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New and Changed Information

This chapter provides release-specific information for each new and changed feature in the *Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide*. The latest version of this document is available at the following Cisco website:
http://www.cisco.com/en/US/docs/switches/datacenter/sw/5_x/nx-os/multicast/command/reference/n7k_mcr_cmd_5x.html

To check for additional information about this Cisco NX-OS Release, see the *Cisco NX-OS Release Notes* available at the following Cisco website:
http://www.cisco.com/en/US/products/ps9402/prod_release_notes_list.htmll

Table 1 summarizes the new and changed features for the *Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide*, and tells you where they are documented.

Table 1 New and Changed Features for Release 5.x

Feature	Description	Changed in Release	Where Documented
Configuring lookup mode to MAC and assigning a static MAC address	You can configure IGMP snooping to use the forwarding lookup mode as MAC-based, as well as assign a static MAC address.	5.2(1)	Chapter 1, “Configuring IGMP Snooping”
Configuring PIMv4 on GRE tunnel interfaces	You can configure multicast on GRE tunnel interfaces including outgoing interfaces (OIFs).	5.2(1)	Chapter 1, “Configuring PIM and PIM6”
Configuring multicast interoperation with F Series modules	You can configure multicast interoperation with F series and M series modules.	5.1(1)	Chapter 1, “Configuring Multicast Interoperation with N7K-F132-15 Modules”
Multicast routing initial holddown period	You can specify the initial holddown period for both IPv4 and IPv6 networks.	4.2(1)	Chapter 1, “Configuring PIM or PIM6 Sparse Mode”

Table 1 New and Changed Features for Release 5.x (continued)

Feature	Description	Changed in Release	Where Documented
Use a route-map policy for commands	You can specify group prefixes in a route-map policy rather than specifying them on the command line for these commands: • **ip igmp join-group** • **ip igmp static-oif** • **ip pim rp-address** • **ip pim ssm range** • **ipv6 [icmp] mld join-group** • **ipv6 [icmp] mld static-oif** • **ipv6 pim rp-address** • **ipv6 pim ssm range**	4.2(1)	Chapter 1, “Configuring IGMP” Chapter 1, “Configuring MLD” Chapter 1, “Configuring Static RPs” Chapter 1, “Configuring SSM”
Virtual Port Channel (vPC)	Cisco NX-OS software for the Nexus 7000 Series devices does not support PIM SSM or BIDR on vPC. Cisco NX-OS software fully supports PIM ASM on vPC.	4.1(4)	Chapter 1, “Virtual Port Channels and Multicast”
Virtual Port Channel (vPC)	A virtual port channel (vPC) allows a single device to use a port channel across two upstream switches.	4.1(3)	Chapter 1, “Virtual Port Channels and Multicast” Chapter 1, “Verifying the IGMP Configuration” Chapter 1, “Configuring ASM and Bidir” Chapter 1, “Guidelines and Limitations for IGMP Snooping” Chapter 1, “Displaying IGMP Snooping Statistics”
Immediate leave	Option that minimizes the leave latency of IGMPv2 or MLDv1 group memberships on a given IGMP or MLD interface because the device does not send group-specific queries.	4.1(3)	Chapter 1, “Configuring IGMP Interface Parameters” Chapter 1, “Configuring MLD Interface Parameters”

Preface

This preface describes the audience, organization, and conventions of the *Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide*. It also provides information on how to obtain related documentation.

This chapter includes the following sections:

Audience

This publication is for experienced users who configure and maintain Cisco NX-OS devices.

Organization

This reference is organized as follows:

Chapter and Title	Description
Chapter 1, “Overview”	Describes the Cisco NX-OS multicast features.
Chapter 1, “Configuring IGMP”	Describes how to configure the Cisco NX-OS IGMP features.
Chapter 1, “Configuring MLD”	Describes how to configure the Cisco NX-OS MLD features.
Chapter 1, “Configuring PIM and PIM6”	Describes how to configure the Cisco NX-OS PIM and PIM6 features.
Chapter 1, “Configuring IGMP Snooping”	Describes how to configure the Cisco NX-OS IGMP snooping feature.
Chapter 1, “Configuring MSDP”	Describes how to configure the Cisco NX-OS MSDP feature.

Chapter and Title	Description
Chapter 1, "Configuring Multicast Interoperation with N7K-F132-15 Modules."	Describes how to configure multicast interoperation with F series and M series modules.
Appendix 1, "IETF RFCs for IP Multicast"	Contains the RFCs related to the Cisco NX-OS multicast features.

Document Conventions

Command descriptions use these conventions:

Convention	Description
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.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.

Screen examples use these conventions:

`screen font`	Terminal sessions and information that 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.

Tip Means *the following information will help you solve a problem.*

Related Documentation

Cisco NX-OS includes the following documents:

Release Notes

Cisco Nexus 7000 Series NX-OS Release Notes, Release 5.x

NX-OS Configuration Guides

Cisco Nexus 7000 Series NX-OS Configuration Examples, Release 5.x
Configuring the Cisco Nexus 2000 Series Fabric Extender
Cisco Nexus 7000 Series NX-OS FabricPath Configuration Guide
Configuring Feature Set for FabricPath
Cisco NX-OS FCoE Configuration Guide for Cisco Nexus 7000 and Cisco MDS 9500
Cisco Nexus 7000 Series NX-OS Fundamentals Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS Layer 2 Switching Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS LISP Configuration Guide
Cisco Nexus 7000 Series NX-OS MPLS Configuration Guide
Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS OTV Configuration Guide
Cisco Nexus 7000 Series OTV Quick Start Guide
Cisco Nexus 7000 Series NX-OS Quality of Service Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS SAN Switching Configuration Guide
Cisco Nexus 7000 Series NX-OS Security Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS System Management Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 5.x
Cisco Nexus 7000 Series NX-OS Virtual Device Context Quick Start, Release 5.x

NX-OS Command References

Cisco Nexus 7000 Series NX-OS Command Reference Master Index
Cisco Nexus 7000 Series NX-OS FabricPath Command Reference
Cisco NX-OS FCoE Command Reference for Cisco Nexus 7000 and Cisco MDS 9500
Cisco Nexus 7000 Series NX-OS Fundamentals Command Reference
Cisco Nexus 7000 Series NX-OS High Availability Command Reference
Cisco Nexus 7000 Series NX-OS Interfaces Command Reference
Cisco Nexus 7000 Series NX-OS Layer 2 Switching Command Reference

Cisco Nexus 7000 Series NX-OS LISP Command Reference

Cisco Nexus 7000 Series NX-OS MPLS Command Reference

Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference

Cisco Nexus 7000 Series NX-OS OTV Command Reference

Cisco Nexus 7000 Series NX-OS Quality of Service Command Reference

Cisco Nexus 7000 Series NX-OS SAN Switching Command Reference

Cisco Nexus 7000 Series NX-OS Security Command Reference

Cisco Nexus 7000 Series NX-OS System Management Command Reference

Cisco Nexus 7000 Series NX-OS Unicast Routing Command Reference

Cisco Nexus 7000 Series NX-OS Virtual Device Context Command Reference

Other Software Documents

Cisco NX-OS Licensing Guide

Cisco Nexus 7000 Series NX-OS MIB Quick Reference

Cisco Nexus 7000 Series NX-OS Software Upgrade and Downgrade Guide, Release 5.x

Cisco NX-OS System Messages Reference

Cisco Nexus 7000 Series NX-OS Troubleshooting Guide

Cisco NX-OS XML Interface User Guide

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

Overview

This chapter describes the multicast features of Cisco NX-OS.

This chapter includes the following sections:

Information About Multicast

IP multicast is a method of forwarding the same set of IP packets to a number of hosts within a network. You can use multicast in both IPv4 and IPv6 networks to provide efficient delivery of data to multiple destinations.

Note Beginning with Cisco NX-OS Release 5.2(1) for the Nexus 7000 Series devices, you can configure Protocol-Independent Multicast v4 (PIMv4) to run over generic routing encapsulation (GRE) tunnels including outgoing interfaces (OIF).
In prior Cisco NX-OS releases, tunnel interfaces do not support PIM.

Multicast involves both a method of delivery and discovery of senders and receivers of multicast data, which is transmitted on IP multicast addresses called groups. A multicast address that includes a group and source IP address is often referred to as a channel. The Internet Assigned Number Authority (IANA) has assigned 224.0.0.0 through 239.255.255.255 as IPv4 multicast addresses. For more information, see http://www.iana.org/assignments/multicast-addresses.

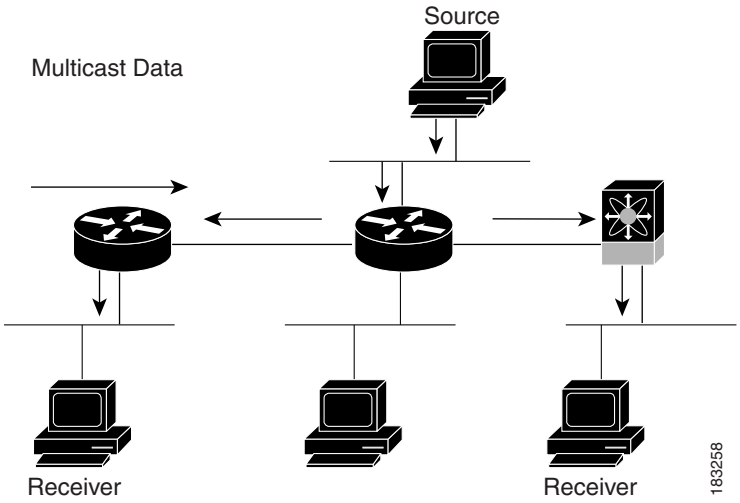
IPv6 multicast addresses begin with 0xFF. The IPv6 addressing architecture is defined by RFC 4291. For more information about the IANA reserved addresses, see http://www.iana.org/assignments/ipv6-multicast-addresses.

Note For a complete list of RFCs related to multicast, see Appendix 1, "IETF RFCs for IP Multicast."

The routers in the network listen for receivers to advertise their interest in receiving multicast data from selected groups. The routers then replicate and forward the data from sources to the interested receivers. Multicast data for a group is transmitted only to those LAN segments with receivers that requested it.

Figure 1-1 shows one source transmitting multicast data that is delivered to two receivers. In the figure, because the center host is on a LAN segment where no receiver requested multicast data, no data is delivered to that receiver.

Figure 1-1 Multicast Traffic from One Source to Two Receivers



This section includes the following topics:

Multicast Distribution Trees

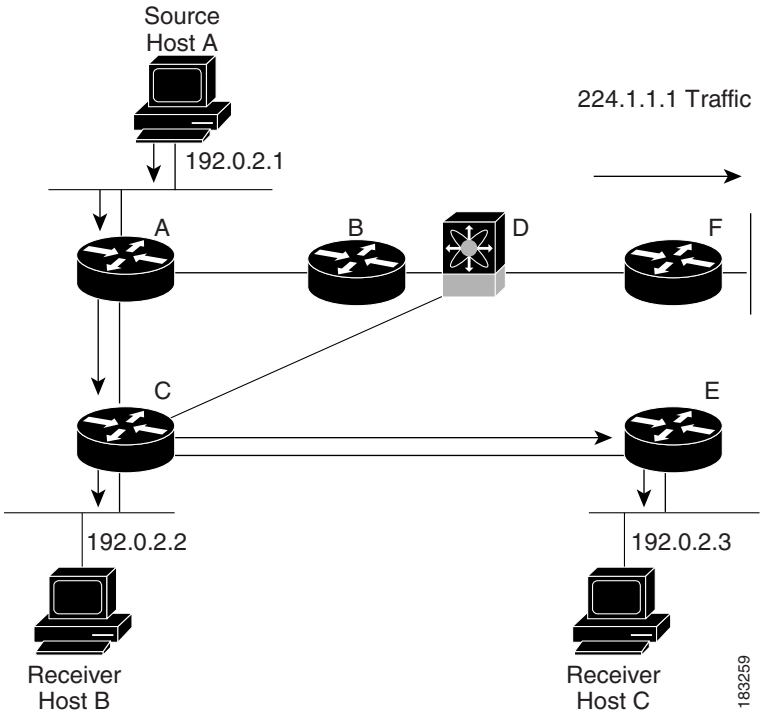
A multicast distribution tree represents the path that multicast data takes between the routers that connect sources and receivers. The multicast software builds different types of trees to support different multicast methods.

This section includes the following topics:

Source Trees

A source tree represents the shortest path that the multicast traffic takes through the network from the sources that transmit to a particular multicast group to receivers that requested traffic from that same group. Because of the shortest path characteristic of a source tree, this tree is often referred to as a shortest path tree (SPT). Figure 1-2 shows a source tree for group 224.1.1.1 that begins at host A and connects to hosts B and C.

Figure 1-2 Source Tree

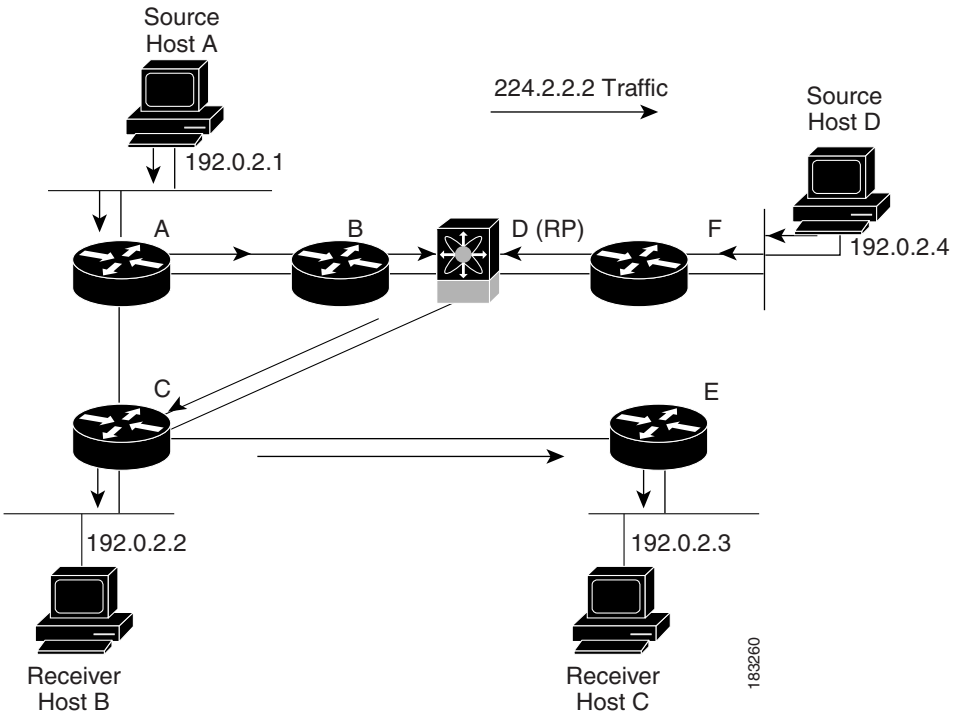


The notation (S, G) represents the multicast traffic from source S on group G. The SPT in Figure 1-2 is written (192.0.2.1, 224.1.1.1). Multiple sources can be transmitting on the same group.

Shared Trees

A shared tree represents the shared distribution path that the multicast traffic takes through the network from a shared root or rendezvous point (RP) to each receiver. (The RP creates an SPT to each source.) A shared tree is also called an RP tree (RPT). Figure 1-3 shows a shared tree for group 224.1.1.1 with the RP at router D. Source hosts A and D send their data to router D, the RP, which then forwards the traffic to receiver hosts B and C.

Figure 1-3 Shared Tree

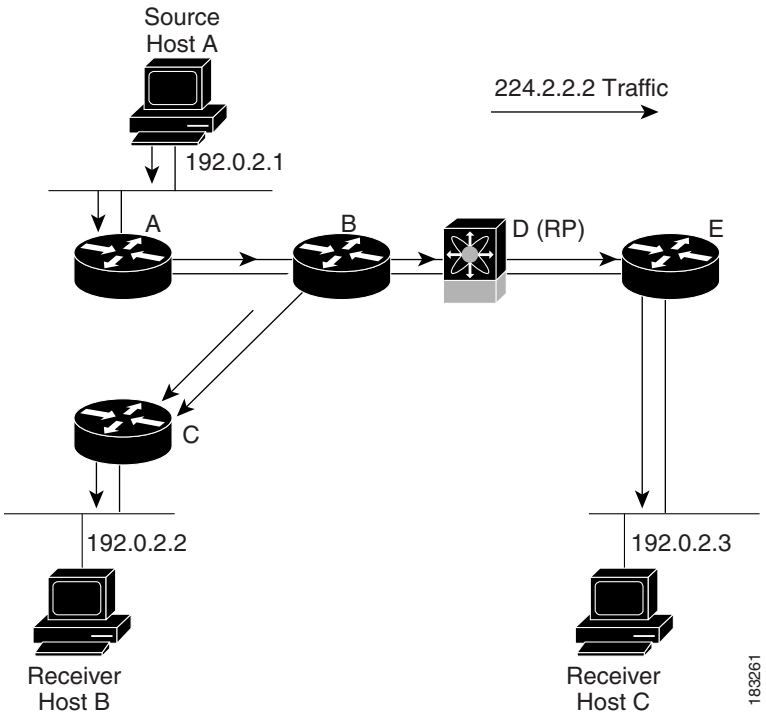


The notation (*, G) represents the multicast traffic from any source on group G. The shared tree in Figure 1-3 is written (*, 224.2.2.2).

Bidirectional Shared Trees

A bidirectional shared tree represents the shared distribution path that the multicast traffic takes through the network from a shared root, or rendezvous point (RP), to each receiver. Multicast data is forwarded to receivers encountered on the way to the RP. The advantage of the bidirectional shared tree is shown in Figure 1-4. Multicast traffic flows directly from host A to host B through routers B and C. In a shared tree, the data from source host A is first sent to the RP (router D) and then forwarded to router B for delivery to host B.

Figure 1-4 Bidirectional Shared Tree



The notation (*, G) represents the multicast traffic from any source on group G. The bidirectional tree in Figure 1-4 is written (*, 224.2.2.2).

Multicast Forwarding

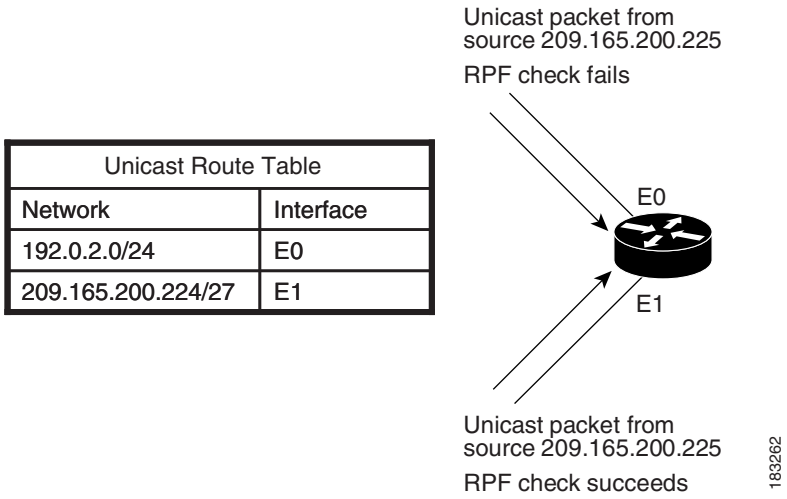
Because multicast traffic is destined for an arbitrary group of hosts, the router uses reverse path forwarding (RPF) to route data to active receivers for the group. When receivers join a group, a path is formed either toward the source (SSM mode) or the RP (ASM or Bidir mode). The path from a source to a receiver flows in the reverse direction from the path that was created when the receiver joined the group.

For each incoming multicast packet, the router performs an RPF check. If the packet arrives on the interface leading to the source, the packet is forwarded out each interface in the outgoing interface (OIF) list for the group. Otherwise, the router drops the packet.

Note In Bidir mode, if a packet arrives on a non-RPF interface, and the interface was elected as the designated forwarder (DF), then the packet is also forwarded in the upstream direction toward the RP. For more information about DFs, see the "Designated Forwarders" section on page 1-17.

Figure 1-5 shows an example of RPF checks on packets coming in from different interfaces. The packet that arrives on E0 fails the RPF check because the unicast route table lists the source of the network on interface E1. The packet that arrives on E1 passes the RPF check because the unicast route table lists the source of that network on interface E1.

Figure 1-5 RPF Check Example



Cisco NX-OS PIM and PIM6

Cisco NX-OS supports multicasting with Protocol Independent Multicast (PIM) sparse mode. PIM is IP routing protocol independent and can leverage whichever unicast routing protocols are used to populate the unicast routing table. In PIM sparse mode, multicast traffic is sent only to locations of the network that specifically request it. PIM dense mode is not supported by Cisco NX-OS.

Note In this publication, the term "PIM" is used for PIM sparse mode version 2.

To access multicast commands, you must enable the PIM or PIM6 feature. Multicast is enabled only after you enable PIM or PIM6 on an interface of each router in a domain. You configure PIM for an IPv4 network and PIM6 for an IPv6 network. By default, IGMP and MLD are running on the system.

PIM, which is used between multicast-capable routers, advertises group membership across a routing domain by constructing multicast distribution trees. PIM builds shared distribution trees on which packets from multiple sources are forwarded, as well as source distribution trees, on which packets from a single source are forwarded.

The distribution trees change automatically to reflect the topology changes due to link or router failures. PIM dynamically tracks both multicast-capable sources and receivers, although the source state is not created in Bidir mode.

The router uses the unicast routing table and RPF routes for multicast to create multicast routing information. In Bidir mode, additional routing information is created.

Note In this publication, "PIM for IPv4" and "PIM6 for IPv6" refer to the Cisco NX-OS implementation of PIM sparse mode. A PIM domain can include both an IPv4 and an IPv6 network.

Figure 1-6 shows two PIM domains in an IPv4 network.

Figure 1-6 PIM Domains in an IPv4 Network

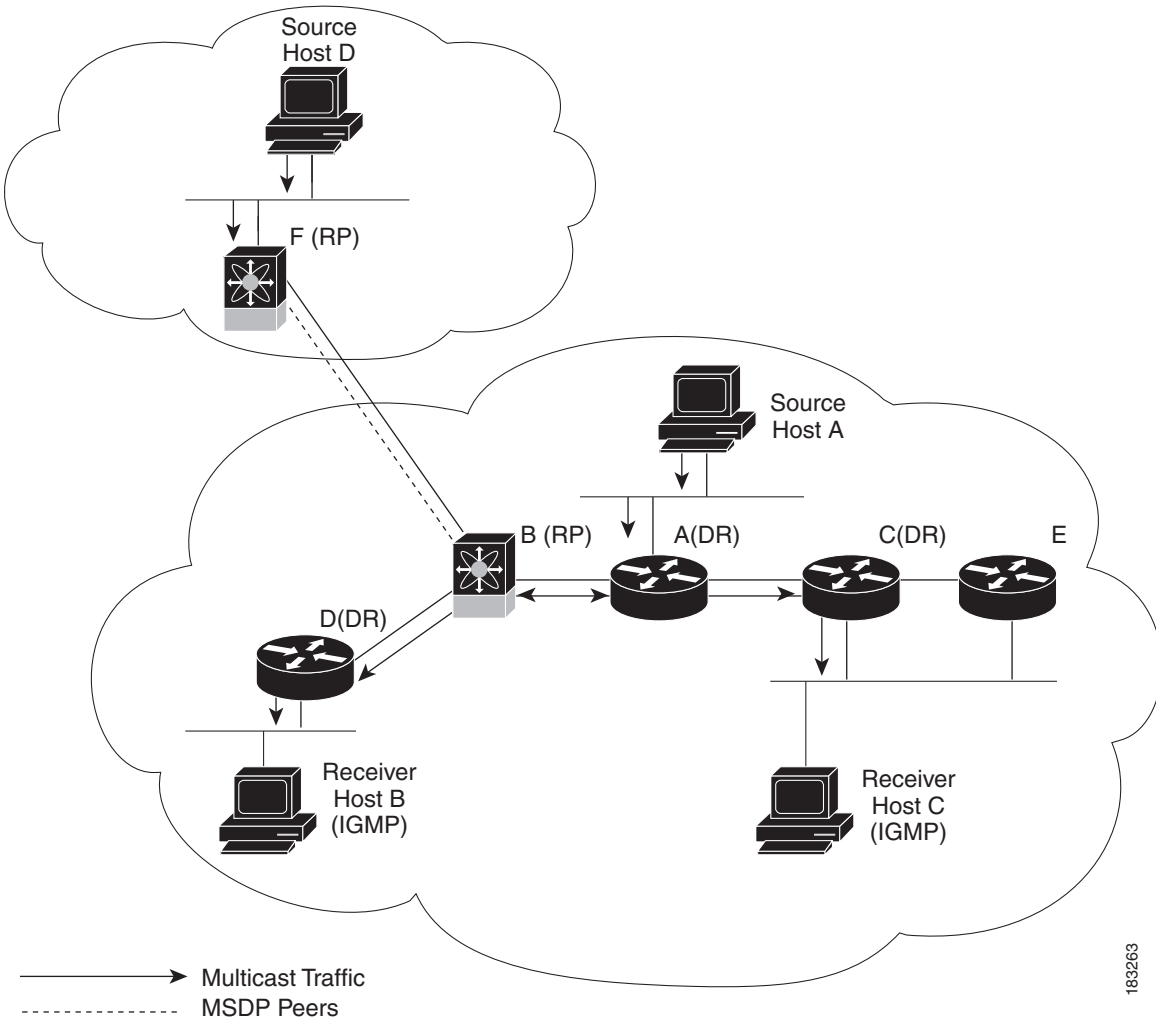


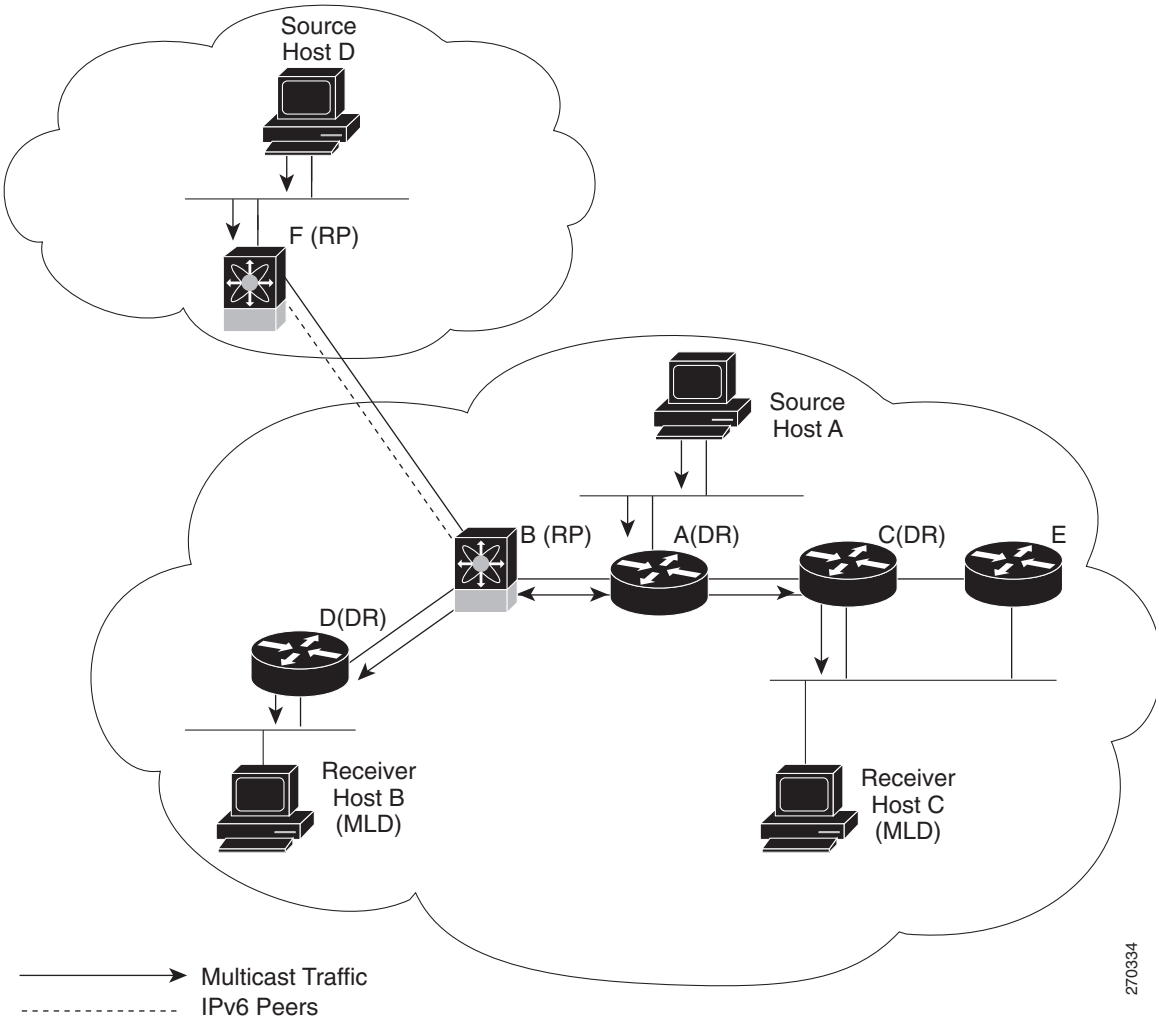
Figure 1-6 shows the following elements of PIM:

- The lines with arrows show the path of the multicast data through the network. The multicast data originates from the sources at hosts A and D.
- The dashed line connects routers B and F, which are Multicast Source Discovery Protocol (MSDP) peers. MSDP supports the discovery of multicast sources in other PIM domains.
- Hosts B and C receive multicast data by using Internet Group Management Protocol (IGMP) to advertise requests to join a multicast group.
- Routers A, C, and D are designated routers (DRs). When more than one router is connected to a LAN segment, such as C and E, the PIM software chooses one router to be the DR so that only one router is responsible for putting multicast data on the segment.

Router B is the rendezvous point (RP) for one PIM domain and router F is the RP for the other PIM domain. The RP provides a common point for connecting sources and receivers within a PIM domain.

Figure 1-7 shows two PIM6 domains in an IPv6 network. In an IPv6 network, receivers that want to receive multicast data use the Multicast Listener Discovery (MLD) protocol to advertise requests to join a multicast group. MSDP, which allows for discovery of multicast sources in other PIM domains, is not supported for IPv6. You can configure IPv6 peers and use Source-Specific Multicast (SSM) and Multiprotocol BGP (MBGP) to forward multicast data between PIM6 domains. For more information, see the "Interdomain Multicast" section on page 1-10.

Figure 1-7 PIM6 Domains in an IPv6 Network



PIM supports three multicast modes for connecting sources and receivers:

- Any source multicast (ASM)
- Source-specific multicast (SSM)
- Bidirectional shared trees (Bidir)

Cisco NX-OS supports a combination of these modes for different ranges of multicast groups. You can also define RPF routes for multicast.

This section includes the following topics:

ASM

Any Source Multicast (ASM) is a PIM tree building mode that uses shared trees to discover new sources and receivers as well as source trees to form shortest paths from receivers to sources. The shared tree uses a network node as the root, called the rendezvous point (RP). The source tree is rooted at first-hop routers, directly attached to each source that is an active sender. The ASM mode requires an RP for a group range. An RP can be configured statically or learned dynamically by the Auto-RP or BSR group-to-RP discovery protocols. If an RP is learned and is not known to be a Bidir-RP, the group operates in ASM mode.

The ASM mode is the default mode when you configure RPs.

For information about configuring ASM, see the "Configuring ASM and Bidir" section on page 1-29.

Bidir

Bidirectional shared trees (Bidir) is a PIM mode that, like the ASM mode, builds a shared tree between receivers and the RP, but does not support switching over to a source tree when a new receiver is added to a group. In the Bidir mode, the router that is connected to a receiver is called the designated forwarder because multicast data can be forwarded directly from the designated router (DR) to the receiver without first going to the RP. The Bidir mode requires that you configure an RP.

The Bidir mode can reduce the amount of resources required on a router when there are many multicast sources and can continue to operate whether or not the RP is operational or connected.

For information about configuring Bidir, see the "Configuring ASM and Bidir" section on page 1-29.

SSM

Source-Specific Multicast (SSM) is a PIM mode that builds a source tree that originates at the designated router on the LAN segment that receives a request to join a multicast source. Source trees are built by sending PIM join messages in the direction of the source. The SSM mode does not require you to configure RPs.

The SSM mode allows receivers to connect to sources outside the PIM domain.

