Implementing an IBM/Cisco SAN

Learn about the latest editions to the IBM/Cisco product family

Increase your skills with this easy-to-follow format

Advance your IBM/Cisco skill set

Jon Tate
Michael Engelbrecht
Jacek Koman

Redbooks

ibm.com/redbooks

International Technical Support Organization

Implementing an IBM/Cisco SAN

March 2009

SG24-7545-01

Note: Before using this information and the product it supports, read the information in “Notices” on page vii.

Second Edition (March 2009)

This edition applies to Version 4.1.n of the Cisco Fabric Manager and Device Manager and the NX-OS operating system.

Contents

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information about the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:
IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1785 U.S.A.

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at http://www.ibm.com/legal/copytrade.shtml

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AIX®
BladeCenter®
ESCON®
eServer™
FICON®
HACMP™
IBM TotalStorage Proven™
IBM®
PowerPC®
PR/SM™
pSeries®
Redbooks®
Redbooks (logo) ®
S/360™
S/370™
S/390®
Storage Tank™
System Storage™
System/360™
System/370™
TotalStorage Proven™
TotalStorage®
z/Architecture®
zSeries®

The following terms are trademarks of other companies:

Oracle, JD Edwards, PeopleSoft, Siebel, and TopLink are registered trademarks of Oracle Corporation and/or its affiliates.

These materials have been reproduced by IBM with the permission of Cisco Systems Inc. COPYRIGHT 2003 - 2007 CISCO SYSTEMS INC. ALL RIGHTS RESERVED.

Java, JDK, JRE, Solaris, Sun, Ultra, and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Excel, Internet Explorer, Microsoft, Visio, Windows Vista, Windows, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

Summary of changes

This section describes the technical changes made in this edition of the book. This edition may also include minor corrections and editorial changes that are not identified.

Summary of Changes
for SG24-7545-01
for Implementing an IBM/Cisco SAN
as created or updated on March 9, 2009.

March 2009, Second Edition

This revision reflects the addition, deletion, or modification of new and changed information described below.

New information

- New products added
- Fabric Manager and Device Manager 4.1.x
- NX-OS operating system

Changed information

- All figures updated
- Removed FICON® chapter

Preface

“Do everything that is necessary and absolutely nothing that is not.”

In this IBM® Redbooks® publication, which is an update and major revision of the previous version, we have consolidated as much of the critical information as possible while discussing procedures and tasks that are likely to be encountered on a daily basis.

Each of the products described has much more functionality than we could cover in just one book. The IBM SAN portfolio is rich in quality products that bring a vast amount of technicality and vitality to the SAN world. Their inclusion and selection is based on a thorough understanding of the storage networking environment that positions IBM, and therefore its customers and partners, in an ideal position to take advantage by their deployment.

We discuss the latest additions to the IBM/Cisco SAN family and we show how they can be implemented in an open systems environment, focusing on the Fibre Channel protocol (FCP) environment. We address some of the key concepts that they bring to the market, and in each case, we give an overview of those functions that are essential to building a robust SAN environment.

In other Redbooks publications we explore in greater depth the IBM SAN product family, Fibre Channel basics, and SAN design concepts. More information can be found in these Redbooks publications:

- *Introduction to Storage Area Networks*, SG24-5470
- *IBM TotalStorage: SAN Product, Design, and Optimization Guide*, SG24-6384
- *IBM/Cisco Multiprotocol Routing: An Introduction and Implementation*, SG24-7543

The team that wrote this book

This book was produced by a team of specialists from around the world working at the International Technical Support Organization, San Jose Center.

Figure 1 Authors (left to right): Jon, Jacek, and Mike

Jon Tate is a Project Manager for IBM System Storage™ SAN Solutions at the International Technical Support Organization, San Jose Center. Before joining the ITSO in 1999, he worked in the IBM Technical Support Center, providing Level 2 support for IBM storage products. Jon has 23 years of experience in storage software and management, services, and support, and is both an IBM Certified IT Specialist and an IBM SAN Certified Specialist. Jon also serves as the UK Chair of the Storage Networking Industry Association.

Michael Engelbrecht is a Senior IT Specialist in IBM Global Technical Services, ITS. He has worked with IBM for 27 years and for the last seven years he as worked for the Hardware Field Support team for South Africa and Africa. Before that he was a Networking Specialist with many years of networking experience and a large range of networking equipment, specializing in ATM and Frame relay. His is currently level 2 support and Product Manager for RMSS, as well as all

SAN switch products for South Africa and all African countries supported from South Africa.

Jacek Koman is an IT Architect for IBM Global Technology Services in Poland. Jacek has 10 years of experience in storage solutions. His areas of expertise include pSeries®, AIX®, HACMP™, virtualization, storage, SAN, and SVC. Jacek provides pre-sales support and technical services for clients throughout Poland. These have included consulting, solution designing and implementation, troubleshooting, performance monitoring, and system migration for a wide range of customers. He is an IBM Certified Specialist in a range of products as well as a Cisco Data Center Storage Networking Design Specialist.

Thanks to the following people for their contributions to this project:

Deanna Polm
Sangam Racherla
International Technical Support Organization, San Jose Center

Marci Nagel
IBM Storage Systems Group

Khalid Ansari
George DeBiasi
Brian Cartwright
Kerry Edwards
Sven Eichelbaum
Michael Engelbrecht
Steve Garraway
Joe Hew
Cameron Hildebran
Uwe Hofmann
Thomas Jahn
Jin Su Kim
Mark Kornakiewicz
Andy McManus
Jeannie Ostdiek
Pauli Ramo
Simon Richardson
Glen Routley
Marcus Thordal
Ricardo Trentin
Eric Wong
The previous authors of this book

John McKibben
Darshak Patel
Hui Chen
Cisco Systems

Become a published author

Join us for a two- to six-week residency program! Help write a book dealing with specific products or solutions, while getting hands-on experience with leading-edge technologies. You will have the opportunity to team with IBM technical professionals, Business Partners, and Clients.

Your efforts will help increase product acceptance and customer satisfaction. As a bonus, you will develop a network of contacts in IBM development labs, and increase your productivity and marketability.

Find out more about the residency program, browse the residency index, and apply online at:

ibm.com/redbooks/residencies.html

Comments welcome

Your comments are important to us!

We want our books to be as helpful as possible. Send us your comments about this book or other IBM Redbooks in one of the following ways:

- Use the online **Contact us** review Redbooks form found at:

  ibm.com/redbooks

- Send your comments in an e-mail to:

  redbooks@us.ibm.com

- Mail your comments to:

  IBM Corporation, International Technical Support Organization
  Dept. HYTD Mail Station P099
  2455 South Road
  Poughkeepsie, NY 12601-5400

1

Product introduction

In this chapter we describe the module, switches, and directors that IBM offers in its Cisco portfolio. We also include older generation equipment.

1.1 Product introduction

The MDS 9000 family provides midrange switches and enterprise directors. In the following sections we briefly describe the product lineup and each model, and then we present a summary, as in Table 1-2 on page 8 and Table 1-3 on page 14. Figure 1-1 shows MDS storage area network (SAN) switch product lineup.

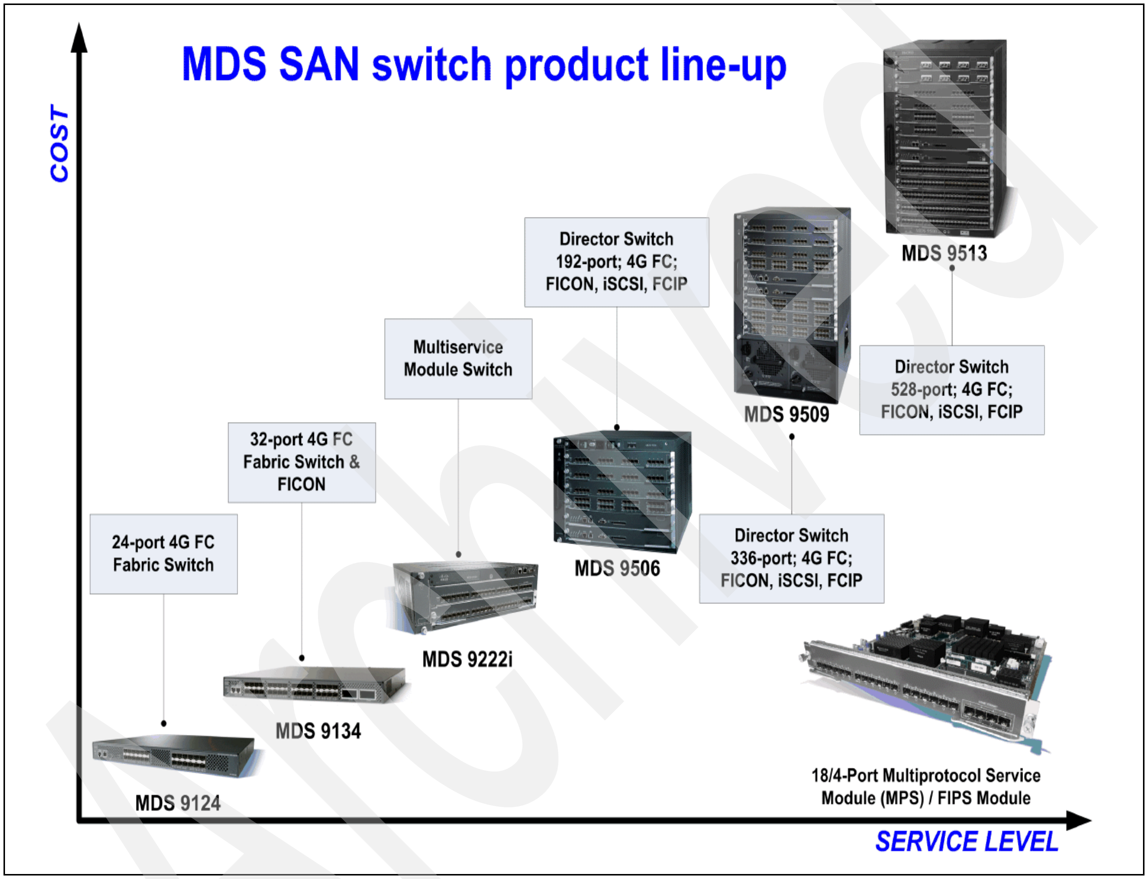

MDS SAN switch product line-up
COST
SERVICE LEVEL
24-port 4G FC Fabric Switch
MDS 9124
32-port 4G FC Fabric Switch & FICON
MDS 9134
Multiservice Module Switch
MDS 9222i
Director Switch 192-port; 4G FC; FICON, iSCSI, FCIP
MDS 9506
Director Switch 336-port; 4G FC; FICON, iSCSI, FCIP
MDS 9509
Director Switch 528-port; 4G FC; FICON, iSCSI, FCIP
MDS 9513
18/4-Port Multiprotocol Service Module (MPS) / FIPS Module

Figure 1-1 MDS SAN switch product lineup

The directors available from IBM and authorized IBM Business Partners are shown in Table 1-1.

Table 1-1 Cisco to IBM machine type cross reference

Cisco machine type	IBM machine type and model
9120	2061-020
9140	2061-040
9020	2061-420
9124	2053-424
9134	2053-434
9216	2062-D01
9216A	2062-D1A/2054-D1A
9216i	2062-D1H/2054-D1H
9222i	2054-E01
9506	2062-D04/2062-T04/2054-E04
9509	2062-D07/2062-T07/2054-E07
9513	2062-E11/2054-E11

Note: All the 2061 and 2062 products have been withdrawn from marketing but are shown here for reference only.

1.1.1 MDS 9020 Fabric Switch (non-modular)

This switch provides 4–20 ports and 4 Gbps fabric switching for open systems, and it is designed to address the requirements of small and medium-sized businesses with a wide range of SAN capabilities. It can be used as part of SAN solutions from simple single-switch configurations to larger multi-switch configurations to support simplification and advanced business continuity capabilities. Figure 1-2 shows the MDS 9020 Fabric Switch.

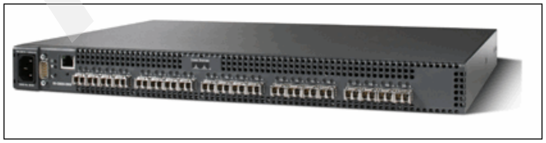


Figure 1-2 MDS 9020 Fabric switch

1.1.2 MDS 9120 Multilayer Fabric Switch (non-modular)

This switch provides 4–20 ports, 2 Gbps fabric switching for open systems, infrastructure simplification, and business continuity solutions. The base switch offers four target-optimized ports and 16 host-optimized ports, Virtual SAN (VSAN), and a Fabric Manager management functionality.

This switch is configured with dual redundant power supplies, either of which can supply power for the entire switch, and shares a common firmware architecture with the MDS 9500 Series of Multilayer Directors, making it an intelligent and flexible fabric switch. Figure 1-3 shows the MDS 9120 Multilayer Fabric Switch.

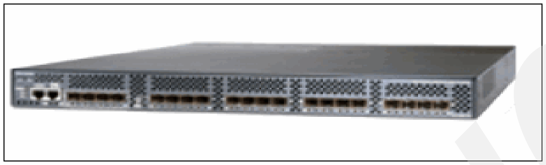


Figure 1-3 MDS 9120 Multilayer Fabric Switch (IBM 2061-020)

1.1.3 MDS 9140 Multilayer Fabric Switch (non-modular)

This switch provides 4–40 ports, 2 Gbps fabric switching for open systems, infrastructure simplification, and business continuity solutions. The base switch offers eight target-optimized ports and 32 host-optimized ports, Virtual SAN (VSAN), and a Fabric Manager management functionality.

This switch is configured with dual redundant power supplies, either of which can supply power for the entire switch, and shares a common firmware architecture with the MDS 9500 Series of Multilayer Directors, making it an intelligent and flexible fabric switch. Figure 1-4 shows the MDS 9140 Multilayer Fabric Switch.

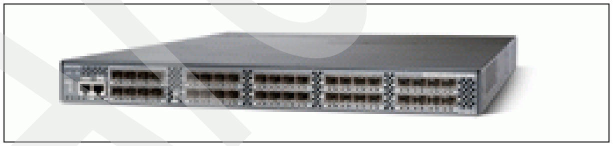


Figure 1-4 MDS 9140 Multilayer Fabric Switch (IBM 2061-040)

1.1.4 MDS 9124 Multilayer Fabric Switch (non-modular)

This switch provides 24 auto-sensing Fibre Channel ports capable of speeds of 4, 2, and 1 Gbps in a compact 1RU form-factor chassis and is designed to meet the performance and scalability requirements of the most demanding environments. The base MDS 9124 comes with eight ports activated, two redundant hot swappable power supplies, and eight shortwave SFPs. Enhanced flexibility of MDS 9124 is provided by the 9124 8-port activation license. Using this functionality, customers can start with a base configuration of eight ports and upgrade to 16 and 24 ports. Figure 1-5 shows the MDS 9124 Multilayer Fabric Switch.

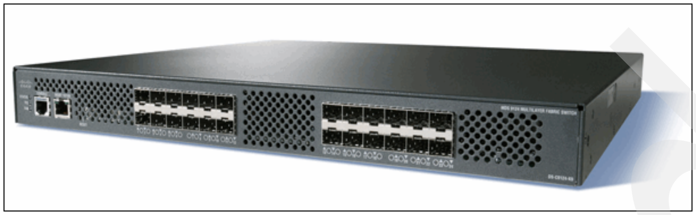


Figure 1-5 MDS 9124 Multilayer Fabric Switch (IBM 2053-424)

> **Note:** The MDS 9124 Multilayer switch supports N-Port identifier virtualization (NPV) to reduce the number of Fibre Channel domain IDs in SANs.

1.1.5 MDS 9134 Multilayer Fabric Switch (non-modular)

This switch provides 32 auto-sensing Fibre Channel ports capable of speeds of 4, 2, and 1 Gbps and two 10 Gbps ports. It offers flexible, on demand port activation. Through software licensing, ports can be activated in eight-port increments. The base MDS 9134 has 24 active ports. Optionally, eight more 4 Gbps or two 10 Gbps ports can be activated. The MDS 9134 can serve as the foundation for small, standalone SANs, as a top-of-the-rack switch, or as an edge switch in large core-edge SAN infrastructures. Figure 1-6 shows the MDS 9134 Multilayer Fabric Switch.

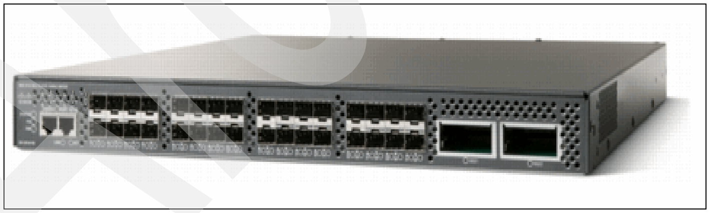


Figure 1-6 MDS 9134 Multilayer Fabric Switch (IBM 2053-434)

> **Note:** The MDS 9134 Multilayer Switch supports N-Port identifier virtualization (NPV) to reduce the number of Fibre Channel domain IDs in SANs.

1.1.6 MDS 9216(A/i) Multilayer Fabric Switch

This switch provides 16-port, 2 Gbps fabric switching for open systems, infrastructure simplification, and business continuity solutions.

The MDS 9216A switch is a three RU, 2-slot fabric switch that can support from 16 to 64 shortwave or long-wave SFP fiber optic transceivers. The chassis consists of two slots. The first slot contains the supervisor module. This provides the control and management functions for the MDS 9216A and includes 16 full capability 2 Gbps target-optimized Fibre Channel ports. It contains 2 GB of DRAM and has one internal CompactFlash card that provides 256 MB of storage for the firmware images. Figure 1-7 shows the MDS 9216A Multilayer Fabric Switch.

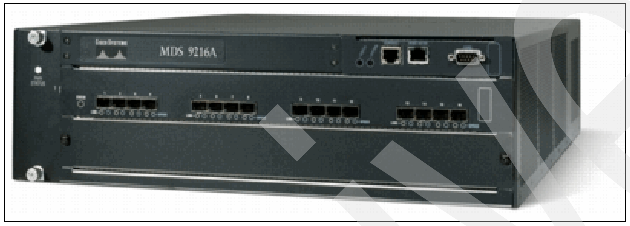


Figure 1-7 MDS 9216A Multilayer Fabric Switch (IBM 2062-D1A/2054-D1A)

The MDS 9216i uses the same backplane as the MDS 9216A. However, the MDS 9216i includes a fixed 14+2 supervisor module to provide 14 full capability 2 Gbps target-optimized Fibre Channel ports and two Gigabit Ethernet interfaces. The Gigabit Ethernet interfaces support iSCSI initiators connecting to Fibre Channel disk systems. The FCIP and IVR features are bundled with the MDS 9216i switch and do not require the Enterprise package. Figure 1-8 shows the MDS 9216i Multilayer Fabric Switch.

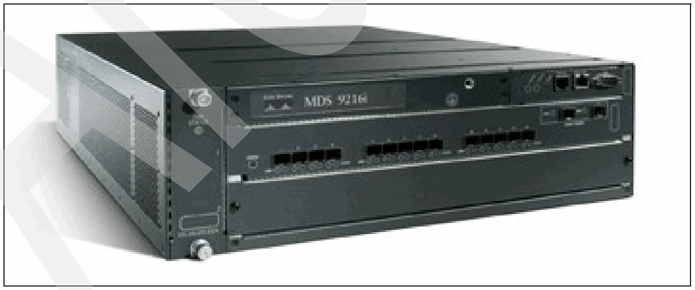


Figure 1-8 MDS 9216i Multilayer Fabric Switch (IBM 2062-D1H/2054-D1H)

The base switch offers 16 Fibre Channel ports (model A) or 14 Fibre Channel and 2-IP ports (model i), Virtual SAN (VSAN), and a Fabric Manager management functionality. Features include:

- 14 Fibre Channel and two IP ports
- 4-port and 8-port IPS Modules with iSCSI and FCIP capabilities
- 16-port and 32-port FC Switch Modules
- 32-port FC Switch Module with *host-optimized* ports
- Caching Services Module for IBM SAN Volume Controller Software
- Mainframe package for 16-port or 32-port FICON switching

1.1.7 MDS 9222i Multiservice Modular Switch

This Multiservice Modular Switch, the next generation of the highly flexible, industry-leading, proven MDS 9200 Series Multilayer Switches, is an optimized platform for deploying high-performance storage area network extension solutions, distributed intelligent fabric services, and cost-effective multiprotocol connectivity for both open and mainframe environments. With a compact form factor, modularity, and advanced capabilities normally available only on director-class switches, the MDS 9222i is an ideal solution for departmental and remote branch-office SANs.

Figure 1-9 shows the MDS 9222i Multiservice Modular Switch. This switch offers eighteen 4 Gbps Fibre Channel ports, 4-Gigabit Ethernet IP storage services ports, and a modular expansion slot to host MDS 9000 family switching and services modules.

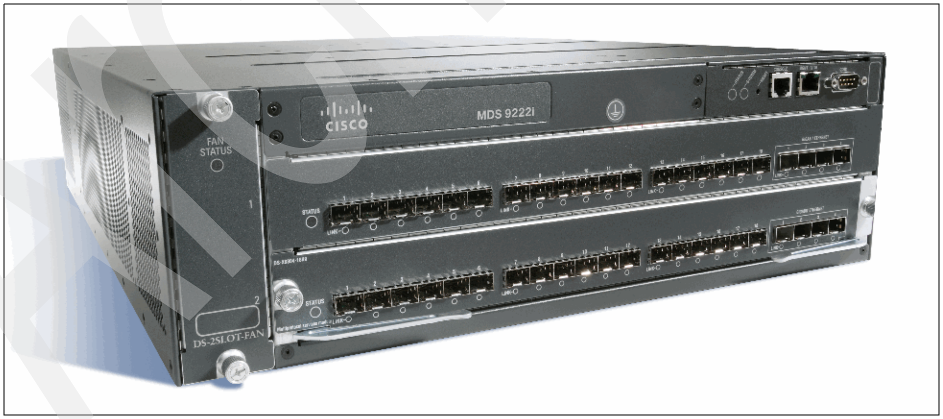


Figure 1-9 MDS 9222i Multiservice Modular Switch (IBM 2054-E01)

Table 1-2 shows the MDS 9000 family of switches.

Table 1-2 MDS 9000 family switches

Switch model	Slots available for switch modules (line cards)	Number of supervisor modules	Max number of FC ports
MDS 9020	NA (fixed configuration)		20
MDS 9120	NA (fixed configuration)		20
MDS 9140	NA (fixed configuration)		40
MDS 9124	NA (fixed configuration)		24
MDS 9134	NA (fixed configuration)		32 + 2(10G)
MDS 9216 (A/i)	1	1 (includes 16 FC ports or 14 + 2 GigE)	64 (or 62+2 GigE)
MDS 9222i	1	1 (includes 18 FC ports + 4 GigE)	66 (66 + 4 GigE)

Note: Throughout this chapter the term *switch* is used interchangeably for both Cisco MDS switches and directors.

1.1.8 MDS 9506 Multilayer Director

The MDS 9506 Multilayer Director is a 7 RU Fibre Channel director that can support from 12 to 192 shortwave or long-wave SFP fiber optic transceivers. It provides 1, 2, 4, and 8 Gbps Fibre Channel switch connectivity and intelligent network services to help improve the security, performance, and manageability required to consolidate geographically dispersed storage devices into a large enterprise SAN.

The chassis has six slots, two of which are reserved for dual, redundant Supervisor Modules. This director supports Supervisor-1 and Supervisor-2 modules. A Supervisor-2 Module combines an intelligent control module and a high-performance crossbar switch fabric in a single unit.

The MDS 9506 Multilayer Director requires a minimum of one and allows a maximum of four switching modules. Third-generation modules are available in 24-port and 48-port 1, 2, 4, and 8 Gbps configurations. Second-generation modules are available in 12-port, 24-port, and 48-port 1, 2, and 4 Gbps configurations.

First-generation modules are supported in this director and are available in 16-port and 32-port, 1 and 2 Gbps configurations. Optionally, a 4-port 10 Gbps Fibre Channel module is available for high-performance Inter-Switch Link (ISL) connections over metro optical networks. Figure 1-10 shows the MDS 9506 Multilayer Director.

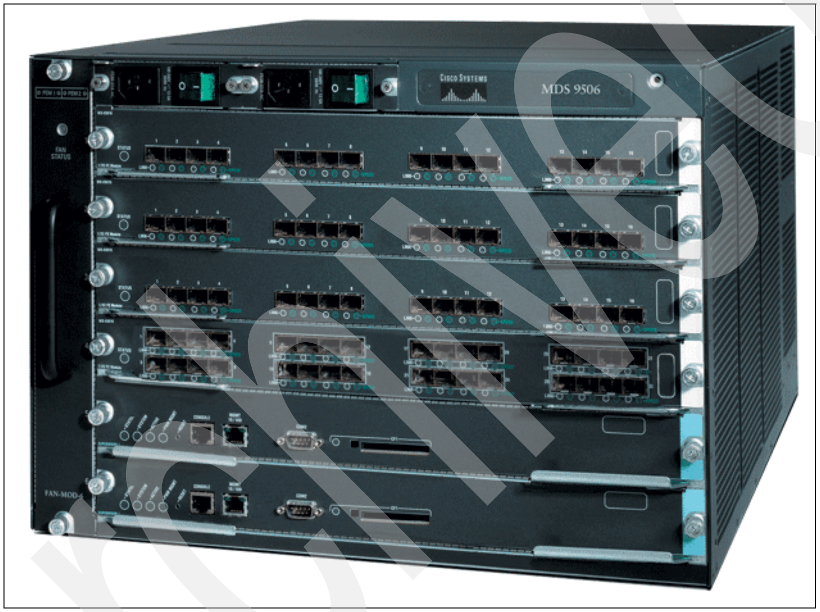


Figure 1-10 MDS 9506 Multilayer Director (IBM 2062-D04/T04 or IBM 2054-E04)

1.1.9 MDS 9509 Multilayer Director

The MDS 9509 Multilayer Director (IBM 2062-E07/T07 or IBM 2054-E07) is a 14 RU Fibre Channel director that can support from 12 to 336 shortwave or long-wave SFP fiber optic transceivers. It provides 1, 2, 4, and 8 Gbps Fibre Channel switch connectivity and intelligent network services to help improve the security, performance, and manageability required to consolidate geographically dispersed storage devices into a large enterprise SAN.

The chassis has nine slots, two of which are reserved for dual, redundant Supervisor Modules, and this director supports Supervisor-1 and Supervisor-2 modules. The Supervisor-2 module combines an intelligent control module and a high-performance crossbar switch fabric in a single unit. It uses Fabric Shortest Path First (FSPF) multipathing routing, which supports load balancing across a maximum of 16 equal-cost paths designed to dynamically reroute traffic if a switch fails.

The MDS 9509 Multilayer Director requires a minimum of one and allows a maximum of seven switching modules. Third-generation modules are available in 24-port and 48-port, 1, 2, 4, and 8 Gbps configurations. Second-generation modules are available in 12-port, 24-port, and 48-port, 1, 2, and 4 Gbps configurations.

First-generation modules are supported in this director and are available in 16-port and 32-port, 1 and 2 Gbps configurations. Optionally, a 4-port 10 Gbps Fibre Channel module is available for high-performance Inter-Switch Link connections over metro optical networks. Figure 1-11 shows the MDS 9509 Multilayer Director.

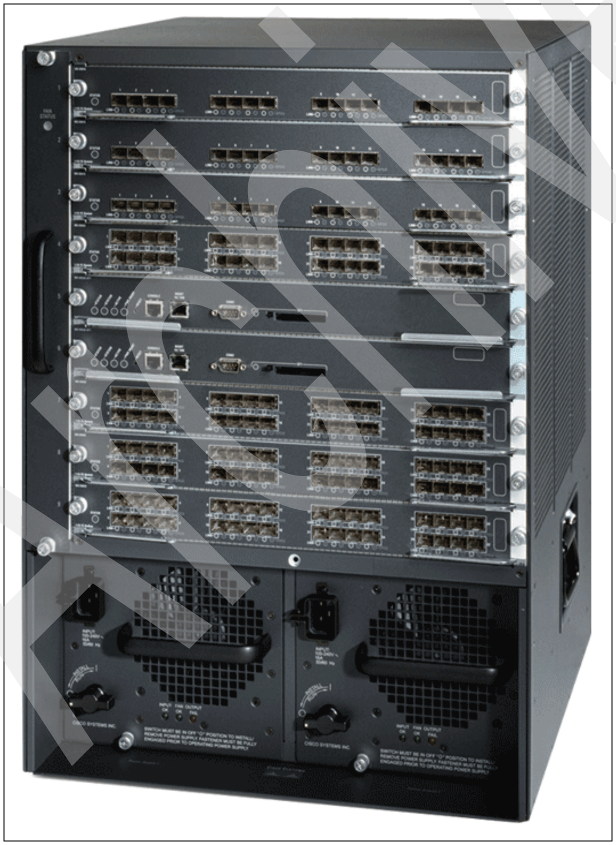


Figure 1-11 MDS 9509 Multilayer Director (IBM 2062-D045/T04 or IBM 2054-E07)

1.1.10 MDS 9513 Multilayer Director

The MDS 9513 Multilayer Director (IBM 2063-E11 or 2054-E11) is a 14 RU Fibre Channel director that can support 12 to 528 shortwave or long-wave SFP fiber optic transceivers, with 4 Gbps support and a high-availability design. It offers 4–44 10 Gbps ports for ISL connectivity across metro optical networks. The MDS 9513 Multilayer Director is designed to provide network security features for large enterprise SANs deployment and offers intelligent networking services to help simplify mainframe FICON and Fibre Channel SAN management and reduce total cost of ownership (TCO).

The MDS 9513 Multilayer Director combines increased scalability and performance, intelligent SAN services, nondisruptive software upgrades, stateful process restart and failover, and full redundant operation in director-class SAN switching.

The MDS 9513 Multilayer Director utilizes two Supervisor-2 modules designed to support high availability. Dual crossbar switching fabric modules provide a total internal switching bandwidth of 2.4 Tbps for inter-connection of up to eleven Fibre Channel switching modules. These modules are available in 12-port, 24-port, or 48-port 1, 2, and 4 Gbps configurations. Third-generation modules are available in 24-port and 48-port 1, 2, 4, and 8 Gbps configurations. Optionally, a 4-port 10 Gbps Fibre Channel module is available for high-performance Inter-Switch Link connections over metro optical networks. Figure 1-12 shows the MDS 9513 Multilayer Director.

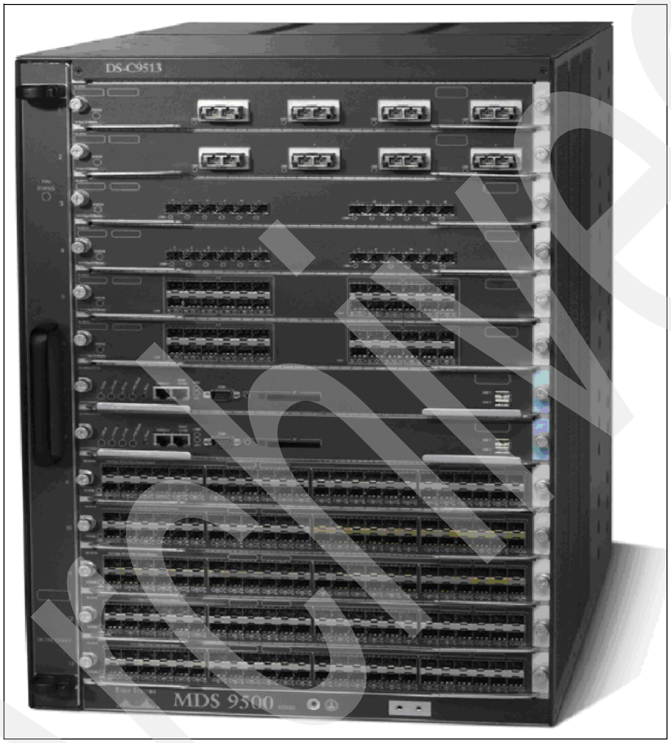


Figure 1-12 MDS 9513 Multilayer Director (IBM 2062-E11 or IBM 2054-E11)

The main features of the MDS 9513 Multilayer Director are:

- Third-generation switching modules for Cisco MDS 9513 Multilayer Director (IBM 2062-E11 or 2054-E11):
  - 24-port 1/2/4/8 Gbps Fibre Channel Switching module
  - 48-port 1/2/4/8 Gbps Fibre Channel Switching module
  - 4/44-port 1/2/3/8 Gbps Host-Optimized Fibre Channel Switching module

- Second-generation switching modules for MDS 9513 Multilayer Director (IBM 2062-E11 or 2054-E11):
  - 12-port 1/2/4 Gbps Fibre Channel Switching module
  - 24-port 1/2/4 Gbps Fibre Channel Switching module
  - 48-port 1/2/4 Gbps Fibre Channel Switching module
  - 4-port 10 Gbps Fibre Channel Switching module
- 1, 2, 4, and 10 Gbps Fibre Channel switching with full bandwidth redundancy delivers highly available Fibre Channel performance with fully redundant bandwidth. Each crossbar module offers full system bandwidth so that the loss or removal of a single crossbar module does not impact system performance. It ensures 100% system throughput even in the event of a crossbar failure.
- The MDS 9513 also supports the following first-generation MDS 9000 modules:
  - 16-port 2 Gbps Fibre Channel Line Card
  - 32-port 2 Gbps Fibre Channel Line Card
  - Storage Services Module
  - Multiprotocol Services Module
  - 8-port IP Services Line Card
- If first-generation modules are used in the MDS 9513 only 252 ports can be used.
- The multilayer (multiprotocol and multi-transport) architecture of the MDS 9000 family enables a consistent feature set over a protocol-agnostic switch fabric. The MDS 9513 chassis transparently integrates Fibre Channel, FICON, SCSI over IP (iSCSI), and Fibre Channel over IP (FCIP) in one system. The flexible architecture of the MDS 9000 family also allows for seamless integration of future storage protocols.
- Integrated support for VSAN technology:
  - Access control lists (ACLs) for hardware-based intelligent frame processing
  - Advanced traffic management features such as Fibre Channel Congestion Control (FCC)
  - Fabric-wide quality of service (QoS) to enable migration from SAN islands to enterprise-wide storage networks
- Integrated hardware-based Virtual SANs (VSANs) and inter-VSAN routing that enables deployment of large-scale, multi-site, heterogeneous SAN topologies. Integration into port-level hardware allows any port within a

system or fabric to be partitioned into any VSAN. Integrated hardware-based Inter-VSAN routing provides line-rate routing between any ports within a system or fabric without the necessity for external routing appliances.

- Advanced FICON services supporting 1, 2, and 4 Gbps FICON environments, including:
  - Cascaded FICON fabrics.
  - VSAN-enabled intermix of mainframe and open systems environments.
  - N_Port ID Virtualization for mainframe Linux® partitions.
  - CUP support enables in-band management of MDS 9000 family switches from the mainframe management console.

> **Note:** The MDS 9513 Director supports only Supervisor-2 modules. Supervisor-1 modules cannot be used and are hardware blocked.

Table 1-3 compares the hardware features within the MDS 95xx Series of Multilayer Directors.

Table 1-3 MDS 95xx hardware feature comparison

Feature	MDS 9506	MDS 9509	MDS 9513
Available slots	6	9	13
Available option slots	4	7	11
Redundant Supervisor	Yes	Yes	Yes
Max/Min 1/2/4 Gbps FC ports per chassis	192/16	336/16	528/12
Max 10 Gbps FC ports per chassis	16	28	44
Max iSCSI and FCIP ports per chassis	24	48	60
Rack units	7	14	14

1.1.11 Generation 1 and Generation 2 optional modules

The MDS 9200 and 9500 Families allow optional modules to provide additional port connectivity, IP services, or storage virtualization functionality into empty expansion slots. Refer to Table 1-3 for the available option slot availability on the switch.

Table 1-4 lists the hardware modules available and the chassis compatibility associated with them.

Table 1-4 MDS 9000 Modules and Platform Compatibility Matrix Generation Line Cards

Module	9513	9509	9506	9222i	9216A	9216i
Supervisor-2 module	X	X	X			
Supervisor-1 module		X	X			
48-port 4 Gbps Fibre Channel switching module	X	X	X	X	X	X
24-port 4 Gbps Fibre Channel switching module	X	X	X	X	X	X
12-port 4 Gbps Fibre Channel switching module	X	X	X	X	X	X
4-port 10 Gbps Fibre Channel switching module	X	X	X	X	X	X
32-port 1 Gbps/2 Gbps Fibre Channel module	X	X	X		X	X
16-port 1 Gbps/2 Gbps Fibre Channel module	X	X	X		X	X
8-port Gigabit Ethernet IP Storage Services module	X	X	X	X	X	X
4-port Gigabit Ethernet IP Storage Services module	X	X	X		X	X
32-port 1 Gbps/2 Gbps Fibre Channel Storage Services Module (SSM)	X	X	X	X	X	X
32-port Fibre Channel Advanced Services Module (ASM)		X	X		X	X
Caching Services Module (CSM)		X	X		X	X
18-port Fibre Channel and 4-port Gigabit Ethernet IP Services (MSM-18/4) module	X	X	X	X	X	X
18-port Fibre Channel and 4-port Gigabit Ethernet IP Services FIPS (MSFM-18/4) module	X	X	X	X	X	X
14-port Fibre Channel/2-port Gigabit Ethernet Multiprotocol Services (MPS-14/2) module	X	X	X		X	X

Note: Supervisor-1 and Supervisor-2 modules cannot be used in the same chassis. It is allowed only for migration from Supervisor-1 to Supervisor-2 for them to both be in the same chassis.

The 16-port Switching Module (feature code 2116)

The 16-port Switching Module provides up to 64 Gbps of continuous aggregate bandwidth. Autosensing 1 Gbps and 2 Gbps target-optimized ports deliver 200 MBps and 255 buffer credits per port.

Note: The 64 Gbps continuous aggregate bandwidth is based on 2 Gbps per port in full duplex mode. That is:

```
16 ports at 2 Gbps (or 213 MBps) in both directions = 64 Gbps
```

The 16-port module is designed for attaching high-performance servers and storage subsystems, and for connecting to other switches using ISL connections. This module also supports optional CWDM SFPs to provide aggregation of multiple links onto a single optical fiber through a passive optical mux. Figure 1-13 shows the 16-port First-Generation Switching Module for the MDS 9000 family.

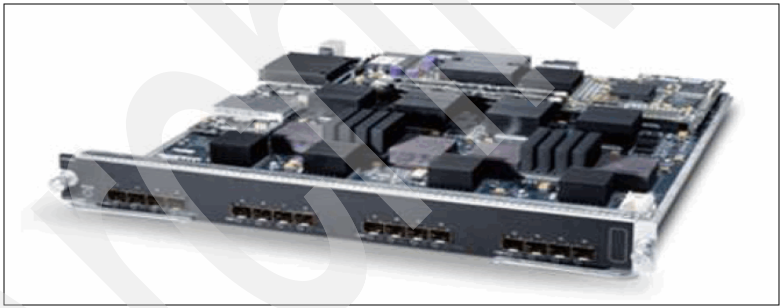


Figure 1-13 16-port Switching Module

The 32-port Switching Module (feature code 2132)

The 32-port Switching Module is designed to deliver an optimal balance of performance and port density. This module provides high line-card port density along with 64 Gbps of total bandwidth and 12 buffer-to-buffer credits per port. Bandwidth is allocated across eight 4-port groups, with each port group sharing 2.5 Gbps, making it an aggregate bandwidth of approximately 5 Gbps full-duplex. This module provides a low-cost means to attach lower performance servers and storage subsystems to high-performance crossbar switches without requiring ISLs.

By combining 16-port and 32-port Switching Modules in a single, modular chassis, administrators can configure price-optimized and performance-optimized storage networks for a wide range of application environments.

The 32-port Switching Module also supports optional CWDM SFPs to provide aggregation of multiple links onto a single optical fiber through a passive optical mux.

Switching modules are designed to be interchanged or shared between all MDS 9200 Switches and 9500 Directors. Figure 1-14 shows the 32-port First-Generation Switching Module for the MDS 9000 family.

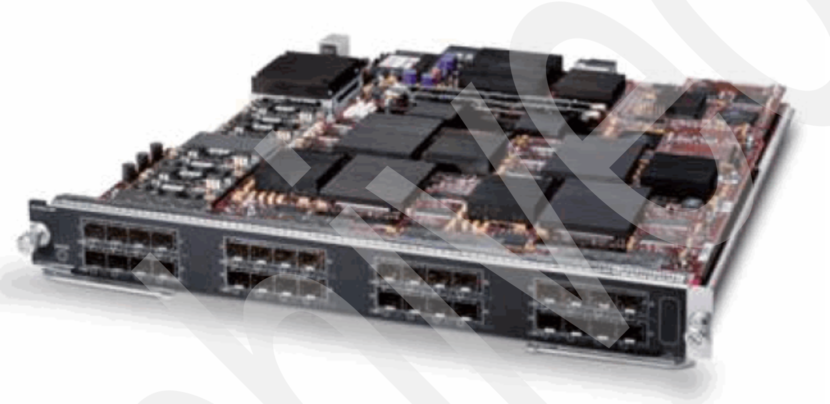


Figure 1-14 32-port Switching Module

The 8-port IP Services Module (feature code 2208)

The IP Services (IPS) Module provides eight Gigabit Ethernet ports that can support iSCSI and FCIP protocols simultaneously. Because the bit rate of Gigabit Ethernet is different from the bit rate of Fibre Channel, the card requires tri-rate SFPs. Figure 1-15 shows the 8-port IP Services Module.

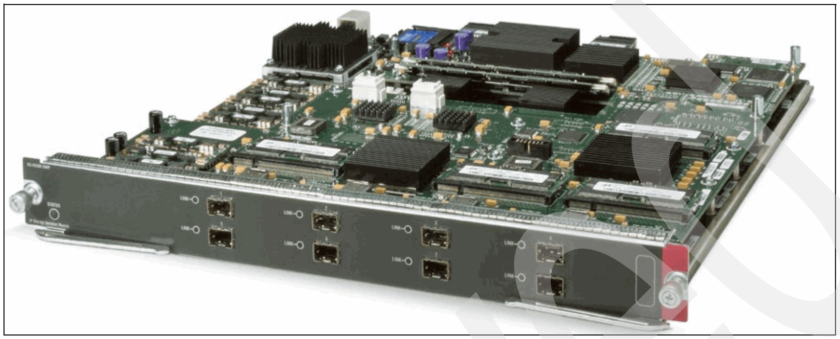


Figure 1-15 8-port IP Services Module

The MDS 9000 14+2 Multiprotocol Services Module (feature code 2214)

The MDS 9000 14+2 Multiprotocol Services Module is designed to provide 14 Fibre Channel ports and two IP storage interfaces. The 14 Fibre Channel ports are based around the same full rate target optimized ports as the 16-port module, providing all the same operating modes. In addition, the 14+2 card can be configured with high buffer credits on one Fibre Channel port to support longer distance FC-to-FC connections.

The two IP storage interfaces are similar to the IP Services Module, including hardware compression and security.

> **Restriction:** The two Ethernet ports on the 14+2 Multiprotocol Services Module *cannot* be combined into a single EtherChannel. However, PortChannel can be used.

Figure 1-16 shows the Cisco MDS 9000 14+2 Multiprotocol Services Module.

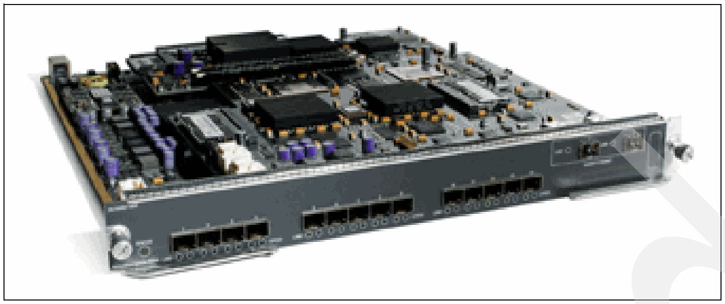


Figure 1-16   MDS 9000 14+2 Multiprotocol Services Module

This module also supports optional CWDM SFPs to provide aggregation of multiple links onto a single optical fiber through a passive optical mux.

> **Note:** Two Ethernet ports on the IPS modules *can* be combined into a single EtherChannel, but only between ports that share the same application-specific integrated circuit (ASIC). However, PortChannel can be used.

Ports configured to run FCIP

The ports configured for FCIP can support up to three virtual ISL connections (FCIP tunnels). This way a Fibre Channel traffic can be transported transparently, except for latency, over an IP network between two FCIP-capable switches. Each virtual ISL connection acts as a normal Fibre Channel ISL or extended ISL (EISL). Advanced functionality includes FCIP compression, FCIP write compression, and FCIP tape acceleration.

To use FCIP an activation for the FCIP 8-port IP Services Line Card feature is required for every 8-port IP line card that needs to support FCIP.

Ports configured to run iSCSI

Ports configured to run iSCSI work as a gateway between iSCSI hosts and Fibre Channel-attached targets. The module terminates iSCSI commands and issues new Fibre Channel commands to the targets.

The Fabric Manager is used to discover and display iSCSI hosts. These iSCSI hosts are bound to assigned worldwide names (WWNs) and create a static relationship that enables:

- Zoning of iSCSI initiators
- Accounting against iSCSI initiators
- Topology mapping of iSCSI initiators
- Fiver thousand simultaneous connections per switch/director

Storage Services Module (feature code 2400)

The Storage Services Module (SSM) is based on the 32-port Fibre Channel Switching Module and provides intelligent storage services in addition to 1 Gbps and 2 Gbps Fibre Channel switching. The SSM uses eight IBM PowerPC® processors for SCSI data-path processing. It can be combined with the optional MDS 9000 Enterprise package to enable Fibre Channel write acceleration (FC-WA).

FC-WA can help improve the performance of remote mirroring applications over extended distances by reducing the effect of transport latency when completing a SCSI operation over distance. This supports longer distances between primary and secondary data centers and can help improve disk replication performance.

The optional Storage Systems Enabler package bundle can enable independent software vendors (ISVs) to develop intelligent fabric applications that can be hosted on the SSM through an application programming interface (API).

ISVs can use the API to offer the following applications:

- Network-accelerated storage applications, such as serverless backup
- Network-assisted appliance-based storage applications using MDS 9000 SANTap Service, such as global data replication
- Network-hosted storage applications based on proposed Fabric Application Interface Standard (FAIS) APIs offered by ISVs

> **Note:** IBM support for these ISV applications is limited to IBM TotalStorage® Proven™ solutions. For the most current IBM TotalStorage Proven information, go to:
>
> http://www.ibm.com/storage/proven

Figure 1-17 shows the Storage Services Module.

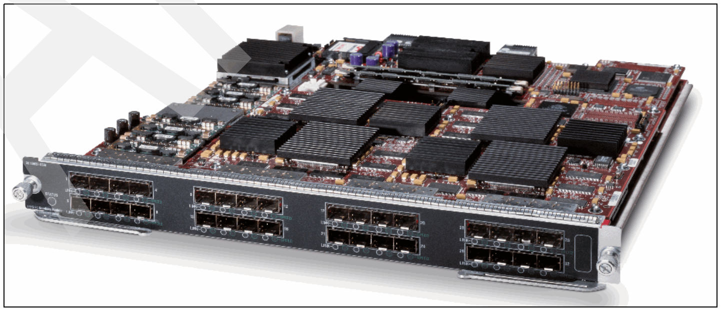


Figure 1-17 Storage Services Module

The 32-port Advanced Services Module

The Cisco MDS 9000 family 32-Port Fibre Channel Advanced Services Module enables pooling of heterogeneous storage for increased storage utilization, simplified storage management, and reducing total cost of storage ownership.

The Advanced Services Module incorporates all the capabilities of the Cisco MDS 9000 family 32-Port Fibre Channel Switching Module and also provides scalable, in-band storage virtualization services. Combining a highly distributed processing architecture and integrated VERITAS Storage Foundation for Networks software, the Cisco Advanced Services Module delivers virtualization performance, which can be scaled by simply adding modules anywhere in the fabric to meet the performance needs of even the largest enterprises.

The Cisco Advanced Services Module is available in a 32-port configuration and accepts 2 Gbps Fibre Channel small form-factor pluggable (SFP) optical modules as MDS 9000 family Fibre Channel switching modules. Figure 1-18 shows the 32-port Advanced Services Module.

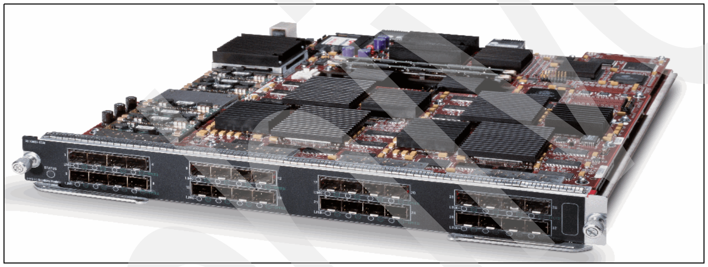


Figure 1-18 The 32-port Advanced Services Module

The 4-port 10 Gbps Switching Module (feature code 2404)

The MDS 9000 family 4-port 10 Gbps Fibre Channel Switching Module delivers uncompromising performance with 10 Gbps link bandwidth, 80 Gbps of continuous aggregate bandwidth per module, and the intelligence and advanced features required to make multilayer storage area networks a reality. The 4-port 10 Gbps Fibre Channel Switching Module includes hardware-enabled innovations designed to dramatically improve performance, scalability, security, and manageability of storage networks, resulting in increased utility and lower total cost of ownership (TCO). The 4-port 10 Gbps Fibre Channel Module is hot-swappable, and individual ports can be configured with shortwave or long-wave X2 optical transceivers for connectivity of up to 10 kilometers. Up to 250 buffer credits per port are supported for maximum extensibility without requiring additional licensing. Ultrahigh per-port bandwidth makes the 4-port 10 Gbps Fibre Channel Switching Module ideal for Inter-Switch Link (ISL) connectivity, both within the data center and between data centers across metro optical networks.

The 4-port 10 Gbps Fibre Channel Switching Model is compatible with all MDS 9500 Series Multilayer Directors, as well as MDS 9216A and MDS 9216i multilayer fabric switches, providing outstanding value and investment protection. Figure 1-19 shows a MDS 9000 family 4-port 10 Gbps Fibre Channel Switching Module.

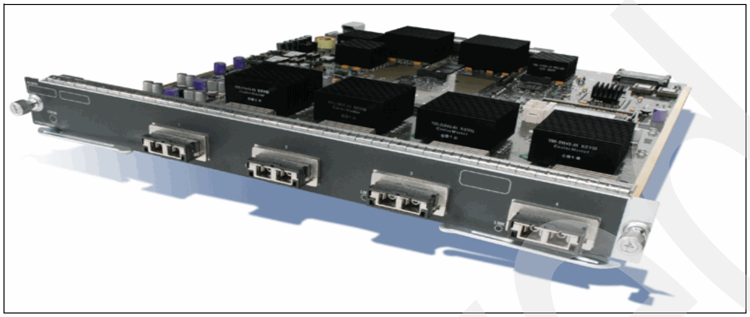


Figure 1-19 4-port 10 Gbps Switching Module

The 12-port 4 Gbps Switching Module (feature code 2412)

The 12-port 4 Gbps Switching Module is ideal for attachment to the highest performance 4 Gbps-enabled storage and for ISL connections. The 12-port 4 Gbps Switching Module can deliver up to 96 Gbps of full duplex bandwidth. Figure 1-20 shows the 12-port Switching Module.

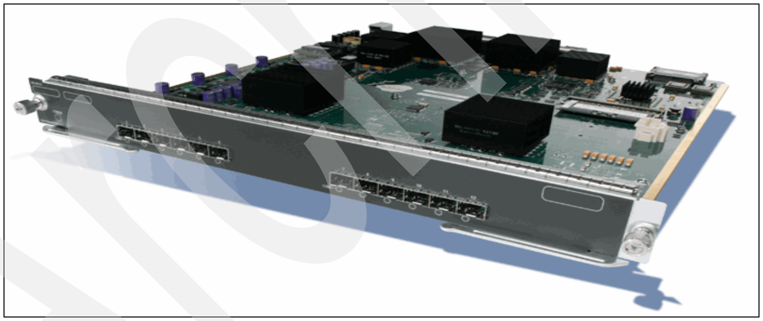


Figure 1-20 Twelve-port Switching Module

The 24-port 4 Gbps Switching Module (feature code 2424)

The 24-port 4 Gbps Switching Module delivers an ideal balance of performance and scalability. The twenty-four 4 Gbps ports deliver up to 96 Gbps of full duplex bandwidth. Bandwidth is allocated across four 6-port port groups, providing 24 Gbps of full-duplex bandwidth per port group. Port bandwidth reservation enables switching bandwidth to be dedicated to a port, providing flexibility to optimize high-demand ports such as ISLs. Figure 1-21 shows the 24-port Switching Module.

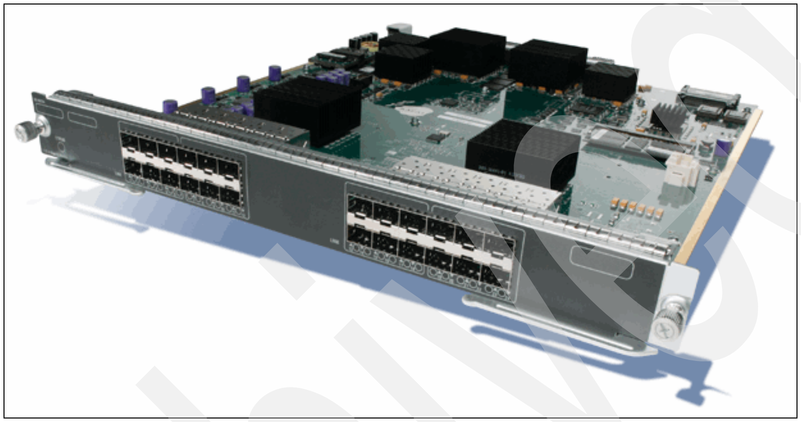


Figure 1-21 Twenty-four-port 4 Gbps Switching Module

The 48-port 4 Gbps Switching Module (feature code 2448)

The 48-port 4 Gbps Switching Module delivers up to 96 Gbps of total bandwidth. Bandwidth is allocated across four 12-port port groups, providing 24 Gbps bandwidth per port group. Port bandwidth reservation enables switching bandwidth to be dedicated to a port, providing flexibility to optimize high-demand ports such as ISLs. Figure 1-22 shows the 48-port 4 Gbps Switching Module.

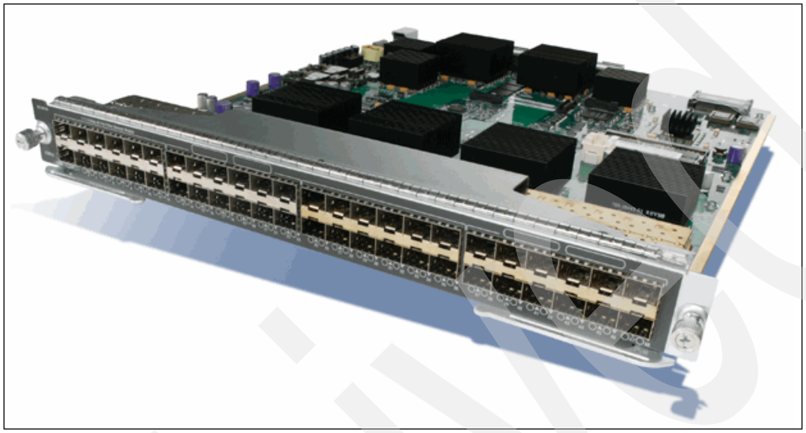


Figure 1-22 Forty-eight-port 4 Gbps Switching Module

The MDS 9000 18+4 Multiservice Module (feature code 2450)

The MDS 18+4 Multiservice Module offers eighteen 4 Gbps Fibre Channel ports and four Gigabit Ethernet IP storage services ports. It is supported in the MDS 9200 Series Switches and MDS 9500 Series Directors.

The MDS 18+4 Multiservice Module provides multiprotocol capabilities integrating, in a single-form-factor Fibre Channel:

- Fibre Channel over IP (FCIP)
- Small Computer System Interface over IP (iSCSI)
- IBM Fiber Connectivity (FICON)
- FICON Control Unit Port (CUP) management
- Switch cascading

It uses knowledge of IP networks to deliver outstanding SAN extension performance, minimizing latency for disk and tape with FCIP acceleration features including FCIP write acceleration and FCIP tape write and read acceleration. Figure 1-23 shows the MDS 9000 18+4 Multiservice Module.

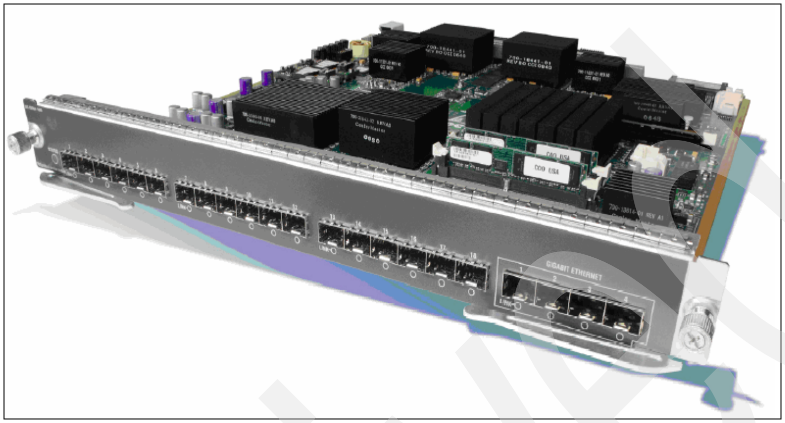


Figure 1-23 MDS 9000 18+4 Multiservice Module

The MDS 9000 18+4 Multiservice FIPS Module

The Cisco MDS 9000 family 18/4-Port Multiservice Federal Information Processing Standards (FIPS) Module, a FIPS 140-2 Level 3 compliant version of the Cisco MDS 9000 family 18/4-Port Multiservice Module, is offered to provide added security to meet regulatory and industry requirements. FIPS Level 3 certification requires enhanced physical security, including a hard, opaque potting material to deter unauthorized access and tampering. Figure 1-24 shows the MDS 9000 18+4 Multiservice FIPS Module.

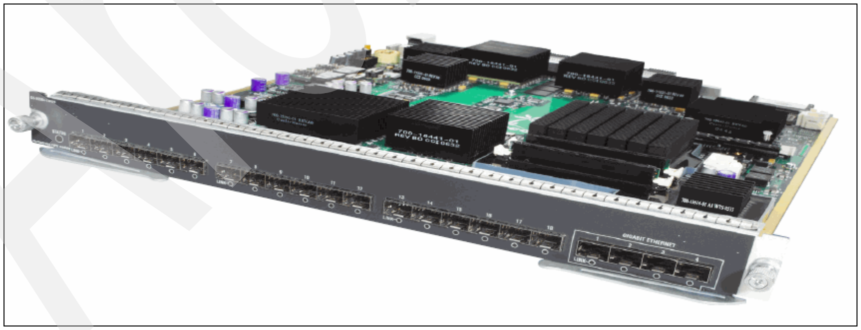


Figure 1-24 MDS 9000 18+4 Multiservice FIPS Module

Buffer credits

Buffer credits affect the number of input/outputs (I/Os) that can be sent before an acknowledgement is received. In extended Fibre Channel networks, you need more buffer credits to keep the *pipe* filled because the latency has increased.

Each target-optimized port supports 255 buffer credits, and host-optimized ports support 12 buffer credits per port. On the 14+2 line card, up to 3,500 buffer credits can be assigned to a single port if you are willing to sacrifice buffers on other ports and shut down three ports on the quad controlled by that ASIC. A maximum of 1500 buffer credits can be configured if the additional three ports are left enabled.

1.1.12 Generation 3 optional modules

Cisco now offers new Generation 3 line cards based on 8G technology.

Note: Generation 3 cards can work only with Supervisor-2 modules, and the NX-OS firmware version 4.x is required.

New Gen3 cards work with all MDS 9500 Multilayer Directors and with MDS 9222i switches, as shown in Table 1-5.

Table 1-5 Generation 3 line cards

Module	9513	9509	9506	922i	9216A	9216i
48-port 8 Gbps Fibre Channel switching module	X	X	X			
24-port 8 Gbps Fibre Channel switching module	X	X	X			
44/4-port 8 Gbps Host-Optimized Fibre Channel switching module	X	X	X	X		

The allowed configurations for the Generation 3 line cards are:

- 24-port 8 Gbps Fibre Channel Switching Module (96 Gbps total). This module has eight port groups and each port group has three ports:
  - One dedicated 8 Gbps plus two shared 8 Gbps (4:1).
  - One dedicated 8 Gbps plus one dedicated 4 Gbps plus one shared 8 Gbps (10:1).
  - Two dedicated 4 Gbps plus one shared 8 Gbps (with 2:1 oversubscription).
  - Three dedicated 4 Gbps.

  - Three shared 8 Gbps (with 2:1 oversubscription). This is the default setup.

- 48-port 8 Gbps Fibre Channel Switching Module (96 Gbps). This module has eight port groups and each port group has six ports:
  - One dedicated 8 Gbps plus five shared 8 Gbps (10:1).
  - Two dedicated 4 Gbps plus four shared 4 Gbps (with 4:1 oversubscription).
  - One dedicated 4 Gbps plus three dedicated 2 Gbps plus two shared 4 Gbps (with 4:1 oversubscription).
  - Six dedicated 2 Gbps.
  - Six shared 8 Gbps (with 4:1 oversubscription). This is the default setup.
- 4/44-port 8 Gbps Host-Optimized Fibre Channel Switching Module (48 Gbps). This module has four port groups and each port group has 12 ports:
  - One dedicated 8 Gbps plus 11 shared 4 Gbps (with 10:1 oversubscription).
  - One dedicated 4 Gbps plus three dedicated 2 Gbps plus two shared 4 Gbps (with 2:1 oversubscription).
  - Twelve dedicated 1 Gbps.
  - Twelve shared 4 Gbps (with 5:1 oversubscription). This is the default setup.

1.1.13 Management tools

For switch and fabric management of the MDS 9000 family, both a command-line interface (CLI) and a graphical user interface (GUI) are available. The CLI uses Telnet, SSH, or a serial console, while the GUI-based Fabric Manager toolset uses SNMP when accessing the switches.

Fabric Manager 3.x

Fabric Manager is a network management toolset, using SNMPv3 (SNMP Versions 1 and 2 are also supported) when communicating with the MDS 9000 family switches (and third-party switches), providing a GUI to manage and perform real-time monitoring.

The toolset consists of the following components:

- Fabric Manager Server

  The Fabric Manager Server is the server component of the toolset and must be started prior to using Fabric Manager. When launching the GUI for the first time, the Fabric Manager Server is installed as a service on Windows® (daemon on Linux or Solaris™).

- Device Manager

  The Device Manager is a switch-embedded Java™ application that is installed (and updated automatically) by Java Web start. While the Device Manager is somewhat complimentary to the Fabric Manager, the difference is that with Device Manager you manage a single switch, whereas with Fabric Manager you can manage multiple switches.

- Fabric Manager Client

  The Fabric Manager Client is a switch-embedded Java application that is installed (and updated automatically) by Java Web start. With the Fabric Manager, switch and fabric configurations are performed.

- Performance Manager

  Performance Manager is used for historic network device statistics collection and graphical presentation (in a Web browser), presenting recent statistics in detail and older statistics in summary. Performance Manager is set up using a configuration wizard.

Fabric Manager 4.x

The new version of Fabric Manager 4.x will be released along with a new version of the MDS operating system NX-OS 4.x. All features will be available in the Cisco MDS NX-OS 4.x and SAN-OS Release 3.x.

Table 1-6 shows the new and changed features of Fabric Manager for SAN-OS 3.x and NX-OS 4.x.

Table 1-6 Features of the Fabric Manager 4.x for SAN-OS 3.x and NX-OS 4.x.

Feature	Description	Changed in Release
Supported platforms Information and FM Express Install	The server platforms supported for Cisco Fabric Manager have been revised.	4.1.(X)
Inventory Report Enhancements	The FMS inventory switch detail report has been enhanced to include a number of summary statistics useful for creating a more comprehensive SAN health report.	4.1.(X)
Server Admin Tool	The Server Admin perspective view limits the scope of Fabric Manager to Flex Attach configuration and relevant data.	4.1.(X)
DPVM Wizard	New pages added.	4.1.(X)
Flex Attach Configuration by Server Administrators	Procedures to use the Flex Attach wizards for pre-configuring all or selected ports, moving a server to a different port or switch, and replacing a server in the same or a different port or switch.	4.1.(X)

Feature	Description	Changed in Release
IP Static Peers for CFS over IP	Added IP static peers configuration steps for CFS distribution over IP.	4.1.(X)
Generation 3 48-Port, 24-Port, and 4/44-Port 8 Gbps Fibre Channel modules configuration	Added configuration guidelines that include port groups, port rate modes, BB_credit buffer allocation, port speed configuration, over subscription ratio restrictions, combining with earlier generation modules, upgrade and downgrade considerations, cross bar management, port channel interface configuration, example configurations, and default settings.	4.1.(X)
Call Home	Added the delayed traps enhancements.	4.1.(X)
Performance Manager	Added the flow creation wizard for performance manager.	4.1.(X)

Cisco Fabric Manager 4.x has been tested with the following software:

- Operating systems
  - Windows 2003 SP2, Windows XP SP2, Windows XP SP3, Windows Vista® SP1 (Enterprise edition)
  - Red Hat Enterprise Linux AS Release 4
  - Solaris (SPARC) 8, 9 and 10
  - VMWare ESX Server 3.5
- Java
  - Sun™ JRE™ and JDK™ 1.5(x) and 1.6(x) supported
  - Java Web Start 1.5 and 1.6
- Browsers
  - Internet Explorer® 6.x and 7.0
  - Firefox 1.5 and 2.0
  - Mozilla 1.7 (packaged with Solaris 9)
- Databases
  - Oracle® Database 10g Express, Oracle Enterprise Edition 10g
  - PostgreSQL 8.2 (Windows and Red Hat Enterprise Linux AS Release 4)
  - PostgreSQL 8.1 (Solaris 8, 9 and 10)

- Security
  - Cisco ACS 3.1 and 4.0
  - PIX Firewall
  - IP tables
  - SSH v2
  - Global Enforce SNMP Privacy Encryption
  - HTTPS

Note: Internet Explorer 7.0 is not supported on Windows 2000 SP4.

Minimum hardware requirements for Fabric Manager 4.x

For a PC running Fabric Manager Server on large fabrics (1,000 or more end devices), we recommend using a dual core/dual CPU high-speed system with 2 GB of RAM and 10 GB of free disk space.

CLI

From the CLI interface we can perform fabric and switch management, while the CLI parser provides both command help and command completion. The keyboard sequence stores previously used commands in the buffer history. Performing ongoing fabric and switch management using the GUI is somewhat more intuitive, and most switch commands are available, though when it comes to troubleshooting, comparably the CLI is a more powerful interface.

Licensing

The licensing model for the MDS 9000 family consists of two options:

- Feature-based licensing, which implies a per-switch cost, for features that apply to the entire switch
- Module-based licensing for features that require a specific hardware module such as the IPS module

The standard license package, which is included with every MDS 9000 family switch (base configuration) includes standard SAN software features, while some advanced features are add-on options bundled in the following license packages and must be acquired separately:

- Enterprise Package (ENTERPRISE_PKG)

  This package mainly consists of two types of advanced features:

  - Advanced Traffic engineering features, which are:
    - Inter-VSAN routing (IVR)
    - Quality of service (QoS)
    - Extended credits
    - Fibre Channel write acceleration and SCSI Flow statistics at LUN level (only available on SSM an ASM)
  - Enhanced Network Security Features, which are:
    - Fibre Channel Security Protocol (FC-SP) providing switch-to-switch and switch-to-host authentication
    - Diffie-Hellman Challenge Handshake Authentication Protocol (DH-CHAP), which can be combined with RADIUS or TACACS+ for remote authentication
    - Hardware-enforced LUN zoning
    - Read-only zones
    - Port Security, mapping a specific device to be the only one able to access the fabric on a given port
    - VSAN-based access control
    - IPsec, available for both FCIP and iSCSI

  The license is acquired on a per-switch basis, though some features require that all switches in the fabric have the license package.

- SAN Extension over IP Package (SAN_EXTN_OVER_IP)

  This package enables integrated Fibre Channel Interface Protocol (FCIP) and must be acquired on a per-module basis. IVR for FCIP is also included with this license.

- Mainframe Package (MAINFRAME_PKG)

  This package enables IBM Fibre Connection (FICON) support and must be acquired on a per-switch basis.

- Fabric Manager Server Package (FMSERVER_PKG)

  This package extends the standard Fabric Manager toolset, providing historical performance monitoring, centralized management services, and advanced application integration. This package is acquired on a per-switch basis.

- MDS9000 Storage Service Enabler Package

  This package is currently not sold by IBM and is not discussed further.

> **Note:** For a complete list of features within each license package, see the respective license package fact sheets:
>
> `http://www.cisco.com/en/US/products/hw/ps4159/ps4358/products_data_sheets_list.html`

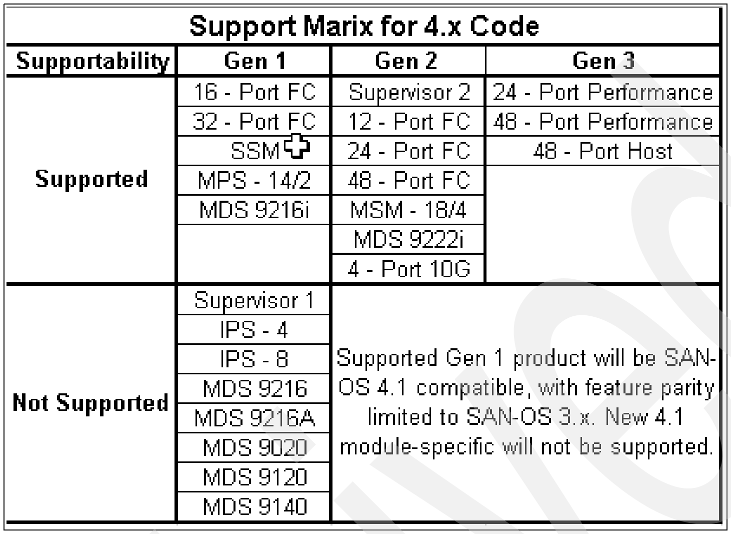
When buying the MDS 9000 family switch, the standard license package is always included. To see which other licenses are available with a specific switch type, refer to Table 1-7.

Table 1-7 MDS 9000 family licensing options

Switch model	ENTERPRISE	SAN_EXTN_OVER_IP	FMSERVER	MAINFRAME
MDS 9020	Optional	N/A	Optional	N/A
MDS 9120	Optional	N/A	Optional	N/A
MDS 9124	Optional	N/A	Optional	N/A
MDS 9134	Optional	N/A	Optional	Optional
MDS 9140	Optional	N/A	Optional	N/A
MDS 9216 (A/i)	Optional	Optional for 9216a	Optional	Optional
MDS 9222i	Optional	Optional	Optional	Optional
MDS 9506	Optional	Optional	Optional	Optional
MDS 9509	Optional	Optional	Optional	Optional
MDS 9513	Optional	Optional	Optional	Optional

1.1.14 Support matrixes for the SAN-OS 3.x and NX-OS 4.x

In Figure 1-25 we show the support matrix for NX-OS 4.x code.

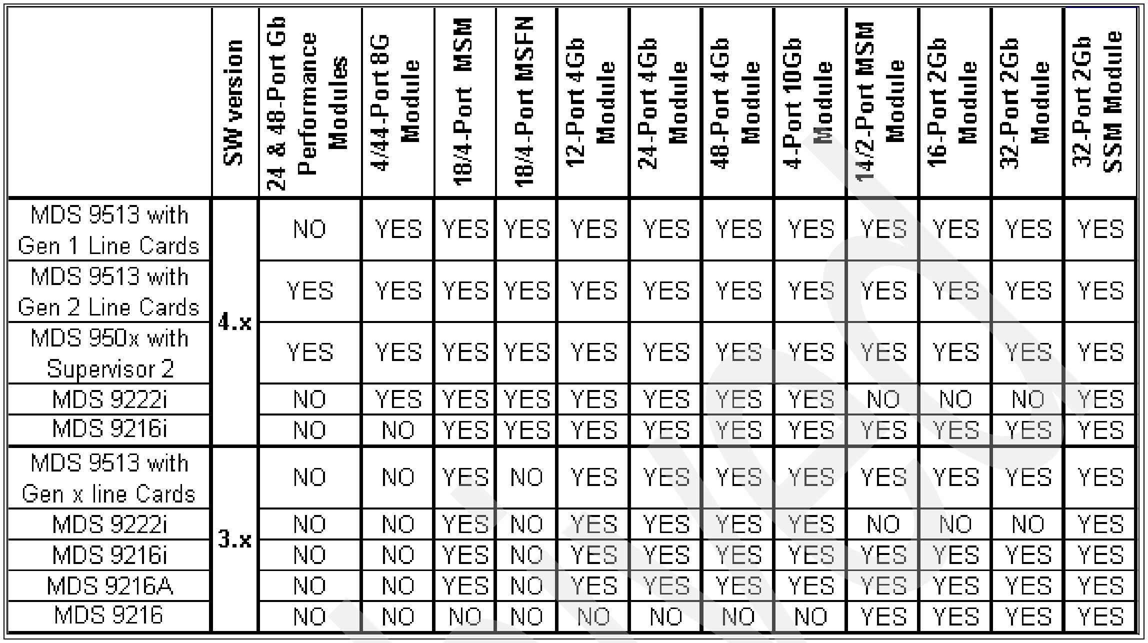


Support Marix for 4.x Code

Supportability	Gen 1	Gen 2	Gen 3
Supported	16 - Port FC	Supervisor 2	24 - Port Performance
	32 - Port FC	12 - Port FC	48 - Port Performance
	SSM	24 - Port FC	48 - Port Host
	MPS - 14/2	48 - Port FC	
	MDS 9216i	MSM - 18/4	
		MDS 9222i	
		4 - Port 10G	
Not Supported	Supervisor 1	Supported Gen 1 product will be SAN-OS 4.1 compatible, with feature parity limited to SAN-OS 3.x. New 4.1 module-specific will not be supported.	
	IPS - 4		
	IPS - 8		
	MDS 9216		
	MDS 9216A		
	MDS 9020		
	MDS 9120		
	MDS 9140		

Figure 1-25 Support matrix for NX-OS 4.x code

In Figure 1-26 we show the support matrix for SAN-OS 3.x and NX-OS 4.x code.



	SW version	24 & 48-Port Gb Performance Modules	4/44-Port 8G Module	18/4-Port MSM	18/4-Port MSFN	12-Port 4Gb Module	24-Port 4Gb Module	48-Port 4Gb Module	4-Port 10Gb Module	14/2-Port MSM Module	16-Port 2Gb Module	32-Port 2Gb Module	32-Port 2Gb SSM Module
MDS 9513 with Gen 1 Line Cards	4.x	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
MDS 9513 with Gen 2 Line Cards		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
MDS 950x with Supervisor 2		YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
MDS 9222i		NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	YES
MDS 9216i		NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
MDS 9513 with Gen x line Cards	3.x	NO	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
MDS 9222i		NO	NO	YES	NO	YES	YES	YES	YES	NO	NO	NO	YES
MDS 9216i		NO	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
MDS 9216A		NO	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
MDS 9216		NO	NO	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES

Figure 1-26 Support matrix for SAN-OS 3.x and NX-OS 4.x code

2

Ports and modules

In this chapter we discuss the Cisco port modes in MDS directors and switches.

2.1 Port addressing and port modes

The Fibre Channel ports in the Cisco MDS 9000 family are numbered with addresses in the form of fc<slot>/<port>, where <slot> is the slot number of the line card (1–9) and <port> is the port number on the line card (1–32). For example, the first port of the line card in slot 1 is fc1/1, and the seventh port of the line card in slot 3 is fc3/7.

2.1.1 Fibre Channel IDs and persistent FCIDs

Contrary to other switch manufacturers, with the Cisco MDS 9000 family there is no fixed correlation between physical Fibre Channel ports and Fibre Channel IDs (FCID). This is necessary to allow intermixing of line cards with different numbers of ports, while being able to utilize all port addresses, to allow both fabric and loop devices to coexist, and also to allow switches larger than 256 ports.

The primary reason for persistent FCIDs is to enable customers to move devices within a switch without having to rebind the disk. This could be used in the case of a linecard or SFP failure, for example.

The following considerations apply to the FCID assignment for any VSAN:

- When an N_Port or NL_Port logs into the switch, it is assigned an FCID.
- N_Ports receive the same FCID if disconnected and reconnected to any port within the same switch, and within the same VSAN.
- NL_Ports receive the same FCID only if reconnected to the same port within the same switch where the port was originally connected.

If the persistent FCIDs feature is not enabled for a VSAN, the following considerations apply:

- The WWN of the N_Port or NL_Port and the assigned FCID are stored in a volatile cache, and are not saved across switch reboots.
- The switch preserves the binding of FCID to WWN on a best-effort basis.
- The volatile cache has room for a maximum of 4,000 entries, and if the cache gets full, the oldest entries are overwritten.

If the persistent FCID feature is enabled for a VSAN, the following considerations apply:

- The FCID-to-WWN mapping of the WWNs currently in use is stored to a nonvolatile database and is saved across reboots.
- The FCID-to-WWN mapping of any new device connected to the switch is automatically stored in the non-volatile database.
- You can manually configure the FCID-to-WWN mappings if necessary.

> **Note:** If you attach AIX or HP-UX hosts to a VSAN, you must have persistent FCIDs enabled for that VSAN. This is because these operating systems use the FCIDs in device addressing. If the FCID of a device changes, the operating system considers it to be a new device, and gives it a new name.
>
> In general, we recommend enabling persistent FCIDs for your VSANs unless you have specific requirements that do not comply with persistent FCIDs. Example 2-1 shows persistent FCID enabled for VSAN 10.

Example 2-1 Persistent FCID enabled for VSAN 10

```
mds9222i-1# show fcdomain vsan 10
The local switch is the Principal Switch.

Local switch run time information:
        State: Stable
        Local switch WWN:    20:0a:00:0d:ec:82:3d:01
        Running fabric name: 20:0a:00:0d:ec:82:3d:01
        Running priority: 10
        Current domain ID: 0x0a(10)

Local switch configuration information:
        State: Enabled
        FCID persistence: Enabled
        Auto-reconfiguration: Disabled
        Contiguous-allocation: Disabled
        Configured fabric name: 20:01:00:05:30:00:28:df
        Optimize Mode: Disabled
        Configured priority: 10
        Configured domain ID: 0x0a(10) (static)

Principal switch run time information:
        Running priority: 10
```

2.1.2 Port operational modes

The Fibre Channel ports in the Cisco MDS 9000 family can operate in several modes. The operational modes are described in Table 2-1.

Table 2-1 Fibre Channel port operational modes

Mode	Description
E_Port	An expansion port (E_Port) interconnects two Fibre Channel switches, forming an ISL between an E_Port in each switch. The ISL belongs to a single VSAN and can also be connected to third-party switches.
F_Port	A fabric port (F_Port) connects the switch to a N_Port in a host or storage device using a point-to-point link. Only one N_Port can connect to the F_Port.
FL_Port	A fabric loop port (FL_Port) connects the switch to a public FC-AL loop. Only one FL_Port can be operational in a single FC-AL loop at any given time.
TE_Port	A trunking E_Port (TE_Port) interconnects two Fibre Channel switches, forming an extended ISL (EISL) between a TE_Port in each switch. The EISL can multiplex the traffic of several VSANs. The EISL is currently only available in the Cisco MDS 9000 family of switches.
TL_Port	A translative loop port (TL_Port) connects the switch to a private FC-AL loop.
B_Port	A bridge port (B_Port) is used to connect some SAN extender devices to the switch, instead of E_Port.
Fx_Port	A Fx_Port can operate as either F_Port or FL_Port, depending on the device connected to it. The port mode is determined during interface initialization.
Auto	A port configured as auto can operate as E_Port, F_Port, FL_Port, or TE_Port, depending on the device connected to it. The port mode is determined during interface initialization.

Mode	Description
SD_Port	A SPAN destination port (SD_Port) acts as a snooper port, allowing the monitoring of the switch traffic with a standard Fibre Channel analyzer. In SPAN destination port (SD port) mode, an interface functions as a switched port analyzer (SPAN).The SPAN feature is specific to switches in the Cisco MDS 9000 family. It monitors network traffic that passes though a Fibre Channel interface. This monitoring is done using a standard Fibre Channel analyzer (or a similar switch probe) that is attached to an SD port. SD ports do not receive frames. They merely transmit a copy of the source traffic. The SPAN feature is non-intrusive and does not affect switching of network traffic for any SPAN source ports
ST_Port	In the SPAN tunnel port (ST port) mode, an interface functions as an entry point port in the source switch for the RSPAN Fibre Channel tunnel. The ST port mode and the remote SPAN (RSPAN) feature are specific to switches in the Cisco MDS 9000 family. When configured in ST port mode, the interface cannot be attached to any device, and thus cannot be used for normal Fibre Channel traffic.
NP_Port	An NP port is a port on a device that is in NPV mode and connected to the core switch via an F port. NP ports behave like N ports except that in addition to providing N port behavior, they also function as proxies for multiple physical N ports.

Figure 2-1 shows an example of the port types that are available with the Cisco MDS 9000 family of products (ST_Port not shown).

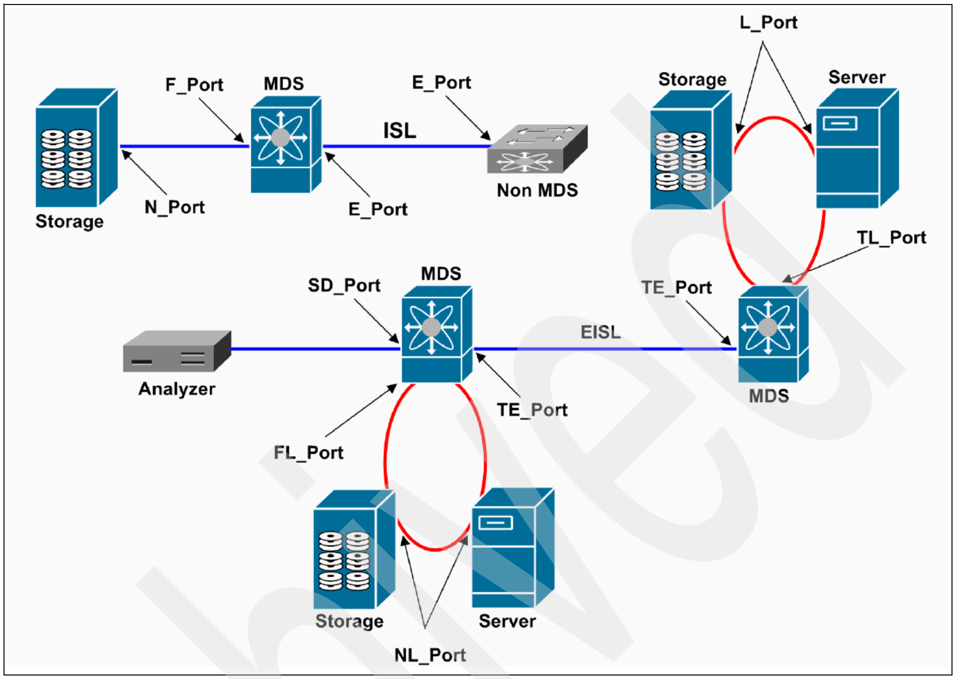


Figure 2-1 Cisco MDS 9000 family port types

The port mode can be changed for any given port through Device Manager, as shown in Figure 2-2 and Figure 2-3 on page 42.

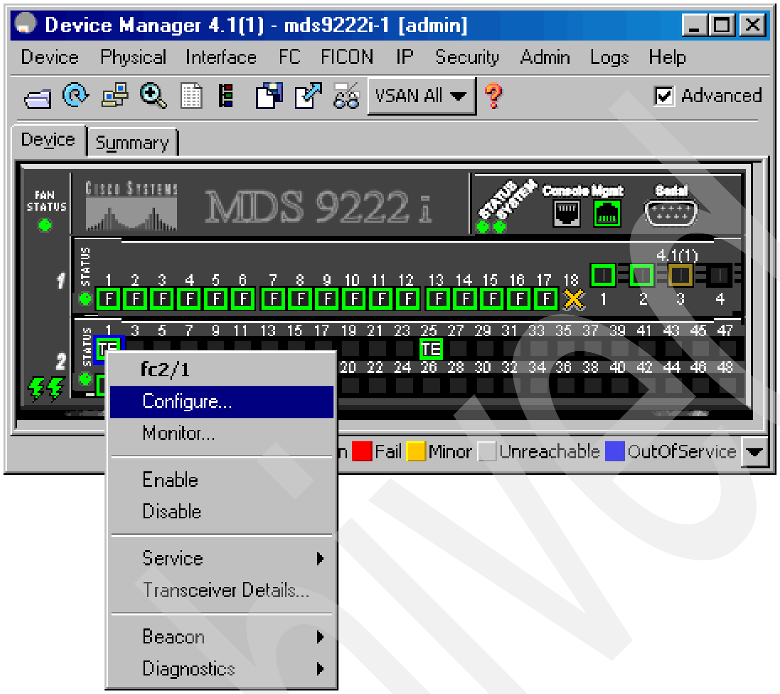

Device Manager 4.1(1) - mds9222i-1 [admin]
Device Physical Interface FC FICON IP Security Admin Help
VSAN All
☑ Advanced
Device
Summary
MDS 9222 i
fc2/1
Configure...
Monitor...
Enable
Disable
Service
Transceiver Details...
Beacon
Diagnostics
Fail Minor Unreachable OutOfService

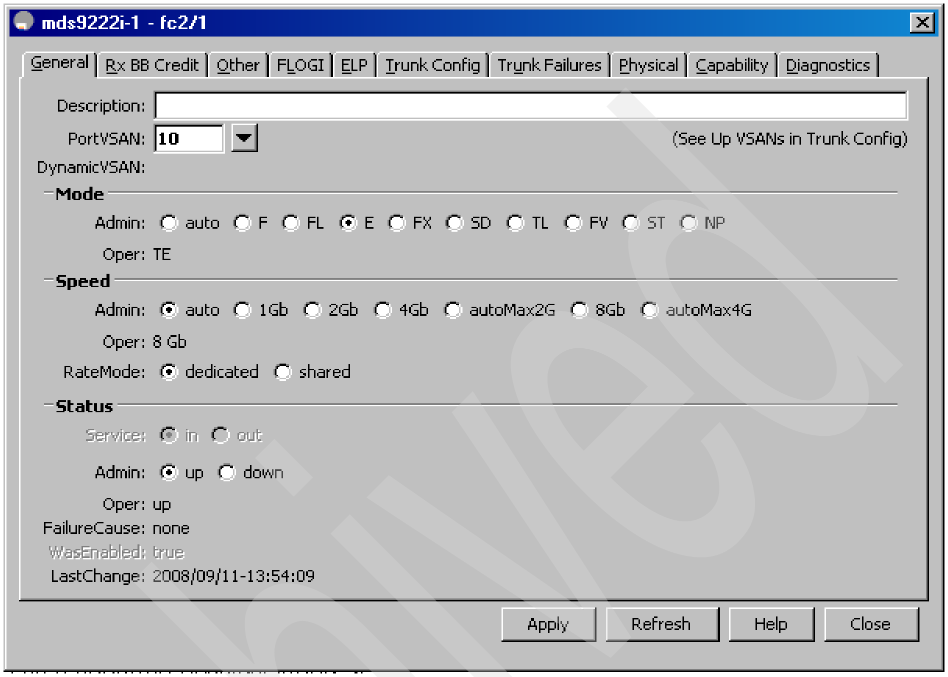
Figure 2-2 Port configuration selection

Example 2-2 shows port mode configuration from the command-line interface.

Example 2-2 Port mode selection from the command-line interface

```
mds9222i-1(config-if)# switchport mode
E       F       FL      Fx      NP      SD      ST      TL      auto
```

Figure 2-3 shows the Device Manager port configuration for the 8 Gbps port.



Description:

PortVSAN: 10 (See Up VSANs in Trunk Config)

DynamicVSAN:

Mode

Admin: ○ auto ○ F ○ FL ● E ○ FX ○ SD ○ TL ○ FV ○ ST ○ NP

Oper: TE

Speed

Admin: ● auto ○ 1Gb ○ 2Gb ○ 4Gb ○ autoMax2G ○ 8Gb ○ autoMax4G

Oper: 8 Gb

RateMode: ● dedicated ○ shared

Status

Service: ● in ○ out

Admin: ● up ○ down

Oper: up

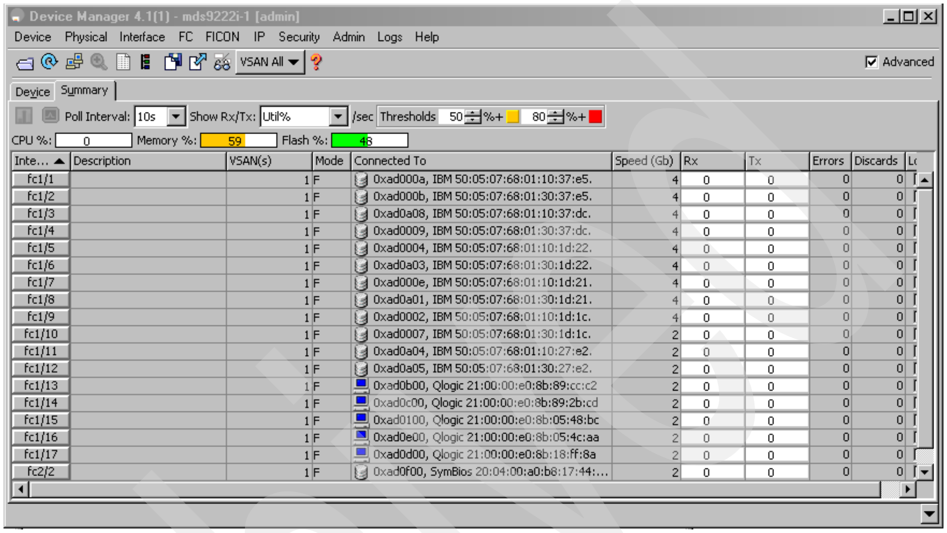
FailureCause: none

WasEnabled: true

LastChange: 2008/09/11-13:54:09

Figure 2-3 Device Manager port configuration window for the 8 Gbps port

Figure 2-4 shows the Device Manager port summary window. It shows port mode for all ports and the WWNs of connected devices. There are statistics for transmission, errors, and discards. Above the list there is current CPU, memory, and flash utilization information and thresholds. This view can be filtered for any particular VSAN.



☑ Advanced

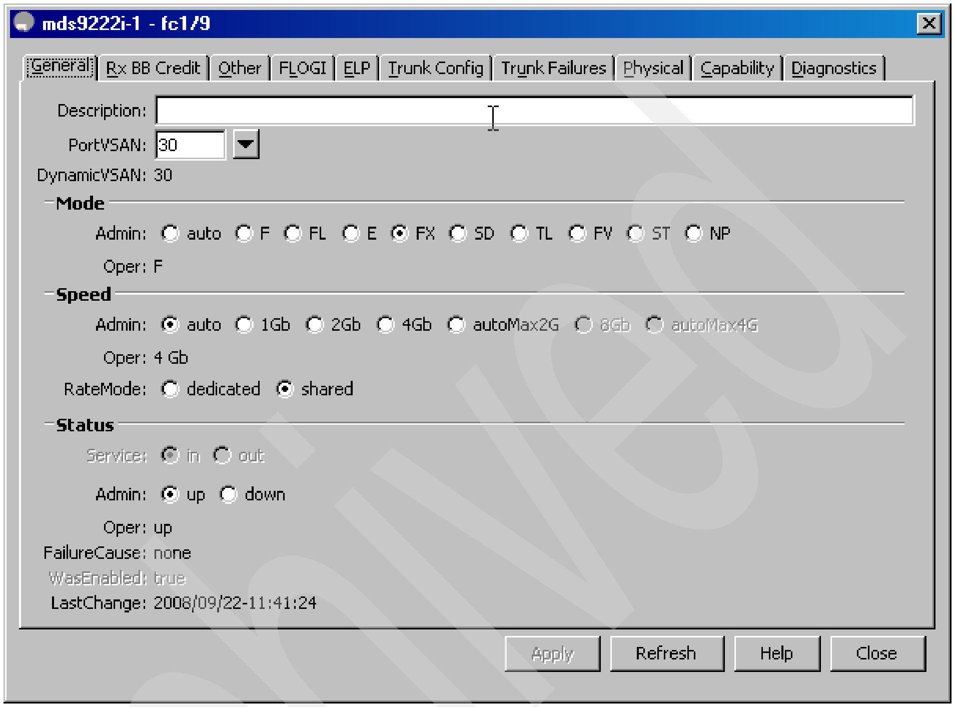
Poll Interval: 10s Show Rx/Tx: Util% /sec Thresholds 50 %+ 🟨 80 %+ 🟥

CPU %: 0 Memory %: 59 Flash %: 48

Inte...	Description	VSAN(s)	Mode	Connected To	Speed (Gb)	Rx	Tx	Errors	Discards	Lc
fc1/1		1	F	0xad000a, IBM 50:05:07:68:01:10:37:e5.	4	0	0	0	0	
fc1/2		1	F	0xad000b, IBM 50:05:07:68:01:30:37:e5.	4	0	0	0	0	
fc1/3		1	F	0xad0a08, IBM 50:05:07:68:01:10:37:dc.	4	0	0	0	0	
fc1/4		1	F	0xad0009, IBM 50:05:07:68:01:30:37:dc.	4	0	0	0	0	
fc1/5		1	F	0xad0004, IBM 50:05:07:68:01:10:1d:22.	4	0	0	0	0	
fc1/6		1	F	0xad0a03, IBM 50:05:07:68:01:30:1d:22.	4	0	0	0	0	
fc1/7		1	F	0xad000e, IBM 50:05:07:68:01:10:1d:21.	4	0	0	0	0	
fc1/8		1	F	0xad0a01, IBM 50:05:07:68:01:30:1d:21.	4	0	0	0	0	
fc1/9		1	F	0xad0002, IBM 50:05:07:68:01:10:1d:1c.	4	0	0	0	0	
fc1/10		1	F	0xad0007, IBM 50:05:07:68:01:30:1d:1c.	2	0	0	0	0	
fc1/11		1	F	0xad0a04, IBM 50:05:07:68:01:10:27:e2.	2	0	0	0	0	
fc1/12		1	F	0xad0a05, IBM 50:05:07:68:01:30:27:e2.	2	0	0	0	0	
fc1/13		1	F	0xad0b00, Qlogic 21:00:00:e0:8b:89:cc:c2	2	0	0	0	0	
fc1/14		1	F	0xad0c00, Qlogic 21:00:00:e0:8b:89:2b:cd	2	0	0	0	0	
fc1/15		1	F	0xad0100, Qlogic 21:00:00:e0:8b:05:48:bc	2	0	0	0	0	
fc1/16		1	F	0xad0e00, Qlogic 21:00:00:e0:8b:05:4c:aa	2	0	0	0	0	
fc1/17		1	F	0xad0d00, Qlogic 21:00:00:e0:8b:18:ff:8a	2	0	0	0	0	
fc2/2		1	F	0xad0f00, SymBios 20:04:00:a0:b8:17:44:...	2	0	0	0	0	

Figure 2-4 Device Manager port summary window

When we choose a port on a Gen 2 or Gen 1 module we will get a similar window to those shown before, but some options will be grayed out, as shown in Figure 2-5.



Description:

PortVSAN: 30

DynamicVSAN: 30

Mode

Admin: ○ auto ○ F ○ FL ○ E ● FX ○ SD ○ TL ○ FV ○ ST ○ NP

Oper: F

Speed

Admin: ● auto ○ 1Gb ○ 2Gb ○ 4Gb ○ autoMax2G ○ 8Gb ○ autoMax4G

Oper: 4 Gb

RateMode: ○ dedicated ● shared

Status

Service: ● in ○ out

Admin: ● up ○ down

Oper: up

FailureCause: none

WasEnabled: true

LastChange: 2008/09/22-11:41:24

Figure 2-5 Device Manager port configuration window for the Gen 2 line card

2.2 Configuration guidelines for Gen 2 and Gen 3

Depending on the type of MDS 9000 device, we can have from one line card in the MDS9222i, up to 11 line cards in the MDS 9513 Director. Depending on the type of the module, we can configure or control the number of options and parameters. There is a set of parameters that are different for different types of line cards.

For all of the line cards we can check, view, or perform configuration steps using the CLI or the GUI. In most cases it is easier, and quicker, to use the GUI as shown in Figure 2-6 and in Figure 2-7 for a Gen 3 line card.

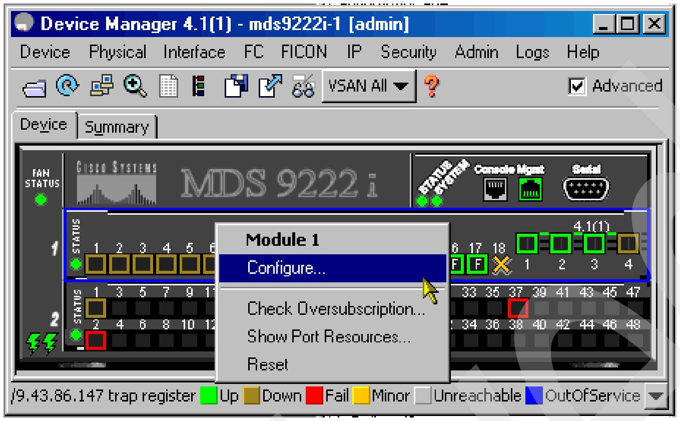

Device Manager 4.1(1) - mds9222i-1 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
☑ Advanced
Device Summary
FAN STATUS
MDS 9222 i
Console Mgmt Serial
4.1(1)
Module 1
Configure...
Check Oversubscription...
Show Port Resources...
Reset
/9.43.86.147 trap register 🟩Up 🟫Down 🟥Fail 🟨Minor □Unreachable 🟦OutOfService

Figure 2-6 Configuration tasks for MDS 9000 line cards

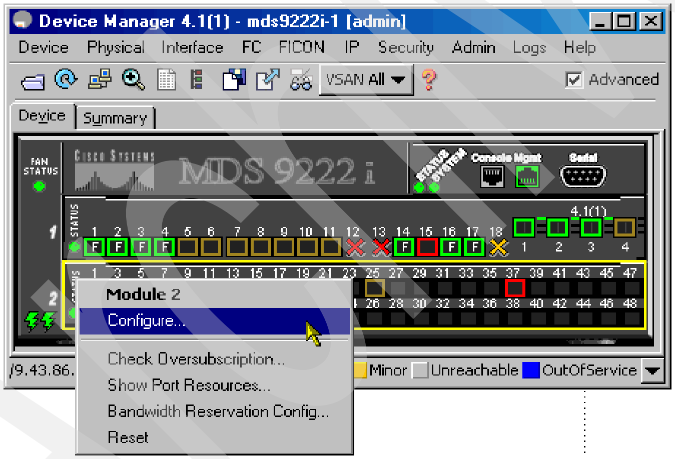
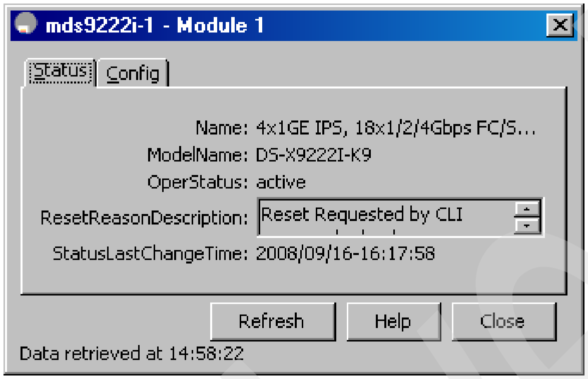

Device Manager 4.1(1) - mds9222i-1 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
☑ Advanced
Device Summary
FAN STATUS
MDS 9222 i
Console Mgmt Serial
4.1(1)
Module 2
Configure...
Check Oversubscription...
Show Port Resources...
Bandwidth Reservation Config...
Reset
/9.43.86.
🟨Minor □Unreachable 🟦OutOfService

Figure 2-7 Configuration tasks for the MDS 9000 Gen 3 line card

Standard administration tasks for MDS line cards

For most of the line cards we can perform the following administration tasks:

1. Check the status and configure a line card as shown in Figure 2-8 and in Figure 2-9.



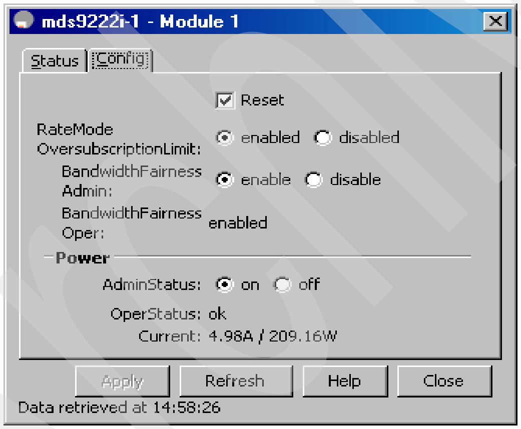
mds9222i-1 - Module 1

Status | Config

Name: 4x1GE IPS, 18x1/2/4Gbps FC/S...
ModelName: DS-X9222I-K9
OperStatus: active
ResetReasonDescription: Reset Requested by CLI
StatusLastChangeTime: 2008/09/16-16:17:58

Data retrieved at 14:58:22

Figure 2-8 Check the status of the line card



mds9222i-1 - Module 1

Status | Config

☑ Reset
RateMode OversubscriptionLimit: ● enabled ○ disabled
BandwidthFairness Admin: ● enable ○ disable
BandwidthFairness Oper: enabled

Power
AdminStatus: ● on ○ off
OperStatus: ok
Current: 4.98A / 209.16W

Data retrieved at 14:58:26

Figure 2-9 Configure the line card

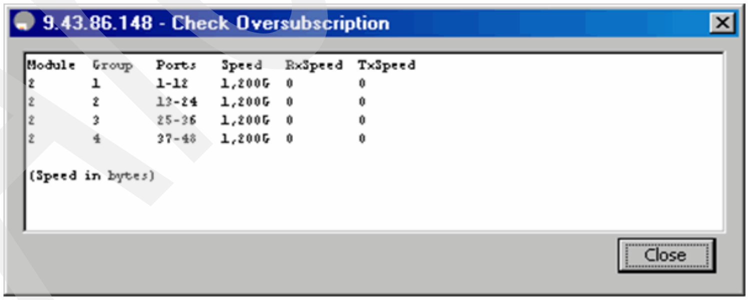
2. Reset the module.
3. Show port resources, as shown in Example 2-3.

Example 2-3 Show port resources command from the CLI

```
mds9222i-2# show port-resources module 2
Module 2
  Available dedicated buffers are 3564
Port-Group 1
```

```
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 4.8 Gbps
  Allocated dedicated bandwidth is 8.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  --------------------------------------------------------------------
  fc2/1                                     125        8.0  dedicated
  fc2/2                                      32        4.0  shared
  fc2/3                                      32        4.0  shared
  fc2/4                                      32        4.0  shared
  fc2/5                                      32        4.0  shared
  fc2/6                                      32        4.0  shared
  fc2/7                                      32        4.0  shared
  fc2/8                                      32        4.0  shared
  fc2/9                                      32        4.0  shared
  fc2/10                                     32        4.0  shared
  fc2/11                                     32        4.0  shared
  fc2/12                                     32        4.0  shared
Port-Group 2
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 8.8 Gbps
  Allocated dedicated bandwidth is 4.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  --------------------------------------------------------------------
  fc2/13                                     32        4.0  shared
  fc2/14                                    125        4.0  dedicated
  fc2/15                                     32        4.0  shared
  fc2/16                                     32        4.0  shared
  fc2/17                                     32        4.0  shared
  fc2/18                                     32        4.0  shared
  fc2/19                                     32        4.0  shared
  fc2/20                                     32        4.0  shared
  fc2/21                                     32        4.0  shared
  fc2/22                                     32        4.0  shared
  fc2/23                                     32        4.0  shared
  fc2/24                                     32        4.0  shared
Port-Group 3
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 4.8 Gbps
  Allocated dedicated bandwidth is 8.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  --------------------------------------------------------------------
  fc2/25                                    125        8.0  dedicated
  fc2/26                                     32        4.0  shared
  fc2/27                                     32        4.0  shared
  fc2/28                                     32        4.0  shared
  fc2/29                                     32        4.0  shared
  fc2/30                                     32        4.0  shared
  fc2/31                                     32        4.0  shared
  fc2/32                                     32        4.0  shared
  fc2/33                                     32        4.0  shared
  fc2/34                                     32        4.0  shared
  fc2/35                                     32        4.0  shared
  fc2/36                                     32        4.0  shared
Port-Group 4
  Total bandwidth is 12.8 Gbps
  Total shared bandwidth is 4.8 Gbps
  Allocated dedicated bandwidth is 8.0 Gbps
  --------------------------------------------------------------------
  Interfaces in the Port-Group       B2B Credit  Bandwidth  Rate Mode
                                        Buffers     (Gbps)
  --------------------------------------------------------------------
  fc2/37                                    125        8.0  dedicated
  fc2/38                                     32        4.0  shared
  fc2/39                                     32        4.0  shared
  fc2/40                                     32        4.0  shared
  fc2/41                                     32        4.0  shared
  fc2/42                                     32        4.0  shared
  fc2/43                                     32        4.0  shared
  fc2/44                                     32        4.0  shared
  fc2/45                                     32        4.0  shared
  fc2/46                                     32        4.0  shared
  fc2/47                                     32        4.0  shared
  fc2/48                                     32        4.0  shared
```

4. Check the oversubscription as shown in Figure 2-10.


9.43.86.148 - Check Oversubscription

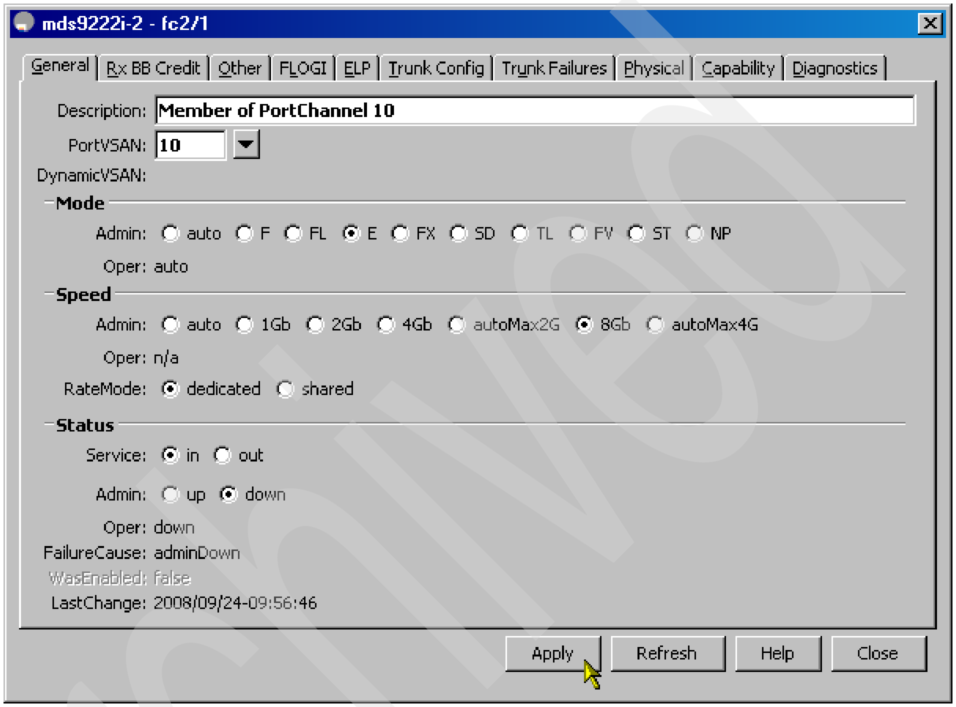
```
Module  Group   Ports   Speed   RxSpeed TxSpeed
2       1       1-12    1,200G  0       0
2       2       13-24   1,200G  0       0
2       3       25-36   1,200G  0       0
2       4       37-48   1,200G  0       0

(Speed in bytes)
```

Figure 2-10 Checking the oversubscription status from the Device Manager

Administration tasks specific to Gen 3 line cards

When working with Gen3 line cards there are a few more parameters to check and configure with respect to the ports and modules.

As shown in Figure 2-11, we can configure 8 Gbps port rate mode.



Description: Member of PortChannel 10

PortVSAN: 10

DynamicVSAN:

Mode

Admin: ○ auto ○ F ○ FL ● E ○ FX ○ SD ○ TL ○ FV ○ ST ○ NP

Oper: auto

Speed

Admin: ○ auto ○ 1Gb ○ 2Gb ○ 4Gb ○ autoMax2G ● 8Gb ○ autoMax4G

Oper: n/a

RateMode: ● dedicated ○ shared

Status

Service: ● in ○ out

Admin: ○ up ● down

Oper: down

FailureCause: adminDown

WasEnabled: false

LastChange: 2008/09/24-09:56:46

Figure 2-11 8 Gbps port configuration in Device Manager

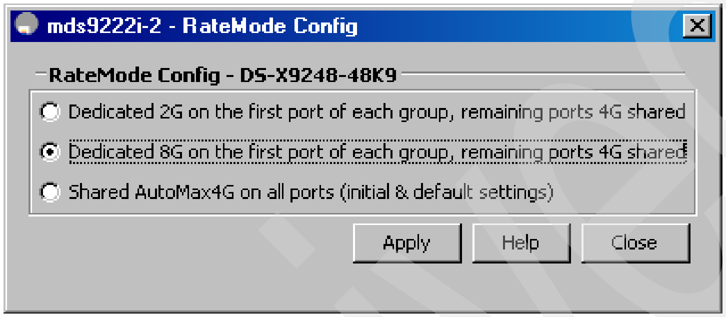
It is possible to use a specific auto option to set the port speed. For example, we can set for an 8 Gbps port autoMax2G or autoMax4G mode. This means that the 8 Gbps port will set its speed automatically to the best allowed, but no faster than respectively 2 Gbps or 4 Gbps. These options are valuable when using oversubscription and sharing modes.

For Gen 3 cards we can configure Bandwidth Reservation Modes. As shown in Figure 2-7 on page 45 there is another option in the menu when you right-click the Gen 3 line card “Bandwidth Reservation Mode”. When you click it you will be offered less options to choose as shown in Figure 2-12 on page 50.

The options to configure are dependent on the type of Gen3 card. This applies to the 44/4-port 8 Gbps Host-Optimized Fibre Channel switching module in our MDS9222i:

- Dedicated 2G on the first port of each group, remaining ports 4G shared
- Dedicated 8G on the first port of each group, remaining ports 4G shared
- Shared AutoMax4G on all ports (initial & default settings)

The 44/4-port 8 Gbps Host-Optimized Fibre Channel switching module has 4 port groups and each port group has 12 ports.



mds9222i-2 - RateMode Config

RateMode Config - DS-X9248-48K9

○ Dedicated 2G on the first port of each group, remaining ports 4G shared
● Dedicated 8G on the first port of each group, remaining ports 4G shared
○ Shared AutoMax4G on all ports (initial & default settings)

Figure 2-12 Bandwidth Reservation Config for Gen 3 line cards

There are three Gen 3 line cards available at the time of writing and all of them follow the same rules with respect to the ports and modules configuration and administration.

3

Operating system

In this chapter we discuss the Cisco SAN-OS and NX-OS operating systems.

3.1 System memory areas

The Cisco MDS contains an internal bootflash used for holding the current bootable images, kickstart and system. License files are also stored here, but the bootflash can also be used for storing any file, including copies of the startup config.

MDS 9500 supervisors also have an external bootflash memory slot called Slot0: that is used for transferring image files between switches.

The system RAM memory is used by the Linux operating system and a Volatile: file system for storing temporary files. Any changes made to the switch operating parameters or configuration are instantly active and held in the running configuration.

All data stored in RAM will be lost when the MDS is rebooted, so an area of non-volatile RAM (NVRAM) is used for the storage of critical data. The most critical of these would be the running configuration for the switch. The running configuration should be saved to the Startup-Configuration in NVRAM using the CLI command **`copy run start`** so that the configuration can be preserved during a switch reboot.

The MDS Cisco 9000 family switches have three main memory areas, as shown in Figure 3-1.

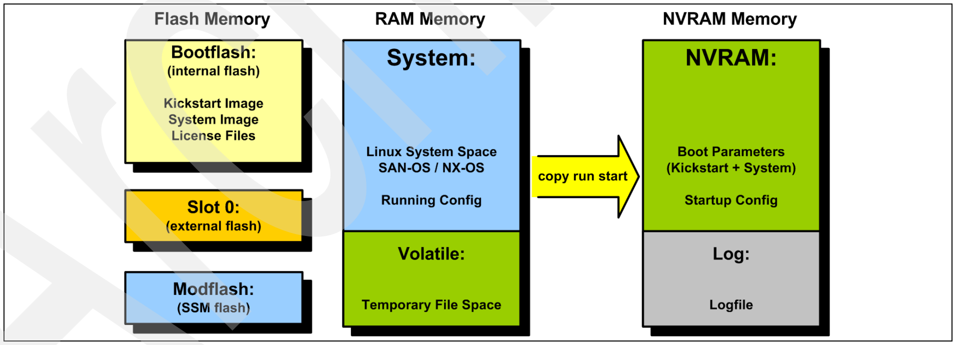


Figure 3-1 MDS Cisco 9000 memory areas

During the switch boot process, it is essential that the switch knows where to find the kickstart and system images and what they are called. Two boot parameters are held in NVRAM:

- Boot system bootflash: <system>.img
- Load kickstart bootflash: <kickstart>.img

An example of boot parameters stored in NVRAM is shown in Example 3-1.

Example 3-1 Boot parameters from NVRAM

```
mds9222i-1# show running-config
---- truncate ----
switchname mds9222i-1
boot kickstart bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin
boot system bootflash:/m9200-s2ek9-mz.4.1.1.bin
---- truncate ----
```

3.1.1 Boot sequence

SAN-OS is the common operating system for all switches in the MDS9000 SAN switch family. Each switch is shipped with the latest MDS SAN-OS, which consists of a kickstart and a system image. Starting from release 4.x SAN-OS, it will be rebranded to NX-OS. The newest MDS9000 devices will be shipped with the NX-OS 4.x operating system based on the same source code tree.

To understand the concept of kickstart and system images, we briefly explain the boot sequence for a MDS 9000 family switch, as shown in Figure 3-2:

1. The BIOS performs HW component tests (runs POST) and loads Bootloader
2. Bootloader gets kickstart boot parameters from the NVRAM, verifies the kickstart image, and loads it from the bootflash. After that we will get a loader prompt Loader>prompt.
3. The kickstart image loads the Linux kernel and drivers from the bootflash and gets system boot parameters from NVRAM. It verifies the system image and loads it. After that we will get a Switch(Boot)# prompt.
4. The system image reads the startup configuration file, loads SAN-OS/NX-OS, checks file systems, and loads startup-config. When the system image has loaded you can access and manage the switch using the management interface Switch#prompt.

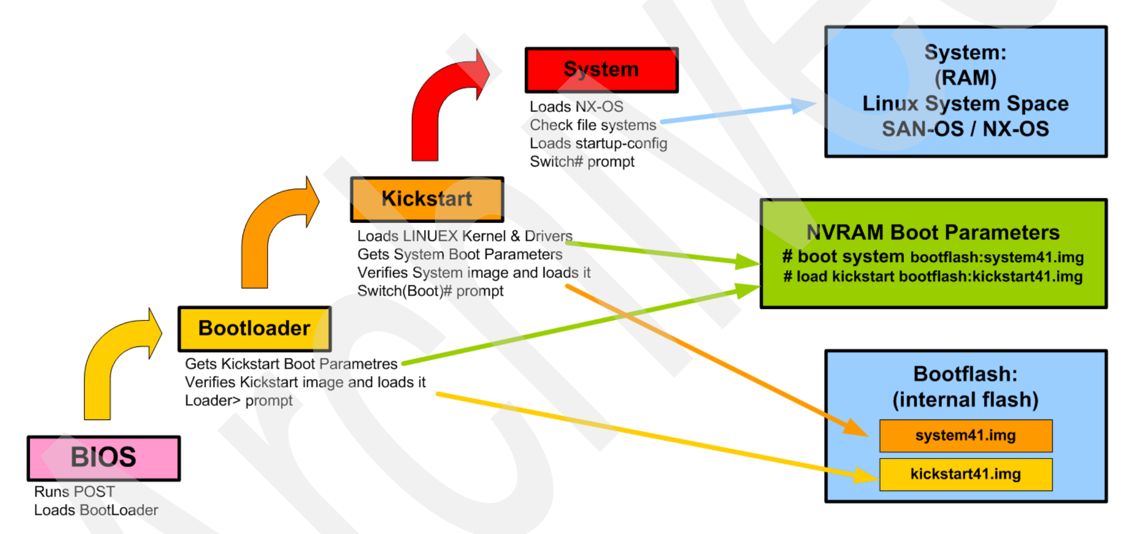


Figure 3-2 Regular boot sequence

> **Note:** If the boot parameters are missing or have an incorrect name or location, then the boot process will fail at the last stage. If this happens, then you must recover from the error and reload the switch. The `install all` command is a script that greatly simplifies the boot procedure and checks for errors and the upgrade impact before proceeding.

The kickstart and system image must be available for the switch to boot, and therefore it is placed in the bootflash. It is possible to boot from an external kickstart image placed on a TFTP server, although this requires manual intervention. This is only used when recovering from corrupted boot images, and the process is to copy the kickstart and system image to the bootflash (after verifying that the switch can boot from the kickstart image on the TFTP server).

3.1.2 Upgrade prerequisites

When upgrading the SAN-OS or NX-OS on a Cisco MDS 9000 family switch, you must specify the variables that direct the switch to the images (kickstart or system).

Verify the following prerequisites prior to upgrading the software images:

- Scheduling

  Verify that the fabric is stable and steady, while ensuring that no switch or network configurations are performed when you plan to upgrade the switch, since all configurations are disallowed while the upgrade is running.

- Space

  Verify that there is enough space available where you intend to copy the new software images (this being the active and the standby supervisor bootflash). Use the command-line interface (CLI) to **dir bootflash** to verify that the required space is available, as shown in Example 3-2.

Example 3-2 Listing files on bootflash

```
mds9222i-1# dir bootflash:
       1567     Sep 18 23:02:05 2008  FOX1216GPOC.lic
         25     Sep 11 02:16:32 2008  cpu_logfile
       1024     Sep 11 06:40:00 2008  epld_dir/
      46080     Sep 17 02:02:16 2008  lost+found/
    3757210     Sep 11 02:06:49 2008  m9000-epld-4.1.1.img
   19542528     Sep 17 02:01:58 2008
m9200-s2ek9-kickstart-mz.4.1.1.bin
  101905006     Sep 17 02:01:51 2008  m9200-s2ek9-mz.4.1.1.bin
  106106231     Sep 18 00:07:29 2008  m9200-s2ek9-mzg.4.1.0.182.bin
       1024     Sep 11 02:16:33 2008  partner/

Usage for bootflash://sup-local
  275624960 bytes used
   71203840 bytes free
  346828800 bytes total
```

- Hardware

  Ensure that the switch is connected to a stable power source, as loss of power during the upgrade could potentially corrupt the image. An example command is shown in Example 3-3.

Example 3-3 Checking the status of the power modules

```
mds9222i-1# show environment power
Power Supply:
Voltage: 42 Volts
-----------------------------------------------------
PS  Model                Power       Power     Status
                         (Watts)     (Amp)
-----------------------------------------------------
1   DS-CAC-845W           800.10     19.05     Ok
2   DS-CAC-845W           800.10     19.05     Ok


Mod Model               Power     Power       Power     Power
Status
                         Requested Requested   Allocated Allocated
                         (Watts)   (Amp)       (Watts)   (Amp)
--- -------------------  -------   ----------  --------- ----------
----------
1    DS-X9222I-K9         209.16    4.98       209.16    4.98
Powered-Up
2    DS-X9248-48K9        214.20    5.10       214.20    5.10
Powered-Up
fan1 DS-2SLOT-FAN         47.88     1.14       47.88     1.14
Powered-Up


Power Usage Summary:
--------------------
Power Supply redundancy mode:                 Redundant
Power Supply redundancy operational mode:     Redundant

Total Power Capacity                              800.10 W

Power reserved for Supervisor(s)                  418.32 W
Power reserved for Fan Module(s)                   47.88 W
Power currently used by Modules                    214.20 W

                                                 -------------
Total Power Available                              119.70 W
                                                 -------------
```

- Connectivity

  Verify that you have connectivity to the server from which you are downloading the software images.

- Images

  Verify that the specified system and kickstart images are compatible. If no kickstart image is specified, the running kickstart image is used. If a different system image is specified, you must verify that it is compatible with the running kickstart image.

When upgrading the SAN-OS or NX-OS on any Cisco MDS 9000 family switch running in production, we strongly recommend that you use the **`install all`** command, which provides a nondisruptive upgrade process.

> **Important:** If you issue the **`install all`** command on a switch that only has a single supervisor system with kickstart and system image changes, or on a dual supervisor system with incompatible system software images, then the process is disruptive.

For switches *not* running in production, you can alternatively perform the quick upgrade procedure using the **`reload`** command. This process is disruptive.

> **Important:** We strongly recommend having a copy of the switch configuration files on an external server or on any other external resource before starting the upgrade firmware process.

3.1.3 Install all

Using the **`install all`** command provides you with the ability to upgrade a switch in the least disruptive way. When invoked, the command first checks the image integrity, including the running kickstart and system images, and performs a platform validity check of the image to which you are upgrading. When the validation is performed, you are presented with an overview of the changes (and impact), and you are prompted to confirm the upgrade process to start (or cancel).

3.1.4 Quick upgrade

Performing a quick upgrade using the **`reload`** command is *only* recommended for switches not in production, while on completion the switch is rebooted. The process is to copy the kickstart and system image to the switch, set the boot variables, and issue the **`reload`** command. When completed, the switch is rebooted.

3.1.5 Manual upgrade

We only recommend performing a manual installation for experienced specialists who are completely familiar with switch configurations. For further details on how to perform manual upgrades, consult the *Cisco MDS 9000 Family Configuration Guide*:

http://www.cisco.com/en/US/products/ps5989/products_installation_and_configuration_guides_list.html

3.2 Upgrading the SAN-OS or NX-OS

In the topics that follow we describe how to upgrade the SAN-OS or NX-OS.

Note: We recommend that you always contact your IBM service representative prior to performing a SAN-OS or NX-OS upgrade, to review your software requirements based on your operating environment.

We upgrade the NX-OS to the latest released level. This can be done using either the CLI or the graphical user interface (GUI) (FM or DM). For completeness we show how to perform the upgrade using both the CLI and the GUI.

Note: For this book we used NX-OS Version 4.1(0.182) and NX-OS Version 4.1(1).

3.2.1 Upgrading the SAN-OS or NX-OS using the CLI

To upgrade the SAN-OS or NX-OS using the CLI:

1. Check the current SAN-OS or NX-OS version.
2. Check the free space of bootflash to copy files
3. Copy files form the FTP server to CISCO bootflash.
4. Back up the running configuration.
5. Install SAN-OS using the command **install all**.
6. Verify the switch version.

Prior to upgrading the switch, we first list the current SAN-OS or NX-OS version running on the switch, as shown in Example 3-4.

Example 3-4 Issuing show version before upgrade

```
mds9222i-1# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained herein are owned by
other third parties and are used and distributed under license.
Some parts of this software are covered under the GNU Public
License. A copy of the license is available at
http://www.gnu.org/licenses/gpl.html.

Software
  BIOS:      version 1.0.15
  loader:    version N/A
  kickstart: version 4.1(1) [build 4.1(0.182)] [gdb]
  system:    version 4.1(1) [build 4.1(0.182)] [gdb]
  BIOS compile time:       07/16/08
  kickstart image file is:
bootflash:/m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
  kickstart compile time:  10/12/2020 25:00:00 [08/15/2008 18:42:09]
  system image file is:    bootflash:/m9200-s2ek9-mzg.4.1.0.182.bin
  system compile time:     12/25/2010 12:00:00 [08/15/2008 20:03:21]

Hardware
  cisco MDS 9222i ("4x1GE IPS, 18x1/2/4Gbps FC/Sup2")
  Motorola, e500v2  with 1036512 kB of memory.
  Processor Board ID JAE12088ZMT

  Device name: mds9222i-1
  bootflash:    1000440 kB
Kernel uptime is 0 day(s), 0 hour(s), 3 minute(s), 38 second(s)
```

```
Last reset at 970000 usecs after  Wed Sep 17 00:31:49 2008

  Reason: Reset Requested by CLI command reload
  System version: 4.1(1)
  Service:
```

After we have done that we verify that there is sufficient space on the supervisor bootflash, as shown in Example 3-5.

Example 3-5   Listing the bootflash

```
mds9222i-1# dir bootflash:
         25     Sep 11 02:16:32 2008  cpu_logfile
       1024     Sep 11 06:40:00 2008  epld_dir/
      46080     Sep 17 00:24:31 2008  lost+found/
    3757210     Sep 11 02:06:49 2008  m9000-epld-4.1.1.img
   19542528     Sep 11 02:08:00 2008  m9200-s2ek9-kickstart-mz.4.1.1.bin
   19560960     Sep 17 00:23:42 2008  m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
  101905006     Sep 11 02:15:15 2008  m9200-s2ek9-mz.4.1.1.bin
  106106231     Sep 17 00:22:14 2008  m9200-s2ek9-mzg.4.1.0.182.bin
       1024     Sep 11 02:16:33 2008  partner/

Usage for bootflash://sup-local
  295262208 bytes used
   51566592 bytes free
  346828800 bytes total
```

Next we copy the NX-OS code from an FTP server to the *bootflash:* on the switch, as shown in Example 3-6.

Note: Ensure that the FTP server is reachable in order to copy the required files. Firewalls may prevent you from reaching the FTP server.

Example 3-6   Copy NX-OS code to bootflash

```
mds9222i-1# copy ftp://9.43.86.49/jaco/4.1.1/m9200-s2ek9-kickstart-mz.4.1.1.bin
bootflash:
Enter username: jaco
File transfer in progress, please wait ...
Password:
mds9222i-1# copy ftp://9.43.86.49/jaco/4.1.1/m9200-s2ek9-mz.4.1.1.bin
bootflash:
Enter username: jaco
```

```
File transfer in progress, please wait ...
Password:
mds9222i-1#
```

Prior to starting the actual upgrade process we back up the running configuration to our FTP server, as shown in Example 3-7.

> **Tip:** A best practice when performing configuration changes is to always save the running configuration to the startup configuration. By doing this you could also preserve previous startup configurations for two generations.

Example 3-7 Back up the running configuration

```
mds9222i-1# copy running-config ftp://9.43.86.49/jaco/backup
Enter username: jaco
Password:*********
mds9222i-1#
```

> **Note:** We recommend verifying that the backup completed successfully, is readable, and is accessible.

After backing up the configuration, start the upgrade using the **install all** command, as shown in Example 3-8.

Example 3-8 Upgrading the switch using the install all command

```
mds9222i-1# install all system bootflash:m9200-s2ek9-mz.4.1.1.bin kickstart
bootflash:m9200-s2ek9-kickstart-mz.4.1.1.bin

Verifying image bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin for boot variable
"kickstart".
[####################] 100% -- SUCCESS

Verifying image bootflash:/m9200-s2ek9-mz.4.1.1.bin for boot variable "system".
[####################] 100% -- SUCCESS

Verifying image type.
[####################] 100% -- SUCCESS

Extracting "system" version from image bootflash:/m9200-s2ek9-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Extracting "kickstart" version from image
bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin.
[####################] 100% -- SUCCESS
```

```
Extracting "bios" version from image bootflash:/m9200-s2ek9-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Extracting "slc2" version from image bootflash:/m9200-s2ek9-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Performing Compact Flash and TCAM sanity test.
[####################] 100% -- SUCCESS

Notifying services about system upgrade.
[####################] 100% -- SUCCESS

Compatibility check is done:
Module  bootable          Impact  Install-type  Reason
------  --------  --------------  ------------  ------
     1       yes  non-disruptive          none
     2       yes  non-disruptive          none

Do you want to continue with the installation (y/n)?  [n] y

Install is in progress, please wait.

Setting boot variables.
[####################] 100% -- SUCCESS

Performing configuration copy.
[####################] 100% -- SUCCESS

Module 1: Refreshing compact flash and upgrading bios/loader/bootrom.
Warning: please do not remove or power off the module at this time.
[####################] 100% -- SUCCESS

Module 2: Refreshing compact flash and upgrading bios/loader/bootrom.
Warning: please do not remove or power off the module at this time.
[####################] 100% -- SUCCESS

Install has been successful.
mds9222i-1#
```

After the upgrade has completed, verify the version using the **show version** command, as shown in Example 3-9.

Example 3-9   Issuing show version after upgrade

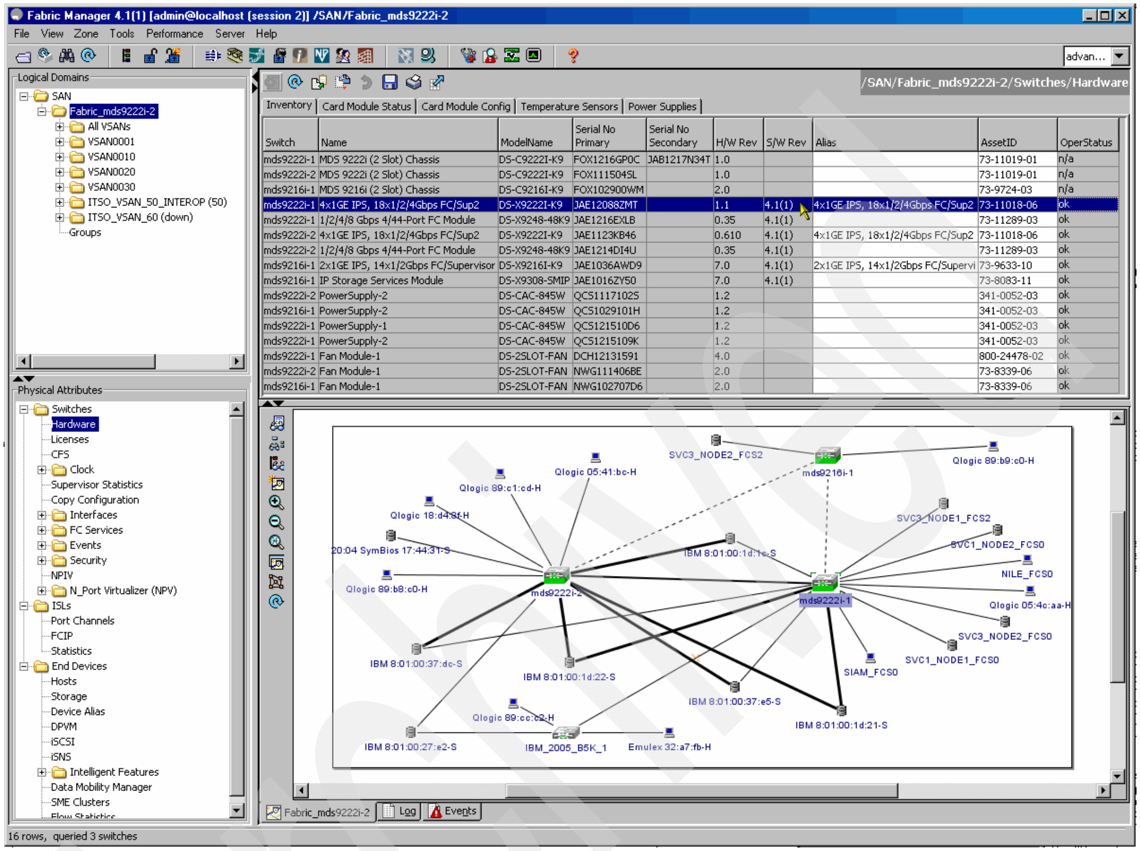
```
mds9222i-1# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
```

```
The copyrights to certain works contained herein are owned by
other third parties and are used and distributed under license.
Some parts of this software are covered under the GNU Public
License. A copy of the license is available at
http://www.gnu.org/licenses/gpl.html.

Software
  BIOS:      version 1.0.15
  loader:    version N/A
  kickstart: version 4.1(1)
  system:    version 4.1(1)
  BIOS compile time:       07/16/08
  kickstart image file is:
bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin
  kickstart compile time:  10/12/2020 25:00:00 [09/09/2008 06:55:47]
  system image file is:    bootflash:/m9200-s2ek9-mz.4.1.1.bin
  system compile time:     8/22/2008 0:00:00 [09/09/2008 08:15:09]

Hardware
  cisco MDS 9222i ("4x1GE IPS, 18x1/2/4Gbps FC/Sup2")
  Motorola, e500v2  with 1036316 kB of memory.
  Processor Board ID JAE12088ZMT

  Device name: mds9222i-1
  bootflash:    1000440 kB
Kernel uptime is 0 day(s), 0 hour(s), 1 minute(s), 59 second(s)

Last reset at 353970 usecs after  Wed Sep 17 00:53:38 2008

  Reason: Reset Requested by CLI command reload
  System version: 4.1(0.182)
  Service:
```

3.2.2 Upgrading the SAN-OS using the GUI

In the following example we upgrade the NX-OS on the MDS switch using the GUI by invoking the process using the Fabric Manager interface.

Before starting an upgrade process we recommend checking the firmware versions on all switches in the fabric, as shown in Figure 3-3.

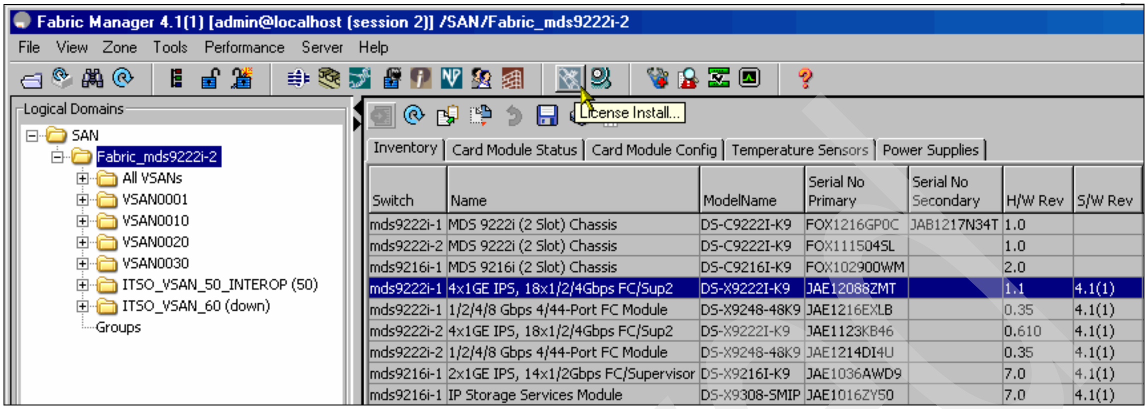


Switch	Name	ModelName	Serial No Primary	Serial No Secondary	H/W Rev	S/W Rev	Alias	AssetID	OperStatus
mds9222i-1	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX1216GP0C	JAB1217N34T	1.0			73-11019-01	n/a
mds9222i-2	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX111504SL		1.0			73-11019-01	n/a
mds9216i-1	MDS 9216i (2 Slot) Chassis	DS-C9216I-K9	FOX102900WM		2.0			73-9724-03	n/a
mds9222i-1	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE12088ZMT		1.1	4.1(1)	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	73-11018-06	ok
mds9222i-1	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1216EXLB		0.35	4.1(1)		73-11289-03	ok
mds9222i-2	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE1123KB46		0.610	4.1(1)	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	73-11018-06	ok
mds9222i-2	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1214DI4U		0.35	4.1(1)		73-11289-03	ok
mds9216i-1	2x1GE IPS, 14x1/2Gbps FC/Supervisor	DS-X9216I-K9	JAE1036AWD9		7.0	4.1(1)	2x1GE IPS, 14x1/2Gbps FC/Supervi	73-9633-10	ok
mds9216i-1	IP Storage Services Module	DS-X9308-SMIP	JAE1016ZY50		7.0	4.1(1)		73-8083-11	ok
mds9222i-2	PowerSupply-2	DS-CAC-845W	QCS11171025		1.2			341-0052-03	ok
mds9216i-1	PowerSupply-2	DS-CAC-845W	QCS1029101H		1.2			341-0052-03	ok
mds9222i-1	PowerSupply-1	DS-CAC-845W	QCS121510D6		1.2			341-0052-03	ok
mds9222i-1	PowerSupply-2	DS-CAC-845W	QCS1215109K		1.2			341-0052-03	ok
mds9222i-1	Fan Module-1	DS-2SLOT-FAN	DCH12131591		4.0			800-24478-02	ok
mds9222i-2	Fan Module-1	DS-2SLOT-FAN	NWG111406BE		2.0			73-8339-06	ok
mds9216i-1	Fan Module-1	DS-2SLOT-FAN	NWG102707D6		2.0			73-8339-06	ok

16 rows, queried 3 switches

Figure 3-3 Checking the firmware versions for all devices in the fabric in the GUI

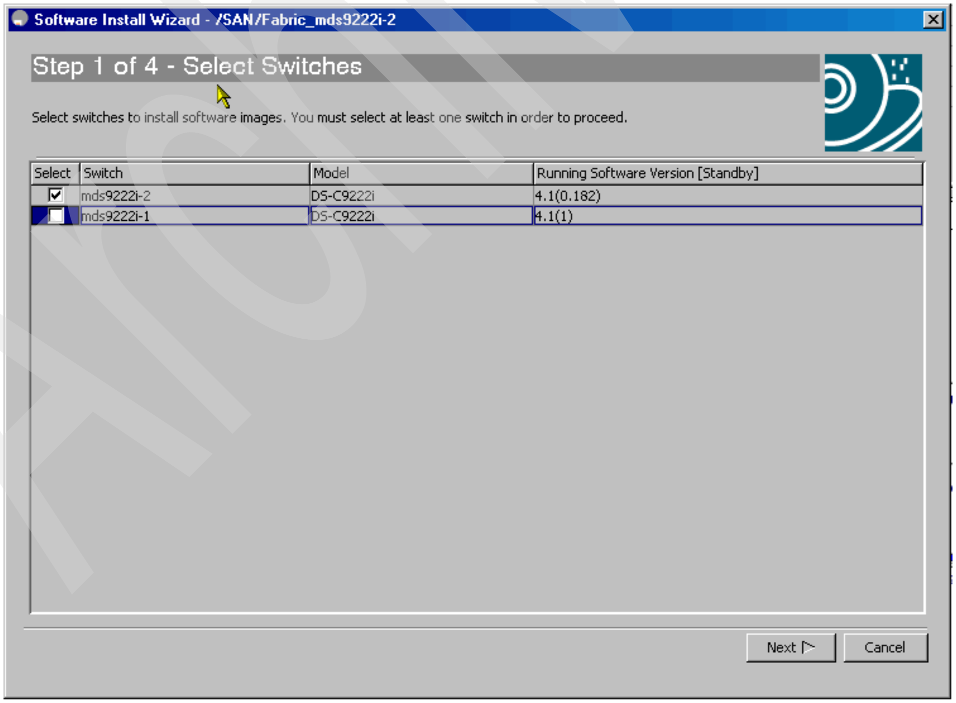
To start the process, invoke the Fabric Manager Software install wizard by clicking the icon, as shown in Figure 3-4.



