INDEX

A

B

C

D

E

F

I

N

P

T

V

Z

New and Changed Information

As of Cisco DCNM Release 5.2, Cisco Fabric Manager and Cisco Data Center Network Manager for LAN are merged into one unified product called Cisco Data Center Network Manager (DCNM) that can manage both LAN and SAN environments. As a part of this product merger, the name Cisco DCNM for SAN replaces the name Cisco Fabric Manager.

The following documentation changes support the merged Cisco DCNM product:

- Cisco DCNM product documentation for Cisco DCNM Release 5.2 is retitled with the name Cisco DCNM for LAN.
- Cisco Fabric Manager product documentation for Cisco DCNM Release 5.2 is retitled with the name Cisco DCNM for SAN.
- Cisco DCNM for SAN product documentation is now published to the Data Center Network Manager listing page on Cisco.com:
  http://www.cisco.com/en/US/products/ps9369/tsd_products_support_configure.html

  This URL is also the listing page for Cisco DCNM for LAN product documentation.
- Cisco Fabric Manager documentation for software releases earlier than Cisco DCNM Release 5.2, retains the name Cisco Fabric Manager and remains available at its current Cisco.com listing page:
  http://www.cisco.com/en/US/products/ps10495/tsd_products_support_configure.html

  You should continue to use the Cisco Fabric Manager documentation if you are using a release of Cisco Fabric Manager software that is earlier than Cisco DCNM Release 5.2.
- The name DCNM-SAN is used in place of Cisco DCNM for SAN in the user interface of Cisco Data Center Network Manager; likewise, the name DCNM-LAN is used in place of Cisco DCNM for LAN in the user interface. To match the user interface, the product documentation also uses the names DCNM-SAN and DCNM-LAN.
- The following new publications support both Cisco DCNM for LAN and DCNM for SAN, and address the new licensing model, the new installation process, and the new features of Cisco DCNM:
  - *Cisco DCNM Installation and Licensing Guide*
  - *Cisco DCNM Release Notes*
- For a complete list of Cisco DCNM documentation, see the “Related Documentation” section in the Preface.

As of Cisco Fabric Manager Release 4.2(1), software configuration information is available in new feature-specific configuration guides for the following information:

- System management
- Interfaces
- Fabric

- Quality of service
- Security
- IP services
- High availability and redundancy

The information in these new guides previously existed in the *Cisco MDS 9000 Family CLI Configuration Guide* and in the *Cisco MDS 9000 Family Fabric Manager Configuration Guide*. Those configuration guides remain available on Cisco.com and should be used for all software releases prior to Cisco Fabric Manager Release 5.0(1). Each guide addresses the features introduced in or available in a particular release. Select and view the configuration guide that pertains to the software installed in your switch.

For a complete list of document titles, see the list of Related Documentation in the "Preface."

To find additional information about Cisco Fabric Manager Release 5.0(1), see the *Cisco MDS 9000 Family Release Notes* available at the following Cisco Systems website:

http://www.cisco.com/en/US/products/ps5989/prod_release_notes_list.htm

About This Guide

The information in the new *Cisco Fabric Manager Inter-VSAN Routing Configuration Guide* previously existed in the Fabric Configuration section in the *Cisco MDS 9000 Family Fabric Manager Configuration Guide, Release 5.0(1).*

Table 1 lists the New and Changed features for this guide, starting with Cisco Fabric Manager Release 5.0(1).

Table 1 New and Changed Features for Cisco Fabric Manager Release 4.2(1)

Feature	New or Changed Topics	Changed in Release	Where Documented
Basic IVR configuration	Reorganized basic IVR configuration information.	4.2(1)	Chapter 1, "Configuring Basic Inter-VSAN Routing"
Advanced IVR configuration	Reorganized advanced IVR configuration information. Added "Working with Existing IVR Topologies" section. Added "Advanced Configuration Task List" section. Added IVR Zone configuration guidelines.	4.2(1)	Chapter 2, "Configuring Advanced Inter-VSAN Routing" Manually Configuring an IVR Topology, page 11 Task Flow for Configuring Advanced Inter-VSAN Routing, page 9 IVR Zone Configuration Guidelines, page 8

Preface

This preface describes the audience, organization, and conventions of the *Inter-VSAN Routing Configuration Guide, Cisco DCNM for SAN*. The preface also provides information on how to obtain related documentation.

Audience

This guide is for experienced network administrators who are responsible for planning, installing, configuring, and maintaining Cisco Inter-VSAN Routing.

Organization

This document is organized as follows:

Chapter	Title	Description
Chapter 1	Configuring Basic Inter-VSAN Routing	Presents concepts and instructions for basic IVR configurations.
Chapter 2	Configuring Advanced Inter-VSAN Routing	Presents concepts and instructions for advanced IVR configurations.

Document Conventions

Command descriptions use these conventions:

boldface font	Commands and keywords are in boldface.
italic font	Arguments for which you supply values are in italics.
[ ]	Elements in square brackets are optional.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.

Screen examples use these conventions:

`screen font`	Terminal sessions and information the switch displays are in screen font.
`boldface screen font`	Information you must enter is in boldface screen font.
italic screen font	Arguments for which you supply values are in italic screen font.
`< >`	Nonprinting characters, such as passwords, are in angle brackets.
`[ ]`	Default responses to system prompts are in square brackets.
`!, #`	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

This document uses the following conventions:

Note Means reader *take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Related Documentation

The documentation set for the Cisco MDS 9000 Family includes the following documents. To find a document online, use the Cisco MDS NX-OS Documentation Locator at:

http://www.cisco.com/en/US/docs/storage/san_switches/mds9000/roadmaps/doclocater.htm

Release Notes

- *Cisco MDS 9000 Family Release Notes for Cisco MDS NX-OS Releases*
- *Cisco MDS 9000 Family Release Notes for MDS SAN-OS Releases*
- *Cisco MDS 9000 Family Release Notes for Cisco MDS 9000 EPLD Images*
- *Cisco DCNM Release Notes*

Regulatory Compliance and Safety Information

- *Regulatory Compliance and Safety Information for the Cisco MDS 9000 Family*

Compatibility Information

- *Cisco Data Center Interoperability Support Matrix*
- *Cisco MDS 9000 NX-OS Hardware and Software Compatibility Information and Feature Lists*
- *Cisco MDS 9000 Family Switch-to-Switch Interoperability Configuration Guide*

Hardware Installation

- *Cisco MDS 9500 Series Hardware Installation Guide*
- *Cisco MDS 9200 Series Hardware Installation Guide*
- *Cisco MDS 9100 Series Hardware Installation Guide*
- *Cisco MDS 9124 and Cisco MDS 9134 Multilayer Fabric Switch Quick Start Guide*

Software Installation and Upgrade

- *Cisco MDS 9000 NX-OS Software Upgrade and Downgrade Guide*

Cisco NX-OS

- *Cisco MDS 9000 Family NX-OS Licensing Guide*
- *Cisco MDS 9000 Family NX-OS Fundamentals Configuration Guide*
- *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*
- *Cisco MDS 9000 Family NX-OS Interfaces Configuration Guide*
- *Cisco MDS 9000 Family NX-OS Fabric Configuration Guide*
- *Cisco MDS 9000 Family NX-OS Quality of Service Configuration Guide*
- *Cisco MDS 9000 Family NX-OS Security Configuration Guide*
- *Cisco MDS 9000 Family NX-OS IP Services Configuration Guide*
- *Cisco MDS 9000 Family NX-OS Intelligent Storage Services Configuration Guide*
- *Cisco MDS 9000 Family NX-OS High Availability and Redundancy Configuration Guide*
- *Cisco MDS 9000 Family NX-OS Inter-VSAN Routing Configuration Guide*
- *Cisco MDS 9000 Family Cookbook for Cisco MDS SAN-OS*

Cisco DCNM for SAN

- *Cisco DCNM Fundamentals Guide, Release 6.x*
- *System Management Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *Interfaces Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *Fabric Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *Quality of Service Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *Security Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *IP Services Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *Intelligent Storage Services Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *High Availability and Redundancy Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *Inter-VSAN Routing Configuration Guide, Cisco DCNM for SAN, Release 6.x*
- *SMI-S and Web Services Programming Guide, Cisco DCNM for SAN, Release 6.x*

Cisco DCNM

The following publications support both Cisco DCNM for LAN and DCNM for SAN, and address the new licensing model, the new installation process, and the new features of Cisco DCNM:

- *Cisco DCNM Fundamentals Guide, Release 6.x*
- *Cisco DCNM Installation Guide, Release 6.x*

Command-Line Interface

- *Cisco MDS 9000 Family Command Reference*

Intelligent Storage Networking Services Configuration Guides

- *Cisco MDS 9000 Family I/O Acceleration Configuration Guide*
- *Cisco MDS 9000 Family SANTap Deployment Guide*
- *Cisco MDS 9000 Family Data Mobility Manager Configuration Guide*
- *Cisco MDS 9000 Family Storage Media Encryption Configuration Guide*

Troubleshooting and Reference

- *Cisco MDS 9000 Family and Nexus 7000 Series System Messages Reference*
- *Cisco MDS 9000 Family SAN-OS Troubleshooting Guide*
- *Cisco MDS 9000 Family NX-OS MIB Quick Reference*
- *Cisco DCNM for SAN Database Schema Reference*

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

- Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

CHAPTER 1

Configuring Basic Inter-VSAN Routing

This chapter describes how to configure basic Inter-VSAN Routing (IVR) feature and provides instructions on sharing resources across VSANs using IVR management interfaces.

This chapter includes the following topics:

Information About Basic Inter-VSAN Routing

This section includes the following topics:

IVR Overview

Virtual SANs (VSANs) improve storage area network (SAN) scalability, availability, and security by allowing multiple Fibre Channel SANs to share a common physical infrastructure of switches and ISLs. These benefits are derived from the separation of Fibre Channel services in each VSAN and the isolation of traffic between VSANs. Data traffic isolation between the VSANs also inherently prevents sharing of resources attached to a VSAN, such as robotic tape libraries. Using IVR, you can access resources across VSANs without compromising other VSAN benefits.

IVR Features

IVR supports the following features:

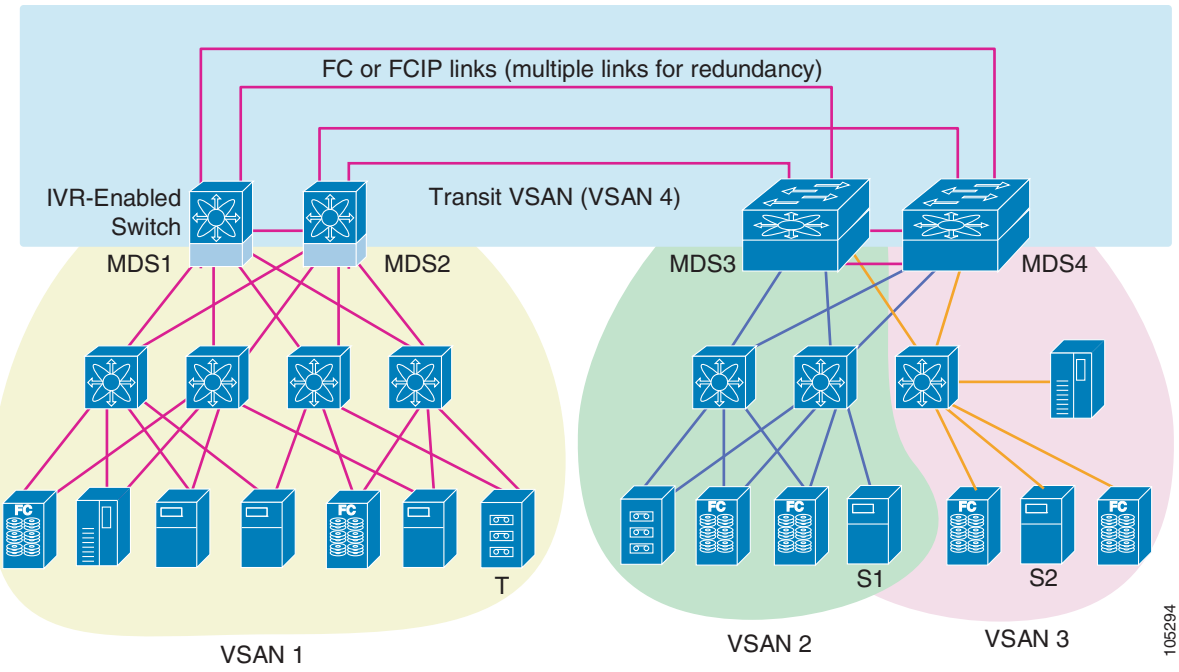
- Accesses resources across VSANs without compromising other VSAN benefits.
- Transports data traffic between specific initiators and targets on different VSANs without merging VSANs into a single logical fabric.
- Establishes proper interconnected routes that connect one or more VSANs across multiple switches. IVR is not limited to VSANs present on a common switch.
- Shares valuable resources (such as tape libraries) across VSANs without compromise. Fibre Channel traffic does not flow between VSANs, nor can initiators access resources across VSANs other than the designated VSAN.
- Provides efficient business continuity or disaster recovery solutions when used in conjunction with FCIP (see Figure 1-1).
- Is in compliance with Fibre Channel standards.
- Incorporates third-party switches, however, IVR-enabled VSANs may need to be configured in one of the interop modes.