For information about configuring SSM, see the "Configuring SSM" section on page 1-42.

RPF Routes for Multicast

You can configure static multicast RPF routes to override what the unicast routing table uses. This feature is used when the multicast topology is different than the unicast topology.

For information about configuring RPF routes for multicast, see the "Configuring RPF Routes for Multicast" section on page 1-44.

IGMP and MLD

By default, the Internet Group Management Protocol (IGMP) for PIM and Multicast Listener Discovery (MLD) for PIM6 are running on the system.

IGMP and MLD protocols are used by hosts that want to receive multicast data to request membership in multicast groups. Once the group membership is established, multicast data for the group is directed to the LAN segment of the requesting host.

You can configure IGMPv2 or IGMPv3 on an interface. You will usually configure IGMPv3 to support SSM mode. By default, the software enables IGMPv2.

You can configure MLDv1 or MLDv2 on an interface. You will usually configure MLDv2 to support SSM mode. By default, the software enables MLDv2.

For information about configuring IGMP and MLD, see Chapter 1, "Configuring IGMP" and Chapter 1, "Configuring MLD."

IGMP Snooping

IGMP snooping is a feature that limits multicast traffic on VLANs to the subset of ports that have known receivers. By examining (snooping) IGMP membership report messages from interested hosts, multicast traffic is sent only to VLAN ports that interested hosts reside on. By default, IGMP snooping is running on the system.

For information about configuring IGMP snooping, see Chapter 1, "Configuring IGMP Snooping."

Interdomain Multicast

Cisco NX-OS provides several methods that allow multicast traffic to flow between PIM domains.

This section includes the following topics:

SSM

The PIM software uses SSM to construct a shortest path tree from the designated router for the receiver to a known source IP address, which may be in another PIM domain. The ASM and Bidir modes cannot access sources from another PIM domain without the use of another protocol.

Once you enable PIM or PIM6 in your networks, you can use SSM to reach any multicast source that has an IP address known to the designated router for the receiver.

For information about configuring SSM, see the "Configuring SSM" section on page 1-42.

MSDP

Multicast Source Discovery Protocol (MSDP) is a multicast routing protocol that is used with PIM to support the discovery of multicast sources in different PIM domains.

Note Cisco NX-OS supports the PIM Anycast-RP, which does not require MSDP configuration. For information about PIM Anycast-RP, see the "Configuring a PIM Anycast-RP Set" section on page 1-37.

For information about MSDP, see Chapter 1, "Configuring MSDP."

MBGP

Multiprotocol BGP (MBGP) defines extensions to BGP4 that enable routers to carry multicast routing information. PIM and PIM6 can use this multicast information to reach sources in external BGP autonomous systems.

For information about MBGP, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Command Reference, Release 5.x*.

MRIB and M6RIB

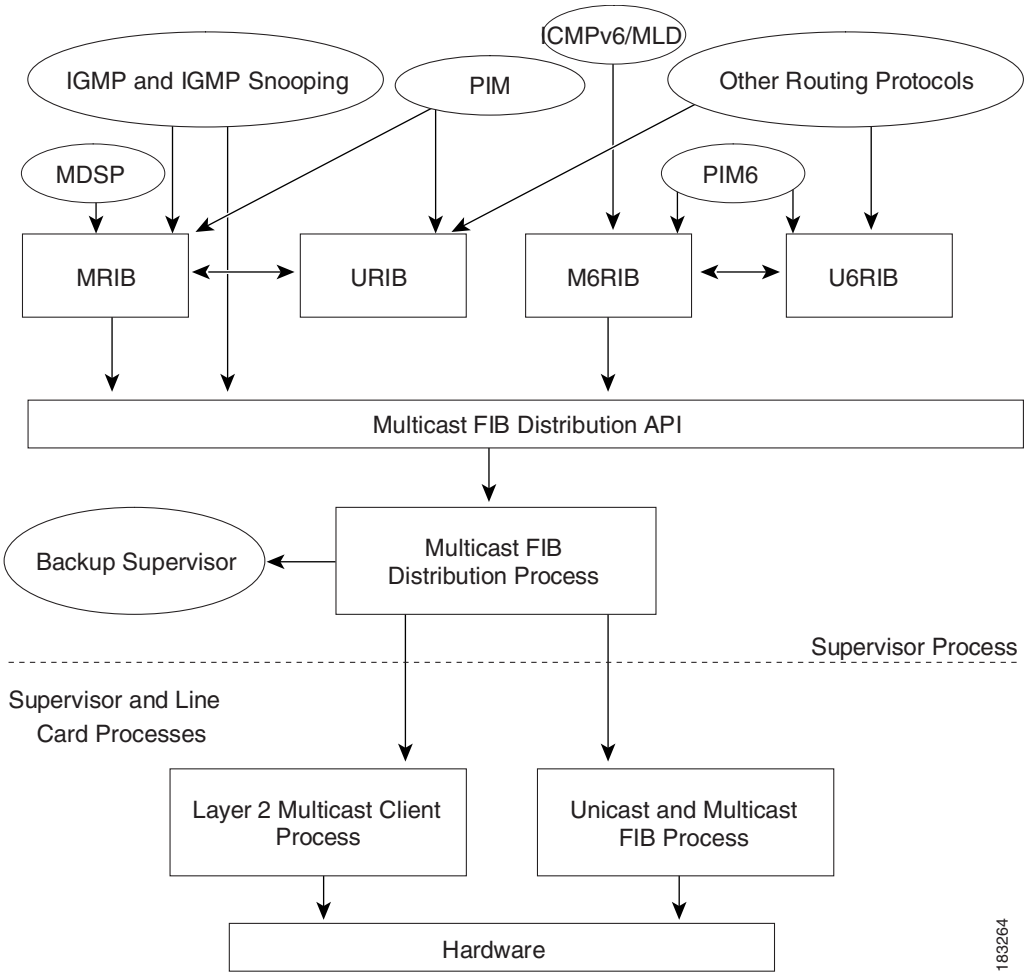
The Cisco NX-OS IPv4 Multicast Routing Information Base (MRIB) is a repository for route information that is generated by multicast protocols such as PIM and IGMP. The MRIB does not affect the route information itself. The MRIB maintains independent route information for each virtual routing and forwarding (VRF) instance in a virtual device context (VDC). For more information about VDCs, see the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*.

Similar to the MRIB for IPv4 routing information, the M6RIB maintains IPv6 routing information that is generated by protocols such as PIM6 and MLD.

Figure 1-8 shows the major components of the Cisco NX-OS multicast software architecture:

- The Multicast FIB (MFIB and M6FIB) Distribution (MFDM) API defines an interface between the multicast Layer 2 and Layer 3 control plane modules, including the MRIB and M6RIB, and the platform forwarding plane. The control plane modules send the Layer 3 route update and Layer 2 lookup information using the MFDM API.
- The multicast FIB distribution process distributes the multicast update messages to all the relevant modules and the standby supervisor. It runs only on the supervisor.
- The Layer 2 multicast client process sets up the Layer 2 multicast hardware forwarding path. It runs on both the supervisor and the modules.
- The unicast and multicast FIB process manages the Layer 3 hardware forwarding path. It runs on both the supervisor and the modules.

Figure 1-8 Cisco NX-OS Multicast Software Architecture



Virtual Port Channels and Multicast

A virtual port channel (vPC) allows a single device to use a port channel across two upstream switches. When you configure a vPC, the following multicast features may be affected:

- PIM and PIM6—Cisco NX-OS software for the Nexus 7000 Series devices does not support PIM SSM or BIDR on a vPC. Cisco NX-OS software fully supports PIM ASM on a vPC.
- IGMP snooping—You should configure the vPC peers identically. For configuration guidelines, see Chapter 1, “Configuring IGMP Snooping.”

For more information about vPCs, see the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide, Release 5.x*.

Maximum Transmission Unit Limitation

On the Cisco NX-OS software for the Nexus 7000 Series devices, the Maximum Transmission Unit (MTU) for a given mroute is equal to the smallest MTU of the OIF. Packets exceeding that MTU value are dropped and not multicast routed to any of the OIFs for that mroute.

Multicasting with both F Series and M Series Modules in a Chassis

Beginning with Cisco NX-OS Release 5.1, you can add an F Series module, which is a Layer 2-only module, into the Cisco Nexus 7000 Series chassis. When you add this module to a chassis that already contains M Series modules, you can provision multicasting.

See Chapter 1, "Configuring Multicast Interoperation with N7K-F132-15 Modules" for information about this functionality.

Licensing Requirements for Multicast

The multicast features that require a license are as follows:

- PIM and PIM6
- MSDP

For information about multicast licensing, see the "Licensing Requirements for PIM and PIM6" section on page 1-18 and the "Licensing Requirements for MSDP" section on page 1-3.

The multicast features that require no license are as follows:

- IGMP
- MLD
- IGMP snooping

For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

High-Availability Requirements for Multicast

After a multicast routing protocol is restarted, its state is recovered from the MRIB process. When a supervisor switchover occurs, the MRIB recovers its state from the hardware, and the multicast protocols recover their state from periodic message activity. For more information about high availability, see the *Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide, Release 5.x.*

Additional References

For additional information related to implementing multicast, see the following sections:

- Related Documents, page 1-14
- Appendix 1, "IETF RFCs for IP Multicast"
- Technical Assistance, page 1-14

Related Documents

Related Topic	Document Title
VDCs	*Cisco Nexus 7000 Series NX-OS Virtual Device Context Command Reference, Release 5.x*
CLI Commands	*Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

CHAPTER 1

Configuring IGMP

This chapter describes how to configure the Internet Group Management Protocol (IGMP) on Cisco NX-OS devices for IPv4 networks.

This chapter includes the following sections:

Information About IGMP

IGMP is an IPv4 protocol that a host uses to request multicast data for a particular group. Using the information obtained through IGMP, the software maintains a list of multicast group or channel memberships on a per-interface basis. The systems that receive these IGMP packets send multicast data that they receive for requested groups or channels out the network segment of the known receivers.

By default, the IGMP process is running. You cannot enable IGMP manually on an interface. IGMP is automatically enabled when you perform one of the following configuration tasks on an interface:

- Enable PIM
- Statically bind a local multicast group
- Enable link-local group reports

This section includes the following topics:

IGMP Versions

The device supports IGMPv2 and IGMPv3, as well as IGMPv1 report reception.

By default, the software enables IGMPv2 when it starts the IGMP process. You can enable IGMPv3 on interfaces where you want its capabilities.

IGMPv3 includes the following key changes from IGMPv2:

- Support for Source-Specific Multicast (SSM), which builds shortest path trees from each receiver to the source, through the following features:
  - Host messages that can specify both the group and the source.
  - The multicast state that is maintained for groups and sources, not just for groups as in IGMPv2.
- Hosts no longer perform report suppression, which means that hosts always send IGMP membership reports when an IGMP query message is received.

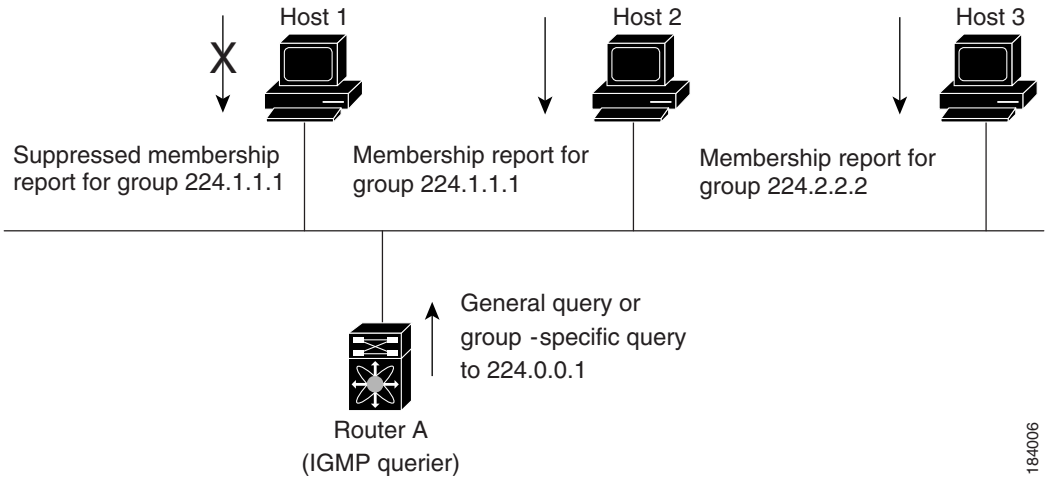
For detailed information about IGMPv2, see RFC 2236.

For detailed information about IGMPv3, see RFC 3376.

IGMP Basics

The basic IGMP process of a router that discovers multicast hosts is shown in Figure 1-1. Hosts 1, 2, and 3 send unsolicited IGMP membership report messages to initiate receiving multicast data for a group or channel.

Figure 1-1 IGMPv1 and IGMPv2 Query-Response Process



In Figure 1-1, router A, which is the IGMP designated querier on the subnet, sends query messages to the all-hosts multicast group at 224.0.0.1 periodically to discover whether any hosts want to receive multicast data. You can configure the group membership timeout value that the router uses to determine that no members of a group or source exist on the subnet. For more information about configuring the IGMP parameters, see the "Configuring IGMP Interface Parameters" section on page 1-6.

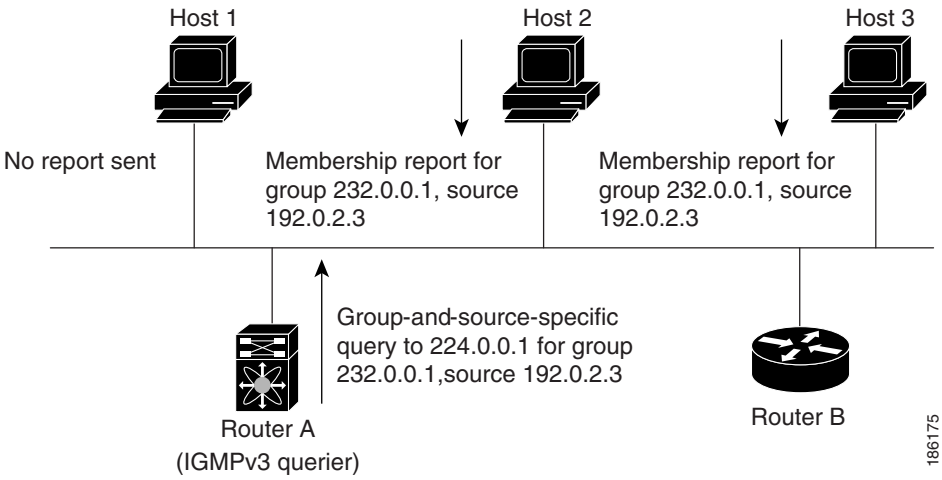
The software elects a router as the IGMP querier on a subnet if it has the lowest IP address. As long as a router continues to receive query messages from a router with a lower IP address, it resets a timer that is based on its querier timeout value. If the querier timer of a router expires, it becomes the designated querier. If that router later receives a host query message from a router with a lower IP address, it drops its role as the designated querier and sets its querier timer again.

In Figure 1-1, host 1's membership report is suppressed and host 2 sends its membership report for group 224.1.1.1 first. Host 1 receives the report from host 2. Because only one membership report per group needs to be sent to the router, other hosts suppress their reports to reduce network traffic. Each host waits for a random time interval to avoid sending reports at the same time. You can configure the query maximum response time parameter to control the interval in which hosts randomize their responses.

Note IGMPv1 and IGMPv2 membership report suppression occurs only on hosts that are connected to the same port.

In Figure 1-2, router A sends the IGMPv3 group-and-source-specific query to the LAN. Hosts 2 and 3 respond to the query with membership reports that indicate that they want to receive data from the advertised group and source. This IGMPv3 feature supports SSM. For information about configuring SSM translation to support SSM for IGMPv1 and IGMPv2 hosts, see the "Configuring an IGMP SSM Translation" section on page 1-11.

Figure 1-2 IGMPv3 Group-and-Source-Specific Query



Note IGMPv3 hosts do not perform IGMP membership report suppression.

Messages sent by the designated querier have a time-to-live (TTL) value of 1, which means that the messages are not forwarded by the directly connected routers on the subnet. You can configure the frequency and number of query messages sent specifically for IGMP startup, and you can configure a short query interval at startup so that the group state is established as quickly as possible. Although usually unnecessary, you can tune the query interval used after startup to a value that balances the responsiveness to host group membership messages and the traffic created on the network.

Caution Changing the query interval can severely impact multicast forwarding.

When a multicast host leaves a group, a host that runs IGMPv2 or later sends an IGMP leave message. To check if this host is the last host to leave the group, the software sends an IGMP query message and starts a timer that you can configure called the last member query response interval. If no reports are received before the timer expires, the software removes the group state. The router continues to send multicast traffic for a group until its state is removed.

You can configure a robustness value to compensate for packet loss on a congested network. The robustness value is used by the IGMP software to determine the number of times to send messages.

Link local addresses in the range 224.0.0.0/24 are reserved by the Internet Assigned Numbers Authority (IANA). Network protocols on a local network segment use these addresses; routers do not forward these addresses because they have a TTL of 1. By default, the IGMP process sends membership reports only for nonlink local addresses, but you can configure the software to send reports for link local addresses.

For more information about configuring the IGMP parameters, see the "Configuring IGMP Interface Parameters" section on page 1-6.

Virtualization Support

A virtual device context (VDC) is a logical representation of a set of system resources. Within each VDC, you can define multiple virtual routing and forwarding (VRF) instances. One IGMP process can run per VDC. The IGMP process supports all VRFs in that VDC and performs the function of IGMP snooping within that VDC. For information about IGMP snooping, see Chapter 1, "Configuring IGMP Snooping."

You can use the **show** commands with a VRF argument to provide a context for the information displayed. The default VRF is used if no VRF argument is supplied.

For information about configuring VDCs, see the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*.

For information about configuring VRFs, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

Licensing Requirements for IGMP

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	IGMP requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for IGMP

IGMP has the following prerequisites:

- You are logged onto the device.
- You are in the correct virtual device context (VDC). A VDC is a logical representation of a set of system resources. You can use the **switchto vdc** command with a VDC number.

- For global configuration commands, you are in the correct virtual routing and forwarding (VRF) mode. The default configuration mode shown in the examples in this chapter applies to the default VRF.

Default Settings for IGMP

Table 1-1 lists the default settings for IGMP parameters.

Table 1-1 Default IGMP Parameters

Parameters	Default
IGMP version	2
Startup query interval	30 seconds
Startup query count	2
Robustness value	2
Querier timeout	255 seconds
Query timeout	255 seconds
Query max response time	10 seconds
Query interval	125 seconds
Last member query response interval	1 second
Last member query count	2
Group membership timeout	260 seconds
Report link local multicast groups	Disabled
Enforce router alert	Disabled
Immediate leave	Disabled

Configuring IGMP Parameters

You can configure the IGMP global and interface parameters to affect the operation of the IGMP process.

This section includes the following topics:

- Configuring IGMP Interface Parameters, page 1-6
- Configuring an IGMP SSM Translation, page 1-11
- Configuring the Enforce Router Alert Option Check, page 1-12
- Restarting the IGMP Process, page 1-13

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Configuring IGMP Interface Parameters

You can configure the optional IGMP interface parameters described in Table 1-2.

Table 1-2 IGMP Interface Parameters

Parameter	Description
IGMP version	IGMP version that is enabled on the interface. The IGMP version can be 2 or 3. The default is 2.
Static multicast groups	Multicast groups that are statically bound to the interface. You can configure the groups to join the interface with the (*, G) state or specify a source IP to join with the (S, G) state. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** Although you can configure the (S, G) state, the source tree is built only if you enable IGMPv3. For information about SSM translation, see the "Configuring an IGMP SSM Translation" section on page 1-11. You can configure a multicast group on all the multicast-capable routers on the network so that pinging the group causes all the routers to respond.
Static multicast groups on OIF	Multicast groups that are statically bound to the output interface. You can configure the groups to join the output interface with the (*, G) state or specify a source IP to join with the (S, G) state. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** Although you can configure the (S, G) state, the source tree is built only if you enable IGMPv3. For information about SSM translation, see the "Configuring an IGMP SSM Translation" section on page 1-11.
Startup query interval	Startup query interval. By default, this interval is shorter than the query interval so that the software can establish the group state as quickly as possible. Values range from 1 to 18,000 seconds. The default is 31 seconds.
Startup query count	Number of queries sent at startup that are separated by the startup query interval. Values range from 1 to 10. The default is 2.
Robustness value	Robustness variable that you can tune to reflect expected packet loss on a congested network. You can increase the robustness variable to increase the number of times that packets are resent. Values range from 1 to 7. The default is 2.
Querier timeout	Number of seconds that the software waits after the previous querier has stopped querying and before it takes over as the querier. Values range from 1 to 65,535 seconds. The default is 255 seconds.
Query max response time	Maximum response time advertised in IGMP queries. You can tune the burstiness of IGMP messages on the network by setting a larger value so that host responses are spread out over a longer time. This value must be less than the query interval. Values range from 1 to 25 seconds. The default is 10 seconds.

Table 1-2 IGMP Interface Parameters (continued)

Parameter	Description
Query interval	Frequency at which the software sends IGMP host query messages. You can tune the number of IGMP messages on the network by setting a larger value so that the software sends IGMP queries less often. Values range from 1 to 18,000 seconds. The default is 125 seconds.
Last member query response interval	Interval in which the software sends a response to an IGMP query after receiving a host leave message from the last known active host on the subnet. If no reports are received in the interval, the group state is deleted. You can use this value to tune how quickly the software stops transmitting on the subnet. The software can detect the loss of the last member of a group or source more quickly when the values are smaller. Values range from 1 to 25 seconds. The default is 1 second.
Last member query count	Number of times that the software sends an IGMP query, separated by the last member query response interval, in response to a host leave message from the last known active host on the subnet. Values range from 1 to 5. The default is 2. **Caution** Setting this value to 1 means that a missed packet in either direction causes the software to remove the multicast state from the queried group or channel. The software may wait until the next query interval before the group is added again.
Group membership timeout	Group membership interval that must pass before the router decides that no members of a group or source exist on the network. Values range from 3 to 65,535 seconds. The default is 260 seconds.
Report link local multicast groups	Option that enables sending reports for groups in 224.0.0.0/24. Link local addresses are used only by protocols on the local network. Reports are always sent for nonlink local groups. The default is disabled.
Report policy	Access policy for IGMP reports that is based on a route-map policy[1].
Access groups	Option that configures a route-map policy[1] to control the multicast groups that hosts on the subnet serviced by an interface can join.
Immediate leave	Option that minimizes the leave latency of IGMPv2 group memberships on a given IGMP interface because the device does not send group-specific queries. When immediate leave is enabled, the device will remove the group entry from the multicast routing table immediately upon receiving a leave message for the group. The default is disabled. **Note** Use this command only when there is one receiver behind the interface for a given group.

1. To configure route-map policies, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

For information about configuring multicast route maps, see the "Configuring Route Maps to Control RP Information Distribution" section on page 1-45.

SUMMARY STEPS

1. **config t**

2. **interface** *interface*
3. **ip igmp version** *value*

   ip igmp join-group {*group* [**source** *source*] | **route-map** *policy-name*}

   ip igmp static-oif {*group* [**source** *source*] | **route-map** *policy-name*}

   ip igmp startup-query-interval *seconds*

   ip igmp startup-query-count *count*

   ip igmp robustness-variable *value*

   ip igmp querier-timeout *seconds*

   ip igmp query-timeout *seconds*

   ip igmp query-max-response-time *seconds*

   ip igmp query-interval *interval*

   ip igmp last-member-query-response-time *seconds*

   ip igmp last-member-query-count *count*

   ip igmp group-timeout *seconds*

   ip igmp report-link-local-groups

   ip igmp report-policy *policy*

   ip igmp access-group *policy*

   ip igmp immediate-leave
4. (Optional) **show ip igmp interface** [*interface*] [**vrf** *vrf-name* | **all**] [**brief**]
5. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface** *interface*
	
	Example:
	`switch(config)# interface ethernet 2/1`
	`switch(config-if)#`
		Enters interface mode on the interface type and number, such as **ethernet** *slot/port*.

Step 3	**ip igmp version** *value* **Example:** `switch(config-if)# ip igmp version 3`	Sets the IGMP version to the value specified. Values can be 2 or 3. The default is 2. The **no** form of the command sets the version to 2.

Command	Purpose
ip igmp join-group {*group* [**source** *source*] | **route-map** *policy-name*} **Example:** `switch(config-if)# ip igmp join-group 230.0.0.0`	Statically binds a multicast group to the interface. If you specify only the group address, the (*, G) state is created. If you specify the source address, the (S, G) state is created. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** A source tree is built for the (S, G) state only if you enable IGMPv3. ⚠ **Caution** The device CPU must be able to handle the traffic generated by using this command. Because of CPU load constraints, using this command, especially in any form of scale, is not recommended. Consider using the **ip igmp static-oif** command instead.
ip igmp static-oif {*group* [**source** *source*] | **route-map** *policy-name*} **Example:** `switch(config-if)# ip igmp static-oif 230.0.0.0`	Statically binds a multicast group to the outgoing interface, which is handled by the device hardware. If you specify only the group address, the (*, G) state is created. If you specify the source address, the (S, G) state is created. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** A source tree is built for the (S, G) state only if you enable IGMPv3.
ip igmp startup-query-interval *seconds* **Example:** `switch(config-if)# ip igmp startup-query-interval 25`	Sets the query interval used when the software starts up. Values can range from 1 to 18,000 seconds. The default is 31 seconds.
ip igmp startup-query-count *count* **Example:** `switch(config-if)# ip igmp startup-query-count 3`	Sets the query count used when the software starts up. Values can range from 1 to 10. The default is 2.
ip igmp robustness-variable *value* **Example:** `switch(config-if)# ip igmp robustness-variable 3`	Sets the robustness variable. You can use a larger value for a lossy network. Values can range from 1 to 7. The default is 2.
ip igmp querier-timeout *seconds* **Example:** `switch(config-if)# ip igmp querier-timeout 300`	Sets the querier timeout that the software uses when deciding to take over as the querier. Values can range from 1 to 65,535 seconds. The default is 255 seconds.

Command	Purpose
ip igmp query-timeout *seconds* **Example:** `switch(config-if)# ip igmp query-timeout 300`	Sets the query timeout that the software uses when deciding to take over as the querier. Values can range from 1 to 65,535 seconds. The default is 255 seconds. **Note** This command has the same functionality as the **ip igmp querier-timeout** command.
ip igmp query-max-response-time *seconds* **Example:** `switch(config-if)# ip igmp query-max-response-time 15`	Sets the response time advertised in IGMP queries. Values can range from 1 to 25 seconds. The default is 10 seconds.
ip igmp query-interval *interval* **Example:** `switch(config-if)# ip igmp query-interval 100`	Sets the frequency at which the software sends IGMP host query messages. Values can range from 1 to 18,000 seconds. The default is 125 seconds.
ip igmp last-member-query-response-time *seconds* **Example:** `switch(config-if)# ip igmp last-member-query-response-time 3`	Sets the query interval waited after sending membership reports before the software deletes the group state. Values can range from 1 to 25 seconds. The default is 1 second.
ip igmp last-member-query-count *count* **Example:** `switch(config-if)# ip igmp last-member-query-count 3`	Sets the number of times that the software sends an IGMP query in response to a host leave message. Values can range from 1 to 5. The default is 2.
ip igmp group-timeout *seconds* **Example:** `switch(config-if)# ip igmp group-timeout 300`	Sets the group membership timeout for IGMPv2. Values can range from 3 to 65,535 seconds. The default is 260 seconds.
ip igmp report-link-local-groups **Example:** `switch(config-if)# ip igmp report-link-local-groups`	Enables sending reports for groups in 224.0.0.0/24. Reports are always sent for nonlink local groups. By default, reports are not sent for link local groups.
ip igmp report-policy *policy* **Example:** `switch(config-if)# ip igmp report-policy my_report_policy`	Configures an access policy for IGMP reports that is based on a route-map policy.
ip igmp access-group *policy* **Example:** `switch(config-if)# ip igmp access-group my_access_policy`	Configures a route-map policy to control the multicast groups that hosts on the subnet serviced by an interface can join.

	Command	Purpose
	ip igmp immediate-leave **Example:** `switch(config-if)# ip igmp immediate-leave`	Enables the device to remove the group entry from the multicast routing table immediately upon receiving a leave message for the group. Use this command to minimize the leave latency of IGMPv2 group memberships on a given IGMP interface because the device does not send group-specific queries. The default is disabled. **Note** Use this command only when there is one receiver behind the interface for a given group.
Step 4	**show ip igmp interface** [*interface*] [**vrf** *vrf-name* | **all**] [**brief**] **Example:** `switch(config)# show ip igmp interface`	(Optional) Displays IGMP information about the interface.
Step 5	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring an IGMP SSM Translation

You can configure an SSM translation to provide SSM support when the router receives IGMPv1 or IGMPv2 membership reports. Only IGMPv3 provides the capability to specify group and source addresses in membership reports. By default, the group prefix range is 232.0.0.0/8. To modify the PIM SSM range, see the "Configuring SSM" section on page 1-42.

Table 1-3 lists the example SSM translations.

Table 1-3 Example SSM Translations

Group Prefix	Source Address
232.0.0.0/8	10.1.1.1
232.0.0.0/8	10.2.2.2
232.1.0.0/16	10.3.3.3
232.1.1.0/24	10.4.4.4

Table 1-4 shows the resulting MRIB routes that the IGMP process creates when it applies an SSM translation to the IGMP membership report. If more than one translation applies, the router creates the (S, G) state for each translation.

Table 1-4 Example Result of Applying SSM Translations

IGMPv2 Membership Report	Resulting MRIB Route
232.1.1.1	(10.4.4.4, 232.1.1.1)
232.2.2.2	(10.1.1.1, 232.2.2.2) (10.2.2.2, 232.2.2.2)

Note This feature is similar to SSM mapping found in some Cisco IOS software.

SUMMARY STEPS

1. **config t**
2. **ip igmp ssm-translate** *group-prefix source-addr*
3. **(Optional) show running-configuration igmp**
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ip igmp ssm-translate** *group-prefix source-addr* **Example:** `switch(config)# ip igmp ssm-translate 232.0.0.0/8 10.1.1.1`	Configures the translation of IGMPv1 or IGMPv2 membership reports by the IGMP process to create the (S,G) state as if the router had received an IGMPv3 membership report.
Step 3	**show running-configuration igmp** **Example:** `switch(config)# show running-configuration igmp`	(Optional) Shows the running-configuration information, including **ssm-translate** command lines.
Step 4	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring the Enforce Router Alert Option Check

You can configure the enforce router alert option check for IGMPv2 and IGMPv3 packets.

SUMMARY STEPS

1. **config t**
2. **ip igmp enforce-router-alert**
   no ip igmp enforce-router-alert
3. **(Optional) show running-configuration igmp**
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip igmp enforce-router-alert** **Example:** switch(config)# ip igmp enforce-router-alert	Enables the enforce router alert option check for IGMPv2 and IGMPv3 packets. By default, the enforce router alert option check is enabled.
	no ip igmp enforce-router-alert **Example:** switch(config)# no ip igmp enforce-router-alert	Disables the enforce router alert option check for IGMPv2 and IGMPv3 packets. By default, the enforce router alert option check is enabled.
Step 3	**show running-configuration igmp** **Example:** switch(config)# show running-configuration igmp	(Optional) Shows the running-configuration information, including the **enforce-router-alert** command line.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Restarting the IGMP Process

You can restart the IGMP process and optionally flush all routes.

