Catalyst 2960-XR Switch IP Multicast Routing Configuration Guide, Cisco IOS Release 15.0(2)EX1

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Preface

This book describes configuration information and examples for IP multicast routing on the switch.

Document Conventions

This document uses the following conventions:

Convention	Description
^ or Ctrl	Both the ^ symbol and Ctrl represent the Control (Ctrl) key on a keyboard. For example, the key combination **^D** or **Ctrl-D** means that you hold down the Control key while you press the D key. (Keys are indicated in capital letters but are not case sensitive.)
bold font	Commands and keywords and user-entered text appear in **bold** font.
Italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
`Courier font`	Terminal sessions and information the system displays appear in `courier` font.
`Bold Courier font`	Bold Courier font indicates text that the user must enter.
[x]	Elements in square brackets are optional.
...	An ellipsis (three consecutive nonbolded periods without spaces) after a syntax element indicates that the element can be repeated.
|	A vertical line, called a pipe, indicates a choice within a set of keywords or arguments.

Convention	Description
[x | y]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
{x | y}	Required alternative keywords are grouped in braces and separated by vertical bars.
[x {y | z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
< >	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.

Reader Alert Conventions

This document uses the following conventions for reader alerts:

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

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

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

Timesaver Means *the described action saves time.* You can save time by performing the action described in the paragraph.

Warning **Means *reader be warned.* In this situation, you might perform an action that could result in bodily injury.**

Related Documentation

Note Before installing or upgrading the switch, refer to the switch release notes.

- Catalyst 2960-XR Switch documentation, located at:

  http://www.cisco.com/go/cat2960xr_docs

- Cisco SFP and SFP+ modules documentation, including compatibility matrixes, located at:

  http://www.cisco.com/en/US/products/hw/modules/ps5455/tsd_products_support_series_home.html

- Cisco Validated Designs documents, located at:

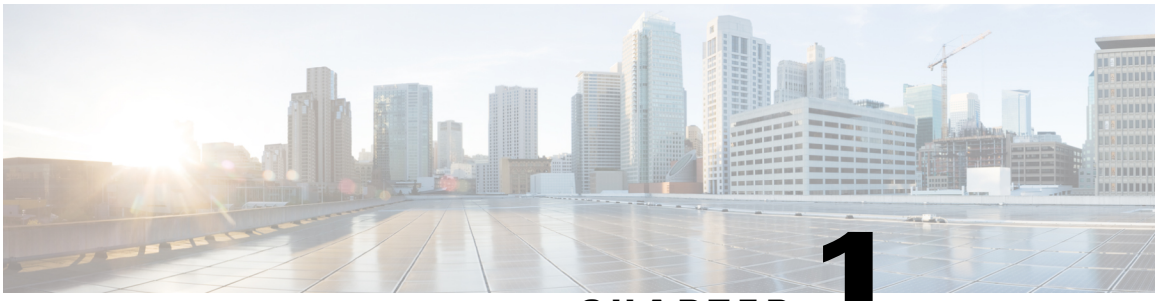
  http://www.cisco.com/go/designzone

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

Using the Command-Line Interface

Information About Using the Command-Line Interface

Command Modes

The Cisco IOS user interface is divided into many different modes. The commands available to you depend on which mode you are currently in. Enter a question mark (?) at the system prompt to obtain a list of commands available for each command mode.

You can start a CLI session through a console connection, through Telnet, a SSH, or by using the browser.

When you start a session, you begin in user mode, often called user EXEC mode. Only a limited subset of the commands are available in user EXEC mode. For example, most of the user EXEC commands are one-time commands, such as **show** commands, which show the current configuration status, and **clear** commands, which clear counters or interfaces. The user EXEC commands are not saved when the switch reboots.

To have access to all commands, you must enter privileged EXEC mode. Normally, you must enter a password to enter privileged EXEC mode. From this mode, you can enter any privileged EXEC command or enter global configuration mode.

Using the configuration modes (global, interface, and line), you can make changes to the running configuration. If you save the configuration, these commands are stored and used when the switch reboots. To access the various configuration modes, you must start at global configuration mode. From global configuration mode, you can enter interface configuration mode and line configuration mode.

This table describes the main command modes, how to access each one, the prompt you see in that mode, and how to exit the mode.