Switch	Name	ModelName	Serial No Primary	Serial No Secondary	H/W Rev	S/W Rev
mds9222i-1	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX1216GP0C	JAB1217N34T	1.0	
mds9222i-2	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX111504SL		1.0	
mds9216i-1	MDS 9216i (2 Slot) Chassis	DS-C9216I-K9	FOX102900WM		2.0	
mds9222i-1	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE12088ZMT		1.1	4.1(1)
mds9222i-1	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1216EXLB		0.35	4.1(1)
mds9222i-2	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE1123KB46		0.610	4.1(1)
mds9222i-2	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1214DI4U		0.35	4.1(1)
mds9216i-1	2x1GE IPS, 14x1/2Gbps FC/Supervisor	DS-X9216I-K9	JAE1036AWD9		7.0	4.1(1)
mds9216i-1	IP Storage Services Module	DS-X9308-SMIP	JAE1016ZY50		7.0	4.1(1)

Figure 3-4   Upgrade using Fabric Manager

In step 1, the Software Install wizard prompts us to select which switches we want to upgrade. Choose the required switch upgrade and click **Next**, as shown in Figure 3-5.



Step 1 of 4 - Select Switches

Select switches to install software images. You must select at least one switch in order to proceed.

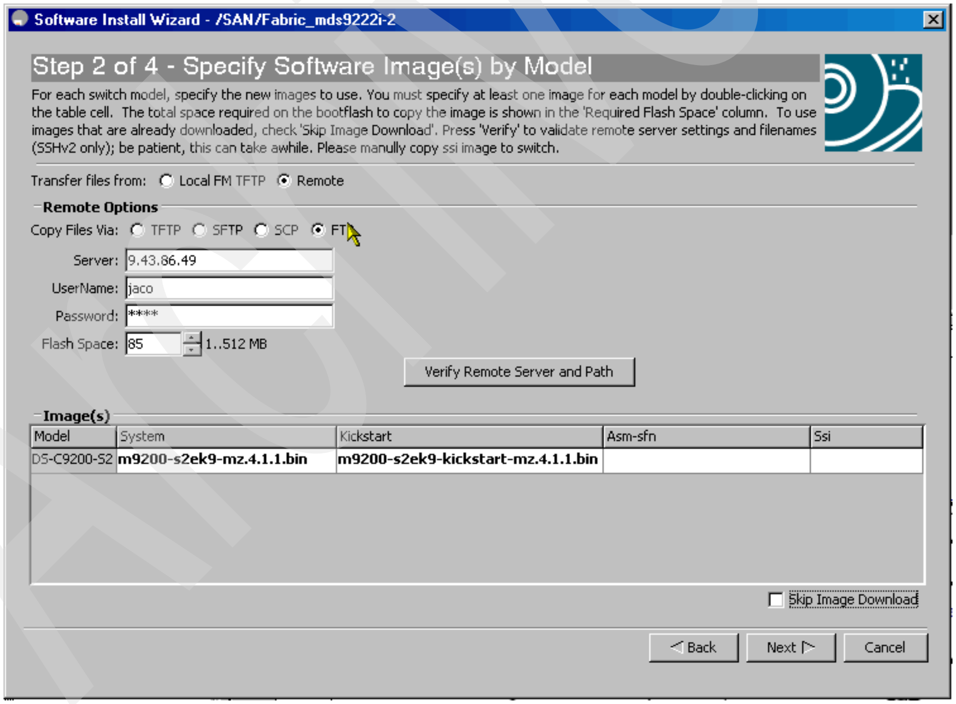
Select	Switch	Model	Running Software Version [Standby]
☑	mds9222i-2	DS-C9222i	4.1(0.182)
□	mds9222i-1	DS-C9222i	4.1(1)

Figure 3-5   Selecting the switches to upgrade

In step 2, the wizard prompts us for the location of the software that we want to install. Specify the FTP server where the *kickstart* and *system* images reside, the size of the images, and the login credentials for the FTP server, and click **Next,** as shown in Figure 3-6.

> **Note:** The complete path to the file location must be specified for this step to complete successfully.
>
> The wizard does not verify automatically whether the images match the specified size, but the value is used to verify whether the amount of corresponding free space is available on the bootflash prior to initiating the download.

> **Tip:** Click **Verify Remote Server and Path** to ensure that you can reach the source server.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 2 of 4 - Specify Software Image(s) by Model

For each switch model, specify the new images to use. You must specify at least one image for each model by double-clicking on the table cell. The total space required on the bootflash to copy the image is shown in the 'Required Flash Space' column. To use images that are already downloaded, check 'Skip Image Download'. Press 'Verify' to validate remote server settings and filenames (SSHv2 only); be patient, this can take awhile. Please manually copy ssi image to switch.

Transfer files from: ○ Local FM TFTP ● Remote

Remote Options

Copy Files Via: ○ TFTP ○ SFTP ○ SCP ● FT

Server: 9.43.86.49

UserName: jaco

Password: ****

Flash Space: 85 1..512 MB

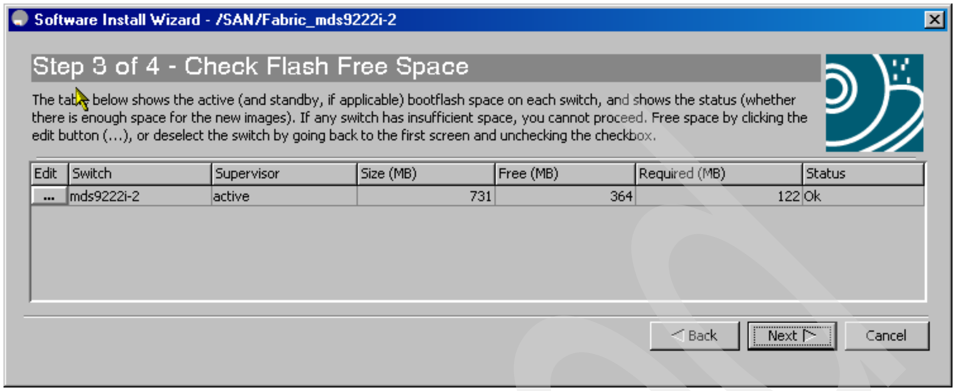
Image(s)

Model	System	Kickstart	Asm-sfn	Ssi
DS-C9200-S2	m9200-s2ek9-mz.4.1.1.bin	m9200-s2ek9-kickstart-mz.4.1.1.bin		

□ Skip Image Download

Figure 3-6 Specifying images and location

In step 3, the software install wizard verifies that the required free space is available on the bootflash, and we click **Next**, as shown in Figure 3-7.



Software Install Wizard - /SAN/Fabric_mds9222i-2

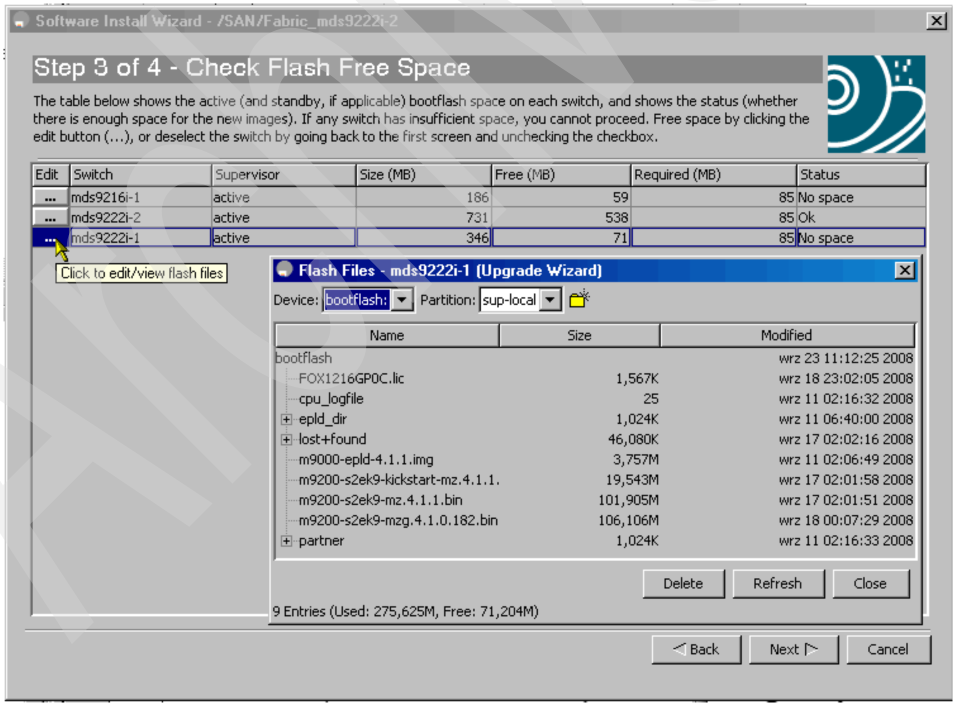
Step 3 of 4 - Check Flash Free Space

The table below shows the active (and standby, if applicable) bootflash space on each switch, and shows the status (whether there is enough space for the new images). If any switch has insufficient space, you cannot proceed. Free space by clicking the edit button (...), or deselect the switch by going back to the first screen and unchecking the checkbox.

Edit	Switch	Supervisor	Size (MB)	Free (MB)	Required (MB)	Status
...	mds9222i-2	active	731	364	122	Ok

Figure 3-7 Verifying required free space on bootflash

When you do not have enough free space to copy the files, just delete the previous version of files stored on the *bootflash*, as shown in Figure 3-8.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 3 of 4 - Check Flash Free Space

The table below shows the active (and standby, if applicable) bootflash space on each switch, and shows the status (whether there is enough space for the new images). If any switch has insufficient space, you cannot proceed. Free space by clicking the edit button (...), or deselect the switch by going back to the first screen and unchecking the checkbox.

Edit	Switch	Supervisor	Size (MB)	Free (MB)	Required (MB)	Status
...	mds9216i-1	active	186	59	85	No space
...	mds9222i-2	active	731	538	85	Ok
...	mds9222i-1	active	346	71	85	No space

Click to edit/view flash files

Flash Files - mds9222i-1 (Upgrade Wizard)

Device: bootflash: Partition: sup-local

Name	Size	Modified
bootflash		wrz 23 11:12:25 2008
FOX1216GP0C.lic	1,567K	wrz 18 23:02:05 2008
cpu_logfile	25	wrz 11 02:16:32 2008
epld_dir	1,024K	wrz 11 06:40:00 2008
lost+found	46,080K	wrz 17 02:02:16 2008
m9000-epld-4.1.1.img	3,757M	wrz 11 02:06:49 2008
m9200-s2ek9-kickstart-mz.4.1.1.	19,543M	wrz 17 02:01:58 2008
m9200-s2ek9-mz.4.1.1.bin	101,905M	wrz 17 02:01:51 2008
m9200-s2ek9-mzg.4.1.0.182.bin	106,106M	wrz 18 00:07:29 2008
partner	1,024K	wrz 11 02:16:33 2008

9 Entries (Used: 275,625M, Free: 71,204M)

Figure 3-8 Delete files from bootflash using Software Install Wizard

You can delete files from the bootflash using the Device Manager functionality, as shown in Figure 3-9 and Figure 3-10.

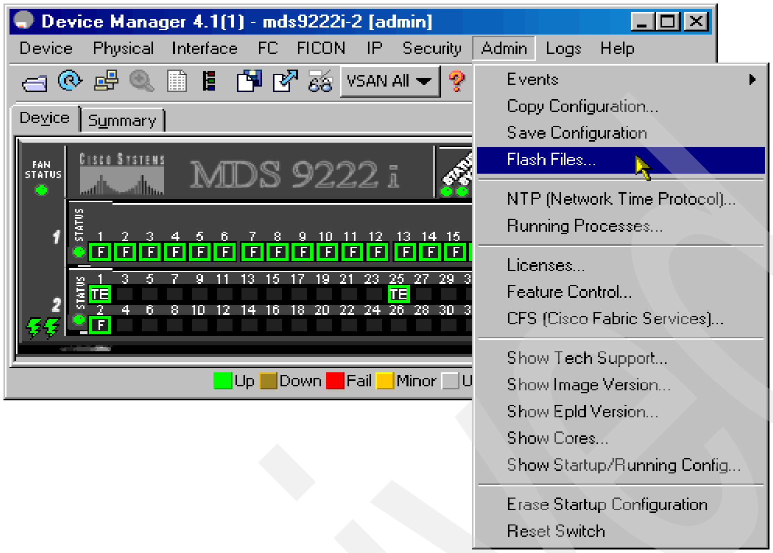
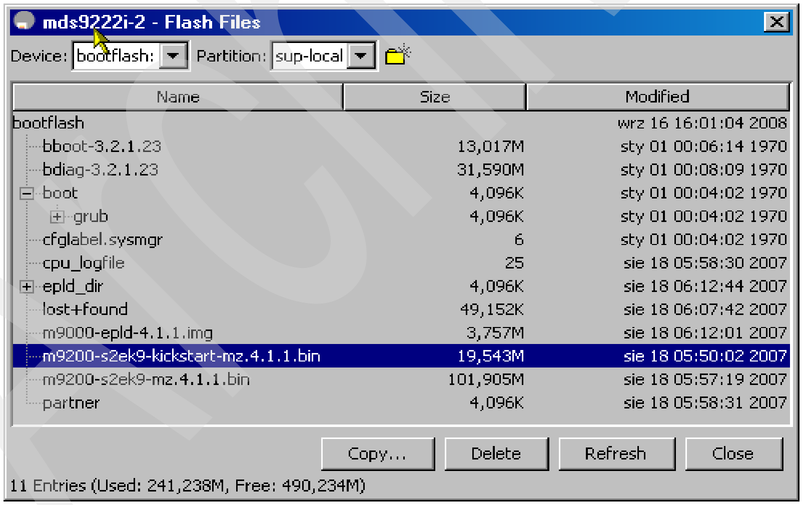


Figure 3-9 Flash Files option in the Device Manager



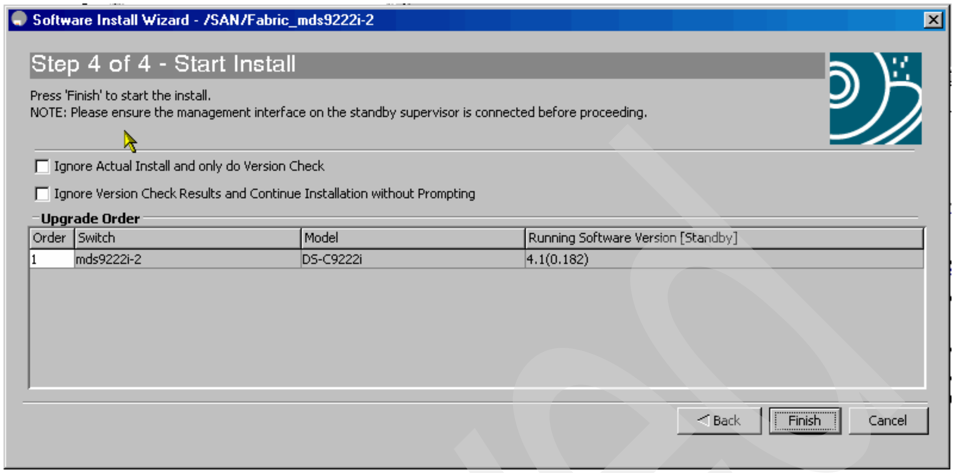
Device: bootflash: Partition: sup-local

Name	Size	Modified
bootflash		wrz 16 16:01:04 2008
bboot-3.2.1.23	13,017M	sty 01 00:06:14 1970
bdiag-3.2.1.23	31,590M	sty 01 00:08:09 1970
boot	4,096K	sty 01 00:04:02 1970
grub	4,096K	sty 01 00:04:02 1970
cfglabel.sysmgr	6	sty 01 00:04:02 1970
cpu_logfile	25	sie 18 05:58:30 2007
epld_dir	4,096K	sie 18 06:12:44 2007
lost+found	49,152K	sie 18 06:07:42 2007
m9000-epld-4.1.1.img	3,757M	sie 18 06:12:01 2007
m9200-s2ek9-kickstart-mz.4.1.1.bin	19,543M	sie 18 05:50:02 2007
m9200-s2ek9-mz.4.1.1.bin	101,905M	sie 18 05:57:19 2007
partner	4,096K	sie 18 05:58:31 2007

11 Entries (Used: 241,238M, Free: 490,234M)

Figure 3-10 Choose files to remove from the bootflash

Next we can start the installation using the GUI, as shown in Figure 3-11.



Step 4 of 4 - Start Install

Press 'Finish' to start the install.
NOTE: Please ensure the management interface on the standby supervisor is connected before proceeding.

□ Ignore Actual Install and only do Version Check

□ Ignore Version Check Results and Continue Installation without Prompting

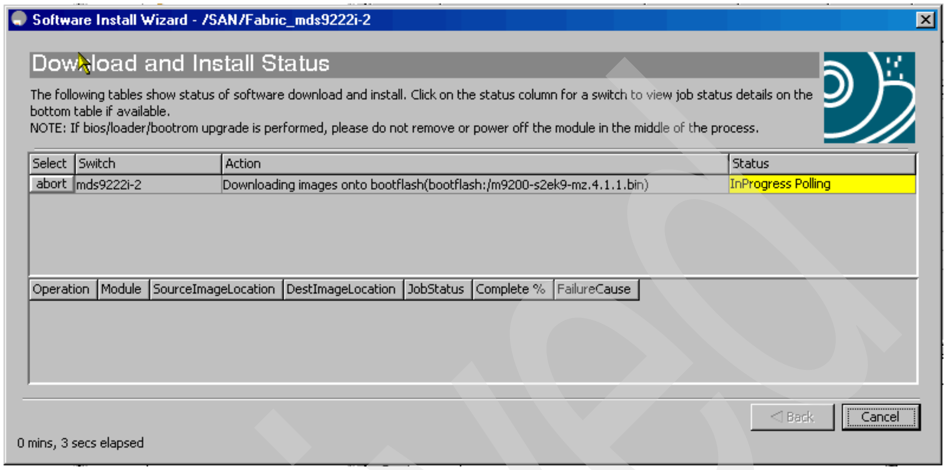
Upgrade Order

Order	Switch	Model	Running Software Version [Standby]
1	mds9222i-2	DS-C9222i	4.1(0.182)

Figure 3-11 Starting the installation for the MDS 9000 family switch

Note: If you want to perform the upgrade unattended, then in order to avoid being prompted to start the upgrade, you can check mark **Ignore versions check results**, as shown in Figure 3-11 on page 69. But in this case you must be sure that new firmware version is correct and all conditions are met.

After starting the installation, the image download process starts, and upon completion bootflash synchronization and compatibility checks are performed, as shown in Figure 3-12.



Download and Install Status

The following tables show status of software download and install. Click on the status column for a switch to view job status details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not remove or power off the module in the middle of the process.

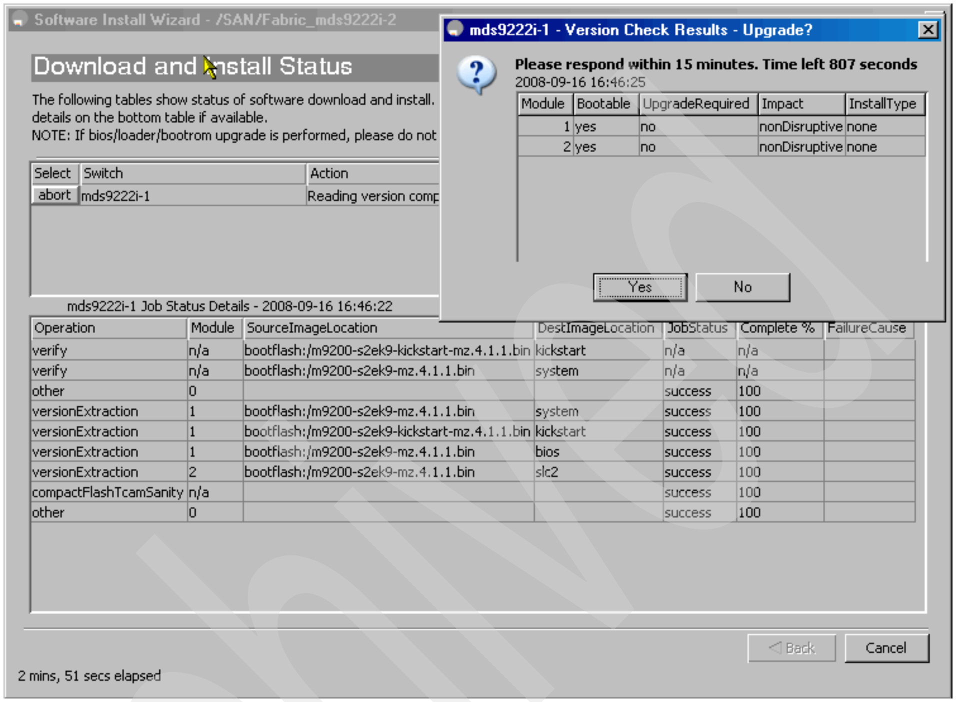
Select	Switch	Action	Status
abort	mds9222i-2	Downloading images onto bootflash(bootflash:/m9200-s2ek9-mz.4.1.1.bin)	InProgress Polling

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause

0 mins, 3 secs elapsed

Figure 3-12 Compatibility checks and synchronization before the upgrade process starts

When the wizard is ready to start the upgrade, we are prompted to click **Yes** (within a time-out period of 5 minutes) to start the upgrade, as shown in Figure 3-13.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Download and Install Status

The following tables show status of software download and install. details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not

Select	Switch	Action
abort	mds9222i-1	Reading version comp

mds9222i-1 Job Status Details - 2008-09-16 16:46:22

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause
verify	n/a	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	n/a	n/a	
verify	n/a	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	n/a	n/a	
other	0			success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	bios	success	100	
versionExtraction	2	bootflash:/m9200-s2ek9-mz.4.1.1.bin	slc2	success	100	
compactFlashTcamSanity	n/a			success	100	
other	0			success	100	

2 mins, 51 secs elapsed

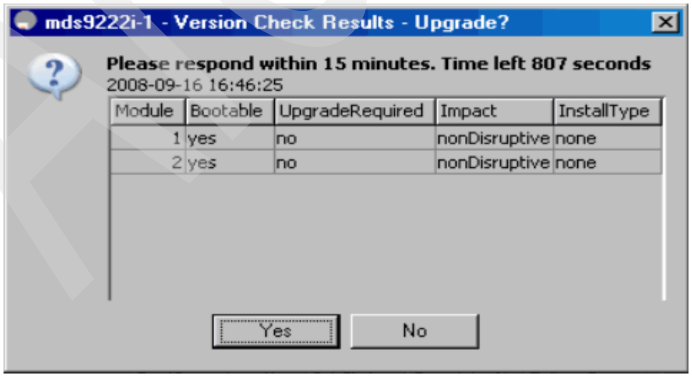
mds9222i-1 - Version Check Results - Upgrade?

Please respond within 15 minutes. Time left 807 seconds
2008-09-16 16:46:25

Module	Bootable	UpgradeRequired	Impact	InstallType
1	yes	no	nonDisruptive	none
2	yes	no	nonDisruptive	none

Figure 3-13 Verification after compatibility checks before running an upgrade process

As shown in Figure 3-14, we are prompted to confirm that we want to start the upgrade process.



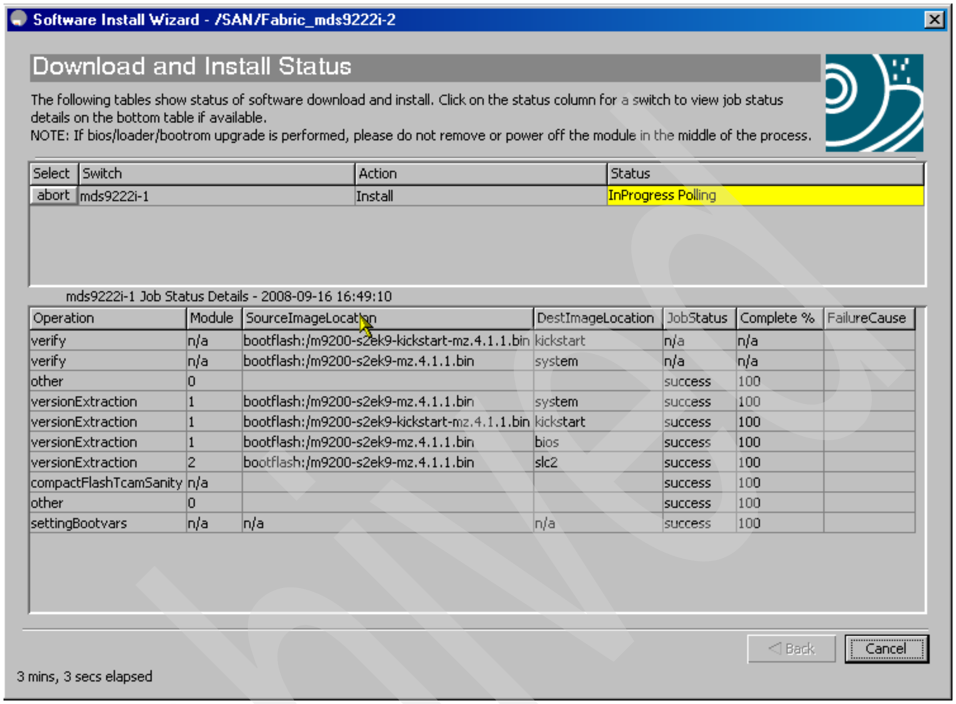
mds9222i-1 - Version Check Results - Upgrade?

Please respond within 15 minutes. Time left 807 seconds
2008-09-16 16:46:25

Module	Bootable	UpgradeRequired	Impact	InstallType
1	yes	no	nonDisruptive	none
2	yes	no	nonDisruptive	none

Figure 3-14 Version Check Results

As shown in Figure 3-15, the installation process step-by-step status is continuously displayed and we can monitor it and verify the progress.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Download and Install Status

The following tables show status of software download and install. Click on the status column for a switch to view job status details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not remove or power off the module in the middle of the process.

Select	Switch	Action	Status
abort	mds9222i-1	Install	InProgress Polling

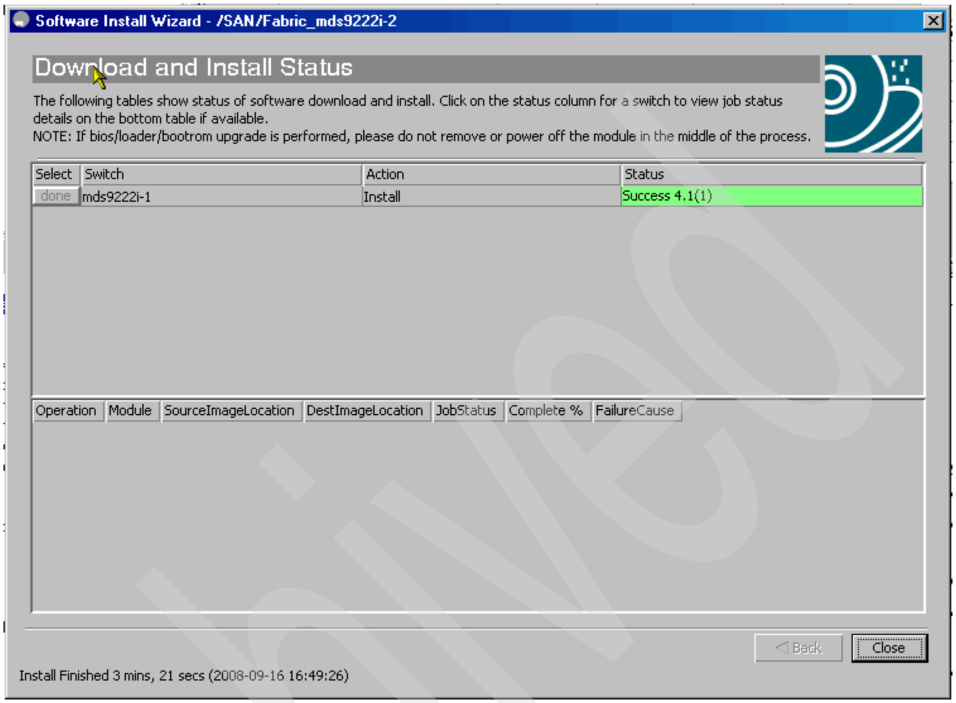
mds9222i-1 Job Status Details - 2008-09-16 16:49:10

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause
verify	n/a	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	n/a	n/a	
verify	n/a	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	n/a	n/a	
other	0			success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	bios	success	100	
versionExtraction	2	bootflash:/m9200-s2ek9-mz.4.1.1.bin	slc2	success	100	
compactFlashTcamSanity	n/a			success	100	
other	0			success	100	
settingBootvars	n/a	n/a	n/a	success	100	

3 mins, 3 secs elapsed

Figure 3-15 Monitoring the installation progress

In the last step, when the installation completes, we can see the status of the upgrade process, as shown in Figure 3-16.



Download and Install Status

The following tables show status of software download and install. Click on the status column for a switch to view job status details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not remove or power off the module in the middle of the process.

Select	Switch	Action	Status
done	mds9222i-1	Install	Success 4.1(1)

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause

Install Finished 3 mins, 21 secs (2008-09-16 16:49:26)

Figure 3-16 Upgrade completed successfully

The upgrade has completed successfully.

4

Management tools

In this chapter we describe some of the useful features of the Cisco management tools.

4.1 Management tools

For switch and fabric management of the Cisco MDS 9000 family, both a command-line interface (CLI) and a graphical user interface (GUI) are available. The CLI uses Telnet, Secure Shell (SSH), or a serial console, while the GUI-based Fabric Manager toolset uses Simple Network Management Protocol (SNMP) when accessing the switches.

Previously, the Cisco Fabric Manager and Cisco Device Manager software was embedded in every Cisco MDS 9000 family switch. This software was downloaded and installed automatically through Java Web Start when you accessed a switch through a supported Java-enabled Web browser, such as Windows Internet Explorer or Netscape Navigator.

SAN-OS Release 3.2(1) brought about a major change in how Fabric Manager Software is upgraded and installed. Fabric Manager is no longer packaged with a Cisco MDS 9000 family switch. You can use an installation media as a compact disc read-only memory (CD-ROM) or you can download Fabric Manager from the Cisco Web site.

4.1.1 Launching the CLI

There are multiple connection options and protocols available to manage the MDS 9000 family switches via the CLI. The initial configuration must be done using a VT100 console access. VT100 console access can be a direct connection or serial link connection such as a modem. Once the initial configuration is complete you can access the switch using either Secure Shell or Telnet.

Secure Shell (SSH) protocol provides a secure encrypted means of access. Terminal Telnet access involves a TCP/IP Out-of-Band (OOB) connection through the 10/100 MB Ethernet port or an in-band connection via IP over FC.

You can access the MDS 9000 family of switches for configuration, status, or management through the console port and initiate a Telnet session through the OOB Ethernet management port or through the in-band IP over FC management feature.

The console port is an asynchronous port with a default configuration of 9600 bps, 8 data bits, no parity, and 1 stop bit. This port is the only means of accessing the switch after the initial power up until an IP address is configured for the management port.

Once an IP address is configured, you can Telnet to the switch through the management Mgmt0 interface on the supervisor card.

In-band IP over FC is used to manage remote switches through the local Mgmt0 interface.

The CLI enables you to configure every feature of the switch. More than 1,700 combinations of commands are available and are structurally consistent with the style of Cisco IOS software CLI.

The CLI help facility provides:

- Context-sensitive help: Provides a list of commands and associated arguments. Type a question mark (`?`) at any time or type part of a command and type `?`.
- Command completion: The Tab key completes the keyword that you have started typing.
- Console error messages: Identify problems with any switch commands that are incorrectly entered so that they may be corrected or modified.
- Command history buffer: Allows recalling of long or complex commands or entries for reentry, renewing, or correction.
- MDS Command Scheduler: Provides a UNIX® *cron*-like facility in the SAN-OS that allows the user to schedule a job at a particular time or periodically.

Configuration changes must be explicitly saved, and configuration commands are serialized for execution across multiple SNMP sessions. To save the configuration, enter the copy **`runningconfig startup-config`** command from the config mode prompt to save the new configuration into nonvolatile storage. Once this command is issued, the running and the startup copies of the configuration are identical.

Every configuration command can be logged to the RADIUS server.

4.1.2 Command mode levels

Switches in the MDS 9000 family have three command mode levels, as shown in Figure 4-1:

- User EXEC mode
- Configuration mode
- Configuration submodes

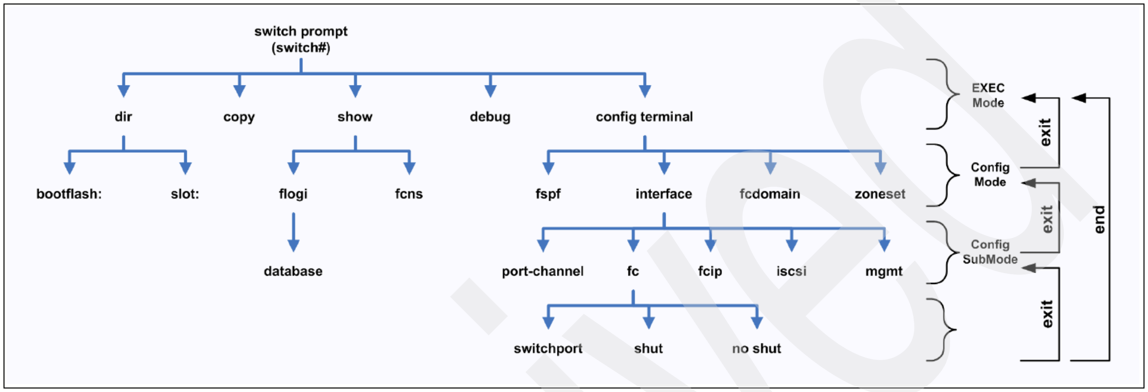


Figure 4-1 The CLI hierarchy

The commands available to you depend on the mode that you are in. To obtain a list of available commands, type a question mark (?) at the system prompt.

Exec mode

From the EXEC mode, you can perform basic tests and display system information. This includes operations other than configuration such as **show** and **debug**. **Show** commands display system configuration and information. **Debug** commands enable printing of debug messages for various system components. Changes made in EXEC mode are generally not saved across system resets (that is, they are not saved to the startup config).

By default, you enter the user EXEC mode when logging on to a switch using the CLI. When in EXEC mode, the prompt is *SwitchName#*.

Configuration mode

Use the config or config terminal command from EXEC mode to go into the configuration mode. The configuration mode has a set of configuration commands that can be entered after a config terminal command in order to set up the switch. The configuration mode enables you to configure features that affect the system as a whole. Changes made in this mode are saved across system resets if you save your configuration (save to startup configuration).

To enter the config mode when in EXEC mode, we enter the command **config terminal** and the prompt changes to *SwitchName(config)#*.

To return to EXEC mode when in config mode, use the command **end** or press Ctrl+z.

The CLI commands are organized hierarchically, with commands that perform similar functions grouped under the same level. For example, all commands that display information about the system, configuration, or hardware are grouped under the **show** command, and all commands that allow you to configure the switch are grouped under the **config terminal** command, which includes switch sub-parameters at the configuration submode level. The CLI hierarchy is shown in Figure 4-1 on page 78.

To execute a command, you enter the command by starting at the top level of the hierarchy. For example, to configure a Fibre Channel interface, use the **config terminal** command. Once you are in configuration mode, issue the **interface** command. When you are in the interface submode, you can query the available commands there.

Apart from invoking the CLI from the Device Manager or GUI interfaces, we can connect to the switch using either Telnet, SSH, or a serial connection physically connected to the switch. In Example 4-1 we connect to the switch via Telnet.

Example 4-1 Connecting via Telnet

```
[root@Palau tmp]# ssh -l admin 9.43.86.147
User Access Verification
Password:
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under
license. Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or the GNU
Lesser General Public License (LGPL) Version 2.1. A copy of each
such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://www.opensource.org/licenses/lgpl-2.1.php
mds9222i-1#
```

Using the CLI provides you with the possibility to perform management tasks using scripts that access the switch utilizing the CLI.

Tip: You can abbreviate commands and keywords by entering just enough characters to make the command unique from other commands. For example, you can abbreviate the **`config terminal`** command to **`conf t`**.

Note: The Cisco MDS 9000 family CLI command structure is very similar to that of the Cisco Internetwork Operating System (IOS) commands.

Command aliases

Some commands can require a lot of typing. An example of this is gigabit Ethernet that can sometimes be shortened to gig, but it is sometimes useful to group several commands and subcommands together. This can be done using command aliases.

Command aliases are saved in NVRAM and so can persist across reboots.

When creating an alias, the individual commands must be typed in fully without abbreviation.

If you define an alias, it will take precedence over CLI keywords starting with the same letters, so be careful when using abbreviations. An example of creating an alias is shown in Example 4-2.

Example 4-2 Creating a command alias from the CLI

```
mds9222i-1# configure terminal
mds9222i-1(config)# cli alias name gigint interface gigabitethernet
mds9222i-1(config)# gigint 1/2
mds9222i-1(config-if)#
```

Command Scheduler

The Cisco MDS SAN-OS provides a UNIX kron-like facility called the Command Scheduler.

Jobs can be defined listing several commands that are to be executed in order.

Jobs can be scheduled to run at the same time every day, week, month or at a user-configurable frequency (delta).

All jobs are executed non-interactively, without administrator response.

Be aware that a job may fail if a command that is issued is disabled or no longer supported, because a license may have expired. The job will fail at the point of error, and all subsequent commands will be ignored.

4.1.3 System management using the GUI management tools

The Cisco Fabric Manager provides an alternative to the command-line interface for most switch configuration commands. It provides powerful Fibre Channel troubleshooting tools. These in-depth health and configuration analysis capabilities leverage unique MDS 9000 switch capabilities: Fibre Channel **`ping`** and **`traceroute`**.

The Cisco Fabric Manager includes these management applications:

- Fabric Manager (client and server)
- Device Manager
- Performance Manager
- Fabric Manager Web Server

Fabric Manager is an SNMP-based device management application with a Java Web-based GUI to view and configure multiple MDS 9000 family director and fabric switches. Secure SNMPv3 communications are used to obtain and set switch parameters.

Fabric Manager provides three management views and a Performance Manager traffic analysis interface:

- The fabric view displays a map of your network fabric, including Cisco MDS 9000 switches, hosts, and storage devices.
- The device view displays a graphic representation of the switch configuration and provides access to statistics and configuration information for a single switch.
- The summary view displays a summary of xE_Ports (interswitch links), Fx_Ports (fabric ports), and Nx_Ports (attached hosts and storage) on a single switch.

For more detailed information, Performance Manager included with the Fabric Manager Server license provides detailed traffic analysis by capturing data with the Cisco Port Analyzer Adapter. This data is compiled into various graphs and charts that can be viewed with any Web browser.

Cisco Device Manager is used to manage a single switch. To open Device Manager, just double-click the green icon for a switch in the Fabric Manager topology view.

Cisco MDS 9000 Fabric Manager 3.x

The Cisco Fabric Manager 3.x for SAN-OS 3.x is included with the Cisco MDS 9000 family of switches prior to Version 3.2(1) and is a Java and SNMP-based network fabric and device management tool. It provides a GUI that displays real-time views of your SAN fabric and installed devices. Fabric Manager provides an alternative to the CLI for most switch configuration commands.

Cisco MDS 9000 Fabric Manager 4.x

The new version of Fabric Manager 4.x will be released along with a new version of the MDS operating system NX-OS 4.x. All features will be available in the Cisco MDS NX-OS 4.x and SAN-OS Release 3.x.

Table 4-1 shows the new and changed features of Fabric Manager for SAN-OS 3.x and NX-OS 4.x.

Table 4-1 Features of the Fabric Manager 4.x for SAN-OS 3.x and NX-OS 4.x

Feature	Description	Changed in Release
Supported platforms Information and FM Express Install	The server platforms supported for Cisco Fabric Manager have been revised.	4.1(1)
Inventory Report Enhancements	The FMS inventory switch detail report has been enhanced to include a number of summary statistics useful for creating a more comprehensive SAN health report.	4.1(1)
Server Admin Tool	The Server Admin perspective view limits the scope of Fabric Manager to Flex Attach configuration and relevant data.	4.1(1)
DPVM Wizard	New pages added.	4.1(1)
Flex Attach Configuration by Server Administrators	Procedures to use the Flex Attach wizards for preconfiguring all or selected ports, moving a server to a different port or switch, and replacing a server in the same or a different port or switch.	4.1(1)
IP Static Peers for CFS over IP	Added IP static peers configuration steps for CFS distribution over IP.	4.1(1)
Generation 3 48-Port, 24-Port, and 4/44-Port 8-Gbps Fibre Channel modules configuration	Added configuration guidelines that include port groups, port rate modes, BB_credit buffer allocation, port speed configuration, over subscription ratio restrictions, combining with earlier generation modules, upgrade and downgrade considerations, cross bar management, port channel interface configuration, example configurations, and default settings.	4.1(1)
Call Home	Added the delayed traps enhancements.	4.1(1)

Feature	Description	Changed in Release
Performance Manager	Added the flow creation wizard for performance manager.	4.1(1)

Cisco Fabric Manager 4.x has been tested with the following software:

- Operating systems
  - Windows 2003 SP2, Windows XP SP2, Windows XP SP3, Windows Vista SP1 (Enterprise edition)
  - Red Hat Enterprise Linux AS Release 4
  - Solaris (SPARC) 8, 9, and 10
  - VMWare ESX Server 3.5
- Java
  - Sun JRE and JDK 1.5(x) and 1.6(x) is supported
  - Java Web Start 1.5 and 1.6
- Browsers
  - Internet Explorer 6.x and 7.0
  - Firefox 1.5 and 2.0
  - Mozilla 1.7 (packaged with Solaris 9)
- Databases
  - Oracle Database 10g Express, Oracle Enterprise Edition 10g
  - PostgreSQL 8.2 (Windows and Red Hat Enterprise Linux AS Release 4)
  - PostgreSQL 8.1 (Solaris 8, 9 and 10)
- Security
  - Cisco ACS 3.1 and 4.0
  - PIX Firewall
  - IP Tables
  - SSH v2
  - Global Enforce SNMP Privacy Encryption
  - HTTPS

Important: Internet Explorer 7.0 is not supported on Windows 2000 SP4.

Minimum hardware requirements for Fabric Manager 4.x

For a PC running Fabric Manager Server on large fabrics (1,000 or more end devices), we recommend using a dual core/dual CPU high-speed system with 2 GB of RAM and 10 GB of free disk space.

FlexAttach functionality in Fabric Manager 4.x

The FlexAttach virtual pWWN feature facilitates server and configuration management. In a SAN environment, the server installation or replacement requires interaction and coordination among the SAN and server administrators. For coordination, it is important that the SAN configuration does not change when a new server is installed or when an existing server is replaced. FlexAttach minimizes the interaction between the server administrator and the SAN administrator by abstracting the real pWWN using virtual pWWNs.

When FlexAttach virtual pWWN is enabled on an interface, a virtual pWWN is assigned to the server interface. The real pWWN is replaced by a virtual pWWN, which is used for a SAN configuration such as zoning.

Server administrators can benefit from FlexAttach in the following ways:

- Preconfigure: Preconfigure SAN for new servers that are not available physically yet. FlexAttach can be enabled on the ports designated for the new servers and use the virtual WWNs assigned for configuring SAN. The new servers are then plugged into the fabric without any change needed in the SAN.
- Replacement to the same port: A failed server can be replaced onto the same port without changing the SAN. The new server gets the same pWWN as the failed server because the virtual pWWN is assigned to the port.
- Replacement to (spare): A spare server, which is on the same NPV device or a different NPV device) can be brought online without changes to the SAN. This action is achieved by moving the virtual port WWN from the current server port to the spare port.
- Server Mobility: A server can be moved to another port on the same NPV device or another NPV device without changing the SAN. This is accomplished by moving the virtual pWWN to the new port. No change is needed if FlexAttach was configured using the physical port WWN of the server to the virtual port WWN mapping.

We recommend the following when deploying FlexAttach virtual pWWN:

- FlexAttach configuration is supported only on NPV switches.
- Cisco Fabric Services (CFS) IP Version 4 (IPv4) distribution should be enabled.
- Virtual WWNs should be unique across the fabric.

4.1.4 Fabric Manager Server

The Fabric Manager Server component must be started before running Fabric Manager. On a PC machine, the Fabric Manager Server is installed as a service. Fabric Manager Server is responsible for the discovery of the physical and logical fabric, and for listening for SNMP traps, syslog messages, and Performance Manager threshold events.

Install Cisco Fabric Manager Server on a computer on which you want to provide centralized MDS management services and performance monitoring. SNMP operations are used to efficiently collect fabric information. Fabric Manager software, including the server components, requires about 60 MB of hard disk space on your workstation. Fabric Manager Server runs on Windows 2000, Windows 2003, Windows XP, Solaris 8 and 10, and Red Hat Enterprise Linux AS Release 4.

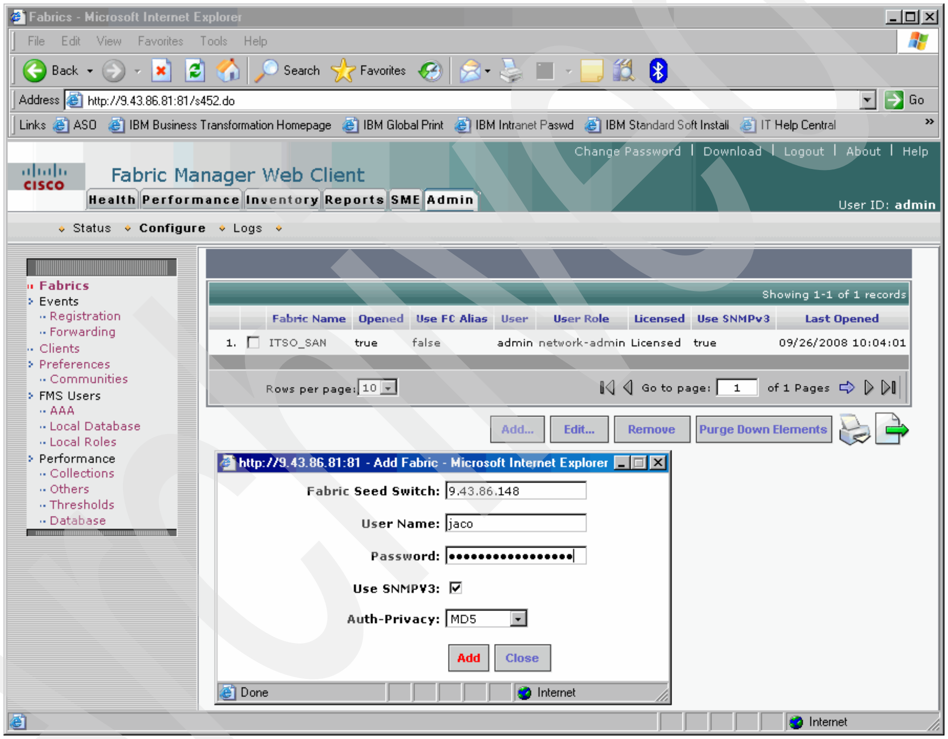
Each computer configured as a Fabric Manager Server can monitor multiple Fibre Channel SAN fabrics. Up to 16 clients (by default) can connect to a single Fabric Manager Server concurrently. The Fabric Manager Clients can also connect directly to an MDS switch in fabrics that are not monitored by a Fabric Manager Server, which ensures that you can manage any of your MDS devices from a single console.

Fabric Manager Server has the following features:

- Multiple fabric management: Fabric Manager Server monitors multiple physical fabrics under the same user interface. This facilitates managing redundant fabrics. A licensed Fabric Manager Server maintains up-to-date discovery information on all configured fabrics so device status and interconnections are immediately available when you open the Fabric Manager Client.
- Continuous health monitoring: MDS health is monitored continuously, so any events that occurred since the last time that you opened the Fabric Manager Client are captured.
- Roaming user profiles: The licensed Fabric Manager Server uses the roaming user profile feature to store your preferences and topology map layouts on the

server so that your user interface will be consistent regardless of which computer you use to manage your storage networks.

> **Note:** The unlicensed Fabric Manager Server can only monitor and configure one fabric at a time. You must use the Admin tab and the Configure option to switch to a new fabric, which causes the application to stop monitoring the previous one and to rediscover the new fabric, as shown in Figure 4-2 on page 86. When you have the unlicensed Fabric Manager Server you must remove the currently monitored fabric before you add a new one.



Fabrics - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s452.do Go
Links ASO IBM Business Transformation Homepage IBM Global Print IBM Intranet Paswd IBM Standard Soft Install IT Help Central
cisco
Fabric Manager Web Client
Change Password | Download | Logout | About | Help
Health Performance Inventory Reports SME Admin
User ID: admin
Status Configure Logs
Fabrics
Events
Registration
Forwarding
Clients
Preferences
Communities
FMS Users
AAA
Local Database
Local Roles
Performance
Collections
Others
Thresholds
Database
Showing 1-1 of 1 records
Rows per page: 10
Go to page: 1 of 1 Pages
Add... Edit... Remove Purge Down Elements
http://9.43.86.81:81 - Add Fabric - Microsoft Internet Explorer
Add Close
Done Internet
Internet

		Fabric Name	Opened	Use FC Alias	User	User Role	Licensed	Use SNMPv3	Last Opened
1.	□	ITSO_SAN	true	false	admin	network-admin	Licensed	true	09/26/2008 10:04:01

Fabric Seed Switch: 9.43.86.148

User Name: jaco

Password: ••••••••••••••••

Use SNMPV3: ☑

Auth-Privacy: MD5

Figure 4-2 Adding a new fabric to monitor in the Fabric Manager Web Client

4.1.5 Fabric Manager Client

Fabric Manager is a Java and SNMP-based network fabric and device management tool with a GUI that displays real-time views of your network fabric, including the MDS 9000 family and third-party switches, hosts, and storage devices.

In addition, to complete configuration and status monitoring capabilities for the MDS 9000 family of switches, Fabric Manager Client provides Fibre Channel troubleshooting tools. These health and configuration analysis tools use the MDS 9000 switch capabilities including Fibre Channel **`ping`** and **`traceroute`**.

Fabric Manager Release 4.1(1) and later provides a multi-level security system by adding a server admin role that allows access to limited features. The configuration capabilities of a server admin is limited to FlexAttach and relevant data. FlexAttach is a new feature in Fabric Manager 4.x and has been described in 4.1.3, “System management using the GUI management tools” on page 81.

4.1.6 Fabric Manager Server proxy services

Fabric Manager Client and Device Manager use SNMP to communicate with the Fabric Manager Server. In typical configurations, the Fabric Manager Server may be installed behind a firewall. The SNMP proxy service available in Fabric Manager Release 2.1(1a) or later provides a TCP-based transport proxy for these SNMP requests.

The SNMP proxy service allows you to block all UDP traffic at the firewall and configure Fabric Manager Client to communicate over a configured TCP port. Fabric Manager uses the CLI for managing some features on the switches. These management tasks are used by Fabric Manager and do not use the proxy services. Your firewall *must* remain open for CLI access for the following:

- External and internal loopback test
- Flash files
- Create CLI user
- Security: ISCSI users
- Show image version
- Show tech
- Switch resident reports (syslog, accounting)
- Zone migration
- Show cores

If you are using the SNMP proxy service and another application on your server is using port 9198, you must modify your workstation settings.

4.1.7 Device Manager

Device Manager presents two views of a single switch:

- The device view displays a graphic representation of the switch configuration and provides access to statistics and configuration information.
- The summary view displays a summary of xE ports (Inter-Switch Links), Fx ports (fabric ports), and Nx ports (attached hosts and storage) on the switch, as well as Fibre Channel and IP neighbor devices.

A summary or detailed statistics can be charted, printed, or saved to a file in tab-delimited format.

4.1.8 Performance Manager

Performance Manager gathers network device statistics historically and provides this information graphically using a Web browser. It presents recent statistics in detail and older statistics in summary. Performance Manager also integrates with external tools such as Cisco Traffic Analyzer.

Performance Manager has three operational stages:

- Definition: The Flow Wizard sets up flows in the switches.
- Collection: The Web Server Performance Collection window collects information about desired fabrics.
- Presentation: Generates Web pages to present the collected data through Fabric Manager Web Server.

Performance Manager can collect statistics for Inter-Switch Links (ISLs), hosts, storage elements, and configured flows. Flows are defined based on a host-to-storage (or storage-to-host) link.

Performance Manager gathers statistics from across the fabric based on collection configuration files. These files determine which SAN elements and SAN links Performance Manager gathers statistics for. Based on this configuration, Performance Manager communicates with the appropriate devices (switches, hosts, or storage elements) and collects the appropriate information at fixed five-minute intervals.

Performance Manager uses a round-robin database to hold the statistical data collected from the fabric. This data is stored based on the configured parameters in the collection configuration file. At each polling interval, Performance Manager gathers the relevant statistics and stores them in the round-robin database. This database is a fixed size and will not grow beyond its preset limits.

Performance Manager creates a series of archived data to hold summarized information present in the real-time round-robin database. This archived data is used to generate daily, weekly, monthly, and yearly consolidated reports. In this way, Performance Manager maintains significant historical data without the cost of an ever-increasing database size.

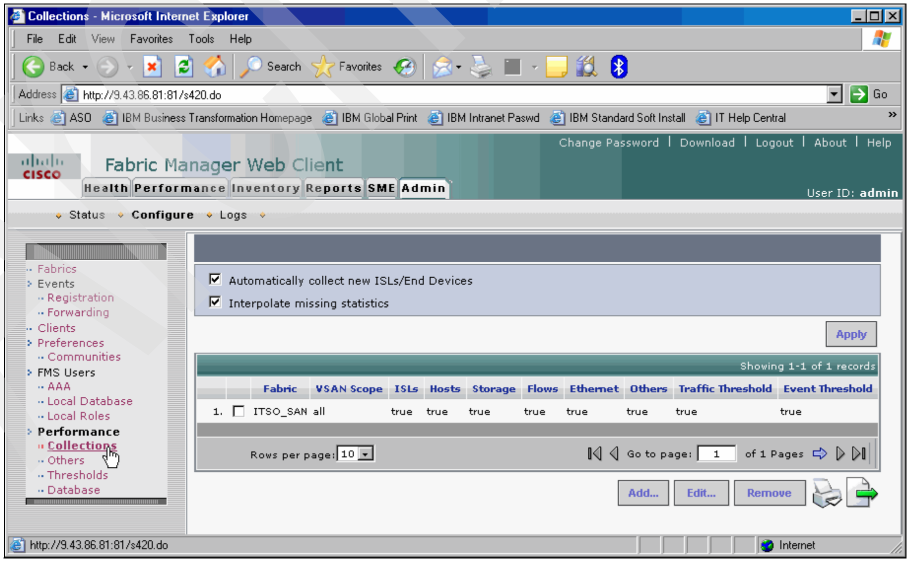
4.1.9 Fabric Manager Web Server

Fabric Manager Web Server allows operators to monitor and obtain reports for MDS events, performance, and inventory from a remote location using a Web browser.

Using Fabric Manager Web Server, you can monitor MDS switch events, performance, and inventory, and perform minor administrative tasks.

Fabric Manager Web Server provides the following features:

- Summary and drill-down reports: The Performance Manager summary report provides a high-level view of your network performance. These reports list the average and peak throughput and provide hot-links to additional performance graphs and tables with additional statistics. Both tabular and graphical reports are available for all interconnections monitored by Performance Manager. Performance Manager also analyzes daily, weekly, monthly, and yearly trends. These reports are only available if you create a collection using Performance Manager and start the collector as shown in Figure 4-3.


Collections - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address
Go
Links ASO IBM Business Transformation Homepage IBM Global Print IBM Intranet Paswd IBM Standard Soft Install IT Help Central
Change Password | Download | Logout | About | Help
cisco
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Status Configure Logs
Fabrics
Events
Registration
Forwarding
Clients
Preferences
Communities
FMS Users
AAA
Local Database
Local Roles
Performance
Collections
Others
Thresholds
Database
Apply
Add... Edit... Remove
Internet

Address: http://9.43.86.81:81/s420.do

☑ Automatically collect new ISLs/End Devices

☑ Interpolate missing statistics

Showing 1-1 of 1 records

		Fabric	VSAN Scope	ISLs	Hosts	Storage	Flows	Ethernet	Others	Traffic Threshold	Event Threshold
1.	□	ITSO_SAN	all	true	true	true	true	true	true	true	true

Rows per page: 10   Go to page: 1 of 1 Pages

http://9.43.86.81:81/s420.do

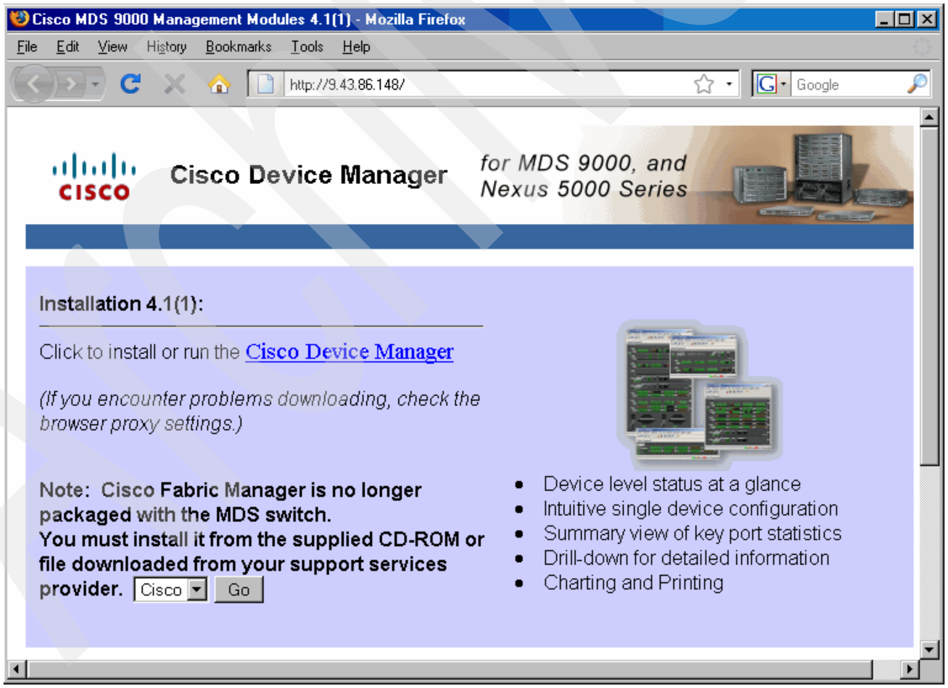
Figure 4-3 Configure performance collection in the Cisco Fabric Manager Web Client

- Zero maintenance database for statistics storage: No maintenance is required to maintain Performance Manager's round-robin database because its size does not grow over time. At prescribed intervals the oldest samples are averaged (rolled-up) and saved. A full two days of raw samples are saved for maximum resolution. Gradually, the resolution is reduced as groups of the oldest samples are rolled up together.

4.2 Fabric Manager software install

The Fabric Manager install process *prior* to Version 3.2(1) was propagated from the switch Web interface. From Fabric Manager 3.2(1) onwards, it is the first version to be delivered on a CD-ROM. All installation steps and tests will be done with Fabric Manager Version 4.1(1).

Be aware that if you try to install as you used to previously by pointing your Web browser to the switch name or IP address, you will get a message similar to the one shown in Figure 4-4.


Cisco MDS 9000 Management Modules 4.1(1) - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://9.43.86.148/
Google
CISCO
Cisco Device Manager
for MDS 9000, and
Nexus 5000 Series

Installation 4.1(1):

Click to install or run the Cisco Device Manager

(If you encounter problems downloading, check the browser proxy settings.)

Note: Cisco Fabric Manager is no longer packaged with the MDS switch.
You must install it from the supplied CD-ROM or file downloaded from your support services provider. Cisco Go

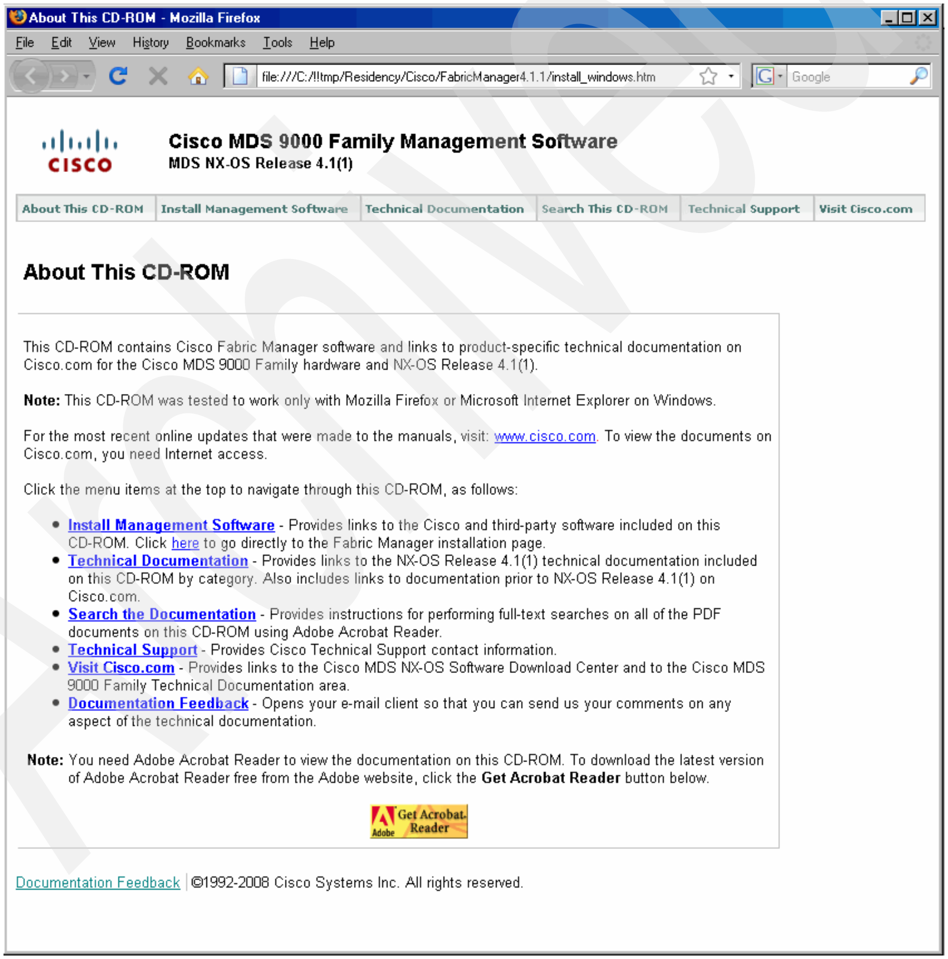
- Device level status at a glance
- Intuitive single device configuration
- Summary view of key port statistics
- Drill-down for detailed information
- Charting and Printing

Figure 4-4 Cisco Device Manager for MDS 9000 family Installation Web page

Fabric Manager Software for Windows launches if autorun is enabled when the CD is placed in the CD-ROM drive. Alternatively, you can point your browser to install _windows.htm to access the documentation and install the software from the CD-ROM.

Once we load the CD-ROM, we see the initial MDS 9000 family Product CD-ROM Web page, as shown in Figure 4-5.

> **Note:** The contents of the CD-ROM were copied to the server's internal disk in our example. Also, the CD-ROM is a source of documentation, and it contains other tools such as Java, PostgreSQL, and Ethereal.


About This CD-ROM - Mozilla Firefox
File Edit View History Bookmarks Tools Help
file:///C:/!!tmp/Residency/Cisco/FabricManager4.1.1/install_windows.htm
Google
cisco
About This CD-ROM
Install Management Software
Technical Documentation
Search This CD-ROM
Technical Support
Visit Cisco.com
Get Acrobat Reader
Adobe

Cisco MDS 9000 Family Management Software
MDS NX-OS Release 4.1(1)

About This CD-ROM

This CD-ROM contains Cisco Fabric Manager software and links to product-specific technical documentation on Cisco.com for the Cisco MDS 9000 Family hardware and NX-OS Release 4.1(1).

Note: This CD-ROM was tested to work only with Mozilla Firefox or Microsoft Internet Explorer on Windows.

For the most recent online updates that were made to the manuals, visit: www.cisco.com. To view the documents on Cisco.com, you need Internet access.

Click the menu items at the top to navigate through this CD-ROM, as follows:

- **Install Management Software** - Provides links to the Cisco and third-party software included on this CD-ROM. Click here to go directly to the Fabric Manager installation page.
- **Technical Documentation** - Provides links to the NX-OS Release 4.1(1) technical documentation included on this CD-ROM by category. Also includes links to documentation prior to NX-OS Release 4.1(1) on Cisco.com.
- **Search the Documentation** - Provides instructions for performing full-text searches on all of the PDF documents on this CD-ROM using Adobe Acrobat Reader.
- **Technical Support** - Provides Cisco Technical Support contact information.
- **Visit Cisco.com** - Provides links to the Cisco MDS NX-OS Software Download Center and to the Cisco MDS 9000 Family Technical Documentation area.
- **Documentation Feedback** - Opens your e-mail client so that you can send us your comments on any aspect of the technical documentation.

Note: You need Adobe Acrobat Reader to view the documentation on this CD-ROM. To download the latest version of Adobe Acrobat Reader free from the Adobe website, click the **Get Acrobat Reader** button below.

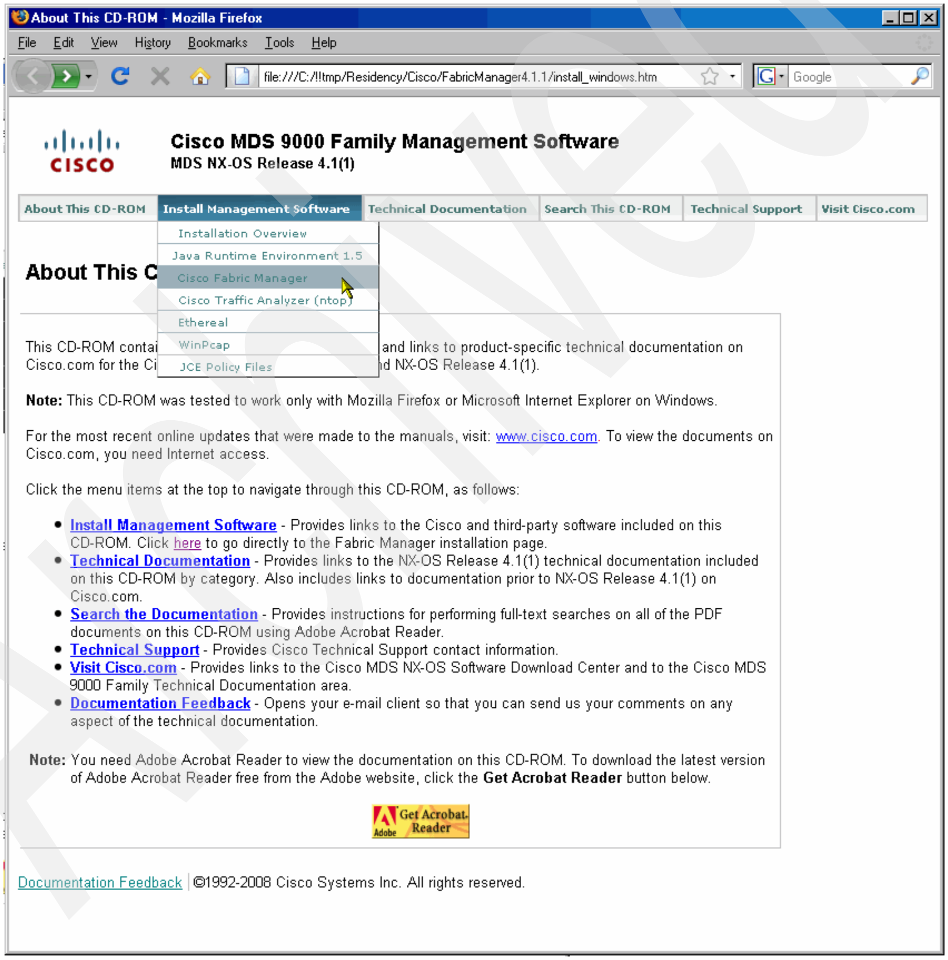
Documentation Feedback | ©1992-2008 Cisco Systems Inc. All rights reserved.

Figure 4-5 Install Management Software

To install:

1. When presented with the Cisco Fabric Manager Software install front page, we select to go directly to the Fabric Manager installation page, as shown in Figure 4-6.

> **Note:** We recommend that you install the latest version of Fabric Manager applications. Fabric Manager is backward-compatible with the Cisco MDS SAN-OS and NX-OS. Upgrade Fabric Manager software first and then upgrade the Cisco MDS SAN-OS or NX-OS.



Cisco MDS 9000 Family Management Software
MDS NX-OS Release 4.1(1)

About This C

This CD-ROM contai [...] and links to product-specific technical documentation on Cisco.com for the Ci [...] d NX-OS Release 4.1(1).

Note: This CD-ROM was tested to work only with Mozilla Firefox or Microsoft Internet Explorer on Windows.

For the most recent online updates that were made to the manuals, visit: www.cisco.com. To view the documents on Cisco.com, you need Internet access.

Click the menu items at the top to navigate through this CD-ROM, as follows:

- **Install Management Software** - Provides links to the Cisco and third-party software included on this CD-ROM. Click here to go directly to the Fabric Manager installation page.
- **Technical Documentation** - Provides links to the NX-OS Release 4.1(1) technical documentation included on this CD-ROM by category. Also includes links to documentation prior to NX-OS Release 4.1(1) on Cisco.com.
- **Search the Documentation** - Provides instructions for performing full-text searches on all of the PDF documents on this CD-ROM using Adobe Acrobat Reader.
- **Technical Support** - Provides Cisco Technical Support contact information.
- **Visit Cisco.com** - Provides links to the Cisco MDS NX-OS Software Download Center and to the Cisco MDS 9000 Family Technical Documentation area.
- **Documentation Feedback** - Opens your e-mail client so that you can send us your comments on any aspect of the technical documentation.

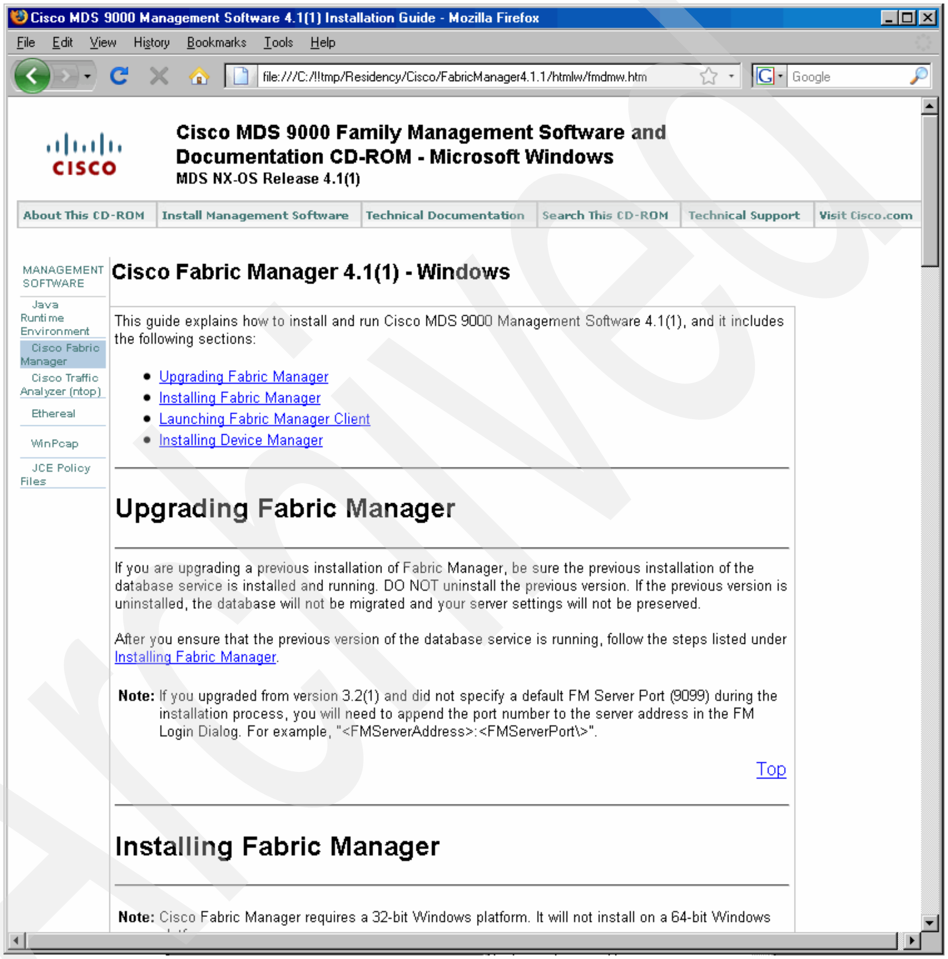
Note: You need Adobe Acrobat Reader to view the documentation on this CD-ROM. To download the latest version of Adobe Acrobat Reader free from the Adobe website, click the **Get Acrobat Reader** button below.

Documentation Feedback | ©1992-2008 Cisco Systems Inc. All rights reserved.

Figure 4-6 Install Management Software drop-down menu

2. Select **Installing Fabric Manager**, as this is the first install, as shown in Figure 4-7.

> **Note:** Before upgrading or uninstalling Fabric Manager or Device Manager, make sure that any instances of these applications have been shut down.



Cisco MDS 9000 Management Software 4.1(1) Installation Guide - Mozilla Firefox
File Edit View History Bookmarks Tools Help
file:///C:/!!tmp/Residency/Cisco/FabricManager4.1.1/htmlw/fmdmw.htm
Google
CISCO
About This CD-ROM
Install Management Software
Technical Documentation
Search This CD-ROM
Technical Support
Visit Cisco.com
MANAGEMENT SOFTWARE
Java Runtime Environment
Cisco Fabric Manager
Cisco Traffic Analyzer (ntop)
Ethereal
WinPcap
JCE Policy Files

Cisco MDS 9000 Family Management Software and Documentation CD-ROM - Microsoft Windows
MDS NX-OS Release 4.1(1)

Cisco Fabric Manager 4.1(1) - Windows

This guide explains how to install and run Cisco MDS 9000 Management Software 4.1(1), and it includes the following sections:

- Upgrading Fabric Manager
- Installing Fabric Manager
- Launching Fabric Manager Client
- Installing Device Manager

Upgrading Fabric Manager

If you are upgrading a previous installation of Fabric Manager, be sure the previous installation of the database service is installed and running. DO NOT uninstall the previous version. If the previous version is uninstalled, the database will not be migrated and your server settings will not be preserved.

After you ensure that the previous version of the database service is running, follow the steps listed under Installing Fabric Manager.

Note: If you upgraded from version 3.2(1) and did not specify a default FM Server Port (9099) during the installation process, you will need to append the port number to the server address in the FM Login Dialog. For example, "<FMServerAddress>:<FMServerPort\>".

Top

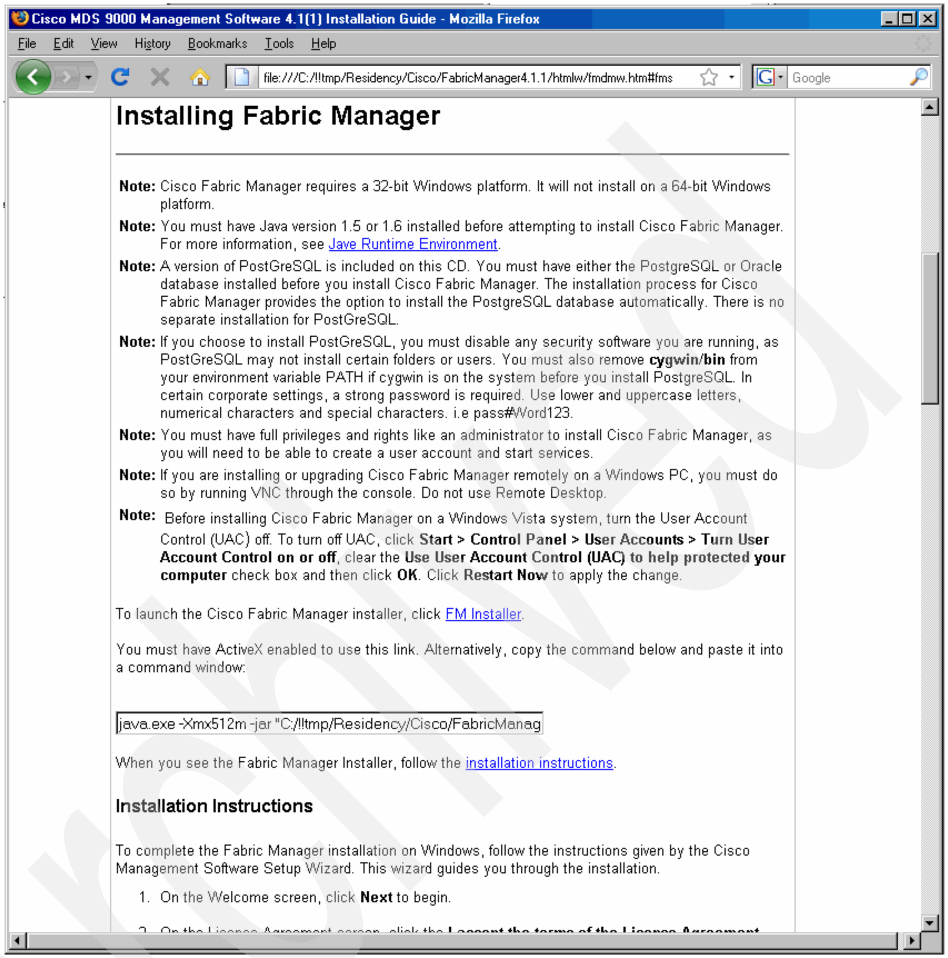
Installing Fabric Manager

Note: Cisco Fabric Manager requires a 32-bit Windows platform. It will not install on a 64-bit Windows

Figure 4-7 Fabric Manager Software options

> **Note:** Fabric Manager requires Java 1.5 or 1.6, and the CD-ROM contains the installation binary if necessary.

3. Next select **Fabric Manager Installer**, as shown in Figure 4-8.


Cisco MDS 9000 Management Software 4.1(1) Installation Guide - Mozilla Firefox
File Edit View History Bookmarks Tools Help
file:///C:/!!tmp/Residency/Cisco/FabricManager4.1.1/htmlw/fmdmw.htm#fms
Google

Installing Fabric Manager

Note: Cisco Fabric Manager requires a 32-bit Windows platform. It will not install on a 64-bit Windows platform.

Note: You must have Java version 1.5 or 1.6 installed before attempting to install Cisco Fabric Manager. For more information, see Jave Runtime Environment.

Note: A version of PostGreSQL is included on this CD. You must have either the PostgreSQL or Oracle database installed before you install Cisco Fabric Manager. The installation process for Cisco Fabric Manager provides the option to install the PostgreSQL database automatically. There is no separate installation for PostGreSQL.

Note: If you choose to install PostGreSQL, you must disable any security software you are running, as PostGreSQL may not install certain folders or users. You must also remove **cygwin/bin** from your environment variable PATH if cygwin is on the system before you install PostgreSQL. In certain corporate settings, a strong password is required. Use lower and uppercase letters, numerical characters and special characters. i.e pass#Word123.

Note: You must have full privileges and rights like an administrator to install Cisco Fabric Manager, as you will need to be able to create a user account and start services.

Note: If you are installing or upgrading Cisco Fabric Manager remotely on a Windows PC, you must do so by running VNC through the console. Do not use Remote Desktop.

Note: Before installing Cisco Fabric Manager on a Windows Vista system, turn the User Account Control (UAC) off. To turn off UAC, click **Start > Control Panel > User Accounts > Turn User Account Control on or off**, clear the **Use User Account Control (UAC) to help protected your computer** check box and then click **OK**. Click **Restart Now** to apply the change.

To launch the Cisco Fabric Manager installer, click FM Installer.

You must have ActiveX enabled to use this link. Alternatively, copy the command below and paste it into a command window:

```
java.exe -Xmx512m -jar "C:/!!tmp/Residency/Cisco/FabricManag
```

When you see the Fabric Manager Installer, follow the installation instructions.

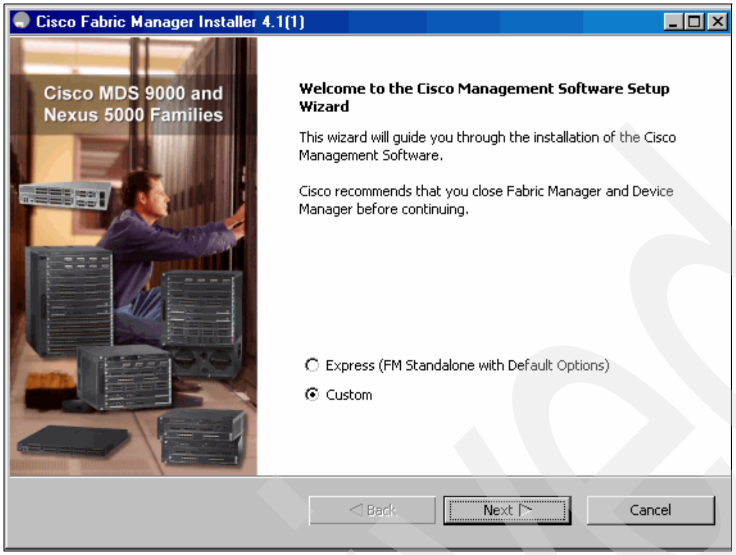
Installation Instructions

To complete the Fabric Manager installation on Windows, follow the instructions given by the Cisco Management Software Setup Wizard. This wizard guides you through the installation.

1. On the Welcome screen, click **Next** to begin.
2. On the License Agreement screen, click the **I accept the terms of the License Agreement**

Figure 4-8 Installing Fabric Manager

The Cisco Fabric Manager Installer pops up, as in Figure 4-9.



Cisco Fabric Manager Installer 4.1(1)

Welcome to the Cisco Management Software Setup Wizard

This wizard will guide you through the installation of the Cisco Management Software.

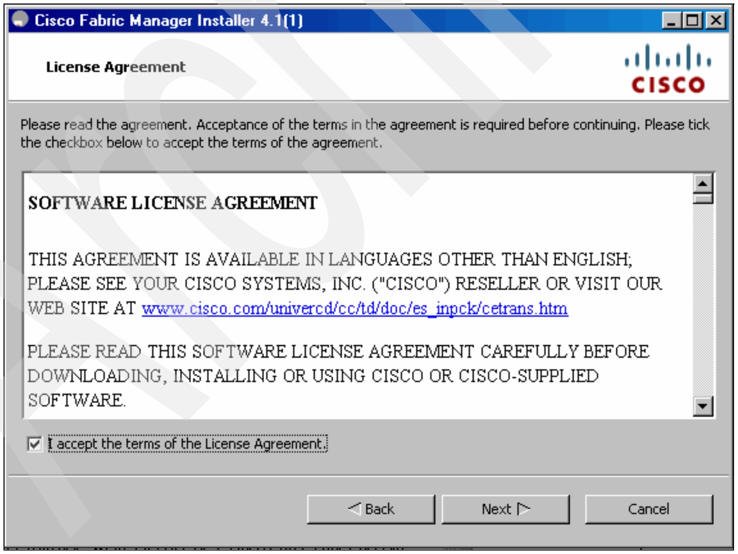
Cisco recommends that you close Fabric Manager and Device Manager before continuing.

○ Express (FM Standalone with Default Options)

● Custom

Figure 4-9 Cisco Fabric Manager Installer Welcome panel

4. Click **Next** and then check the selection box, as shown in Figure 4-10.



Cisco Fabric Manager Installer 4.1(1)

License Agreement

Please read the agreement. Acceptance of the terms in the agreement is required before continuing. Please tick the checkbox below to accept the terms of the agreement.

SOFTWARE LICENSE AGREEMENT

THIS AGREEMENT IS AVAILABLE IN LANGUAGES OTHER THAN ENGLISH; PLEASE SEE YOUR CISCO SYSTEMS, INC. ("CISCO") RESELLER OR VISIT OUR WEB SITE AT www.cisco.com/univercd/cc/td/doc/es_inpck/cetrans.htm

PLEASE READ THIS SOFTWARE LICENSE AGREEMENT CAREFULLY BEFORE DOWNLOADING, INSTALLING OR USING CISCO OR CISCO-SUPPLIED SOFTWARE.

☑ I accept the terms of the License Agreement.

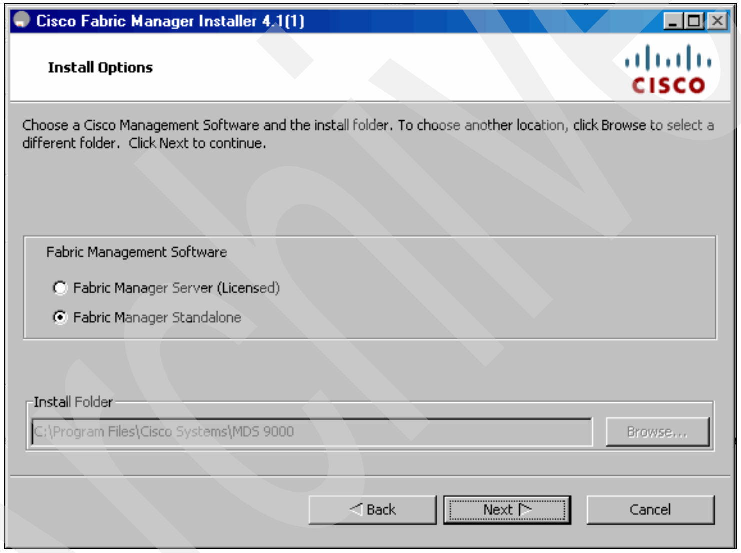
Figure 4-10 Cisco Fabric Manager Installer License Agreement panel

There are two types of installation:

- Fabric Manager Server
- Fabric Manager Standalone

Fabric Manager Standalone is a single application containing Fabric Manager Client and a local version of Fabric Manager Server bundled together. Fabric Manager Standalone allows you to discover and monitor the immediate fabric. Fabric Manager Server has the same functionality, but, as described in 4.1.4, “Fabric Manager Server” on page 85, it allows you to connect by default up to 16 users concurrently.

Additionally, it allows the Fabric Manager Web Server to access a number of configuration and monitoring options using a Web browser. The Fabric Manager Web Server functionality is discussed later in this chapter. To continue the installation choose Fabric Manager Standalone and select **Next** (Figure 4-11).



Choose a Cisco Management Software and the install folder. To choose another location, click Browse to select a different folder. Click Next to continue.

Fabric Management Software

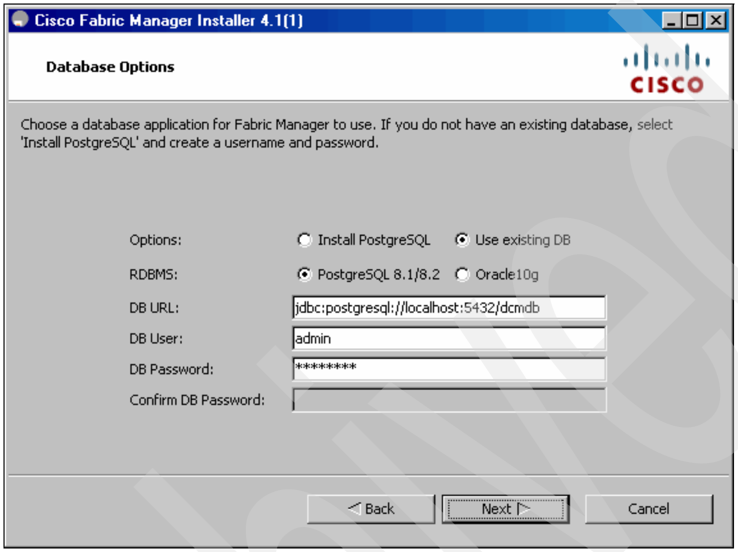
○ Fabric Manager Server (Licensed)

● Fabric Manager Standalone

Install Folder: C:\Program Files\Cisco Systems\MDS 9000

Figure 4-11 Cisco Fabric Manager Installer Install Options panel

Fabric Manager requires a database. If you have an Oracle database, you can use it by providing the connection information. If you do not have an Oracle database, or you prefer a GNU licensed database, the MDS 9000 family Product CD-ROM includes PostgreSQL (Figure 4-12). To install PostgreSQL check **PostgreSQL**, fill in the database password field, and click **Next**.



Cisco Fabric Manager Installer 4.1(1)

Database Options

Choose a database application for Fabric Manager to use. If you do not have an existing database, select 'Install PostgreSQL' and create a username and password.

Options: ○ Install PostgreSQL ● Use existing DB

RDBMS: ● PostgreSQL 8.1/8.2 ○ Oracle10g

DB URL: jdbc:postgresql://localhost:5432/dcmdb

DB User: admin

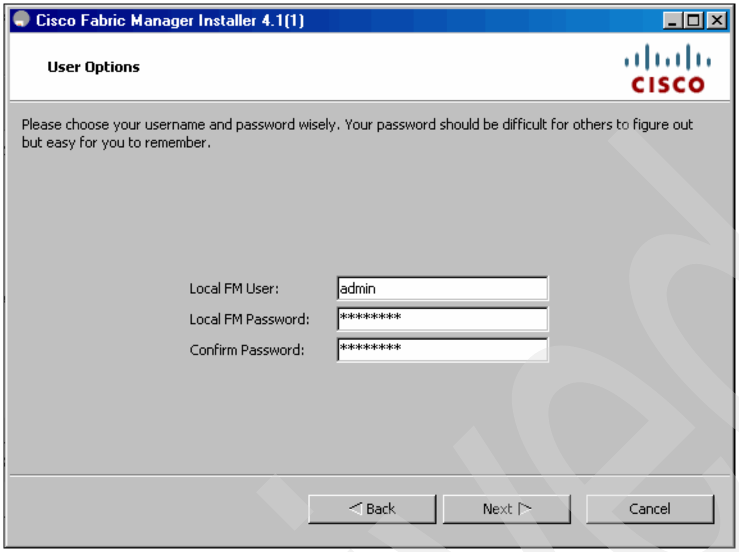
DB Password: *********

Confirm DB Password:

Figure 4-12 Cisco Fabric Manager Installer Database Options panel

> **Note:** You can use an existing Postgres installation, but before installing FM you must create a database with the name *dcmd*, and define a user and a password. After that you must choose an existing database option in the FM installation panel and specify a database URL, DB user name, and password, as shown in Figure 4-12 on page 97.

We enter a password for Fabric Manager (Figure 4-13) and select **Next**.



Please choose your username and password wisely. Your password should be difficult for others to figure out but easy for you to remember.

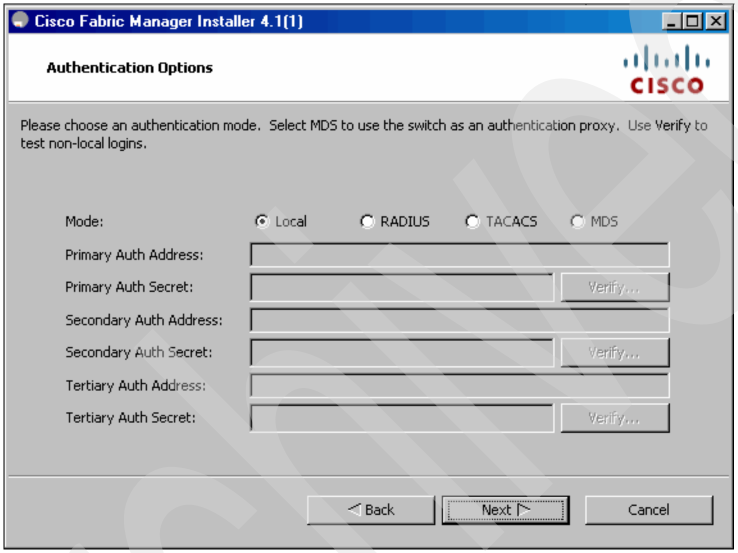
Local FM User: admin
Local FM Password: *********
Confirm Password: *********

Figure 4-13 Cisco Fabric Manager Installer User Options panel

Next we must choose the authentication and authorization mode. All MDS 9000 family switches can perform local authentication or authorization using the local database stored on the MDS 9000 family switch, director, management workstation, or remote authentication or authorization using AAA servers. The authentication, authorization, and accounting (AAA) feature verifies the identity of, grants access to, and tracks the actions of users managing a switch.

We choose **Local** as the authentication and authorization mode. This means that all user accounts and authentication credentials are stored locally on a management workstation where we are going to install the Fabric Manager software. The other authentication options that you can choose are Radius, TACACS, and MDS, as shown in Figure 4-14.

> **Note:** When the MDS radio button is selected, the FM authentication uses the user database in the switch for authentication.



Authentication Options

Please choose an authentication mode. Select MDS to use the switch as an authentication proxy. Use Verify to test non-local logins.

Mode: ● Local ○ RADIUS ○ TACACS ○ MDS

Primary Auth Address:

Primary Auth Secret:

Secondary Auth Address:

Secondary Auth Secret:

Tertiary Auth Address:

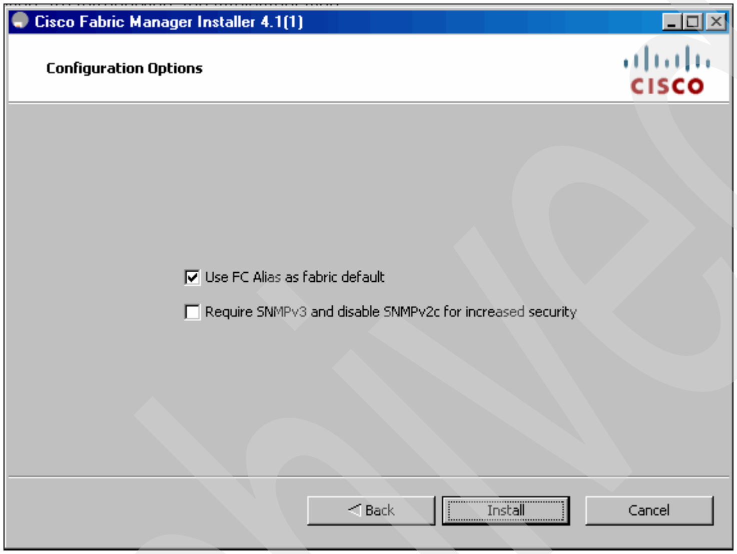
Tertiary Auth Secret:

Figure 4-14 Cisco Fabric Manager Installer Authentication Options panel

Figure 4-15 shows two possible configuration options:

- FC Alias
- SNMPv3 against SNMPv2

We choose FC Aliases as the fabric default to simplify fabric management using aliases instead of WWN addresses. We can choose to use only SNMPv3 and disable SNMPv2 for security reasons if required.

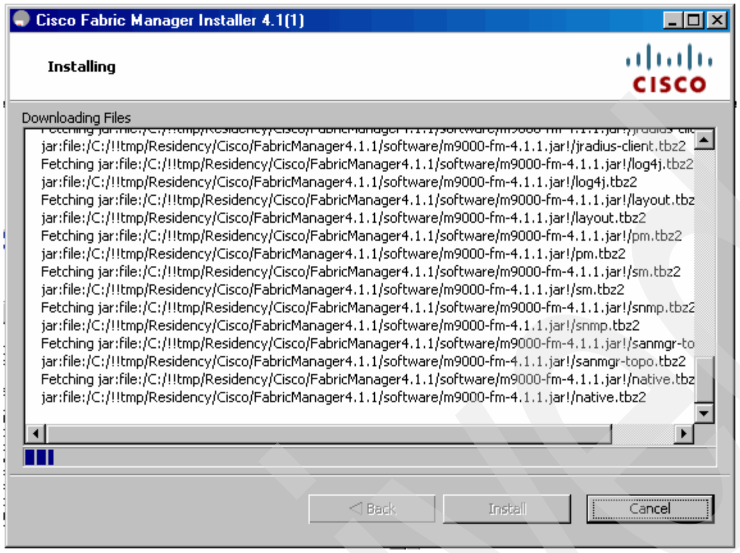


☑ Use FC Alias as fabric default

□ Require SNMPv3 and disable SNMPv2c for increased security

Figure 4-15 Cisco Fabric Manager Installer Configuration Options panel

The install process starts. In our case it ran for approximately five minutes. To follow what is happening use the log window (Figure 4-16).

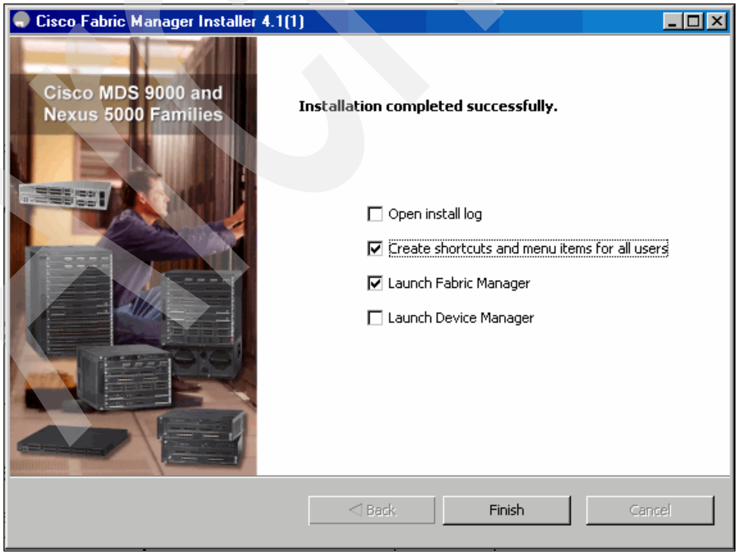


Downloading Files

```
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/jradius-clie
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/jradius-client.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/log4j.tbz2
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/log4j.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/layout.tbz
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/layout.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/pm.tbz2
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/pm.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/sm.tbz2
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/sm.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/snmp.tbz2
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/snmp.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/sanmgr-to
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/sanmgr-topo.tbz2
Fetching jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/native.tbz
jar:file:/C:/!!tmp/Residency/Cisco/FabricManager4.1.1/software/m9000-fm-4.1.1.jar!/native.tbz2
```

Figure 4-16 Cisco Fabric Manager Installer installing panel

At the end of the installation process we can elect to have Fabric Manager create desktop icons and launch Fabric Manager or Desktop Manager, as shown in Figure 4-17. We select only to create icons and click **Finish**.


Cisco Fabric Manager Installer 4.1(1)
Cisco MDS 9000 and Nexus 5000 Families

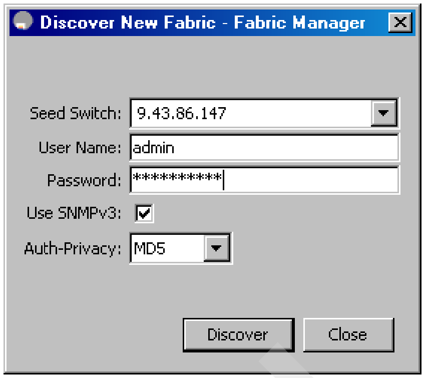
Installation completed successfully.

□ Open install log
☑ Create shortcuts and menu items for all users
☑ Launch Fabric Manager
□ Launch Device Manager

Figure 4-17 Cisco Fabric Manager Installer Installation completed successfully panel

4.2.1 Launching Fabric Manager

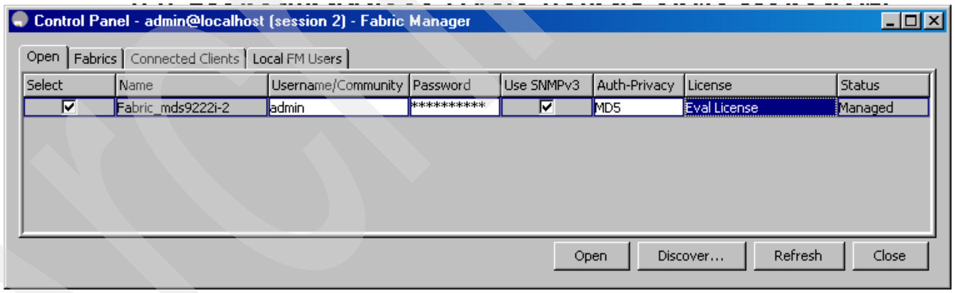
You can start Fabric Manager from the icon on your desktop or the Windows Start menu. Enter the IP address or host name of your switch, the user name and password, and click **Discover**, as shown in Figure 4-18.



Seed Switch: 9.43.86.147
User Name: admin
Password: ***********
Use SNMPv3: ☑
Auth-Privacy: MD5

Figure 4-18 FM Discover New Fabric

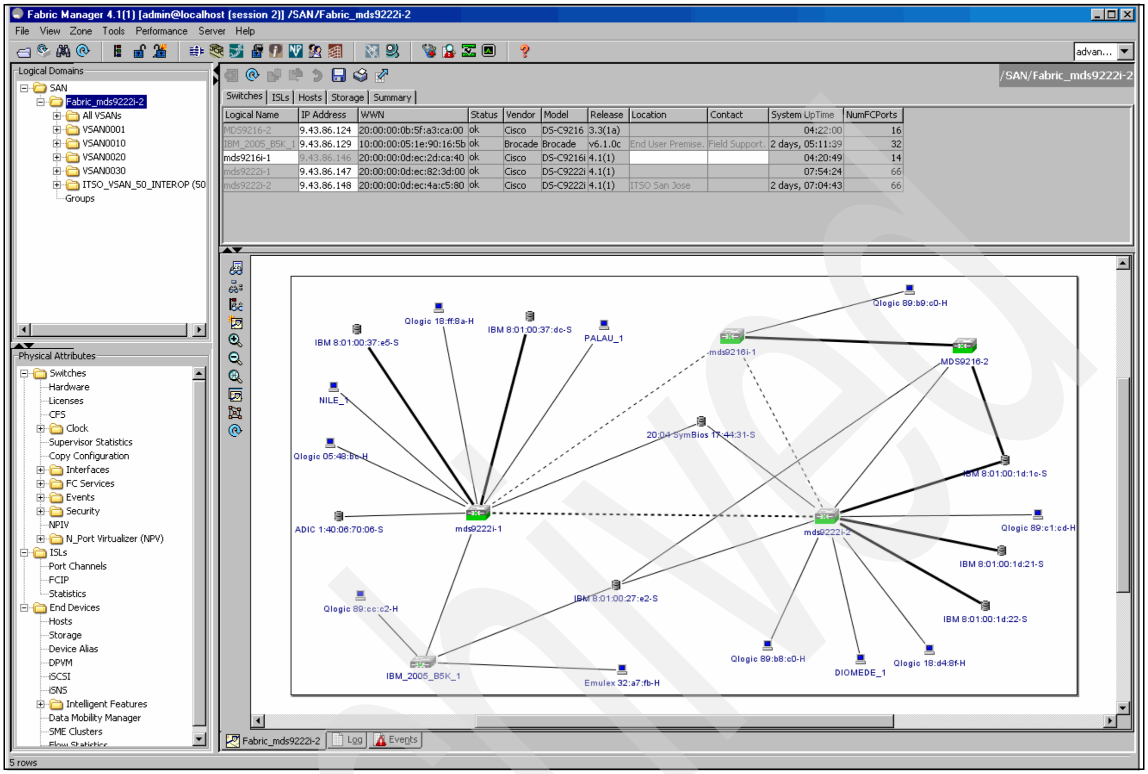
If you have more than one fabric to manage, repeat the above process until you have all your fabrics discovered. Select which fabric you want to manage and click **Open** (Figure 4-19).


Control Panel - admin@localhost (session 2) - Fabric Manager
Open
Fabrics
Connected Clients
Local FM Users

Select	Name	Username/Community	Password	Use SNMPv3	Auth-Privacy	License	Status
☑	Fabric_mds9222i-2	admin	**********	☑	MD5	Eval License	Managed

Figure 4-19 Fabric Manager Control Panel

When starting Fabric Manager, you will see the logical view of your fabric, as shown in Figure 4-20.



Logical Name	IP Address	WWN	Status	Vendor	Model	Release	Location	Contact	System UpTime	NumFCPorts
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	ok	Cisco	DS-C9216	3.3(1a)			04:22:00	16
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c	End User Premise.	Field Support.	2 days, 05:11:39	32
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	ok	Cisco	DS-C9216i	4.1(1)			04:20:49	14
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	ok	Cisco	DS-C9222i	4.1(1)			07:54:24	66
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	ok	Cisco	DS-C9222i	4.1(1)	ITSO San Jose		2 days, 07:04:43	66

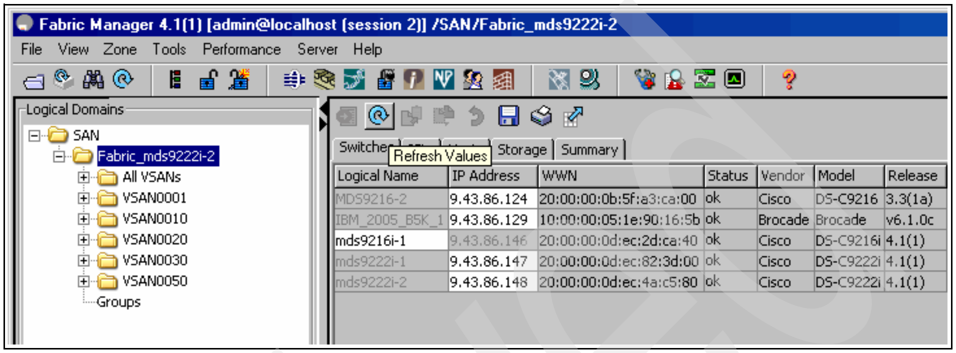
Figure 4-20 Fabric logical view

The Fabric Manager window shows a graphical presentation of our switch fabric on the bottom right, an information area on the top, and a navigation window on the left, which is divided into a logical menu at the top and a physical menu at the bottom. The content of the information area changes accordingly to represent the selection chosen in the navigation menu, showing the current selection at the top.

SNMP time outs

Fabric Manager uses the SNMP protocol to communicate with the switch. SNMP is a stateless protocol, and when you apply changes to the switch, Fabric Manager sends a request packet with the changes to the switch and waits for a response packet.

Depending on your network, either the request packet or the response packet might end up being dropped. This results in a SNMP time-out message. If you get this message, you do not know which of the packets was dropped. This means that you do not know whether your changes are applied to the switch. We recommend that you click **Refresh Values**, as shown in Figure 4-21, to ensure that the information in Fabric Manager is up to date before making any further changes.

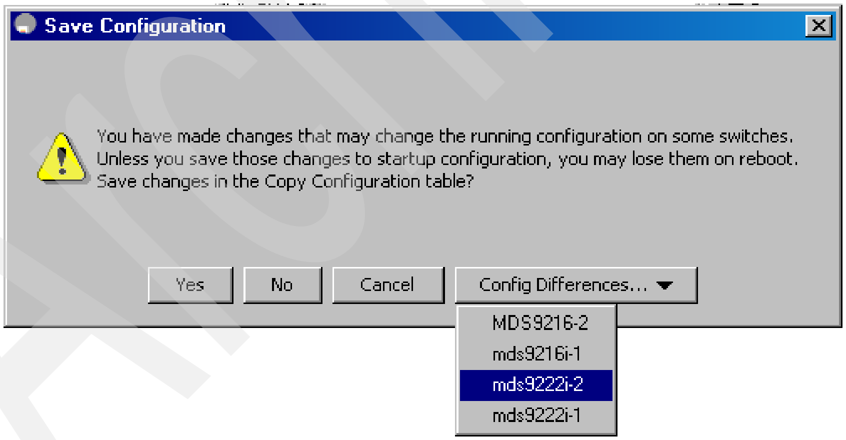


Logical Name	IP Address	WWN	Status	Vendor	Model	Release
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	ok	Cisco	DS-C9216	3.3(1a)
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	ok	Cisco	DS-C9216i	4.1(1)
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	ok	Cisco	DS-C9222i	4.1(1)
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	ok	Cisco	DS-C9222i	4.1(1)

Figure 4-21 Refresh displayed values

Stopping Fabric Manager

If you made changes to the running configuration that have not yet been copied to the startup configuration, you get a message similar to that shown in Figure 4-22 when you exit from a Fabric Manager session.



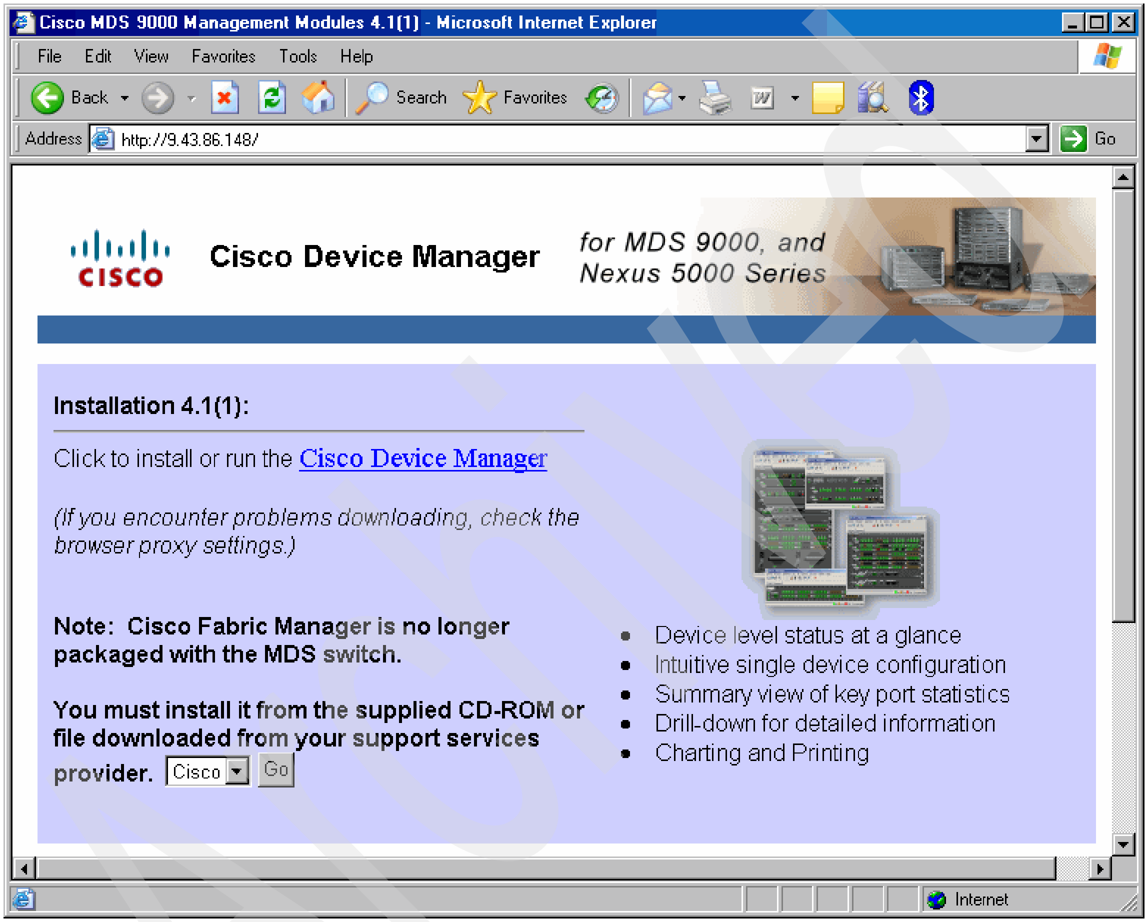
You have made changes that may change the running configuration on some switches.
Unless you save those changes to startup configuration, you may lose them on reboot.
Save changes in the Copy Configuration table?

Figure 4-22 Save changes

Click **Yes** to save changes to the copy configuration table. After the copy process is finished you can close Fabric Manager.

4.2.2 Launching Device Manager

To launch or install Device Manager, you can use a Web browser. Provide the IP address of the switch that you want to manage. When you click **Device Manager**, as shown in Figure 4-23, Device Manager will be run or installed.


Cisco MDS 9000 Management Modules 4.1(1) - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://9.43.86.148/
Go
Internet

Cisco Device Manager

for MDS 9000, and Nexus 5000 Series

Installation 4.1(1):

Click to install or run the Cisco Device Manager

(If you encounter problems downloading, check the browser proxy settings.)

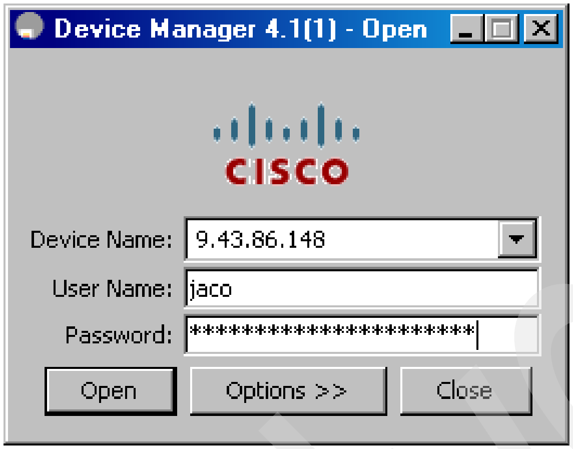
Note: Cisco Fabric Manager is no longer packaged with the MDS switch.

You must install it from the supplied CD-ROM or file downloaded from your support services provider. Cisco Go

- Device level status at a glance
- Intuitive single device configuration
- Summary view of key port statistics
- Drill-down for detailed information
- Charting and Printing

Figure 4-23 Launching or running the Cisco Device Manager

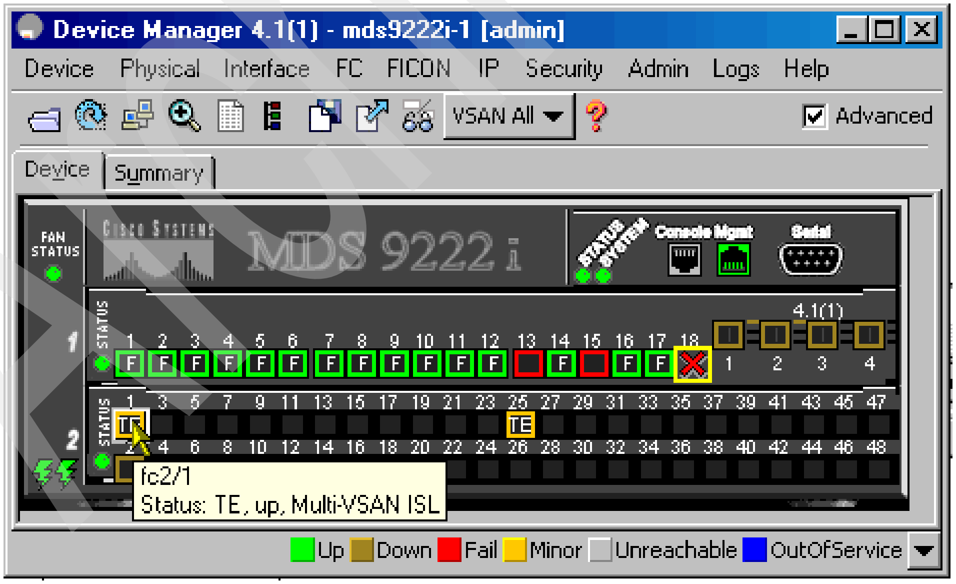
When starting Device Manager, we are prompted for authentication to log in to the switch. Use the same user name and password as for Fabric Manager as shown in Figure 4-24.



Device Name: 9.43.86.148
User Name: jaco
Password: **********************

Figure 4-24 Device Manager Login

Upon successful login, the Device Manager application is started and we are presented with a graphical representation of the physical switch, as shown in Figure 4-25.

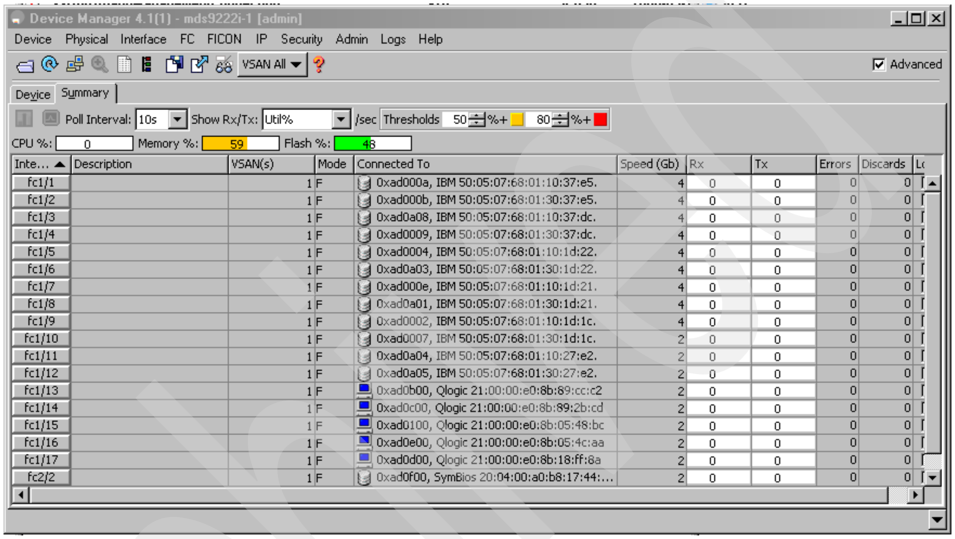


fc2/1
Status: TE, up, Multi-VSAN ISL

Figure 4-25 Device Manager

The Device Manager window shows a graphical presentation of the switch while displaying the power, fan trays, switch modules, and respective ports installed.

Figure 4-26 shows the Device Manager port summary window. It shows port mode for all ports and the WWNs of connected devices. There are statistics for transmission, errors, and discards. Above the list are current CPU, memory, and flash utilization information and thresholds. This view can be filtered for any particular VSAN.


Device Manager 4.1(1) - mds9222i-1 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
☑ Advanced
Device Summary

Poll Interval: 10s Show Rx/Tx: Util% /sec Thresholds 50 %+ 🟨 80 %+ 🟥

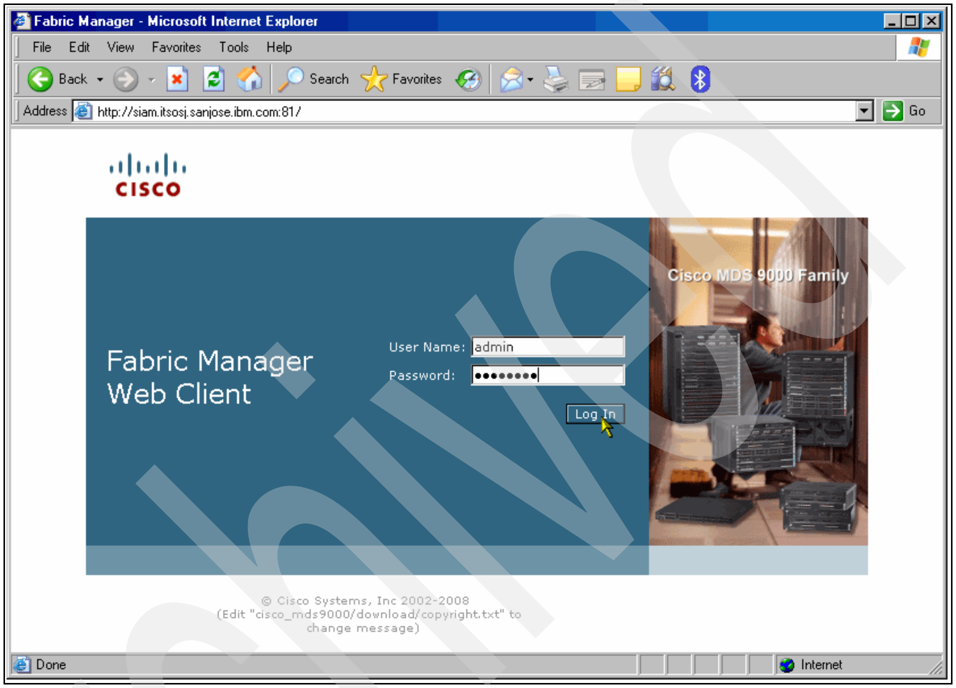
CPU %: 0 Memory %: 59 Flash %: 48

Inte...	Description	VSAN(s)	Mode	Connected To	Speed (Gb)	Rx	Tx	Errors	Discards	Lc
fc1/1		1	F	0xad000a, IBM 50:05:07:68:01:10:37:e5.	4	0	0	0	0	
fc1/2		1	F	0xad000b, IBM 50:05:07:68:01:30:37:e5.	4	0	0	0	0	
fc1/3		1	F	0xad0a08, IBM 50:05:07:68:01:10:37:dc.	4	0	0	0	0	
fc1/4		1	F	0xad0009, IBM 50:05:07:68:01:30:37:dc.	4	0	0	0	0	
fc1/5		1	F	0xad0004, IBM 50:05:07:68:01:10:1d:22.	4	0	0	0	0	
fc1/6		1	F	0xad0a03, IBM 50:05:07:68:01:30:1d:22.	4	0	0	0	0	
fc1/7		1	F	0xad000e, IBM 50:05:07:68:01:10:1d:21.	4	0	0	0	0	
fc1/8		1	F	0xad0a01, IBM 50:05:07:68:01:30:1d:21.	4	0	0	0	0	
fc1/9		1	F	0xad0002, IBM 50:05:07:68:01:10:1d:1c.	4	0	0	0	0	
fc1/10		1	F	0xad0007, IBM 50:05:07:68:01:30:1d:1c.	2	0	0	0	0	
fc1/11		1	F	0xad0a04, IBM 50:05:07:68:01:10:27:e2.	2	0	0	0	0	
fc1/12		1	F	0xad0a05, IBM 50:05:07:68:01:30:27:e2.	2	0	0	0	0	
fc1/13		1	F	0xad0b00, Qlogic 21:00:00:e0:8b:89:cc:c2	2	0	0	0	0	
fc1/14		1	F	0xad0c00, Qlogic 21:00:00:e0:8b:89:2b:cd	2	0	0	0	0	
fc1/15		1	F	0xad0100, Qlogic 21:00:00:e0:8b:05:48:bc	2	0	0	0	0	
fc1/16		1	F	0xad0e00, Qlogic 21:00:00:e0:8b:05:4c:aa	2	0	0	0	0	
fc1/17		1	F	0xad0d00, Qlogic 21:00:00:e0:8b:18:ff:8a	2	0	0	0	0	
fc2/2		1	F	0xad0f00, SymBios 20:04:00:a0:b8:17:44:...	2	0	0	0	0	

Figure 4-26 Device Manager summary

4.2.3 Launching the Fabric Manager Web Server Client

To launch the Fabric Manager Web Client, use a Web browser and point to the IP address of the Fabric Manager Web Server (FMS) and a port number, as shown in Figure 4-27.



Address: http://siam.itsosj.sanjose.ibm.com:81/

User Name: admin

Password: ••••••••

Fabric Manager - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Go
cisco
Fabric Manager
Web Client
Log In
Cisco MDS 9000 Family
© Cisco Systems, Inc 2002-2008
(Edit "cisco_mds9000/download/copyright.txt" to change message)
Done
Internet

Figure 4-27 Fabric Manager Web Server Login window

Note: To be able to use the Performance Manager, you must acquire and install the Cisco Fabric Manager Server Package (FMSERVER_PKG), if not already present on the switch. The Fabric Manager Server Package License installed on the MDS 9222i is shown in Example 4-3 on page 108.

Another way to display the licenses is to use the CLI. In Example 4-3 we use the CLI to display the licenses that are installed on the switch.

Example 4-3 Fabric Manager Server lIcense installed on the MDS switch

```
mds9222i-1# show license usage
Feature                      Ins  Lic   Status Expiry Date Comments Count
-------------------------------------------------------------------------------
DMM_184_PKG                   No    0   Unused             Grace 120D 0H
DMM_9222i_PKG                 No    0   Unused             Grace 120D 0H
```

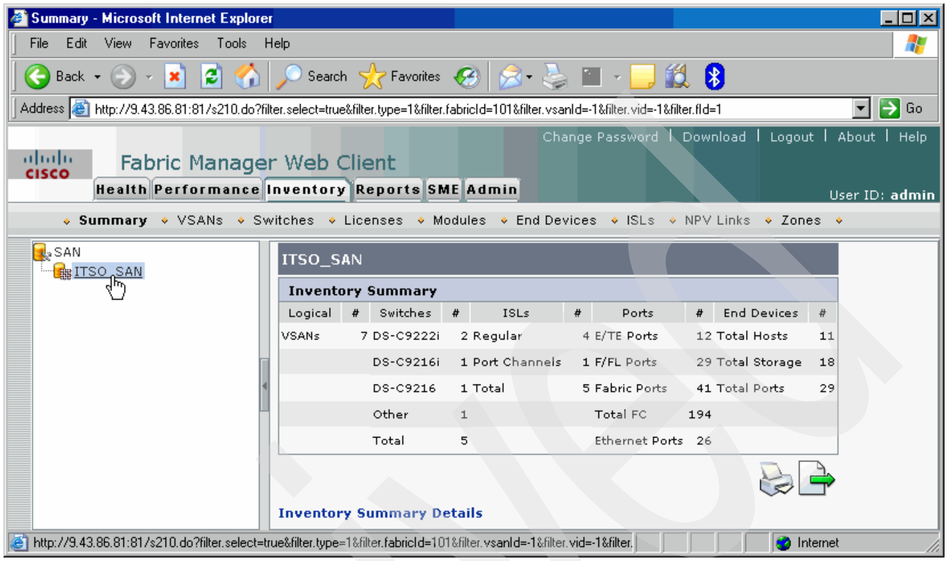
```
FM_SERVER_PKG                Yes   -   In use never       -
MAINFRAME_PKG                Yes   -   Unused never       -
ENTERPRISE_PKG               Yes   -   Unused never       -
DMM_FOR_SSM_PKG              No    0   Unused             Grace 120D 0H
SAN_EXTN_OVER_IP             Yes   1   Unused never       -
SME_FOR_9222I_PKG            Yes   -   Unused never       -
PORT_ACTIVATION_PKG          No    0   Unused             -
SME_FOR_IPS_184_PKG          No    0   Unused             Grace 120D 0H
STORAGE_SERVICES_184         No    0   Unused             Grace 120D 0H
SAN_EXTN_OVER_IP_18_4        Yes   1   Unused never       -
SAN_EXTN_OVER_IP_IPS2        No    0   Unused             Grace 120D 0H
SAN_EXTN_OVER_IP_IPS4        No    0   Unused             Grace 120D 0H
STORAGE_SERVICES_9222i       No    0   Unused             Grace 120D 0H
STORAGE_SERVICES_SSN16       No    0   Unused             Grace 120D 0H
10G_PORT_ACTIVATION_PKG      No    0   Unused             -
STORAGE_SERVICES_ENABLER_PKG Yes   1   Unused never       -
-------------------------------------------------------------------------------
```

Fabric Manager Web Server can be used to gather inventory information regarding monitored SANs. The Inventory tab shows an inventory of the selected SAN, fabric, or switch. You can export this information to an ASCII file in comma-separated value (CSV) format that can be read by applications such as Microsoft® Excel®. You can set the number of rows and columns per page.

The Inventory tab contains the following subtabs:

- VSANs: Shows details about VSANs
- Switches: Shows details about switches
- Licenses: Shows details about the licenses in use in the fabric
- Modules: Shows details for MDS switching and services modules, fans, and power supplies
- End Devices: Shows the host and storage ports
- ISLs: Shows the Inter-Switch Links
- NPV Links: Shows the links between NPV devices and ports
- Zones: Shows the active zone members (including those in inter-VSAN zones)
- Summary: Shows VSANs, switches, ISLs, ports, and end devices

To view the inventory summary regarding SAN switches in our fabrics use the Inventory tab, as shown in Figure 4-28.


Summary - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s210.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=-1&filter.vid=-1&filter.fId=1
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
http://9.43.86.81:81/s210.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=-1&filter.vid=-1&filter.
Internet

ITSO_SAN

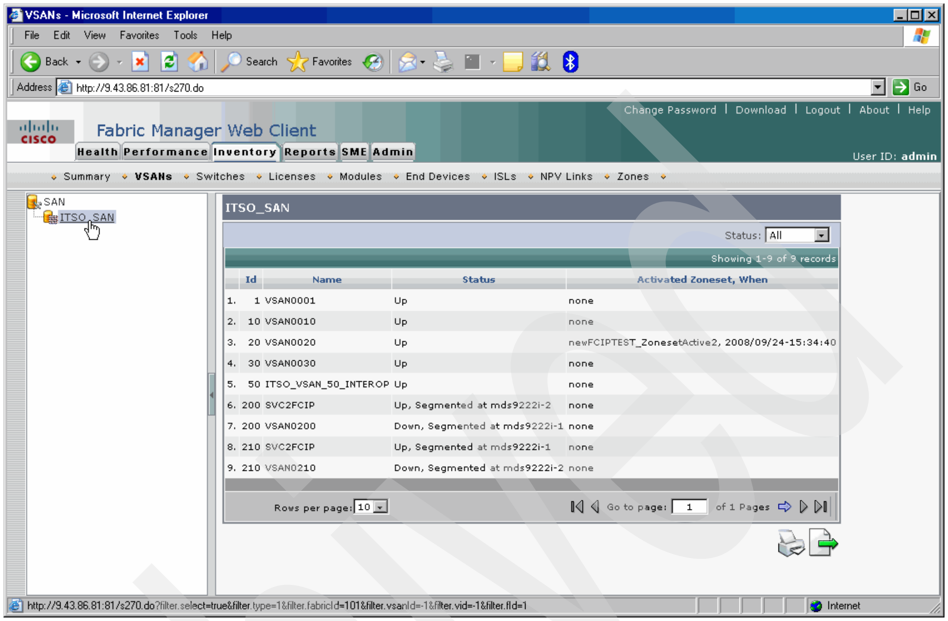
Inventory Summary

Logical	#	Switches	#	ISLs	#	Ports	#	End Devices	#
VSANs	7	DS-C9222i	2	Regular	4	E/TE Ports	12	Total Hosts	11
		DS-C9216i	1	Port Channels	1	F/FL Ports	29	Total Storage	18
		DS-C9216	1	Total	5	Fabric Ports	41	Total Ports	29
		Other	1			Total FC	194		
		Total	5			Ethernet Ports	26		

Inventory Summary Details

Figure 4-28 Inventory Summary tab in the CISCO Fabric Manager Web Client

To view inventory information regarding VSANs click the **VSANs** tab in the Inventory section, as shown in Figure 4-29.


VSANs - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s270.do Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
Status: All
Rows per page: 10
Go to page: 1 of 1 Pages
http://9.43.86.81:81/s270.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=-1&filter.vid=-1&filter.fId=1
Internet

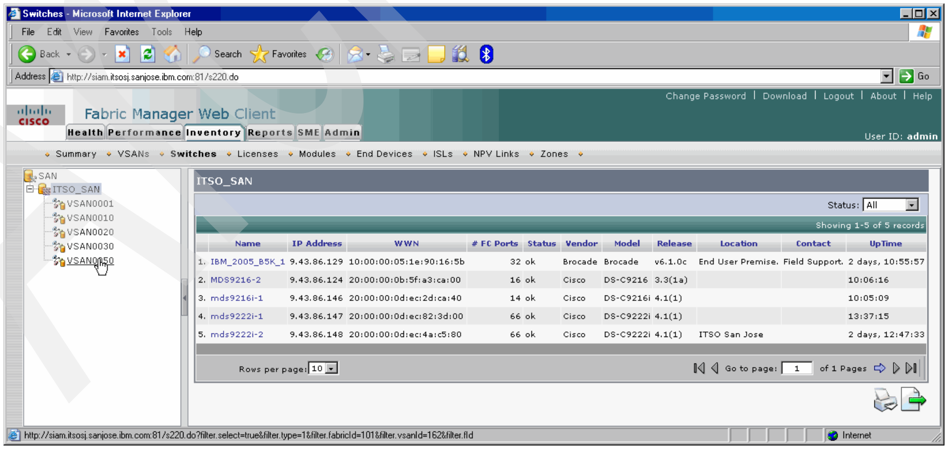
ITSO_SAN

Showing 1-9 of 9 records

	Id	Name	Status	Activated Zoneset, When
1.	1	VSAN0001	Up	none
2.	10	VSAN0010	Up	none
3.	20	VSAN0020	Up	newFCIPTEST_ZonesetActive2, 2008/09/24-15:34:40
4.	30	VSAN0030	Up	none
5.	50	ITSO_VSAN_50_INTEROP	Up	none
6.	200	SVC2FCIP	Up, Segmented at mds9222i-2	none
7.	200	VSAN0200	Down, Segmented at mds9222i-1	none
8.	210	SVC2FCIP	Up, Segmented at mds9222i-1	none
9.	210	VSAN0210	Down, Segmented at mds9222i-2	none

Figure 4-29 VSAN's Inventory tab in the Cisco Fabric Manager Web Server

To view inventory information regarding FC switches in a particular fabric click the **Switches** tab in the Inventory section, as shown in Figure 4-30.


Switches - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://siam.itsosj.sanjose.ibm.com:81/s220.do Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
VSAN0050
Status: All
Rows per page: 10
Go to page: 1 of 1 Pages
http://siam.itsosj.sanjose.ibm.com:81/s220.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=162&filter.fId
Internet

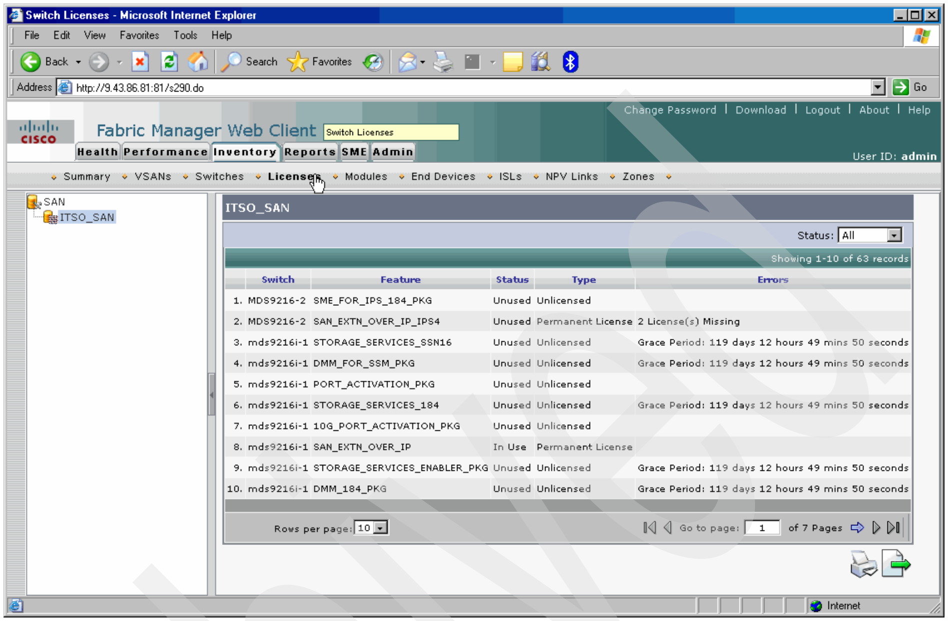
ITSO_SAN

Showing 1-5 of 5 records

	Name	IP Address	WWN	# FC Ports	Status	Vendor	Model	Release	Location	Contact	UpTime
1.	IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	32	ok	Brocade	Brocade	v6.1.0c	End User Premise.	Field Support.	2 days, 10:55:57
2.	MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	16	ok	Cisco	DS-C9216	3.3(1a)			10:06:16
3.	mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	14	ok	Cisco	DS-C9216i	4.1(1)			10:05:09
4.	mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	66	ok	Cisco	DS-C9222i	4.1(1)			13:37:15
5.	mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	66	ok	Cisco	DS-C9222i	4.1(1)	ITSO San Jose		2 days, 12:47:33

Figure 4-30 Switches Inventory tab in the Cisco Fabric Manager Web Client

To view inventory information regarding licenses installed on switches click the **License** tab in the Inventory section, as shown in Figure 4-31.