SUMMARY STEPS

1. **restart igmp**
2. **config t**
3. **ip igmp flush-routes**
4. **(Optional) show running-configuration igmp**
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**restart igmp** **Example:** switch# restart igmp	Restarts the IGMP process.
Step 2	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 3	**ip igmp flush-routes** **Example:** switch(config)# ip igmp flush-routes	Removes routes when the IGMP process is restarted. By default, routes are not flushed.
Step 4	**show running-configuration igmp** **Example:** switch(config)# show running-configuration igmp	(Optional) Shows the running-configuration information, including **flush-routes** command lines.
Step 5	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Verifying the IGMP Configuration

To display the IGMP configuration information, perform one of the following tasks:

Command	Purpose
show ip igmp interface [*interface*] [**vrf** *vrf-name* | **all**] [**brief**]	Displays IGMP information about all interfaces or a selected interface, the default VRF, a selected VRF, or all VRFs. If IGMP is in vPC mode. Use this command to display vPC statistics.
show ip igmp groups [*group* | *interface*] [**vrf** *vrf-name* | **all**]	Displays the IGMP attached group membership for a group or interface, the default VRF, a selected VRF, or all VRFs.
show ip igmp route [*group* | *interface*] [**vrf** *vrf-name* | **all**]	Displays the IGMP attached group membership for a group or interface, the default VRF, a selected VRF, or all VRFs.
show ip igmp local-groups	Displays the IGMP local group membership.
show running-configuration igmp	Displays the IGMP running-configuration information.
show startup-configuration igmp	Displays the IGMP startup-configuration information.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Configuration Examples for IGMP

The following example shows how to configure the IGMP parameters:

```
config t
  ip igmp ssm-translate 232.0.0.0/8 10.1.1.1
  interface ethernet 2/1
    ip igmp version 3
    ip igmp join-group 230.0.0.0
    ip igmp startup-query-interval 25
    ip igmp startup-query-count 3
    ip igmp robustness-variable 3
    ip igmp querier-timeout 300
    ip igmp query-timeout 300
    ip igmp query-max-response-time 15
    ip igmp query-interval 100
    ip igmp last-member-query-response-time 3
    ip igmp last-member-query-count 3
    ip igmp group-timeout 300
    ip igmp report-link-local-groups
    ip igmp report-policy my_report_policy
    ip igmp access-group my_access_policy
```

Where to Go Next

You can enable the following features that work with PIM and IGMP:

- Chapter 1, “Configuring IGMP Snooping”
- Chapter 1, “Configuring MSDP”

Feature History for IGMP

Table 1-5 lists the release history for this feature.

Table 1-5 Feature History for IGMP

Feature Name	Releases	Feature Information
vPC	4.1(3)	Displays vPC statistics with the **show ip igmp interface** command. The following section provides information about this feature: • "Verifying the IGMP Configuration" section on page 1-14
Immediate Leave	4.1(3)	Minimizes the leave latency of IGMPv2 or MLDv1 group memberships on a given IGMP or MLD interface because the device does not send group-specific queries. The following section provides information about this feature: • "Configuring IGMP Interface Parameters" section on page 1-6

CHAPTER 1

Configuring MLD

This chapter describes how to configure the Multicast Listener Discovery (MLD) on Cisco NX-OS devices for IPv6 networks.

This chapter includes the following sections:

Information About MLD

MLD is an IPv6 protocol that a host uses to request multicast data for a particular group. Using the information obtained through MLD, the software maintains a list of multicast group or channel memberships on a per-interface basis. The devices that receive MLD packets send the multicast data that they receive for requested groups or channels out the network segment of the known receivers.

MLDv1 is derived from IGMPv2, and MLDv2 is derived from IGMPv3. IGMP uses IP Protocol 2 message types, while MLD uses IP Protocol 58 message types, which is a subset of the ICMPv6 messages.

The MLD process is started automatically on the device. You cannot enable MLD manually on an interface. MLD is automatically enabled when you perform one of the following configuration tasks on an interface:

- Enable PIM6
- Statically bind a local multicast group
- Enable link-local group reports

This section includes the following topics:

MLD Versions

The device supports MLDv1 and MLDv2. MLDv2 supports MLDv1 listener reports.

By default, the software enables MLDv2 when it starts the MLD process. You can enable MLDv1 on interfaces where you want only its capabilities.

MLDv2 includes the following key changes from MLDv1:

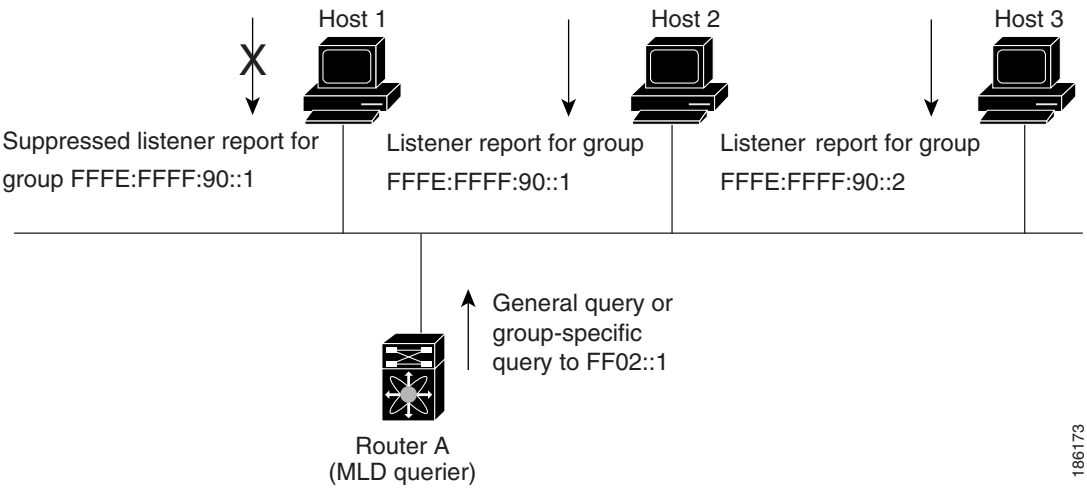
- Support for Source-Specific Multicast (SSM), which builds shortest path trees from each receiver to the source, through the following features:
  - Host messages that can specify both the group and the source.
  - The multicast state that is maintained for groups and sources, not just for groups as in MLDv1.
- Hosts no longer perform report suppression, which means that hosts always send MLD listener reports when an MLD query message is received.

For detailed information about MLDv1, see RFC 2710. For detailed information about MLDv2, see RFC 3810.

MLD Basics

The basic MLD process of a router that discovers multicast hosts is shown in Figure 1-1. Hosts 1, 2, and 3 send unsolicited MLD listener report messages to initiate receiving multicast data for a group or channel.

Figure 1-1 MLD Query-Response Process



In Figure 1-1, router A, which is the MLD designated querier on the subnet, sends a general query message to the link-scope all-nodes multicast address FF02::1 periodically to discover what multicast groups hosts want to receive. The group-specific query is used to discover whether a specific group is requested by any hosts. You can configure the group membership timeout value that the router uses to determine that no members of a group or source exist on the subnet. For more information about configuring the MLD parameters, see the "Configuring MLD Interface Parameters" section on page 1-6.

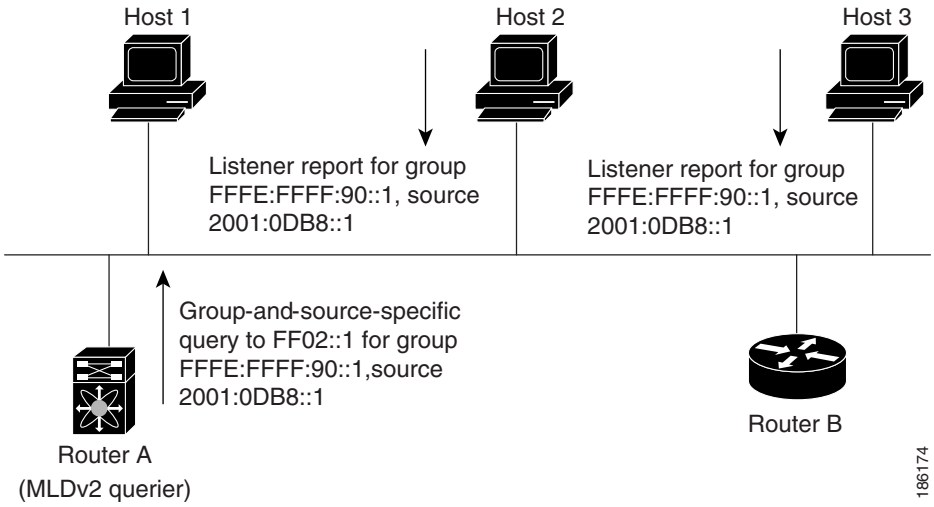
In Figure 1-1, host 1's listener report is suppressed, and host 2 sends its listener report for group FFFE:FFFF:90::1 first. Host 1 receives the report from host 2. Because only one listener report per group needs to be sent to the router, other hosts suppress their reports to reduce network traffic. Each host waits for a random time interval to avoid sending reports at the same time. You can configure the query maximum response time parameter to control the interval in which hosts randomize their responses.

Note MLDv1 membership report suppression occurs only on hosts that are connected to the same port.

In Figure 1-2, router A sends the MLDv2 group-and-source-specific query to the LAN. Hosts 2 and 3 respond to the query with listener reports that indicate that they want to receive data from the advertised group and source. This MLDv2 feature supports SSM. For information about configuring SSM translation to support SSM for MLDv1 hosts, see the "Configuring an MLD SSM Translation" section on page 1-11.

Note In MLDv2, all hosts respond to queries.

Figure 1-2 MLDv2 Group-and-Source-Specific Query



The software elects a router as the MLD querier on a subnet if it has the lowest IP address. As long as a router continues to receive query messages from a router with a lower IP address, it remains a nonquerier and resets a timer that is based on its querier timeout value. If the querier timer of a router expires, it becomes the designated querier. If that router later receives a host query message from a router with a lower IP address, it drops its role as the designated querier and sets its querier timer again.

Messages sent by the designated querier have a time-to-live (TTL) value of 1, which means that the messages are not forwarded by the directly connected routers on the subnet, and you can configure the frequency and number of query messages sent specifically for MLD startup. You can configure a short

query interval at startup so that the group state is established as quickly as possible. Although usually unnecessary, you can tune the query interval used after startup to a value that balances responsiveness to host group membership and the traffic created on the network.

Caution If you change the query interval, you can severely impact multicast forwarding in your network.

When a multicast host leaves a group, it should send a done message for MLDv1, or a listener report that excludes the group to the link-scope all-routers multicast address FF02::2. To check if this host is the last host to leave the group, the software sends an MLD query message and starts a timer that you can configure called the last member query response interval. If no reports are received before the timer expires, the software removes the group state. The router continues to send multicast traffic for a group until its state is removed.

You can configure a robustness value to compensate for the packet loss on a congested network. The robustness value is used by the MLD software to determine the number of times to send messages.

Link local addresses in the range FF02::0/16 have link scope, as defined by the Internet Assigned Numbers Authority (IANA). Network protocols on a local network segment use these addresses; routers do not forward these addresses because they have a TTL of 1. By default, the MLD process sends listener reports only for nonlink local addresses, but you can configure the software to send reports for link local addresses.

For more information about configuring the MLD parameters, see the "Configuring MLD Interface Parameters" section on page 1-6.

Virtualization Support

A virtual device context (VDC) is a logical representation of a set of system resources. Within each VDC, you can define multiple virtual routing and forwarding (VRF) instances. One MLD process can run per VDC. The MLD process supports all VRFs in that VDC.

You can use the **show** commands with a VRF argument to provide a context for the information displayed. The default VRF is used if no VRF argument is supplied.

For information about configuring VDCs, see the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*.

For information about configuring VRFs, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x.*

Licensing Requirements for MLD

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	MLD requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for MLD

MLD has the following prerequisites:

- You are logged onto the device.
- You are in the correct virtual device context (VDC). A VDC is a logical representation of a set of system resources. You can use the **switchto vdc** command with a VDC number.
- For global configuration commands, you are in the correct virtual routing and forwarding (VRF) mode. The default configuration mode shown in the examples in this chapter applies to the default VRF.

Guidelines and Limitations for MLD

MLD has the following guidelines and limitations:

- You must disable IGMP optimized multicast forwarding (OMF) for IPv6 multicast networks that require multicast forwarding over a layer 2 network.

Default Settings for MLD

Table 1-1 lists the default settings for MLD parameters.

Table 1-1 Default MLD Parameters

Parameters	Default
MLD version	2
Startup query interval	30 seconds
Startup query count	2
Robustness value	2
Querier timeout	255 seconds
Query timeout	255 seconds
Query max response time	10 seconds
Query interval	125 seconds
Last member query response interval	1 second
Last member query count	2
Group membership timeout	260 seconds
Report link local multicast groups	Disabled
Immediate leave	Disabled

Configuring MLD Parameters

You can configure the MLD global and interface parameters to affect the operation of the MLD process.

Note Before you can access the MLD commands, you must enable the MLD feature.

This section includes the following topics:

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Configuring MLD Interface Parameters

You can configure the optional MLD interface parameters described in Table 1-2.

Table 1-2 MLD Interface Parameters

Parameter	Description
MLD version	MLD version that is enabled on the interface. MLDv2 supports MLDv1. The MLD version can be 1 or 2. The default is 2.
Static multicast groups	Multicast groups that are statically bound to the interface. You can configure the groups to join the interface with the (*, G) state or specify a source IP to join with the (S, G) state. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** Although you can configure the (S, G) state, the source tree is built only if you enable MLDv2. For information about SSM translation, see the "Configuring an MLD SSM Translation" section on page 1-11. You can configure a multicast group on all the multicast-capable routers on the network so that pinging the group causes all the routers to respond.
Static multicast groups on OIF	Multicast groups that are statically bound to the output interface. You can configure the groups to join the output interface with the (*, G) state or specify a source IP to join with the (S, G) state. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** Although you can configure the (S, G) state, the source tree is built only if you enable MLDv2. For information about SSM translation, see the "Configuring an MLD SSM Translation" section on page 1-11.
Startup query interval	Startup query interval. By default, this interval is shorter than the query interval so that the software can establish the group state as quickly as possible. Values range from 1 to 18,000 seconds. The default is 30 seconds.

Table 1-2 MLD Interface Parameters (continued)

Parameter	Description
Startup query count	Number of queries sent at startup that are separated by the startup query interval. Values range from 1 to 10. The default is 2.
Robustness value	Robustness variable that you can tune to reflect expected packet loss on a congested network. You can increase the robustness variable to increase the number of times that packets are resent. Values range from 1 to 7. The default is 2.
Querier timeout	Number of seconds that the software waits after the previous querier has stopped querying and before it takes over as the querier. Values range from 1 to 65,535 seconds. The default is 255 seconds.
Query max response time	Maximum response time advertised in MLD queries. You can tune the burstiness of MLD messages on the network by setting a larger value so that host responses are spread out over a longer time. This value must be less than the query interval. Values range from 1 to 25 seconds. The default is 10 seconds.
Query interval	Frequency at which the software sends MLD host query messages. You can tune the number of MLD messages on the network by setting a larger value so that the software sends MLD queries less often. Values range from 1 to 18,000 seconds. The default is 125 seconds.
Last member query response interval	Query interval for response to an MLD query that the software sends after receiving a host leave message from the last known active host on the subnet. If no reports are received in the interval, the group state is deleted. You can use this value to tune how quickly the software stops transmitting on the subnet. The software can detect the loss of the last member of a group or source more quickly when the values are smaller. Values range from 1 to 25 seconds. The default is 1 second.
Last member query count	Number of times that the software sends an MLD query, separated by the last member query response interval, in response to a host leave message from the last known active host on the subnet. Values range from 1 to 5. The default is 2. **Caution** Setting this value to 1 means that a missed packet in either direction causes the software to remove the multicast state from the queried group or channel. The software can wait until the next query interval before the group is added again.
Group membership timeout	Group membership interval that must pass before the router decides that no members of a group or source exist on the network. Values range from 3 to 65,535 seconds. The default is 260 seconds.
Report link local multicast groups	Option that enables sending reports for groups in FF02::0/16. Link local addresses are used only by protocols on the local network. Reports are always sent for nonlink local groups. The default is disabled.
Report policy	Access policy for MLD reports that is based on a route-map policy[1].

Table 1-2 MLD Interface Parameters (continued)

Parameter	Description
Access groups	Option that configures a route-map policy[1] to control the multicast groups that hosts on the subnet serviced by an interface can join.
Immediate leave	Option that minimizes the leave latency of MLDv1 group memberships on a given MLD interface because the device does not send group-specific queries. When immediate leave is enabled, the device will remove the group entry from the multicast routing table immediately upon receiving a leave message for the group. The default is disabled. **Note** Use this command only when there is one receiver behind the interface for a given group.

1. To configure route-map policies, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

For information about configuring multicast route maps, see the "Configuring Route Maps to Control RP Information Distribution" section on page 1-45.

SUMMARY STEPS

1. **config t**
2. **interface** *interface*
3. **ipv6 mld version** *value*

   ipv6 mld join-group {*group* [**source** *source*] | **route-map** *policy-name*}

   ipv6 mld static-oif {*group* [**source** *source*] | **route-map** *policy-name*}

   ipv6 mld startup-query-interval *seconds*

   ipv6 mld startup-query-count *count*

   ipv6 mld robustness-variable *value*

   ipv6 mld querier-timeout *seconds*

   ipv6 mld query-timeout *seconds*

   ipv6 mld query-max-response-time *seconds*

   ipv6 mld query-interval *interval*

   ipv6 mld last-member-query-response-time *seconds*

   ipv6 mld last-member-query-count *count*

   ipv6 mld group-timeout *seconds*

   ipv6 mld report-link-local-groups

   ipv6 mld report-policy *policy*

   ipv6 mld access-group *policy*

   ipv6 mld immediate-leave
4. **(Optional) show ipv6 mld interface** [*interface*] [**vrf** *vrf-name* | **all**] [**brief**]
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**interface** *interface* **Example:** switch(config)# interface ethernet 2/1 switch(config-if)#	Enters interface mode on the interface type and number, such as **ethernet** *slot/port*.
Step 3	**ipv6 mld version** *value* **Example:** switch(config-if)# ipv6 mld version 2	Sets the MLD version to the value specified. Values can be 1 or 2. The default is 2. The **no** form of the command sets the version to 2.
	ipv6 mld join-group {**group** [**source** *source*] | **route-map** *policy-name*} **Example:** switch(config-if)# ipv6 mld join-group FFFE::1	Statically binds a multicast group to the interface. If you specify only the group address, the (*, G) state is created. If you specify the source address, the (S, G) state is created. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** A source tree is built for the (S, G) state only if you enable MLDv2. **Caution** The device CPU must handle the traffic generated by using this command.
	ipv6 mld static-oif {**group** [**source** *source*] | **route-map** *policy-name*} **Example:** switch(config-if)# ipv6 mld static-oif FFFE::1	Statically binds a multicast group to the outgoing interface, which is handled by the device hardware. If you specify only the group address, the (*, G) state is created. If you specify the source address, the (S, G) state is created. You can specify a route-map policy name that lists the group prefixes, group ranges, and source prefixes to use with the **match ip multicast** command. **Note** A source tree is built for the (S, G) state only if you enable MLDv2.
	ipv6 mld startup-query-interval *seconds* **Example:** switch(config-if)# ipv6 mld startup-query-interval 25	Sets the query interval used when the software starts up. Values can range from 1 to 18,000 seconds. The default is 31 seconds.
	ipv6 mld startup-query-count *count* **Example:** switch(config-if)# ipv6 mld startup-query-count 3	Sets the query count used when the software starts up. Values can range from 1 to 10. The default is 2.

Command	Purpose
ipv6 mld robustness-variable *value* **Example:** `switch(config-if)# ipv6 mld robustness-variable 3`	Sets the robustness variable. You can use a larger value for a lossy network. Values can range from 1 to 7. The default is 2.
ipv6 mld querier-timeout *seconds* **Example:** `switch(config-if)# ipv6 mld querier-timeout 300`	Sets the querier timeout that the software uses when deciding to take over as the querier. Values can range from 1 to 65,535 seconds. The default is 255 seconds.
ipv6 mld query-timeout *seconds* **Example:** `switch(config-if)# ipv6 mld query-timeout 300`	Sets the query timeout that the software uses when deciding to take over as the querier. Values can range from 1 to 65,535 seconds. The default is 255 seconds. **Note** This command has the same functionality as the **ipv6 mld querier-timeout** command.
ipv6 mld query-max-response-time *seconds* **Example:** `switch(config-if)# ipv6 mld query-max-response-time 15`	Sets the response time advertised in MLD queries. Values can range from 1 to 25 seconds. The default is 10 seconds.
ipv6 mld query-interval *interval* **Example:** `switch(config-if)# ipv6 mld query-interval 100`	Sets the frequency at which the software sends MLD host query messages. Values can range from 1 to 18,000 seconds. The default is 125 seconds.
ipv6 mld last-member-query-response-time *seconds* **Example:** `switch(config-if)# ipv6 mld last-member-query-response-time 3`	Sets the query interval waited after sending membership reports before the software deletes the group state. Values can range from 1 to 25 seconds. The default is 1 second.
ipv6 mld last-member-query-count *count* **Example:** `switch(config-if)# ipv6 mld last-member-query-count 3`	Sets the number of times that the software sends an MLD query in response to a host leave message. Values can range from 1 to 5. The default is 2.
ipv6 mld group-timeout *seconds* **Example:** `switch(config-if)# ipv6 mld group-timeout 300`	Sets the group membership timeout for MLDv2. Values can range from 3 to 65,535 seconds. The default is 260 seconds.
ipv6 mld report-link-local-groups **Example:** `switch(config-if)# ipv6 mld report-link-local-groups`	Enables sending reports for groups in 224.0.0.0/24. Reports are always sent for nonlink local groups. By default, reports are not sent for link local groups.
ipv6 mld report-policy *policy* **Example:** `switch(config-if)# ipv6 mld report-policy my_report_policy`	Configures an access policy for MLD reports that is based on a route-map policy.

	Command	Purpose
	ipv6 mld access-group *policy* **Example:** `switch(config-if)# ipv6 mld access-group my_access_policy`	Configures a route-map policy to control the multicast groups that hosts on the subnet serviced by an interface can join.
	ipv6 mld immediate-leave **Example:** `switch(config-if)# ipv6 mld immediate-leave`	Enables the device to remove the group entry from the multicast routing table immediately upon receiving a leave message for the group. Use this command to mnimize the leave latency of MLDv1 group memberships on a given MLD interface because the device does not send group-specific queries. The default is disabled. **Note** Use this command only when there is one receiver behind the interface for a given group.
Step 4	**show ipv6 mld interface** [*interface*] [**vrf** *vrf-name* | **all**] [**brief**] **Example:** `switch(config)# show ipv6 mld interface`	(Optional) Displays MLD information about the interface.
Step 5	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring an MLD SSM Translation

You can configure an SSM translation to provide SSM support when the router receives MLDv1 listener reports. Only MLDv2 provides the capability to specify group and source addresses in listener reports. By default, the group prefix range is FF3x/96. To modify the PIM SSM range, see the "Configuring SSM" section on page 1-42.

Table 1-3 lists the example SSM translations.

Table 1-3 Example SSM Translations

Group Prefix	Source Address
FF30::0/16	2001:0DB8:0:ABCD::1
FF30::0/16	2001:0DB8:0:ABCD::2
FF30:30::0/24	2001:0DB8:0:ABCD::3
FF32:40::0/24	2001:0DB8:0:ABCD::4

Table 1-4 shows the resulting M6RIB routes that the MLD process creates when it applies an SSM translation to the MLD v1 listener report. If more than one translation applies, the router creates the (S, G) state for each translation.

Table 1-4 Example Result of Applying SSM Translations

MLDv1 Listener Report	Resulting M6RIB Route
FF32:40::40	(2001:0DB8:0:ABCD::4, FF32:40::40)
FF30:10::10	(2001:0DB8:0:ABCD::1, FF30:10::10) (2001:0DB8:0:ABCD::2, FF30:10::10)

SUMMARY STEPS

1. **config t**
2. **ipv6** [**icmp**] **mld ssm-translate** *group-prefix source-addr*
3. **(Optional) show running-configuration ssm-translate**
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ipv6** [**icmp**] **mld ssm-translate** *group-prefix source-addr* **Example:** `switch(config)# ipv6 mld ssm-translate FF30::0/16 2001:0DB8:0:ABCD::1`	Configures the translation of MLDv1 listener reports by the MLD process to create the (S,G) state as if the router had received an MLDv2 listener report.
Step 3	**show running-configuration ssm-translate** **Example:** `switch(config)# show running-configuration ssm-translate`	(Optional) Shows **ssm-translate** configuration lines in the running configuration.
Step 4	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Verifying the MLD Configuration

To display the MLD configuration information, perform one of the following tasks:

Command	Purpose
show ipv6 mld interface [*interface*] [**vrf** *vrf-name* | **all**] [**brief**]	Displays MLD information about all interfaces or a selected interface, the default VRF, a selected VRF, or all VRFs.
show ipv6 mld groups [*group* | *interface*] [**vrf** *vrf-name* | **all**]	Displays the MLD attached group membership for a group or interface, the default VRF, a selected VRF, or all VRFs.
show ipv6 mld route [*group* | *interface*] [**vrf** *vrf-name* | **all**]	Displays the MLD attached group membership for a group or interface, the default VRF, a selected VRF, or all VRFs.
show ipv6 mld local-groups	Displays the MLD local group membership.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Configuration Example for MLD Example Configuration

The following example shows how to configure the MLD parameters:

```
config t
  ipv6 mld ssm-translate FF30::0/16 2001:0DB8:0:ABCD::1
  interface ethernet 2/1
    ipv6 mld version 2
    ipv6 mld join-group FFFE::1
    ipv6 mld startup-query-interval 25
    ipv6 mld startup-query-count 3
    ipv6 mld robustness-variable 3
    ipv6 mld querier-timeout 300
    ipv6 mld query-timeout 300
    ipv6 mld query-max-response-time 15
    ipv6 mld query-interval 100
    ipv6 mld last-member-query-response-time 3
    ipv6 mld last-member-query-count 3
    ipv6 mld group-timeout 300
    ipv6 mld report-link-local-groups
    ipv6 mld report-policy my_report_policy
    ipv6 mld access-group my_access_policy
```

Where to Go Next

You can configure the MBGP feature that works with PIM6 and MLD:

- Chapter 1, “Configuring MSDP”

Additional References

For additional information related to implementing IGMP, see the following sections:

- Related Documents, page 1-14
- Standards, page 1-14
- Appendix 1, "IETF RFCs for IP Multicast"

Related Documents

Related Topic	Document Title
VDCs	*Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*
CLI commands	*Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

Feature History for MLD

Table 1-5 lists the release history for this feature.

Table 1-5 Feature History for MLD

Feature Name	Releases	Feature Information
Immediate Leave	4.1(3)	Minimizes the leave latency of IGMPv2 or MLDv1 group memberships on a given IGMP or MLD interface because the device does not send group-specific queries. • "Configuring MLD Interface Parameters" section on page 1-6

CHAPTER 1

Configuring PIM and PIM6

This chapter describes how to configure the Protocol Independent Multicast (PIM) and PIM6 features on Cisco NX-OS devices in your IPv4 and IPv6 networks.

This chapter includes the following sections:

Information About PIM and PIM6

Note Beginning with Cisco NX-OS Release 5.0(2a), Bidirectional Forwarding Detection (BFD) supports PIM. See the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide, Release 5.x*, for information on BFD.

PIM, which is used between multicast-capable routers, advertises group membership across a routing domain by constructing multicast distribution trees. PIM builds shared distribution trees on which packets from multiple sources are forwarded, as well as source distribution trees on which packets from a single source are forwarded. For more information about multicast, see the "Information About Multicast" section on page 1-1.

Cisco NX-OS supports PIM sparse mode for IPv4 networks (PIM) and for IPv6 networks (PIM6). In PIM sparse mode, multicast traffic is sent only to locations of the network that specifically request it. You can configure PIM and PIM6 to run simultaneously on a router. You can use PIM and PIM6 global

parameters to configure RPs, message packet filtering, and statistics. You can use PIM and PIM6 interface parameters to enable multicast, identify PIM borders, set the PIM hello message interval, and set the designated router (DR) priority. For more information, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

Note Cisco NX-OS does not support PIM dense mode.

In Cisco NX-OS, multicast is enabled only after you enable the PIM or PIM6 feature on each router and then enable PIM or PIM6 sparse mode on each interface that you want to participate in multicast. You can configure PIM for an IPv4 network and PIM6 for an IPv6 network. In an IPv4 network, if you have not already enabled IGMP on the router, PIM enables it automatically. In an IPv6 network, MLD is enabled by default. For information about configuring IGMP and MLD, see Chapter 1, "Configuring IGMP" and Chapter 1, "Configuring MLD."

Note Beginning with Cisco NX-OS Release 5.2(1) for the Nexus 7000 Series devices, you can configure PIMv4 to run over generic routing encapsulation (GRE) tunnels including outgoing interfaces (OIFs).

You use the PIM and PIM6 global configuration parameters to configure the range of multicast group addresses to be handled by each of the three distribution modes:

- Any Source Multicast (ASM) provides discovery of multicast sources. It builds a shared tree between sources and receivers of a multicast group and supports switching over to a source tree when a new receiver is added to a group. ASM mode requires that you configure an RP.
- Single Source Multicast (SSM) builds a source tree originating at the designated router on the LAN segment that receives a request to join a multicast source. SSM mode does not require you to configure RPs. Source discovery must be accomplished through other means.
- Bidirectional shared trees (Bidir) build a shared tree between sources and receivers of a multicast group but do not support switching over to a source tree when a new receiver is added to a group. Bidir mode requires that you configure an RP. Bidir forwarding does not require source discovery because only the shared tree is used.

You can combine the three modes to cover different ranges of group addresses. For more information, see the "Configuring PIM and PIM6" section on page 1-20.

For more information about PIM sparse mode and shared distribution trees used by ASM and Bidir modes, see RFC 4601.

For more information about PIM SSM mode, see RFC 3569.

For more information about PIM Bidir mode, see draft-ietf-pim-bidir-09.txt.

This section includes the following topics:

Hello Messages

The PIM process begins when the router establishes PIM neighbor adjacencies by sending PIM hello messages to the multicast address 224.0.0.13. Hello messages are sent periodically at the interval of 30 seconds. When all neighbors have replied, the PIM software chooses the router with the highest priority in each LAN segment as the designated router (DR). The DR priority is based on a DR priority value in the PIM hello message. If the DR priority value is not supplied by all routers, or the priorities match, the highest IP address is used to elect the DR.

The hello message also contains a hold-time value, which is typically 3.5 times the hello interval. If this hold time expires without a subsequent hello message from its neighbor, the device detects a PIM failure on that link.

For added security, you can configure an MD5 hash value that the PIM software uses to authenticate PIM hello messages with PIM neighbors.

For information about configuring hello message authentication, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

Join-Prune Messages

When the DR receives an IGMP membership report message from a receiver for a new group or source, the DR creates a tree to connect the receiver to the source by sending a PIM join message out the interface toward the rendezvous point (ASM or Bidir mode) or source (SSM mode).The rendezvous point (RP) is the root of a shared tree, which is used by all sources and hosts in the PIM domain in the ASM or the Bidir mode. SSM does not use an RP but builds a shortest path tree (SPT) that is the lowest cost path between the source and the receiver.

When the DR determines that the last host has left a group or source, it sends a PIM prune message to remove the path from the distribution tree.

The routers forward the join or prune action hop by hop up the multicast distribution tree to create (join) or tear down (prune) the path.

Note In this publication, the terms "PIM join message" and "PIM prune message" are used to simplify the action taken when referring to the PIM join-prune message with only a join or prune action.

Join-prune messages are sent as quickly as possible by the software. You can filter the join-prune messages by defining a routing policy. For information about configuring the join-prune message policy, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

State Refreshes

PIM requires that multicast entries are refreshed within a 3.5-minute timeout interval. The state refresh ensures that traffic is delivered only to active listeners, and it keeps routers from using unnecessary resources.

To maintain the PIM state, the last-hop DR sends join-prune messages once per minute. State creation applies to both (*, G) and (S, G) states as follows:

- (*, G) state creation example—An IGMP (*, G) report triggers the DR to send a (*, G) PIM join message toward the RP.
- (S, G) state creation example—An IGMP (S, G) report triggers the DR to send an (S, G) PIM join message toward the source.

If the state is not refreshed, the PIM software tears down the distribution tree by removing the forwarding paths in the multicast outgoing interface list of the upstream routers.

Rendezvous Points

A rendezvous point (RP) is a router that you select in a multicast network domain that acts as a shared root for a multicast shared tree. You can configure as many RPs as you like, and you can configure them to cover different group ranges.

This section includes the following topics:

Static RP

You can statically configure an RP for a multicast group range. You must configure the address of the RP on every router in the domain.

You can define static RPs for the following reasons:

- To configure routers with the Anycast-RP address
- To manually configure an RP on a device

For information about configuring static RPs, see the "Configuring Static RPs" section on page 1-29.