Table 1: Command Mode Summary

Mode	Access Method	Prompt	Exit Method	About This Mode
User EXEC	Begin a session using Telnet, SSH, or console.	`Switch>`	Enter **logout** or **quit**.	Use this mode to • Change terminal settings. • Perform basic tests. • Display system information.
Privileged EXEC	While in user EXEC mode, enter the **enable** command.	`Switch#`	Enter **disable** to exit.	Use this mode to verify commands that you have entered. Use a password to protect access to this mode.
Global configuration	While in privileged EXEC mode, enter the **configure** command.	`Switch(config)#`	To exit to privileged EXEC mode, enter **exit** or **end**, or press **Ctrl-Z**.	Use this mode to configure parameters that apply to the entire switch.
VLAN configuration	While in global configuration mode, enter the **vlan** *vlan-id* command.	`Switch(config-vlan)#`	To exit to global configuration mode, enter the **exit** command. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure VLAN parameters. When VTP mode is transparent, you can create extended-range VLANs (VLAN IDs greater than 1005) and save configurations in the switch startup configuration file.
Interface configuration	While in global configuration mode, enter the **interface** command (with a specific interface).	`Switch(config-if)#`	To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure parameters for the Ethernet ports.

Mode	Access Method	Prompt	Exit Method	About This Mode
Line configuration	While in global configuration mode, specify a line with the **line vty** or **line console** command.	`Switch(config-line)#`	To exit to global configuration mode, enter **exit**. To return to privileged EXEC mode, press **Ctrl-Z** or enter **end**.	Use this mode to configure parameters for the terminal line.

Using the Help System

You can enter a question mark (?) at the system prompt to display a list of commands available for each command mode. You can also obtain a list of associated keywords and arguments for any command.

SUMMARY STEPS

1. **help**
2. *abbreviated-command-entry* **?**
3. *abbreviated-command-entry* <Tab>
4. **?**
5. *command* **?**
6. *command keyword* **?**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**help** **Example:** `Switch# help`	Obtains a brief description of the help system in any command mode.

Step 2	*abbreviated-command-entry* **?**
	Example:
	`Switch# di?`
	`dir disable disconnect`
		Obtains a list of commands that begin with a particular character string.

Step 3	*abbreviated-command-entry* <Tab>
	Example:
	`Switch# sh conf<tab>`
	`Switch# show configuration`
		Completes a partial command name.

	Command or Action	Purpose
Step 4	**?** **Example:** `Switch> ?`	Lists all commands available for a particular command mode.
Step 5	*command* **?** **Example:** `Switch> show ?`	Lists the associated keywords for a command.

Step 6	*command keyword* **?**
	
	Example:
	`Switch(config)# cdp holdtime ?`
	`  <10-255> Length of time (in sec) that receiver must keep this packet`
		Lists the associated arguments for a keyword.

Understanding Abbreviated Commands

You need to enter only enough characters for the switch to recognize the command as unique.

This example shows how to enter the **show configuration** privileged EXEC command in an abbreviated form:

```
Switch# show conf
```

No and default Forms of Commands

Almost every configuration command also has a **no** form. In general, use the **no** form to disable a feature or function or reverse the action of a command. For example, the **no shutdown** interface configuration command reverses the shutdown of an interface. Use the command without the keyword **no** to reenable a disabled feature or to enable a feature that is disabled by default.

Configuration commands can also have a **default** form. The **default** form of a command returns the command setting to its default. Most commands are disabled by default, so the **default** form is the same as the **no** form. However, some commands are enabled by default and have variables set to certain default values. In these cases, the **default** command enables the command and sets variables to their default values.

CLI Error Messages

This table lists some error messages that you might encounter while using the CLI to configure your switch.

Table 2: Common CLI Error Messages

Error Message	Meaning	How to Get Help
`% Ambiguous command: "show con"`	You did not enter enough characters for your switch to recognize the command.	Reenter the command followed by a question mark (?) with a space between the command and the question mark. The possible keywords that you can enter with the command appear.
`% Incomplete command.`	You did not enter all the keywords or values required by this command.	Reenter the command followed by a question mark (?) with a space between the command and the question mark. The possible keywords that you can enter with the command appear.
`% Invalid input detected at '^' marker.`	You entered the command incorrectly. The caret (^) marks the point of the error.	Enter a question mark (?) to display all the commands that are available in this command mode. The possible keywords that you can enter with the command appear.

Configuration Logging

You can log and view changes to the switch configuration. You can use the Configuration Change Logging and Notification feature to track changes on a per-session and per-user basis. The logger tracks each configuration command that is applied, the user who entered the command, the time that the command was entered, and the parser return code for the command. This feature includes a mechanism for asynchronous notification to registered applications whenever the configuration changes. You can choose to have the notifications sent to the syslog.

Note Only CLI or HTTP changes are logged.

How to Use the CLI to Configure Features

Configuring the Command History

The software provides a history or record of commands that you have entered. The command history feature is particularly useful for recalling long or complex commands or entries, including access lists. You can customize this feature to suit your needs.

Changing the Command History Buffer Size

By default, the switch records ten command lines in its history buffer. You can alter this number for a current terminal session or for all sessions on a particular line. This procedure is optional.

SUMMARY STEPS

1. **terminal history** [**size** *number-of-lines*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal history** [**size** *number-of-lines*] **Example:** `Switch# terminal history size 200`	Changes the number of command lines that the switch records during the current terminal session in the privileged EXEC mode. You can configure the size from 0 through 256.

