2.7; FC-FG, rev 3.5; FC-SW-2, rev 5.3; FC-AL, rev 4.5, FC-AL-2, rev 7.0, FC-PLDA, rev 2.1; FC-VI, rev 1.61; FCP, rev 12; FCP-2 rev 7a; FC-SB-2, rev 2.1; FC-BB, rev 4.7; FC-FS, rev 1.7; FC-PI, rev 13; FC-MI, rev 1.99, FC-Tape, rev 1.17) IP over FC (RFC 2625) Extensive IETF-standards based TCP/IP SNMPv3 and RMON MIBs Class of Service: Class 2, Class 3, Class F FC standard port types: E, F, FL FC enhanced port types: SD, TE, TL Internet standards (RFC 791 IPv4, RFC 793, 1323 TCP, RFC 894 IP/Ethernet, RFC 1041 IP/802, RFC 792, 950, 1256 ICMP, RFC 1323 TCP performance enhancements, RFC 2338 VRRP)
Number of IP ports	8
IP port load balancing	Yes (part of MDS 9000 family)
IP interface	Optical
IP connectors	N/A (part of MDS 9000 family)
Power supply	N/A (part of MDS 9000 family)

Feature	Specification
Input voltage, current	N/A (part of MDS 9000 family)
Power dissipation	N/A (part of MDS 9000 family)
Hot-swap power supply	Yes
Hot-swap fans	Yes
Field replaceable units	Yes
Out-of-band management ports	Yes
SNMP support, version	Yes (via MDS 9500)
Form factor	Blade module that slides into MDS 9500

Other Features
FCIP requires license, iSCSI is in base product
Vendor Statement of Competitive Advantages
<p>The IP Storage Services Module supports both iSCSI and FCIP for both cost-effective and long distance SAN connectivity across customers' existing networking infrastructures. The integration of the IP Storage Services Module with the Cisco MDS 9000 SAN family of switches can help customers more efficiently manage their storage resources, drive SAN consolidation, increase data availability, and reduce the cost of storage networking.</p>

Cisco PA-FC-1G Fact Sheet (10/100 Mbps)

Vendor: Cisco Systems, Inc.

<http://www.cisco.com>

Cisco 7200 and Cisco 7401 routers with the FCIP port adapter module (PA-FC-1G)

Original Certification Date:
03/06/2003

Feature	Specification
Supported hardware revision	Cisco 7200 series and Cisco 7200VXR series, Cisco 7401, NPE-400 Network Processing Engine and NSE-1
Supported firmware revision	Cisco IOS software release 12.2(13)ZD
Product function	Gateway
Fibre Channel speed	1 Gbps
Number of FC ports	1 per port adapter (1 max on Model 7401, 2 max on Model 7200)
FC buffer-to-buffer credits	128
FC optical interface	MM 1310 nm, distance 500 m for 50/125 micron multimode fiber, 300 m for 62.5/125 micron multimode fiber
FC optical connector	LC
IP interface	10/100/1000 GE, 10/100 FE, channelized T1, E1/T1, DS-3, T3, OC-12, OC-3, POS, STS-1, HSSI
IP protocol	TCP
Number of IP ports	Variable depending on IP interface type
IP port load balancing	Yes
IP interface	MM, SM, serial, WAN
IP connectors	Variable depending on IP interface type
Power supply	72XX=single or dual 7401=single
Input voltage, current	100-240 VAC wide input with power factor correction
Power dissipation	72XX=approx. 370 W max configuration 7401= approx. 75 W max configuration
Hot-swap power supply	72XX=Yes 7401=No
Hot-swap fans	Yes
Field replaceable units	Yes
Out-of-band management ports	Yes

Feature	Specification
SNMP support, version	SNMP v1, v2, v3
Form factor	7200=4 or 6 slot chassis: 5.25"H x 16.8"W x 17"D 7401=1U chassis, 2 slots

Other Features

- IP routing: EIGRO, OSPF v2, BGP-4, OSPF/BGP-4 route interaction, RIP/RIP-II
- Access lists, firewall, QoS
- 2 to 1 compression and encryption with optional SA-VAM, SA-VAM2 port adapter module
- High-density LAN and WAN interfaces
- Supports QoS security, MPLS, broadband, multiservice, and management features for next-generation networks
- 1 Mpps IP routing capability

Vendor Statement of Competitive Advantages

- Unique among SAN extension solutions, the Cisco Fibre Channel over IP port adapter interface provides advanced networking services such as data compression, encryption, access control lists, firewalls, and quality of service using Cisco IOS[®] software, to enable highly available and secure SAN extensions solutions
- Wide range of WAN interfaces from fractional T1 to OC-12
- Wide range of LAN interfaces including GIGE, Fast Ethernet, Token Ring, and FDDI
- Key applications include offsite data backup and disaster recovery, data replication and mirroring, and storage hosting

CNT FCIP Gateway Model 1000 Fact Sheet (10/100 Mbps)

Vendor: Computer Network Technology Corporation (CNT)

<http://www.cnt.com>

UltraNet Edge Storage Router Model 1000 (10/100 Mbps model)

Original Certification Date: 12/03/2001

Feature	Specification
Supported hardware revision	00910010 Revision F
Supported firmware revision	1.2.1.1
Product function	Gateway
Fibre Channel speed	1 Gbps
Number of FC ports	1
FC buffer-to-buffer credits	7
FC optical interface	Single-mode, multimode—SFF pluggable
FC optical connector	LC class 1 optics
Ethernet speed (maximum)	100 Mbps full duplex with compression
Ethernet interface	100Base-T
Ethernet connectors	RJ-45
Number of Ethernet ports	1
Ethernet port load balancing	N/A
IP protocol	TCP
Power supply	Single standard, dual optional
Input voltage, current	90-240 VAC, 47-63 Hz, 2.5 Amps
Power dissipation	60 W
Hot-swap power supply	Yes
Hot-swap fans	Yes
Field replaceable units	Power supply, fans, entire unit
Out-of-band management ports	RS-232 serial, 10/100 Ethernet
SNMP support, version	SNMP v1, MIB-II, partial RFC 2233 (extended interface), partial FCMGMT-MIB (Fibre Channel MIB)
Form factor	1 rack unit (1U): 1.75"H x 17.5"W x 14.5"D

Vendor Statement of Competitive Advantages

- Data compression: Maximum bandwidth utilization, saving on expensive WAN costs
- Fabric-to-fabric CRC: End-to-end data checking for guaranteed data integrity
- Incremental Session Management: Network-level error recovery for more efficient data delivery
- Data caching: Maximum throughput and flow control across the network, regardless of distance
- FC and IP payload matching for maximum bandwidth utilization
- 100 Mbps Ethernet support: Use existing network without costly Gbps Ethernet upgrade
- Management tools: Point-and-click GUI configuration tool and web-based monitoring tool, simplifying and reducing management costs

CNT-Specific Setup Information

Fibre Channel SAN Switch Firmware

For switch firmware specifications, go to the following tables in this document:

[Table 5](#)—ACS Version 8.6P Specifications for Switch Firmware and Available MTRs, on page 20

[Table 6](#)—ACS Version 8.7P Specifications for Switch Firmware and Available MTRs, on page 21

[Table 7](#)—VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs, on page 22

Remote Switch License

A Remote Switch license is required for B-series switches attached directly to CNT Edge devices.