Switch Licenses - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s290.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Switch Licenses
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
Internet

ITSO_SAN

Status: All

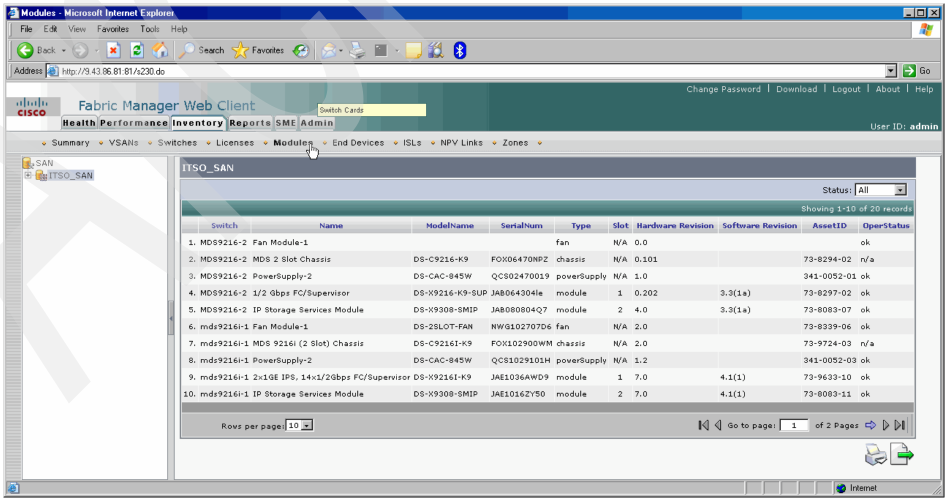
Showing 1-10 of 63 records

	Switch	Feature	Status	Type	Errors
1.	MDS9216-2	SME_FOR_IPS_184_PKG	Unused	Unlicensed	
2.	MDS9216-2	SAN_EXTN_OVER_IP_IPS4	Unused	Permanent License	2 License(s) Missing
3.	mds9216i-1	STORAGE_SERVICES_SSN16	Unused	Unlicensed	Grace Period: 119 days 12 hours 49 mins 50 seconds
4.	mds9216i-1	DMM_FOR_SSM_PKG	Unused	Unlicensed	Grace Period: 119 days 12 hours 49 mins 50 seconds
5.	mds9216i-1	PORT_ACTIVATION_PKG	Unused	Unlicensed	
6.	mds9216i-1	STORAGE_SERVICES_184	Unused	Unlicensed	Grace Period: 119 days 12 hours 49 mins 50 seconds
7.	mds9216i-1	10G_PORT_ACTIVATION_PKG	Unused	Unlicensed	
8.	mds9216i-1	SAN_EXTN_OVER_IP	In Use	Permanent License	
9.	mds9216i-1	STORAGE_SERVICES_ENABLER_PKG	Unused	Unlicensed	Grace Period: 119 days 12 hours 49 mins 50 seconds
10.	mds9216i-1	DMM_184_PKG	Unused	Unlicensed	Grace Period: 119 days 12 hours 49 mins 50 seconds

Rows per page: 10 Go to page: 1 of 7 Pages

Figure 4-31 License Inventory tab in the Cisco Fabric Manager Web Client

To view inventory information regarding line cards and modules in a particular switch click the **Modules** tab in the Inventory section, as shown in Figure 4-32.


Modules - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s230.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Switch Cards
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
Internet

ITSO_SAN

Status: All

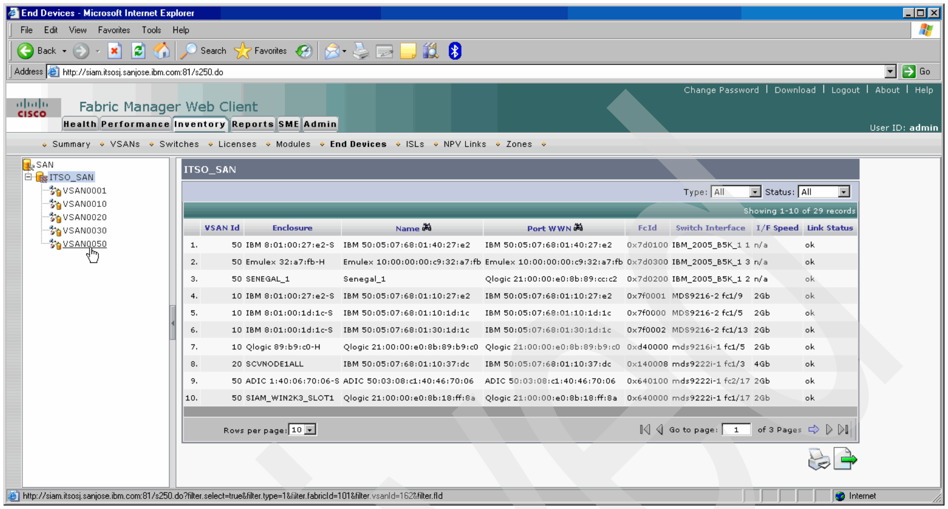
Showing 1-10 of 20 records

	Switch	Name	ModelName	SerialNum	Type	Slot	Hardware Revision	Software Revision	AssetID	OperStatus
1.	MDS9216-2	Fan Module-1			fan	N/A	0.0			ok
2.	MDS9216-2	MDS 2 Slot Chassis	DS-C9216-K9	FOX06470NPZ	chassis	N/A	0.101		73-8294-02	n/a
3.	MDS9216-2	PowerSupply-2	DS-CAC-845W	QCS02470019	powerSupply	N/A	1.0		341-0052-01	ok
4.	MDS9216-2	1/2 Gbps FC/Supervisor	DS-X9216-K9-SUP	JAB064304le	module	1	0.202	3.3(1a)	73-8297-02	ok
5.	MDS9216-2	IP Storage Services Module	DS-X9308-SMIP	JAB080804Q7	module	2	4.0	3.3(1a)	73-8083-07	ok
6.	mds9216i-1	Fan Module-1	DS-2SLOT-FAN	NWG102707D6	fan	N/A	2.0		73-8339-06	ok
7.	mds9216i-1	MDS 9216i (2 Slot) Chassis	DS-C9216I-K9	FOX102900WM	chassis	N/A	2.0		73-9724-03	n/a
8.	mds9216i-1	PowerSupply-2	DS-CAC-845W	QCS1029101H	powerSupply	N/A	1.2		341-0052-03	ok
9.	mds9216i-1	2x1GE IPS, 14x1/2Gbps FC/Supervisor	DS-X9216I-K9	JAE1036AWD9	module	1	7.0	4.1(1)	73-9633-10	ok
10.	mds9216i-1	IP Storage Services Module	DS-X9308-SMIP	JAE1016ZY50	module	2	7.0	4.1(1)	73-8083-11	ok

Rows per page: 10 Go to page: 1 of 2 Pages

Figure 4-32 Modules Inventory tab in the Cisco Fabric Manager Web Client

To view inventory information regarding end devices in our SAN click the **End Devices** tab in the Inventory section, as shown in Figure 4-33.



ITSO_SAN

Type: All Status: All

Showing 1-10 of 29 records

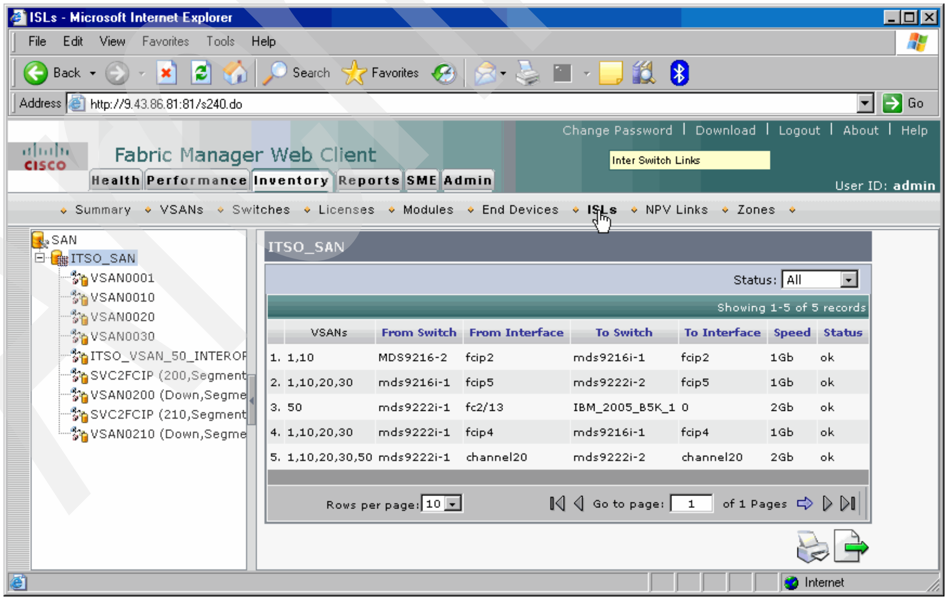
	VSAN Id	Enclosure	Name	Port WWN	FcId	Switch Interface	I/F Speed	Link Status
1.	50	IBM 8:01:00:27:e2-S	IBM 50:05:07:68:01:40:27:e2	IBM 50:05:07:68:01:40:27:e2	0x7d0100	IBM_2005_B5K_1 1	n/a	ok
2.	50	Emulex 32:a7:fb-H	Emulex 10:00:00:00:c9:32:a7:fb	Emulex 10:00:00:00:c9:32:a7:fb	0x7d0300	IBM_2005_B5K_1 3	n/a	ok
3.	50	SENEGAL_1	Senegal_1	Qlogic 21:00:00:e0:8b:89:cc:c2	0x7d0200	IBM_2005_B5K_1 2	n/a	ok
4.	10	IBM 8:01:00:27:e2-S	IBM 50:05:07:68:01:10:27:e2	IBM 50:05:07:68:01:10:27:e2	0x7f0001	MDS9216-2 fc1/9	2Gb	ok
5.	10	IBM 8:01:00:1d:1c-S	IBM 50:05:07:68:01:10:1d:1c	IBM 50:05:07:68:01:10:1d:1c	0x7f0000	MDS9216-2 fc1/5	2Gb	ok
6.	10	IBM 8:01:00:1d:1c-S	IBM 50:05:07:68:01:30:1d:1c	IBM 50:05:07:68:01:30:1d:1c	0x7f0002	MDS9216-2 fc1/13	2Gb	ok
7.	10	Qlogic 89:b9:c0-H	Qlogic 21:00:00:e0:8b:89:b9:c0	Qlogic 21:00:00:e0:8b:89:b9:c0	0xd40000	mds9216i-1 fc1/5	2Gb	ok
8.	20	SCVNODE1ALL	IBM 50:05:07:68:01:10:37:dc	IBM 50:05:07:68:01:10:37:dc	0x140008	mds9222i-1 fc1/3	4Gb	ok
9.	50	ADIC 1:40:06:70:06-S	ADIC 50:03:08:c1:40:46:70:06	ADIC 50:03:08:c1:40:46:70:06	0x640100	mds9222i-1 fc2/17	2Gb	ok
10.	50	SIAM_WIN2K3_SLOT1	Qlogic 21:00:00:e0:8b:18:ff:8a	Qlogic 21:00:00:e0:8b:18:ff:8a	0x640000	mds9222i-1 fc1/17	2Gb	ok

Rows per page: 10 Go to page: 1 of 3 Pages

End Devices - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://siam.itsosj.sanjose.ibm.com:81/s250.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
VSAN0050
http://siam.itsosj.sanjose.ibm.com:81/s250.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=162&filter.fId
Internet

Figure 4-33 End Devices inventory tab in the Cisco Fabric Manager Web Client

To view inventory information regarding ISLs in our SAN click the **ISLs** tab in the the Inventory section, as shown in Figure 4-34.



ITSO_SAN

Status: All

Showing 1-5 of 5 records

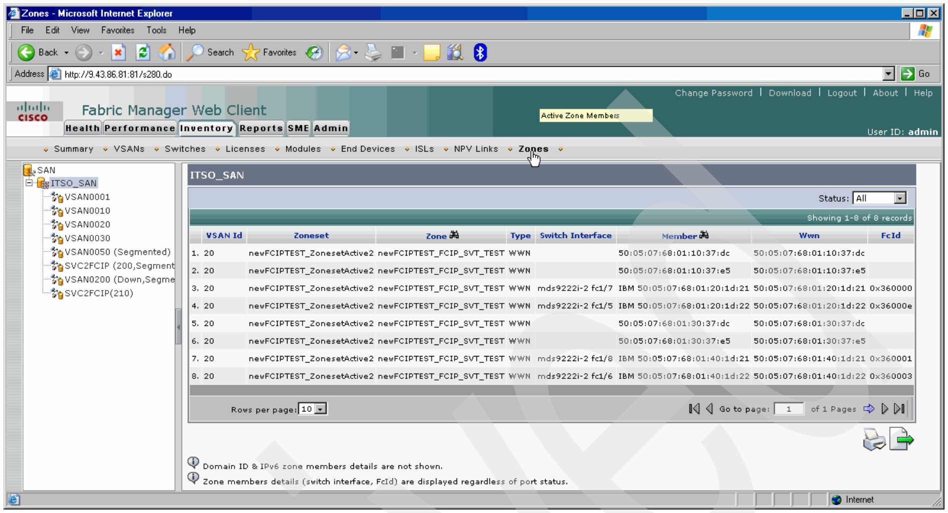
	VSANs	From Switch	From Interface	To Switch	To Interface	Speed	Status
1.	1,10	MDS9216-2	fcip2	mds9216i-1	fcip2	1Gb	ok
2.	1,10,20,30	mds9216i-1	fcip5	mds9222i-2	fcip5	1Gb	ok
3.	50	mds9222i-1	fc2/13	IBM_2005_B5K_1	0	2Gb	ok
4.	1,10,20,30	mds9222i-1	fcip4	mds9216i-1	fcip4	1Gb	ok
5.	1,10,20,30,50	mds9222i-1	channel20	mds9222i-2	channel20	2Gb	ok

Rows per page: 10 Go to page: 1 of 1 Pages

ISLs - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s240.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Inter Switch Links
Health Performance Inventory Reports SME Admin
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
ITSO_VSAN_50_INTEROP
SVC2FCIP (200,Segment
VSAN0200 (Down,Segme
SVC2FCIP (210,Segment
VSAN0210 (Down,Segme
Internet

Figure 4-34 ISLs inventory tab in the Cisco Fabric Manager Web Client

To view inventory information regarding zones in our SAN click the **Zones** tab in the Inventory section, as shown in Figure 4-35.


Zones - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s280.do Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
Active Zone Members
User ID: admin
Summary VSANs Switches Licenses Modules End Devices ISLs NPV Links Zones
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
VSAN0050 (Segmented)
SVC2FCIP (200,Segment
VSAN0200 (Down,Segme
SVC2FCIP(210)
ITSO_SAN
Status: All
Showing 1-8 of 8 records
Rows per page: 10
Go to page: 1 of 1 Pages
Internet

	VSAN Id	Zoneset	Zone	Type	Switch Interface	Member	Wwn	FcId
1.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN		50:05:07:68:01:10:37:dc	50:05:07:68:01:10:37:dc	
2.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN		50:05:07:68:01:10:37:e5	50:05:07:68:01:10:37:e5	
3.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-2 fc1/7	IBM 50:05:07:68:01:20:1d:21	50:05:07:68:01:20:1d:21	0x360000
4.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-2 fc1/5	IBM 50:05:07:68:01:20:1d:22	50:05:07:68:01:20:1d:22	0x36000e
5.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN		50:05:07:68:01:30:37:dc	50:05:07:68:01:30:37:dc	
6.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN		50:05:07:68:01:30:37:e5	50:05:07:68:01:30:37:e5	
7.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-2 fc1/8	IBM 50:05:07:68:01:40:1d:21	50:05:07:68:01:40:1d:21	0x360001
8.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-2 fc1/6	IBM 50:05:07:68:01:40:1d:22	50:05:07:68:01:40:1d:22	0x360003

Domain ID & IPv6 zone members details are not shown.

Zone members details (switch interface, FcId) are displayed regardless of port status.

Figure 4-35 Zones inventory tab in the Cisco Fabric Manager Web Client

The Fabric Manager Web Server allows you to create customized reports based on historical performance, events, and inventory information gathered by the Fabric Manager Server. You can create aggregate reports with summary and detailed views. You can also view previously saved reports.

The Report tab contains the following subtabs:

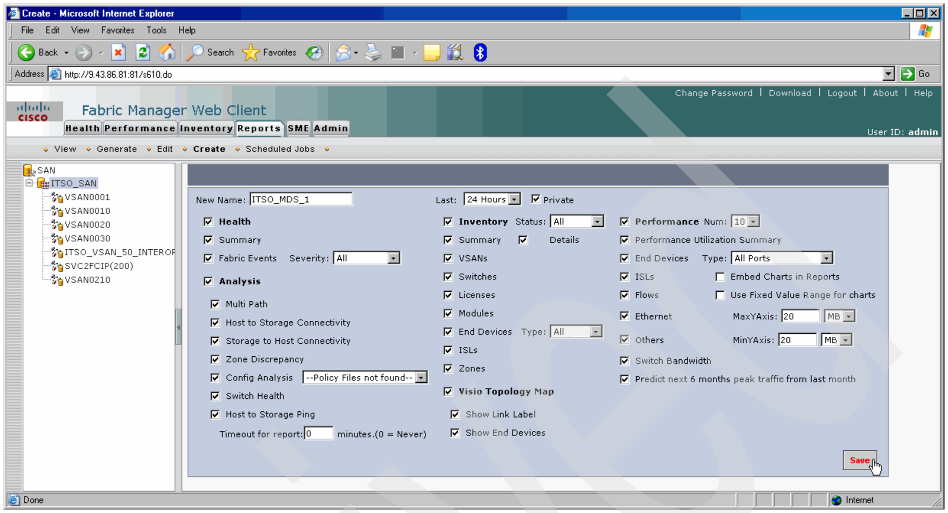
- View: Displays previously saved reports
- Generate: Generates a custom report based on the selected report template
- Edit: Edits an existing report template
- Create: Creates a report template, allowing you to select any combination of events, performance categories, and inventory
- Scheduled Jobs: Displays scheduled jobs based on the selected report template

You can create custom reports from all or any subset of information gathered by Fabric Manager Server. You create a report template by selecting events, performance, and inventory statistics that you want in your report and set the desired SAN, fabric, or VSAN to limit the scope of the template.

You can generate and schedule a report of your fabric based on this template immediately or at a later time. Fabric Manager Web Server saves each report based on the report template used and the time at which you generate the report.

To create a custom report in Fabric Manager Web Client:

1. Click the **Reports** tab, then the **Create** button, as shown in Figure 4-36.


Create - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s610.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
View Generate Edit Create Scheduled Jobs
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
ITSO_VSAN_50_INTEROP
SVC2FCIP(200)
VSAN0210
Save
Done
Internet

New Name: ITSO_MDS_1 Last: 24 Hours ☑ Private

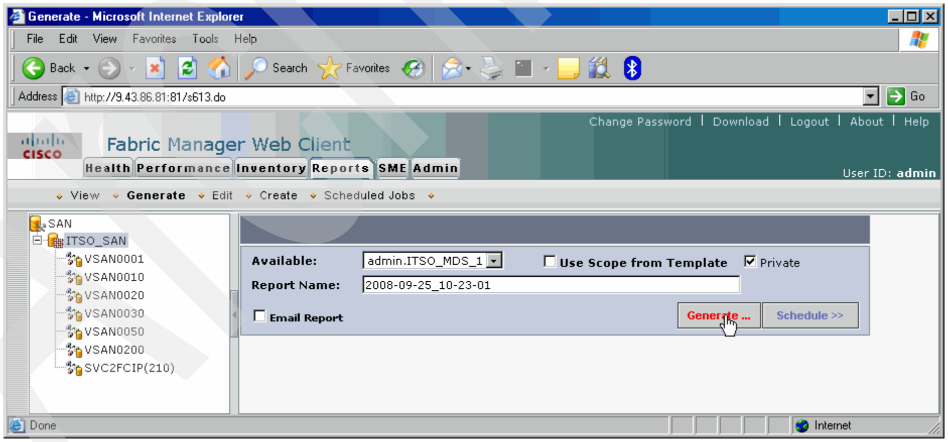
☑ **Health**
☑ Summary
☑ Fabric Events Severity: All
☑ **Analysis**
☑ Multi Path
☑ Host to Storage Connectivity
☑ Storage to Host Connectivity
☑ Zone Discrepancy
☑ Config Analysis --Policy Files not found--
☑ Switch Health
☑ Host to Storage Ping
Timeout for report: 0 minutes.(0 = Never)

☑ **Inventory** Status: All
☑ Summary ☑ Details
☑ VSANs
☑ Switches
☑ Licenses
☑ Modules
☑ End Devices Type: All
☑ ISLs
☑ Zones
☑ **Visio Topology Map**
☑ Show Link Label
☑ Show End Devices

☑ **Performance** Num: 10
☑ Performance Utilization Summary
☑ End Devices Type: All Ports
☑ ISLs ☐ Embed Charts in Reports
☑ Flows ☐ Use Fixed Value Range for charts
☑ Ethernet MaxYAxis: 20 MB
☑ Others MinYAxis: 20 MB
☑ Switch Bandwidth
☑ Predict next 6 months peak traffic from last month

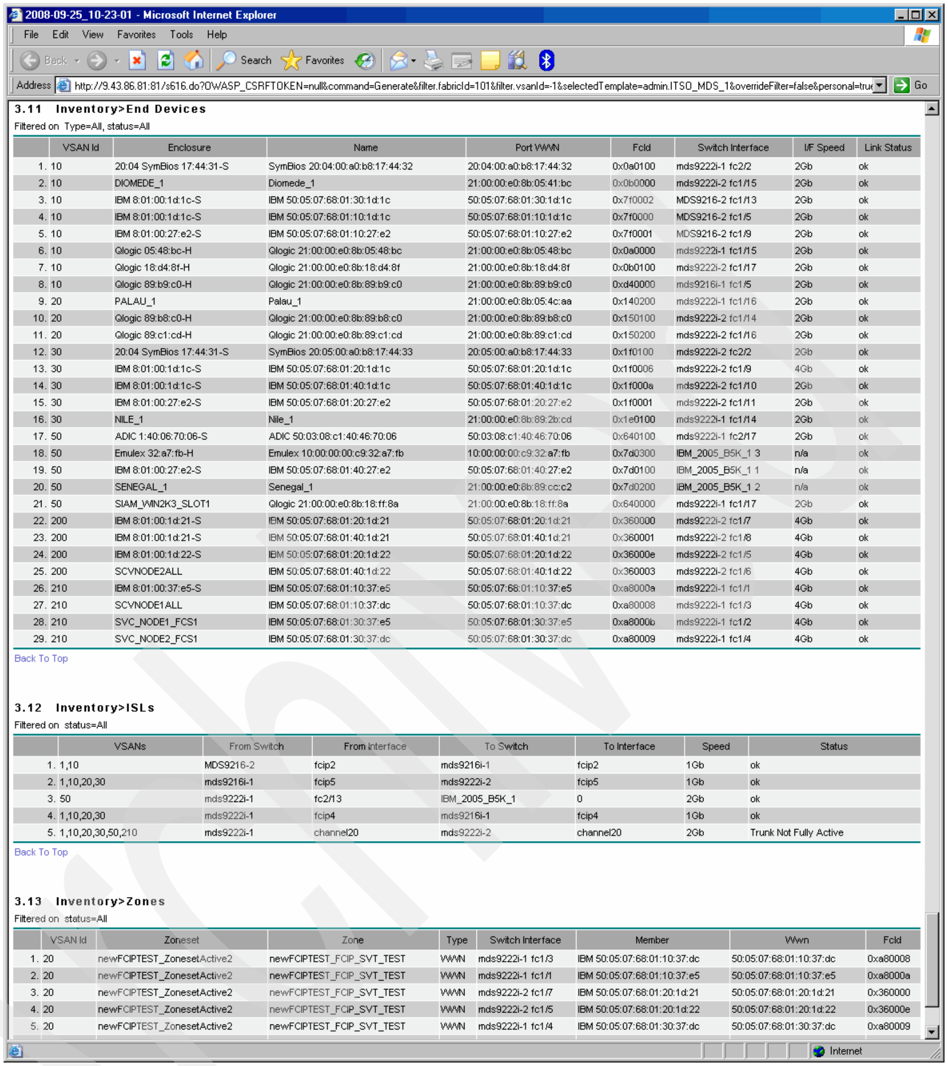
Figure 4-36 Create a customer report in the Cisco Fabric Manager Web Client

2. Choose the **Generate** button and get the report from the SAN network, as shown in Figure 4-37 and Figure 4-38 on page 116.


Generate - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s613.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
View Generate Edit Create Scheduled Jobs
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
VSAN0050
VSAN0200
SVC2FCIP(210)
Generate ...
Schedule >>
Done
Internet

Available: admin.ITSO_MDS_1 ☐ **Use Scope from Template** ☑ Private
Report Name: 2008-09-25_10-23-01
☐ **Email Report**

Figure 4-37 Generate the report from the SAN in the Cisco Fabric Manager Web Client


2008-09-25_10-23-01 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address
http://9.43.86.81:81/s616.do?OWASP_CSRFTOKEN=null&command=Generate&filter.fabricId=101&filter.vsanId=-1&selectedTemplate=admin.ITSO_MDS_1&overrideFilter=false&personal=true
Go
Internet

3.11 Inventory>End Devices

Filtered on Type=All, status=All

	VSAN Id	Enclosure	Name	Port WWN	FcId	Switch Interface	I/F Speed	Link Status
1.	10	20:04 SymBios 17:44:31-S	SymBios 20:04:00:a0:b8:17:44:32	20:04:00:a0:b8:17:44:32	0x0a0100	mds9222i-1 fc2/2	2Gb	ok
2.	10	DIOMEDE_1	Diomede_1	21:00:00:e0:8b:05:41:bc	0x0b0000	mds9222i-2 fc1/15	2Gb	ok
3.	10	IBM 8:01:00:1d:1c-S	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0x7f0002	MDS9216-2 fc1/13	2Gb	ok
4.	10	IBM 8:01:00:1d:1c-S	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0x7f0000	MDS9216-2 fc1/5	2Gb	ok
5.	10	IBM 8:01:00:27:e2-S	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0x7f0001	MDS9216-2 fc1/9	2Gb	ok
6.	10	Qlogic 05:48:bc-H	Qlogic 21:00:00:e0:8b:05:48:bc	21:00:00:e0:8b:05:48:bc	0x0a0000	mds9222i-1 fc1/15	2Gb	ok
7.	10	Qlogic 18:d4:8f-H	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x0b0100	mds9222i-2 fc1/17	2Gb	ok
8.	10	Qlogic 89:b9:c0-H	Qlogic 21:00:00:e0:8b:89:b9:c0	21:00:00:e0:8b:89:b9:c0	0xd40000	mds9216i-1 fc1/5	2Gb	ok
9.	20	PALAU_1	Palau_1	21:00:00:e0:8b:05:4c:aa	0x140200	mds9222i-1 fc1/16	2Gb	ok
10.	20	Qlogic 89:b8:c0-H	Qlogic 21:00:00:e0:8b:89:b8:c0	21:00:00:e0:8b:89:b8:c0	0x150100	mds9222i-2 fc1/14	2Gb	ok
11.	20	Qlogic 89:c1:cd-H	Qlogic 21:00:00:e0:8b:89:c1:cd	21:00:00:e0:8b:89:c1:cd	0x150200	mds9222i-2 fc1/16	2Gb	ok
12.	30	20:04 SymBios 17:44:31-S	SymBios 20:05:00:a0:b8:17:44:33	20:05:00:a0:b8:17:44:33	0x1f0100	mds9222i-2 fc2/2	2Gb	ok
13.	30	IBM 8:01:00:1d:1c-S	IBM 50:05:07:68:01:20:1d:1c	50:05:07:68:01:20:1d:1c	0x1f0006	mds9222i-2 fc1/9	4Gb	ok
14.	30	IBM 8:01:00:1d:1c-S	IBM 50:05:07:68:01:40:1d:1c	50:05:07:68:01:40:1d:1c	0x1f000a	mds9222i-2 fc1/10	2Gb	ok
15.	30	IBM 8:01:00:27:e2-S	IBM 50:05:07:68:01:20:27:e2	50:05:07:68:01:20:27:e2	0x1f0001	mds9222i-2 fc1/11	2Gb	ok
16.	30	NILE_1	Nile_1	21:00:00:e0:8b:89:2b:cd	0x1e0100	mds9222i-1 fc1/14	2Gb	ok
17.	50	ADIC 1:40:06:70:06-S	ADIC 50:03:08:c1:40:46:70:06	50:03:08:c1:40:46:70:06	0x640100	mds9222i-1 fc2/17	2Gb	ok
18.	50	Emulex 32:a7:fb-H	Emulex 10:00:00:00:c9:32:a7:fb	10:00:00:00:c9:32:a7:fb	0x7d0300	IBM_2005_B5K_1 3	n/a	ok
19.	50	IBM 8:01:00:27:e2-S	IBM 50:05:07:68:01:40:27:e2	50:05:07:68:01:40:27:e2	0x7d0100	IBM_2005_B5K_1 1	n/a	ok
20.	50	SENEGAL_1	Senegal_1	21:00:00:e0:8b:89:cc:c2	0x7d0200	IBM_2005_B5K_1 2	n/a	ok
21.	50	SIAM_WIN2K3_SLOT1	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0x640000	mds9222i-1 fc1/17	2Gb	ok
22.	200	IBM 8:01:00:1d:21-S	IBM 50:05:07:68:01:20:1d:21	50:05:07:68:01:20:1d:21	0x360000	mds9222i-2 fc1/7	4Gb	ok
23.	200	IBM 8:01:00:1d:21-S	IBM 50:05:07:68:01:40:1d:21	50:05:07:68:01:40:1d:21	0x360001	mds9222i-2 fc1/8	4Gb	ok
24.	200	IBM 8:01:00:1d:22-S	IBM 50:05:07:68:01:20:1d:22	50:05:07:68:01:20:1d:22	0x36000e	mds9222i-2 fc1/5	4Gb	ok
25.	200	SCVNODE2ALL	IBM 50:05:07:68:01:40:1d:22	50:05:07:68:01:40:1d:22	0x360003	mds9222i-2 fc1/6	4Gb	ok
26.	210	IBM 8:01:00:37:e5-S	IBM 50:05:07:68:01:10:37:e5	50:05:07:68:01:10:37:e5	0xa8000a	mds9222i-1 fc1/1	4Gb	ok
27.	210	SCVNODE1ALL	IBM 50:05:07:68:01:10:37:dc	50:05:07:68:01:10:37:dc	0xa80008	mds9222i-1 fc1/3	4Gb	ok
28.	210	SVC_NODE1_FCS1	IBM 50:05:07:68:01:30:37:e5	50:05:07:68:01:30:37:e5	0xa8000b	mds9222i-1 fc1/2	4Gb	ok
29.	210	SVC_NODE2_FCS1	IBM 50:05:07:68:01:30:37:dc	50:05:07:68:01:30:37:dc	0xa80009	mds9222i-1 fc1/4	4Gb	ok

Back To Top

3.12 Inventory>ISLs

Filtered on status=All

	VSANs	From Switch	From Interface	To Switch	To Interface	Speed	Status
1.	1,10	MDS9216-2	fcip2	mds9216i-1	fcip2	1Gb	ok
2.	1,10,20,30	mds9216i-1	fcip5	mds9222i-2	fcip5	1Gb	ok
3.	50	mds9222i-1	fc2/13	IBM_2005_B5K_1	0	2Gb	ok
4.	1,10,20,30	mds9222i-1	fcip4	mds9216i-1	fcip4	1Gb	ok
5.	1,10,20,30,50,210	mds9222i-1	channel20	mds9222i-2	channel20	2Gb	Trunk Not Fully Active

Back To Top

3.13 Inventory>Zones

Filtered on status=All

	VSAN Id	Zoneset	Zone	Type	Switch Interface	Member	Wwn	FcId
1.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-1 fc1/3	IBM 50:05:07:68:01:10:37:dc	50:05:07:68:01:10:37:dc	0xa80008
2.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-1 fc1/1	IBM 50:05:07:68:01:10:37:e5	50:05:07:68:01:10:37:e5	0xa8000a
3.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-2 fc1/7	IBM 50:05:07:68:01:20:1d:21	50:05:07:68:01:20:1d:21	0x360000
4.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-2 fc1/5	IBM 50:05:07:68:01:20:1d:22	50:05:07:68:01:20:1d:22	0x36000e
5.	20	newFCIPTEST_ZonesetActive2	newFCIPTEST_FCIP_SVT_TEST	WWN	mds9222i-1 fc1/4	IBM 50:05:07:68:01:30:37:dc	50:05:07:68:01:30:37:dc	0xa80009

Figure 4-38 A part of the SAN report generated in the Cisco Fabric Manager Web Client

If you choose to attach to the SAN report a Visio® drawing of the SAN network you can download the Visio file and get a detailed graphical view of your SAN, as shown in Figure 4-39. A link to the Visio drawing is found at the top the report.

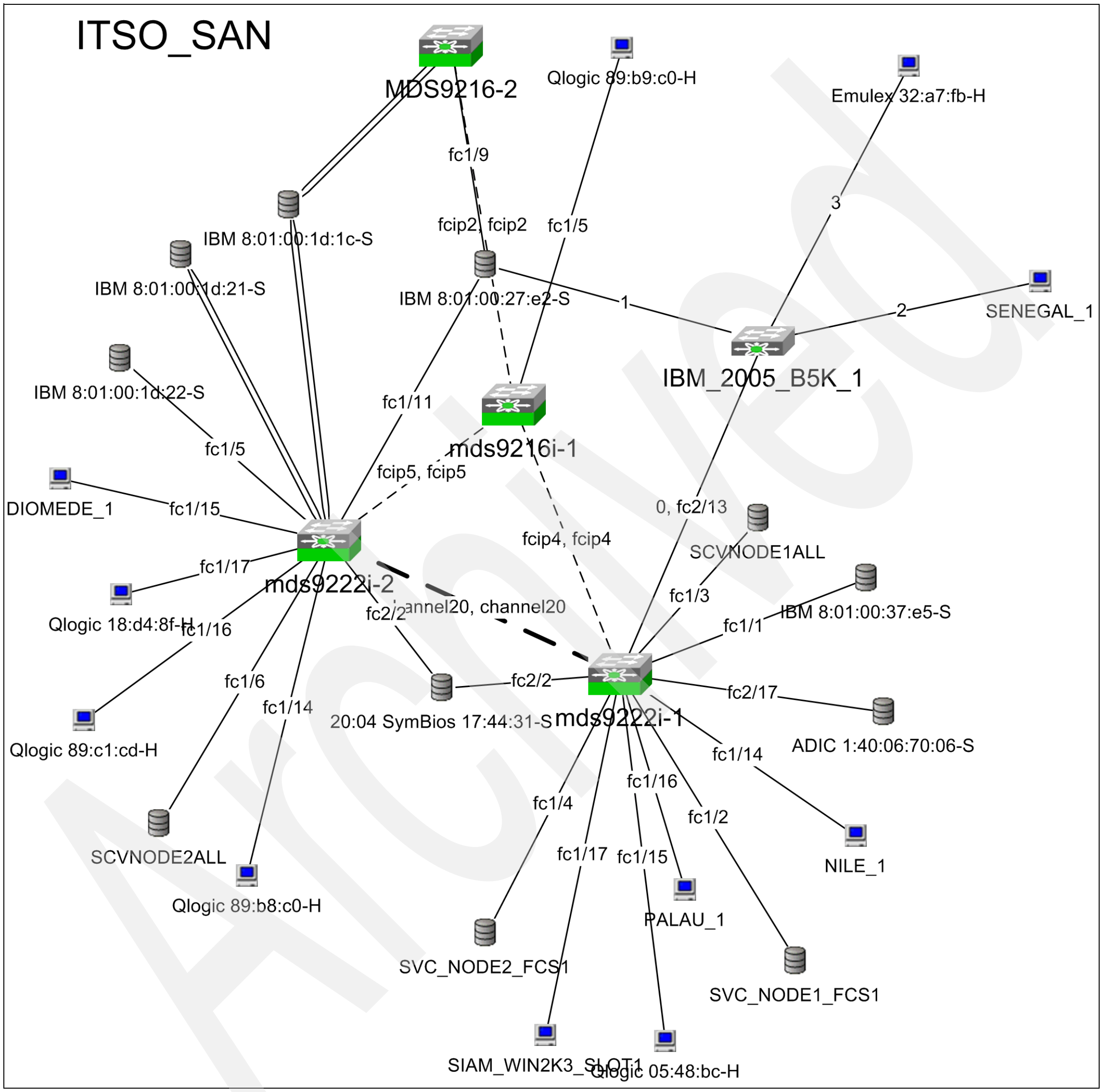
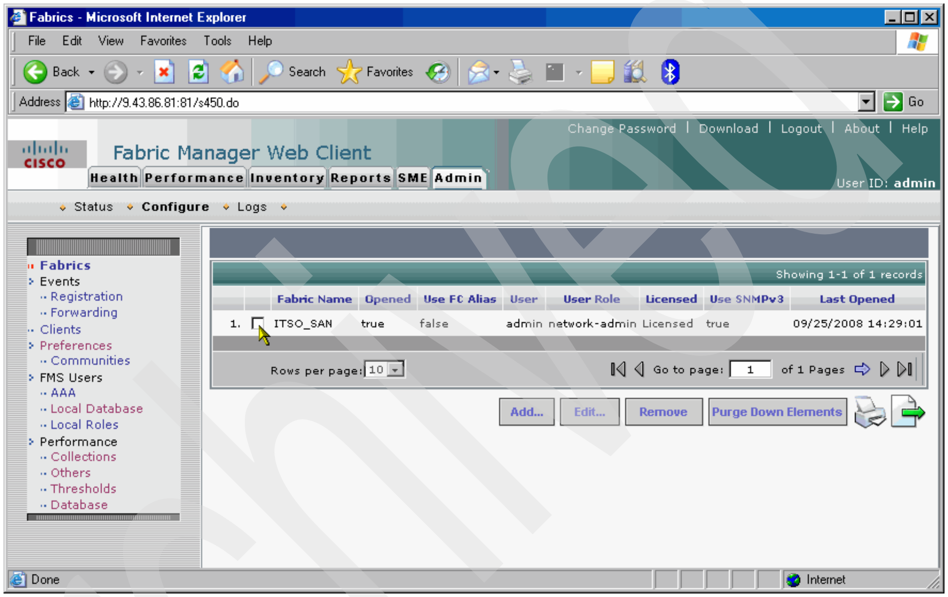


Figure 4-39 Visio Drawing of the SAN network created by the reporting tool

You can use the Fabric Manager Web Client to collect and analyze performance data from a monitored SAN. Before doing that it is necessary to configure a performance monitoring environment.

As shown in Figure 4-40, select **Configure** under the Admin tab to configure a fabric performance data collection.

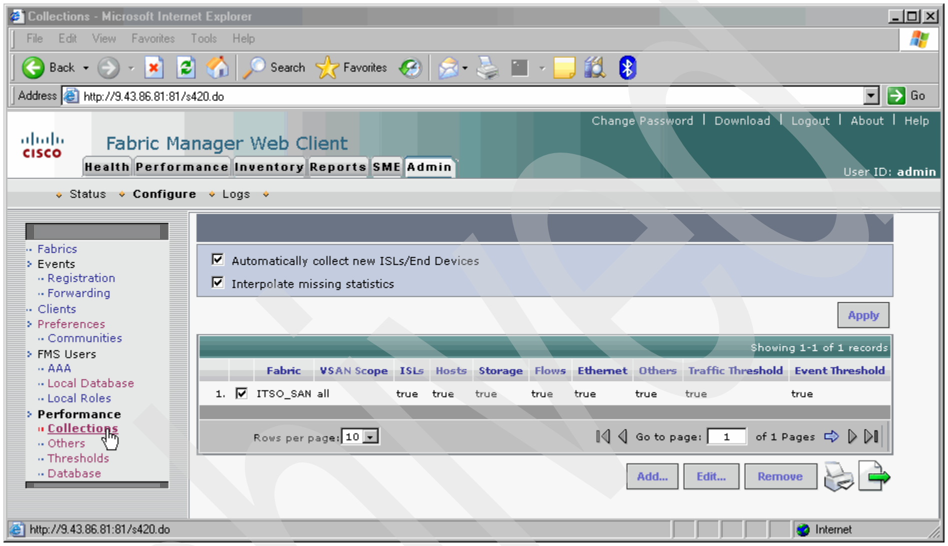
> **Note**: If you are managing your fabrics with Performance Manager, you need to set up an initial set of flows and collections on the fabric. You can use the Fabric Manager Web server to add and remove performance collections. See Creating Performance Collections under the Help panel.



		Fabric Name	Opened	Use FC Alias	User	User Role	Licensed	Use SNMPv3	Last Opened
1.	□	ITSO_SAN	true	false	admin	network-admin	Licensed	true	09/25/2008 14:29:01

Figure 4-40 Configure Fabric Manager to collect performance data

If you are managing your fabrics with Performance Manager, you need to set up an initial set of flows and collections on the fabric. You can use Fabric Manager Web Server to add and remove performance collections. In order to configure performance collections click the **Admin** tab, choose **Configure**, and from the menu on the left choose **Collections**, as shown in Figure 4-41. You will get the Edit Collection window to set up the required parameters, as shown in Figure 4-42.


Collections - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s420.do
Go
Change Password | Download | Logout | About | Help
cisco
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Status Configure Logs
Fabrics
Events
Registration
Forwarding
Clients
Preferences
Communities
FMS Users
AAA
Local Database
Local Roles
Performance
Collections
Others
Thresholds
Database
Apply
Add... Edit... Remove
http://9.43.86.81:81/s420.do
Internet

☑ Automatically collect new ISLs/End Devices

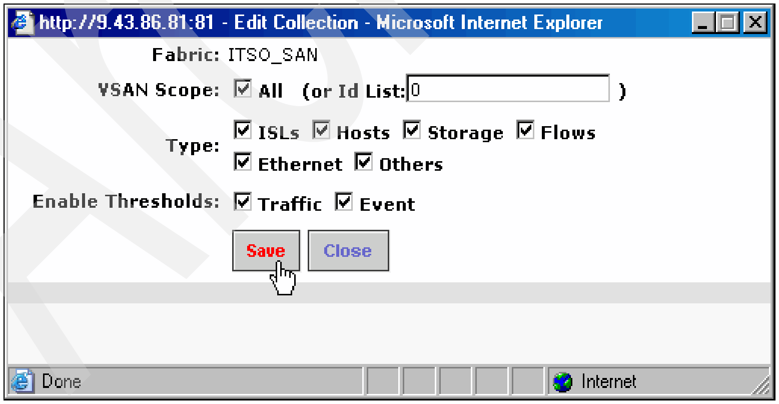
☑ Interpolate missing statistics

Showing 1-1 of 1 records

		Fabric	VSAN Scope	ISLs	Hosts	Storage	Flows	Ethernet	Others	Traffic Threshold	Event Threshold
1.	☑	ITSO_SAN	all	true	true	true	true	true	true	true	true

Rows per page: 10 Go to page: 1 of 1 Pages

Figure 4-41 Configure performance collections


http://9.43.86.81:81 - Edit Collection - Microsoft Internet Explorer
Save
Close
Done
Internet

Fabric: ITSO_SAN

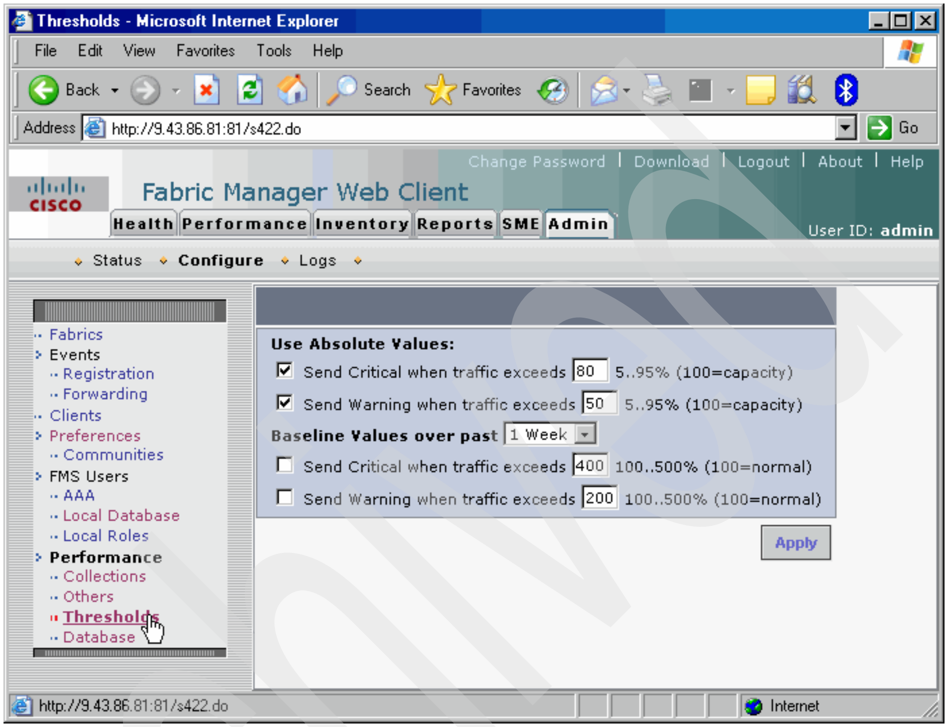
VSAN Scope: ☑ All (or Id List: 0)

Type: ☑ ISLs ☑ Hosts ☑ Storage ☑ Flows ☑ Ethernet ☑ Others

Enable Thresholds: ☑ Traffic ☑ Event

Figure 4-42 Edit collection parameters

Next you must configure thresholds for performance monitoring and alerting. You can use absolute values or baseline values for a defined period of time such as a week, a month, and a year. An example configuration is shown in Figure 4-43.


Thresholds - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s422.do Go
Change Password | Download | Logout | About | Help
cisco
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Status Configure Logs
Fabrics
Events
Registration
Forwarding
Clients
Preferences
Communities
FMS Users
AAA
Local Database
Local Roles
Performance
Collections
Others
Thresholds
Database
Apply
http://9.43.86.81:81/s422.do
Internet

Use Absolute Values:

☑ Send Critical when traffic exceeds 80 5..95% (100=capacity)

☑ Send Warning when traffic exceeds 50 5..95% (100=capacity)

Baseline Values over past 1 Week

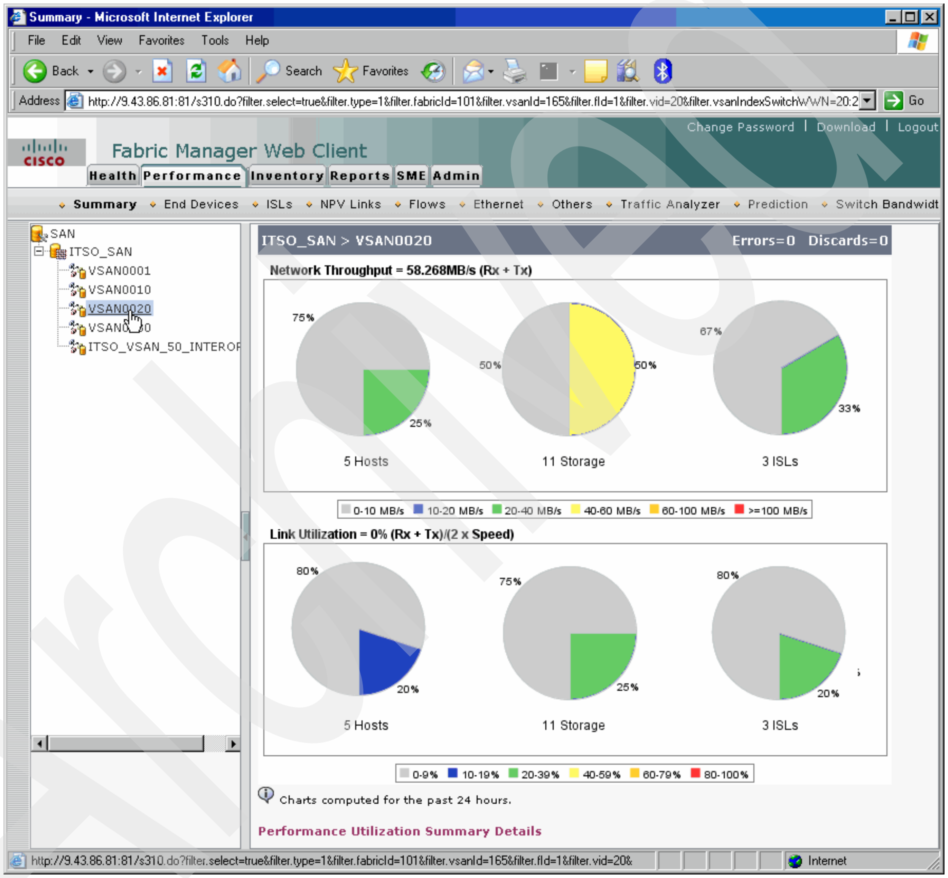
☐ Send Critical when traffic exceeds 400 100..500% (100=normal)

☐ Send Warning when traffic exceeds 200 100..500% (100=normal)

Figure 4-43 Configuring threshold for traffic and performance monitoring

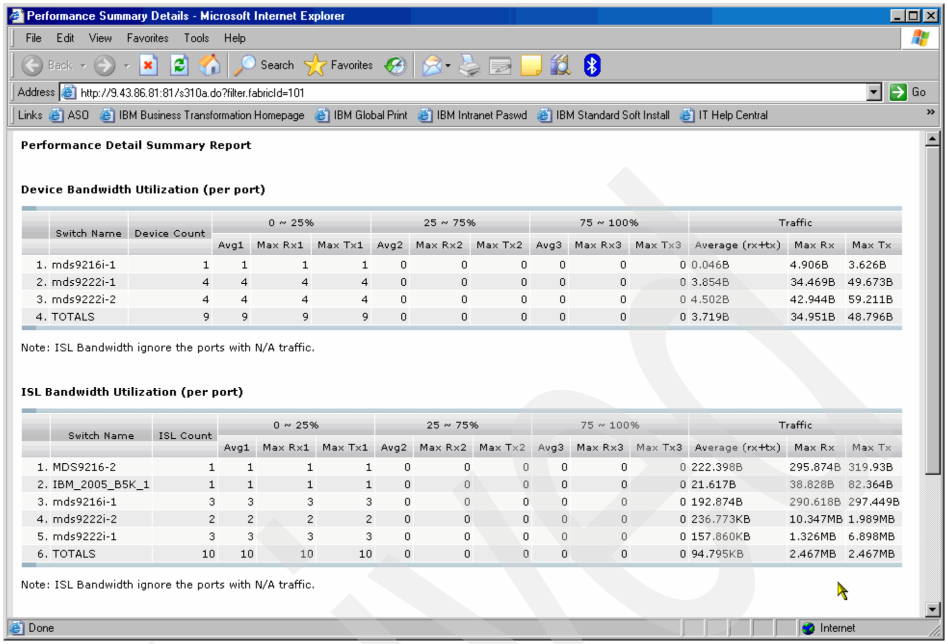
When all performance parameters are set you can start to collect performance data regarding traffic in your monitored fabrics. As a presentation you can use graphical or spreadsheet reports, as shown respectively in Figure 4-44 and in Figure 4-45 on page 122.

> **Note:** Performance data is available for display once data collection has progressed for a time period.


Summary - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s310.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=165&filter.fId=1&filter.vid=20&filter.vsanIndexSwitchWWN=20:2
Go
Change Password | Download | Logout
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidt
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0_0
ITSO_VSAN_50_INTEROP
ITSO_SAN > VSAN0020
Errors=0 Discards=0
Network Throughput = 58.268MB/s (Rx + Tx)
75%
25%
5 Hosts
50%
50%
11 Storage
67%
33%
3 ISLs
0-10 MB/s 10-20 MB/s 20-40 MB/s 40-60 MB/s 60-100 MB/s >=100 MB/s
Link Utilization = 0% (Rx + Tx)/(2 x Speed)
80%
20%
5 Hosts
75%
25%
11 Storage
80%
20%
3 ISLs
0-9% 10-19% 20-39% 40-59% 60-79% 80-100%
Performance Utilization Summary Details
http://9.43.86.81:81/s310.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=165&filter.fId=1&filter.vid=20&
Internet

Charts computed for the past 24 hours.

Figure 4-44 Graphical performance reports from the Cisco Fabric Manager Web Client


Performance Summary Details - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s310a.do?filter.fabricId=101
Go
Links ASO IBM Business Transformation Homepage IBM Global Print IBM Intranet Paswd IBM Standard Soft Install IT Help Central
Done
Internet

Performance Detail Summary Report

Device Bandwidth Utilization (per port)

	Switch Name	Device Count	0 ~ 25%			25 ~ 75%			75 ~ 100%			Traffic		
			Avg1	Max Rx1	Max Tx1	Avg2	Max Rx2	Max Tx2	Avg3	Max Rx3	Max Tx3	Average (rx+tx)	Max Rx	Max Tx
1.	mds9216i-1	1	1	1	1	0	0	0	0	0	0	0.046B	4.906B	3.626B
2.	mds9222i-1	4	4	4	4	0	0	0	0	0	0	3.854B	34.469B	49.673B
3.	mds9222i-2	4	4	4	4	0	0	0	0	0	0	4.502B	42.944B	59.211B
4.	TOTALS	9	9	9	9	0	0	0	0	0	0	3.719B	34.951B	48.796B

Note: ISL Bandwidth ignore the ports with N/A traffic.

ISL Bandwidth Utilization (per port)

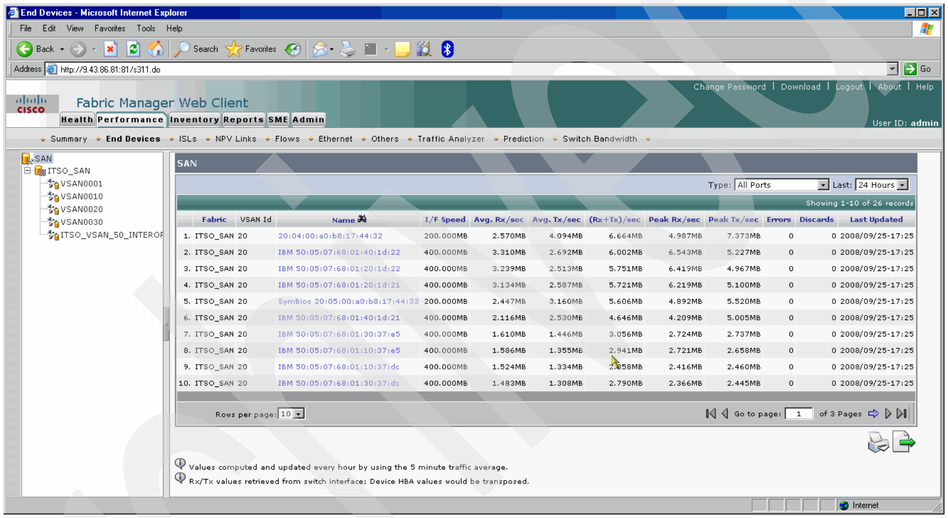
	Switch Name	ISL Count	0 ~ 25%			25 ~ 75%			75 ~ 100%			Traffic		
			Avg1	Max Rx1	Max Tx1	Avg2	Max Rx2	Max Tx2	Avg3	Max Rx3	Max Tx3	Average (rx+tx)	Max Rx	Max Tx
1.	MDS9216-2	1	1	1	1	0	0	0	0	0	0	222.398B	295.874B	319.93B
2.	IBM_2005_B5K_1	1	1	1	1	0	0	0	0	0	0	21.617B	38.828B	82.364B
3.	mds9216i-1	3	3	3	3	0	0	0	0	0	0	192.874B	290.618B	297.449B
4.	mds9222i-2	2	2	2	2	0	0	0	0	0	0	236.773KB	10.347MB	1.989MB
5.	mds9222i-1	3	3	3	3	0	0	0	0	0	0	157.860KB	1.326MB	6.898MB
6.	TOTALS	10	10	10	10	0	0	0	0	0	0	94.795KB	2.467MB	2.467MB

Note: ISL Bandwidth ignore the ports with N/A traffic.

Figure 4-45 Spreadsheet performance reports from Cisco Fabric Manager Web Client

Additionally, you can collect performance reports for specific components or characteristics of your SAN networks such as:

- End devices (Figure 4-46)
- ISLs (Figure 4-47 on page 124)
- NPV links
- Flows
- Ethernet (FCIP and iSCSI) (Figure 4-48 on page 124)
- CPU and memory utilization (Figure 4-49 on page 125)
- Traffic Analyzer reports
- Traffic predictions (Figure 4-50 on page 125)
- Switch bandwidth (Figure 4-51 on page 126)


End Devices - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s311.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidth
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
ITSO_VSAN_50_INTEROP
SAN
Internet

Type: All Ports Last: 24 Hours

Showing 1-10 of 26 records

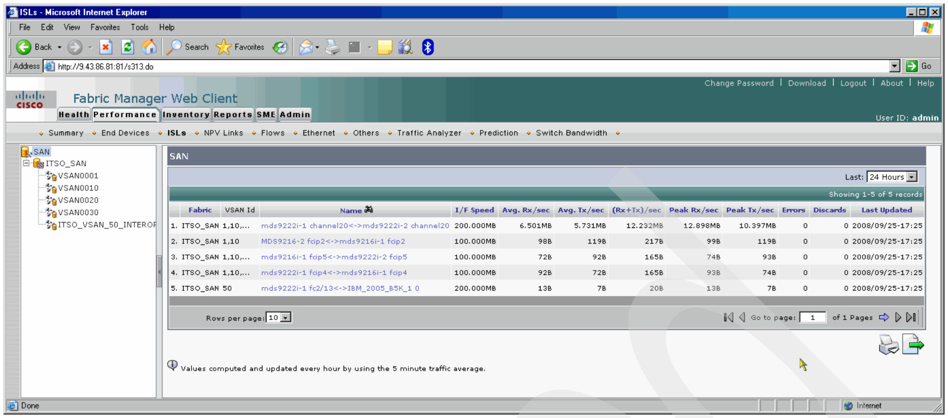
	Fabric	VSAN Id	Name	I/F Speed	Avg. Rx/sec	Avg. Tx/sec	(Rx+Tx)/sec	Peak Rx/sec	Peak Tx/sec	Errors	Discards	Last Updated
1.	ITSO_SAN	20	20:04:00:a0:b8:17:44:32	200.000MB	2.570MB	4.094MB	6.664MB	4.987MB	7.373MB	0	0	2008/09/25-17:25
2.	ITSO_SAN	20	IBM 50:05:07:68:01:40:1d:22	400.000MB	3.310MB	2.692MB	6.002MB	6.543MB	5.227MB	0	0	2008/09/25-17:25
3.	ITSO_SAN	20	IBM 50:05:07:68:01:20:1d:22	400.000MB	3.239MB	2.513MB	5.751MB	6.419MB	4.967MB	0	0	2008/09/25-17:25
4.	ITSO_SAN	20	IBM 50:05:07:68:01:20:1d:21	400.000MB	3.134MB	2.587MB	5.721MB	6.219MB	5.100MB	0	0	2008/09/25-17:25
5.	ITSO_SAN	20	SymBios 20:05:00:a0:b8:17:44:33	200.000MB	2.447MB	3.160MB	5.606MB	4.892MB	5.520MB	0	0	2008/09/25-17:25
6.	ITSO_SAN	20	IBM 50:05:07:68:01:40:1d:21	400.000MB	2.116MB	2.530MB	4.646MB	4.209MB	5.005MB	0	0	2008/09/25-17:25
7.	ITSO_SAN	20	IBM 50:05:07:68:01:30:37:e5	400.000MB	1.610MB	1.446MB	3.056MB	2.724MB	2.737MB	0	0	2008/09/25-17:25
8.	ITSO_SAN	20	IBM 50:05:07:68:01:10:37:e5	400.000MB	1.586MB	1.355MB	2.941MB	2.721MB	2.658MB	0	0	2008/09/25-17:25
9.	ITSO_SAN	20	IBM 50:05:07:68:01:10:37:dc	400.000MB	1.524MB	1.334MB	2.858MB	2.416MB	2.460MB	0	0	2008/09/25-17:25
10.	ITSO_SAN	20	IBM 50:05:07:68:01:30:37:dc	400.000MB	1.483MB	1.308MB	2.790MB	2.366MB	2.445MB	0	0	2008/09/25-17:25

Rows per page: 10 Go to page: 1 of 3 Pages

Values computed and updated every hour by using the 5 minute traffic average.

Rx/Tx values retrieved from switch interface; Device HBA values would be transposed.

Figure 4-46 Performance report for end devices


ISLs - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s313.do
Go
Fabric Manager Web Client
Change Password | Download | Logout | About | Help
Health Performance Inventory Reports SME Admin
User ID: admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidth
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
ITSO_VSAN_50_INTEROP
Done
Internet

SAN

Last: 24 Hours

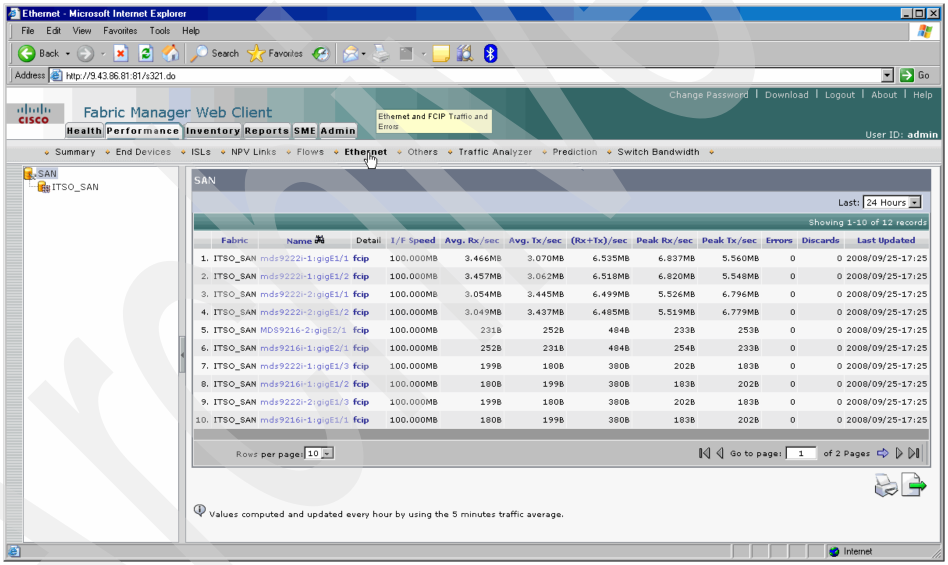
Showing 1-5 of 5 records

	Fabric	VSAN Id	Name	I/F Speed	Avg. Rx/sec	Avg. Tx/sec	(Rx+Tx)/sec	Peak Rx/sec	Peak Tx/sec	Errors	Discards	Last Updated
1.	ITSO_SAN	1,10,...	mds9222i-1 channel20<->mds9222i-2 channel20	200.000MB	6.501MB	5.731MB	12.232MB	12.898MB	10.397MB	0	0	2008/09/25-17:25
2.	ITSO_SAN	1,10	MDS9216-2 fcip2<->mds9216i-1 fcip2	100.000MB	98B	119B	217B	99B	119B	0	0	2008/09/25-17:25
3.	ITSO_SAN	1,10,...	mds9216i-1 fcip5<->mds9222i-2 fcip5	100.000MB	72B	92B	165B	74B	93B	0	0	2008/09/25-17:25
4.	ITSO_SAN	1,10,...	mds9222i-1 fcip4<->mds9216i-1 fcip4	100.000MB	92B	72B	165B	93B	74B	0	0	2008/09/25-17:25
5.	ITSO_SAN	50	mds9222i-1 fc2/13<->IBM_2005_B5K_1 0	200.000MB	13B	7B	20B	13B	7B	0	0	2008/09/25-17:25

Rows per page: 10   Go to page: 1 of 1 Pages

Values computed and updated every hour by using the 5 minute traffic average.

Figure 4-47   Performance report for ISLs


Ethernet - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s321.do
Go
Fabric Manager Web Client
Change Password | Download | Logout | About | Help
Health Performance Inventory Reports SME Admin
Ethernet and FCIP Traffic and Errors
User ID: admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidth
SAN
ITSO_SAN
Internet

SAN

Last: 24 Hours

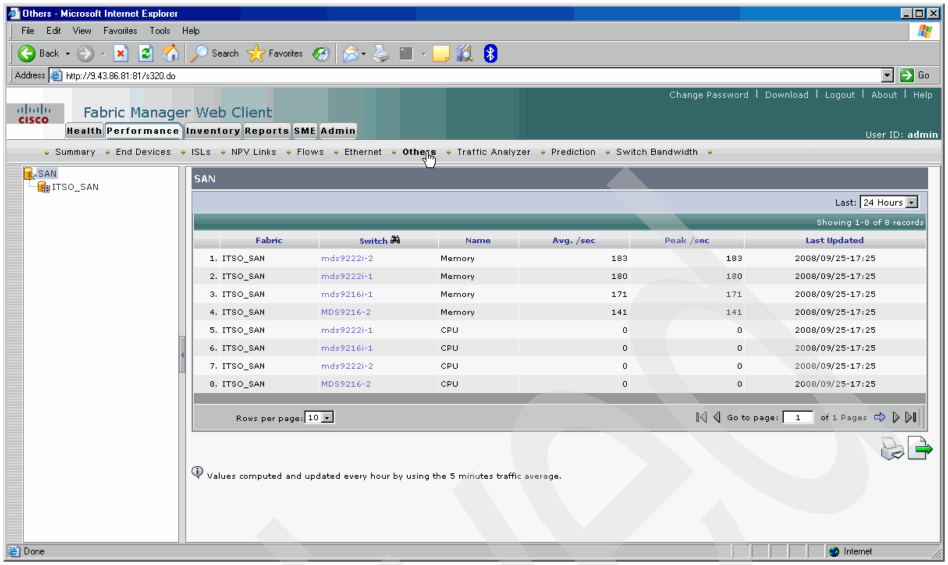
Showing 1-10 of 12 records

	Fabric	Name	Detail	I/F Speed	Avg. Rx/sec	Avg. Tx/sec	(Rx+Tx)/sec	Peak Rx/sec	Peak Tx/sec	Errors	Discards	Last Updated
1.	ITSO_SAN	mds9222i-1:gigE1/1	fcip	100.000MB	3.466MB	3.070MB	6.535MB	6.837MB	5.560MB	0	0	2008/09/25-17:25
2.	ITSO_SAN	mds9222i-1:gigE1/2	fcip	100.000MB	3.457MB	3.062MB	6.518MB	6.820MB	5.548MB	0	0	2008/09/25-17:25
3.	ITSO_SAN	mds9222i-2:gigE1/1	fcip	100.000MB	3.054MB	3.445MB	6.499MB	5.526MB	6.796MB	0	0	2008/09/25-17:25
4.	ITSO_SAN	mds9222i-2:gigE1/2	fcip	100.000MB	3.049MB	3.437MB	6.485MB	5.519MB	6.779MB	0	0	2008/09/25-17:25
5.	ITSO_SAN	MDS9216-2:gigE2/1	fcip	100.000MB	231B	252B	484B	233B	253B	0	0	2008/09/25-17:25
6.	ITSO_SAN	mds9216i-1:gigE2/1	fcip	100.000MB	252B	231B	484B	254B	233B	0	0	2008/09/25-17:25
7.	ITSO_SAN	mds9222i-1:gigE1/3	fcip	100.000MB	199B	180B	380B	202B	183B	0	0	2008/09/25-17:25
8.	ITSO_SAN	mds9216i-1:gigE1/2	fcip	100.000MB	180B	199B	380B	183B	202B	0	0	2008/09/25-17:25
9.	ITSO_SAN	mds9222i-2:gigE1/3	fcip	100.000MB	199B	180B	380B	202B	183B	0	0	2008/09/25-17:25
10.	ITSO_SAN	mds9216i-1:gigE1/1	fcip	100.000MB	180B	199B	380B	183B	202B	0	0	2008/09/25-17:25

Rows per page: 10   Go to page: 1 of 2 Pages

Values computed and updated every hour by using the 5 minutes traffic average.

Figure 4-48   Performance report for FCIP and iSCSI connections


Others - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s320.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidth
SAN
ITSO_SAN
Done
Internet

SAN

Last: 24 Hours

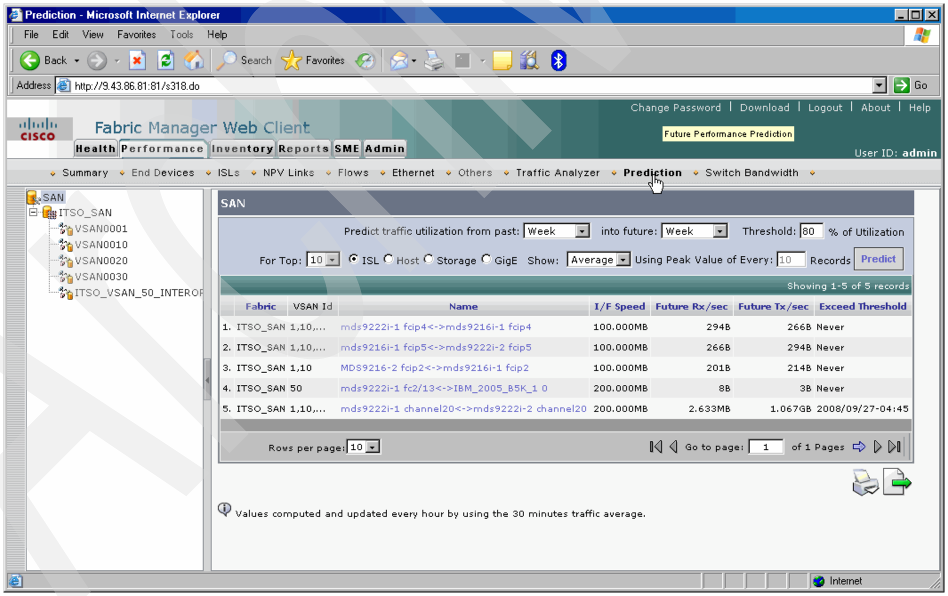
Showing 1-8 of 8 records

	Fabric	Switch	Name	Avg. /sec	Peak /sec	Last Updated
1.	ITSO_SAN	mds9222i-2	Memory	183	183	2008/09/25-17:25
2.	ITSO_SAN	mds9222i-1	Memory	180	180	2008/09/25-17:25
3.	ITSO_SAN	mds9216i-1	Memory	171	171	2008/09/25-17:25
4.	ITSO_SAN	MDS9216-2	Memory	141	141	2008/09/25-17:25
5.	ITSO_SAN	mds9222i-1	CPU	0	0	2008/09/25-17:25
6.	ITSO_SAN	mds9216i-1	CPU	0	0	2008/09/25-17:25
7.	ITSO_SAN	mds9222i-2	CPU	0	0	2008/09/25-17:25
8.	ITSO_SAN	MDS9216-2	CPU	0	0	2008/09/25-17:25

Rows per page: 10   Go to page: 1 of 1 Pages

Values computed and updated every hour by using the 5 minutes traffic average.

Figure 4-49 Performance report for CPU and memory utilization


Prediction - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s318.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Future Performance Prediction
Health Performance Inventory Reports SME Admin
User ID: admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidth
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
ITSO_VSAN_50_INTEROP
Internet

SAN

Predict traffic utilization from past: Week into future: Week Threshold: 80 % of Utilization

For Top: 10 ● ISL ○ Host ○ Storage ○ GigE Show: Average Using Peak Value of Every: 10 Records Predict

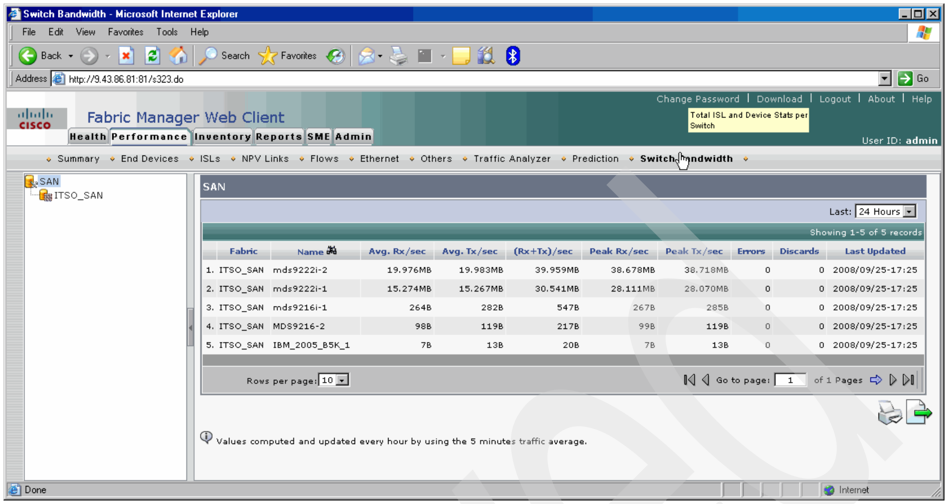
Showing 1-5 of 5 records

	Fabric	VSAN Id	Name	I/F Speed	Future Rx/sec	Future Tx/sec	Exceed Threshold
1.	ITSO_SAN	1,10,...	mds9222i-1 fcip4<->mds9216i-1 fcip4	100.000MB	294B	266B	Never
2.	ITSO_SAN	1,10,...	mds9216i-1 fcip5<->mds9222i-2 fcip5	100.000MB	266B	294B	Never
3.	ITSO_SAN	1,10	MDS9216-2 fcip2<->mds9216i-1 fcip2	100.000MB	201B	214B	Never
4.	ITSO_SAN	50	mds9222i-1 fc2/13<->IBM_2005_B5K_1 0	200.000MB	8B	3B	Never
5.	ITSO_SAN	1,10,...	mds9222i-1 channel20<->mds9222i-2 channel20	200.000MB	2.633MB	1.067GB	2008/09/27-04:45

Rows per page: 10   Go to page: 1 of 1 Pages

Values computed and updated every hour by using the 30 minutes traffic average.

Figure 4-50 Traffic prediction for ISLs in a one week period of time


Switch Bandwidth - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s323.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Total ISL and Device Stats per Switch
Health Performance Inventory Reports SME Admin
User ID: admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Bandwidth
SAN
ITSO_SAN
SAN
Last: 24 Hours
Showing 1-5 of 5 records
Rows per page: 10
Go to page: 1 of 1 Pages
Done
Internet

	Fabric	Name	Avg. Rx/sec	Avg. Tx/sec	(Rx+Tx)/sec	Peak Rx/sec	Peak Tx/sec	Errors	Discards	Last Updated
1.	ITSO_SAN	mds9222i-2	19.976MB	19.983MB	39.959MB	38.678MB	38.718MB	0	0	2008/09/25-17:25
2.	ITSO_SAN	mds9222i-1	15.274MB	15.267MB	30.541MB	28.111MB	28.070MB	0	0	2008/09/25-17:25
3.	ITSO_SAN	mds9216i-1	264B	282B	547B	267B	285B	0	0	2008/09/25-17:25
4.	ITSO_SAN	MDS9216-2	98B	119B	217B	99B	119B	0	0	2008/09/25-17:25
5.	ITSO_SAN	IBM_2005_B5K_1	7B	13B	20B	7B	13B	0	0	2008/09/25-17:25

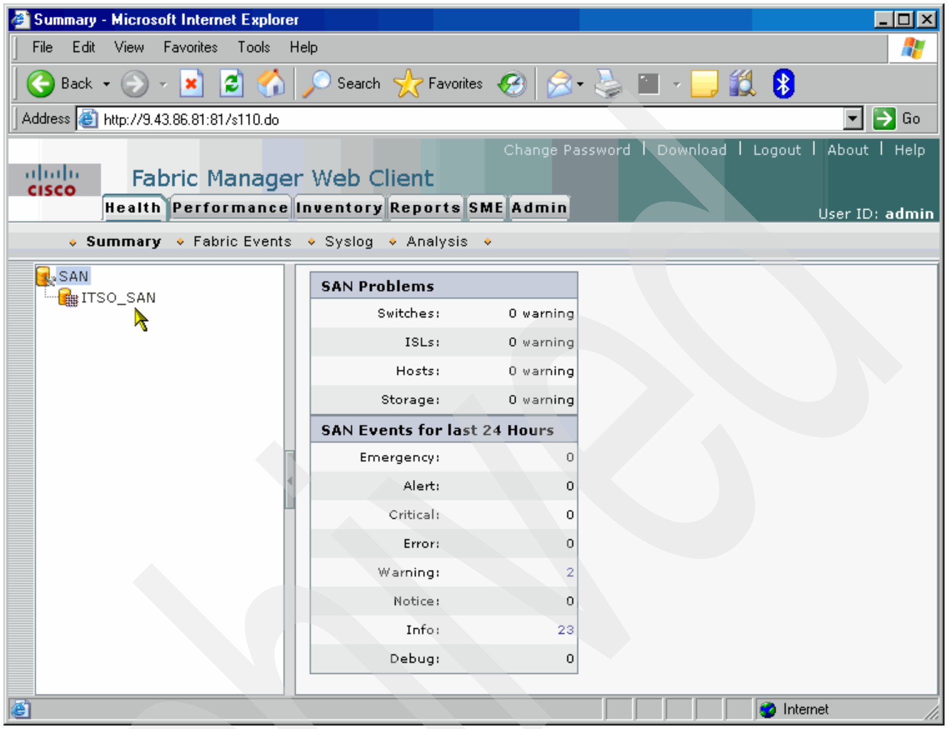
Values computed and updated every hour by using the 5 minutes traffic average.

Figure 4-51 Switch bandwidth report

You can use the Fabric Manager Web Client to gather and present data regarding the health status of monitored SAN networks. There are a few options available to gather valuable information regarding your SAN:

- Summary report: Shows a summary of events and problems for all SANs, or a selected SAN, fabric, or switch. You can click any blue link for more information about that item.
- Fabric Events: Shows a detailed list of events and hardware, or accounting. You can filter these events by severity, date, and type of event.
- SysLog: Shows a detailed list of system messages. You can filter these events by severity, date, and type of event.
- Analysis: Enables you to schedule or run analysis reports and compile results to analyze the Fabric Manager Server database statistics.

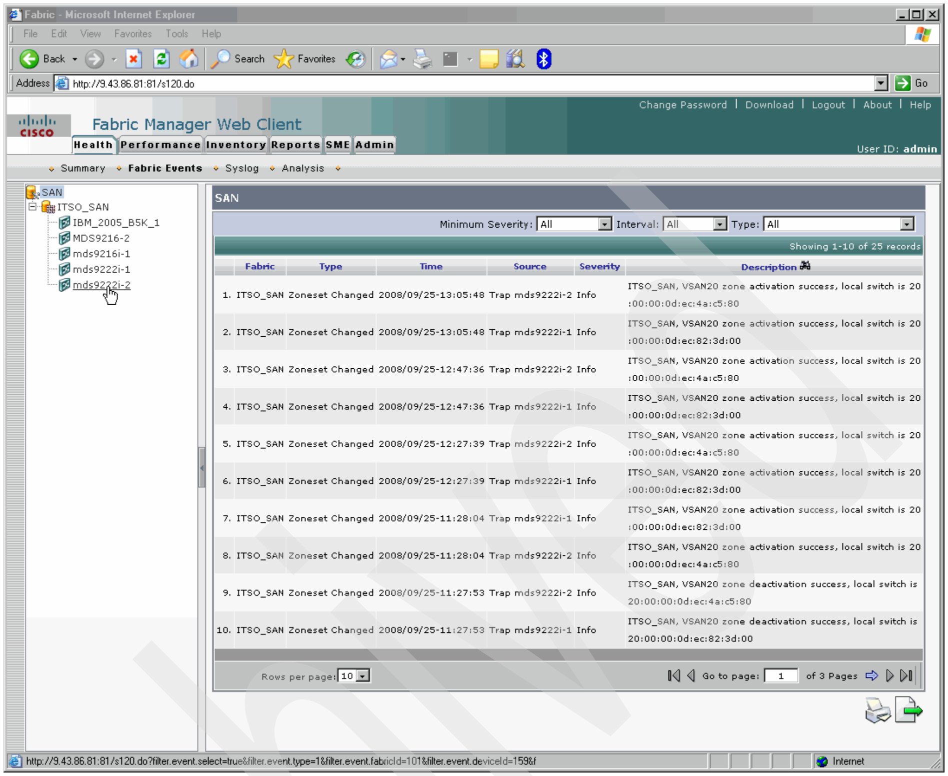
Examples of reports are shown in Figure 4-52, Figure 4-53 on page 128 and Figure 4-54 on page 129.


Summary - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s110.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary Fabric Events Syslog Analysis
SAN
ITSO_SAN
Internet

SAN Problems	
Switches:	0 warning
ISLs:	0 warning
Hosts:	0 warning
Storage:	0 warning

SAN Events for last 24 Hours	
Emergency:	0
Alert:	0
Critical:	0
Error:	0
Warning:	2
Notice:	0
Info:	23
Debug:	0

Figure 4-52 Overall summary SAN Health report


Fabric - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address http://9.43.86.81:81/s120.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health
Performance
Inventory
Reports
SME
Admin
User ID: admin
Summary
Fabric Events
Syslog
Analysis
SAN
ITSO_SAN
IBM_2005_B5K_1
MDS9216-2
mds9216i-1
mds9222i-1
mds9222i-2
http://9.43.86.81:81/s120.do?filter.event.select=true&filter.event.type=1&filter.event.fabricId=101&filter.event.deviceId=159&f
Internet

SAN

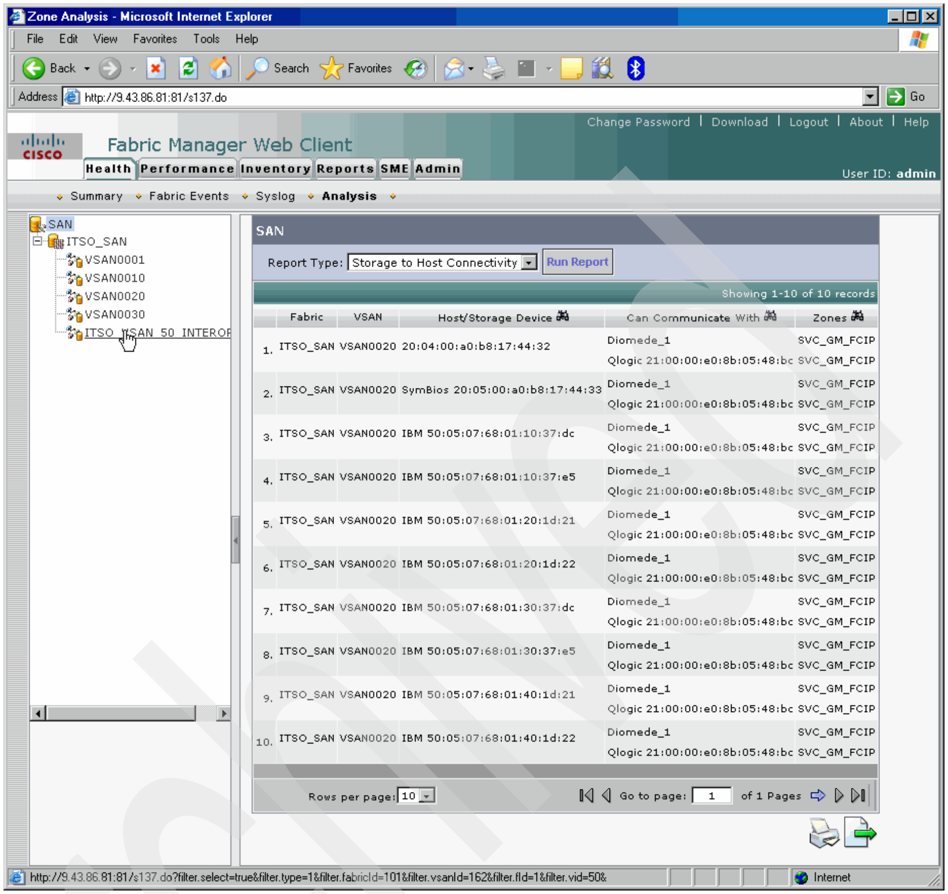
Minimum Severity: All Interval: All Type: All

Showing 1-10 of 25 records

	Fabric	Type	Time	Source	Severity	Description
1.	ITSO_SAN	Zoneset Changed	2008/09/25-13:05:48	Trap mds9222i-2	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:4a:c5:80
2.	ITSO_SAN	Zoneset Changed	2008/09/25-13:05:48	Trap mds9222i-1	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:82:3d:00
3.	ITSO_SAN	Zoneset Changed	2008/09/25-12:47:36	Trap mds9222i-2	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:4a:c5:80
4.	ITSO_SAN	Zoneset Changed	2008/09/25-12:47:36	Trap mds9222i-1	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:82:3d:00
5.	ITSO_SAN	Zoneset Changed	2008/09/25-12:27:39	Trap mds9222i-2	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:4a:c5:80
6.	ITSO_SAN	Zoneset Changed	2008/09/25-12:27:39	Trap mds9222i-1	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:82:3d:00
7.	ITSO_SAN	Zoneset Changed	2008/09/25-11:28:04	Trap mds9222i-1	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:82:3d:00
8.	ITSO_SAN	Zoneset Changed	2008/09/25-11:28:04	Trap mds9222i-2	Info	ITSO_SAN, VSAN20 zone activation success, local switch is 20:00:00:0d:ec:4a:c5:80
9.	ITSO_SAN	Zoneset Changed	2008/09/25-11:27:53	Trap mds9222i-2	Info	ITSO_SAN, VSAN20 zone deactivation success, local switch is 20:00:00:0d:ec:4a:c5:80
10.	ITSO_SAN	Zoneset Changed	2008/09/25-11:27:53	Trap mds9222i-1	Info	ITSO_SAN, VSAN20 zone deactivation success, local switch is 20:00:00:0d:ec:82:3d:00

Rows per page: 10 Go to page: 1 of 3 Pages

Figure 4-53 Fabric Events for all VSANs


Zone Analysis - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://9.43.86.81:81/s137.do
Go
Change Password | Download | Logout | About | Help
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
User ID: admin
Summary Fabric Events Syslog Analysis
SAN
ITSO_SAN
VSAN0001
VSAN0010
VSAN0020
VSAN0030
ITSO_VSAN_50_INTEROP
http://9.43.86.81:81/s137.do?filter.select=true&filter.type=1&filter.fabricId=101&filter.vsanId=162&filter.fId=1&filter.vid=50&
Internet

SAN

Report Type: Storage to Host Connectivity Run Report

Showing 1-10 of 10 records

	Fabric	VSAN	Host/Storage Device	Can Communicate With	Zones
1.	ITSO_SAN	VSAN0020	20:04:00:a0:b8:17:44:32	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
2.	ITSO_SAN	VSAN0020	SymBios 20:05:00:a0:b8:17:44:33	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
3.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:10:37:dc	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
4.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:10:37:e5	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
5.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:20:1d:21	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
6.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:20:1d:22	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
7.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:30:37:dc	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
8.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:30:37:e5	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
9.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:40:1d:21	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP
10.	ITSO_SAN	VSAN0020	IBM 50:05:07:68:01:40:1d:22	Diomede_1 Qlogic 21:00:00:e0:8b:05:48:bc	SVC_GM_FCIP SVC_GM_FCIP

Rows per page: 10 Go to page: 1 of 1 Pages

Figure 4-54 Analysis of the Storage to Host Connectivity

4.2.4 Obtaining the latest source files

Directors and switches in the Cisco MDS 9000 Multilayer Fabric Switch Family are shipped with the current levels of firmware already installed at the time of shipping. This code level is usually sufficient to begin the switch implementation process, but we recommend that you regularly check for the latest supported code levels and install updated code when required.

> **Note:** We strongly recommend checking new firmware compatibility with all devices and vendors connected to the SAN.

Attention: Cisco regularly makes new code releases available on their Web site for authorized users to download. IBM conducts additional integration testing on this code before issuing its approval, so we recommend that you always install only the IBM recommended code levels.

If you experience problems with an unapproved code release, IBM might ask you to install an approved release before continuing with problem resolution.

5

Security

Before the existence of storage area networks (SANs), and during the initial migration to SANs, the storage environment was fairly secure due to its physical isolation from the remainder of the communication network. SANs were typically entirely contained in the data center, and there are explicit procedural and physical controls to control access to the data center. However, with the advent of optical and FCIP solutions designed to improve high availability and disaster recovery this is no longer the case. SANs that span outside a single data center are now commonplace.

The concepts of who will manage the SAN and how will they manage the SAN are also areas that need to be considered. Effective security management strategies can only be implemented once these procedural questions have been discussed and finalized.

A complete discussion of all the advanced security functions available in the MDS 9000 Multilayer Fabric Switch family is beyond the scope of this book. The purpose of this chapter is to provide a high-level overview of the security features that are available. We discuss security from two different perspectives:

- Securing management access to the MDS switch itself
- Securing the Fibre Channel fabric

5.1 Securing management access to the switch

Typically, both CLI and SNMP are used to manage the switch. As such, they both need to be addressed with regards to security. The following security features are available on the MDS 9000 Multilayer Fabric Switch family in order to secure management access to the MDS switch:

- SSH service is available.
- SNMPv1, SNMPv2c, and SNMPv3 are all available.
- IP Access Control Lists.
- Role-based authorization.
- Authentication, Authorization, Accounting (AAA) with Terminal Access Controller Access Control System Plus (TACACS+) and Remote Access Dial-In User Services (RADIUS).
- The Federal Information Processing Standards (FIPS).

5.1.1 SSH service

Each switch in the MDS 9000 Multilayer Fabric Switch family supports the Secure Shell (SSH) facility. SSH provides several benefits over traditional management facilities such at Telnet, FTP, and TFTP, among which are strong authentication and encryption. SSH can be enabled on each switch to ensure secure access using the CLI, providing encrypted user authentication and data exchange.

The SSH Client in the MDS also supports a secured method when copying files (configuration files, log files, SAN-OS and NX-OS images) to and from the switch.

SSH provides secure communications to the Cisco SAN-OS and NX-OS CLI. You can use SSH keys for the following SSH options:

- SSH1
- SSH2, using RSA
- SSH2, using DSA

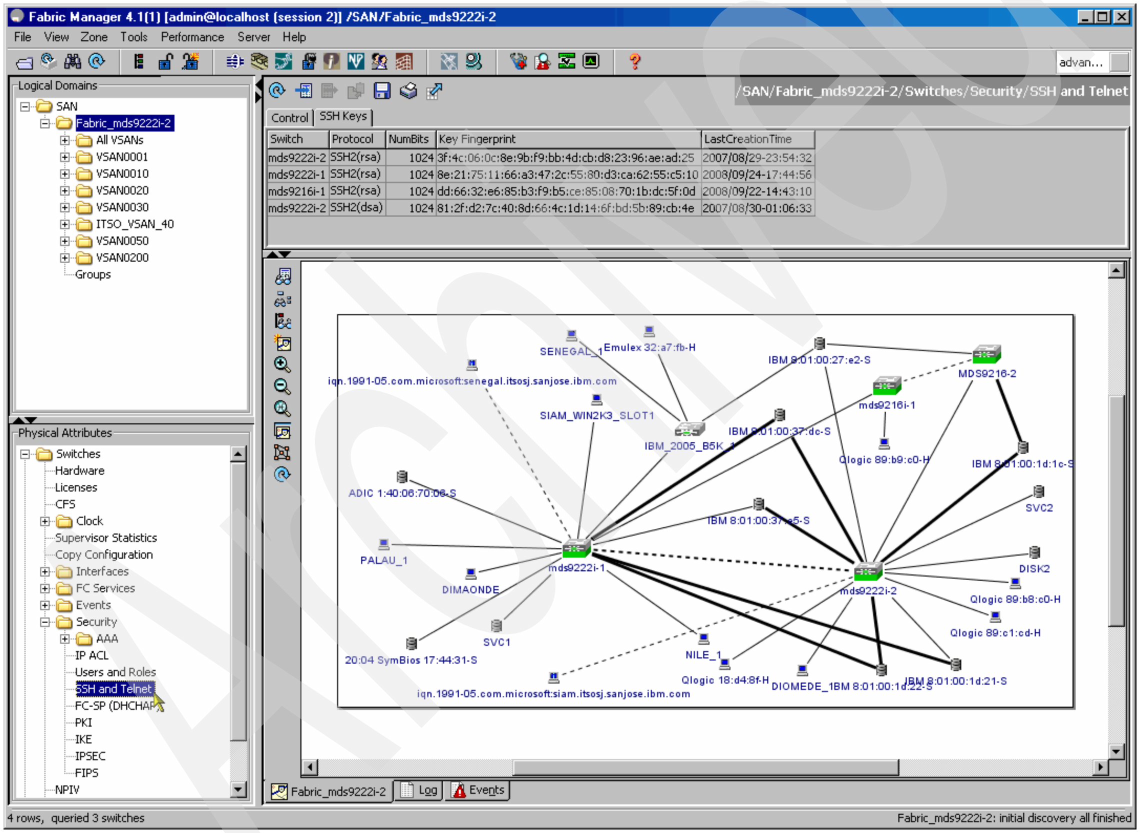
Be sure to have an SSH server key pair with the appropriate version before enabling the SSH service. Generate the SSH server key pair according to the SSH client version used. The number of bits specified for each key pair ranges from 768 to 2048.

The SSH service accepts three types of key pairs for use by SSH versions 1 and 2:

- The rsa1 option generates the RSA1 key pair for the SSH Version 1 protocol.
- The dsa option generates the DSA key pair for the SSH Version 2 protocol.
- The rsa option generates the RSA key pair for the SSH Version 2 protocol.

> **Note:** If you delete all of the SSH keys, you cannot start a new SSH session.

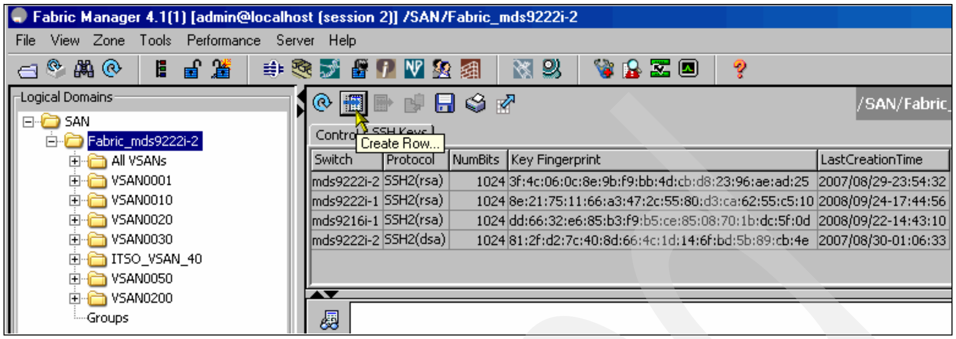
In order to check or modify the SSH configuration go to the Physical Attributes section in Fabric Manager and select **Switches** → **Security** → **SSH and Telnet**, as shown in Figure 5-1.



Switch	Protocol	NumBits	Key Fingerprint	LastCreationTime
mds9222i-2	SSH2(rsa)	1024	3f:4c:06:0c:8e:9b:f9:bb:4d:cb:d8:23:96:ae:ad:25	2007/08/29-23:54:32
mds9222i-1	SSH2(rsa)	1024	8e:21:75:11:66:a3:47:2c:55:80:d3:ca:62:55:c5:10	2008/09/24-17:44:56
mds9216i-1	SSH2(rsa)	1024	dd:66:32:e6:85:b3:f9:b5:ce:85:08:70:1b:dc:5f:0d	2008/09/22-14:43:10
mds9222i-2	SSH2(dsa)	1024	81:2f:d2:7c:40:8d:66:4c:1d:14:6f:bd:5b:89:cb:4e	2007/08/30-01:06:33

Figure 5-1 SSH keys configuration in Fabric Manager

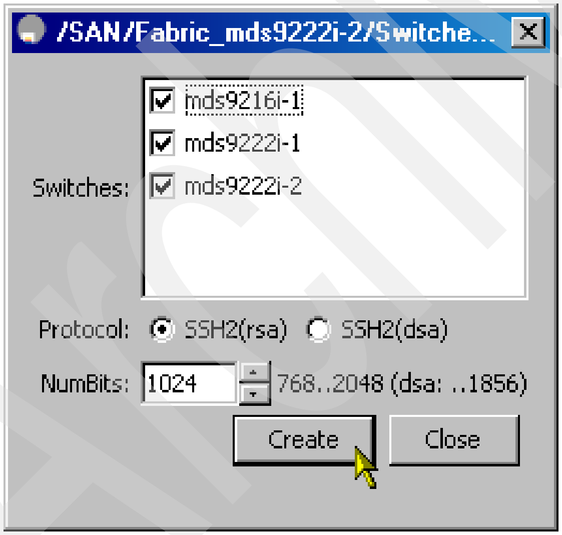
Select the create row icon to generate the SSH server key pair, as shown in Figure 5-2.



Switch	Protocol	NumBits	Key Fingerprint	LastCreationTime
mds9222i-2	SSH2(rsa)	1024	3f:4c:06:0c:8e:9b:f9:bb:4d:cb:d8:23:96:ae:ad:25	2007/08/29-23:54:32
mds9222i-1	SSH2(rsa)	1024	8e:21:75:11:66:a3:47:2c:55:80:d3:ca:62:55:c5:10	2008/09/24-17:44:56
mds9216i-1	SSH2(rsa)	1024	dd:66:32:e6:85:b3:f9:b5:ce:85:08:70:1b:dc:5f:0d	2008/09/22-14:43:10
mds9222i-2	SSH2(dsa)	1024	81:2f:d2:7c:40:8d:66:4c:1d:14:6f:bd:5b:89:cb:4e	2007/08/30-01:06:33

Figure 5-2 Create new SSH keys pair in Fabric Manager

In the Create SSH Key dialog box select the MDS switches, define the SSH protocol, and specify the number of bits used to generate the key pairs in the NumBits drop-down menu, as shown in Figure 5-3.



Switches: ☑ mds9216i-1 ☑ mds9222i-1 ☑ mds9222i-2

Protocol: ● SSH2(rsa) ○ SSH2(dsa)

NumBits: 1024 768..2048 (dsa: ..1856)

Figure 5-3 Define SSH keys pair configuration

Note: We strongly recommend using SSH instead of Telnet to manage MDS 9000 family switches.

To transfer files to and from MDS 9000 family switches we recommend using SCP (secure copy) and SFTP (secure FTP) instead of FTP or TFTP.

5.1.2 SNMP security

The MDS switch supports SNMPv1, SNMPv2c, and SNMPv3 (encrypted) for SNMP access to the switch. SNMPv1 and SNMPv2c use the concept of a community string to authorize read and write access to the switch. SNMPv3 requires that a user ID/password be entered in order to access the switch, as shown in Figure 5-4.

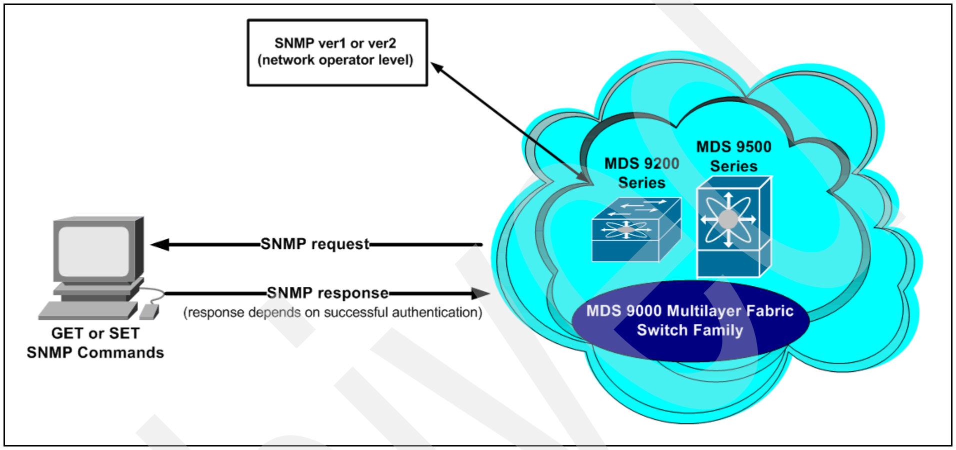


Figure 5-4 SNMP security

The CLI and SNMP user ID and password are maintained separately, so it is possible for the same ID to have a different password for both the SNMP and the CLI. However, we do not recommend this.

SNMPv3 is an interoperable standards-based protocol for network management. SNMPv3 provides secure access to devices by a combination of authenticating and encrypting frames over the network. The security features provided in SNMPv3 are:

- Message integrity: Ensures that a packet has not been tampered with in-transit
- Authentication: Determines whether the message is from a valid source
- Encryption: Scrambles the packet content to prevent it from being seen by unauthorized sources

SNMPv3 provides for both security models and security levels. A security model is an authentication strategy that is set up for a user and the role in which the user resides. A security level is the permitted level of security within a security model. A combination of a security model and a security level determines which security mechanism is employed when handling an SNMP packet.

The Cisco SAN-OS and NX-OS software implement RFC 3414 and RFC 3415, including user-based security model (USM) and role-based access control. While SNMP and the CLI have common role management and share the same credentials and access privileges, the local user database was not synchronized in earlier releases. SNMPv3 user management can be centralized at the AAA server level. This centralized user management allows the SNMP agent running on the Cisco MDS switch to leverage the user authentication service of the AAA server. Once user authentication is verified, the SNMP PDUs are processed further. Additionally, the AAA server is also used to store user group names. SNMP uses the group names to apply the access/role policy that is locally available in the switch.

Any configuration changes made to the user group, role, or password results in database synchronization for both SNMP and AAA.

Users are synchronized as follows:

- Deleting a user using either command results in the user being deleted for both SNMP and the CLI.
- User-role mapping changes are synchronized in SNMP and the CLI.
- Existing SNMP users continue to retain the auth and priv passphrases without any changes.
- If the management station creates an SNMP user in the usmUserTable, the corresponding CLI user is created without any password (login is disabled) and will have the network-operator role.

5.1.3 IP Access Control Lists

The MDS 9000 Multilayer Switch family can route IP Version 4 (IPv4) traffic between Ethernet and Fibre Channel interfaces. The IP static routing feature routes traffic between VSANs. To do so, each VSAN must be in a different IPv4 subnetwork. Each MDS 9000 Multilayer Switch family provides the following services for network management systems:

- IP forwarding on the out-of-band Ethernet interface on the front panel of the supervisor modules.
- IP forwarding on the in-band Fibre Channel interface using the IP over Fibre Channel (IPFC) function: IPFC specifies how IP frames can be transported over Fibre Channel frames so network management systems information can cross the Fibre Channel network without using an overlay Ethernet network.
- IP routing (default routing and static routing): If your configuration does not need an external router, you can configure a default route using static routing.

In the MDS 9000 Multilayer Switch family, IP Access Control Lists (ACLs) provide a basic mechanism to secure the Ethernet management interface and in-band management via IP over Fibre Channel (IPFC). Therefore, these ACLs can only be applied to either the management interface or logical VSAN interfaces.

IPv4 Access Control Lists (IPv4-ACLs and IPv6-ACLs) provide basic network security to all switches in the MDS 9000 Multilayer Switch family. IPv4-ACLs and IPv6-ACLs restrict IP-related traffic based in the configured IP filters. A filter contains the rules to match an IP packet, and if the packet matches, the rule also stipulates whether the packet should be permitted or denied.

Each switch in the MDS 9000 Multilayer Switch family can have a maximum of 128 IPv4-ACLs or 128 IPv6-ACLs, and each IPv4-ACL or IPv6-ACL can have a maximum of 256 filters.

An ACL is a sequential collection of permit and deny conditions that apply to IP addresses. The MDS SAN-OS software tests addresses against the conditions in an access list one by one. The first match determines whether the software accepts or rejects the address. Because the software stops testing conditions after the first match, the order of the conditions is critical. If no conditions match, the software rejects the address.

An IP protocol can be configured using an integer ranging from 0 to 255 to represent a particular IP protocol. Alternatively, you can specify the name of a protocol (iCMP, IP, TCP, OR UDP). IP includes Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Internet Control Message Protocol (ICMP), and other protocols.

The source/source-wildcard and destination/destination-wildcard are specified in one of two ways:

- Using the 32-bit quantity in four-part, dotted decimal format (10.1.1.2/0.0.0.0 is the same as host 10.1.1.2.)
- Using the any option as an abbreviation for a source/source-wildcard or destination/destination-wildcard (0.0.0.0/255.255.255.255)

Crypto IPv4-ACLs

IP access control lists (IPv4-ACLs) provide basic network security to all switches in the Cisco MDS 9000 family. IPv4 IP-ACLs restrict IP-related traffic based on the configured IP filters.

In the context of crypto maps, IPv4-ACLs are different from regular IPv4-ACLs. Regular IPv4-ACLs determine what traffic to forward or block at an interface. For example, IPv4-ACLs can be created to protect all IP traffic between subnet A and subnet Y or Telnet traffic between host A and host B.

Crypto IPv4-ACLs are used to define which IP traffic requires crypto protection and which traffic does not.

Crypto IPv4-ACLs associated with IPsec crypto map entries have four primary functions:

- Select outbound traffic to be protected by IPsec (permit = protect).
- Indicate the data flow to be protected by the new SAs (specified by a single permit entry) when initiating negotiations for IPsec SAs.
- Process inbound traffic to filter out and discard traffic that should have been protected by IPsec.
- Determine whether to accept requests for IPsec SAs on behalf of the requested data flows when processing IKE negotiation from the IPsec peer.

> **Note:** If you want some traffic to receive one type of IPsec protection (for example, encryption only) and other traffic to receive a different type of IPsec protection (for example, both authentication and encryption), create two IPv4-ACLs. Use both IPv4-ACLs in different crypto maps to specify different IPsec policies.

5.1.4 Role-based authorization

All management access within the MDS 9000 Multilayer Switch family is based on roles. Role-based authorization limits access to switch operations by assigning users to roles. Users are restricted to performing the management operations that are explicitly permitted based on the roles to which they belong.

> **Note:** Each role can contain multiple users, and each user can be part of multiple roles. For example, if role 1 users are only allowed access to configuration commands, and role 2 users are only allowed access to debug commands, then if *user* belongs to both role 1 and role 2, he can access configuration as well as debug commands.

By default, these roles exist in all switches:

- Network operator (network-operator)

  Has permission to view the configuration only. The operator cannot make any configuration changes.
- Network administrator (network-admin)

  Has permission to execute all commands and make configuration changes. The administrator can also create and customize up to an additional 64 roles.
- Default-role

  Has permission to use the GUI (Fabric Manager and Device Manager). This access is automatically granted to all users in order for them to use the GUI.

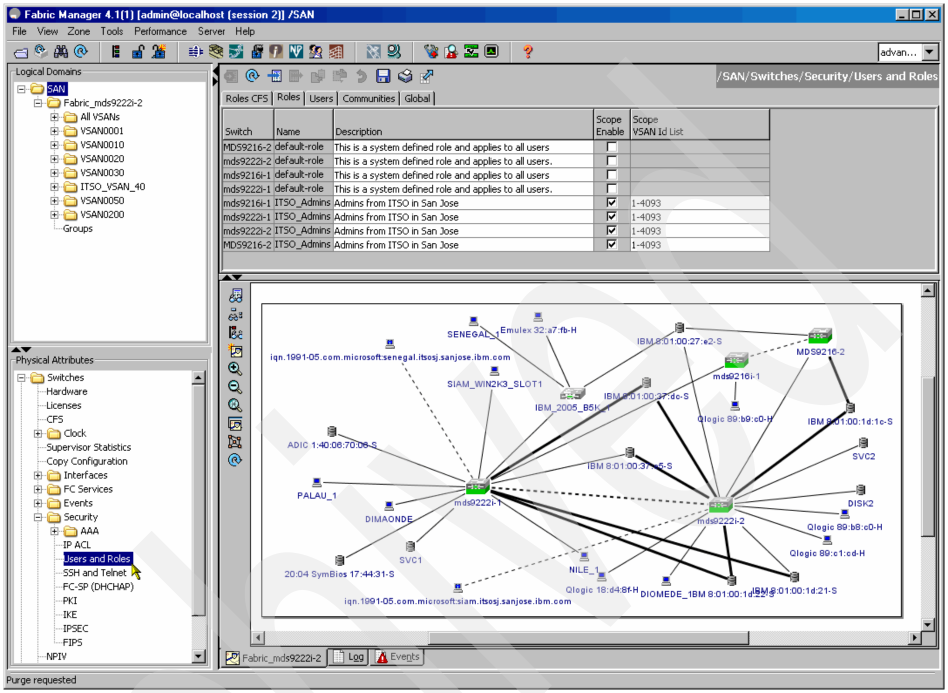
These default roles cannot be changed or deleted.

Note: If a user only belongs to one of the newly created roles and that role is subsequently deleted, then the user immediately defaults to the network-operator role.

You can use SNMP to modify a role that was created using CLI and vice versa. Each role in SNMP is the same as a role created or modified through the CLI. Common roles allow you to use a set of rules to set the scope of VSAN security. Each role can be restricted to one or more VSANs as required.

Note: If you belong to multiple roles, you can execute a union of all the commands permitted by these roles. Access to a command takes priority over being denied access to a command. For example, suppose that you belong to a group called STG and you were denied access to configuration commands. However, you also belong to the ITSO group and are permitted access to configuration commands. In this case, you will have access to configuration commands.

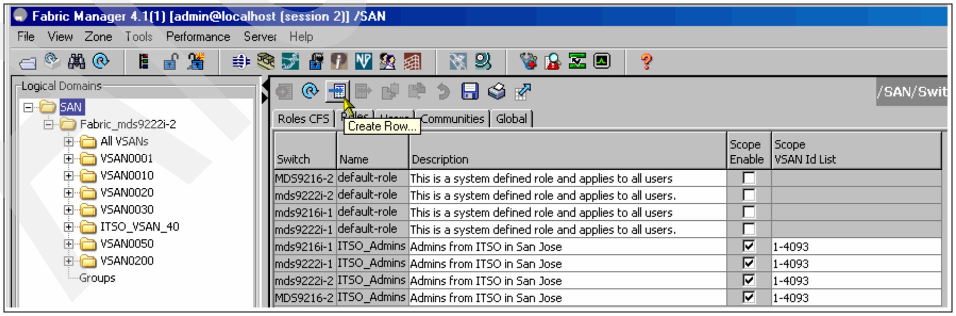
If you need to configure roles using the GUI, expand **Switches** → **Security** and then select **Users and Roles** from the Physical Attribute pane. Click the **Roles** tab in the Information pane, as shown in Figure 5-5.



Switch	Name	Description	Scope Enable	Scope VSAN Id List
MDS9216-2	default-role	This is a system defined role and applies to all users	☐	
mds9222i-2	default-role	This is a system defined role and applies to all users.	☐	
mds9216i-1	default-role	This is a system defined role and applies to all users	☐	
mds9222i-1	default-role	This is a system defined role and applies to all users.	☐	
mds9216i-1	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093
mds9222i-1	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093
mds9222i-2	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093
MDS9216-2	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093

Figure 5-5 Configuring Users and Roles in Fabric Manager

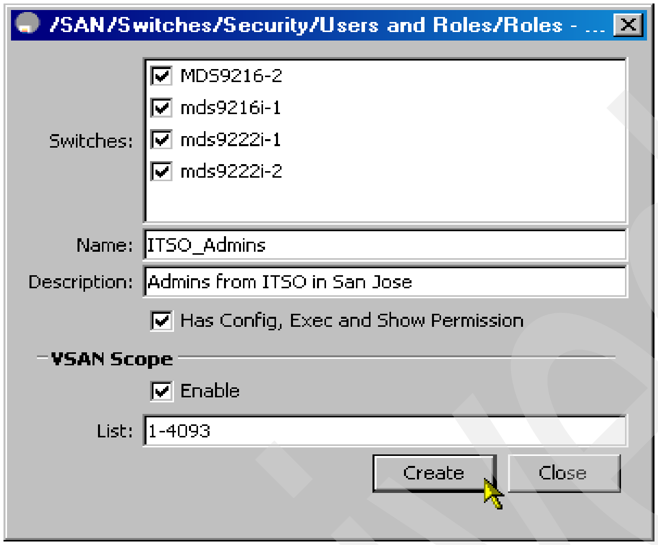
You can add a new role by selecting the create row icon in Fabric Manager, as shown in Figure 5-6.



Switch	Name	Description	Scope Enable	Scope VSAN Id List
MDS9216-2	default-role	This is a system defined role and applies to all users	☐	
mds9222i-2	default-role	This is a system defined role and applies to all users.	☐	
mds9216i-1	default-role	This is a system defined role and applies to all users	☐	
mds9222i-1	default-role	This is a system defined role and applies to all users.	☐	
mds9216i-1	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093
mds9222i-1	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093
mds9222i-2	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093
MDS9216-2	ITSO_Admins	Admins from ITSO in San Jose	☑	1-4093

Figure 5-6 Add new Role in Fabric Manager

At the next step you must provide information regarding new role configuration, as shown in Figure 5-7, and click **Create**.


/SAN/Switches/Security/Users and Roles/Roles - ...

Switches:
☑ MDS9216-2
☑ mds9216i-1
☑ mds9222i-1
☑ mds9222i-2

Name: ITSO_Admins

Description: Admins from ITSO in San Jose

☑ Has Config, Exec and Show Permission

VSAN Scope

☑ Enable

List: 1-4093

Figure 5-7 Define a new role in Fabric Manager

Role configuration tasks can also be done from the CLI, as shown in Example 5-1.

Example 5-1 Create and verify roles in CLI

```
mds9222i-1# configure terminal
mds9222i-1(config)# role name SAN_monitor
ds9222i-1(config-role)# description SAN Monitoring
mds9222i-1(config-role)# vsan policy deny
mds9222i-1(config-role-vsan)# permit vsan 10
mds9222i-1(config-role-vsan)# permit vsan 20
mds9222i-1(config-role-vsan)# permit vsan 30
mds9222i-1(config-role-vsan)# exit
mds9222i-1(config-role)# rule
mds9222i-1(config-role)# rule 1 permit show feature system
mds9222i-1(config-role)# rule 2 permit show feature module
mds9222i-1(config-role)# rule 3 permit show feature hardware
mds9222i-1(config-role)# rule 4 permit show feature environment
mds9222i-1(config-role)# rule 5 permit show feature snmp
mds9222i-1(config-role)# rule 6 deny exec
mds9222i-1(config-role)# end
mds9222i-1# show role
Role: network-admin
Description: Predefined Network Admin group. This role cannot be modified
Access to all the switch commands
```

```
Role: network-operator
Description: Predefined Network Operator group. This role cannot be modified
Access to Show commands and selected Exec commands

Role: server-admin
  Description: Predefined system role for server administrators. This role
  cannot be modified.
  Vsan policy: permit (default)
  -------------------------------------------------
  Rule    Type    Command-type    Feature
  -------------------------------------------------
  1       permit  show            *
  2       permit  exec            install

Role: default-role
  Description: This is a system defined role and applies to all users.
  Vsan policy: permit (default)
  -------------------------------------------------
  Rule    Type    Command-type    Feature
  -------------------------------------------------
  1       permit  show            system
  2       permit  show            snmp
  3       permit  show            module
  4       permit  show            hardware
  5       permit  show            environment

Role: ITSO_Admins
  Description: Admins from ITSO in San Jose
  Vsan policy: deny
  Permitted vsans: 1-4093
  -------------------------------------------------
  Rule    Type    Command-type    Feature
  -------------------------------------------------
  1       permit  show            *
  2       permit  config          *
  3       permit  exec            *

Role: SAN_monitor
  Description: SAN Monitoring
  Vsan policy: deny
  Permitted vsans: 10,20,30
  -------------------------------------------------
  Rule    Type    Command-type    Feature
  -------------------------------------------------
  1       permit  show            system
  2       permit  show            module
  3       permit  show            hardware
  4       permit  show            environment
```

```
5       permit  show            snmp
6       deny    exec            *
```

5.1.5 AAA using RADIUS and TACACS+

The authentication, authorization, and accounting (AAA) mechanism verifies the identify of, grants access to, and tracks the actions of users managing a switch. Authentication is the process of verifying one's identity. The verification is based on the user ID and password entered by the person logging into the switch. On the MDS switch you can either use local authentication or remote authentication using TACACS+ or RADIUS to communicate with AAA servers. Figure 5-11 on page 148 shows a flow chart of the process.

Along with the authentication process is an authorization process, where your management capabilities are determined based upon the access given when your user ID was created. Access rights can be determined by role as well as VSAN.

Accounting refers to the log that is kept for tracking each management session in a switch. This log provides accountability and can be an invaluable tool for troubleshooting.

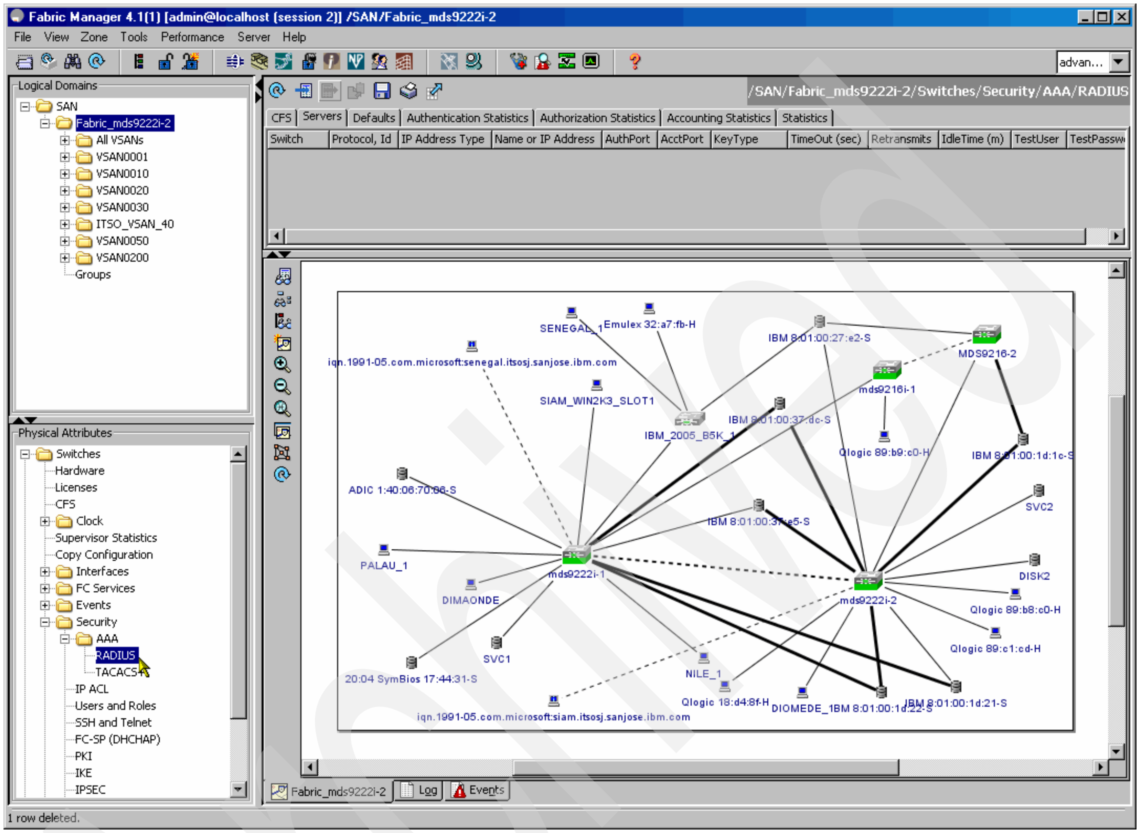
RADIUS is a distributed client-server system that secures networks against unauthorized access. RADIUS clients run on MDS switches and sends authentication requests to a central RADIUS server that contains all user authentication and network service access information.

RADIUS is a fully open protocol, distributed in source code format, that can be modified to work with any security system currently available on the market.

You can set the RADIUS server address, the RADIUS preshared key, the RADIUS server time-out interval, and iterations of the RADIUS server; define vendor-specific attributes; and display RADIUS server details.

You must configure the RADIUS preshared key to authenticate the switch to the RADIUS server. The length of the key is restricted to 64 characters and can include any printable ASCII characters (white spaces are not allowed). You can configure a global key to be used for all RADIUS server configurations on the switch. You can override this global key assignment by explicitly using the key option when configuring an individual RADIUS server.

To configure a RADIUS server and all its options using Fabric Manager go to Physical Attributes and select **Switches** → **Security** → **AAA** → **RADIUS**, as shown in Figure 5-8.



Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2

/SAN/Fabric_mds9222i-2/Switches/Security/AAA/RADIUS

Switch	Protocol, Id	IP Address Type	Name or IP Address	AuthPort	AcctPort	KeyType	TimeOut (sec)	Retransmits	IdleTime (m)	TestUser	TestPassw

1 row deleted.

Figure 5-8 Configure RADIUS server in Fabric Manager

To configure a new RADIUS server select the create row icon, as shown in Figure 5-9.

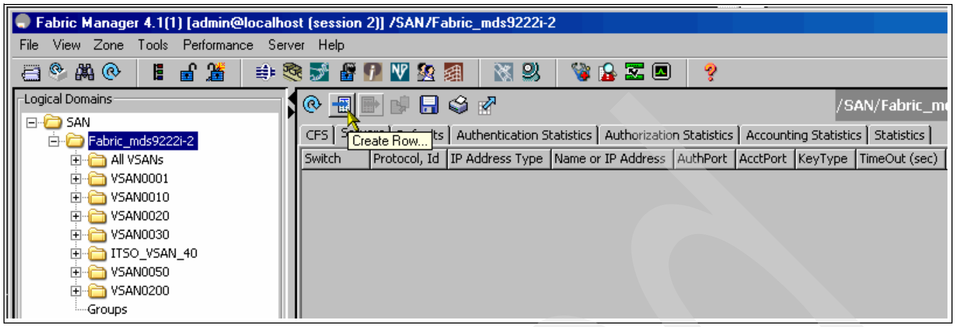
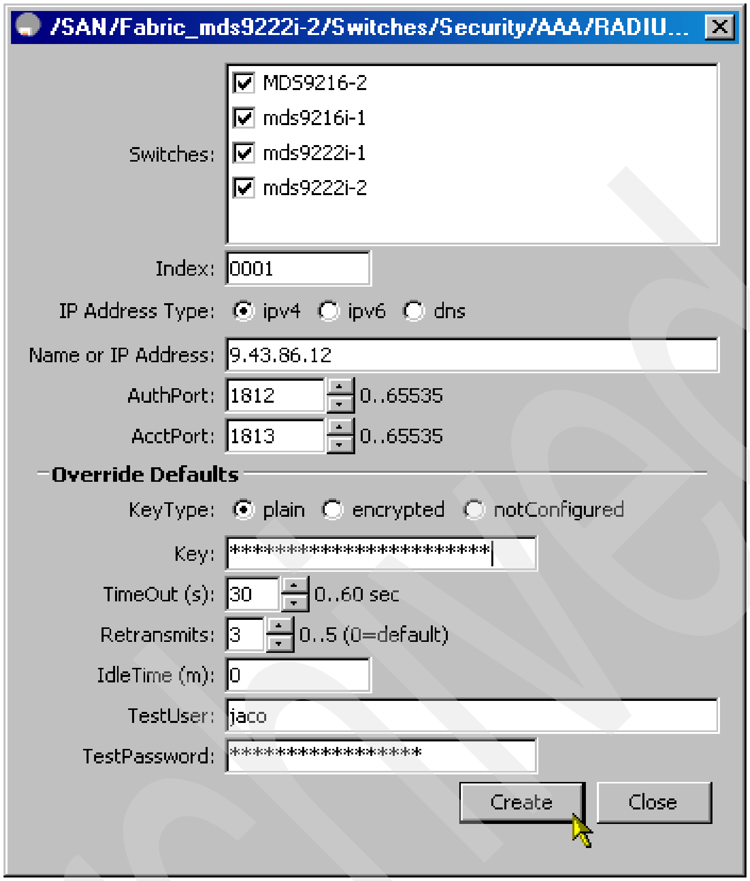


Figure 5-9 Create a new RADIUS server configuration in Fabric Manager

As shown in Figure 5-10 on page 146, in the Create RADIUS Server dialog box you are required to specify parameters to configure the RADIUS server:

- Select the switches that you want to assign as RADIUS servers.
- Assign an index number to identify the RADIUS server.
- Select the IP address type for the RADIUS server.
- Fill in the IP address or name for the RADIUS server.
- Optionally, modify the authentication and accounting ports used by this RADIUS server.
- Select the appropriate key type for the RADIUS server.
- Select the TimeOut value in seconds. The valid range is 0 to 60 seconds.
- Select the number of times the switch tries to connect to RADIUS servers before reverting to local authentication.
- Enter the test idle time interval value in minutes. The valid range is 1 to 1440 minutes.
- Enter the test user with the default password. The default username is test.



/SAN/Fabric_mds9222i-2/Switches/Security/AAA/RADIU...

Switches:
☑ MDS9216-2
☑ mds9216i-1
☑ mds9222i-1
☑ mds9222i-2

Index: 0001

IP Address Type: ● ipv4 ○ ipv6 ○ dns

Name or IP Address: 9.43.86.12

AuthPort: 1812 0..65535

AcctPort: 1813 0..65535

Override Defaults

KeyType: ● plain ○ encrypted ○ notConfigured

Key: ***********************

TimeOut (s): 30 0..60 sec

Retransmits: 3 0..5 (0=default)

IdleTime (m): 0

TestUser: jaco

TestPassword: *****************

Figure 5-10 Configure RADIUS server parameters

You can verify the RADIUS server configuration from the CLI, as shown in Example 5-2.

Example 5-2 Verify RADIUS server configuration from the CLI

```
mds9222i-1# show radius-server sorted
timeout value:5
retransmission count:1
deadtime value:0
total number of servers:1

following RADIUS servers are configured:
        9.43.86.12:
                available for authentication on port:1812
                available for accounting on port:1813
                RADIUS shared secret:********
                timeout:30
                retries:3
```

A Cisco MDS switch uses the Terminal Access Controller Access Control System Plus (TACACS+) protocol to communicate with remote AAA servers. You can configure multiple TACACS+ servers and set timeout values.

TACACS+ is a client/server protocol that uses TCP (TCP port 49) for transport requirements. All switches in the Cisco MDS 9000 family provide centralized authentication using the TACACS+ protocol. TACACS+ has the following advantages over RADIUS authentication:

- Provides independent, modular AAA facilities. Authorization can be done without authentication.
- Uses the TCP transport protocol to send data between the AAA client and server, making reliable transfers with a connection-oriented protocol.
- Encrypts the entire protocol payload between the switch and the AAA server to ensure higher data confidentiality. The RADIUS protocol only encrypts passwords.

Fabric Manager allows you to set up a default configuration that can be used for any TACACS+ server that you configure the switch to communicate with. The default configuration includes:

- Encryption type
- Preshared key
- Timeout value
- Number of retransmission attempts
- Allowing the user to specify a TACACS+ server at login

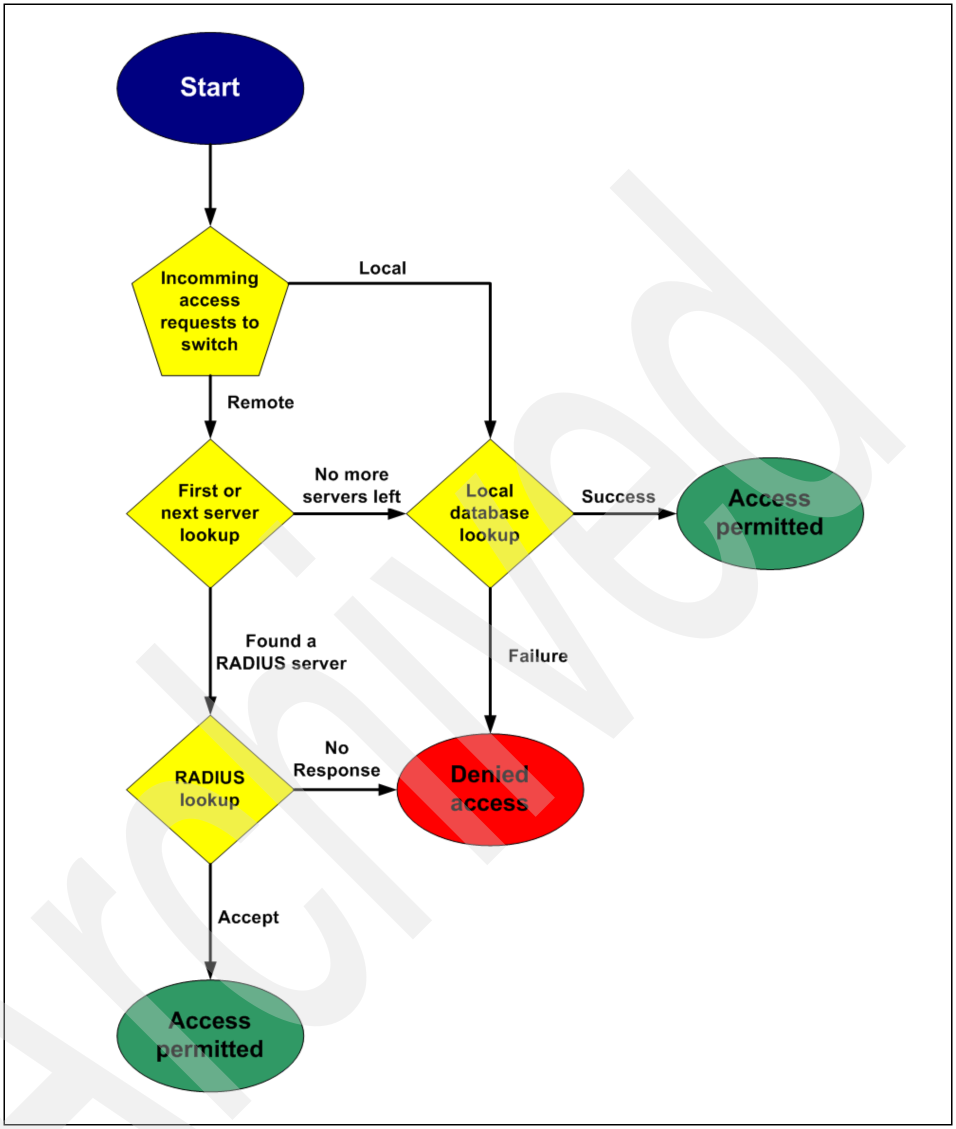


Figure 5-11 Switch authorization and authentication flow

For high-availability purposes you can specify multiple remote AAA servers to authenticate users using server groups. If you had multiple servers you would enter the index ID of each server sequentially, separated by commas. All members of a group must use the same protocol, either RADIUS or TACACS+.

You need to configure the TACACS+ preshared key to authenticate the switch to the TACACS+ server. The length of the key is restricted to 64 characters and can include any printable ASCII characters (white spaces are not allowed). You can configure a global key to be used for all TACACS+ server configurations on the switch.

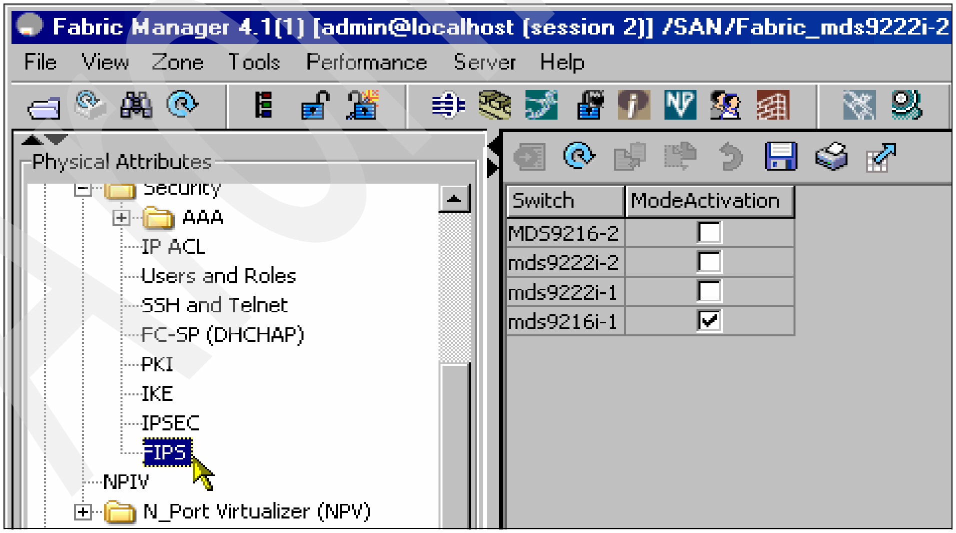
> **Note:** You can override this global key assignment by explicitly using the key option when configuring an individual TACACS+ server.

5.1.6 Federal Information Processing Standards

The Federal Information Processing Standards (FIPS) Publication 140-2, Security Requirements for Cryptographic Modules, details the U.S. Government's requirements for cryptographic modules. FIPS 140-2 specifies that a cryptographic module shall be a set of hardware, software, firmware, or some combination thereof that implements cryptographic functions or processes, including cryptographic algorithms and, optionally, key generation, and is contained within a defined cryptographic boundary.

FIPS specifies certain crypto algorithms as secure, and it also identifies which algorithms should be used if a cryptographic module is to be called FIPS compliant.

In order to configure FIPS go to Physical Attributes and select **Switches** → **Security** → **FIPS**, as shown in Figure 5-12.



Switch	ModeActivation
MDS9216-2	□
mds9222i-2	□
mds9222i-1	□
mds9216i-1	☑

Figure 5-12 Enable FIPS for selected servers

Note: Cisco MDS SAN-OS Release 3.1(1) implements FIPS features and is currently in the certification process with the U.S. Government, but it is *not* FIPS compliant at this time.

5.2 Securing access to the fabric

The following features are available to facilitate securing the FC fabric from accidental or intentional wrong-doing:

- VSANs
- Zoning
- Fibre Channel Security Protocol (FC-SP) support
- Port Security
- Control of principal switch selection
- Static Domain ID assignment
- Static, persistent FCID assignment

5.2.1 VSANs

You can achieve higher security and greater stability in Fibre Channel fabrics by using virtual SANs (VSANs). VSANs provide isolation among devices that are physically connected to the same fabric. With VSANs you can create multiple logical SANs over a common physical infrastructure. Each VSAN can contain up to 239 switches and has an independent address space that allows identical Fibre Channel IDs (FC IDs) to be used simultaneously in different VSANs.

A VSAN is a virtual storage area network (SAN). A SAN is a dedicated network that interconnects hosts and storage devices primarily to exchange SCSI traffic. In SANs you use the physical links to make these interconnections. A set of protocols run over the SAN to handle routing, naming, and zoning. You can design multiple SANs with different topologies.

VSANs are a very effective tool for securing access to the fabric and preventing intentional or accidental wrongdoing. Fibre Channel services are replicated across VSANs, and no communication occurs between VSANs unless configured to do so using Inter-VSAN Routing (IVR).

There are two VSANs created on the switch by default. They are VSANs 1 and 4094. VSAN 4094 is referred to as the isolated VSAN. When a VSAN is deleted that has active ports, the ports are subsequently moved to the isolated VSAN. Ports in the isolated VSAN are unable to communicate with any other ports, including other ports that are in the isolated VSAN. Because of this behavior, moving all ports into the isolated VSAN at initial configuration would be a very effective way to secure ports in the fabric. Ports would then require a manual configuration change to be placed in an active VSAN. Table 5-1 shows the default VSAN 1 attributes.

Table 5-1 Default VSAN 1 attributes

Parameters	Default
Default VSAN	VSAN 1
State	Active state
Name	Concatenation of VSAN and a four-digit string representing the VSAN ID (For example, VSAN 3 is VSAN0003.)
Load-balancing attribute	OX ID (src-dst-ox-id)

By default all ports are in VSAN 1. We do not recommend using VSAN 1 as your production VSAN. By creating a separate VSAN for your production traffic you effectively isolate your production devices from any device that is later connected to the switch. Again, a manual configuration change would be required to move a port from VSAN 1 to an active production VSAN. Creating separate VSANs also allows zoning granularity such that a misconfiguration of the zone in one VSAN does not cause a problem for any of the other VSANs. Extra precautions need to be considered in IVR environments.

Note: In complex environments we strongly recommend defining in a SAN network security areas and create a separate VSAN for every area.

VSANs can effectively separate traffic in the following scenarios:

- Different customers in storage provider data centers
- Production and test environments
- Low and high security requirements
- Backup traffic from user traffic
- Replication traffic from user traffic

The use of VSANs does not preclude the use of zoning. The two features are complimentary.

5.2.2 Zoning

Zoning is the mechanism in FC fabrics that controls what ports are allowed to inter-communicate. Zoning is done on a per-fabric basis, or in the case of MDS switches on a per-VSAN/fabric basis. There can only be one active zoneset per fabric. There can be multiple zonesets, but only one can be active at a time.

Several zones make up a zoneset. Each member in the MDS 9000 Multilayer Fabric Switch family can support hardware-enforced zoning for up to 2,000 zones and 20,000 zone members. Changes to the active zoneset can be made nondisruptively.

Zoning enables you to set up access control between storage devices or user groups. If you have administrator privileges in your fabric, you can create zones to increase network security and to prevent data loss or corruption. Zoning is enforced by examining the source-destination ID field.

Advanced zoning capabilities specified in the FC-GS-4 and FC-SW-3 standards are provided. You can use either the existing basic zoning capabilities or the advanced, standards-compliant zoning capabilities.

On the MDS 9000 Multilayer Fabric Switch family zone members can be identified using the following methods:

- Port world wide name (pWWN): Specifies the pWWN of an N port attached to the switch as a member of the zone.
- Fabric pWWN: Specifies the WWN of the fabric port (switch port's WWN). This membership is also referred to as port-based zoning.
- FC ID: Specifies the FC ID of an N port attached to the switch as a member of the zone.
- FC alias: The alias name is in alphabetic characters and identifies a port ID or WWN. The alias can include multiple members.
- Interface and switch WWN (sWWN): Specifies the interface of a switch identified by the sWWN. This membership is also referred to as interface-based zoning.
- Domain ID and port number: Specifies the domain ID of an MDS domain and additionally specifies a port belonging to a non-Cisco switch.
- Interface and domain ID: Specifies the interface of a switch identified by the domain ID.
- IPv4 address: Specifies the IPv4 address (and optionally the subnet mask) of an attached device.
- iSCSI Qualified Name: Unique identifier used in iSCSI to identify devices.
- IPv6 address: The IPv6 address of an attached device in 128 bits in colon-separated hexadecimal format.