Recalling Commands

To recall commands from the history buffer, perform one of the actions listed in this table. These actions are optional.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

SUMMARY STEPS

1. **Ctrl-P** or use the **up arrow** key
2. **Ctrl-N** or use the **down arrow** key
3. **show history**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**Ctrl-P** or use the **up arrow** key	Recalls commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Step 2	**Ctrl-N** or use the **down arrow** key	Returns to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the up arrow key. Repeat the key sequence to recall successively more recent commands.

	Command or Action	Purpose
Step 3	**show history** **Example:** `Switch# show history`	Lists the last several commands that you just entered in privileged EXEC mode. The number of commands that appear is controlled by the setting of the **terminal history** global configuration command and the **history** line configuration command.

Disabling the Command History Feature

The command history feature is automatically enabled. You can disable it for the current terminal session or for the command line. This procedure is optional.

SUMMARY STEPS

1. **terminal no history**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal no history** **Example:** `Switch# terminal no history`	Disables the feature during the current terminal session in the privileged EXEC mode.

Enabling and Disabling Editing Features

Although enhanced editing mode is automatically enabled, you can disable it, and reenable it.

SUMMARY STEPS

1. **terminal editing**
2. **terminal no editing**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**terminal editing** **Example:** `Switch# terminal editing`	Reenables the enhanced editing mode for the current terminal session in the privileged EXEC mode.

	Command or Action	Purpose
Step 2	**terminal no editing** **Example:** `Switch# terminal no editing`	Disables the enhanced editing mode for the current terminal session in the privileged EXEC mode.

Editing Commands through Keystrokes

The keystrokes help you to edit the command lines. These keystrokes are optional.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

Table 3: Editing Commands

Editing Commands	Description
Ctrl-B or use the **left arrow** key	Moves the cursor back one character.
Ctrl-F or use the **right arrow** key	Moves the cursor forward one character.
Ctrl-A	Moves the cursor to the beginning of the command line.
Ctrl-E	Moves the cursor to the end of the command line.
Esc B	Moves the cursor back one word.
Esc F	Moves the cursor forward one word.
Ctrl-T	Transposes the character to the left of the cursor with the character located at the cursor.
Delete or **Backspace** key	Erases the character to the left of the cursor.
Ctrl-D	Deletes the character at the cursor.
Ctrl-K	Deletes all characters from the cursor to the end of the command line.
Ctrl-U or **Ctrl-X**	Deletes all characters from the cursor to the beginning of the command line.
Ctrl-W	Deletes the word to the left of the cursor.

Esc D	Deletes from the cursor to the end of the word.
Esc C	Capitalizes at the cursor.
Esc L	Changes the word at the cursor to lowercase.
Esc U	Capitalizes letters from the cursor to the end of the word.
Ctrl-V or **Esc Q**	Designates a particular keystroke as an executable command, perhaps as a shortcut.
Return key	Scrolls down a line or screen on displays that are longer than the terminal screen can display. **Note** The More prompt is used for any output that has more lines than can be displayed on the terminal screen, including **show** command output. You can use the **Return** and **Space** bar keystrokes whenever you see the More prompt.
Space bar	Scrolls down one screen.
Ctrl-L or **Ctrl-R**	Redisplays the current command line if the switch suddenly sends a message to your screen.

Editing Command Lines That Wrap

You can use a wraparound feature for commands that extend beyond a single line on the screen. When the cursor reaches the right margin, the command line shifts ten spaces to the left. You cannot see the first ten characters of the line, but you can scroll back and check the syntax at the beginning of the command. The keystroke actions are optional.

To scroll back to the beginning of the command entry, press **Ctrl-B** or the left arrow key repeatedly. You can also press **Ctrl-A** to immediately move to the beginning of the line.

Note The arrow keys function only on ANSI-compatible terminals such as VT100s.

The following example shows how to wrap a command line that extend beyond a single line on the screen.

SUMMARY STEPS

1. **access-list**
2. **Ctrl-A**
3. **Return** key

DETAILED STEPS

	Command or Action	Purpose

Step 1	**access-list**
	
	Example:
	`Switch(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35`
	`Switch(config)# $ 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35 255.25`
	`Switch(config)# $t tcp 10.15.22.25 255.255.255.0 131.108.1.20 255.255.255.0 eq`
	`Switch(config)# $15.22.25 255.255.255.0 10.15.22.35 255.255.255.0 eq 45`
		Displays the global configuration command entry that extends beyond one line.
		
		When the cursor first reaches the end of the line, the line is shifted ten spaces to the left and redisplayed. The dollar sign ($) shows that the line has been scrolled to the left. Each time the cursor reaches the end of the line, the line is again shifted ten spaces to the left.