Note: When loading this license, do not change the following parameters from the default values:

- Suppress Class F Traffic (Set to 0, F class traffic is supported)
 - SYNC IO mode (Set to 0, default)
-

CNT FCIP Gateway Model 1001 Fact Sheet (1000 Mbps)

Vendor: Computer Network Technology Corporation
(CNT)

<http://www.cnt.com>

UltraNet Edge Storage Router Model 1001 (1000 Mbps
model)

Original Certification Date:
5/01/2002

Feature	Specification
Supported hardware revision	00910010 Revision F
Supported firmware revision	1.3.1, 1.5.1
Product function	Gateway
Fibre Channel speed	1 Gbps
Number of FC ports	1
FC buffer-to-buffer credits	7
FC optical interface	Single-mode, multimode—SFF-pluggable
FC optical connector	LC class 1 optics
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet) with compression
Ethernet interface	1000Base-T
Ethernet connectors	Single-mode, multimode—SFF pluggable
Number of Ethernet ports	1
Ethernet port load balancing	N/A
IP protocol	TCP
Power supply	Dual standard
Input voltage, current	90-240 VAC, 47-63 Hz, 2.5 Amps
Power dissipation	60 W
Hot-swap power supply	Yes
Hot-swap fans	Yes
Field Replaceable Units	Power supply, fans, entire unit
Out-of-band management ports	RS-232 serial, 10/100 Ethernet
SNMP support, version	SNMP v1, MIB-II, partial RFC 2233 (extended interface), partial FCMGMT-MIB (Fibre Channel MIB)
Form factor	1 rack unit (1U): 1.75"H x 17.5"W x 14.5"D

Vendor Statement of Competitive Advantages

- Data compression: Maximum bandwidth utilization, saving on expensive WAN costs
- Fabric-to-fabric CRC: End-to-end data checking for guaranteed data integrity
- Incremental Session Management: Network-level error recovery for more efficient data delivery
- Data caching: Maximum throughput and flow control across the network, regardless of distance
- FC and IP payload matching for maximum bandwidth utilization
- Management tools: Point-and-click GUI configuration tool and web-based monitoring tool, simplifying and reducing management costs

CNT-Specific Setup Information

Fibre Channel SAN Switch Firmware

For switch firmware specifications, go to the following tables in this document:

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[Table 6](#)—ACS Version 8.7P Specifications for Switch Firmware and Available MTRs, on page 21

[Table 7](#)—VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs, on page 22

Remote Switch License

A Remote Switch license is required for B-series switches attached directly to CNT Edge devices.

Note: When loading this license, do not change the following parameters from the default values:

- Suppress Class F Traffic (Set to 0, F class traffic is supported)
 - SYNC IO mode (Set to 0, default)
-

CNT FCIP Gateway Model 1101 Fact Sheet (1000 Mbps)

Vendor: Computer Network Technology Corporation
(CNT)

<http://www.cnt.com>

UltraNet Edge Storage Router Model 1101 (1000 Mbps
model)

Original Certification Date:
06/06/2003

Feature	Specification
Supported hardware revision	00910010 Revision F
Supported firmware revision	1.5.1
Product function	Gateway
Fibre Channel speed	1 Gbps
Number of FC ports	2
FC buffer-to-buffer credits	7
FC optical interface	Single-mode, multimode—SFF-pluggable
FC optical connector	LC class 1 optics
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet) with compression
Ethernet interface	1000Base-T
Ethernet connectors	Single-mode, multimode—SFF pluggable
Number of Ethernet ports	2
Ethernet port load balancing	N/A
IP protocol	TCP
Power supply	Dual standard
Input voltage, current	90-240 VAC, 47-63 Hz, 2.5 Amps
Power dissipation	60 W
Hot-swap power supply	Yes
Hot-swap fans	Yes
Field Replaceable Units	Power supply, fans, entire unit
Out-of-band management ports	RS-232 serial, 10/100 Ethernet
SNMP support, version	SNMP v1, MIB-II, partial RFC 2233 (extended interface), partial FCMGMT-MIB (Fibre Channel MIB)
Form factor	1 rack unit (1U): 1.75"H x 17.5"W x 14.5"D

Vendor Statement of Competitive Advantages

- Data compression: Maximum bandwidth utilization, saving on expensive WAN costs
- Fabric-to-fabric CRC: End-to-end data checking for guaranteed data integrity
- Incremental Session Management: Network-level error recovery for more efficient data delivery
- Data caching: Maximum throughput and flow control across the network, regardless of distance
- FC and IP payload matching for maximum bandwidth utilization
- Management tools: Point-and-click GUI configuration tool and web-based monitoring tool, simplifying and reducing management costs

CNT-Specific Setup Information

Fibre Channel SAN Switch Firmware

For switch firmware specifications, go to the following tables in this document:

[Table 7](#)—VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs, on page 22

Remote Switch License

A Remote Switch license is required for B-series switches attached directly to CNT Edge devices.

Note: When loading this license, do not change the following parameters from the default values:

- Suppress Class F Traffic (Set to 0, F class traffic is supported)
 - SYNC IO mode (Set to 0, default)
-

HP StorageWorks IP Storage Router 2122-2 Fact Sheet

Vendor: Hewlett-Packard Company

<http://www.hp.com>

HP StorageWorks IP Storage Router 2122-2 (HP part number 350074-B21)

Original Certification Date: 02/17/2004

Feature	Specification
Supported hardware revision	N/A
Supported firmware revision	3.4.2
Product function	Gateway/bridge
Fibre Channel speed	1 or 2 Gbps
Number of FC ports	2
FC buffer-to-buffer credits	62
FC optical interface	MM SFP
FC optical connector	LC class 1 optics
Data IP interface	1,000 Mbps
IP protocol	TCP
Number of data IP ports (GigE)	2
IP port load balancing	No
IP interface	Optical
IP connectors	LC
Power supply	Single
Input voltage, current	90–264 VAC
Power dissipation	80–90 W
Hot-swap power supply	No
Hot-swap fans	No
Field Replaceable Units	No
Out-of-band management ports	2
SNMP support, version	V2
Form factor	1 rack unit (1U): 1.75" x 17.375" x 16"