BSRs

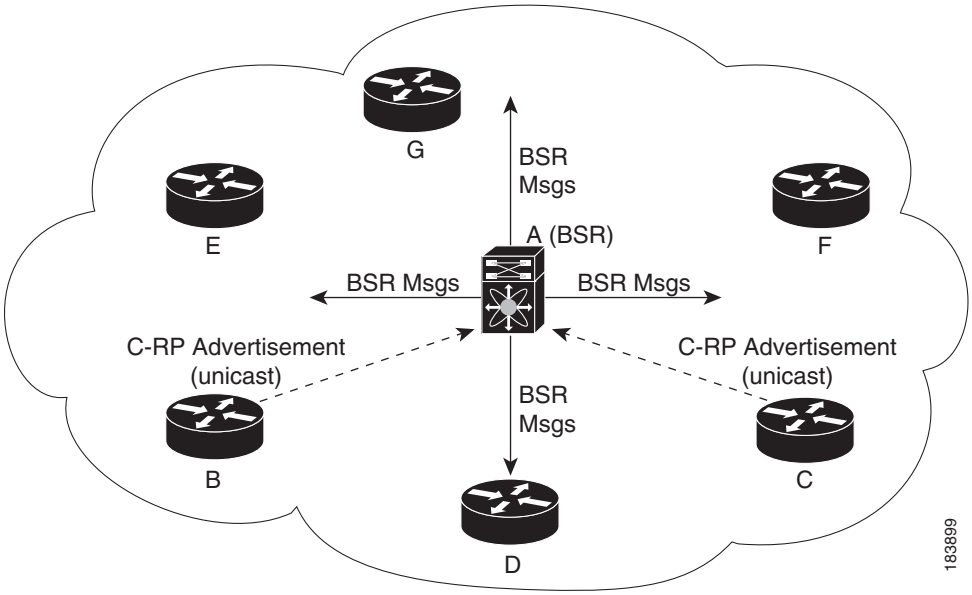
The bootstrap router (BSR) ensures that all routers in the PIM domain have the same RP cache as the BSR. You can configure the BSR to help you select an RP set from BSR candidate RPs. The function of the BSR is to broadcast the RP set to all routers in the domain. You select one or more candidate BSRs to manage the RPs in the domain. Only one candidate BSR is elected as the BSR for the domain.

Caution Do not configure both Auto-RP and BSR protocols in the same network.

Figure 1-1 shows the BSR mechanism. Router A, the software-elected BSR, sends BSR messages out all enabled interfaces (shown by the solid lines in the figure). The messages, which contain the RP set, are flooded hop by hop to all routers in the network. Routers B and C are candidate RPs that send their candidate-RP advertisements directly to the elected BSR (shown by the dashed lines in the figure).

The elected BSR receives candidate-RP messages from all the candidate RPs in the domain. The bootstrap message sent by the BSR includes information about all of the candidate RPs. Each router uses a common algorithm to select the same RP address for a given multicast group.

Figure 1-1 BSR Mechanism



In the RP selection process, the RP address with the best priority is determined by the software. If the priorities match for two or more RP addresses, the software may use the RP hash in the selection process. Only one RP address is assigned to a group.

By default, routers are not enabled to listen or forward BSR messages. You must enable the BSR listening and forwarding feature so that the BSR mechanism can dynamically inform all routers in the PIM domain of the RP set assigned to multicast group ranges.

For more information about bootstrap routers, see RFC 5059.

Note The BSR mechanism is a nonproprietary method of defining RPs that can be used with third-party routers.

For information about configuring BSRs and candidate RPs, see the "Configuring BSRs" section on page 1-31.

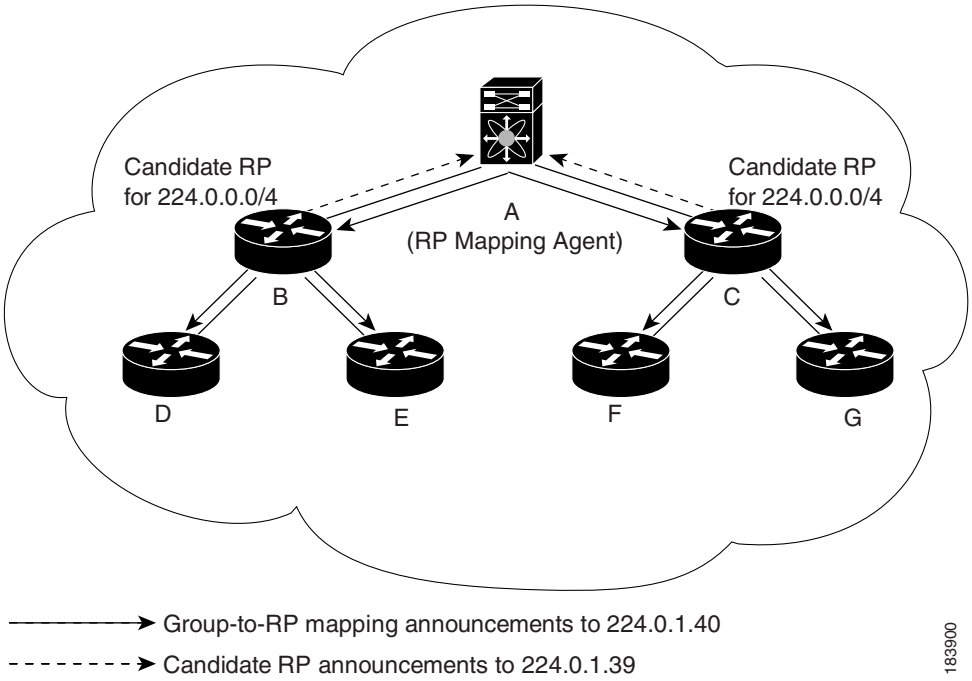
Auto-RP

Auto-RP is a Cisco protocol that was prior to the Internet standard bootstrap router mechanism. You configure Auto-RP by selecting candidate mapping agents and RPs. Candidate RPs send their supported group range in RP-Announce messages to the Cisco RP-Announce multicast group 224.0.1.39. An Auto-RP mapping agent listens for RP-Announce messages from candidate RPs and forms a Group-to-RP mapping table. The mapping agent multicasts the Group-to-RP mapping table in RP-Discovery messages to the Cisco RP-Discovery multicast group 224.0.1.40.

Caution Do not configure both Auto-RP and BSR protocols in the same network.

Figure 1-2 shows the Auto-RP mechanism. Periodically, the RP mapping agent multicasts the RP information that it receives to the Cisco-RP-Discovery group 224.0.1.40 (shown by the solid lines in the figure).

Figure 1-2 Auto-RP Mechanism



By default, routers are not enabled to listen or forward Auto-RP messages. You must enable the Auto-RP listening and forwarding feature so that the Auto-RP mechanism can dynamically inform routers in the PIM domain of the group-to-RP mapping.

Note Auto-RP is not supported for PIM6.

For information about configuring Auto-RP, see the "Configuring Auto-RP" section on page 1-35.

Multiple RPs Configured in a PIM Domain

This section describes the election process rules when multiple RPs are configured in a PIM domain and includes the following topics:

- PIM BSR Bootstrap/Auto-RP Mapping-Agent Election Process, page 1-6
- PIM RP versus RP Election Process, page 1-9

PIM BSR Bootstrap/Auto-RP Mapping-Agent Election Process

This section includes the following topics:

- Bootstrap Router (BSR) Election Process Details, page 1-7
- Auto-RP Mapping Agent Election Process, page 1-8

Bootstrap Router (BSR) Election Process Details

If the BSR priorities are different, the BSR with the highest priority (highest numerical value) is elected as the BSR router for the PIM domain (see configuration example 1).

- Configuration example 1—Different BSR-candidate priorities: In this example, the system elects the device labeled N7K-1 as the BSR candidate for the PIM domain because it has the highest priority. The device labeled N7K-2 has the default priority of 64.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0 priority 128

ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0

ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim rp
    PIM RP Status Information for VRF "default"
    BSR: 192.168.1.1*, next Bootstrap message in: 00:00:12,
         priority: 128, hash-length: 30
```

Verification for N7K-2:

```
show ip pim rp
    PIM RP Status Information for VRF "default"
    BSR: 192.168.1.1, uptime: 00:04:27, expires: 00:02:00,
         priority: 128, hash-length: 30
```

If the BSR priorities are the same, the BSR with the highest BSR-candidate IP address is elected as the BSR router for the PIM domain (see configuration example 2).

- Configuration example 2—Identical BSR-candidate priorities: In this example, the system elects the device labeled N7K-2 as the BSR for the PIM domain because it has the highest BSR-candidate IP address.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0

ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0

ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim rp
PIM RP Status Information for VRF "default"
    BSR: 192.168.2.1, uptime: 01:45:20, expires: 00:01:54,
         priority: 64, hash-length: 30
```

Verification for N7K-2:

```
show ip pim rp
PIM RP Status Information for VRF "default"
    BSR: 192.168.2.1*, next Bootstrap message in: 00:00:30,
         priority: 64, hash-length: 30
```

Auto-RP Mapping Agent Election Process

The router with the highest mapping-agent IP address is elected as the mapping agent for the PIM domain. You cannot configure the priority for the Auto-RP mapping agent (see configuration example):

- Configuration example—Highest IP address: In this example, the system elects the device labeled N7K-2 as the mapping agent for the PIM domain because it has the highest mapping-agent IP address.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim auto-rp mapping-agent loopback0

ip pim auto-rp forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim auto-rp mapping-agent loopback0

ip pim auto-rp forward listen
```

Verification for N7K-1:

```
show ip pim rp
PIM RP Status Information for VRF "default"
    BSR disabled
    Auto-RP RPA: 192.168.2.1, next Discovery message in: 00:00:52
```

Verification for N7K-2:

```
show ip pim rp
PIM RP Status Information for VRF "default"
    BSR disabled
    Auto-RP RPA: 192.168.2.1*, next Discovery message in: 00:00:47
```

PIM RP versus RP Election Process

Table 1-1 shows the process that the system uses to select the RP for a multicast group if multiple RPs are configured in the network using BSR, Auto-RP, or static RP configurations.

Table 1-1 PIM RP Versus RP Election Process Summary Table

BSR-RP vs. BSR-RP	BSR-RP vs. Static RP	Auto-RP vs. Auto- RP	Auto-RP vs. Static RP
1. Most specific RP group-list	1.Most specific RP group-list	1. Most specific RP group-list	1. Most specific RP group-list
2. Lowest RP priority	2. Highest RP IP address	2. Highest RP IP address	2. Highest RP IP address
3. Highest RP IP address	—	—	—

Note BSR-RP versus Auto-RP is not listed in Table 1-1 because we recommend that you do not run both simultaneously in the same network.

This section includes the following topics:

- PIM BSR RP-Candidate vs. BSR RP-Candidate Election Process, page 1-9
- PIM BSR RP-Candidate vs. Static RP Election Process, page 1-12
- PIM Auto-RP-Candidate vs. Auto-RP-Candidate Election Process, page 1-15
- PIM Auto-RP-Candidate vs. Static RP Election Process, page 1-15

PIM BSR RP-Candidate vs. BSR RP-Candidate Election Process

The BSR RP-candidate with the most specific group-list is elected as the RP for any multicast addresses specified in its configured group list. The most specific group list takes priority over the BSR RP-candidate priority and the highest BSR RP-candidate IP address (see configuration example 1).

- Configuration example 1—Most specific group-list: In this example, the system elects the device labeled N7K-1 as the RP for all multicast addresses specified in the 224.1.1.0/24 group-list. The system elects the device labeled N7K-2 for the multicast addresses within the less specific 224.0.0.0/4 group-list.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim bsr rp-candidate loopback0 group-list 224.1.1.0/24
```

```
ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode
ip pim bsr bsr-candidate loopback0
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4
ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.1.1.0/24       ASM       192.168.1.1      -

show ip pim group 224.3.0.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

Verification for N7K-2:

```
show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.1.1.0/24       ASM       192.168.1.1      -

show ip pim group 224.3.0.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1
```

When multiple BSR RP-candidates advertise the same group list (for example, 224.0.0.0/4), the system elects the BSR RP-candidate with the highest priority (lowest numerical value) as the RP for any multicast address specified in its group-list (see configuration example 2).

- Configuration example 2—Identical group-list with different RP priorities: In this example, the system elects the device labeled N7K-1 as the RP for all multicast addresses specified in the 224.0.0.0/4 group-list because it has the lowest RP-candidate priority. The device labeled N7K-2 has a default priority of 192.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4 priority 10
ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4
ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim rp
    PIM RP Status Information for VRF "default"
    BSR: 192.168.2.1, uptime: 00:09:14, expires: 00:01:37,
        priority: 64, hash-length: 30
    Auto-RP disabled
    BSR RP Candidate policy: None
    BSR RP policy: None
    Auto-RP Announce policy: None
    Auto-RP Discovery policy: None

    RP: 192.168.1.1*, (0), uptime: 00:08:15, expires: 00:01:57,
        priority: 10, RP-source: 192.168.2.1 (B), group ranges:
    224.0.0.0/4

    RP: 192.168.2.1, (0), uptime: 00:08:15, expires: 00:01:57,
        priority: 192, RP-source: 192.168.2.1 (B), group ranges:
    224.0.0.0/4

show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.1.1
```

Verification for N7K-2:

```
show ip pim rp
    PIM RP Status Information for VRF "default"
    BSR: 192.168.2.1*, next Bootstrap message in: 00:00:55,
        priority: 64, hash-length: 30
    Auto-RP disabled
    BSR RP Candidate policy: None
    BSR RP policy: None
    Auto-RP Announce policy: None
    Auto-RP Discovery policy: None

    RP: 192.168.1.1, (0), uptime: 00:11:34, expires: 00:02:26,
        priority: 10, RP-source: 192.168.1.1 (B), group ranges:
    224.0.0.0/4

    RP: 192.168.2.1*, (0), uptime: 00:12:21, expires: 00:02:22,
        priority: 192, RP-source: 192.168.2.1 (B), group ranges:
    224.0.0.0/4

show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.1.1      -
```

When multiple BSR RP-candidates advertise the same group list (for example, 224.0.0.0/4) and are configured with the same BSR RP-candidate priority, the system elects the BSR RP-candidate with the highest IP address as the RP for any multicast address specified in its group list (see configuration example 3).

- Configuration example 3—Identical group list with identical RP priorities: In this example, the system elects the device labeled N7K-2 as the RP for all multicast addresses specified in the 224.0.0.0/4 group list because it has the highest RP-candidate IP address.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
```

```
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4
ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4
ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

Verification for N7K-2:

```
show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

PIM BSR RP-Candidate vs. Static RP Election Process

The RP with the most specific group list is elected as the RP for any multicast addresses specified in its configured group list. The most specific group list takes priority over the highest RP IP address (see configuration example 1). (RP priorities are not applicable when comparing BSR RP-candidates to static RPs.)

- Configuration example 1—Most specific group list: In this example, the system elects the device labeled N7K-1 as the BSR RP for all multicast addresses specified in the 224.1.1.0/24 group-list. The system elects the device labeled N7K-2 as the RP for the multicast addresses within the less specific 224.0.0.0/4 group list because of the static RP statement.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim rp-address 192.168.2.1 group-list 224.0.0.0/4
ip pim bsr rp-candidate loopback0 group-list 224.1.1.0/24
ip pim forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim rp-address 192.168.2.1 group-list 224.0.0.0/4
```

```
ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.1.1.0/24       ASM       192.168.1.1      -

show ip pim group 224.3.0.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

Verification for N7K-2:

```
show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.1.1.0/24       ASM       192.168.1.1      -

show ip pim group 224.3.0.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

When a static RP and the BSR RP-candidate advertise the same group list (for example, 224.0.0.0/4), the system elects the system with the highest RP IP address as the RP for any multicast addresses specified in its group-list (see configuration example 2).

- Configuration example 2—Identical RP group list: In this example, the system elects the device labeled N7K-2 as the RP for all multicast addresses specified in the 224.0.0.0/4 group list because it has the highest RP IP address.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim rp-address 192.168.1.1 group-list 224.0.0.0/4

ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim rp-address 192.168.1.1 group-list 224.0.0.0/4
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4
ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim group 224.1.1.0
PIM Group-Range Configuration for VRF "default"
Group-range        Mode      RP-address       Shared-tree-only range
224.0.0.0/4        ASM       192.168.2.1
```

Verification for N7K-2:

```
show ip pim group 224.1.1.0
PIM Group-Range Configuration for VRF "default"
Group-range        Mode      RP-address       Shared-tree-only range
224.0.0.0/4        ASM       192.168.2.1      -
```

Because you cannot configure a static RP and its default value is 0, the RP priority has no impact. You can configure the BSR RP-candidate with a value between 0 and 255. The system elects the device with the most specific group list. If both devices have the same group list, the system elects the device with the highest RP IP address (see configuration example 3).

- Configuration example 3—Identical group list and identical RP priorities: In this example, the system elects the device labeled N7K-2 as the RP for all multicast addresses specified in the 224.0.0.0/4 group list because it has the highest RP IP address. The system does not compare RP priorities between BSR RPs and static RPs.

Configuration for N7K-1:

```
interface loopback0
  ip address 192.168.1.1/32
  ip pim sparse-mode

ip pim bsr bsr-candidate loopback0
ip pim rp-address 192.168.2.1 group-list 224.0.0.0/4
ip pim bsr rp-candidate loopback0 group-list 224.0.0.0/4 priority 0

ip pim bsr forward listen
```

Configuration for N7K-2:

```
interface loopback0
  ip address 192.168.2.1/32
  ip pim sparse-mode

ip pim rp-address 192.168.2.1 group-list 224.0.0.0/4

ip pim bsr forward listen
```

Verification for N7K-1:

```
show ip pim rp
    PIM RP Status Information for VRF "default"
    BSR: 192.168.1.1*, next Bootstrap message in: 00:00:52,
        priority: 64, hash-length: 30
    Auto-RP disabled
    BSR RP Candidate policy: None
    BSR RP policy: None
    Auto-RP Announce policy: None
    Auto-RP Discovery policy: None

    RP: 192.168.1.1*, (0), uptime: 00:01:57, expires: 00:02:25,
    priority: 0, RP-source: 192.168.1.1 (B), group ranges:
        224.0.0.0/4
    RP: 192.168.2.1, (0), uptime: 02:16:09, expires: never,
    priority: 0, RP-source: (local), group ranges:
        224.0.0.0/4

show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

Verification for N7K-2:

```
show ip pim rp
```

```
    PIM RP Status Information for VRF "default"
    BSR: 192.168.1.1, uptime: 00:29:47, expires: 00:01:45,
        priority: 64, hash-length: 30
    Auto-RP disabled
    BSR RP Candidate policy: None
    BSR RP policy: None
    Auto-RP Announce policy: None
    Auto-RP Discovery policy: None

    RP: 192.168.1.1, (0), uptime: 00:06:59, expires: 00:02:05,
    priority: 0, RP-source: 192.168.1.1 (B), group ranges:
        224.0.0.0/4
    RP: 192.168.2.1*, (0), uptime: 00:13:15, expires: never,
    priority: 0, RP-source: (local), group ranges:
        224.0.0.0/4

show ip pim group 224.1.1.0
    PIM Group-Range Configuration for VRF "default"
    Group-range        Mode      RP-address       Shared-tree-only range
    224.0.0.0/4        ASM       192.168.2.1      -
```

PIM Auto-RP-Candidate vs. Auto-RP-Candidate Election Process

The auto-RP-candidate election is similar to the BSR RP-candidate election process, but it does not support priorities (see the "PIM BSR RP-Candidate vs. BSR RP-Candidate Election Process" section on page 1-9). You cannot configure the priority for an auto-RP, and the default value is 0.

PIM Auto-RP-Candidate vs. Static RP Election Process

The auto-RP-candidate versus static RP election uses the same rules as the election process for the BSR RP-candidate versus static RP (see "PIM BSR RP-Candidate vs. Static RP Election Process" section on page 1-12).

Anycast-RP

Anycast-RP has two implementations: one uses Multicast Source Discovery Protocol (MSDP) and the other is based on RFC 4610, *Anycast-RP Using Protocol Independent Multicast (PIM)*. This section describes how to configure PIM Anycast-RP.

You can use PIM Anycast-RP to assign a group of routers, called the Anycast-RP set, to a single RP address that is configured on multiple routers. The set of routers that you configure as Anycast-RPs is called the Anycast-RP set. This method is the only RP method that supports more than one RP per multicast group, which allows you to load balance across all RPs in the set. The Anycast RP supports all multicast groups.

PIM register messages are sent to the closest RP and PIM join-prune messages are sent in the direction of the closest RP as determined by the unicast routing protocols. If one of the RPs goes down, unicast routing ensures these message will be sent in the direction of the next-closest RP.

You must configue PIM on the loopback interface that is used for the PIM Anycast RP.

For more information about PIM Anycast-RP, see RFC 4610.

For information about configuring Anycast-RPs, see the "Configuring a PIM Anycast-RP Set" section on page 1-37.

PIM Register Messages

PIM register messages are unicast to the RP by designated routers (DRs) that are directly connected to multicast sources. The PIM register message has the following functions:

- To notify the RP that a source is actively sending to a multicast group.
- To deliver multicast packets sent by the source to the RP for delivery down the shared tree.

The DR continues to send PIM register messages to the RP until it receives a Register-Stop message from the RP. The RP sends a Register-Stop message in either of the following cases:

- The RP has no receivers for the multicast group being transmitted.
- The RP has joined the SPT to the source but has not started receiving traffic from the source.

You can use the **ip pim register-source** command to configure the IP source address of register messages when the IP source address of a register message is not a uniquely routed address to which the RP can send packets. This situation might occur if the source address is filtered so that the packets sent to it are not forwarded or if the source address is not unique to the network. In these cases, the replies sent from the RP to the source address will fail to reach the DR, resulting in Protocol Independent Multicast sparse mode (PIM-SM) protocol failures.

The following example shows how to configure the IP source address of the register message to the loopback 3 interface of a DR:

```
ip pim register-source loopback 3
```

Note In Cisco NX-OS, PIM register messages are rate limited to avoid overwhelming the RP.

You can filter PIM register messages by defining a routing policy. For information about configuring the PIM register message policy, see the "Configuring Shared Trees Only for ASM" section on page 1-40.

Designated Routers

In PIM ASM and SSM modes, the software chooses a designated router (DR) from the routers on each network segment. The DR is responsible for forwarding multicast data for specified groups and sources on that segment.

The DR for each LAN segment is determined as described in the "Hello Messages" section on page 1-3.

In ASM mode, the DR is responsible for unicasting PIM register packets to the RP. When a DR receives an IGMP membership report from a directly connected receiver, the shortest path is formed to the RP, which may or may not go through the DR. The result is a shared tree that connects all sources transmitting on the same multicast group to all receivers of that group.

In SSM mode, the DR triggers (*, G) or (S, G) PIM join messages toward the RP or the source. The path from the receiver to the source is determined hop by hop. The source must be known to the receiver or the DR.

For information about configuring the DR priority, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

Designated Forwarders

In PIM Bidir mode, the software chooses a designated forwarder (DF) at RP discovery time from the routers on each network segment. The DF is responsible for forwarding multicast data for specified groups on that segment. The DF is elected based on the best metric from the network segment to the RP.

If the router receives a packet on the RPF interface toward the RP, the router forwards the packet out all interfaces in the OIF-list. If a router receives a packet on an interface on which the router is the elected DF for that LAN segment, the packet is forwarded out all interfaces in the OIF-list except the interface that it was received on and also out the RPF interface toward the RP.

Note Cisco NX-OS puts the RPF interface into the OIF-list of the MRIB, but not in the OIF-list of the MFIB.

ASM Switchover from Shared Tree to Source Tree

In ASM mode, the DR that is connected to a receiver switches over from the shared tree to the shortest-path tree (SPT) to a source unless you configure the PIM parameter to use shared trees only. For information about configuring the use of shared trees only, see the "Configuring Shared Trees Only for ASM" section on page 1-40.

During the switchover, messages on the SPT and shared tree may overlap. These messages are different. The shared tree messages are propagated upstream toward the RP, while SPT messages go toward the source.

For information about SPT switchovers, see the "Last-Hop Switchover" to the SPT section in RFC 4601.

Administratively Scoped IP Multicast

The administratively scoped IP multicast method allows you to set boundaries on the delivery of multicast data. For more information, see RFC 2365.

You can configure an interface as a PIM boundary so that PIM messages are not sent out that interface. For information about configuring the domain border parameter, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

You can use the Auto-RP scope parameter to set a time-to-live (TTL) value. For more information, see the "Configuring Shared Trees Only for ASM" section on page 1-40.

Bidirectional Forwarding Detection for PIM

Beginning with Cisco NX-OS Release 5.0(2a), Bidirectional Forwarding Detection (BFD) allows the system to rapidly detect failures in a network. See the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x* for more information about BFD.

In PIM, a link or neighbor group failure is detected when the hold-time, which is set as part of the hello interval, expires. However, BFD provides a more efficient method to detect a failure. This protocol establishes a session between the two endpoints over a link and uses the forwarding engine. When BFD is enabled, the PIM process attempts to add a BFD session as each neighbor is discovered. If a BFD session already exists, no duplicate is created but PIM receives a callback that contains the state of the BFD session. You can enable BFD for PIM per VRF or per interface.

PIM removes the BFD session when you disable BFD for that VRF or interface, the interface is no longer a PIM interface, or the neighboring BFD session goes down.

Virtualization Support

A virtual device context (VDC) is a logical representation of a set of system resources. Within each VDC, multiple virtual routing and forwarding (VRF) instances can be defined. For each VRF in a VDC in the system, independent multicast system resources are maintained, including the MRIB and M6RIB.

You can use the PIM and PIM6 **show** commands with a VRF argument to provide a context for the information displayed. The default VRF is used if no VRF argument is supplied.

For information about configuring VDCs, see the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*.

For information about configuring VRFs, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

High Availability

For information about high availability, see the *Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide, Release 5.x*.

Licensing Requirements for PIM and PIM6

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	PIM and PIM6 require an Enterprise Services license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for PIM and PIM6

PIM and PIM6 have the following prerequisites:

- You are logged onto the device.
- You are in the correct virtual device context (VDC). A VDC is a logical representation of a set of system resources. You can use the **switchto vdc** command with a VDC number.
- For global commands, you are in the correct virtual routing and forwarding (VRF) mode. The default configuration mode shown in the examples in this chapter applies to the default VRF.

Guidelines and Limitations for PIM and PIM6

PIM and PIM6 have the following guidelines and limitations:

- Tunnel interfaces do not support PIM until Cisco NX-OS Release 5.2(1). Beginning with Release 5.2(1), you can configure multicast on GRE tunnel interfaces.
- Cisco NX-OS PIM and PIM6 do not interoperate with any version of PIM dense mode or PIM sparse mode version 1.
- Do not configure both Auto-RP and BSR protocols in the same network.
- Configure candidate RP intervals to a minimum of 15 seconds.
- If a device is configured with a BSR policy that should prevent it from being elected as the BSR, the device ignores the policy. This behavior results in the following undesirable conditions:
  - If a device receives a BSM that is permitted by the policy, the device, which incorrectly elected itself as the BSR, drops that BSM so that routers downstream fail to receive it. Downstream devices correctly filter the BSM from the incorrect BSR so that these devices do not receive RP information.
  - A BSM received by a BSR from a different device sends a new BSM but ensures that downstream devices do not receive the correct BSM.
- While using avirtual port channel (vPC) with dual supervisors, you must use the default timers as follows:
  - While using dual supervisors where we recommend high default timer values; convergence will suffer on a link failure. If you want to perform ISSU or you want the system to do an SSO without any network reconvergence, you must specify higher default timer values.
  - Beginning with Release 5.x, we recommend that you use BFD for PIM instead of nondefault timers.
- Default PIM timer values are recommended for most deployments. ISSU/SSO may not function as expected if timers are modified from the default values.
- Beginning with Release 5.x, we recommend that you use BFD for PIM to support subsecond failure detection.

Default Settings

Table 1-2 lists the default settings for PIM and PIM6 parameters.

Table 1-2 Default PIM and PIM6 Parameters

Parameters	Default
Use shared trees only	Disabled
Flush routes on restart	Disabled
Log Neighbor changes	Disabled
Auto-RP message action	Disabled
BSR message action	Disabled
SSM multicast group range or policy	232.0.0.0/8 for IPv4 and FF3x::/96 for IPv6
PIM sparse mode	Disabled
Designated router priority	0
Hello authentication mode	Disabled
Domain border	Disabled

Table 1-2 Default PIM and PIM6 Parameters (continued)

Parameters	Default
RP address policy	No message filtering
PIM register message policy	No message filtering
BSR candidate RP policy	No message filtering
BSR policy	No message filtering
Auto-RP mapping agent policy	No message filtering
Auto-RP RP candidate policy	No message filtering
Join-prune policy	No message filtering
Neighbor adjacency policy	Become adjacent with all PIM neighbors
BFD	Disabled

Configuring PIM and PIM6

You can configure both PIM and PIM6 on the same router. You configure either PIM or PIM6 for each interface, depending on whether that interface is running IPv4 or IPv6.

Note Cisco NX-OS supports only PIM sparse mode version 2. In this publication, "PIM" refers to PIM sparse mode version 2.

You can configure separate ranges of addresses in the PIM or PIM6 domain using the multicast distribution modes described in Table 1-3.

Table 1-3 PIM and PIM6 Multicast Distribution Modes

Multicast Distribution Mode	Requires RP Configuration	Description
ASM	Yes	Any source multicast
Bidir	Yes	Bidirectional shared trees
SSM	No	Single source multicast
RPF routes for multicast	No	RPF routes for multicast

To configure PIM and PIM6, follow these steps:

Step 1 From the multicast distribution modes described in Table 1-3, select the range of multicast groups that you want to configure in each mode.

Step 2 Enable the PIM and PIM6 features. See the "Enabling the PIM and PIM6 Features" section on page 1-21.

Step 3 Configure PIM or PIM6 sparse mode on each interface that you want to participate in a PIM domain. See the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

Step 4 Follow the configuration steps for the multicast distribution modes that you selected in Step 1 as follows:

- For ASM or Bidir mode, see the "Configuring ASM and Bidir" section on page 1-29.

- For SSM mode, see the "Configuring SSM" section on page 1-42.
- For RPF routes for multicast, see the "Configuring RPF Routes for Multicast" section on page 1-44.

Step 5 Configure message filtering. See the "Configuring Message Filtering" section on page 1-48.

The CLI commands used to configure PIM or PIM6 differ as follows:

- Commands begin with **ip pim** for PIM and begin with **ipv6 pim** for PIM6.
- Commands begin with **show ip pim** for PIM and begin with **show ipv6 pim** for PIM6.

This section includes the following topics:

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Enabling the PIM and PIM6 Features

Before you can access the PIM or PIM6 commands, you must enable the PIM or PIM6 feature.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license.

SUMMARY STEPS

1. **config t**
2. **feature pim**
3. **feature pim6**
4. **(Optional) show running-configuration pim**
5. **(Optional) show running-configuration pim6**
6. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**feature pim** **Example:** switch(config)# feature pim	Enables PIM. By default, PIM is disabled.
Step 3	**feature pim6** **Example:** switch(config)# feature pim6	Enables PIM6. By default, PIM6 is disabled.
Step 4	**show running-configuration pim** **Example:** switch(config)# show running-configuration pim	(Optional) Shows the running-configuration information for PIM, including the **feature** command.
Step 5	**show running-configuration pim6** **Example:** switch(config)# show running-configuration pim6	(Optional) Shows the running-configuration information for PIM6, including the **feature** command.
Step 6	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring PIM or PIM6 Sparse Mode

You configure PIM or PIM6 sparse mode on every device interface that you want to participate in a sparse mode domain. You can configure the sparse mode parameters described in Table 1-4.

Table 1-4 PIM and PIM6 Sparse Mode Parameters

Parameter	Description
Global to the device	
Auto-RP message action	Enables listening and forwarding of Auto-RP messages. The default is disabled, which means that the router does not listen or forward Auto-RP messages unless it is configured as a candidate RP or mapping agent. **Note** PIM6 does not support the Auto-RP method.
BSR message action	Enables listening and forwarding of BSR messages. The default is disabled, which means that the router does not listen or forward BSR messages unless it is configured as a candidate RP or BSR candidate.