Note IVR is not supported on the Cisco MDS 9124 Fabric Switch, the Cisco MDS 9134 Fabric Switch, the Cisco MDS 9148 Fabric Switch, the Cisco Fabric Switch for HP c-Class BladeSystem, and the Cisco Fabric Switch for IBM BladeCenter.

Originator Exchange ID (OX ID) load balancing of IVR traffic from IVR-enabled switches is not supported on Generation 1 switching modules. OX ID-based load balancing of IVR traffic from a non-IVR MDS switch could work in some environments. Generation 2 switching modules support OX ID-based load balancing of IVR traffic from IVR-enabled switches.

Note To configure the sample scenario shown in Figure 1-1, follow the steps in “Configuration Examples for IVR Auto Topology Mode” on page 1-33.

Figure 1-1 Traffic Continuity Using IVR and FCIP



IVR Terminology

The following IVR-related terms are used in the IVR documentation:

- Native VSAN—The VSAN to which an end device logs on is the native VSAN for that end device.
- Current VSAN—The VSAN currently being configured for IVR.
- Inter-VSAN Routing zone (IVR zone)—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. Prior to Cisco SAN-OS Release 3.0(3), you could configure up to 2000 IVR zones and 10,000 IVR zone members on the switches in the network. As of Cisco SAN-OS Release 3.0(3), you can configure up to 8000 IVR zones and 20,000 IVR zone members on the switches in the network.
- Inter-VSAN routing zone sets (IVR zone sets)—One or more IVR zones make up an IVR zone set. You can configure up to 32 IVR zone sets on any switch in the Cisco MDS 9000 Family. Only one IVR zone set can be active at any time.
- IVR path—An IVR path is a set of switches and Inter-Switch Links (ISLs) through which a frame from an end device in one VSAN can reach another end device in some other VSAN. Multiple paths can exist between two such end devices.
- IVR-enabled switch—A switch on which the IVR feature is enabled.
- Edge VSAN—A VSAN that initiates (source edge-VSAN) or terminates (destination edge-VSAN) an IVR path. Edge VSANs may be adjacent to each other or they may be connected by one or more transit VSANs. VSANs 1, 2, and 3 (see Figure 1-1), are edge VSANs.

Note An edge VSAN for one IVR path can be a transit VSAN for another IVR path.

- Transit VSAN—A VSAN that exists along an IVR path from the source edge VSAN of that path to the destination edge VSAN of that path. VSAN 4 is a transit VSAN (see Figure 1-1).

Note When the source and destination edge VSANs are adjacent to each other, then a transit VSAN is not required between them.

- Border switch—An IVR-enabled switch that is a member of two or more VSANs. Border switches, such as the IVR-enabled switch between VSAN 1 and VSAN 4 (see Figure 1-1), span two or more different color-coded VSANs.
- Edge switch—A switch to which a member of an IVR zone has logged in to. Edge switches are unaware of the IVR configurations in the border switches. Edge switches do not need to be IVR-enabled.
- Autonomous Fabric Identifier (AFID)—Allows you to configure more than one VSAN in the network with the same VSAN ID and avoid downtime when configuring IVR between fabrics that contain VSANs with the same ID.
- Service group—Allows you to reduce the amount of IVR traffic to non-IVR-enabled VSANs by configuring one or more service groups that restrict the traffic to the IVR-enabled VSANs.

IVR Configuration Limits

Table 1-1 summarizes the configuration limits for IVR.

Table 1-1 IVR Configuration Limits

IVR Feature	Maximum Limit
IVR VSANs	128
IVR zone members	As of Cisco SAN-OS Release 3.0(3), 20,000 IVR zone members per physical fabric Prior to Cisco SAN-OS Release 3.0(3), 10,000 IVR zone members per physical fabric
IVR zones	As of Cisco SAN-OS Release 3.0(3), 8000 IVR zones per physical fabric Prior to Cisco SAN-OS Release 3.0(3), 2000 IVR zones per physical fabric
IVR zone sets	32 IVR zone sets per physical fabric
IVR service groups	16 service groups per physical fabric
IVR switches	25 (IVR auto topology mode) **Note** We recommend IVR manual topology mode if you have more than 25 IVR switches. See "Manually Configuring an IVR Topology" on page 2-16.

IVR CFS Distribution

The IVR feature uses the Cisco Fabric Services (CFS) infrastructure to enable efficient configuration management and to provide a single point of configuration for the entire fabric in the VSAN. For information on CFS, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*.

The following configurations are distributed:

- IVR zones
- IVR zone sets
- IVR VSAN topology
- IVR active topology and zone set (activating these features in one switch propagates the configuration to all other distribution-enabled switches in the fabric)
- AFID database

Database Implementation

The IVR feature uses three databases to accept and implement configurations.

- Configured database—The database is manually configured by the user.
- Active database—The database is currently enforced by the fabric.
- Pending database—If you modify the configuration, you need to commit or discard the configured database changes to the pending database. The fabric remains locked during this period. Changes to the pending database are not reflected in the active database until you commit the changes to CFS.

Locking the Fabric

The first action that modifies the database creates the pending database and locks the feature in the VSAN. Once you lock the fabric, the following situations apply:

- No other user can make any configuration changes to this feature.
- A copy of the configuration database becomes the pending database along with the first active change.

Fibre Channel Header Modifications

IVR virtualizes the remote end devices in the native VSAN using a virtual domain. When IVR is configured to link end devices in two disparate VSANs, the IVR border switches are responsible for modifying the Fibre Channel headers for all communication between the end devices. The sections of the Fibre Channel frame headers that are modified include:

- VSAN number
- Source FCID
- Destination FCID

When a frame travels from the initiator to the target, the Fibre Channel frame header is modified such that the initiator VSAN number is changed to the target VSAN number. If IVR Network Address Translation (NAT) is enabled, then the source and destination FCIDs are also translated at the edge border switch. If IVR NAT is not enabled, then you must configure unique domain IDs for all switches involved in the IVR path.

IVR Network Address Translation

IVR Network Address Translation (NAT) can be enabled to allow non-unique domain IDs; however, without NAT, IVR requires unique domain IDs for all switches in the fabric. IVR NAT simplifies the deployment of IVR in an existing fabric where non-unique domain IDs might be present.

To use IVR NAT, it must be enabled on all IVR-enabled switches in the fabric. For information on distributing the IVR configuring using CFS, see "Distributing the IVR Configuration Using CFS" on page 1-17. By default, IVR NAT and IVR configuration distributions are disabled on all switches in the Cisco MDS 9000 Family.

See "Enabling IVR NAT and IVR Auto Topology Mode" on page 1-19 for information on IVR requirements and guidelines as well as configuration information.

IVR VSAN Topology

IVR uses a configured IVR VSAN topology to determine how to route traffic between the initiator and the target across the fabric.

IVR auto topology mode automatically builds the IVR VSAN topology and maintains the topology database when fabric reconfigurations occur. IVR auto topology mode also distributes the IVR VSAN topology to IVR-enabled switches using CFS.

Using IVR auto topology mode, you no longer need to manually update the IVR VSAN topology when reconfigurations occur in your fabric. If an IVR manual topology database exists, IVR auto topology mode initially uses that topology information. The automatic update reduces disruption in the network by gradually migrating from the user-specified topology database to the automatically-learned topology database. User-configured topology entries that are not part of the network are aged out in about three minutes. New entries that are not part of the user-configured database are added as they are discovered in the network.

When IVR auto topology mode is enabled, it starts with the previously active IVR manual topology if it exists, and then the discovery process begins. New, alternate, or better paths my be discovered. If the traffic is switched to an alternate or better path, there may be temporary traffic disruptions that are normally associated with switching paths.

Note IVR topology in IVR auto topology mode requires Cisco MDS SAN-OS Release 2.1(1a) or later and CFS must be enabled for IVR on all switches in the fabric.

FICON over IVR

FICON over IVR facilitates communication between various FICON devices in different VSANs through IVR. This communication is established by instantiating FICON devices in all the VSANs that are included in an IVR zone. To enable instantiation of FICON devices across all VSANs in the IVR zone database, IVR performs the following procedure:

1. Creates a virtual device.
2. Starts instantiating all the devices across all VSANs in the IVR zone database.
3. Checks for the FICON device listing in the fabric binding database of the remote VSAN where it is to be instantiated.
4. If it exists in the fabric binding database of a remote VSAN, the FICON device is instantiated. If it does not exist in the fabric binding database of the remote VSAN, then none of the FICON devices are instantiated in the selected VSAN.

Note If you have FICON VSANs enabled for IVR on your switch, none of the other VSANs enabled for IVR on the switch can use IVR NAT.

The advantages of FICON over IVR are traffic isolation and scalability across the VSANs included in the IVR zone.Without FICON over IVR, if FICON devices located at multiple locations are communicating through an FCIP link, the cost for transporting VSAN traffic can be very high. Even if no communication exists between the devices, traffic runs over the FCIP link because the VSAN containing the devices extends across remote sites.

With FICON over IVR, instead of configuring one VSAN with devices at various sites, you can configure each location as a separate logical VSAN. This means you can transport traffic between only the required devices, significantly reducing the traffic load on the FCIP link. An IVR zone, with the devices, is created and activated to establish communication between the devices. IVR then transports traffic only between the necessary devices from one VSAN to the other.

FICON requires that the last byte be a constant in an FC ID (one area per port) which means only 255 ports (maximum number of domains in a VSAN) are allowed on a switch in a VSAN. So the number of devices that can communicate using FICON in a VSAN is restricted to 255. Scalability is built in by duplicating the FICON devices and grouping them in different VSANs and using IVR to establish communication between them.

One of the requirements that FICON enforces, to function in a FICON-enabled VSAN, is the Control Unit Port (CUP) protocol. The CUP protocol is used for inband management of the switch by a FICON host. It collects information such as ports statistics, topology details. In some cases (such as zone server messages ACA, SFC, and so on destined to the virtual domains), IVR proxies for the virtual domain. For name server/RSCN messages, the name server or RSCN processes handle requests to the virtual domain. Typically, gathering the information from the real switch makes it difficult to proxy. Instead of the virtual switch responding to the CUP request, the request is sent across the VSAN boundary to the real switch. Because of this the FICON host collects extra information than what the virtual domain contains.

The various FICON requirements allow you to use FICON only over IVR (but not with IVR NAT). The NAT version of IVR represents one whole VSAN using a single domain. All the domains in a VSAN are virtualized to create one domain in another VSAN. Because this does not comply with the insistent domain ID requirement, FICON cannot be supported in an IVR NAT environment.

If IVR is enabled in any of the switches in the VSAN, ensure that the following restrictions for configuring FICON over IVR are applied:

- IVR enforced restrictions — Apply the following IVR related restrictions, in case IVR NAT is enabled in any of the
- s.
  - In a VSAN topology, disable IVR NAT on the switch if any of the configured and active VSANs in the topology clash with a FICON-enabled VSAN.
  - In an auto-VSAN topology, disable IVR NAT on the switches in IVR-enabled VSANs if FICON is enabled on any of the local VSANs.
  - With IVR NAT enabled, disable auto-VSAN topology if FICON is enabled on the local switch.
  - With IVR NAT enabled, do not add any VSANs that are FICON-enabled.
- FICON enforced restrictions—Disable IVR NAT on all switches in the IVR-enabled VSAN in which FICON is being enabled.

Note FICON over IVR cannot use persistent FC IDs.

IVR Virtual Domains

In a remote VSAN, the IVR application does not automatically add the virtual domain to the assigned domains list. Some switches (for example, the Cisco SN5428 switch) do not query the remote name server until the remote domain appears in the assigned domains list in the fabric. In such cases, add the IVR virtual domains in a specific VSAN to the assigned domains list in that VSAN. When adding IVR domains, all IVR virtual domains that are currently present in the fabric (and any virtual domain that is created in the future) will appear in the assigned domains list for that VSAN.

Tip Be sure to add IVR virtual domains if Cisco SN5428 or Cisco MDS 9020 switches exist in the VSAN.

When you enable the IVR virtual domains, links may fail to come up due to overlapping virtual domain identifiers. If this occurs, temporarily withdraw the overlapping virtual domain from that VSAN.

Note Withdrawing an overlapping virtual domain from an IVR VSAN disrupts IVR traffic to and from that domain.

Use the **ivr withdraw domain** command in EXEC mode to temporarily withdraw the overlapping virtual domain interfaces from the affected VSAN.

Tip Only add IVR domains in the edge VSANs and not in transit VSANs.