Other Features

- Protocol support: iSCSI 1.0 and FCIP
- OS support: Windows® 2000 & 2003, Red Hat, HP-UX, and Linux
- Weight:
 - unit, 11.2 lbs
 - shipping, 16.5 lbs
- Input requirements:
 - Nominal line voltage: 5.0 VDC
 - Range line voltage: 1.8 VDC to 12.0 VDC
 - Line frequency: 50 to 60 Hz
 - Typical input current: 2.8 A
- Power:
 - Operating voltage: 100 to 120 VAC, 50 to 60 Hz auto sensing; 200 to 240 VAC, 50 to 60 Hz auto sensing
 - Power source loading: 1.0 A max at 100 to 120 VAC, 0.5 A max at 200 to 240 VAC
- Reliability: IEC 68-2 compliant (vibration and shock)
- Relative humidity (non condensing):
 - Operating: 15 to 80%
 - Shipping: 5 to 90%
- Temperature Range:
 - Operating: 23 to 113 °F (-5 to 45 °C)
 - Shipping: -13 to 158 °F (-25 to 70 °C)
- Altitude:
 - Operating: 0 to 9843 ft (0 to 3000 m)
 - Shipping: 0 to 15,000 ft (0 to 4750 m)

Vendor Statement of Competitive Advantages

- Delivers SAN-like benefits over the Ethernet IP network. The SR2122 is an iSCSI to Fibre Channel bridge that enables access to block storage on an FC SAN across an Ethernet network.
- Provides a flexible and easy way to connect stranded servers to existing Fibre Channel storage, thereby increasing return on investment.
- Multiple Ethernet ports provide management and high availability between two SR2122s.
- DAS to SAN via IP.
- Extends HP Continuous Access data replication applications over IP networks using Fibre Channel over IP for B- and M-series based SANs.
- Extends access to and the virtues of FC SANs across Ethernet networks, including:
 - Consolidated storage
 - Improved disk utilization
 - Centralized backup
 - Improved IT efficiency
- GUI provided for setup and management simplicity, compatible with Netscape and Internet Explorer Web browsers.

Lucent FC Gateway Equipment Fact Sheet (1000 Mbps)

Vendor: Lucent Technologies
OptiStar® EdgeSwitch—FCIP Modules

<http://www.lucent.com>
Original Certification Date: 11/06/2002

Feature	Specification
Supported hardware revision	Part Number 4086671111 Version 19
Supported firmware revision	01.61 00297
Product function	Fibre Channel Over IP (FCIP) switch/router
Fibre Channel speed	1 Gbps
Number of FC ports	Any combination of up to 4 modules for up to 8 ports per switch
FC buffer-to-buffer credits	16 buffer credits for local SAN side only; hardware-based FC flow control over the WAN (buffer credits do not apply)
FC optical interface	Single mode, multimode, copper GBIC
FC connector	SC class 1 for MMF, SMF, or copper (HSSDC)
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet)
Ethernet interface	1000 Base-T, 1310/1550 nm single mode, multimode, and HSSDC copper GBIC
Ethernet connectors	SC class 1 for MMF, SMF, or copper
Number of Ethernet ports	1–8 ports (1 Gbps), GBIC interface
Ethernet port load balancing	N/A
IP Protocol	IP with exclusive patent-pending flow control
Power supply	Dual-redundant power modules, with auto-failover and N+1 cooling
Input voltage, current	90–132/180–264 VAC, 47–63 Hz, auto-ranging
Power dissipation	200 W
Hot-swap power supply	Yes
Hot-swap fans	Yes—Fan module also features redundant N+1 cooling
Field replaceable units	All network modules, power modules, fan modules (hot-swappable)
Out-of-band management ports	RS-232 serial, 10/100 Ethernet

Feature	Specification
SNMP support	SNMP v2; FCMGMT-MIB, MIB-II, RMON, SONET, EtherLike, OSPF, BGP-4, RIP-II, AgentX, Bridge, IF, Lucent MIBs
Routing support	IP: OSPFv2, BGP-4, OSPF/BGP-4 Route Interaction, RIP/RIP-II, Spanning Tree, Static FC: FSPF, FSPF/OSPF Route Interaction
Form factor	3 units (3U), fits into standard 19-inch rack (5.25"H x 17.5"W x 15.75"D)

Vendor Statement of Competitive Advantages
<ul style="list-style-type: none"> <li data-bbox="142 590 1279 789">■ The OptiStar® EdgeSwitch is a high-capacity IP switch/router that enables interconnection of Fibre Channel storage area networks (SAN) over IP metropolitan (MAN) and wide area networks (WAN). It provides Layer 2 switching and Layer 3 routing at the network edge, supporting interconnectivity between 1-Gbps Fibre Channel, OC-48c/STM-16c Packet over SONET/SDH, OC-12c/STM-4c Packet over SONET/SDH, OC-3c/STM-1c Packet over SONET/SDH, and Gigabit Ethernet (GbE). Key applications include off-site data backup and disaster recovery, data replication and mirroring, and storage hosting. <li data-bbox="142 789 1279 928">■ The OptiStar® EdgeSwitch offers a unique combination of storage, IP, and optical features, including Lucent's exclusive patent-pending flow control for reliable long-distance transport up to and beyond 35,000 km. It uses efficient and cost-effective point-to-multipoint routing capabilities with extremely high performance and scalability while integrating FC fabric services, zoning, and management. <li data-bbox="142 928 1279 1102">■ The OptiStar® EdgeSwitch can deliver solutions with significant CapEx and OpEx savings over alternative solutions, with unparalleled performance-over-distance capabilities. Domain Virtualization™ technology is being developed by Lucent to leverage the existing SAN infrastructure by enabling selective sharing and/or segregation of SAN fabrics. This feature improves scalability, reliability, interoperability, manageability, and security during large-scale distributed SAN operations. <li data-bbox="142 1102 1279 1263">■ The OptiStar® EdgeSwitch has total flexibility to operate over virtually any type of network (IP, Ethernet, DWDM, SONET and/or SDH, supporting rates from 100 Mbps to 2.4 Gbps) producing reliable and scalable options for both the enterprise and service provider customer. Lucent has trusted industry relationships and recognized industry leading service and support.

Lucent Zoning Steps for DRM

Use the following procedure to zone the OptiStar EdgeSwitch for the DRM FCIP solution.

Zone Planning

Decide which logical fabric subsets (or zones) should be created, by recognizing that any two or more devices requiring access to each other must be included in a common zone. DRM requires two kinds of zones: peer-to-peer remote connection (PPRC) zones and host bus adapter (HBA) zones.