By default all devices are initially placed into a default zone. When devices are moved to a user-defined zone they are removed from this default zone. On an MDS switch the default zone is set to deny by default.

Zoning has the following features:

- A zone consists of multiple zone members.
  - Members in a zone can access each other. Members in different zones cannot access each other.
  - If zoning is not activated, all devices are members of the default zone.
  - If zoning is activated, any device that is not in an active zone (a zone that is part of an active zone set) is a member of the default zone.
  - Zones can vary in size.
  - Devices can belong to more than one zone.
  - A physical fabric can have a maximum of 16,000 members. This includes all VSANs in the fabric.
- A zone set consists of one or more zones.
  - A zone set can be activated or deactivated as a single entity across all switches in the fabric.
  - Only one zone set can be activated at any time.
  - A zone can be a member of more than one zone set.
  - A zone switch can have a maximum of 500 zone sets.
- Zoning can be administered from any switch in the fabric.
  - When you activate a zone (from any switch), all switches in the fabric receive the active zone set. Additionally, full zone sets are distributed to all switches in the fabric if this feature is enabled in the source switch.
  - If a new switch is added to an existing fabric, zone sets are acquired by the new switch.
- Zone changes can be configured nondisruptively. New zones and zone sets can be activated without interrupting traffic on unaffected ports or devices.
- Default zone membership includes all ports or WWNs that do not have a specific membership association. Access between default zone members is controlled by the default zone policy.
- You can configure up to 8,000 zones per VSAN and a maximum of 8,000 zones for all VSANs on the switch.

> **Important:** Default zoning is denied by default for Open Systems VSANs. When you configure FICON using either FM/DM or the CLI FICON setup script, it is changed to permit automatically. If you use the CLI to configure FICON, you must change it manually.

This means that devices in this default zone cannot communicate with each other. Remember that FICON requires the default zone to be permitted, because in FICON environments the devices that are allowed to communicate are explicitly defined in HCD. The default setting of deny was selected because it is more secure, as this prevents accidental communication between devices.

5.2.3 Fibre Channel Security Protocol support

Fibre Channel Security Protocol (FC-SP) capabilities in SAN-OS and NX-OS provide switch-to-switch and host-to-switch authentication. The Diffie-Hellman Challenge Handshake Authentication Protocol (DHCHAP) is a protocol used to provide authentication between any switch in the MDS 9000 Multilayer Fabric Switch family and other devices. It consists of the CHAP protocol combined with the Diffie-Hellman exchange. Fibre Channel authentication allows only trusted devices to be added to a fabric, thus preventing unauthorized devices from accessing the switch.

All switches in the MDS 9000 Multilayer Fabric Switch family support switch-to-switch and host-to-switch authentication, and the authentication can be performed either locally or remotely. Configuring this feature requires the Enterprise package license. Use of the DHCHAP authentication protocol helps to prevent either accidental or intentional fabric disruption by preventing unauthorized switches or devices from connecting to the fabric.

DHCHAP is a mandatory password-based, key-exchange authentication protocol. DHCHAP negotiates hash algorithms and DH groups before performing authentication. It supports MD-5 and SHA-1 algorithm-based authentication.

The impact of configuring the DHCHAP feature along with existing MDS features is identified below:

- PortChannel interfaces: If DHCHAP is enabled for ports belonging to a PortChannel, DHCHAP authentication is performed at the physical interface level, not at the PortChannel level.
- FCIP interfaces: The DHCHAP protocol works with the FCIP interface just as it would with a physical interface.
- Port security or fabric binding: Fabric binding policies are enforced based on identities authenticated by DHCHAP.
- VSANs: DHCHAP authentication is not done on a per-VSAN basis.
- High availability: DHCHAP authentication works transparently with existing HA features.

We have only scratched the surface of the FC-SP's capabilities. For a detailed discussion of this advanced security feature see the *CISCO MDS 9000 family Fabric Manager Configuration Guide, Release 4.X,* OL-17256-01.

5.2.4 Port security

In most cases, a Fibre Channel device can attach to any SAN switch port and access SAN services based on VSAN and zone membership. Port security is a feature that was introduced in SAN-OS 1.3 to prevent unauthorized access to a switch port. The port security feature requires the Enterprise Package license.

When port security is enabled, all FLOGI and initialization requests from unauthorized devices, including (Nx ports) and switches (xE ports), are rejected and the intrusion attempts are logged.

To enforce port security, you need to configure the devices and switch port interfaces through which each device or switch is connected. You can use either the port world wide name (pWWN) or the node world wide name (nWWN) to specify the Nx port connection for each device. For switches, you use the switch world wide name (sWWN) to specify the xE port connection. Each Nx and xE port can be configured to restrict a single port or a range of ports.

Enforcement of port security policies is done on every activation and when the port tries to initialize.

- Use the port world wide name or the node world wide name to specify the Nx port connection for each device.
- Use the switch world wide name to specify the xE port connection for each switch.

The port security feature uses two databases and implements configuration changes:

- Configuration database: All configuration changes are stored in the configuration database.
- Active database: The database currently enforced by the fabric. The port security feature requires all devices connecting to a switch to be part of the port security active database. The software uses this active database to enforce authorization.

You can instruct the switch to automatically learn (auto-learn) the port security configurations. The auto-learn option allows any switch in the MDS 9000 Multilayer Fabric Switch family to automatically learn about devices and switches that connect to it. Using this feature to implement port security saves tedious manual configuration for each port. Auto-learn is configured on a per-VSAN basis. If enabled, devices and switches that are allowed to connect to the switch are automatically learned, even if you have not configured any port access.

Learned entries on a port are cleaned up after that port is shut down if auto-learning is still enabled. Learning does not override the existing configured port security policies. So, for example, if an interface is configured to allow a specific pWWN, then auto-learning does not add a new entry to allow any other pWWN to that interface. All other pWWNs will be blocked even in auto-learning mode. No entries are learned for a port in the shutdown state.

Note: If you enable auto-learning before activating port security, you cannot activate until auto-learning is disabled.

By default, the port security feature is not activated. When you activate the port security feature, the auto-learn option is also automatically enabled. You can choose to activate the port security feature and disable auto-learn. In this case, you need to manually configure the port security database by individually adding each port.

5.2.5 Control of principal switch selection

The distribution of domain IDs in Fibre Channel is one of the responsibilities of the principal switch. When connectivity is lost (ISL failure) to this principal switch a new principal switch must be elected. Although it is possible that the same switch could end up being the principal switch, this is not guaranteed. This election process may or may not be disruptive, depending largely on the presence or absence of domain ID conflicts.

A principal switch is elected based upon switch priority (MDS switches default to 128) and switch WWN (sWWN). The lower the switch priority value, the higher the switch priority. When two switches have the same priority the switch with the lower sWWN becomes the principal switch.

To avoid a potential problem with principal switch selection and the subsequent domain ID distribution, each switch in the MDS 9000 Multilayer Fabric Switch family has the ability to set the switch priority.

Example 5-3 shows priority configuration for VSANs defined on the mds9222i-1 switch.

Example 5-3 Domain priority configuration

```
mds9222i-1# configure terminal
mds9222i-1(config)# fcdomain priority 64 vsan 10
mds9222i-1(config)# fcdomain priority 96 vsan 20
mds9222i-1(config)# fcdomain priority 128 vsan 30
mds9222i-1(config)# fcdomain priority 140 vsan 40
mds9222i-1(config)# fcdomain priority 164 vsan 50
mds9222i-1(config)# fcdomain restart vsan 10
mds9222i-1(config)# fcdomain restart vsan 20
mds9222i-1(config)# fcdomain restart vsan 30
mds9222i-1(config)# fcdomain restart vsan 40
mds9222i-1(config)# fcdomain restart vsan 50
mds9222i-1# show fcdomain vsan 20
The local switch is a Subordinated Switch.

Local switch run time information:
        State: Stable
        Local switch WWN:    20:14:00:0d:ec:82:3d:01
        Running fabric name: 20:14:00:0d:ec:2d:ca:41
        Running priority: 96
        Current domain ID: 0x14(20)

Local switch configuration information:
        State: Enabled
        FCID persistence: Enabled
        Auto-reconfiguration: Disabled
        Contiguous-allocation: Disabled
        Configured fabric name: 20:01:00:05:30:00:28:df
        Optimize Mode: Disabled
        Configured priority: 96
        Configured domain ID: 0x00(0) (preferred)

Principal switch run time information:
        Running priority: 2

Interface               Role         RCF-reject
----------------    -------------    ------------
fc2/37              Upstream         Disabled
port-channel 20     Downstream       Disabled
----------------    -------------    ------------
```

5.2.6 Static domain ID assignment

The configured domain ID on any switch in the MDS 9000 Multilayer Fabric Switch family can be set to an IDType of preferred or static. The configured domain is set to 0 by default and the configured type is preferred. If you do not configure a domain ID, the local switch sends a random domain ID in its Request Domain ID (RDI) switch fabric internal link service command.

If the domain ID of a switch changes, this is a disruptive event for devices that are logged into the local switch. Remember that the first byte of the FCID contains the domain ID of the switch that the device is connected to, so if this changes, locally attached devices need to log out and back into the fabric in order to be assigned a new FCID.

When a subordinate switch requests a configured domain ID, the following process takes place:

1. The local switch asks for the configured domain ID in the RDI command sent to the principal switch.
2. The principal switch assigns the requested domain ID if available. Otherwise, it assigns another available domain ID.

When the assigned and requested domain IDs are different, the following cases apply:

- If the configured type is static, the assigned domain ID is discarded, all local interfaces are isolated, and the local switch assigns itself the configured domain ID, which becomes the running domain ID.
- If the configured type is preferred, the local switch accepts the domain ID assigned by the principal switch and the assigned domain ID becomes the running domain ID.

> **Note:** Configuring domain IDs on each switch in the fabric and setting the type to static can help to prevent accidental or intentional disruption caused by domain ID distribution. This is also beneficial when troubleshooting switch-to-switch type of problems.

Example 5-4 shows how to configure and verify static domain IDs.

Example 5-4 Configure static domain IDs

```
mds9222i-1# configure terminal
mds9222i-1(config)# fcdomain domain 10 static vsan 10
mds9222i-1(config)# fcdomain domain 20 static vsan 20
mds9222i-1(config)# fcdomain domain 30 static vsan 30
mds9222i-1(config)# fcdomain domain 40 static vsan 40
```

```
mds9222i-1(config)# fcdomain domain 50 static vsan 50
mds9222i-1(config)# fcdomain restart vsan 10
mds9222i-1(config)# fcdomain restart vsan 20
mds9222i-1(config)# fcdomain restart vsan 30
mds9222i-1(config)# fcdomain restart vsan 40
mds9222i-1(config)# fcdomain restart vsan 50
mds9222i-1(config)# end
mds9222i-1# show fcdomain vsan 50
The local switch is a Subordinated Switch.

Local switch run time information:
        State: Principal Switch Selection ongoing
        Local switch WWN:    20:32:00:0d:ec:82:3d:01
        Running fabric name: 20:32:00:0d:ec:4a:c5:81
        Running priority: 164
        Current domain ID: 0x32(50)

Local switch configuration information:
        State: Enabled
        FCID persistence: Enabled
        Auto-reconfiguration: Disabled
        Contiguous-allocation: Disabled
        Configured fabric name: 20:01:00:05:30:00:28:df
        Optimize Mode: Disabled
        Configured priority: 164
        Configured domain ID: 0x32(50) (static)

Principal switch run time information:
        Running priority: 2

Interface             Role          RCF-reject
----------------    -------------   ------------
fc2/37              Non-principal   Disabled
port-channel 20     Non-principal   Disabled
----------------    -------------   ------------
```

5.2.7 Static, persistent FCID assignment

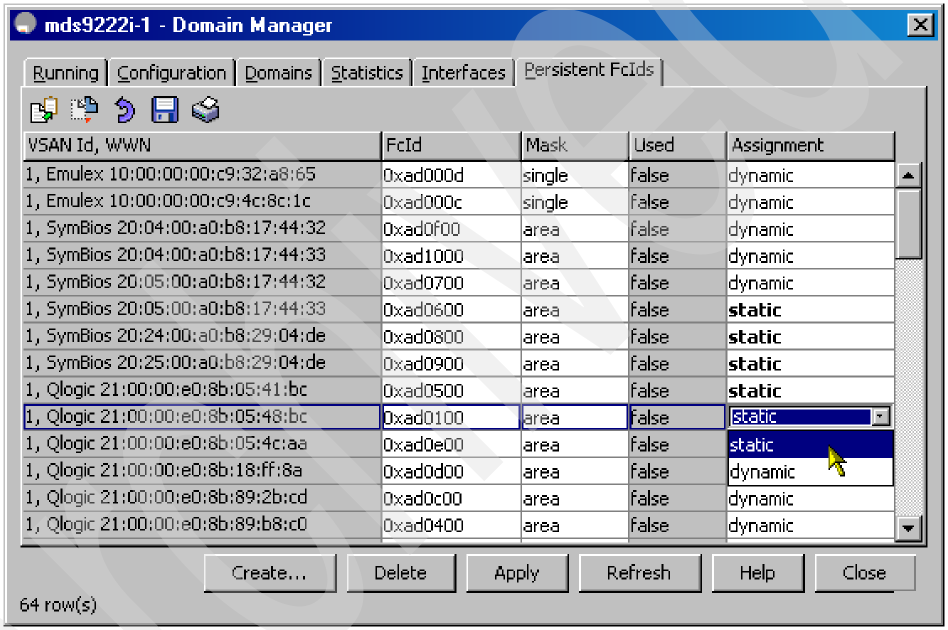
MDS switches cache-assigned FCIDs by device PWWN in switch volatile memory by default. If a switch loses power or is powered off manually, these assignments are gone. Enabling persistent FCIDs changes this behavior such that when a device is attached to the switch for the first time it is assigned a FCID, and the FCID-PWWN relationship is stored in non-volatile memory.

Enabling this feature is less of a security precaution and more of an availability feature. Certain operating systems such as HP-UX and AIX map the FCID of the storage device as the SCSI target number. So it is critical that these devices get the same FCID every time that they FLOGI into the switch.

Remember that the first byte of the FCID is the domain ID of the switch, so static switch domain IDs should be configured when using persistent FCIDs.

MDS switches also provide the ability to statically assign FCIDs. For the most part this is not necessary except in high security situations or migration scenarios where AIX or HP-UX servers are being migrated.

As shown in Figure 5-13, you can change FCIDs from dynamic to static from the Domain Manager by selecting the **Persistent FcIDs** tab.



VSAN Id, WWN	FcId	Mask	Used	Assignment
1, Emulex 10:00:00:00:c9:32:a8:65	0xad000d	single	false	dynamic
1, Emulex 10:00:00:00:c9:4c:8c:1c	0xad000c	single	false	dynamic
1, SymBios 20:04:00:a0:b8:17:44:32	0xad0f00	area	false	dynamic
1, SymBios 20:04:00:a0:b8:17:44:33	0xad1000	area	false	dynamic
1, SymBios 20:05:00:a0:b8:17:44:32	0xad0700	area	false	dynamic
1, SymBios 20:05:00:a0:b8:17:44:33	0xad0600	area	false	**static**
1, SymBios 20:24:00:a0:b8:29:04:de	0xad0800	area	false	**static**
1, SymBios 20:25:00:a0:b8:29:04:de	0xad0900	area	false	**static**
1, Qlogic 21:00:00:e0:8b:05:41:bc	0xad0500	area	false	**static**
1, Qlogic 21:00:00:e0:8b:05:48:bc	0xad0100	area	false	static
1, Qlogic 21:00:00:e0:8b:05:4c:aa	0xad0e00	area	false	static
1, Qlogic 21:00:00:e0:8b:18:ff:8a	0xad0d00	area	false	dynamic
1, Qlogic 21:00:00:e0:8b:89:2b:cd	0xad0c00	area	false	dynamic
1, Qlogic 21:00:00:e0:8b:89:b8:c0	0xad0400	area	false	dynamic

64 row(s)

Figure 5-13 Change FCIDs from dynamic to static

6

Implementation

In this chapter we describe the steps necessary to implement and set up the Cisco MDS 9000 family switches.

6.1 Initial setup of the Cisco MDS 9000 family

Before you can manage the Cisco MDS 9000 series switch through the network, you must set up the TCP/IP parameters for the switch.

The first time that the switch is powered on it automatically runs the setup program and prompts you for the IP address and other configuration information necessary to communicate over the management Ethernet interface. You can also start the setup program with the **`setup`** command later if necessary.

6.1.1 Preparing the MDS switch for configuration

Before you configure the switch for the first time, gather the following information:

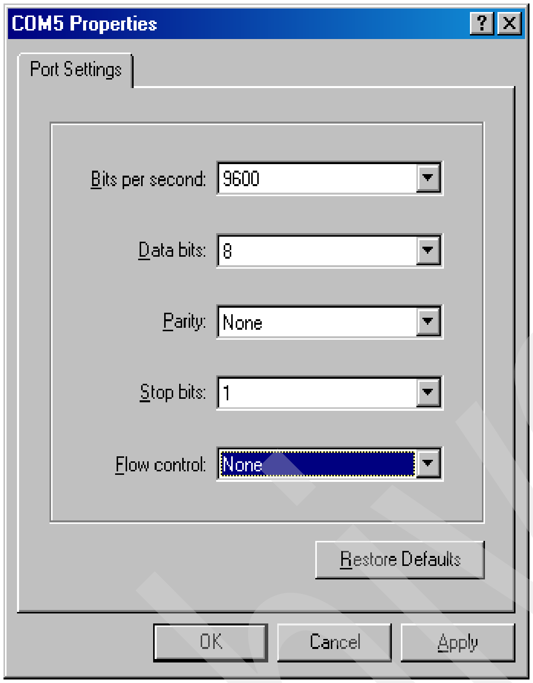
- New administrator password
- Switch name
- IP address for the management Ethernet
- Subnet mask for the management Ethernet
- Default gateway IP address (optional)
- DNS server IP address (optional)
- NTP server IP address (optional)
- SNMP v3 secret key (optional)

6.1.2 Connecting to the switch via the serial port

The steps for this procedure are:

1. Connect the serial cable provided with the switch to the RJ-45 socket in the switch using the console port in these modules:
   - Interface module in MDS 9100 or 9200 switches
   - Supervisor module in slot 5/6 in the MDS 9500 directors
2. Connect the other end of the serial cable to an RS-232 serial port on the workstation.
3. Disable any serial communication programs running on the workstation.
4. Open a terminal emulation application (such as HyperTerminal on a PC) and configure it as follows:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: none
   - Stop bits: 1
   - Flow control: None

An example of the HyperTerminal serial port properties window is shown in Figure 6-1.


COM5 Properties

Port Settings

Bits per second: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Figure 6-1 HyperTerminal serial port properties window

6.1.3 Setting up the initial parameters with the setup program

We assume that you are already connected to the console serial port of the switch, but that the switch is still powered off. In Example 6-1 we connect to an MDS 9222i and power on the switch. The basic system configuration dialog starts.

> **Note:** The steps shown in our example might differ, depending on which features you want to activate and configure. However, the prompts in the basic system configuration dialog are somewhat self-explanatory.

Example 6-1 Initial setup: Powering up the switch

```
login as: admin
User Access Verification
Using keyboard-interactive authentication.
Password:
```

```
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained in this software are
owned by other third parties and used and distributed under
license. Certain components of this software are licensed under
the GNU General Public License (GPL) version 2.0 or the GNU
Lesser General Public License (LGPL) Version 2.1. A copy of each
such license is available at
http://www.opensource.org/licenses/gpl-2.0.php and
http://www.opensource.org/licenses/lgpl-2.1.php
mds9222i-2# setup


         ---- Basic System Configuration Dialog ----

This setup utility will guide you through the basic configuration of
the system. Setup configures only enough connectivity for management
of the system.

*Note: setup is mainly used for configuring the system initially,
when no configuration is present. So setup always assumes system
defaults and not the current system configuration values.

Press Enter at anytime to skip a dialog. Use ctrl-c at anytime
to skip the remaining dialogs.

Would you like to enter the basic configuration dialog (yes/no): yes

Do you want to enforce secure password standard (yes/no)[y]:

  Create another login account (yes/no) [n]:

  Configure read-only SNMP community string (yes/no) [n]:

  Configure read-write SNMP community string (yes/no) [n]:

  Enter the switch name : mds9222i-2

  Continue with Out-of-band (mgmt0) management configuration? (yes/no)
[y]:

    Mgmt0 IPv4 address : 9.43.86.148

    Mgmt0 IPv4 netmask : 255.255.252.0
  Configure the default gateway? (yes/no) [y]:

    IPv4 address of the default gateway : 9.43.85.1

  Configure advanced IP options? (yes/no) [n]: y

  Continue with In-band (vsan1) management configuration? (yes/no) [n]:

  Enable IP routing? (yes/no) [n]:

  Configure static route? (yes/no) [n]:

  Configure the default network? (yes/no) [n]:

  Configure the DNS IPv4 address? (yes/no) [n]:

  Configure the default domain name? (yes/no) [n]:

  Enable the telnet service? (yes/no) [n]:

  Enable the ssh service? (yes/no) [y]:

    Type of ssh key you would like to generate (dsa/rsa) : dsa

 Configure clock? (yes/no) [n]:

 Configure timezone? (yes/no) [n]: y

Enter timezone config :PST

 Configure summertime? (yes/no) [n]:

  Configure the ntp server? (yes/no) [n]:

  Configure default switchport interface state (shut/noshut) [shut]:

  Configure default switchport trunk mode (on/off/auto) [on]:

  Configure default switchport port mode F (yes/no) [n]:

  Configure default zone policy (permit/deny) [deny]:

  Enable full zoneset distribution? (yes/no) [n]:
```

```
  Configure default zone mode (basic/enhanced) [basic]:

The following configuration will be applied:
  password strength-check
  switchname mds9222i-2
  interface mgmt0
    ip address 9.43.86.148 255.255.252.0
    no shutdown
  ip default-gateway 9.43.85.1
  no telnet server enable
  ssh key dsa  force
  ssh server enable
 clock timezone PST
  system default switchport shutdown
  system default switchport trunk mode on
  no system default zone default-zone permit
  no system default zone distribute full
  no system default zone mode enhanced

Would you like to edit the configuration? (yes/no) [n]:

Use this configuration and save it? (yes/no) [y]: y
```

Note: If you confirm to save the configuration in the last step, none of your changes are updated until the next time that the switch is rebooted. Ensure that you type yes here to save the new configuration.

The basic configuration is now finished, and we can proceed to upgrade the SAN-OS or NX-OS to the latest available level.

6.1.4 Upgrading SAN-OS or NX-OS

In this section we upgrade the NX-OS Version 4.1(0.182) to the latest released level of NX-0S Version 4.1(1). This can be done using the Device Manager (DM) command-line interface (CLI) or the Fabric Manager (FM) graphical user interface (GUI). For completeness, we show how to perform the upgrade with both the CLI and the GUI.

The CLI can be invoked by two methods on the Device Manager, as shown in Figure 6-2 and Figure 6-3.

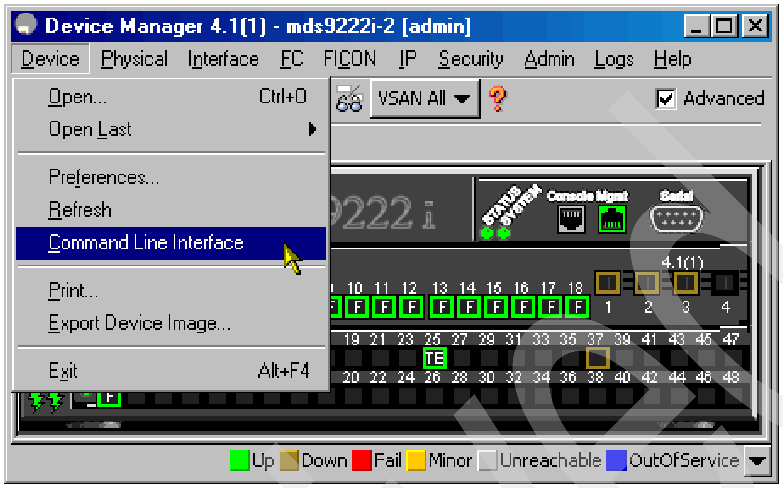


Figure 6-2 Starting a command-line interface from Device Manager

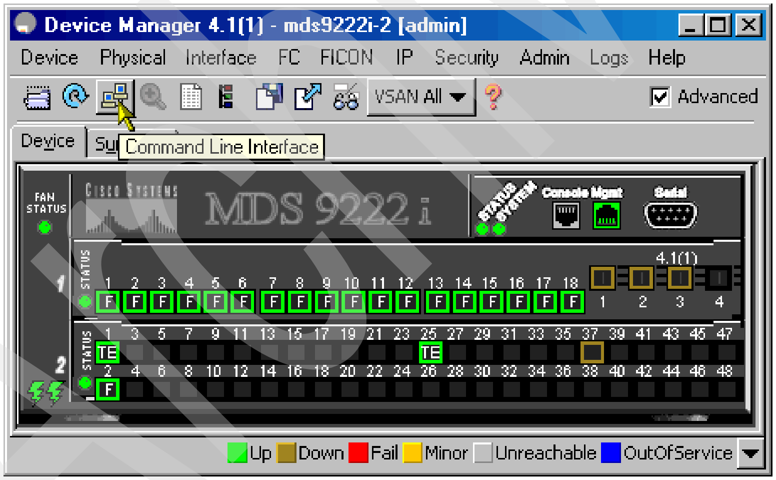


Figure 6-3 Second method to start a command-line interface from a Device Manager

Upgrading the SAN-OS or NX-OS using the CLI

Prior to upgrading the switch:

1. List the current SAN-OS or NX-OS version running on the switch.
2. Verify that there is sufficient free space in the bootflash to copy the necessary files over.

3. Copy the SAN-OS code from a FTP server to the bootflash on the switch, as shown in Example 6-2.

Example 6-2 Show the current SAN OS version

```
mds9222i-1# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained herein are owned by
other third parties and are used and distributed under license.
Some parts of this software are covered under the GNU Public
License. A copy of the license is available at
http://www.gnu.org/licenses/gpl.html.

Software
  BIOS:      version 1.0.15
  loader:    version N/A
  kickstart: version 4.1(1) [build 4.1(0.182)] [gdb]
  system:    version 4.1(1) [build 4.1(0.182)] [gdb]
  BIOS compile time:       07/16/08
  kickstart image file is:
bootflash:/m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
  kickstart compile time:  10/12/2020 25:00:00 [08/15/2008 18:42:09]
  system image file is:    bootflash:/m9200-s2ek9-mzg.4.1.0.182.bin
  system compile time:     12/25/2010 12:00:00 [08/15/2008 20:03:21]

Hardware
  cisco MDS 9222i ("4x1GE IPS, 18x1/2/4Gbps FC/Sup2")
  Motorola, e500v2  with 1036512 kB of memory.
  Processor Board ID JAE12088ZMT

  Device name: mds9222i-1
  bootflash:    1000440 kB
Kernel uptime is 0 day(s), 0 hour(s), 3 minute(s), 38 second(s)

Last reset at 970000 usecs after  Wed Sep 17 00:31:49 2008

  Reason: Reset Requested by CLI command reload
  System version: 4.1(1)
  Service:
```

You may list the active supervisor bootflash space, as shown in Example 6-3.

Example 6-3 Listing the active supervisors bootflash

```
mds9222i-1# dir bootflash:
        25     Sep 11 02:16:32 2008  cpu_logfile
      1024     Sep 11 06:40:00 2008  epld_dir/
     46080     Sep 17 00:24:31 2008  lost+found/
   3757210     Sep 11 02:06:49 2008  m9000-epld-4.1.1.img
  19542528     Sep 11 02:08:00 2008  m9200-s2ek9-kickstart-mz.4.1.1.bin
  19560960     Sep 17 00:23:42 2008  m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
 101905006     Sep 11 02:15:15 2008  m9200-s2ek9-mz.4.1.1.bin
 106106231     Sep 17 00:22:14 2008  m9200-s2ek9-mzg.4.1.0.182.bin
      1024     Sep 11 02:16:33 2008  partner/

Usage for bootflash://sup-local
  295262208 bytes used
   51566592 bytes free
  346828800 bytes total
```

If needed, you may list the remote supervisor bootflash space as in a MDS 9513, which has dual supervisors. List the bootflash space as shown in Example 6-4.

Example 6-4 Listing the remote supervisors bootflash

```
mds9513-1# dir bootflash://sup-remote
13017088     Jan 01 00:06:14 1970  bboot-3.2.1.23
   31590136     Jan 01 00:08:09 1970  bdiag-3.2.1.23
       4096     Jan 01 00:04:02 1970  boot/
          6     Jan 01 00:04:02 1970  cfglabel.sysmgr
         25     Aug 18 05:58:30 2007  cpu_logfile
       4096     Aug 18 06:12:44 2007  epld_dir/
      49152     Aug 24 05:46:26 2007  lost+found/
    3757210     Aug 18 06:12:01 2007  m9000-epld-4.1.1.img
   19542528     Aug 18 05:50:02 2007  m9500-s2ek9-kickstart-mz.4.1.1.bin
   19560960     Aug 24 05:45:49 2007  m9500-s2ek9-kickstart-mzg.4.1.0.182.bin
  101905006     Aug 18 05:57:19 2007  m9500-s2ek9-mz.4.1.1.bin
  106106231     Aug 24 05:45:11 2007  m9500-s2ek9-mzg.4.1.0.182.bin
       4096     Aug 18 05:58:31 2007  partner/

Usage for bootflash://sup-local
  367042560 bytes used
  364429312 bytes free
  731471872 bytes total
```

Copy the SAN-OS or NX-OS files from the FTP server to the bootflash in the switch, as shown in Example 6-5.

Ensure that the FTP server is reachable in order to copy the required files. Firewalls may prevent you from reaching the FTP server.

Example 6-5 Copy files to a remote server

```
mds9222i-1# copy ftp://9.43.86.49/jaco/4.1.1/m9200-s2ek9-kickstart-mz.4.1.1.bin
bootflash:
Enter username: jaco
File transfer in progress, please wait ...
Password:
mds9222i-1# copy ftp://9.43.86.49/jaco/4.1.1/m9200-s2ek9-mz.4.1.1.bin
bootflash:
Enter username: jaco
File transfer in progress, please wait ...
Password:
mds9222i-1#
```

Prior to starting the actual upgrade process, back up the running configuration to a FTP server, as shown in Example 6-6.

> **Note:** A best practice when performing configuration changes is to always save the running configuration to the startup configuration. As a way of operation, you could also preserve the previous startup configurations for two generations.

Example 6-6 Back up the running configuration

```
mds9222i-1# copy running-config ftp://9.43.86.49/jaco/backup
Enter username: jaco
Password:
mds9222i-1#
```

After backing up the configuration, start the upgrade using the **`install all`** command, as shown in Example 6-7.

Example 6-7 Upgrading the director using the install all command

```
mds9222i-1# install all system bootflash:m9200-s2ek9-mz.4.1.1.bin kickstart
bootflash:m9200-s2ek9-kickstart-mz.4.1.1.bin

Verifying image bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin for boot variable
"kickstart".
[####################] 100% -- SUCCESS
```

```
Verifying image bootflash:/m9200-s2ek9-mz.4.1.1.bin for boot variable "system".
[####################] 100% -- SUCCESS

Verifying image type.
[####################] 100% -- SUCCESS

Extracting "system" version from image bootflash:/m9200-s2ek9-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Extracting "kickstart" version from image
bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Extracting "bios" version from image bootflash:/m9200-s2ek9-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Extracting "slc2" version from image bootflash:/m9200-s2ek9-mz.4.1.1.bin.
[####################] 100% -- SUCCESS

Performing Compact Flash and TCAM sanity test.
[####################] 100% -- SUCCESS

Notifying services about system upgrade.
[####################] 100% -- SUCCESS

Compatibility check is done:
Module  bootable          Impact  Install-type  Reason
------  --------  --------------  ------------  ------
     1       yes  non-disruptive          none
     2       yes  non-disruptive          none

Do you want to continue with the installation (y/n)?  [n] y

Install is in progress, please wait.

Setting boot variables.
[####################] 100% -- SUCCESS

Performing configuration copy.
[####################] 100% -- SUCCESS

Module 1: Refreshing compact flash and upgrading bios/loader/bootrom.
Warning: please do not remove or power off the module at this time.
[####################] 100% -- SUCCESS

Module 2: Refreshing compact flash and upgrading bios/loader/bootrom.
Warning: please do not remove or power off the module at this time.
[####################] 100% -- SUCCESS
```

```
Install has been successful.
mds9222i-1#
```

After the upgrade has completed, we verify the version using the **show version** command, as shown in Example 6-8.

Example 6-8 Issuing show version after upgrade command

```
mds9222i-1# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained herein are owned by
other third parties and are used and distributed under license.
Some parts of this software are covered under the GNU Public
License. A copy of the license is available at
http://www.gnu.org/licenses/gpl.html.

Software
  BIOS:      version 1.0.15
  loader:    version N/A
  kickstart: version 4.1(1)
  system:    version 4.1(1)
  BIOS compile time:       07/16/08
  kickstart image file is:
bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin
  kickstart compile time:  10/12/2020 25:00:00 [09/09/2008 06:55:47]
  system image file is:    bootflash:/m9200-s2ek9-mz.4.1.1.bin
  system compile time:     8/22/2008 0:00:00 [09/09/2008 08:15:09]

Hardware
  cisco MDS 9222i ("4x1GE IPS, 18x1/2/4Gbps FC/Sup2")
  Motorola, e500v2  with 1036316 kB of memory.
  Processor Board ID JAE12088ZMT

  Device name: mds9222i-1
  bootflash:    1000440 kB
Kernel uptime is 0 day(s), 0 hour(s), 1 minute(s), 59 second(s)

Last reset at 353970 usecs after  Wed Sep 17 00:53:38 2008
```

```
  Reason: Reset Requested by CLI command reload
  System version: 4.1(0.182)
  Service:
```

The CLI can be used to delete old NX-OS files to free up bootflash space on the active supervisor if needed, as shown in Example 6-9.

Example 6-9   Freeing up bootflash space

```
mds9222i-1# dir bootflash:
         25     Sep 11 02:16:32 2008  cpu_logfile
       1024     Sep 11 06:40:00 2008  epld_dir/
      46080     Sep 17 00:47:28 2008  lost+found/
    3757210     Sep 11 02:06:49 2008  m9000-epld-4.1.1.img
   19542528     Sep 17 00:41:54 2008
m9200-s2ek9-kickstart-mz.4.1.1.bin
   19560960     Sep 17 00:23:42 2008
m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
  101905006     Sep 17 00:42:45 2008  m9200-s2ek9-mz.4.1.1.bin
  106106231     Sep 17 00:22:14 2008  m9200-s2ek9-mzg.4.1.0.182.bin
       1024     Sep 11 02:16:33 2008  partner/

Usage for bootflash://sup-local
  295262208 bytes used
   51566592 bytes free
  346828800 bytes total
mds9222i-1# delete bootflash:m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
mds9222i-1# delete bootflash:m9200-s2ek9-mzg.4.1.0.182.bin
mds9222i-1# dir bootflash:
         25     Sep 11 02:16:32 2008  cpu_logfile
       1024     Sep 11 06:40:00 2008  epld_dir/
      46080     Sep 17 00:47:28 2008  lost+found/
    3757210     Sep 11 02:06:49 2008  m9000-epld-4.1.1.img
   19542528     Sep 17 00:41:54 2008
m9200-s2ek9-kickstart-mz.4.1.1.bin
  101905006     Sep 17 00:42:45 2008  m9200-s2ek9-mz.4.1.1.bin
       1024     Sep 11 02:16:33 2008  partner/

Usage for bootflash://sup-local
  169098240 bytes used
  177730560 bytes free
  346828800 bytes total
```

The CLI can also be used to delete old SAN-OS or NX-OS files to free up bootflash space on the remote supervisor if needed, as shown in Example 6-10.

Example 6-10 Delete bootflash files on remote supervisor

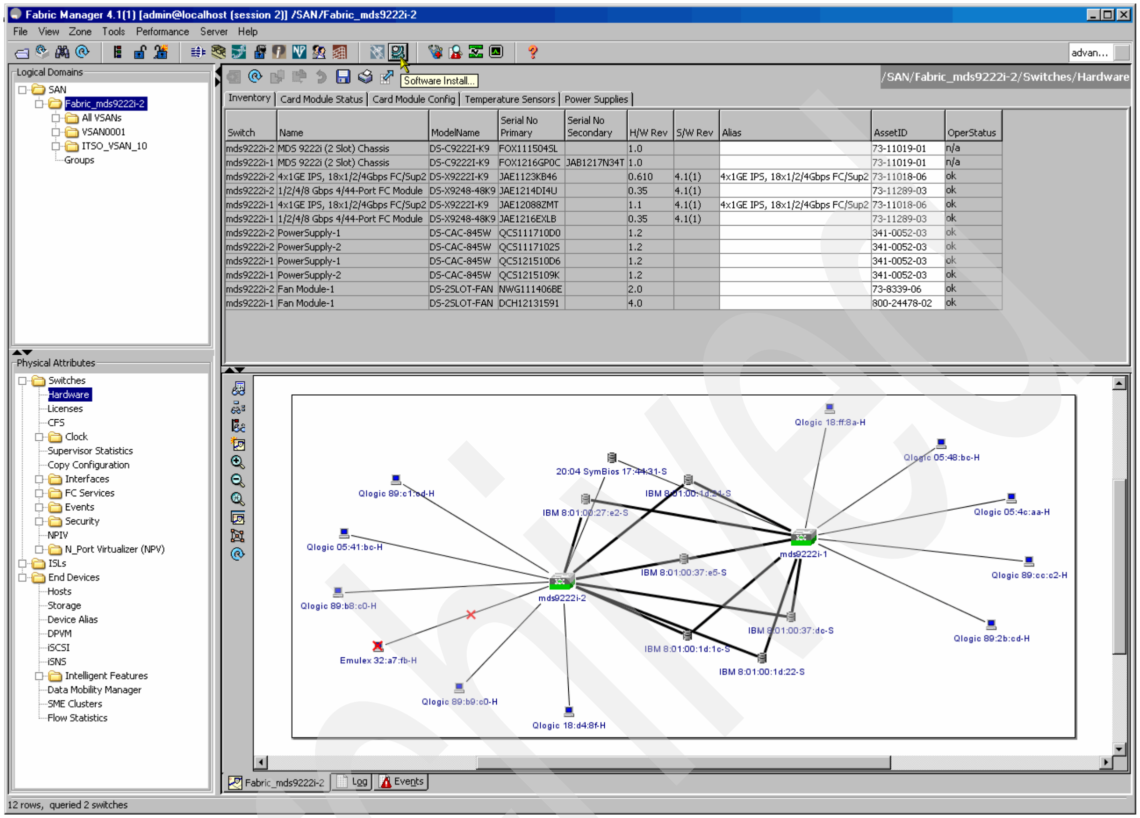
```
mds9513# delete bootflash://sup-remote/m9200-s2ek9-mzg.4.1.0.182.bin
mds9513# delete bootflash://sup-remote/m9200-s2ek9-kickstart-mzg.4.1.0.182.bin
mds9513# dir bootflash://sup-remote

25      Sep 11 02:16:32 2008  cpu_logfile
       1024     Sep 11 06:40:00 2008  epld_dir/
      46080     Sep 17 00:47:28 2008  lost+found/
    3757210     Sep 11 02:06:49 2008  m9000-epld-4.1.1.img
   19542528     Sep 17 00:41:54 2008  m9500-s2ek9-kickstart-mz.4.1.1.bin
  101905006     Sep 17 00:42:45 2008  m9500-s2ek9-mz.4.1.1.bin
       1024     Sep 11 02:16:33 2008  partner/
```

Note: When deleting files from the bootflash make sure that they will no longer be needed.

Upgrading the SAN-OS and the NX-OS using the GUI

In the following example, we upgrade a director using the GUI, invoking the process using the Fabric Manager interface.

To start the process, we invoke the Fabric Manager Software install wizard by clicking the icon shown in Figure 6-4.

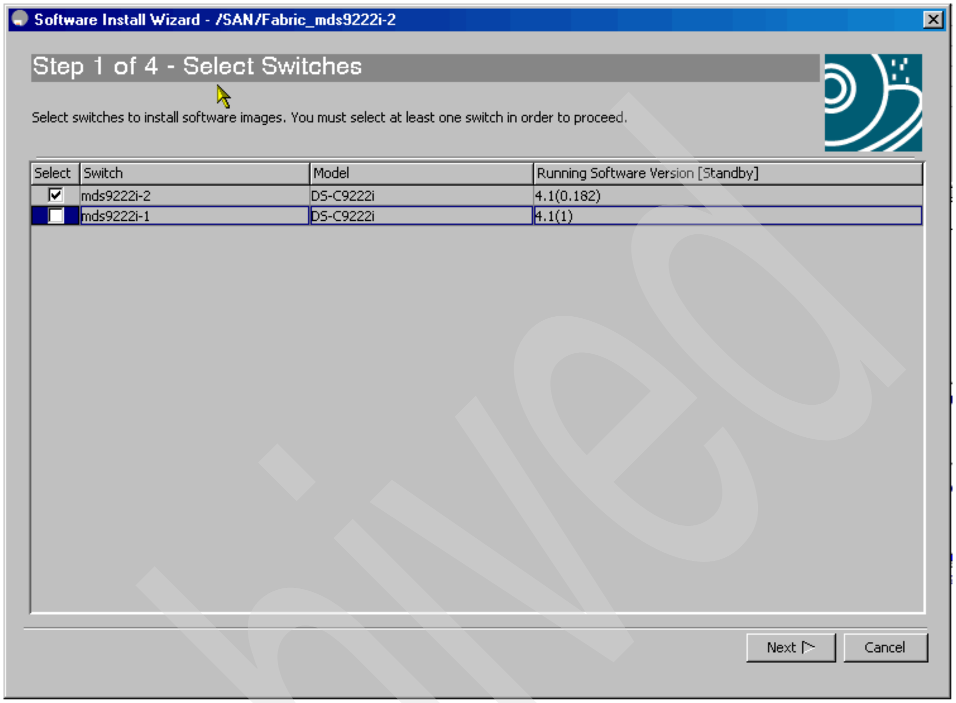


Switch	Name	ModelName	Serial No Primary	Serial No Secondary	H/W Rev	S/W Rev	Alias	AssetID	OperStatus
mds9222i-2	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX111504SL		1.0			73-11019-01	n/a
mds9222i-1	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX1216GP0C	JAB1217N34T	1.0			73-11019-01	n/a
mds9222i-2	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE1123KB46		0.610	4.1(1)	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	73-11018-06	ok
mds9222i-2	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1214DI4U		0.35	4.1(1)		73-11289-03	ok
mds9222i-1	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE12088ZMT		1.1	4.1(1)	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	73-11018-06	ok
mds9222i-1	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1216EXLB		0.35	4.1(1)		73-11289-03	ok
mds9222i-2	PowerSupply-1	DS-CAC-845W	QCS111710D0		1.2			341-0052-03	ok
mds9222i-2	PowerSupply-2	DS-CAC-845W	QCS1117102S		1.2			341-0052-03	ok
mds9222i-1	PowerSupply-1	DS-CAC-845W	QCS121510D6		1.2			341-0052-03	ok
mds9222i-1	PowerSupply-2	DS-CAC-845W	QCS1215109K		1.2			341-0052-03	ok
mds9222i-2	Fan Module-1	DS-2SLOT-FAN	NWG111406BE		2.0			73-8339-06	ok
mds9222i-1	Fan Module-1	DS-2SLOT-FAN	DCH12131591		4.0			800-24478-02	ok

12 rows, queried 2 switches

Figure 6-4 Upgrade the SAN-OS or the NX-OS using Fabric Manager

In step 1, the Software Install wizard prompts us to select which switches we want to upgrade, and we click **Next**, as shown in Figure 6-5.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 1 of 4 - Select Switches

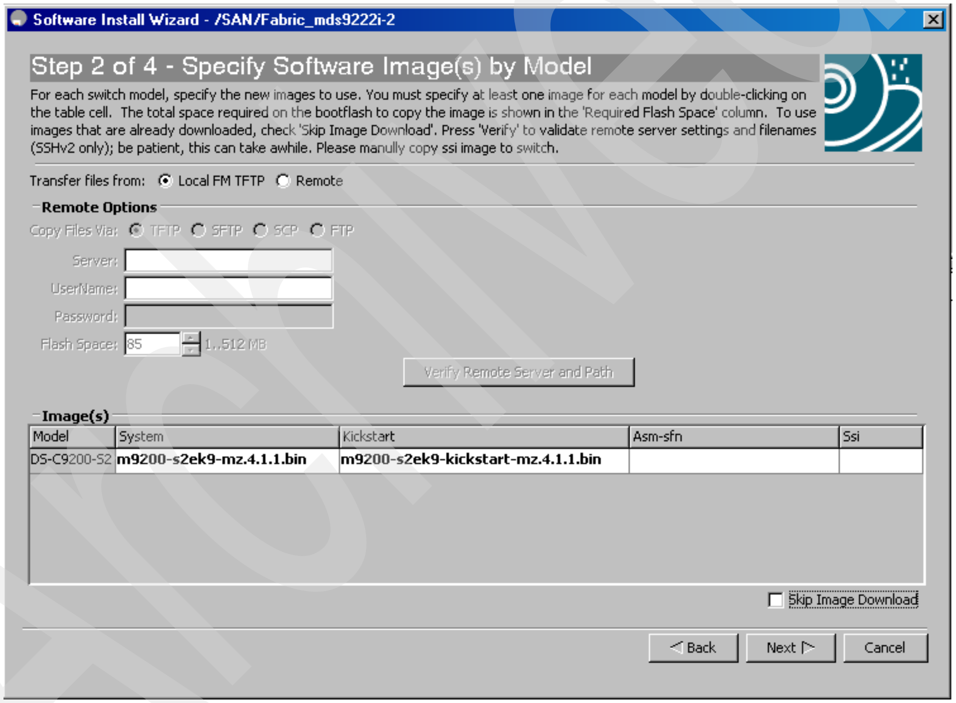
Select switches to install software images. You must select at least one switch in order to proceed.

Select	Switch	Model	Running Software Version [Standby]
☑	mds9222i-2	DS-C9222i	4.1(0.182)
□	mds9222i-1	DS-C9222i	4.1(1)

Figure 6-5 Selecting the switches to upgrade

In step 2, the wizard prompts for the location of the software that we want to install. Specify the FTP server where the kickstart and system images reside, the size of the images, and login credentials for the FTP server, and click **Next** (Figure 6-6).

> **Note:** The complete path to the file location must be specified for this step to complete successfully. Ensure that the firewall does not prevent access to the FTP server.
>
> The wizard does not verify whether the images match the specified size, but the value is used to verify whether the amount of corresponding free space is available on the bootflash, prior to initiating the download.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 2 of 4 - Specify Software Image(s) by Model

For each switch model, specify the new images to use. You must specify at least one image for each model by double-clicking on the table cell. The total space required on the bootflash to copy the image is shown in the 'Required Flash Space' column. To use images that are already downloaded, check 'Skip Image Download'. Press 'Verify' to validate remote server settings and filenames (SSHv2 only); be patient, this can take awhile. Please manully copy ssi image to switch.

Transfer files from: ● Local FM TFTP ○ Remote

Remote Options

Copy Files Via: ● TFTP ○ SFTP ○ SCP ○ FTP

Server:

UserName:

Password:

Flash Space: 85 1..512 MB

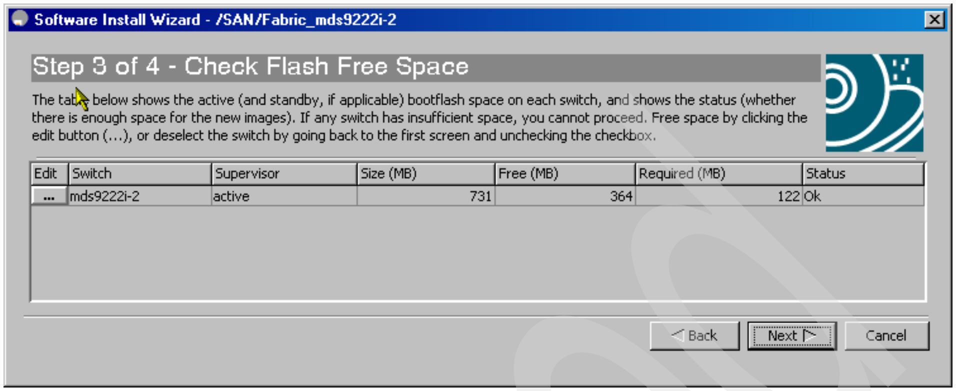
Image(s)

Model	System	Kickstart	Asm-sfn	Ssi
DS-C9200-S2	m9200-s2ek9-mz.4.1.1.bin	m9200-s2ek9-kickstart-mz.4.1.1.bin		

□ Skip Image Download

Figure 6-6 Specifying images and location

In step 3, the software install wizard verifies whether the required free space is available on the bootflash, and we click **Next**, as shown in Figure 6-7.


Software Install Wizard - /SAN/Fabric_mds9222i-2

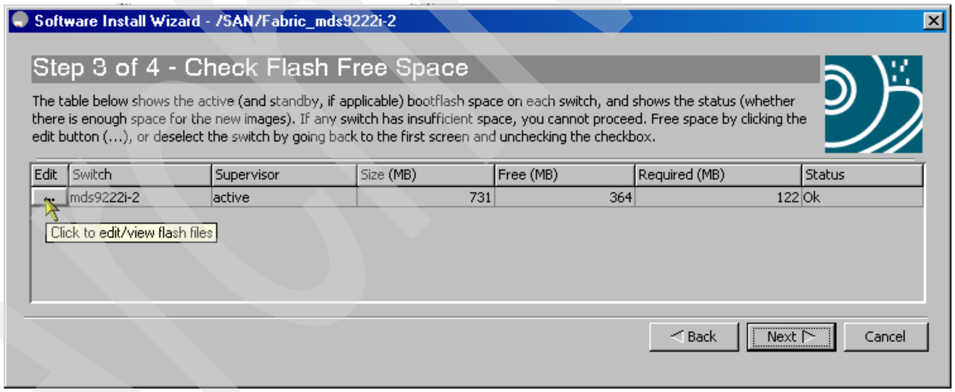
Step 3 of 4 - Check Flash Free Space

The table below shows the active (and standby, if applicable) bootflash space on each switch, and shows the status (whether there is enough space for the new images). If any switch has insufficient space, you cannot proceed. Free space by clicking the edit button (...), or deselect the switch by going back to the first screen and unchecking the checkbox.

Edit	Switch	Supervisor	Size (MB)	Free (MB)	Required (MB)	Status
...	mds9222i-2	active	731	364	122	Ok

Figure 6-7 Verifying required free space on bootflash

Should you encounter an insufficient amount of bootflash space you may take recovery action by clicking the **Edit** button, as suggested in Figure 6-8, or you may use the Device Manager option to delete bootflash files, as shown in Figure 6-9 on page 179 and Figure 6-10 on page 179.


Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 3 of 4 - Check Flash Free Space

The table below shows the active (and standby, if applicable) bootflash space on each switch, and shows the status (whether there is enough space for the new images). If any switch has insufficient space, you cannot proceed. Free space by clicking the edit button (...), or deselect the switch by going back to the first screen and unchecking the checkbox.

Edit	Switch	Supervisor	Size (MB)	Free (MB)	Required (MB)	Status
...	mds9222i-2	active	731	364	122	Ok

Figure 6-8 Space recovery during the installation process

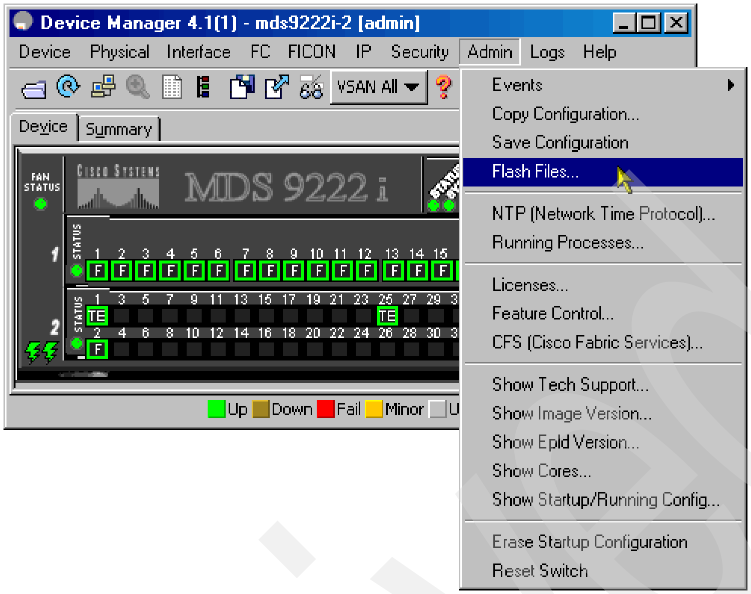
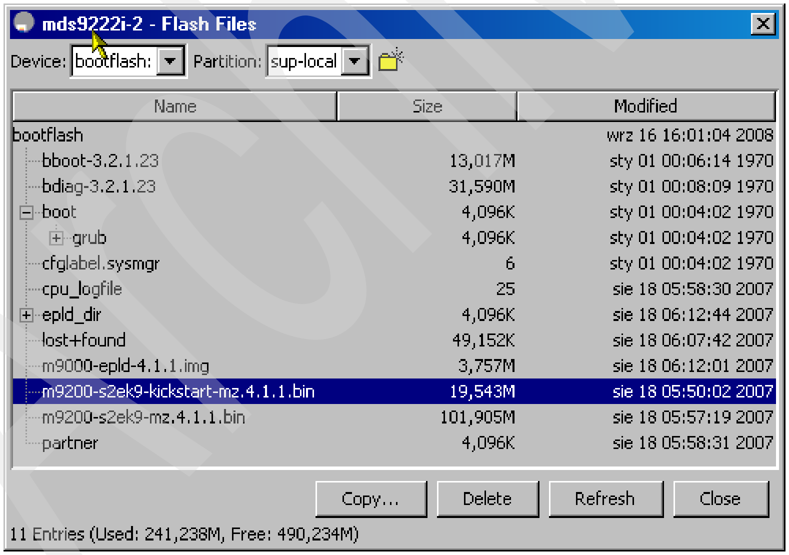


Figure 6-9 Selecting FlashFiles in Device Manager to recover space in the bootflash



mds9222i-2 - Flash Files

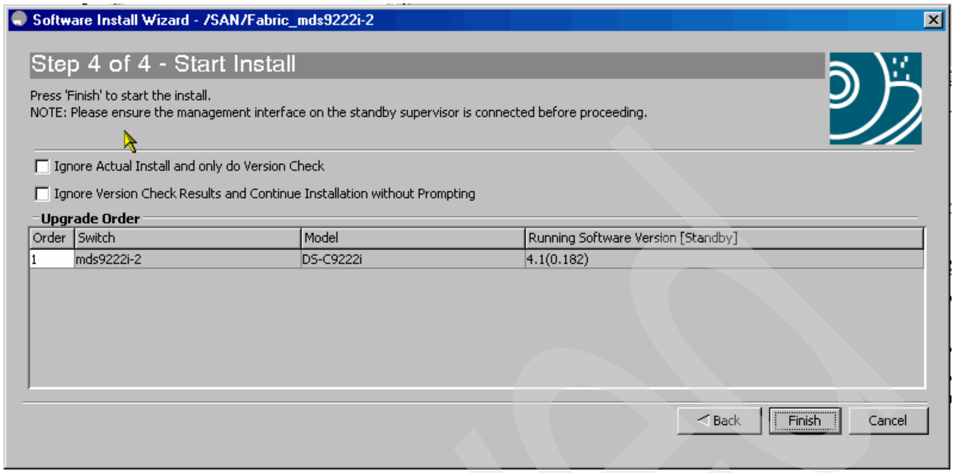
Device: bootflash: Partition: sup-local

Name	Size	Modified
bootflash		wrz 16 16:01:04 2008
bboot-3.2.1.23	13,017M	sty 01 00:06:14 1970
bdiag-3.2.1.23	31,590M	sty 01 00:08:09 1970
boot	4,096K	sty 01 00:04:02 1970
grub	4,096K	sty 01 00:04:02 1970
cfglabel.sysmgr	6	sty 01 00:04:02 1970
cpu_logfile	25	sie 18 05:58:30 2007
epld_dir	4,096K	sie 18 06:12:44 2007
lost+found	49,152K	sie 18 06:07:42 2007
m9000-epld-4.1.1.img	3,757M	sie 18 06:12:01 2007
m9200-s2ek9-kickstart-mz.4.1.1.bin	19,543M	sie 18 05:50:02 2007
m9200-s2ek9-mz.4.1.1.bin	101,905M	sie 18 05:57:19 2007
partner	4,096K	sie 18 05:58:31 2007

11 Entries (Used: 241,238M, Free: 490,234M)

Figure 6-10 Select the files to delete

In step 4 we start the installation, as shown in Figure 6-11.


Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 4 of 4 - Start Install

Press 'Finish' to start the install.
NOTE: Please ensure the management interface on the standby supervisor is connected before proceeding.

☐ Ignore Actual Install and only do Version Check

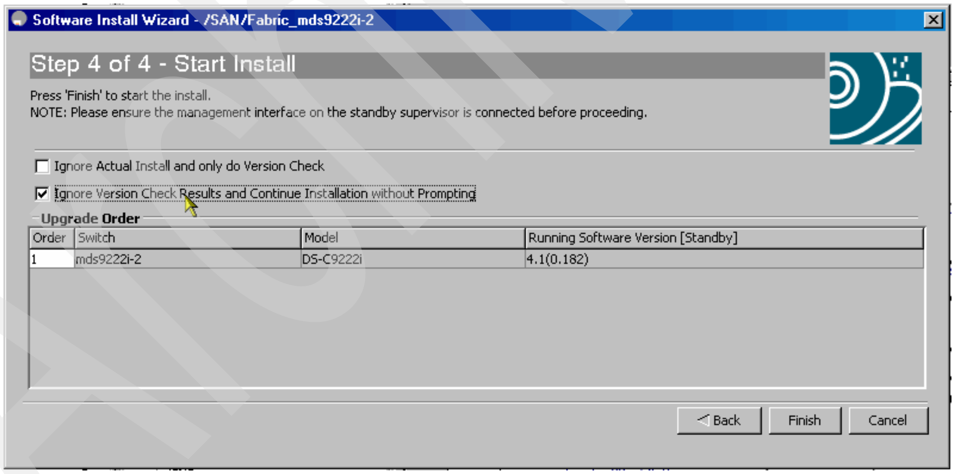
☐ Ignore Version Check Results and Continue Installation without Prompting

Upgrade Order

Order	Switch	Model	Running Software Version [Standby]
1	mds9222i-2	DS-C9222i	4.1(0.182)

Figure 6-11 Starting the installation

If you want to perform the upgrade unattended, then in order to avoid being prompted to start the upgrade, you can check **Ignore Versions Check Results**, as shown in Figure 6-12.


Software Install Wizard - /SAN/Fabric_mds9222i-2

Step 4 of 4 - Start Install

Press 'Finish' to start the install.
NOTE: Please ensure the management interface on the standby supervisor is connected before proceeding.

☐ Ignore Actual Install and only do Version Check

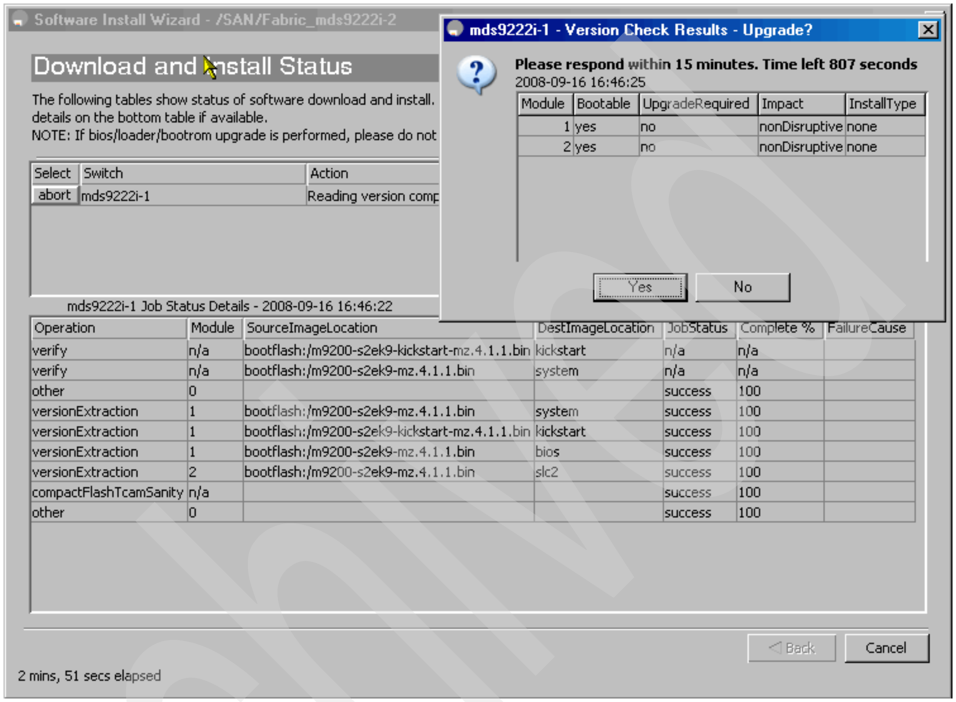
☑ Ignore Version Check Results and Continue Installation without Prompting

Upgrade Order

Order	Switch	Model	Running Software Version [Standby]
1	mds9222i-2	DS-C9222i	4.1(0.182)

Figure 6-12 Ignore versions check results

In step 5 the image download starts and, upon completion, bootflash synchronization and compatibility checks are performed. When the wizard is ready to start the upgrade, we are prompted to click **Yes** (within a time-out period of 15 minutes) to start the upgrade, as shown in Figure 6-13.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Download and Install Status

The following tables show status of software download and install.
details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not

Select	Switch	Action
abort	mds9222i-1	Reading version comp

mds9222i-1 Job Status Details - 2008-09-16 16:46:22

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause
verify	n/a	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	n/a	n/a	
verify	n/a	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	n/a	n/a	
other	0			success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	bios	success	100	
versionExtraction	2	bootflash:/m9200-s2ek9-mz.4.1.1.bin	slc2	success	100	
compactFlashTcamSanity	n/a			success	100	
other	0			success	100	

2 mins, 51 secs elapsed

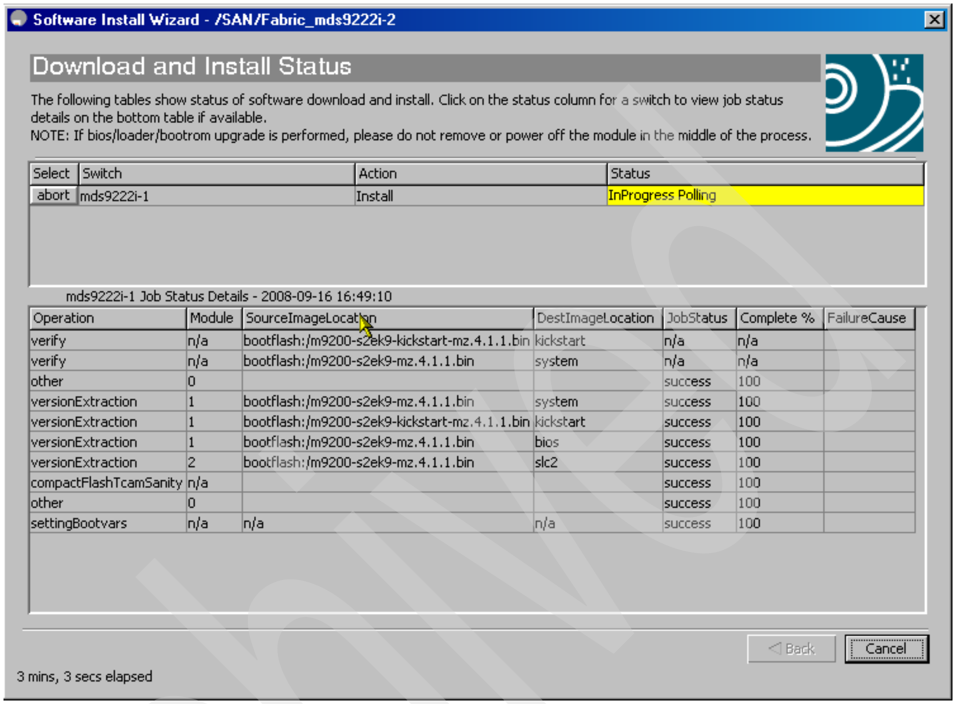
mds9222i-1 - Version Check Results - Upgrade?

Please respond within 15 minutes. Time left 807 seconds
2008-09-16 16:46:25

Module	Bootable	UpgradeRequired	Impact	InstallType
1	yes	no	nonDisruptive	none
2	yes	no	nonDisruptive	none

Figure 6-13 Download and install status

In step 6, as the installation progresses, a step-by-step status is continuously displayed, as shown in Figure 6-14.



Software Install Wizard - /SAN/Fabric_mds9222i-2

Download and Install Status

The following tables show status of software download and install. Click on the status column for a switch to view job status details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not remove or power off the module in the middle of the process.

Select	Switch	Action	Status
abort	mds9222i-1	Install	InProgress Polling

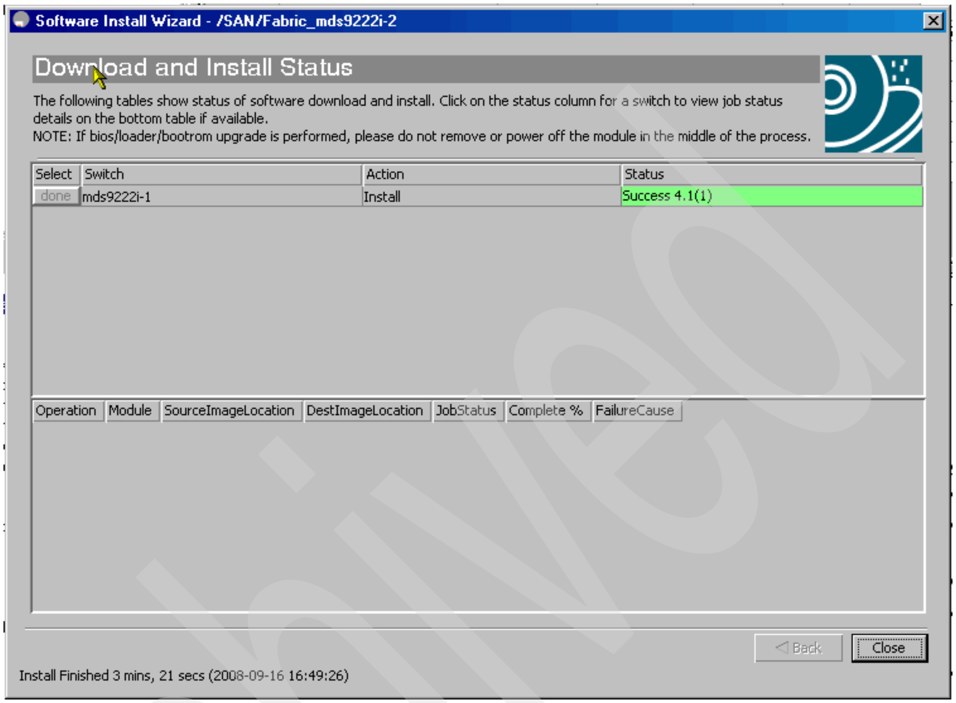
mds9222i-1 Job Status Details - 2008-09-16 16:49:10

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause
verify	n/a	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	n/a	n/a	
verify	n/a	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	n/a	n/a	
other	0			success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	system	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin	kickstart	success	100	
versionExtraction	1	bootflash:/m9200-s2ek9-mz.4.1.1.bin	bios	success	100	
versionExtraction	2	bootflash:/m9200-s2ek9-mz.4.1.1.bin	slc2	success	100	
compactFlashTcamSanity	n/a			success	100	
other	0			success	100	
settingBootvars	n/a	n/a	n/a	success	100	

3 mins, 3 secs elapsed

Figure 6-14 Monitoring installation progress

In step 7, when the installation completes, the status of the upgrade is displayed, as shown in Figure 6-15.



Download and Install Status

The following tables show status of software download and install. Click on the status column for a switch to view job status details on the bottom table if available.
NOTE: If bios/loader/bootrom upgrade is performed, please do not remove or power off the module in the middle of the process.

Select	Switch	Action	Status
done	mds9222i-1	Install	Success 4.1(1)

Operation	Module	SourceImageLocation	DestImageLocation	JobStatus	Complete %	FailureCause

Install Finished 3 mins, 21 secs (2008-09-16 16:49:26)

Figure 6-15 Upgrade completed

6.1.5 Managing licenses

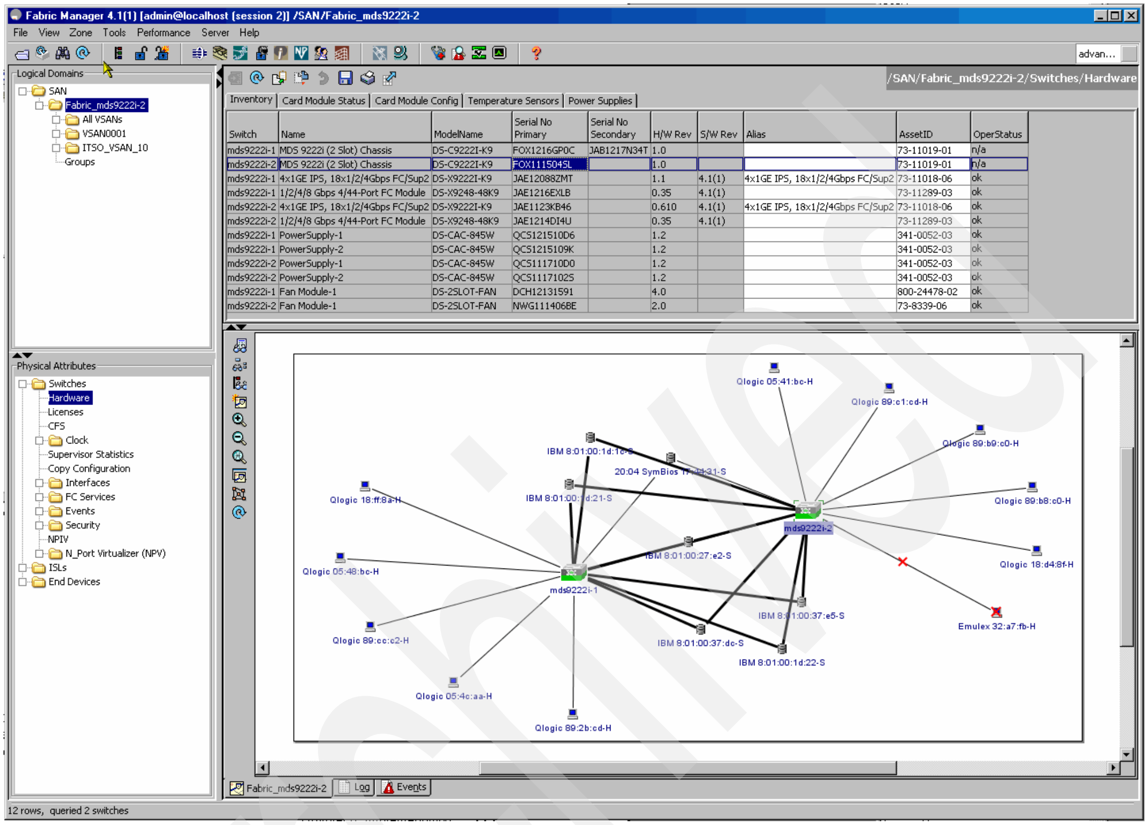
To obtain new or updated license key files:

1. Collect the host ID of the switch, also referred to as the switch serial number, using the command **show license host-id** from the CLI, as shown in Example 6-11. The host ID is FOX111504SL.

Example 6-11 Listing the switch serial number

```
mds9222i-2#
mds9222i-2# show license host-id
License hostid: VDH=FOX111504SL
mds9222i-2#
```

This can also be done using the GUI, as shown in Figure 6-16. The Serial No Primary switch is equivalent to the license host_id.



Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2

Switch	Name	ModelName	Serial No Primary	Serial No Secondary	H/W Rev	S/W Rev	Alias	AssetID	OperStatus
mds9222i-1	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX1216GP0C	JAB1217N34T	1.0			73-11019-01	n/a
mds9222i-2	MDS 9222i (2 Slot) Chassis	DS-C9222I-K9	FOX111504SL		1.0			73-11019-01	n/a
mds9222i-1	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE12088ZMT		1.1	4.1(1)	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	73-11018-06	ok
mds9222i-1	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1216EXLB		0.35	4.1(1)		73-11289-03	ok
mds9222i-2	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	DS-X9222I-K9	JAE1123KB46		0.610	4.1(1)	4x1GE IPS, 18x1/2/4Gbps FC/Sup2	73-11018-06	ok
mds9222i-2	1/2/4/8 Gbps 4/44-Port FC Module	DS-X9248-48K9	JAE1214DI4U		0.35	4.1(1)		73-11289-03	ok
mds9222i-1	PowerSupply-1	DS-CAC-845W	QCS121510D6		1.2			341-0052-03	ok
mds9222i-1	PowerSupply-2	DS-CAC-845W	QCS1215109K		1.2			341-0052-03	ok
mds9222i-2	PowerSupply-1	DS-CAC-845W	QCS111710D0		1.2			341-0052-03	ok
mds9222i-2	PowerSupply-2	DS-CAC-845W	QCS1117102S		1.2			341-0052-03	ok
mds9222i-1	Fan Module-1	DS-2SLOT-FAN	DCH12131591		4.0			800-24478-02	ok
mds9222i-2	Fan Module-1	DS-2SLOT-FAN	NWG111406BE		2.0			73-8339-06	ok

12 rows, queried 2 switches

Figure 6-16 Listing the serial number

2. Obtain your claim certificate or the proof of purchase document.
3. Locate the product authorization key (PAK) from the claim certificate or proof of purchase document.
4. Locate the Web site URL from the claim certificate or proof of purchase document.
5. Access the specified URL that applies to your switch and enter the switch serial number and the PAK.

The license key file is sent to you by e-mail. The license key file is digitally signed to only authorize use on the switch for which it was requested. The requested features are also enabled once the NX-OS or SAN-OS software on the specified switch accesses the license key file.

When you have received your digitally signed license keys, they can be installed on the switch. The license files can be copied to the switch bootflash beforehand, or they can be copied during the install process.

Viewing installed licenses

To list the installed licenses on a switch, you can issue the command **`show license`** from the CLI or use GUI license selection or from the Device Manager by selecting **Admin** → **Licenses**, as shown in Figure 6-17.

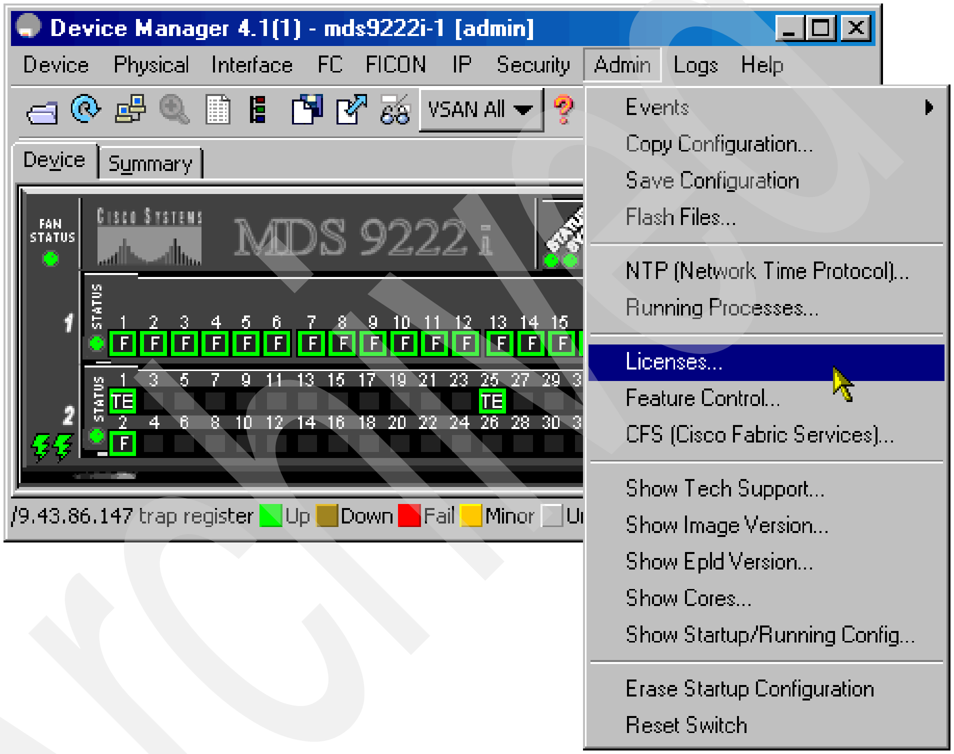
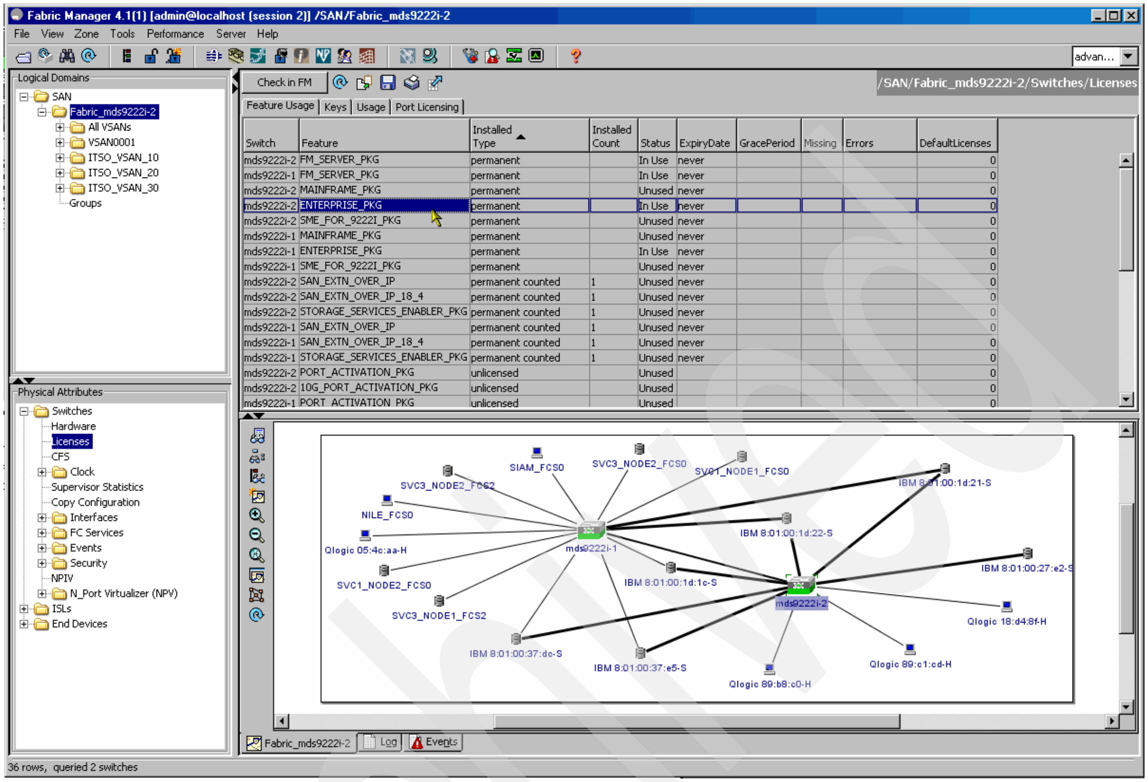


Figure 6-17 Selecting the licensing interface

License features can be listed via the GUI, as shown in Figure 6-18.

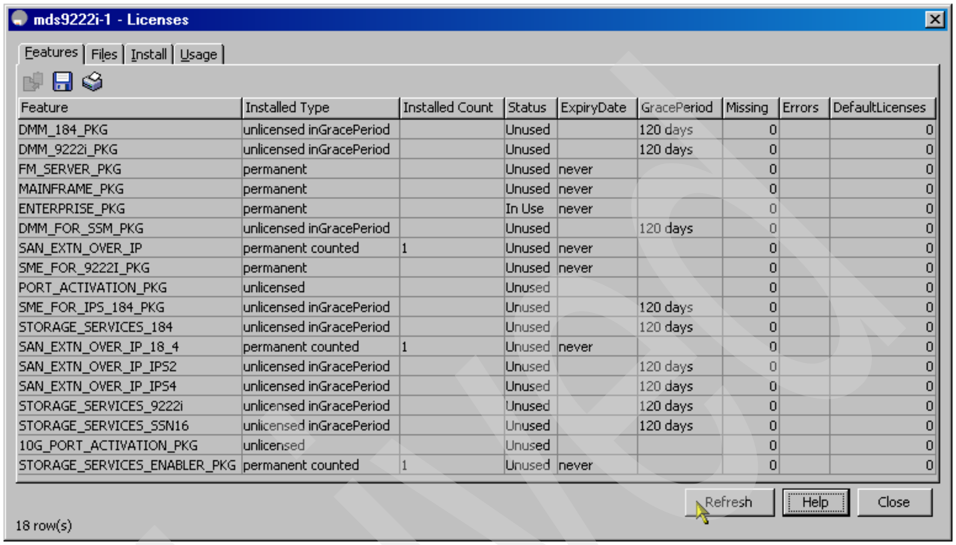


Switch	Feature	Installed Type	Installed Count	Status	ExpiryDate	GracePeriod	Missing	Errors	DefaultLicenses
mds9222i-2	FM_SERVER_PKG	permanent		In Use	never				0
mds9222i-1	FM_SERVER_PKG	permanent		In Use	never				0
mds9222i-2	MAINFRAME_PKG	permanent		Unused	never				0
mds9222i-2	ENTERPRISE_PKG	permanent		In Use	never				0
mds9222i-2	SME_FOR_9222I_PKG	permanent		Unused	never				0
mds9222i-1	MAINFRAME_PKG	permanent		Unused	never				0
mds9222i-1	ENTERPRISE_PKG	permanent		In Use	never				0
mds9222i-1	SME_FOR_9222I_PKG	permanent		Unused	never				0
mds9222i-2	SAN_EXTN_OVER_IP	permanent counted	1	Unused	never				0
mds9222i-2	SAN_EXTN_OVER_IP_18_4	permanent counted	1	Unused	never				0
mds9222i-2	STORAGE_SERVICES_ENABLER_PKG	permanent counted	1	Unused	never				0
mds9222i-1	SAN_EXTN_OVER_IP	permanent counted	1	Unused	never				0
mds9222i-1	SAN_EXTN_OVER_IP_18_4	permanent counted	1	Unused	never				0
mds9222i-1	STORAGE_SERVICES_ENABLER_PKG	permanent counted	1	Unused	never				0
mds9222i-2	PORT_ACTIVATION_PKG	unlicensed		Unused					0
mds9222i-2	10G_PORT_ACTIVATION_PKG	unlicensed		Unused					0
mds9222i-1	PORT_ACTIVATION_PKG	unlicensed		Unused					0

36 rows, queried 2 switches

Figure 6-18 License features

The list of available license features is shown, as well as the properties for each feature, via the Device Manager option of displaying licenses, as shown in Figure 6-19.



Feature	Installed Type	Installed Count	Status	ExpiryDate	GracePeriod	Missing	Errors	DefaultLicenses
DMM_184_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
DMM_9222i_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
FM_SERVER_PKG	permanent		Unused	never		0		0
MAINFRAME_PKG	permanent		Unused	never		0		0
ENTERPRISE_PKG	permanent		In Use	never		0		0
DMM_FOR_SSM_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP	permanent counted	1	Unused	never		0		0
SME_FOR_9222I_PKG	permanent		Unused	never		0		0
PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
SME_FOR_IPS_184_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_184	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP_18_4	permanent counted	1	Unused	never		0		0
SAN_EXTN_OVER_IP_IPS2	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP_IPS4	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_9222i	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_SSN16	unlicensed inGracePeriod		Unused		120 days	0		0
10G_PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
STORAGE_SERVICES_ENABLER_PKG	permanent counted	1	Unused	never		0		0

18 row(s)

Figure 6-19 Displaying installed licenses

Copying files to the bootflash using the Device Manager

Prior to applying a license file, we upload it to the bootflash. In the window shown in Figure 6-20 select **Admin** → **Flash Files** in the Device Manager to invoke the Flash Files interface.

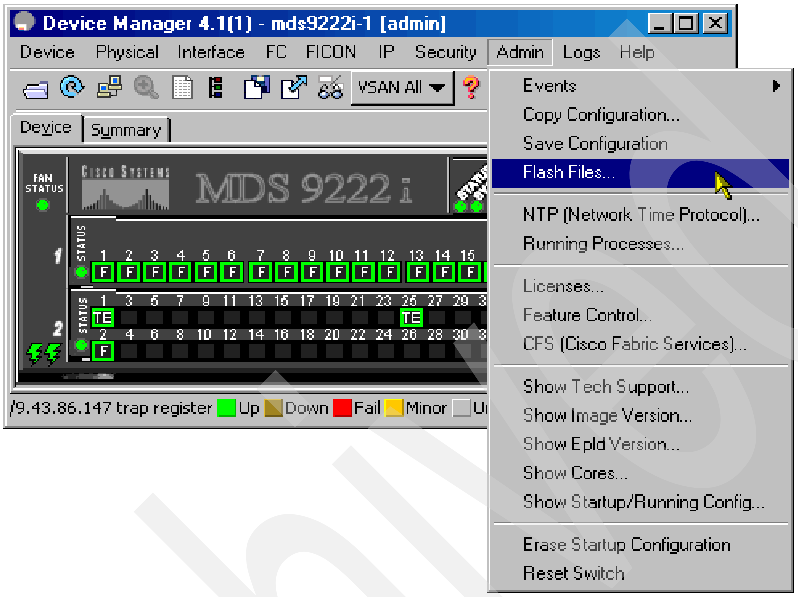
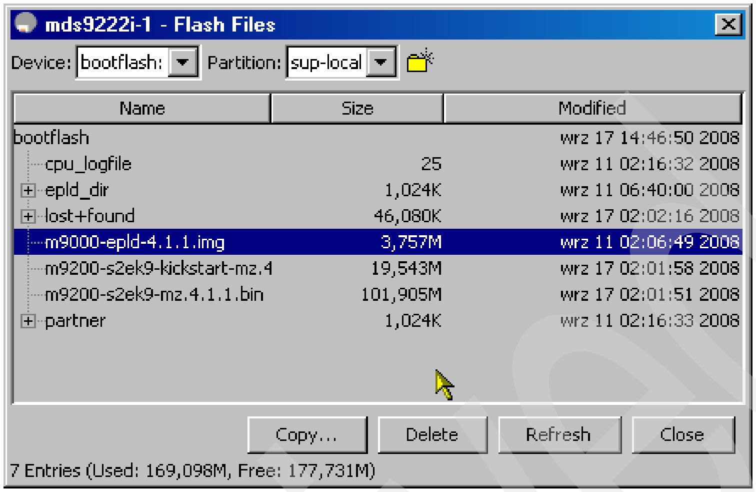


Figure 6-20 Starting the Flash Files interface

The Flash Files interface is initialized as shown in Figure 6-21. Select the **Copy** option.



mds9222i-1 - Flash Files

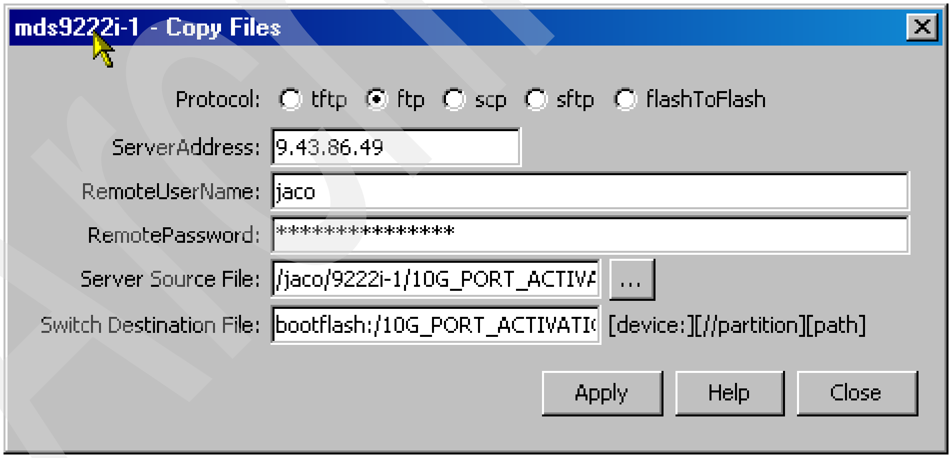
Device: bootflash: Partition: sup-local

Name	Size	Modified
bootflash		wrz 17 14:46:50 2008
cpu_logfile	25	wrz 11 02:16:32 2008
epld_dir	1,024K	wrz 11 06:40:00 2008
lost+found	46,080K	wrz 17 02:02:16 2008
m9000-epld-4.1.1.img	3,757M	wrz 11 02:06:49 2008
m9200-s2ek9-kickstart-mz.4	19,543M	wrz 17 02:01:58 2008
m9200-s2ek9-mz.4.1.1.bin	101,905M	wrz 17 02:01:51 2008
partner	1,024K	wrz 11 02:16:33 2008

7 Entries (Used: 169,098M, Free: 177,731M)

Figure 6-21 Selecting the copy option

When selecting the Copy option, when prompted, define the transfer protocol, server address, login credentials, and the source and target file names, and once done, click **Apply** to start the copy, as in Figure 6-22.



mds9222i-1 - Copy Files

Protocol: ○ tftp ● ftp ○ scp ○ sftp ○ flashToFlash

ServerAddress: 9.43.86.49

RemoteUserName: jaco

RemotePassword: ****************

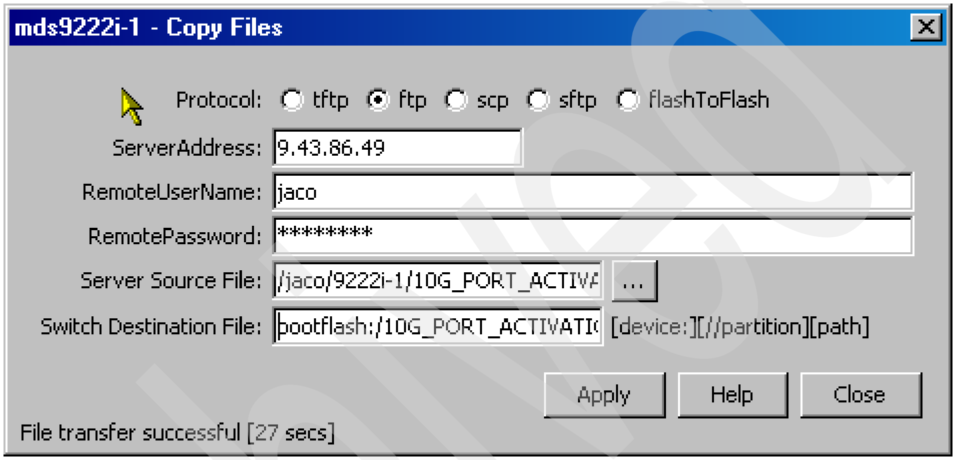
Server Source File: /jaco/9222i-1/10G_PORT_ACTIVA ...

Switch Destination File: bootflash:/10G_PORT_ACTIVATI [device:][/partition][path]

Figure 6-22 Specifying file to copy

Note: During the execution of tasks using Device Manager occasionally prompts to provide CLI login credentials. This is because the Java applet issues the commands towards the SAN-OS/NX-OS using the CLI.

Copy status notification is displayed in the bottom left of the Copy Files window, and upon completion we are notified that the file transfer was successful, as shown in Figure 6-23.



mds9222i-1 - Copy Files

Protocol: ○ tftp ● ftp ○ scp ○ sftp ○ flashToFlash

ServerAddress: 9.43.86.49

RemoteUserName: jaco

RemotePassword: *********

Server Source File: /jaco/9222i-1/10G_PORT_ACTIVA

Switch Destination File: bootflash:/10G_PORT_ACTIVATI [device:][//partition][path]

File transfer successful [27 secs]

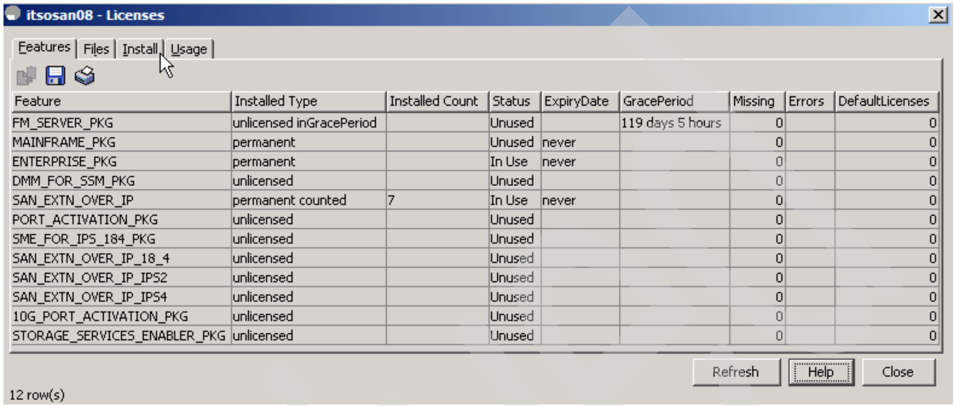
Figure 6-23 File transfer completed successfully

We have now transferred the license file to the bootflash, and we can proceed with installation of the license feature.

Installing a license using the Device Manager

To install:

1. To install a license on the switch, select the **Install** tab, as shown in Figure 6-24.

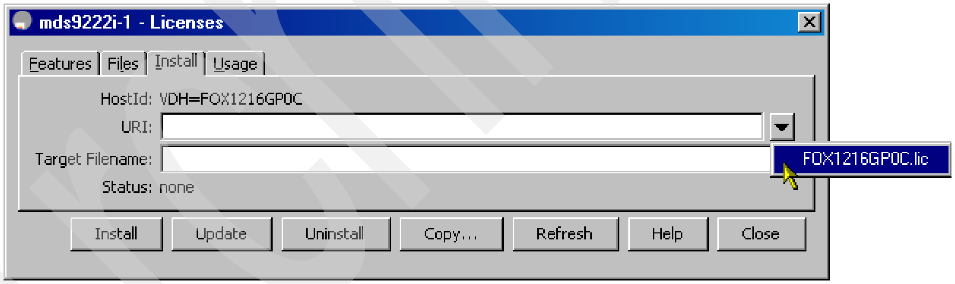


Feature	Installed Type	Installed Count	Status	ExpiryDate	GracePeriod	Missing	Errors	DefaultLicenses
FM_SERVER_PKG	unlicensed inGracePeriod		Unused		119 days 5 hours	0		0
MAINFRAME_PKG	permanent		Unused	never		0		0
ENTERPRISE_PKG	permanent		In Use	never		0		0
DMM_FOR_SSM_PKG	unlicensed		Unused			0		0
SAN_EXTN_OVER_IP	permanent counted	7	In Use	never		0		0
PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
SME_FOR_IPS_184_PKG	unlicensed		Unused			0		0
SAN_EXTN_OVER_IP_18_4	unlicensed		Unused			0		0
SAN_EXTN_OVER_IP_IPS2	unlicensed		Unused			0		0
SAN_EXTN_OVER_IP_IPS4	unlicensed		Unused			0		0
10G_PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
STORAGE_SERVICES_ENABLER_PKG	unlicensed		Unused			0		0

12 row(s)

Figure 6-24 Selecting the Install panel

2. On the **Install** tab, click the pull-down icon to display available license files (in the bootflash), as shown in Figure 6-25.



HostId: VDH=FOX1216GP0C

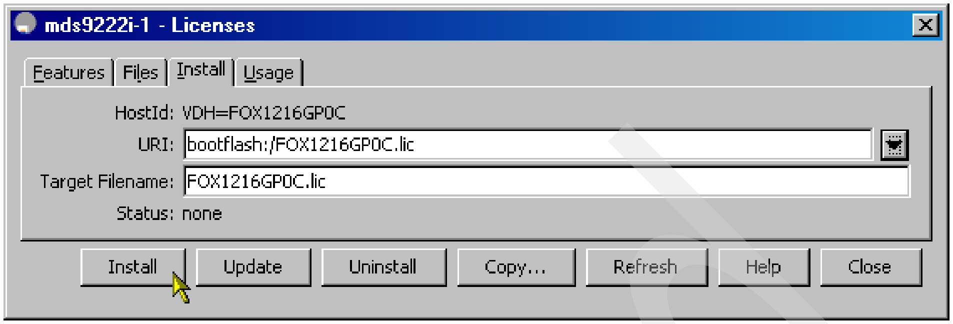
URI:

Target Filename:

Status: none

Figure 6-25 Selecting a license file to install

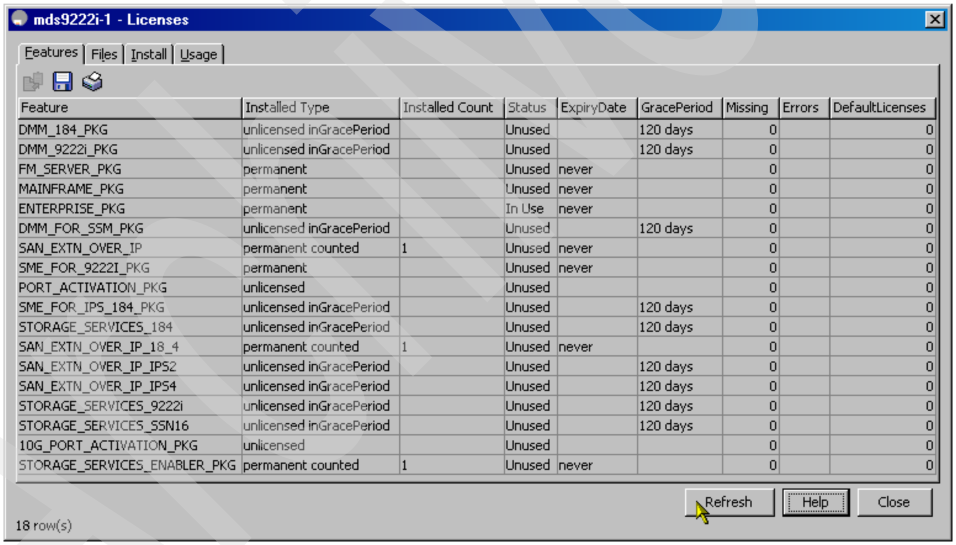
3. Click **Install** to start the license file installation, as shown in Figure 6-26.



HostId: VDH=FOX1216GP0C
URI: bootflash:/FOX1216GP0C.lic
Target Filename: FOX1216GP0C.lic
Status: none

Figure 6-26 Installing the license file

4. Upon completion of the license file installation, click **Refresh** on the Feature tab, and verify that the desired feature has been activated, as shown in Figure 6-27.



Feature	Installed Type	Installed Count	Status	ExpiryDate	GracePeriod	Missing	Errors	DefaultLicenses
DMM_184_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
DMM_9222i_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
FM_SERVER_PKG	permanent		Unused	never		0		0
MAINFRAME_PKG	permanent		Unused	never		0		0
ENTERPRISE_PKG	permanent		In Use	never		0		0
DMM_FOR_SSM_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP	permanent counted	1	Unused	never		0		0
SME_FOR_9222I_PKG	permanent		Unused	never		0		0
PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
SME_FOR_IPS_184_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_184	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP_18_4	permanent counted	1	Unused	never		0		0
SAN_EXTN_OVER_IP_IPS2	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP_IPS4	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_9222i	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_SSN16	unlicensed inGracePeriod		Unused		120 days	0		0
10G_PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
STORAGE_SERVICES_ENABLER_PKG	permanent counted	1	Unused	never		0		0

18 row(s)

Figure 6-27 Verifying the desired feature is activated

Installing a license using the CLI

First we copy the license to the bootflash, as shown in Example 6-12.

Example 6-12 Copy license file to the bootflash and list files on the bootflash

```
mds9222i-2# show license host-id
License hostid: VDH=FOX111504SL
mds9222i-2# copy ftp://9.43.86.49/root/Lic/FOX111504SL.lic bootflash:
```

```
Enter username: root
File transfer in progress, please wait ...
Password:
mds9222i-2# dir bootflash:
       1567     Aug 26 04:26:13 2007  FOX111504SL.lic
       4096     Jan 01 00:04:02 1970  boot/
          6     Jan 01 00:04:02 1970  cfglabel.sysmgr
         25     Aug 18 05:58:30 2007  cpu_logfile
       4096     Aug 18 06:12:44 2007  epld_dir/
      49152     Aug 25 00:27:53 2007  lost+found/
   19542528     Aug 24 07:17:41 2007  m9200-s2ek9-kickstart-mz.4.1.1.bin
  101905006     Aug 24 07:17:33 2007  m9200-s2ek9-mz.4.1.1.bin
       4096     Aug 18 05:58:31 2007  partner/

Usage for bootflash://sup-local
  192811008 bytes used
  538660864 bytes free
  731471872 bytes total
```

Subsequently, install the received license on the switch and then display the installed licenses, as shown in Example 6-13.

Example 6-13 Installing the Fabric Manager Server license

```
mds9222i-2# show license host-id
License hostid: VDH=FOX111504SL
mds9222i-2# show license
mds9222i-2# install license bootflash:FOX111504SL.lic
Installing license .....done
mds9222i-2# show license
FOX111504SL.lic:
SERVER this_host ANY
VENDOR cisco
INCREMENT FM_SERVER_PKG cisco 1.0 permanent uncounted \
        VENDOR_STRING=MDS HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>0</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=F08238B68D9E
INCREMENT MAINFRAME_PKG cisco 1.0 permanent uncounted \
        VENDOR_STRING=MDS HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>1</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=9EADA1E472C6
INCREMENT ENTERPRISE_PKG cisco 1.0 permanent uncounted \
        VENDOR_STRING=MDS HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>2</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=BEE71C380B56
INCREMENT SAN_EXTN_OVER_IP cisco 1.0 permanent 1 VENDOR_STRING=MDS \
        HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>3</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=12060E603650
```

```
INCREMENT SAN_EXTN_OVER_IP_18_4 cisco 1.0 permanent 1 \
        VENDOR_STRING=MDS HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>4</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=C811C45CAC88
INCREMENT STORAGE_SERVICES_ENABLER_PKG cisco 1.0 permanent 1 \
        VENDOR_STRING=MDS HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>5</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=0B949EC6009A
INCREMENT SME_FOR_9222I_PKG cisco 1.0 permanent uncounted \
        VENDOR_STRING=MDS HOSTID=VDH=FOX111504SL \
NOTICE="<LicFileID>FOX111504SL.lic</LicFileID><LicLineID>6</LicLineID> \
        <PAK>dummyPak</PAK>" SIGN=0B47CB66112E

mds9222i-2# show license brief
FOX111504SL.lic
mds9222i-2# show license usage
Feature                      Ins  Lic   Status Expiry Date Comments
                                 Count
-------------------------------------------------------------------------------
DMM_184_PKG                   No    0   Unused             Grace 120D 0H
DMM_9222i_PKG                 No    0   Unused             Grace 120D 0H
FM_SERVER_PKG                 Yes   -   Unused never       -
MAINFRAME_PKG                 Yes   -   Unused never       -
ENTERPRISE_PKG                Yes   -   In use never       -
DMM_FOR_SSM_PKG               No    0   Unused             Grace 120D 0H
SAN_EXTN_OVER_IP              Yes   1   Unused never       -
SME_FOR_9222I_PKG             Yes   -   Unused never       -
PORT_ACTIVATION_PKG           No    0   Unused             -
SME_FOR_IPS_184_PKG           No    0   Unused             Grace 120D 0H
STORAGE_SERVICES_184          No    0   Unused             Grace 120D 0H
SAN_EXTN_OVER_IP_18_4         Yes   1   Unused never       -
SAN_EXTN_OVER_IP_IPS2         No    0   Unused             Grace 120D 0H
SAN_EXTN_OVER_IP_IPS4         No    0   Unused             Grace 120D 0H
STORAGE_SERVICES_9222i        No    0   Unused             Grace 120D 0H
STORAGE_SERVICES_SSN16        No    0   Unused             Grace 120D 0H
10G_PORT_ACTIVATION_PKG       No    0   Unused             -
STORAGE_SERVICES_ENABLER_PKG  Yes   1   Unused never       -
-------------------------------------------------------------------------------
```

6.1.6 Managing users

When accessing Cisco MDS 9000 family switches, you are required to authenticate with a user name and a password, after which access is granted and role-based authorization is applied.

> **Note:** It is possible to disable login authentication, although we do *not* recommend it.

Authentication

User authentication can be configured to be performed locally on the switch (in the lookup database) or remotely using one or more RADIUS, TACACS+ servers, or MDS.

In the following section we authenticate using local authentication. For detailed information about how to set up remote authentication (RADIUS, TACACS+, MDS) consult the MDS config-guide:

`http://www.cisco.com/en/US/products/ps5989/products_installation_and_configuration_guides_list.html`

Authorization

By default the two roles, *network-operator* and *network-admin*, exist in all Cisco MDS 9000 family switches and cannot be changed or deleted, although you can create other roles:

- Network-operator

  Has permission to view the configuration only and cannot make any configuration changes.

- Network-admin

  Has permission to execute all commands and configuration changes. The administrator has the permission to create up to 64 additional roles.

Creating roles

To create a role, we define the name of the role and the profile, which specifies the permissions for the role. In Example 6-14 we create the ITSO_role role and give this administrator access only to VSANs 10 and 20.

Finally, we issue the command **`show role`** to list defined roles.

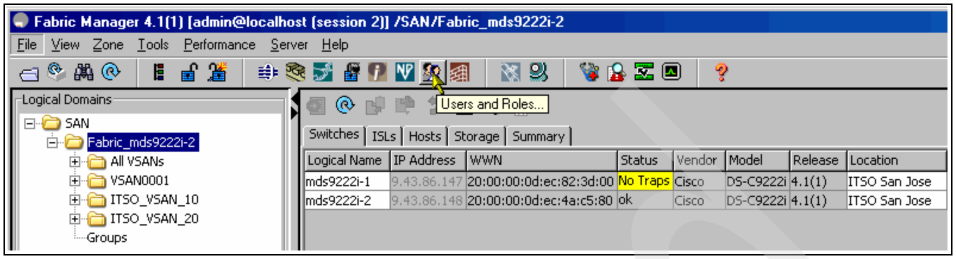
Example 6-14 Creating a VSAN role

```
mds9222i-2# configure terminal
mds9222i-2(config)# role name ITSO_role
mds9222i-2(config-role)# description Admin for VSAN10_VSAN20
mds9222i-2(config-role)# role name ITSO_role
mds9222i-2(config-role)# vsan policy deny
after grace period of approximately 120 day(s).
mds9222i-2(config-role-vsan)# permit vsan 10
```

```
mds9222i-2(config-role-vsan)# permit vsan 20

mds9222i-2# show role

Role: network-admin
Description: Predefined Network Admin group. This role cannot be 
modified
Access to all the switch commands

Role: network-operator
Description: Predefined Network Operator group. This role cannot be 
modified
Access to Show commands and selected Exec commands

Role: server-admin
  Description: Predefined system role for server administrators. 
This role cannot be modified.
  Vsan policy: permit (default)
  -------------------------------------------------
  Rule    Type    Command-type    Feature
  -------------------------------------------------
  1       permit  show            *
  2       permit  exec            install

Role: default-role
  Description: This is a system defined role and applies to all users.
  Vsan policy: permit (default)
  -------------------------------------------------
  Rule    Type    Command-type    Feature
  -------------------------------------------------
  1       permit  show            system
  2       permit  show            snmp
  3       permit  show            module
  4       permit  show            hardware
  5       permit  show            environment

Role: ITSO_role
  Description: Admin for VSAN10_VSAN20
  Vsan policy: deny
  Permitted vsans: 10,20
```

To perform the same configuration using Fabric Manager:

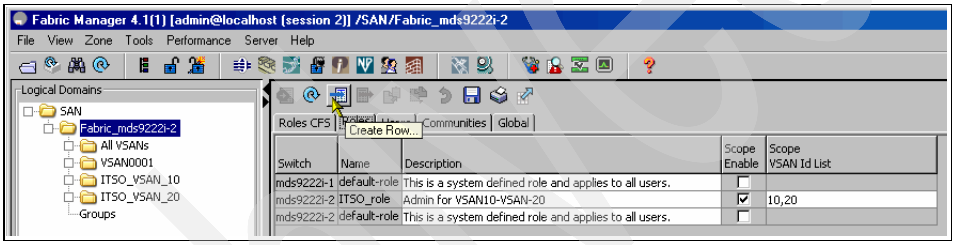
1. Click the users and roles icon, as shown in Figure 6-28.



Logical Name	IP Address	WWN	Status	Vendor	Model	Release	Location
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	ok	Cisco	DS-C9222i	4.1(1)	ITSO San Jose

Figure 6-28 Selecting users and roles

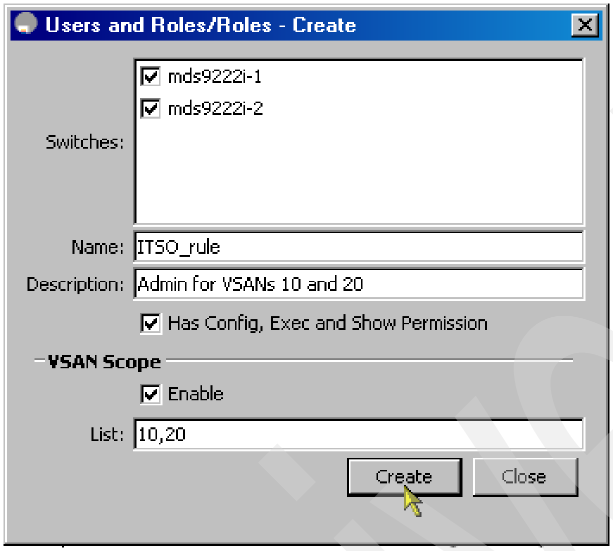
2. Select the **Roles** tab and click the create row icon, as shown in Figure 6-29.



Switch	Name	Description	Scope Enable	Scope VSAN Id List
mds9222i-1	default-role	This is a system defined role and applies to all users.	☐	
mds9222i-2	ITSO_role	Admin for VSAN10-VSAN-20	☑	10,20
mds9222i-2	default-role	This is a system defined role and applies to all users.	☐	

Figure 6-29 Selecting create row in the Fabric Manager

3. In the role creation window, define the name of the role and the VSAN properties, as shown in Figure 6-30, and click **Create**.



Switches: ☑ mds9222i-1 ☑ mds9222i-2

Name: ITSO_rule

Description: Admin for VSANs 10 and 20

☑ Has Config, Exec and Show Permission

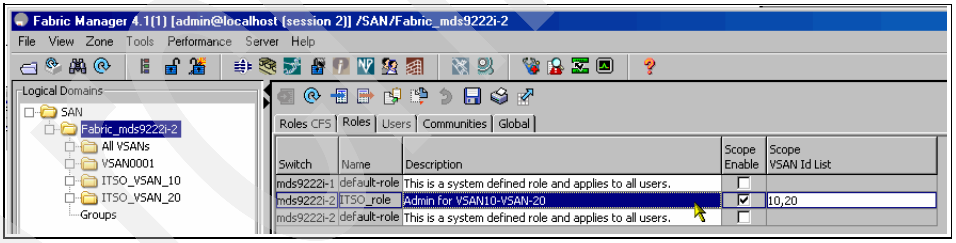
VSAN Scope

☑ Enable

List: 10,20

Figure 6-30 Defining a new role

After closing the role creation window, see that the created role is now listed, as shown in Figure 6-31.



Switch	Name	Description	Scope Enable	Scope VSAN Id List
mds9222i-1	default-role	This is a system defined role and applies to all users.	☐	
mds9222i-2	ITSO_role	Admin for VSAN10-VSAN-20	☑	10,20
mds9222i-2	default-role	This is a system defined role and applies to all users.	☐	

Figure 6-31 Listing the defined roles

Creating users

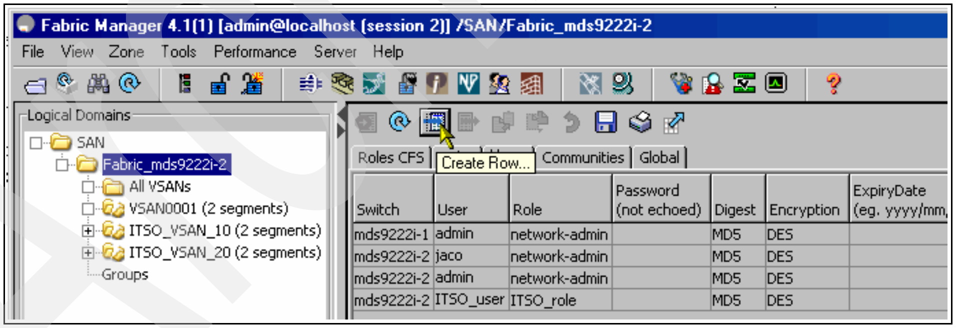
To create a user define the name of the user and the profiles, which specifies the permissions for the user. In Example 6-14 on page 195 the role ITSO_role has been created. Now apply the ITSO_role to the ITSO_user, which only has permissions for VSANs 10 and 20, as shown in Example 6-15.

Example 6-15 Creating a user

```
mds9222i-2# configure terminal
mds9222i-2(config)# username ITSO_user password confidential role ITSO_role

mds9222i-2# show user-account
user:admin
        this user account has no expiry date
        roles:network-admin
user:ITSO_user
        this user account has no expiry date
        roles:ITSO_role
user:jaco
        this user account has no expiry date
        roles:network-admin
```

To create the same user using Fabric Manager:

1. Click the users and roles icon, as shown earlier in Figure 6-28 on page 197.
2. Select the **Users** tab and click the create row icon, as shown in Figure 6-32.

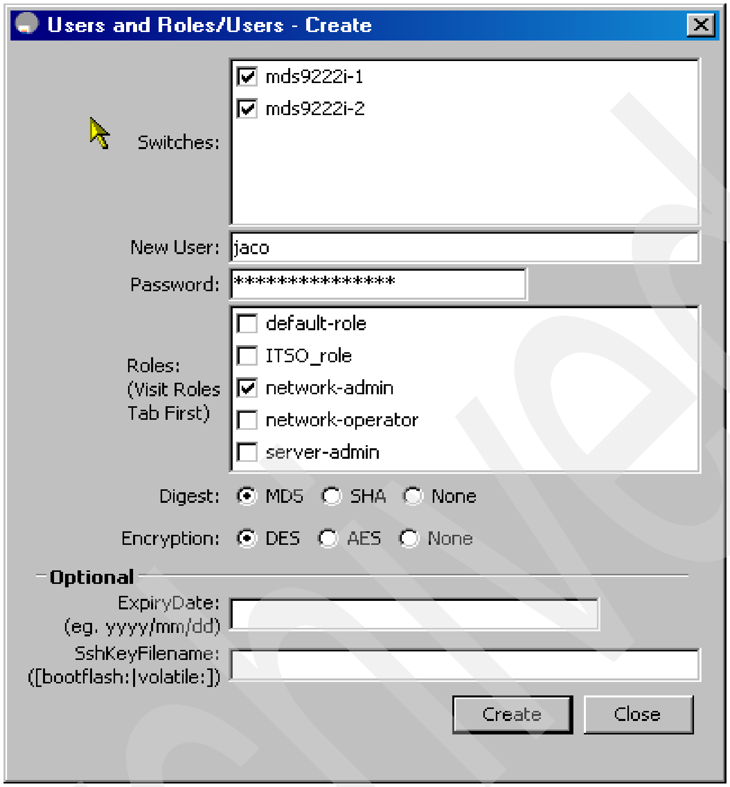


Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2

Switch	User	Role	Password (not echoed)	Digest	Encryption	ExpiryDate (eg. yyyy/mm,
mds9222i-1	admin	network-admin		MD5	DES	
mds9222i-2	jaco	network-admin		MD5	DES	
mds9222i-2	admin	network-admin		MD5	DES	
mds9222i-2	ITSO_user	ITSO_role		MD5	DES	

Figure 6-32 Selecting create row icon

3. In the user creation window define the name of the user and the roles to apply, as shown in Figure 6-33, and click **Create**.



Users and Roles/Users - Create

Switches:
☑ mds9222i-1
☑ mds9222i-2

New User: jaco

Password: ***************

Roles: (Visit Roles Tab First)
□ default-role
□ ITSO_role
☑ network-admin
□ network-operator
□ server-admin

Digest: ● MD5 ○ SHA ○ None

Encryption: ● DES ○ AES ○ None

Optional

ExpiryDate: (eg. yyyy/mm/dd)

SshKeyFilename: ([bootflash:|volatile:])

Figure 6-33 Creating a new user using Fabric Manager

As you can see, we have the option to define an expiry date for the user that we create. To delete a user, we simply delete the row of the user to be deleted.

For further details on user and host creation, consult the MDS Cisco Configuration Guide:

http://www.cisco.com/en/US/products/ps5989/products_installation_and_configuration_guides_list.html

6.1.7 VSAN

A Virtual Storage Area Network (VSAN) is a unique feature of the Cisco MDS 9000 family that enables dividing the physical Fibre Channel fabric into virtual SAN fabrics. Each VSAN is a completely separate SAN fabric, with its own set of domain IDs, fabric services, zones, namespace, and interoperability mode.

Each port in the switch fabric belongs to exactly one of the VSANs at any given time, with the exception of trunking E_Ports (TE_Ports) that can multiplex the traffic of several VSANs over a single physical link.

Up to 256 VSANs can be configured in a single switch. The VSAN numbers can range from 1 to 4094. VSAN number 1 is called the default VSAN and is the VSAN that initially contains all of the ports in the switch. If you do not have to divide the fabric into VSANs, you can leave all ports in the default VSAN.

The VSAN number 4094 is called the isolated VSAN, and any port configured into that VSAN is isolated from all other ports. If you delete a VSAN, all ports in it are moved to the isolated VSAN to avoid implicit transfer of the ports to the default VSAN.

> **Note:** A best practice for a large SAN environment is not to use VSAN1 while disallowing communication between ports that are not defined in a zone (at setup this is defined as default zone policy *deny*) and additionally not define any zones in VSAN1. Doing this prevents any accidental communication of new devices or hosts attached to the fabric since they by default belong to VSAN1.

Creating a VSAN using the CLI

When creating a VSAN, assign a VSAN ID and (optional) name, which must be unique. In Example 6-16 VSAN 20 and VSAN 30 have been created with names ITSO_VSAN_20 and ITSO_VSAN_30, using the default setting for interoperability and load balancing, then suspend it. After creating VSANs, list the defined VSANs.

Example 6-16 Creating a VSAN

```
mds9222i-1(config)# vsan database
mds9222i-1(config-vsan-db)# vsan 20 name ITSO_VSAN_20
mds9222i-1(config-vsan-db)# vsan 30 name ITSO_VSAN_30

mds9222i-1# show vsan
vsan 1 information
         name:VSAN0001  state:active
         interoperability mode:default
         loadbalancing:src-id/dst-id/oxid
         operational state:up

vsan 10 information
         name:ITSO_VSAN_10  state:active
         interoperability mode:default
         loadbalancing:src-id/dst-id/oxid
```

```
        operational state:up

vsan 20 information
        name:ITSO_VSAN_20  state:active
        interoperability mode:default
        loadbalancing:src-id/dst-id/oxid
        operational state:up

vsan 30 information
        name:ITSO_VSAN_30  state:active
        interoperability mode:default
        loadbalancing:src-id/dst-id/oxid
        operational state:up

vsan 4094:isolated_vsan
```

Assigning ports to a VSAN

Now that new VSANs have been created assign membership to the VSANs of ports fc1/5-8,16 to the VSAN 20 and fc1/9-12,17 to the VSAN 30. Afterwards list the VSANs memberships, as shown in Example 6-17.

Example 6-17 Assigning membership to a VSAN

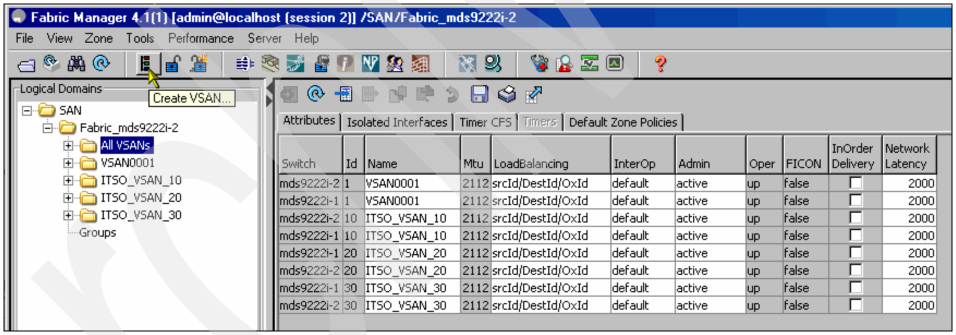
```
mds9222i-1# config terminal
mds9222i-1(config)# vsan database
mds9222i-1(config-vsan-db)# vsan 20 interface fc 1/5-8
mds9222i-1(config-vsan-db)# vsan 20 interface fc 1/16
mds9222i-1(config-vsan-db)# vsan 30 interface fc 1/9-12
mds9222i-1(config-vsan-db)# vsan 30 interface fc 1/17

mds9222i-1# show vsan membership
vsan 1 interfaces:
    fc1/13            fc1/15            fc1/18            fc2/1
    fc2/2             fc2/3             fc2/4             fc2/5
    fc2/6             fc2/7             fc2/8             fc2/9
    fc2/10            fc2/11            fc2/12            fc2/13
    fc2/14            fc2/15            fc2/16            fc2/17
    fc2/18            fc2/19            fc2/20            fc2/21
    fc2/22            fc2/23            fc2/24            fc2/25
    fc2/26            fc2/27            fc2/28            fc2/29
    fc2/30            fc2/31            fc2/32            fc2/33
    fc2/34            fc2/35            fc2/36            fc2/37
    fc2/38            fc2/39            fc2/40            fc2/41
    fc2/42            fc2/43            fc2/44            fc2/45
    fc2/46            fc2/47            fc2/48            port-channel 1

vsan 10 interfaces:
    fc1/1              fc1/2              fc1/3              fc1/4
    fc1/14

vsan 20 interfaces:
    fc1/5              fc1/6              fc1/7              fc1/8
    fc1/16

vsan 30 interfaces:
    fc1/9              fc1/10             fc1/11             fc1/12
    fc1/17

vsan 4094(isolated_vsan) interfaces:
```

Note: When assigning port membership to a VSAN, the port is removed from its previous membership, since a port can only be part of one VSAN at a time.

Creating a VSAN using the GUI

Perform the same task using the Fabric Manager interface:

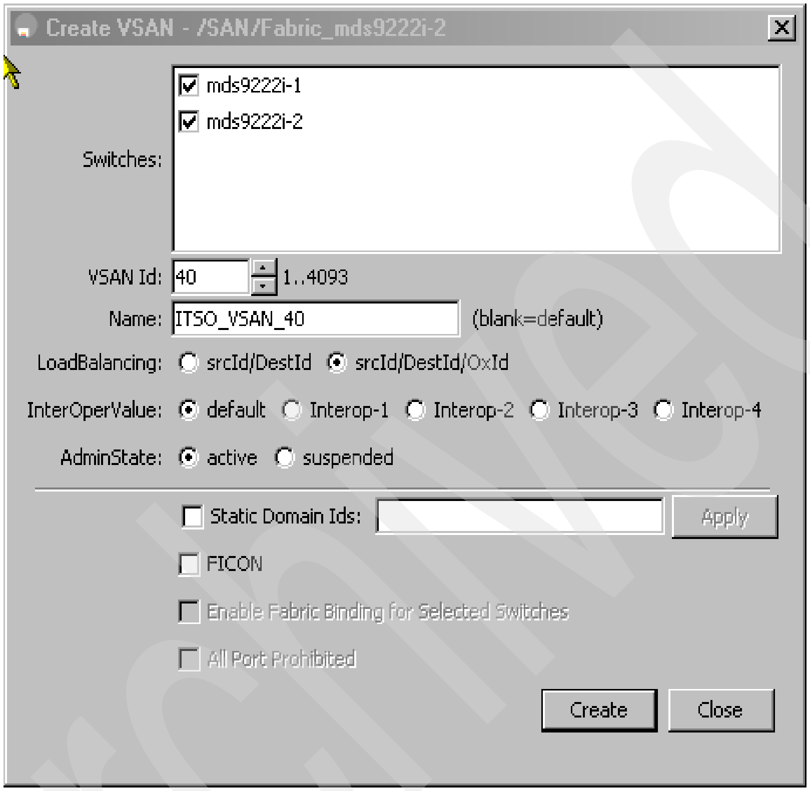
1. Click the create VSAN icon, as shown in Figure 6-34.



Switch	Id	Name	Mtu	LoadBalancing	InterOp	Admin	Oper	FICON	InOrder Delivery	Network Latency
mds9222i-2	1	VSAN0001	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-1	1	VSAN0001	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-2	10	ITSO_VSAN_10	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-1	10	ITSO_VSAN_10	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-1	20	ITSO_VSAN_20	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-2	20	ITSO_VSAN_20	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-1	30	ITSO_VSAN_30	2112	srcId/DestId/OxId	default	active	up	false	□	2000
mds9222i-2	30	ITSO_VSAN_30	2112	srcId/DestId/OxId	default	active	up	false	□	2000

Figure 6-34 Creating a VSAN from a GUI

2. In the Create VSAN window specify the VSAN ID name, load balancing and interop properties, and whether the VSAN should be active or suspended. To enforce static domain IDs, check the **Static Domain Ids** box, as shown in Figure 6-35.



Create VSAN - /SAN/Fabric_mds9222i-2

Switches: ☑ mds9222i-1 ☑ mds9222i-2

VSAN Id: 40 1..4093

Name: ITSO_VSAN_40 (blank=default)

LoadBalancing: ○ srcId/DestId ● srcId/DestId/OxId

InterOperValue: ● default ○ Interop-1 ○ Interop-2 ○ Interop-3 ○ Interop-4

AdminState: ● active ○ suspended

☐ Static Domain Ids:

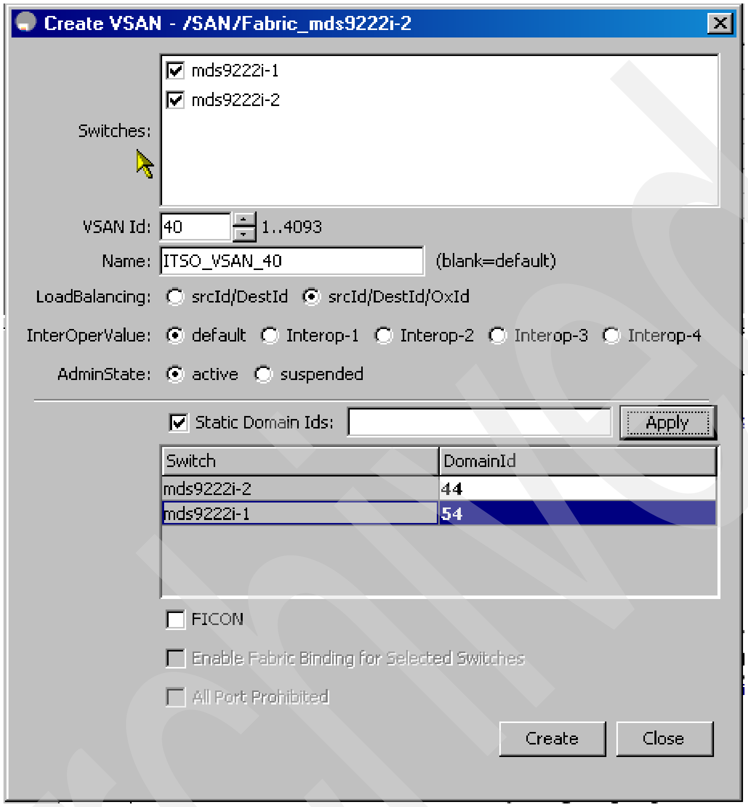
☐ FICON

☐ Enable Fabric Binding for Selected Switches

☐ All Port Prohibited

Figure 6-35 Assigning VSAN ID and name

3. If necessary, use static domain IDs, so check this box and click **Apply** to get a static domain ID assigned on the switch, as shown in Figure 6-36. Then click **Create** to create the VSAN.



Create VSAN - /SAN/Fabric_mds9222i-2

Switches: ☑ mds9222i-1 ☑ mds9222i-2

VSAN Id: 40 1..4093

Name: ITSO_VSAN_40 (blank=default)

LoadBalancing: ○ srcId/DestId ● srcId/DestId/OxId

InterOperValue: ● default ○ Interop-1 ○ Interop-2 ○ Interop-3 ○ Interop-4

AdminState: ● active ○ suspended

☑ Static Domain Ids: Apply

Switch	DomainId
mds9222i-2	44
mds9222i-1	54

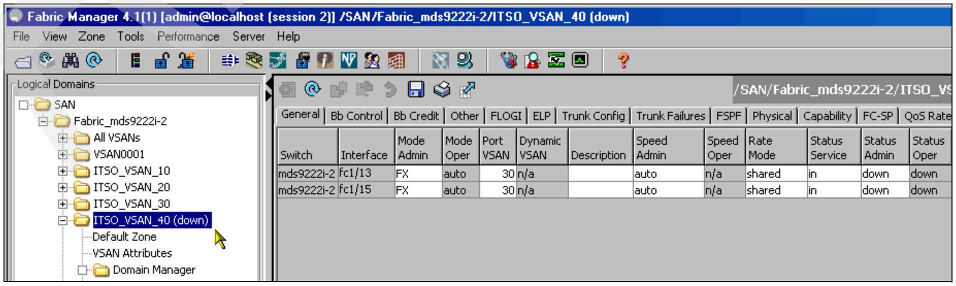
□ FICON

□ Enable Fabric Binding for Selected Switches

□ All Port Prohibited

Figure 6-36 Applying static domains

The VSAN has now been created and appears in Fabric Manager. As shown in Figure 6-37, the VSAN is down, since we have not yet assigned any ports to the VSAN. Thus, there are no active ports in the VSAN.



Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2/ITSO_VSAN_40 (down)

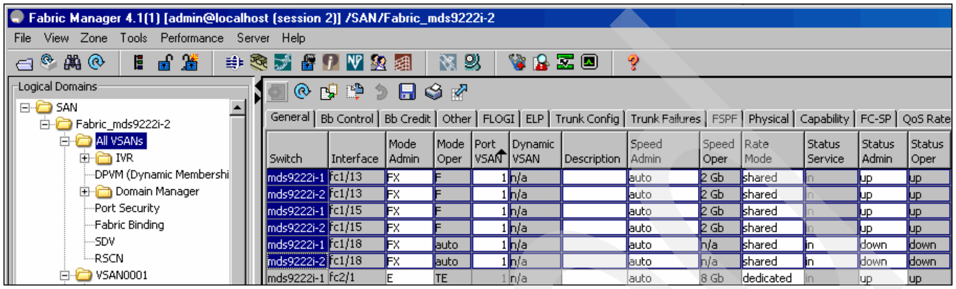
Switch	Interface	Mode Admin	Mode Oper	Port VSAN	Dynamic VSAN	Description	Speed Admin	Speed Oper	Rate Mode	Status Service	Status Admin	Status Oper
mds9222i-2	fc1/13	FX	auto	30	n/a		auto	n/a	shared	in	down	down
mds9222i-2	fc1/15	FX	auto	30	n/a		auto	n/a	shared	in	down	down

Figure 6-37 VSAN created: VSAN is down while empty

Assigning ports to a VSAN

Since a host and device are already connected to the switch:

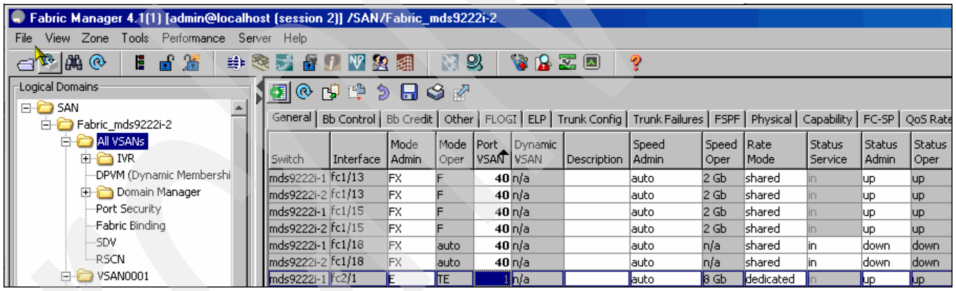
1. Highlight **FC Interfaces** in VSAN001 to list the ports that are required to assign to the created VSAN, as shown in Figure 6-38.



Switch	Interface	Mode Admin	Mode Oper	Port VSAN	Dynamic VSAN	Description	Speed Admin	Speed Oper	Rate Mode	Status Service	Status Admin	Status Oper
mds9222i-1	fc1/13	FX	F	1	n/a		auto	2 Gb	shared	in	up	up
mds9222i-2	fc1/13	FX	F	1	n/a		auto	2 Gb	shared	in	up	up
mds9222i-1	fc1/15	FX	F	1	n/a		auto	2 Gb	shared	in	up	up
mds9222i-2	fc1/15	FX	F	1	n/a		auto	2 Gb	shared	in	up	up
mds9222i-1	fc1/18	FX	auto	1	n/a		auto	n/a	shared	in	down	down
mds9222i-2	fc1/18	FX	auto	1	n/a		auto	n/a	shared	in	down	down
mds9222i-1	fc2/1	E	TE	1	n/a		auto	8 Gb	dedicated	in	up	up

Figure 6-38 Listing devices in VSAN1

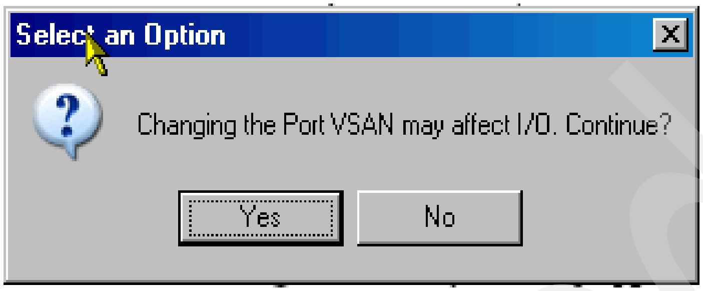
2. Double-click the Port VSAN cell and change the VSAN ID to the VSAN ID of the VSAN that is required to assign the port to, and subsequently click the **apply changes ic**on to save the changes, as shown in Figure 6-39.



Switch	Interface	Mode Admin	Mode Oper	Port VSAN	Dynamic VSAN	Description	Speed Admin	Speed Oper	Rate Mode	Status Service	Status Admin	Status Oper
mds9222i-1	fc1/13	FX	F	40	n/a		auto	2 Gb	shared	in	up	up
mds9222i-2	fc1/13	FX	F	40	n/a		auto	2 Gb	shared	in	up	up
mds9222i-1	fc1/15	FX	F	40	n/a		auto	2 Gb	shared	in	up	up
mds9222i-2	fc1/15	FX	F	40	n/a		auto	2 Gb	shared	in	up	up
mds9222i-1	fc1/18	FX	auto	40	n/a		auto	n/a	shared	in	down	down
mds9222i-2	fc1/18	FX	auto	40	n/a		auto	n/a	shared	in	down	down
mds9222i-1	fc2/1	E	TE	1	n/a		auto	8 Gb	dedicated	in	up	up

Figure 6-39 Changing the VSAN ID for a port to assign it to the VSAN

3. We are presented with a warning that changing the Port VSAN might be disruptive to I/O on the port, and we confirm that we want to perform the change, as shown in Figure 6-40.

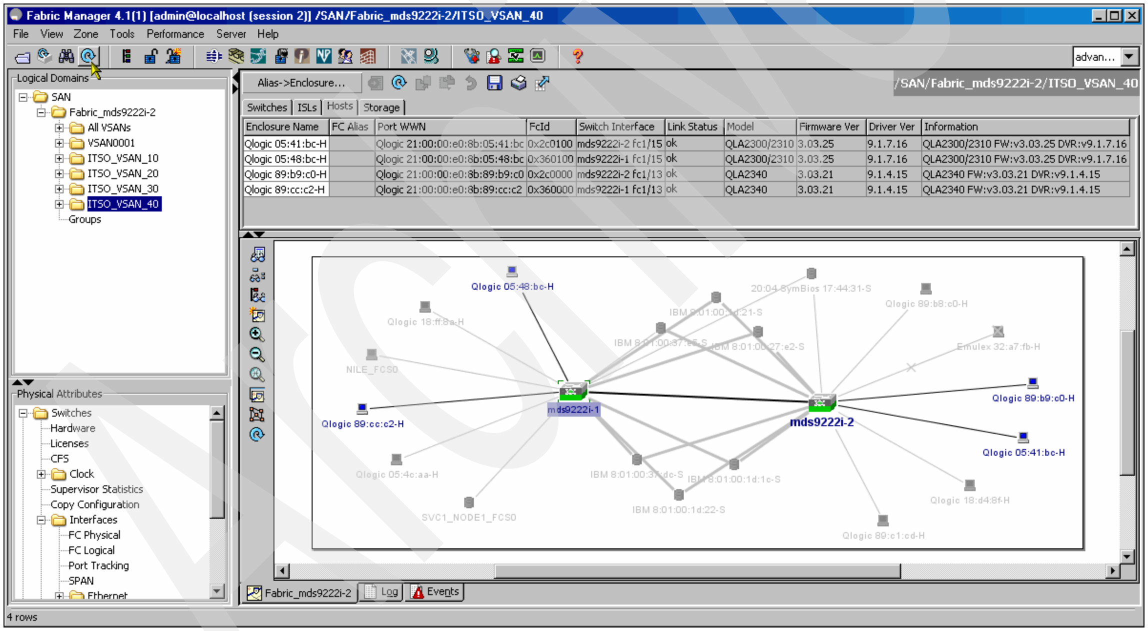


Select an Option

Changing the Port VSAN may affect I/O. Continue?