IVR Zones

As part of the IVR configuration, you need to configure one or more IVR zones to enable cross-VSAN communication. To achieve this result, you must specify each IVR zone as a set of (pWWN, VSAN) entries. Like zones, several IVR zone sets can be configured to belong to an IVR zone. You can define several IVR zone sets and activate only one of the defined IVR zone sets.

Note The same IVR zone set must be activated on *all* of the IVR-enabled switches.

Table 1-2 identifies the key differences between IVR zones and zones.

Table 1-2 Key Differences Between IVR Zones and Zones

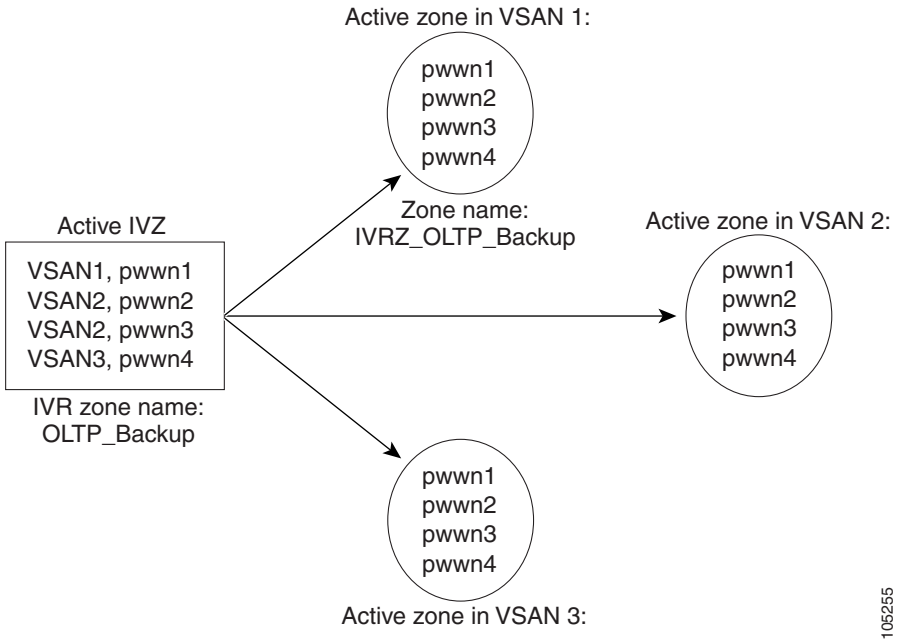
IVR Zones	Zones
IVR zone membership is specified using the VSAN and pWWN combination.	Zone membership is specified using pWWN, fabric WWN, sWWN, or the AFID.
Default zone policy is always deny (not configurable).	Default zone policy is deny (configurable).

Automatic IVR Zone Creation

Figure 1-2 depicts an IVR zone consisting of four members. To allow pwwn1 to communicate with pwwn2, they must be in the same zone in VSAN 1, as well as in VSAN 2. If they are not in the same zone, then the hard-zoning ACL entries will prohibit pwwn1 from communicating with pwwn2.

A zone corresponding to each active IVR zone is automatically created in each edge VSAN specified in the active IVR zone. All pWWNs in the IVR zone are members of these zones in each VSAN.

Figure 1-2 Creating Zones Upon IVR Zone Activation



The zones are created automatically by the IVR process when an IVR zone set is activated. They are not stored in a full zone set database and are lost when the switch reboots or when a new zone set is activated. The IVR feature monitors these events and adds the zones corresponding to the active IVR zone set configuration when a new zone set is activated. Like zone sets, IVR zone sets are also activated nondisruptively.

Note If pwwn1 and pwwn2 are in an IVR zone in the current as well as the new IVR zone set, then activation of the new IVR zone set does not cause any traffic disruption between them.

IVR zone and IVR zone set names are restricted to 64 alphanumeric characters.

Caution Prior to Cisco SAN-OS Release 3.0(3), you can only configure a total of 2000 IVR zones and 32 IVR zone sets on the switches in the network. As of Cisco SAN-OS Release 3.0(3), you can only configure a total of 8000 IVR zones and 32 IVR zone sets on the switches in the network. See "Database Merge Guidelines" on page 1-13.

IVR Interoperability

When using the IVR feature, all border switches in a fabric must be Cisco MDS switches. However, other switches in the fabric may be non-MDS switches. For example, end devices that are members of the active IVR zone set may be connected to non-MDS switches. Non-MDS switches may also be present in the transit VSAN(s) or in the edge VSANs if one of the interop modes is enabled.

For additional information on switch interoperability, refer to the *Cisco Data Center Interoperability Support Matrix*.

Guidelines and Limitations

This section includes the following topics:

IVR NAT Requirements and Guidelines

IVR NAT has the following requirements and guidelines:

- All IVR-enabled switches must run Cisco MDS SAN-OS Release 2.1(1a) or later.
- IVR NAT port login (PLOGI) requests that are received from hosts are delayed a few seconds to perform the rewrite on the FC ID address. If the host's PLOGI timeout value is set to a value less than five seconds, it may result in the PLOGI being unnecessarily aborted and the host being unable to access the target. We recommend that you configure the host bus adapter for a timeout of at least ten seconds (most HBAs default to a value of 10 or 20 seconds).
- IVR NAT requires Cisco MDS SAN-OS Release 2.1(1a) or later on all IVR switches in the fabric. If you have isolated switches with an earlier release that are configured in an IVR topology, you must remove any isolated fabrics from being monitored by DCNM-SAN and then re-open the fabric to use IVR NAT. See the *Cisco DCNM Fundamentals Guide* for information on selecting a fabric to manage continuously.

- Load balancing of IVR NAT traffic across equal cost paths from an IVR-enabled switch is not supported. However, load balancing of IVR NAT traffic over PortChannel links is supported. The load-balancing algorithm for IVR NAT traffic over PortChannel with Generation 1 modules is SRC/DST only. Generation 2 modules support SRC/DST/OXID-based load balancing of IVR NAT traffic across a PortChannel.
- You cannot configure IVR NAT and preferred Fibre Channel routes on Generation 1 module interfaces.
- IVR NAT allows you to set up IVR in a fabric without needing unique domain IDs on every switch in the IVR path. IVR NAT virtualizes the switches in other VSANs by using local VSAN for the destination IDs in the Fibre Channel headers. In some Extended Link Service message types, the destination IDs are included in the packet data. In these cases, IVR NAT replaces the actual destination ID with the virtualized destination ID. IVR NAT supports destination ID replacement in the Extended Link Service messages described in Table 1-3.

Table 1-3 Extended Link Service Messages Supported by IVR NAT

Extended Link Service Messages	Link Service Command (LS_COMMAND)	Mnemonic
Abort Exchange	0x06 00 00 00	ABTX
Discover Address	0x52 00 00 00	ADISC
Discover Address Accept	0x02 00 00 00	ADISC ACC
Fibre Channel Address Resolution Protocol Reply	0x55 00 00 00	FARP-REPLY
Fibre Channel Address Resolution Protocol Request	0x54 00 00 00	FARP-REQ
Logout	0x05 00 00 00	LOGO
Port Login	0x30 00 00 00	PLOGI
Read Exchange Concise	0x13 00 00 00	REC
Read Exchange Concise Accept	0x02 00 00 00	REC ACC
Read Exchange Status Block	0x08 00 00 00	RES
Read Exchange Status Block Accept	0x02 00 00 00	RES ACC
Read Link Error Status Block	0x0F 00 00 00	RLS
Read Sequence Status Block	0x09 00 00 00	RSS
Reinstate Recovery Qualifier	0x12 00 00 00	RRQ
Request Sequence Initiative	0x0A 00 00 00	RSI
Scan Remote Loop	0x7B 00 00 00	RSL
Third Party Process Logout	0x24 00 00 00	TPRLO
Third Party Process Logout Accept	0x02 00 00 00	TPRLO ACC

- If you have a message that is not recognized by IVR NAT and contains the destination ID in the packet data, you cannot use IVR with NAT in your topology. You can still use IVR with unique domain IDs.

Transit VSAN Guidelines

Consider the following guidelines for transit VSANs:

- In addition to defining the IVR zone membership, you can choose to specify a set of transit VSANs to provide connectivity between two edge VSANs:
  - If two edge VSANs in an IVR zone overlap, then a transit VSAN is not required (though, not prohibited) to provide connectivity.
  - If two edge VSANs in an IVR zone do not overlap, you may need one or more transit VSANs to provide connectivity. Two edge VSANs in an IVR zone will not overlap if IVR is not enabled on a switch that is a member of both the source and destination edge VSANs.
- Traffic between the edge VSANs only traverses through the shortest IVR path.
- Transit VSAN information is common to all IVR zone sets. Sometimes, a transit VSAN can also act as an edge VSAN in another IVR zone.

Border Switch Guidelines

Before configuring border switches, consider the following guidelines:

- Border switches require Cisco MDS SAN-OS Release 2.1(1a) or later.
- A border switch must be a member of two or more VSANs.
- A border switch that facilitates IVR communsications must be IVR-enabled.
- IVR can (optionally) be enabled on additional border switches to provide redundant paths between active IVR zone members.
- The VSAN topology configuration updates automatically when a border switch is added or removed.

IVR Zone Limits and Image Downgrading Guidelines

Table 1-4 identifies the IVR zone limits per physical fabric.

Table 1-4 IVR Zone Limits

Cisco Release	IVR Zone Limit	IVR Zone Member Limit	IVR Zone Set Limit
SAN-OS Release 3.0(3 or later	8000	20,000	32
SAN-OS Release 3.0(2b) or earlier	2000	10,000	32

Note A zone member is counted twice if it exists in two zones. See "Database Merge Guidelines" on page 1-13.

Caution If you want to downgrade to a release prior to Cisco SAN-OS Release 3.0(3), the number of IVR zones cannot exceed 2000 and the number of IVR zone members cannot exceed 10,000.

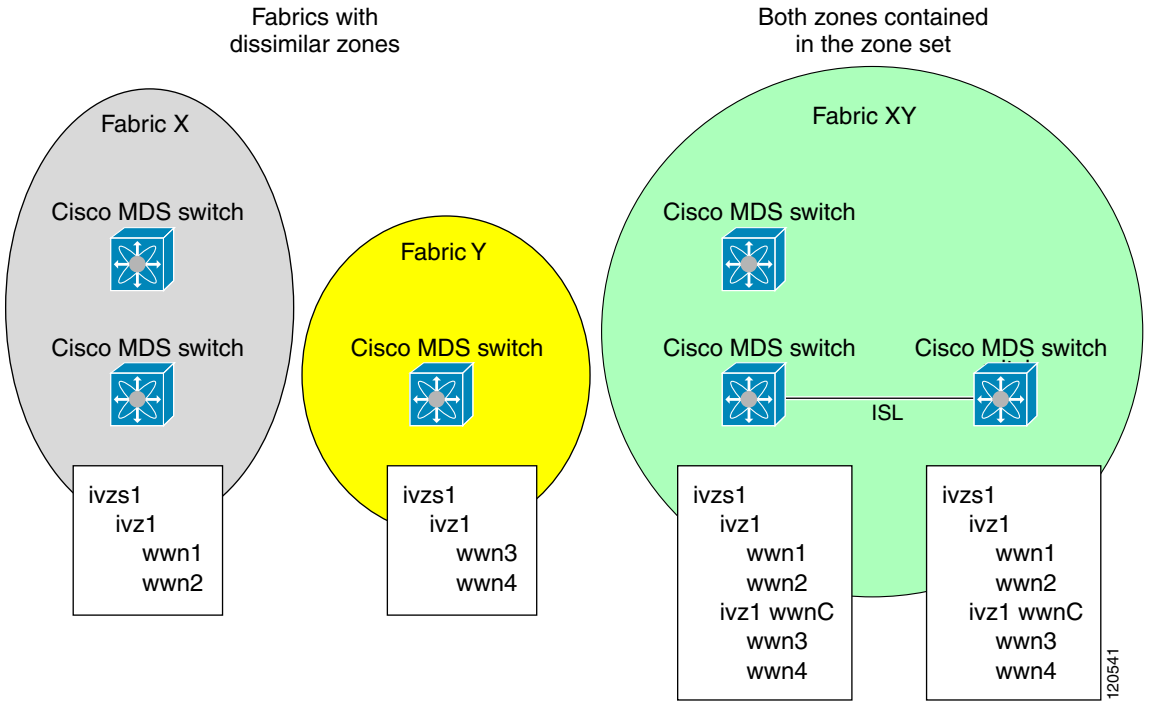
Database Merge Guidelines

A database merge refers to the combination of the configuration database and static (unlearned) entries in the active database. For information on CFS merge support, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide* or *System Management Configuration Guide, Cisco DCNM for SAN*.

Consider the following guidelines when merging two IVR fabrics:

- The IVR configurations are merged even if two fabrics contain different configurations.
- If dissimilar zones exist in two merged fabrics, the zone from each fabric is cloned in the distributed zone set with appropriate names (see Figure 1-3).