Table 1-4 PIM and PIM6 Sparse Mode Parameters (continued)

Parameter	Description
Bidir RP limit	Configures the number of Bidir RPs that you can configure for IPv4 and IPv6. The maximum number of Bidir RPs supported per VRF for PIM and PIM6 combined cannot exceed 8. Values range from 0 to 8. The default is 6 for IPv4 and 2 for IPv6.
Register rate limit	Configures the IPv4 or IPv6 register rate limit in packets per second. The range is from 1 to 65,535. The default is no limit.
Initial holddown period	Configures the IPv4 or IPv6 initial holddown period in seconds. This holddown period is the time it takes for the MRIB to come up initially. If you want faster convergence, enter a lower value. The range is from 90 to 210. Specify 0 to disable the holddown period. The default is 210.
Per device interface	
PIM sparse mode	Enables PIM or PIM6 on an interface.
Designated router priority	Sets the designated router (DR) priority that is advertised in PIM hello messages on this interface. On a multi-access network with multiple PIM-enabled routers, the router with the highest DR priority is elected as the DR router. If the priorities match, the software elects the DR with the highest IP address. The DR originates PIM register messages for the directly connected multicast sources and sends PIM join messages toward the rendezvous point (RP) for directly connected receivers. Values range from 1 to 4294967295. The default is 1.
Hello authentication mode	Enables an MD5 hash authentication key, or password, in PIM hello messages on the interface so that directly connected neighbors can authenticate each other. The PIM hello messages are IPsec encoded using the Authentication Header (AH) option. You can enter an unencrypted (cleartext) key or one of these values followed by a space and the MD5 authentication key: • 0—Specifies an unencrypted (cleartext) key • 3—Specifies a 3-DES encrypted key • 7—Specifies a Cisco Type 7 encrypted key The authentication key can be up to 16 characters. The default is disabled. **Note** PIM6 does not support hello authentication.
Hello interval	Configures the interval at which hello messages are sent in milliseconds. The range is from 1 to 4294967295. The default is 30000.

Table 1-4 PIM and PIM6 Sparse Mode Parameters (continued)

Parameter	Description
Domain border	Enables the interface to be on the border of a PIM domain so that no bootstrap, candidate-RP, or Auto-RP messages are sent or received on the interface. The default is disabled. **Note** PIM6 does not support the Auto-RP method.
Neighbor policy	Configures which PIM neighbors to become adjacent to based on a route-map policy[1] where you can specify IP addresses to become adjacent to with the **match ip**[**v6**] **address** command. If the policy name does not exist, or no IP addresses are configured in a policy, adjacency is established with all neighbors. The default is to become adjacent with all PIM neighbors. **Note** We recommend that you should configure this feature only if you are an experienced network administrator.

1. To configure route-map policies, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

For information about configuring multicast route maps, see the "Configuring Route Maps to Control RP Information Distribution" section on page 1-45.

Note To configure the join-prune policy, see the "Configuring Message Filtering" section on page 1-48.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **(Optional) ip pim auto-rp** {**listen** [**forward**] | **forward** [**listen**]}
3. **(Optional) ip pim bsr** {**listen** [**forward**] | **forward** [**listen**]}
4. **(Optional) show ip pim rp** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
5. **(Optional) ip pim bidir-rp-limit** *limit*
6. **(Optional) ip pim register-rate-limit** *rate*
7. **(Optional)** [**ip** | **ipv4**] **routing multicast holddown** *holddown-period*
8. **show running-configuration pim**
9. **interface** *interface*
10. **ip pim sparse-mode**
11. **(Optional) ip pim dr-priority** *priority*
12. **(Optional) ip pim hello-authentication ah-md5** *auth-key*
13. **(Optional) ip pim hello-interval** *interval*
14. **(Optional) ip pim border**

15. **(Optional) ip pim neighbor-policy** *policy-name*
16. **(Optional) show ip pim interface** [*interface* | **brief**] [**vrf** *vrf-name* | **all**]
17. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **(Optional) ipv6 pim bsr** {**listen** [**forward**] | **forward** [**listen**]}
3. **(Optional) show ipv6 pim rp** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**]
4. **(Optional) ipv6 pim bidir-rp-limit** *limit*
5. **(Optional) ipv6 pim register-rate-limit** *rate*
6. **(Optional) ipv6 routing multicast holddown** *holddown-period*
7. **show running-configuration pim6**
8. **interface** *interface*
9. **ipv6 pim sparse-mode**
10. **(Optional) ipv6 pim dr-priority** *priority*
11. **(Optional) ipv6 pim hello-interval** *interval*
12. **(Optional) ipv6 pim border**
13. **(Optional) ipv6 pim neighbor-policy** *policy-name*
14. **(Optional) show ipv6 pim interface** [*interface* | **brief**] [**vrf** *vrf-name* | **all**]
15. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip pim auto-rp** {**listen** [**forward**] | **forward** [**listen**]} **Example:** switch(config)# ip pim auto-rp listen	(Optional) Enables listening or forwarding of Auto-RP messages. The default is disabled, which means that the software does not listen to or forward Auto-RP messages.
Step 3	**ip pim bsr** {**listen** [**forward**] | **forward** [**listen**]} **Example:** switch(config)# ip pim bsr forward	(Optional) Enables listening or forwarding of BSR messages. The default is disabled, which means that the software does not listen or forward BSR messages.
Step 4	**show ip pim rp** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** switch(config)# show ip pim rp	(Optional) Displays PIM RP information, including Auto-RP and BSR listen and forward states.

	Command	Purpose
Step 5	**ip pim bidir-rp-limit** *limit* **Example:** `switch(config)# ip pim bidir-rp-limit 4`	(Optional) Specifies the number of Bidir RPs that you can configure for IPv4. The maximum number of Bidir RPs supported per VRF for PIM and PIM6 combined cannot exceed 8. Values range from 0 to 8. The default is 6.
Step 6	**ip pim register-rate-limit** *rate* **Example:** `switch(config)# ip pim register-rate-limit 1000`	(Optional) Configures the rate limit in packets per second. The range is from 1 to 65,535. The default is no limit.
Step 7	[**ip** | **ipv4**] **routing multicast holddown** *holddown-period* **Example:** `switch(config)# ip routing multicast holddown 100`	(Optional) Configures the initial holddown period in seconds. The range is from 90 to 210. Specify 0 to disable the holddown period. The default is 210.
Step 8	**show running-configuration pim** **Example:** `switch(config)# show running-configuration pim`	(Optional) Displays PIM running-configuration information, including the Bidir RP limit and register rate limit.

Step 9	**interface** *interface*
	
	Example:
	`switch(config)# interface ethernet 2/1`
	`switch(config-if)#`
		Enters interface mode on the interface type and number, such as **ethernet** *slot/port*.

Step 10	**ip pim sparse-mode** **Example:** `switch(config-if)# ip pim sparse-mode`	Enables PIM sparse mode on this interface. The default is disabled.
Step 11	**ip pim dr-priority** *priority* **Example:** `switch(config-if)# ip pim dr-priority 192`	(Optional) Sets the designated router (DR) priority that is advertised in PIM hello messages. Values range from 1 to 4294967295. The default is 1.
Step 12	**ip pim hello-authentication ah-md5** *auth-key* **Example:** `switch(config-if)# ip pim hello-authentication ah-md5 my_key`	(Optional) Enables an MD5 hash authentication key in PIM hello messages. You can enter an unencrypted (cleartext) key or one of these values followed by a space and the MD5 authentication key: • 0—Specifies an unencrypted (cleartext) key • 3—Specifies a 3-DES encrypted key • 7—Specifies a Cisco Type 7 encrypted key The key can be up to 16 characters. The default is disabled.
Step 13	**ip pim hello-interval** *interval* **Example:** `switch(config-if)# ip pim hello-interval 25000`	(Optional) Configures the interval at which hello messages are sent in milliseconds. The range is from 1000 to 18724286. The default is 30000. **Note** Before Cisco NX-OS Release 5.2(1), the minimum value was 1 millisecond.

	Command	Purpose
Step 14	**ip pim border** **Example:** switch(config-if)# ip pim border	(Optional) Enables the interface to be on the border of a PIM domain so that no bootstrap, candidate-RP, or Auto-RP messages are sent or received on the interface. The default is disabled.
Step 15	**ip pim neighbor-policy** *policy-name* **Example:** switch(config-if)# ip pim neighbor-policy my_neighbor_policy	(Optional) Configures which PIM neighbors to become adjacent to based on a route-map policy with the **match ip address** command. The policy name can be up to 63 characters. The default is to become adjacent with all PIM neighbors. **Note** We recommend that you should configure this feature only if you are an experienced network administrator.
Step 16	**show ip pim interface** [*interface* | **brief**] [**vrf** *vrf-name* | **all**] **Example:** switch(config-if)# show ip pim interface	(Optional) Displays PIM interface information.
Step 17	**copy running-config startup-config** **Example:** switch(config-if)# copy running-config startup-config	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ipv6 pim bsr** {**listen** [**forward**] | **forward** [**listen**]} **Example:** switch(config)# ipv6 pim bsr forward	(Optional) Enables listening or forwarding of BSR messages. The default is disabled, which means that the software does not listen or forward BSR messages.
Step 3	**show ipv6 pim rp** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**] **Example:** switch(config)# show ipv6 pim rp	(Optional) Displays PIM6 RP information, including BSR listen and forward states.
Step 4	**ipv6 pim bidir-rp-limit** *limit* **Example:** switch(config)# ipv6 pim bidir-rp-limit 4	(Optional) Specifies the number of Bidir RPs that you can configure for IPv6. The maximum number of Bidir RPs supported per VRF for PIM and PIM6 combined cannot exceed 8. Values range from 0 to 8. The default is 2.
Step 5	**ipv6 pim register-rate-limit** *rate* **Example:** switch(config)# ipv6 pim register-rate-limit 1000	(Optional) Configures the rate limit in packets per second. The range is from 1 to 65,535. The default is no limit.

	Command	Purpose
Step 6	**ipv6 routing multicast holddown** *holddown-period* **Example:** `switch(config)# ipv6 routing multicast holddown 100`	(Optional) Configures the initial holddown period in seconds. The range is from 90 to 210. Specify 0 to disable the holddown period. The default is 210.
Step 7	**show running-configuration pim6** **Example:** `switch(config)# show running-configuration pim6`	(Optional) Displays PIM6 running-configuration information, including the Bidir RP limit and register rate limit.

Step 8	**interface** *interface*
	
	Example:
	`switch(config)# interface ethernet 2/1`
	`switch(config-if)#`
		Enters interface mode on the specified interface.

Step 9	**ipv6 pim sparse-mode** **Example:** `switch(config-if)# ipv6 pim sparse-mode`	Enables PIM6 sparse mode on this interface. The default is disabled.
Step 10	**ipv6 pim dr-priority** *priority* **Example:** `switch(config-if)# ipv6 pim dr-priority 192`	(Optional) Sets the designated router (DR) priority that is advertised in PIM6 hello messages. Values range from 1 to 4294967295. The default is 1.
Step 11	**ipv6 pim hello-interval** *interval* **Example:** `switch(config-if)# ipv6 pim hello-interval 25000`	(Optional) Configures the interval at which hello messages are sent in milliseconds. The range is from 1000 to 18724286. The default is 30000. **Note** Before Cisco NX-OS Release 5.2(1), the minimum value was 1 millisecond.
Step 12	**ipv6 pim border** **Example:** `switch(config-if)# ipv6 pim border`	(Optional) Enables the interface to be on the border of a PIM6 domain so that no bootstrap, candidate-RP, or Auto-RP messages are sent or received on the interface. The default is disabled.
Step 13	**ipv6 pim neighbor-policy** *policy-name* **Example:** `switch(config-if)# ipv6 pim neighbor-policy my_neighbor_policy`	(Optional) Configures which PIM6 neighbors to become adjacent to based on a route-map policy with the **match ipv6 address** command. The policy name can be up to 63 characters. The default is to become adjacent with all PIM6 neighbors. **Note** We recommend that you should configure this feature only if you are an experienced network administrator.
Step 14	**show ipv6 pim interface** [*interface* | **brief**] [**vrf** *vrf-name* | **all**] **Example:** `switch(config-if)# show ipv6 pim interface`	(Optional) Displays PIM6 interface information.
Step 15	**copy running-config startup-config** **Example:** `switch(config-if)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring ASM and Bidir

Any Source Multicast (ASM) and bidirectional shared trees (Bidir) are multicast distribution modes that require the use of RPs to act as a shared root between sources and receivers of multicast data.

To configure ASM or Bidir mode, you configure sparse mode and the RP selection method, where you indicate the distribution mode and assign the range of multicast groups.

Note Bidir mode is not supported for vPCs. For more information about vPCs, see the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide, Release 5.x*.

This section includes the following topics:

Configuring Static RPs

You can configure an RP statically by configuring the RP address on every router that will participate in the PIM domain.

You can specify a route-map policy name that lists the group prefixes to use with the **match ip multicast** command.

Beginning with Cisco NX-OS Release 5.1(3), the **ip pim rp-address** command has been enhanced with the following functionalities:

- Added prefix-list method of configuration in addition to existing route-map method.
- Added support for policy actions (route-map or prefix-list).

Note Cisco NX-OS always uses the longest-match prefix to find the RP. So, the behavior is the same irrespective of the position of the group prefix in the route map or in the prefix list.

The following example configuration produce the same output using Cisco NX-OS (231.1.1.0/24 is always denied irrespective of the sequence number):

```
ip prefix-list plist seq 10 deny 231.1.1.0/24
ip prefix-list plist seq 20 permit 231.1.0.0/16


ip prefix-list plist seq 10 permit 231.1.0.0/16
ip prefix-list plist seq 20 deny 231.1.1.0/24
```

This behavior differs from Cisco IOS. See the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*, behavior for more samples for the **ip pim rp-address** command.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **ip pim rp-address** *rp-address* [**group-list** *ip-prefix* | **route-map** *policy-name*] [**bidir**]
3. **(Optional) show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **ipv6 pim rp-address** *rp-address* [**group-list** *ipv6-prefix* | **route-map** *policy-name*] [**bidir**]
3. **(Optional) show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ip pim rp-address** *rp-address* [**group-list** *ip-prefix* | **route-map** *policy-name*] [**bidir**]
	
	Example 1:
	`switch(config)# ip pim rp-address 192.0.2.33 group-list 224.0.0.0/9`
	
	Example 2:
	`switch(config)# ip pim rp-address 192.0.2.34 group-list 224.128.0.0/9 bidir`
		Configures a PIM static RP address for a multicast group range. You can specify a route-map policy name that lists the group prefixes to use with the **match ip multicast** command. The default mode is ASM unless you specify the **bidir** keyword. The default group range is 224.0.0.0 through 239.255.255.255.
		
		Example 1 configures PIM ASM mode for the specified group range.
		
		Example 2 configures PIM Bidir mode for the specified group range.

Step 3	**show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ip pim group-range`	(Optional) Displays PIM modes and group ranges.
Step 4	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ipv6 pim rp-address** *rp-address* [**group-list** *ipv6-prefix* | **route-map** *policy-name*] [**bidir**] **Example 1:** switch(config)# ipv6 pim rp-address 2001:0db8:0:abcd::1 group-list ff1e:abcd:def1::0/24 **Example 2:** switch(config)# ipv6 pim rp-address 2001:0db8:0:abcd::2 group-list ff1e:abcd:def2::0/96 bidir	Configures a PIM6 static RP address for a multicast group range. You can specify a route-map policy name that lists the group prefixes to use with the **match ip multicast** command. The mode is ASM unless you specify the **bidir** keyword. The default group range is ff00::0/8. Example 1 configures PIM6 ASM mode for the specified group range. Example 2 configures PIM6 Bidir mode for the specified group range.
Step 3	**show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**] **Example:** switch(config)# show ipv6 pim group-range	(Optional) Displays PIM6 modes and group ranges.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring BSRs

You configure BSRs by selecting candidate BSRs and RPs.

Caution Do not configure both Auto-RP and BSR protocols in the same network.

You can configure a candidate BSR with the arguments described in Table 1-5.

Table 1-5 Candidate BSR Arguments

Argument	Description
interface	Interface type and number used to derive the BSR source IP address used in bootstrap messages.
hash-length	Number of high order 1s used to form a mask that is ANDed with group address ranges of candidate RPs to form a hash value. The mask determines the number of consecutive addresses to assign across RPs with the same group range. For PIM, this value ranges from 0 to 32 and has a default of 30. For PIM6, this value ranges from 0 to 128 and has a default of 126.
priority	Priority assigned to this BSR. The software elects the BSR with the highest priority, or if the BSR priorities match, the software elects the BSR with the highest IP address. This value ranges from 0, the lowest priority, to 255 and has a default of 64.

You can configure a candidate RP with the arguments and keywords described in Table 1-6.

Table 1-6 BSR Candidate RP Arguments and Keywords

Argument or Keyword	Description
interface	Interface type and number used to derive the BSR source IP address used in Bootstrap messages.
group-list *ip-prefix*	Multicast groups handled by this RP specified in a prefix format.
interval	Number of seconds between sending candidate-RP messages. This value ranges from 1 to 65,535 and has a default of 60 seconds. **Note** We recommend that you configure the candidate RP interval to a minimum of 15 seconds.
priority	Priority assigned to this RP. The software elects the RP with the highest priority for a range of groups, or if the priorities match, the highest IP address. (The highest priority is the lowest numerical value.) This value ranges from 0, the highest priority, to 255 and has a default of 192. **Note** This priority differs from the BSR BSR-candidate priority, which prefers the highest value between 0 and 255.
bidir	Unless you specify bidir, this RP will be in ASM mode. If you specify bidir, the RP will be in Bidir mode.
route-map *policy-name*	Route-map policy name that defines the group prefixes where this feature is applied.

Tip You should choose the candidate BSRs and candidate RPs that have good connectivity to all parts of the PIM domain.

You can configure the same router to be both a BSR and a candidate RP. In a domain with many routers, you can select multiple candidate BSRs and RPs to automatically fail over to alternates if a BSR or an RP fails.

To configure candidate BSRs and RPs, follow these steps:

Step 1 Configure whether each router in the PIM domain should listen and forward BSR messages. A router configured as either a candidate RP or a candidate BSR will automatically listen to and forward all bootstrap router protocol messages, unless an interface is configured with the domain border feature. For more information, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

Step 2 Select the routers to act as candidate BSRs and RPs.

Step 3 Configure each candidate BSR and candidate RP as described in this section.

Step 4 Configure BSR message filtering. See the "Configuring Message Filtering" section on page 1-48.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **ip pim bsr listen forward**
3. **ip pim** [**bsr**] **bsr-candidate** *interface* [**hash-len** *hash-length*] [**priority** *priority*]
4. **ip pim** [**bsr**] **rp-candidate** *interface* {**group-list** *ip-prefix* | **route-map** *policy-name*}[**priority** *priority*] [**interval** *interval*] [**bidir**]
5. **(Optional) show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
6. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **ipv6 pim** [**bsr**] **bsr-candidate** *interface* [**hash-len** *hash-length*] [**priority** *priority*]
3. **ipv6 pim** [**bsr**] **rp-candidate** *interface* {**group-list** *ipv6-prefix* | **route-map** *policy-name*} [**priority** *priority*] [**interval** *interval*] [**bidir**]
4. **(Optional) show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**]
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ip pim bsr listen forward** **Example:** `switch(config)# ip pim bsr listen forward`	Configures listen and forward. Ensure that you have entered this command in each VRF on the remote PE.
Step 3	**ip pim** [**bsr**] **bsr-candidate** *interface* [**hash-len** *hash-length*] [**priority** *priority*] **Example:** `switch(config)# ip pim bsr-candidate ethernet 2/1 hash-len 24`	Configures a candidate bootstrap router (BSR). The source IP address used in a bootstrap message is the IP address of the interface. The hash length ranges from 0 to 32 and has a default of 30. The priority ranges from 0 to 255 and has a default of 64. For parameter details, see Table 1-5.

	Command	Purpose

Step 4	**ip pim** [**bsr**] **rp-candidate** *interface* {**group-list** *ip-prefix* | **route-map** *policy-name*} [**priority** *priority*] [**interval** *interval*] [**bidir**]
	
	Example 1:
	`switch(config)# ip pim rp-candidate ethernet 2/1 group-list 239.0.0.0/24`
	
	Example 2:
	`switch(config)# ip pim rp-candidate ethernet 2/1 group-list 239.0.0.0/24 bidir`
		Configures a candidate RP for BSR. The priority ranges from 0, the highest priority, to 65,535 and has a default of 192. The interval ranges from 1 to 65,535 seconds and has a default of 60.
		
		Note We recommend that you configure the candidate RP interval to a minimum of 15 seconds.
		
		Example 1 configures an ASM candidate RP.
		
		Example 2 configures a Bidir candidate RP.

Step 5	**show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ip pim group-range`	(Optional) Displays PIM modes and group ranges.
Step 6	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ipv6 pim** [**bsr**] **bsr-candidate** *interface* [**hash-len** *hash-length*] [**priority** *priority*] **Example:** `switch(config)# ipv6 pim bsr-candidate ethernet 2/1 hash-len 24 priority 192`	Configures a candidate bootstrap router (BSR). The source IP address used in a bootstrap message is the IP address of the interface. The hash length ranges from 0 to 128 and has a default of 126. The priority ranges from 0, the lowest priority, to 255 and has a default of 64. For parameter details, see Table 1-5.

Step 3	**ipv6 pim** [**bsr**] **rp-candidate** *interface* {**group-list** *ipv6-prefix* | **route-map** *policy-name*} [**priority** *priority*] [**interval** *interval*] [**bidir**]
	
	Example 1:
	`switch(config)# ipv6 pim rp-candidate ethernet 2/1 group-list ff1e:abcd:def1::0/24`
	
	Example 2:
	`switch(config)# ipv6 pim rp-candidate ethernet 2/1 group-list ff1e:abcd:def2::0/24 bidir`
		Configures a candidate RP for BSR. The priority ranges from 0, the highest priority, to 65,535 and has a default of 192. The interval ranges from 1 to 65,535 seconds and has a default of 60. For parameter details, see Table 1-6.
		
		Example 1 configures an ASM candidate RP.
		
		Example 2 configures a Bidir candidate RP.

	Command	Purpose
Step 4	**show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ipv6 pim group-range`	(Optional) Displays PIM6 modes and group ranges.
Step 5	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Use the **show ipv6 pim group-range** command to display the configured PIM6 modes and group ranges.

Configuring Auto-RP

You can configure Auto-RP by selecting candidate mapping agents and RPs. You can configure the same router to be both a mapping agent and a candidate RP.

Note Auto-RP is not supported by PIM6.

Caution Do not configure both Auto-RP and BSR protocols in the same network.

You can configure an Auto-RP mapping agent with the arguments described in Table 1-7.

Table 1-7 Auto-RP Mapping Agent Arguments

Argument	Description
interface	Interface type and number used to derive the IP address of the Auto-RP mapping agent used in bootstrap messages.
scope *ttl*	Time-To-Live (TTL) value that represents the maximum number of hops that RP-Discovery messages are forwarded. This value can range from 1 to 255 and has a default of 32. **Note** See the border domain feature in the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

If you configure multiple Auto-RP mapping agents, only one is elected as the mapping agent for the domain. The elected mapping agent ensures that all candidate RP messages are sent out. All mapping agents receive the candidate RP messages and advertise the same RP cache in their RP-discovery messages.

You can configure a candidate RP with the arguments and keywords described in Table 1-8.

Table 1-8 Auto-RP Candidate RP Arguments and Keywords

Argument or Keyword	Description
interface	Interface type and number used to derive the IP address of the candidate RP used in Bootstrap messages.
group-list *ip-prefix*	Multicast groups handled by this RP. It is specified in a prefix format.
scope *ttl*	Time-To-Live (TTL) value that represents the maximum number of hops that RP-Discovery messages are forwarded. This value can range from 1 to 255 and has a default of 32. **Note** See the border domain feature in the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.
interval	Number of seconds between sending RP-Announce messages. This value can range from 1 to 65,535 and has a default of 60. **Note** We recommend that you configure the candidate RP interval to a minimum of 15 seconds.
bidir	If not specified, this RP will be in ASM mode. If specified, this RP will be in Bidir mode.
route-map *policy-name*	Route-map policy name that defines the group prefixes where this feature is applied.

Tip You should choose mapping agents and candidate RPs that have good connectivity to all parts of the PIM domain.

To configure Auto-RP mapping agents and candidate RPs, follow these steps:

Step 1 For each router in the PIM domain, configure whether that router should listen and forward Auto-RP messages. A router configured as either a candidate RP or an Auto-RP mapping agent will automatically listen to and forward all Auto-RP protocol messages, unless an interface is configured with the domain border feature. For more information, see the "Configuring PIM or PIM6 Sparse Mode" section on page 1-22.

Step 2 Select the routers to act as mapping agents and candidate RPs.

Step 3 Configure each mapping agent and candidate RP as described in this section.

Step 4 Configure Auto-RP message filtering. See the "Configuring Message Filtering" section on page 1-48.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **ip pim** {**send-rp-discovery** | {**auto-rp mapping-agent**}} *interface* [**scope** *ttl*]
3. **ip pim** {**send-rp-announce** | {**auto-rp rp-candidate**}} *interface* {**group-list** *ip-prefix* | **route-map** *policy-name*} [**scope** *ttl*] [**interval** *interval*] [**bidir**]
4. **(Optional) show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip pim** {**send-rp-discovery** | {**auto-rp mapping-agent**}} *interface* [**scope** *ttl*] **Example:** switch(config)# ip pim auto-rp mapping-agent ethernet 2/1	Configures an Auto-RP mapping agent. The source IP address used in Auto-RP Discovery messages is the IP address of the interface. The default scope is 32. For parameter details, see Table 1-7.
Step 3	**ip pim** {**send-rp-announce** | {**auto-rp rp-candidate**}} *interface* {**group-list** *ip-prefix* | **route-map** *policy-name*} [**scope** *ttl*] [**interval** *interval*] [**bidir**] **Example 1:** switch(config)# ip pim auto-rp rp-candidate ethernet 2/1 group-list 239.0.0.0/24 **Example 2:** switch(config)# ip pim auto-rp rp-candidate ethernet 2/1 group-list 239.0.0.0/24 bidir	Configures an Auto-RP candidate RP. The default scope is 32. The default interval is 60 seconds. By default, the command creates an ASM candidate RP. For parameter details, see Table 1-8. **Note** We recommend that you configure the candidate RP interval to a minimum of 15 seconds. Example1 configures an ASM candidate RP. Example 2 configures a Bidir candidate RP.
Step 4	**show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** switch(config)# show ip pim group-range	(Optional) Displays PIM modes and group ranges.
Step 5	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring a PIM Anycast-RP Set

To configure a PIM Anycast-RP set, follow these steps:

Step 1 Select the routers in the PIM Anycast-RP set.

Step 2 Select an IP address for the PIM Anycast-RP set.

Step 3 Configure each peer RP in the PIM Anycast-RP set as described in this section.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **interface loopback** *number*
3. **ip address** *ip-prefix*
4. **exit**
5. **ip pim anycast-rp** *anycast-rp-address anycast-rp-peer-address*
6. Repeat Step 5 using the same *anycast-rp* for each RP in the RP set (including local router)
7. **(Optional) show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
8. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **interface loopback** *number*
3. **ipv6 address** *ipv6-prefix*
4. **exit**
5. **ipv6 pim anycast-rp** *anycast-rp-address anycast-rp-peer-address*
6. Repeat Step 5 using the same *anycast-rp* for each RP in the RP set (including local router)
7. **(Optional) show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**]
8. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface loopback** *number* **Example:** `switch(config)# interface loopback 0`	Configures an interface loopback. This example configures interface loopback 0.

	Command	Purpose
Step 3	**ip address** *ip-prefix* **Example:** `switch(config-if)# ip address 192.0.2.3/32`	Configures an IP address for this interface. This example configures an IP address for the Anycast-RP.
Step 4	**exit** **Example:** `switch(config)# exit`	Returns to configuration mode.
Step 5	**ip pim anycast-rp** *anycast-rp-address anycast-rp-peer-address* **Example:** `switch(config)# ip pim anycast-rp 192.0.2.3 192.0.2.31`	Configures a PIM Anycast-RP peer address for the specified Anycast-RP address. Each command with the same Anycast-RP address forms an Anycast-RP set. The IP addresses of RPs are used for communication with RPs in the set.
Step 6	Repeat Step 5 using the same Anycast-RP address for each RP in the RP set (including the local router).	—
Step 7	**show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ip pim group-range`	(Optional) Displays PIM modes and group ranges.
Step 8	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**interface loopback** *number* **Example:** `switch(config)# interface loopback 0`	Configures an interface loopback. This example configures loopback 0.
Step 3	**ipv6 address** *ipv6-prefix* **Example:** `switch(config-if)# ipv6 address 2001:0db8:0:abcd::3/32`	Configures an IP address for this interface. This example configures an IP address for the Anycast-RP.
Step 4	**exit** **Example:** `switch(config)# exit`	Returns to configuration mode.
Step 5	**ipv6 pim anycast-rp** *anycast-rp-address anycast-rp-peer-address* **Example:** `switch(config)# ipv6 pim anycast-rp 2001:0db8:0:abcd::3 2001:0db8:0:abcd::31`	Configures a PIM6 Anycast-RP peer address for the specified Anycast-RP address. Each command with the same Anycast-RP address forms an Anycast-RP set. The IP addresses of RPs are used for communication with RPs in the set.

	Command	Purpose
Step 6	Repeat Step 5 using the same Anycast-RP address for each RP in the RP set (including local router).	—
Step 7	**show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ipv6 pim group-range`	(Optional) Displays PIM6 modes and group ranges.
Step 8	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring Shared Trees Only for ASM

You can configure shared trees only on the last-hop router for Any Source Multicast (ASM) groups, which means that the router never switches over from the shared tree to the SPT when a receiver joins an active group. You can specify a group range where the use of shared trees is to be enforced with the **match ip**[**v6**] **multicast** command. This option does not affect the normal operation of the router when a source tree join-prune message is received.

Note The Cisco NX-OS software does not support the shared-tree feature on vPCs. For more information about vPCs, see the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide, Release 5.x*.

The default is disabled, which means that the software can switch over to source trees.

Note In ASM mode, only the last-hop router switches from the shared tree to the SPT.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **ip pim use-shared-tree-only group-list** *policy-name*
3. **(Optional) show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **ipv6 pim use-shared-tree-only group-list** *policy-name*
3. **(Optional) show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**]

4. (Optional) copy running-config startup-config

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip pim use-shared-tree-only group-list** *policy-name* **Example:** switch(config)# ip pim use-shared-tree-only group-list my_group_policy	Builds only shared trees, which means that the software never switches over from the shared tree to the SPT. You specify a route-map policy name that lists the groups to use with the **match ip multicast** command. By default, the software triggers a PIM (S, G) join toward the source when it receives multicast packets for a source for which it has the (*, G) state.
Step 3	**show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** switch(config)# show ip pim group-range	(Optional) Displays PIM modes and group ranges.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ipv6 pim use-shared-tree-only group-list** *policy-name* **Example:** switch(config)# ipv6 pim use-shared-tree-only group-list my_group_policy	Builds only shared trees, which means that the software never builds source trees. You specify a route-map policy name that lists the groups to use with the **match ipv6 multicast** command. By default, the software triggers a PIM (S, G) join toward the source when it receives multicast packets for a source for which it has the (*, G) state.

	Command	Purpose
Step 3	**show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ipv6 pim group-range`	(Optional) Displays PIM6 modes and group ranges.
Step 4	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring SSM

Source-Specific Multicast (SSM) is a multicast distribution mode where the software on the DR connected to a receiver that is requesting data for a multicast source builds a shortest path tree (SPT) to that source.

On an IPv4 network, a host can request multicast data for a specific source only if it is running IGMPv3 and the DR for that host is running IGMPv3. You will usually enable IGMPv3 when you configure an interface for PIM in the SSM mode. For hosts running IGMPv1 or IGMPv2, you can configure a group to source mapping using SSM translation. For more information, see Chapter 1, "Configuring IGMP"and Chapter 1, "Configuring MLD."

You can configure the group range that is used by SSM by specifying values on the command line. By default, the SSM group range for PIM is 232.0.0.0/8 and for PIM6 is FF3x/96.

You can specify a route-map policy name that lists the group prefixes to use with the **match ip multicast** command.