Figure 6-40 Confirm to change the Port VSAN

4. When this is completed, list the ports in our VSAN, as shown in Figure 6-41, and the VSAN is now up, since active ports are present in the VSAN.



Fabric Manager 4.1(1) [admin@localhost [session 2]] /SAN/Fabric_mds9222i-2/ITSO_VSAN_40

/SAN/Fabric_mds9222i-2/ITSO_VSAN_40

Enclosure Name	FC Alias	Port WWN	FcId	Switch Interface	Link Status	Model	Firmware Ver	Driver Ver	Information
Qlogic 05:41:bc-H		Qlogic 21:00:00:e0:8b:05:41:bc	0x2c0100	mds9222i-2 fc1/15	ok	QLA2300/2310	3.03.25	9.1.7.16	QLA2300/2310 FW:v3.03.25 DVR:v9.1.7.16
Qlogic 05:48:bc-H		Qlogic 21:00:00:e0:8b:05:48:bc	0x360100	mds9222i-1 fc1/15	ok	QLA2300/2310	3.03.25	9.1.7.16	QLA2300/2310 FW:v3.03.25 DVR:v9.1.7.16
Qlogic 89:b9:c0-H		Qlogic 21:00:00:e0:8b:89:b9:c0	0x2c0000	mds9222i-2 fc1/13	ok	QLA2340	3.03.21	9.1.4.15	QLA2340 FW:v3.03.21 DVR:v9.1.4.15
Qlogic 89:cc:c2-H		Qlogic 21:00:00:e0:8b:89:cc:c2	0x360000	mds9222i-1 fc1/13	ok	QLA2340	3.03.21	9.1.4.15	QLA2340 FW:v3.03.21 DVR:v9.1.4.15

4 rows

Figure 6-41 Listing ports in the our new VSAN

Dynamic VSANs

Port VSAN membership on the switch is assigned on a port-by-port basis. By default each port belongs to the default VSAN.

You can dynamically assign VSAN membership to ports by assigning VSANs based on the device WWN. This method is referred to as the Dynamic Port VSAN Membership (DPVM) feature. DPVM offers flexibility and eliminates the necessity to reconfigure the VSAN to maintain fabric topology when a host or storage device connection is moved between two Cisco MDS switches. It retains the configured VSAN regardless of where a device is connected or moved.

About DPVM

DPVM configurations are based on port world wide name (pWWN) and node world wide name (nWWN) assignments. A DPVM database contains mapping information for each device pWWN/nWWN assignment and the corresponding VSAN. The Cisco SAN-OS and NX-OS software checks the database during a device FLOGI and obtains the required VSAN details.

The pWWN identifies the host or device and the nWWN identifies a node consisting of multiple devices. You can assign any one of these identifiers or any combination of these identifiers to configure DPVM mapping. If you assign a combination, then preference is given to the pWWN. DPVM uses the Cisco Fabric Services (CFS) infrastructure to allow efficient database management and distribution. DPVM uses the application-driven, coordinated distribution mode and the fabric-wide distribution scope.

DPVM requirements

To use the DPVM feature as designed, be sure to verify the following requirements:

- The interface through which the dynamic device connects to the Cisco MDS 9000 family switch must be configured as an F port.
- The static port VSAN of the F port should be valid (not isolated, not suspended, and in existence).
- The dynamic VSAN configured for the device in the DPVM database should be valid (not isolated, not suspended, and in existence).

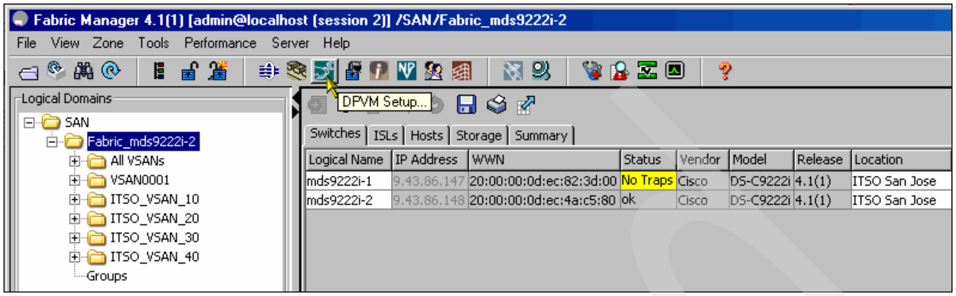
> **Note:** The DPVM feature overrides any existing static port VSAN membership configuration. If the VSAN corresponding to the dynamic port is deleted or suspended, the port is shut down.

Enabling DPVM

To begin configuring the DPVM feature, you must explicitly enable DPVM on the required switches in the fabric. By default, this feature is disabled in all switches in the Cisco MDS 9000 family. The configuration and verification commands for the DPVM feature are only available when DPVM is enabled on a switch. When you disable this feature, all related configurations are automatically discarded.

To use DPVM using the GUI:

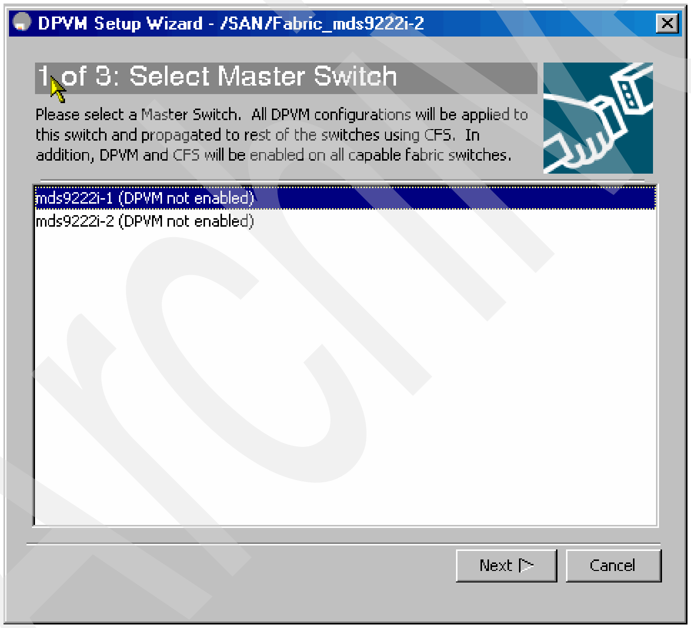
1. Click the DPVM icon, as shown in Figure 6-42.



Logical Name	IP Address	WWN	Status	Vendor	Model	Release	Location
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	ok	Cisco	DS-C9222i	4.1(1)	ITSO San Jose

Figure 6-42 Launching the DPVM wizard

2. Select the switch that is required to be the master DPVM switch and click **Next**, as shown in Figure 6-43.

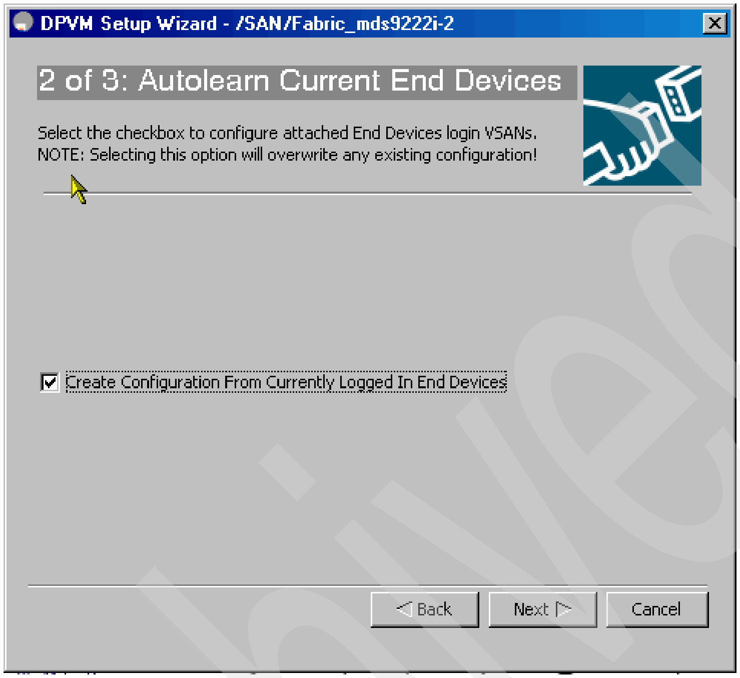

DPVM Setup Wizard - /SAN/Fabric_mds9222i-2
1 of 3: Select Master Switch

Please select a Master Switch. All DPVM configurations will be applied to this switch and propagated to rest of the switches using CFS. In addition, DPVM and CFS will be enabled on all capable fabric switches.

mds9222i-1 (DPVM not enabled)
mds9222i-2 (DPVM not enabled)

Figure 6-43 Selecting the master switch for DPVM

3. Select to create the configuration from already logged-in devices, as shown in Figure 6-44.



DPVM Setup Wizard - /SAN/Fabric_mds9222i-2

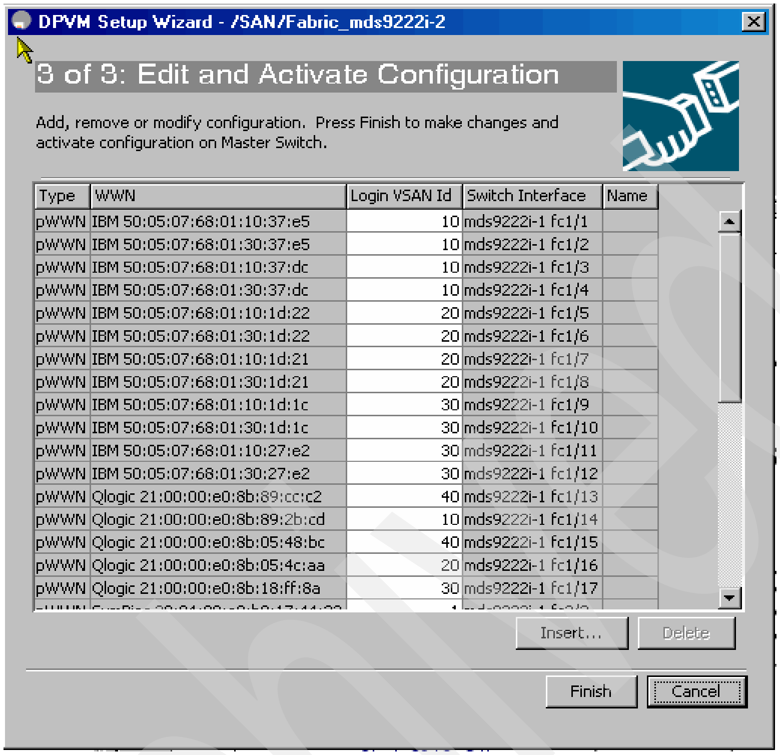
2 of 3: Autolearn Current End Devices

Select the checkbox to configure attached End Devices login VSANs.
NOTE: Selecting this option will overwrite any existing configuration!

☑ Create Configuration From Currently Logged In End Devices

Figure 6-44 Creating configuration from end devices currently logged in

4. As shown in Figure 6-45, click **Finish** to activate the configuration.



3 of 3: Edit and Activate Configuration

Add, remove or modify configuration. Press Finish to make changes and activate configuration on Master Switch.

Type	WWN	Login VSAN Id	Switch Interface	Name
pWWN	IBM 50:05:07:68:01:10:37:e5	10	mds9222i-1 fc1/1	
pWWN	IBM 50:05:07:68:01:30:37:e5	10	mds9222i-1 fc1/2	
pWWN	IBM 50:05:07:68:01:10:37:dc	10	mds9222i-1 fc1/3	
pWWN	IBM 50:05:07:68:01:30:37:dc	10	mds9222i-1 fc1/4	
pWWN	IBM 50:05:07:68:01:10:1d:22	20	mds9222i-1 fc1/5	
pWWN	IBM 50:05:07:68:01:30:1d:22	20	mds9222i-1 fc1/6	
pWWN	IBM 50:05:07:68:01:10:1d:21	20	mds9222i-1 fc1/7	
pWWN	IBM 50:05:07:68:01:30:1d:21	20	mds9222i-1 fc1/8	
pWWN	IBM 50:05:07:68:01:10:1d:1c	30	mds9222i-1 fc1/9	
pWWN	IBM 50:05:07:68:01:30:1d:1c	30	mds9222i-1 fc1/10	
pWWN	IBM 50:05:07:68:01:10:27:e2	30	mds9222i-1 fc1/11	
pWWN	IBM 50:05:07:68:01:30:27:e2	30	mds9222i-1 fc1/12	
pWWN	Qlogic 21:00:00:e0:8b:89:cc:c2	40	mds9222i-1 fc1/13	
pWWN	Qlogic 21:00:00:e0:8b:89:2b:cd	10	mds9222i-1 fc1/14	
pWWN	Qlogic 21:00:00:e0:8b:05:48:bc	40	mds9222i-1 fc1/15	
pWWN	Qlogic 21:00:00:e0:8b:05:4c:aa	20	mds9222i-1 fc1/16	
pWWN	Qlogic 21:00:00:e0:8b:18:ff:8a	30	mds9222i-1 fc1/17	

Figure 6-45 Edit and activate configuration

6.1.8 Zoning

The Cisco MDS 9000 family zoning can be administrated from any switch in the fabric, and all changes are automatically distributed to all of the switches.

The Cisco MDS 9000 family supports zoning by the following criteria:

- World Wide Port Name (WWPN): The WWN of the Nx_Port (device) attached to the switch.
- Fabric Port WWN (fWWN): The WWN of the fabric port (port-based zoning).
- FCID: The FCID of the N_Port attached to the switch.
- FC alias: The alias used.
- Domain ID: Where the domain ID is the domain ID of a switch.

- IP address: Where the IP address of the devices is entered as a 32-byte dotted decimal optionally specifying a subnet mask that includes all addresses in the specified subnet.
- Interface: Switch interface zoning is similar to port zoning and can be defined as a zone member on both a local and a remote switch. This type of zoning is for iSCSI initiators.

To make zone management easier, the Cisco MDS 9000 family supports alias names for practically all of the elements above.

The Cisco MDS 9000 family supports a default zone. All ports and WWNs not assigned to any zone belong to the default zone. If zoning is not activated, all devices belong to the default zone. You can control access between default zone members by default zone policy. This is both a per-switch (defined at setup) and a per-VSAN setting. The default is deny, but can be changed using the config command **zone default-zone permit**. In Example 6-18 we set the default zone policy to permit for VSAN20.

Example 6-18 Setting the default zone policy for a VSAN

```
mds9222i-1# configure terminal
mds9222i-1(config)# zone default-zone permit vsan 20
```

The Cisco MDS 9000 family supports both soft and hard zoning. The difference between soft and hard zone enforcement is described below.

Soft zoning

In soft zoning, zoning restrictions are applied during the interaction between the name server and the end device.

Hard zoning

In hard zoning, the zoning is enforced for each frame sent by an Nx_Port as the frame enters the switch. This prevents any unauthorized access at all times. The enforcement is done by the switch hardware at wire speed.

6.1.9 Zoning using the CLI

When creating zoning, we recommend that you use aliases, since this eases administration and troubleshooting, especially when your SAN environment increases in size.

Alias

Alias members can be assigned to an alias based on FC ID, fabric port WWN, or WWPN.

Next we list the entries in the name server and create the aliases SVC2_NODE1_FCS0 and PALAU_FCS0, assigning the FC IDs of the ports the hosts are attached to, as shown in Example 6-19.

Example 6-19 Creating an alias and assigning a member based on FC ID

```
mds9222i-1# show fcns database vsan 20

VSAN 20:
--------------------------------------------------------------------------
FCID        TYPE  PWWN                    (VENDOR)        FC4-TYPE:FEATURE
--------------------------------------------------------------------------
0x9c0001    N     50:05:07:68:01:30:1d:21 (IBM)           scsi-fcp:target
0x9c0003    N     50:05:07:68:01:30:1d:22 (IBM)           scsi-fcp:target
0x9c0004    N     50:05:07:68:01:10:1d:22 (IBM)           scsi-fcp:target
0x9c000e    N     50:05:07:68:01:10:1d:21 (IBM)           scsi-fcp:target
0x9c0100    N     21:00:00:e0:8b:05:4c:aa (Qlogic)        scsi-fcp:init

Total number of entries = 5
mds9222i-1# configure terminal
mds9222i-1(config)# fcalias name SVN2_NODE1_FCS0 vsan 20
mds9222i-1(config-fcalias)# member fcid 0x9c0004
mds9222i-1(config-fcalias)# exit
mds9222i-1(config)# fcalias name PALAU_FCS0 vsan 20
mds9222i-1(config-fcalias)# member fcid 0x9c0100
mds9222i-1(config-fcalias)# end
mds9222i-1# show fcalias vsan 20
fcalias name PALAU_FCS0 vsan 20
  fcid 0x9c0100

fcalias name SVN2_NODE1_FCS0 vsan 20
  fcid 0x9c0004
```

Zones

When creating a zone, we recommend zones based on aliases, and in the following coding, we create a zone called SVC2_NODE1_FCS0_PALAU_FCS0 for PALAU to access SVC2_NODE1_FCS0. As shown in Example 6-20, we create the zone and subsequently list defined zones.

Example 6-20 Creating a zone

```
mds9222i-1# configure terminal
mds9222i-1(config)# zone name SVC2_NODE1_FCS0_PALAU_FCS0 vsan 20
mds9222i-1(config-zone)# member fcalias PALAU_FCS0
mds9222i-1(config-zone)# member fcalias SVN2_NODE1_FCS0
mds9222i-1(config-zone)# end
mds9222i-1# show zone vsan 20
zone name SVC2_NODE1_FCS0_PALAU_FCS0 vsan 20
```

```
  fcalias name SVN2_NODE1_FCS0 vsan 20
    fcid 0x9c0004

  fcalias name PALAU_FCS0 vsan 20
    fcid 0x9c0100
```

For the zone to become active, we must then assign the zone to a zoneset and activate the zoneset.

Zoneset

Whereas a zone is used to specify access control, confining the specified members in a zone, zonesets are used to group zones and to enforce the access control defined by each zone when the zoneset is activated.

To create a zoneset specify the name, VSAN, and members of the zoneset. In Example 6-21 we create the zoneset ZonesetActive2 and add the zone SVC2_NODE1_FCS0_PALAU_FCS0, and subsequently list the zoneset.

Example 6-21 Creating a zoneset

```
sc9222i-1# sho zoneset
Zoneset not present

mds9222i-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-1(config-zoneset)# member SVC2_NODE1_FCS0_PALAU_FCS0
mds9222i-1(config-zoneset)# end
zoneset name ZonesetActive2 vsan 20
  zone name SVC2_NODE1_FCS0_PALAU_FCS0 vsan 20
    fcalias name SVN2_NODE1_FCS0 vsan 20
      fcid 0x9c0004

    fcalias name PALAU_FCS0 vsan 20
      fcid 0x9c0100
```

Before a zoneset is enforced, it must be activated. To activate a zoneset specify a zoneset and a VSAN. In Example 6-22 we first list active zonesets, then we activate the zoneset ZonesetActive2 in VSAN20, and subsequently list active zonesets.

Example 6-22 Activating a zoneset

```
sc9222i-1# sho zoneset active
Zoneset not present

mds9222i-1# configure terminal
mds9222i-1(config)# zoneset activate name ZonesetActive2 vsan 20
```

```
Zoneset activation initiated. check zone status
mds9222i-1(config)# end
mds9222i-1# show zoneset active vsan 20

zoneset name ZonesetActive2 vsan 20
  zone name SVC2_NODE1_FCS0_PALAU_FCS0 vsan 20
  * fcid 0x9c0004
  * fcid 0x9c0100
```

When working with zonesets, it is crucial to understand that while you can create multiple zonesets (and zones can be members of multiple zonesets), only *one* zoneset can be active at any given time (for each VSAN).

When creating a zoneset, the zoneset becomes part of the full zoneset, and when activating a zoneset, a copy of the zoneset from the full zoneset is activated and the member zones become active.

Although the active zoneset cannot be modified, we can modify the full zoneset, and even a zoneset with the same name. However, modifications only take effect when reactivated.

While the zoneset is active, it is automatically stored in the persistent configuration. It is not necessary to copy the running-config to the startup-config, though changes to inactive zonesets are not automatically saved to the startup-config unless you perform this by issuing the **`copy running-config startup config`** command.

6.1.10 Zoning using the GUI

When creating zoning, we recommend that you use aliases, since this eases administration and troubleshooting, especially when your SAN environment increases in size.

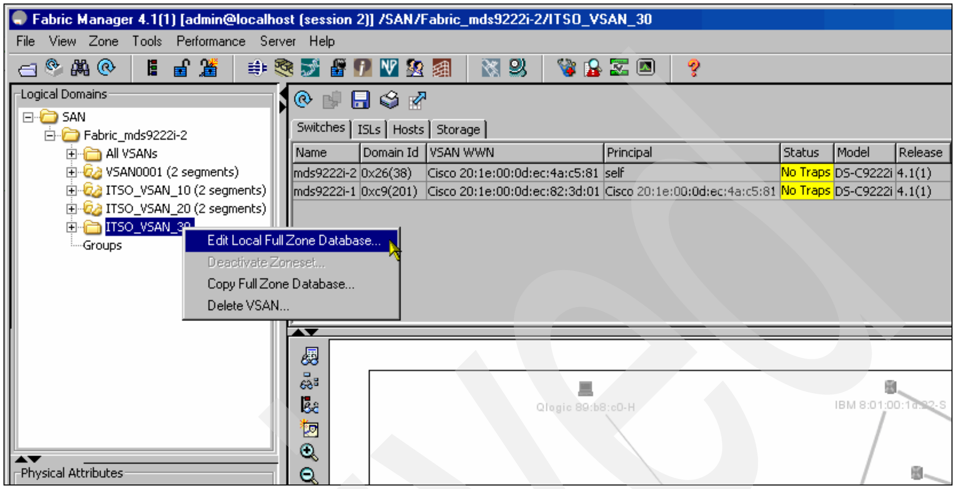
> **Note:** In the following sections we go through the examples mainly by right-clicking the objects that we want to alter. When you become more familiar with the GUI, you will see that there are multiple ways to perform the same task, and that drag-and-drop is also available for many tasks.

Alias

Alias members can be assigned to an alias based on FC ID, fabric port WWN, or WWPN.

In the following example we create two aliases, SVC3_NODE1_FCS0 and SIAM_FCS0, and assign the WWPNs of the SVC and a host adapter.

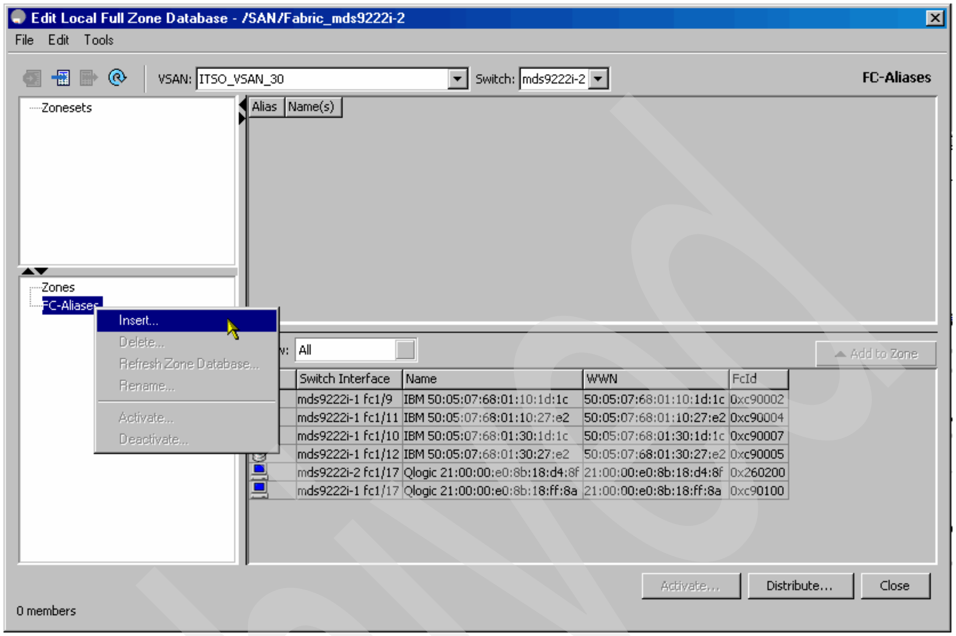
1. As shown in Figure 6-46, right-click the VSAN to select to edit the full zoneset.


Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2/ITSO_VSAN_30
File View Zone Tools Performance Server Help
Logical Domains
SAN
Fabric_mds9222i-2
All VSANs
VSAN0001 (2 segments)
ITSO_VSAN_10 (2 segments)
ITSO_VSAN_20 (2 segments)
ITSO_VSAN_30
Groups
Edit Local Full Zone Database...
Deactivate Zoneset...
Copy Full Zone Database...
Delete VSAN...
Switches
ISLs
Hosts
Storage
Qlogic 89:b8:c0-H
IBM 8:01:00:1d:32:S
Physical Attributes

Name	Domain Id	VSAN WWN	Principal	Status	Model	Release
mds9222i-2	0x26(38)	Cisco 20:1e:00:0d:ec:4a:c5:81	self	No Traps	DS-C9222i	4.1(1)
mds9222i-1	0xc9(201)	Cisco 20:1e:00:0d:ec:82:3d:01	Cisco 20:1e:00:0d:ec:4a:c5:81	No Traps	DS-C9222i	4.1(1)

Figure 6-46 Edit full zone database for VSAN 30

2. In the edit full zoneset database right-click **Aliases** to insert a new alias, as shown in Figure 6-47.



VSAN: ITSO_VSAN_30 Switch: mds9222i-2

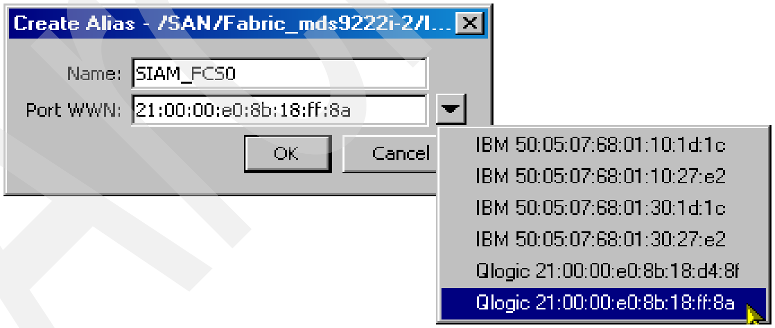
Show: All

Switch Interface	Name	WWN	FcId
mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
mds9222i-1 fc1/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
mds9222i-1 fc1/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
mds9222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
mds9222i-1 fc1/17	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0xc90100

0 members

Figure 6-47 Inserting a new alias

3. In the Create Alias window, name the alias and assign the WWPN (selected from the drop-down menu) and click **OK**, as shown in Figure 6-48.


Create Alias - /SAN/Fabric_mds9222i-2/I...
OK
Cancel
IBM 50:05:07:68:01:10:1d:1c
IBM 50:05:07:68:01:10:27:e2
IBM 50:05:07:68:01:30:1d:1c
IBM 50:05:07:68:01:30:27:e2
Qlogic 21:00:00:e0:8b:18:d4:8f
Qlogic 21:00:00:e0:8b:18:ff:8a

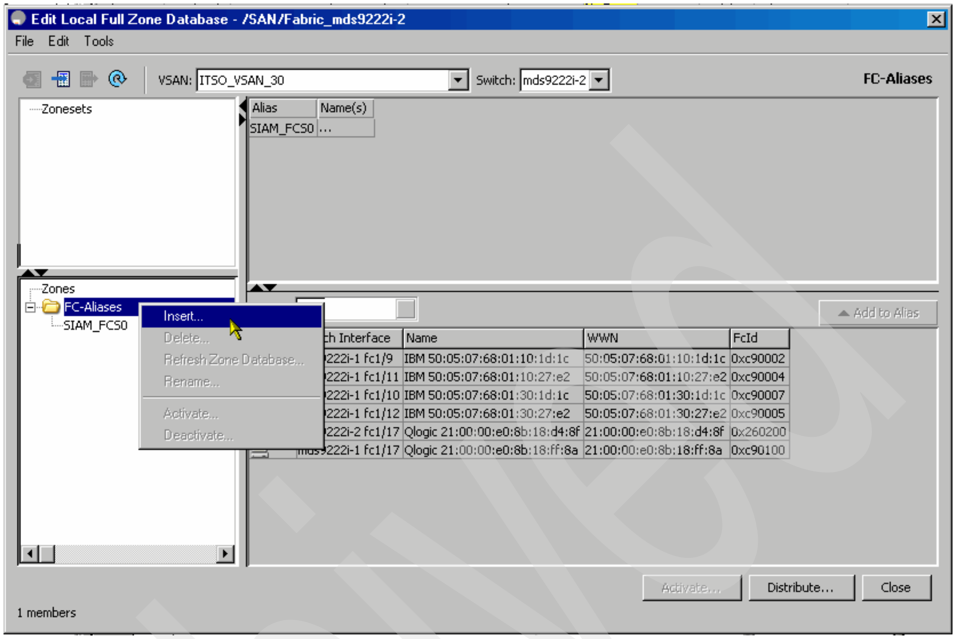
Name: SIAM_FCS0

Port WWN: 21:00:00:e0:8b:18:ff:8a

Figure 6-48 Creating alias based on WWPN

Then we create the alias SVC3_NODE1_FCS0, assigning the FC ID of the port that the host is attached to as a member.

4. Click **Insert** to create a new FC Alias, as shown in Figure 6-49.



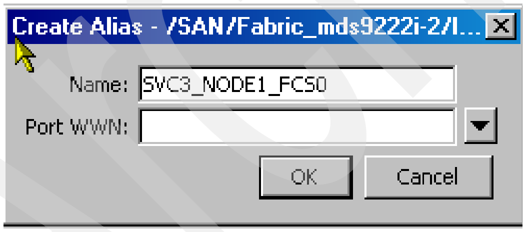
VSAN: ITSO_VSAN_30   Switch: mds9222i-2

Alias	Name(s)
SIAM_FCS0	...

ch Interface	Name	WWN	FcId
222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
222i-1 fc1/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
222i-1 fc1/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
mds9222i-1 fc1/17	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0xc90100

Figure 6-49 Clicking insert

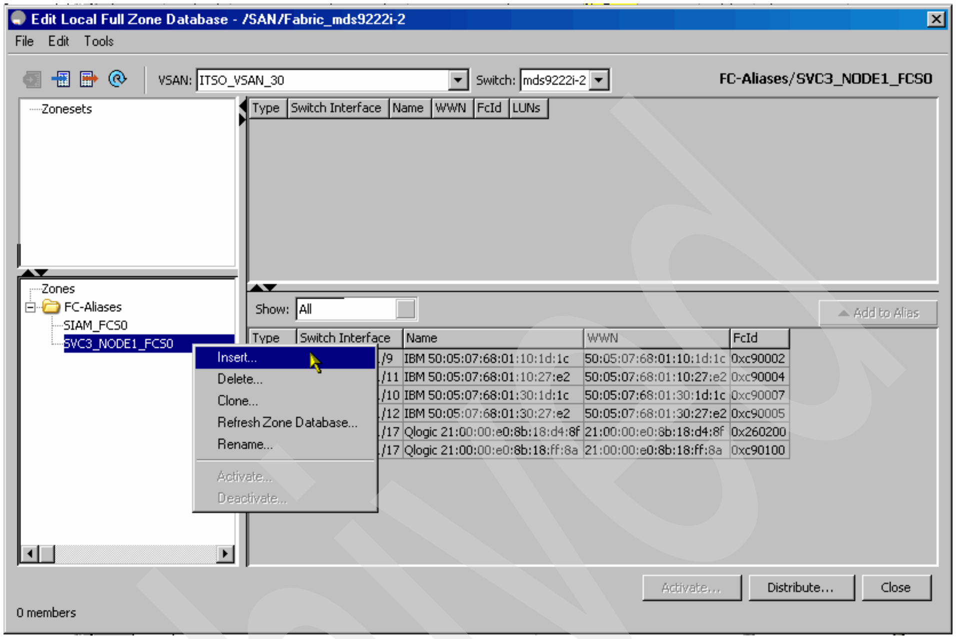
5. Name the new alias `SVC3_NODE1_FCS0` and click **OK** to create the empty alias, as shown in Figure 6-50.



Name: SVC3_NODE1_FCS0
Port WWN:

Figure 6-50 Defining an empty alias

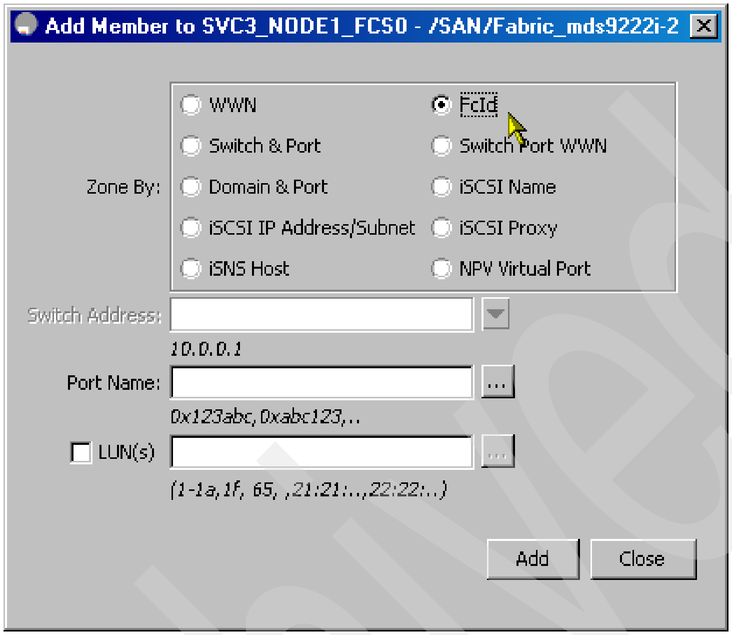
6. Right-click the created **alias SVC3_NODE1_FCS0** and select **Insert,** as shown in Figure 6-51, to modify the alias.



Type	Switch Interface	Name	WWN	FcId
	/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
	/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
	/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
	/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	/17	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0xc90100

Figure 6-51 Selecting the alias to be modified

7. To define the alias member, we mark the FCID and click the select end device icon, as shown in Figure 6-53.



Add Member to SVC3_NODE1_FCS0 - /SAN/Fabric_mds9222i-2

Zone By:

○ WWN	● FcId
○ Switch & Port	○ Switch Port WWN
○ Domain & Port	○ iSCSI Name
○ iSCSI IP Address/Subnet	○ iSCSI Proxy
○ iSNS Host	○ NPV Virtual Port

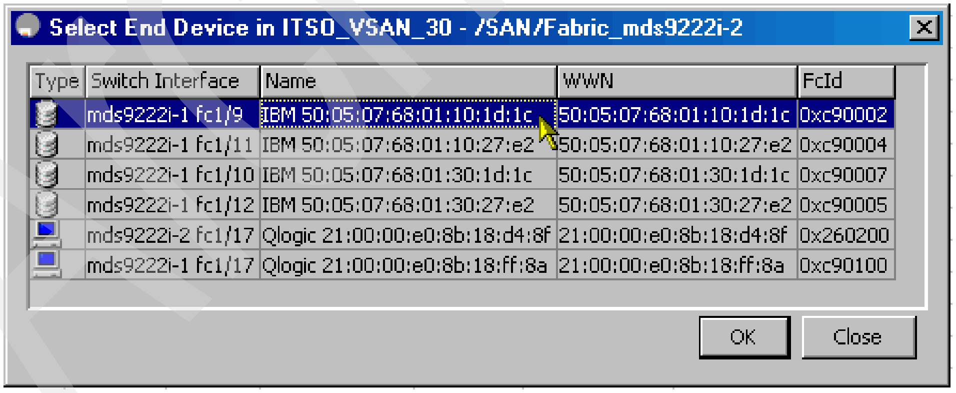
Switch Address:
10.0.0.1

Port Name: ...
0x123abc,0xabc123,..

□ LUN(s) ...
(1-1a,1f, 65, ,21:21:..,22:22:..)

Figure 6-52 Select membership type and end device

8. Highlight the desired end device and click **OK**, as shown in Figure 6-53.

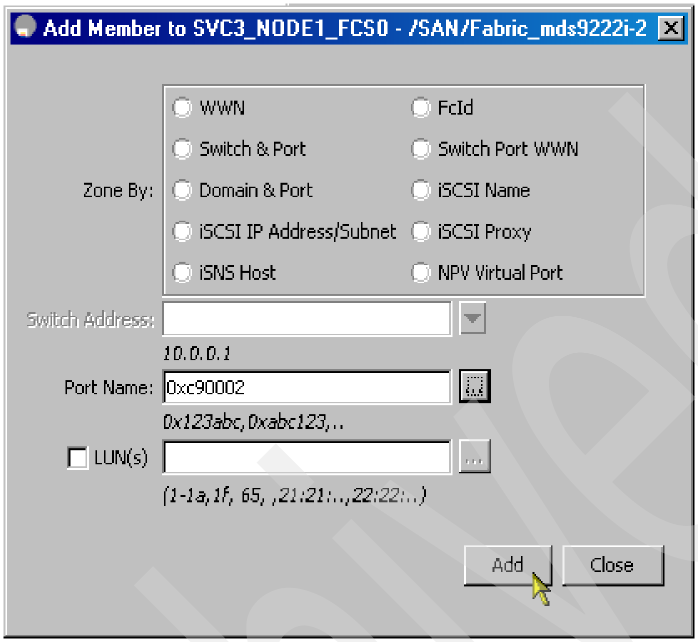


Select End Device in ITSO_VSAN_30 - /SAN/Fabric_mds9222i-2

Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0xc90100

Figure 6-53 Selecting the end device

9. We have now defined the properties for the alias member Host_A. Click **Add**, as shown in Figure 6-54.


Add Member to SVC3_NODE1_FCS0 - /SAN/Fabric_mds9222i-2

Zone By:
○ WWN ○ FcId
○ Switch & Port ○ Switch Port WWN
○ Domain & Port ○ iSCSI Name
○ iSCSI IP Address/Subnet ○ iSCSI Proxy
○ iSNS Host ○ NPV Virtual Port

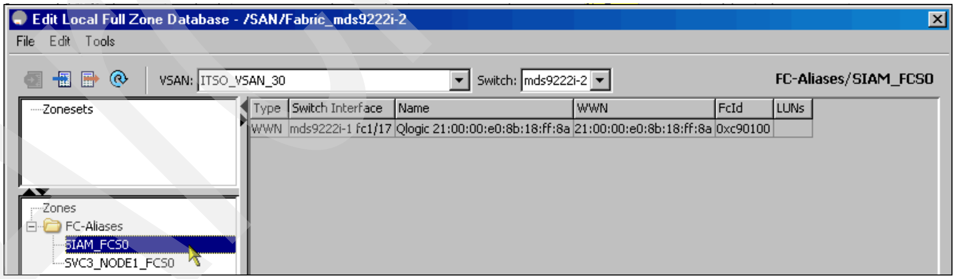
Switch Address:
10.0.0.1

Port Name: 0xc90002
0x123abc,0xabc123,..

□ LUN(s)
(1-1a,1f, 65, ,21:21:..,22:22:..)

Figure 6-54 Add the alias member

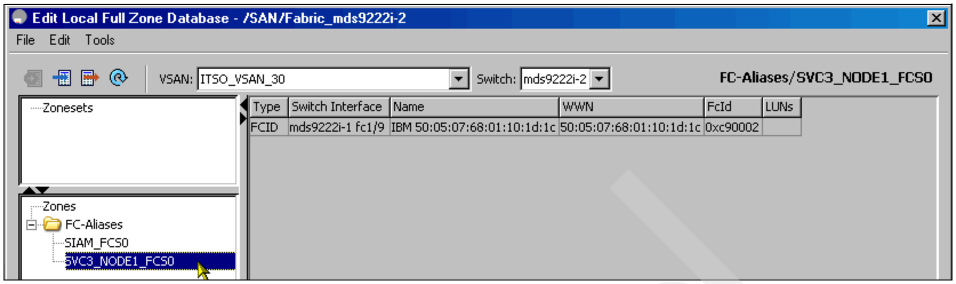
10. Finally, we list the defined aliases and verify that they are created as we intended, as shown in Figure 6-55 and Figure 6-56 on page 222.


Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2

VSAN: ITSO_VSAN_30 Switch: mds9222i-2 FC-Aliases/SIAM_FCS0

Type	Switch Interface	Name	WWN	FcId	LUNs
WWN	mds9222i-1 fc1/17	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0xc90100	

Figure 6-55 Listing defined aliases


Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2
File
Edit
Tools
FC-Aliases/SVC3_NODE1_FCS0
Zonesets
Zones
FC-Aliases
SIAM_FCS0
SVC3_NODE1_FCS0

VSAN: ITSO_VSAN_30
Switch: mds9222i-2

Type	Switch Interface	Name	WWN	FcId	LUNs
FCID	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002	

Figure 6-56 Listing defined aliases

You can create FC aliases using the command-line interface as shown in Example 6-23.

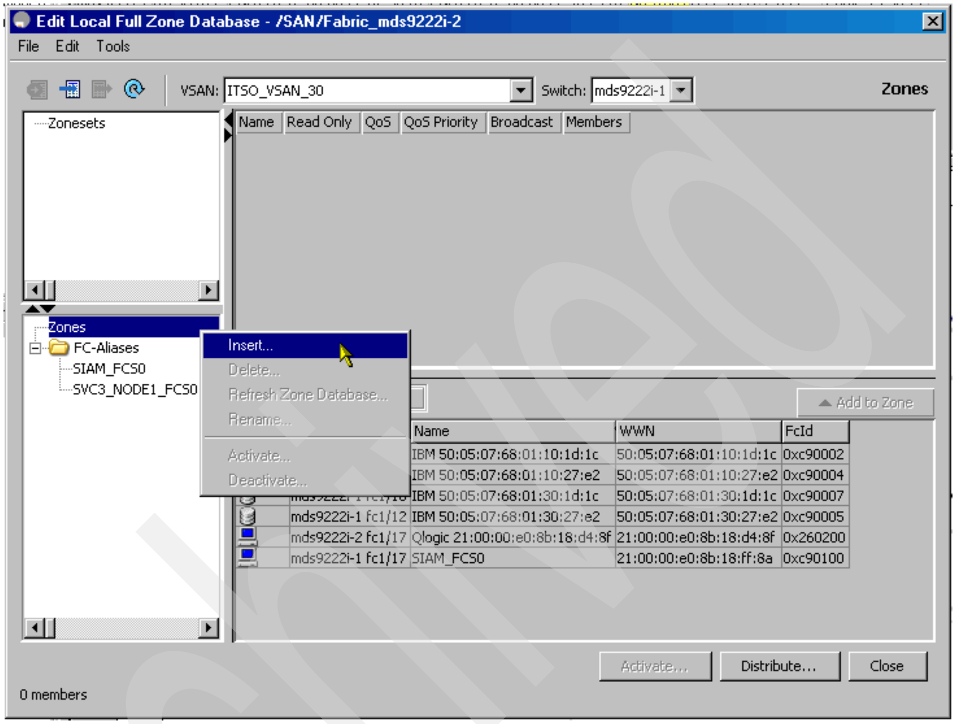
Example 6-23 Create FC aliases in the command-line interface

```
mds9222i-1# show flogi database
--------------------------------------------------------------------------------
INTERFACE        VSAN    FCID           PORT NAME               NODE NAME
--------------------------------------------------------------------------------
fc1/1            10    0x0b000a  50:05:07:68:01:10:37:e5 50:05:07:68:01:00:37:e5
fc1/7            20    0x9c000e  50:05:07:68:01:10:1d:21 50:05:07:68:01:00:1d:21
fc1/8            20    0x9c0001  50:05:07:68:01:30:1d:21 50:05:07:68:01:00:1d:21
fc1/9            30    0xc90002  50:05:07:68:01:10:1d:1c 50:05:07:68:01:00:1d:1c
fc1/10           30    0xc90007  50:05:07:68:01:30:1d:1c 50:05:07:68:01:00:1d:1c
fc1/11           30    0xc90004  50:05:07:68:01:10:27:e2 50:05:07:68:01:00:27:e2
fc1/12           30    0xc90005  50:05:07:68:01:30:27:e2 50:05:07:68:01:00:27:e2
fc1/14           10    0x0b0100  21:00:00:e0:8b:89:2b:cd 20:00:00:e0:8b:89:2b:cd
fc1/16           20    0x9c0100  21:00:00:e0:8b:05:4c:aa 20:00:00:e0:8b:05:4c:aa
fc1/17           30    0xc90100  21:00:00:e0:8b:18:ff:8a 20:00:00:e0:8b:18:ff:8a
fc2/2            1     0xad0f00  20:04:00:a0:b8:17:44:32 20:04:00:a0:b8:17:44:31

Total number of flogi = 11.

mds9222i-1# configure terminal
mds9222i-1(config)# fcalias name SIAM_FCS0 vsan 30
mds9222i-1(config-fcalias)# member pwwn 21:00:00:e0:8b:18:ff:8a
mds9222i-1(config-fcalias)# exit
mds9222i-1(config)# fcalias name SVC3_NODE1_FCS0 vsan 30
mds9222i-1(config-fcalias)# member fcid 0xc90002
mds9222i-1(config-fcalias)# end

mds9222i-1# show fcalias vsan 30
fcalias name SIAM_FCS0 vsan 30
  pwwn 21:00:00:e0:8b:18:ff:8a

fcalias name SVC3_NODE1_FCS0 vsan 30
  fcid 0xc90002
```

Zones

In order to create a zone:

1. Right-click **Zones** to insert a new zone, as shown in Figure 6-57.



Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2

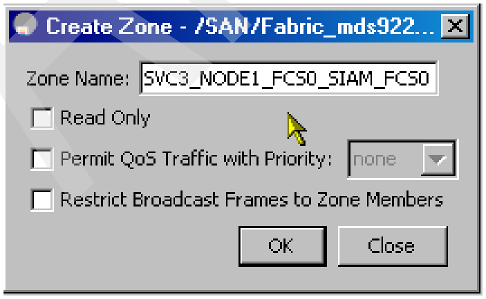
VSAN: ITSO_VSAN_30 Switch: mds9222i-1

		Name	WWN	FcId
		IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
		IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/16	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

0 members

Figure 6-57 Creating a new zone using the GUI

2. Name the new zone and apply specific properties for the zone such as *Read Only*, *QoS*, and *broadcast frame restrictions*, as shown in Figure 6-58. We name the zone `SVC3_NODE1_FCS0_SIAM_FCS0` with default zone properties and click **OK**.



Create Zone - /SAN/Fabric_mds922...

Zone Name: SVC3_NODE1_FCS0_SIAM_FCS0

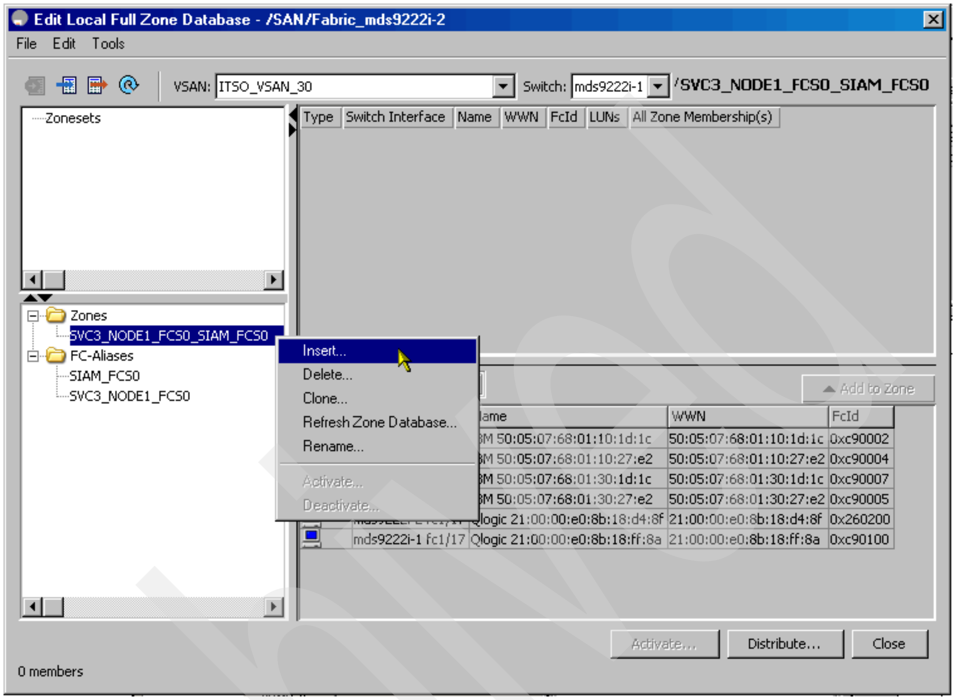
□ Read Only

□ Permit QoS Traffic with Priority: none

□ Restrict Broadcast Frames to Zone Members

Figure 6-58 Naming a new zone

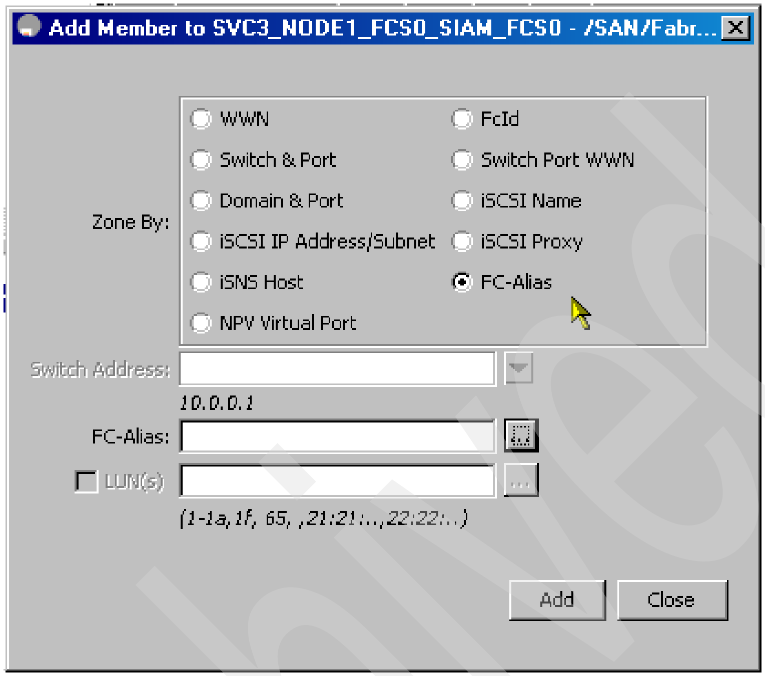
3. Right-click the created zone and select **Insert** to define members of the zone, as shown in Figure 6-59.



		lame	WWN	FcId
		3M 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
		3M 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
		3M 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
		3M 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
		Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	Qlogic 21:00:00:e0:8b:18:ff:8a	21:00:00:e0:8b:18:ff:8a	0xc90100

Figure 6-59 Select a zone to be modified

4. Select **FC-Alias** to add as members and then click the select devices icon to list available aliases, as shown in Figure 6-60.



Add Member to SVC3_NODE1_FCS0_SIAM_FCS0 - /SAN/Fabr...

Zone By:

○ WWN	○ FcId
○ Switch & Port	○ Switch Port WWN
○ Domain & Port	○ iSCSI Name
○ iSCSI IP Address/Subnet	○ iSCSI Proxy
○ iSNS Host	● FC-Alias
○ NPV Virtual Port	

Switch Address:

10.0.0.1

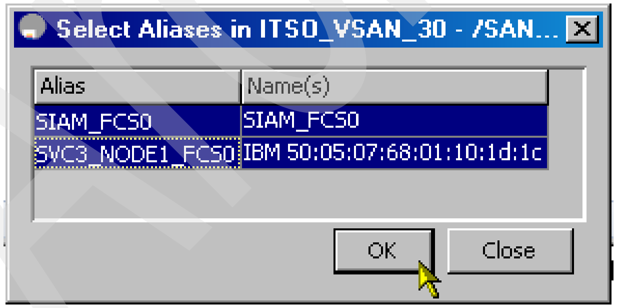
FC-Alias:

□ LUN(s)

(1-1a,1f, 65, ,21:21:..,22:22:..)

Figure 6-60 Selecting FC-Aliases to list

5. Select the two newly created FC-Aliases to be members of the zone and click **OK**, as shown in Figure 6-61.

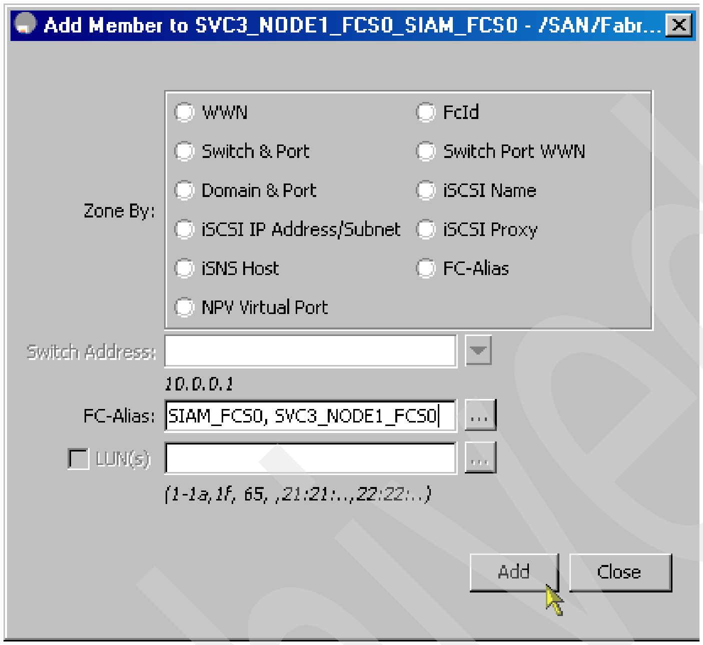


Select Aliases in ITSO_VSAN_30 - /SAN...

Alias	Name(s)
SIAM_FCS0	SIAM_FCS0
SVC3_NODE1_FCS0	IBM 50:05:07:68:01:10:1d:1c

Figure 6-61 Selecting FC-Aliases as zone members

6. Click **Add** to insert the chosen aliases as members of the zone, as shown in Figure 6-62.



Add Member to SVC3_NODE1_FCS0_SIAM_FCS0 - /SAN/Fabr...

Zone By:

○ WWN	○ FcId
○ Switch & Port	○ Switch Port WWN
○ Domain & Port	○ iSCSI Name
○ iSCSI IP Address/Subnet	○ iSCSI Proxy
○ iSNS Host	○ FC-Alias
○ NPV Virtual Port	

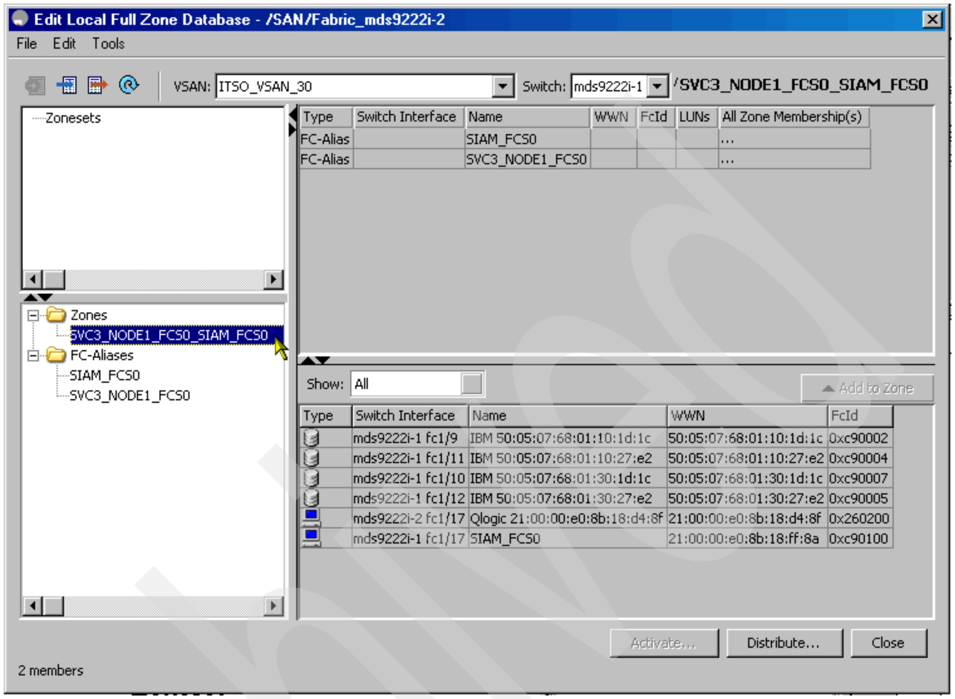
Switch Address:
10.0.0.1

FC-Alias: SIAM_FCS0, SVC3_NODE1_FCS0

□ LUN(s):
(1-1a,1f, 65, ,21:21:..,22:22:..)

Figure 6-62 Adding FC-Aliases devices to the zone

7. Click the zone **SVC3_NODE1_FCS0_SIAM_FCS0** to verify its members, as shown in Figure 6-63.



VSAN: ITSO_VSAN_30 Switch: mds9222i-1 /SVC3_NODE1_FCS0_SIAM_FCS0

Type	Switch Interface	Name	WWN	FcId	LUNs	All Zone Membership(s)
FC-Alias		SIAM_FCS0				...
FC-Alias		SVC3_NODE1_FCS0				...

Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

2 members

Figure 6-63 Listing members of the created zone

You can create zones using the CLI, as shown in Example 6-24.

Example 6-24 Managing zones using the CLI

```
mds9222i-1# show fcalias vsan 30
fcalias name SIAM_FCS0 vsan 30
  pwwn 21:00:00:e0:8b:18:ff:8a

fcalias name SVC3_NODE1_FCS0 vsan 30
  fcid 0xc90002
mds9222i-1# configure terminal
mds9222i-1(config)# zone name SVC3_NODE1_FCS0_SIAM_FCS0 vsan 30
mds9222i-1(config-zone)# member fcalias SIAM_FCS0
mds9222i-1(config-zone)# member fcalias SVC3_NODE1_FCS0
mds9222i-1(config-zone)# end
mds9222i-1# show zone vsan 30
zone name SVC3_NODE1_FCS0_SIAM_FCS0 vsan 30
  fcalias name SIAM_FCS0 vsan 30
    pwwn 21:00:00:e0:8b:18:ff:8a
```

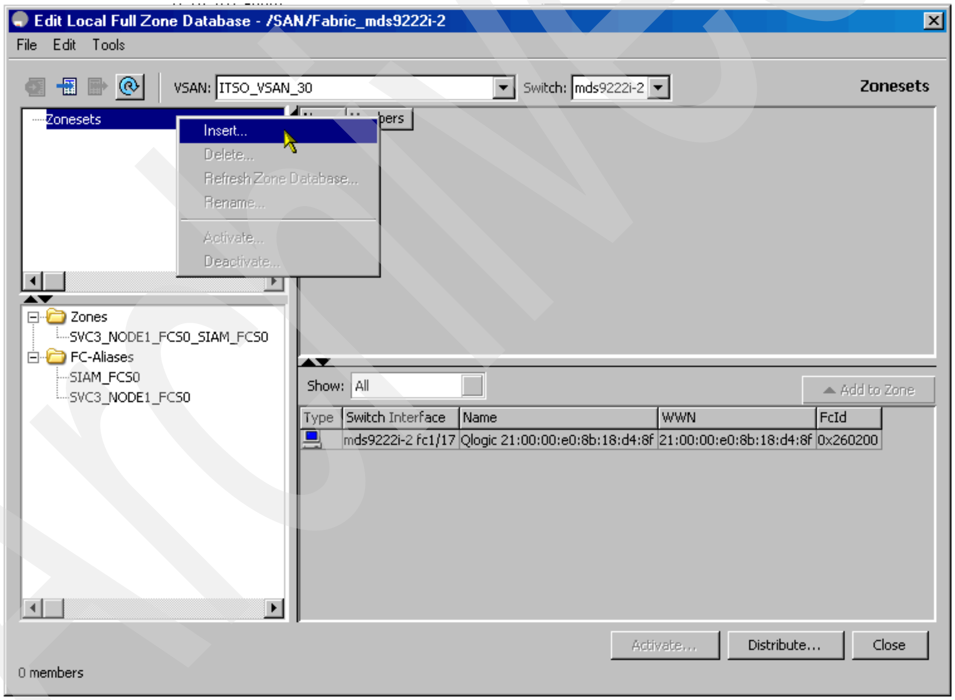
```
fcalias name SVC3_NODE1_FCS0 vsan 30
  fcid 0xc90002
```

Zoneset

Whereas a zone is used to specify access control, confining the specified members in a zone, zonesets are used to group zones and to enforce the access control defined by each zone when the zoneset is activated.

To create a zoneset, specify the name, VSAN, and members of the zoneset. In the following example we go through the steps to create the zoneset ZonesetActive3 in VSAN 30 and add the zone SVC3_NODE1_FCS0_SIAM_FCS0.

1. Right-click **Zonesets** and select **Insert** to create a new zoneset, as shown in Figure 6-64.



Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2

VSAN: ITSO_VSAN_30

Switch: mds9222i-2

Zones
- SVC3_NODE1_FCS0_SIAM_FCS0

FC-Aliases
- SIAM_FCS0
- SVC3_NODE1_FCS0

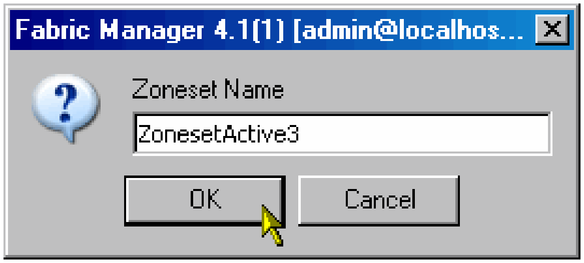
Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200

0 members

Figure 6-64 Define a new zoneset

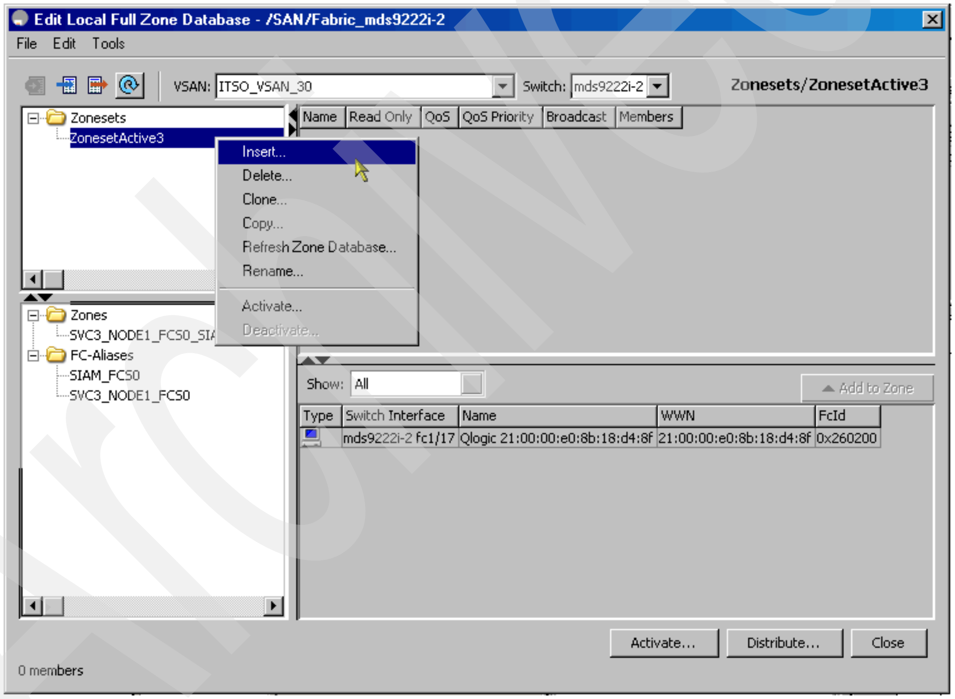
2. Define the name for the new zoneset and click **OK**, as shown in Figure 6-65.



Zoneset Name: ZonesetActive3

Figure 6-65 Name the zoneset

At the next step, right-click the newly created zoneset **ZonesetActive3** and select **Insert** to define members for the zoneset, as shown in Figure 6-66.



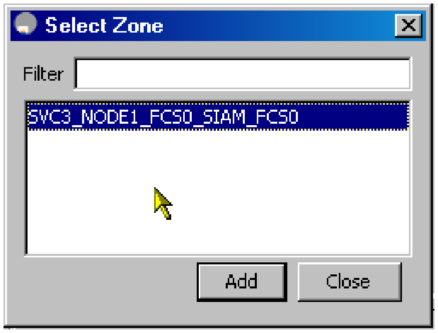
VSAN: ITSO_VSAN_30 Switch: mds9222i-2

Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200

Figure 6-66 Insert zone members for a zoneset

3. Select the zones to be members of the zoneset and click **Add**, as shown in Figure 6-67.



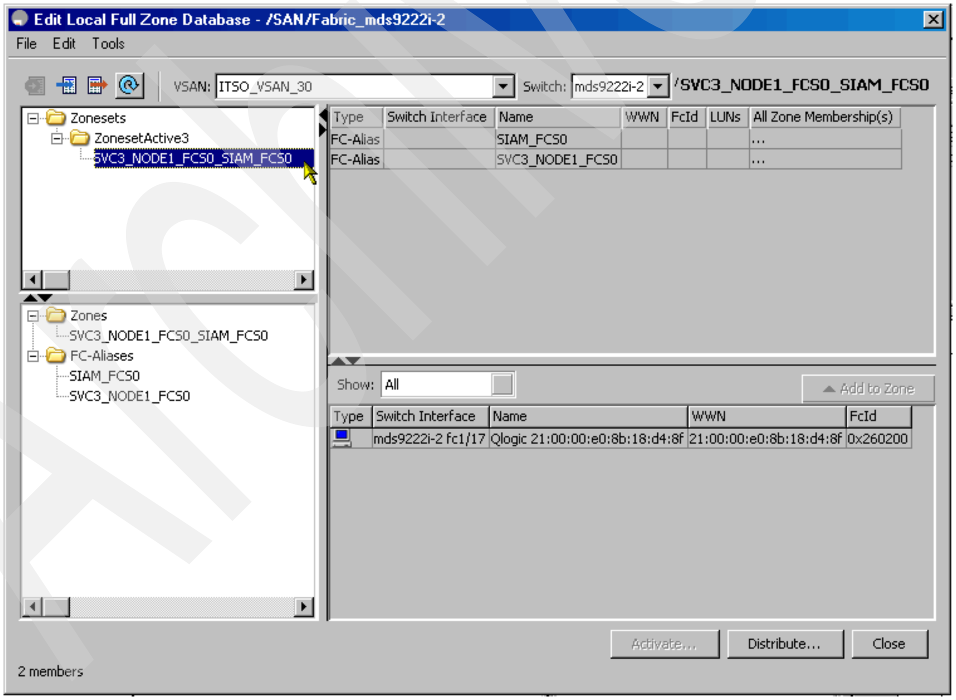
Select Zone

Filter

SVC3_NODE1_FCS0_SIAM_FCS0

Figure 6-67 Selecting the zoneset members

4. Verify that the zoneset contains the member SVC3_NODE1_FCS0_SIAM_FCS0 that we inserted, as shown in Figure 6-68.



Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2

VSAN: ITSO_VSAN_30 Switch: mds9222i-2 /SVC3_NODE1_FCS0_SIAM_FCS0

- Zonesets
  - ZonesetActive3
    - SVC3_NODE1_FCS0_SIAM_FCS0
- Zones
  - SVC3_NODE1_FCS0_SIAM_FCS0
- FC-Aliases
  - SIAM_FCS0
  - SVC3_NODE1_FCS0

Type	Switch Interface	Name	WWN	FcId	LUNs	All Zone Membership(s)
FC-Alias		SIAM_FCS0				...
FC-Alias		SVC3_NODE1_FCS0				...

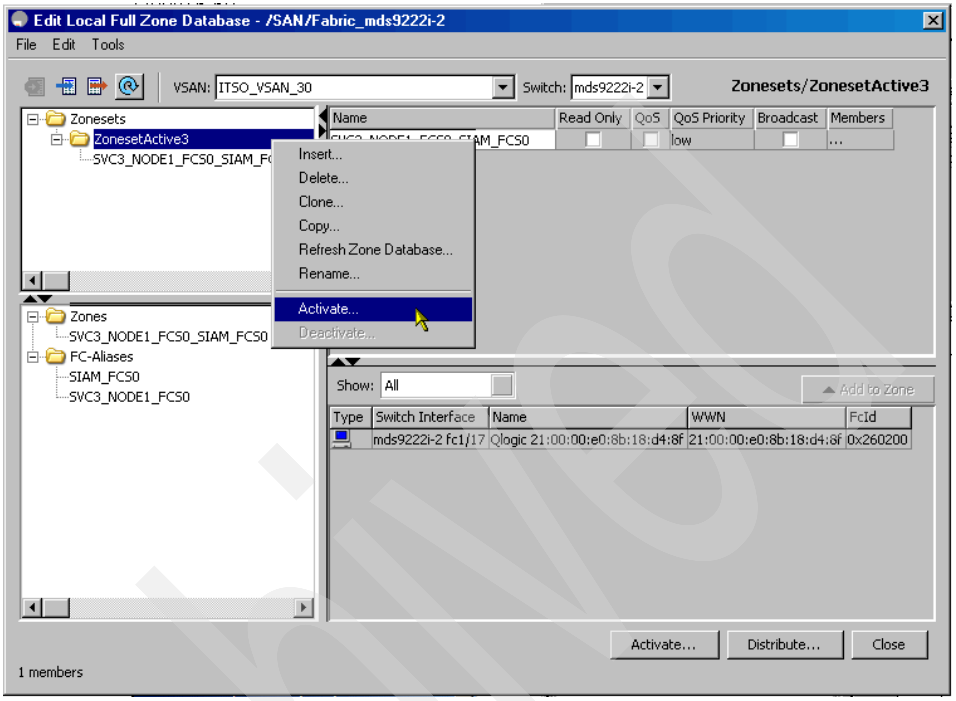
Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200

2 members

Figure 6-68 Listing members of a newly created zoneset

5. In order to activate a zoneset right-click the zoneset **ZonesetActive3**, as shown in Figure 6-69.



VSAN: ITSO_VSAN_30 Switch: mds9222i-2

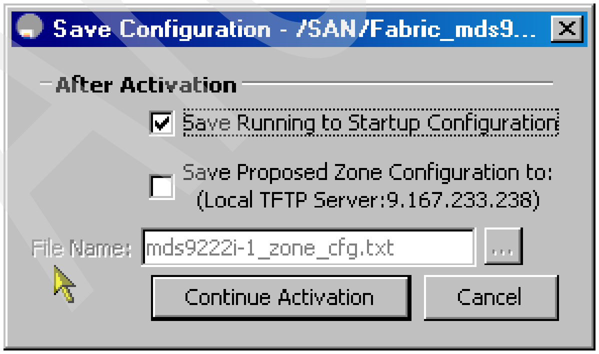
Name	Read Only	QoS	QoS Priority	Broadcast	Members
SVC3_NODE1_FCS0_SIAM_FCS0	□	□	low	□	...

Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200

Figure 6-69 Activate the zoneset

6. When prompted to save the running configuration to the startup configuration, and alternatively to a config file, click **Continue Activation** to activate the configuration, as shown in Figure 6-70.



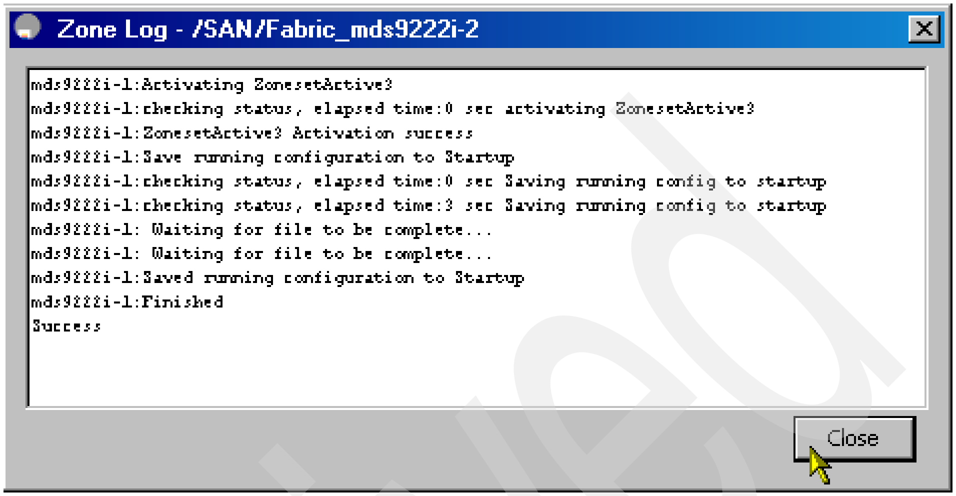
☑ Save Running to Startup Configuration

□ Save Proposed Zone Configuration to: (Local TFTP Server:9.167.233.238)

File Name: mds9222i-1_zone_cfg.txt

Figure 6-70 Zoneset activation

7. Monitor the status of the activation (and save to the startup configuration) in the Zone Log window, as shown in Figure 6-71.



```
mds9222i-1:Activating ZonesetActive3
mds9222i-1:checking status, elapsed time:0 sec activating ZonesetActive3
mds9222i-1:ZonesetActive3 Activation success
mds9222i-1:Save running configuration to Startup
mds9222i-1:checking status, elapsed time:0 sec Saving running config to startup
mds9222i-1:checking status, elapsed time:3 sec Saving running config to startup
mds9222i-1: Waiting for file to be complete...
mds9222i-1: Waiting for file to be complete...
mds9222i-1:Saved running configuration to Startup
mds9222i-1:Finished
Success
```

Figure 6-71 Monitoring status for the zoneset activation

You can create and configure zonesets using the CLI, as shown in Example 6-25.

Example 6-25 Managing zonesets using the CLI

```
mds9222i-1# show zone vsan 30
zone name SVC3_NODE1_FCS0_SIAM_FCS0 vsan 30
  fcalias name SIAM_FCS0 vsan 30
    pwwn 21:00:00:e0:8b:18:ff:8a

  fcalias name SVC3_NODE1_FCS0 vsan 30
    fcid 0xc90002
mds9222i-1# configure terminal
mds9222i-1(config)# zoneset name ZonesetActive3 vsan 30
mds9222i-1(config-zoneset)# member SVC3_NODE1_FCS0_SIAM_FCS0
mds9222i-1(config-zoneset)# exit
mds9222i-1(config)# zoneset activate name ZonesetActive3 vsan 30
Zoneset activation initiated. check zone status
mds9222i-1(config)# exit
mds9222i-1# show zoneset active vsan 30
zoneset name ZonesetActive3 vsan 30
  zone name SVC3_NODE1_FCS0_SIAM_FCS0 vsan 30
  * fcid 0xc90100 [pwwn 21:00:00:e0:8b:18:ff:8a]
  * fcid 0xc90002
```

Working with zonesets

When performing changes to the active zoneset, you work on a copy of the active zoneset in the full zoneset database. This means that any change does not take effect until you reactivate the zoneset, since the active zoneset cannot be altered while active.

To illustrate this, add a zone SVC1_NODE2_FCS0_NILE_FCS0 to the zoneset ZonesetActive1, show that it does not apply to the activated zoneset, and after that reactivate the zoneset ZonesetActive1.

As shown in Example 6-26, perform the following actions:

1. List zonesets for VSAN 10.
2. List the active zoneset for VSAN 10.
3. Add zone name SVC1_NODE2_FCS0_NILE_FCS0.
4. Add the zone SVC1_NODE2_FCS0_NILE_FCS0 to ActiveZoneset1.
5. List zonesets for VSAN 10.
6. List the active zoneset.
7. Reactivate the active zoneset.
8. Verify that SVC1_NODE2_FCS0_NILE_FCS0 is part of the active zoneset.

Example 6-26 Performing changes to the active zoneset

1.

```
mds9222i-1# show zoneset vsan 10
zoneset name ActiveZoneset1 vsan 10
  zone name SVC1_NODE1_FCS0_NILE_FCS0 vsan 10
    fcalias name SVC1_NODE1_FCS0 vsan 10
      pwwn 50:05:07:68:01:10:37:e5

    fcalias name NILE_FCS0 vsan 10
      pwwn 21:00:00:e0:8b:89:2b:cd
```

2.

```
mds9222i-1# show zoneset active vsan 10
zoneset name ActiveZoneset1 vsan 10
  zone name SVC1_NODE1_FCS0_NILE_FCS0 vsan 10
  * fcid 0x0b000a [pwwn 50:05:07:68:01:10:37:e5]
  * fcid 0x0b0100 [pwwn 21:00:00:e0:8b:89:2b:cd]
```

3.

```
mds9222i-1# configure terminal
mds9222i-1(config)# zone name SVC1_NODE2_FCS0_NILE_FCS0 vsan 10
mds9222i-1(config-zone)# member fcalias NILE_FCS0
mds9222i-1(config-zone)# member fcalias SVC1_NODE2_FCS0
Alias not present
mds9222i-1(config-zone)# exit
```

```
mds9222i-1(config)# fcalias name SVC1_NODE2_FCS0 vsan 10
mds9222i-1(config-fcalias)# member pwwn 50:05:07:68:01:10:37:dc
mds9222i-1(config-fcalias)# exit
mds9222i-1(config)# zone name SVC1_NODE2_FCS0_NILE_FCS0 vsan 10
mds9222i-1(config-zone)# member fcalias SVC1_NODE2_FCS0
mds9222i-1(config-zone)# end
```

4.

```
mds9222i-1# configure terminal
mds9222i-1(config)# zoneset name ZonesetActive1 vsan 10
mds9222i-1(config-zoneset)# member SVC1_NODE2_FCS0_NILE_FCS0
mds9222i-1(config-zoneset)# end
```

5.

```
mds9222i-1# show zoneset vsan 10
zoneset name ZonesetActive1 vsan 10
  zone name SVC1_NODE1_FCS0_NILE_FCS0 vsan 10
    fcalias name SVC1_NODE1_FCS0 vsan 10
      pwwn 50:05:07:68:01:10:37:e5

    fcalias name NILE_FCS0 vsan 10
      pwwn 21:00:00:e0:8b:89:2b:cd

  zone name SVC1_NODE2_FCS0_NILE_FCS0 vsan 10
    fcalias name NILE_FCS0 vsan 10
      pwwn 21:00:00:e0:8b:89:2b:cd

    fcalias name SVC1_NODE2_FCS0 vsan 10
      pwwn 50:05:07:68:01:10:37:dc
```

6.

```
mds9222i-1# show zoneset active vsan 10
zoneset name ActiveZoneset1 vsan 10
  zone name SVC1_NODE1_FCS0_NILE_FCS0 vsan 10
  * fcid 0x0b000a [pwwn 50:05:07:68:01:10:37:e5]
  * fcid 0x0b0100 [pwwn 21:00:00:e0:8b:89:2b:cd]
```

7.

```
mds9222i-1# configure terminal
mds9222i-1(config)# zoneset activate name ZonesetActive1 vsan 10
Zoneset activation initiated. check zone status
mds9222i-1(config)# end
```

8.

```
mds9222i-1# show zoneset active vsan 10
zoneset name ZonesetActive1 vsan 10
  zone name SVC1_NODE1_FCS0_NILE_FCS0 vsan 10
  * fcid 0x0b000a [pwwn 50:05:07:68:01:10:37:e5]
  * fcid 0x0b0100 [pwwn 21:00:00:e0:8b:89:2b:cd]
```

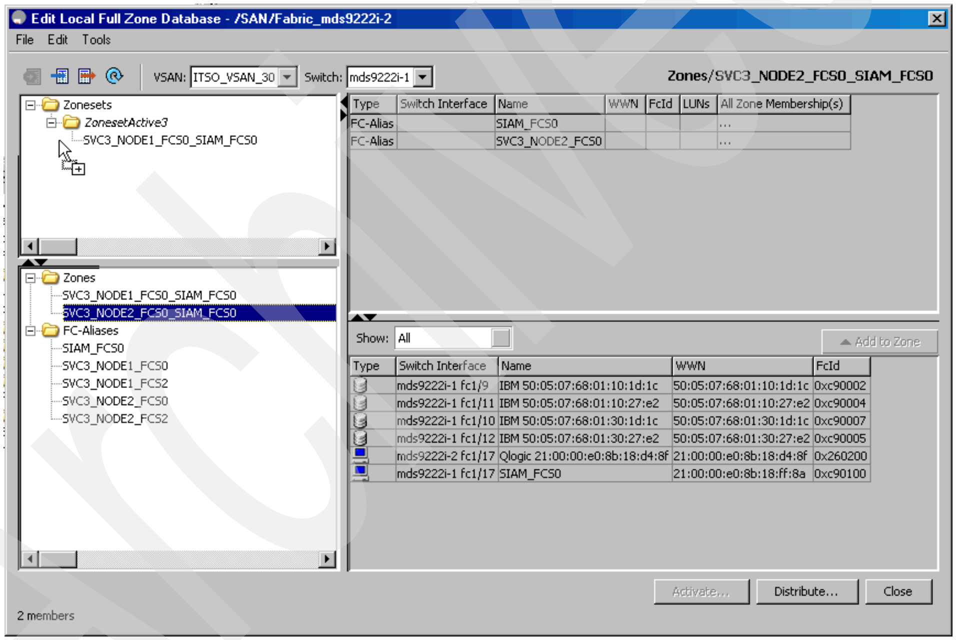
```
zone name SVC1_NODE2_FCS0_NILE_FCS0 vsan 10
* fcid 0x0b0100 [pwwn 21:00:00:e0:8b:89:2b:cd]
* fcid 0x0b0008 [pwwn 50:05:07:68:01:10:37:dc]
```

When comparing step 5 with step 7, notice that the newly created zone has become a part of the active zoneset due to the reactivation of ZonesetActive1 in step 7.

Working with zonesets using the GUI

When working with zonesets using the GUI, the same conditions apply, in that changes only take effect after you activate or reactivate the zoneset.

In Figure 6-72 a new zone has been dragged and dropped into the zoneset.



VSAN: ITSO_VSAN_30 Switch: mds9222i-1

Zones/SVC3_NODE2_FCS0_SIAM_FCS0

Type	Switch Interface	Name	WWN	FcId	LUNs	All Zone Membership(s)
FC-Alias		SIAM_FCS0				...
FC-Alias		SVC3_NODE2_FCS0				...

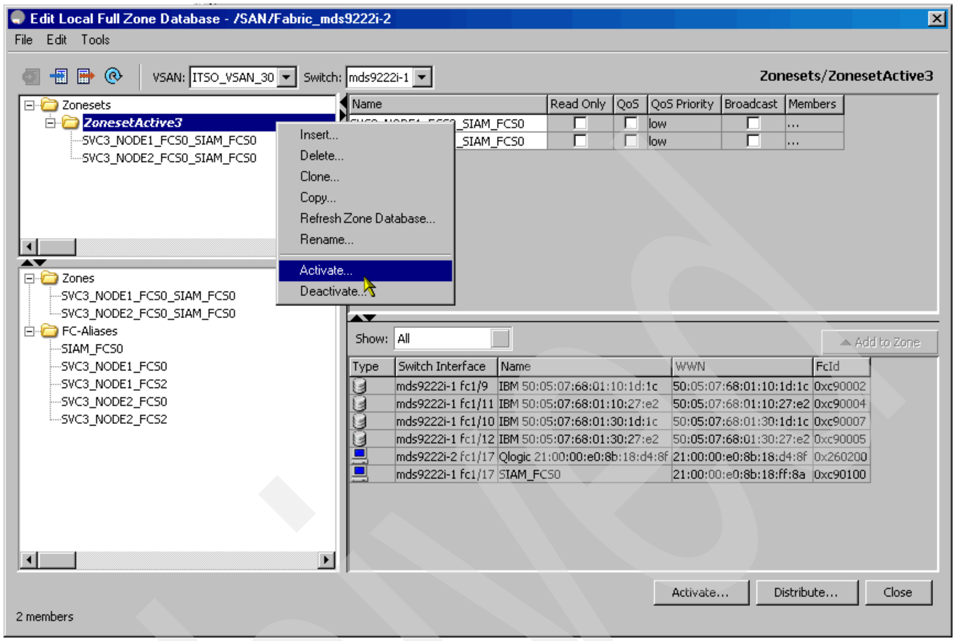
Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

2 members

Figure 6-72 Dragging and dropping a new zone into the zoneset

In Figure 6-73 a modified zoneset will be reactivated.

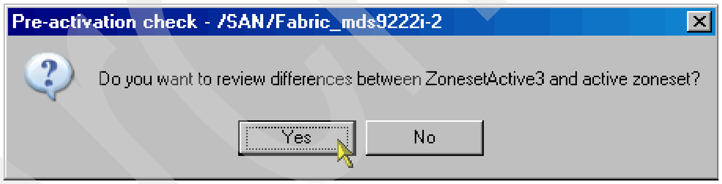


Name	Read Only	QoS	QoS Priority	Broadcast	Members
SVC3_NODE1_FCS0_SIAM_FCS0	□	□	low	□	...
_SIAM_FCS0	□	□	low	□	...

Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	IBM 50:05:07:68:01:10:27:e2	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	IBM 50:05:07:68:01:30:1d:1c	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	IBM 50:05:07:68:01:30:27:e2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

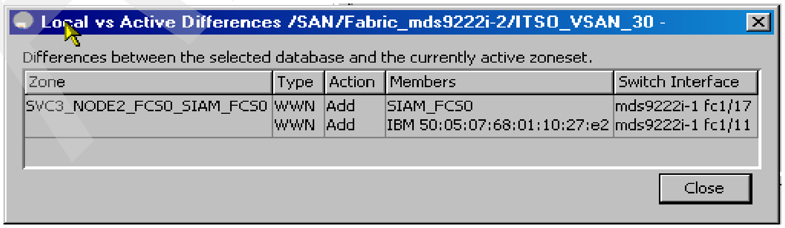
Figure 6-73 Reactivating the zoneset

Fabric Manager will prompt you to review the changes that have been implemented, as shown in Figure 6-74 and Figure 6-75.



Do you want to review differences between ZonesetActive3 and active zoneset?

Figure 6-74 Review changes before reactivating zoneset

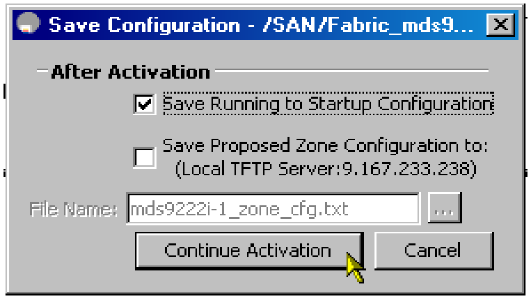

Local vs Active Differences /SAN/Fabric_mds9222i-2/ITSO_VSAN_30 -
Close

Differences between the selected database and the currently active zoneset.

Zone	Type	Action	Members	Switch Interface
SVC3_NODE2_FCS0_SIAM_FCS0	WWN	Add	SIAM_FCS0	mds9222i-1 fc1/17
	WWN	Add	IBM 50:05:07:68:01:10:27:e2	mds9222i-1 fc1/11

Figure 6-75 Review changes made in zoneset before reactivation

In Figure 6-76 we save changes to a startup configuration to keep changes after a switch reboot.



Save Configuration - /SAN/Fabric_mds9...

After Activation

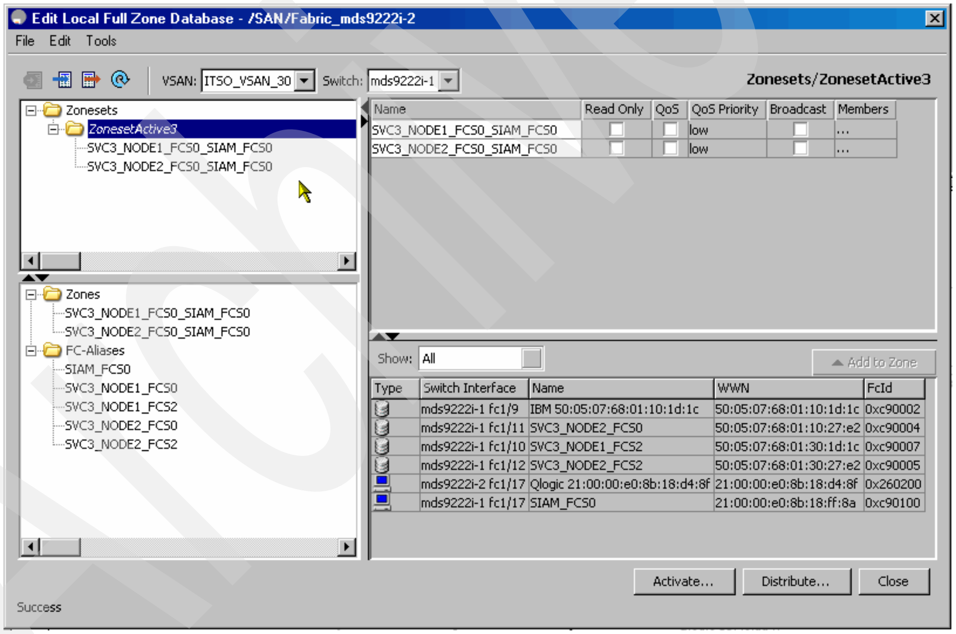
☑ Save Running to Startup Configuration

□ Save Proposed Zone Configuration to:
(Local TFTP Server:9.167.233.238)

File Name: mds9222i-1_zone_cfg.txt

Figure 6-76 Saving changes to the startup configuration

Verify the zoneset after reactivation and saving the configuration, as shown in Figure 6-77.



Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2

VSAN: ITSO_VSAN_30 Switch: mds9222i-1 Zonesets/ZonesetActive3

- Zonesets
  - ZonesetActive3
    - SVC3_NODE1_FCS0_SIAM_FCS0
    - SVC3_NODE2_FCS0_SIAM_FCS0

Name	Read Only	QoS	QoS Priority	Broadcast	Members
SVC3_NODE1_FCS0_SIAM_FCS0	□	□	low	□	...
SVC3_NODE2_FCS0_SIAM_FCS0	□	□	low	□	...

- Zones
  - SVC3_NODE1_FCS0_SIAM_FCS0
  - SVC3_NODE2_FCS0_SIAM_FCS0
- FC-Aliases
  - SIAM_FCS0
  - SVC3_NODE1_FCS0
  - SVC3_NODE1_FCS2
  - SVC3_NODE2_FCS0
  - SVC3_NODE2_FCS2

Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	SVC3_NODE2_FCS0	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	SVC3_NODE1_FCS2	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	SVC3_NODE2_FCS2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

Success

Figure 6-77 Verifying a zoneset configuration after changes

Zone distribution

While all Cisco MDS 9000 family switches distribute the active zonesets when new E_Port links (ISL) appear, or when a new zone is activated in a VSAN, the full zoneset is not distributed automatically.

Distributing the full zoneset can be done either in Config or in EXEC mode.

Config mode

The **zoneset distribute VSAN** command in config mode is used on a per-VSAN basis to distribute the specified VSANs to all switches along with the active zoneset.

To configure distribution of the full zoneset database of a VSAN along with the active zoneset, use the config command **zoneset distribute full**, as shown in Example 6-27.

Example 6-27 Config command zoneset distribute full

```
mds9222i-1# config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-1(config)# zoneset distribute full vsan 10
```

EXEC mode

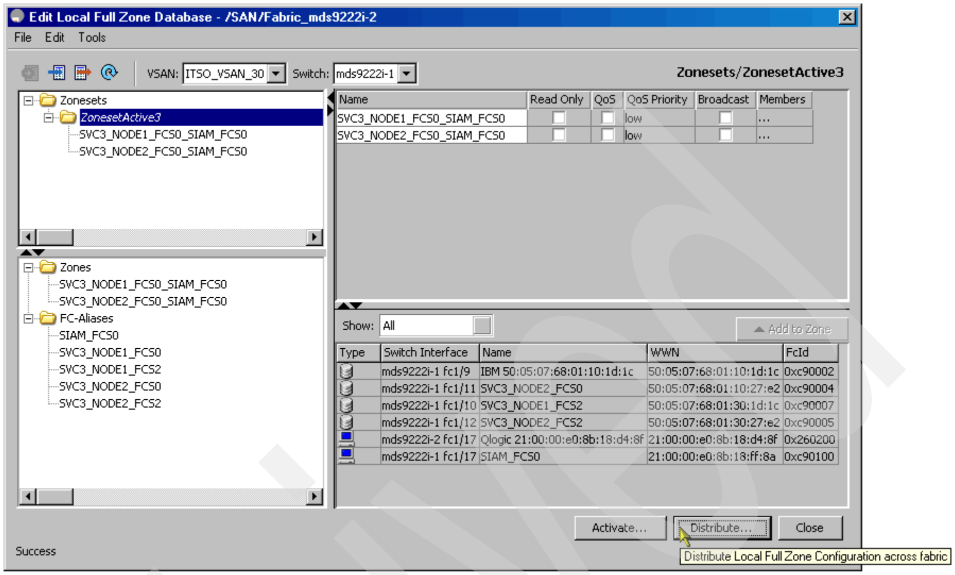
The **zoneset distribute VSAN** command in config mode is used to perform a one-time distribution of all inactive, unmodified zonesets to all switches in the fabric.

To distribute the full zoneset database of a VSAN, use the command **zoneset distribute**. As shown in Example 6-28, the full zoneset for VSAN 10 has been distributed, and this is verified using the command **show zone status**, as shown in Example 6-28.

Example 6-28 Distributing the full zoneset database for a VSAN

```
mds9222i-1# zoneset distribute vsan 10
Zoneset distribution initiated. check zone status
mds9222i-1# show zone status vsan 10
VSAN: 10 default-zone: permit distribute: full Interop: default
    mode: basic merge-control: allow
    session: none
    hard-zoning: enabled broadcast: disabled
Default zone:
    qos: none broadcast: disabled ronly: disabled
Full Zoning Database :
    DB size: 484 bytes
    Zonesets:1  Zones:2 Aliases: 3
Active Zoning Database :
    DB size: 152 bytes
    Name: ZonesetActive1  Zonesets:1  Zones:3
Status: Zoneset distribution completed at 00:53:46 UTC Sep 19 2008
```

To distribute the full zoneset database using the GUI, click **Distribute**, as shown in Figure 6-78.



Edit Local Full Zone Database - /SAN/Fabric_mds9222i-2

VSAN: ITSO_VSAN_30 Switch: mds9222i-1

Zonesets/ZonesetActive3

- Zonesets
  - ZonesetActive3
    - SVC3_NODE1_FCS0_SIAM_FCS0
    - SVC3_NODE2_FCS0_SIAM_FCS0

Name	Read Only	QoS	QoS Priority	Broadcast	Members
SVC3_NODE1_FCS0_SIAM_FCS0	□	□	low	□	...
SVC3_NODE2_FCS0_SIAM_FCS0	□	□	low	□	...

- Zones
  - SVC3_NODE1_FCS0_SIAM_FCS0
  - SVC3_NODE2_FCS0_SIAM_FCS0
- FC-Aliases
  - SIAM_FCS0
  - SVC3_NODE1_FCS0
  - SVC3_NODE1_FCS2
  - SVC3_NODE2_FCS0
  - SVC3_NODE2_FCS2

Show: All

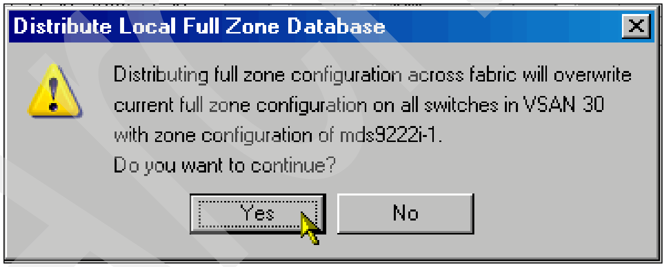
Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	SVC3_NODE2_FCS0	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	SVC3_NODE1_FCS2	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	SVC3_NODE2_FCS2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

Success

Distribute Local Full Zone Configuration across fabric

Figure 6-78 Distributing the full zoneset database

Fabric Manager will prompt us to confirm zoneset distribution since this will overwrite the current full zone configuration on all switches in VSAN 30, as shown in Figure 6-79.

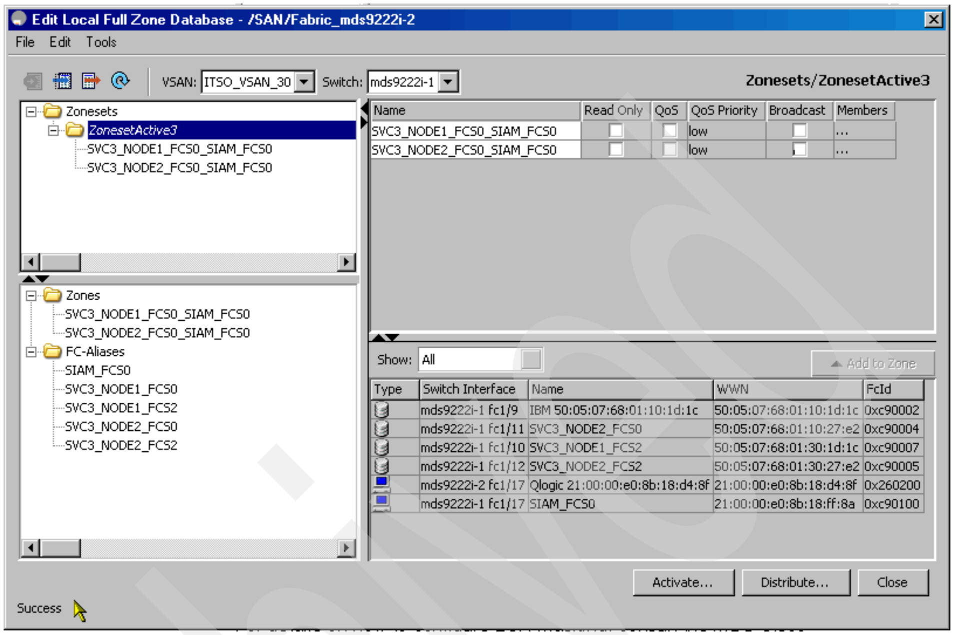


Distribute Local Full Zone Database

Distributing full zone configuration across fabric will overwrite current full zone configuration on all switches in VSAN 30 with zone configuration of mds9222i-1.
Do you want to continue?

Figure 6-79 Confirm distribution of full zoneset database

Verification that the zoneset distribution has completed is shown in Figure 6-80 in the lower left corner.



VSAN: ITSO_VSAN_30 Switch: mds9222i-1

Zonesets/ZonesetActive3

- Zonesets
  - ZonesetActive3
    - SVC3_NODE1_FCS0_SIAM_FCS0
    - SVC3_NODE2_FCS0_SIAM_FCS0

Name	Read Only	QoS	QoS Priority	Broadcast	Members
SVC3_NODE1_FCS0_SIAM_FCS0	□	□	low	□	...
SVC3_NODE2_FCS0_SIAM_FCS0	□	□	low	□	...

- Zones
  - SVC3_NODE1_FCS0_SIAM_FCS0
  - SVC3_NODE2_FCS0_SIAM_FCS0
- FC-Aliases
  - SIAM_FCS0
  - SVC3_NODE1_FCS0
  - SVC3_NODE1_FCS2
  - SVC3_NODE2_FCS0
  - SVC3_NODE2_FCS2

Show: All

Type	Switch Interface	Name	WWN	FcId
	mds9222i-1 fc1/9	IBM 50:05:07:68:01:10:1d:1c	50:05:07:68:01:10:1d:1c	0xc90002
	mds9222i-1 fc1/11	SVC3_NODE2_FCS0	50:05:07:68:01:10:27:e2	0xc90004
	mds9222i-1 fc1/10	SVC3_NODE1_FCS2	50:05:07:68:01:30:1d:1c	0xc90007
	mds9222i-1 fc1/12	SVC3_NODE2_FCS2	50:05:07:68:01:30:27:e2	0xc90005
	mds9222i-2 fc1/17	Qlogic 21:00:00:e0:8b:18:d4:8f	21:00:00:e0:8b:18:d4:8f	0x260200
	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

Success

Figure 6-80 Verifying the status of the zoneset distribution

Note: When removing only a few zones from a zoneset, the full zoneset database for the VSAN is only distributed across the fabric and is not saved to the startup configuration on the other switches (regardless of whether you use the CLI or GUI). Therefore, you subsequently must perform this task on the other switches in the fabric.

6.1.11 LUN zoning

The LUN zoning feature, at the time of writing, is specific for the Cisco MDS family, and is not available in interop mode. Since most storage devices used in today’s production environments provide LUN masking, this feature is not extensively used, although it is available and can even be combined with LUN masking at the storage subsystem.

For details on how to configure LUN masking, consult the MDS Cisco Configuration Guide:

http://www.cisco.com/en/US/products/ps5989/products_installation_and_configuration_guides_list.html

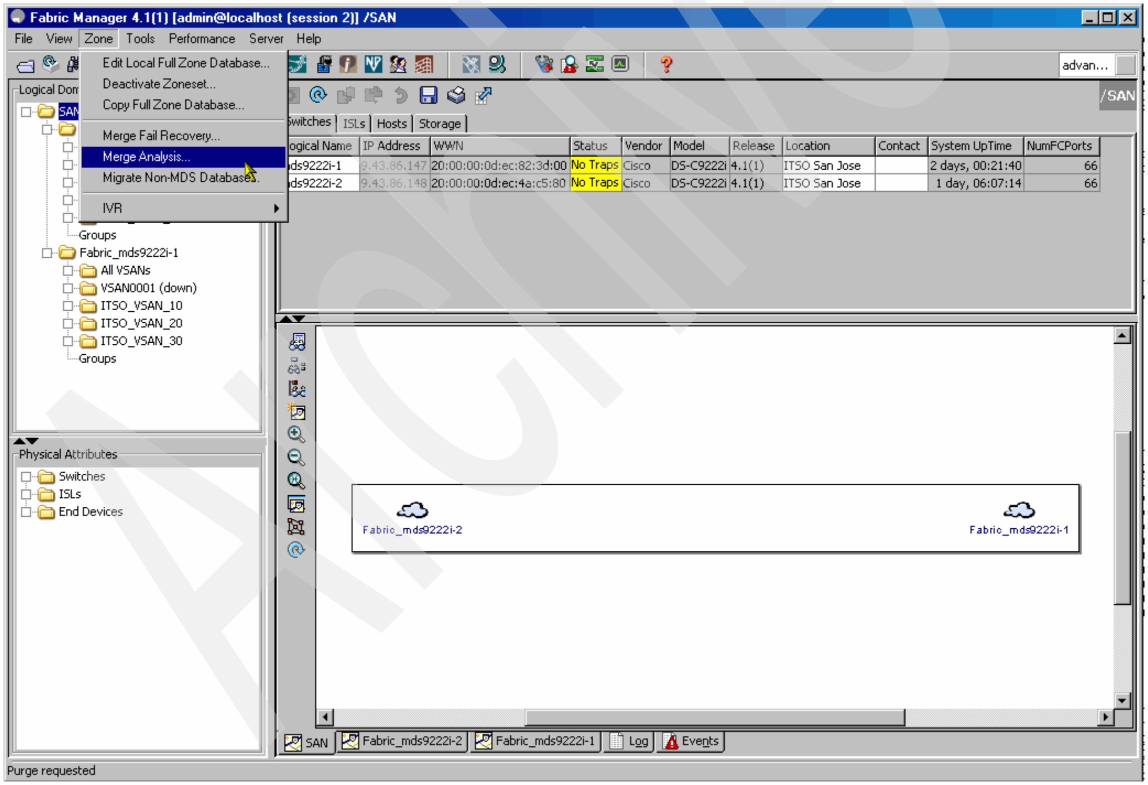
6.2 Multiple switch environment

In the topics that follow, we show how to configure an Inter-Switch Link.

6.2.1 Inter-switch link

An Inter-Switch Link (ISL) is created when connecting an E_Port (expansion port) of one switch to an E_Port on another switch. When multiple ISLs are used, these can be congregated to become a single *logical ISL*, which, in Cisco terminology, is called a PortChannel.

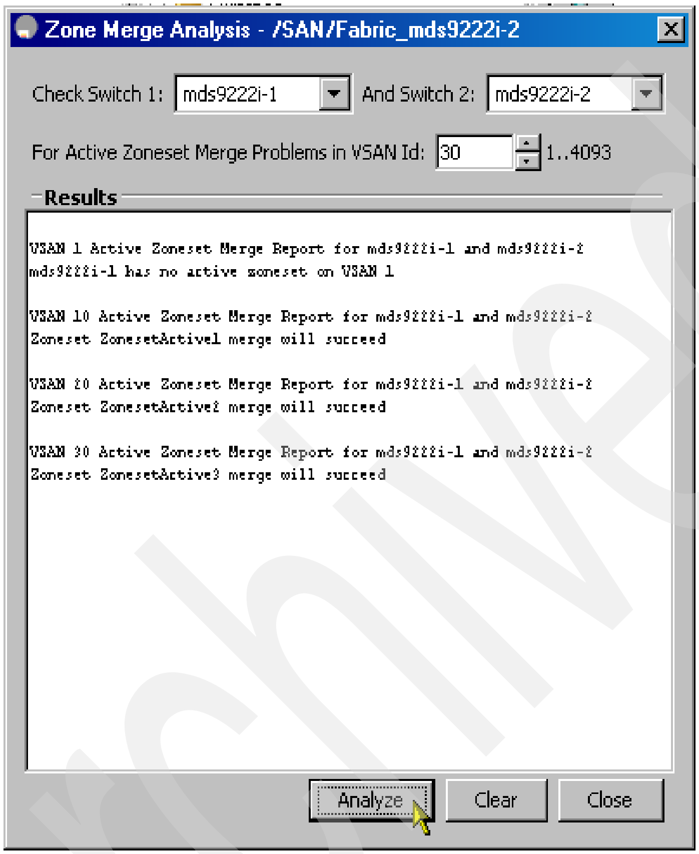
Prior to establishing an ISL between two switches, we launch the *merge analysis* tool to verify that our existing VSANs can merge successfully across the fabric to avoid segmentation. In Figure 6-81 click **Zone** and select **Merge Analysis** to launch the tool.



ogical Name	IP Address	WWN	Status	Vendor	Model	Release	Location	Contact	System UpTime	NumFCPorts
ds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose		2 days, 00:21:40	66
ds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose		1 day, 06:07:14	66

Figure 6-81 Launching the merge analysis tool

We then enter the IP address (or FQDN if all devices are defined in the DNS server) and click **Analyze**, as shown in Figure 6-82, to analyze the merge of VSAN1, VSAN10, VSAN20, and VSAN30.



Check Switch 1: mds9222i-1 And Switch 2: mds9222i-2

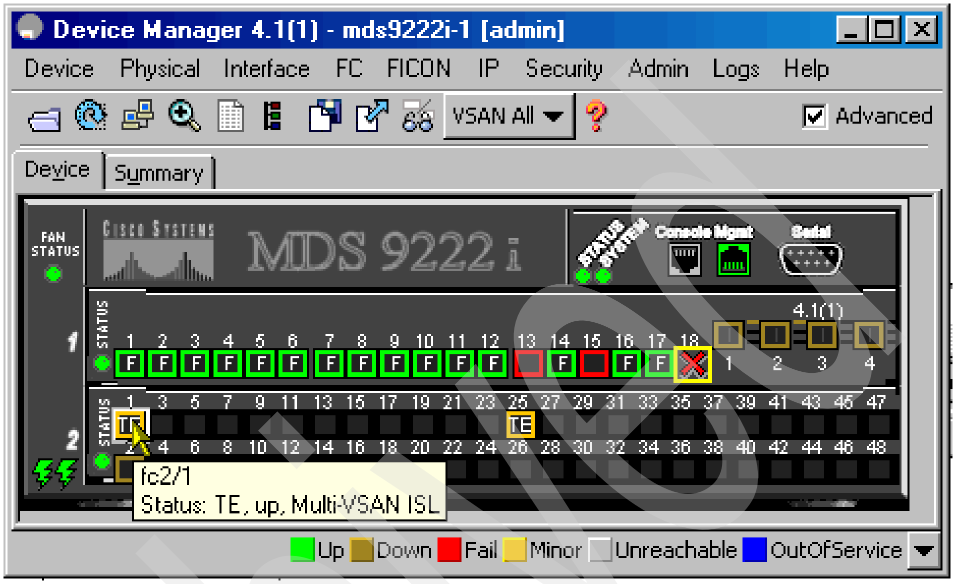
For Active Zoneset Merge Problems in VSAN Id: 30 1..4093

```
VSAN 1 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
mds9222i-1 has no active zoneset on VSAN 1

VSAN 10 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
Zoneset ZonesetActive1 merge will succeed

VSAN 20 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
Zoneset ZonesetActive2 merge will succeed

VSAN 30 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
Zoneset ZonesetActive3 merge will succeed
```

Figure 6-82 Merge analysis for VSAN's 1, VSAN10, VSAN20 and VSAN30

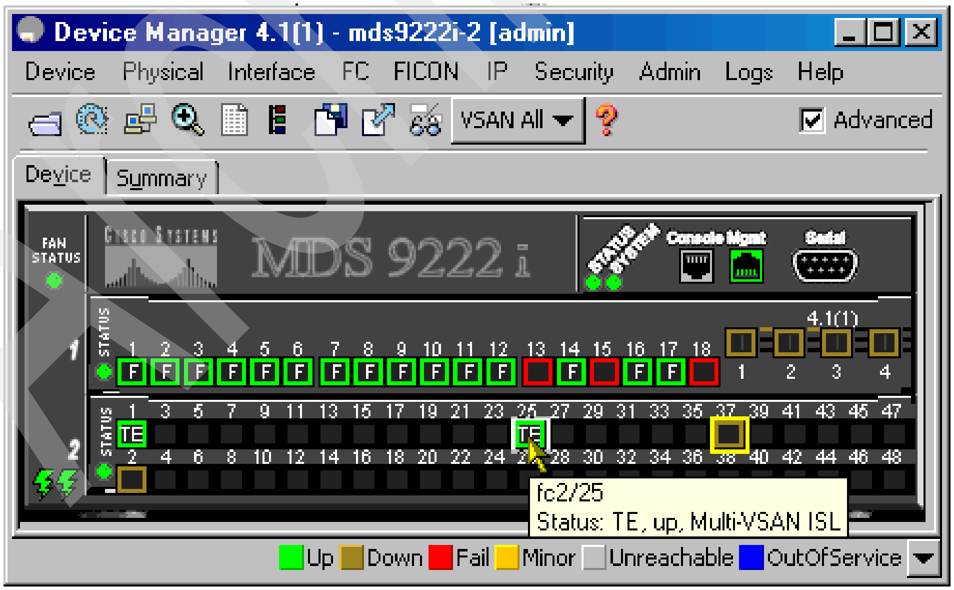
After successful merge analysis we are now ready to establish ISLs between the two switches. In this case we will establish EISL links using TE ports.

We will connect two switches using two ISLs, as shown in Figure 6-83 and Figure 6-84. Depending on the trunk setting for the port, it becomes either an E_Port or a TE_Port. In our example, both ports are TE_Ports.


Device Manager 4.1(1) - mds9222i-1 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
☑ Advanced
Device
Summary
FAN STATUS
CISCO SYSTEMS
MDS 9222 i
STATUS SYSTEM
Console Mgmt
Serial
4.1(1)
STATUS
F
TE
🟩 Up 🟫 Down 🟥 Fail 🟨 Minor □ Unreachable 🟦 OutOfService

fc2/1
Status: TE, up, Multi-VSAN ISL

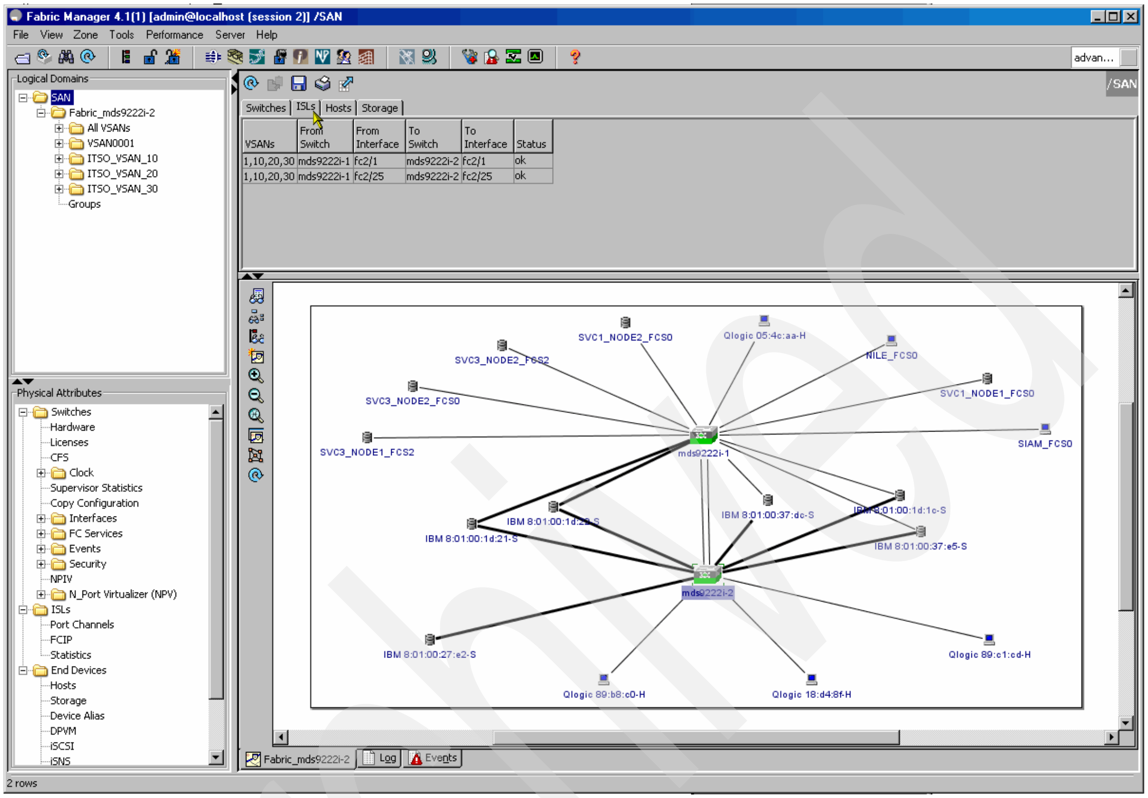
Figure 6-83 ISL connections, TE_Ports on MDS9222i-1 switch


Device Manager 4.1(1) - mds9222i-2 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
☑ Advanced
Device
Summary
FAN STATUS
CISCO SYSTEMS
MDS 9222 i
STATUS SYSTEM
Console Mgmt
Serial
4.1(1)
STATUS
F
TE
🟩 Up 🟫 Down 🟥 Fail 🟨 Minor □ Unreachable 🟦 OutOfService

fc2/25
Status: TE, up, Multi-VSAN ISL

Figure 6-84 ISL connections, TE_Ports on MDS9222i-2 switch

After connecting the two switches, Fabric Manager shows the added switch and ISLs in the graphical presentation of the fabric, as shown in Figure 6-85.



VSANs	From Switch	From Interface	To Switch	To Interface	Status
1,10,20,30	mds9222i-1	fc2/1	mds9222i-2	fc2/1	ok
1,10,20,30	mds9222i-1	fc2/25	mds9222i-2	fc2/25	ok

Figure 6-85 Fabric expanded by adding a switch

6.2.2 Trunking and PortChannel

In Cisco terminology, the term *trunking* is used to describe a single trunking E_Port (TE_Port) that can multiplex the traffic of more than one VSAN on a single physical interface. This is in contrast to other Fibre Channel switch manufacturers that use the term trunking to describe the aggregation of several physical interfaces into a single logical interface. Cisco calls this latter feature *PortChannel*.

Trunking and PortChannel features are available for both Fibre Channel and gigabit Ethernet interfaces on the Cisco MDS 9000 family. Since the configuration rules for these features are different, we describe both of them separately.

6.2.3 FC trunking

Trunking (also known as VSAN trunking) enables interconnect ports to transmit and receive frames in more than one VSAN over the same physical link. In this case the link is configured as an extended ISL (EISL) link using the EISL frame format.

Trunking is only applicable to E_Ports and used for inter-switch connections. Trunking is normally enabled for all ports in the switch but can be disabled on a port-by-port basis. If the port becomes operational as a trunking E_Port, it is referred to as a TE_Port. If a port with trunking enabled is connected to a third-party switch, it works as a normal E_Port.

6.2.4 FC PortChannel

The PortChannel feature can be used to aggregate up to 16 ISL or EISL links into a single logical link. The Fibre Channel ports can be any Fibre Channel ports in any 16-port Fibre Channel line card.

The PortChannel feature increases the available aggregate bandwidth of the logical link since the traffic is distributed among all functional links in the channel. It also provides high availability, since the channel remains active as long as at least one of the links forming it remains active, and the traffic is transparently distributed over the remaining links.

Since PortChannel can be built on EISL links, both trunking and PortChannel are supported simultaneously.

Defining a PortChannel using the CLI

In our setup we have the EISLs listed in Table 6-1.

Table 6-1 EISLs in our LAB setup

MDS9222i-1	MDS9222i-2	Link speed	Trunk
fc2/1	fc2/1	8 Gbps	On
fc2/25	fc2/25	8 Gbps	On

In Example 6-29 we define PortChannel 10 to include all (two) EISLs between the switches mds92222i-1 and mds9222i-2, which takes the EISL ports down. When performing the **no shutdown** command, the ports come back up and the PortChannel will be established. Finally, we will list the PortChannel database on each switch, using the command **show port-channel database**.

Example 6-29 Setting up PortChannel

```
mds9222i-1# show topology
FC Topology for VSAN 1 :
-------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
-------------------------------------------------------------------------------
            fc2/1 0xa1(161)            fc2/1  9.43.86.148
           fc2/25 0xa1(161)           fc2/25  9.43.86.148

FC Topology for VSAN 10 :
-------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
-------------------------------------------------------------------------------
            fc2/1  0x0c(12)            fc2/1  9.43.86.148
           fc2/25  0x0c(12)           fc2/25  9.43.86.148

FC Topology for VSAN 20 :
-------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
-------------------------------------------------------------------------------
            fc2/1  0x19(25)            fc2/1  9.43.86.148
           fc2/25  0x19(25)           fc2/25  9.43.86.148

FC Topology for VSAN 30 :
-------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
-------------------------------------------------------------------------------
            fc2/1  0x26(38)            fc2/1  9.43.86.148
           fc2/25  0x26(38)           fc2/25  9.43.86.148

mds9222i-1# configure terminal
mds9222i-1(config)# interface fc 2/1, fc 2/25
mds9222i-1(config-if)# channel-group 10
fc2/1 fc2/25 added to port-channel 10 and disabled
please do the same operation on the switch at the other end of the
port-channel, then do "no shutdown" at both end to bring them up

mds9222i-2# configure terminal
mds9222i-2(config)# interface fc 2/1, fc 2/25
mds9222i-2(config-if)# channel-group 10
fc2/1 fc2/25 added to port-channel 10 and disabled
```

```
please do the same operation on the switch at the other end of the
port-channel,then do "no shutdown" at both end to bring them up

mds9222i-2(config-if)# no shutdown

mds9222i-1(config-if)# no shutdown

mds9222i-1# show port-channel database
port-channel 10
    Administrative channel mode is on
    Operational channel mode is on
    Last membership update succeeded
    First operational port is fc2/25
    2 ports in total, 2 ports up
    Ports:   fc2/1    [up]
             fc2/25   [up] *

mds9222i-2# show port-channel database
port-channel 10
    Administrative channel mode is on
    Operational channel mode is on
    Last membership update succeeded
    First operational port is fc2/25
    2 ports in total, 2 ports up
    Ports:   fc2/1    [up]
             fc2/25   [up] *
mds9222i-2# show topology

FC Topology for VSAN 10 :
--------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
--------------------------------------------------------------------------------
  port-channel 10  0x0b(11)  port-channel 10  9.43.86.147

FC Topology for VSAN 20 :
--------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
--------------------------------------------------------------------------------
  port-channel 10 0x9c(156)  port-channel 10  9.43.86.147

FC Topology for VSAN 30 :
--------------------------------------------------------------------------------
       Interface  Peer Domain Peer Interface     Peer IP Address
--------------------------------------------------------------------------------
  port-channel 10 0xc9(201)  port-channel 10  9.43.86.147
```

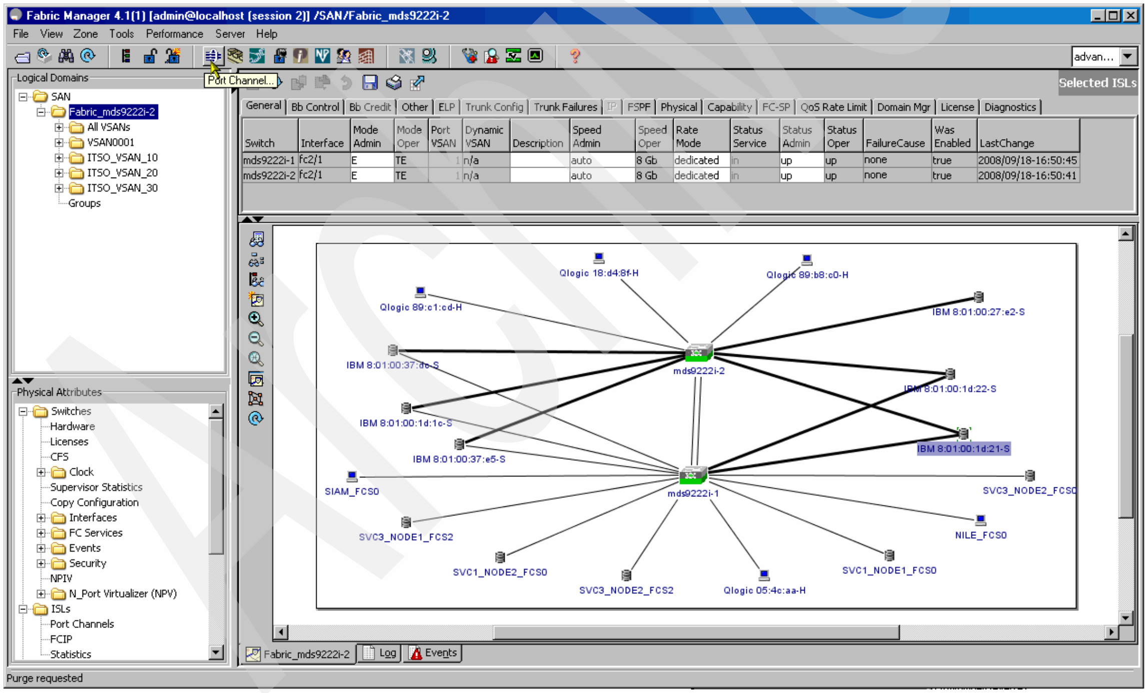
Note: When creating a PortChannel, a compatibility check is performed to ensure that all configuration parameters for each physical port in the channel are the same. Therefore, a port cannot become operational if incompatibility issues exist. For example, to enable trunk mode, all ports must be configured with trunk mode enabled prior to creating the PortChannel.

Tip: Using the **`force`** option when adding a port to a PortChannel forces the configuration of the ports in the PortChannel onto the added port to achieve compatibility.

Defining a PortChannel using the GUI

Now we configure a PortChannel group using the GUI. As the first step we need to verify that we have EISLs between our switches mds92222i-1 and mds9222i-2.

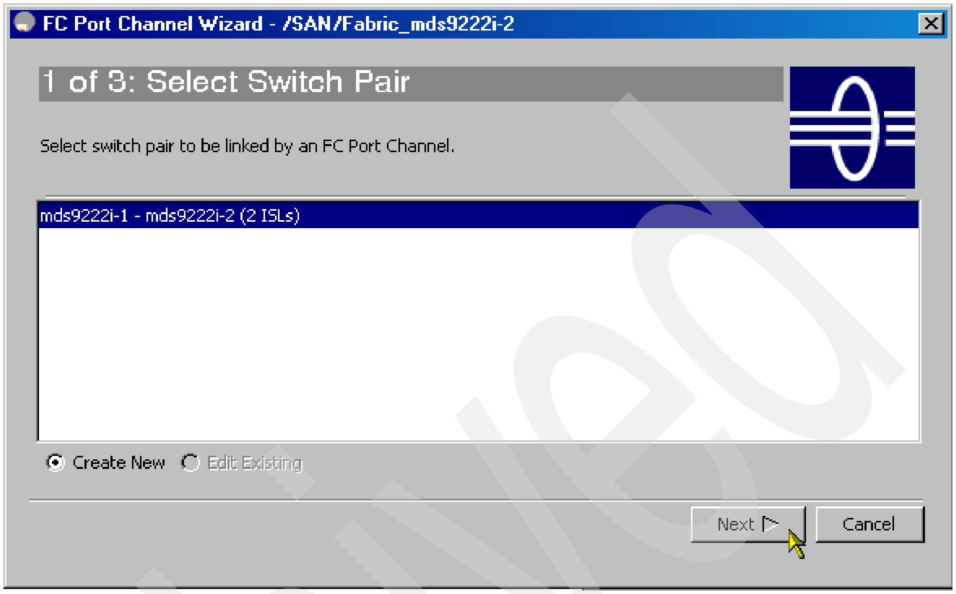
1. To start the PortChannel configuration from the GUI, select the icon, as shown in Figure 6-86.



Switch	Interface	Mode Admin	Mode Oper	Port VSAN	Dynamic VSAN	Description	Speed Admin	Speed Oper	Rate Mode	Status Service	Status Admin	Status Oper	FailureCause	Was Enabled	LastChange
mds9222i-1	fc2/1	E	TE	1	n/a		auto	8 Gb	dedicated	in	up	up	none	true	2008/09/18-16:50:45
mds9222i-2	fc2/1	E	TE	1	n/a		auto	8 Gb	dedicated	in	up	up	none	true	2008/09/18-16:50:41

Figure 6-86 Two MDS9222i connected by two EISL 8 Gbps links

2. Select switch pair to establish a PortChannel and select **Create New**, as shown in Figure 6-87.


FC Port Channel Wizard - /SAN/Fabric_mds9222i-2
1 of 3: Select Switch Pair

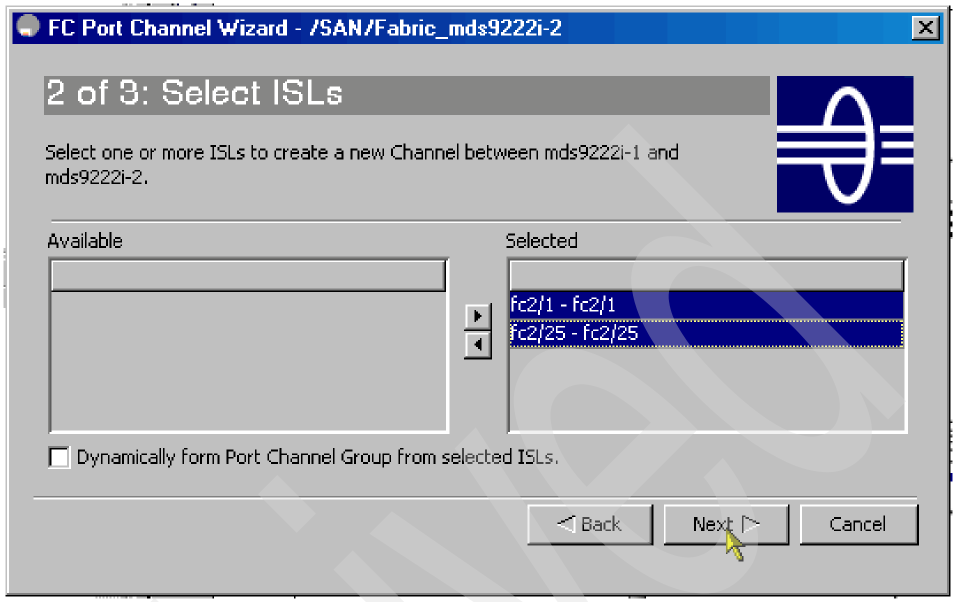
Select switch pair to be linked by an FC Port Channel.

mds9222i-1 - mds9222i-2 (2 ISLs)

● Create New ○ Edit Existing

Figure 6-87 Select switch pair to establish a PortChannel

3. Choose the ports to form a PortChannel, as shown in Figure 6-88.



FC Port Channel Wizard - /SAN/Fabric_mds9222i-2

2 of 3: Select ISLs

Select one or more ISLs to create a new Channel between mds9222i-1 and mds9222i-2.

Available

Selected

fc2/1 - fc2/1
fc2/25 - fc2/25

□ Dynamically form Port Channel Group from selected ISLs.

Figure 6-88 Select ports to form a PortChannel

4. In the final step for both switches we must define all the required parameters to set up a PortChannel, as shown in Figure 6-89:

   – Channel ID number for both switches: We recommend using the same ID for both switches to simplify administration.

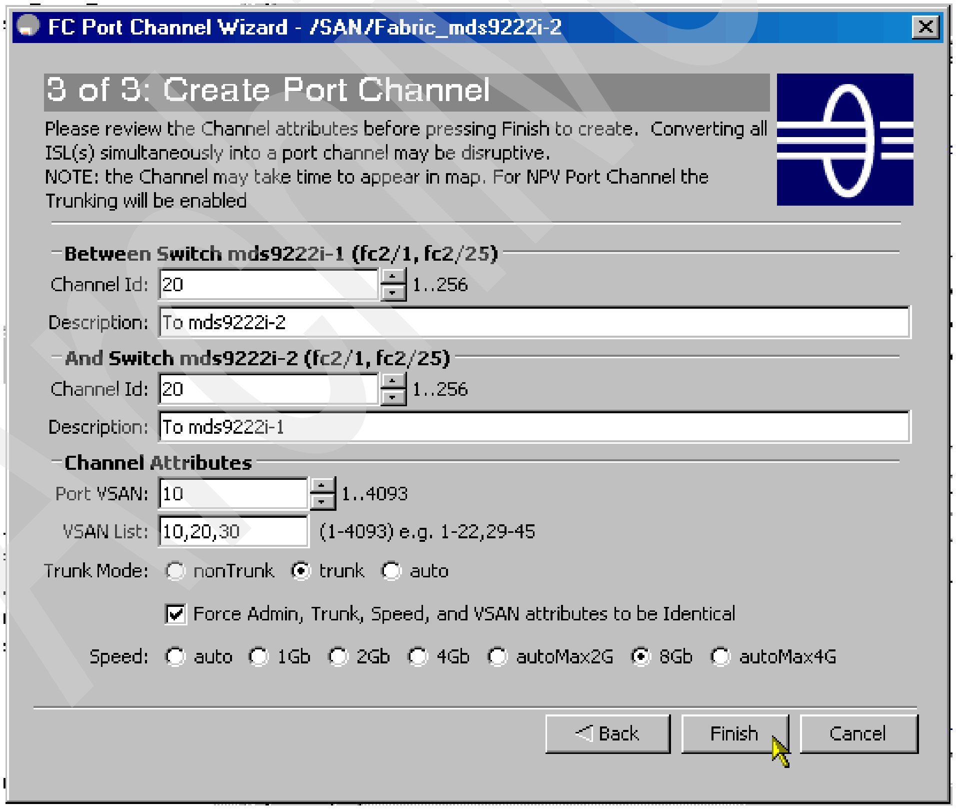
   – VSAN List gives a list of VSANs to which the ISLs belong.

   – Port VSAN for a PortChannel: Logical assignment of the PortChannel to a particular VSAN. There are no functional implications.

   – The aggregated speed of the PortChannel.

   – Trunk Mode to enable trunking on the links in the PortChannel. Select trunking if your link is between TE_ports. Select non-trunking if your link is between E_ports. Select auto if you are not sure.

   – Force Admin, Trunk, Speed, and VSAN attributes to be identical: This check box ensures that the same parameter settings are used in all physical ports in the channel. If these settings are not identical, the ports cannot become part of the PortChannel.



FC Port Channel Wizard - /SAN/Fabric_mds9222i-2

3 of 3: Create Port Channel

Please review the Channel attributes before pressing Finish to create. Converting all ISL(s) simultaneously into a port channel may be disruptive.
NOTE: the Channel may take time to appear in map. For NPV Port Channel the Trunking will be enabled

Between Switch mds9222i-1 (fc2/1, fc2/25)

Channel Id: 20 1..256

Description: To mds9222i-2

And Switch mds9222i-2 (fc2/1, fc2/25)

Channel Id: 20 1..256

Description: To mds9222i-1

Channel Attributes

Port VSAN: 10 1..4093

VSAN List: 10,20,30 (1-4093) e.g. 1-22,29-45

Trunk Mode: ○ nonTrunk ● trunk ○ auto

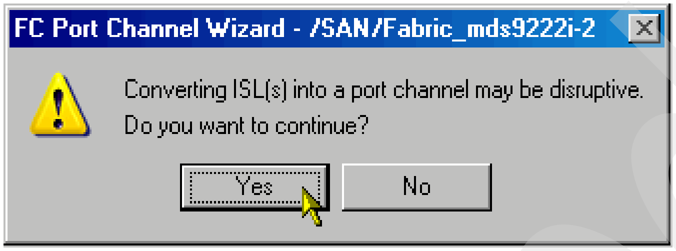
☑ Force Admin, Trunk, Speed, and VSAN attributes to be Identical

Speed: ○ auto ○ 1Gb ○ 2Gb ○ 4Gb ○ autoMax2G ● 8Gb ○ autoMax4G

Figure 6-89 Final step to configure a PortChannel using the GUI

5. In our example we use 8 Gbps TE ports to set up a PortChannel between two MDS9222i switches.

Fabric Manager will warn us that the process of converting ports into a PortChannel may be disruptive, as shown in Figure 6-90.

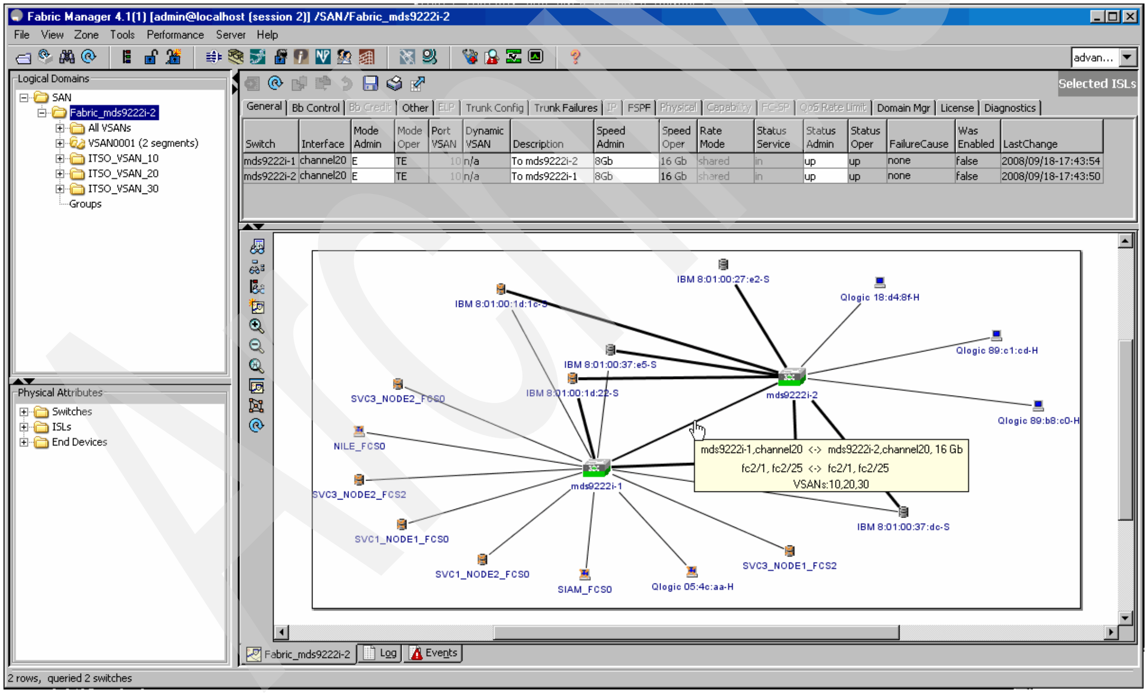


FC Port Channel Wizard - /SAN/Fabric_mds9222i-2

Converting ISL(s) into a port channel may be disruptive.
Do you want to continue?

Figure 6-90 Converting ports into a PortChannel may be disruptive message

Verify the PortChannel configuration and the status of the connection, as shown in Figure 6-91.



Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2

Switch	Interface	Mode Admin	Mode Oper	Port VSAN	Dynamic VSAN	Description	Speed Admin	Speed Oper	Rate Mode	Status Service	Status Admin	Status Oper	FailureCause	Was Enabled	LastChange
mds9222i-1	channel20	E	TE	10	n/a	To mds9222i-2	8Gb	16 Gb	shared	in	up	up	none	false	2008/09/18-17:43:54
mds9222i-2	channel20	E	TE	10	n/a	To mds9222i-1	8Gb	16 Gb	shared	in	up	up	none	false	2008/09/18-17:43:50

mds9222i-1,channel20 <-> mds9222i-2,channel20, 16 Gb
fc2/1, fc2/25 <-> fc2/1, fc2/25
VSANs:10,20,30

2 rows, queried 2 switches

Figure 6-91 PortChannel status in GUI

6.3 Inter VSAN Routing (IVR)

VSANs provide the benefit of sharing the physical switch infrastructure while isolating traffic between VSANs. This inherently prevents resource sharing between VSANs. Using IVR provides resource sharing across VSANs without compromising the benefits of VSANs. IVR is done by specifying initiators and devices in different VSANs without merging the respective VSANs together.