Figure 1-3 Fabric Merge Consequences



- You can configure different IVR configurations in different Cisco MDS switches.
- To avoid traffic disruption, after the database merge is complete, the configuration is a combination of the configurations that were present on the two switches involved in the merge.
  - The configurations are merged even if both fabrics have different configurations.
  - A combination of zones and zone sets are used to get the merged zones and zone sets. If a dissimilar zone exists in two fabrics, the dissimilar zones are cloned into the zone set with appropriate names so both zones are present.
  - The merged topology contains a combination of the topology entries for both fabrics.
  - The merge will fail if the merged database contains more topology entries than the allowed maximum.
  - The total number of VSANs across the two fabrics cannot exceed 128.

Note VSANs with the same VSAN ID but different AFIDs are counted as two separate VSANs.

- The total number of IVR-enabled switches across the two fabrics cannot exceed 128.
- The total number of zone members across the two fabrics cannot exceed 10,000. As of Cisco SAN-OS Release 3.0(3), the total number of zone members across the two fabrics cannot exceed 20,000. A zone member is counted twice if it exists in two zones.

Note If one or more of the fabric switches are running Cisco SAN-OS Release 3.0(3) or later, and the number of zone members exceeds 10,000, you must either reduce the number of zone members in the fabric or upgrade all switches in both fabrics to Cisco SAN-OS Release 3.0(3) or later.

- The total number of zones across the two fabrics cannot exceed 2000. As of Cisco SAN-OS Release 3.0(3), the total number of zones across the two fabrics cannot exceed 8000.

Note If only some of the switches in the fabrics are running Cisco SAN-OS Release 3.0(3) or later, and if the number of zones exceeds 2000, you must either reduce the number of zones in the fabric or upgrade all switches in both fabrics to Cisco SAN-OS Release 3.0(3) or later.

- The total number or zone sets across the two fabrics cannot exceed 32.

Table 1-5 describes the results of a CFS merge of two IVR-enabled fabrics under different conditions.

Table 1-5 Results of Merging Two IVR-Enabled Fabrics

IVR Fabric 1	IVR Fabric 2	After Merge
NAT enabled	NAT disabled	Merge succeeds and NAT is enabled
Auto mode enabled	Auto mode disabled	Merge succeeds and IVR auto topology mode is enabled
Conflicting AFID database		Merge fails
Conflicting IVR zone set database		Merge succeeds with new zones created to resolve conflicts
Combined configuration exceeds limits (such as maximum number of zones or VSANs)		Merge fails
Service group 1	Service group 2	Merge succeeds with service groups combined
User-configured VSAN topology configuration with conflicts		Merge fails
User-configured VSAN topology configuration without conflicts		Merge succeeds

Caution If you do not follow these conditions, the merge will fail. The next distribution will forcefully synchronize the databases and the activation states in the fabric.

Default Settings

Table 1-6 lists the default settings for IVR parameters.

Table 1-6 Default IVR Parameters

Parameters	Default
IVR feature	Disabled
IVR VSANs	Not added to virtual domains
IVR NAT	Disabled
QoS for IVR zones	Low
Configuration distribution	Disabled

Configuring Basic Inter-VSAN Routing

This section includes the following topics:

Task Flow for Configuring Basic Inter-VSAN Routing

To configure basic IVR, follow these steps:

	Task	Reference
Step 1	Enable IVR on all border switches.	See "Enabling IVR" on page 1-17.
Step 2	Enable IVR distribution.	See "Distributing the IVR Configuration Using CFS" on page 1-17.
Note	The following steps need to be performed on one switch in the fabric.	
Step 3	Enable IVR NAT.	See "Enabling IVR NAT and IVR Auto Topology Mode" on page 1-19.

	Task	Reference
Step 4	Enable IVR auto topology mode.	See "Enabling IVR NAT and IVR Auto Topology Mode" on page 1-19.
Step 5	Configure IVR virtual domains.	See "Manually Configuring IVR Virtual Domains" on page 1-21
Step 6	Configure and activate zone sets.	See "Configuring IVR Zones and IVR Zone Sets" on page 1-22.
Step 7	Commit the IVR configuration.	See "Committing the Changes" on page 1-18.
Step 8	Verify the IVR configuration.	See "Verifying IVR Zone and IVR Zone Set Configuration" on page 1-28.

Configuring IVR and IVR Zones Using the IVR Zone Wizard

The IVR Zone Wizard simplifies the process of configuring IVR zones in a fabric. The IVR Zone Wizard checks the following conditions and identifies any related issues:

- Checks all switches in the fabric to identify the Cisco SAN-OS or NX-OS release that is running on the switch. If Cisco MDS SAN-OS Release 2.1(1a) or later is running on the switch, you can decide to migrate to IVR NAT with IVR auto topology mode.
- Checks all switches in the fabric to identify the Cisco SAN-OS or NX-OS release that is running on the switch. If Cisco MDS SAN-OS Release 2.1(1a) or later is running on a switch, you can decide to upgrade the switch or disable IVR NAT or IVR auto topology mode if they are enabled.

Detailed Steps

To configure IVR and IVR zones using IVR Zone Wizard, follow these steps:

Step 1 Click the **IVR Zone Wizard** icon in the Zone toolbar.

To migrate to IVR NAT mode click **Yes**, otherwise, click **No**. You see the IVR Zone Wizard dialog box.

Step 2 Select the VSANs that will participate in IVR in the fabric. Click **Next**.

Step 3 Select the end devices that you want to connect using IVR.

Note If you are not using IVR NAT, DCNM for SAN might display an error message if all the switches participating in IVR do not have unique domain IDs. You must reconfigure those switches before configuring IVR. See Step 6.

Step 4 If you enable IVR NAT, verify which switches that DCNM-SAN will enable with IVR NAT, CFS for IVR, and IVR auto topology mode.

Step 5 Enter the VSAN ID of the VSAN that you want to use as the transit VSAN between the VSANs selected for the IVR zone. Click **Next**.

Step 6 (Optional) Configure a unique AFID for switches in the fabric that have non-unique VSAN IDs in the Select AFID dialog box.

Step 7 If you did not enable IVR NAT, verify the transit VSAN or configure the transit VSAN if DCNM-SAN cannot find an appropriate transit VSAN.

Step 8 Set the IVR zone and IVR zone set.

Step 9 Verify all steps that DCNM-SAN will take to configure IVR in the fabric.

Step 10 Click **Finish** if you want to enable IVR NAT and IVR auto topology mode and to create the associated IVR zones and IVR zone set.

You see the **Save Configuration** dialog box. You can save the configuration of the master switch to be copied to other IVR-enabled switches.

Step 11 Click **Continue Activation,** or click **Cancel**.

Step 12 Click **Finish**.

Note IVR NAT and IVR auto topology mode can be configured independently if you configure these features outside the IVR Zone Wizard. See "Configuring Basic Inter-VSAN Routing" on page 1-15.

Enabling IVR

The IVR feature must be enabled in all border switches in the fabric that participate in the IVR. By default, this feature is disabled in all Cisco MDS 9000 Family switches. You can manually enable IVR on all required switches in the fabric or configure fabric-wide distribution of the IVR configuration. See "Distributing the IVR Configuration Using CFS" on page 1-17.

Restrictions

The configuration and verification commands for the IVR feature are only available when IVR is enabled on a switch. When you disable this configuration, all related configurations are automatically discarded.

Detailed Steps

To enable IVR on any participating switch, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# feature ivr`	Enables IVR on the switch.
	`switch(config)# no feature ivr`	Disables (default) IVR on the switch.

Distributing the IVR Configuration Using CFS

IVR configuration distribution is disabled by default. For the feature to function correctly, you must enable it on all IVR-enabled switches in the network.

This section includes the following topics:

Enabling Configuration Distribution

Detailed Steps

To enable IVR configuration distribution, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr distribute`	Enables IVR distribution.
	`switch(config)# no ivr distribute`	Disables (default) IVR distribution.

Committing the Changes

If you commit the changes made to the active database, the configuration is committed to all the switches in the fabric. On a successful commit, the configuration change is applied throughout the fabric and the lock is released.

Detailed Steps

To commit IVR configuration changes, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr commit`	Commits the IVR changes.

Discarding the Changes

If you discard (abort) the changes made to the pending database, the configuration database remains unaffected and the lock is released.

Detailed Steps

To discard IVR configuration changes, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr abort`	Discards the IVR changes and clears the pending configuration database.

Clearing a Locked Session

If you have performed an IVR task and have forgotten to release the lock by either committing or discarding the changes, an administrator can release the lock from any switch in the fabric. If the administrator performs this task, your changes to the pending database are discarded and the fabric lock is released.

Tip The pending database is only available in the volatile directory and is subject to being discarded if the switch is restarted.

To use administrative privileges and release a locked DPVM session, use the **clear ivr session** command in EXEC mode.

```
switch# clear ivr session
```

Enabling IVR NAT and IVR Auto Topology Mode

This section describes how to enable IVR NAT and how to enable IVR auto topology mode.

Prerequisites

Before configuring an IVR SAN fabric to use IVR NAT and IVR auto topology mode, consider the following:

- Configure IVR only in the relevant switches.
- Enable CFS for IVR on all switches in the fabric. You must first click the **CFS** tab in order for the other tabs on the dialog boxes to become available.
- Verify that all switches in the fabric are running Cisco MDS SAN-OS Release 2.1(1a) or later.
- Acquire a mandatory Enterprise License Package or SAN-EXTENSION license package if you have Cisco MDS SAN-OS Release 2.1(1a) or later and one active IPS card for this feature. For information on licensing, refer to the *Cisco MDS 9000 Family NX-OS Licensing Guide*.
- Enable IVR configuration distribution before configuring IVR auto topology mode (see "Distributing the IVR Configuration Using CFS" on page 1-17). Once IVR auto topology mode is enabled, you cannot disable IVR configuration distribution.

Restrictions

- If you change any FSPF link cost, ensure that the FSPF path distance (that is, the sum of the link costs on the path) of any IVR path is less than 30,000.
- The IVR over FCIP feature is bundled with the Cisco MDS 9216i Switch and does not require the SAN extension over IP package for the fixed IP ports on the supervisor module.
- IVR-enabled VSANs can be configured when the interop mode is enabled (any interop mode) or disabled (no interop mode).

Detailed Steps

To enable IVR NAT, follow these steps:

	Command	Purpose
Step 1	`switch# config t`	Enters configuration mode.
Step 2	`switch(config)# ivr nat`	Enables IVR NAT on the switch.
	`switch(config)# no ivr nat`	Disables (default) IVR NAT on the switch.

To enable IVR auto topology mode, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr vsan-topology auto`	Enables IVR auto topology mode.

To view an automatically discovered IVR topology, use the **show ivr vsan-topology** command.

```
switch# show ivr vsan-topology
AFID  SWITCH WWN                 Active   Cfg. VSANS
------------------------------------------------------------
   1  20:00:00:05:30:01:1b:c2 *   yes     yes  1-2
   1  20:02:00:44:22:00:4a:05     yes     yes  1-2,6
   1  20:02:00:44:22:00:4a:07     yes     yes  2-5

Total:   3 entries in active and configured IVR VSAN-Topology

Current Status: Inter-VSAN topology is AUTO
Last activation time: Mon Mar 24 07:19:53 1980
```

Note The asterisk (*) indicates the local switch.

To enable IVR NAT and IVR auto topology mode, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the inter-VSAN routing configuration in the Information pane.

Step 2 Select **Enable** from the Admin column drop-down menu for the primary switch.

Step 3 Click the **Apply Changes** icon to distribute this change to all switches in the fabric.

Step 4 Click the **Action** tab.

Step 5 Check the **Enable IVR NAT** check box to enable IVR in NAT mode.

Step 6 Check the **Auto Discover Topology** check box to enable IVR auto topology mode.

Step 7 Click the **Apply Changes** icon to enable IVR on the switches.

Adding Virtualized Switches to FICON VSAN Fabric Binding Database

FICON requires that all switches in a VSAN are included in the fabric binding database, including IVR virtualized switches.

To add virtualized switches in FICON-enables VSANs to the fabric binding database, follow these steps:

	Command	Purpose
Step 1	`switch# show ivr virtual-switch-wwn native-switch-wwn 20:00:00:0d:ec:00:8c:c0 native-vsan 1` `virtual switch wwn : 20:01:00:0d:ec:00:8c:c1`	Displays virtualized switch information for a native switch and native VSAN.
Step 2	`switch# config t` `switch(config)#`	Enters configuration mode.

	Command	Purpose
Step 3	`switch(config)# feature fabric-binding`	Enables fabric binding.
Step 4	`switch(config)# fabric-binding database vsan 1` `switch(config-fabric-binding)#`	Enters fabric binding database mode for the VSAN.
Step 5	`switch(config-fabric-binding)# swwn 20:01:00:0d:ec:00:8c:c1 domain 20`	Configures the virtual sWWN, display in Step 1, and domain 20 in the fabric binding database.