Step 2	**Ctrl-A** **Example:** `Switch(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.2$`	Checks the complete syntax. The dollar sign ($) appears at the end of the line to show that the line has been scrolled to the right.
Step 3	**Return** key	Execute the commands. The software assumes that you have a terminal screen that is 80 columns wide. If you have a different width, use the **terminal width** privileged EXEC command to set the width of your terminal. Use line wrapping with the command history feature to recall and modify previous complex command entries.

Searching and Filtering Output of show and more Commands

You can search and filter the output for **show** and **more** commands. This is useful when you need to sort through large amounts of output or if you want to exclude output that you do not need to see. Using these commands is optional.

SUMMARY STEPS

1. {**show** | **more**} *command* | {**begin** | **include** | **exclude**} *regular-expression*

DETAILED STEPS

	Command or Action	Purpose
Step 1	{**show** | **more**} *command* | {**begin** | **include** | **exclude**} *regular-expression*	Searches and filters the output.

	Command or Action	Purpose

	Example:
	`Switch# show interfaces | include protocol`
	`Vlan1 is up, line protocol is up`
	`Vlan10 is up, line protocol is down`
	`GigabitEthernet1/0/1 is up, line protocol is down`
	`GigabitEthernet1/0/2 is up, line protocol is up`
		Expressions are case sensitive. For example, if you enter **| exclude output**, the lines that contain **output** are not displayed, but the lines that contain **output** appear.

Accessing the CLI through a Console Connection or through Telnet

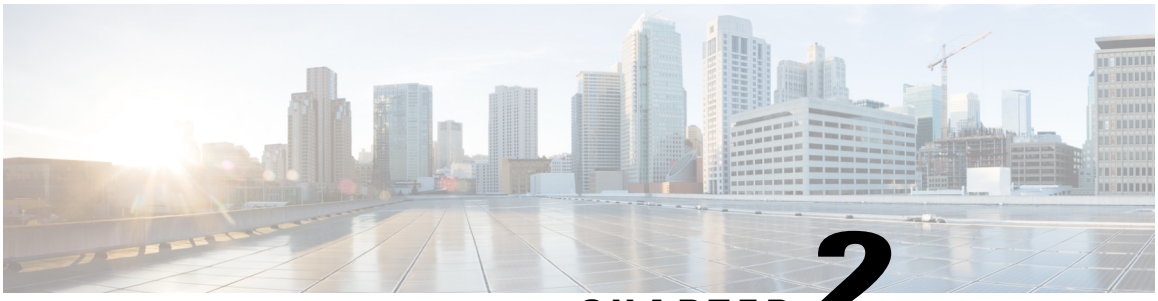
Before you can access the CLI, you must connect a terminal or a PC to the switch console or connect a PC to the Ethernet management port and then power on the switch, as described in the hardware installation guide that shipped with your switch.

If your switch is already configured, you can access the CLI through a local console connection or through a remote Telnet session, but your switch must first be configured for this type of access.

You can use one of these methods to establish a connection with the switch:

- Connect the switch console port to a management station or dial-up modem, or connect the Ethernet management port to a PC. For information about connecting to the console or Ethernet management port, see the switch hardware installation guide.
- Use any Telnet TCP/IP or encrypted Secure Shell (SSH) package from a remote management station. The switch must have network connectivity with the Telnet or SSH client, and the switch must have an enable secret password configured.
    - The switch supports up to 16 simultaneous Telnet sessions. Changes made by one Telnet user are reflected in all other Telnet sessions.
    - The switch supports up to five simultaneous secure SSH sessions.

  After you connect through the console port, through the Ethernet management port, through a Telnet session or through an SSH session, the user EXEC prompt appears on the management station.



CHAPTER 2

Understanding Cisco's Implementation of IP Multicast Routing

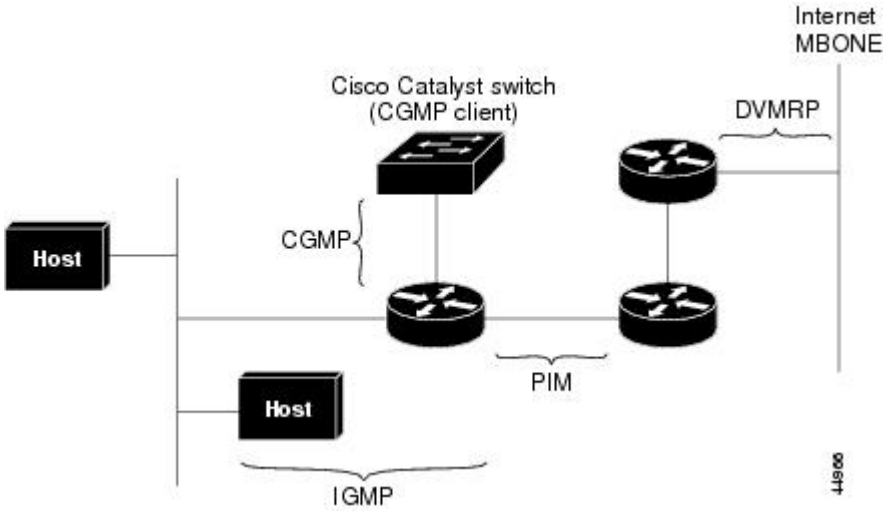
Cisco's Implementation of IP Multicast Routing