A PPRC zone is required for each fabric in which the local and remote PPRC controller ports are zoned to access each other across the fabric. HBA zones are also required where each HBA device is configured in a zone with its corresponding host controller port.

Verify Connections

Establish the fiber connection between the local and remote GigE ports on the GigE modules of the OptiStar units. If the connections are working properly, all devices to be configured into zones appear in the OptiStar's CLI management window as members that can be added to a zoneset. If all SAN devices are not included in the member list of World Wide Names (WWNs), recheck the port-to-port connections to and from each attached device before attempting Step 4 below. After all attached devices have good connections, the OptiStar zoning can be implemented using the following steps:

1. Log on to the CLI at the management level for the FCIP network module for which you would like to set up zoning.
2. From the FCIP Network Module CLI Root menu, type the following:

```
config zone wwn zoneset
```

The zoneset menu is displayed.

3. From the zoneset menu (config/zone/wwn/zoneset), create empty zonesets using the following command:

```
add <ZoneSetName>
```

where *ZoneSetName* is the name of the empty zoneset.

For example,

```
(config/zone/wwn/zoneset) > add Backup
```

4. Add zones to the zoneset using one of the following two methods:

- Create an empty zone and add it to the zoneset created earlier. Go to the zone menu (config/zone/wwn/zone) and type:

```
zadd <ZoneName> <ZoneSetName>
```

where *ZoneName* is the name of the empty zone and *ZoneSetName* is the name of the zoneset.

For example:

```
(config/zone/wwn/zone)> zadd backupNT Backup
```

- Select from zones that were already created. Go to the zoneset menu (config/zone/wwn/zoneset) and type:

```
define <ZoneSetName>
```

where *ZoneSetName* is the name of the zoneset.

Enter a **Y** for Yes in the brackets for each zone to be added to the zoneset.

For example:

```
(config/zone/wwn/zoneset)> define Backup
(Enter 0 to exit)
backupNT [Y]
```

5. Add members to the zones using one of the following three methods:

- To select from World Wide N_Port_Names within the fabric (from the zoneset menu config/zone/wwn/zone), use the command:

```
madd
```

For example:

```
(config/zone/wwn/zone)> madd
Item Member Identifier
1) 21 00 00 20 37 C6 E4 BD
Enter item from list to select member
(Enter 0 to exit, r to repeat list, or <CR> to continue)
(config/zone/wwn/zone - member)> 1
Item Zone Name
1) backupNT
Enter item from list to select zone
(Enter 0 to exit, r to repeat list, or <CR> to continue)
(config/zone/wwn/zone - zone)> 1
```

- To manually enter World Wide N_Port_Names, use the command:

```
madd <WWPN> <ZoneName>
```

where *WWPN* is the World Wide N_Port_Name and *ZoneName* is the name of the zone.

For example:

```
(config/zone/wwn/zone) > madd FF EE DD CC BB AA 99 88 backupNT
(config/zone/wwn/zone) > madd 11 22 33 44 55 66 77 88
backupUNIX
```

- To quickly select from the pool of members that already exist in the zoning database (members have already been added to one or more zones), use the following command:

```
define <ZoneName>
```

where *ZoneName* is the name of the zone.

Note: This method is recommended only as a shortcut once all potential members have been previously added to the database, since the `define` command only allows selection from a predefined list.

For example:

```
(config/zone/wwn/zone) > define backupNT
(Enter 0 to exit)
11 22 33 44 55 66 77 88 [N]:
FF EE DD CC BB AA 99 88 [Y]:
OptiStar EdgeSwitch Configuration
Storing zoneset information...
Do you wish to continue (Yes/No): [Y]
```

6. To place the zoning you have created into effect, you must activate a zoneset. To activate a zoneset, go to the zoneset menu. Choose either 1) config 2)zone 3)wwn 4)zoneset or the shortcut config zone wwn zoneset) and type:

```
activate <ZoneSetName>
```

where *ZoneSetName* is the name of the zoneset.

For example:

```
(config/zone/wwn/zoneset) > activate Backup
```

At this command, the switch activates the zoneset on itself and then attempts to force the zoneset onto other switches in the fabric (zone merge). After you have entered this command, press the down arrow key to scroll to a message that states “depress any key to cancel.”

Note: Pressing any key at this point, including the **Enter** key, will cancel the `activate` command.

If the `activate` command is completely successful (usually in under 15 seconds), the message “OK” is displayed.

After a zoneset is activated, it is stored in the temporary memory of all switches in the fabric. If the attempt is unsuccessful, error messages are displayed, event messages are logged, and an isolated E_Port condition occurs, as indicated by a blinking green LED and solid amber LED combination on the affected port.

7. Verify that the zoneset is enforced by entering the `senf` command from the zoneset menu. For example:

```
(conf/zone/wwn/zoneset) > senf
```

or from the Root menu, type:

```
config zone wwn show
```

Additional Comments

- Powering on the OptiStar EdgeSwitch—Install and configure each EdgeSwitch and the WAN connection prior to connecting the FC attached devices.
- Port configuration—To set port configuration parameters on the FCIP module (such as domain ID, port type, zone information, and so on), the parameters must be set twice: once for each boot image. Currently, the FCIP network module has two separate configuration databases (one associated with the current image in flash memory and one associated with the alternate image).
- Momentary drive drop and recovery during fabric updates—When performing zone enforcements (zoneset activation) after modification of zones (adding or deleting zone members) or after creation of new zones or removal of existing zones, the initiators (hosts) may momentarily lose visibility to the targets (storage devices). This momentary drive loss and recovery may occur fabric wide, independent of separate defined zones within an active zoneset, but should have little or no effect on live applications.
- Disruptive action required to join two segregated fabrics—When performing a zone merge with two separate fabrics, the zone merge will fail if the zoning configuration rules are violated. This is a known limitation of the zoning rules inherent in the Fibre Channel protocol. The fabrics will remain segregated as long as the following conditions exist:
 - Two separate fabrics exist with the active zonesets of the same name in each fabric.

- There are duplicate (matching) zone names within the active zonesets of each fabric, but the zones contain different zone members.
- Upon fabric segregation, the following actions must be taken to reinitiate the zone merge:
 - The zone member mismatch causing the failure must be corrected by either removing the mismatched zones from the active zonesets or by matching the zone members within the duplicate zones in each separate fabric.
 - One of the following four actions must be taken to join the segregated fabrics into a single fabric:
 - Disconnect and then reconnect the WAN link (virtual ISL).
 - Disable the WAN Network Module, and then re-enable.
 - Reset the FCIP Network Module.
 - Reboot the EdgeSwitch.

Note: Actions 1, 2, and 4 will interrupt traffic running across the WAN link. Action 3 will cause an interrupt to local SAN traffic routed through the FCIP Network Module ports.