Manually Configuring IVR Virtual Domains

Detailed Steps

To manually configure an IVR virtual domain in a specified VSAN, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr virtual-fcdomain-add vsan-ranges 1-4093`	Adds the IVR virtual domains in VSAN 1. Perform this step on all IVR switches.
	`switch(config)# no ivr virtual-fcdomain-add vsan-ranges 1-4093`	Reverts to the factory default of not adding IVR virtual domains and removes the currently active virtual domains for that VSAN from the fcdomain manager list

Note As of Cisco SAN-OS Release 3.1(2), Cisco Fabric Configuration Services (FCS) supports the discovery of virtual devices. The **fcs virtual-device-add vsan-ranges** command, issued in FCS configuration submode, allows you to discover virtual devices in a particular VSAN or in all VSANs. To discover the devices that are zoned for IVR using this command, the devices must have request domain_ID (RDI) enabled. For information on using FCS, refer to the *Cisco MDS 9000 Family NX-OS System Management Configuration Guide*.

To configure fabric-wide IVR virtual domains in a specified VSAN, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr virtual-fcdomain-add 2 vsan-ranges 1-4093`	Adds the IVR virtual domains in VSAN 1. Perform this step on all IVR switches.
Step 3	`switch(config)# ivr commit`	Commits the fabric-wide configuration.
Step 4	`switch(config)# no ivr virtual-fcdomain-add2 vsan-ranges 1-4093`	Reverts to the factory default of not adding IVR virtual domains and removes the currently active virtual domains for that VSAN from the fcdomain manager list

Configuring IVR Zones and IVR Zone Sets

Restrictions

- Do not create a zone with the prefix IVRZ or a zone set with the name **nozoneset**. These names are created by the system and they are used for identifying IVR zones.

Detailed Steps

To create IVR zones and IVR zone sets, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr zone name sample_vsan2-3` `switch(config-ivr-zone)#`	Creates an IVR zone named sample_vsan2-3.
Step 3	`switch(config-ivr-zone)# member pwwn 21:00:00:e0:8b:02:ca:4a vsan 3`	Adds the specified pWWN in VSAN 3 as an IVR zone member.
Step 4	`switch(config-ivr-zone)# member pwwn 21:00:00:20:37:c8:5c:6b vsan 2`	Adds the specified pWWN in VSAN 2 as an IVR zone member.
Step 5	`switch(config-ivr-zone)# exit` `switch(config)#`	Returns to configuration mode.
Step 6	`switch(config)# ivr zone name sample_vsan4-5` `switch(config-ivr-zone)#`	Creates an IVR zone named sample_vsan4-5.
Step 7	`switch(config-ivr-zone)# member pwwn 21:00:00:e0:8b:06:d9:1d vsan 4`	Adds the specified pWWN in VSAN 4 as an IVR zone member.
Step 8	`switch(config-ivr-zone)# member pwwn 21:01:00:e0:8b:2e:80:93 vsan 4`	Adds the specified pWWN in VSAN 4 as an IVR zone member.
Step 9	`switch(config-ivr-zone)# member pwwn 10:00:00:00:c9:2d:5a:dd vsan 5`	Adds the specified pWWN in VSAN 5 as an IVR zone member.
Step 10	`switch(config-ivr-zone)# exit` `switch(config)#`	Returns to configuration mode.
Step 11	`switch(config)# ivr zoneset name Ivr_zoneset1` `switch(config-ivr-zoneset)#`	Creates an IVR zone set named Ivr_zoneset1.
Step 12	`switch(config-ivr-zoneset)# member sample_vsan2-3`	Adds the sample_vsan2-3 IVR zone as an IVR zone set member.
Step 13	`switch(config-ivr-zoneset)# member sample_vsan4-5`	Adds the sample_vsan4-5 IVR zone as an IVR zone set member.
Step 14	`switch(config-ivr-zoneset)# exit` `switch(config)`	Returns to configuration mode.

	Command	Purpose
Step 15	`switch(config)# ivr zoneset activate name IVR_ZoneSet1`	Activates the newly created IVR zone set.
	`switch(config)# ivr zoneset activate name IVR_ZoneSet1 force`	Forcefully activates the specified IVR zone set.
	`switch(config)# no ivr zoneset activate name IVR_ZoneSet1`	Deactivates the specified IVR zone set.
Step 16	`switch(config)# end` `switch#`	Returns to EXEC mode.

To create IVR zones and IVR zone sets, follow these steps:

Step 1 Choose **Zone > IVR > Edit Local Full Zone Database**.

You see the Edit IVR Local Full Zone Database dialog box for the selected VSAN.

If you want to view zone membership information, right-click in the **Members** column, and then click **Show Details** for the current row or all rows from the pop-up menu.

Step 2 Click **Zones** in the left pane and click the **Insert** icon to create a zone.

You see the Create IVR Zone dialog box.

Step 3 Enter an IVR zone name.

Step 4 Check one of the following check boxes:

a. **Read Only**—The zone permits read and denies write.

b. **Permit QoS traffic with Priority**—You set the priority from the drop-down menu.

Step 5 Click **OK** to create the IVR zone.

Step 6 To add members to this zone, select the members you want to add from the Fabric pane and click **Add to Zone**.

Step 7 Alternatively, click the zone where you want to add members and click the **Insert** icon.

You see the Add Member to Zone dialog box.

Step 8 If you added a zone set, select the new zone set and then click **Activate**.

You see the Save Configuration dialog box.

Step 9 Check the **Save Running to Startup Configuration** check box to save all changes to the startup configuration.

Step 10 Click **Continue Activation** to activate the zone set.

Note Sometimes zone names beginning with the prefix IVRZ and a zone set with the name **nozoneset** appear in a logical view. The zones with prefix the IVRZ are IVR zones that get appended to regular active zones. The prefix IVRZ is appended to active IVR zones by the system. Similarly, the zone set with the name **nozoneset** is an IVR active zone set created by the system if no active zone set is available for that VSAN and if the ivrZonesetActivateForce flag is enabled on the switch.

In the server.properties file, you can set the property zone.ignoreIVRZones to **true** or **false** to either hide or view IVR zones as part of regular active zones. For information on the server.properties file, refer to the *Cisco DCNM Fundamentals Configuration Guide*.

Step 11 Select the new zone or zone set from the list in the Information pane, and then click **Distribute**.

Configuring IVR Zone with IVR CFS Regions

Detailed Steps

To create IVR zone with IVR CFS regions, follow these steps:

Step 1 Enable IVR on all the switches.

An IVR CFS region should not be configured on the IVR-enabled switches at this point.

Step 2 Choose **Zone > IVR > Edit Local Full Zone Database.**

You see the Edit IVR Local Full Zone Database dialog box for the selected VSAN.

Step 3 From the **Regions** drop-down menu, select the IVR Region ID.

Only the IVR-enabled switches should be included in these regions.

Step 4 In the left pane, click **Zones** and click the **Insert** icon to create a zone.

You see the Create IVR Zone dialog box.

Step 5 Enter an IVR zone name.

Step 6 Check one of the following check boxes:

a. **Read Only**—The zone permits read and denies write.

b. **Permit QoS traffic with Priority**—You set the priority from the drop-down menu.

Step 7 Click **OK** to create the IVR zone.

Step 8 To add members to this zone, select the members you want to add from the Fabric pane and click **Add to Zone**.

Step 9 Alternatively, click the zone where you want to add members and click the **Insert** icon.

You see the Add Member to Zone dialog box.

Step 10 If you added a zone set, select the new zone set and then click **Activate**.

You see the Save Configuration dialog box.

Step 11 Check the **Save Running to Startup Configuration** check box to save all changes to the startup configuration.

Step 12 Click **Continue Activation** to activate the zone set.

Note If the activation is performed on a switch with a CFS region ID, complete the activation on a single switch with commit. You can verify the activation status through SNMP trace.

If switches in a configured IVR CFS region do not have CFS enabled, you will receive an error message on activation.

Configuring IVR CFS Regions with Enforced IVR Zone Set

Detailed Steps

To create an IVR zone with IVR CFS regions, follow these steps:

Step 1 Enable IVR on all the switches.

An IVR CFS region should not be configured on the IVR-enabled switches at this point.

Step 2 Choose **Zone > IVR > Edit Local Full Zone Database.**

You see the Edit IVR Local Full Zone Database dialog box for the selected VSAN.

Step 3 From the **Regions** drop-down menu, select the IVR Region ID.

Only the IVR-enabled switches should be included in these regions.

Step 4 In the left pane, click **Zones** and click the **Insert** icon to create a zone.

You see the Create IVR Zone dialog box.

Step 5 Create enforced IVR zones for each region.

The logical pane VSAN tree shows a node for each enforced zone set per region under the IVR tree node. When you click the enforced zone tree node, the table in the right pane shows the enforced zones and zone members for the relevant IVR CFS region. If zones in a region are either activated or deactivated, the VSAN tree dynamically updates itself.

Activating Zone Sets and Using the force Option

Once the zone sets have been created and populated, you must activate the zone set. When you activate an IVR zone set, IVR automatically adds an IVR zone to the regular active zone set of each edge VSAN. If a VSAN does not have an active zone set, IVR can only activate an IVR zone set using the force option, which causes IVR to create an active zone set called “nozoneset” and adds the IVR zone to that active zone set.

Caution If you deactivate the regular active zone set in a VSAN, the IVR zone set is also deactivated. This occurs because the IVR zone in the regular active zone set, and all IVR traffic to and from the switch, is stopped. To reactivate the IVR zone set, you must reactivate the regular zone set.

Note If IVR and iSLB are enabled in the same fabric, at least one switch in the fabric must have both features enabled. Any zoning-related configuration or activation operation (for normal zones, IVR zones, or iSLB zones) must be performed on this switch. Otherwise, traffic might be disrupted in the fabric.

You can also use the **force activate** option**force** command to activate IVR zone sets. Table 1-7 lists the various scenarios with and without the **force activateforce command** option.

Table 1-7 IVR Scenarios with and without the Force Activate Optionthe force Command

Case	Default Zone Policy	Active Zone Set before IVR Zone Activation	`Force Activate force command` Option Used?	IVR Zone Set Activation Status	Active IVR Zone Created?	Possible Traffic Disruption
1	Deny	No active zone set	No	Failure	No	No
2			Yes	Success	Yes	No
3[1]	Deny	Active zone set present	No/Yes	Success	Yes	No
4	Permit	No active zone set *or* Active zone set present	No	Failure	No	No
5			Yes	Success	Yes	Yes

1. We recommend that you use the Case 3 scenario.

Caution Using the **force activate** option**force** command of IVR zone set activation may cause traffic disruption, even for devices that are not involved in IVR. For example, if your configuration does not have any active zone sets and the default zone policy is permit, then an IVR zone set activation will fail. However, IVR zone set activation will be successful if the **force activate** option**force** command is used. Because zones are created in the edge VSANs corresponding to each IVR zone, traffic may be disrupted in edge VSANs where the default zone policy is permit.

Activating or Deactivating IVR Zone Sets

Restrictions

- To replace the active IVR zone set with a new IVR zone set without disrupting traffic, activate the new IVR zone set without deactivating the current active IVR zone set.

Detailed Steps

To activate or deactivate an existing IVR zone set, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# ivr zoneset activate name IVR_ZoneSet1`	Activates the newly created IVR zone set.
	`switch(config)# ivr zoneset activate name IVR_ZoneSet1 force`	Forcefully activates the specified IVR zone set.
	`switch(config)# no ivr zoneset activate name IVR_ZoneSet1`	Deactivates the specified IVR zone set.

To activate or deactivate an existing IVR zone set, follow these steps:

Step 1 Click **Zone** and then select **Edit Local Full Zone Database**.

You see the Edit Local Full Zone Database dialog box.

Step 2 Select a **Zoneset** folder, and then click **Activate** to activate the zone set or click **Deactivate** to deactivate an activated zone set.

You see the Save Configuration dialog box.

Step 3 (Optional) Check one of the **Save Running to Configuration** check boxes to save these changes to the startup configuration.

Step 4 Click **Continue Activation** to activate the zone set or **Yes** if you are deactivating the zone set.

Note If you make any changes to the full zone set that results in a difference between the active zone set and full zone set, the active zone set in Edit Zone is shown in bold. Activating the zone set, unbolds it.

Configuring IVR Logging Severity Levels

You can configure Telnet or SSH logging for the IVR feature. For example, if you configure the IVR logging level at level 4 (warning), then messages with a severity level of 4 or above are displayed. Use the instructions in this section to configure and verify the logging levels.

Detailed Steps

To configure the severity level for logging messages from the IVR feature, follow these steps:

	Command	Purpose
Step 1	`switch# config t` `switch(config)#`	Enters configuration mode.
Step 2	`switch(config)# logging level ivr 4`	Configures Telnet or SSH logging for the IVR feature at level 4 (warning). As a result, logging messages with a severity level of 4 or above are displayed.

To configure the severity level for logging messages from the IVR feature, follow these steps:

Step 1 Expand **Switches** > **Events**, and then select **Syslog** from the Physical Attributes pane.