Cisco IOS software supports the following protocols to implement IP multicast routing:

- Internet Group Management Protocol (IGMP) is used among hosts on a LAN and the routers (and multilayer switches) on that LAN to track the multicast groups of which hosts are members.
- Protocol-Independent Multicast (PIM) protocol is used among routers and multilayer switches to track which multicast packets to forward to each other and to their directly connected LANs.
- Distance Vector Multicast Routing Protocol (DVMRP) is used on the multicast backbone of the Internet (MBONE). The software supports PIM-to-DVMRP interaction.
- Cisco Group Management Protocol (CGMP) is used on Cisco routers and multilayer switches connected to Layer 2 Catalyst switches to perform tasks similar to those performed by IGMP.

The following figure shows where these protocols operate within the IP multicast environment.

Figure 1: IP Multicast Routing Protocols



According to IPv4 multicast standards, the MAC destination multicast address begins with 0100:5e and is appended by the last 23 bits of the IP address. For example, if the IP destination address is 239.1.1.39, the MAC destination address is 0100:5e01:0127.

A multicast packet is unmatched when the destination IPv4 address does not match the destination MAC address. The switch forwards the unmatched packet in hardware based on the MAC address table. If the destination MAC address is not in the MAC address table, the switch floods the packet to the all port in the same VLAN as the receiving port.

Information About IGMP

To participate in IP multicasting, multicast hosts, routers, and multilayer switches must have the Internet Group Management Protocol (IGMP) operating. This protocol defines the querier and host roles:

- A querier is a network device that sends query messages to discover which network devices are members of a given multicast group.
- A host is a receiver that sends report messages (in response to query messages) to inform a querier of a host membership.

A set of queriers and hosts that receive multicast data streams from the same source is called a multicast group. Queriers and hosts use IGMP messages to join and leave multicast groups.

Any host, regardless of whether it is a member of a group, can send to a group. However, only the members of a group receive the message. Membership in a multicast group is dynamic; hosts can join and leave at any time. There is no restriction on the location or number of members in a multicast group. A host can be a member of more than one multicast group at a time. How active a multicast group is and what members it has can vary from group to group and from time to time. A multicast group can be active for a long time, or it can be very short-lived. Membership in a group can constantly change. A group that has members can have no activity.

IGMP Versions

The switch supports IGMP version 1, IGMP version 2, and IGMP version 3. These versions are interoperable on the switch. For example, if IGMP snooping is enabled and the querier's version is IGMPv2. and the switch receives an IGMPv3 report from a host, then the switch can forward the IGMPv3 report to the multicast router.

IGMP Version 1

IGMP version 1 (IGMPv1) primarily uses a query-response model that enables the multicast router and multilayer switch to find which multicast groups are active (have one or more hosts interested in a multicast group) on the local subnet. IGMPv1 has other processes that enable a host to join and leave a multicast group. For more information, see RFC 1112.

IGMP Version 2

IGMPv2 extends IGMP functionality by providing such features as the IGMP leave process to reduce leave latency, group-specific queries, and an explicit maximum query response time. IGMPv2 also adds the capability for routers to elect the IGMP querier without depending on the multicast protocol to perform this task. For more information, see RFC 2236.

Note IGMP version 2 is the default version for the switch.

Default IGMP Configuration

This table displays the default IGMP configuration for the switch.

Table 4: Default IGMP Configuration

Feature	Default Setting
Multilayer switch as a member of a multicast group	No group memberships are defined.
Access to multicast groups	All groups are allowed on an interface.
IGMP version	Version 2 on all interfaces.
IGMP host-query message interval	60 seconds on all interfaces.
IGMP query timeout	60 seconds on all interfaces.
IGMP maximum query response time	10 seconds on all interfaces.
Multilayer switch as a statically connected member	Disabled.

Configuring Optional IGMP Features

Configuring the Switch as a Member of a Group

You can configure the switch as a member of a multicast group and discover multicast reachability in a network. If all the multicast-capable routers and multilayer switches that you administer are members of a multicast group, pinging that group causes all of these devices to respond. The devices respond to ICMP echo-request packets addressed to a group of which they are members. Another example is the multicast trace-route tools provided in the software.