Note If you want to use the default SSM group range, you do not need to configure the SSM group range.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **ip pim ssm** {**range** {*ip-prefix* | **none**} | **route-map** *policy-name*}
   no ip pim ssm {**range** {*ip-prefix* | **none**} | **route-map** *policy-name*}
3. **(Optional) show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **ipv6 pim ssm** {**range** {*ipv6-prefix* | **none**} | **route-map** *policy-name*}
   no ipv6 pim ssm {**range** {*ipv6-prefix* | **none**} | **route-map** *policy-name*}

3. **(Optional) show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip pim ssm range** {*ip-prefix* | **none**} | **route-map** *policy-name*} **Example:** switch(config)# ip pim ssm range 239.128.1.0/24	Configures up to four group ranges to be treated in SSM mode. You can specify a route-map policy name that lists the group prefixes to use with the **match ip multicast** command. The default range is 232.0.0.0/8. If the keyword **none** is specified, all group ranges are removed.
	no ip pim ssm {**range** {*ip-prefix* | **none**} | **route-map** *policy-name*} **Example:** switch(config)# no ip pim ssm range none	Removes the specified prefix from the SSM range, or removes the route-map policy. If the keyword **none** is specified, resets the SSM range to the default of 232.0.0.0/8.
Step 3	**show ip pim group-range** [*ip-prefix*] [**vrf** *vrf-name* | **all**] **Example:** switch(config)# show ip pim group-range	(Optional) Displays PIM modes and group ranges.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ipv6 pim ssm** {**range** {*ipv6-prefix* | **none**} | **route-map** *policy-name*} **Example:** switch(config)# ipv6 pim ssm range FF30::0/32	Configures up to four group ranges to be treated in SSM mode. You can specify a route-map policy name that lists the group prefixes to use with the **match ip multicast** command. If the keyword **none** is specified, all group ranges are removed. The default range is FF3x/96.
	no ipv6 pim ssm {**range** {*ipv6-prefix* | **none**} | **route-map** *policy-name*} **Example:** switch(config)# no ipv6 pim ssm range none	Removes the specified prefix from the SSM range, or removes the route-map policy. If the keyword **none** is specified, resets the SSM range to the default of FF3x/96.

	Command	Purpose
Step 3	**show ipv6 pim group-range** [*ipv6-prefix*] [**vrf** *vrf-name* | **all**] **Example:** `switch(config)# show ipv6 pim group-range`	(Optional) Displays PIM6 modes and group ranges.
Step 4	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring RPF Routes for Multicast

You can define RPF routes for multicast when you want multicast data to diverge from the unicast traffic path. You can define RPF routes for multicast on border routers to enable reverse path forwarding (RPF) to an external network.

Multicast routes are used not to directly forward traffic but to make RPF checks. RPF routes for multicast cannot be redistributed. For more information about multicast forwarding, see the "Multicast Forwarding" section on page 1-5.

Note IPv6 static multicast routes are not supported.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **ip mroute** {*ip-addr mask* | *ip-prefix*} {*next-hop* | *nh-prefix* | *interface*} [*route-preference*] [**vrf** *vrf-name*]
3. **(Optional) show ip static-route** [**multicast**] [**vrf** *vrf-name*]
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip mroute** {*ip-addr mask* | *ip-prefix*} {*next-hop* | *nh-prefix* | *interface*} [*route-preference*] [**vrf** *vrf-name*] **Example:** switch(config)# ip mroute 192.0.2.33/1 224.0.0.0/1	Configures an RPF route for multicast for use in RPF calculations. Route preference values range from 1 to 255. The default preference is 1.
Step 3	**show ip static-route** [**multicast**] [**vrf** *vrf-name*] **Example:** switch(config)# show ip static-route multicast	(Optional) Displays configured static routes.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring Route Maps to Control RP Information Distribution

You can configure route maps to help protect against some RP configuration errors and malicious attacks. You use route maps in commands that are described in the "Configuring Message Filtering" section on page 1-48.

By configuring route maps, you can control distribution of RP information that is distributed throughout the network. You specify the BSRs or mapping agents to be listened to on each client router and the list of candidate RPs to be advertised (listened to) on each BSR and mapping agent to ensure that what is advertised is what you expect.

See the "Configuring BSRs" section on page 1-31 and "Configuring Auto-RP" section on page 1-35 for more information.

Note Only the **match ip [v6] multicast** command has an effect in the route map.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**

2. **route-map** *map-name* [**permit** | **deny**] [*sequence-number*]
3. **match ip multicast** {{**rp** ip-address [**rp-type** rp-type]} {{**group-range** {gadrr_start to gadrr_end} | {**group** ip-prefix}} {**source** source-ip-address}
4. **(Optional) show route-map**
5. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **route-map** *map-name* [**permit** | **deny**] [*sequence-number*]
3. **match ipv6 multicast** {{**rp** ip-address [**rp-type** rp-type]} {{**group-range** {gadrr_start to gadrr_end} | {**group** ip-prefix}} {**source** source-ip-address}
4. **(Optional) show route-map**
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**route-map** *map-name* [**permit** | **deny**] [*sequence-number*] **Example for ASM only:** switch(config)# route-map ASM_only permit 10 switch(config-route-map)# **Example for Bidir only:** switch(config)# route-map Bidir_only permit 10 switch(config-route-map)#	Enters route-map configuration mode. **Note** This configuration method uses the **permit** keyword.
Step 3	**match ip multicast** {{**rp** *ip-address* [**rp-type** *rp-type*]} {{**group-range** {*gadrr_start* **to** *gadrr_end*} | {**group** *ip-prefix*}} {**source** source-*ip-address*} **Example for ASM only:** switch(config-route-map)# match ip multicast group 224.0.0.0/4 rp 0.0.0.0/0 rp-type ASM **Example for Bidir only:** switch(config-route-map)# match ip multicast group 224.0.0.0/4 rp 0.0.0.0/0 rp-type Bidir	Matches the group, RP, and RP type specified. You can specify the RP type (ASM or Bidir). This configuration method requires the group and RP specified as shown in the examples. **Note** BSR RP, auto-RP, and static RP cannot use the **group-range** keyword. This command allows both **permit** or **deny**. Some **match** *mask* commands do not allow permit or deny.

	Command	Purpose
Step 4	**show route-map** **Example:** switch(config-route-map)# show route-map	(Optional) Displays configured route maps.
Step 5	**copy running-config startup-config** **Example:** switch(config-route-map)# copy running-config startup-config	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**route-map** *map-name* [**permit** | **deny**] [*sequence-number*] **Example for ASM only:** switch(config)# route-map ASM_only permit 10 switch(config-route-map)# **Example for Bidir only:** switch(config)# route-map Bidir_only permit 10 switch(config-route-map)#	Enters route-map configuration mode. **Note** This configuration method uses the **permit** keyword.
Step 3	**match ipv6 multicast** {{**rp** *ip-address* [**rp-type** *rp-type*]} {{**group-range** {*gadrr_start* **to** *gadrr_end*} | {**group** *ip-prefix*}} {**source** source-*ip-address*} **Example for ASM only:** switch(config)# match ipv6 multicast group ff0e::2:101:0:0/96 rp 2001::0348:0:0/96 rp-type ASM **Example for Bidir only:** switch(config)# match ipv6 multicast group ff0e::2:101:0:0/96 rp 2001::0348:0:0/96 rp-type Bidir	Matches the group, RP, and RP type specified. You can specify the RP type (ASM or Bidir). This configuration method requires the group and RP specified as shown in the examples. **Note** BSR RP, auto-RP, and static RP cannot use the **group-range** keyword. This command allows both **permit** or **deny**. Some **match** *mask* commands do not allow permit or deny.
Step 4	**show route-map** **Example:** switch(config-route-map)# show route-map	(Optional) Displays configured route maps.
Step 5	**copy running-config startup-config** **Example:** switch(config-route-map)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring Message Filtering

Note Prefix matches in the rp-candidate-policy must be exact relative to what the c-rp is advertising. Subset matches are not possible.

You can configure filtering of the PIM and PIM6 messages described in Table 1-9.

Table 1-9 PIM and PIM6 Message Filtering

Message Type	Description
Global to the Device	
Log Neighbor changes	Enables syslog messages that list the neighbor state changes to be generated. The default is disabled.
PIM register policy	Enables PIM register messages to be filtered based on a route-map policy[1] where you can specify group or group and source addresses with the **match ip**[**v6**] **multicast** command. This policy applies to routers that act as an RP. The default is disabled, which means that the software does not filter PIM register messages.
BSR candidate RP policy	Enables BSR candidate RP messages to be filtered by the router based on a route-map policy[1] where you can specify the RP and group addresses and whether the type is Bidir or ASM with the **match ip**[**v6**] **multicast** command. This command can be used on routers that are eligible for BSR election. The default is no filtering of BSR messages.
BSR policy	Enables BSR messages to be filtered by the BSR client routers based on a route-map policy[1] where you can specify BSR source addresses with the **match ip**[**v6**] **multicast** command. This command can be used on client routers that listen to BSR messages. The default is no filtering of BSR messages.
Auto-RP candidate RP policy	Enables Auto-RP announce messages to be filtered by the Auto-RP mapping agents based on a route-map policy[1] where you can specify the RP and group addresses, and whether the type is Bidir or ASM with the **match ip multicast** command. This command can be used on a mapping agent. The default is no filtering of Auto-RP messages. **Note** PIM6 does not support the Auto-RP method.
Auto-RP mapping agent policy	Enables Auto-RP discover messages to be filtered by client routers based on a route-map policy[1] where you can specify mapping agent source addresses with the **match ip multicast** command. This command can be used on client routers that listen to discover messages. The default is no filtering of Auto-RP messages. **Note** PIM6 does not support the Auto-RP method.
Per Device Interface	
Join-prune policy	Enables join-prune messages to be filtered based on a route-map policy[1] where you can specify group, group and source, or group and RP addresses with the **match ip**[**v6**] **multicast** command. The default is no filtering of join-prune messages.

1. For information about configuring route-map policies, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

For information about configuring multicast route maps, see the "Configuring Route Maps to Control RP Information Distribution" section on page 1-45.

Route maps as a filtering policy can be used (either **permit** or **deny** for each statement) for the following commands:

- **jp-policy** can use (S,G), (*,G), or (RP,G)
- **register-policy** can use (S,G) or (*,G)
- **igmp report-policy** can use (*,G) or (S,G)
- **state-limit reserver-policy** can use (*,G) or (S,G)
- **auto-rp rp-candidate-policy** can use (RP,G)
- **bsr rp-candidate-policy** can use (RP,G)
- **autorp mapping-agent policy** can use (S)
- **bsr bsr-policy** can use (S)

Route maps as containers can be use for the following commands, where route-map action (**permit** or **deny**) is ignored:

- **ip pim rp-address route map** can use only G
- **ip pim ssm-range route map** can use only G
- **ip igmp static-oif route map** can use (S,G), (*,G), (S,G-range), (*,G-range)
- **ip igmp join-group route map** can use (S,G), (*,G), (S,G-range, (*, G-range)

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **config t**
2. **(Optional) ip pim log-neighbor-changes**
3. **(Optional) ip pim register-policy** *policy-name*
4. **(Optional) ip pim bsr rp-candidate-policy** *policy-name*
5. **(Optional) ip pim bsr bsr-policy** *policy-name*
6. **(Optional) ip pim auto-rp rp-candidate-policy** *policy-name*
7. **(Optional) ip pim auto-rp mapping-agent-policy** *policy-name*
8. **interface** *interface*
9. **(Optional) ip pim jp-policy** *policy-name* [**in** | **out**]
10. **(Optional) show run pim**
11. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **config t**
2. **(Optional) ipv6 pim log-neighbor-changes**

3. **(Optional) ipv6 pim register-policy** *policy-name*
4. **(Optional) ipv6 pim bsr rp-candidate-policy** *policy-name*
5. **(Optional) ipv6 pim bsr bsr-policy** *policy-name*
6. **interface** *interface*
7. **(Optional) ipv6 pim jp-policy** *policy-name* [**in** | **out**]
8. **(Optional) show run pim6**
9. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip pim log-neighbor-changes** **Example:** switch(config)# ip pim log-neighbor-changes	(Optional) Enables syslog messages that list the neighbor state changes to be generated. The default is disabled.
Step 3	**ip pim register-policy** *policy-name* **Example:** switch(config)# ip pim register-policy my_register_policy	(Optional) Enables PIM register messages to be filtered based on a route-map policy. You can specify group or group and source addresses with the **match ip multicast** command.
Step 4	**ip pim bsr rp-candidate-policy** *policy-name* **Example:** switch(config)# ip pim bsr rp-candidate-policy my_bsr_rp_candidate_policy	(Optional) Enables BSR candidate RP messages to be filtered by the router based on a route-map policy where you can specify the RP and group addresses and whether the type is Bidir or ASM with the **match ip multicast** command. This command can be used on routers that are eligible for BSR election. The default is no filtering of BSR messages.
Step 5	**ip pim bsr bsr-policy** *policy-name* **Example:** switch(config)# ip pim bsr bsr-policy my_bsr_policy	(Optional) Enables BSR messages to be filtered by the BSR client routers based on a route-map policy where you can specify BSR source addresses with the **match ip multicast** command. This command can be used on client routers that listen to BSR messages. The default is no filtering of BSR messages.
Step 6	**ip pim auto-rp rp-candidate-policy** *policy-name* **Example:** switch(config)# ip pim auto-rp rp-candidate-policy my_auto_rp_candidate_policy	(Optional) Enables Auto-RP announce messages to be filtered by the Auto-RP mapping agents based on a route-map policy where you can specify the RP and group addresses and whether the type is Bidir or ASM with the **match ip multicast** command. This command can be used on a mapping agent. The default is no filtering of Auto-RP messages.

	Command	Purpose
Step 7	**ip pim auto-rp mapping-agent-policy** *policy-name* **Example:** `switch(config)# ip pim auto-rp mapping-agent-policy my_auto_rp_mapping_policy`	(Optional) Enables Auto-RP discover messages to be filtered by client routers based on a route-map policy where you can specify mapping agent source addresses with the **match ip multicast** command. This command can be used on client routers that listen to discover messages. The default is no filtering of Auto-RP messages.

Step 8	**interface** *interface*
	
	Example:
	`switch(config)# interface ethernet 2/1`
	`switch(config-if)#`
		Enters interface mode on the specified interface.

Step 9	**ip pim jp-policy** *policy-name* [**in** | **out**] **Example:** `switch(config-if)# ip pim jp-policy my_jp_policy`	(Optional) Enables join-prune messages to be filtered based on a route-map policy where you can specify group, group and source, or group and RP addresses with the **match ip multicast** command. The default is no filtering of join-prune messages. Beginning with Cisco NX-OS Release 4.2(3), this command filters messages in both incoming and outgoing directions.
Step 10	**show run pim** **Example:** `switch(config-if)# show run pim`	(Optional) Displays PIM configuration commands.
Step 11	**copy running-config startup-config** **Example:** `switch(config-if)# copy running-config startup-config`	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ipv6 pim log-neighbor-changes** **Example:** `switch(config)# ipv6 pim log-neighbor-changes`	(Optional) Enables syslog messages that list the neighbor state changes to be generated. The default is disabled.
Step 3	**ipv6 pim register-policy** *policy-name* **Example:** `switch(config)# ipv6 pim register-policy my_register_policy`	(Optional) Enables PIM register messages to be filtered based on a route-map policy. You can specify group or group and source addresses with the **match ipv6 multicast** command. The default is disabled.

	Command	Purpose
Step 4	**ipv6 pim bsr rp-candidate-policy** *policy-name* **Example:** `switch(config)# ipv6 pim bsr rp-candidate-policy my_bsr_rp_candidate_policy`	(Optional) Enables BSR candidate RP messages to be filtered by the router based on a route-map policy where you can specify the RP and group addresses and whether the type is Bidir or ASM with the **match ipv6 multicast** command. This command can be used on routers that are eligible for BSR election. The default is no filtering of BSR messages.
Step 5	**ipv6 pim bsr bsr-policy** *policy-name* **Example:** `switch(config)# ipv6 pim bsr bsr-policy my_bsr_policy`	(Optional) Enables BSR messages to be filtered by the BSR client routers based on a route-map policy[1] where you can specify BSR source addresses with the **match ipv6 multicast** command. This command can be used on client routers that listen to BSR messages. The default is no filtering of BSR messages.

Step 6	**interface** *interface*
	
	Example:
	`switch(config)# interface ethernet 2/1`
	`switch(config-if)#`
		Enters interface mode on the specified interface.

Step 7	**ipv6 pim jp-policy** *policy-name* [**in** | **out**] **Example:** `switch(config-if)# ipv6 pim jp-policy my_jp_policy`	(Optional) Enables join-prune messages to be filtered based on a route-map policy where you can specify group, group and source, or group and RP addresses with the **match ipv6 multicast** command. The default is no filtering of join-prune messages. Beginning with Cisco NX-OS Release 4.2(3), this command filters messages in both incoming and outgoing directions.
Step 8	**show run pim6** **Example:** `switch(config-if)# show run pim6`	(Optional) Displays PIM6 configuration commands.
Step 9	**copy running-config startup-config** **Example:** `switch(config-if)# copy running-config startup-config`	(Optional) Saves configuration changes.

Restarting the PIM and PIM6 Processes

You can restart the PIM and PIM6 processes and optionally flush all routes. By default, routes are not flushed.

When routes are flushed, they are removed from the Multicast Routing Information Base (MRIB and M6RIB) and the Multicast Forwarding Information Base (MFIB and M6FIB).

When you restart PIM or PIM6, the following tasks are performed:

- The PIM database is deleted.
- The MRIB and MFIB are unaffected and forwarding of traffic continues.
- The multicast route ownership is verified through the MRIB.
- Periodic PIM join and prune messages from neighbors are used to repopulate the database.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM or PIM6.

SUMMARY STEPS

PIM Commands

1. **restart pim**
2. **config t**
3. **ip pim flush-routes**
4. **(Optional) show running-configuration pim**
5. **(Optional) copy running-config startup-config**

PIM6 Commands

1. **restart pim6**
2. **config t**
3. **ipv6 pim flush-routes**
4. **(Optional) show running-configuration pim6**
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

PIM Commands

	Command	Purpose
Step 1	**restart pim** **Example:** `switch# restart pim`	Restarts the PIM process.

Step 2	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 3	**ip pim flush-routes** **Example:** `switch(config)# ip pim flush-routes`	Removes routes when the PIM process is restarted. By default, routes are not flushed.
Step 4	**show running-configuration pim** **Example:** `switch(config)# show running-configuration pim`	(Optional) Displays the PIM running-configuration information, including the **flush-routes** command.
Step 5	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

PIM6 Commands

	Command	Purpose
Step 1	**restart pim6** **Example:** switch# restart pim6	Restarts the PIM6 process.
Step 2	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 3	**ipv6 pim flush-routes** **Example:** switch(config)# ipv6 pim flush-routes	Removes routes when the PIM6 process is restarted. By default, routes are not flushed.
Step 4	**show running-configuration pim6** **Example:** switch(config)# show running-configuration pim6	(Optional) Displays the PIM6 running-configuration, including the **flush-routes** command.
Step 5	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring BFD for PIM

You can configure BFD for PIM by either VRF or by interface.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license, enabled PIM or PIM6, and enabled BFD.

SUMMARY STEPS

1. **config t**
2. **vrf context** *vrf-name*
3. **ip pim bfd**

   or

1. **config t**
2. **interface** *interface-type*
3. **ip pim bfd instance**
4. **exit**
5. **(Optional) show running-configuration pim**
6. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**vrf context** *vrf-name* **Example:** switch# vrf context test switch(config-vrf)#	Enters VRF configuration mode.
Step 3	**ip pim bfd** **Example:** switch(config-vrf)# ip pim bfd	Enables BFD on the specified VRFs. **Note** You can also enter the **ip pim bfd** command in configuration mode, which enables BFD on VRF.
	OR	
Step 1	**config t**	Enters configuration mode.
Step 2	**interface** *interface-type* **Example:** switch(config)# interface ethernet 7/40 switch(config-if)#	Enters interface configuration mode.
Step 3	**ip pim bfd instance** **Example:** switch(config-if)# ip pim bfd instance	Enables BFD on the specified interfaces. You can enable or disable BFD on RIM interfaces irrespective of whether BFD is enabled on the VRF.
Step 4	**exit** **Example:** switch(config)# exit	Exits out of VRF or interface configuration mode.
Step 5	**show running-configuration pim** **Example:** switch(config)# show running-configuration pim	(Optional) Displays the PIM running-configuration information.
Step 6	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Verifying the PIM and PIM6 Configuration

To display the PIM and PIM6 configurations information, perform one of the following tasks. Use the **show ip** form of the command for PIM and the **show ipv6** form of the command for PIM6.

Table 1-10 PIM show Commands

Command	Description
show ip [**v6**] **mroute** {*source group* | *group* [*source*]} [**vrf** *vrf-name* | **all**]	Displays the IP or IPv6 multicast routing table.
show ip [**v6**] **pim df** [**vrf** *vrf-name* | **all**]	Displays the designated forwarder (DF) information for each RP by interface.
show ip [**v6**] **pim group-range** [**vrf** *vrf-name* | **all**]	Displays the learned or configured group ranges and modes. For similar information, see also the **show ip pim rp** command.
show ip [**v6**] **pim interface** [*interface* | **brief**] [**vrf** *vrf-name* | **all**]	Displays information by the interface.
show ip [**v6**] **pim neighbor** [**vrf** *vrf-name* | **all**]	Displays neighbors by the interface.
show ip [**v6**] **pim oif-list** *group* [*source*] [**vrf** *vrf-name* | **all**]	Displays all the interfaces in the OIF-list.
show ip [**v6**] **pim route** {source group | group [source]} [**vrf** *vrf-name* | **all**]	Displays information for each multicast route, including interfaces on which a PIM join for that (S, G) has been received.
show ip [**v6**] **pim rp** [**vrf** *vrf-name* | **all**]	Displays rendezvous points (RPs) known to the software, how they were learned, and their group ranges. For similar information, see also the **show ip pim group-range** command.
show ip [**v6**] **pim rp-hash** [**vrf** *vrf-name* | **all**]	Displays the bootstrap router (BSR) RP hash information. For information about the RP hash, see RFC 5059.
show running-configuration pim[**6**]	Displays the running-configuration information.
show startup-configuration pim[**6**]	Displays the startup-configuration information.
show ip [v6] pim vrf [*vrf-name* | **all**] [**detail**]	Displays per-VRF information.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Displaying Statistics

You can display and clear PIM and PIM6 statistics by using the commands in this section.

This section includes the following topics:

Displaying PIM and PIM6 Statistics

You can display the PIM and PIM6 statistics and memory usage using the commands listed in Table 1-11. Use the **show ip** form of the command for PIM and the **show ipv6** form of the command for PIM6.

Table 1-11 PIM and PIM6 Statistics Commands

Command	Description
show ip [v6] pim policy statistics	Displays policy statistics for Register, RP, and join-prune message policies.
show ip [v6] pim statistics [**vrf** *vrf-name* | **all**]	Displays global statistics. If PIM is in vPC mode, displays vPC statistics.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Clearing PIM and PIM6 Statistics

You can clear the PIM and PIM6 statistics using the commands listed in Table 1-12. Use the **show ip** form of the command for PIM and the **show ipv6** form of the command for PIM6.

Table 1-12 PIM and PIM6 Commands to Clear Statistics

Command	Description
clear ip [v6] pim interface statistics *interface*	Clears counters for the specified interface.
clear ip [v6] pim policy statistics	Clears policy counters for Register, RP, and join-prune message policies.
clear ip [v6] pim statistics [**vrf** *vrf-name* | **all**]	Clears global counters handled by the PIM process.

Configuration Examples for PIM

Note See the "Multiple RPs Configured in a PIM Domain" section on page 1-6 for more configuration examples.

This section describes how to configure PIM using different data distribution modes and RP selection methods.

This section includes the following topics:

- Prefix-Based and Route-Map-Based Configurations, page 1-61

SSM Configuration Example

To configure PIM in SSM mode, follow these steps for each router in the PIM domain:

Step 1 Configure PIM sparse mode parameters on the interfaces that you want to participate in the domain. We recommend that you enable PIM on all interfaces.

```
switch# config t
switch(config)# interface ethernet 2/1
switch(config-if)# ip pim sparse-mode
```

Step 2 Configure the parameters for IGMP that support SSM. See Chapter 1, "Configuring IGMP" Usually, you configure IGMPv3 on PIM interfaces to support SSM.

```
switch# config t
switch(config)# interface ethernet 2/1
switch(config-if)# ip igmp version 3
```

Step 3 Configure the SSM range if you do not want to use the default range.

```
switch# config t
switch(config)# ip pim ssm range 239.128.1.0/24
```

Step 4 Configure message filtering.

```
switch# config t
switch(config)# ip pim log-neighbor-changes
```

The following example shows how to configure PIM SSM mode:

```
config t
  interface ethernet 2/1
    ip pim sparse-mode
    ip igmp version 3
    exit
  ip pim ssm range 239.128.1.0/24
  ip pim log-neighbor-changes
```

BSR Configuration Example

To configure PIM in ASM mode using the BSR mechanism, follow these steps for each router in the PIM domain:

Step 1 Configure PIM sparse mode parameters on the interfaces that you want to participate in the domain. We recommend that you enable PIM on all interfaces.

```
switch# config t
switch(config)# interface ethernet 2/1
switch(config-if)# ip pim sparse-mode
```

Step 2 Configure whether that router should listen and forward BSR messages.

```
switch# config t
switch(config)# ip pim bsr forward listen
```

Step 3 Configure the BSR parameters for each router that you want to act as a BSR.

```
switch# config t
switch(config)# ip pim bsr-candidate ethernet 2/1 hash-len 30
```

Step 4 Configure the RP parameters for each router that you want to act as a candidate RP.

```
switch# config t
switch(config)# ip pim rp-candidate ethernet 2/1 group-list 239.0.0.0/24
```

Step 5 Configure message filtering.

```
switch# config t
switch(config)# ip pim log-neighbor-changes
```

The following example shows how to configure PIM ASM mode using the BSR mechanism and how to configure the BSR and RP on the same router:

```
config t
  interface ethernet 2/1
    ip pim sparse-mode
    exit
  ip pim bsr forward listen
ip pim bsr-candidate ethernet 2/1 hash-len 30
  ip pim rp-candidate ethernet 2/1 group-list 239.0.0.0/24
  ip pim log-neighbor-changes
```

Auto-RP Configuration Example

To configure PIM in Bidir mode using the Auto-RP mechanism, follow these steps for each router in the PIM domain:

Step 1 Configure PIM sparse mode parameters on the interfaces that you want to participate in the domain. We recommend that you enable PIM on all interfaces.

```
switch# config t
switch(config)# interface ethernet 2/1
switch(config-if)# ip pim sparse-mode
```

Step 2 Configure whether that router should listen and forward Auto-RP messages.

```
switch# config t
switch(config)# ip pim auto-rp forward listen
```

Step 3 Configure the mapping agent parameters for each router that you want to act as a mapping agent.

```
switch# config t
switch(config)# ip pim auto-rp mapping-agent ethernet 2/1
```

Step 4 Configure the RP parameters for each router that you want to act as a candidate RP.

```
switch# config t
switch(config)# ip pim auto-rp rp-candidate ethernet 2/1 group-list 239.0.0.0/24 bidir
```

Step 5 Configure message filtering.

```
switch# config t
switch(config)# ip pim log-neighbor-changes
```

The following example shows how to configure PIM Bidir mode using the Auto-RP mechanism and how to configure the mapping agent and RP on the same router:

```
config t
  interface ethernet 2/1
    ip pim sparse-mode
    exit
  ip pim auto-rp listen
  ip pim auto-rp forward
  ip pim auto-rp mapping-agent ethernet 2/1
  ip pim auto-rp rp-candidate ethernet 2/1 group-list 239.0.0.0/24 bidir
  ip pim log-neighbor-changes
```

PIM Anycast-RP Configuration Example

To configure ASM mode using the PIM Anycast-RP method, follow these steps for each router in the PIM domain:

Step 1 Configure PIM sparse mode parameters on the interfaces that you want to participate in the domain. We recommend that you enable PIM on all interfaces.

```
switch# config t
switch(config)# interface ethernet 2/1
switch(config-if)# ip pim sparse-mode
```

Step 2 Configure the RP address that you configure on all routers in the Anycast-RP set.

```
switch# config t
switch(config)# interface loopback 0
switch(config-if)# ip address 192.0.2.3/32
```

Step 3 Configure a loopback with an address to use in communication between routers in the Anycast-RP set for each router that you want to be in the Anycast-RP set.

```
switch# config t
switch(config)# interface loopback 1
switch(config-if)# ip address 192.0.2.31/32
```

Step 4 Configure the Anycast-RP parameters and repeat with the IP address of each Anycast-RP for each router that you want to be in the Anycast-RP set. This example shows two Anycast-RPs.

```
switch# config t
switch(config)# ip pim anycast-rp 192.0.2.3 193.0.2.31
switch(config)# ip pim anycast-rp 192.0.2.3 193.0.2.32
```

Step 5 Configure message filtering.

```
switch# config t
switch(config)# ip pim log-neighbor-changes
```

The following example shows how to configure PIM ASM mode using two Anycast-RPs:

```
config t
  interface ethernet 2/1
    ip pim sparse-mode
    exit
```

```
interface loopback 0
  ip address 192.0.2.3/32
  exit
ip pim anycast-rp 192.0.2.3 192.0.2.31
ip pim anycast-rp 192.0.2.3 192.0.2.32
ip pim log-neighbor-changes
```

Prefix-Based and Route-Map-Based Configurations

```
ip prefix-list plist11 seq 10 deny 231.129.128.0/17
ip prefix-list plist11 seq 20 deny 231.129.0.0/16
ip prefix-list plist11 seq 30 deny 231.128.0.0/9
ip prefix-list plist11 seq 40 permit 231.0.0.0/8

ip prefix-list plist22 seq 10 deny 231.129.128.0/17
ip prefix-list plist22 seq 20 deny 231.129.0.0/16
ip prefix-list plist22 seq 30 permit 231.128.0.0/9
ip prefix-list plist22 seq 40 deny 231.0.0.0/8

ip prefix-list plist33 seq 10 deny 231.129.128.0/17
ip prefix-list plist33 seq 20 permit 231.129.0.0/16
ip prefix-list plist33 seq 30 deny 231.128.0.0/9
ip prefix-list plist33 seq 40 deny 231.0.0.0/8

ip pim rp-address 21.21.0.11 prefix-list plist11
ip pim rp-address 21.21.0.22 prefix-list plist22
ip pim rp-address 21.21.0.33 prefix-list plist33


route-map rmap11 deny 10
 match ip multicast group 231.129.128.0/17
route-map rmap11 deny 20
 match ip multicast group 231.129.0.0/16
route-map rmap11 deny 30
 match ip multicast group 231.128.0.0/9
route-map rmap11 permit 40
 match ip multicast group 231.0.0.0/8

route-map rmap22 deny 10
 match ip multicast group 231.129.128.0/17
route-map rmap22 deny 20
 match ip multicast group 231.129.0.0/16
route-map rmap22 permit 30
 match ip multicast group 231.128.0.0/9
route-map rmap22 deny 40
 match ip multicast group 231.0.0.0/8

route-map rmap33 deny 10
 match ip multicast group 231.129.128.0/17
route-map rmap33 permit 20
 match ip multicast group 231.129.0.0/16
route-map rmap33 deny 30
 match ip multicast group 231.128.0.0/9
route-map rmap33 deny 40
 match ip multicast group 231.0.0.0/8

ip pim rp-address 21.21.0.11 route-map rmap11
ip pim rp-address 21.21.0.22 route-map rmap22
ip pim rp-address 21.21.0.33 route-map rmap33
```

Output

```
dc3rtg-d2(config-if)# show ip pim rp
PIM RP Status Information for VRF "default"
BSR disabled
Auto-RP disabled
BSR RP Candidate policy: None
BSR RP policy: None
Auto-RP Announce policy: None
Auto-RP Discovery policy: None

RP: 21.21.0.11, (0), uptime: 00:12:36, expires: never,
  priority: 0, RP-source: (local), group-map: rmap11, group ranges:
      231.0.0.0/8  231.128.0.0/9 (deny)
      231.129.0.0/16 (deny) 231.129.128.0/17 (deny)
RP: 21.21.0.22, (0), uptime: 00:12:36, expires: never,
  priority: 0, RP-source: (local), group-map: rmap22, group ranges:
      231.0.0.0/8 (deny) 231.128.0.0/9
      231.129.0.0/16 (deny) 231.129.128.0/17 (deny)
RP: 21.21.0.33, (0), uptime: 00:12:36, expires: never,
  priority: 0, RP-source: (local), group-map: rmap33, group ranges:
      231.0.0.0/8 (deny) 231.128.0.0/9 (deny)
      231.129.0.0/16  231.129.128.0/17 (deny)

dc3rtg-d2(config-if)# show ip mroute
IP Multicast Routing Table for VRF "default"

(*, 231.1.1.1/32), uptime: 00:07:20, igmp pim ip
  Incoming interface: Ethernet2/1, RPF nbr: 1.1.0.1
  Outgoing interface list: (count: 1)
    loopback1, uptime: 00:07:20, igmp

(*, 231.128.1.1/32), uptime: 00:14:27, igmp pim ip
  Incoming interface: Ethernet2/1, RPF nbr: 1.1.0.1
  Outgoing interface list: (count: 1)
    loopback1, uptime: 00:14:27, igmp

(*, 231.129.1.1/32), uptime: 00:14:25, igmp pim ip
  Incoming interface: Ethernet2/1, RPF nbr: 1.1.0.1
  Outgoing interface list: (count: 1)
    loopback1, uptime: 00:14:25, igmp

(*, 231.129.128.1/32), uptime: 00:14:26, igmp pim ip
  Incoming interface: Null, RPF nbr: 0.0.0.0
  Outgoing interface list: (count: 1)
    loopback1, uptime: 00:14:26, igmp

(*, 232.0.0.0/8), uptime: 1d20h, pim ip
  Incoming interface: Null, RPF nbr: 0.0.0.0
  Outgoing interface list: (count: 0)

dc3rtg-d2(config-if)# show ip pim group-range
PIM Group-Range Configuration for VRF "default"
Group-range        Mode      RP-address       Shared-tree-only range
232.0.0.0/8        SSM       -                -
231.0.0.0/8        ASM       21.21.0.11       -
231.128.0.0/9      ASM       21.21.0.22       -
231.129.0.0/16     ASM       21.21.0.33       -
231.129.128.0/17   Unknown   -                -
```

Where to Go Next

You can configure the following features that work with PIM or PIM6:

- Chapter 1, "Configuring IGMP"
- Chapter 1, "Configuring MLD"
- Chapter 1, "Configuring IGMP Snooping"
- Chapter 1, "Configuring MSDP"

Additional References

For additional information related to implementing PIM, see the following sections:

- Related Documents, page 1-63
- Standards, page 1-63
- MIBs, page 1-63
- Appendix 1, "IETF RFCs for IP Multicast"
- Feature History for PIM and PIM6, page 1-64

Related Documents

Related Topic	Document Title
VDCs	*Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*
CLI commands	*Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*
Configuring VRFs and Policy Based Routing	*Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
• IPMCAST-MIB • PIM MIB--Beginning in Cisco Release 5.2(1) for the Cisco Nexus 7000 Series devices	To locate and download MIBs, go to the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

Feature History for PIM and PIM6

Table 1-13 lists the release history for this feature.