> **Note:** The Enterprise License Package (ENTERPRISE_PKG) must be installed on all IVR edge or transit switches.

To understand how IVR works, we first clarify the following IVR definitions:

- Inter VSAN Zone (IVZ): A set of end devices that are allowed to communicate across VSANs within their interconnected SAN fabric. This definition is based on their port World Wide Names (pWWNs) and their native VSAN associations. You can configure up to 200 IVZs and 2,000 IVZ members on any switch in the Cisco MDS 9000 family.
- Inter VSAN zonesets (IVZS): One or more IVZs make up an IVZS. You can configure up to 32 IVZSs on any switch in the Cisco MDS 9000 family. Only one IVZS can be active at any time.
- Inter VSAN Path (IVR Path): An IVR path is a set of switches and Inter-Switch Links through which a frame from one end device in one VSAN can reach another end device in some other VSAN. Multiple paths can exist between two such end devices.
- Edge and Transit VSANs: A VSAN that initiates (source edge-VSAN) or terminates (destination edge-VSAN) an IVR path. Edge VSANs might be adjacent to each other or they might be connected by one or more transit VSANs.

Some guidelines to follow before IVR creation are:

- Verify that unique domain IDs are configured in all switches and VSANs participating in IVR.

  > **Note:** Unique domain IDs are not a requirement when using IVR-NAT. A common domain ID (10, for example) could be in VSAN 5 and VSAN 6 and you could still route between devices in these VSANs attached to the switches with domain ID 10.

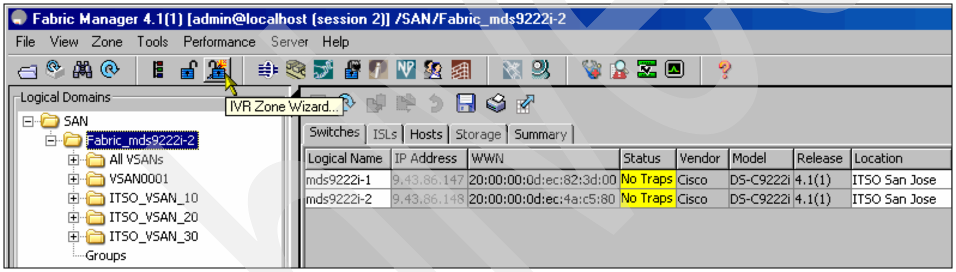
- Enable IVR in the border switches.

- Configure the required IVR topology in all the IVR-enabled border switches, or use the recommended auto-topology feature, which eliminates the necessity for the user to define one.
- Create and activate IVZSs in all the IVR-enabled border switches.
- Verify the IVR configuration.

6.3.1 Configuring IVR using the GUI

We now demonstrate a simple IVR to allow selected members of different VSANs to communicate.

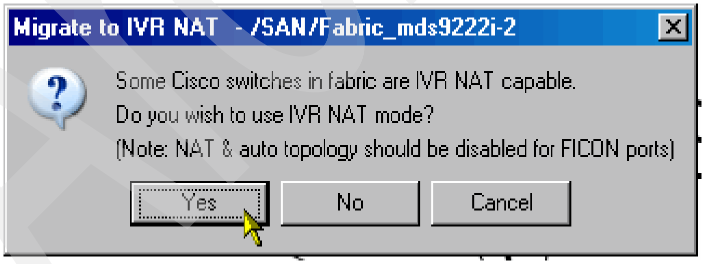
The first step is to locate the IVR Wizard. This is the same wizard that we use for normal zoning operations, and is found by starting with the Fabric Manager IVR Wizard icon, as seen in Figure 6-92.


Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2
File View Zone Tools Performance Server Help
IVR Zone Wizard...
Logical Domains
SAN
Fabric_mds9222i-2
All VSANs
VSAN0001
ITSO_VSAN_10
ITSO_VSAN_20
ITSO_VSAN_30
Groups
Switches ISLs Hosts Storage Summary

Logical Name	IP Address	WWN	Status	Vendor	Model	Release	Location
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose

Figure 6-92 Starting the IVR wizard

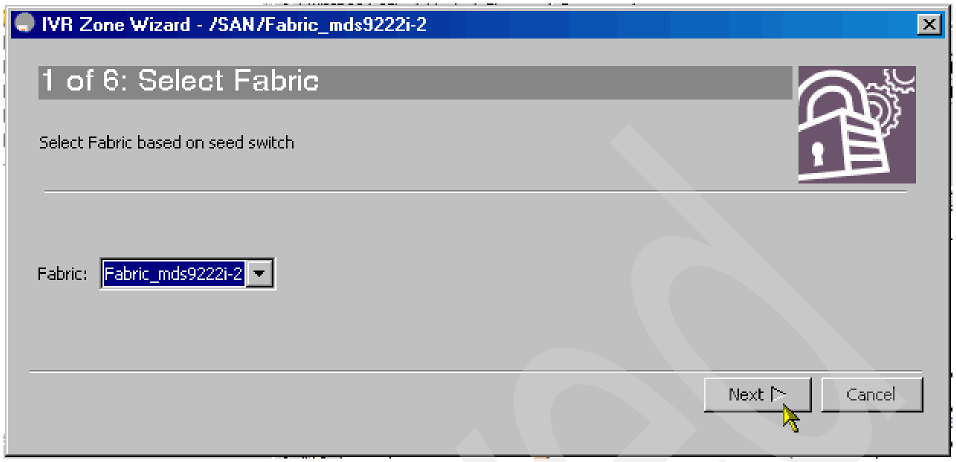
As we want to use IVR NAT, we select the IVR NAT option, as shown in Figure 6-93.



Some Cisco switches in fabric are IVR NAT capable.
Do you wish to use IVR NAT mode?
(Note: NAT & auto topology should be disabled for FICON ports)

Figure 6-93 Selecting IVR NAT

In Figure 6-94 we select the fabric.

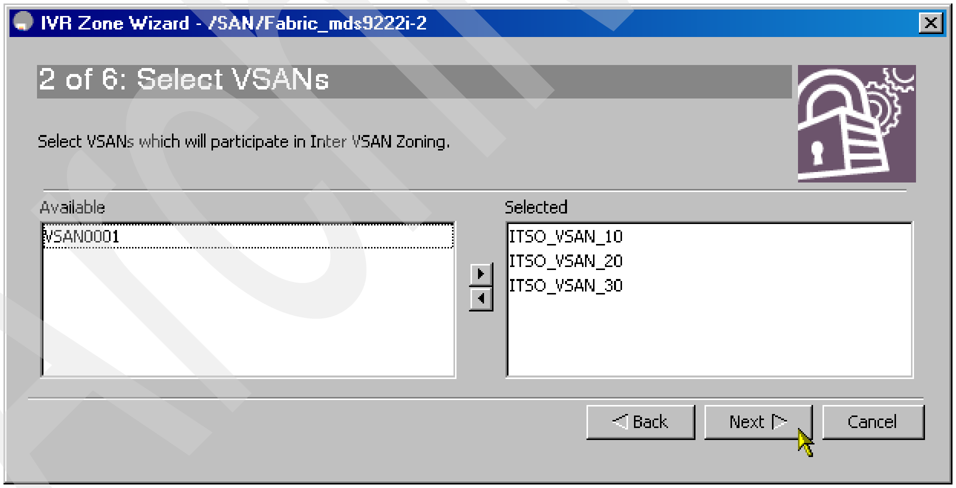


Select Fabric based on seed switch

Fabric: Fabric_mds9222i-2

Figure 6-94 Select fabric to set up IVR

We continue setting up our IVR by proceeding to the next panel, where we have to move the VSANs that we are working with to the appropriate window, as seen in Figure 6-95.



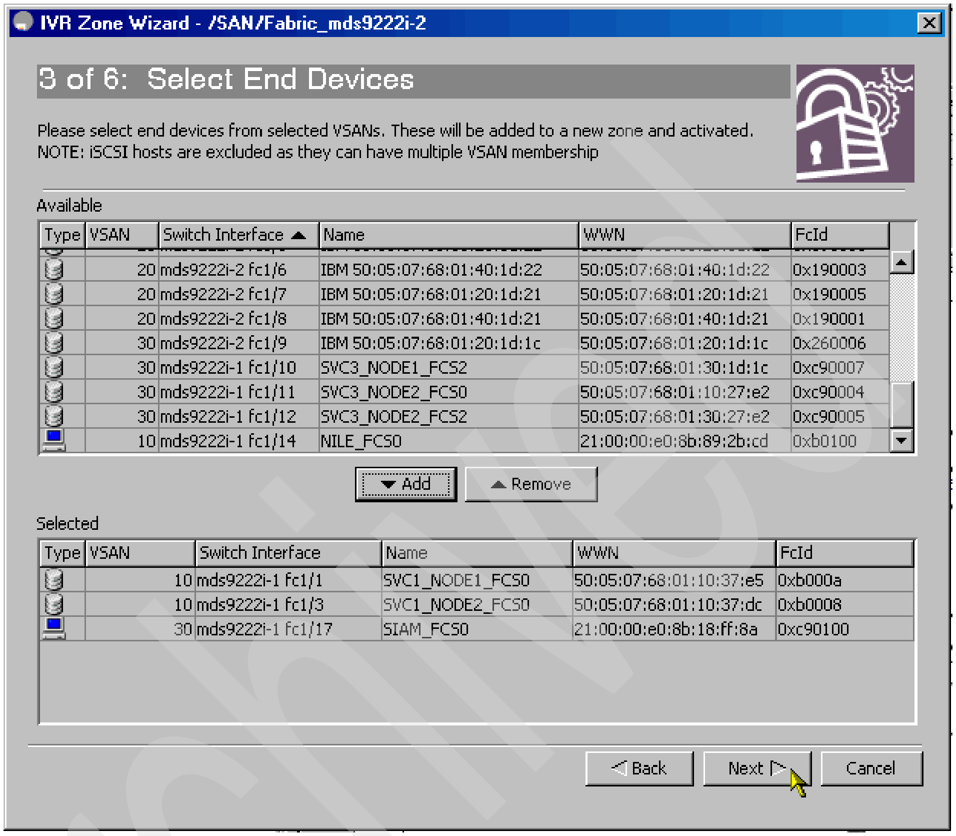
Select VSANs which will participate in Inter VSAN Zoning.

Available
VSAN0001

Selected
ITSO_VSAN_10
ITSO_VSAN_20
ITSO_VSAN_30

Figure 6-95 Selecting VSANs

We proceed to the next panel, as shown in Figure 6-96.



IVR Zone Wizard - /SAN/Fabric_mds9222i-2

3 of 6: Select End Devices

Please select end devices from selected VSANs. These will be added to a new zone and activated.
NOTE: iSCSI hosts are excluded as they can have multiple VSAN membership

Available

Type	VSAN	Switch Interface ▲	Name	WWN	FcId
	20	mds9222i-2 fc1/6	IBM 50:05:07:68:01:40:1d:22	50:05:07:68:01:40:1d:22	0x190003
	20	mds9222i-2 fc1/7	IBM 50:05:07:68:01:20:1d:21	50:05:07:68:01:20:1d:21	0x190005
	20	mds9222i-2 fc1/8	IBM 50:05:07:68:01:40:1d:21	50:05:07:68:01:40:1d:21	0x190001
	30	mds9222i-2 fc1/9	IBM 50:05:07:68:01:20:1d:1c	50:05:07:68:01:20:1d:1c	0x260006
	30	mds9222i-1 fc1/10	SVC3_NODE1_FCS2	50:05:07:68:01:30:1d:1c	0xc90007
	30	mds9222i-1 fc1/11	SVC3_NODE2_FCS0	50:05:07:68:01:10:27:e2	0xc90004
	30	mds9222i-1 fc1/12	SVC3_NODE2_FCS2	50:05:07:68:01:30:27:e2	0xc90005
	10	mds9222i-1 fc1/14	NILE_FCS0	21:00:00:e0:8b:89:2b:cd	0xb0100

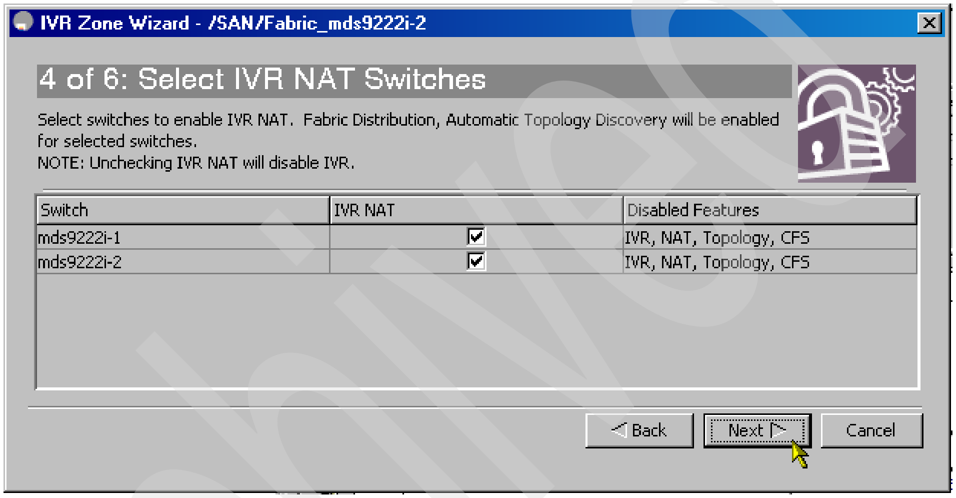
Selected

Type	VSAN	Switch Interface	Name	WWN	FcId
	10	mds9222i-1 fc1/1	SVC1_NODE1_FCS0	50:05:07:68:01:10:37:e5	0xb000a
	10	mds9222i-1 fc1/3	SVC1_NODE2_FCS0	50:05:07:68:01:10:37:dc	0xb0008
	30	mds9222i-1 fc1/17	SIAM_FCS0	21:00:00:e0:8b:18:ff:8a	0xc90100

Figure 6-96 Selecting end devices

After selecting the IVR NAT participants, we add them to the Selected window, as seen in Figure 6-97.

Note: Cisco MDS SAN-OS Release 2.1(1a) introduced IVR NAT, which allows you to set up IVR in a fabric without requiring unique domain IDs on every switch in the IVR path. When IVR NAT is enabled, the virtualized end device that appears in the native VSAN uses a virtual domain ID that is unique to the native VSAN.



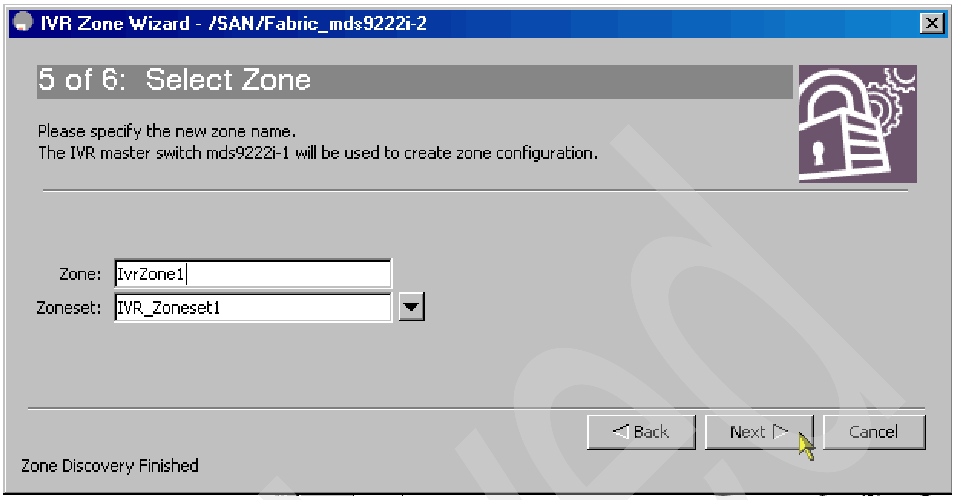
4 of 6: Select IVR NAT Switches

Select switches to enable IVR NAT. Fabric Distribution, Automatic Topology Discovery will be enabled for selected switches.
NOTE: Unchecking IVR NAT will disable IVR.

Switch	IVR NAT	Disabled Features
mds9222i-1	☑	IVR, NAT, Topology, CFS
mds9222i-2	☑	IVR, NAT, Topology, CFS

Figure 6-97 Selecting IVR switches

Now we must specify a zone name, as shown in Figure 6-98.



IVR Zone Wizard - /SAN/Fabric_mds9222i-2

5 of 6: Select Zone

Please specify the new zone name.
The IVR master switch mds9222i-1 will be used to create zone configuration.

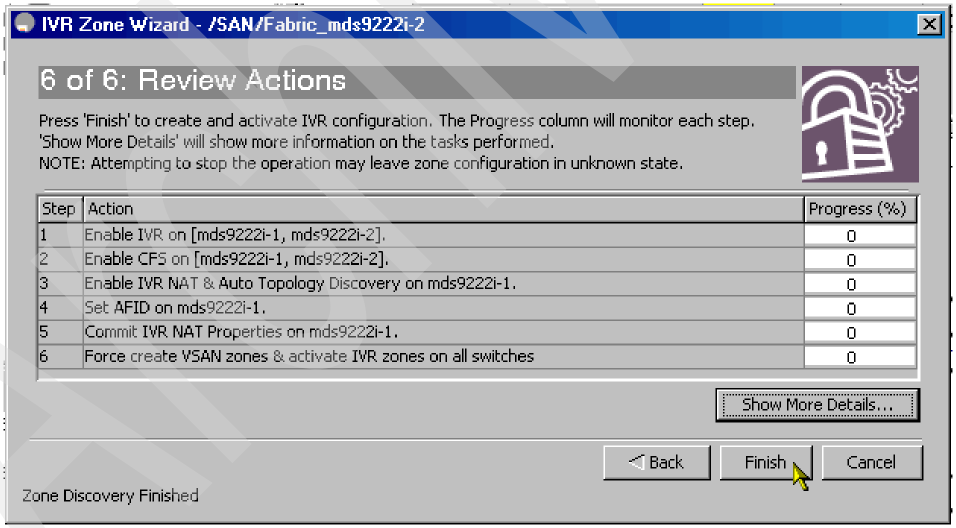
Zone: IvrZone1

Zoneset: IVR_Zoneset1

Zone Discovery Finished

Figure 6-98 Selecting a zone name

Now we can review our actions and the progress, as seen in Figure 6-99.



IVR Zone Wizard - /SAN/Fabric_mds9222i-2

6 of 6: Review Actions

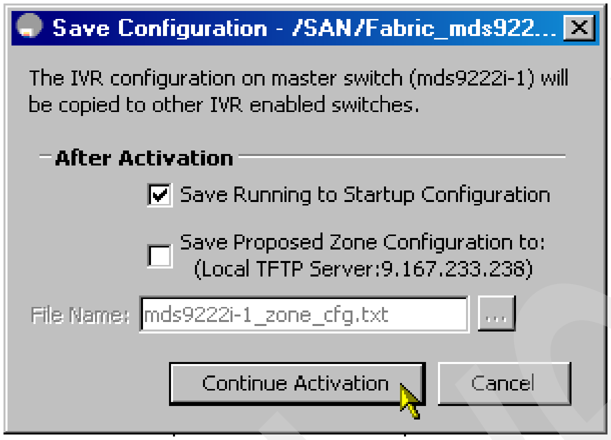
Press 'Finish' to create and activate IVR configuration. The Progress column will monitor each step.
'Show More Details' will show more information on the tasks performed.
NOTE: Attempting to stop the operation may leave zone configuration in unknown state.

Step	Action	Progress (%)
1	Enable IVR on [mds9222i-1, mds9222i-2].	0
2	Enable CFS on [mds9222i-1, mds9222i-2].	0
3	Enable IVR NAT & Auto Topology Discovery on mds9222i-1.	0
4	Set AFID on mds9222i-1.	0
5	Commit IVR NAT Properties on mds9222i-1.	0
6	Force create VSAN zones & activate IVR zones on all switches	0

Zone Discovery Finished

Figure 6-99 Review our actions

When we have done this, we are asked whether we want to continue with the activation to the startup configuration or save it as a proposed configuration, as shown in Figure 6-100.



Save Configuration - /SAN/Fabric_mds922...

The IVR configuration on master switch (mds9222i-1) will be copied to other IVR enabled switches.

After Activation

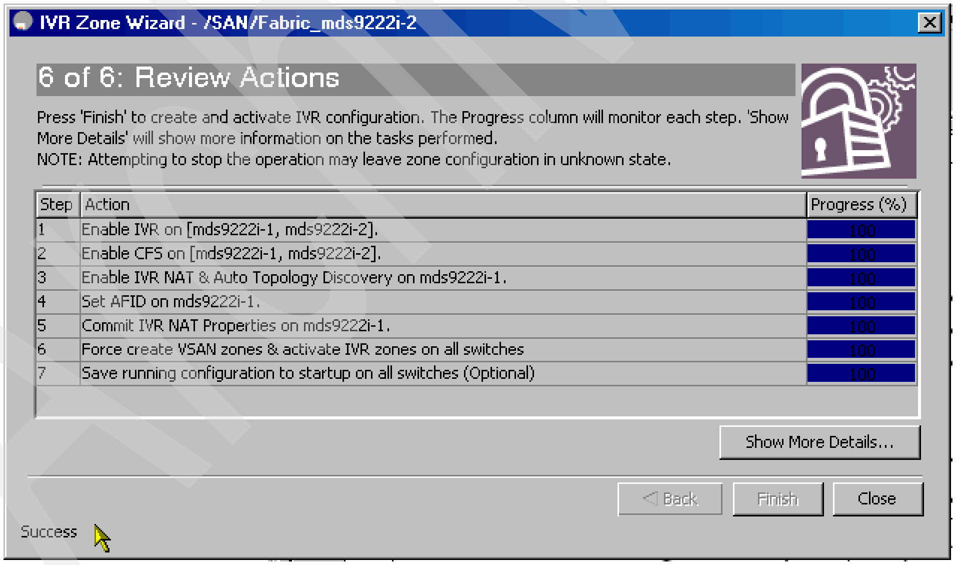
☑ Save Running to Startup Configuration

□ Save Proposed Zone Configuration to: (Local TFTP Server:9.167.233.238)

File Name: mds9222i-1_zone_cfg.txt

Figure 6-100 Confirm activation

IVR has been configured successfully, as shown in Figure 6-101.



IVR Zone Wizard - /SAN/Fabric_mds9222i-2

6 of 6: Review Actions

Press 'Finish' to create and activate IVR configuration. The Progress column will monitor each step. 'Show More Details' will show more information on the tasks performed.
NOTE: Attempting to stop the operation may leave zone configuration in unknown state.

Step	Action	Progress (%)
1	Enable IVR on [mds9222i-1, mds9222i-2].	100
2	Enable CFS on [mds9222i-1, mds9222i-2].	100
3	Enable IVR NAT & Auto Topology Discovery on mds9222i-1.	100
4	Set AFID on mds9222i-1.	100
5	Commit IVR NAT Properties on mds9222i-1.	100
6	Force create VSAN zones & activate IVR zones on all switches	100
7	Save running configuration to startup on all switches (Optional)	100

Success

Figure 6-101 IVR configuration completed for each listed action

You can check the status of IVR using the CLI, as shown in Example 6-30.

Example 6-30   IVR status using the CLI

```
mds9222i-1# show ivr zoneset
zoneset name IVR_Zoneset1
  zone name IvrZone1
      pwwn 50:05:07:68:01:10:37:e5            vsan   10 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:10:37:dc            vsan   10 autonomous-fabric-id  1
      pwwn 21:00:00:e0:8b:18:ff:8a            vsan   30 autonomous-fabric-id  1

mds9222i-1# show ivr session status
Last Action Time Stamp     : Fri Sep 19 03:26:41 2008
Last Action                : Commit
Last Action Result         : Success
Last Action Failure Reason : none

mds9222i-1# show ivr virtual-domains vsan 10
VSAN  # Domains  IVR Virtual Domains
---- --------- ----------------------------------------------
  10     1         75
----  ---------  ----------------------------------------------

mds9222i-1# show ivr virtual-domains vsan 30
VSAN  # Domains  IVR Virtual Domains
---- --------- ----------------------------------------------
  30     1         121
----  ---------  ----------------------------------------------

mds9222i-1# show ivr vsan-topology

AFID  SWITCH WWN                 Active   Cfg. VSANS           Switch-Name
-------------------------------------------------------------------------
   1  20:00:00:0d:ec:4a:c5:80     yes      no  1,10,20,30
   1  20:00:00:0d:ec:82:3d:00 *   yes      no  1,10,20,30

Total:   2 entries in active and configured IVR VSAN-Topology
```

6.3.2 Configuring IVR using the CLI

All IVR configuration steps can also be performed using the CLI. Example 6-31 shows how to manage the IVR zone and zone set configuration.

Example 6-31 IVR zone and zoneset configuration from the CLI

```
mds9222i-2# show flogi database
-----------------------------------------------------------------------INTERFACE
VSAN    FCID           PORT NAME               NODE NAME
-----------------------------------------------------------------------fc1/5
20    0x15000e  50:05:07:68:01:20:1d:22 50:05:07:68:01:00:1d:22
fc1/6            20    0x150003  50:05:07:68:01:40:1d:22 50:05:07:68:01:00:1d:22
fc1/7            20    0x150000  50:05:07:68:01:20:1d:21 50:05:07:68:01:00:1d:21
fc1/8            20    0x150001  50:05:07:68:01:40:1d:21 50:05:07:68:01:00:1d:21
fc1/9            30    0x1f0006  50:05:07:68:01:20:1d:1c 50:05:07:68:01:00:1d:1c
fc1/10           30    0x1f000a  50:05:07:68:01:40:1d:1c 50:05:07:68:01:00:1d:1c
fc1/11           30    0x1f0001  50:05:07:68:01:20:27:e2 50:05:07:68:01:00:27:e2
fc1/14           20    0x150100  21:00:00:e0:8b:89:b8:c0 20:00:00:e0:8b:89:b8:c0
fc1/15           50    0x6e0000  21:00:00:e0:8b:05:41:bc 20:00:00:e0:8b:05:41:bc
                           [Diomede_1]
fc1/16           20    0x150200  21:00:00:e0:8b:89:c1:cd 20:00:00:e0:8b:89:c1:cd
fc1/17           10    0x0b0100  21:00:00:e0:8b:18:d4:8f 20:00:00:e0:8b:18:d4:8f
fc2/2            20    0x150300  20:05:00:a0:b8:17:44:33 20:04:00:a0:b8:17:44:31

Total number of flogi = 12.

mds9222i-1# show flogi database
-----------------------------------------------------------------------INTERFACE
VSAN    FCID           PORT NAME               NODE NAME
-----------------------------------------------------------------------fc1/1
20    0x14000a  50:05:07:68:01:10:37:e5 50:05:07:68:01:00:37:e5
fc1/2            20    0x14000b  50:05:07:68:01:30:37:e5 50:05:07:68:01:00:37:e5
fc1/3            20    0x140008  50:05:07:68:01:10:37:dc 50:05:07:68:01:00:37:dc
fc1/4            20    0x140009  50:05:07:68:01:30:37:dc 50:05:07:68:01:00:37:dc
fc1/14           30    0x1e0100  21:00:00:e0:8b:89:2b:cd 20:00:00:e0:8b:89:2b:cd
                           [Nile_1]
fc1/15           20    0x140400  21:00:00:e0:8b:05:48:bc 20:00:00:e0:8b:05:48:bc
fc1/16           20    0x140200  21:00:00:e0:8b:05:4c:aa 20:00:00:e0:8b:05:4c:aa
                           [Palau_1]
fc1/17           50    0x640000  21:00:00:e0:8b:18:ff:8a 20:00:00:e0:8b:18:ff:8a
fc2/2            20    0x140300  20:04:00:a0:b8:17:44:32 20:04:00:a0:b8:17:44:31
fc2/17           20    0x140000  50:03:08:c1:40:46:70:06 50:03:08:c1:40:06:70:06

Total number of flogi = 10.

mds9222i-2# configure terminal
mds9222i-2(config)# ivr zone name IVR_SVC_Diomede
mds9222i-2(config-ivr-zone)# member pwwn 21:00:00:e0:8b:05:41:bc vsan 50
mds9222i-2(config-ivr-zone)# member pwwn 50:05:07:68:01:10:37:e5 vsan 20
mds9222i-2(config-ivr-zone)# member pwwn 50:05:07:68:01:30:37:e5 vsan 20
mds9222i-2(config-ivr-zone)# member pwwn 50:05:07:68:01:10:37:dc vsan 20
```

```
mds9222i-2(config-ivr-zone)# member pwwn 50:05:07:68:01:30:37:dc vsan 20
mds9222i-2(config-ivr-zone)# exit
mds9222i-2(config)# ivr zoneset name IVR_Zoneset_SVC
mds9222i-2(config-ivr-zoneset)# member IVR_SVC_Diomede
mds9222i-2(config-ivr-zoneset)# exit
mds9222i-2(config)# ivr distribute
mds9222i-2(config)# ivr commit
commit initiated. check ivr status
mds9222i-2(config)# end
mds9222i-2# show ivr zoneset

zoneset name IVR_Zoneset_SVC
  zone name IvrZone_SIAM_SVC_1
      pwwn 21:00:00:e0:8b:18:ff:8a             vsan   50 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:10:37:e5             vsan   20 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:30:37:e5             vsan   20 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:30:37:dc             vsan   20 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:10:37:dc             vsan   20 autonomous-fabric-id  1

  zone name IVR_SVC_Diamonde
      pwwn 21:00:00:e0:8b:05:41:bc             vsan   50 autonomous-fabric-id  1
           [Diomede_1]
      pwwn 50:05:07:68:01:10:37:e5             vsan   20 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:30:37:e5             vsan   20 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:10:37:dc             vsan   20 autonomous-fabric-id  1
      pwwn 50:05:07:68:01:30:37:dc             vsan   20 autonomous-fabric-id  1

mds9222i-2# show ivr zoneset active

zoneset name IVR_Zoneset_SVC
  zone name IvrZone_SIAM_SVC_1
    * pwwn 21:00:00:e0:8b:18:ff:8a             vsan   50 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:10:37:e5             vsan   20 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:30:37:e5             vsan   20 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:30:37:dc             vsan   20 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:10:37:dc             vsan   20 autonomous-fabric-id  1

  zone name IVR_SVC_Diomede
    * pwwn 21:00:00:e0:8b:05:41:bc             vsan   50 autonomous-fabric-id  1
           [Diomede_1]
    * pwwn 50:05:07:68:01:30:37:e5             vsan   20 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:30:37:dc             vsan   20 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:10:37:dc             vsan   20 autonomous-fabric-id  1
    * pwwn 50:05:07:68:01:10:37:e5             vsan   20 autonomous-fabric-id  1
```

6.4 N-Port Identifier Virtualization

N-Port identifier virtualization (NPV) reduces the number of Fibre Channel domain IDs in SANs. Switches operating in NPV mode do not join a fabric. Rather, they pass traffic between NPV core switch links and end devices, which eliminates the domain IDs for these edge switches.

Typically, Fibre Channel networks are deployed using a core-edge model with a large number of fabric switches connected to edge devices. Such a model is cost-effective because the per-port cost for director class switches is much higher than that of fabric switches. However, as the number of ports in the fabric increases, the number of switches deployed also increases, and you can end up with a dramatic increase in the number of domain IDs (the maximum number supported is 239). This challenge becomes even more difficult when additional blade chassis are deployed in Fibre Channel networks.

NPV addresses the increase in the number of domain IDs needed to deploy a large number of the ports by making a fabric or blade switch appear as a host to the core Fibre Channel switch, and as a Fibre Channel switch to the servers in the fabric or blade switch. NPV aggregates multiple locally connected N-ports into one or more external NP links, thereby sharing the domain ID of the NPV core switch among multiple NPV switches. NPV also allows multiple devices to attach to the same port on the NPV core switch, thereby reducing the need for more ports on the core.

Attention: NPV is supported on the MDS 9124, 9134, and IBM BladeCenter®. When you enable NPV or disable NPV mode a warning message appears that the current configuration will be erased and the system will be rebooted. After reboot of the NPV-enabled switch, ports enter into default port modes of F and NP automatically in the 3.2(1) SAN-OS release and in the NX-OS 4.x releases. In the case of an MDS 9124, six NP ports will be created by default when NPV is enabled. In the case of an MDS 9134 6 NP ports will be created by default. With a 10G_PORT_ACTIVATION_PKG license eight NP ports will be created. The IBM BladeCenter module creates six NP ports by default. The NPV-enabled edge switch port type NP must connect to an NPV-enabled core switch port type F.

The NP ports can be considered as passthru ports. If you add more NP ports after a configuration has been running you must disable/enable all F ports or NP ports on the edge switch in order to load balance over all the NP ports.

6.4.1 Configuring NPV on an edge switch and NPV on a core switch

Using Device Manager:

1. Launch Device Manager from the core NPV switch to enable NPV. From the Admin drop-down menu, select **Feature Control**. Select **enable** for the NPV feature.
2. Click **Apply**.
3. From the Interface drop-down menu, select **FC All** to configure the NPV core switch port as an F-Port.
4. In the Mode Admin column, select the **F port** mode and click **Apply**.
5. Launch Device Manager from the NPV edge switch to enable NPV. From the Admin drop-down menu, select **Feature Control**. Select **enable** for the NPV feature and click **Apply**.
6. From the Interface drop-down menu, select **FC All** to configure the external interfaces on the NPV device.
7. In the Mode Admin column, select the **NP port** mode and click **Apply**.
8. To configure the server interfaces on the NPV edge switch, from the Interface drop-down menu, select **FC All**.
9. In the Mode Admin column, select **F port** mode and click **Apply**.
10. The default admin status is down. After configuring port modes, you must select up admin status to bring up the links.

6.4.2 Enable or disable NPV via the CLI on supported edge switches

Using the CLI, at the prompt enter these commands:

1. Enter **`config t`** to get into config mode.
2. Enter **`npv enable`** when in config mode.
3. Enter **`no npv enable`** when in config mode.
4. End config mode by entering the command **`end`**.

6.4.3 Enable or disable NPV via the CLI on supported core switches

Using the CLI, at the prompt enter these commands:

1. Enter **`config t`** to get into config mode.
2. Enter **`npv enable`** when in config mode.
3. Enter **`no npv enable`** when in config mode.
4. End config mode by entering the command **`end`**.

Note: NPV configuration is allowed only on NPV-capable MDS switches like MDS 9124, MDS 9134, and Blade Server switches with SAN-OS Version 3.2(2) or later. NPV is supported in NX-OS as well.

7

IP services

FCIP provides the capability to extend a SAN over existing IP networks. For short distances, SANs can be extended using traditional FC ISLs and multimode fiber. For longer distances, extend SANs using single-mode fiber with Coarse Wave Division Multiplexing (CWDM) or Dense Wave Division Multiplexing (DWDM) equipment. FCIP provides a third alternative for extending SANs over IP networks where IP is the most viable transport option, either due to cost or distance.

When implementing any MDS 9000 family IP services module (as well as the MDS 9216i and MDS 9222i), the traffic can be routed between any IP storage port and any other port on the MDS 9000 family switches in the fabric. It is configurable on a per-port basis, providing either Fibre Channel over IP (FCIP) or iSCSI on the defined port.

In this chapter we configure FCIP links from the MDS 9222i (9222i-1) to the MDS 9222i (9222i-2), as shown in Figure 7-1.

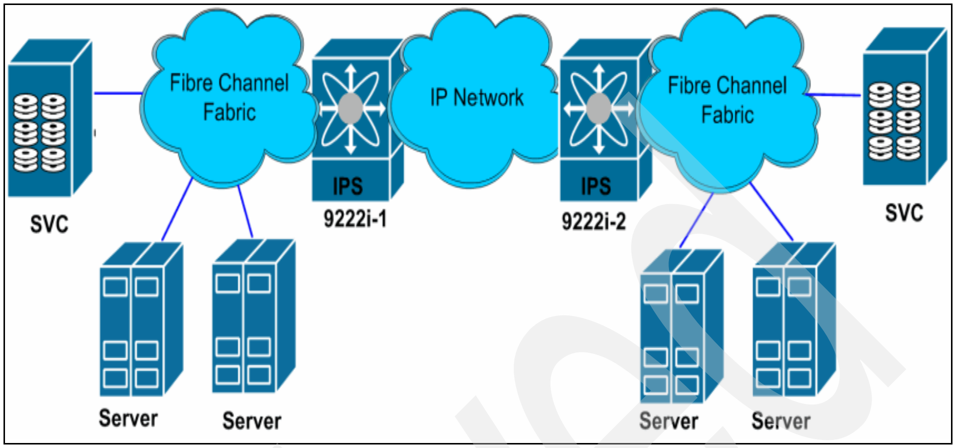


Figure 7-1 Implementation scenario

7.1 FCIP licensing

Most Cisco MDS 9000 family software features are included in the base switch configuration. However, some features are logically grouped into add-on packages that must be licensed separately, such as the Cisco MDS 9000 Enterprise package, SAN Extension over IP package, Mainframe package, Fabric Manager Server package, and Storage Services Enabler package.

To enable FCIP in a MDS switch equipped with the IP module you need a SAN Extension over IP package license. This package is licensed on a per-module basis. The number of licenses is equal to the number of IP Storage Services and Multiprotocol Services modules in a switch.

The SAN Extension over IP (SAN_EXTN_OVER_IP) license for IPS modules includes:

- FCIP protocol
- FCIP compression
- FCIP write acceleration

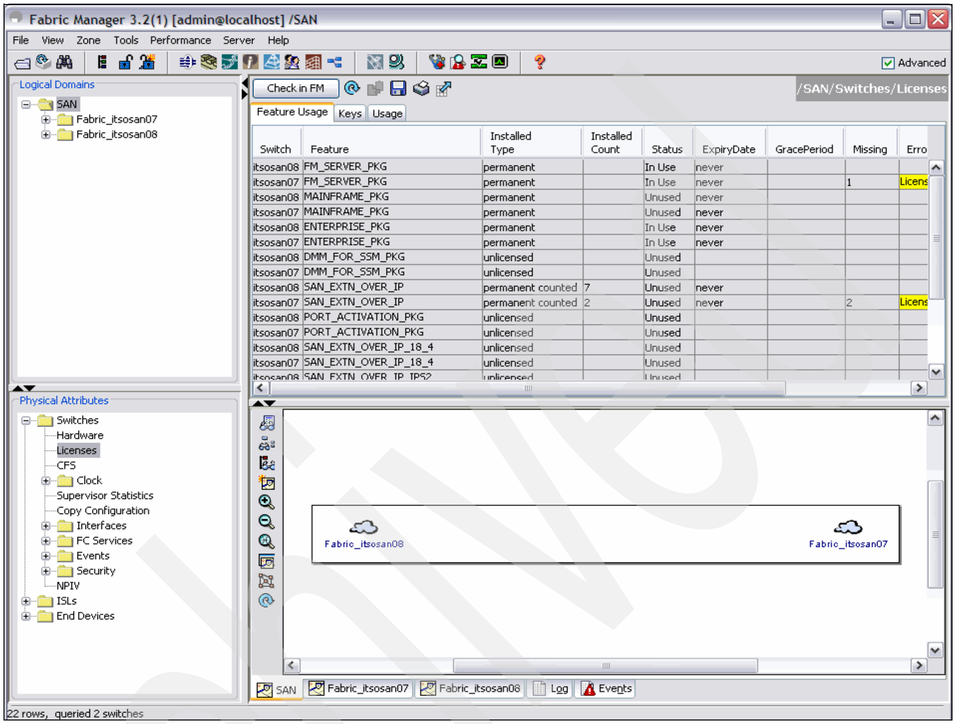
Note: For SAN-OS 2.0 and later, the SAN Extension licence also includes:

- IVR
- Tape acceleration

The 9216i and 9222i are shipped with the required licences for FCIP. The included licence is *SAN Extension over IP package for integrated IP ports* and includes all of the protocols that are in the SAN_EXTN_OVER_IP licence.

The licenses are, however, needed on a per-module basis. For example, if you have two 18/4-port MSM modules running FCIP in a switch, you need two SAN_EXTN_OVER_IP licenses. If you added an 18/4-port MSM module to your MDS9216i or 9222i, you still need the SAN_EXTN_OVER_IP license for that module.

You can verify license and feature information in Fabric Manager by opening the **Switches** folder in the Physical Attributes pane and selecting **Licenses**, as shown in Figure 7-2.

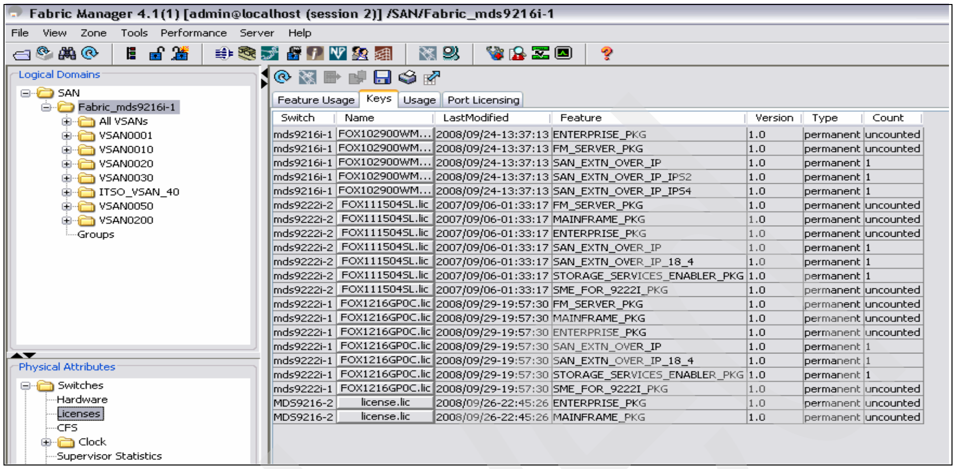


Switch	Feature	Installed Type	Installed Count	Status	ExpiryDate	GracePeriod	Missing	Erro
itsosan08	FM_SERVER_PKG	permanent		In Use	never			
itsosan07	FM_SERVER_PKG	permanent		In Use	never		1	Licens
itsosan08	MAINFRAME_PKG	permanent		Unused	never			
itsosan07	MAINFRAME_PKG	permanent		Unused	never			
itsosan08	ENTERPRISE_PKG	permanent		In Use	never			
itsosan07	ENTERPRISE_PKG	permanent		In Use	never			
itsosan08	DMM_FOR_SSM_PKG	unlicensed		Unused				
itsosan07	DMM_FOR_SSM_PKG	unlicensed		Unused				
itsosan08	SAN_EXTN_OVER_IP	permanent counted	7	Unused	never			
itsosan07	SAN_EXTN_OVER_IP	permanent counted	2	Unused	never		2	Licens
itsosan08	PORT_ACTIVATION_PKG	unlicensed		Unused				
itsosan07	PORT_ACTIVATION_PKG	unlicensed		Unused				
itsosan08	SAN_EXTN_OVER_IP_18_4	unlicensed		Unused				
itsosan07	SAN_EXTN_OVER_IP_18_4	unlicensed		Unused				
itsosan08	SAN_EXTN_OVER_IP_IPS2	unlicensed		Unused				

22 rows, queried 2 switches

Figure 7-2 Verifying features in FM

Select the **Keys** tab to display the licence keys, as shown in Figure 7-3. Your display might look different, but still displays the switch licensed information.



Switch	Name	LastModified	Feature	Version	Type	Count
mds9216i-1	FOX102900WM...	2008/09/24-13:37:13	ENTERPRISE_PKG	1.0	permanent	uncounted
mds9216i-1	FOX102900WM...	2008/09/24-13:37:13	FM_SERVER_PKG	1.0	permanent	uncounted
mds9216i-1	FOX102900WM...	2008/09/24-13:37:13	SAN_EXTN_OVER_IP	1.0	permanent	1
mds9216i-1	FOX102900WM...	2008/09/24-13:37:13	SAN_EXTN_OVER_IP_IPS2	1.0	permanent	1
mds9216i-1	FOX102900WM...	2008/09/24-13:37:13	SAN_EXTN_OVER_IP_IPS4	1.0	permanent	1
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	FM_SERVER_PKG	1.0	permanent	uncounted
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	MAINFRAME_PKG	1.0	permanent	uncounted
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	ENTERPRISE_PKG	1.0	permanent	uncounted
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	SAN_EXTN_OVER_IP	1.0	permanent	1
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	SAN_EXTN_OVER_IP_18_4	1.0	permanent	1
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	STORAGE_SERVICES_ENABLER_PKG	1.0	permanent	1
mds9222i-2	FOX111504SL.lic	2007/09/06-01:33:17	SME_FOR_9222I_PKG	1.0	permanent	uncounted
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	FM_SERVER_PKG	1.0	permanent	uncounted
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	MAINFRAME_PKG	1.0	permanent	uncounted
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	ENTERPRISE_PKG	1.0	permanent	uncounted
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	SAN_EXTN_OVER_IP	1.0	permanent	1
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	SAN_EXTN_OVER_IP_18_4	1.0	permanent	1
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	STORAGE_SERVICES_ENABLER_PKG	1.0	permanent	1
mds9222i-1	FOX1216GP0C.lic	2008/09/29-19:57:30	SME_FOR_9222I_PKG	1.0	permanent	uncounted
MDS9216-2	license.lic	2008/09/26-22:45:26	ENTERPRISE_PKG	1.0	permanent	uncounted
MDS9216-2	license.lic	2008/09/26-22:45:26	MAINFRAME_PKG	1.0	permanent	uncounted

Figure 7-3 LIcense keys in FM

7.2 FCIP concepts

To configure the IPS module for FCIP, you should have a basic understanding of the following concepts:

- FCIP and VE_Ports
- FCIP links
- FCIP profiles
- FCIP interfaces

FCIP and VE_Ports describe the internal model of FCIP with respect to Fibre Channel Inter-Switch Links (ISLs) and Cisco's enhanced ISLs (EISLs).

FCIP defines virtual E (VE) ports, which behave exactly like standard Fibre Channel E_Ports, except that the transport in this case is FCIP instead of Fibre Channel. The only requirement is for the other end of the VE_Port to be another VE_Port. A virtual ISL is established over an FCIP link and transports Fibre Channel traffic. Each associated virtual ISL looks like a Fibre Channel ISL with either an E_Port or a TE_Port at each end, as shown in Figure 7-4.

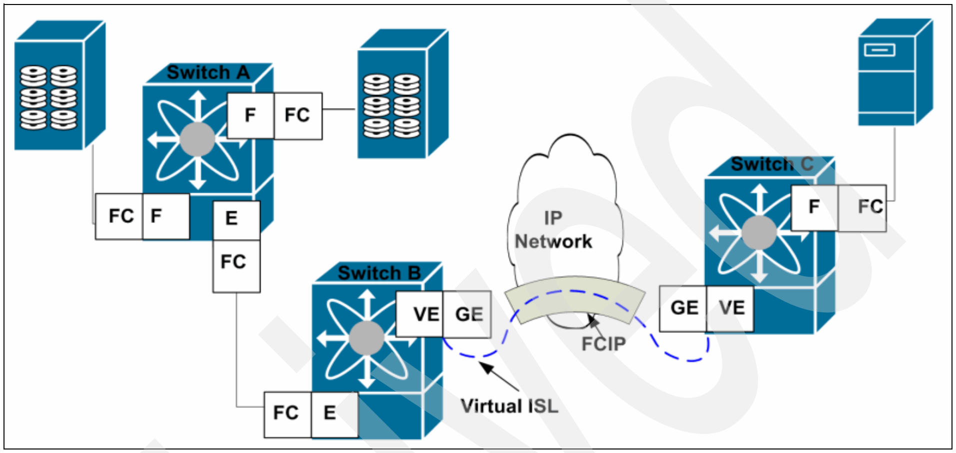


Figure 7-4 FCIP Links and Virtual ISLs

FCIP links consist of one or more TCP connections between two FCIP link end points. Each link carries encapsulated Fibre Channel frames. When the FCIP link comes up, the VE_Ports at both ends of the FCIP link create a virtual Fibre Channel (E)ISL and initiate the E_Port protocol to bring up the (E)ISL. By default, the FCIP feature on any Cisco MDS 9000 family switch creates two TCP connections for each FCIP link.

- One connection is used for data frames.
- The second connection is used only for Fibre Channel control frames, that is, switch-to-switch protocol frames (all Class F) frames. This arrangement is used to provide low latency for all control frames.

To enable FCIP on the IPS module, an FCIP profile and FCIP interface (interface FCIP) must be configured. The FCIP link is established between two peers. The VE_Port initialization behavior is identical to a normal E_Port. This behavior is independent of the link being FCIP or pure Fibre Channel, and is based on the E_Port discovery process (ELP, ESC). When the FCIP link is established, the VE_Port behavior is identical to E_Port behavior for all inter-switch communication (including domain management, zones, and VSANs). At the Fibre Channel layer, all VE and E_Port operations are identical.

The FCIP profile contains information about local IP address and TCP parameters. The profile defines the following information:

- The local connection points (IP address and TCP port number)
- The behavior of the underlying TCP connections for all FCIP links that use this profile

The FCIP profile's local IP address determines the Gigabit Ethernet port where the FCIP links terminate.

The FCIP interface is the local endpoint of the FCIP link and a VE_Port interface. All the FCIP and E_Port parameters are configured in context with the FCIP interface.

The FCIP profile determines which Gigabit Ethernet port initiates the FCIP links and defines the TCP connection behavior.

The FCIP parameters consist of the following data:

- Peer information
- Number of TCP connections for the FCIP link
- E_Port parameters: Trunking mode and trunk-allowed VSAN list

7.2.1 Configuring FCIP using the CLI

Setting up FCIP is a step-by-step process, and in the following sections we perform each of the following steps to set up FCIP using the CLI:

1. Enable FCIP.
2. Configure the GigE interface.
3. Create an FCIP profile and assign the GigE interface IP address.
4. Create an FCIP interface and assign the FCIP profile.
5. Configure the peer IP address for the FCIP interface.
6. Enable the FCIP interface.

Enable FCIP

To enable FCIP we use the command **`fcip enable`**, as shown in Example 7-1. If you do not have a license installed you will be informed that you are using a temporary license that is valid for 120 days from the first activation (this must be done on both switches).

> **Note:** Prior to setting up FCIP we must enable the FCIP feature on the switches, as it is disabled by default on all switches.
>
> When enabling FCIP there is a check to see whether you have a current SAN_EXTN_OVER_IP license installed. The 9221i and 9216i will have this licence pre-installed for their integrated IP services module.

Example 7-1 Enabling FCIP

```
mds9222i-1(config)# exit
mds9222i-1# configure terminal
mds9222i-1(config)# fcip enable
mds9222i-1(config)#
```

Configure GigE interface

In Example 7-2 we assign an IP address (10.1.1.1/24) on switch 9222i-1 to the GigE interface GigabitEthernet1/1, and on switch 9222i-2 we assign an IP address (10.1.1.2/24) to the interface GigabitEthernet4/1.

Example 7-2 Configure the GigE interface

```
mds9222i-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-1(config)# interface gigabitethernet 1/1
mds9222i-1(config-if)# ip address 10.1.1.1 255.255.255.0
mds9222i-1(config-if)#

mds9222i-2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-2(config)# interface gigabitethernet 1/1
mds9222i-2(config-if)# ip address 10.1.1.2 255.255.255.0
mds9222i-2(config-if)#
```

Create FCIP profile

Next we create the FCIP profile, as shown in Example 7-3.

Example 7-3 Create FCIP profile

```
mds9222i-1# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-1(config)# fcip profile 1
mds9222i-1(config-profile)#ip address 10.1.1.1
mds9222i-1(config-profile)# tcp max-bandwidth-mbps 1000
min-available-bandwidth-mbps 500 rouround-trip-time-ms 600
mds9222i-1(config-profile)#

mds9222i-2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-2(config)# fcip profile 1
mds9222i-2(config-profile)#ip address 10.1.1.2
mds9222i-2(config-profile)# tcp max-bandwidth-mbps 1000
min-available-bandwidth-mbps 500 rouround-trip-time-ms 600
mds9222i-2(config-profile)#
```

> **Important:** It is important to configure your link details in the profile, such as the maximum available bandwidth, minimum available bandwidth, and RTT. We discuss how to measure the round-trip time (RTT) or latency to ensure that you have the correct entry for this field when we show you how to set up FCIP using the GUI in Figure 7-9 on page 281.

Create FCIP interface

In Example 7-4 we create the FCIP interface.

Example 7-4 Create FCIP interface

```
mds9222i-1# config t
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-1(config)# interface fcip 2
mds9222i-1(config-if)# use-profile 1
mds9222i-1(config-if)# peer info address 10.1.1.2
mds9222i-1(config-if)# no shutdown

mds9222i-2# config t
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-2(config)# interface fcip 2
mds9222i-2(config-if)# use-profile 1
mds9222i-2(config-if)# peer info address 10.1.1.2
mds9222i-2(config-if)# no shutdown
```

In Example 7-5 we show the FCIP interfaces and profiles.

Example 7-5 Using the show fcip summary command

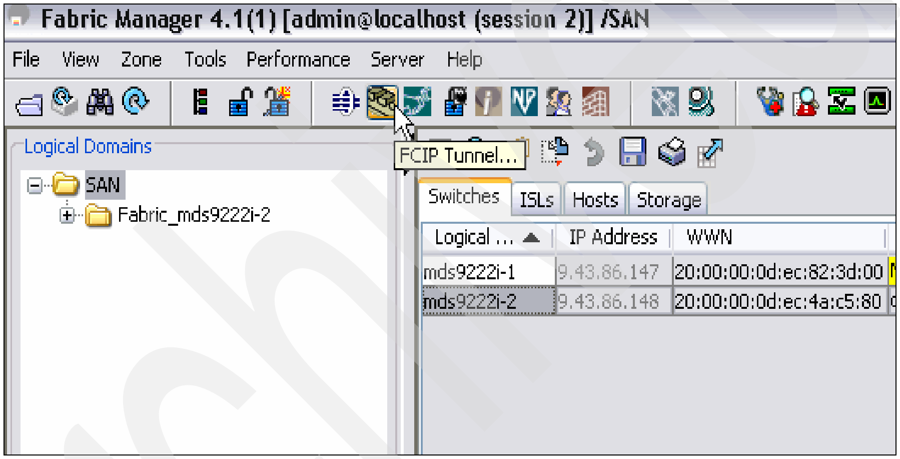
```
mds9222i-2# show fcip summary
-------------------------------------------------------------------------------
Tun prof    Eth-if    peer-ip       Status T W T Enc Comp   Bandwidth    rtt
                                           E A A             max/min     (us)
-------------------------------------------------------------------------------
2   1    GE1/1      10.1.1.1         TRNK  Y N N  N   N    1000M/500M  600
mds9222i-2#

mds9222i-1# show fcip summary
-------------------------------------------------------------------------------
Tun prof    Eth-if    peer-ip       Status T W T Enc Comp   Bandwidth    rtt
                                           E A A             max/min     (us)
-------------------------------------------------------------------------------
2   1    GE1/1      10.1.1.2         TRNK  Y N N  N   N    1000M/500M  600
mds9222i-1#
```

We have now set up FCIP.

7.2.2 Configuring FCIP using the GUI

Now we show how to use the GUI to create the FCIP tunnel. In Figure 7-5 we show how to locate the FCIP wizard. This automates the configuration process. We can run the FCIP tunnel wizard again if we want to make modifications to the original configuration.

> **Tip:** Before starting the FCIP tunnel wizard, ensure that you select **SAN** in the Logical Domains pane on the left side of FM, as shown in Figure 7-5 on page 277. This enables you to select your switches from the drop-down menus in the wizard. Also, ensure that you have the physical gigE interfaces cabled to your LAN.

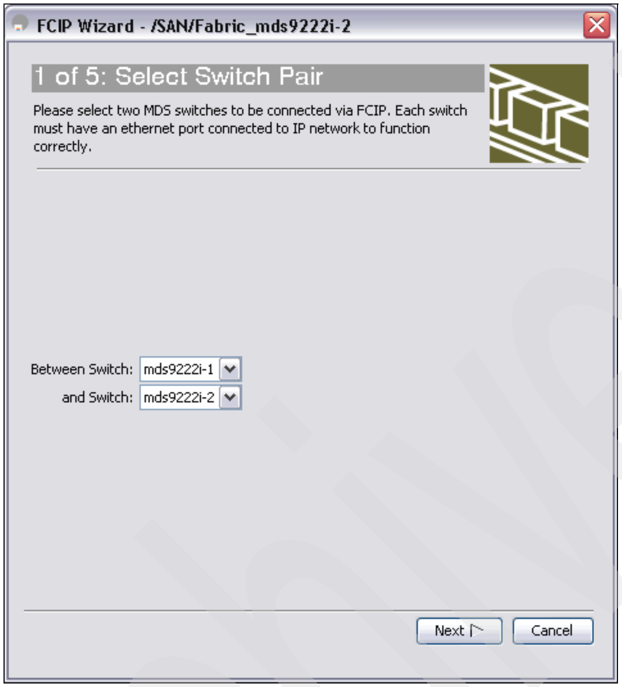


Logical ...	IP Address	WWN
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80

Figure 7-5 FM FCIP wizard

When the wizard starts:

1. We select the switch pair between which we establish the link, as shown in Figure 7-6. Click **Next** after making your choice.



FCIP Wizard - /SAN/Fabric_mds9222i-2

1 of 5: Select Switch Pair

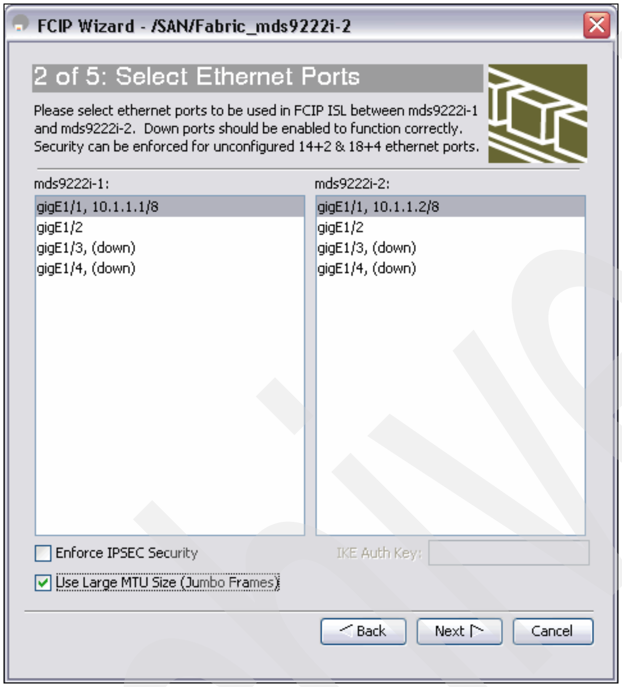
Please select two MDS switches to be connected via FCIP. Each switch must have an ethernet port connected to IP network to function correctly.

Between Switch: mds9222i-1

and Switch: mds9222i-2

Figure 7-6 FM FCIP Wizard panel 1 of 5

2. In the next panel, shown in Figure 7-7, we configure which Gigabit Ethernet interfaces will make up the link. Highlight the correct interface from each switch and click **Next**. In this example, we connect interface gigE1/1 on 9222i-1 to the interface gigE1/1 on 9222i-2 by clicking the ports.



FCIP Wizard - /SAN/Fabric_mds9222i-2

2 of 5: Select Ethernet Ports

Please select ethernet ports to be used in FCIP ISL between mds9222i-1 and mds9222i-2. Down ports should be enabled to function correctly. Security can be enforced for unconfigured 14+2 & 18+4 ethernet ports.

mds9222i-1:	mds9222i-2:
gigE1/1, 10.1.1.1/8	gigE1/1, 10.1.1.2/8
gigE1/2	gigE1/2
gigE1/3, (down)	gigE1/3, (down)
gigE1/4, (down)	gigE1/4, (down)

□ Enforce IPSEC Security   IKE Auth Key:

☑ Use Large MTU Size (Jumbo Frames)

Figure 7-7 FM FCIP Wizard panel 2 of 5

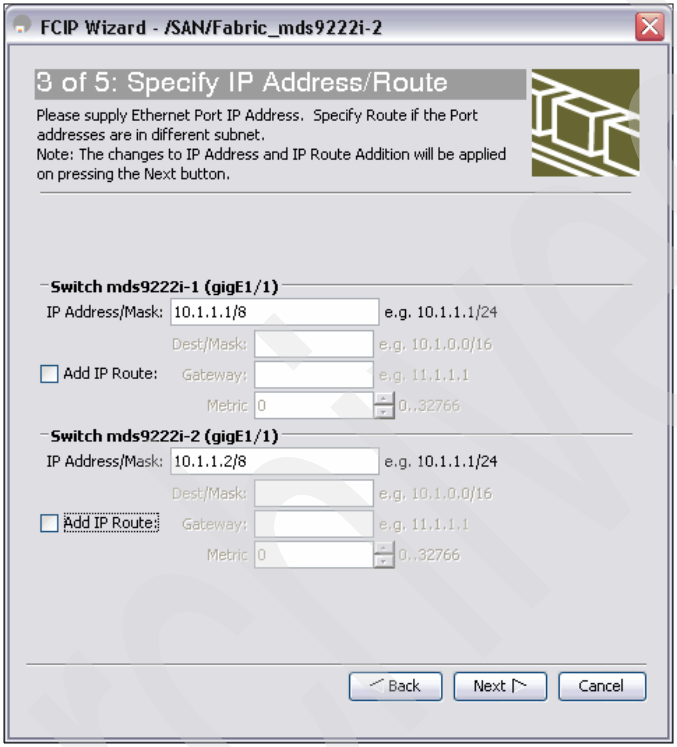
3. If IPsec is to be used then check the Enforce IPSEC Security check box and set the IKE Auth Key. For further information about this refer to the Configuring IPsec Network Security IPSEC chapter in the *Cisco MDS 9000 Family Fabric Manager Configuration Guide*, Release MDS NX-OS 4.1(x).

4. In this panel you can check the Use Large MTU Size (Jumbo Frames) option to use jumbo size frames of 2300. Since Fibre Channel frames are 2112, we recommended that you use this option. If you leave the box unchecked the FCIP Wizard does not set the MTU size, and the default value of 1500 is set.

5. Click **Next**. In this example, we connect interface gigE1/1 on mds9222i-1 to the interface gigE2/1 on mds9222i-2 by clicking the ports.

> **Note:** In Cisco MDS 9000 NX-OS, Release 4.1(1), by default the Use Large MTU Size (Jumbo Frames) option is not selected.

6. In Figure 7-8 we show how to create the FCIP ISL with the properties that we want. We configure the IP addresses of the GigE interfaces. We use a single subnet in our example, but your interfaces may be connected across a routed network. You have the option on this panel to add IP routes. To do this select the **Add IP Routes** button and fill in the IP gateway details. Click **Next** to continue.



FCIP Wizard - /SAN/Fabric_mds9222i-2

3 of 5: Specify IP Address/Route

Please supply Ethernet Port IP Address. Specify Route if the Port addresses are in different subnet.
Note: The changes to IP Address and IP Route Addition will be applied on pressing the Next button.

Switch mds9222i-1 (gigE1/1)

IP Address/Mask: 10.1.1.1/8 e.g. 10.1.1.1/24

□ Add IP Route: Dest/Mask: e.g. 10.1.0.0/16 Gateway: e.g. 11.1.1.1 Metric 0 0..32766

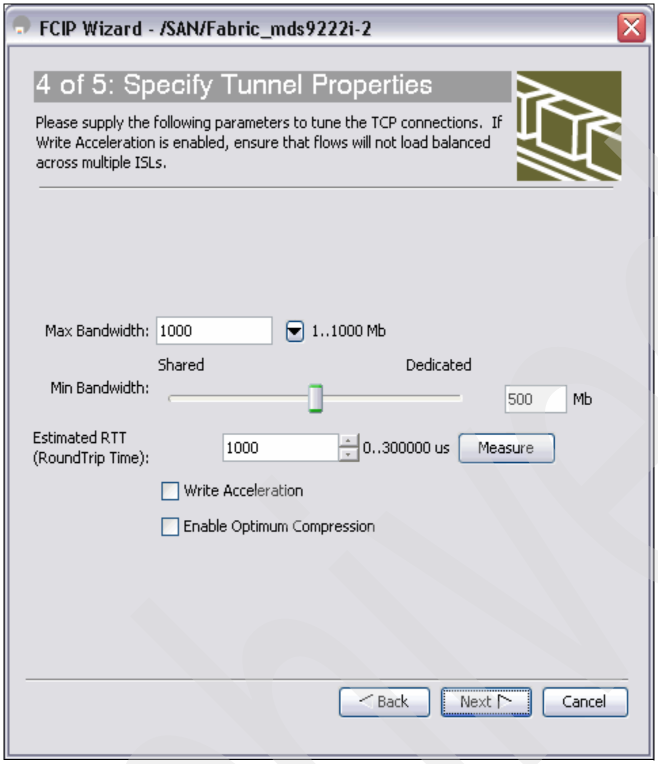
Switch mds9222i-2 (gigE1/1)

IP Address/Mask: 10.1.1.2/8 e.g. 10.1.1.1/24

□ Add IP Route: Dest/Mask: e.g. 10.1.0.0/16 Gateway: e.g. 11.1.1.1 Metric 0 0..32766

Figure 7-8 FM FCIP Wizard panel 3 of 5

7. We then specify the tunnel properties, as shown in Figure 7-9.


FCIP Wizard - /SAN/Fabric_mds9222i-2

4 of 5: Specify Tunnel Properties

Please supply the following parameters to tune the TCP connections. If Write Acceleration is enabled, ensure that flows will not load balanced across multiple ISLs.

Max Bandwidth: 1000 1..1000 Mb

Min Bandwidth: Shared Dedicated 500 Mb

Estimated RTT (RoundTrip Time): 1000 0..300000 us

□ Write Acceleration

□ Enable Optimum Compression

Figure 7-9 FM FCIP Wizard panel 4 of 5

8. On this frame we can also check the Write Acceleration check box to enable FCIP write acceleration, as well as check the Enable Optimum Compression check box to enable IP compression on this FCIP link. Take note of the Measure button, as we refer to it later.

> **Important:** Although we leave the default settings, do not leave the min, max, and RTT at their defaults. You must configure real values, and ensure that the min is greater than 1/20 of the max.

Tip: To determine the round-trip time or latency, there are three methods:

- The correct method is to use the **`ping`** command in the MDS 9000. Set the target **`ping`** IP address to the IP address of the Gigabit Ethernet port of the peer IPS Module, set the repeat count to 5, set the datagram size to 1500, and set the timeout (in seconds) to 1s.

  We recommend that you use the average latency expressed in seconds for this calculation.

- The second method is to use the NX-OS CLI, as it provides a command to obtain an estimated RTT value, as shown in Example 7-7. Values obtained from examples are different because we used a datagram size of 1500 instead of the default values. A **`ping`** value with a datagram size of 1500 represents a more real-world value.
- The third method to measure the round-trip time between the Gigabit Ethernet endpoints is by clicking the **Measure** button, as in Figure 7-9 on page 281

Example 7-6 shows an example of the **`ping`** procedure and the results.

Example 7-6 ping command output

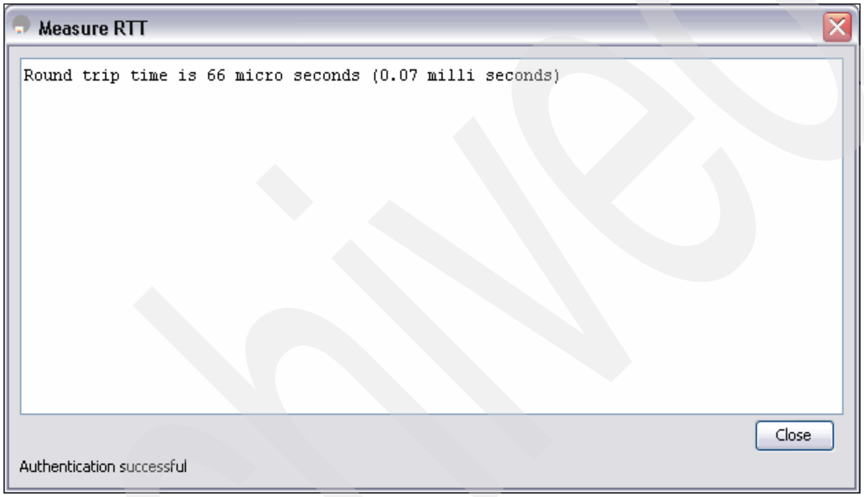
```
mds9222i-1# ping
Target IP address: 10.1.1.2
Repeat count [5]:
Datagram size [100]: 1500
Timeout in seconds [1]:
Extended commands [n]:
PING 10.1.1.2 (10.1.1.2) 1500(1528) bytes of data.
1508 bytes from 10.1.1.2: icmp_seq=1 ttl=255 time=0.478 ms
1508 bytes from 10.1.1.2: icmp_seq=2 ttl=255 time=0.430 ms
1508 bytes from 10.1.1.2: icmp_seq=3 ttl=255 time=0.449 ms
1508 bytes from 10.1.1.2: icmp_seq=4 ttl=255 time=0.512 ms
1508 bytes from 10.1.1.2: icmp_seq=5 ttl=255 time=0.419 ms

--- 10.1.1.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3998ms
rtt min/avg/max/mdev = 0.419/0.457/0.512/0.041 ms
mds9222i-1#
```

The NX-OS CLI provides a command to obtain an estimated RTT value, as in Example 7-7.

Example 7-7   ips command output

```
mds9222i-1# ips measure-rtt 10.1.1.2 interface gigabitethernet 1/1
Round trip time is 66 micro seconds (0.07 milli seconds)
mds9222i-1#
```

Figure 7-10 shows an example using the Measure button (see Figure 7-9 on page 281 for the Measure button).

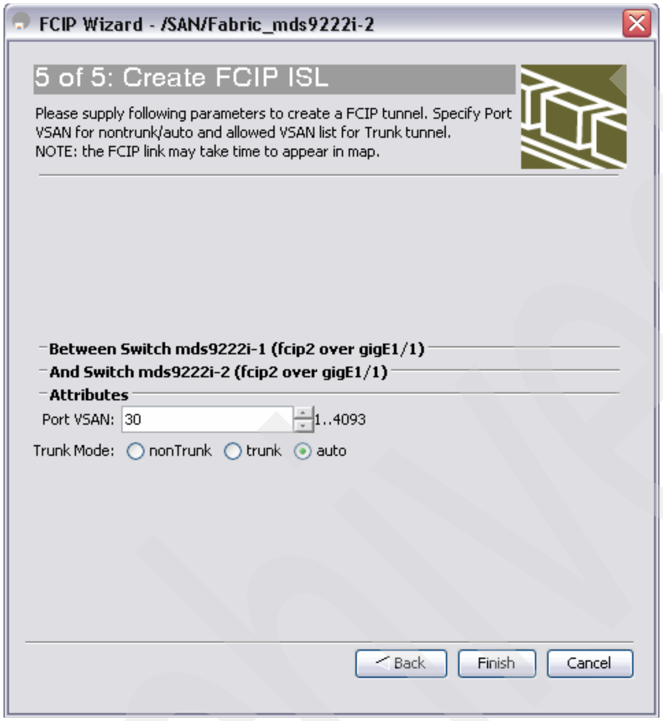


```
Round trip time is 66 micro seconds (0.07 milli seconds)
```

Authentication successful

Figure 7-10   RTT delay using the measure button

We also select the default VSAN for this interface and configure the trunking behavior. In this case we select **auto** for the trunk behavior. This creates a FC E port. Selecting **Trunk** creates an FC TE port. See Figure 7-11.



5 of 5: Create FCIP ISL

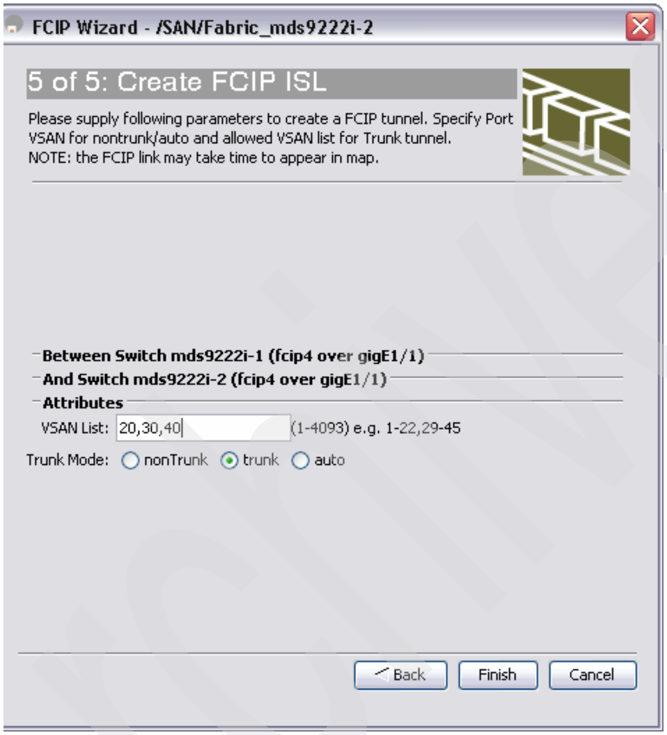
Please supply following parameters to create a FCIP tunnel. Specify Port VSAN for nontrunk/auto and allowed VSAN list for Trunk tunnel.
NOTE: the FCIP link may take time to appear in map.

Between Switch mds9222i-1 (fcip2 over gigE1/1)
And Switch mds9222i-2 (fcip2 over gigE1/1)
Attributes
Port VSAN: 30 1..4093
Trunk Mode: ○ nonTrunk ○ trunk ● auto

Figure 7-11 FM FCIP Wizard panel 5 of 5

> **Important:** If you are going to configure two or more FCIP links and wish to create PortChannels with multiple VSANs, make sure that you select the trunk button in the frame, as shown in Figure 7-12 on page 285, and then select the VSANs that you want to connect across this trunk.

Figure 7-12 shows the selected VSANs.



FCIP Wizard - /SAN/Fabric_mds9222i-2

5 of 5: Create FCIP ISL

Please supply following parameters to create a FCIP tunnel. Specify Port VSAN for nontrunk/auto and allowed VSAN list for Trunk tunnel.
NOTE: the FCIP link may take time to appear in map.

Between Switch mds9222i-1 (fcip4 over gigE1/1)

And Switch mds9222i-2 (fcip4 over gigE1/1)

Attributes

VSAN List: 20,30,40 (1-4093) e.g. 1-22,29-45

Trunk Mode: ○ nonTrunk ● trunk ○ auto

Figure 7-12 FCIP Wizard with trunking set on

Table 7-1 explains the trunk behavior based on individual switch trunk configurations.

Table 7-1 Trunk behavior

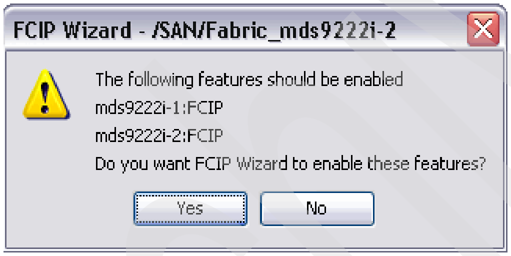
Trunk config switch 1	Trunk config switch 2	Trunk behavior
On	On	On
Off	On	Off
Off	Off	Off

Trunk config switch 1	Trunk config switch 2	Trunk behavior
Auto	Auto	Off
Auto	On	On
Auto	Off	Off

When we create the PortChannel (discussed later in this chapter), it will be configured to trunk. After clicking **Finish** (Figure 7-13), the FCIP link is created.

> **Note:** IP addresses must not be in the same network as the mgmt0 (management) interface.

If FCIP has not previously been enabled then the FM wizard asks for confirmation to enable FCIP on the switches that are not enabled, as shown in Figure 7-13.

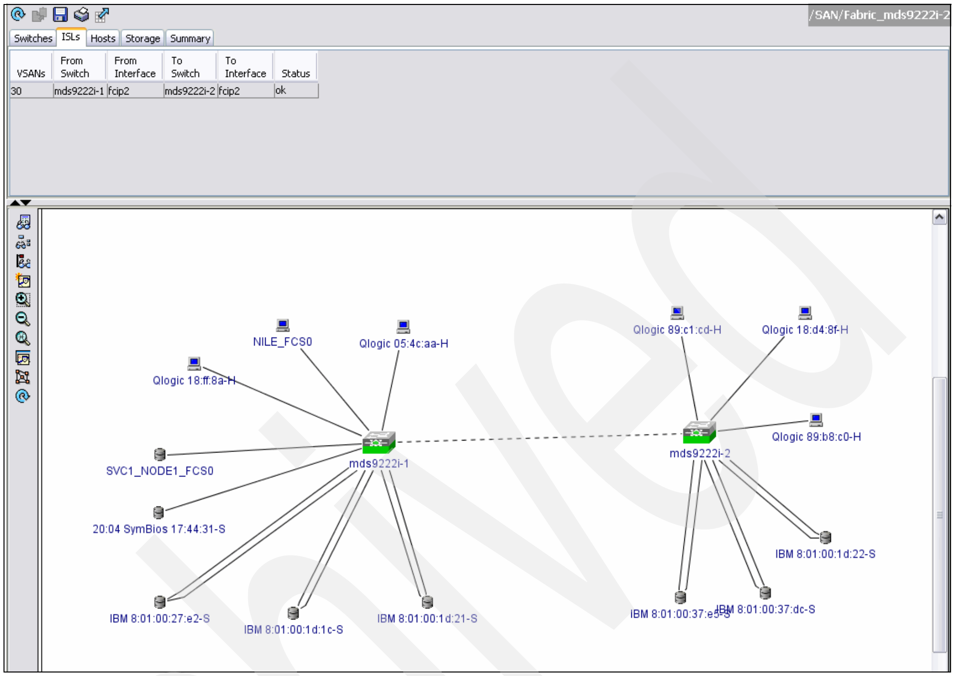


FCIP Wizard - /SAN/Fabric_mds9222i-2

The following features should be enabled
mds9222i-1:FCIP
mds9222i-2:FCIP
Do you want FCIP Wizard to enable these features?

Figure 7-13 FCIP feature activation confirmation

We can quickly check our setup by selecting **SAN** in the Logical Domains panel. The dotted line shown in Figure 7-14 represents the FCIP link between 9222i-1 and 9222i-2.



VSANs	From Switch	From Interface	To Switch	To Interface	Status
30	mds9222i-1	fcip2	mds9222i-2	fcip2	ok

Figure 7-14 The created FCIP tunnel is displayed in FM

7.3 Fibre Channel PortChannels

To perform this configuration you need two IP addresses on each SAN island. This solution addresses link failures.

The following characteristics set Fibre Channel PortChannel solutions apart from other solutions:

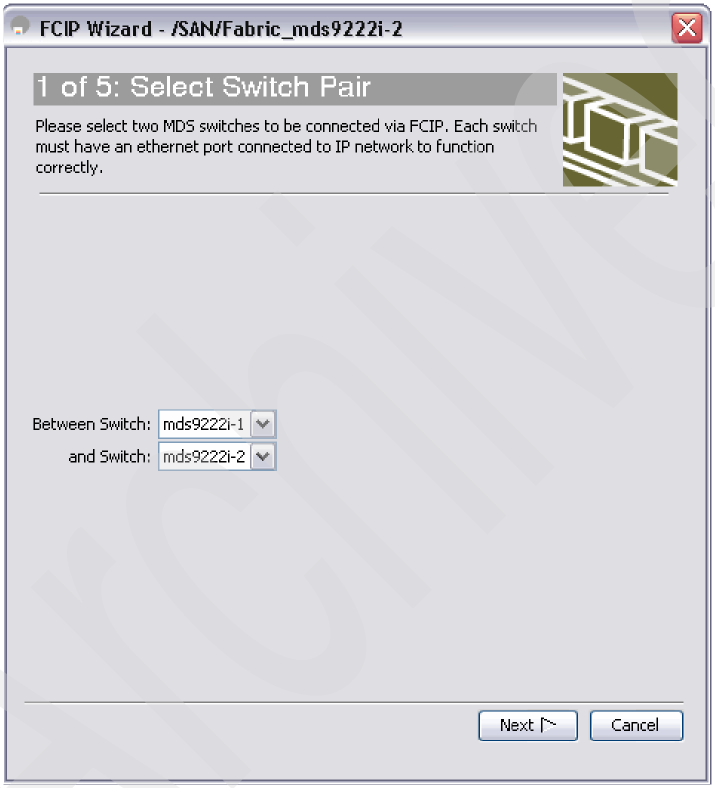
- The entire bundle is one logical (E)ISL link.
- All FCIP links in the PortChannel should be across the same two switches.
- The Fibre Channel traffic is load balanced across the FCIP links in the PortChannel.

7.4 Creating FC PortChannels

In the topics that follow we show how to create PortChannels in our environment.

7.4.1 Creating another FCIP tunnel using FM

We again select the FCIP tunnel wizard, as shown in Figure 7-7 on page 279. We have to go through the five steps required to configure a second FCIP tunnel. The first step, shown in Figure 7-15, asks for the switch pairs.



1 of 5: Select Switch Pair

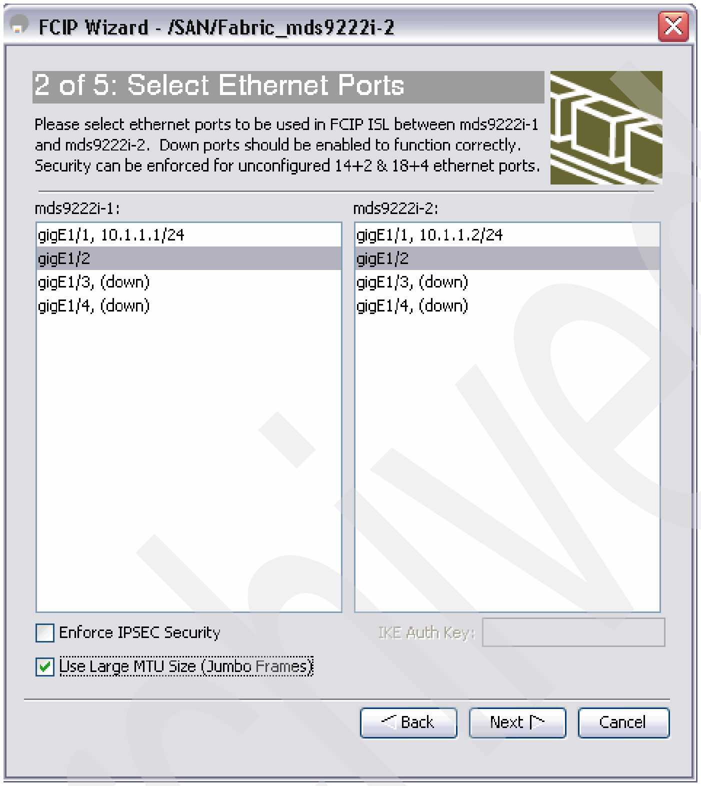
Please select two MDS switches to be connected via FCIP. Each switch must have an ethernet port connected to IP network to function correctly.

Between Switch: mds9222i-1

and Switch: mds9222i-2

Figure 7-15 FM FCIP Wizard panel 1 of 5

In the panel, shown in Figure 7-16, we configure which Gigabit Ethernet interfaces will make up the link. Highlight the correct interface from each switch and click **Next**. In this example, we connect interface gigE1/2 on both switches.



FCIP Wizard - /SAN/Fabric_mds9222i-2

2 of 5: Select Ethernet Ports

Please select ethernet ports to be used in FCIP ISL between mds9222i-1 and mds9222i-2. Down ports should be enabled to function correctly. Security can be enforced for unconfigured 14+2 & 18+4 ethernet ports.

mds9222i-1:	mds9222i-2:
gigE1/1, 10.1.1.1/24	gigE1/1, 10.1.1.2/24
gigE1/2	gigE1/2
gigE1/3, (down)	gigE1/3, (down)
gigE1/4, (down)	gigE1/4, (down)

☐ Enforce IPSEC Security

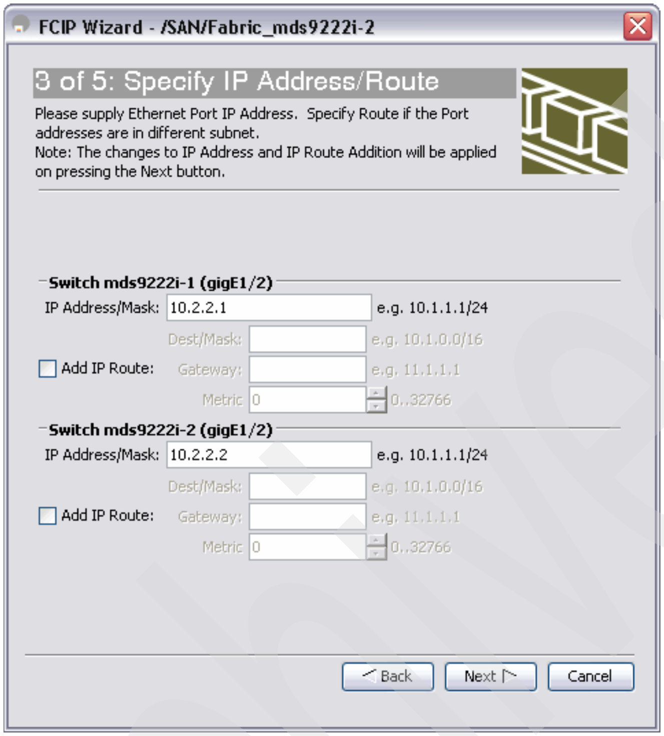
IKE Auth Key:

☑ Use Large MTU Size (Jumbo Frames)

Figure 7-16 FM FCIP Wizard panel 2 of 4

You can set up IPsec for your link in this panel and set your Ethernet frame size.

In Figure 7-17 we show how to create the FCIP ISL with the properties that we want. We code the IP addresses of the GigE interfaces.


FCIP Wizard - /SAN/Fabric_mds9222i-2

3 of 5: Specify IP Address/Route

Please supply Ethernet Port IP Address. Specify Route if the Port addresses are in different subnet.
Note: The changes to IP Address and IP Route Addition will be applied on pressing the Next button.

Switch mds9222i-1 (gigE1/2)

IP Address/Mask: 10.2.2.1 e.g. 10.1.1.1/24

□ Add IP Route: Dest/Mask: e.g. 10.1.0.0/16 Gateway: e.g. 11.1.1.1 Metric 0 0..32766

Switch mds9222i-2 (gigE1/2)

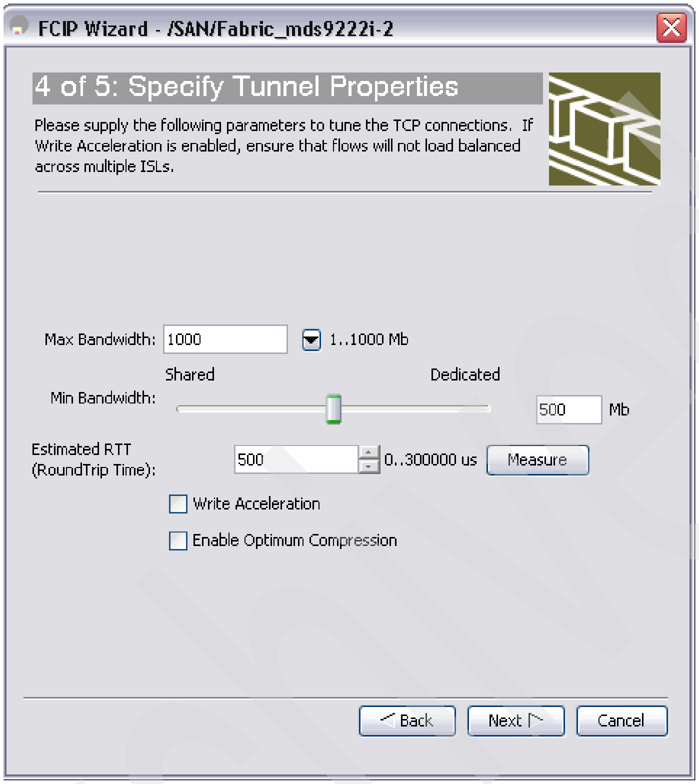
IP Address/Mask: 10.2.2.2 e.g. 10.1.1.1/24

□ Add IP Route: Dest/Mask: e.g. 10.1.0.0/16 Gateway: e.g. 11.1.1.1 Metric 0 0..32766

Figure 7-17 FM FCIP Wizard panel 3 of 5

We use a different subnet, which is recommended but is not a requirement. Your interfaces may be across a routed network, and you have the ability on this panel to add IP routes. To do this select the **Add IP Routes** button and fill in the route details. Press **Next** and addresses from different subnets can be used, combined with static routes defined on each switch indicating the correct path.

Click **Next** to continue. In the next panel (Figure 7-18), we configure the FCIP tunnel properties as described in more detail in Figure 7-9 on page 281.


FCIP Wizard - /SAN/Fabric_mds9222i-2

4 of 5: Specify Tunnel Properties

Please supply the following parameters to tune the TCP connections. If Write Acceleration is enabled, ensure that flows will not load balanced across multiple ISLs.

Max Bandwidth: 1000 1..1000 Mb

Min Bandwidth: Shared Dedicated 500 Mb

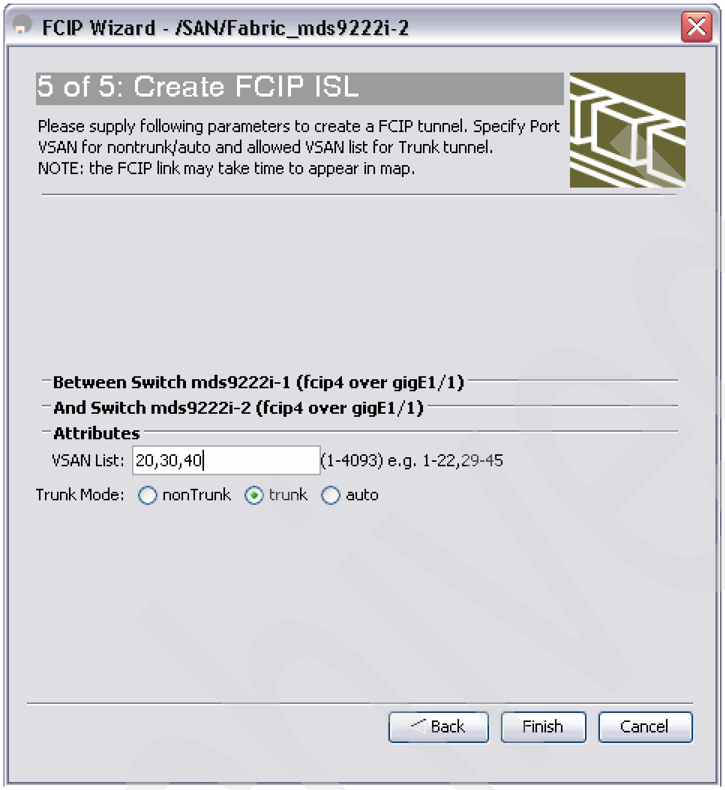
Estimated RTT (RoundTrip Time): 500 0..300000 us

□ Write Acceleration

□ Enable Optimum Compression

Figure 7-18 FM FCIP Wizard panel 4 of 5

Figure 7-19 is the final panel and we select our VSAN list and trunk mode.



FCIP Wizard - /SAN/Fabric_mds9222i-2

5 of 5: Create FCIP ISL

Please supply following parameters to create a FCIP tunnel. Specify Port VSAN for nontrunk/auto and allowed VSAN list for Trunk tunnel.
NOTE: the FCIP link may take time to appear in map.

Between Switch mds9222i-1 (fcip4 over gigE1/1)

And Switch mds9222i-2 (fcip4 over gigE1/1)

Attributes

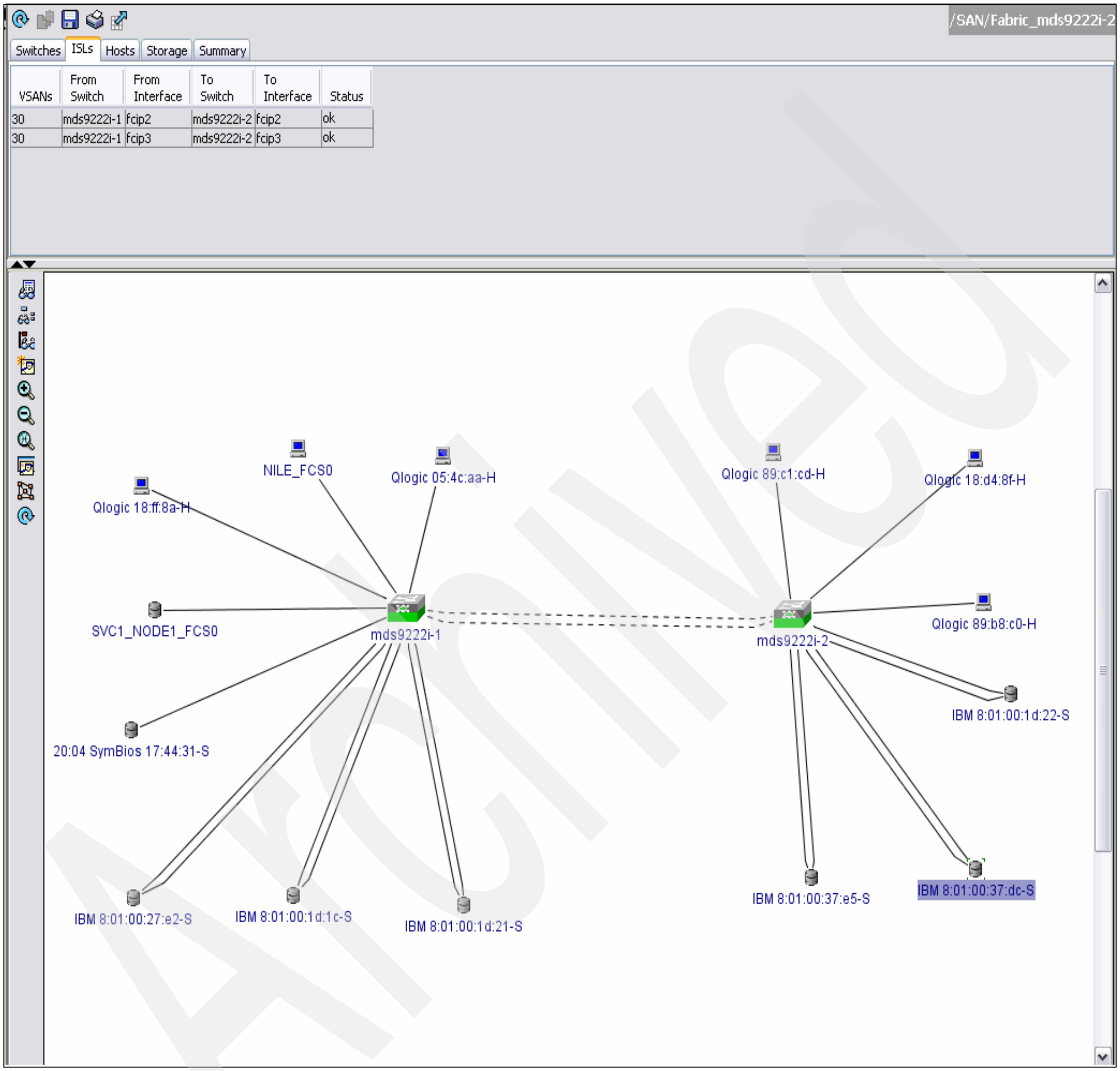
VSAN List: 20,30,40 (1-4093) e.g. 1-22,29-45

Trunk Mode: ○ nonTrunk ● trunk ○ auto

Figure 7-19 FM FCIP Wizard panel 5 of 5

We select the default VSAN for this interface and configure the trunking behavior for **trunk** and click **Finish**.

In Figure 7-20, we can see the two individual FCIP links in the FM map. Notice that the FCIP links show up as dotted lines to distinguish them from FC ISLs.



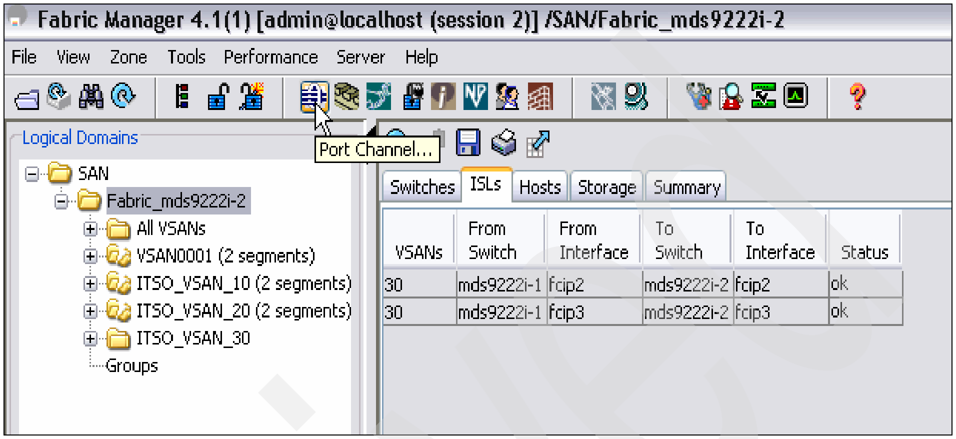
VSANs	From Switch	From Interface	To Switch	To Interface	Status
30	mds9222i-1	fcip2	mds9222i-2	fcip2	ok
30	mds9222i-1	fcip3	mds9222i-2	fcip3	ok

Figure 7-20 FM map display of FCIP interfaces

7.4.2 Creating a PortChannel on FCIP tunnels using FM

Now we show how to create a PortChannel on the FCIP tunnel using the GUI.

1. We start the PortChannel wizard, as shown in Figure 7-21.

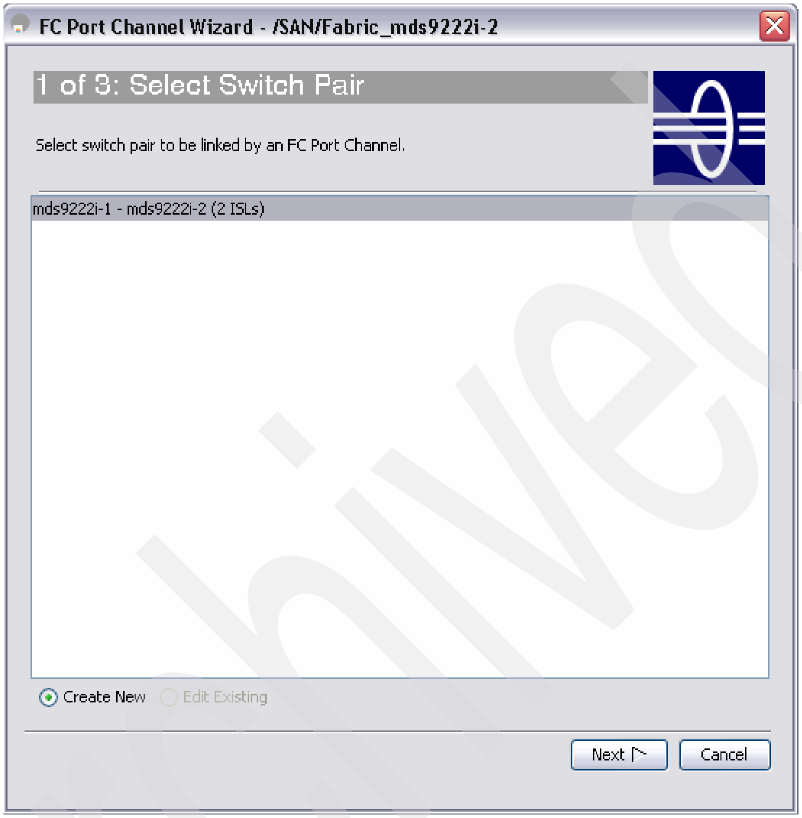


VSANs	From Switch	From Interface	To Switch	To Interface	Status
30	mds9222i-1	fcip2	mds9222i-2	fcip2	ok
30	mds9222i-1	fcip3	mds9222i-2	fcip3	ok

Figure 7-21 Starting the Port Channel wizard

> **Note:** The maximum number of Fibre Channel ports that can be put into a Fibre Channel PortChannel is 16.

2. In the first panel of the wizard (Figure 7-22) we identify the switch pair that will be linked by the PortChannel. In our case, **Create New** is automatically selected (because there are no existing links to edit).



FC Port Channel Wizard - /SAN/Fabric_mds9222i-2

1 of 3: Select Switch Pair

Select switch pair to be linked by an FC Port Channel.

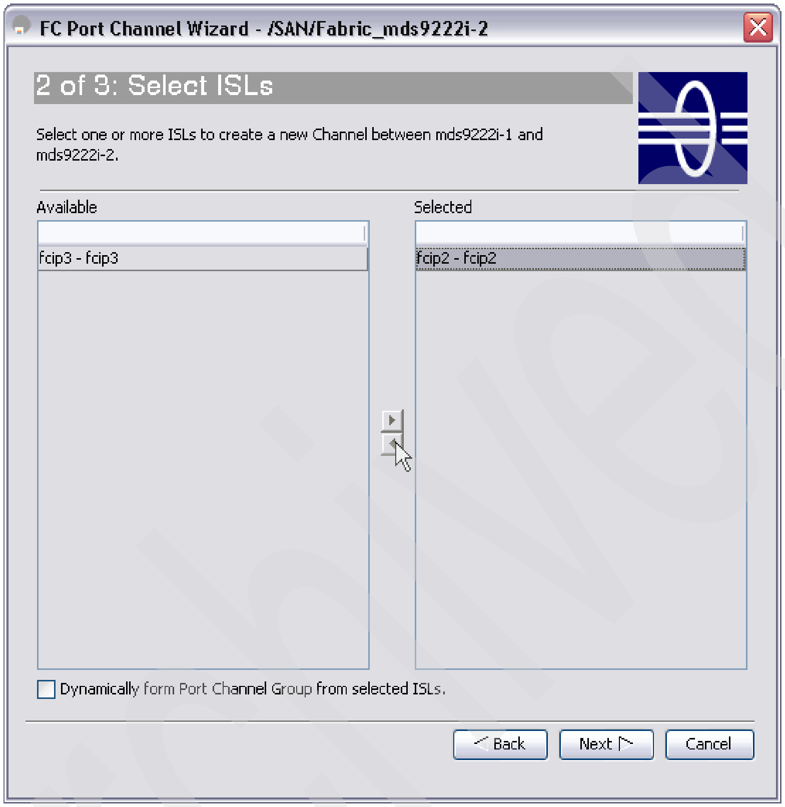
mds9222i-1 - mds9222i-2 (2 ISLs)

● Create New ○ Edit Existing

Figure 7-22 FM Port Channel Wizard panel 1 of 3

> **Note:** Allow sufficient time after creating FCIP tunnel links before creating a channel so that Fabric Manager can discover all the new links. You could press Ctlr+R on FM to manually force a rediscover of the fabric.

3. Highlight the links that will make up the PortChannel and, if necessary, using the arrow keys, move them from the Available to the Selected column (Figure 7-23). Click **Next** to proceed.



FC Port Channel Wizard - /SAN/Fabric_mds9222i-2

2 of 3: Select ISLs

Select one or more ISLs to create a new Channel between mds9222i-1 and mds9222i-2.

Available: fcip3 - fcip3

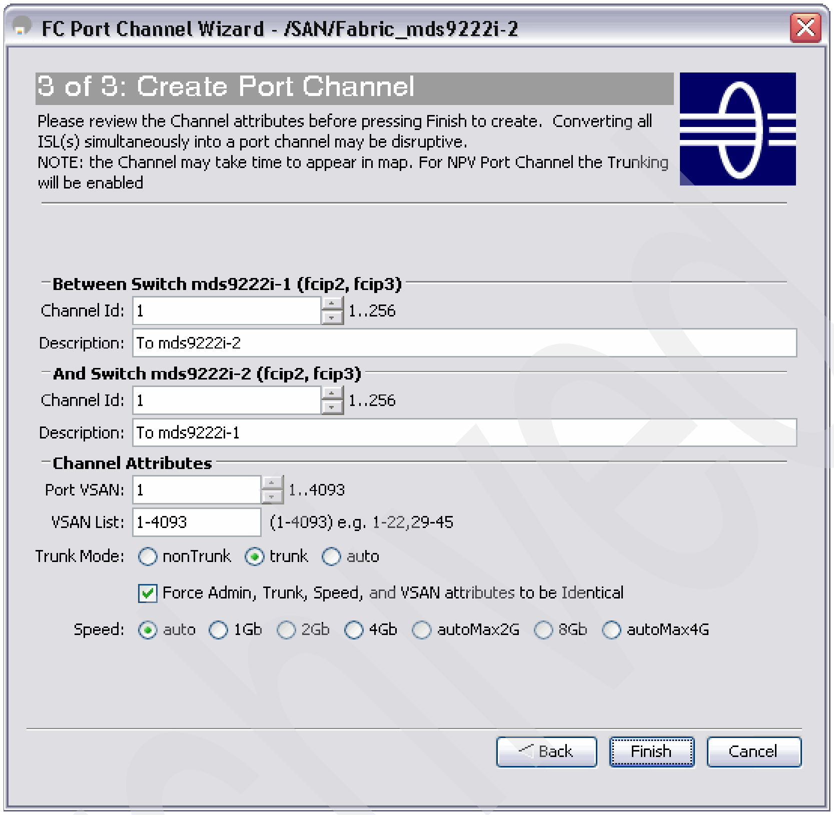
Selected: fcip2 - fcip2

□ Dynamically form Port Channel Group from selected ISLs.

Figure 7-23   FM Port Channel Wizard panel 2 of 3

> **Tip:** Select the **Dynamically form Port Channel Group from selected ISLs** check box if you want to dynamically create the PortChannel and make the ISL properties identical for the admin, trunk, speed, and VSAN attributes.

4. On the panel shown in Figure 7-24 we create the PortChannel.



FC Port Channel Wizard - /SAN/Fabric_mds9222i-2

3 of 3: Create Port Channel

Please review the Channel attributes before pressing Finish to create. Converting all ISL(s) simultaneously into a port channel may be disruptive.
NOTE: the Channel may take time to appear in map. For NPV Port Channel the Trunking will be enabled

Between Switch mds9222i-1 (fcip2, fcip3)

Channel Id: 1 1..256

Description: To mds9222i-2

And Switch mds9222i-2 (fcip2, fcip3)

Channel Id: 1 1..256

Description: To mds9222i-1

Channel Attributes

Port VSAN: 1 1..4093

VSAN List: 1-4093 (1-4093) e.g. 1-22,29-45

Trunk Mode: ○ nonTrunk ● trunk ○ auto

☑ Force Admin, Trunk, Speed, and VSAN attributes to be Identical

Speed: ● auto ○ 1Gb ○ 2Gb ○ 4Gb ○ autoMax2G ○ 8Gb ○ autoMax4G

< Back | Finish | Cancel

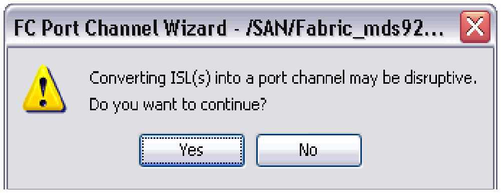
Figure 7-24 FM Port Channel Wizard panel 3 of 3

This panel contains the following options:

- VSAN List: This lists the VSANs that the PortChannel will allow to traverse the link. We allowed *all* of them to use our link.
- Trunk Mode: You can enable trunking on the links in the PortChannel. Select **trunking** if your link is between TE_Ports. Select **nontrunking** if your link is between E_Ports (for example, if your link is between an MDS switch and another vendor's switch). Select **auto** if you are not sure.
- Force Admin, Trunk, Speed, and VSAN attributes to be Identical: This option ensures that the same parameter settings are used in all physical ports in the channel. If these settings are not identical, the ports cannot become part of the PortChannel.
- Speed: The port speed values are auto, 1 Gb, 2 Gb, 4 Gb, autoMax2G. 8 Gb, and autoMax4G.

Note: In our example we allowed *all* VSANs to traverse this PortChannel. In a production environment ensure that only the necessary VSANs are configured for its use. The reason for this is the limited bandwidth associated with the WAN connections.

5. In the pop-up shown in Figure 7-25 we confirm that we want to create the PortChannel.



FC Port Channel Wizard - /SAN/Fabric_mds92...

Converting ISL(s) into a port channel may be disruptive.
Do you want to continue?

Figure 7-25 Confirm creation of the PortChannel

Important: The FM PortChannel wizard resets FCIP tunnels involved in the process of PortChannel creation, and therefore it is disruptive for any extended zones or IVR zones making use of those FCIP tunnels. Each tunnel making part of the PortChannel will be taken down and then brought up as part of the configuration process.

7.4.3 Implementing iSCSI

To demonstrate the steps involved in an iSCSI implementation we use the small test environment shown in Figure 7-26.

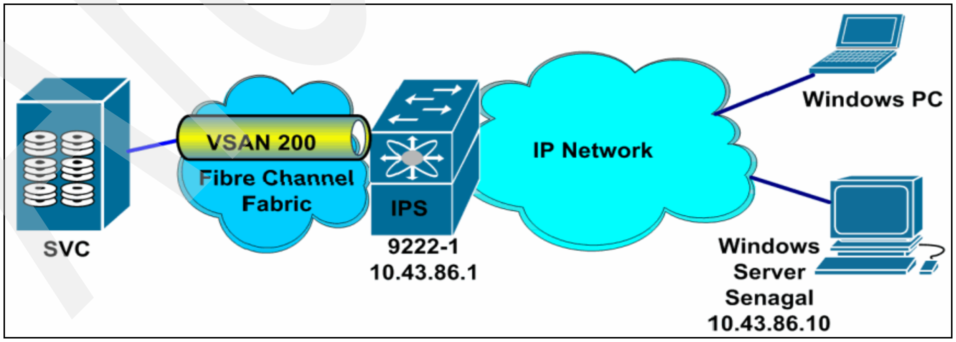


Figure 7-26 Test environment

One IBM SAN Volume Controller cluster is connected to an MDS 9222i equipped with an integrated 18/4 MSM module. One interface of the MSM module is connected to an Ethernet switch. Our Windows XP workstation and the Windows 2003 server are connected to the same IP network.

7.4.4 Target configuration

As is true with any implementation, make sure to take the appropriate time to check all the relevant compatibility and support matrixes. For example, if you plan on having Windows 2003 iSCSI initiators and the SVC as back-end storage, check the Windows 2003 compatibility matrix where you should find supported network cards (NIC), service packs, and additional recommendations. Cross-reference this information with what you find from the storage matrix compatibility:

`http://www.microsoft.com/windowsserver2003/technologies/storage/iscsi/default.mspx`

The IBM storage and SVC interoperability sites are a useful references for ensuring that you have a supported matrix:

`http://www-03.ibm.com/systems/support/storage/config/ssic/displayesssearchwithoutjs.wss?start_over=yes`

`http://www-03.ibm.com/systems/storage/software/virtualization/svc/interop.html`

Also check the Cisco Interoperability site for compatibility:

`http://www.cisco.com/en/US/docs/storage/san_switches/mds9000/interoperability/matrix/Matrix.pdf`

> **Note:** The Cisco MDS management interface, mgt0, must be in an IP network address range that is different from the GigabitEthernet port.

Licences

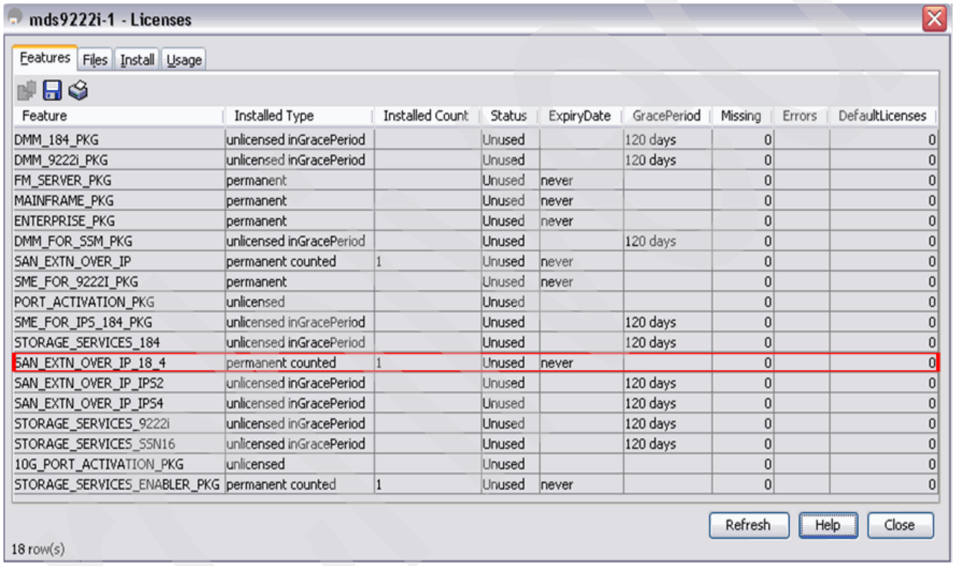
Depending on which module is installed, we need to activate this on a module-by-module basis:

- SAN extension over IP package for IPS-8 modules (SAN_EXTN_OVER_IP)
- SAN extension over IP package for IPS-4 modules (SAN_EXTN_OVER_IP_IPS4)
- SAN extension over IP package for MPS-14/2 modules (SAN_EXTN_OVER_IP_IPS2)

- SAN extension over IP package for one MPS-18/4 or one MPS-18/4 FIPS in the Cisco MDS 9500 series (SAN_EXTN_OVER_IP_18_4)

We select **Admin** → **Licenses** on Device Manager to see which licenses are loaded and the status of each one. In particular, we want to check whether we have SAN_EXT_OVER_IP_18_4, as we are using a 9222i. Make sure that it is highlighted on the Licenses panel, as shown in Figure 7-27.

> **Important:** If the licence is not installed, you will have a grace period of 120 days to purchase and install the licence.



Feature	Installed Type	Installed Count	Status	ExpiryDate	GracePeriod	Missing	Errors	DefaultLicenses
DMM_184_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
DMM_9222i_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
FM_SERVER_PKG	permanent		Unused	never		0		0
MAINFRAME_PKG	permanent		Unused	never		0		0
ENTERPRISE_PKG	permanent		Unused	never		0		0
DMM_FOR_SSM_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP	permanent counted	1	Unused	never		0		0
SME_FOR_9222I_PKG	permanent		Unused	never		0		0
PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
SME_FOR_IPS_184_PKG	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_184	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP_18_4	permanent counted	1	Unused	never		0		0
SAN_EXTN_OVER_IP_IPS2	unlicensed inGracePeriod		Unused		120 days	0		0
SAN_EXTN_OVER_IP_IPS4	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_9222i	unlicensed inGracePeriod		Unused		120 days	0		0
STORAGE_SERVICES_SSN16	unlicensed inGracePeriod		Unused		120 days	0		0
10G_PORT_ACTIVATION_PKG	unlicensed		Unused			0		0
STORAGE_SERVICES_ENABLER_PKG	permanent counted	1	Unused	never		0		0

18 row(s)

Figure 7-27 Device Manager Licenses panel

Enabling iSCSI

We select **Admin** → **Feature Control** on Device Manager, as shown in Figure 7-28.

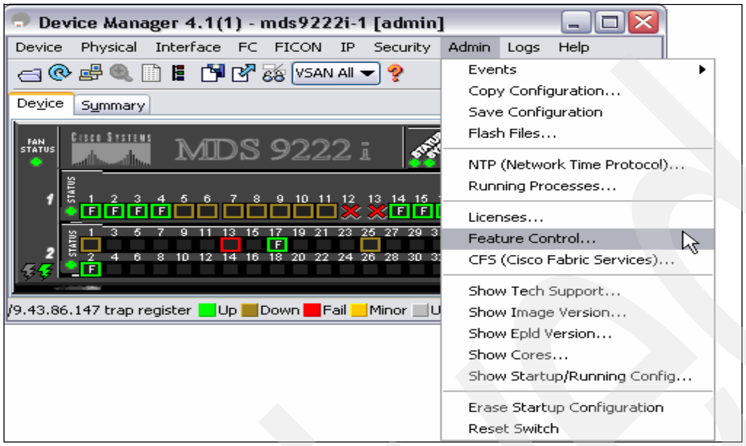
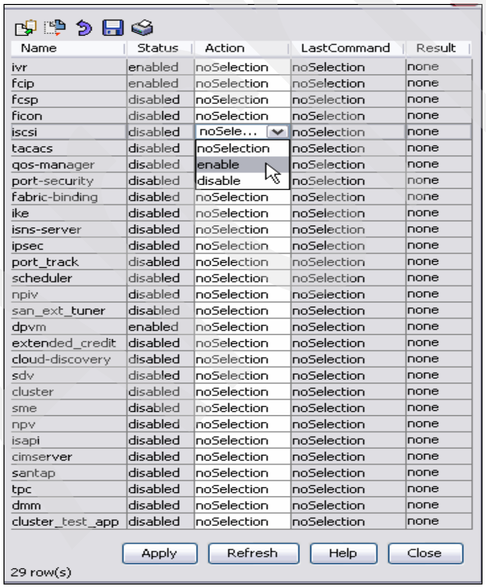

Device Manager 4.1(1) - mds9222i-1 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
Device Summary
MDS 9222 i
/9.43.86.147 trap register Up Down Fail Minor
Events
Copy Configuration...
Save Configuration
Flash Files...
NTP (Network Time Protocol)...
Running Processes...
Licenses...
Feature Control...
CFS (Cisco Fabric Services)...
Show Tech Support...
Show Image Version...
Show Epld Version...
Show Cores...
Show Startup/Running Config...
Erase Startup Configuration
Reset Switch

Figure 7-28 Device Manager Admin drop-down menu

We go to the iSCSI feature and click **Enable** in the drop-down menu, as shown in Figure 7-29. Then we click **Apply** at the lower end of the Feature Control panel.



Name	Status	Action	LastCommand	Result
ivr	enabled	noSelection	noSelection	none
fcip	enabled	noSelection	noSelection	none
fcsp	disabled	noSelection	noSelection	none
ficon	disabled	noSelection	noSelection	none
iscsi	disabled	noSele...	noSelection	none
tacacs	disabled	noSelection	noSelection	none
qos-manager	disabled	enable	noSelection	none
port-security	disabled	disable	noSelection	none
fabric-binding	disabled	noSelection	noSelection	none
ike	disabled	noSelection	noSelection	none
isns-server	disabled	noSelection	noSelection	none
ipsec	disabled	noSelection	noSelection	none
port_track	disabled	noSelection	noSelection	none
scheduler	disabled	noSelection	noSelection	none
npiv	disabled	noSelection	noSelection	none
san_ext_tuner	disabled	noSelection	noSelection	none
dpvm	enabled	noSelection	noSelection	none
extended_credit	disabled	noSelection	noSelection	none
cloud-discovery	disabled	noSelection	noSelection	none
sdv	disabled	noSelection	noSelection	none
cluster	disabled	noSelection	noSelection	none
sme	disabled	noSelection	noSelection	none
npv	disabled	noSelection	noSelection	none
isapi	disabled	noSelection	noSelection	none
cimserver	disabled	noSelection	noSelection	none
santap	disabled	noSelection	noSelection	none
tpc	disabled	noSelection	noSelection	none
dmm	disabled	noSelection	noSelection	none
cluster_test_app	disabled	noSelection	noSelection	none

Figure 7-29 Device Manager Feature Control

iSCSI feature is now enabled for the 9222i-1 switch.

7.4.5 Enabling iSCSI on the module

We now need to enable iSCSI on the module that we will use for our configuration. In our case we use module 1. We use the command-line interface to perform this function.

First we check to see whether iSCSI is already enabled by displaying the iSCSI port that we are going to use. In Example 7-8 we use iSCSI interface iSCSI 1/4. We can see that this interface does not exist. If the port does exist then iSCSI is already enabled on this module.

Example 7-8 Show iSCSI interface

```
mds9222i-1# show interface iscsi 1/4
                                 ^
Invalid range at '^' marker.
```

If it is not already enabled, we need to enable our module for iSCSI and then perform the same command as before to make sure that it is ready (Example 7-9).

Example 7-9 Enable iSCSI on module 1

```
mds9222i-1# configure terminal
mds9222i-1(config)# iscsi enable module 1
mds9222i-1(config)# show interface iscsi 1/4
iscsi1/4 is down (Administratively down)
    Hardware is GigabitEthernet
    Port WWN is 20:13:00:0d:ec:82:3d:00
    Admin port mode is ISCSI
    snmp link state traps are enabled
    Port vsan is 1
    iSCSI initiator is identified by name
    Number of iSCSI session: 0 (discovery session: 0)
    Number of TCP connection: 0
    Configured TCP parameters
        Local Port is 3260
        PMTU discover is enabled, reset timeout is 3600 sec
        Keepalive-timeout is 60 sec
        Minimum-retransmit-time is 300 ms
        Max-retransmissions 4
        Sack is enabled
        QOS code point is 0
        Maximum allowed bandwidth is 1000000 kbps
        Minimum available bandwidth is 70000 kbps
        Configured round trip time is 1000 usec
        Send buffer size is 4096 KB
        Congestion window monitoring is enabled, burst size is 50 KB
```

We can now continue with our configuration using Device Manager.

7.4.6 Configuring GigabitEthernet for iSCSI

We use interface gigE 1/4 for our configuration:

1. Open Device Manager and right-click the port, then select **Configure** in the drop-down menu, as shown in Figure 7-30.

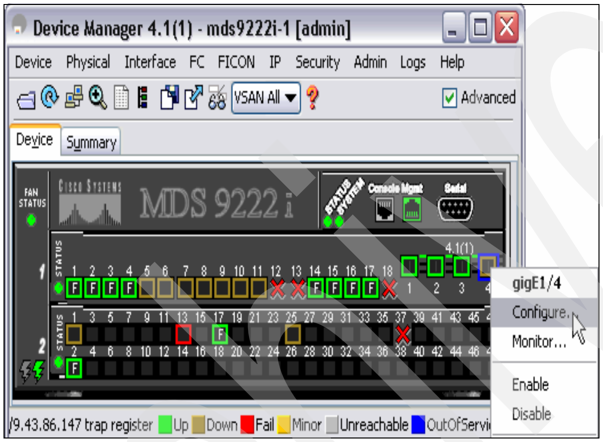
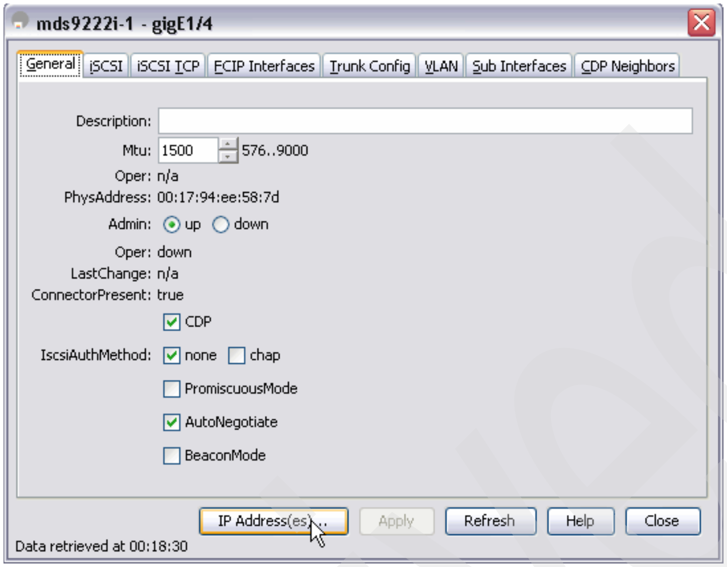


Figure 7-30 Device Manager Interface drop-down menu

2. Select **Edit IP Address**, as shown in Figure 7-31.

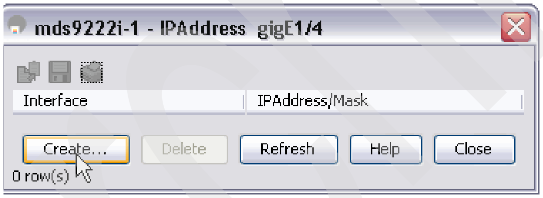


Description:
Mtu: 1500 576..9000
Oper: n/a
PhysAddress: 00:17:94:ee:58:7d
Admin: ● up ○ down
Oper: down
LastChange: n/a
ConnectorPresent: true
☑ CDP
IscsiAuthMethod: ☑ none □ chap
□ PromiscuousMode
☑ AutoNegotiate
□ BeaconMode

Data retrieved at 00:18:30

Figure 7-31 Device Manager Interface panel

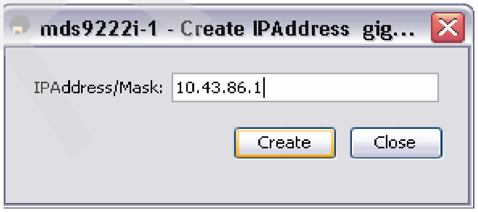
3. Select **Create**, as shown in Figure 7-32.



0 row(s)

Figure 7-32 Device Manager IP Address panel

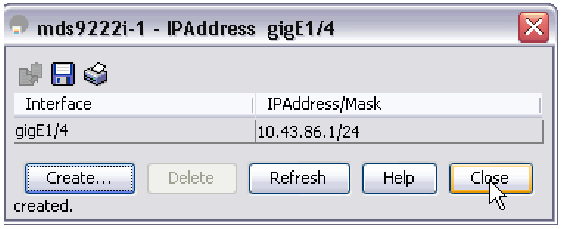
4. Enter the IP address in the fields provided (Figure 7-33). The format is IP Address/Netmask.



IPAddress/Mask: 10.43.86.1

Figure 7-33 Device Manager Create IP Address panel

5. Select the **Close** button to return to the IP Address page, confirm that the correct IP address is set, and select the **Close** button (Figure 7-34).

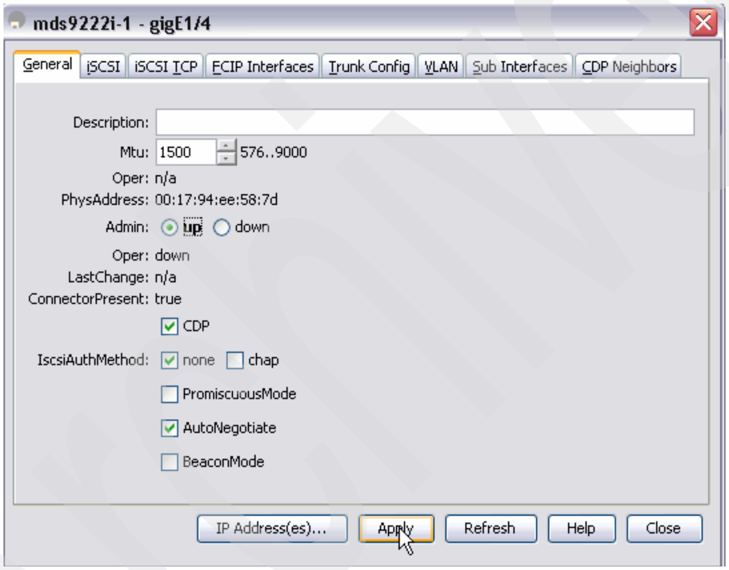

mds9222i-1 - IPAddress gigE1/4

Interface	IPAddress/Mask
gigE1/4	10.43.86.1/24

created.

Figure 7-34 IP address set

6. Select the check box **Admin up** and apply our changes (Figure 7-35).


mds9222i-1 - gigE1/4

Description:
Mtu: 1500 576..9000
Oper: n/a
PhysAddress: 00:17:94:ee:58:7d
Admin: ● up ○ down
Oper: down
LastChange: n/a
ConnectorPresent: true
☑ CDP
IscsiAuthMethod: ☑ none □ chap
□ PromiscuousMode
☑ AutoNegotiate
□ BeaconMode

Figure 7-35 Device Manager Interface panel

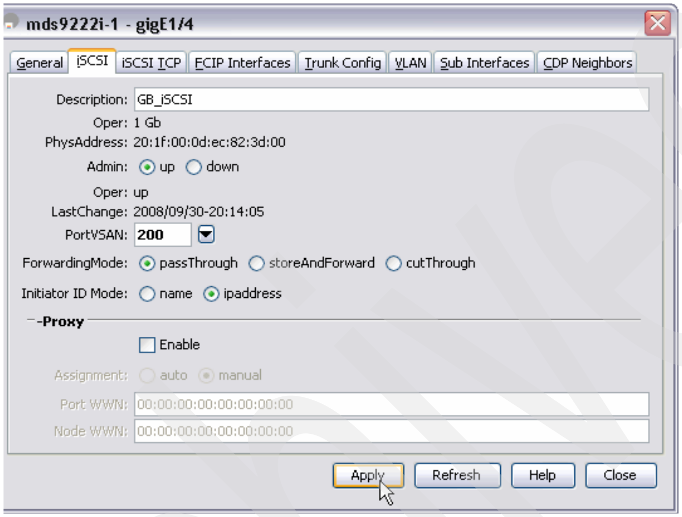
It is a good idea to check whether the interface has come up. If you want to be sure that it is working, you can **ping** the server where you installed the initiator, as shown in Example 7-10.

Example 7-10 ping to our iSCSI initiator

```
mds9222i-1# ping 10.43.86.10
PING 10.43.86.10 (10.43.86.10) 56(84) bytes of data.
64 bytes from 10.43.86.10: icmp_seq=2 ttl=128 time=0.397 ms
64 bytes from 10.43.86.10: icmp_seq=3 ttl=128 time=0.386 ms
64 bytes from 10.43.86.10: icmp_seq=4 ttl=128 time=0.410 ms
```

```
64 bytes from 10.43.86.10: icmp_seq=5 ttl=128 time=0.410 ms

--- 10.43.86.10 ping statistics ---
5 packets transmitted, 4 received, 20% packet loss, time 4010ms
rtt min/avg/max/mdev = 0.386/0.400/0.410/0.026 ms
```

7. Select the **iSCSI** tab. On this tab we select the **Admin up** check box, **VSAN 200**, **passThrough**, and **ipaddress** options, as shown in Figure 7-36.



Description: GB_iSCSI
Oper: 1 Gb
PhysAddress: 20:1f:00:0d:ec:82:3d:00
Admin: ● up ○ down
Oper: up
LastChange: 2008/09/30-20:14:05
PortVSAN: 200
ForwardingMode: ● passThrough ○ storeAndForward ○ cutThrough
Initiator ID Mode: ○ name ● ipaddress

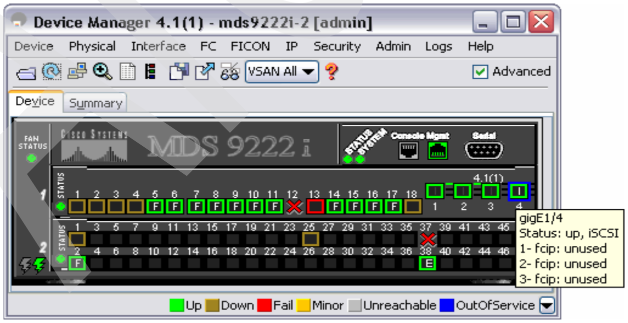
Proxy

□ Enable

Assignment: ○ auto ● manual
Port WWN: 00:00:00:00:00:00:00:00
Node WWN: 00:00:00:00:00:00:00:00

Figure 7-36 Device Manager Interface panel

8. The Device Manager panel (Figure 7-37) shows that interface 4 in the MSM module is up (shows as green) and that iSCSI is enabled in this interface (small mark inside the interface).



gigE1/4
Status: up, iSCSI
1- fcip: unused
2- fcip: unused
3- fcip: unused

🟩Up 🟫Down 🟥Fail 🟨Minor ⬜Unreachable 🟦OutOfService

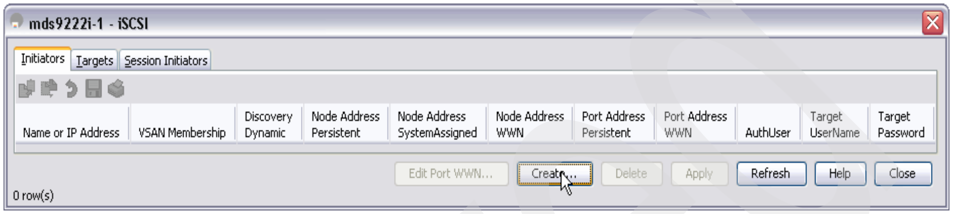
Figure 7-37 Device Manager Interface gigE2/2

At this point, iSCSI is enabled and we have a gateway working. Next we must create an initiator and targets and zone them.

7.4.7 Creating initiators

With Device Manager started:

1. Select **IP** → **iSCSI** to get the panel shown in Figure 7-38. Click **Create**.



mds9222i-1 - iSCSI

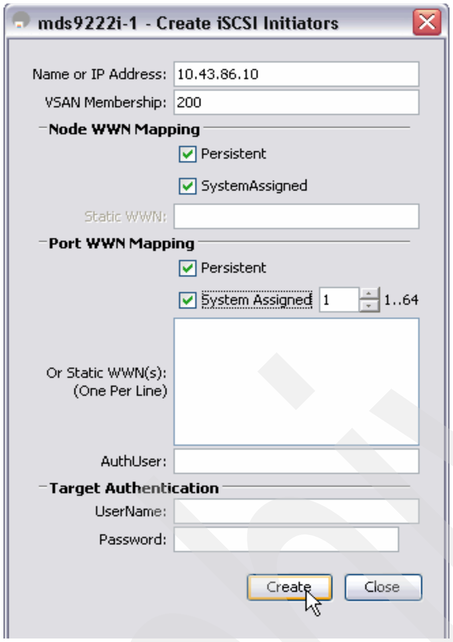
Name or IP Address	VSAN Membership	Discovery Dynamic	Node Address Persistent	Node Address SystemAssigned	Node Address WWN	Port Address Persistent	Port Address WWN	AuthUser	Target UserName	Target Password

0 row(s)

Figure 7-38 Device Manager iSCSI panel

Our Windows 2003 server used for this example, Senegal, has 10.43.86.10 configured as its interface that is connected to the storage LAN network. VSAN200 is the VSAN where we have our SVC ports.

2. Select the following check boxes:
   - **Persistent** and **System Assigned** for the node WWN mapping
   - **Persistent** and **System Assigned** for the port WWN mapping (as shown in Figure 7-39)



mds9222i-1 - Create iSCSI Initiators

Name or IP Address: 10.43.86.10

VSAN Membership: 200

Node WWN Mapping

☑ Persistent

☑ SystemAssigned

Static WWN:

Port WWN Mapping

☑ Persistent

☑ System Assigned 1 1..64

Or Static WWN(s): (One Per Line)

AuthUser:

Target Authentication

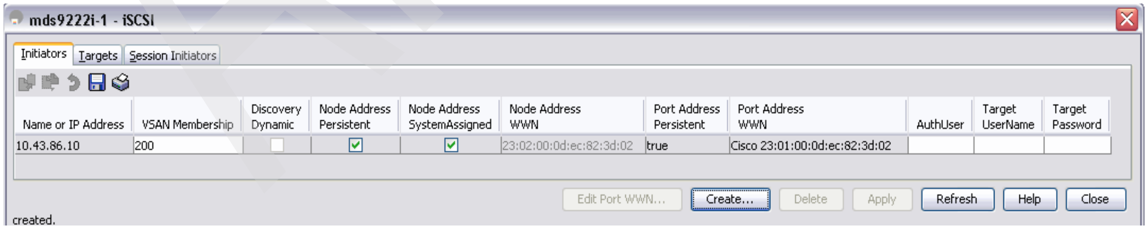
UserName:

Password:

Figure 7-39 Device Manager Create iSCSI initiator panel

3. After we select **Create**, we have the IP address of Senegal registered as an iSCSI initiator, and we have dynamically generated a WWN for it, as shown in Figure 7-40.

   Also, pWWN and nWWN were dynamically generated, and they are persistent because we checked the **Persistent** check box.



mds9222i-1 - iSCSI

Name or IP Address	VSAN Membership	Discovery Dynamic	Node Address Persistent	Node Address SystemAssigned	Node Address WWN	Port Address Persistent	Port Address WWN	AuthUser	Target UserName	Target Password
10.43.86.10	200	□	☑	☑	23:02:00:0d:ec:82:3d:02	true	Cisco 23:01:00:0d:ec:82:3d:02			

created.

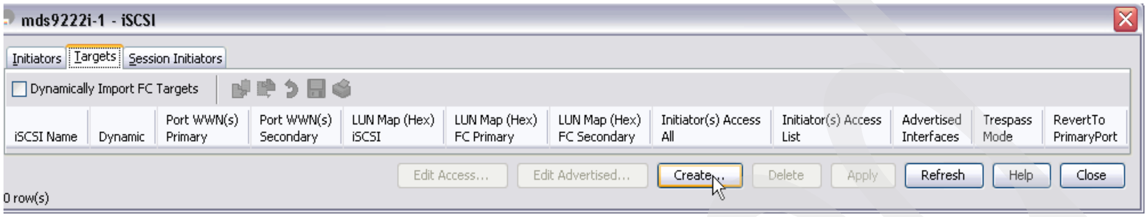
Figure 7-40 Device Manager iSCSI Initiators panel

7.4.8 Creating targets

We use an IBM SAN Volume Controller for our example.