Step 2 Click the **Severity Levels** tab.

Step 3 Click the **Facility** column header to sort the table by facility name.

Step 4 Select the severity level at which the IVR logs system messages from the Severity drop-down menu.

Tip Setting the severity to **warning** means that all IVR messages at the warning level or above will be logged to DCNM-SAN.

Step 5 Click the **Apply Changes** icon to save these changes locally.

Verifying Basic Inter-VSAN Routing Configuration

This section includes the following topics:

Verifying an IVR Virtual Domain Configuration

To view the status of the IVR virtual domain configuration, use the **show ivr virtual-fcdomain-add-status** command.

```
switch# show ivr virtual-fcdomain-add-status
IVR virtual domains are added to fcdomain list in VSANS: 1
(As well as to VSANs in interoperability mode 2 or 3)
```

Verifying IVR Zone and IVR Zone Set Configuration

Verify the IVR zone and IVR zone set configurations using the **show ivr zone** and **show ivr zoneset** commands. See Example 1-1 to Example 1-9.

Example 1-1 Displays the IVR Zone Configuration

```
switch# show ivr zone
zone name sample_vsan2-3
    pwwn 21:00:00:e0:8b:02:ca:4a vsan 3
    pwwn 21:00:00:20:37:c8:5c:6b vsan 2

zone name ivr_qa_z_all
    pwwn 21:00:00:e0:8b:06:d9:1d vsan 1
    pwwn 21:01:00:e0:8b:2e:80:93 vsan 4
    pwwn 10:00:00:00:c9:2d:5a:dd vsan 1
    pwwn 10:00:00:00:c9:2d:5a:de vsan 2
    pwwn 21:00:00:20:37:5b:ce:af vsan 6
    pwwn 21:00:00:20:37:39:6b:dd vsan 6
    pwwn 22:00:00:20:37:39:6b:dd vsan 3
    pwwn 22:00:00:20:37:5b:ce:af vsan 3
    pwwn 50:06:04:82:bc:01:c3:84 vsan 5
```

Example 1-2 Displays Information for a Specified IVR Zone

```
switch# show ivr zone name sample_vsan2-3
zone name sample_vsan2-3
    pwwn 21:00:00:e0:8b:02:ca:4a vsan 3
    pwwn 21:00:00:20:37:c8:5c:6b vsan 2
```

Example 1-3 Displays the Specified Zone in the Active IVR Zone

```
switch# show ivr zone name sample_vsan2-3 active
zone name sample_vsan2-3
    pwwn 21:00:00:e0:8b:02:ca:4a vsan 3
    pwwn 21:00:00:20:37:c8:5c:6b vsan 2
```

Example 1-4 Displays the IVR Zone Set Configuration

```
switch# show ivr zoneset
zoneset name ivr_qa_zs_all
  zone name ivr_qa_z_all
    pwwn 21:00:00:e0:8b:06:d9:1d vsan 1
    pwwn 21:01:00:e0:8b:2e:80:93 vsan 4
    pwwn 10:00:00:00:c9:2d:5a:dd vsan 1
    pwwn 10:00:00:00:c9:2d:5a:de vsan 2
    pwwn 21:00:00:20:37:5b:ce:af vsan 6
    pwwn 21:00:00:20:37:39:6b:dd vsan 6
    pwwn 22:00:00:20:37:39:6b:dd vsan 3
    pwwn 22:00:00:20:37:5b:ce:af vsan 3
    pwwn 50:06:04:82:bc:01:c3:84 vsan 5

zoneset name IVR_ZoneSet1
  zone name sample_vsan2-3
    pwwn 21:00:00:e0:8b:02:ca:4a vsan 3
    pwwn 21:00:00:20:37:c8:5c:6b vsan 2
```

Example 1-5 Displays the Active IVR Zone Set Configuration

```
switch# show ivr zoneset active
zoneset name IVR_ZoneSet1
  zone name sample_vsan2-3
    pwwn 21:00:00:e0:8b:02:ca:4a vsan 3
    pwwn 21:00:00:20:37:c8:5c:6b vsan 2
```

Example 1-6 Displays the Specified IVR Zone Set Configuration

```
switch# show ivr zoneset name IVR_ZoneSet1
zoneset name IVR_ZoneSet1
  zone name sample_vsan2-3
    pwwn 21:00:00:e0:8b:02:ca:4a vsan 3
    pwwn 21:00:00:20:37:c8:5c:6b vsan 2
```

Example 1-7 Displays Brief Information for All IVR Zone Sets

```
switch# show ivr zoneset brief Active
zoneset name IVR_ZoneSet1
  zone name sample_vsan2-3
```

Example 1-8 Displays Brief Information for the Active IVR Zone Set

```
switch# show ivr zoneset brief Active
zoneset name IVR_ZoneSet1
  zone name sample_vsan2-3
```

Example 1-9 Displays Status Information for the IVR Zone Set

```
switch# show ivr zoneset status
Zoneset Status
_______________
    name               : IVR_ZoneSet1
    state              : activation success
    last activate time : Sat Mar 22 21:38:46 1980
    force option       : off

status per vsan:
__________________
     vsan     status
     ____     ______
       1      active
       2      active
```

Tip Repeat this configuration in all border switches participating in the IVR configuration.

Note You can use Cisco Fabric Manager to distribute IVR zone configurations to all IVR-capable switches in the interconnected VSAN network. Refer to the *Cisco Fabric Manager Inter-VSAN Routing Configuration Guide*.

Verifying Logging Level Configuration

Use the **show logging level** command to view the configured logging level for the IVR feature.

```
switch# show logging level
Facility        Default Severity        Current Session Severity
--------        ----------------        ------------------------
...
ivr                     5                       4
...
0(emergencies)          1(alerts)       2(critical)
3(errors)               4(warnings)     5(notifications)
6(information)          7(debugging)
```

Monitoring Basic Inter-VSAN Routing Configuration

This section includes the following topics:

Clearing an IVR fcdomain Database

To clear the IVR fcdomain database, use the following command:

```
switch# clear ivr fcdomain database
```

Detailed Steps

To manually configure an IVR virtual domain, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Domains** tab to display the existing IVR topology.

Step 3 Click the **Create Row** icon to create rows in the IVR topology.

Step 4 Enter the Current Fabric, Current VSAN, Native Fabric, Native VSAN and Domain ID in the dialog box. These are the VSANs that will add the IVR virtual domains to the assigned domains list.

Step 5 Click **Create** to create this new row.

Recovering an IVR Full Zone Database

You can recover an IVR zone database by copying the IVR full zone database from another switch.

Detailed Steps

To recover an IVR zone database, follow these steps:

Step 1 Choose **Zone > IVR > Edit Local Full Zone Database**.

You see the Edit IVR Local Full Zone Database dialog box.

Step 2 Choose **Edit > Copy Full Zone Database**.

You see the Copy Full Zone Database dialog box.

Step 3 Choose either **Active** or **Full**, depending on which type of IVR database you want to copy.

Step 4 Select the source switch from which to copy the information from the drop-down list.

Step 5 Select the destination switch from the drop-down list.

Step 6 Click **Copy** to copy the database.

Recovering an IVR Topology

You can recover a topology by copying the active zone database or the full zone database.

Detailed Steps

To recover a zone topology, follow these steps:

Step 1 Choose **Zone > IVR > Edit Local Full Zone Database**.

You see the Edit IVR Local Full Zone Database dialog box.

Step 2 Choose **Edit > Copy Full Topology**.

You see the Copy Full Topology dialog box.

Step 3 Choose either **Active** or **Full**, depending on which type of IVR database you want to copy from.

Step 4 Select the source switch from which to copy the information from the drop-down list.

Step 5 Select the destination switch from the drop-down list.

Step 6 Click **Copy** to copy the topology.

Clearing the IVR Zone Database

Clearing a zone set only erases the configured zone database, not the active zone database.

To clear the IVR zone database, use the **clear ivr zone database** command.

```
switch# clear ivr zone database
```

This command clears all configured IVR zone information.

Note After issuing a **clear ivr zone database** command, you need to explicitly issue the **copy running-config startup-config** command to ensure that the running configuration is used when you next start the switch.

Resolving Database Merge Failures

If a merge failure occurs, you can use the following CLI commands to display the error conditions:

- **show ivr merge status**
- **show cfs merge status name ivr**
- **show logging last** *lines* (and look for MERGE failures)

To resolve merge failures, review the failure information indicated in the **show** command outputs, then find the scenario in this list that relates to the failure and follow the troubleshooting instructions:

- If the failure is due to exceeding the maximum configuration limits in a fabric where the switches are running more than one Cisco SAN-OS or NX-OS release, then either upgrade the switches running the earlier release or reduce the number of IVR zones and IVR zone members on the switches running the more recent release to the earlier release limit (see "IVR Configuration Limits" on page 1-4).
- If the failure is due to exceeding maximum limits in a fabric where all switches are running the same Cisco SAN-OS or NX-OS release, identify the switch that has the correct configuration and perform a CFS commit to distribute the IVR configuration. See "Distributing the IVR Configuration Using CFS" on page 1-17 and "Autonomous Fabric IDs" on page 2-2.

- For other failures, resolve the error causing the merge failure on the switch that has the correct configuration and perform a CFS commit to distribute the IVR configuration. See "Distributing the IVR Configuration Using CFS" on page 1-17 and "Autonomous Fabric IDs" on page 2-2.

Note After a successful CFS commit, the merge will be successful.

Configuration Examples for IVR Auto Topology Mode

This section provides example configuration steps for enabling IVR auto topology mode.

Step 1 Enable IVR on every border switch in the fabric.

```
switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# feature ivr
switch(config)# exit
switch#
```

Step 2 Verify that IVR is enabled on every IVR-enabled switch.

```
switch# show ivr
Inter-VSAN Routing is enabled

Inter-VSAN enabled switches
---------------------------
No IVR-enabled VSAN is active. Check VSAN-Topology configuration.

Inter-VSAN topology status
--------------------------
Current Status: Inter-VSAN topology is INACTIVE

Inter-VSAN zoneset status
-------------------------
    name               :
    state              : idle
    last activate time :

Fabric distribution status
----------------------
fabric distribution disabled
Last Action                : None
Last Action Result         : None
Last Action Failure Reason : None

Inter-VSAN NAT mode status
--------------------------
FCID-NAT is disabled

License status
-----------------
IVR is running based on the following license(s)
ENTERPRISE_PKG
```

Step 3 Enable CFS distribution on every IVR-enabled switch in the fabric.

```
switch# config t
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# ivr distribution
```

Step 4 Enable IVR auto topology mode.

```
switch(config)# ivr vsan-topology auto
fabric is locked for configuration. Please commit after configuration is done.
```

Step 5 Commit the change to the fabric.

```
switch(config)# ivr commit
switch(config)# exit
switch#
```

Step 6 Verify the status of the commit request.

```
switch# show ivr session status
Last Action                : Commit
Last Action Result         : Success
Last Action Failure Reason : None
```

Step 7 Verify the active IVR auto topology.

```
switch# show ivr vsan-topology active

AFID  SWITCH WWN                 Active   Cfg. VSANS
------------------------------------------------------------
   1  20:00:00:0d:ec:08:6e:40 *  yes      no   1,336-338
   1  20:00:00:0d:ec:0c:99:40    yes      no   336,339
```

Step 8 Configure IVR zone set and zones. Two zones are required:

- One zone has tape T (pwwn 10:02:50:45:32:20:7a:52) and server S1 (pwwn 10:02:66:45:00:20:89:04).
- Another zone has tape T and server S2 (pwwn 10:00:ad:51:78:33:f9:86).