Table 1-13 Feature History for PIM and PIM6

Feature Name	Releases	Feature Information
Support for the **ip pim register-source** command.	5.2(1)	Support for configuring the IP source address of register messages.
BFD support for PIM (IPv4)	5.0(2)	BFD supported for PIM with IPv4.
vPC	4.1(3)	Cisco NX-OS software for the Nexus 7000 Series devices does not support PIM SSM or BIDR on a vPC. Cisco NX-OS software fully supports PIM ASM on a vPC. Display vPC statistics with the **show ip pim statistics** command. The following section provides information about this feature: • "Configuring ASM and Bidir" section on page 1-29 • "Displaying PIM and PIM6 Statistics" section on page 1-57

CHAPTER 1

Configuring IGMP Snooping

This chapter describes how to configure Internet Group Management Protocol (IGMP) snooping on a Cisco NX-OS device.

This chapter includes the following sections:

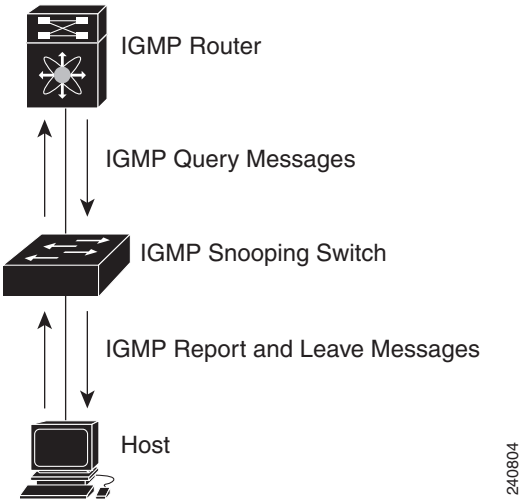
Information About IGMP Snooping

Note We recommend that you do not disable IGPM snooping on the device. If you disable IGMP snooping, you might see reduced multicast performance because of excessive false flooding within the device.

IGMP snooping software examines Layer 2 IP multicast traffic within a VLAN to discover the ports where interested receivers reside. Using the port information, IGMP snooping can reduce bandwidth consumption in a multi-access LAN environment to avoid flooding the entire VLAN. IGMP snooping tracks which ports are attached to multicast-capable routers to help the routers forward IGMP membership reports. The IGMP snooping software responds to topology change notifications. By default, IGMP snooping is enabled on the device.

Figure 1-1 shows an IGMP snooping switch that sits between the host and the IGMP router. The IGMP snooping switch snoops the IGMP membership reports and Leave messages and forwards them only when necessary to the connected IGMP routers.

Figure 1-1 IGMP Snooping Switch



The IGMP snooping software operates upon IGMPv1, IGMPv2, and IGMPv3 control plane packets where Layer 3 control plane packets are intercepted and influence the Layer 2 forwarding behavior.

For more information about IGMP, see Chapter 1, "Configuring IGMP."

The Cisco NX-OS IGMP snooping software has the following proprietary features:

- Source filtering that allows forwarding of multicast packets based on destination and source IP.
- Multicast forwarding based on IP addresses rather than MAC address.
- Beginning with Cisco Release 5.2(1) for the Nexus 7000 Series devices, multicast forwarding alternately based on the MAC address
- Optimized multicast flooding (OMF) that forwards unknown traffic to routers only and performs no data-driven state creation.

For more information about IGMP snooping, see RFC 4541.

This section includes the following topics:

IGMPv1 and IGMPv2

Both IGMPv1 and IGMPv2 support membership report suppression, which means that if two hosts on the same subnet want to receive multicast data for the same group, then the host that receives a member report from the other host suppresses sending its report. Membership report suppression occurs for hosts that share a port.

If no more than one host is attached to each VLAN switch port, you can configure the fast leave feature in IGMPv2. The fast leave feature does not send last member query messages to hosts. As soon as the software receives an IGMP leave message, the software stops forwarding multicast data to that port.

IGMPv1 does not provide an explicit IGMP leave message, so the software must rely on the membership message timeout to indicate that no hosts remain that want to receive multicast data for a particular group.

Note The software ignores the configuration of the last member query interval when you enable the fast leave feature because it does not check for remaining hosts.

IGMPv3

The IGMPv3 snooping implementation on Cisco NX-OS supports full IGMPv3 snooping, which provides constrained flooding based on the (S, G) information in the IGMPv3 reports. This source-based filtering enables the device to constrain multicast traffic to a set of ports based on the source that sends traffic to the multicast group.

By default, the software tracks hosts on each VLAN port. The explicit tracking feature provides a fast leave mechanism. Because every IGMPv3 host sends membership reports, report suppression limits the amount of traffic that the device sends to other multicast-capable routers. When report suppression is enabled, and no IGMPv1 or IGMPv2 hosts requested the same group, the software provides proxy reporting. The proxy feature builds the group state from membership reports from the downstream hosts and generates membership reports in response to queries from upstream queriers.

Even though the IGMPv3 membership reports provide a full accounting of group members on a LAN segment, when the last host leaves, the software sends a membership query. You can configure the parameter last member query interval. If no host responds before the timeout, the software removes the group state.

IGMP Snooping Querier

When PIM is not enabled on an interface because the multicast traffic does not need to be routed, you must configure an IGMP snooping querier to send membership queries. You define the querier in a VLAN that contains multicast sources and receivers but no other active querier.

When an IGMP snooping querier is enabled, it sends out periodic IGMP queries that trigger IGMP report messages from hosts that want to receive IP multicast traffic. IGMP snooping listens to these IGMP reports to establish appropriate forwarding.

Static Multicast MAC Address

Beginning with the Cisco Release 5.2(1) for the Nexus 7000 Series devices, you configure an outgoing interface statically for a multicast MAC address. Also, you can configure the IGMP snooping to use a MAC-based lookup mode.

Previously, the system performs the lookup on Layer 2 multicast table using the destination IP address rather than the destination MAC address. However, some applications share a single unicast cluster IP and multicast cluster MAC address. The system forwards traffic destined to the unicast cluster IP address by the last-hop router with the shared multicast MAC address. This action can be accomplished by assigning a static multicast MAC address for the destination IP address for the end host or cluster.

The default lookup mode remains IP, but you can configure the lookup type to MAC address-based. You can configure the lookup mode globally or per VLAN:

- If the VDC contains ports from only an M Series module and the global lookup mode is set to IP, VLANs can be set to either one of the two lookup modes. But, if the global lookup mode is set to MAC address, the operational lookup mode for all the VLANs changes to MAC-address mode.
- If the VDC contains ports from both an M Series module and an F Series module and if you change the lookup mode to a MAC address in any VLAN, the operation lookup mode changes for all of the VLANs to a MAC-address based. With these modules in the chassis, you have the same lookup mode globally and for the VLANs. Similarly, if the global lookup mode is MAC-address based, the operational lookup mode for all VLAN is also MAC-address based.

Note Changing the lookup mode is disruptive. Multicast forwarding is not optimal until all multicast entries are programmed with the new lookup mode. Also, when 32 IP addresses are mapped to a single MAC address, you might see suboptimal forwarding on the device.

IGMP Snooping with VDCs and VRFs

A virtual device context (VDC) is a logical representation of a set of system resources. Within each VDC, you can define multiple virtual routing and forwarding (VRF) instances. One IGMP process can run per VDC. The IGMP process supports all VRFs in that VDC and performs the function of IGMP snooping within that VDC.

You can use the **show** commands with a VRF argument to provide a context for the information displayed. The default VRF is used if no VRF argument is supplied.

For information about configuring VDCs, see the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*.

For information about configuring VRFs, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x.*

Licensing Requirements for IGMP Snooping

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	IGMP snooping requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for IGMP Snooping

IGMP snooping has the following prerequisites:

- You are logged onto the device.
- You are in the correct virtual device context (VDC). A VDC is a logical representation of a set of system resources. You can use the **switchto vdc** command with a VDC number.
- For global commands, you are in the correct virtual routing and forwarding (VRF) mode. The default configuration mode shown in the examples in this chapter applies to the default VRF.

Guidelines and Limitations for IGMP Snooping

IGMP snooping has the following guidelines and limitations:

- You must disable IGMP optimized multicast forwarding (OMF) for IPv6 multicast networks that require multicast forwarding over a layer 2 network.
- If you are configuring vPC peers, the differences in the IGMP snooping configuration options between the two devices have the following results:
  - If IGMP snooping is enabled on one device but not on the other, the device on which snooping is disabled floods all multicast traffic.
  - A difference in multicast router or static group configuration can cause traffic loss.
  - The fast leave, explicit tracking, and report suppression options can differ if they are used for forwarding traffic.
  - If a query parameter is different between the devices, one device expires the multicast state faster while the other device continues to forward. This difference results in either traffic loss or forwarding for an extended period.
  - If an IGMP snooping querier is configured on both devices, only one of them will be active because an IGMP snooping querier shuts down if a query is seen in the traffic.

Network applications that use unicast destination IP addresses with multicast destination MAC addresses

Network applications which use unicast destination IP addresses with multicast destination MAC addresses might require the configuration of IGMP snooping to use MAC-based forwarding lookups on the switch.

If the destination MAC address used for this kind of applications is a non-IP multicast MAC address, use the **mac address-table multicast** command to statically configure the port membership.

In addition, if the destination MAC address is in the IP multicast range, 0100.5E00.0000 to 0100.5E7F.FFFF, use static IGMP snooping membership entries for the corresponding Layer 3 IP multicast address to configure the port membership. For example, if the application uses destination MAC address 0100.5E01.0101, configure a static IGMP snooping membership entry for an IP multicast address that maps to that MAC address. An example of this is **ip igmp snooping static-group 239.1.1.1**.

Default Settings

Table 1-1 lists the default settings for IGMP snooping parameters.

Table 1-1 Default IGMP Snooping Parameters

Parameters	Default
IGMP snooping	Enabled
Explicit tracking	Enabled
Fast leave	Disabled
Last member query interval	1 second
Snooping querier	Disabled
Report suppression	Enabled
Link-local groups suppression	Enabled
IGMPv3 report suppression for the entire device	Disabled
IGMPv3 report suppression per VLAN	Enabled

Configuring IGMP Snooping Parameters

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

You can configure IGMP snooping both globally and per VLAN. This section includes the following topics:

- Configuring Global IGMP Snooping Parameters, page 1-7
- Configuring IGMP Snooping Parameters per VLAN, page 1-9
- Changing the Lookup Mode, page 1-14
- Configuring a Static Multicast MAC Address, page 1-15

Note You must enable IGMP snooping globally before any of the other commands take effect.

Configuring Global IGMP Snooping Parameters

To affect the operation of the IGMP snooping process globally, you can configure the optional IGMP snooping parameters described in Table 1-1.

Table 1-2 Global IGMP Snooping Parameters

Parameter	Description
IGMP snooping	Enables IGMP snooping on the active VDC. The default is enabled. **Note** If the global setting is disabled, all VLANs are treated as disabled, whether they are enabled or not.
Event history	Configures the size of the IGMP snooping history buffers. The default is small.
Group timeout	Configures the group membership timeout for all VLANs on the device.
Link-local groups suppression	Configures link-local groups suppression on the device. The default is enabled.
Optimise-multicast-flood	Configures Optimized Multicast Flood (OMF) on all VLANs on the device. The default is enabled.
Proxy	Configures IGMP snooping proxy for the device. The default is 5 seconds.
Report suppression	Limits the membership report traffic sent to multicast-capable routers on the device. When you disable report suppression, all IGMP reports are sent as is to multicast-capable routers. The default is enabled.
IGMPv3 report suppression	Configures IGMPv3 report suppression and proxy reporting on the device. The default is disabled.

SUMMARY STEPS

1. **config t**
2. **ip igmp snooping**

   ip igmp snooping event-history

   ip igmp snooping group-timeout {*minutes* | **never**}

   ip igmp snooping link-local-groups-suppression

   ip igmp optimise-multicast-flood

   ip igmp snooping proxy general-inquiries [**mrt** *seconds*]

   ip igmp snooping report-suppression

   ip igmp snooping v3-report-suppression
3. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip igmp snooping** **Example:** switch(config)# ip igmp snooping	Enables IGMP snooping for the device. The default is enabled. **Note** If the global setting is disabled with the **no** form of this command, IGMP snooping on all VLANs is disabled, whether IGMP snooping is enabled on a VLAN or not. If you disable IGMP snooping, Layer 2 multicast frames flood to all modules.
	ip igmp snooping event-history **Example:** switch(config)# ip igmp snooping event-history	Configures the size of the event history buffer. The default is **small**.
	ip igmp snooping group-timeout {*minutes* | **never**} **Example:** switch(config)# ip igmp snooping group-timeout never	Configures the group membership timeout value for all VLANs on the device.
	ip igmp snooping link-local-groups-suppression **Example:** switch(config)# ip igmp snooping link-local-groups-suppression	Configures link-local groups suppression for the entire device. The default is enabled.
	ip igmp snooping optimise-multicast-flood **Example:** switch(config)# ip igmp snooping optimise-multicast-flood	Optimizes OMF on all VLANs on the device. The default is enabled.
	ip igmp snooping proxy general-inquiries [**mrt** *seconds*] **Example:** switch(config)# ip igmp snooping proxy general-inquiries	Configures IGMP snooping proxy for the device. The default is 5 seconds.
	ip igmp snooping report-suppression **Example:** switch(config)# ip igmp snooping report-suppression	Limits the membership report traffic sent to multicast-capable routers. When you disable report suppression, all IGMP reports are sent as is to multicast-capable routers. The default is enabled.

	Command	Purpose
	ip igmp snooping v3-report-suppression **Example:** `switch(config)# ip igmp snooping v3-report-suppression`	Configures IGMPv3 report suppression and proxy reporting. The default is disabled.
Step 3	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Configuring IGMP Snooping Parameters per VLAN

To affect the operation of the IGMP snooping process per VLAN, you can configure the optional IGMP snooping parameters described in Table 1-3.

Table 1-3 IGMP Snooping Parameters per VLAN

Parameter	Description
IGMP snooping	Enables IGMP snooping on a per-VLAN basis. The default is enabled. **Note** If the global setting is disabled, all VLANs are treated as disabled, whether they are enabled or not.
Explicit tracking	Tracks IGMPv3 membership reports from individual hosts for each port on a per-VLAN basis. The default is enabled.
Fast leave	Enables the software to remove the group state when it receives an IGMP Leave report without sending an IGMP query message. This parameter is used for IGMPv2 hosts when no more than one host is present on each VLAN port. The default is disabled.
Group timeout	Configures the group membership timeout for the specified VLANs.
Last member query interval	Sets the interval that the software waits after sending an IGMP query to verify that no hosts that want to receive a particular multicast group remain on a network segment. If no hosts respond before the last member query interval expires, the software removes the group from the associated VLAN port. Values range from 1 to 25 seconds. The default is 1 second.
Optimise-multicast-flood	Configures Optimized Multicast Flood (OMF) on specified VLANs. The default is enabled.
Proxy	Configures IGMP snooping proxy for the specified VLANs. The default is 5 seconds.

Table 1-3 IGMP Snooping Parameters per VLAN (continued)

Parameter	Description
Snooping querier	Configures a snooping querier on an interface when you do not enable PIM because multicast traffic does not need to be routed. You can also configure the following values for the snooping querier: • timeout—Timeout value for IGMPv2 • interval—Time between query transmissions • maximum response time—MRT for query messages • startup count—Number of queries sent at startup • startup interval—Interval between queries at startup
Robustness variable	Configures the robustness value for the specified VLANs.
Report suppression	Limits the membership report traffic sent to multicast-capable routers on a per-VLAN basis. When you disable report suppression, all IGMP reports are sent as is to multicast-capable routers. The default is enabled.
Multicast router	Configures a static connection to a multicast router. The interface to the router must be in the selected VLAN.
Static group	Configures a Layer 2 port of a VLAN as a static member of a multicast group.
Link-local groups suppression	Configures link-local groups suppression on a per-VLAN basis. The default is enabled.
IGMPv3 report suppression	Configures IGMPv3 report suppression and proxy reporting on a per-VLAN basis. The default is enabled per VLAN.
Version	Configures the IGMP version number for the specified VLANs.

Note Beginning with Cisco Release 5.1(1), step 3 in the following configuration changed from **vlan** *vlan-id* to **vlan configuration** *vlan-id.*
You configure the IP IGMP snooping parameters that you want by using this configuration mode; however, the configurations apply only after you specifically create the specified VLAN. See the *Cisco Nexus 7000 Series NX-OS Layer 2 Switching Configuration Guide, Release 5.x*, for information on creating VLANs.

SUMMARY STEPS

1. **config t**
2. **ip igmp snooping**
3. **vlan** *vlan-id*

   vlan configuration *vlan-id*—Beginning with Cisco Release 5.1(1), use this command
4. **ip igmp snooping**

   ip igmp snooping explicit-tracking

   ip igmp snooping fast-leave

   ip igmp snooping group-timeout {*minutes* | **never**}

ip igmp snooping last-member-query-interval *seconds*

ip igmp optimised-multicast-flood

ip igmp snooping proxy general-queries [**mrt** *seconds*]

ip igmp snooping querier *ip-address*

ip igmp snooping querier-timeout *seconds*

ip igmp snooping query-interval *seconds*

ip igmp snooping query-max-response-time *seconds*

ip igmp snooping startup-query-count *value*

ip igmp snooping startup-query-interval *seconds*

ip igmp snooping robustness-variable *value*

ip igmp snooping report-suppression

ip igmp snooping mrouter interface *interface*

ip igmp snooping static-group *group-ip-addr* [**source** *source-ip-addr*] **interface** *interface*

ip igmp snooping link-local-groups-suppression

ip igmp snooping v3-report-suppression

ip igmp snooping version *value*

5. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ip igmp snooping** **Example:** `switch(config)# ip igmp snooping`	Enables IGMP snooping for the current VDC. The default is enabled. **Note** If the global setting is disabled with the **no** form of this command, IGMP snooping on all VLANs is disabled, whether IGMP snooping is enabled on a VLAN or not. If you disable IGMP snooping, Layer 2 multicast frames flood to all modules.

Step 3	**vlan** *vlan-id*
	
	Example:
	`switch(config)# vlan 2`
	`switch(config-vlan)#`
		Enters VLAN configuration mode.

	vlan configuration *vlan-id*
	
	Example:
	`switch(config)# vlan configuration 2`
	`switch(config-vlan-config)#`
		Beginning with Cisco Release 5.1(1), use this command to configure the IGMP snooping parameters you want for the VLAN. These configurations do not apply until you specifically create the specified VLAN.

	Command	Purpose
Step 4	**ip igmp snooping** **Example:** `switch(config-vlan-config)# ip igmp snooping`	Enables IGMP snooping for the current VLAN. The default is enabled.
	ip igmp snooping explicit-tracking **Example:** `switch(config-vlan-config)# ip igmp snooping explicit-tracking`	Tracks IGMPv3 membership reports from individual hosts for each port on a per-VLAN basis. The default is enabled on all VLANs.
	ip igmp snooping fast-leave **Example:** `switch(config-vlan-config)# ip igmp snooping fast-leave`	Supports IGMPv2 hosts that cannot be explicitly tracked because of the host report suppression mechanism of the IGMPv2 protocol. When you enable fast leave, the IGMP software assumes that no more than one host is present on each VLAN port. The default is disabled for all VLANs.
	ip igmp snooping group-timeout {*minutes* | **never**} **Example:** `switch(config-vlan-config)# ip igmp snooping group-timeout never`	Configures the group membership timeout for the specified VLANs.
	ip igmp snooping last-member-query-interval *seconds* **Example:** `switch(config-vlan-config)# ip igmp snooping last-member-query-interval 3`	Removes the group from the associated VLAN port if no hosts respond to an IGMP query message before the last member query interval expires. Values range from 1 to 25 seconds. The default is 1 second.
	ip igmp snooping optimised-multicast-flood **Example:** `switch(config-vlan-config)# ip igmp snooping optimised-multicast-flood`	Optimizes OMF on selected VLANs. The default is enabled.
	ip igmp snooping proxy general-queries [**mrt** | *seconds*] **Example:** `switch(config-vlan-config)# ip igmp snooping proxy general-queries`	Configures an IGMP snooping proxy for specified VLANs. The default is 5 seconds.
	ip igmp snooping querier *ip-address* **Example:** `switch(config-vlan-config)# ip igmp snooping querier 172.20.52.106`	Configures a snooping querier when you do not enable PIM because multicast traffic does not need to be routed. The IP address is used as the source in messages.
	ip igmp snooping querier-timeout *seconds* **Example:** `switch(config-vlan-config)# ip igmp snooping querier-timeout 300`	Configures a snooping querier timeout value for IGMPv2 when you do not enable PIM because multicast traffic does not need to be routed. The default is 255 seconds.
	ip igmp snooping query-interval *seconds* **Example:** `switch(config-vlan-config)# ip igmp snooping query-interval 120`	Configures a snooping query interval when you do not enable PIM because multicast traffic does not need to be routed. The default value is 125 seconds.

Command	Purpose
ip igmp snooping query-max-response-time *seconds* **Example:** `switch(config-vlan-config)# ip igmp snooping query-max-response-time 12`	Configures a snooping MRT for query messages when you do not enable PIM because multicast traffic does not need to be routed. The default value is 10 seconds.
ip igmp snooping startup-query-count *value* **Example:** `switch(config-vlan-config)# ip igmp snooping startup-query-count 5`	Configures snooping for a number of queries sent at startup when you do not enable PIM because multicast traffic does not need to be routed.
ip igmp snooping startup-query-interval *seconds* **Example:** `switch(config-vlan-config)# ip igmp snooping startup-query-interval 15000`	Configures a snooping query interval at startup when you do not enable PIM because multicast traffic does not need to be routed.
ip igmp snooping robustness-variable *value* **Example:** `switch(config-vlan-config)# ip igmp snooping robustness-variable 5`	Configures the robustness value for the specified VLANs. The default value is 2.
ip igmp snooping report-suppression **Example:** `switch(config-vlan-config)# ip igmp snooping report-suppression`	Limits the membership report traffic sent to multicast-capable routers. When you disable report suppression, all IGMP reports are sent as is to multicast-capable routers. The default is enabled.
ip igmp snooping mrouter interface *interface* **Example:** `switch(config-vlan-config)# ip igmp snooping mrouter interface ethernet 2/1`	Configures a static connection to a multicast router. The interface to the router must be in the selected VLAN. You can specify the interface by the type and the number, such as **ethernet** *slot/port*.
ip igmp snooping static-group *group-ip-addr* [**source** *source*-ip-addr] **interface** *interface* **Example:** `switch(config-vlan-config)# ip igmp snooping static-group 230.0.0.1 interface ethernet 2/1`	Configures a Layer 2 port of a VLAN as a static member of a multicast group. You can specify the interface by the type and the number, such as **ethernet** *slot/port*.
ip igmp snooping link-local-groups-suppression **Example:** `switch(config-vlan-config)# ip igmp snooping link-local-groups-suppression`	Configures link-local groups suppression for the specified VLANs. The default is enabled.
ip igmp snooping v3-report-suppression **Example:** `switch(config-vlan-config)# ip igmp snooping v3-report-suppression`	Configures IGMPv3 report suppression and proxy reporting for the specified VLANs. The default is enabled per VLAN.

	Command	Purpose
	ip igmp snooping version *value* **Example:** switch(config-vlan-config)# ip igmp snooping version 2	Configures the IGMP version number for the specified VLANs.
Step 5	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Changing the Lookup Mode

Beginning with Cisco Release 5.2(1) for the Nexus 7000 Series chassis, you can configure the lookup mode to be based on the MAC address either globally or per VLAN.

SUMMARY STEPS

1. **config t**
2. **layer-2 multicast lookup mode**

   Use this command to change the lookup mode globally
3. **vlan** *vlan-id*
   layer-2 multicast lookup mac

   Use these 2 commands to change the lookup mode per VLAN. See the *Cisco Nexus 7000 Series NX-OS Layer 2 Switching Configuration Guide, Release 5.x* for information on the VLAN configuration mode.
4. **exit**
5. (Optional) **show ip igmp snooping lookup-mode** [**vlan** *vlan-id*]
6. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters global configuration mode.
Step 2	**layer-2 multicast lookup mode** **Example:** switch(config)# layer-2 multicast lookup mode	Globally changes the lookup mode to be based on MAC address. To return to the default IP lookup mode, use the **no** form of this command.

	Command	Purpose

Step 3	**vlan** *vlan-id*
	
	Example:
	`switch(config)# vlan 5`
	`switch(config-vlan)#`
	
	layer-2 multicast lookup mode
	
	Example:
	`switch(config-vlan)# layer-2 multicast lookup mode`
	`switch(config-vlan)`
		Changes the lookup mode to be based on the MAC address for the specified VLANs. To return to the default IP lookup mode for these VLANs, use the **no** form of this command.

Step 4	**exit**
	
	Example:
	`switch(config)# exit`
	`switch#`
		Exits configuration and/or VLAN configuration mode.

Step 5	**show ip igmp snooping lookup-mode** [**vlan** *vlan-id*] **Example:** `switch# show ip igmp snooping lookup-mode`	(Optional) Displays the IGMP snooping lookup mode.
Step 6	**copy running-config startup-config** **Example:** `switch# copy running-config startup-config`	(Optional) Copies the running configuration to the startup configuration.

Configuring a Static Multicast MAC Address

Beginning with Cisco Release 5.2(1) for the Nexus 7000 Series chassis, you can configure an outgoing interface statically for a multicast MAC address.

SUMMARY STEPS

1. **config t**
2. **mac address-table multicast** *multicast-mac-addr* **vlan** *vlan-id* **interface** *slot/port*
3. **exit**
4. (Optional) **show ip igmp snooping mac-oif** [**detail** | **vlan** *vlan-id* [**detail**]]
5. (Optional) **copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters global configuration mode.
Step 2	**mac address-table multicast** *multicast-mac-addr* **vlan** *vlan-id* **interface** *slot/port* **Example:** switch(config)# mac address-table multicast 01:00:5f:00:00:00 vlan 5 interface ethernet 2/5	Configures the specified outgoing interface statically for a multicast MAC address.
Step 3	**exit** **Example:** switch(config)# exit switch#	Exits configuration and/or VLAN configuration mode.
Step 4	**show ip igmp snooping mac-oif** [**detail** | **vlan** *vlan-id* [**detail**]] **Example:** switch# show feature-set	(Optional) Displays the IGMP snooping static MAC addresses.
Step 5	**copy running-config startup-config** **Example:** switch# copy running-config startup-config	(Optional) Copies the running configuration to the startup configuration.

Verifying IGMP Snooping Configuration

To display the IGMP snooping configuration information, perform one of the following tasks:

Command	Purpose
show ip igmp snooping [**vlan** *vlan-id*]	Displays the IGMP snooping configuration by VLAN.
show ip igmp snooping groups [*source* [*group*] | *group* [*source*]] [**vlan** *vlan-id*] [**detail**]	Displays IGMP snooping information about groups by VLAN.
show ip igmp snooping querier [**vlan** *vlan-id*]	Displays IGMP snooping queriers by VLAN.
show ip igmp snooping mroute [**vlan** *vlan-id*]	Displays multicast router ports by VLAN.
show ip igmp snooping explicit-tracking [**vlan** *vlan-id*]	Displays IGMP snooping explicit tracking information by VLAN.
show ip igmp snooping lookup-mode [**vlan** *vlan-id*]	Displays the IGMP snooping lookup mode.
show ip igmp snooping mac-oif [**detail** | **vlan** *vlan-i*d [**detail**]]	Displays IGMP snooping static MAC addresses.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Displaying IGMP Snooping Statistics

Use the **show ip igmp snooping statistics vlan** command to display IGMP snooping statistics. You can see the virtual port channel (vPC) statistics in this output.

Use the **clear ip igmp snooping statistics vlan** command to clear IGMP snooping statistics.

For detailed information about using these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Configuration Example for IGMP Snooping

The following example shows how to configure the IGMP snooping parameters:

```
config t
  ip igmp snooping
  vlan 2
    ip igmp snooping
    ip igmp snooping explicit-tracking
    ip igmp snooping fast-leave
    ip igmp snooping last-member-query-interval 3
    ip igmp snooping querier 172.20.52.106
    ip igmp snooping report-suppression
    ip igmp snooping mrouter interface ethernet 2/1
    ip igmp snooping static-group 230.0.0.1 interface ethernet 2/1
    ip igmp snooping link-local-groups-suppression
    ip igmp snooping v3-report-suppression
```

The following example shows how to configure the IGMP snooping parameters beginning with Cisco Release 5.1(1):

```
config t
  ip igmp snooping
  vlan configuration 2
    ip igmp snooping
    ip igmp snooping explicit-tracking
    ip igmp snooping fast-leave
    ip igmp snooping last-member-query-interval 3
    ip igmp snooping querier 172.20.52.106
    ip igmp snooping report-suppression
    ip igmp snooping mrouter interface ethernet 2/1
    ip igmp snooping static-group 230.0.0.1 interface ethernet 2/1
    ip igmp snooping link-local-groups-suppression
    ip igmp snooping v3-report-suppression
```

These configurations do not apply until you specifically create the specified VLAN. See *Cisco Nexus 7000 Series NX-OS Layer 2 Switching Configuration Guide, Release 5.x* for information on creating VLANs.

Where to Go Next

You can enable the following features that work with PIM:

- Chapter 1, “Configuring IGMP”
- Chapter 1, “Configuring MLD”
- Chapter 1, “Configuring MSDP”

Additional References

For additional information related to implementing IGMP snooping, see the following sections:

- Related Documents, page 1-18
- Standards, page 1-18
- Feature History for IGMP Snooping in CLI, page 1-18

Related Documents

Related Topic	Document Title
VDCs	*Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*
CLI commands	*Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

Feature History for IGMP Snooping in CLI

Table 1-4 lists the release history for this feature.

Table 1-4 Feature History for IGMP Snooping

Feature Name	Releases	Feature Information
Configuring lookup mode to MAC and assigning a static MAC address	5.2(1)	You can configure IGMP snooping to use the forwarding lookup mode as MAC-based, as well as assign a static MAC address.

Table 1-4 Feature History for IGMP Snooping

Feature Name	Releases	Feature Information
vlan configuration *vlan-id*	5.1(1)	Command added to allow you to configure a VLAN before you actually create the VLAN.
vPC	4.1(3)	List of guidelines and limitations that apply to a vPC. Display vPC statistics with the **show ip igmp snooping statistics vlan** command. The following sections provide information about this feature: • "Guidelines and Limitations for IGMP Snooping" section on page 1-5 • "Displaying IGMP Snooping Statistics" section on page 1-17

CHAPTER 1

Configuring MSDP

This chapter describes how to configure Multicast Source Discovery Protocol (MSDP) on a Cisco NX-OS device.