To create iSCSI targets using Device Manager:

1. Select **IP** → **SCSI** → **Targets** → **Create**, as shown in Figure 7-41.



iSCSI Name	Dynamic	Port WWN(s) Primary	Port WWN(s) Secondary	LUN Map (Hex) iSCSI	LUN Map (Hex) FC Primary	LUN Map (Hex) FC Secondary	Initiator(s) Access All	Initiator(s) Access List	Advertised Interfaces	Trespass Mode	RevertTo PrimaryPort

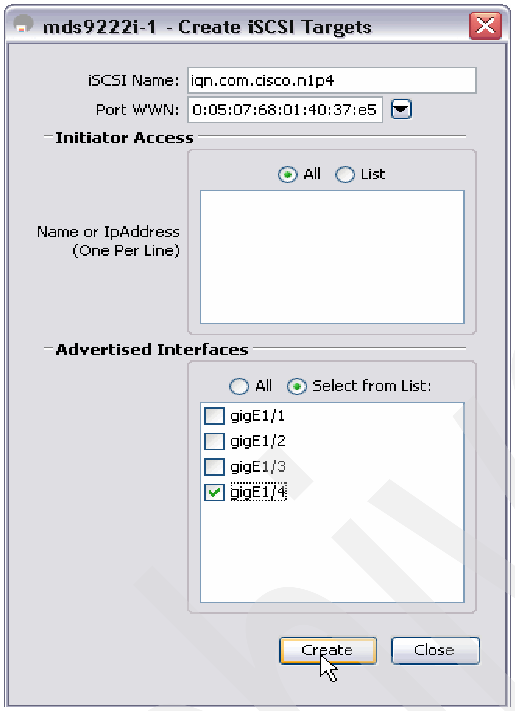
0 row(s)

Figure 7-41 Device Manager iSCSI Targets panel

2. We create the name iqn.com.cisco.itsocl1.n1p4 and pick node1 port 4 WWN from the Port WWN drop-down menu. We set Initiator **Access to ALL** because we have zoning and LUN masking to control the access.

   There are multiple options for access control. One is access by IP address or iqn.xxx name. This can be done at the LUN level as well. The other method is by utilizing Fibre Channel zoning. Since each iSCSI initiator gets its own pWWN per IP address, zoning by pWWN is feasible and preferred. Cisco's MDS does allow for zoning by IP address or iqn.xxx name as well.

3. We choose **gigE 1/4** as the only interface where that target will be mapped (Figure 7-42).


mds9222i-1 - Create iSCSI Targets

iSCSI Name: iqn.com.cisco.n1p4

Port WWN: 0:05:07:68:01:40:37:e5

Initiator Access

● All ○ List

Name or IpAddress (One Per Line)

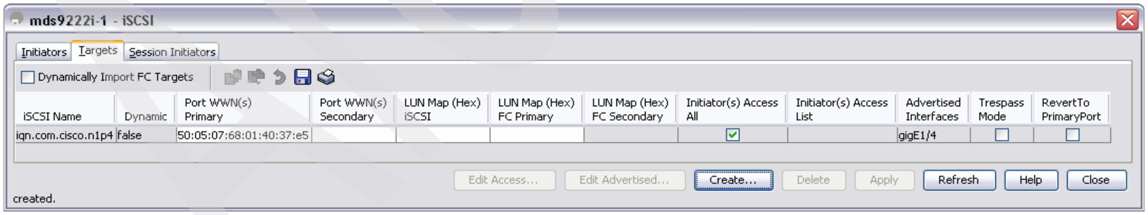
Advertised Interfaces

○ All ● Select from List:

□ gigE1/1
□ gigE1/2
□ gigE1/3
☑ gigE1/4

Figure 7-42 Device Manager Create iSCSi Targets panel

After we select **Create**, we have itsosvccl1 node 1 port 4 registered as an iSCSI target (Figure 7-43).


mds9222i-1 - iSCSI

□ Dynamically Import FC Targets

iSCSI Name	Dynamic	Port WWN(s) Primary	Port WWN(s) Secondary	LUN Map (Hex) iSCSI	LUN Map (Hex) FC Primary	LUN Map (Hex) FC Secondary	Initiator(s) Access All	Initiator(s) Access List	Advertised Interfaces	Trespass Mode	RevertTo PrimaryPort
iqn.com.cisco.n1p4	false	50:05:07:68:01:40:37:e5					☑		gigE1/4	□	□

created.

Figure 7-43 Device Manager iSCSI Targets panel

At this point our initiators and targets are created. We are ready to zone targets and initiators as we do for FC. After zoning, we must load the client portion of the code into the server and configure it before we are able to map disks from the SVC to the server.

7.4.9 Zoning iSCSI initiators

As stated previously, there are multiple options for access control. One is access by IP address or iqn.xxx name. This can be done at the LUN level as well. The other method is by utilizing Fibre Channel zoning. Since each iSCSI initiator gets its own pWWN per IP address, zoning by pWWN is feasible and preferred. Cisco's MDS allows for zoning by IP address or iqn.xxx name.

Guidelines for zoning iSCSI hosts and the SVC

In a conventional Fibre Channel SAN, there will normally be a number of SAN paths between a particular SVC I/O group and the server HBA ports that use the VDisks supplied by that I/O group. A multipathing device driver is run on the server to resolve these multiple paths into a single logical device to which the server can perform I/O.

The multipathing device driver also provides failover and path recovery functions that deal with scenarios where the SAN fabric paths change or fail. The present iSCSI solution only supports a single path between the iSCSI host NIC and the SVC VDisk, and there is no multipathing driver in the iSCSI host. This means that there is no recovery from errors and it is not possible to concurrently upgrade the SVC firmware while maintaining connectivity from an iSCSI host system.

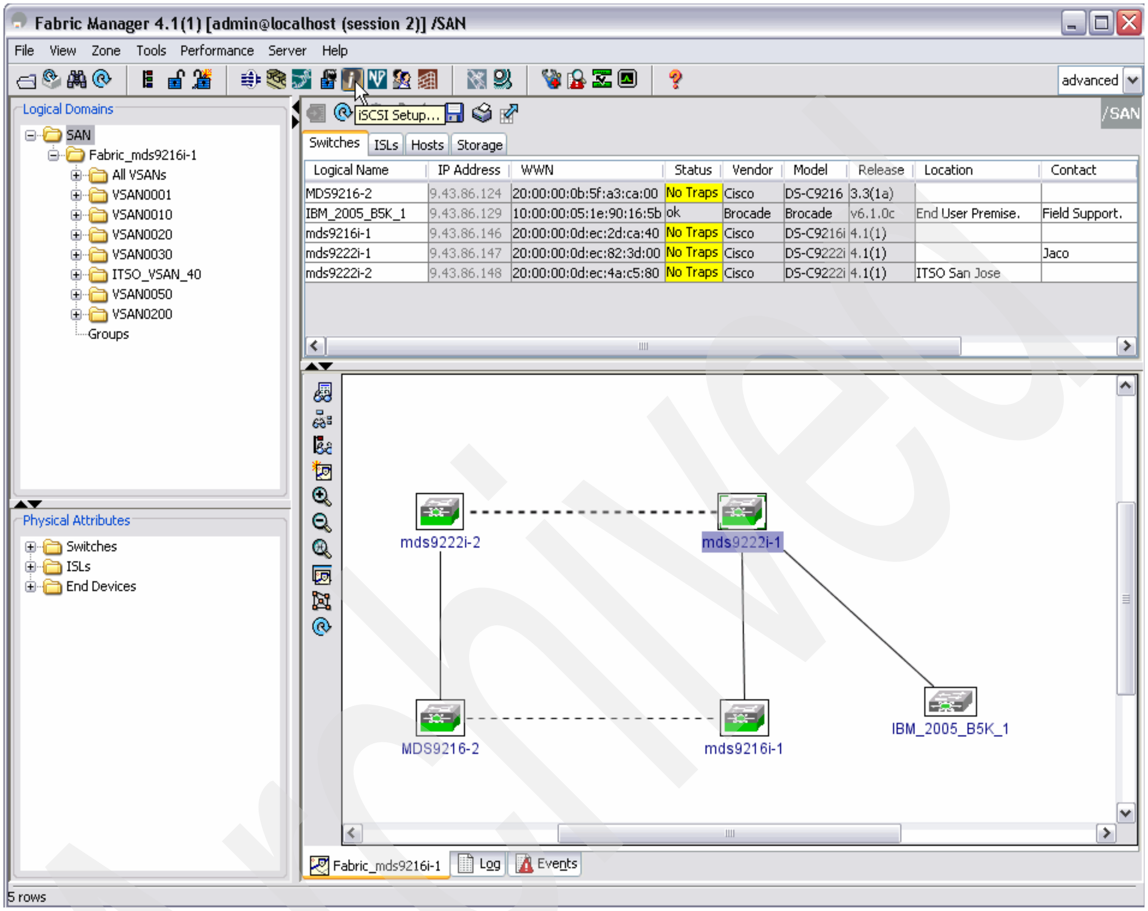
As such, it is inappropriate for the SVC to present the VDisk at multiple ports in the Fibre Channel SAN, and to prevent this the user must select a single SVC port in each SVC I/O group that is to be associated with each iSCSI host. Zoning is then applied in the MDS switch so that each iSCSI host can see only one SVC port in each SVC I/O group. If multiple iSCSI hosts are in use, the hosts should be evenly spread across the ports in each SVC I/O group. The SVC svctask **mkvdiskhostmap** command should then be used to ensure that each SVC VDisk is mapped to a single NIC in the server.

In our example we configured the SVC and the DS4500 into a zone called SVC_BACKEND. We now configure the host to SVC using the wizard.

Creating zones using the Fabric Manager iSCSi Setup Wizard

Since the iSCSI initiator has not logged into the switch at this point, manually adding the pWWN (iSCSI initiator was created previously) into a zone is required. Then we also need to add the pWWN of the storage.

The easiest way to accomplish this task is to use the Fabric Manager iSCSI Setup Wizard (Figure 7-44).

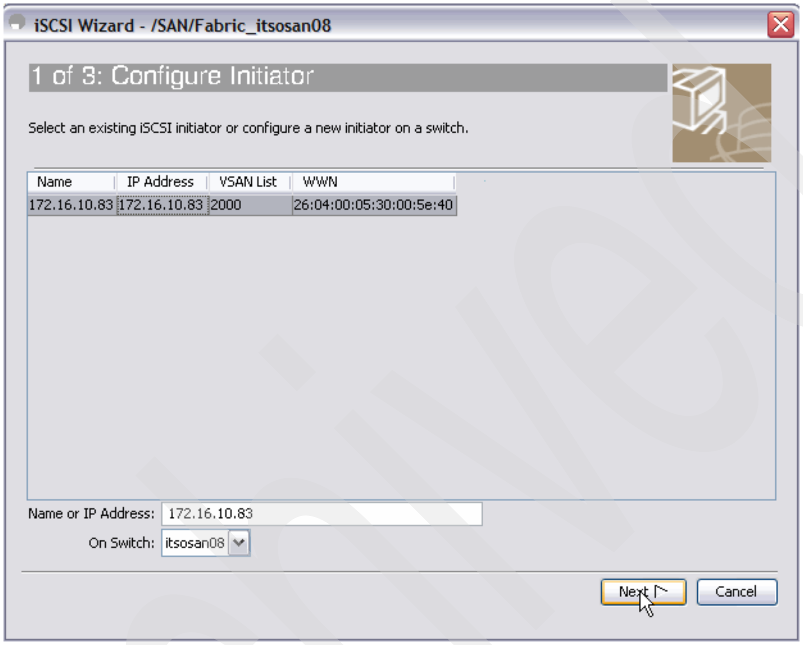


Logical Name	IP Address	WWN	Status	Vendor	Model	Release	Location	Contact
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	No Traps	Cisco	DS-C9216	3.3(1a)		
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c	End User Premise.	Field Support.
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	No Traps	Cisco	DS-C9216i	4.1(1)		
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)		Jaco
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)	ITSO San Jose	

Figure 7-44 Fabric Manager iSCSI Setup Wizard

To do this:

1. A portion of our work was done when we created the initiator. A list of known initiators is displayed in the first panel of the Fabric Manager iSCSI Setup Wizard, as shown in Figure 7-45. In our example, there is just one initiator, Senegal, with IP address 10.43.86.10. We highlight it and click **Next**.



iSCSI Wizard - /SAN/Fabric_itsosan08

1 of 3: Configure Initiator

Select an existing iSCSI initiator or configure a new initiator on a switch.

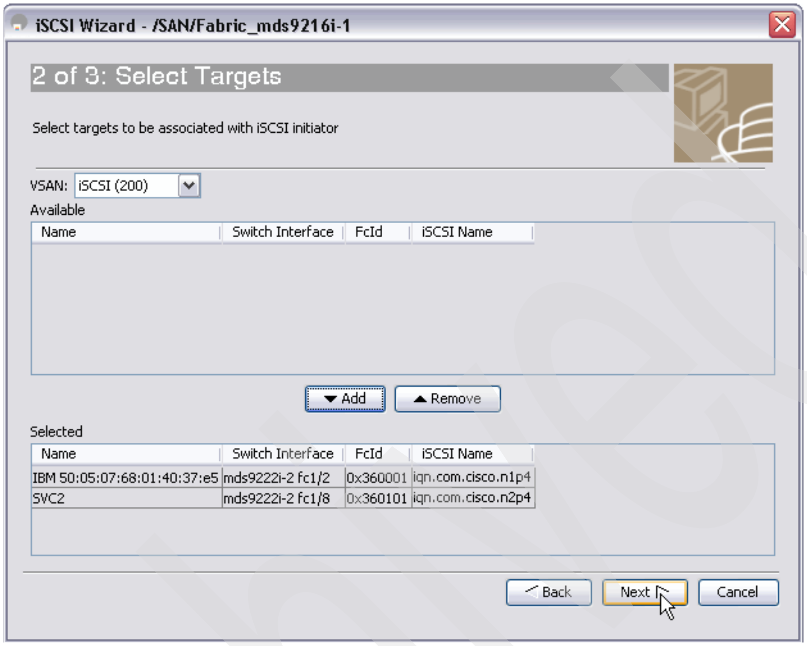
Name	IP Address	VSAN List	WWN
172.16.10.83	172.16.10.83	2000	26:04:00:05:30:00:5e:40

Name or IP Address: 172.16.10.83

On Switch: itsosan08

Figure 7-45 Fabric Manager iSCSI Wizard panel 1 of 3

2. In the next step, all known targets are displayed (Figure 7-46). We select both and click **Add**, located in the middle of the upper and lower panels. We click **Next**.



iSCSI Wizard - /SAN/Fabric_mds9216i-1

2 of 3: Select Targets

Select targets to be associated with iSCSI initiator

VSAN: iSCSI (200)

Available

Name	Switch Interface	FcId	iSCSI Name

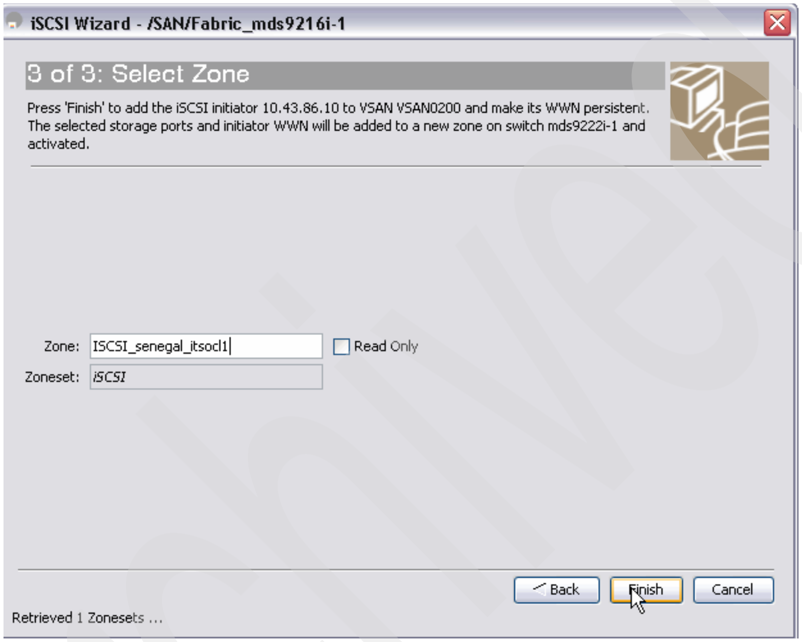
Selected

Name	Switch Interface	FcId	iSCSI Name
IBM 50:05:07:68:01:40:37:e5	mds9222i-2 fc1/2	0x360001	iqn.com.cisco.n1p4
SVC2	mds9222i-2 fc1/8	0x360101	iqn.com.cisco.n2p4

Figure 7-46 Fabric Manager iSCSI Wizard panel 2 of 3

3. Once the targets are selected, we are able to name our zone. Cisco's MDS prompts us to name it starting with the prefix iSCSI (Figure 7-47). We click **Finish** → **Commit** to activate our changes.

> **Note:** For easier management we recommend prefixing the zone names so that they start with ISCSI (for example, ISCSI_senegal_itsocl1).



iSCSI Wizard - /SAN/Fabric_mds9216i-1

3 of 3: Select Zone

Press 'Finish' to add the iSCSI initiator 10.43.86.10 to VSAN VSAN0200 and make its WWN persistent. The selected storage ports and initiator WWN will be added to a new zone on switch mds9222i-1 and activated.

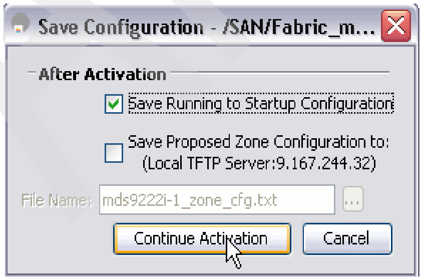
Zone: ISCSI_senegal_itsocl1 □ Read Only

Zoneset: iSCSI

Retrieved 1 Zonesets ...

Figure 7-47 Fabric Manager iSCSI Wizard panel 3 of 3

4. Click **Continue Activation** to continue and save the configuration, as shown in Figure 7-48.



Save Configuration - /SAN/Fabric_m...

After Activation

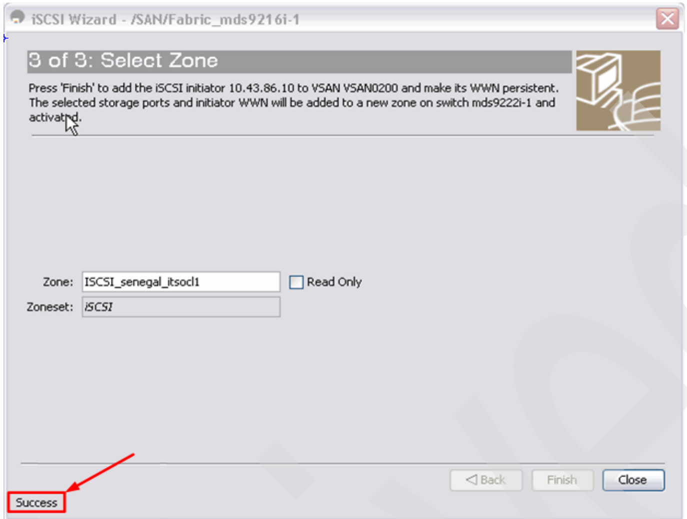
☑ Save Running to Startup Configuration

□ Save Proposed Zone Configuration to: (Local TFTP Server:9.167.244.32)

File Name: mds9222i-1_zone_cfg.txt

Figure 7-48 Activation of new zoneset

5. Wait for the zone addition and activation to complete then select the **Close** buttons, as shown in Figure 7-49.



iSCSI Wizard - /SAN/Fabric_mds9216i-1

3 of 3: Select Zone

Press 'Finish' to add the iSCSI initiator 10.43.86.10 to VSAN VSAN0200 and make its WWN persistent. The selected storage ports and initiator WWN will be added to a new zone on switch mds9222i-1 and activated.

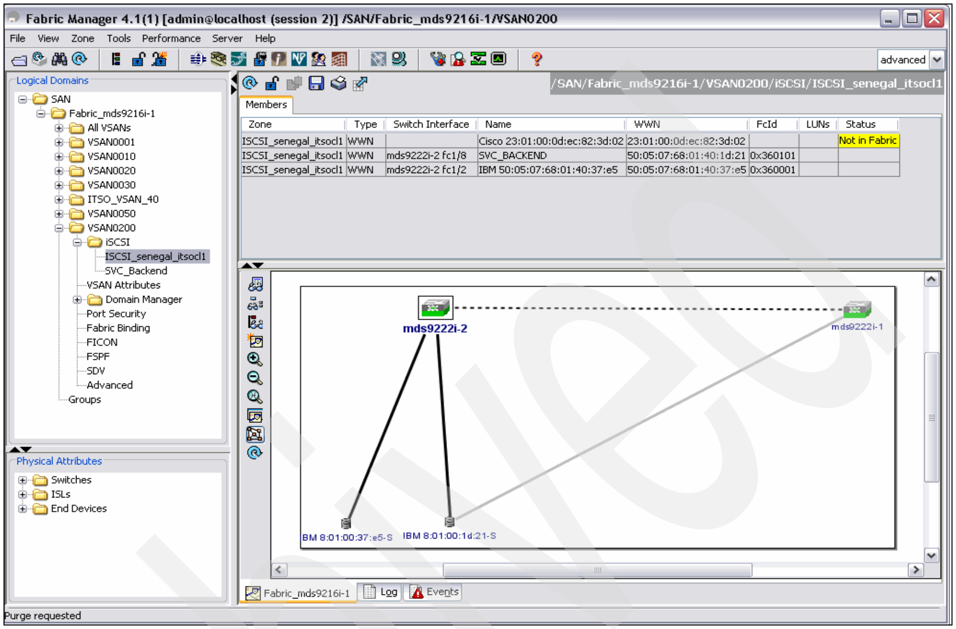
Zone: ISCSI_senegal_itsocl1 □ Read Only

Zoneset: iSCSI

Success

Figure 7-49 Successful completion of iSCSI zone

In Figure 7-50 in the upper right panel, last column, we can see the status of our initiators and targets. In our case, the initiator is Not in Fabric. This is to be expected since we have not configured the client at this stage.



Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9216i-1/VSAN0200

/SAN/Fabric_mds9216i-1/VSAN0200/iSCSI/ISCSI_senegal_itsocl1

Zone	Type	Switch Interface	Name	WWN	FcId	LUNs	Status
ISCSI_senegal_itsocl1	WWN		Cisco 23:01:00:0d:ec:82:3d:02	23:01:00:0d:ec:82:3d:02			Not in Fabric
ISCSI_senegal_itsocl1	WWN	mds9222i-2 fc1/8	SVC_BACKEND	50:05:07:68:01:40:1d:21	0x360101		
ISCSI_senegal_itsocl1	WWN	mds9222i-2 fc1/2	IBM 50:05:07:68:01:40:37:e5	50:05:07:68:01:40:37:e5	0x360001		

Purge requested

Figure 7-50   Fabric Manager zone sets and zone display

At this point we are ready to load the client code and initiator into the server. Once we have the code loaded and we have the initiator driver configured, we can assign volumes from the SVC to the server.

7.4.10 Client configuration

Before implementing iSCSI check the compatibility matrix for the different components that comprise your solution.

The Microsoft iSCSI Software Initiator supported hardware list is found at:

http://www.microsoft.com/windowsserver2003/technologies/storage/iscsi/default.mspx

Note: At the time of this writing, Microsoft iSCSI Software Initiator Version 2.07 was released, but we used Microsoft iSCSI Software Initiator Version 1.06 for our implementation due to its compatibility with IBM SVC 4.3.0.

Use the link below to access the Cisco interoperability site and determine the correct iSCSI software required:

http://www.cisco.com/en/US/docs/storage/san_switches/mds9000/interoperability/matrix/Matrix5.html#wp266259

In our case this was 1.06, as shown in Figure 7-51.

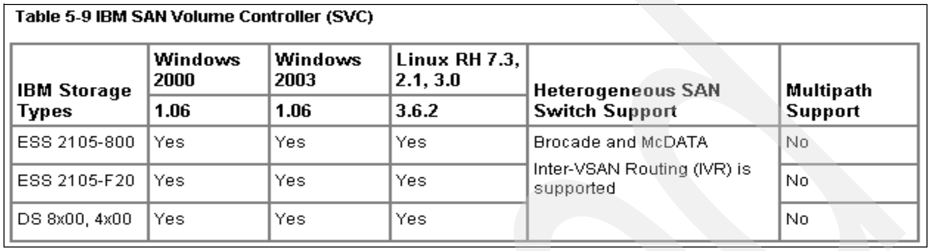


Table 5-9 IBM SAN Volume Controller (SVC)

IBM Storage Types	Windows 2000	Windows 2003	Linux RH 7.3, 2.1, 3.0	Heterogeneous SAN Switch Support	Multipath Support
	1.06	1.06	3.6.2		
ESS 2105-800	Yes	Yes	Yes	Brocade and McDATA	No
ESS 2105-F20	Yes	Yes	Yes	Inter-VSAN Routing (IVR) is supported	No
DS 8x00, 4x00	Yes	Yes	Yes		No

Figure 7-51 SVC software interoperability

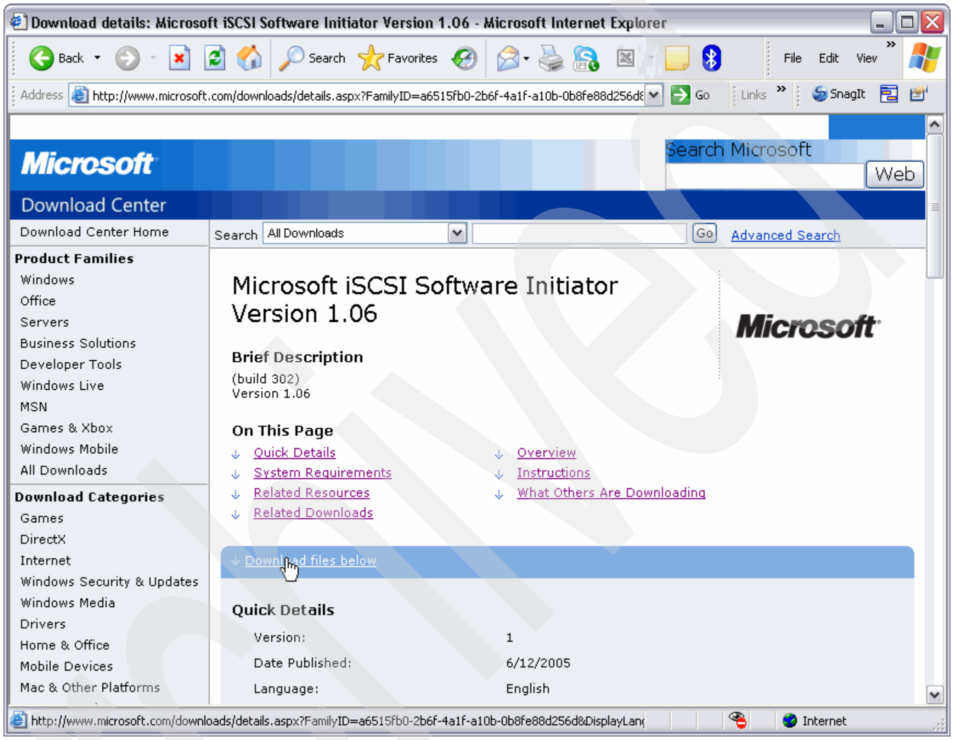
Downloading the Microsoft iSCSI Software Initiator

The Microsoft iSCSI Software Initiator is obtained from the following link:

http://www.microsoft.com/downloads/details.aspx?FamilyID=a6515fb0-2b6f-4a1f-a10b-0b8fe88d256d&DisplayLang=en

We click the **Download files below** link, as shown in Figure 7-52.

Notice: Microsoft product images are reprinted with permission from Microsoft Corporation.



Download details: Microsoft iSCSI Software Initiator Version 1.06 - Microsoft Internet Explorer

Address http://www.microsoft.com/downloads/details.aspx?FamilyID=a6515fb0-2b6f-4a1f-a10b-0b8fe88d256d

Microsoft

Download Center

Search Microsoft

Web

Download Center Home

Search All Downloads Go Advanced Search

Product Families
- Windows
- Office
- Servers
- Business Solutions
- Developer Tools
- Windows Live
- MSN
- Games & Xbox
- Windows Mobile
- All Downloads

Download Categories
- Games
- DirectX
- Internet
- Windows Security & Updates
- Windows Media
- Drivers
- Home & Office
- Mobile Devices
- Mac & Other Platforms

Microsoft iSCSI Software Initiator Version 1.06

Brief Description

(build 302)
Version 1.06

On This Page
- Quick Details
- System Requirements
- Related Resources
- Related Downloads
- Overview
- Instructions
- What Others Are Downloading

Download files below

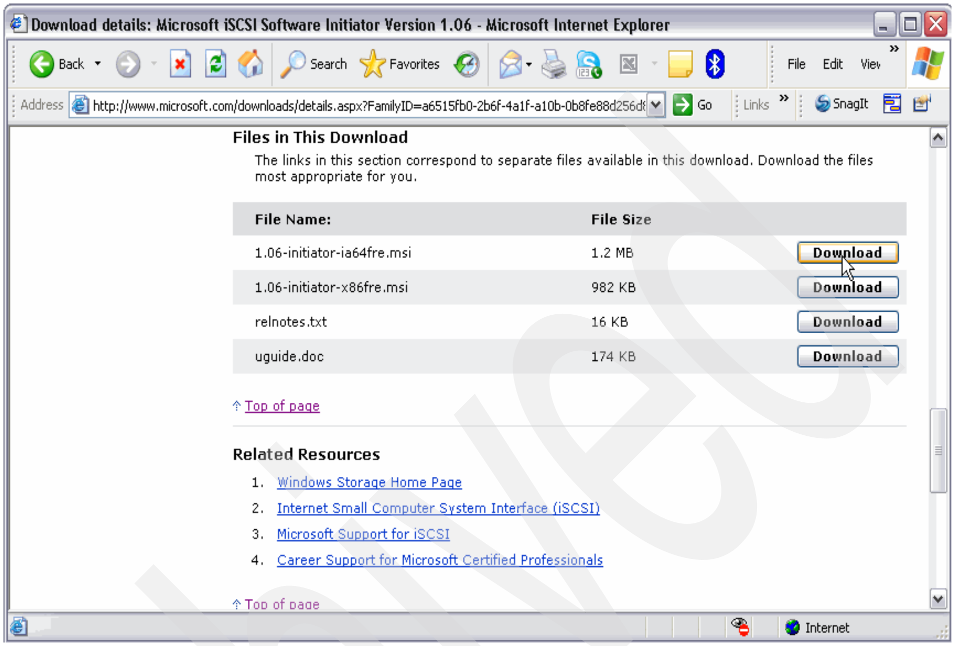
Quick Details

Version:	1
Date Published:	6/12/2005
Language:	English

http://www.microsoft.com/downloads/details.aspx?FamilyID=a6515fb0-2b6f-4a1f-a10b-0b8fe88d256d&DisplayLan

Figure 7-52 Microsoft iSCSI Software Initiator Version 1.06 Web page

We pick the 32-bit version, as shown in Figure 7-53, because we are running our test in a 32-bit Windows 2003 server.


Download details: Microsoft iSCSI Software Initiator Version 1.06 - Microsoft Internet Explorer
Back
Search
Favorites
File
Edit
View
Address
http://www.microsoft.com/downloads/details.aspx?FamilyID=a6515fb0-2b6f-4a1f-a10b-0b8fe88d256d
Go
Links
SnagIt
Internet

Files in This Download

The links in this section correspond to separate files available in this download. Download the files most appropriate for you.

File Name:	File Size	
1.06-initiator-ia64fre.msi	1.2 MB	Download
1.06-initiator-x86fre.msi	982 KB	Download
relnotes.txt	16 KB	Download
uguide.doc	174 KB	Download

↑ Top of page

Related Resources

1. Windows Storage Home Page
2. Internet Small Computer System Interface (iSCSI)
3. Microsoft Support for iSCSI
4. Career Support for Microsoft Certified Professionals

↑ Top of page

Figure 7-53 Microsoft iSCSI Software Initiator Version 1.06 download Web page

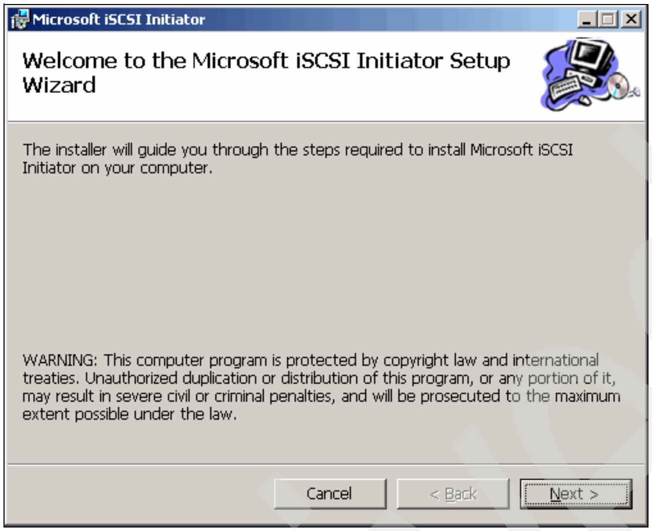
Installing Microsoft iSCSI Software Initiator

In this section we install the Microsoft iSCSI Software Initiator in a server equipped with two Ethernet cards. One of these is dedicated to the storage LAN network. If you are going to implement iSCSI with high availability in mind, the installation process is the same.

To install the iSCSI Initiator package, we run the appropriate MSI installer package by double-clicking the file icon (Figure 7-54) from an Explorer window. You must be logged in as an administrator to install the Microsoft iSCSI Software Initiator package.

Figure 7-54 iSCSI initiator installation package icon

The first panel we see is the Wizard welcome panel, as shown in Figure 7-55.



Welcome to the Microsoft iSCSI Initiator Setup Wizard

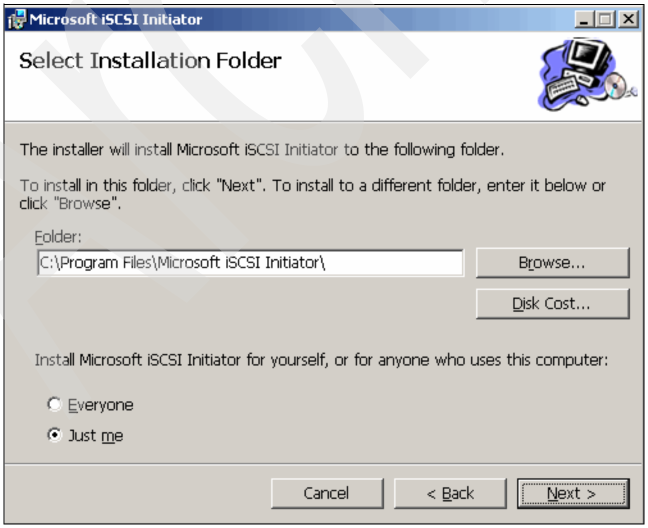
The installer will guide you through the steps required to install Microsoft iSCSI Initiator on your computer.

WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.

Figure 7-55 Microsoft iSCSI Initiator Setup Wizard welcome panel

From there:

1. Choose the install location. We use the default value, as shown in Figure 7-56. This operation is conducted by the superuser (in this case, administrator). We do not want anyone else to have access to this software, so we leave **Just me** checked and select **Next**.



Select Installation Folder

The installer will install Microsoft iSCSI Initiator to the following folder.

To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".

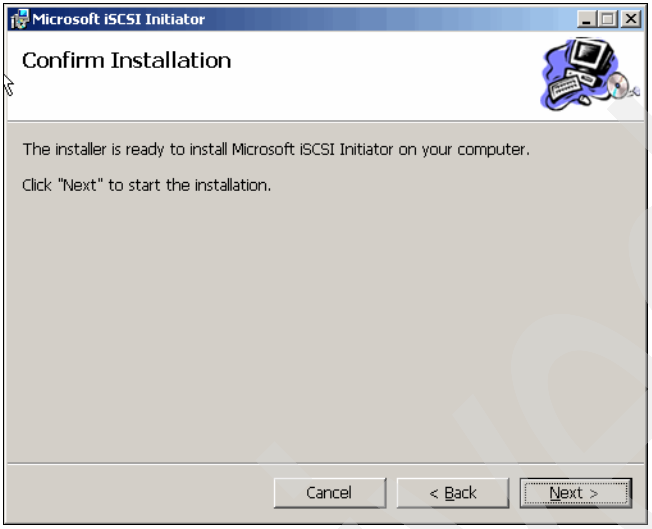
Folder: C:\Program Files\Microsoft iSCSI Initiator\

Install Microsoft iSCSI Initiator for yourself, or for anyone who uses this computer:

○ Everyone
● Just me

Figure 7-56 Microsoft iSCSI Initiator Select Installation Folder panel

Before any further action takes place, the Microsoft iSCSI Initiator Wizard says that is ready to start the installation process (Figure 7-57).



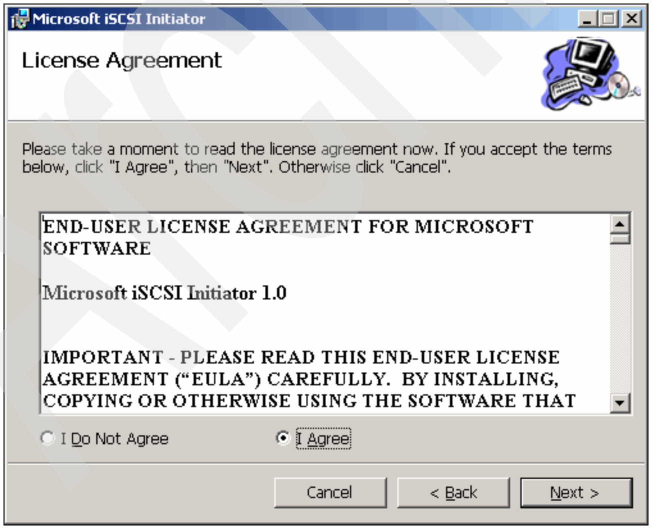
Confirm Installation

The installer is ready to install Microsoft iSCSI Initiator on your computer.

Click "Next" to start the installation.

Figure 7-57 Microsoft iSCSI Initiator Confirm Installation panel

2. After reading the software license agreement, check the **I agree** box and then click **Next**, as shown in Figure 7-58.



License Agreement

Please take a moment to read the license agreement now. If you accept the terms below, click "I Agree", then "Next". Otherwise click "Cancel".

END-USER LICENSE AGREEMENT FOR MICROSOFT SOFTWARE

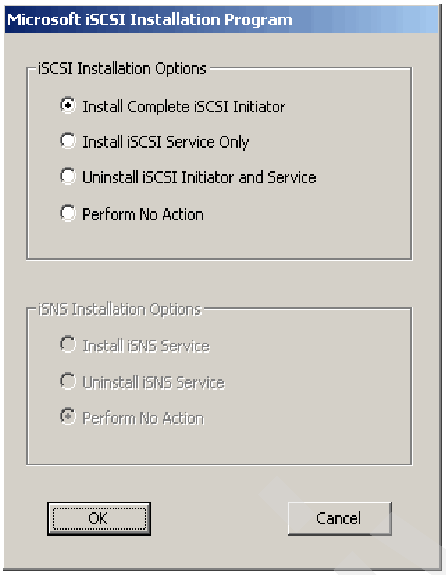
Microsoft iSCSI Initiator 1.0

IMPORTANT - PLEASE READ THIS END-USER LICENSE AGREEMENT ("EULA") CAREFULLY. BY INSTALLING, COPYING OR OTHERWISE USING THE SOFTWARE THAT

○ I Do Not Agree ● I Agree

Figure 7-58 Microsoft iSCSI Initiator License Agreement panel

3. Select **Install Complete iSCSi Initiator** (Figure 7-59).



Microsoft iSCSI Installation Program

iSCSI Installation Options

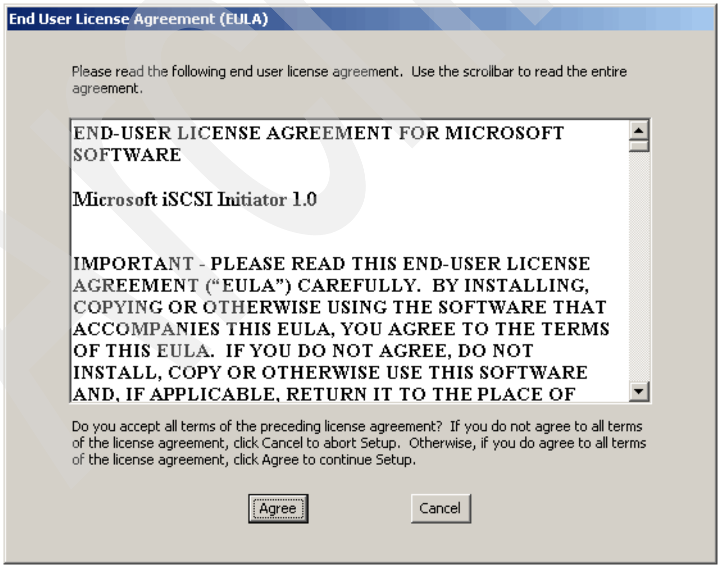
● Install Complete iSCSI Initiator
○ Install iSCSI Service Only
○ Uninstall iSCSI Initiator and Service
○ Perform No Action

iSNS Installation Options

○ Install iSNS Service
○ Uninstall iSNS Service
● Perform No Action

Figure 7-59 Microsoft iSCSI Initiator iSCSI installation options

4. The End User License Agreement (EULA) appears. After reading it, click **Agree** (Figure 7-60).



End User License Agreement (EULA)

Please read the following end user license agreement. Use the scrollbar to read the entire agreement.

END-USER LICENSE AGREEMENT FOR MICROSOFT SOFTWARE

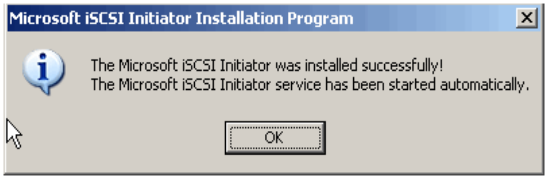
Microsoft iSCSI Initiator 1.0

IMPORTANT - PLEASE READ THIS END-USER LICENSE AGREEMENT ("EULA") CAREFULLY. BY INSTALLING, COPYING OR OTHERWISE USING THE SOFTWARE THAT ACCOMPANIES THIS EULA, YOU AGREE TO THE TERMS OF THIS EULA. IF YOU DO NOT AGREE, DO NOT INSTALL, COPY OR OTHERWISE USE THIS SOFTWARE AND, IF APPLICABLE, RETURN IT TO THE PLACE OF

Do you accept all terms of the preceding license agreement? If you do not agree to all terms of the license agreement, click Cancel to abort Setup. Otherwise, if you do agree to all terms of the license agreement, click Agree to continue Setup.

Figure 7-60 Microsoft iSCSI Initiator End User License Agreement

The software is installed and if everything has been successful you will see a pop-up similar to that shown in Figure 7-61.

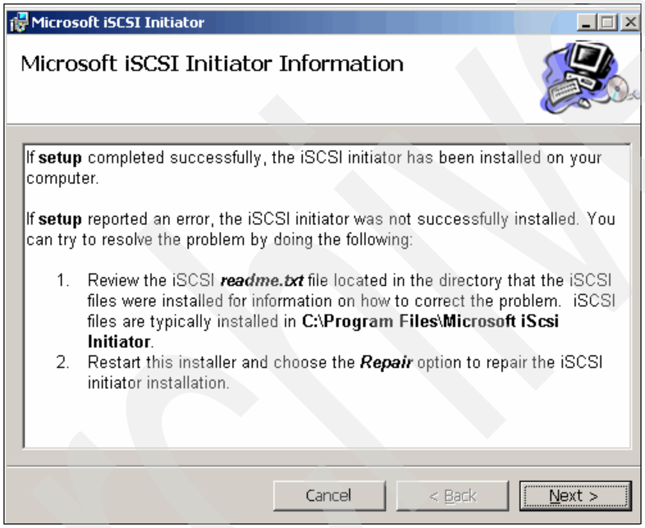


Microsoft iSCSI Initiator Installation Program

The Microsoft iSCSI Initiator was installed successfully!
The Microsoft iSCSI Initiator service has been started automatically.

Figure 7-61 Microsoft iSCSI Initiator Installation Program

Figure 7-62 shows a panel that contains information about how to solve a possible installation problem.



Microsoft iSCSI Initiator

Microsoft iSCSI Initiator Information

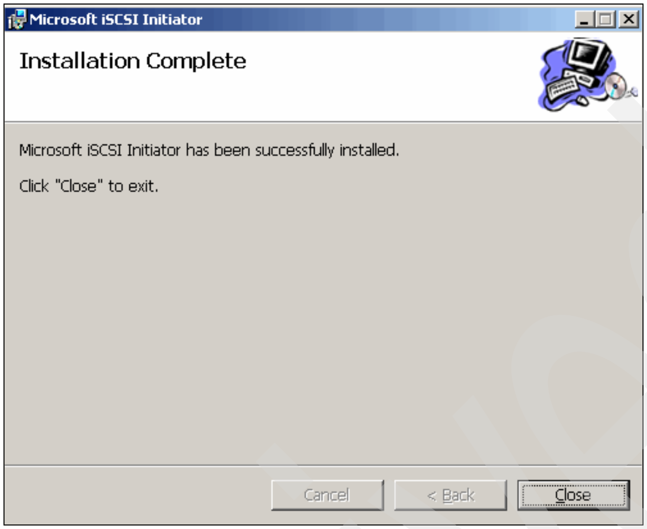
If **setup** completed successfully, the iSCSI initiator has been installed on your computer.

If **setup** reported an error, the iSCSI initiator was not successfully installed. You can try to resolve the problem by doing the following:

1. Review the iSCSI ***readme.txt*** file located in the directory that the iSCSI files were installed for information on how to correct the problem. iSCSI files are typically installed in **C:\Program Files\Microsoft iScsi Initiator**.
2. Restart this installer and choose the ***Repair*** option to repair the iSCSI initiator installation.

Figure 7-62 Microsoft iSCSI Initiator Installation Information

5. Our installation was successful, so we select **Next**. The following panel, shown in Figure 7-63, states that our installation was successful.



Microsoft iSCSI Initiator has been successfully installed.

Click "Close" to exit.

Figure 7-63 Microsoft iSCSI Initiator Installation complete

Configuring Microsoft iSCSI Software Initiator

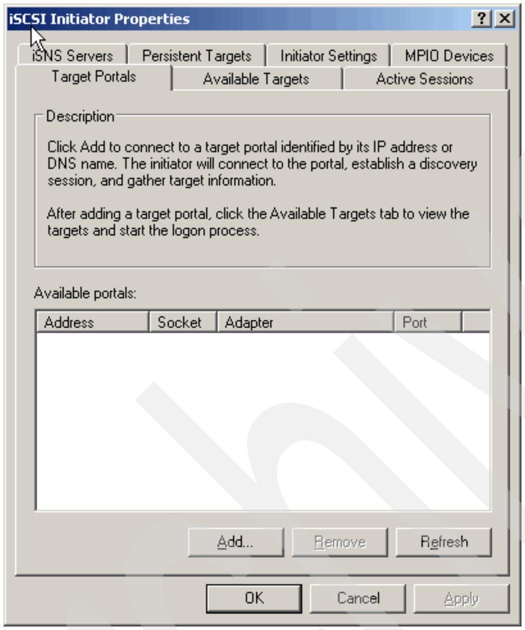
A Microsoft iSCSI Initiator icon is placed on our server desktop after the successful installation, as shown in Figure 7-64

Figure 7-64 iSCSI icon

To configure Microsoft iSCSI Software Initiator:

1. Double-click the icon to get started and click **Add** on the Target Portal tab, as shown in Figure 7-65.

> **Note:** Before proceeding, make sure that you have the iSCSI target gateway IP address and your host zoned to the targets.

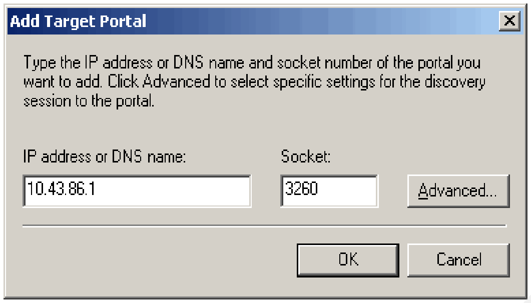


Click Add to connect to a target portal identified by its IP address or DNS name. The initiator will connect to the portal, establish a discovery session, and gather target information.

After adding a target portal, click the Available Targets tab to view the targets and start the logon process.

Figure 7-65 Microsoft iSCSI Initiator Properties panel

2. Fill in the fields by entering the IP address of the gateway (Figure 7-66). The IP address 10.43.86.1 was previously configured in the MDS to act as an iSCSI target gateway.



Add Target Portal

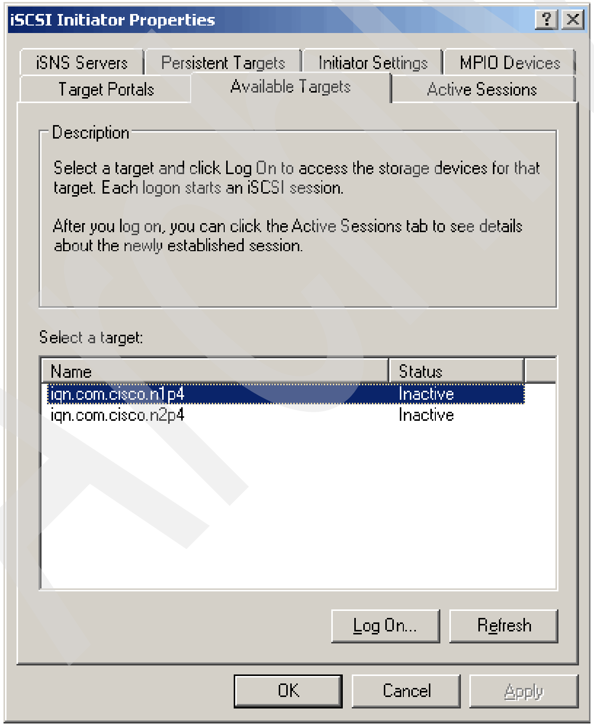
Type the IP address or DNS name and socket number of the portal you want to add. Click Advanced to select specific settings for the discovery session to the portal.

IP address or DNS name: 10.43.86.1

Socket: 3260

Figure 7-66 Microsoft iSCSI Initiator Add Target Portal form

3. Once the Target Portal is established under the Available Targets tab, click **Refresh**, After a short period of time, all the available iSCSI targets are listed. Highlight the target and click **Log on**, as shown in Figure 7-67.



iSCSI Initiator Properties

Description

Select a target and click Log On to access the storage devices for that target. Each logon starts an iSCSI session.

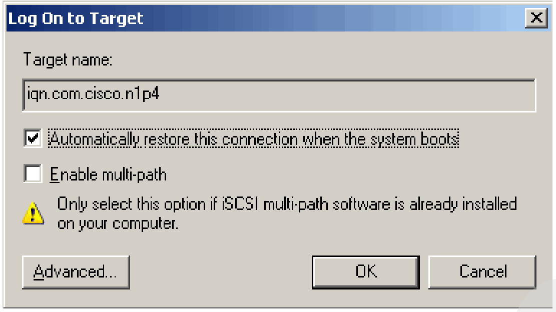
After you log on, you can click the Active Sessions tab to see details about the newly established session.

Select a target:

Name	Status
iqn.com.cisco.n1p4	Inactive
iqn.com.cisco.n2p4	Inactive

Figure 7-67 Microsoft iSCSI Initiator Available Targets panel

4. After clicking **Log on** we are prompted for additional options (Figure 7-68). Select the check box **Automatically restore this connection when the system boots**.



Log On to Target

Target name:
iqn.com.cisco.n1p4

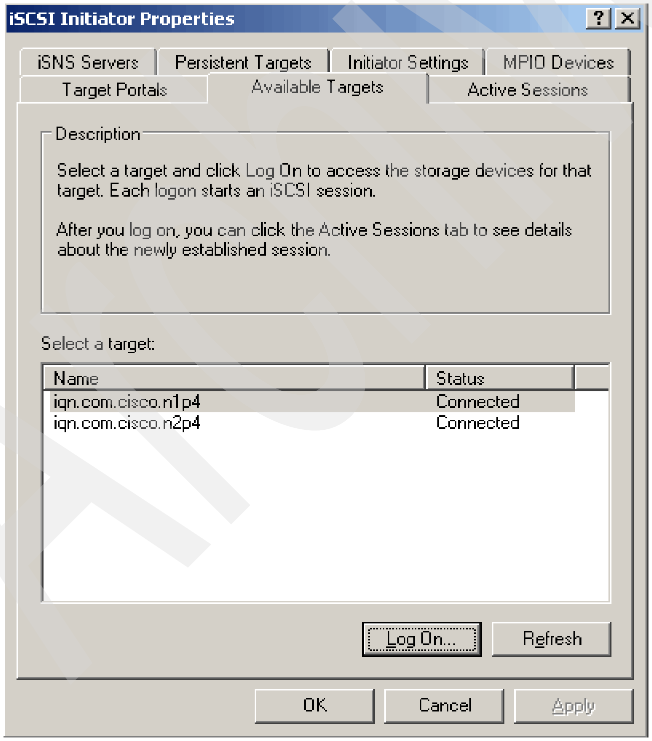
☑ Automatically restore this connection when the system boots

□ Enable multi-path

⚠ Only select this option if iSCSI multi-path software is already installed on your computer.

Figure 7-68 Microsoft iSCSI Initiator Log On to Target panel

5. Repeat the same process for each target. The final result is shown in Figure 7-69.



iSCSI Initiator Properties

Description

Select a target and click Log On to access the storage devices for that target. Each logon starts an iSCSI session.

After you log on, you can click the Active Sessions tab to see details about the newly established session.

Select a target:

Name	Status
iqn.com.cisco.n1p4	Connected
iqn.com.cisco.n2p4	Connected

Figure 7-69 Microsoft iSCSI Initiator Available Targets panel

At this point, we are now able to assign volumes from the SVC.

7.4.11 Additional information

An in-depth discussion and implementation of iSCSI with high-availability and security considerations is available in *IBM/Cisco Multiprotocol Routing: An Introduction and Implementation*, SG24-7543.

8

Analysis tools

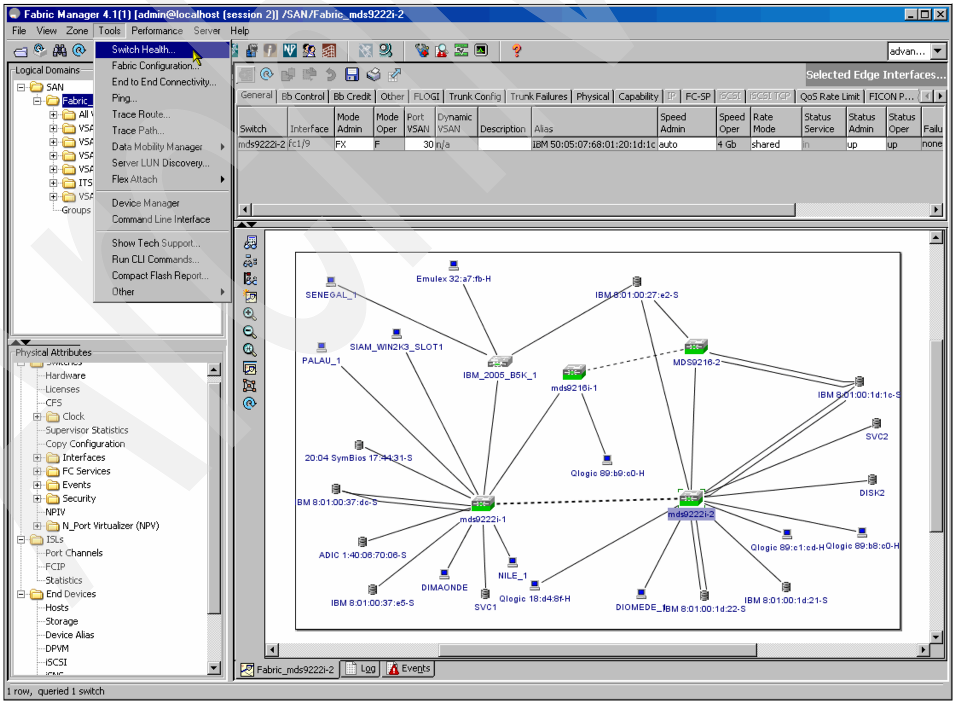
8.1 Fabric Manager analysis tools

Fabric Manager has several tools that can be useful in monitoring the health of the fabric, the status of individual switches, test end-to-end connectivity of devices, and monitor ISL performance. The following tools will be discussed in the topics that follow:

- Switch Health
- Zone Merge Analysis
- Fabric Configuration Analysis
- End to End Connectivity Analysis
- FC Ping
- FC Traceroute
- Show Tech Support

8.1.1 Switch Health

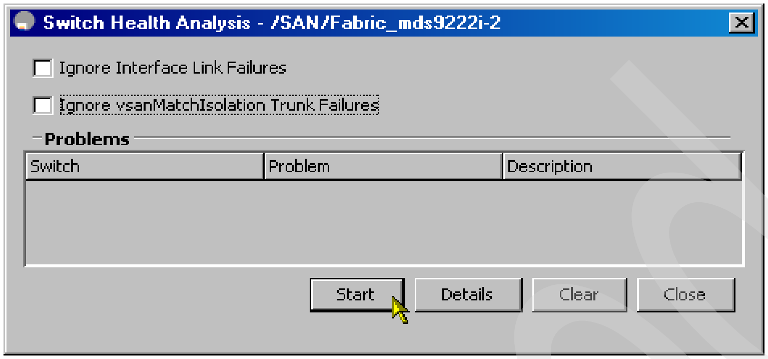
The Switch Health tool performs a check on the status of the components on each switch in the fabric. Start this tool by selecting **Tools** → **Switch Health** from the Fabric Manager menu bar, as shown in Figure 8-1.



Switch	Interface	Mode Admin	Mode Oper	Port VSAN	Dynamic VSAN	Description	Alias	Speed Admin	Speed Oper	Rate Mode	Status Service	Status Admin	Status Oper	Failu
mds9222i-2	fc1/9	FX	F	30	n/a		IBM 50:05:07:68:01:20:1d:1c	auto	4 Gb	shared	in	up	up	none

Figure 8-1 Start Switch Health Analysis from the Fabric Manager Tools menu

You will be given the Fabric Manager Switch Health Analysis window, shown in Figure 8-2. Select **Start** to begin the analysis. When it has performed its analysis, the results are shown under the Problems heading.



Switch Health Analysis - /SAN/Fabric_mds9222i-2

□ Ignore Interface Link Failures

□ Ignore vsanMatchIsolation Trunk Failures

Problems

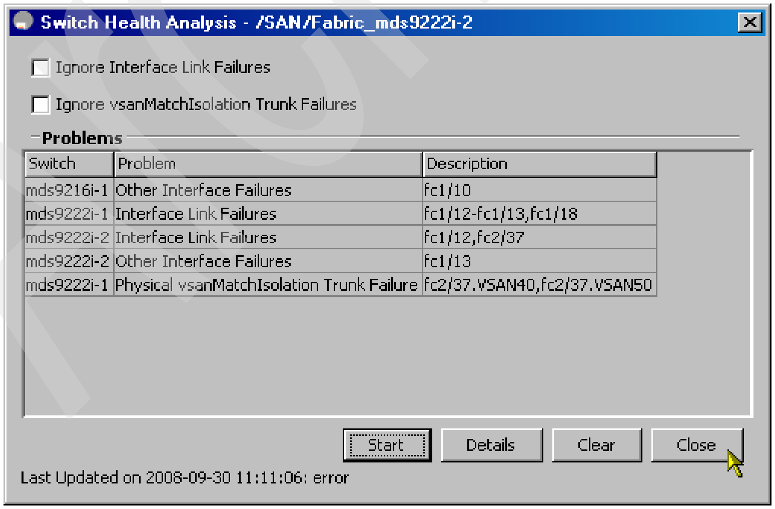
Switch	Problem	Description

Figure 8-2 Start Switch Health Analysis

When performing health analysis you can change the default configuration of health analysis by selecting the following options, and as shown in Figure 8-3:

- Ignore Interface Link Failures.
- Ignore vsanMatchIsolation Trunk Failures.

An in-depth switch health analysis using Fabric Manager will verify the status of all critical Cisco MDS switches, modules, ports, and Fibre Channel services. Over 40 conditions are checked. This tool provides a very fast, simple, and thorough way to assess Cisco MDS switch health.



Switch Health Analysis - /SAN/Fabric_mds9222i-2

□ Ignore Interface Link Failures

□ Ignore vsanMatchIsolation Trunk Failures

Problems

Switch	Problem	Description
mds9216i-1	Other Interface Failures	fc1/10
mds9222i-1	Interface Link Failures	fc1/12-fc1/13,fc1/18
mds9222i-2	Interface Link Failures	fc1/12,fc2/37
mds9222i-2	Other Interface Failures	fc1/13
mds9222i-1	Physical vsanMatchIsolation Trunk Failure	fc2/37.VSAN40,fc2/37.VSAN50

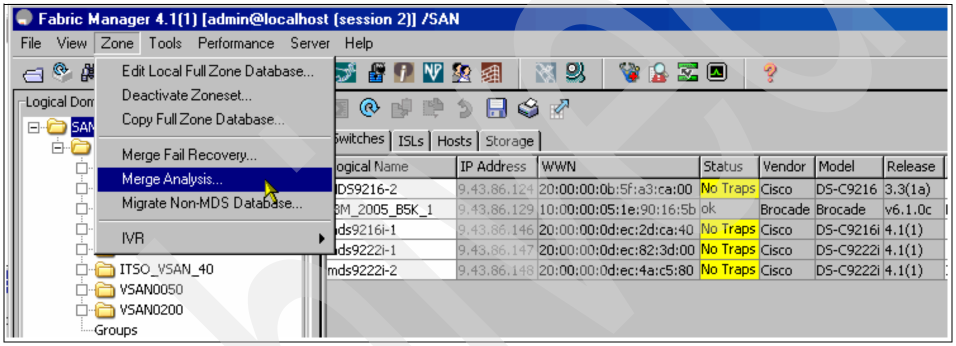
Last Updated on 2008-09-30 11:11:06: error

Figure 8-3 Switch Health Analysis output

We can highlight specific problems and select the **Details** button to get further details.

8.1.2 Zone Merge Analysis

The Zone Merge Analysis tool (available from the Zone menu) enables you to determine whether zones will merge successfully when two Cisco MDS switches are interconnected. If the interconnected switch ports allow VSANs with identical names or contain zones with identical names, then Fabric Manager verifies that the zones contain identical members. The merge analysis tool can be run before attempting a merge, or after fabrics are interconnected to determine zone merge failure causes. Figure 8-4 shows how to start the analysis.

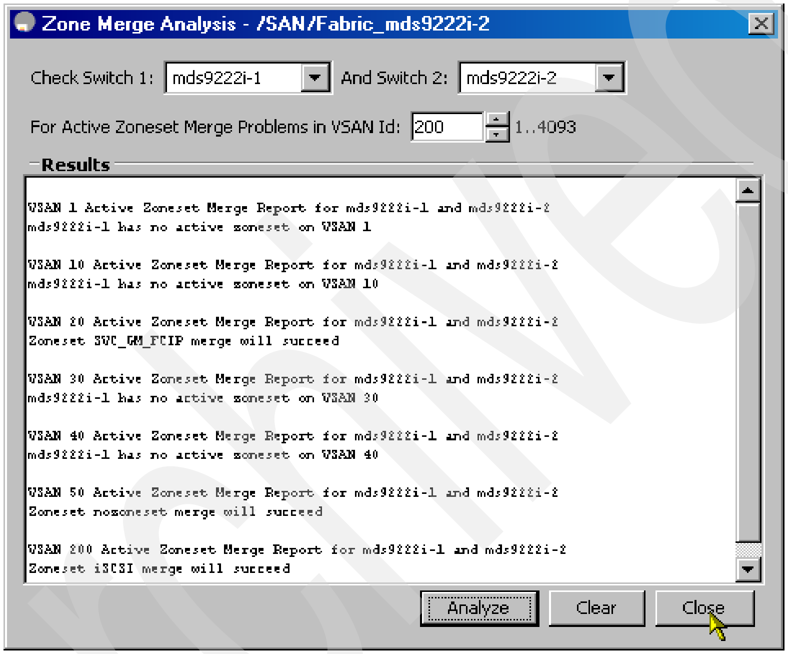


ogical Name	IP Address	WWN	Status	Vendor	Model	Release
DS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	No Traps	Cisco	DS-C9216	3.3(1a)
3M_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c
ds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	No Traps	Cisco	DS-C9216i	4.1(1)
ds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)

Figure 8-4 Start Zone Merge Analysis

You will be given the option to perform zone merge analysis for every VSAN in your SAN network, as shown in Figure 8-5.

Note: We strongly recommend that you conduct zone merge analysis before merging or connecting two or more switches and initiating the zone merge process. This tool allows us to avoiding problems caused by, for example, duplicate zone names, duplicate aliases, zone membership conflicts, and so on.



Check Switch 1: mds9222i-1 And Switch 2: mds9222i-2

For Active Zoneset Merge Problems in VSAN Id: 200 1..4093

Results

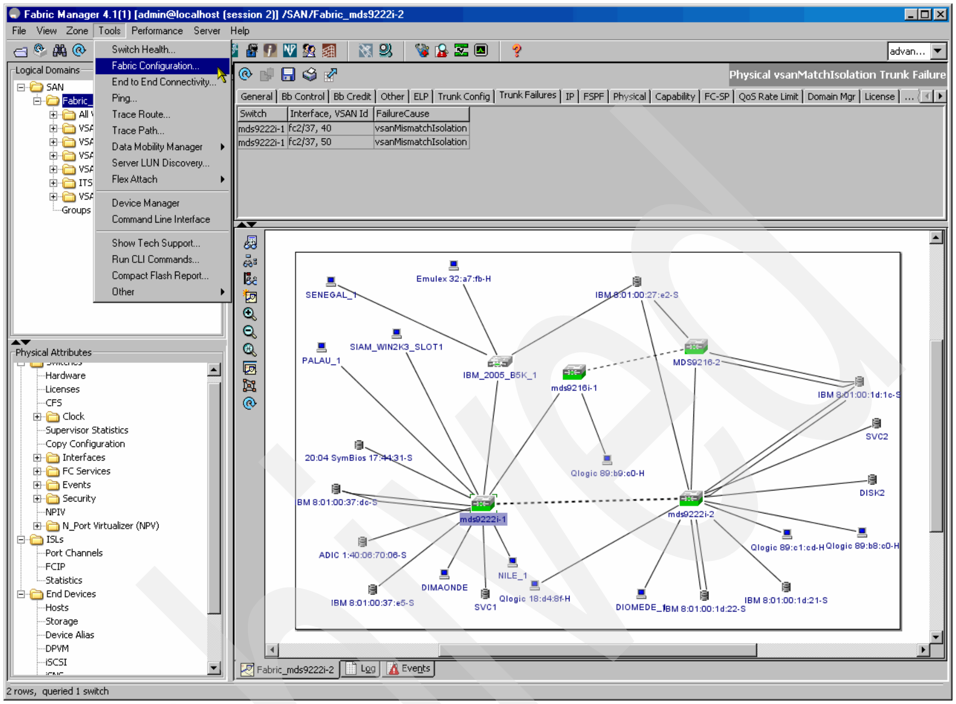
```
VSAN 1 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
mds9222i-1 has no active zoneset on VSAN 1

VSAN 10 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
mds9222i-1 has no active zoneset on VSAN 10

VSAN 20 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
Zoneset SVC_GM_FCIP merge will succeed

VSAN 30 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
mds9222i-1 has no active zoneset on VSAN 30

VSAN 40 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
mds9222i-1 has no active zoneset on VSAN 40

VSAN 50 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
Zoneset nozoneset merge will succeed

VSAN 200 Active Zoneset Merge Report for mds9222i-1 and mds9222i-2
Zoneset iSCSI merge will succeed
```

Figure 8-5 Zone Merge Analysis output

8.1.3 Fabric Configuration Analysis

Fabric Manager includes a Fabric Configuration Analysis tool. It compares the configurations of all Cisco MDS switches in a fabric to a reference switch or a policy file. You can define what functions to check and what type of checks to perform. The analysis can look for mismatched values and missing or extra values. If all configuration checking is performed for all functions, over 200 checks are performed for each Cisco MDS switch.

To run this tool select **Tools** → **Fabric Configuration** from the Fabric Manager menu bar, as shown in Figure 8-6.



Switch	Interface, VSAN Id	FailureCause
mds9222i-1	fc2/37, 40	vsanMismatchIsolation
mds9222i-1	fc2/37, 50	vsanMismatchIsolation

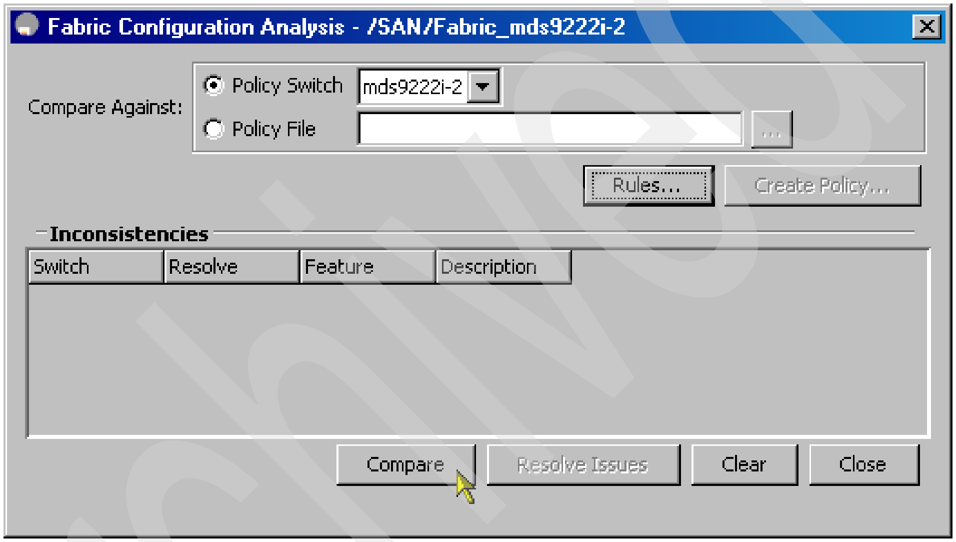
2 rows, queried 1 switch

Figure 8-6 Selecting Fabric Configuration analysis

Figure 8-7 shows the Fabric Configuration Analysis window. Select **Compare** to perform the check. In this example we have four Cisco MDS switches in our fabric:

- mds9222i-1
- mds9222i-2
- mds9216i-1
- mds9216i-2

We will perform analysis of all switches, and as our policy switch we choose the mds9222i-2 switch.



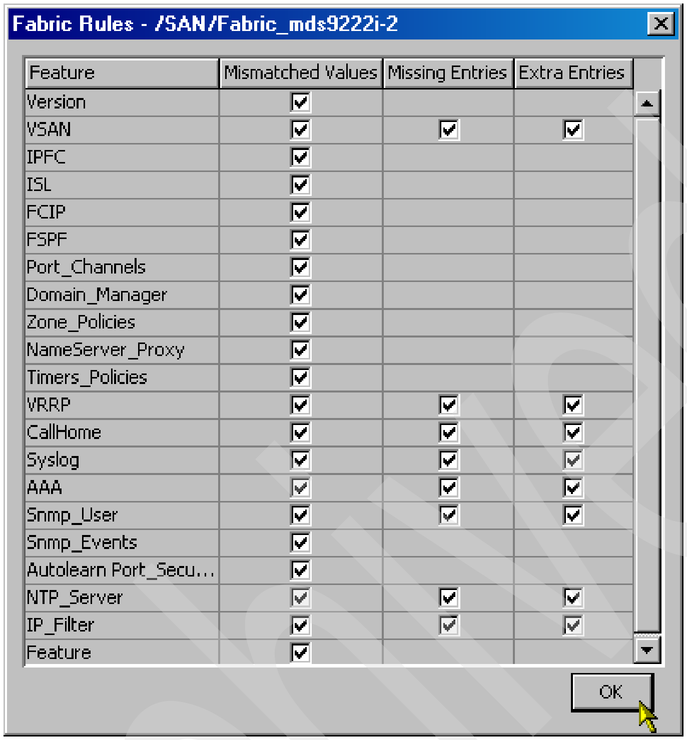
Fabric Configuration Analysis - /SAN/Fabric_mds9222i-2

Compare Against: ● Policy Switch mds9222i-2 ○ Policy File

Figure 8-7 Comparing configuration

Before starting Fabric Configuration Analysis you can configure parameters to check during configuration analysis. You can select the **Rules** button, as shown in Figure 8-7, and decide what conditions will be validated during configuration analysis.

When you click the **Rules** button you will be presented with the conditions to define for analysis, as shown in Figure 8-8.

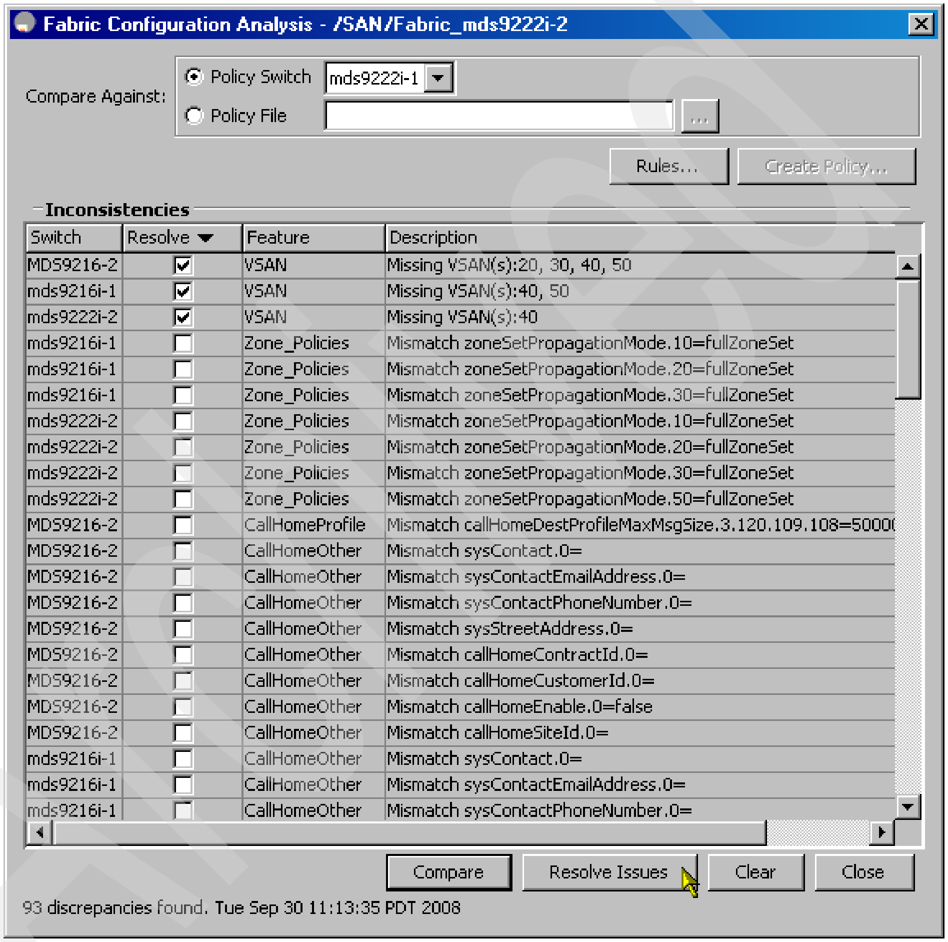

Fabric Rules - /SAN/Fabric_mds9222i-2

Feature	Mismatched Values	Missing Entries	Extra Entries
Version	☑		
VSAN	☑	☑	☑
IPFC	☑		
ISL	☑		
FCIP	☑		
FSPF	☑		
Port_Channels	☑		
Domain_Manager	☑		
Zone_Policies	☑		
NameServer_Proxy	☑		
Timers_Policies	☑		
VRRP	☑	☑	☑
CallHome	☑	☑	☑
Syslog	☑	☑	☑
AAA	☑	☑	☑
Snmp_User	☑	☑	☑
Snmp_Events	☑		
Autolearn Port_Secu...	☑		
NTP_Server	☑	☑	☑
IP_Filter	☑	☑	☑
Feature	☑		

Figure 8-8   Select condition to validate during configuration analysis

To start analysis select **Compare** and the configuration of the other three switches will be checked against the configuration of the mds9222i-2. As shown in Figure 8-9, inconsistencies have been found.

Figure 8-9 shows that you might be able to resolve some of the errors (indicated by the check mark). Click the **Resolve Issues** button to attempt to solve the selected problems.



Compare Against: ● Policy Switch mds9222i-1
○ Policy File

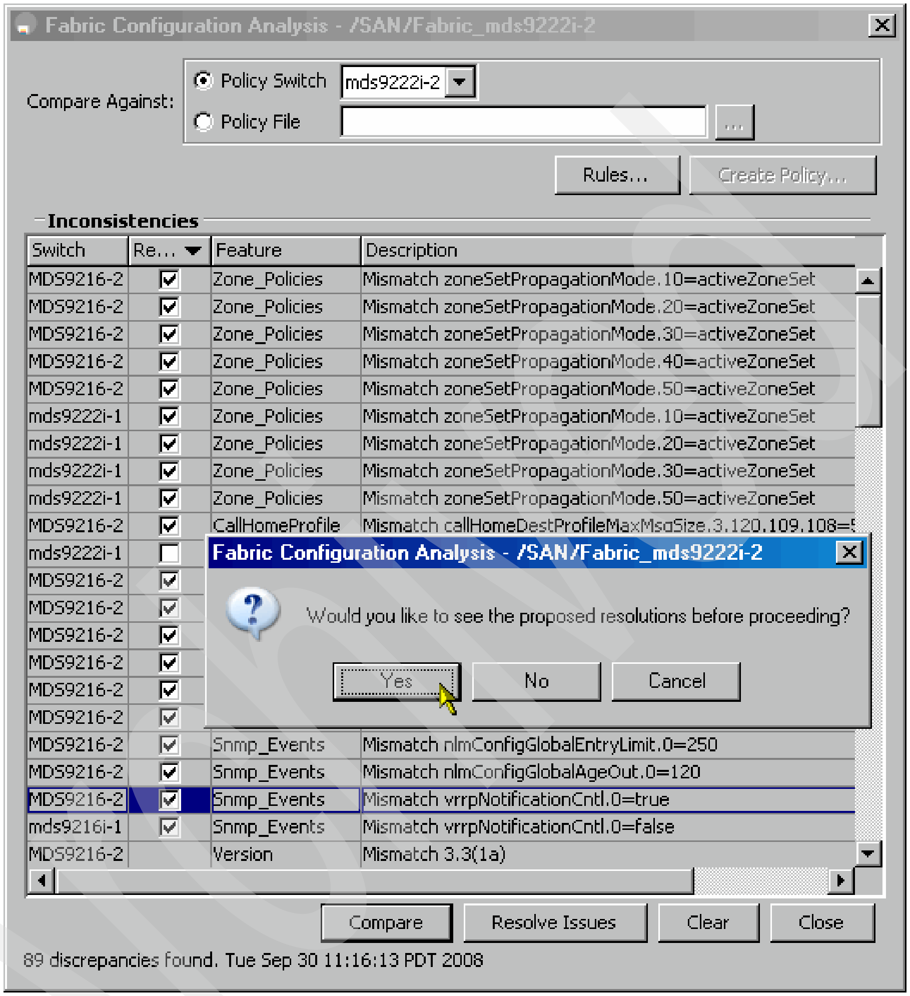
Inconsistencies

Switch	Resolve	Feature	Description
MDS9216-2	☑	VSAN	Missing VSAN(s):20, 30, 40, 50
mds9216i-1	☑	VSAN	Missing VSAN(s):40, 50
mds9222i-2	☑	VSAN	Missing VSAN(s):40
mds9216i-1	☐	Zone_Policies	Mismatch zoneSetPropagationMode.10=fullZoneSet
mds9216i-1	☐	Zone_Policies	Mismatch zoneSetPropagationMode.20=fullZoneSet
mds9216i-1	☐	Zone_Policies	Mismatch zoneSetPropagationMode.30=fullZoneSet
mds9222i-2	☐	Zone_Policies	Mismatch zoneSetPropagationMode.10=fullZoneSet
mds9222i-2	☐	Zone_Policies	Mismatch zoneSetPropagationMode.20=fullZoneSet
mds9222i-2	☐	Zone_Policies	Mismatch zoneSetPropagationMode.30=fullZoneSet
mds9222i-2	☐	Zone_Policies	Mismatch zoneSetPropagationMode.50=fullZoneSet
MDS9216-2	☐	CallHomeProfile	Mismatch callHomeDestProfileMaxMsgSize.3.120.109.108=5000
MDS9216-2	☐	CallHomeOther	Mismatch sysContact.0=
MDS9216-2	☐	CallHomeOther	Mismatch sysContactEmailAddress.0=
MDS9216-2	☐	CallHomeOther	Mismatch sysContactPhoneNumber.0=
MDS9216-2	☐	CallHomeOther	Mismatch sysStreetAddress.0=
MDS9216-2	☐	CallHomeOther	Mismatch callHomeContractId.0=
MDS9216-2	☐	CallHomeOther	Mismatch callHomeCustomerId.0=
MDS9216-2	☐	CallHomeOther	Mismatch callHomeEnable.0=false
MDS9216-2	☐	CallHomeOther	Mismatch callHomeSiteId.0=
mds9216i-1	☐	CallHomeOther	Mismatch sysContact.0=
mds9216i-1	☐	CallHomeOther	Mismatch sysContactEmailAddress.0=
mds9216i-1	☐	CallHomeOther	Mismatch sysContactPhoneNumber.0=

93 discrepancies found. Tue Sep 30 11:13:35 PDT 2008

Figure 8-9 Inconsistencies found during configuration analysis

You will be asked whether you would like to see the proposed resolutions, as shown in Figure 8-10.



Fabric Configuration Analysis - /SAN/Fabric_mds9222i-2

Compare Against: ● Policy Switch mds9222i-2 ○ Policy File

Inconsistencies

Switch	Re...	Feature	Description
MDS9216-2	☑	Zone_Policies	Mismatch zoneSetPropagationMode.10=activeZoneSet
MDS9216-2	☑	Zone_Policies	Mismatch zoneSetPropagationMode.20=activeZoneSet
MDS9216-2	☑	Zone_Policies	Mismatch zoneSetPropagationMode.30=activeZoneSet
MDS9216-2	☑	Zone_Policies	Mismatch zoneSetPropagationMode.40=activeZoneSet
MDS9216-2	☑	Zone_Policies	Mismatch zoneSetPropagationMode.50=activeZoneSet
mds9222i-1	☑	Zone_Policies	Mismatch zoneSetPropagationMode.10=activeZoneSet
mds9222i-1	☑	Zone_Policies	Mismatch zoneSetPropagationMode.20=activeZoneSet
mds9222i-1	☑	Zone_Policies	Mismatch zoneSetPropagationMode.30=activeZoneSet
mds9222i-1	☑	Zone_Policies	Mismatch zoneSetPropagationMode.50=activeZoneSet
MDS9216-2	☑	CallHomeProfile	Mismatch callHomeDestProfileMaxMsgSize.3.120.109.108=!
mds9222i-1	□		
MDS9216-2	☑		
MDS9216-2	☑		
MDS9216-2	☑		
MDS9216-2	☑		
MDS9216-2	☑		
MDS9216-2	☑		
MDS9216-2	☑	Snmp_Events	Mismatch nlmConfigGlobalEntryLimit.0=250
MDS9216-2	☑	Snmp_Events	Mismatch nlmConfigGlobalAgeOut.0=120
MDS9216-2	☑	Snmp_Events	Mismatch vrrpNotificationCntl.0=true
mds9216i-1	☑	Snmp_Events	Mismatch vrrpNotificationCntl.0=false
MDS9216-2		Version	Mismatch 3.3(1a)

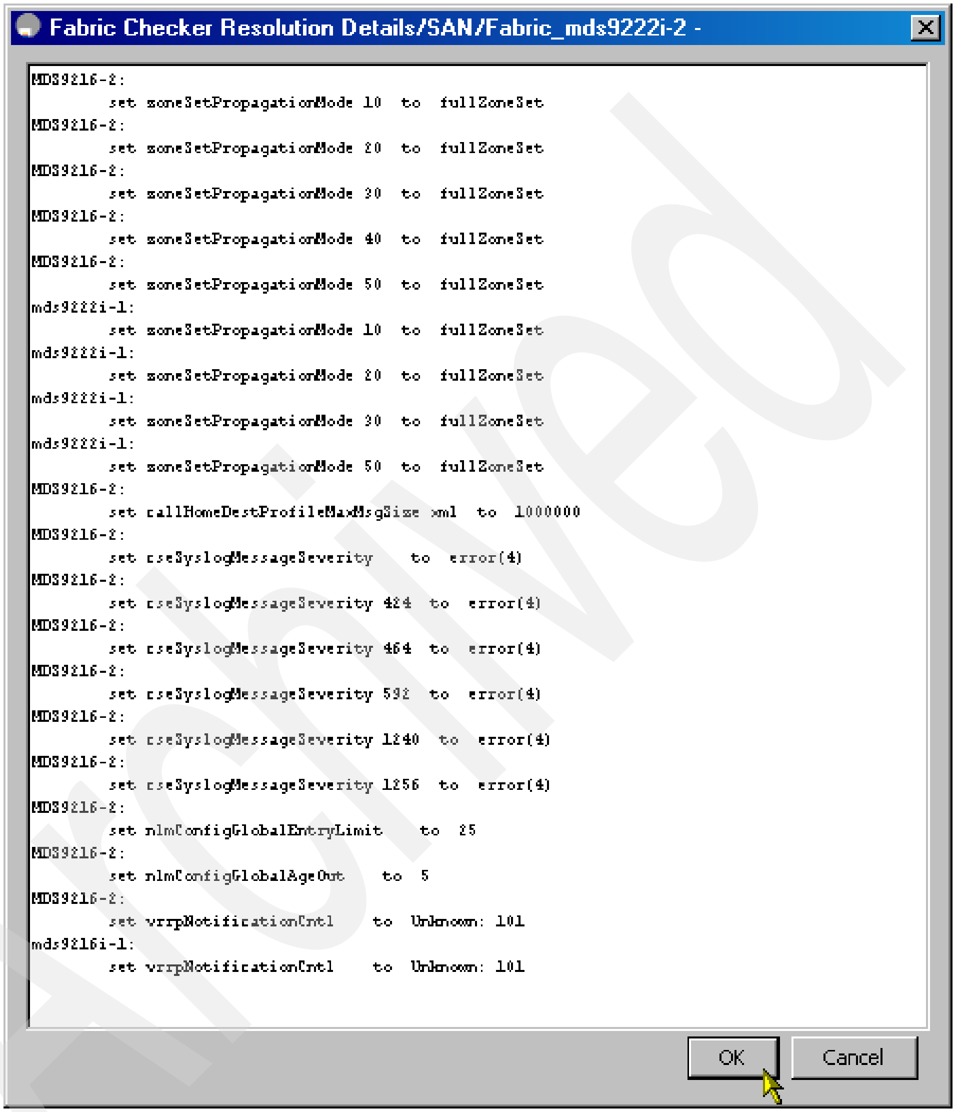
Fabric Configuration Analysis - /SAN/Fabric_mds9222i-2

Would you like to see the proposed resolutions before proceeding?

89 discrepancies found. Tue Sep 30 11:16:13 PDT 2008

Figure 8-10 Check proposed solution

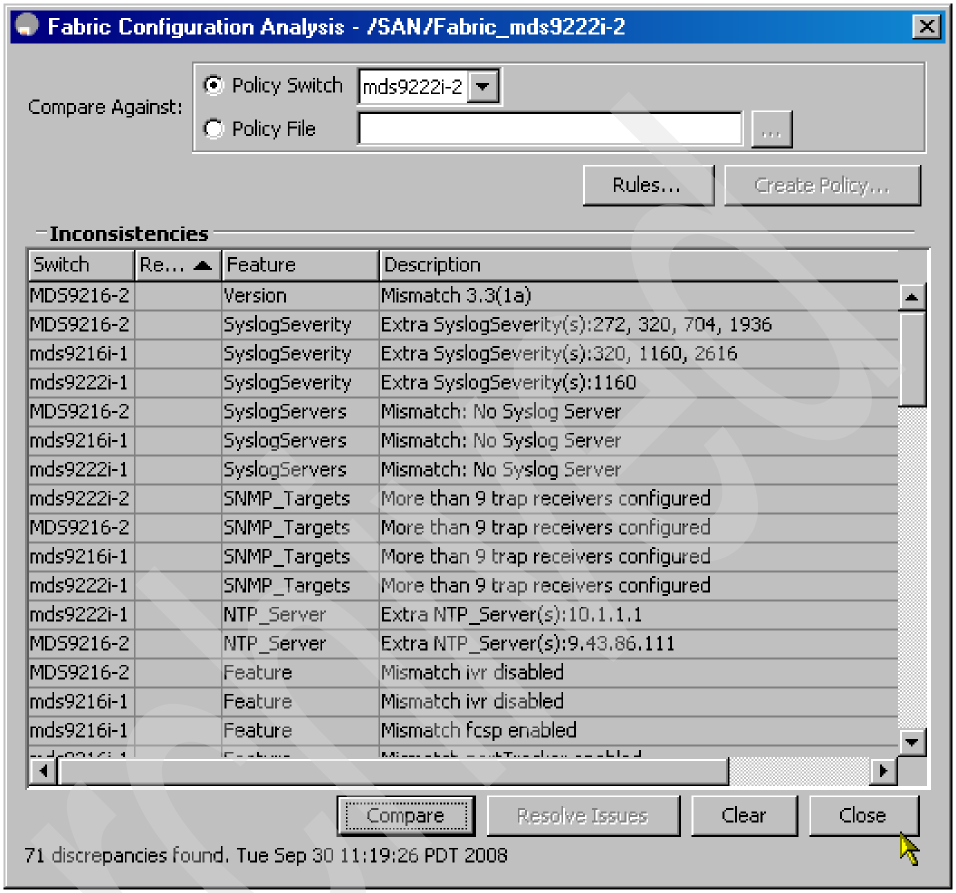
The proposed solution will be presented as Fabric Checker Resolution Details in a separate window, as shown in Figure 8-11.



```
MDS9216-2:
        set zoneSetPropagationMode 10  to  fullZoneSet
MDS9216-2:
        set zoneSetPropagationMode 20  to  fullZoneSet
MDS9216-2:
        set zoneSetPropagationMode 30  to  fullZoneSet
MDS9216-2:
        set zoneSetPropagationMode 40  to  fullZoneSet
MDS9216-2:
        set zoneSetPropagationMode 50  to  fullZoneSet
mds9222i-1:
        set zoneSetPropagationMode 10  to  fullZoneSet
mds9222i-1:
        set zoneSetPropagationMode 20  to  fullZoneSet
mds9222i-1:
        set zoneSetPropagationMode 30  to  fullZoneSet
mds9222i-1:
        set zoneSetPropagationMode 50  to  fullZoneSet
MDS9216-2:
        set callHomeDestProfileMaxMsgSize xml  to  1000000
MDS9216-2:
        set cseSyslogMessageSeverity    to  error(4)
MDS9216-2:
        set cseSyslogMessageSeverity 424  to  error(4)
MDS9216-2:
        set cseSyslogMessageSeverity 464  to  error(4)
MDS9216-2:
        set cseSyslogMessageSeverity 592  to  error(4)
MDS9216-2:
        set cseSyslogMessageSeverity 1240  to  error(4)
MDS9216-2:
        set cseSyslogMessageSeverity 1256  to  error(4)
MDS9216-2:
        set nlmConfigGlobalEntryLimit    to  25
MDS9216-2:
        set nlmConfigGlobalAgeOut    to  5
MDS9216-2:
        set vrrpNotificationCntl    to  Unknown: 101
mds9216i-1:
        set vrrpNotificationCntl    to  Unknown: 101
```

Figure 8-11 Fabric Checker Resolution Details

When you click **OK** details regarding the applied solution will be presented, as shown in Figure 8-12.



Compare Against: ● Policy Switch mds9222i-2 ○ Policy File

Inconsistencies

Switch	Re...	Feature	Description
MDS9216-2		Version	Mismatch 3.3(1a)
MDS9216-2		SyslogSeverity	Extra SyslogSeverity(s):272, 320, 704, 1936
mds9216i-1		SyslogSeverity	Extra SyslogSeverity(s):320, 1160, 2616
mds9222i-1		SyslogSeverity	Extra SyslogSeverity(s):1160
MDS9216-2		SyslogServers	Mismatch: No Syslog Server
mds9216i-1		SyslogServers	Mismatch: No Syslog Server
mds9222i-1		SyslogServers	Mismatch: No Syslog Server
mds9222i-2		SNMP_Targets	More than 9 trap receivers configured
MDS9216-2		SNMP_Targets	More than 9 trap receivers configured
mds9216i-1		SNMP_Targets	More than 9 trap receivers configured
mds9222i-1		SNMP_Targets	More than 9 trap receivers configured
mds9222i-1		NTP_Server	Extra NTP_Server(s):10.1.1.1
MDS9216-2		NTP_Server	Extra NTP_Server(s):9.43.86.111
MDS9216-2		Feature	Mismatch ivr disabled
mds9216i-1		Feature	Mismatch ivr disabled
mds9216i-1		Feature	Mismatch fcsp enabled
mds9216i-1		Feature	Mismatch portTracker enabled

71 discrepancies found. Tue Sep 30 11:19:26 PDT 2008

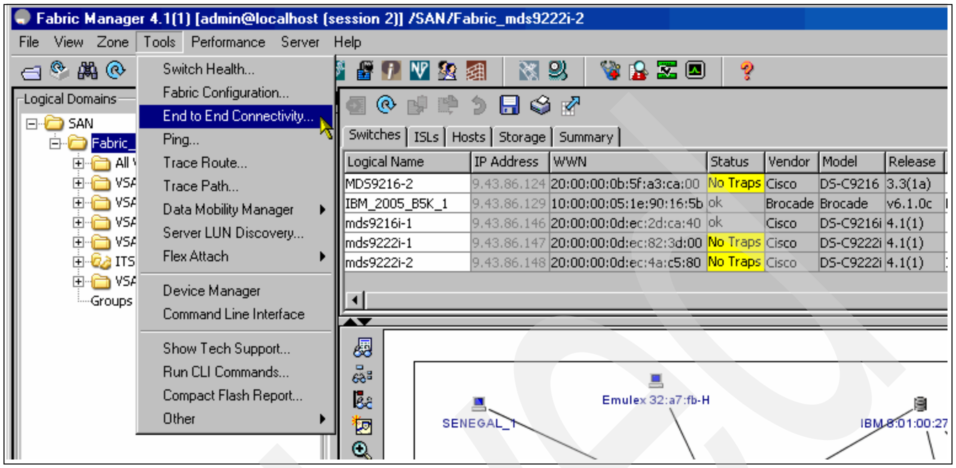
Figure 8-12 Displaying the successful resolutions

8.1.4 End-to-end connectivity analysis

Fabric Manager's end-to-end connectivity analysis tool uses FC Ping to verify interconnections between Cisco MDS switches and end devices (HBAs and storage devices) in a particular VSAN. In addition to basic connectivity, Fabric Manager can optionally verify the following:

- Paths that are redundant.
- Zones contain at least two members.

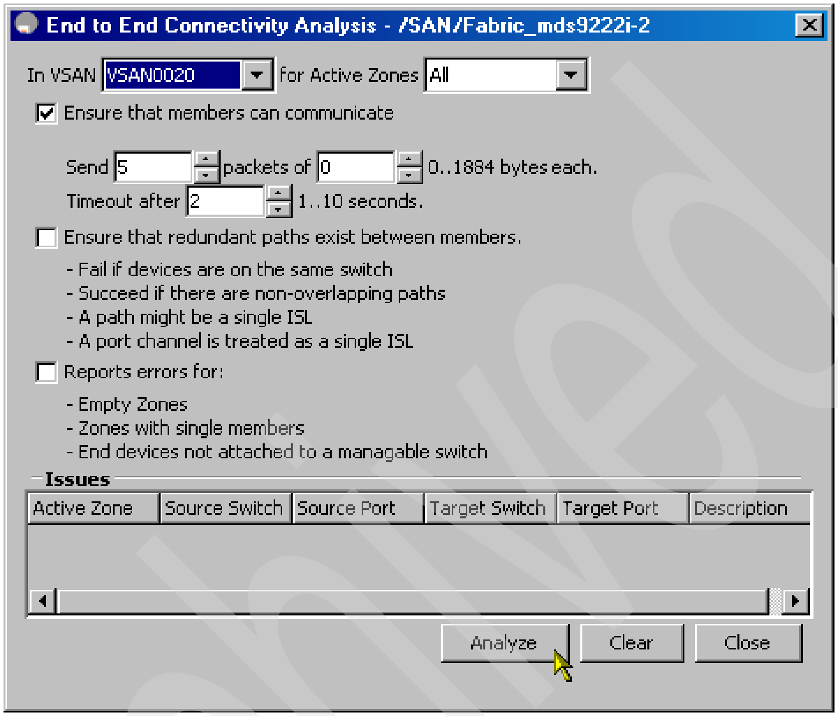
Start this tool by selecting **Tools** → **End to End Connectivity** from the Fabric Manager menu bar, as shown in Figure 8-13.



Logical Name	IP Address	WWN	Status	Vendor	Model	Release
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	No Traps	Cisco	DS-C9216	3.3(1a)
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	ok	Cisco	DS-C9216i	4.1(1)
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)

Figure 8-13 Select End-to-End Connectivity analysis from Fabric Manager menu

When you select to start end-to-end connectivity analysis you will be presented with the window shown in Figure 8-14. You can select a VSAN and the conditions to conduct the analysis.


End to End Connectivity Analysis - /SAN/Fabric_mds9222i-2

In VSAN VSAN0020 for Active Zones All

☑ Ensure that members can communicate

Send 5 packets of 0 0..1884 bytes each.

Timeout after 2 1..10 seconds.

□ Ensure that redundant paths exist between members.

- Fail if devices are on the same switch
- Succeed if there are non-overlapping paths
- A path might be a single ISL
- A port channel is treated as a single ISL

□ Reports errors for:

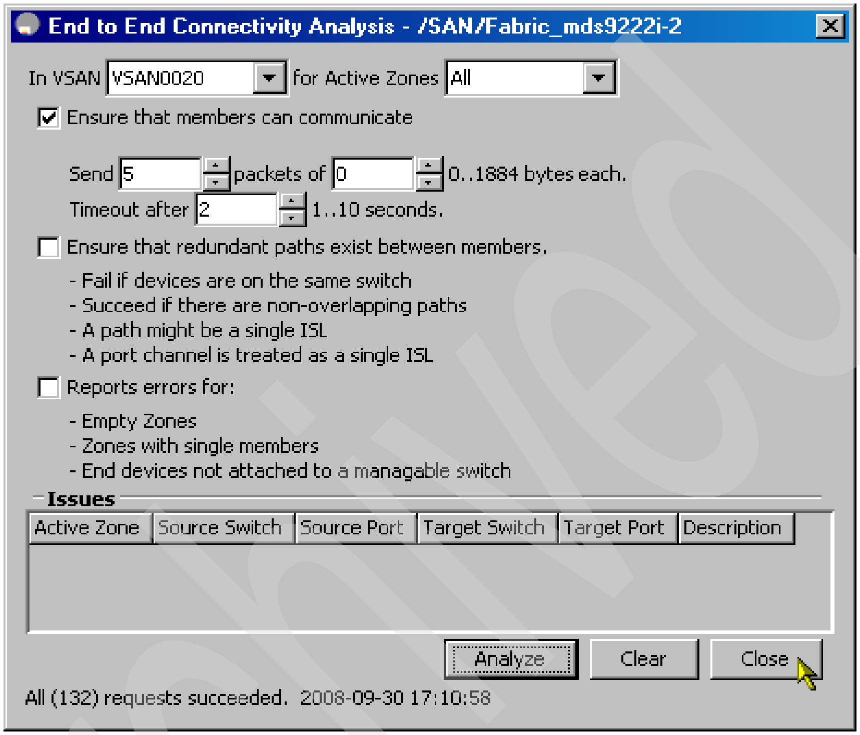
- Empty Zones
- Zones with single members
- End devices not attached to a managable switch

Issues

Active Zone	Source Switch	Source Port	Target Switch	Target Port	Description

Figure 8-14 End to End Connectivity Analysis configuration window

In Figure 8-15 we have selected **VSAN0020** to conduct analysis. Additionally, we decided to choose **All** zone options to ensure that all members within a particular zone can communicate. The Issues are shown at the bottom of the window. It states that all 132 requests have been completed successfully.



End to End Connectivity Analysis - /SAN/Fabric_mds9222i-2

In VSAN VSAN0020 for Active Zones All

☑ Ensure that members can communicate

Send 5 packets of 0 0..1884 bytes each.

Timeout after 2 1..10 seconds.

□ Ensure that redundant paths exist between members.

- Fail if devices are on the same switch
- Succeed if there are non-overlapping paths
- A path might be a single ISL
- A port channel is treated as a single ISL

□ Reports errors for:

- Empty Zones
- Zones with single members
- End devices not attached to a managable switch

Issues

Active Zone	Source Switch	Source Port	Target Switch	Target Port	Description

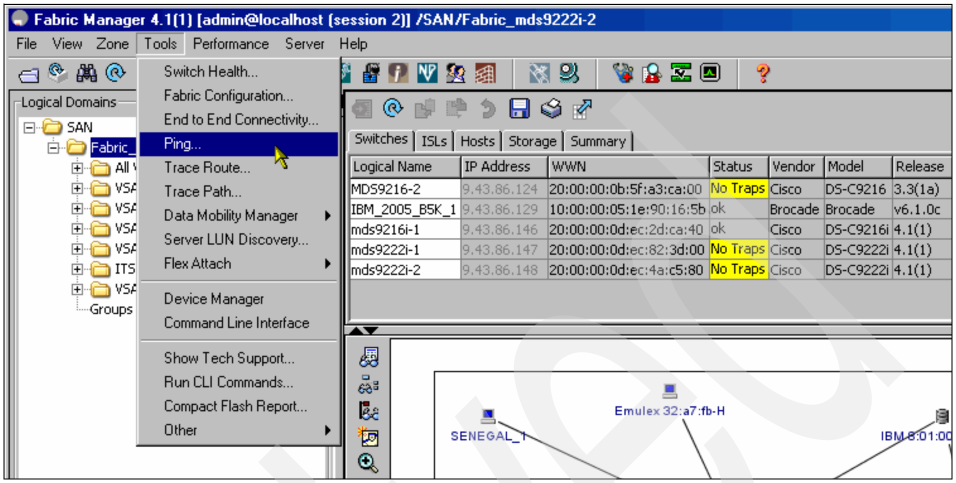
All (132) requests succeeded. 2008-09-30 17:10:58

Figure 8-15 End to End Connectivity Analysis

8.1.5 FC Ping

Fabric Manager also provides an FC Ping tool that allows you to check connectivity to end devices. the ping consists of a Port Login (PLOGI), followed by an ECHO extended link service command sourced with the switch FCID FF.FC.*XX*, where *XX* is the domain ID of the switch for that VSAN.

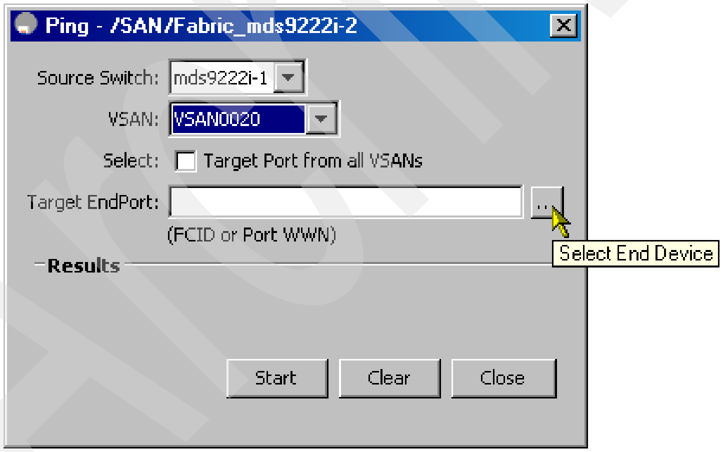
To use the tool, select **Tools** → **Ping** from the Fabric Manager menu, as shown in Figure 8-16.



Logical Name	IP Address	WWN	Status	Vendor	Model	Release
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	No Traps	Cisco	DS-C9216	3.3(1a)
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	ok	Cisco	DS-C9216i	4.1(1)
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)

Figure 8-16 Select FC Ping tool for connectivity analysis

As shown in Figure 8-17, you are prompted to select a source mds switch, a VSAN to use, and a target device to ping it.



Source Switch: mds9222i-1

VSAN: VSAN0020

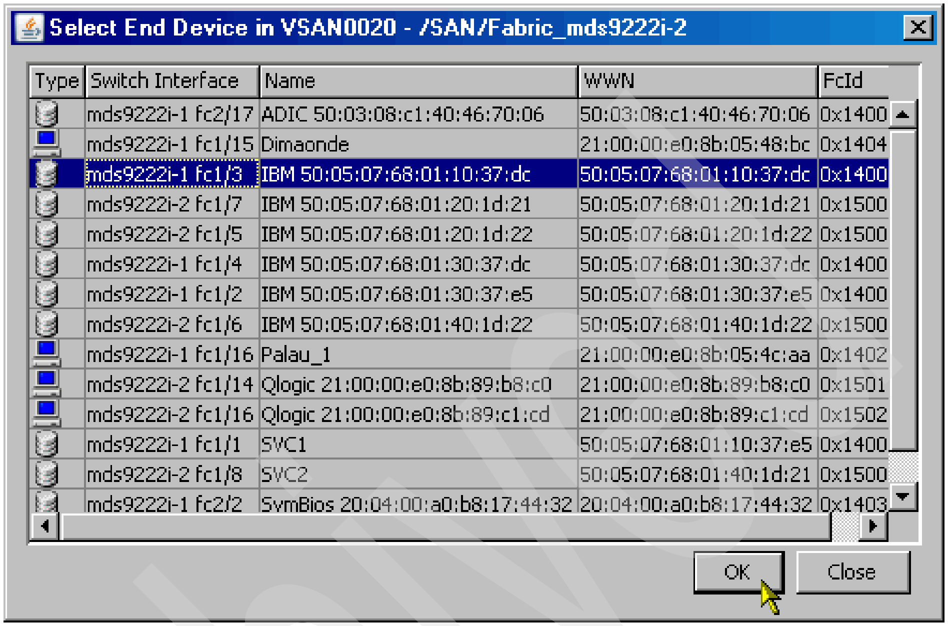
Select: ☐ Target Port from all VSANs

Target EndPort:

(FCID or Port WWN)

Figure 8-17 FC ping selection window

You do not need to remember or copy the end devices' WWN addresses or FCIDs. You can select an end device from the list, as shown in Figure 8-18.

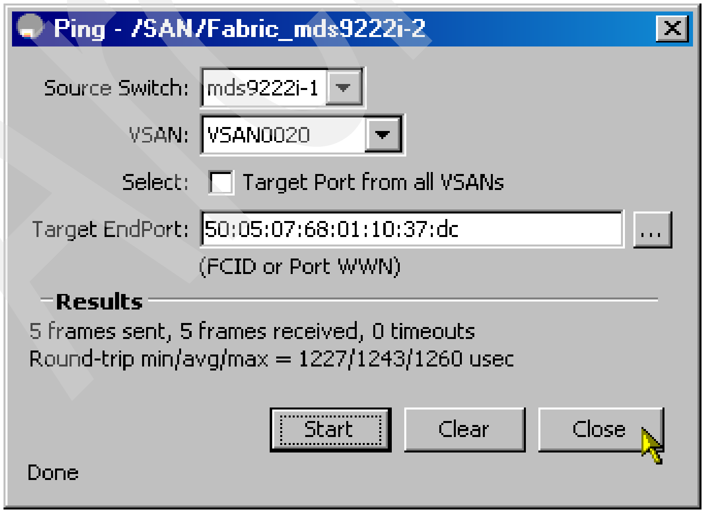


Select End Device in VSAN0020 - /SAN/Fabric_mds9222i-2

Type	Switch Interface	Name	WWN	FcId
🗄	mds9222i-1 fc2/17	ADIC 50:03:08:c1:40:46:70:06	50:03:08:c1:40:46:70:06	0x1400
🖥	mds9222i-1 fc1/15	Dimaonde	21:00:00:e0:8b:05:48:bc	0x1404
🗄	mds9222i-1 fc1/3	IBM 50:05:07:68:01:10:37:dc	50:05:07:68:01:10:37:dc	0x1400
🗄	mds9222i-2 fc1/7	IBM 50:05:07:68:01:20:1d:21	50:05:07:68:01:20:1d:21	0x1500
🗄	mds9222i-2 fc1/5	IBM 50:05:07:68:01:20:1d:22	50:05:07:68:01:20:1d:22	0x1500
🗄	mds9222i-1 fc1/4	IBM 50:05:07:68:01:30:37:dc	50:05:07:68:01:30:37:dc	0x1400
🗄	mds9222i-1 fc1/2	IBM 50:05:07:68:01:30:37:e5	50:05:07:68:01:30:37:e5	0x1400
🗄	mds9222i-2 fc1/6	IBM 50:05:07:68:01:40:1d:22	50:05:07:68:01:40:1d:22	0x1500
🖥	mds9222i-1 fc1/16	Palau_1	21:00:00:e0:8b:05:4c:aa	0x1402
🖥	mds9222i-2 fc1/14	Qlogic 21:00:00:e0:8b:89:b8:c0	21:00:00:e0:8b:89:b8:c0	0x1501
🖥	mds9222i-2 fc1/16	Qlogic 21:00:00:e0:8b:89:c1:cd	21:00:00:e0:8b:89:c1:cd	0x1502
🗄	mds9222i-1 fc1/1	SVC1	50:05:07:68:01:10:37:e5	0x1400
🗄	mds9222i-2 fc1/8	SVC2	50:05:07:68:01:40:1d:21	0x1500
🗄	mds9222i-1 fc2/2	SymBios 20:04:00:a0:b8:17:44:32	20:04:00:a0:b8:17:44:32	0x1403

Figure 8-18 Select the end device to ping

When all the required information is provided you can start FC ping, as shown in Figure 8-19. In this case the FC ping was successful.



Ping - /SAN/Fabric_mds9222i-2

Source Switch: mds9222i-1

VSAN: VSAN0020

Select: □ Target Port from all VSANs

Target EndPort: 50:05:07:68:01:10:37:dc
(FCID or Port WWN)

Results

5 frames sent, 5 frames received, 0 timeouts
Round-trip min/avg/max = 1227/1243/1260 usec

Done

Figure 8-19 FC ing output

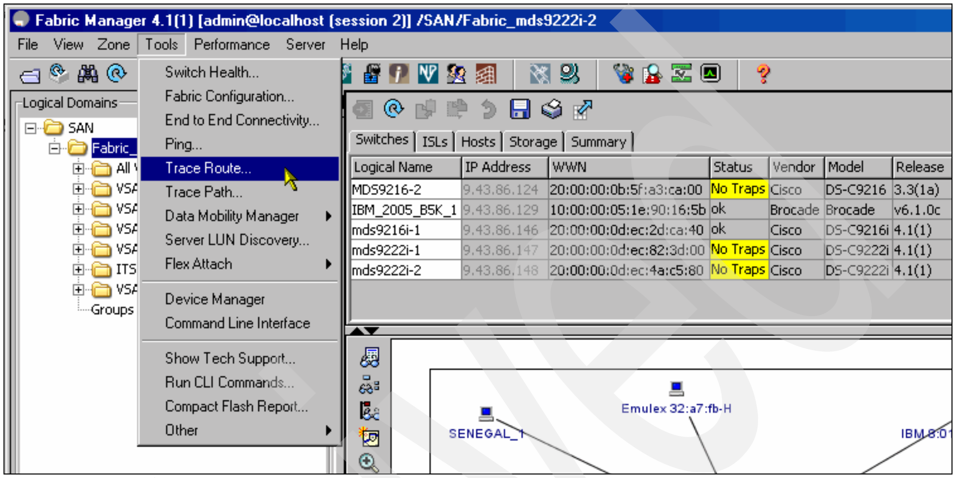
You can conduct an FC ping test from the CLI, as shown in Example 8-1.

Example 8-1   FC Ping tests from the CLI

```
mds9222i-1# show flogi database
--------------------------------------------------------------------------------
INTERFACE        VSAN    FCID           PORT NAME               NODE NAME
--------------------------------------------------------------------------------
fc1/1            20    0x14000a  50:05:07:68:01:10:37:e5 50:05:07:68:01:00:37:e5
fc1/2            20    0x14000b  50:05:07:68:01:30:37:e5 50:05:07:68:01:00:37:e5
fc1/3            20    0x140008  50:05:07:68:01:10:37:dc 50:05:07:68:01:00:37:dc
fc1/4            20    0x140009  50:05:07:68:01:30:37:dc 50:05:07:68:01:00:37:dc
fc1/14           30    0x1e0100  21:00:00:e0:8b:89:2b:cd 20:00:00:e0:8b:89:2b:cd
                           [Nile_1]
fc1/15           20    0x140400  21:00:00:e0:8b:05:48:bc 20:00:00:e0:8b:05:48:bc
fc1/16           20    0x140200  21:00:00:e0:8b:05:4c:aa 20:00:00:e0:8b:05:4c:aa
                           [Palau_1]
fc1/17           50    0x7e0000  21:00:00:e0:8b:18:ff:8a 20:00:00:e0:8b:18:ff:8a
fc2/2            20    0x140300  20:04:00:a0:b8:17:44:32 20:04:00:a0:b8:17:44:31
fc2/17           20    0x140000  50:03:08:c1:40:46:70:06 50:03:08:c1:40:06:70:06

Total number of flogi = 10.

mds9222i-1# fcping device-alias Nile_1 vsan 20
No switch with the given wwn is present in the vsan
mds9222i-1# fcping
device-alias   fcid           pwwn
mds9222i-1# fcping fcid 0x1e0100 vsan 30
28 bytes from  0x1e0100  time = 1266 usec
28 bytes from  0x1e0100  time = 1222 usec
28 bytes from  0x1e0100  time = 1203 usec
28 bytes from  0x1e0100  time = 1243 usec
28 bytes from  0x1e0100  time = 1210 usec

5 frames sent, 5 frames received, 0 timeouts
Round-trip min/avg/max = 1203/1228/1266 usec
mds9222i-1# fcping pwwn 21:00:00:e0:8b:18:ff:8a vsan 50
28 bytes from 21:00:00:e0:8b:18:ff:8a time = 1260 usec
28 bytes from 21:00:00:e0:8b:18:ff:8a time = 1243 usec
28 bytes from 21:00:00:e0:8b:18:ff:8a time = 1210 usec
28 bytes from 21:00:00:e0:8b:18:ff:8a time = 1241 usec
28 bytes from 21:00:00:e0:8b:18:ff:8a time = 1237 usec

5 frames sent, 5 frames received, 0 timeouts
Round-trip min/avg/max = 1210/1238/1260 usec
```

8.1.6 FC Traceroute

The MDS NX-OS also provides a modified FC Traceroute tool as an aid in determining end-to-end connectivity. To access this tool from FM select **Tools** → **Trace Route** from the FM menu bar, as shown in Figure 8-20.



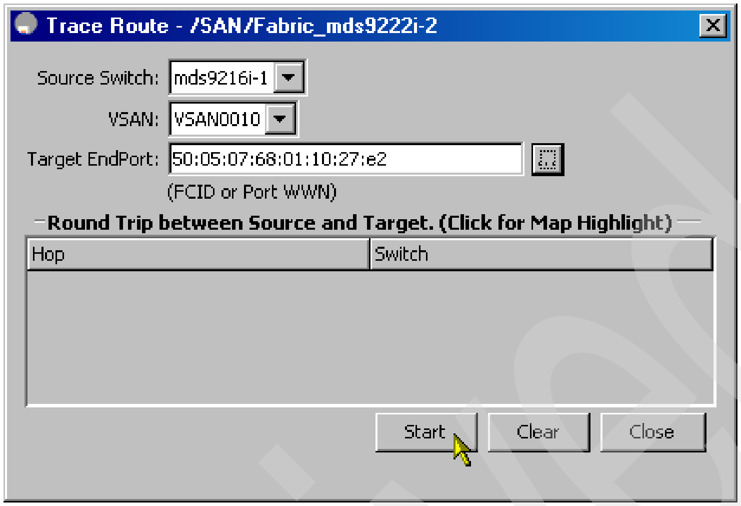
Logical Name	IP Address	WWN	Status	Vendor	Model	Release
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	No Traps	Cisco	DS-C9216	3.3(1a)
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	ok	Cisco	DS-C9216i	4.1(1)
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)

Figure 8-20 Selecting trace route

You should follow this procedure:

1. Select the source switch from the Source Switch drop-down list.
2. Select the VSAN for which to verify connectivity from the VSAN drop-down list.
3. Select the target end port for which to verify connectivity from the Target Endport drop-down list.

4. Click **Start** to perform the traceroute between your switch and the selected port, as shown in Figure 8-21.



Trace Route - /SAN/Fabric_mds9222i-2

Source Switch: mds9216i-1

VSAN: VSAN0010

Target EndPort: 50:05:07:68:01:10:27:e2

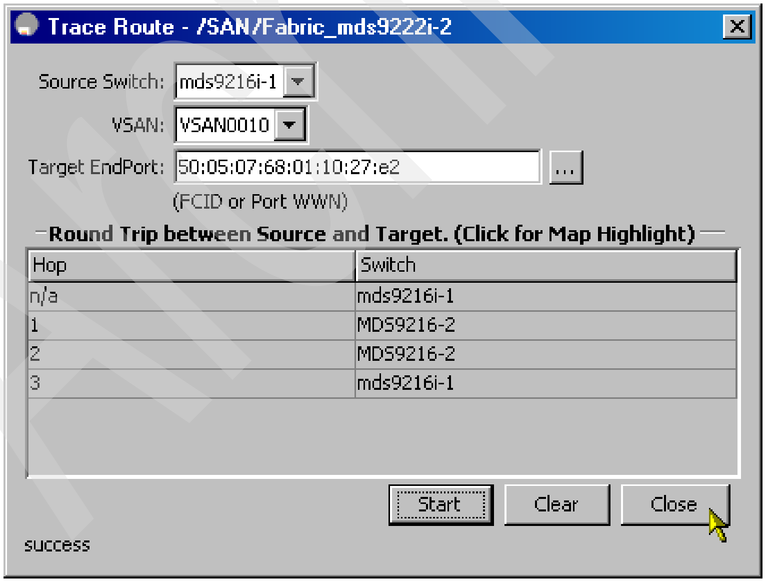
(FCID or Port WWN)

Round Trip between Source and Target. (Click for Map Highlight)

Hop	Switch

Figure 8-21 Trace Route configuration window

As you see in Figure 8-22, our traceroute test has completed successfully and we have obtained the possible routes to the specified target.



Trace Route - /SAN/Fabric_mds9222i-2

Source Switch: mds9216i-1

VSAN: VSAN0010

Target EndPort: 50:05:07:68:01:10:27:e2

(FCID or Port WWN)

Round Trip between Source and Target. (Click for Map Highlight)

Hop	Switch
n/a	mds9216i-1
1	MDS9216-2
2	MDS9216-2
3	mds9216i-1

success

Figure 8-22 Trace route possible routes

Trace route analysis can be conducted from the CLI, as shown in Example 8-2.

Example 8-2 Trace route analysis from the CLI

```
mds9222i-1# fctrace pwwn 21:00:00:e0:8b:18:ff:8a vsan 50
Route present for : 21:00:00:e0:8b:18:ff:8a
20:00:00:0d:ec:2d:ca:40(0xfffcb7)
20:00:00:0d:ec:82:3d:00(0xfffc7e)
20:00:00:0d:ec:82:3d:00(0xfffc7e)
mds9222i-1#
```

8.1.7 Show tech support

The **show tech support** command is useful when collecting a large amount of information about your switch for troubleshooting purposes. The output can be provided to technical support representatives when reporting a problem.

You can issue a **show tech support** command from Fabric Manager for one or more switches in a fabric. The results of each command are written to a text file, one file per switch, in a directory that you specify. You can then view these files using Fabric Manager.

You can also save the Fabric Manager map as a JPG file. The file is saved with the name of the seed switch or fabric.

You can zip up all the files (the show tech support output and the map file image) and send the resulting zipped file to technical support.

show tech support displays the output of several **show** commands at once. The output varies depending on the configuration that you have.

> **Note:** Use the **show tech-support** command in EXEC mode to display general information about the switch when reporting a problem.

The output is equivalent to the output of the following commands:

- **show version** (Example 8-3)

Example 8-3 Show version output from the CLI

```
mds9222i-1# show version
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained herein are owned by
other third parties and are used and distributed under license.
Some parts of this software are covered under the GNU Public
```

```
License. A copy of the license is available at
http://www.gnu.org/licenses/gpl.html.

Software
  BIOS:      version 1.0.15
  loader:    version N/A
  kickstart: version 4.1(1)
  system:    version 4.1(1)
  BIOS compile time:       07/16/08
  kickstart image file is: bootflash:///m9200-s2ek9-kickstart-mz.4.1.1.bin
  kickstart compile time:  10/12/2020 25:00:00 [09/09/2008 06:55:47]
  system image file is:    bootflash:/m9200-s2ek9-mz.4.1.1.bin
  system compile time:     8/22/2008 0:00:00 [09/09/2008 08:15:09]


Hardware
  cisco MDS 9222i ("4x1GE IPS, 18x1/2/4Gbps FC/Sup2")
  Motorola, e500v2  with 1036316 kB of memory.
  Processor Board ID JAE12088ZMT

  Device name: mds9222i-1
  bootflash:    1000440 kB
Kernel uptime is 1 day(s), 0 hour(s), 23 minute(s), 8 second(s)

Last reset at 299946 usecs after  Mon Sep 29 19:53:17 2008

  Reason: Reset Requested by CLI command reload
  System version: 4.1(1)
  Service:
```

- **show environment** (Example 8-4)

Example 8-4   Show environment output from the CLI

```
mds9222i-1# show environment
Clock:
----------------------------------------------------------
Clock           Model                Hw         Status
----------------------------------------------------------
A                                    0.0        Ok/Active

Fan:
------------------------------------------------------
Fan             Model                Hw         Status
------------------------------------------------------
ChassisFan1     DS-2SLOT-FAN         4.0        Ok
Fan_in_PS1      --                   --         Absent
Fan_in_PS2      --                   --         Ok
Fan Air Filter : NotSupported

Temperature:
--------------------------------------------------------------------
Module   Sensor        MajorThresh   MinorThres   CurTemp     Status
                       (Celsius)     (Celsius)    (Celsius)
```

```
--------------------------------------------------------------------
1        Outlet1         75              60         44         Ok
1        Outlet2         75              65         51         Ok
1        Intake1         65              50         34         Ok
2        Outlet1         75              60         45         Ok
2        Outlet2         75              65         53         Ok
2        Intake1         65              50         40         Ok

Power Supply:
Voltage: 42 Volts
-----------------------------------------------------
PS  Model                Power       Power     Status
                         (Watts)     (Amp)
-----------------------------------------------------
1   ------------            0.00      0.00     Absent
2   DS-CAC-845W           800.10     19.05     Ok

Mod Model                Power     Power       Power     Power       Status
                         Requested Requested   Allocated Allocated
                         (Watts)   (Amp)       (Watts)   (Amp)
--- -------------------  -------   ----------  --------- ----------  ----------
1    DS-X9222I-K9         209.16    4.98       209.16    4.98        Powered-Up
2    DS-X9248-48K9        214.20    5.10       214.20    5.10        Powered-Up
fan1 DS-2SLOT-FAN         47.88     1.14       47.88     1.14        Powered-Up

Power Usage Summary:
--------------------
Power Supply redundancy mode:                 Redundant
Power Supply redundancy operational mode:     Redundant

Total Power Capacity                              800.10 W

Power reserved for Supervisor(s)                  418.32 W
Power reserved for Fan Module(s)                   47.88 W
Power currently used by Modules                   214.20 W

                                                -------------
Total Power Available                             119.70 W
                                                -------------
```

- **`show module`** (Example 8-5)

Example 8-5 Show module output from the CLI

```
mds9222i-1# show module
Mod  Ports  Module-Type                      Model              Status
---  -----  -------------------------------- ------------------ ------------
1    22     4x1GE IPS, 18x1/2/4Gbps FC/Sup2  DS-X9222I-K9       active *
2    48     1/2/4/8 Gbps 4/44-Port FC Module DS-X9248-48K9      ok

Mod  Sw              Hw      World-Wide-Name(s) (WWN)
---  --------------  ------  --------------------------------------------------
1    4.1(1)          1.1     20:01:00:0d:ec:82:3d:00 to 20:12:00:0d:ec:82:3d:00
2    4.1(1)          0.35    20:41:00:0d:ec:82:3d:00 to 20:70:00:0d:ec:82:3d:00
```

```
Mod  MAC-Address(es)                         Serial-Num
---  --------------------------------------  ----------
1    00-17-94-ee-58-74 to 00-17-94-ee-58-7c  JAE12088ZMT
2    00-0d-ec-75-24-68 to 00-0d-ec-75-24-6c  JAE1216EXLB

* this terminal session
```

- **show hardware** (Example 8-6)

Example 8-6 Show module output from the CLI

```
mds9222i-1# show hardware
Cisco Nexus Operating System (NX-OS) Software
TAC support: http://www.cisco.com/tac
Copyright (c) 2002-2008, Cisco Systems, Inc. All rights reserved.
The copyrights to certain works contained herein are owned by
other third parties and are used and distributed under license.
Some parts of this software are covered under the GNU Public
License. A copy of the license is available at
http://www.gnu.org/licenses/gpl.html.

Software
  BIOS:      version 1.0.15
  loader:    version N/A
  kickstart: version 4.1(1)
  system:    version 4.1(1)
  BIOS compile time:       07/16/08
  kickstart image file is: bootflash:///m9200-s2ek9-kickstart-mz.4.1.1.bin
  kickstart compile time:  10/12/2020 25:00:00 [09/09/2008 06:55:47]
  system image file is:    bootflash:/m9200-s2ek9-mz.4.1.1.bin
  system compile time:     8/22/2008 0:00:00 [09/09/2008 08:15:09]


Hardware
  cisco MDS 9222i ("4x1GE IPS, 18x1/2/4Gbps FC/Sup2")
  Motorola, e500v2  with 1036316 kB of memory.
  Processor Board ID JAE12088ZMT

  Device name: mds9222i-1
  bootflash:    1000440 kB
Kernel uptime is 1 day(s), 0 hour(s), 26 minute(s), 12 second(s)

Last reset at 299946 usecs after  Mon Sep 29 19:53:17 2008

  Reason: Reset Requested by CLI command reload
  System version: 4.1(1)
  Service:
--------------------------------
Switch hardware ID information
--------------------------------

Switch is booted up
```

```
  Switch type is : MDS 9222i
  Model number is DS-C9222I-K9
  H/W version is 1.0
  Part Number is 73-11019-01
  Part Revision is A1
  Manufacture Date is Year 12 Week 16
  Serial number is FOX1216GP0C
  CLEI code is COM9310ARA

--------------------------------
Chassis has 2 Module slots
--------------------------------

Module1  ok
  Module type is : 4x1GE IPS, 18x1/2/4Gbps FC/Sup2
  0 submodules are present
  Model number is DS-X9222I-K9
  H/W version is 1.1
  Part Number is 73-11018-06
  Part Revision is B0
  Manufacture Date is Year 12 Week 8
  Serial number is JAE12088ZMT
  CLEI code is COUIAMCCAA

Module2  ok
  Module type is : 1/2/4/8 Gbps 4/44-Port FC Module
  0 submodules are present
  Model number is DS-X9248-48K9
  H/W version is 0.35
  Part Number is 73-11289-03
  Part Revision is 03
  Manufacture Date is Year 12 Week 16
  Serial number is JAE1216EXLB
  CLEI code is 0000000000

---------------------------------------
Chassis has 2 PowerSupply Slots
---------------------------------------

PS1 absent

PS2 ok
  Power supply type is: 800.10W 110v AC
  Model number is DS-CAC-845W
  H/W version is 1.2
  Part Number is 341-0052-03
  Part Revision is B0
  Manufacture Date is Year 12 Week 15
  Serial number is QCS1215109K
  CLEI code is CNUPAA8AAA

----------------------------------
Chassis has 1 Fan slots
----------------------------------
```

```
Fan1 ok
  Model number is DS-2SLOT-FAN
  H/W version is 4.0
  Part Number is 800-24478-02
  Part Revision is B0
  Manufacture Date is Year 12 Week 13
  Serial number is DCH12131591
  CLEI code is CNUQABBAAC

-----------------------------------------
Chassis has 1 Interface slot
-----------------------------------------

  Interface module ok
  Model number is DS-X9222-MGT
  H/W version is 1.0
  Part Number is 73-11488-02
  Part Revision is A0
  Manufacture Date is Year 12 Week 6
  Serial number is JAE12067IIM
  CLEI code is 0
```

- **`show running-config`** (Example 8-7)

Example 8-7 Show running-config from the CLI

```
mds9222i-1# show running-config
version 4.1(1)
feature fcip
feature dpvm
role name default-role
  description This is a system defined role and applies to all users.
  rule 5 permit show feature environment
--- truncateed ---
  rule 1 permit show feature system
  vsan policy deny
    permit vsan 10-10
username admin password 5 $1$w.fBQFNO$FLQdKnS2V65A39FbZjQwd1  role network-admin
feature telnet
ntp server 10.1.1.1
ip domain-lookup
ip host mds9222i-1 9.43.86.147
kernel core target 0.0.0.0
kernel core limit 1
aaa group server radius radius
snmp-server contact Jaco
snmp-server user admin network-admin auth md5 0x5f504840456bd68853696954ecfa9f0b priv
--- truncateed ---
snmp-server host 9.43.86.81 traps version 2c public  udp-port 2162
callhome
  contract-id ABC12345
--- truncateed ---
fcip profile 1
```

```
  ip address 10.1.1.1
  tcp max-bandwidth-mbps 1000 min-available-bandwidth-mbps 500  round-trip-time-us 
600
ip access-list Test permit ip any any
vsan database
  vsan 10
  vsan 20
fcsp enable
device-alias database
  device-alias name Nile_1 pwwn 21:00:00:e0:8b:89:2b:cd
vsan database
  vsan 200 interface iscsi1/4
--- truncateed ---
  vsan 50 interface fc2/37
islb distribute
interface iscsi1/1
--- truncateed ---
interface iscsi1/4
  switchport initiator id ip-address
  mode pass-thru
  switchport description GB_iSCSI
  no shutdown
interface mgmt0
  ip address 9.43.86.147 255.255.252.0
--- truncateed ---
fcflow stats module 2 index 24 0x150000 0x140400 0xffffff vsan 20
ip default-gateway 9.43.85.1
switchname mds9222i-1
cli alias name gigint interface gigabitethernet
feature iscsi
iscsi initiator ip-address 10.43.86.10
  static nWWN 23:03:00:0d:ec:82:3d:02
vsan 200
boot kickstart bootflash:/m9200-s2ek9-kickstart-mz.4.1.1.bin
boot system bootflash:/m9200-s2ek9-mz.4.1.1.bin
feature ivr
ivr distribute
ivr nat
dpvm database
  pwwn 21:00:00:e0:8b:05:4c:aa vsan 20
dpvm activate force
dpvm commit
--- truncateed ---
interface fc2/48
interface GigabitEthernet1/1
  ip address 10.1.1.1 255.255.255.0
  switchport mtu 2300
  no shutdown
--- truncateed ---
interface port-channel 20
  switchport mode E
  channel mode active
  switchport description To mds9222i-2
  no shutdown
```

```
--- truncateed ---
interface fc1/13
  switchport rate-mode dedicated
interface fc2/13
  switchport speed auto
  switchport rate-mode dedicated
--- truncateed ---
fcalias name SVC1 vsan 20
    member pwwn 50:05:07:68:01:30:37:dc
--- truncateed ---
zone name SVC_GM_FCIP vsan 20
    member fcalias SVC1
--- truncateed ---
zoneset activate name iSCSI vsan 200
ivr zone name IvrZone_SIAM_SVC_1
  member pwwn 21:00:00:e0:8b:18:ff:8a                vsan 50
--- truncateed ---
ivr zoneset activate name IVR_Zoneset_SVC force
ivr commit
```

- **`show interface`** (Example 8-8)

Example 8-8 Show interface output from the CLI

```
mds9222i-1# show interface brief

-------------------------------------------------------------------------------
Interface  Vsan   Admin  Admin   Status          SFP    Oper  Oper   Port
                  Mode   Trunk                          Mode  Speed  Channel
                         Mode                                 (Gbps)
-------------------------------------------------------------------------------
fc1/1      10     FX     --      up               swl    F       4    --
fc1/2      200    FX     --      up               swl    F       4    --
fc1/3      10     FX     --      up               swl    F       4    --
fc1/4      10     FX     --      up               swl    F       4    --
fc1/5      20     FX     --      up               swl    F       4    --
fc1/6      20     FX     --      up               swl    F       4    --
fc1/7      20     FX     --      up               swl    F       4    --
fc1/8      20     FX     --      up               swl    F       4    --
fc1/9      4094   FX     --      down             swl    --            --
fc1/10     4094   FX     --      down             swl    --            --
fc1/11     20     FX     --      down             swl    --            --
fc1/12     30     FX     --      notConnected     swl    --            --
fc1/13     1      E      on      notConnected     swl    --            --
fc1/14     30     FX     --      up               swl    F       2    --
fc1/15     20     FX     --      up               swl    F       2    --
fc1/16     20     FX     --      up               swl    F       2    --
fc1/17     50     FX     --      up               swl    F       2    --
fc1/18     20     FX     --      notConnected     swl    --            --
fc2/1      1      E      on      down             swl    --            --
fc2/2      20     FX     --      up               swl    F       2    --
fc2/3      40     FX     --      sfpAbsent        --     --            --
--- trunkated ---
fc2/12     1      FX     --      sfpAbsent        --     --            --
```

```
fc2/13     40     E      on      up              swl    E       2    --
fc2/14     1      FX     --      sfpAbsent       --     --           --
fc2/15     1      FX     --      sfpAbsent       --     --           --
fc2/16     1      FX     --      sfpAbsent       --     --           --
fc2/17     20     FX     --      up              swl    F       2    --
fc2/18     1      FX     --      sfpAbsent       --     --           --
--- trunkated ---
fc2/24     1      FX     --      sfpAbsent       --     --           --
fc2/25     1      E      on      down            swl    --           --
fc2/26     1      FX     --      sfpAbsent       --     --           --
--- trunkated ---
fc2/36     1      FX     --      sfpAbsent       --     --           --
fc2/37     50     E      on      trunking        swl    TE      2    --
fc2/38     1      FX     --      sfpAbsent       --     --           --
--- trunkated ---
fc2/48     1      FX     --      sfpAbsent       --     --           --

-------------------------------------------------------------------------------
Interface           Status              Oper Mode           Oper Speed
                                                            (Gbps)
-------------------------------------------------------------------------------
iscsi1/1            down                --
iscsi1/2            down                --
iscsi1/3            down                --
iscsi1/4            up                  ISCSI               1

-------------------------------------------------------------------------------
Interface                Status                              Speed
                                                             (Gbps)
-------------------------------------------------------------------------------
sup-fc0                  up                                  1
--------------------------------------------------------------------------------
Interface                Status     IP Address        Speed    MTU    Port
                                                                      Channel
--------------------------------------------------------------------------------
GigabitEthernet1/1       up         10.1.1.1/24        1 Gbps   2300  --
GigabitEthernet1/2       up         10.2.2.1/24        1 Gbps   2300  --
GigabitEthernet1/3       up         10.3.3.1/24        1 Gbps   2300  --
GigabitEthernet1/4       up         10.43.86.1/24      1 Gbps   1500  --

-------------------------------------------------------------------------------
Interface Vsan Admin Admin  Status      Oper Profile    Eth Int   Port-channel
               Mode  Trunk              Mode
                     Mode
-------------------------------------------------------------------------------
fcip1     1    auto  on    srcUnbound   --             --          --
fcip2     1    E     on    trunking     TE    1 GigabitEthernet1/1    port-channel 20
fcip3     1    E     on    trunking     TE    2 GigabitEthernet1/2    port-channel 20

-------------------------------------------------------------------------------
Interface               Status     IP Address         Speed     MTU
-------------------------------------------------------------------------------
mgmt0                    up         9.43.86.147/22     100 Mbps 1500
```

```
-------------------------------------------------------------------------------
Interface             Vsan  Admin  Status        Oper  Oper    IP
                            Trunk                Mode  Speed   Address
                            Mode                       (Gbps)
-------------------------------------------------------------------------------
port-channel 20       1     on     trunking       TE   2       --
```

- **show accounting log** (Example 8-9)

Example 8-9 Show accounting log output from the CLI

```
mds9222i-1# show accounting log

Tue Sep 23 23:30:40 2008:update:snmp_4522_9.167.197.161:admin:Interface fc1/4 state
updated to up
Tue Sep 23 23:36:17 2008:start:9.167.197.161@pts/2:admin:
Tue Sep 23 23:36:20 2008:update:9.167.197.161@pts/2:admin:terminal length 0 (SUCCESS)
Tue Sep 23 23:36:20 2008:update:9.167.197.161@pts/2:admin:terminal session-timeout 30
(SUCCESS)
Wed Sep 24 17:45:34 2008:update:console0:root:enabled (null)
Wed Sep 24 17:45:34 2008:update:console0:root:configure terminal ; password
strength-check (SUCCESS)
Wed Sep 24 17:45:35 2008:update:console0:root:updated v3 user : admin
Wed Sep 24 17:45:35 2008:update:console0:root:configure terminal ; username admin
password ******** role network-admin (SUCCESS)
Wed Sep 24 17:46:49 2008:update:console0:root:enabled (null)
Wed Sep 24 17:46:49 2008:update:console0:root:configure terminal ; password
strength-check (SUCCESS)
Wed Sep 24 17:46:49 2008:update:console0:root:configure terminal ; interface mgmt0
(SUCCESS)

---- truncated ----
```

- **show process** (Example 8-10)

Example 8-10 Show process output from the CLI

```
mds9222i-1# show processes

PID    State  PC        Start_cnt    TTY   Type  Process
-----  -----  --------  -----------  ----  ----  -------------
    1      S   ff67dbc            1     -     0  init
    2      S         0            1     -     0  ksoftirqd/0
    3      S         0            1     -     0  desched/0
    4      S         0            1     -     0  events/0
    5      S         0            1     -     0  khelper
   10      S         0            1     -     0  kthread
   29      S         0            1     -     0  kblockd/0
   64      S         0            1     -     0  pdflush
   65      S         0            1     -     0  pdflush
   67      S         0            1     -     0  aio/0
   66      S         0            1     -     0  kswapd0
  931      S         0            1     -     0  kjournald
  936      S         0            1     -     0  kjournald
 1237      S         0            1     -     0  kjournald
 1244      S         0            1     -     O  kjournald
 1251      S         0            1     -     O  kjournald
 1533      S   ff052e0            1     -     O  portmap
--- truncated ---
2308      S   ff12dbc           1     -     O  cisco
 2311      S   eb91a80            1     -    VL  clis
 2312      S   fb59248            1     -    VL  vshd
 2320      S   fd9d248            1     -    VU  xbar_client
--- truncated ---
2372      S   eb2c730           1     -    VL  cdp
 2373      S   ff67dbc            1     -     O  dhcpd
 2375      S   e9a5730            1     -    VL  radius
 2376      S   fef8248            1     -    VL  ipv6_dummy
 2377      S   fbace08            1     -    VU  fspf
 2380      S   fc55dbc            1     -    VU  device-alias
 2381      S   fc9ddbc            1     -    VU  epp
 2382      S   fb75dbc            1     -    VU  fcdomain
--- truncated ---
2466      S   fd95248           1     -     O  proc_mgr
 2467      S   fd85248            1     -    VU  fvpd
 2468      S   fb62dbc            1     -    VU  fc-tunnel
 2469      S   fc9ddbc            1     -    VU  ipacl
 2472      S   fb65dbc            1     -    VU  fc-redirect
 2473      S   f84cdbc            1     -    VU  ivr
--- truncated ---
20762      S   f588dbc            1     0     O  vsh
22208      S   fcaedbc            1     -     O  dcos_sshd
22210      S   f588dbc            1     1     O  vsh
23884      Z         0            1     -     O  df
23885      Z         0            1     -     O  df
25087      S   fef40ac            1     5     O  more
25088      S   f588248            1     5     O  vsh
25089      R   ff1e0ac            1     -     O  ps
--- truncated ---
-     NR        -            0     -    VL  scheduler
    -     NR        -            0     -    VU  sdv
    -     NR        -            0     -    VU  sfm
    -     NR        -            0     -    VU  sme
    -     NR        -            0     -    VU  vbuilder

State: R(runnable), S(sleeping), Z(defunct)

Type:  U(unknown), O(non sysmgr)
       VL(vdc-local), VG(vdc-global), VU(vdc-unaware)
       NR(not running), ER(terminated etc)
```

- **show process log** (Example 8-11)

Example 8-11 Show process log output from the CLI

```
mds9222i-1# show processes log
Process          PID     Normal-exit  Stack  Core   Log-create-time
---------------  ------  -----------  -----  -----  ---------------
installer        23639             N      N      N  Wed Sep 17 00:19:24
2008
```

- **show processes log** (Example 8-12)

Example 8-12 Show process log details output from the CLI

```
mds9222i-1# show processes log details
============================================================
Service: installer
Description: Installer

Started at Wed Sep 17 00:19:22 2008 (403287 us)
Stopped at Wed Sep 17 00:19:24 2008 (247072 us)
Uptime: 2 seconds

Start type: SRV_OPTION_RESTART_STATELESS (23)
Death reason: SYSMGR_DEATH_REASON_FAILURE_NOCALLHOME (12)
Last heartbeat 0.00 secs ago
RLIMIT_AS: 46777216
System image name: m9200-s2ek9-mz.4.1.1.bin
System image version: 4.1(1) S16
Exit code: SYSMGR_EXITCODE_FAILURE_NOCALLHOME (20)

PID: 23639
SAP: 0
UUID: 0

======================================================
```

- **show tech-support (brief)** (Example 8-13)

Example 8-13 Show tech-support output from the CLI (brief version)

```
mds9222i-1# show tech-support brief
Switch Name           : mds9222i-1
Switch Type           :
Kickstart Image       : 4.1(1) bootflash:///m9200-s2ek9-kickstart-mz.4.1.1.bin
System Image          : 4.1(1) bootflash:/m9200-s2ek9-mz.4.1.1.bin
IP Address/Mask       : 9.43.86.147/22
Switch WWN            : 20:00:00:0d:ec:82:3d:00
No of VSANs           : 7
Configured VSANs      : 1,10,20,30,40,50,200

VSAN    1:    name:VSAN0001, state:active, interop mode:default
```

```
              domain id:0xad(173), WWN:20:01:00:0d:ec:82:3d:01
              active-zone:<NONE>, default-zone:deny

VSAN   10:    name:VSAN0010, state:active, interop mode:default
              domain id:0x0a(10), WWN:20:0a:00:0d:ec:82:3d:01
              active-zone:<NONE>, default-zone:deny

VSAN   20:    name:VSAN0020, state:active, interop mode:default
              domain id:0x14(20), WWN:20:14:00:0d:ec:82:3d:01
              active-zone:size:, default-zone:deny

VSAN   30:    name:VSAN0030, state:active, interop mode:default
              domain id:0x1e(30), WWN:20:1e:00:0d:ec:82:3d:01
              active-zone:<NONE>, default-zone:deny

VSAN   40:    name:ITSO_VSAN_40, state:active, interop mode:2
              domain id:0x6f(111), WWN:20:28:00:0d:ec:82:3d:01
              active-zone:<NONE>, default-zone:deny

VSAN   50:    name:VSAN0050, state:active, interop mode:default
              domain id:0x7e(126), WWN:20:32:00:0d:ec:82:3d:01
              active-zone:size:, default-zone:deny

VSAN  200:    name:VSAN0200, state:active, interop mode:default
              domain id:0x54(84), WWN:20:c8:00:0d:ec:82:3d:01
              active-zone:<NONE>, default-zone:deny


-------------------------------------------------------------------------------
Interface  Vsan   Admin  Admin    Status          SFP    Oper  Oper   Port
                  Mode   Trunk                           Mode  Speed  Channel
                         Mode                                  (Gbps)
-------------------------------------------------------------------------------
fc1/1      20     FX     --      up               swl    F       4    --
fc1/2      20     FX     --      up               swl    F       4    --
fc1/3      20     FX     --      up               swl    F       4    --
fc1/4      10     FX     --      up               swl    F       4    --
fc1/5      20     FX     --      up               swl    F       4    --
fc1/6      20     FX     --      up               swl    F       4    --
fc1/7      20     FX     --      up               swl    F       4    --
fc1/8      20     FX     --      up               swl    F       4    --
fc1/9      4094   FX     --      down             swl    --           --
fc1/10     4094   FX     --      down             swl    --           --
fc1/11     20     FX     --      down             swl    --           --
fc1/12     30     FX     --      notConnected     swl    --           --
fc1/13     1      E      on      notConnected     swl    --           --
fc1/14     30     FX     --      up               swl    F       2    --
fc1/15     20     FX     --      up               swl    F       2    --
fc1/16     20     FX     --      up               swl    F       2    --
fc1/17     50     FX     --      up               swl    F       2    --
fc1/18     20     FX     --      notConnected     swl    --           --
fc2/1      1      E      on      down             swl    --           --
fc2/2      20     FX     --      up               swl    F       2    --
fc2/3      40     FX     --      sfpAbsent        --     --           --
```

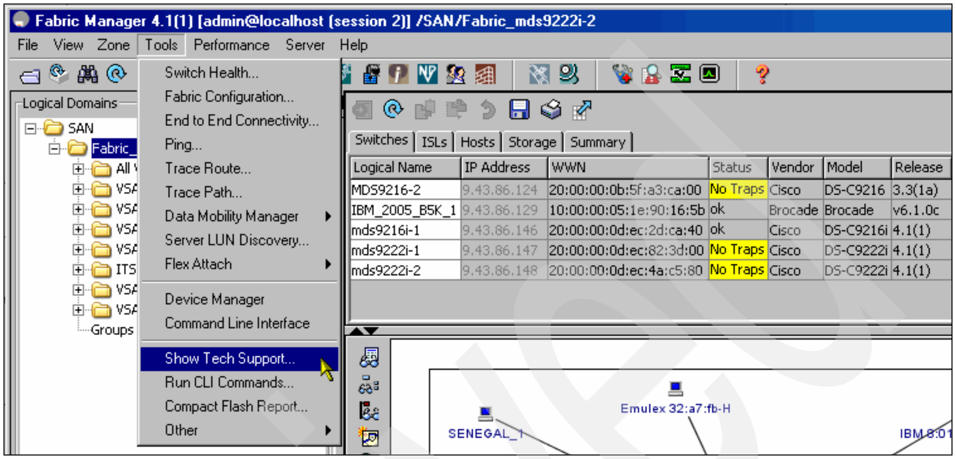
```
fc2/4      20     FX     --      sfpAbsent        --     --             --
fc2/5      40     FX     --      sfpAbsent        --     --             --
fc2/6      40     FX     --      sfpAbsent        --     --             --
fc2/7      40     FX     --      sfpAbsent        --     --             --
fc2/8      40     FX     --      sfpAbsent        --     --             --
fc2/9      40     FX     --      sfpAbsent        --     --             --
fc2/10     1      FX     --      sfpAbsent        --     --             --
fc2/11     1      FX     --      sfpAbsent        --     --             --
fc2/12     1      FX     --      sfpAbsent        --     --             --
fc2/13     40     E      on      up               swl    E       2      --
fc2/14     1      FX     --      sfpAbsent        --     --             --
fc2/15     1      FX     --      sfpAbsent        --     --             --
fc2/16     1      FX     --      sfpAbsent        --     --             --
fc2/17     20     FX     --      up               swl    F       2      --
fc2/18     1      FX     --      sfpAbsent        --     --             --
fc2/19     1      FX     --      sfpAbsent        --     --             --
fc2/20     1      FX     --      sfpAbsent        --     --             --
fc2/21     1      FX     --      sfpAbsent        --     --             --
fc2/22     1      FX     --      sfpAbsent        --     --             --
fc2/23     1      FX     --      sfpAbsent        --     --             --
fc2/24     1      FX     --      sfpAbsent        --     --             --
fc2/25     1      E      on      down             swl    --             --
fc2/26     1      FX     --      sfpAbsent        --     --             --
fc2/27     1      FX     --      sfpAbsent        --     --             --
fc2/28     1      FX     --      sfpAbsent        --     --             --
fc2/29     1      FX     --      sfpAbsent        --     --             --
fc2/30     1      FX     --      sfpAbsent        --     --             --
fc2/31     1      FX     --      sfpAbsent        --     --             --
fc2/32     1      FX     --      sfpAbsent        --     --             --
fc2/33     1      FX     --      sfpAbsent        --     --             --
fc2/34     1      FX     --      sfpAbsent        --     --             --
fc2/35     1      FX     --      sfpAbsent        --     --             --
fc2/36     1      FX     --      sfpAbsent        --     --             --
fc2/37     50     E      on      trunking         swl    TE      2      --
fc2/38     1      FX     --      sfpAbsent        --     --             --
fc2/39     1      FX     --      sfpAbsent        --     --             --
fc2/40     1      FX     --      sfpAbsent        --     --             --
fc2/41     1      FX     --      sfpAbsent        --     --             --
fc2/42     1      FX     --      sfpAbsent        --     --             --
fc2/43     1      FX     --      sfpAbsent        --     --             --
fc2/44     1      FX     --      sfpAbsent        --     --             --
fc2/45     1      FX     --      sfpAbsent        --     --             --
fc2/46     1      FX     --      sfpAbsent        --     --             --
fc2/47     1      FX     --      sfpAbsent        --     --             --
fc2/48     1      FX     --      sfpAbsent        --     --             --

-------------------------------------------------------------------------------
Interface           Status              Oper Mode           Oper Speed
                                                            (Gbps)
-------------------------------------------------------------------------------
iscsi1/1            down                --
iscsi1/2            down                --
iscsi1/3            down                --
iscsi1/4            up                  ISCSI               1
```

```
-------------------------------------------------------------------------------
Interface                Status                            Speed
                                                           (Gbps)
-------------------------------------------------------------------------------
sup-fc0                  up                                1
--------------------------------------------------------------------------------
Interface                Status     IP Address        Speed    MTU   Port
                                                                     Channel
--------------------------------------------------------------------------------
GigabitEthernet1/1       up         10.1.1.1/24        1 Gbps   2300  --
GigabitEthernet1/2       up         10.2.2.1/24        1 Gbps   2300  --
GigabitEthernet1/3       up         10.3.3.1/24        1 Gbps   2300  --
GigabitEthernet1/4       up         10.43.86.1/24      1 Gbps   1500  --

-------------------------------------------------------------------------------
Interface Vsan Admin Admin  Status      Oper Profile    Eth Int    Port-channel
               Mode  Trunk              Mode
                     Mode
-------------------------------------------------------------------------------
fcip1     1    auto  on    srcUnbound   --              --          --
fcip2     1    E     on    trunking     TE     1 GigabitEthernet1/1   port-channel 20
fcip3     1    E     on    trunking     TE     2 GigabitEthernet1/2   port-channel 20

-------------------------------------------------------------------------------
Interface               Status     IP Address         Speed     MTU
-------------------------------------------------------------------------------
mgmt0                    up         9.43.86.147/22     100 Mbps 1500

-------------------------------------------------------------------------------
Interface             Vsan   Admin  Status        Oper  Oper    IP
                             Trunk                Mode  Speed   Address
                             Mode                       (Gbps)
-------------------------------------------------------------------------------
port-channel 20       1      on     trunking       TE   2       --
```

Note: The examples above were truncated for brevity, or the brief versions of commands have been used. For technical support full versions of commands are used to collect all relevant data from your fabric for support and analysis.