Tip Instead of creating two IVR zones, you can also create one IVR zone with the tape and both servers.

```
mds(config)# ivr zoneset name tape_server1_server2

mds(config-ivr-zoneset)# zone name tape_server1
mds(config-ivr-zoneset-zone)# member pwwn 10:02:50:45:32:20:7a:52 vsan 1
mds(config-ivr-zoneset-zone)# member pwwn 10:02:66:45:00:20:89:04 vsan 2
mds(config-ivr-zoneset-zone)# exit

mds(config-ivr-zoneset)# zone name tape_server2
mds(config-ivr-zoneset-zone)# member pwwn 10:02:50:45:32:20:7a:52 vsan 1
mds(config-ivr-zoneset-zone)# member pwwn 10:00:ad:51:78:33:f9:86 vsan 3
mds(config-ivr-zoneset-zone)# exit
```

Step 9 View the IVR zone configuration to confirm that the IVR zone set and IVR zones are properly configured.

```
mds(config)# do show ivr zoneset
zoneset name tape_server1_server2
  zone name tape_server1
      pwwn 10:02:50:45:32:20:7a:52 vsan 1
      pwwn 10:02:66:45:00:20:89:04 vsan 2

  zone name tape_server2
      pwwn 10:02:50:45:32:20:7a:52 vsan 1
      pwwn 10:00:ad:51:78:33:f9:86 vsan 3
```

Step 10 View the zone set prior to IVR zone set activation. Prior to activating the IVR zone set, view the active zone set. Repeat this step for VSANs 2 and 3.

```
mds(config)# do show zoneset active vsan 1
zoneset name finance_dept vsan 1
  zone name accounts_database vsan 1
    pwwn 10:00:23:11:ed:f6:23:12
    pwwn 10:00:56:43:11:56:fe:ee

  zone name $default_zone$ vsan 1
```

Step 11 Activate the configured IVR zone set.

```
mds(config)# ivr zoneset activate name tape_server1_server2
zoneset activation initiated. check inter-VSAN zoneset status
mds(config)# exit
mds#
```

Step 12 Verify the IVR zone set activation.

```
mds# show ivr zoneset active
zoneset name tape_server1_server2
  zone name tape_server1
      pwwn 10:02:50:45:32:20:7a:52 vsan 1
      pwwn 10:02:66:45:00:20:89:04 vsan 2

  zone name tape_server2
      pwwn 10:02:50:45:32:20:7a:52 vsan 1
      pwwn 10:00:ad:51:78:33:f9:86 vsan 3
```

Step 13 Verify the zone set updates. Upon successful IVR zone set activation, verify that appropriate zones are added to the active zone set. Repeat this step for VSANs 2 and 3.

```
mds# show zoneset active vsan 1
zoneset name finance_dept vsan 1
  zone name accounts_database vsan 1
    pwwn 10:00:23:11:ed:f6:23:12
    pwwn 10:00:56:43:11:56:fe:ee

  zone name IVRZ_tape_server1 vsan 1
    pwwn 10:02:66:45:00:20:89:04
    pwwn 10:02:50:45:32:20:7a:52

  zone name IVRZ_tape_server2 vsan 1
    pwwn 10:02:50:45:32:20:7a:52
    pwwn 10:00:ad:51:78:33:f9:86

  zone name $default_zone$ vsan 1

mds# show ivr zoneset status
Zoneset Status
_____________
    name               : tape_server1_server2
    state              : activation success
    last activate time : Tue May 20 23:23:01 1980
    force option       : on

status per vsan:
___________________
     vsan     status
     ____     ______
     1        active
```

Where to Go Next

After setting up a basic IVR configuration, see Chapter 2, "Configuring Advanced Inter-VSAN Routing," if you need to set up any advanced IVR configurations.

CHAPTER 2

Configuring Advanced Inter-VSAN Routing

This chapter provides advanced configuration information and instructions. Before setting up advanced IVR configurations, see Chapter 1, "Configuring Basic Inter-VSAN Routing," which includes basic configuration instructions and descriptions of IVR features, limits, and terminology.

This chapter includes the following sections:

Information About Advanced Inter-VSAN Routing

This section includes the following topics:

IVR Service Groups

In a complex network topology, you might only have a few IVR-enabled VSANs. To reduce the amount of traffic to non-IVR-enabled VSANs, you can configure service groups that restrict the traffic to the IVR-enabled VSANs. A maximum of 16 IVR service groups are allowed in a network. When a new IVR-enabled switch is added to the network, you must update the service groups to include the new VSANs.

Default Service Group

All AFID and VSAN combinations that are part of an IVR VSAN topology but are not part of any user-defined service group are members of the default service group. The identifier of the default service group is 0.

By default, IVR communication is permitted between members of the default service group. You can change the default policy to deny. To change the default policy, see "Configuring IVR Service Groups" on page 2-9. The default policy is not part of ASCII configuration.

Service Group Activation

A configured service group must be activated. Like zone set activation or VSAN topology activation, the activation of a configured service group replaces the currently active service group, if any, with the configured one. There is only one configured service group database and one active service group database. Each of these databases can have up to 16 service groups.

Autonomous Fabric IDs

The autonomous fabric ID (AFID) distinguishes segmented VSANS (for example, two VSANs that are logically and physically separate but have the same VSAN number). Cisco Fabric Manager Release 4.2(1) supports AFIDs 1 through 64. AFIDs are used in conjunction with IVR auto topology mode to allow segmented VSANs in the IVR VSAN topology database.

FC ID Features and Benefits

FC ID persistence improves IVR management by providing the following features:

- Allows you to control and assign a specific virtual domain to use in a native VSAN.
- Allows you to control and assign a specific virtual FC ID for a device.

The benefits of persistent FC IDs for IVR are as follows:

- Host devices always see the same FC ID for targets.
- FC IDs help you plan your SAN layout better by assigning virtual domains for IVR to use.
- FC IDs can make SAN monitoring and management easier. When you see the same domain or FC ID consistently assigned, you can readily determine the native VSAN or device to which it refers.

Advanced IVR Zones and IVR Zone Sets

This section describes advanced configuration information for IVR zones and IVR zone sets. For basic information on configuring IVR zones and zone sets, see "Configuring IVR Zones and IVR Zone Sets" on page 1-22.

As part of the IVR configuration, you need to configure one or more IVR zone to enable cross-VSAN communication. To achieve this, you must specify each IVR zone as a set of (pWWN, VSAN) entries. Different IVR zone sets can contain the same IVR zone, because IVR zones can be members of one or more IVR zone sets.

Note The same IVR zone set must be activated on *all* of the IVR-enabled switches.

Caution Prior to Cisco SAN-OS Release 3.0(3) you can only configure a total of 10,000 zone members on all switches in a network. As of Cisco SAN-OS Release 3.0(3) you can only configure a total of 20,000 zone members on all switches in a network. A zone member is counted twice if it exists in two zones. See "Database Merge Guidelines" on page 1-13.

IVR CFS Region

IVR is used for devices from different VSANs to communicate with each other. As the fabric size increases, there is a need to create IVR islands. The IVR data communication is limited only within the islands. By creating various IVR CFS regions, the data communication can be limited to the regions.

Currently, DCNM-SAN only supports a single IVR CFS region.

Beginning with Release 5.2, DCNM-SAN supports multiple IVR regions and has the following features:

- Supports multiple IVR enforced zone sets and IVR master switch (per region).
- Shows active and local topology for all switches in DCNM-SAN tables. You need to select a master switch to change the topology for each region.
- If no CFS IVR region is configured, the switch belong to a default region.
- DCNM-SAN discovers multiple enforced IVR zones by region, region ID, and IVR CFS state of each switch.
- The client or server events are modified to account for changes in the IVR CFS state, region ID, and enforced IVR zones (for each region).
- The log window in DCNM-SAN client will reflect all regions information for IVR.

Currently, DCNM-SAN client supports zoning in CFS regions.

Advanced Fabric Services on IVR Flows

Advanced fabric services (such as SME and IOA) use a fabric-wide FC-Redirect infrastructure to redirect the traffic flows. These services can now be enabled on IVR flows using an internal feature, Abstract ACL Manager (AAM).

Guidelines and Limitations

This section includes the following topics:

- IVR Zone Configuration Guidelines, page 2-8
- Advanced Fabric Services Guidelines and Limitations, page 2-8

Service Group Guidelines

When configuring IVR service groups, consider these guidelines:

- If you use service groups with IVR auto topology mode, you should enable IVR and configure your service groups first, then distribute them with CFS before setting the IVR auto topology mode.
- The CFS distribution is restricted within the service group only when the IVR VSAN topology is in IVR auto topology mode. See "IVR VSAN Topology" on page 1-6.
- You can configure as many as 16 service groups in a network.
- When a new IVR-enabled switch is added to the network, you must update the service group to include the new VSANs.
- The same VSAN and AFID combination cannot be a member of more than one service group, otherwise, a CFS merge will fail.
- The total number of AFID and VSAN combinations in all the service groups combined cannot exceed 128. The maximum number of AFID and VSAN combinations in a single service group is 128.
- The IVR service group configuration is distributed in all IVR-enabled switches. IVR data traffic between two end devices belonging to a service group stays within that service group. For example, two members (for example, pWWN 1 and pWWN 2) cannot communicate if they belong to the same IVR zone and they belong to different service groups.
- During a CFS merge, service groups with the same name would be merged, as long as there are no conflicts with other service groups.
- If the total number of service groups exceeds 16 during a CFS merge, the CFS merge fails.
- CFS distributes service group configuration information to all reachable SANs. If you do not enable CFS distribution, you must ensure that the service group configuration is the same on all IVR-enabled switches in all VSANs.
- IVR end devices belonging to an IVR service group are not exported to any AFID or VSAN outside of its service group.
- When at least one service group is defined and an IVR zone member does not belong to the service group, that IVR zone member is not able to communicate with any other device.
- The default service group ID is zero (0).

Autonomous Fabric ID Guidelines

You can configure AFIDs individually for VSANs, or you can set the default AFIDs for all VSANs on a switch. If you configure an individual AFID for a subset of the VSANs on a switch that has a default AFID, that subset uses the configured AFID while all other VSANs on that switch use the default AFID.

You can only use an AFID configuration when the VSAN topology is in IVR auto topology mode. In IVR manual topology mode, the AFIDs are specified in the VSAN topology configuration itself and a separate AFID configuration is not needed.

Note Two VSANs with the same VSAN number but different AFIDs are counted as two VSANs out of the total 128 VSANs allowed in the fabric.

When devices attached to multiple switches belong to one VSAN, they cannot communicate with each other by configuring the regular zone set because the AFIDs are different. You can consider that the different AFIDs are different fabrics; therefore, the three switches represent three separate fabrics.

IVR Without IVR NAT or IVR Auto Topology Guidelines

Before configuring an IVR SAN fabric without IVR in NAT mode or IVR auto topology mode, consider the following general guidelines:

- Acquire a mandatory Enterprise License Package or SAN-EXTENSION license package and one active IPS card for this feature.
- If you change an FSPF link cost, ensure that the FSPF path distance (the sum of the link costs on the path) of any IVR path is less than 30,000.
- IVR-enabled VSANs can be configured when an interop mode is enabled or disabled.

This section also includes the following topics:

Domain ID Guidelines

Before configuring domain IDs, consider the following guidelines:

- Configure unique domain IDs across all VSANs and switches participating in IVR operations if you are not using IVR NAT. The following switches participate in IVR operations:
  - All edge switches in the edge VSANs (source and destination)
  - All switches in transit VSANs
- Minimize the number of switches that require a domain ID assignment. This ensures minimum traffic disruption.
- Minimize the coordination between interconnected VSANs when configuring the SAN for the first time as well as when you add each new switch.

You can configure domain IDs using one of two options:

- Configure the allowed-domains list so that the domains in different VSANs are non-overlapping on all participating switches and VSANs.
- Configure static, non-overlapping domains for each participating switch and VSAN.

Note In a configuration involving IVR without NAT, if one VSAN in the IVR topology is configured with static domain IDs, then the other VSANs (edge or transit) in the topology must be configured with static domain IDs.

Transit VSAN Guidelines

Before configuring transit VSANS, consider the following guidelines:

- Besides defining the IVR zone membership, you can choose to specify a set of transit VSANs to provide connectivity between two edge VSANs:
  - If two edge VSANs in an IVR zone overlap, then a transit VSAN is not required (though, not prohibited) to provide connectivity.
  - If two edge VSANs in an IVR zone do not overlap, you may need one or more transit VSANs to provide connectivity. Two edge VSANs in an IVR zone will not overlap if IVR is not enabled on a switch that is a member of both the source and destination edge VSANs.
- Traffic between the edge VSANs only traverses through the shortest IVR path.
- Transit VSAN information is common to all IVR zone sets. Sometimes, a transit VSAN can also act as an edge VSAN in another IVR zone.

Border Switch Guidelines

Before configuring border switches, consider the following guidelines:

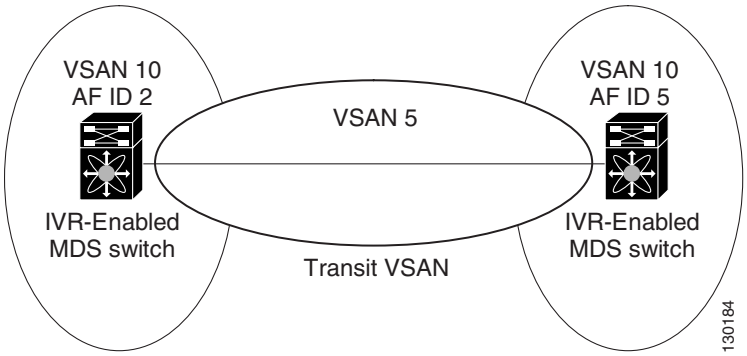
- Configure IVR only in the relevant border switches.
- Border switches require Cisco MDS SAN-OS Release 1.3(1) or later.
- A border switch must be a member of two or more VSANs.
- A border switch that facilitates IVR communications must be IVR enabled.
- IVR can also be enabled on additional border switches to provide redundant paths between active IVR zone members.
- The VSAN topology configuration must be updated before a border switch is added or removed.