Caution Performing this procedure might impact the CPU performance because the CPU will receive all data traffic for the group address.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp join-group** *group-address*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode.
Step 3	**ip igmp join-group** *group-address* **Example:** `Switch(config-if)# ip igmp`	Configures the switch to join a multicast group. By default, no group memberships are defined. For *group-address*, specify the multicast IP address in dotted decimal notation.

	Command or Action	Purpose
	`join-group 225.2.2.2`	**Note** To cancel membership in a group, use the **no ip igmp join-group** *group-address* interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Example: Configuring the Switch as a Member of a Multicast Group, on page 26

Controlling Access to IP Multicast Group

The switch sends IGMP host-query messages to find which multicast groups have members on attached local networks. The switch then forwards to these group members all packets addressed to the multicast group. You can place a filter on each interface to restrict the multicast groups that hosts on the subnet serviced by the interface can join.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp access-group** *access-list-number*
4. **exit**
5. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
6. **end**
7. **show ip igmp interface** [*interface-id*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface GigabitEthernet 1/0/12`	Specifies the interface to be configured, and enters interface configuration mode.
Step 3	**ip igmp access-group** *access-list-number* **Example:** `Switch(config-if)# ip igmp access-group 10`	Specifies the multicast groups that hosts on the subnet serviced by an interface can join. By default, all groups are allowed on an interface. For *access-list-number*, specify an IP standard access list number. The range is 1 to 199. **Note** To disable groups on an interface, use the **no ip igmp access-group** interface configuration command.
Step 4	**exit** **Example:** `Switch(config-if)# exit`	Returns to global configuration mode.
Step 5	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 10 permit`	Creates a standard access list. • For *access-list-number*, specify the access list created in Step 3. • The **deny** keyword denies access if the conditions are matched. The **permit** keyword permits access if the conditions are matched. • For *source*, specify the multicast group that hosts on the subnet can join. • (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. Recall that the access list is always terminated by an implicit deny statement for everything.

	Command or Action	Purpose
Step 6	**end** **Example:** `Switch(config-igmp-profile)# end`	Returns to privileged EXEC mode.
Step 7	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.

Related Topics

Example: Controlling Access to IP Multicast Groups, on page 27

Changing the IGMP Version

By default, the switch uses IGMP Version 2, which provides features such as the IGMP query timeout and the maximum query response time.

All systems on the subnet must support the same version. The switch does not automatically detect Version 1 systems and switch to Version 1. You can mix Version 1 and Version 2 hosts on the subnet because Version 2 routers or switches always work correctly with IGMPv1 hosts.

Configure the switch for Version 1 if your hosts do not support Version 2.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp version** {**1** | **2** | **3** }
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be configured, and enters the interface configuration mode.
Step 3	**ip igmp version** {**1** | **2** | **3** } **Example:** `Switch(config-if)# ip igmp version 2`	Specifies the IGMP version that the switch uses. **Note** If you change to Version 1, you cannot configure the **ip igmp query-interval** or the **ip igmp query-max-response-time** interface configuration commands. To return to the default setting, use the **no ip igmp version** interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Modifying the IGMP Host-Query Message Interval

The switch periodically sends IGMP host-query messages to discover which multicast groups are present on attached networks. These messages are sent to the all-hosts multicast group (224.0.0.1) with a time-to-live

(TTL) of 1. The switch sends host-query messages to refresh its knowledge of memberships present on the network. If, after some number of queries, the software discovers that no local hosts are members of a multicast group, the software stops forwarding multicast packets to the local network from remote origins for that group and sends a prune message upstream toward the source.

The switch elects a PIM designated router (DR) for the LAN (subnet). The DR is the router or multilayer switch with the highest IP address for IGMPv2. For IGMPv1, the DR is elected according to the multicast routing protocol that runs on the LAN. The designated router is responsible for sending IGMP host-query messages to all hosts on the LAN. In sparse mode, the designated router also sends PIM register and PIM join messages toward the RP router.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp query-interval** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode.
Step 3	**ip igmp query-interval** *seconds* **Example:** `Switch(config-if)# ip igmp query-interval 75`	Configures the frequency at which the designated router sends IGMP host-query messages. By default, the designated router sends IGMP host-query messages every 60 seconds to keep the IGMP overhead very low on hosts and networks. The range is 1 to 18000. **Note** To return to the default setting, use the **no ip igmp query-interval** interface configuration command.