- The EdgeSwitch helps FCIP applications avoid fragmentation by offering a configurable MTU size and support for Ethernet Jumbo Frames. However, in order to transport 2K Fibre Channel frame sizes over Gigabit Ethernet using FCIP, Ethernet Jumbo Frames must be supported end-to-end across the IP network. If the IP network is configured to the standard Ethernet MTU size of 1518 bytes, then the maximum Fibre Channel frame size needs to be configured to be less than 1500 bytes. For these environments, a 1-K Fibre Channel frame size is recommended.
- Fibre Channel interoperability:
 - Credit support—The EdgeSwitch currently supports a maximum of 16 credits through the fabric for flow control on the local SAN side of the FCIP application. Any HBA that supports greater than 16 credits should be configured to use a maximum of 16 credits.
 - B-series switches—Some proprietary Infrastructure fabric services are not supported. To interoperate with B-series switches, take the following steps:

- ❑ Set the domain IDs used for the FCIP Network Module should be set within a range of 97 to 127 (0x61 to 0x7F in hex).
- ❑ Set the operating policy on the EdgeSwitch to Open Fabric mode.
- ❑ Ensure that the B-series switches are operating in interoperability mode by setting the Interopmode parameter to 1.
- ❑ Issue a `fabricshow` command on each B-series switch to verify that all switches in the FC fabric show up by name. The FCIP Network Modules should be displayed with their WWN, followed by their Ethernet address, and by “Lucent/Vixel.”

Nishan Systems FCIP Gateway Equipment Fact Sheet

Vendor: Nishan Systems

<http://www.nishansystems.com>

IPS3300 Multiprotocol IP Storage Switch

Original Certification Date: 05/01/2002

Feature	Specification
Supported hardware revision	IPS3300 rev - 01
Supported firmware revision	2.0.3
Product function	Multiservice IP storage switch and gateway
Fibre Channel speed	1 Gbps
Number of FC ports	1 to 8 FC ports
FC buffer-to-buffer credits	512 KB per port with 16 credits advertised
FC optical interface	MM, SM, and copper GBICs
FC optical connector	SC connectors for MMF and SMF
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet)
Ethernet interface	MM, SM, and copper GBICs
Ethernet connectors	SC connectors for MMF and SMF
Number of Ethernet ports	1 to 8 GE ports
Ethernet port load balancing	Yes
IP protocol	TCP (iFCP, iSCSI); UDP
Power supply	Dual
Input voltage, current	100-240 VAC, 4A (two per supply) 50/60 Hz
Power dissipation	210 W
Hot-swap power supply	Yes
Hot-swap fans	No—redundant fans
Field Replaceable Units	Yes
Out-of-band management ports	one serial console port, one 10/100 Ethernet Port
SNMP support, version	SNMP support V
Form factor	2U

Vendor Statement of Competitive Advantages

- Supports Layer 2 switching, Layer 3 routing, zoning, QoS, traffic shaping, OSPF, and flow control. Future release will include compression and enhanced bandwidth management.
- Performance: Wire-speed for IP (iSCSI, iFCP) and FC storage protocols
- Flexibility/Investment Protection: Multiprotocol support allows switching between any combination of FC and IP devices. Any port is configurable as FC or GE.
- High-Availability: Nishan's implementation of IP protocols gives customer higher availability and scalability over distributed WAN links vs. tunneling solutions. Redundant GE links for HA via OSPF or STP. End-to-end CRC data integrity. TCP provides guaranteed data delivery.
- TCO: Lower than existing WAN technologies. Combines data center switch and WAN router in one box.
- Management: Consolidated for zoning of heterogeneous storage resources
- E_Port: Supported, including linking of disparate vendor or firmware fabric versions
- Security: Tested with multiple products to deliver secure end-to-end storage

Nishan-Specific Setup Information

Note: The Nishan IPS3300 has been certified as an FCIP gateway, not as a Fibre Channel switch.

Fibre Channel SAN Switch Firmware

For switch firmware specifications, go to the following tables in this document:

[Table 5](#)—ACS Version 8.6P Specifications for Switch Firmware and Available MTRs, on page 20

[Table 6](#)—ACS Version 8.7P Specifications for Switch Firmware and Available MTRs, on page 21

[Table 7](#)—VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs, on page 22

Configuration Used in Certification

Note: The Nishan Systems Model IPS3300 was certified only in a TCP configuration. This unit was not tested in a UDP configuration.

Nishan DRM Setup

The following planning and procedures must be followed to zone the Nishan IPS3300 for the DRM FCIP solution:

Zone Planning

Decide which logical fabric subsets (or zones) should be created. This is done by recognizing that any two or more devices that require access to each other must be included in a common zone.

DRM requires two kinds of zones: peer-to-peer remote connection zones and host bus adapter zones.

A peer-to-peer remote connection (PPRC) zone is required for each fabric, in which the local and remote PPRC controller ports (the right-most controller port, also known as Controller Port 2) are zoned to access each other across the fabric.

Host bus adapter (HBA) zones are also required, in which each HBA device is configured in a zone with its corresponding host controller port (the left-most controller port, also known as Controller Port 1).

Verify Connections

Establish the fiber connection between the iFCP gateway port on the local IPS3300 to the corresponding port on the remote IPS3300. If the connection is working properly, all devices that will need to be configured into zones will appear in the Devices pane of the Zone Configuration window, which can be found using the SANvergence Element Manager for each IPS3300.

If all SAN devices are not listed in the Devices pane of the Zone Configuration window, double-check the port-to-port connections to/from those devices. Use the **Refresh** button in the Zone Configuration window to verify changes to the connection status.

Create PPRC Zones

1. Choose **New Zone** from the menu bar of the Zone Configuration window of the local IPS3300.
2. You are prompted to name the zone and to select a **Zone ID**. Name this new zone with a label that is in some way descriptive of the device members of that zone, such as “PPRC Zone - Fabric A.” Select a Zone ID for that zone using any number between 0 and 512. This same Zone ID will be used for the corresponding PPRC zone on the other side of the fabric. These two local and remote PPRC “partner” zones having the same Zone ID will eventually be merged into one PPRC zone.

3. While the zone name is still highlighted in the Zones pane of the Zone Configuration window, go to the Devices pane in the same window and look for the PPRC controller port listed under the E_Port (labeled “EP”). Select that device, and then click the **Add** icon on the menu bar near the top of the window.
4. Follow the previous three steps for any additional fabrics that are required.

Create HBA Zones

The HBA zones are configured similarly to the steps used in setting up the PPRC zones, with the most significant difference being the selection of the Zone IDs.