Manual IVR Topology Configuration Guidelines

You must create the IVR topology on every IVR-enabled switch in the fabric if you have not enabled IVR auto topology mode. Consider the following guidelines when using IVR manual topology mode:

- You can configure a maximum of 128 IVR-enabled switches and 128 distinct VSANs in an IVR topology (see "Database Merge Guidelines" on page 1-13).
- You will need to specify the IVR topology using the following information:
  - The switch WWNs of the IVR-enabled switches.
  - A minimum of two VSANs to which the IVR-enabled switch belongs.
  - The AFID, which distinguishes two VSANs that are logically and physically separate, but have the same VSAN number. You can specify up to 64 AFIDs. See Figure 2-1.

Figure 2-1 Example IVR Topology with Non-Unique VSAN IDs Using AFIDs



- If two VSANs in an IVR topology have the same VSAN ID and different AFIDs, they count as two VSANs for the 128-VSAN limit for IVR.
- The use of a single AFID does not allow for segmented VSANs in an inter-VSAN routing topology.

FC ID Guidelines

Before configuring persistent FC IDs, consider the following:

- You can configure two types of database entries for persistent IVR FC IDs:
  - Virtual domain entries—Contain the virtual domain that should be used to represent a native VSAN in a specific VSAN (current VSAN). Virtual domain entries contain the following information:

    Native AFID

    Native VSAN

    Current AFID

    Current VSAN

    Virtual domain to be used for the native AFID and VSAN in current AFID and VSAN

  - Virtual FC ID entries—Contain the virtual FC ID that should be used to represent a device in a specific VSAN (current VSAN). Virtual FC ID entries contain the following information:

    Port WWN

    Current AFID

    Current VSAN

    Virtual FC ID to be used to represent a device for the given pWWN in the current AFID and VSAN
- If you use persistent FC IDs for IVR, we recommend that you use them for all the devices in the IVR zone set. We do not recommend using persistent FC IDs for some of the IVR devices while using automatic allocation for other devices.
- IVR NAT must be enabled to use IVR persistent FC IDs.
- In an IVR NAT configuration, if one VSAN in the IVR topology is configured with static domain IDs, then the IVR domains that can be exported to that VSAN must also be assigned static domains.

IVR Zone Configuration Guidelines

When interop mode is enabled, consider the following IVR configuration guidelines:

- When a member's native VSAN is in interop mode (for example, when the interop mode is 2, 3, or 4), then ReadOnly, the QoS attribute, and LUN zoning are not permitted.
- When a member's VSAN is already in interop mode and an attempt is made to configure ReadOnly, the QoS attribute, or LUN zoning, a warning message is displayed to indicate that the configuration is not permitted.
- When you configure ReadOnly, the QoS attribute, or LUN zoning first, and then change the member's VSAN interop mode, a warning message is displayed to indicate the configuration is not permitted. You are then prompted to change the configuration.

Advanced Fabric Services Guidelines and Limitations

The following guidelines and limitations must be considered before enabling AAM for IVR:

- CFS distribution must be enabled for IVR.
- AAM is supported only in IVR-NAT mode.
- The switches where the fabric services (such as SME and IOA) are enabled must be running the AAM supported NX-OS Release 5.0(1) or later.
- FC-Redirect can be running in version 1 or version 2 mode.
- AAM support for IVR must be enabled before enabling IVR support for FCR.
- Generation 1 modules are not supported when IVR support is enabled for FCR. Specifically, ISLs should not be configured on Generation 1 modules, and the devices that support IVR for FCR should not be connected to Generation 1 modules.
- LUN zoning is not supported when AAM is enabled for IVR.
- IVR merge is supported only when both the fabrics have AAM enabled or both the fabrics have AAM disabled. The IVR merge will fail if one of the fabric has AAM enabled and the other fabric has AAM disabled.
- You must delete all the advanced fabric service (SME and IOA) configurations for IVR devices and then disable IVR support for FCR before disabling AAM support for IVR.
- Before downgrading to an earlier release to MDS NX-OS Release 5.0(1), you must delete all of the advanced fabric service (SME and IOA) configurations for IVR devices, disable IVR support for FCR, and then disable AAM support for IVR.

Configuring Advanced Inter-VSAN Routing

This section includes the following topics:

Task Flow for Configuring Advanced Inter-VSAN Routing

To configure an advanced IVR topology in a SAN fabric, follow these steps:

	Configuration Task	Resource
Step 1	Determine whether or not to use IVR Network Address Translation (NAT).	See "IVR Network Address Translation" on page 1-6 and "IVR NAT Requirements and Guidelines" on page 1-10.
Step 2	If you do not plan to use IVR NAT, verify that unique domain IDs are configured in all switches and VSANs participating in IVR.	See "Domain ID Guidelines" on page 2-5.
Step 3	Enable IVR in the border switches.	See "Configuring IVR and IVR Zones Using the IVR Zone Wizard" on page 1-16
Step 4	Configure the service group as required.	See "IVR Service Groups" on page 2-1.
Step 5	Configure the IVR distribution as required.	
Step 6	Configure the IVR topology, either manually or automatically.	See"Manually Configuring an IVR Topology" on page 2-11 and "Configuring Basic Inter-VSAN Routing" on page 1-15.
Step 7	Create and activate IVR zone sets in *all* of the IVR-enabled border switches, either manually or using fabric distribution.	See "Advanced IVR Zones and IVR Zone Sets" on page 2-2.

Configuring IVR Service Groups

Detailed Steps

To configure an IVR service group, follow these steps:

Step 1 Expand **All VSANs**, and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Service Group** tab to display the existing service groups.

Step 3 Click the **Create Row** icon to make a new service group.

You see the service group dialog box.

Step 4 Check the switch check box for each switch involved in IVR.

Step 5 Complete the Name field for the service group and fill in the Fabric ID field for this entry.

Step 6 Enter a comma-separated list of VSAN IDs in the VSAN List text box.

Step 7 Click **Create** to create this entry or click **Cancel** to discard all changes.

Step 8 Repeat Step 1 through Step 7 for all switches and AFIDs associated with your IVR topology.

Configuring Default AFIDs

Detailed Steps

To configure default AFIDs, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Default Fabric ID** tab to display the existing default AFIDs.

Step 3 Click the **Create Row** icon to create a default AFID.

Step 4 Check the check boxes next to each switch involved in IVR that you want to use this default AFID.

Step 5 Provide a name for each switch WWN and set the default fabric ID.

Step 6 Click **Create** to create this entry.

Step 7 Repeat Step 1 through Step 6 for all default AFIDs that you want to configure in your IVR topology.

Configuring Individual AFIDs

Detailed Steps

To configure individual AFIDs, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Fabric ID** tab to display the existing AFIDs.

Step 3 Click the **Create Row** icon to create an AFID.

Step 4 Check the check box next to each switch involved in IVR that you want to use this default AFID.

Step 5 Provide a name for each switch WWN and set the fabric ID.

Step 6 Enter a comma-separated list of VSAN IDs in the VSAN List text box.

Step 7 Click **Create** to create this entry.

Step 8 Repeat Step 1 through Step 6 for all switches and AFIDs you want to configure in your IVR topology.

Configuring IVR Without NAT

Detailed Steps

To enable IVR without NAT, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Action** tab.

Step 3 Uncheck the **Enable IVR NAT** check box.

Step 4 Click the **Apply Changes** icon to distribute this change to all switches in the fabric.

Manually Configuring an IVR Topology

Restrictions

- Transit VSANs are determined based on your configuration. The IVR feature does not have an explicit transit-VSAN configuration.
- Most tabs in the Information pane for features using CFS are dimmed until you click the CFS tab. The CFS tab shows which switches have CFS enabled and shows the master switch for this feature. Once the CFS tab is clicked, the other tabs in the Information pane are activated.
- You can configure IVR using the IVR tables in the Information pane in DCNM-SAN. Use these tables only if you are familiar with all IVR concepts. We recommend you configure IVR using the IVR Wizard. See "Configuring IVR and IVR Zones Using the IVR Zone Wizard" on page 1-16.

Detailed Steps

To manually configure an IVR topology, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Local Topology** tab to display the existing IVR topology.

Step 3 Click the **Create Row** icon to create rows in the IVR topology.

Step 4 Select the switch, switch WWN, and a comma-separated list of VSAN IDs for this topology.

Step 5 Click **Create** to create this new row.

Step 6 Click the **Apply Changes** icon to create the IVR topology.

Repeat this configuration on all IVR-enabled switches or distribute the IVR configuration using CFS.

Activating a Manually Configured IVR Topology

After manually configuring the IVR topology, you must activate it.

Restrictions

- Active IVR topologies cannot be deactivated. You can only switch to IVR auto topology mode.

Detailed Steps

To activate a manually configured IVR topology, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.
You see the IVR configuration in the Information pane.

Step 2 Click the **Action** tab to display the existing IVR topology.

Step 3 Check the **Activate Local Topology** check box.

Step 4 Click the **Apply Changes** icon to activate the IVR topology.

Clearing a Manually Configured IVR Topology Database

Detailed Steps

To clear a manually created IVR topology database, follow these steps:

Step 1 Expand **All VSANs a**nd then select **IVR** in the Logical Domains pane.

Step 2 Click the **Control** tab if it is not already displayed.

Step 3 Highlight the rows you want to delete from the IVR topology.

Step 4 Click the **Delete Row** icon to delete these rows from the IVR topology.

Step 5 Click the **Apply Changes** icon to delete the IVR topology.

Migrating from IVR Auto Topology Mode to IVR Manual Topology Mode

Prerequisites

- If you want to migrate from IVR auto topology mode to IVR manual topology mode, copy the active IVR VSAN topology database to the user-configured IVR VSAN topology database before switching modes.

Detailed Steps

To migrate from IVR auto topology mode to IVR manual topology mode, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Action** tab.

Step 3 Highlight the switch on which you want to disable IVR auto topology mode.

Step 4 Uncheck the **Auto Discover Topology** check box.

Step 5 Click the **Apply Changes** icon.

Configuring Persistent FC IDs for IVR

Detailed Steps

To configure persistent FC IDs for IVR, follow these steps:

Step 1 Expand **All VSANs** and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **FCID** tab.

Step 3 Click the **Create Row** icon to create an FC ID.

Step 4 Select the switch for which you are configuring the virtual FC ID to be used to represent a device in a specific VSAN (current VSAN).

Step 5 Enter the current fabric in the **Current Fabric ID** field for the fcdomain database.

Step 6 Enter the current VSAN in the **Current VSAN ID** field for the fcdomain database.

Step 7 Enter the **pWWN.**

Step 8 Click the drop-down menu to select the FC ID to map to the pWWN you selected.

Step 9 Click **Create** to create this new row.

Configuring LUNs in IVR Zoning

LUN zoning can be used between members of active IVR zones.You can configure the service by creating and activating LUN zones between the desired IVR zone members in all relevant edge VSANs using the zoning interface or you can use LUN zoning directly supported by IVR. For more details on the advantages of LUN zoning, refer to the Cisco *MDS 9000 Family NX-OS Fabric Configuration Guide* or the *Fabric Configuration Guide, Cisco DCNM for SAN*.

Note You can configure LUN zoning in an IVR zone set setup.

Configuring QoS for IVR Zones

Note The default QoS attribute setting is low.

Detailed Steps

To configure QoS for an IVR zone, follow these steps:

Step 1 Choose **Zone > Edit Local Full Zone Database**.

You see the Edit IVR Local Full Zone Database dialog box for the VSAN you selected.

Step 2 Select **Zones** or a zone set.

Step 3 Check the **QoS** check box and set the QoS priority.

Step 4 Click **Activate** to make the changes.

Renaming IVR Zones and IVR Zone Sets

Detailed Steps

To rename an IVR zone or IVR zone set, follow these steps:

Step 1 Choose **Zone > Edit Local Full Zone Database**.

You see the Edit IVR Local Full Zone Database dialog box for the VSAN you selected.

Step 2 Click a zone or zone set in the left pane.

Step 3 Choose **Edit > Rename**.

An edit box appears around the zone or zone set name.

Step 4 Enter a new name.

Step 5 Click **Activate** or **Commit Changes**.

Configuring IVR CFS Region ID

To configure IVR CFS region, follow these steps:

Step 1 Expand **All VSANs**, and then select **IVR** in the Logical Domains pane.

You see the IVR configuration in the Information pane.

Step 2 Click the **Control** tab to enable the feature on the switch.

You see only the switches in the selected region. All switches without the IVR region configuration are a part of a default region.

Step 3 Expand **Switches** and select **CFS** in the Physical Attributes pane.

If the feature is enabled correctly, the switch appears in the CFS tab.

Step 4 Select **All Regions** and click **Create Row.**

Step 5 Enter the **Region ID** for the switch.

Step 6 Click **Activate** or **Commit Changes**.

Configuring IVR Using Read-Only Zoning

Read-only zoning (with or without LUNs) can be used between members of active IVR zones. To configure this service, you must create and activate read-only zones between the desired IVR zone members in all relevant edge VSANs using the zoning interface.

Note Read-only zoning cannot be configured in an IVR zone set setup.