To launch tech support from the Fabric Manager menu:

1. Choose **Tools** → **Show Tech Support**, as shown in Figure 8-23. You will see the Show Tech Support dialog box.

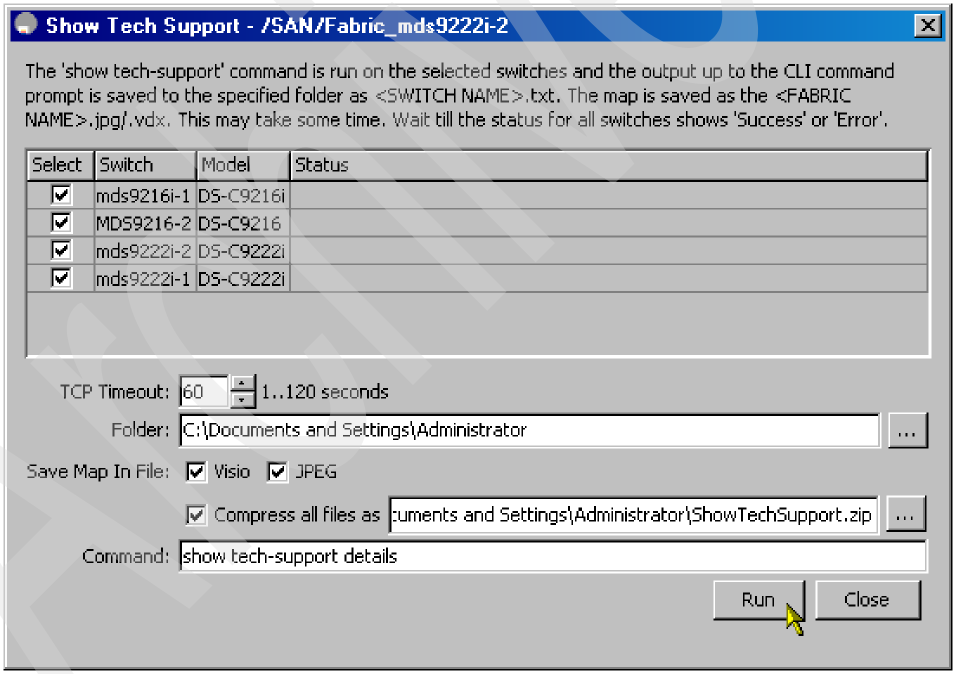


Logical Name	IP Address	WWN	Status	Vendor	Model	Release
MDS9216-2	9.43.86.124	20:00:00:0b:5f:a3:ca:00	No Traps	Cisco	DS-C9216	3.3(1a)
IBM_2005_B5K_1	9.43.86.129	10:00:00:05:1e:90:16:5b	ok	Brocade	Brocade	v6.1.0c
mds9216i-1	9.43.86.146	20:00:00:0d:ec:2d:ca:40	ok	Cisco	DS-C9216i	4.1(1)
mds9222i-1	9.43.86.147	20:00:00:0d:ec:82:3d:00	No Traps	Cisco	DS-C9222i	4.1(1)
mds9222i-2	9.43.86.148	20:00:00:0d:ec:4a:c5:80	No Traps	Cisco	DS-C9222i	4.1(1)

Figure 8-23 Launching Show Tech Support from Fabric Manager menu

2. Select the switches from which to view tech support information by checking the check boxes for each switch, as shown in Figure 8-24.
3. Set the time-out value. The default is 30 seconds (Figure 8-24).
4. Select the folder where you want the text files (containing the tech support information) to be written (Figure 8-24).
5. Check the **Save Map** check box if you want to save an image of your map as a JPG file (Figure 8-24).
6. Check the **Compress all files as** check box to compress the files into a zip file, as shown in Figure 8-24.
7. Click **Run** to start issuing the show tech support command to the switches that you specified, or click **Close** to close the Show Tech Support dialog box without issuing the `show tech support` command.

In Figure 8-24 there are switches for we want to capture tech support data along with all the parameters that we need to set.



Show Tech Support - /SAN/Fabric_mds9222i-2

The 'show tech-support' command is run on the selected switches and the output up to the CLI command prompt is saved to the specified folder as <SWITCH NAME>.txt. The map is saved as the <FABRIC NAME>.jpg/.vdx. This may take some time. Wait till the status for all switches shows 'Success' or 'Error'.

Select	Switch	Model	Status
☑	mds9216i-1	DS-C9216i	
☑	MDS9216-2	DS-C9216	
☑	mds9222i-2	DS-C9222i	
☑	mds9222i-1	DS-C9222i	

TCP Timeout: 60 1..120 seconds

Folder: C:\Documents and Settings\Administrator

Save Map In File: ☑ Visio ☑ JPEG

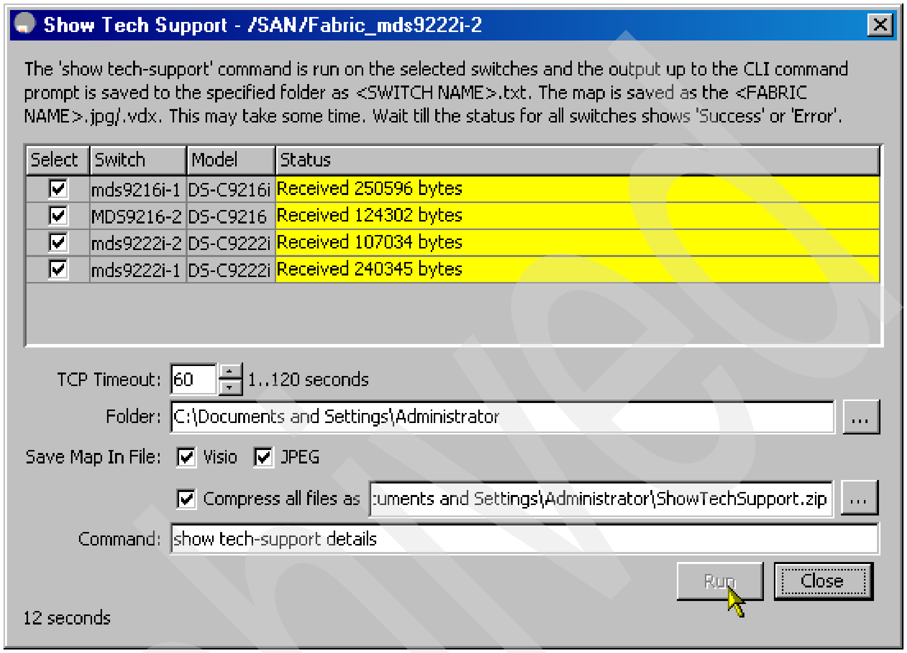
☑ Compress all files as :uments and Settings\Administrator\ShowTechSupport.zip

Command: show tech-support details

Figure 8-24 Select MDS switches to collect tech support data

When you start the process of tech support data collection, in the Status column next to each switch you will see a highlighted status. A yellow highlight, as shown in Figure 8-25 on page 368, indicates that the `show tech support` command is currently running on that switch. A red highlight indicates an error. A green highlight, like the one shown in Figure 8-26 on page 369, indicates that the **`show tech support`** command has completed successfully.

Figure 8-25 shows the progress of the tech support data collection process.



The 'show tech-support' command is run on the selected switches and the output up to the CLI command prompt is saved to the specified folder as <SWITCH NAME>.txt. The map is saved as the <FABRIC NAME>.jpg/.vdx. This may take some time. Wait till the status for all switches shows 'Success' or 'Error'.

Select	Switch	Model	Status
☑	mds9216i-1	DS-C9216i	Received 250596 bytes
☑	MDS9216-2	DS-C9216	Received 124302 bytes
☑	mds9222i-2	DS-C9222i	Received 107034 bytes
☑	mds9222i-1	DS-C9222i	Received 240345 bytes

TCP Timeout: 60 1..120 seconds

Folder: C:\Documents and Settings\Administrator

Save Map In File: ☑ Visio ☑ JPEG

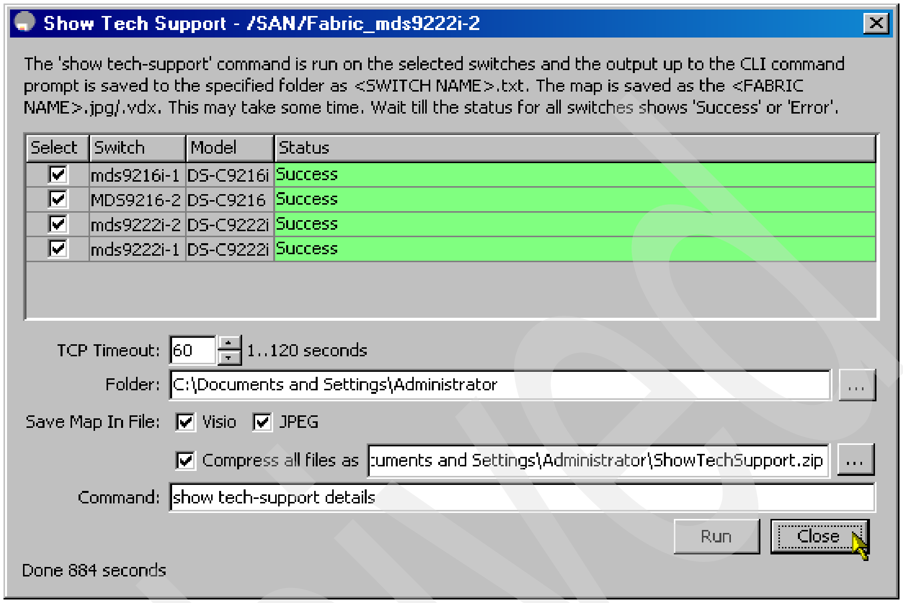
☑ Compress all files as :uments and Settings\Administrator\ShowTechSupport.zip

Command: show tech-support details

12 seconds

Figure 8-25 Data collection is in progress

Figure 8-26 shows that the tech support data collection process has finished successfully for all selected switches.



Show Tech Support - /SAN/Fabric_mds9222i-2

The 'show tech-support' command is run on the selected switches and the output up to the CLI command prompt is saved to the specified folder as <SWITCH NAME>.txt. The map is saved as the <FABRIC NAME>.jpg/.vdx. This may take some time. Wait till the status for all switches shows 'Success' or 'Error'.

Select	Switch	Model	Status
☑	mds9216i-1	DS-C9216i	Success
☑	MDS9216-2	DS-C9216	Success
☑	mds9222i-2	DS-C9222i	Success
☑	mds9222i-1	DS-C9222i	Success

TCP Timeout: 60 1..120 seconds

Folder: C:\Documents and Settings\Administrator

Save Map In File: ☑ Visio ☑ JPEG

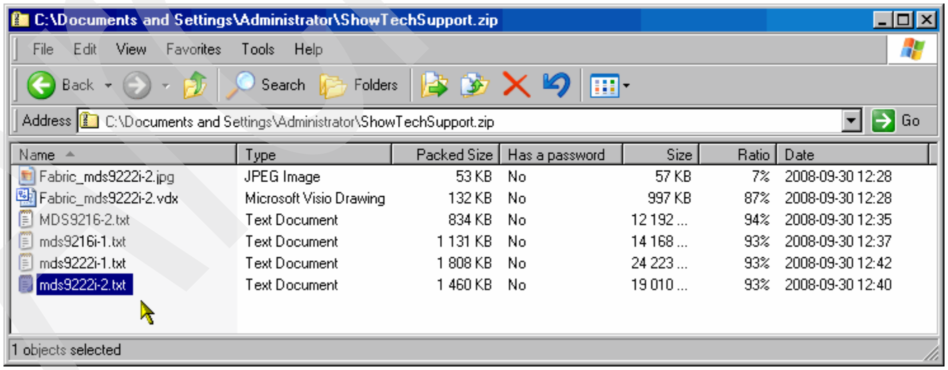
☑ Compress all files as :uments and Settings\Administrator\ShowTechSupport.zip

Command: show tech-support details

Done 884 seconds

Figure 8-26 Data collection completed successfully

As shown in Figure 8-27, all tech support data from all mds switches in the fabric have been saved to a zip file along with images of the fabric map in the JPG and VXD format.



C:\Documents and Settings\Administrator\ShowTechSupport.zip

Address C:\Documents and Settings\Administrator\ShowTechSupport.zip

Name	Type	Packed Size	Has a password	Size	Ratio	Date
Fabric_mds9222i-2.jpg	JPEG Image	53 KB	No	57 KB	7%	2008-09-30 12:28
Fabric_mds9222i-2.vdx	Microsoft Visio Drawing	132 KB	No	997 KB	87%	2008-09-30 12:28
MDS9216-2.txt	Text Document	834 KB	No	12 192 ...	94%	2008-09-30 12:35
mds9216i-1.txt	Text Document	1 131 KB	No	14 168 ...	93%	2008-09-30 12:37
mds9222i-1.txt	Text Document	1 808 KB	No	24 223 ...	93%	2008-09-30 12:42
mds9222i-2.txt	Text Document	1 460 KB	No	19 010 ...	93%	2008-09-30 12:40

1 objects selected

Figure 8-27 Tech support files saved into a ZIP file

A fabric map, as shown in Figure 8-28, could be useful to support experts in analysis and problem determination.

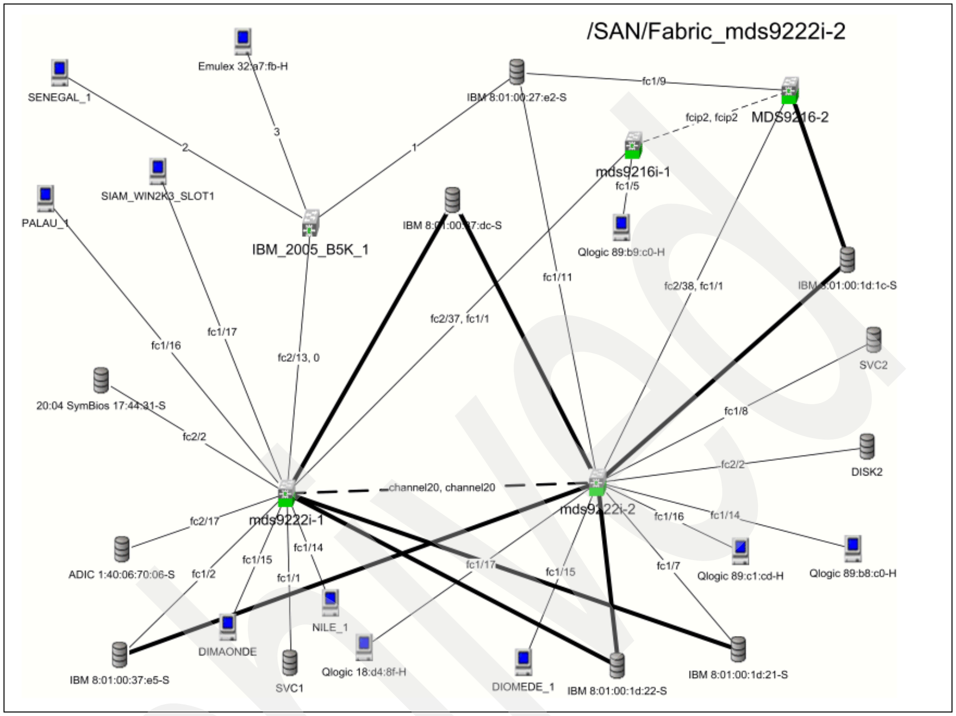


Figure 8-28 A fabric map as show tech support output

8.1.8 Cisco Fabric Analyzer

Fibre Channel protocol analyzers capture, decode, and analyze frames and ordered sets on a link. Existing Fibre Channel analyzers can capture traffic at wire rate speed. They are also expensive and support limited frame decoding. Also, to snoop traffic, the existing analyzers disrupt the traffic on the link while the analyzer is inserted into the link. With the Cisco Fabric Analyzer you can capture Fibre Channel control traffic from a switch and decode it without having to disrupt any connectivity, and without having to be local to the point of analysis. The Cisco Fibre Channel protocol analyzer is based on two popular public-domain software applications:

- libpcap

  `http://www.tcpdump.org`

- Wireshark (formerly Etherreal)

  `http://www.wireshark.org`

Note: The Cisco Fabric Analyzer is useful for capturing and decoding control traffic, not data traffic. It is suitable for control path captures, and is not intended for high-speed data path captures.

The Cisco Fabric Analyzer consists of two separate components:

- Software that runs on the Cisco MDS 9000 family switch and supports two modes of capture:
  - A text-based analyzer that supports local capture and decodes captured frames
  - A daemon that supports remote capture
- GUI-based client that runs on a host that supports libpcap, such as Windows or Linux, and communicates with the remote capture daemon in a Cisco MDS 9000 family switch.

Local text-based capture

This component is a command-line-driven text-based interface that captures traffic to and from the supervisor module in a Cisco MDS 9000 family switch. It is a fully functional decoder that is useful for quick debug purposes or for use when the remote capture daemon is not enabled. Additionally, because this tool is accessed from within the Cisco MDS 9000 family switch, it is protected by the roles-based policy that limits access in each switch.

Remote capture daemon

This daemon is the server end of the remote capture component. The Ethereal analyzer running on a host is the client end. They communicate with each other using the Remote Capture Protocol (RPCAP). RPCAP uses two endpoints:

- A TCP-based control connection
- A TCP or UDP-based data connection based on TCP (default) or UDP.

The control connection is used to remotely control the captures (start or stop the capture, or specify capture filters). Remote capture can only be performed to explicitly configured hosts. This technique prevents an unauthorized machine in the network from snooping on the control traffic in the network.

RPCAP supports two setup connection modes based on firewall restrictions:

- Passive mode (default): The configured host initiates connection to the switch. Multiple hosts can be configured to be in passive mode and multiple hosts can be connected and receive remote captures at the same time.
- Active mode: The switch initiates the connection to a configured host, one host at a time.

Using capture filters, you can limit the amount of traffic that is sent to the client. Capture filters are specified at the client end (on Ethereal, not on the switch).

GUI-based client

The Wireshark software (formerly Etherreal) runs on a host, such as a PC or workstation, and communicates with the remote capture daemon. This software is available in the public domain from:

`http://www.wireshark.org`

The Ethereal GUI front-end supports a rich interface such as a colorized display, graphical assists in defining filters, and specific frame searches. These features are documented on Ethereal's Web site. While remote capture through Ethereal supports capturing and decoding Fibre Channel frames from a Cisco MDS 9000 family switch, the host running Ethereal does not require a Fibre Channel connection to the switch. The remote capture daemon running on the switch sends the captured frames over the out-of-band Ethernet management port. This capability allows you to capture and decode Fibre Channel frames from your desktop or mobile computer.

8.1.9 Monitoring network traffic using SPAN

The Cisco MDS 9000 family provides a feature called the switch port analyzer (SPAN). The SPAN or SD_Ports allow us to monitor network traffic through the Fibre Channel interface.

Traffic through any Fibre Channel interface can be replicated to a special port called the SPAN destination port. Any Fibre Channel port in a switch can be configured as an SD_Port. When an interface is in SD_Port mode, it cannot be used for normal data traffic. You can attach a Fibre Channel analyzer to the SD_Port to monitor SPAN traffic.

Note: RSPAN has all the features of SPAN in addition to support for source ports and destination ports distributed across multiple switches, allowing remote monitoring of multiple switches across your network.

The traffic for each RSPAN session is carried over a user-specified RSPAN VLAN that is dedicated for that RSPAN session in all participating switches. The SPAN traffic from the sources, which cannot be in the RSPAN VLAN, is switched to the RSPAN VLAN and then forwarded to destination ports configured in the RSPAN VLAN.

The traffic type for sources (ingress, egress, or both) in an RSPAN session can be different in different source switches, but is the same for all sources in each source switch for each RSPAN session. Do not configure any ports in an RSPAN VLAN except those selected to carry RSPAN traffic. Learning is disabled on the RSPAN VLAN.

SD_Ports do not receive frames. They only transmit a copy of the SPAN source traffic. The SPAN feature is non-intrusive and does not affect switching of network traffic for any SPAN source port.

An overview of the SPAN port is illustrated in Figure 8-29.

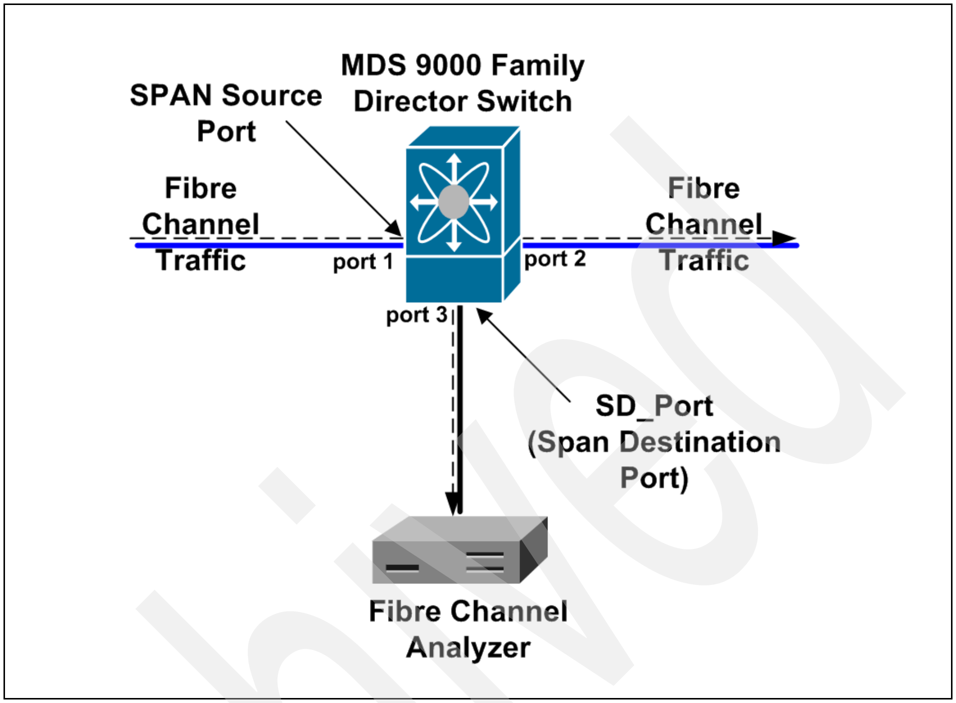


Figure 8-29 SPAN destination ports

SPAN sources

A SPAN source is the interface from which traffic can be monitored. You can also specify a VSAN as a SPAN source, in which case all supported interfaces in the specified VSAN are included as SPAN sources. You can choose the SPAN traffic in the ingress direction, the egress direction, or both directions for any source interface.

- Ingress source (rx): Traffic entering the switch fabric through this source is spanned or copied to the SD_Port, as shown in Figure 8-30.

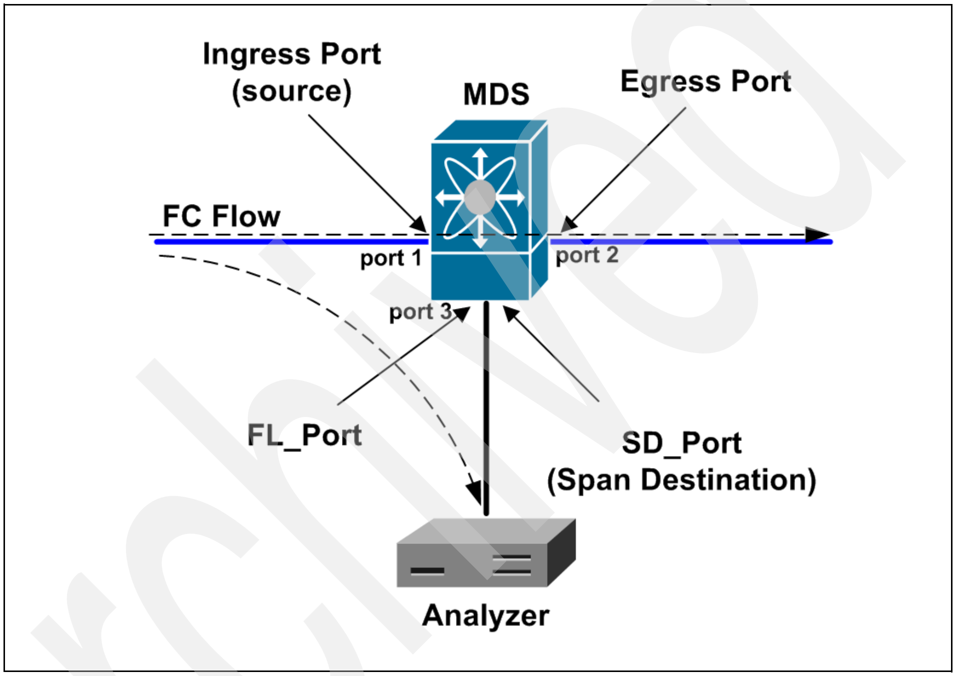


Figure 8-30 SD_Port for incoming traffic (ingress direction)

- Egress source (tx): Traffic exiting the switch fabric through this source interface is spanned or copied to the SD_Port, as shown in Figure 8-31.

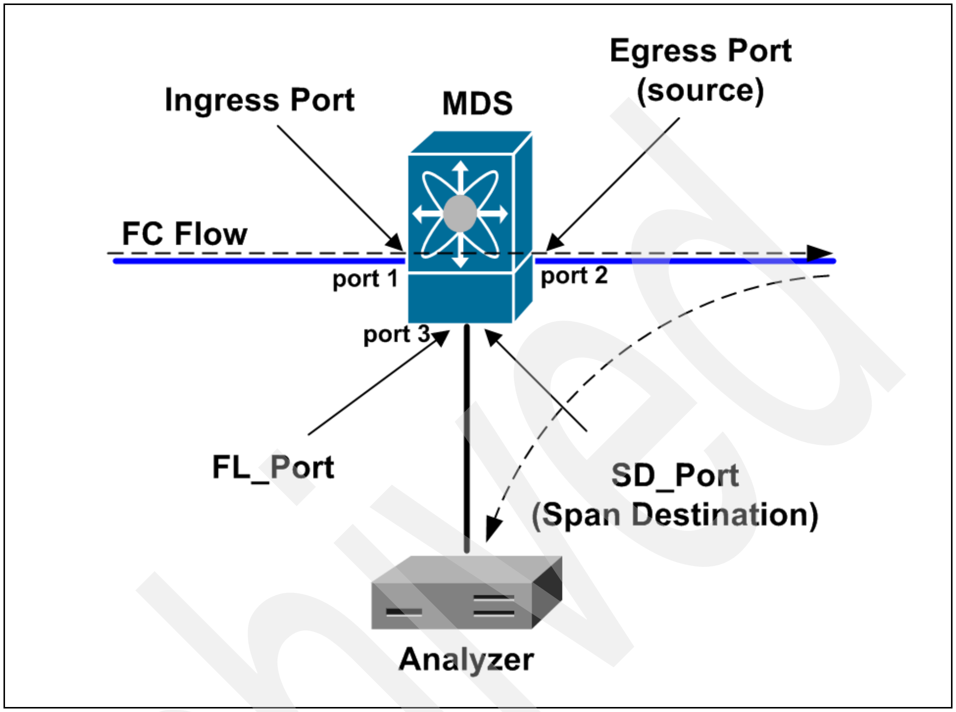


Figure 8-31 SD_Port for outgoing traffic (egress direction)

Allowed source interface types

The SPAN feature is available for the following interface types:

- Physical ports:
  - F_Ports
  - FL_Ports
  - TE_Ports
  - E_Ports
  - TL_Ports
- Interface sup-fc0 (traffic to and from the supervisor):
  - The Fibre Channel traffic from the supervisor module to the switch fabric, through the sup-fc0 interface, is called ingress traffic. It is spanned when sup-fc0 is chosen as an ingress source port.

  - The Fibre Channel traffic from the switch fabric to the supervisor module, through the sup-fc0 interface, is called egress traffic. It is spanned when sup-fc0 is chosen as an egress source port.
- PortChannels:
  - All ports in the PortChannel are included and spanned as sources.
  - You cannot specify individual ports in a PortChannel as SPAN sources. Previously configured SPAN-specific interface information is discarded.

VSAN as a SPAN source

When a VSAN is specified as a source, all physical ports and PortChannels in that VSAN are included as SPAN sources. A TE_Port is included only when the port VSAN of the TE_Port matches the SPAN source VSAN. A TE_Port is excluded even if the configured allowed VSAN list has the SPAN source VSAN, but the port VSAN configured for the PortChannel is different.

Guidelines for configuring VSANs as a source

The following guidelines apply when configuring VSANs as a source:

- Traffic on all interfaces included in a source VSAN is spanned only in the ingress direction.
- When a VSAN is specified as a source, you will not be able to perform interface-level configuration on the interfaces that are included in the VSAN. Previously configured SPAN-specific interface information is discarded.
- If an interface in a VSAN is configured as a SPAN source, you will not be able to configure that VSAN as a source. You must first remove the existing SPAN configurations on such interfaces before configuring VSAN as a source.
- Interfaces are only included as sources when the port VSAN matches the source VSAN.

SPAN sessions

Each SPAN session represents an association of one destination with a set of sources along with various other parameters that you specify to monitor the network traffic. One destination can be used by one or more SPAN sessions. You can configure up to 16 SPAN sessions in a switch. Each session can have several source ports and one destination port.

To activate a SPAN session, at least one source and the SD_Port must be up and functioning. Otherwise, traffic is not directed to the SD_Port.

To temporarily deactivate (suspend) a SPAN session use the **`suspend`** command in the SPAN submode. The traffic monitoring is stopped during this time. You can reactivate the SPAN session using the **`no suspend`** command.

Specifying filters

You can perform VSAN-based filtering to selectively monitor network traffic on specified VSANs. You can apply this VSAN filter to the selected source or to all sources in a session. Only traffic in the selected VSANs is spanned when you configure VSAN filters. You can specify two types of VSAN filters:

- Interface-level filters: You can apply VSAN filters for a specified TE_Port or trunking PortChannel to filter traffic using one of three options:
  - The ingress direction
  - The egress direction
  - Both directions
- Session filters: This option filters all sources in the specified session. These filters are bi-directional and apply to all sources configured in the session.

Guidelines for specifying filters

The following guidelines apply to SPAN filters:

- Specify filters in the ingress direction or in the egress direction, or in both directions.
- PortChannel filters are applied to all ports in the PortChannel.
- If no filters are specified, the traffic from all active VSANs for that interface is spanned.
- The effective filter on a port is the intersection (filters common to both) of interface filters and session filters.
- While you can specify any arbitrary VSAN filters in an interface, traffic can only be monitored on the port VSAN or on allowed-active VSANs in that interface.
- When you configure VSAN as a source, that VSAN is implicitly applied as an interface filter to all sources included in the specified VSAN.

SD_Port characteristics

An SD_Port has the following characteristics:

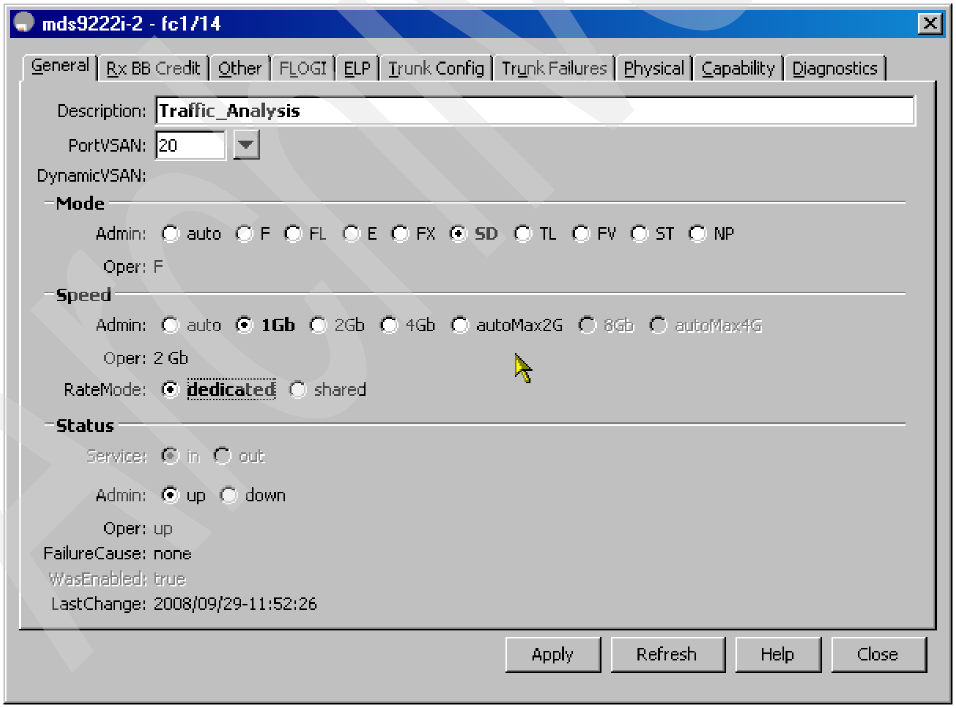
- It ignores buffer-to-buffer credits.
- It allows data traffic only in the egress (tx) direction.
- It does not require a device or an analyzer to be physically connected.
- It supports only 1 Gbps or 2 Gbps speeds. The auto speed option is not allowed.
- Multiple sessions can share the same destination ports.
- If the SD_Port is shut down, all shared sessions stop generating SPAN traffic.

- The port mode cannot be changed if it is being used for a SPAN session.
- The outgoing frames can be encapsulated in EISL format.
- The SD_Port does not have a port VSAN.

The following guidelines apply for a SPAN configuration:

- You can configure up to 16 SPAN sessions with multiple ingress (rx) sources.
- You can configure a maximum of three SPAN sessions with one egress (tx) port.
- In a 32-port switching module you must configure the same session in all four ports in one port group. If you want, you can also configure only two or three ports in this unit.
- SPAN frames are dropped if the sum of the bandwidth of the sources exceeds the speed of the destination port.
- Frames dropped by a source port are not spanned.

In Figure 8-32 we show how to set FC1/14 as an SD port.



Description: Traffic_Analysis

PortVSAN: 20

DynamicVSAN:

Mode

Admin: ○ auto ○ F ○ FL ○ E ○ FX ● SD ○ TL ○ FV ○ ST ○ NP

Oper: F

Speed

Admin: ○ auto ● 1Gb ○ 2Gb ○ 4Gb ○ autoMax2G ○ 8Gb ○ autoMax4G

Oper: 2 Gb

RateMode: ● dedicated ○ shared

Status

Service: ● in ○ out

Admin: ● up ○ down

Oper: up

FailureCause: none

WasEnabled: true

LastChange: 2008/09/29-11:52:26

Figure 8-32 Set FC 1/14 port as SD

In Device Manager you can see that it is now an SD port, as shown in Figure 8-33.

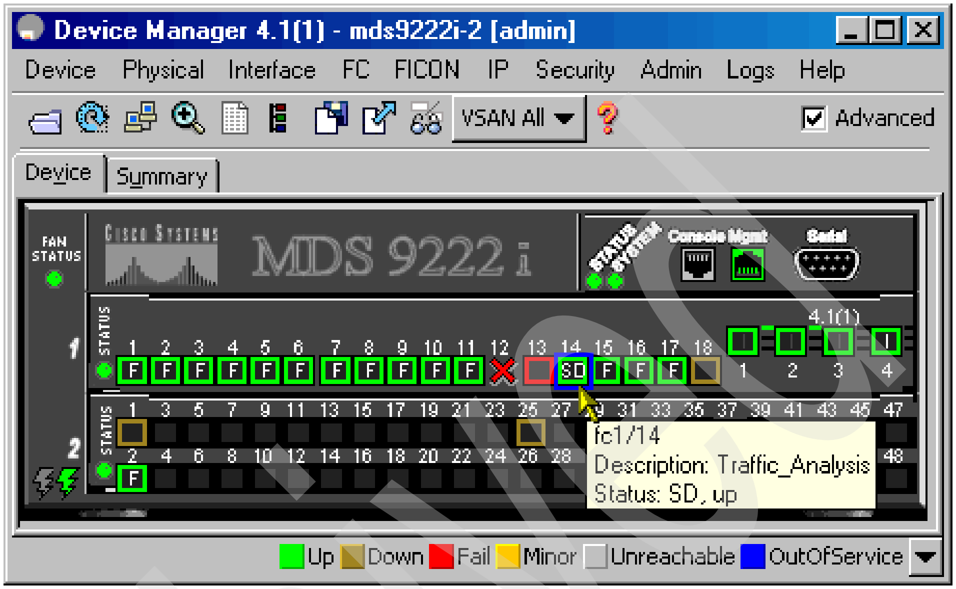

Device Manager 4.1(1) - mds9222i-2 [admin]
Device Physical Interface FC FICON IP Security Admin Logs Help
VSAN All
☑ Advanced
Device
Summary
FAN STATUS
CISCO SYSTEMS
MDS 9222i
STATUS SYSTEM
Console Mgmt
Serial
4.1(1)
fc1/14
Description: Traffic_Analysis
Status: SD, up
Up Down Fail Minor Unreachable OutOfService

Figure 8-33 FC1/14 is an SD port

You can configure an SD port from the CLI, as shown in Example 8-14.

Example 8-14 Configure an SD port from the CLI

```
mds9222i-2# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
mds9222i-2(config)# interface fc 1/14
mds9222i-2(config-if)# switchport mode
E       F       FL      Fx      NP      SD      ST      TL      auto
mds9222i-2(config-if)# switchport mode SD
mds9222i-2(config-if)# switchport speed
1000    2000    4000    8000    auto
mds9222i-2(config-if)# switchport speed 1000
mds9222i-2(config-if)# switchport description Traffic_Analysis
mds9222i-2(config-if)# shutdown
mds9222i-2(config-if)# no shutdown
mds9222i-2(config-if)# end
mds9222i-2# show interface fc 1/14
fc1/14 is up
    Port description is Traffic_Analysis
    Hardware is Fibre Channel, SFP is short wave laser w/o OFC (SN)
    Port WWN is 20:0e:00:0d:ec:4a:c5:80
    Admin port mode is SD
    snmp link state traps are enabled
```

```
Port mode is SD
Port vsan is 20
Speed is 1 Gbps
Rate mode is shared
Beacon is turned off
5 minutes input rate 88 bits/sec, 11 bytes/sec, 0 frames/sec
5 minutes output rate 64 bits/sec, 8 bytes/sec, 0 frames/sec
  164 frames input, 8296 bytes
    0 discards, 0 errors
    0 CRC,  0 unknown class
    0 too long, 0 too short
  93 frames output, 6376 bytes
    0 discards, 0 errors
  2 input OLS, 2 LRR, 0 NOS, 2 loop inits
  4 output OLS, 0 LRR, 0 NOS, 1 loop inits
  1 receive B2B credit remaining
  0 transmit B2B credit remaining
  0 low priority transmit B2B credit remaining
Interface last changed at Fri Sep  7 02:19:59 2007
```

8.1.10 Cisco Traffic Analyzer and Performance Manager

Performance Manager works in conjunction with Cisco Traffic Analyzer to monitor and manage the traffic on your fabric. Using Cisco Traffic Analyzer with Performance Manager requires the following components:

- A configured Fibre Channel Switched Port Analyzer (SPAN) destination (SD) port to forward Fibre Channel traffic.
- A Port Analyzer Adapter 2 (PAA-2) to convert the Fibre Channel traffic to Ethernet traffic.
- Cisco Traffic Analyzer software to analyze the traffic from the PAA-2.

Note: We recommend that you install Traffic Analyzer and Performance Manager on separate servers. We recommend a Linux server for installing Traffic Analyzer because of efficiency of resources allocation when analyzing extensive traffic.

Figure 8-34 shows how Performance Manager works with Cisco Traffic Analyzer to monitor traffic on your fabric.

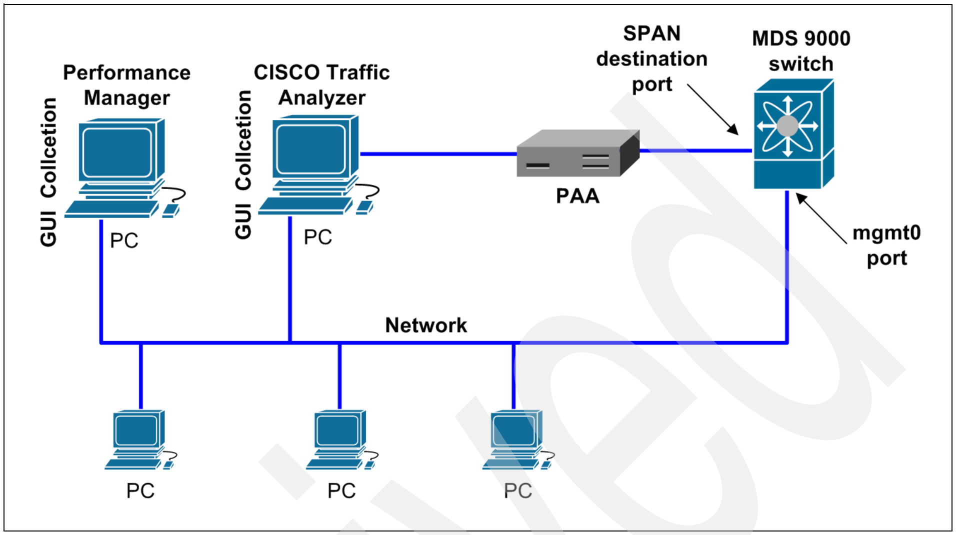


Figure 8-34 Performance manager working with Cisco Traffic Analyzer

Port Analyzer Adapter 2 (PAA-2)

The PAA-2 enables effective, low-cost analysis of Fibre Channel traffic. The device is a standalone Fibre Channel-to-Ethernet adapter, designed primarily to analyze SPAN traffic from a Fibre Channel port on a Cisco MDS 9000 family switch. The main function of the Port Analyzer Adapter 2 is to encapsulate Fibre Channel frames into Ethernet frames. This allows low-cost analysis of Fibre Channel traffic while leveraging the existing Ethernet infrastructure.

The PAA-2 allows you to examine Fibre Channel frames of various sizes. Fibre Channel frames from layers 2, 3, and 4 may be examined without network disruption.

Cisco Traffic Analyzer

Performance Manager collects Fibre Channel level performance statistics using SNMP to access counters on Cisco MDS 9000 family switches. To view detailed SCSI I/O statistics, look at the data on an SD port with the help of the Cisco Traffic Analyzer, which uses the Cisco Port Analyzer Adapter 2 (PAA-2).

Cisco Traffic Analyzer provides real-time analysis of SPAN traffic or analysis of captured traffic through a Web browser user interface. Traffic encapsulated by one or more Port Analyzer Adapter 2 products can be analyzed concurrently with a single workstation running Cisco Traffic Analyzer, which is based on ntop (a network traffic probe), a public domain software enhanced by Cisco for Fibre Channel traffic analysis.

Round-trip response times, SCSI I/Os per second, SCSI read or traffic throughput and frame counts, SCSI session status, and management task information are monitored. Additional statistics are also available on Fibre Channel frame sizes and network management protocols.

For seamless performance analysis and troubleshooting, Cisco Traffic Analyzer can be launched in-context from Fabric Manager. Port world wide name, Fibre Channel ID (FC ID), FC alias, and VSAN names are passed to Cisco Traffic Analyzer.

Cisco Traffic Analyzer must be downloaded and installed separately from the following Web site:

http://www.cisco.com/kobayashi/sw-center/sw-stornet.shtml

Cisco Traffic Analyzer software is available under the Port Analyzer Adapter link.

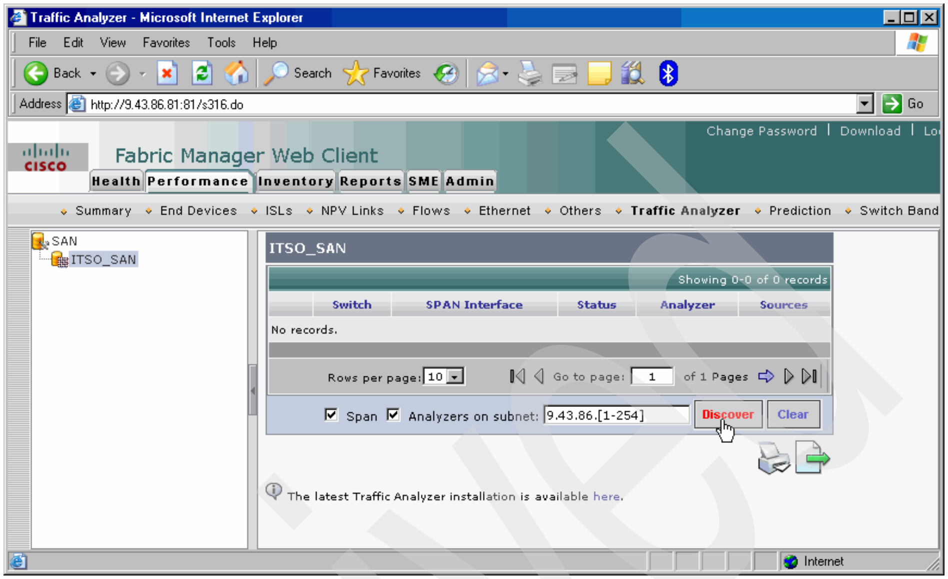
8.1.11 Traffic Analyzer in Fabric Manager Web Server

Fabric Manager supports discovering instances of Traffic Analyzer and SPAN ports configured within your fabric.

Fabric Manager Web Server supports the following Traffic Analyzer integration features:

- SCSI I/O Traffic Analyzer pages can be viewed within the Web client.
- Traffic Analyzer can reside on a different server from Performance Manager.
- Performance Manager integrates with multiple servers running Traffic Analyzer.
- Instances of Traffic Analyzer servers can be discovered by Fabric Manager Server.
- The Web client report lists SPAN destination ports and associations with Traffic Analyzers.

Figure 8-35 shows Traffic Analyzer in the Fabric Manager Web Server.


Traffic Analyzer - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Go
Change Password | Download | Lo
Fabric Manager Web Client
Health Performance Inventory Reports SME Admin
Summary End Devices ISLs NPV Links Flows Ethernet Others Traffic Analyzer Prediction Switch Band
SAN
ITSO_SAN
ITSO_SAN
Switch SPAN Interface Status Analyzer Sources
Discover Clear
Internet

Address http://9.43.86.81:81/s316.do

Showing 0-0 of 0 records

Switch	SPAN Interface	Status	Analyzer	Sources
No records.				

Rows per page: 10 Go to page: 1 of 1 Pages

☑ Span ☑ Analyzers on subnet: 9.43.86.[1-254]

The latest Traffic Analyzer installation is available here.

Figure 8-35 Traffic Analyzer in Fabric Manager Web Server

8.1.12 System message logging

The system message logging software saves messages in a log file or directs the messages to other devices. This feature provides you with the following capabilities:

- It provides logging information for monitoring and troubleshooting.
- It allows you to select the types of captured logging information.
- It allows you to select the destination server to forward the captured logging information.

By default, the switch logs normal but significant system messages to a log file and sends these messages to the system console. You can specify which system messages should be saved based on the type of facility and the severity level. Messages are time-stamped to enhance real-time debugging and management.

You can access logged system messages using the CLI or by saving them to a properly configured system message logging server. The switch software saves system messages in a file that can be configured to save up to 4 MB. You can monitor system messages remotely by accessing the switch through Telnet, SSH, or the console port, or by viewing the logs on a system message logging server.

Use the **`show logging`** command to display the current system message logging configuration. In Table 8-1 there are some examples of logging commands and, in the interests of brevity, outputs are omitted.

Table 8-1 Show logging commands

Show command	Description
`show logging nvram`	Displays NVRM log contents
`show logging logfile`	Displays the log file
`show logging console`	Displays the console logging status
`show logging level`	Displays the logging facility
`show logging info`	Displays logging information
`show logging last 2`	Displays the last two lines of a log file
`show logging monitor`	Displays monitor logging status
`show logging server`	Displays server information
`show logging module`	Displays switching module logging status

8.1.13 Call Home

Call Home provides an e-mail-based notification of critical system events. A versatile range of message formats is available for optimal compatibility with pager services, standard e-mail, or XML-based automated parsing applications.

Common uses of this feature can include direct paging of a network support engineer, e-mail notification to a network operations center, and utilization of Cisco AutoNotify services for direct case generation with the technical assistance center.

The Call Home feature provides message throttling capabilities. Periodic inventory messages, port syslog messages, and RMON alert messages are added to the list of deliverable Call Home messages. If required, you can also use the Cisco Fabric Services application to distribute the Call Home configuration to all other switches in the fabric.

You can configure the call home functionality using a **callhome** command in EXEC mode from the CLI. After the configuration is done you can check it, as shown in Example 8-15.

Example 8-15 CallHome example configuration

```
mds9222i-1# configure terminal
mds9222i-1(config)# snmp-server contact Jaco
mds9222i-1(config)# callhome
mds9222i-1(config-callhome)# email-contact jaco@helpmeplease.org
mds9222i-1(config-callhome)# phone-contact +123-321-123-321
mds9222i-1(config-callhome)# streetaddress TrackMe 911
mds9222i-1(config-callhome)# site-id BlueBusinessPark
mds9222i-1(config-callhome)# customer-id BraveOne
mds9222i-1(config-callhome)# contract-id ABC12345
mds9222i-1(config-callhome)# distribute
mds9222i-1(config-callhome)# enable
mds9222i-1(config-callhome)# end
mds9222i-1# show callhome
callhome enabled
Callhome Information:
contact person name(sysContact):Jaco
contact person's email:jaco@helpmeplease.org
contact person's phone number:+123-321-123-321
street addr:TrackMe 911
site id:BlueBusinessPark
customer id:BraveOne
contract id:ABC12345
switch priority:7
duplicate message throttling : enabled
periodic inventory : enabled
periodic inventory time-period : 7 days
periodic inventory timeofday : 08:00 (HH:MM)
Distribution : Enabled
```

8.2 Performance Manager

Performance Manager gathers network device statistics historically and provides this information graphically using a Web browser. It presents recent statistics in detail and older statistics in summary. Performance Manager also integrates with external tools such as Cisco Traffic Analyzer.

The Performance Manager has three operational stages:

- Definition: The Flow Wizard sets up flows in the switches.
- Collection: The Web Server Performance Collection panel collects information about desired fabrics.
- Presentation: Generates Web pages to present the collected data through Fabric Manager Web Server.

Performance Manager can collect statistics for ISLs, hosts, storage elements, and configured flows. Flows are defined based on a host-to-storage (or storage-to-host) link. Performance Manager gathers statistics from across the fabric based on collection configuration files. These files determine which SAN elements and SAN links Performance Manager gathers statistics for. Based on this configuration, Performance Manager communicates with the appropriate devices (switches, hosts, or storage elements) and collects the appropriate information at fixed five-minute intervals.

Performance Manager uses a round-robin database to hold the statistical data collected from the fabric. This data is stored based on the configured parameters in the collection configuration file. At each polling interval, Performance Manager gathers the relevant statistics and stores them in the round-robin database. This database is a fixed size and will not grow beyond its preset limits.

Performance Manager creates a series of archived data to hold summarized information present in the real-time round-robin database. This archived data is used to generate daily, weekly, monthly, and yearly consolidated reports. In this way, Performance Manager maintains significant historical data without the cost of an ever-increasing database size.

Data interpolation

One of the unique features of Performance Manager is its ability to interpolate data when statistical polling results are missing or delayed. Other performance tools may store the missing data point as zero, but this can distort historical trending. Performance Manager interpolates the missing data point by comparing the data point that preceded the missing data and the data point stored in the polling interval after the missing data. This maintains the continuity of the performance information.

Data collection

One year’s worth of data for two variables (Rx and Tx bytes) requires a round-robin database (rrd) file size of 76 K. If errors and discards are also collected, the rrd file size becomes 110 K. The default internal values are:

- 600 samples of 5 minutes (2 days and 2 hours)
- 700 samples of 30 minutes (12.5 days)
- 775 samples of 2 hours (50 days)
- 300 samples of 1 day

A 1000-port SAN requires 110 MB for a year’s worth of historical data that includes errors and discards. If there were 20 switches in this SAN with equal distribution of fabric ports, about two to three SNMP packets per switch would be sent every 5 minutes for a total of about 100 request or response SNMP packets required to monitor the data.

Flows, because of their variable counter requests, are more difficult to predict storage space requirements for. But as a rule of thumb, each extra flow adds another 76 kB.

> **Note:** Performance Manager does not collect statistics on non-manageable and non-MDS switches. Loop devices (FL/NL) are not collected.

Performance thresholds

The Performance Manager Configuration Wizard allows you to set up two thresholds that will trigger events when the monitored traffic exceeds the percent utilization configured. These event triggers can be set as either critical or warning events that are reported on the Fabric Manager Web client Events browser page.

Absolute value thresholds apply directly to the statistics gathered. These statistics, as a percent of the total link capacity, are compared to the percent utilization configured for the threshold type. If the statistics exceed either configured threshold, an event is shown on the Fabric Manager Web client Events tab.

Baseline thresholds create a threshold that adapts to the typical traffic pattern for each link for the same time window each day, week, or every two weeks. Baseline thresholds are set as a percent of the average (110% to 500%), where 100% equals the calculated weighted average.

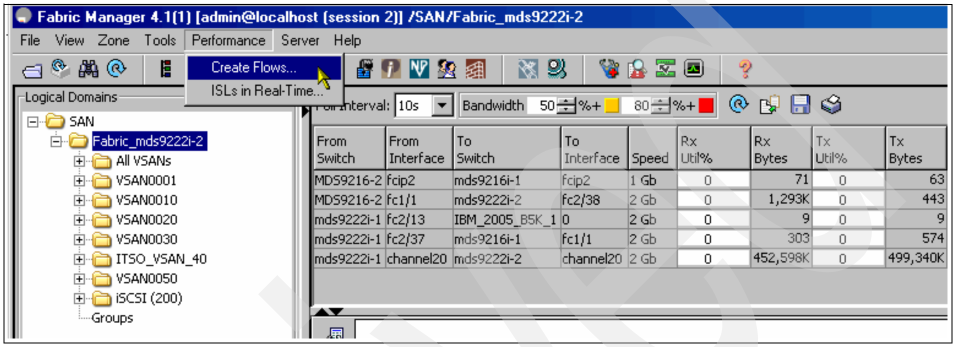
Flow definition

The Performance Manager Flow and Performance Manager Setup wizards greatly simplify configuration. All you need to do is select the categories of statistics to capture and the wizards provide a list of flows and links to monitor.

You can remove entries if desired, or just accept the provided list and start data collection. Statistics for host and storage links are not associated with a specific port on a switch, so you do not lose long-term statistics if a connection is moved to a different port.

To create a flow using Fabric Manager:

1. Choose **Performance** → **Create Flow,** as shown in Figure 8-36.



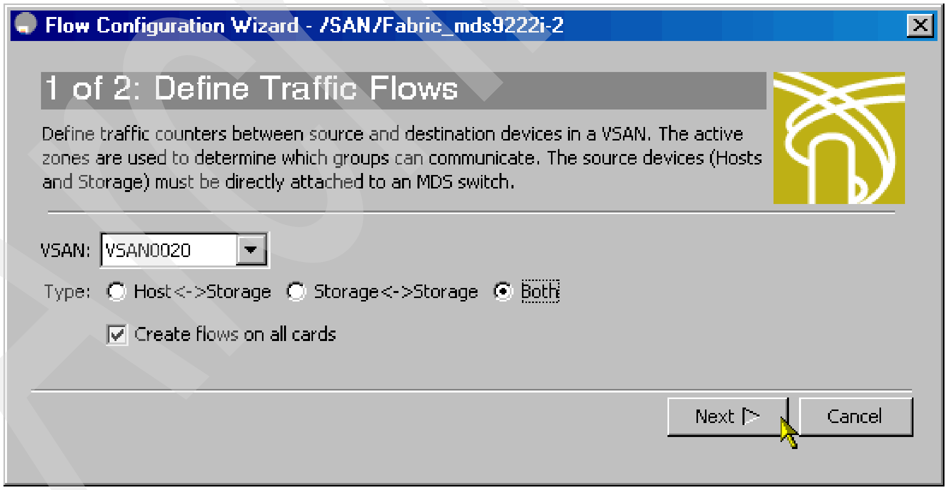
Fabric Manager 4.1(1) [admin@localhost (session 2)] /SAN/Fabric_mds9222i-2

Poll Interval: 10s   Bandwidth 50 %+ 🟨 80 %+ 🟥

From Switch	From Interface	To Switch	To Interface	Speed	Rx Util%	Rx Bytes	Tx Util%	Tx Bytes
MDS9216-2	fcip2	mds9216i-1	fcip2	1 Gb	0	71	0	63
MDS9216-2	fc1/1	mds9222i-2	fc2/38	2 Gb	0	1,293K	0	443
mds9222i-1	fc2/13	IBM_2005_B5K_1	0	2 Gb	0	9	0	9
mds9222i-1	fc2/37	mds9216i-1	fc1/1	2 Gb	0	303	0	574
mds9222i-1	channel20	mds9222i-2	channel20	2 Gb	0	452,598K	0	499,340K

Figure 8-36 Define a Flow using the Fabric Manager

2. Specify a VSAN to define a flow and specify the type of traffic to capture data, as shown in Figure 8-37.



Flow Configuration Wizard - /SAN/Fabric_mds9222i-2

1 of 2: Define Traffic Flows

Define traffic counters between source and destination devices in a VSAN. The active zones are used to determine which groups can communicate. The source devices (Hosts and Storage) must be directly attached to an MDS switch.

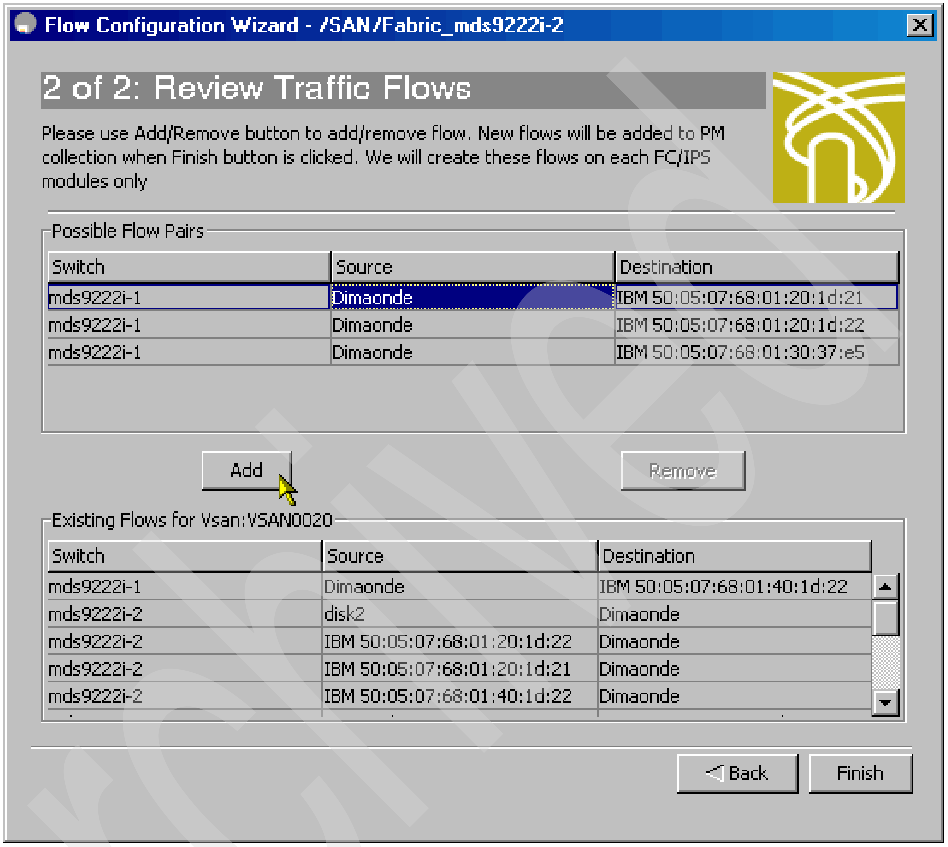
VSAN: VSAN0020

Type: ○ Host<->Storage ○ Storage<->Storage ● Both

☑ Create flows on all cards

Figure 8-37 Define flow conditions

3. The Review Traffic Flows window displays all VSAN flow pairs in the existing flows for VSANs area. Select traffic pairs to create flows and select **Add**, as shown in Figure 8-38.



Flow Configuration Wizard - /SAN/Fabric_mds9222i-2

2 of 2: Review Traffic Flows

Please use Add/Remove button to add/remove flow. New flows will be added to PM collection when Finish button is clicked. We will create these flows on each FC/IPS modules only

Possible Flow Pairs

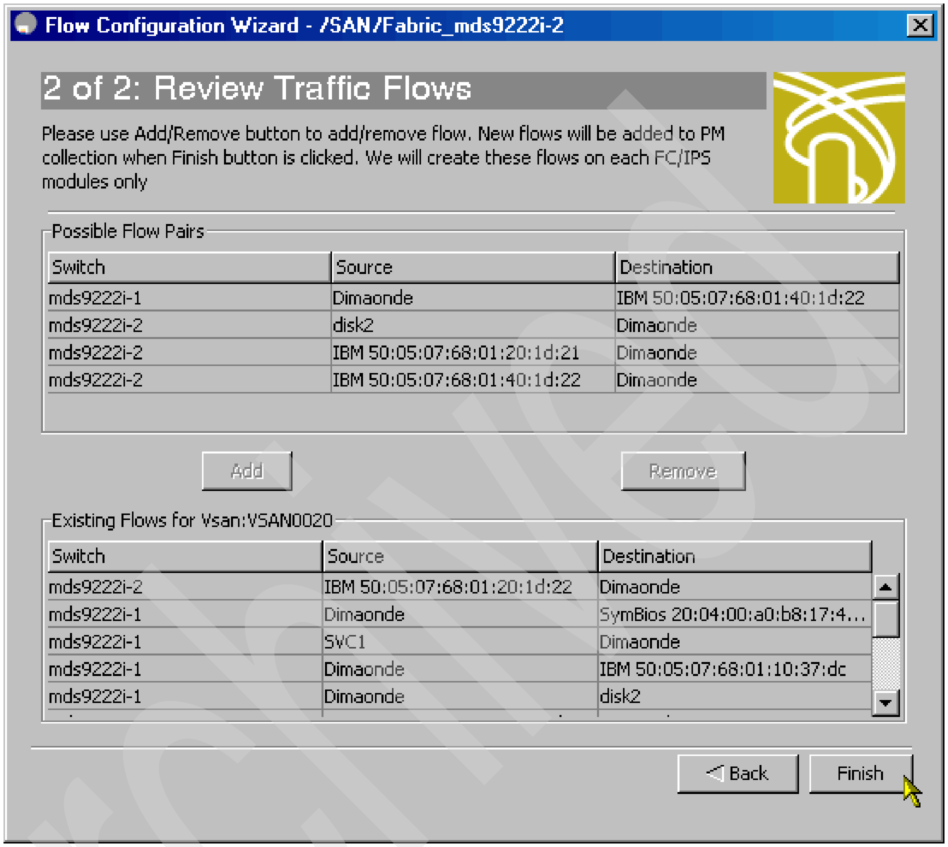
Switch	Source	Destination
mds9222i-1	Dimaonde	IBM 50:05:07:68:01:20:1d:21
mds9222i-1	Dimaonde	IBM 50:05:07:68:01:20:1d:22
mds9222i-1	Dimaonde	IBM 50:05:07:68:01:30:37:e5

Existing Flows for Vsan:VSAN0020

Switch	Source	Destination
mds9222i-1	Dimaonde	IBM 50:05:07:68:01:40:1d:22
mds9222i-2	disk2	Dimaonde
mds9222i-2	IBM 50:05:07:68:01:20:1d:22	Dimaonde
mds9222i-2	IBM 50:05:07:68:01:20:1d:21	Dimaonde
mds9222i-2	IBM 50:05:07:68:01:40:1d:22	Dimaonde

Figure 8-38 Add traffic pairs to flows for a specified VSAN

4. When you have finished selecting traffic pairs and creating flows click **Finish**, as shown in Figure 8-39, to complete the flow definition.



2 of 2: Review Traffic Flows

Please use Add/Remove button to add/remove flow. New flows will be added to PM collection when Finish button is clicked. We will create these flows on each FC/IPS modules only

Possible Flow Pairs

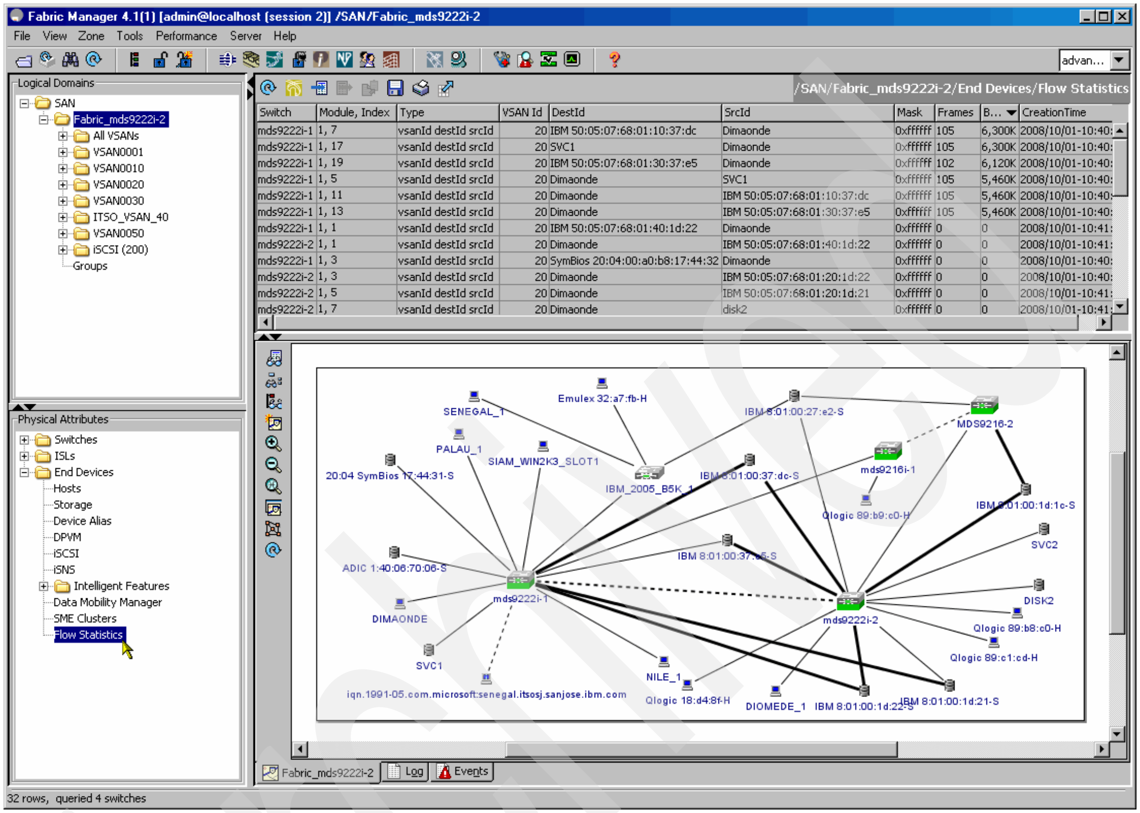
Switch	Source	Destination
mds9222i-1	Dimaonde	IBM 50:05:07:68:01:40:1d:22
mds9222i-2	disk2	Dimaonde
mds9222i-2	IBM 50:05:07:68:01:20:1d:21	Dimaonde
mds9222i-2	IBM 50:05:07:68:01:40:1d:22	Dimaonde

Existing Flows for Vsan:VSAN0020

Switch	Source	Destination
mds9222i-2	IBM 50:05:07:68:01:20:1d:22	Dimaonde
mds9222i-1	Dimaonde	SymBios 20:04:00:a0:b8:17:4...
mds9222i-1	SVC1	Dimaonde
mds9222i-1	Dimaonde	IBM 50:05:07:68:01:10:37:dc
mds9222i-1	Dimaonde	disk2

Figure 8-39   Traffic flow definition completed

5. To verify the newly created flows, choose **Physical Attributes** → **End Devices** → **Flow Statistics**, as shown in Figure 8-40. The newly created flows are displayed in the upper right panel.



Switch	Module, Index	Type	VSAN Id	DestId	SrcId	Mask	Frames	B...	CreationTime
mds9222i-1	1, 7	vsanId destId srcId	20	IBM 50:05:07:68:01:10:37:dc	Dimaonde	0xffffff	105	6,300K	2008/10/01-10:40:
mds9222i-1	1, 17	vsanId destId srcId	20	SVC1	Dimaonde	0xffffff	105	6,300K	2008/10/01-10:40:
mds9222i-1	1, 19	vsanId destId srcId	20	IBM 50:05:07:68:01:30:37:e5	Dimaonde	0xffffff	102	6,120K	2008/10/01-10:40:
mds9222i-1	1, 5	vsanId destId srcId	20	Dimaonde	SVC1	0xffffff	105	5,460K	2008/10/01-10:40:
mds9222i-1	1, 11	vsanId destId srcId	20	Dimaonde	IBM 50:05:07:68:01:10:37:dc	0xffffff	105	5,460K	2008/10/01-10:40:
mds9222i-1	1, 13	vsanId destId srcId	20	Dimaonde	IBM 50:05:07:68:01:30:37:e5	0xffffff	105	5,460K	2008/10/01-10:40:
mds9222i-1	1, 1	vsanId destId srcId	20	IBM 50:05:07:68:01:40:1d:22	Dimaonde	0xffffff	0	0	2008/10/01-10:41:
mds9222i-2	1, 1	vsanId destId srcId	20	Dimaonde	IBM 50:05:07:68:01:40:1d:22	0xffffff	0	0	2008/10/01-10:41:
mds9222i-1	1, 3	vsanId destId srcId	20	SymBios 20:04:00:a0:b8:17:44:32	Dimaonde	0xffffff	0	0	2008/10/01-10:40:
mds9222i-2	1, 3	vsanId destId srcId	20	Dimaonde	IBM 50:05:07:68:01:20:1d:22	0xffffff	0	0	2008/10/01-10:40:
mds9222i-2	1, 5	vsanId destId srcId	20	Dimaonde	IBM 50:05:07:68:01:20:1d:21	0xffffff	0	0	2008/10/01-10:41:
mds9222i-2	1, 7	vsanId destId srcId	20	Dimaonde	disk2	0xffffff	0	0	2008/10/01-10:41:

32 rows, queried 4 switches

Figure 8-40 Newly created flows in Fabric Manager

Glossary

8b/10b A data encoding scheme developed by IBM, translating byte-wide data to an encoded 10-bit format. The Fibre Channel (FC) FC-1 level defines this as the method to use to encode and decode data transmissions over the Fibre Channel.

active configuration In an ESCON® environment, the ESCON Director configuration determined by the status of the current set of connectivity attributes. Contrast with *saved configuration*.

adapter A hardware unit that aggregates other input/output (I/O) units, devices, or communications links to a system bus.

ADSM ADSTAR Distributed Storage Manager.

Advanced Intelligent Tape (AIT) A magnetic tape format by Sony that uses 8 mm cassettes, but is only used in specific drives.

agent In the client-server model, the part of the system that performs information preparation and exchange on behalf of a client or server application. In the Simple Network Management Protocol (SNMP), the managed system. See also *management agent*.

aggregation In the Storage Networking Industry Association Storage Model (SNIA), *virtualization* is known as *aggregation*. This aggregation can take place at the file level or at the level of individual blocks that are transferred to disk.

AIT See *Advanced Intelligent Tape*.

AL See *arbitrated loop*.

allowed In an ESCON Director, the attribute that, when set, establishes dynamic connectivity capability. Contrast with *prohibited*.

AL_PA Arbitrated Loop Physical Address.

American National Standards Institute (ANSI) The primary organization for fostering the development of technology standards in the United States. The ANSI family of Fibre Channel documents provides the standards basis for the Fibre Channel architecture and technology. See also *FC-PH*.

ANSI See *American National Standards Institute*.

APAR See *authorized program analysis report*.

arbitrated loop (AL) A Fibre Channel interconnection technology that allows up to 126 participating node ports and one participating fabric port to communicate.

arbitration The process of selecting one respondent from a collection of several candidates that request service concurrently.

Asynchronous Transfer Mode (ATM) A type of packet switching that transmits fixed-length units of data.

ATL See *Automated Tape Library.*

ATM See *Asynchronous Transfer Mode*.

authorized program analysis report (APAR) A report of a problem caused by a suspected defect in a current, unaltered release of a program.

Automated Tape Library (ATL) Large-scale tape storage system that uses multiple tape drives and mechanisms to address 50 or more cassettes.

backup A copy of computer data, or the act of copying such data, that is used to recreate data that has been lost, mislaid, corrupted, or erased.

bandwidth A measure of the information capacity of a transmission channel.

basic mode An S/390® or IBM eServer™ zSeries® central processing mode that does not use logical partitioning. Contrast with *logically partitioned mode*.

blocked In an ESCON and FICON Director, the attribute that, when set, removes the communication capability of a specific port. Contrast with *unblocked*.

bridge A component used to attach more than one I/O unit to a port. Also a data communications device that connects two or more networks and forwards packets between them. The bridge may use similar or dissimilar media and signaling systems. It operates at the data link level of the OSI model. Bridges read and filter data packets and frames.

bridge/router A device that can provide the functions of a bridge, router, or both, concurrently. A bridge/router can route one or more protocols, such as TCP/IP, and bridge all other traffic. See also *bridge* and *router*.

broadcast To send a transmission to all N_Ports on a fabric.

byte 1) In Fibre Channel, an 8-bit entity prior to encoding or after decoding, with its least significant bit denoted as bit 0 and most significant bit as bit 7. The most significant bit is shown on the left side in FC-FS unless otherwise shown. 2) In S/390 architecture or z/Architecture® for zSeries (and FICON), an 8-bit entity prior to encoding or after decoding, with its least significant bit denoted as bit 7 and most significant bit as bit 0. The most significant bit is shown on the left side in S/390 architecture and z/Architecture for zSeries.

cascaded switches The connecting of one Fibre Channel switch to another Fibre Channel switch, creating a cascaded switch route between two N_Nodes connected to a Fibre Channel fabric.

chained In an ESCON environment, pertaining to the physical attachment of two ESCON Directors (ESCDs) to each other.

channel 1) A processor system element that controls one channel path, whose mode of operation depends on the type of hardware to which it is attached. In a channel subsystem, each channel controls an I/O interface between the channel control element and the logically attached control units. 2) In ESA/390 or z/Architecture, the part of a channel subsystem that manages a single I/O interface between a channel subsystem and a set of controllers (control units).

channel to channel See *CTC*.

channel to converter See *CVC*.

channel-attached Devices attached directly by data channels (I/O channels) to a computer. Also refers to devices attached to a controlling unit by cables rather than by telecommunication lines.

channel I/O A form of I/O where request and response correlation is maintained through a form of source, destination, and request identification.

channel path (CHP) A single interface between a central processor and one or more control units along which signals and data can be sent to perform I/O requests.

channel path identifier (CHPID) In a channel subsystem, a value assigned to each installed channel path of the system that uniquely identifies that path to the system.

channel subsystem (CSS) Relieves the processor of direct I/O communication tasks and performs path management functions. Uses a collection of subchannels to direct a channel to control the flow of information between I/O devices and main storage.

CHP See *channel path*.

CHPID See *channel path identifier*.

CIFS Common Internet File System.

cladding In an optical cable, the region of low refractive index surrounding the core. See also *core* and *optical fiber.*

Class of Service A Fibre Channel frame delivery scheme that exhibits a specified set of delivery characteristics and attributes.

Class-1 A class of service that provides dedicated connection between two ports with confirmed delivery or notification of nondeliverability.

Class-2 A class of service that provides a frame-switching service between two ports with confirmed delivery or notification of nondeliverability.

Class-3 A class of service that provides frame-switching datagram service between two ports or a multicast service between a multicast originator and one or more multicast recipients.

Class-4 A class of service that provides a fractional bandwidth virtual circuit between two ports with confirmed delivery or notification of nondeliverability.

Class-6 A class of service that provides a multicast connection between a multicast originator and one or more multicast recipients with confirmed delivery or notification of nondeliverability.

client A software program used to contact and obtain data from a *server* software program on another computer, often across a great distance. Each *client* program is designed to work specifically with one or more kinds of server programs, and each server requires a specific kind of client program.

client/server The relationship between machines in a communications network. The client is the requesting machine and the server is the supplying machine. Also used to describe the information management relationship between software components in a processing system.

cluster A type of parallel or distributed system that consists of a collection of interconnected whole computers and is used as a single, unified computing resource.

CNC A mnemonic for an ESCON channel used to communicate to an ESCON-capable device.

coaxial cable A transmission media (cable) used for high-speed transmission. It is called *coaxial* because it includes one physical channel that carries the signal surrounded (after a layer of insulation) by another concentric physical channel, both of which run along the same axis. The inner channel carries the signal and the outer channel serves as a ground.

configuration matrix In an ESCON environment or FICON, an array of connectivity attributes that appear as rows and columns on a display device and can be used to determine or change active and saved ESCON or FICON director configurations.

connected In an ESCON Director, the attribute that, when set, establishes a dedicated connection between two ESCON ports. Contrast with *disconnected.*

connection In an ESCON Director, an association established between two ports that provides a physical communication path between them.

connectivity attribute In an ESCON and FICON Director, the characteristic that determines a particular element of a port's status. See *allowed, prohibited, blocked, unblocked,* as well as *connected* and *disconnected*.

control unit A hardware unit that controls the reading, writing, or displaying of data at one or more I/O units.

controller A component that attaches to the system topology through a channel semantic protocol that includes some form of request/response identification.

core In an optical cable, the central region of an optical fiber through which light is transmitted and that has an index of refraction greater than the surrounding cladding material. See also *cladding* and *optical fiber*.

coupler In an ESCON environment, link hardware used to join optical fiber connectors of the same type. Contrast with *adapter*.

CRC See *Cyclic Redundancy Check*.

CSS See *channel subsystem*.

CTC Channel-to-channel. A mnemonic for an ESCON channel attached to another ESCON channel, where one of the two ESCON channels is defined as an ESCON CTC channel and the other ESCON channel is defined as a ESCON CNC channel. Also a mnemonic for a FICON channel supporting a CTC Control Unit function logically or physically connected to another FICON channel that also supports a CTC Control Unit function. FICON channels supporting the FICON CTC control unit function are defined as normal FICON native (FC) mode channels.

CVC A mnemonic for an ESCON channel attached to an IBM 9034 convertor. The 9034 converts ESCON CVC signals to parallel channel interface (OEMI) communication operating in block multiplex mode (Bus and Tag).

Cyclic Redundancy Check (CRC) An error-correcting code used in Fibre Channel.

DASD See *direct access storage device.*

DAT See *Digital Audio Tape*.

data sharing A SAN solution in which files on a storage device are shared between multiple hosts.

datagram Refers to the Class 3 Fibre Channel Service that allows data to be sent rapidly to multiple devices attached to the fabric, with no confirmation of delivery.

DDM See *disk drive module.*

dedicated connection In an ESCON Director, a connection between two ports that is not affected by information contained in the transmission frames. This connection, which restricts those ports from communicating with any other port, can be established or removed only as a result of actions performed by a host control program or at the ESCD console. Contrast with *dynamic connection*.

Note: The two links having a dedicated connection appear as one continuous link.

default Pertaining to an attribute, value, or option that is assumed when none is explicitly specified.

Dense Wavelength Division Multiplexing (DWDM) The concept of packing multiple signals tightly together in separate groups, and transmitting them simultaneously over a common carrier wave.

destination Any point or location, such as a node, station, or a particular terminal, to which information is to be sent. An example is a Fibre Channel fabric F_Port; when attached to a Fibre Channel N_port, communication to the N_port via the F_port is said to be to the F_Port destination identifier (D_ID).

device A mechanical, electrical, or electronic contrivance with a specific purpose.

device address 1) In ESA/390 architecture and z/Architecture for zSeries, the field of an ESCON device-level frame that selects a specific device on a control unit image. 2) In the FICON channel FC-SB-2 architecture, the device address field in an SB-2 header that is used to select a specific device on a control unit image.

device number 1) In ESA/390 and z/Architecture for zSeries, a four-hexadecimal character identifier (for example, 19A0) that you associate with a device to facilitate communication between the program and the host operator. 2) The device number that you associate with a subchannel that uniquely identifies an I/O device.

dB Decibel. A ratio measurement distinguishing the percentage of signal attenuation (loss) between the I/O power. Attenuation is expressed as dB/km.

Digital Audio Tape (DAT) A tape media technology designed for very high quality audio recording and data backup. DAT cartridges look like audio cassettes and are often used in mechanical auto-loaders. Typically, a DAT cartridge provides 2 GB of storage, but new DAT systems have much larger capacities.

Digital Linear Tape (DLT) A magnetic tape technology originally developed by Digital Equipment Corporation (DEC) and now sold by Quantum. DLT cartridges provide storage capacities from 10 GB to 35 GB.

direct access storage device (DASD) A mass storage medium on which a computer stores data. any online storage device: a disc, drive or CD-ROM.

disconnected In an ESCON Director, the attribute that, when set, removes a dedicated connection. Contrast with *connected*.

disk A mass storage medium on which a computer stores data.

disk drive module (DDM) A disk storage medium that you use for any host data that is stored within a disk subsystem.

disk mirroring A fault-tolerant technique that writes data simultaneously to two hard disks using the same hard disk controller.

disk pooling A SAN solution in which disk storage resources are pooled across multiple hosts rather than dedicated to a specific host.

distribution panel In an ESCON and FICON environment, a panel that provides a central location for the attachment of trunk and jumper cables and can be mounted in a rack, wiring closet, or on a wall.

DLT See *Digital Linear Tape*.

duplex Pertaining to communication in which data or control information can be sent and received at the same time, from the same node. Contrast with *half duplex.*

duplex connector In an ESCON environment, an optical fiber component that terminates both jumper cable fibers in one housing and provides physical keying for attachment to a duplex receptacle.

duplex receptacle In an ESCON environment, a fixed or stationary optical fiber component that provides a keyed attachment method for a duplex connector.

DWDM See *Dense Wavelength Division Multiplexing*.

dynamic connection In an ESCON Director, a connection between two ports, established or removed by the ESCD and that, when active, appears as one continuous link. The duration of the connection depends on the protocol defined for the frames transmitted through the ports and on the state of the ports. Contrast with *dedicated connection.*

dynamic connectivity In an ESCON Director, the capability that allows connections to be established and removed at any time.

Dynamic I/O Reconfiguration An S/390 and z/Architecture function that allows I/O configuration changes to be made nondisruptively to the current operating I/O configuration.

ECL See *Emitter Coupled Logic*.

ELS See *Extended Link Services.*

EMIF See *ESCON Multiple Image Facility.*

Emitter Coupled Logic (ECL) The type of transmitter used to drive copper media such as Twinax, Shielded Twisted Pair, or Coax.

enterprise network A geographically dispersed network under the auspices of one organization.

Enterprise Systems Architecture/390 (ESA/390) An IBM architecture for mainframe computers and peripherals. Processors that follow this architecture include the S/390 Server family of processors.

Enterprise System Connection (ESCON) 1) An ESA/390 computer peripheral interface. The I/O interface uses ESA/390 logical protocols over a serial interface that configures attached units to a communication fabric. 2) A set of IBM products and services that provide a dynamically connected environment within an enterprise.

entity In general, a real or existing object from the Latin ens, or being, which makes the distinction between an object's existence and its qualities. In programming, engineering and probably many other contexts, the word is used to identify units, whether concrete items or abstract ideas, that have no ready name or label.

E_Port Expansion Port. A port on a switch used to link multiple switches together into a Fibre Channel switch fabric.

ESA/390 See *Enterprise Systems Architecture/390*.

ESCD Enterprise Systems Connection (ESCON) Director.

ESCD console The ESCON Director display and keyboard device used to perform operator and service tasks at the ESCD.

ESCON See *Enterprise System Connection.*

ESCON channel A channel having an Enterprise Systems Connection channel-to-control-unit I/O interface that uses optical cables as a transmission medium. May operate in CBY, CNC, CTC or CVC mode. Contrast with *parallel channel.*

ESCON Director An I/O interface switch that provides the interconnection capability of multiple ESCON interfaces (or FICON Bridge (FCV) mode - 9032-5) in a distributed-star topology.

ESCON Multiple Image Facility (EMIF) In the ESA/390 architecture and z/Architecture for zSeries, a function that allows logical partitions (LPARs) to share an ESCON and FICON channel path (and other channel types) by providing each LPAR with its own channel-subsystem image.

exchange A group of sequences which share a unique identifier. All sequences within a given exchange use the same protocol. Frames from multiple sequences can be multiplexed to prevent a single exchange from consuming all the bandwidth. See also *sequence*.

Extended Link Services (ELS) Via a command request, solicits a destination port (N_Port or F_Port) to perform a function or service. Each ELS request consists of an Link Service (LS) command; the N_Port ELS commands are defined in the FC-FS architecture.

fabric Fibre Channel employs a fabric to connect devices. A fabric can be as simple as a single cable connecting two devices. The term is most often used to describe a more complex network using hubs, switches, and gateways.

Fabric Login (FLOGI) Used by an N_Port to determine if a fabric is present and, if so, to initiate a session with the fabric by exchanging service parameters with the fabric. Fabric Login is performed by an N_Port following link initialization and before communication with other N_Ports is attempted.

Fabric Shortest Path First (FSPF) An intelligent path selection and routing standard and is part of the Fibre Channel Protocol.

FC 1) A short form when referring to something that is part of the Fibre Channel standard. Used by the IBM I/O definition process when defining a FICON channel (using IOCP of HCD) that will be used in FICON native mode (using the FC-SB-2 communication protocol. See also *Fibre Channel*.

FC-0 Lowest level of the Fibre Channel Physical standard, covering the physical characteristics of the interface and media.

FC-1 Middle level of the Fibre Channel Physical standard, defining the 8b/10b encoding and decoding and transmission protocol.

FC-2 Highest level of the Fibre Channel Physical standard, defining the rules for signaling protocol and describing transfer of frame, sequence, and exchanges.

FC-3 The hierarchical level in the Fibre Channel standard that provides common services such as striping definition.

FC-4 The hierarchical level in the Fibre Channel standard that specifies the mapping of upper-layer protocols to levels below.

FCA See *Fibre Channel Association*.

FC-AL See *Fibre Channel Arbitrated Loop*.

FC-CT Fibre Channel Common Transport Protocol

FC-FG See *Fibre Channel Fabric Generic*.

FC-FP See *Fibre Channel HIPPI Framing Protocol*.

FC-FS See *Fibre Channel-Framing and Signaling*.

FC-GS See *Fibre Channel Generic Services*.

FCLC See *Fibre Channel Loop Association*.

FC-LE See *Fibre Channel Link Encapsulation*.

FCP See *Fibre Channel Protocol*.

FC-PH See *Fibre Channel Physical and Signaling*.

FC-PLDA Fibre Channel Private Loop Direct Attach. See *Private Loop Direct Attach*.

FCS See *Fibre Channel standard*.

FC-SB See *Fibre Channel Single Byte Command Code Set*.

FC Storage Director SAN Storage Director.

FC-SW See *Fibre Channel Switch Fabric*.

fiber See *optical fiber*.

Fibre Channel A technology for transmitting data between computer devices at a data rate of up to 4 Gbps. It is especially suited for connecting computer servers to shared storage devices and for interconnecting storage controllers and drives.

Fibre Channel Arbitrated Loop (FC-AL) A reference to the FC-AL standard, a shared gigabit media for up to 127 nodes, one of which may be attached to a switch fabric. See also *arbitrated loop*.

Fibre Channel Association (FCA) A Fibre Channel industry association that works to promote awareness and understanding of the Fibre Channel technology and its application, and provides a means for implementers to support the standards committee activities.

Fibre Channel Fabric Generic (FC-FG) A reference to the document (ANSI X3.289-1996) which defines the concepts, behavior, and characteristics of the Fibre Channel fabric along with suggested partitioning of the 24-bit address space to facilitate the routing of frames.

Fibre Channel-Framing and Signaling (FC-FS) The term used to describe the FC-FS architecture.

Fibre Channel Generic Services (FC-GS) A reference to the document (ANSI X3.289-1996) that describes a common transport protocol used to communicate with the server functions, a full X500-based directory service, mapping of the SNMP directly to the Fibre Channel, a time server, and an alias server.

Fibre Channel HIPPI Framing Protocol (FCFP) A reference to the document (ANSI X3.254-1994) that defines how the HIPPI framing protocol is transported via the Fibre Channel.

Fibre Channel Link Encapsulation (FC-LE) A reference to the document (ANSI X3.287-1996) which defines how IEEE 802.2 Logical Link Control (LLC) information is transported via the Fibre Channel.

Fibre Channel Loop Association (FCLC) An independent working group of the FCA focused on the marketing aspects of the Fibre Channel loop technology.

Fibre Channel Physical and Signaling (FC-PH) A reference to the ANSI X3.230 standard, that contains the definition of the three lower levels (FC-0, FC-1, and FC-2) of the Fibre Channel.

Fibre Channel Protocol (FCP) The mapping of SCSI-3 operations to Fibre Channel.

Fibre Channel Service Protocol (FSP) The common FC-4 level protocol for all services, transparent to the fabric type or topology.

Fibre Channel Single Byte Command Code Set (FC-SB) A reference to the document (ANSI X.271-1996) which defines how the ESCON command set protocol is transported using the Fibre Channel.

Fibre Channel standard (FCS) An ANSI standard for a computer peripheral interface. The I/O interface defines a protocol for communication over a serial interface that configures attached units to a communication fabric. The protocol has four layers. The lower of the four layers defines the physical media and interface, the upper of the four layers defines one or more Upper Layer Protocols (ULP), for example, FCP for SCSI command protocols and FC-SB-2 for FICON protocol supported by ESA/390 and z/Architecture. Refer to ANSI X3.230.1999x.

Fibre Channel Switch Fabric (FC-SW) A reference to the ANSI standard under development that further defines the fabric behavior described in FC-FG and defines the communications between different fabric elements required for those elements to coordinate their operations and management address assignment.

fiber optic cable See *optical cable.*

fiber optics The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica, and plastic.

Note: Telecommunication applications of fiber optics use optical fibers. Either a single discrete fiber or a non-spatially aligned fiber bundle can be used for each information channel. Such fibers are often called “optical fibers” to differentiate them from fibers used in non-communication applications.

FICON 1) An ESA/390 and zSeries computer peripheral interface. The I/O interface uses ESA/390 and zSeries FICON protocols (FC-FS and FC-SB-2) over a Fibre Channel serial interface that configures attached units to a FICON supported Fibre Channel communication fabric. 2) An FC4 proposed standard that defines an effective mechanism for the export of the SBCCS-2 (FC-SB-2) command protocol via Fibre Channels.

FICON channel A channel having a Fibre Channel connection (FICON) channel-to-control-unit I/O interface that uses optical cables as a transmission medium. May operate in either FC or FCV mode.

FICON Director A Fibre Channel switch that supports the ESCON-like “control unit port” (CUP function) that is assigned a 24-bit Fibre Channel port address to allow FC-SB-2 addressing of the CUP function to perform command and data transfer. (In the Fibre Channel world, it is a means of in-band management using a FC-4 ULP.)

field replaceable unit (FRU) An assembly that is replaced in its entirety when any one of its required components fails.

F_Node Fabric Node. A fabric attached node.

FLOGI See *Fabric Login*.

F_Port Fabric Port. A port used to attach a Node Port (N_Port) to a switch fabric.

frame A linear set of transmitted bits that define the basic transport unit. The frame is the most basic element of a message in Fibre Channel communications, consisting of a 24-byte header and zero to 2112 bytes of data. See also *sequence*.

FRU See *field replaceable unit*.

FSP See *Fibre Channel Service Protocol*.

FSPF See *Fabric Shortest Path First*.

full duplex A mode of communications allowing simultaneous transmission and reception of frames.

gateway A node on a network that interconnects two otherwise incompatible networks.

Gbps Gigabits per second. Also sometimes referred to as Gbps. In computing terms, it is approximately 1 000 000 000 bits per second. Most precisely it is 1 073 741 824 (1024 x 1024 x 1024) bits per second.

Gbps Gigabytes per second. Also sometimes referred to as Gbps. In computing terms, it is approximately 1 000 000 000 bytes per second. Most precisely it is 1 073 741 824 (1024 x 1024 x 1024) bytes per second.

GBIC See *Gigabit Interface Converter*.

Gigabit One billion bits or one thousand megabits.

Gigabit Interface Converter (GBIC) Industry standard transceivers for connection of Fibre Channel nodes to arbitrated loop hubs and fabric switches.

Gigabit Link Module (GLM) A generic Fibre Channel transceiver unit that integrates the key functions necessary for the installation of a Fibre channel media interface on most systems.

GLM See *Gigabit Link Module*.

G_Port Generic Port. A generic switch port that is either an F_Port or E_Port. The function is automatically determined during login.

half duplex In data communication, pertaining to transmission in only one direction at a time. Contrast with *duplex.*

hard disk drive Storage media within a storage server used to maintain information that the storage server requires. Also a mass storage medium for computers that is typically available as a fixed disk or a removable cartridge.

hardware The mechanical, magnetic, and electronic components of a system, such as computers, telephone switches, and terminals.

HBA Host bus adapter.

HCD Hardware configuration dialog.

HDA See *head and disk assembly.*

HDD See *hard disk drive.*

head and disk assembly (HDA) The portion of an HDD associated with the medium and the read/write head.

hierarchical storage management (HSM) A software and hardware system that moves files from disk to slower, less expensive storage media based on rules and observation of file activity. Modern HSM systems move files from magnetic disk to optical disk to magnetic tape.

High Performance Parallel Interface (HPPI) An ANSI standard that defines a channel that transfers data between CPUs and from a CPU to disk arrays and other peripherals.

HIPPI See *High Performance Parallel Interface*.

HMMP HyperMedia Management Protocol.

HMMS See *HyperMedia Management Schema*.

hop An Fibre Channel frame may travel from a switch to a director, a switch to a switch, or a director to a director, which in this case is one hop.

HSM See *Hierarchical Storage Management*.

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

hub topology See *loop topology.*

Hunt Group A set of associated N_Ports attached to a single node, assigned a special identifier that allows any frames containing this identifier to be routed to any available N_Port in the set.

HyperMedia Management Schema (HMMS) The definition of an implementation-independent, extensible, common data description/schema, that allows data from a variety of sources to be described and accessed in real time regardless of the source of the data. See also *WEBM* and *HMMP.*

ID See *identifier.*

identifier A unique name or address that identifies such items as programs, devices, or systems.

in-band signaling Signaling that is carried in the same channel as the information. Also referred to as in-band.

in-band virtualization An implementation in which the virtualization process takes place in the data path between servers and disk systems. The virtualization can be implemented as software running on servers or in dedicated engines.

information unit A unit of information defined by an FC-4 mapping. Information units are transferred as a Fibre Channel sequence.

initial program load (IPL) 1) The initialization procedure that causes an operating system to commence operation. 2) The process by which a configuration image is loaded into storage at the beginning of a work day or after a system malfunction. (3) The process of loading system programs and preparing a system to run jobs.

input/output (I/O) 1) Pertaining to a device whose parts can perform an input process and an output process at the same time. 2) Pertaining to a functional unit or channel involved in an input process, output process, or both, concurrently or not, and to the data involved in such a process. (3) Pertaining to input, output, or both.

input/output configuration data set (IOCDS) The data set in the S/390 and zSeries processor (in the support element) that contains an I/O configuration definition built by the I/O configuration program (IOCP).

input/output configuration program (IOCP) An S/390 program that defines to a system the channels, I/O devices, paths to the I/O devices, and the addresses of the I/O devices. The output is normally written to a S/390 or zSeries IOCDS.

interface 1) A shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate. The concept includes the specification of the connection of two devices having different functions. 2) Hardware, software, or both, that link systems, programs, or devices.

intermix A mode of service defined by Fibre Channel that reserves the full Fibre Channel bandwidth for a dedicated Class 1 connection, but allows connection-less Class 2 traffic to share the link if the bandwidth is available.

Inter-Switch Link (ISL) An Fibre Channel connection between switches and directors.

I/O See *input/output.*

I/O configuration The collection of channel paths, control units, and I/O devices that attaches to the processor. This may also include channel switches (for example, an ESCON Director).

IOCDS See *input/output configuration data set.*

IOCP See *input/output configuration control program.*

IODF The data set that contains the S/390 or zSeries I/O configuration definition file produced during the definition of the S/390 or zSeries I/O configuration by HCD. Used as a source for IPL, IOCP, and Dynamic I/O Reconfiguration.

IP Internet Protocol

IPI Intelligent Peripheral Interface

IPL See *initial program load*.

ISL See *Inter-Switch Link*.

isochronous transmission Data transmission which supports network-wide timing requirements. A typical application for isochronous transmission is a broadcast environment which needs information to be delivered at a predictable time.

JBOD Just a bunch of disks.

jukebox A device that holds multiple optical disks and one or more disk drives, and can swap disks in and out of the drive as needed.

jumper cable In an ESCON and FICON environment, an optical cable having two conductors that provide physical attachment between a channel and a distribution panel or an ESCON/FICON Director port or a control unit/device, between an ESCON/FICON Director port and a distribution panel or a control unit/device, or between a control unit/device and a distribution panel. Contrast with *trunk cable.*

LAN See *local area network*.

laser A device that produces optical radiation using a population inversion to provide *light amplification by stimulated emission of radiation* and (generally) an optical resonant cavity to provide positive feedback. Laser radiation can be highly coherent temporally, spatially, or both.

latency A measurement of the time it takes to send a frame between two locations.

LC Lucent Connector. A registered trademark of Lucent Technologies.

LCU See *logical control unit.*

LED See *light emitting diode*.

licensed internal code (LIC) Microcode that IBM does not sell as part of a machine, but instead, licenses it to the client. LIC is implemented in a part of storage that is not addressable by user programs. Some IBM products use it to implement functions as an alternate to hard-wire circuitry.

light emitting diode (LED) A semiconductor chip that gives off visible or infrared light when activated. Contrast with *laser*.

link 1) In an ESCON environment or FICON environment (Fibre Channel environment), the physical connection and transmission medium used between an optical transmitter and an optical receiver. A link consists of two conductors, one used for sending and the other for receiving, thereby providing a duplex communication path. 2) In an ESCON I/O interface, the physical connection and transmission medium used between a channel and a control unit, a channel and an ESCD, a control unit and an ESCD, or at times between two ESCDs. 3) In a FICON I/O interface, the physical connection and transmission medium used between a channel and a control unit, a channel and a FICON Director, a control unit and a Fibre Channel FICON Director, or at times between two Fibre Channels switches.

link address 1) On an ESCON interface, the portion of a source or destination address in a frame that ESCON uses to route a frame through an ESCON director. ESCON associates the link address with a specific switch port that is on the ESCON director. 2) On a FICON interface, the port address (1-byte link address), or domain and port address (2-byte link address) portion of a source (S_ID) or destination address (D_ID) in a Fibre Channel frame that the Fibre Channel switch uses to route a frame through a Fibre Channel switch or Fibre Channel switch fabric. See also *port address.*

Link_Control_Facility A termination card that handles the logical and physical control of the Fibre Channel link for each mode of use.

LIP See *loop initialization primitive sequence*.

local area network (LAN) A computer network located in a user's premises within a limited geographic area, usually not larger than a floor or small building. Transmissions within a LAN are mostly digital, carrying data among stations at rates usually above one Mbps.

logical control unit (LCU) A separately addressable control unit function within a physical control unit. Usually a physical control unit that supports several LCUs. For ESCON, the maximum number of LCUs that can be in a control unit (and addressed from the same ESCON fiber link) is 16. They are addressed from x'0' to x'F'. For FICON architecture, the maximum number of LCUs that can be in a control unit (and addressed from the same FICON fibre link) is 256. They are addressed from x'00' to x'FF'. For both ESCON and FICON, the actual number supported, and the LCU address value, is both processor- and control unit implementation-dependent.

logical partition (LPAR) A set of functions that create a programming environment that is defined by the ESA/390 architecture or z/Architecture for zSeries. The ESA/390 architecture or z/Architecture for zSeries uses the term LPAR when more than one LPAR is established on a processor. An LPAR is conceptually similar to a virtual machine environment except that the LPAR is a function of the processor. Also, LPAR does not depend on an operating system to create the virtual machine environment.

logical switch number (LSN) A two-digit number used by the IOCP to identify a specific ESCON or FICON Director. This number is separate from the director's "switch device number" and, for FICON, it is separate from the director's "Fibre Channel switch address".

logically partitioned mode A central processor mode, available on the configuration frame when using the PR/SM™ facility, that allows an operator to allocate processor hardware resources among LPARs. Contrast with *basic mode.*

login server An entity within the Fibre Channel fabric that receives and responds to login requests.

loop circuit A temporary point-to-point like path that allows bidirectional communications between loop-capable ports.

loop initialization primitive (LIP) sequence A special Fibre Channel sequence that is used to start loop initialization. Allows ports to establish their port addresses.

loop topology An interconnection structure in which each point has physical links to two neighbors resulting in a closed circuit. In a loop topology, the available bandwidth is shared.

LPAR See *logical partition*.

L_Port Loop Port. A node or fabric port capable of performing arbitrated loop functions and protocols. NL_Ports and FL_Ports are loop-capable ports.

LSN See *logical switch number*.

Lucent Connector (LC) A registered trademark of Lucent Technologies

LVD Low Voltage Differential.

management agent A process that exchanges a managed node's information with a management station.

managed node A computer, a storage system, a gateway, a media device such as a switch or hub, a control instrument, a software product such as an operating system or an accounting package, or a machine on a factory floor, such as a robot.

managed object A variable of a managed node. This variable contains one piece of information about the node. Each node can have several objects.

Management Information Block (MIB) A formal description of a set of network objects that can be managed using the SNMP. The format is defined as part of SNMP and is a hierarchical structure of information relevant to a specific device, defined in object-oriented terminology as a collection of objects, relations, and operations among objects.

management station A host system that runs the management software.

MAR See *Media Access Rules*.

Mbps Megabits per second. Also sometimes referred to as MBps. In computing terms, it is approximately 1000000 bits per second. Most precisely it is 1048576 (1024 x 1024) bits per second.

MBps Megabytes per second. Also sometimes referred to as MBps. In computing terms, it is approximately 1000000 bytes per second. Most precisely it is 1048576 (1024 x 1024) bytes per second.

media Plural of medium. The physical environment through which transmission signals pass. Common media include copper and fiber optic cable.

Media Access Rules (MAR) Enable systems to self-configure themselves is a SAN environment.

Media Interface Adapter (MIA) Enables optic-based adapters to interface with copper-based devices, including adapters, hubs, and switches.

metadata server In Storage Tank™, servers that maintain information (metadata) about the data files and grant permission for application servers to communicate directly with disk systems.

meter Equal to 39.37 inches, or just slightly larger than a yard (36 inches)

MIA See *Media Interface Adapter*.

MIB See *Management Information Block*.

mirroring The process of writing data to two separate physical devices simultaneously.

MM Multi-Mode. See *Multi-Mode Fiber.*

MMF See *Multi-Mode Fiber*.

multicast Sending a copy of the same transmission from a single source device to multiple destination devices on a fabric. This includes sending to all N_Ports on a fabric (broadcast) or to only a subset of the N_Ports on a fabric (multicast).

Multi-Mode Fiber (MMF) In optical fiber technology, an optical fiber that is designed to carry multiple light rays or modes concurrently, each at a slightly different reflection angle within the optical core. Multi-Mode fiber transmission is used for relatively short distances because the modes tend to disperse over longer distances. See also *Single-Mode Fiber*.

multiplex The ability to intersperse data from multiple sources and destinations onto a single transmission medium. Refers to delivering a single transmission to multiple destination N_Ports.

name server Provides translation from a given node name to one or more associated N_Port identifiers.

NAS See *Network Attached Storage*.

ND See *node descriptor*.

NDMP Network Data Management Protocol

NED See *node-element descriptor.*

network An aggregation of interconnected nodes, workstations, file servers, and peripherals, with its own protocol that supports interaction.

Network Attached Storage (NAS) A term used to describe a technology where an integrated storage system is attached to a messaging network that uses common communications protocols, such as TCP/IP.

Network File System (NFS) A distributed file system in UNIX developed by Sun Microsystems. It allows a set of computers to cooperatively access each other's files in a transparent manner.

Network Management System (NMS) A system responsible for managing at least part of a network. NMSs communicate with agents to help keep track of network statistics and resources.

network topology Physical arrangement of nodes and interconnecting communications links in networks based on application requirements and geographical distribution of users.

NFS See *Network File System*.

NL_Port Node Loop Port. A node port that supports arbitrated loop devices.

NMS See *Network Management System*. A system responsible for managing at least part of a network. NMSs communicate with agents to help keep track of network statistics and resources.

node An entity with one or more N_Ports or NL_Ports.

node descriptor (ND) In an ESCON and FICON environment, a 32-byte field that describes a node, channel, ESCON Director or FICON Director port, or a control unit.

node-element descriptor (NED) In an ESCON and FICON environment, a 32-byte field that describes a node element, such as a disk (DASD) device.

non-blocking Indicates that the capabilities of a switch are such that the total number of available transmission paths is equal to the number of ports. Therefore, all ports can have simultaneous access through the switch.

Non-L_Port A Node or Fabric port that is not capable of performing the arbitrated loop functions and protocols. N_Ports and F_Ports are not loop-capable ports.

N_Port Node Port. A Fibre Channel-defined hardware entity at the end of a link which provides the mechanisms necessary to transport information units to or from another node.

N_Port Login (PLOGI) Allows two N_Ports to establish a session and exchange identities and service parameters. It is performed following completion of the FLOGI process and prior to the FC-4 level operations with the destination port. May be either explicit or implicit.

OEMI See *original equipment manufacturer information.*

open system A system whose characteristics comply with standards made available throughout the industry and that can be connected to other systems that comply with the same standards.

operation A term defined in FC-2 that refers to one of the Fibre Channel *building blocks* composed of one or more, possibly concurrent, exchanges.

optical cable A fiber, multiple fibers, or a fiber bundle in a structure built to meet optical, mechanical, and environmental specifications. See also *jumper cable*, *optical cable assembly*, and *trunk cable.*

optical cable assembly An optical cable that is connector-terminated. Generally, an optical cable that has been connector-terminated by a manufacturer and is ready for installation. See also *jumper cable* and *optical cable*.

optical fiber Any filament made of dialectic materials that guides light, regardless of its ability to send signals. See also *fiber optics* and *optical waveguide*.

optical fiber connector A hardware component that transfers optical power between two optical fibers or bundles and is designed to be repeatedly connected and disconnected.

optical waveguide A structure capable of guiding optical power. In optical communications, generally a fiber designed to transmit optical signals. See *optical fiber.*

ordered set A Fibre Channel term referring to four 10 -bit characters (a combination of data and special characters) providing low-level link functions, such as frame demarcation and signaling between two ends of a link.

original equipment manufacturer information (OEMI) A reference to an IBM guideline for a computer peripheral interface. More specifically, it refers to IBM S/360™ and S/370™ Channel to Control Unit OEMI. The interface uses ESA/390 logical protocols over an I/O interface that configures attached units in a multi-drop bus environment. This OEMI interface is also supported by the zSeries 900 processors.

originator A Fibre Channel term referring to the initiating device.

out-of-band signaling Signaling that is separated from the channel carrying the information. Also referred to as *out-of-band*.

out-of-band virtualization An alternative type of virtualization in which servers communicate directly with disk systems under control of a virtualization function that is not involved in the data transfer.

parallel channel A channel having a System/360™ and System/370™ channel-to-control-unit I/O interface that uses bus and tag cables as a transmission medium. Contrast with *ESCON channel*.

path In a channel or communication network, any route between any two nodes. For ESCON and FICON, this is the route between the channel and the control unit/device, or sometimes from the operating system control block for the device and the device itself.

path group The ESA/390 and zSeries architecture (z/Architecture) term for a set of channel paths that are defined to a controller as being associated with a single S/390 image. The channel paths are in a group state and are online to the host.

path-group identifier ESA/390 and z/Architecture term for the identifier that uniquely identifies a given LPAR. The path-group identifier is used in communication between the system image program and a device. The identifier associates the path group with one or more channel paths, defining these paths to the control unit as being associated with the same system image.

PCICC (IBM) PCI Cryptographic Coprocessor.

peripheral Any computer device that is not part of the essential computer (the processor, memory and data paths) but is situated relatively close by. A near synonym is I/O device.

petard A device that is small and sometimes explosive.

PLDA See *Private Loop Direct Attach*.

PLOGI See *N_Port Login*.

point-to-point topology An interconnection structure in which each point has physical links to only one neighbor resulting in a closed circuit. In point-to-point topology, the available bandwidth is dedicated.

policy-based management Management of data on the basis of business policies (for example, “all production database data must be backed up every day”), rather than technological considerations (for example, “all data stored on this disk system is protected by remote copy”).

port An access point for data entry or exit. A receptacle on a device to which a cable for another device is attached. See also *duplex receptacle*.

port address In an ESCON Director, an address used to specify port connectivity parameters and to assign link addresses for attached channels and control units. In a FICON director or Fibre Channel switch, it is the middle 8 bits of the full 24-bit Fibre Channel port address. This field is also referred to as the *area field* in the 24-bit Fibre Channel port address. See also *link address.*

port bypass circuit A circuit used in hubs and disk enclosures to automatically open or close the loop to add or remove nodes on the loop.

port card In an ESCON and FICON environment, a field-replaceable hardware component that provides the optomechanical attachment method for jumper cables and performs specific device-dependent logic functions.

port name In an ESCON or FICON Director, a user-defined symbolic name of 24 characters or less that identifies a particular port.

Private Loop Direct Attach (PLDA) A technical report which defines a subset of the relevant standards suitable for the operation of peripheral devices such as disks and tapes on a private loop.

Private NL_Port An NL_Port which does not attempt login with the fabric and only communicates with other NL Ports on the same loop.

processor complex A system configuration that consists of all the machines required for operation; for example, a processor unit, a processor controller, a system display, a service support display, and a power and coolant distribution unit.

program temporary fix (PTF) A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of a program.

prohibited In an ESCON or FICON Director, the attribute that, when set, removes dynamic connectivity capability. Contrast with *allowed.*

protocol 1) A set of semantic and syntactic rules that determine the behavior of functional units in achieving communication. 2) In Fibre Channel, the meaning of, and sequencing rules for, requests and responses used for managing the switch or switch fabric, transferring data, and synchronizing states of Fibre Channel fabric components. 3) A specification for the format and relative timing of information exchanged between communicating parties.

PTF See *program temporary fix*.

Public NL_Port An NL_Port that attempts login with the fabric and can observe the rules of either public or private loop behavior. A public NL_Port may communicate with both private and public NL_Ports.

QoS See *Quality of Service*.

Quality of Service (QoS) A set of communications characteristics required by an application. Each QoS defines a specific transmission priority, level of route reliability, and security level.

Quick Loop A unique Fibre Channel topology that combines arbitrated loop and fabric topologies. It is an optional licensed product that allows arbitrated loops with private devices to be attached to a fabric.

RAID See *Redundant Array of Inexpensive or Independent Disks.*

RAID 0 Level 0 RAID support. Striping, no redundancy.

RAID 1 Level 1 RAID support. Mirroring, complete redundancy.

RAID 5 Level 5 RAID support. Striping with parity.

Redundant Array of Inexpensive or Independent Disks (RAID) A method of configuring multiple disk drives in a storage subsystem for high availability and high performance.

repeater A device that receives a signal on an electromagnetic or optical transmission medium, amplifies the signal, and then retransmits it along the next leg of the medium.

responder A Fibre Channel term referring to the answering device.

route The path that an ESCON frame takes from a channel through an ESCD to a control unit/device.

router 1) A device that can decide which of several paths network traffic will follow based on some optimal metric. Routers forward packets from one network to another based on network-layer information. 2) A dedicated computer hardware or software package which manages the connection between two or more networks. See also *bridge* and *bridge/router*.

SAF-TE SCSI Accessed Fault-Tolerant Enclosures.

SAN See *storage area network*.

SAN See *System Area Network*.

SANSymphony In-band block-level virtualization software made by DataCore Software Corporation and resold by IBM.

saved configuration In an ESCON or FICON Director environment, a stored set of connectivity attributes whose values determine a configuration that can be used to replace all or part of the ESCD's or FICON's active configuration. Contrast with *active configuration*.

SC connector A fiber optic connector standardized by ANSI TIA/EIA-568A for use in structured wiring installations.

scalability The ability of a computer application or product (hardware or software) to continue to function because of a change in size or volume. For example, the ability to retain performance levels when adding additional processors, memory, and storage.

SCSI See *Small Computer System Interface.*

SCSI-3 SCSI-3 consists of a set of primary commands and additional specialized command sets to meet the needs of specific device types. The SCSI-3 command sets are used not only for the SCSI-3 parallel interface but for additional parallel and serial protocols, including Fibre Channel, Serial Bus Protocol (used with IEEE 1394 Firewire physical protocol), and the Serial Storage Protocol (SSP).

SCSI Enclosure Services (SES) ANSI SCSI-3 proposal that defines a command set for soliciting basic device status (temperature, fan speed, power supply status, etc.) from a storage enclosures.

SCSI-FCP The term used to refer to the ANSI Fibre Channel Protocol for SCSI document (X3.269-199x) that describes the FC-4 protocol mappings and the definition of how the SCSI protocol and command set are transported using a Fibre Channel interface.

SE See *service element*.

sequence A series of frames strung together in numbered order which can be transmitted over a Fibre Channel connection as a single operation. See also *exchange*.

SERDES Serializer Deserializer.

Serial Storage Architecture (SSA) A high speed serial loop-based interface developed as a high speed point-to-point connection for peripherals, particularly high speed storage arrays, RAID, and CD-ROM storage by IBM.

server A computer which is dedicated to one task.

service element (SE) A dedicated service processing unit used to service a S/390 machine (processor).

SES See *SCSI Enclosure Services.*

Simple Network Management Protocol (SNMP) The Internet network management protocol that provides a means to monitor and set network configuration and run-time parameters.

Single-Mode Fiber (SMF) In optical fiber technology, an optical fiber that is designed for the transmission of a single ray or mode of light as a carrier. It is a single light path used for long-distance signal transmission. See also *Multi-Mode Fiber*.

Small Computer System Interface (SCSI) 1) A set of evolving ANSI standard electronic interfaces that allow personal computers to communicate with peripheral hardware such as disk drives, tape drives, CD_ROM drives, printers, and scanners faster and more flexibly than previous interfaces. The interface uses a SCSI logical protocol over an I/O interface that configures attached targets and initiators in a multidrop bus topology. The following table identifies the major characteristics of the different SCSI versions.

SCSI version	Signal rate (MHz)	BusWidth (bits)	Maximum DTR (MBps)	Maximum no. devices	Maximum cable length (m)
SCSI-1	5	8	5	7	6
SCSI-2	5	8	5	7	6
Wide SCSI-2	5	16	10	15	6
Fast SCSI-2	10	8	10	7	6
Fast Wide SCSI-2	10	16	20	15	6
Ultra™ SCSI	20	8	20	7	1.5
Ultra SCSI-2	20	16	40	7	12
Ultra2 LVD SCSI	40	16	80	15	12

SM Single Mode. See *Single-Mode Fiber*.

SMART Self Monitoring and Reporting Technology.

SMF See *Single-Mode Fiber*.

SNIA See *Storage Networking Industry Association*.

SN storage network. See also *SAN*.

SNMP See *Simple Network Management Protocol*.

SNMWG See *Storage Network Management Working Group.*

SSA See *Serial Storage Architecture.*

star The physical configuration used with hubs in which each user is connected by communications links radiating out of a central hub that handles all communications.

storage area network (SAN) A dedicated, centrally managed, secure information infrastructure, which enables any-to-any interconnection of servers and storage systems.

storage media The physical device onto which data is recorded. Magnetic tape, optical disks, and floppy disks are all storage media.

Storage Network Management Working Group (SNMWG) Chartered to identify, define, and support open standards needed to address the increased management requirements imposed by storage area network environments.

Storage Networking Industry Association (SNIA) A non-profit organization comprised of more than 77 companies and individuals in the storage industry.

Storage Tank An IBM file aggregation project that enables a pool of storage, and even individual files, to be shared by servers of different types. In this way, Storage Tank can greatly improve storage utilization and enables data sharing.

StorWatch Expert StorWatch applications that employ a three-tiered architecture that includes a management interface, a StorWatch manager and agents that run on the storage resource or resources being managed. Products employ a StorWatch database that can be used for saving key management data, such as capacity or performance metrics. Products also use the agents and analysis of storage data saved in the database to perform higher value functions including the reporting of capacity and performance over time (trends), configuration of multiple devices based on policies, monitoring of capacity and performance, automated responses to events or conditions, and storage related data mining.

StorWatch Specialist A StorWatch interface for managing an individual Fibre Channel device or a limited number of like devices (that can be viewed as a single group). Typically provide simple, point-in-time management functions such as configuration, reporting on asset and status information, simple device and event monitoring, and some service utilities.

STP Shielded Twisted Pair.

striping A method for achieving higher bandwidth using multiple N_Ports in parallel to transmit a single information unit across multiple levels.

subchannel A logical function of a channel subsystem associated with the management of a single device.

subsystem A secondary or subordinate system, or programming support, usually capable of operating independently of or asynchronously with a controlling system.

SWCH In ESCON Manager, the mnemonic used to represent an ESCON Director.

switch A component with multiple entry and exit points (ports) that provides dynamic connection between any two of these points.

switch topology An interconnection structure in which any entry point can be dynamically connected to any exit point. The available bandwidth is scalable.

system area network (SAN) Term originally used to describe a particular symmetric multiprocessing (SMP) architecture in which a switched interconnect is used in place of a shared bus. Server area network refers to a switched interconnect between multiple SMPs.

T11 A technical committee of the National Committee for Information Technology Standards, titled T11 I/O Interfaces. Develops standards for moving data into and out of computers.

tape backup Making magnetic tape copies of hard disk and optical disc files for disaster recovery.

tape pooling A SAN solution in which tape resources are pooled and shared across multiple hosts rather than being dedicated to a specific host.

TCP See *Transmission Control Protocol.*

TCP/IP See *Transmission Control Protocol/ Internet Protocol.*

time server A Fibre Channel-defined service function that allows for the management of all timers used within a Fibre Channel system.

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.

TL_Port A private to public bridging of switches or directors, referred to as Translative Loop.

T_Port An ISL port more commonly known as an E_Port, referred to as a Trunk port and used by INRANGE.

Transmission Control Protocol (TCP) A reliable, full duplex, connection-oriented end-to-end transport protocol running on top of IP.

Transmission Control Protocol/ Internet Protocol (TCP/IP) A set of communications protocols that support peer-to-peer connectivity functions for both LAN and WANs.

trunk cable In an ESCON and FICON environment, a cable consisting of multiple fiber pairs that do not directly attach to an active device. This cable usually exists between distribution panels (or sometimes between a set processor channels and a distribution panel) and can be located within, or external to, a building. Contrast with *jumper cable*.

twinax A transmission media (cable) consisting of two insulated central conducting leads of coaxial cable.

twisted pair The most common type of transmission media (cable), that consists of two insulated copper wires twisted around each other to reduce the induction (interference) from one wire to another. The twists, or lays, are varied in length to reduce the potential for signal interference between pairs. Several sets of twisted pair wires may be enclosed in a single cable.

ULP Upper Level Protocols,

unblocked In an ESCON and FICON Director, the attribute that, when set, establishes communication capability for a specific port. Contrast with *blocked.*

Under-The-Covers (UTC) A term used to characterize a subsystem in which a small number of hard drives are mounted inside a higher function unit. The power and cooling are obtained from the system unit. Connection is by parallel copper ribbon cable or pluggable backplane, using IDE or SCSI protocols.

unit address The ESA/390 and zSeries term for the address associated with a device on a given controller. On ESCON and FICON interfaces, the unit address is the same as the device address. On OEMI interfaces, the unit address specifies a controller and device pair on the interface.

UTC See *Under-The-Covers*.

UTP Unshielded Twisted Pair

virtual circuit A unidirectional path between two communicating N_Ports that permits fractional bandwidth.

virtualization An abstraction of storage where the representation of a storage unit to the operating system and applications on a server is divorced from the actual physical storage where the information is contained.

virtualization engine Dedicated hardware and software that are used to implement virtualization.

WAN See *wide area network*.

Wave Division Multiplexing (WDM) A technology that puts data from different sources together on an optical fiber, with each signal carried on its own separate light wavelength. Using WDM, up to 80 (and theoretically more) separate wavelengths or channels of data can be multiplexed into a stream of light transmitted on a single optical fiber.

WDM See *Wave Division Multiplexing*.

Web-Based Enterprise Management (WEBM) A consortium working on the development of a series of standards to enable active management and monitoring of network-based elements.

WEBM See *Web-Based Enterprise Management*.

wide area network (WAN) A network which encompasses inter-connectivity between devices over a wide geographic area. A WAN may be privately owned or rented, but the term usually indicates the inclusion of public (shared) networks.

z/Architecture An IBM architecture for mainframe computers and peripherals. Processors that follow this architecture include the zSeries family of processors.

zoning In Fibre Channel environments, the grouping together of multiple ports to form a virtual private storage network. Ports that are members of a group or zone can communicate with each other but are isolated from ports in other zones.

zSeries A family of IBM mainframe servers that support high performance, availability, connectivity, security, and integrity.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this IBM Redbooks publication.

Redbooks

These Redbooks publications are relevant as further information sources:

- *Introduction to Storage Area Networks*, SG24-5470
- *IBM TotalStorage: SAN Product, Design, and Optimization Guide*, SG24-6384
- *IBM/Cisco Multiprotocol Routing: An Introduction and Implementation*, SG24-7543

Referenced Web sites

These Web sites are also relevant as further information sources:

- IBM System Storage hardware, software, and solution

  `http://www.storage.ibm.com`
- IBM System Storage storage area network

  `http://www.storage.ibm.com/snetwork/index.html`
- Cisco

  `http://www.cisco.com`
- Tivoli

  `http://www.tivoli.com`
- IEEE

  `http://www.ieee.org`
- Storage Networking Industry Association

  `http://www.snia.org`
- SCSI Trade Association

  `http://www.scsita.org`
- Internet Engineering Task Force

  `http://www.ietf.org`

- American National Standards Institute

  http://www.ansi.org
- Technical Committee T10

  http://www.t10.org
- Technical Committee T11

  http://www.t11.org

How to get Redbooks publications

You can search for, view, or download Redbooks publications, Redpapers publications, Hints and Tips, draft publications and Additional materials, as well as order hardcopy Redbooks or CD-ROMs, at this Web site:

ibm.com/redbooks

Help from IBM

IBM Support and downloads

ibm.com/support

IBM Global Services

ibm.com/services

Index

IBM

Redbooks

Implementing an IBM/Cisco SAN

Implementing an IBM/Cisco SAN

Learn about the latest editions to the IBM/Cisco product family

Increase your skills with this easy-to-follow format

Advance your IBM/Cisco skill set

"Do everything that is necessary and absolutely nothing that is not."

In this IBM Redbooks publication, which is an update and major revision of the previous version, we consolidate as much critical information as possible while covering procedures and tasks that are likely to be encountered on a daily basis.

Each of the products described has much more functionality than can be covered in just one book. The IBM SAN portfolio is rich in quality products that bring a vast amount of technicality and vitality to the SAN world. Their inclusion and selection is based on a thorough understanding of the storage networking environment that positions IBM, and therefore its customers and partners, in an ideal position to take advantage by their deployment.

We discuss the latest additions to the IBM/Cisco SAN family and we show how they can be implemented in an open systems environment, focusing on the Fibre Channel protocol (FCP) environment. We address some of the key concepts that they bring to the market, and in each case we provide an overview of the functions that are essential to building a robust SAN environment.

INTERNATIONAL TECHNICAL SUPPORT ORGANIZATION

BUILDING TECHNICAL INFORMATION BASED ON PRACTICAL EXPERIENCE

IBM Redbooks are developed by the IBM International Technical Support Organization. Experts from IBM, Customers and Partners from around the world create timely technical information based on realistic scenarios. Specific recommendations are provided to help you implement IT solutions more effectively in your environment.

For more information:
ibm.com/redbooks

SG24-7545-01 ISBN 0738432032