1. Choose **New Zone** from the menu bar of the Zone Configuration window. You are prompted to name the zone and select a Zone ID. Name this new zone with a label that is descriptive of the member devices occupying that zone, such as “HBA Zone - OS1.”
2. Select a **Zone ID** using any number between 0 and 512 that has not been previously selected for another zone. This same Zone ID will be used for a corresponding zone on the other side of the fabric, provided there are device(s) that must directly access each other across the fabric.
3. While the zone name is still highlighted in the Zones pane of the Zone Configuration window, go over to the Devices pane in the same window and look for the host controller port(s) listed under the E_Port (labeled “EP”). Select that device, and then click the **Add** icon on the menu bar near the top of the window. Select the HBA device from the Devices pane and click the **Add** icon.
4. Follow the previous three steps for any additional HBA zones that are required.
5. This zoning configuration must be committed by clicking the **Commit** icon on the menu bar near the top of the window.

Zone Across Fabric

The PPRC and HBA zones must be repeated on the remote IPS3300 across the fabric. Remember to use a common Zone ID for any zone that must eventually be merged with its ‘partner’ zone on the local IPS3300. When completed, commit the zoning configuration as shown in Step 5 above.

Export Partner Zones into Merged Zone

After the zoning configurations are set, use the following procedures to export the partner zones exported across the fabric into a single merged zone:

1. Use the SANvergence application to access the Element Manager window for the local IPS3300. Under the Configuration menu, select **iFCP**, and then select **Remote Connections**.
2. Select (highlight) the line corresponding to the iFCP gateway port connection.
 - a. Choose **Edit**.
 - b. Under the heading “Select local zones to share” is a box showing all zones with their corresponding Zone IDs. Choose the **Share** box for each zone that has a corresponding partner zone across the fabric.
 - c. Click **Apply**, and then click **OK**. Check the right-most column in the gateway port connection line to verify that the desired zones will be exported. The Zone ID numbers should be listed there.
3. Repeat steps 1 and 2 for the remote IPS3300.
4. Save the new zoning configuration on each IPS3300 by returning to the Element Manager for each IPS3300 and choosing **Save Configuration** on the File menu.
5. Verify the zone/device exportation by returning to the Zone Configuration window in each IPS3300 Element Manager, where a bold capital “R” should appear superimposed on the icon of each zone and each device that has been successfully exported across the fabric. If the Rs do not appear on the zones/devices icons where expected, even after all connections have been double-checked and the Zone Configuration has been refreshed (using the **Refresh** button), the IPS3300 may require a reset. A reset is done either by choosing **Reset System** from the Element Manager File menu or by performing a hard reset.

For any additional details, refer to standard Nishan installation guidelines in the IPS3000 Series Users Manual.

SANcastle FCIP Gateway Equipment Fact Sheet (GFS-2)

Vendor: SANcastle Technologies, Inc.
GFS-2 Gateway

<http://www.sancastle.com>

Original Certification Date: 05/01/2002

Feature	Specification
Supported hardware revision	1.2
Supported firmware revision	1.2
Product function	Gateway
Fibre Channel speed	1 Gbps
Number of FC ports	1
FC buffer-to-buffer credits	27
FC optical interface	MM
FC optical connector	SC
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet)
Ethernet interface	MM
Ethernet connectors	SC
Number of Ethernet ports	1
Ethernet port load balancing	No
IP protocol	UDP with a ULP for completeness and sequence of delivery
Power supply	Single
Input voltage, current	120/240 VAC, 1.0 Amp with 120 VAC, 0.5 Amps with 240 VAC
Power dissipation	135 W
Hot-swap power supply	No
Hot-swap fans	No
Field Replaceable Units	No
Out-of-band management ports	One 10Base-T RJ45 and one RS232 serial port with RJ45 connection (cable included)
SNMP support, version	SNMP v1, v2, MIB 2, FE-MIB (rfc2837), FCMGMT-MIB
Form factor	1U rack mount or shelf mount

Other Features

- Autonomous region support for enhanced SAN fabric management
- Direct IP-to-Fibre Channel translation for LAN/SAN integration includes mapping VLAN tags to FC zones
- Point-multipoint for cost effective SAN island integration

Vendor Statement of Competitive Advantages

- The GFS-2 connects to the fabric as a full E_Port ISL that can be managed as part of the FC fabric.
- GbE port can provide connection to six or more remote connected GFS-2 or GFS-8 end-points.
- Best in class Buffer Credit supports communications at line speed over long distances up to 2048 KM providing lease line QoS.
- E_Port is interoperable with Brocade and SANmark certified switches.

SANcastle FCIP Gateway Equipment Fact Sheet (GFS-8)

Vendor: SANcastle Technologies, Inc.
 GFS-8 Global Data Fabric Switch

<http://www.sancastle.com>
 Original Certification Date: 12/03/2001

Feature	Specification
Supported hardware revision	1.2
Supported firmware revision	1.1, 1.2
Product function	Multifunction 8-port FC storage switch and IP gateway
Fibre Channel speed	1 Gbps full duplex
Number of FC ports	All ports can be configured as FC or IP
FC buffer-to-buffer credits	29
FC optical interface	MM
FC optical connector	SC
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet)
Ethernet interface	MM
Ethernet connectors	SC
Number of Ethernet ports	All ports can be configured as FC or IP
Ethernet port load balancing	Yes
IP protocol	UDP
Power supply	Single
Input voltage, current	120/240 VAC 1.4 Amps
Power dissipation	135 W
Hot-swap power supply	No
Hot-swap fans	No
Field Replaceable Units	No
Out-of-band management ports	10Base-T Ethernet and RS232 serial port
SNMP support, version	SNMP v1, v2 MIB 2, FE-MIB (rfc2837), FCMGMT-MIB
Form factor	2.5U rack mount or shelf mount

Other Features

Supports:

- Direct IP-to-Fibre Channel translation for IP/SAN integration, includes VLAN tags to FC zones.
- Autonomous regions for highly secured nets.
- Dual hot-swap power supplies and load balancing.

Vendor Statement of Competitive Advantages

- The switch function allows multiple FC links to talk to more than one GbE port.
- Best in class Buffer Credit to support distance.
- E_Port is interoperable with Brocade and InRange.

SANcastle-Specific Setup Information

Note: The SANcastle GFS-8 Global Data Fabric Switch has been certified as an FCIP gateway, not as a Fibre Channel switch.

Fibre Channel SAN Switch Firmware

For switch firmware specifications, go to the following tables in this document:

[Table 5](#)—ACS Version 8.6P Specifications for Switch Firmware and Available MTRs, on page 20

[Table 6](#)—ACS Version 8.7P Specifications for Switch Firmware and Available MTRs, on page 21

[Table 7](#)—VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs, on page 22

DRM Setup

No DRM-specific setup information is required. Refer to SANcastle installation documentation.