This chapter includes the following sections:

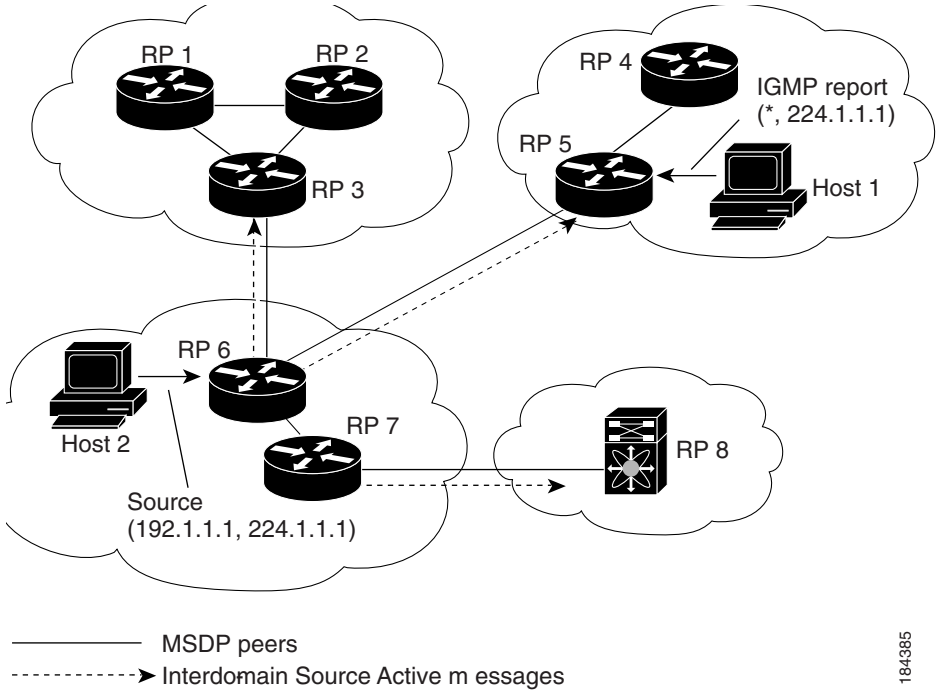
Information About MSDP

You can use the Multicast Source Discovery Protocol (MSDP) to exchange multicast source information between multiple BGP-enabled Protocol Independent Multicast (PIM) sparse-mode domains. For information about PIM, see Chapter 1, "Configuring PIM and PIM6." For information about BGP, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

When a receiver for a group matches the group transmitted by a source in another domain, the rendezvous point (RP) sends PIM join messages in the direction of the source to build a shortest path tree. The designated router (DR) sends packets on the source-tree within the source domain, which may travel through the RP in the source domain and along the branches of the source-tree to other domains. In domains where there are receivers, RPs in those domains can be on the source-tree. The peering relationship is conducted over a TCP connection.

Figure 1-1 shows four PIM domains. The connected RPs (routers) are called MSDP peers because each RP maintains its own set of multicast sources. Source host 2 sends the multicast data to group 224.1.1.1. On RP 6, the MSDP process learns about the source through PIM register messages and generates Source-Active (SA) messages to its MSDP peers that contain information about the sources in its domain. When RP 3 and RP 5 receive the SA messages, they forward them to their MSDP peers. When RP 5 receives the request from host 2 for the multicast data on group 224.1.1.1, it builds a shortest path tree to the source by sending a PIM join message in the direction of host 1 at 192.1.1.1.

Figure 1-1 MSDP Peering Between RPs in Different PIM Domains



When you configure MSDP peering between each RP, you create a full mesh. Full MSDP meshing is typically done within an autonomous system, as shown between RPs 1, 2, and 3, but not across autonomous systems. You use BGP to do loop suppression and MSDP peer-RPF to suppress looping SA messages. For more information about mesh groups, see the "MSDP Mesh Groups" section on page 1-3.

Note You do not need to configure MSDP in order to use Anycast-RP (a set of RPs that can perform load balancing and failover) within a PIM domain. For more information, see the "Configuring a PIM Anycast-RP Set" section on page 1-37.

For detailed information about MSDP, see RFC 3618.

This section includes the following topics:

SA Messages and Caching

MSDP peers exchange Source-Active (SA) messages that the MSDP software uses to propagate information about active sources. SA messages contain the following information:

- Source address of the data source
- Group address that the data source uses
- IP address of the RP or the configured originator ID

When a PIM register message advertises a new source, the MSDP process reencapsulates the message in an SA message that is immediately forwarded to all MSDP peers.

The SA cache holds the information for all sources learned through SA messages. Caching reduces the join latency for new receivers of a group because the information for all known groups can be found in the cache. You can limit the number of cached source entries by configuring the SA limit peer parameter. You can limit the number of cached source entries for a specific group prefix by configuring the group limit global parameter.

The MSDP software sends SA messages for each group in the SA cache every 60 seconds or at the configured SA interval global parameter. An entry in the SA cache is removed if an SA message for that source and group is not received within SA interval plus 3 seconds.

MSDP Peer-RPF Forwarding

MSDP peers forward the SA messages that they receive away from the originating RP. This action is called peer-RPF flooding. The router examines the BGP or MBGP routing table to determine which peer is the next hop in the direction of the originating RP of the SA message. This peer is called a reverse path forwarding (RPF) peer.

If the MSDP peer receives the same SA message from a non-RPF peer in the direction of the originating RP, it drops the message. Otherwise, it forwards the message to all its MSDP peers.

MSDP Mesh Groups

You can use MSDP mesh groups to reduce the number of SA messages that are generated by peer-RPF flooding. In Figure 1-1, RPs 1, 2, and 3 receive SA messages from RP 6. By configuring a peering relationship between all the routers in a mesh and then configuring a mesh group of these routers, the SA messages that originate at a peer are sent by that peer to all other peers. SA messages received by peers in the mesh are not forwarded. An SA message that originates at RP 3 is forwarded to RP 1 and RP 2, but these RPs do not forward those messages to other RPs in the mesh.

A router can participate in multiple mesh groups. By default, no mesh groups are configured.

Virtualization Support

A virtual device context (VDC) is a logical representation of a set of system resources. Within each VDC, you can define multiple virtual routing and forwarding (VRF) instances. The MSDP configuration applies to the VRF selected within the current VDC.

You can use the **show** commands with a VRF argument to provide a context for the information displayed. The default VRF is used if no VRF argument is supplied.

For information about configuring VDCs, see the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*.

For information about configuring VRFs, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

Licensing Requirements for MSDP

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	MSDP requires an Enterprise Services license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for MSDP

MSDP has the following prerequisites:

- You are logged onto the device.
- You are in the correct virtual device context (VDC). A VDC is a logical representation of a set of system resources. You can use the **switchto vdc** command with a VDC number.
- For global commands, you are in the correct virtual routing and forwarding (VRF) mode. The default configuration mode shown in the examples in this chapter applies to the default VRF.
- You configured PIM for the networks where you want to configure MSDP.

Default Settings

Table 1-1 lists the default settings for MSDP parameters.

Table 1-1 Default MSDP Parameters

Parameters	Default
Description	Peer has no description
Administrative shutdown	Peer is enabled when it is defined
MD5 password	No MD5 password is enabled
SA policy IN	All SA messages are received
SA policy OUT	All registered sources are sent in SA messages
SA limit	No limit is defined
Originator interface name	RP address of the local system
Group limit	No group limit is defined
SA interval	60 seconds

Configuring MSDP

You can establish MSDP peering by configuring the MSDP peers within each PIM domain.

To configure MSDP peering, follow these steps:

Step 1 Select the routers to act as MSDP peers.

Step 2 Enable the MSDP feature. See the "Enabling the MSDP Feature" section on page 1-5.

Step 3 Configure the MSDP peers for each router identified in Step 1. See the "Configuring MSDP Peers" section on page 1-6.

Step 4 Configure the optional MSDP peer parameters for each MSDP peer. See the "Configuring MSDP Peer Parameters" section on page 1-7.

Step 5 Configure the optional global parameters for each MSDP peer. See the "Configuring MSDP Global Parameters" section on page 1-10.

Step 6 Configure the optional mesh groups for each MSDP peer. See the "Configuring MSDP Mesh Groups" section on page 1-11.

Note The MSDP commands that you enter before you enable MSDP are cached and then run when MSDP is enabled. Use the **ip msdp peer** or **ip msdp originator-id** command to enable MSDP.

This section includes the following topics:

Note If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Enabling the MSDP Feature

Before you can access the MSDP commands, you must enable the MSDP feature.

SUMMARY STEPS

1. **config t**
2. **feature msdp**
3. **(Optional) show running-configuration | grep** *feature*
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**feature msdp** **Example:** switch# feature msdp	Enables the MSDP feature so that you can enter MSDP commands. By default, the MSDP feature is disabled.
Step 3	**show running-configuration | grep** *feature* **Example:** switch# show running-configuration | grep feature	(Optional) Shows **feature** commands that you specified.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring MSDP Peers

You can configure an MSDP peer when you configure a peering relationship with each MSDP peer that resides either within the current PIM domain or in another PIM domain. MSDP is enabled on the router when you configure the first MSDP peering relationship.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM and MSDP.

Ensure that you configured BGP and PIM in the domains of the routers that you will configure as MSDP peers.

SUMMARY STEPS

1. **config t**
2. **ip msdp peer** *peer-ip-address* **connect-source** *interface* [**remote-as** *as-number*]
3. Repeat Step 2 for each MSDP peering relationship.
4. **(Optional) show ip msdp summary** [**vrf** *vrf-name* | *known-vrf-name* | **all**]
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip msdp peer** *peer-ip-address* **connect-source** *interface* [**remote-as** *as-number*] **Example:** switch(config)# ip msdp peer 192.168.1.10 connect-source ethernet 2/1 remote-as 8	Configures an MSDP peer with the specified peer IP address. The software uses the source IP address of the interface for the TCP connection with the peer. The interface can take the form of *type slot/port*. If the AS number is the same as the local AS, then the peer is within the PIM domain; otherwise, this peer is external to the PIM domain. By default, MSDP peering is disabled. **Note** MSDP peering is enabled when you use this command.
Step 3	Repeat Step 2 for each MSDP peering relationship by changing the peer IP address, the interface, and the AS number as appropriate.	—
Step 4	**show ip msdp summary** [**vrf** *vrf-name* | *known-vrf-name* | **all**] **Example:** switch# show ip msdp summary	(Optional) Displays a summary of MDSP peers.
Step 5	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring MSDP Peer Parameters

You can configure the optional MSDP peer parameters described in Table 1-2. You configure these parameters in global configuration mode for each peer based on its IP address.

Table 1-2 MSDP Peer Parameters

Parameter	Description
Description	Description string for the peer. By default, the peer has no description.
Administrative shutdown	Method to shut down the MSDP peer. The configuration settings are not affected by this command. You can use this parameter to allow configuration of multiple parameters to occur before making the peer active. The TCP connection with other peers is terminated by the shutdown. By default, a peer is enabled when it is defined.
MD5 password	MD5-shared password key used for authenticating the peer. By default, no MD5 password is enabled.
SA policy IN	Route-map policy[1] for incoming SA messages. By default, all SA messages are received.
SA policy OUT	Route-map policy[1] for outgoing SA messages. By default, all registered sources are sent in SA messages.
SA limit	Number of (S, G) entries accepted from the peer and stored in the SA cache. By default, there is no limit.

1. To configure route-map policies, see the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*.

For information about configuring multicast route maps, see the "Configuring Route Maps to Control RP Information Distribution" section on page 1-45.

Note For information about configuring mesh groups, see the "Configuring MSDP Mesh Groups" section on page 1-11.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM and MSDP.

SUMMARY STEPS

1. **config t**
2. **ip msdp description** *peer-ip-address string*
   ip msdp shutdown *peer-ip-address*
   ip msdp password *peer-ip-address password*
   ip msdp sa-policy *peer-ip-address policy-name* **in**
   ip msdp sa-policy *peer-ip-address policy-name* **out**
   ip msdp sa-limit *peer-ip-address limit*

3. **(Optional) show ip msdp peer** [*peer-address*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip msdp description** *peer-ip-address string* **Example:** switch(config)# ip msdp description 192.168.1.10 peer in Engineering network	Sets a description string for the peer. By default, the peer has no description.
	ip msdp shutdown *peer-ip-address* **Example:** switch(config)# ip msdp shutdown 192.168.1.10	Shuts down the peer. By default, the peer is enabled when it is defined.
	ip msdp password *peer-ip-address password* **Example:** switch(config)# ip msdp password 192.168.1.10 my_md5_password	Enables an MD5 password for the peer. By default, no MD5 password is enabled.
	ip msdp sa-policy *peer-ip-address policy-name* **in** **Example:** switch(config)# ip msdp sa-policy 192.168.1.10 my_incoming_sa_policy in	Enables a route-map policy for incoming SA messages. By default, all SA messages are received.
	ip msdp sa-policy *peer-ip-address policy-name* **out** **Example:** switch(config)# ip msdp sa-policy 192.168.1.10 my_outgoing_sa_policy out	Enables a route-map policy for outgoing SA messages. By default, all registered sources are sent in SA messages.
	ip msdp sa-limit *peer-ip-address limit* **Example:** switch(config)# ip msdp sa-limit 192.168.1.10 5000	Sets a limit on the number of (S, G) entries accepted from the peer. By default, there is no limit.
Step 3	**show ip msdp peer** [*peer-address*] [**vrf** *vrf-name* | *known-vrf-name* | **all**] **Example:** switch# show ip msdp peer 1.1.1.1	(Optional) Displays detailed MDSP peer information.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring MSDP Global Parameters

You can configure the optional MSDP global parameters described in Table 1-3.

Table 1-3 MSDP Global Parameters

Parameter	Description
Originator interface name	IP address used in the RP field of an SA message entry. When Anycast RPs are used, all RPs use the same IP address. You can use this parameter to define a unique IP address for the RP of each MSDP peer. By default, the software uses the RP address of the local system. **Note** We recommend that you use a loopback interface for the RP address.
Group limit	Maximum number of (S, G) entries that the software creates for the specified prefix. The software ignores groups when the group limit is exceeded and logs a violation. By default, no group limit is defined.
SA interval	Interval at which the software transmits Source-Active (SA) messages. The range is from 60 to 65,535 seconds. The default is 60 seconds.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM and MSDP.

SUMMARY STEPS

1. **config t**
2. **ip msdp originator-id** *interface*

   ip msdp group-limit *limit* **source** *source-prefix*

   ip msdp sa-interval *seconds*
3. **(Optional) show ip msdp summary** [**vrf** *vrf-name* | *known-vrf-name* | **all**]
4. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 2	**ip msdp originator-id** *interface* **Example:** switch(config)# ip msdp originator-id loopback0	Sets the IP address used in the RP field of an SA message entry. The interface can take the form of *type slot/port*. By default, the software uses the RP address of the local system. **Note** We recommend that you use a loopback interface for the RP address.
	ip msdp group-limit *limit* **source** *source-prefix* **Example:** switch(config)# ip msdp group-limit 1000 source 192.168.1.0/24	Maximum number of (S, G) entries that the software creates for the specified prefix. The software ignores groups when the group limit is exceeded and logs a violation. By default, no group limit is defined.
	ip msdp sa-interval *seconds* **Example:** switch(config)# ip msdp sa-interval 80	Interval at which the software transmits Source-Active (SA) messages. The range is from 60 to 65,535 seconds. The default is 60 seconds.
Step 3	**show ip msdp summary** [**vrf** *vrf-name* | *known-vrf-name* | **all**] **Example:** switch# show ip msdp summary	(Optional) Displays a summary of the MDSP configuration.
Step 4	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Configuring MSDP Mesh Groups

You can configure optional MDSP mesh groups in global configuration mode by specifying each peer in the mesh. You can configure multiple mesh groups on the same router and multiple peers per mesh group.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM and MSDP.

SUMMARY STEPS

1. **config t**
2. **ip msdp mesh-group** *peer-ip-addr mesh-name*
3. Repeat Step 2 for each MSDP peer in the mesh.
4. **show ip msdp mesh-group** [*mesh-group*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]

5. **copy running-config startup-config**

DETAILED STEPS

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters configuration mode.

Step 2	**ip msdp mesh-group** *peer-ip-addr mesh-name* **Example:** `switch(config)# ip msdp mesh-group 192.168.1.10 my_mesh_1`	Configures an MSDP mesh with the peer IP address specified. You can configure multiple meshes on the same router and multiple peers per mesh group. By default, no mesh groups are configured.
Step 3	Repeat Step 2 for each MSDP peer in the mesh by changing the peer IP address.	—
Step 4	**show ip msdp mesh-group** [*mesh-group*] [**vrf** *vrf-name* | *known-vrf-name* | **all**] **Example:** `switch# show ip msdp summary`	(Optional) Displays information about the MDSP mesh group configuration.
Step 5	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Saves configuration changes.

Restarting the MSDP Process

You can restart the MSDP process and optionally flush all routes.

BEFORE YOU BEGIN

Ensure that you have installed the Enterprise Services license and enabled PIM and MSDP.

SUMMARY STEPS

1. **restart msdp**
2. **config t**
3. **ip msdp flush-routes**
4. **(Optional) show running-configuration | include flush-routes**
5. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose
Step 1	**restart msdp** **Example:** switch# restart msdp	Restarts the MSDP process.
Step 2	**config t** **Example:** switch# config t switch(config)#	Enters configuration mode.
Step 3	**ip msdp flush-routes** **Example:** switch(config)# ip msdp flush-routes	Removes routes when the MSDP process is restarted. By default, routes are not flushed.
Step 4	**show running-configuration | include flush-routes** **Example:** switch(config)# show running-configuration | include flush-routes	(Optional) Shows flush-routes configuration lines in the running configuration.
Step 5	**copy running-config startup-config** **Example:** switch(config)# copy running-config startup-config	(Optional) Saves configuration changes.

Verifying the MSDP Configuration

To display the MSDP configuration information, perform one of the following tasks:

Command	Purpose
show ip msdp count [*as-number*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays MSDP (S, G) entry and group counts by the AS number.
show ip msdp mesh-group [*mesh-group*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays the MSDP mesh group configuration.
show ip msdp peer [*peer-address*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays MSDP information for the MSDP peer.
show ip msdp rpf [*rp-address*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays next-hop AS on the BGP path to an RP address.
show ip msdp sources [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays the MSDP-learned sources and violations of configured group limits.
show ip msdp summary [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays a summary of the MSDP peer configuration.

For detailed information about the fields in the output from these commands, see the *Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*.

Monitoring MSDP

You can display and clear MSDP statistics by using the features in this section.

This section has the following topics:

Displaying Statistics

You can display MSDP statistics using the commands listed in Table 1-4.

Table 1-4 MSDP Statistics Commands

Command	Purpose
show ip msdp [*as-number*] **internal event-history** {**errors** | **messages**}	Displays memory allocation statistics.
show ip msdp policy statistics sa-policy *peer-address* {**in** | **out**} [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Displays the MSDP policy statistics for the MSDP peer.
show ip msdp {**sa-cache** | **route**} [*source-address*] [*group-address*] [**vrf** *vrf-name* | *known-vrf-name* | **all**] [*asn-number*] [**peer** *peer-address*]	Displays the MSDP SA route cache. If you specify the source address, all groups for that source are displayed. If you specify a group address, all sources for that group are displayed.

Clearing Statistics

You can clear the MSDP statistics using the commands listed in Table 1-5.

Table 1-5 MSDP Clear Statistics Commands

Command	Description
clear ip msdp peer [*peer-address*] [**vrf** *vrf-name* | *known-vrf-name*]	Clears the TCP connection to an MSDP peer.
clear ip msdp policy statistics sa-policy *peer-address* {**in** | **out**} [**vrf** *vrf-name* | *known-vrf-name*]	Clears statistics counters for MSDP peer SA policies.
clear ip msdp statistics [*peer-address*] [**vrf** *vrf-name* | *known-vrf-name*]	Clears statistics for MSDP peers.
clear ip msdp {**sa-cache** | **route**} [*group-address*] [**vrf** *vrf-name* | *known-vrf-name* | **all**]	Clears the group entries in the SA cache.

Configuration Examples for MSDP

To configure MSDP peers, some of the optional parameters, and a mesh group, follow these steps for each MSDP peer:

Step 1 Configure the MSDP peering relationship with other routers.

```
switch# config t
switch(config)# ip msdp peer 192.168.1.10 connect-source ethernet 1/0 remote-as 8
```

Step 2 Configure the optional peer parameters.

```
switch# config t
switch(config)# ip msdp password 192.168.1.10 my_peer_password_AB
```

Step 3 Configure the optional global parameters.

```
switch# config t
switch(config)# ip msdp sa-interval 80
```

Step 4 Configure the peers in each mesh group.

```
switch# config t
switch(config)# ip msdp mesh-group 192.168.1.10 mesh_group_1
```

The following example shows how to configure a subset of the MSDP peering that is shown in Figure 1-1.

- RP 3: 192.168.3.10 (AS 7)

```
config t
  ip msdp peer 192.168.1.10 connect-source ethernet 1/1
  ip msdp peer 192.168.2.10 connect-source ethernet 1/2
  ip msdp peer 192.168.6.10 connect-source ethernet 1/3 remote-as 9
  ip msdp password 192.168.6.10 my_peer_password_36
  ip msdp sa-interval 80
  ip msdp mesh-group 192.168.1.10 mesh_group_123
  ip msdp mesh-group 192.168.2.10 mesh_group_123
  ip msdp mesh-group 192.168.3.10 mesh_group_123
```

- RP 5: 192.168.5.10 (AS 8)

```
config t
  ip msdp peer 192.168.4.10 connect-source ethernet 1/1
  ip msdp peer 192.168.6.10 connect-source ethernet 1/2 remote-as 9
  ip msdp password 192.168.6.10 my_peer_password_56
  ip msdp sa-interval 80
```

- RP 6: 192.168.6.10 (AS 9)

```
config t
  ip msdp peer 192.168.7.10 connect-source ethernet 1/1
  ip msdp peer 192.168.3.10 connect-source ethernet 1/2 remote-as 7
  ip msdp peer 192.168.5.10 connect-source ethernet 1/3 remote-as 8
  ip msdp password 192.168.3.10 my_peer_password_36
  ip msdp password 192.168.5.10 my_peer_password_56
  ip msdp sa-interval 80
```

Additional References

For additional information related to implementing MSDP, see the following sections:

Related Documents

Related Topic	Document Title
VDCs	*Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 4.2*
CLI commands	*Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference, Release 5.x*
Configuring Policy Based Routing and MBGP	*Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x*

Standards

Standards	Title
RFC 4624	*Multicast Source Discovery Protocol (MSDP) MIB*

CHAPTER 1

Configuring Multicast Interoperation with N7K-F132-15 Modules

This chapter describes how multicasting interoperates in a chassis that contains both M Series and N7K-F132-15 modules.

This chapter includes the following sections:

Information About Multicast Interoperation

Beginning with Cisco NX-OS Release 5.1, you can add an N7K-F132-15 module, which is a Layer 2-only module, into the Cisco Nexus 7000 Series chassis. You can add this module to a chassis that already contains M Series modules to provide multicasting in a chassis that contains both N7K-F132-15 and M Series modules.

This section includes the following topics:

Multicast Interoperation with N7K-F132-15 and M Series Modules

Note You must install an N7K-M series module in the Cisco Nexus 7000 Series chassis to run Layer 3 routing and multicasting with the N7K-F132-15 module because you must have interfaces from both the M Series and the N7K-F132-15 modules in the same virtual device context (VDC). See the *Cisco Nexus 7000 Series Virtual Device Context Configuration Guide, Release 5.x,* for more information on VDCs.

Layer 3 routing and multicasting come up automatically when you have an N7K-M series module installed in the chassis with the N7K-F132-15 module. You can position a chassis with both N7K-F132-15 and M Series modules at the boundary between the Layer 2 and Layer 3 networks.

You must configure a VLAN interface for each VLAN on the N7K-F132-15 module that you want to use the proxy-routing functionality in a chassis that contains both N7K-F132-15 and M series modules. See the *Cisco Nexus 7000 Series Interfaces Configuration Guide,Release 5.x,* for information on configuring VLAN interfaces.

By default, all of the physical interfaces on the N7K-M series modules in the VDC become proxy routing ports for the VLANs that are configured with VLAN interfaces on the Layer 2-only N7K-F132-15 module in the same VDC. The physical interfaces on the M Series module can be administratively down and they still pass traffic as proxy routers.

Packets that enter an interface on the N7K-F132-15 module are automatically forwarded to one of the interfaces on the M Series modules in the same VDC to be routed. The interface on the M Series module also performs egress replication for Layer 3 multicast packets that enter an interface on the N7K-F132-15 module in the same VDC. See the *Cisco Nexus 7000 Series NX-OS Unicast Routing Configuration Guide, Release 5.x,* for additional information about the routing interoperation with the N7K-F132-15 module.

You can specify which interfaces on the M Series modules in the VDC where you want to perform the egress replication of VLAN interfaces for Layer 3 multicast packets. For multicast egress replication, the system automatically rebalances all the VLAN interfaces among all the available M Series proxy routing interfaces. You can specify automatic or manual rebalancing among the proxy multicast replicators. If you specify manual rebalancing, you trigger a rebalance by entering a command. This command is useful when you are inserting or removing modules.

Note When you configure manual egress multicast replication load balancing and enter the rebalancing command, that command is not part of the configuration. It is not included in the commands that are copied when you enter the **copy running-config startup-config** command.

Virtualization Support

You must have interfaces from both the M Series and the N7K-F132-15 modules in the same VDC.

See the *Cisco Nexus 7000 Series Virtual Device Context Configuration Guide, Release 5.x,* for more information about VDCs.

High Availability

For information about high availability, see the *Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide, Release 5.x*.

Licensing Requirements for Multicast Interoperation

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	Multicast replication requires no license. However, PIM and PIM6 require an Enterprise Services license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the *Cisco NX-OS Licensing Guide.*

Prerequisites for Multicast Interoperation

For multicast interoperation, you must have at least one module of the following series in the Cisco Nexus 7000 Series chassis, as well as a valid license installed:

- M Series
- N7K-F132-15

Guidelines and Limitations

Multicasting has the following configuration guidelines and limitations:

- You must have interfaces from both the M Series and the N7K-F132-15 modules in the same VDC.

Configuring Layer 3 Multicast Using a Mixed Chassis

You can configure a Layer 3 gateway in a chassis with N7K-F132-15 and M series modules, by using the proxy routing functionality. You enable routing on a specific VLAN by configuring a VLAN interface. See the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide, Release 5.x,* for more information about Layer 3 routing and VLAN interfaces.

By default, Layer 3 routing and multicasting come up automatically when you have an N7K-M Series module installed in the chassis with the N7K-F132-15 module. Layer 3 routing, multicasting, and load balancing among the available N7K-M Series works by default using proxy routing on the N7K-M Series modules.

Optionally, you can specify which physical interfaces on the N7K-M Series modules that you want to use for egress multicast replication, as well as forcing rebalancing.

BEFORE YOU BEGIN

You must configure a VLAN interface for each VLAN on the N7K-F132-15 module where you want to use the proxy-routing functionality in a mixed chassis.

You must have interfaces from both the M Series and the N7K-F132-15 modules in the same VDC.

If you remove an interface from the VDC and then enter this command, the removed interface only display when you reload the VDC.

SUMMARY STEPS

1. **config t**
2. **hardware proxy layer-3 replication** {**use** | **exclude**} {**module** *mod-number* | **interface** *slot/port*} [**module-type f1**]
3. **hardware proxy layer-3 replication rebalance-mode** {**auto** | **manual**}
4. **hardware proxy layer-3 replication trigger rebalance**
5. **exit**
6. **(Optional) show hardware proxy layer-3 detail**
7. **(Optional) copy running-config startup-config**

DETAILED STEPS

	Command	Purpose

Step 1	**config t**
	
	Example:
	`switch# config t`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**hardware proxy layer-3 replication** {**use** | **exclude**} {**module** *mod-number* | **interface** *slot/port*} [**module-type f1**] **Example:** `switch(config)# hardware proxy layer-3 replication exclude interface ethernet 2/1-16, ethernet 3/1, ethernet 4/1-2`	Configures specific modules and physical interfaces on the N7K-M Series module to provide egress proxy replication of Layer 3 multicast packets on the N7K-F132-15 module.
Step 3	**hardware proxy layer-3 replication rebalance-mode** {**auto** | **manual**} **Example:** `switch(config)# hardware proxy layer-3 replication rebalance-mode auto`	Configures the load balancing among the proxy routing replication interfaces. When you choose **auto**, the switch automatically rebalances the configured VLAN interface multicast replication traffic load among all the N7K-M Series replicators. The default value is **manual**. **Note** In the **manual** mode, the switch automatically balances all traffic among the available proxy routing interfaces on the M Series modules in the chassis when you first start up the switch.
Step 4	**hardware proxy layer-3 replication trigger rebalance** **Example:** `switch(config)# hardware proxy layer-3 replication trigger rebalance`	When you configure **manual** again in Step 3, use this command to trigger one-time load balancing among all the proxy routing multicast replication interfaces. This command is not effective if you have configured **auto** in Step 3. **Note** This command is not saved in the configuration; it is a one-time event.

	Command	Purpose
Step 5	**exit** **Example:** switch(config)# exit switch#	Exits configuration mode.
Step 6	**show hardware proxy layer-3 detail** **Example:** switch# show hardware proxy layer-3 detail	(Optional) Displays the information on the proxy Layer-3 functionality.
Step 7	**copy running-config startup-config** **Example:** switch# copy running-config startup-config	(Optional) Copies the running configuration to the startup configuration.

EXAMPLES

This example shows how to specify certain physical interfaces on the N7K-M Series modules to perform egress multicast replication for VLANs on the N7K-F132-15 module in a mixed chassis and to trigger a rebalance:

```
switch# config t
switch(config)# hardware proxy layer-3 replication exclude interface ethernet 2/1-16, 3/1,
4/1-2
switch(config)# hardware proxy layer-3 replication rebalance mode manual
switch(config)# hardware proxy layer-3 replication trigger rebalance
switch(config)#
```

Verifying the Multicast Configuration

To display multicast configuration information, perform one of the following tasks:

Command	Purpose
show hardware proxy layer-3 detail	Displays information about the Layer 3 proxy routing functionality in a mixed chassis with both M series and N7K-F132-15 modules.
show hardware proxy layer-3 counters {**brief** | **detail**}	Displays information about the number of packets that are sent by the N7K-F132-15 modules to each of the M Series modules for proxy forwarding. **Note** Enter the **clear hardware proxy layer-3 counters** command to reset the counters to 0.

Feature History for Multicast Interoperation

Table 1-1 lists the release history for this feature.

Table 1-1 Feature History for Multicast Interoperation

Feature Name	Releases	Feature Information
Multicast interoperation between F Series and M Series modules in the Cisco Nexus 7000 Series chassis	5.1(1)	This feature, along with the N7K-F132-15 modules, was introduced in this release.

APPENDIX 1

IETF RFCs for IP Multicast

This appendix contains Internet Engineering Task Force (IETF) RFCs related to IP multicast. For information about IETF RFCs, see http://www.ietf.org/rfc.html.

RFCs	Title
RFC 2236	*Internet Group Management Protocol, Version 2*
RFC 2365	*Administratively Scoped IP Multicast*
RFC 2858	*Multiprotocol Extensions for BGP-4*
RFC 3376	*Internet Group Management Protocol, Version 3*
RFC 3446	*Anycast Rendezvous Point (RP) mechanism using Protocol Independent Multicast (PIM) and Multicast Source Discovery Protocol (MSDP)*
RFC 3569	*An Overview of Source-Specific Multicast (SSM)*
RFC 3618	*Multicast Source Discovery Protocol (MSDP)*
RFC 4291	*IP Version 6 Addressing Architecture*
RFC 4541	*Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches*
RFC 4601	*Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)*
RFC 4610	*Anycast-RP Using Protocol Independent Multicast (PIM)*
RFC 5059	*Bootstrap Router (BSR) Mechanism for Protocol Independent Multicast (PIM)*
RFC 5132	*IP Multicast MIB*

APPENDIX 1

Configuration Limits for Cisco NX-OS Multicast

The features supported by Cisco NX-OS have maximum configuration limits. Some of the features have configurations that support limits less than the maximum limits.

The configuration limits are documented in the *Cisco Nexus 7000 Series NX-OS Verified Scalability Guide.*