	Command or Action	Purpose
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Changing the IGMP Query Timeout for IGMPv2

If you are using IGMPv2, you can specify the period of time before the switch takes over as the querier for the interface. By default, the switch waits twice the query interval period controlled by the **ip igmp query-interval** interface configuration command. After that time, if the switch has received no queries, it becomes the querier.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp querier-timeout** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode.
Step 3	**ip igmp querier-timeout** *seconds* **Example:** `Switch(config-if)# ip igmp querier-timeout 120`	Specifies the IGMP query timeout. The default is 60 seconds (twice the query interval). The range is 60 to 300. **Note** To return to the default setting, use the **no ip igmp querier-timeout** interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Changing the Maximum Query Response Time for IGMPv2

If you are using IGMPv2, you can change the maximum query response time advertised in IGMP queries. The maximum query response time enables the switch to quickly detect that there are no more directly connected group members on a LAN. Decreasing the value enables the switch to prune groups faster.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp query-max-response-time** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode.
Step 3	**ip igmp query-max-response-time** *seconds* **Example:** `Switch(config-if)# ip igmp query-max-response-time 15`	Changes the maximum query response time advertised in IGMP queries. The default is 10 seconds. The range is 1 to 25. **Note** To return to the default setting, use the **no ip igmp query-max-response-time** interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.

	Command or Action	Purpose
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring the Switch as a Statically Connected Member

At various times, either there is not a group member on a network segment or a host that cannot report its group membership by using IGMP. However, you may want multicast traffic to be sent to that network segment. The following commands are used to pull multicast traffic down to a network segment:

- **ip igmp join-group—**The switch accepts the multicast packets in addition to forwarding them. Accepting the multicast packets prevents the switch from fast switching.
- **ip igmp static-group—**The switch does not accept the packets itself, but only forwards them. This method enables fast switching. The outgoing interface appears in the IGMP cache, but the switch itself is not a member, as evidenced by lack of an L (local) flag in the multicast route entry.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp static-group** *group-address*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode.
Step 3	**ip igmp static-group** *group-address* **Example:** `Switch(config-if)# ip igmp static-group 239.100.100.101`	Configures the switch as a statically connected member of a group. By default, this feature is disabled. **Note** To remove the switch as a member of the group, use the **no ip igmp static-group** *group-address* interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface gigabitethernet 1/0/1`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuration Examples for IGMP Features

Example: Configuring the Switch as a Member of a Multicast Group

This example shows how to enable the switch to join multicast group 255.2.2.2:

```
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# ip igmp join-group 255.2.2.2
Switch(config-if)#
```

Related Topics

Configuring the Switch as a Member of a Group, on page 16

Example: Controlling Access to IP Multicast Groups

This example shows how to configure hosts attached to a port as able to join only group 255.2.2.2:

```
Switch(config)# access-list 1 255.2.2.2 0.0.0.0
Switch(config-if)# interface gigabitethernet1/0/1
Switch(config-if)# ip igmp access-group 1
```

Related Topics

Controlling Access to IP Multicast Group, on page 17

Where to Go Next

You can configure the following for your IP multicast configuration:

- CGMP feature support
- PIM feature support
- SSM feature support
- IP Multicast Routing

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this book.	*Catalyst 2960-XR Switch IP Multicast Command Reference*

Standards and RFCs

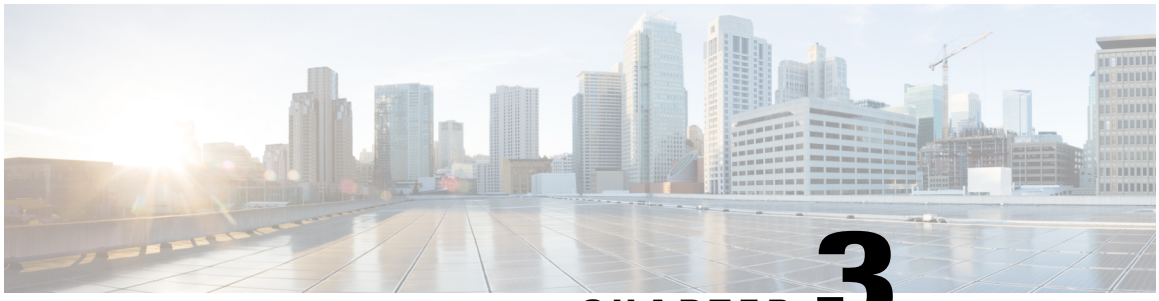
Standard/RFC	Title
RFC 1112	*Host Extensions for IP Multicasting*
RFC 2236	*Internet Group Management Protocol, Version 2*

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support



CHAPTER 3

Configuring CGMP

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring CGMP

The following are the prerequisites for configuring CGMP:

- When multiple Cisco CGMP-capable devices are connected to a switched network and the **ip cgmp proxy** command is needed, we recommend that all devices be configured with the same CGMP option and have precedence for becoming the IGMP querier over non-Cisco routers.

Restrictions for CGMP

The following are the restrictions for CGMP:

- CGMP is mutually exclusive with HSRPv1. You cannot enable CGMP leaving processing and HSRPv1 at the same time. However, you can enable CGMP and HSRPv2 at the same time.