SAN Valley Systems FCIP Gateway (SL700) Equipment Fact Sheet

Vendor: SAN Valley Systems, Inc.

<http://www.sanvalley.com>

SL700-AC & SL700-DC IP-SAN Gateway

Original Certification Date: 12/03/2001

HP product number: QS-SN105-HK

Feature	Specification
Supported hardware revision	04
Supported firmware revision	1.6.0
Product function	Fibre Channel over IP gateway
Fibre Channel speed	1 Gbps full-duplex (200 Mbps)
Number of FC ports	1
FC buffer-to-buffer credits	Supports 64 BB credits
FC optical interface	50-62.5 micron MM, 850 nm
FC optical connector	LC
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet)
Ethernet interface	50-62.5 micron MM, 850 nm
Ethernet connectors	LC
Number of Ethernet ports	1
Ethernet port load balancing	No
IP protocol	UDP
Power supply	2 power supplies per chassis
Input voltage, current	SL700-AC: Universal input 90-240 VAC, 50-60 HZ front power entry SL700-DC: DC input voltage: 36 V to 75 V, DC input current: 2 Amps
Power dissipation	80 W
Hot-swap power supply	No—but redundant power supplies
Hot-swap fans	No—but redundant fans
Field Replaceable Units	Entire unit
Out-of-band management ports	10/100Base-T & RS232 serial port

Feature	Specification
SNMP support, version	SNMP v1, v2, v3; FCMGMT-MIB
Form factor	1U 19-inch rack mount 1.72"H x 17"W x 19"D

Other Features
End-to-end flow control, IP Layer 2 & 4 Modes, traffic shaping, QoS via ToS (RFC 791)/DiffServ (RFC 2475), integrated GUI-based management platform

Vendor Statement of Competitive Advantages
<ul style="list-style-type: none"> ■ Wire speed gigabit performance up to 2000 km, minimum of 1.5 Mbps up to 2 million km ■ Traffic shaping: Optimized bandwidth utilization leveraging any MAN/WAN to fit every IT budget ■ Credit management: Low-latency, high-performance solution with full data path management ■ Easy-to-use management GUI for configuration/monitoring; integrates with CA, HP, and Tivoli ■ Security—tested with security solutions including the Cylink NetHawk VPN device ■ E_Port interoperability with all major FC switch vendors; extensive testing with multiple Brocade Fabric OS versions

Fibre Channel SAN Switch Firmware

For switch firmware specifications, go to the following tables in this document:

[Table 5](#)—ACS Version 8.6P Specifications for Switch Firmware and Available MTRs, on page 20

[Table 6](#)—ACS Version 8.7P Specifications for Switch Firmware and Available MTRs, on page 21

[Table 7](#)—VCS Versions 3.0/3.010 Specifications for Switch Firmware and Available MTRs, on page 22

DRM Setup

No DRM-specific setup information is required. Refer to SAN Valley installation documentation.

SAN Valley Systems FCIP Gateway (SL1000) Equipment Fact Sheet

Vendor: SAN Valley Systems, Inc.

<http://www.sanvalley.com>

SL1000-AC & SL1000-DC IP-SAN Gateway

Original Certification Date: 12/03/2001

HP product number: QS-SN105-HK

Feature	Specification
Supported hardware revision	04
Supported firmware revision	1.6.0
Product function	Fibre Channel over IP Gateway
Fibre Channel speed	1 Gbps full-duplex (200 Mbps)
Number of FC ports	4
FC buffer-to-buffer credits	Supports 64 BB credits
FC optical interface	50-62.5 micron MM, 850 nm
FC optical connector	MT-RJ
Ethernet speed (maximum)	1 Gbps (Gigabit Ethernet)
Ethernet interface	50-62.5 micron MM, 850 nm
Ethernet connectors	MT-RJ
Number of Ethernet ports	4
Ethernet port load balancing	No
IP protocol	UDP
Power supply	2 power supplies per chassis
Input voltage, current	SL1000-AC: Universal input 90-240 VAC, 50-60 HZ front power entry SL1000-DC: DC input voltage 36 V to 75 V, DC input current 2 Amps
Power dissipation	80 W
Hot-swap power supply	No—but redundant power supplies
Hot-swap fans	No—but redundant fans
Field Replaceable Units	Entire unit
Out-of-band management ports	10/100Base-T & RS232 serial port

Feature	Specification
SNMP support, version	SNMP v1, v2, v3; FCMGMT-MIB
Form factor	1U 19-inch rack mount 1.72"H x 17"W x 19"D

Other Features

End-to-end flow control, IP Layer 2 & 4 Modes, traffic shaping, QoS via ToS (RFC 791)/DiffServ (RFC 2475), integrated GUI-based management platform

Vendor Statement of Competitive Advantages

Vendor statement of competitive advantages:

- Wire speed gigabit performance up to 2000 km, minimum of 1.5 Mbps up to 2 million km
- Traffic shaping: Optimized bandwidth utilization leveraging any MAN/WAN to fit every IT budget
- Credit management: Low-latency, high-performance solution with full data path management
- Easy-to-use management GUI for configuration/monitoring; integrates with CA, HP and Tivoli
- Security—tested with security solutions including the Cylink NetHawk VPN device
- E_Port interoperability with all major FC switch vendors; extensive testing with multiple Brocade Fabric OS versions

For switch firmware specifications, go to the following tables in this document:

[Table 5](#)—ACS Version 8.6P Specifications for Switch Firmware and Available MTRs, on page 20

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DRM Setup

No DRM-specific setup information is required. Refer to SAN Valley installation documentation.

Certified SONET Vendor Products



The fact sheets in this appendix list third-party SONET gateways that have been approved for use in Continuous Access EVA and Data Replication Manager environments. Fact sheets are provided on the listed pages for the following vendor equipment:

- Ciena SONET Gateway Fact Sheet, on page 80

Ciena SONET Gateway Fact Sheet

Vendor: Ciena (formerly Akara) Corporation
 OUSP 2048

<http://www.ciena.com>

Original Certification Date:
 02/28/2003

Feature	Specification
Supported hardware revision	Rel 2
Supported firmware revision	Rel 2
Product function	SONET/DWDM/Dark Fiber Gateway
Fibre Channel speed	1 Gbps
Number of FC ports	6
FC buffer-to-buffer credits	No limit
FC optical interface	MM/SM—850 nm, 1310 nm
FC optical connector	SC
SONET interfaces	OC-3, OC-12, OC-48
SDH interfaces	STM-1, STM-4, STM-16
Number of SONET/SDH interfaces	2
SONET load balancing	Yes
SONET/SDH interface	SM, 1310 & 1550 nm
SONET connector	SC
Power supply	Dual
Input voltage, current	120/220 Vac, -48 Vdc
Power dissipation	100 W
Hot-swap power supply	Yes
Hot-swap fans	Yes
Field replaceable units	Yes
Out-of-band management ports	Yes
SNMP support, version	Yes, Version 1
Form factor	3 rack unit (3U): 5.25"H x 19"W x 24"D

Other Features

- SONET GR-253 compliant
- Automatic recovery from WAN failure
- Highly featured management platform

Vendor Statement of Competitive Advantages

- Fibre Channel performance independent of distance
- Complete bandwidth isolation among ISLs sharing the same SONET link
- Guaranteed performance independent of bursty loads
- Load balanced SONET aggregates
- Detailed performance monitoring
- Instrumented for fast trouble isolation

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

asynchronous mode

A mode of operation of a copy set where the write operation reports completion of the command to the host after the data is on the initiating controller, but before completion of the remote command.

See also synchronous mode.

Asynchronous Transfer Mode (ATM)

A dedicated connection-switching technology that organizes digital data into 53-byte cell units and transmits them over a physical medium using digital signal technology. ATM is capable of transmitting at speeds of 155 or 622 Mbps and faster.

bandwidth

The transmission capacity of a link or system, usually measured in bits per second.

buffer-to-buffer credit

A link-level flow control mechanism. Buffers in the expansion port of switches are used to determine how many frames can be outstanding when data is sent to a recipient.

certification

Successful completion of a comprehensive test plan.

coarse wavelength division multiplexing (CWDM)

Transmitting multiple, spaced wavelengths through the same fiber. Wavelengths are spaced 2 nanometers apart.

controller

A hardware device that uses software to facilitate communications between a host and one or more storage devices organized in an array.

copy set

A generic term for a logical disk in one storage array that is replicated to another logical disk in another storage array.

dark fiber

Unused fiber optic cable.

data rate

The amount of data transferred per second by a communications channel, computing device, or storage device.

default gateway

The default path that a computer or router uses to forward and route data between two or more networks that have different protocols.

dense wavelength division multiplexing (DWDM)

Transmitting multiple, closely spaced wavelengths through the same fiber. The result is wavelength spacings of 1 nanometer or less.

fabric

A network of one or more Fibre Channel switches

FCIP

A configuration in which Fibre Channel Protocol data is transmitted via an Internet Protocol intersite link.

Fibre Channel

A technology protocol standardized by ANSI that allows very high-speed, switching-based serial transmissions.

Fibre Channel switch

A device that provides high-speed, high-bandwidth routing of data (in Fibre Channel protocol) via link-level addressing.

frame

The basic unit of communication using the Fibre Channel Protocol. Each frame consists of a payload encapsulated in control information. The maximum size of the payload is 2112 bytes.

full copy

A copy operation in which all 1 MB blocks written on a source disk since it was created are replicated to a destination disk.

gigabit interface converter (GBIC)

A standard transceiver with specified dimensions that converts electrical signals used by Fibre Channel devices for transmission over either optical or copper media. GBICs are hot swappable. Optical GBICs use SC connectors.

high availability

Redundant systems, software, and IT processes to reduce the risk of downtime. No single point of failure.

Internet Protocol (IP)

An address of a device on a network using TCP/IP.

interswitch link (ISL)

A connection between two switches using their expansion ports.

latency

The amount of time required for a transmission to reach its destination.

link

A connection between two adjacent Fibre Channel ports, consisting of a transmit fiber and a receive fiber. An example is the connection between the Fibre Channel switch port and the HSG80 controller.

maximum transmission rate

A user-defined data transfer parameter that is used to govern the highest speed at which data may flow from a gateway device.

merge or merging

Transferring the contents of the log to the destination disk in order to synchronize the source and destination disks.

mirroring

The act of creating an exact copy or image of data.

multimode fiber (MMF)

In fiber optics, a class of fibers with a core thick enough for light to take several paths (known as modes) through the core. The core for a multimode fiber is normally either 50 microns or 62.5 microns.

network

In data communication, a configuration in which two or more terminals or devices are connected to enable information transfer.

Quality of Service (QoS)

Each virtual connection in an ATM network has a service category. The performance of the connection is measured by six established QoS parameters, which are outlined by the ATM forum.

redundancy

The provision of multiple interchangeable components to perform a single function to deal with failures and errors. A RAIDset is considered to be redundant when user data is recorded directly to one member, and all the other members and associated parity also are recorded. If a member is missing from the RAIDset, its data can be regenerated as needed, but the RAIDset is no longer redundant until the missing member is replaced and reconstructed.

single-mode fiber (SMF)

Optical fiber designed to allow just a single path of light through the core. The core for a single-mode fiber is extremely thin—less than 10 microns, which makes the signal extremely clean.

small form factor pluggable (SFP) GBIC

A standard transceiver with specified dimensions that converts electrical signals used by Fibre Channel devices for transmission over either optical or copper media. SFPs are hot swappable. Optical SFPs use LC connectors.

speed of light through fiber

Approximately 200,000 kilometers per second or 5 microseconds to traverse one kilometer.

subnet mask

Also known as address mask. An IP network that can be reached through a single IP address. All the members of the subnet share the mask value. Members of the subnet can then be referenced more easily. A subnetwork is a network that is part of another network, connected through a gateway, bridge, or router.

Synchronous Digital Hierarchy (SDH)

An international digital telecommunications network hierarchy that standardizes transmission around the bit rate of 51.84 megabits per second, which is also called STS-1. SDH is the European counterpart to SONET.

synchronous mode

A mode of operation of the remote copy set where the data is written simultaneously to the cache of the local subsystem and the cache of the remote subsystem. The I/O completion status is returned to the sender after the I/O is in the cache at both sites.

See also asynchronous mode.

Synchronous Optical Network (SONET)

A broadband networking standard (ANSI T1.105) based on point-to-point optical fibre networks. SONET is the American version of SDH.

time division multiplexing (TDM)

A technology that combines several slow-speed transmission channels into one high-speed transmission channel. Each low-speed channel is located in a time slot.

topology

An interconnection scheme that allows multiple Fibre Channel ports to communicate. For example, point-to-point, arbitrated loop, and switched fabric are all Fibre Channel topologies.

Transmission Control Protocol over Internet Protocol (TCP/IP)

A language governing communications among all computers on the Internet.

wavelength

The distance an electromagnetic wave travels in the time it takes to oscillate through a complete cycle. Wavelengths of light are measured in nanometers (10^{-9} m) or micrometers (10^{-6} m).

wavelength division multiplexing (WDM)

A technology that uses multiple lasers to transmit several wavelengths of light simultaneously over a single optical fiber.

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