Information About CGMP

This software release provides Cisco Group Management Protocol or CGMP-server support on your switch; no client-side functionality is provided. The switch serves as a CGMP server for devices that do not support IGMP snooping but have CGMP-client functionality.

CGMP is a protocol used on Cisco routers and multilayer switches connected to Layer 2 Catalyst switches to perform tasks similar to those performed by IGMP. CGMP permits Layer 2 group membership information to be communicated from the CGMP server to the switch. The switch can then learn on which interfaces multicast members reside instead of flooding multicast traffic to all switch interfaces. (IGMP snooping is another method to constrain the flooding of multicast packets.)

CGMP is necessary because the Layer 2 switch cannot distinguish between IP multicast data packets and IGMP report messages, which are both at the MAC level and are addressed to the same group address.

Enabling CGMP Server Support

The switch serves as a CGMP server for devices that do not support IGMP snooping but have CGMP client functionality. CGMP is a protocol used on Cisco routers and multilayer switches connected to Layer 2 Catalyst switches to perform tasks similar to those performed by IGMP. CGMP is necessary because the Layer 2 switch cannot distinguish between IP multicast data packets and IGMP report messages, which are both at the MAC level and are addressed to the same group address.

When multiple Cisco CGMP-capable devices are connected to a switched network and the **ip cgmp proxy** command is needed, we recommend that all devices be configured with the same CGMP option and have precedence for becoming the IGMP querier over non-Cisco routers.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip cgmp** [**proxy** | **router-only**]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface that is connected to the Layer 2 Catalyst switch, and enters interface configuration mode.
Step 3	**ip cgmp** [**proxy** | **router-only**] **Example:** `Switch(config-if)# ip cgmp proxy`	Enables CGMP on the interface. By default, CGMP is disabled on all interfaces. Enabling CGMP triggers a CGMP join message. Enable CGMP only on Layer 3 interfaces connected to Layer 2 Catalyst switches. (Optional) When you enter the **proxy** keyword, the CGMP proxy function is enabled. The proxy router advertises the existence of non-CGMP-capable routers by sending a CGMP join message with the non-CGMP-capable router MAC address and a group address of 0000.0000.0000. **Note** To perform CGMP proxy, the switch must be the IGMP querier. If you configure the **ip cgmp proxy** command, you must manipulate the IP addresses so that the switch is the IGMP querier, which might be the highest or lowest IP address, depending on which version of IGMP is running on the network. An IGMP Version 2 querier is selected based on the lowest IP address on the interface. An IGMP Version 1 querier is selected based on the multicast routing protocol used on the interface. **Note** To disable CGMP on the interface, use the **no ip cgmp** interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

	Command or Action	Purpose
	Example: `Switch# copy running-config startup-config`	Verifies the Layer 2 Catalyst switch CGMP-client configuration. For more information, see the documentation that shipped with the product.

Monitoring CGMP

You can display specific statistics, such as the contents of IP routing tables, caches, and databases.

Note This release does not support per-route statistics.

You can display information to learn resource usage and solve network problems. You can also display information about node reachability and discover the routing path that packets of your device are taking through the network.

You can use any of the privileged EXEC commands in the following table to display various routing statistics.

Table 5: Commands for Displaying System and Network Statistics

Command	Purpose
ping [*group-name* | *group-address*]	Sends an ICMP Echo Request to a multicast group address.
show ip igmp groups [*group-name* | *group-address* | *type number*]	Displays the multicast groups that are directly connected to the switch and that were learned through IGMP.
show ip igmp interface [*type number*]	Displays multicast-related information about an interface.
show ip mcache [*group* [*source*]]	Displays the contents of the IP fast-switching cache.
show ip mpacket [*source-address* | *name*] [*group-address* | *name*] [**detail**]	Displays the contents of the circular cache-header buffer.
show ip mroute [*group-name* | *group-address*] [*source*] [**summary**] [**count**] [**active** *kbps*]	Displays the contents of the IP multicast routing table.
show ip pim interface [*type number*] [**count**] [**detail**]	Displays information about interfaces configured for PIM. This command is available in all software images.
show ip pim neighbor [*type number*]	Lists the PIM neighbors discovered by the switch. This command is available in all software images.

Command	Purpose
show ip pim rp [*group-name* | *group-address*]	Displays the RP routers associated with a sparse-mode multicast group. This command is available in all software images.
show ip rpf {*source-address* | *name*}	Displays how the switch is doing Reverse-Path Forwarding (that is, from the unicast routing table, DVMRP routing table, or static mroutes).
show ip sap [*group* | *session-name* | **detail**]	Displays the Session Announcement Protocol (SAP) Version 2 cache.

Where to Go Next

You can configure the following for your IP multicast configuration:

- IGMP feature support
- PIM feature support
- SSM feature support
- IP Multicast Routing

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this book.	*Catalyst 2960-XR Switch IP Multicast Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

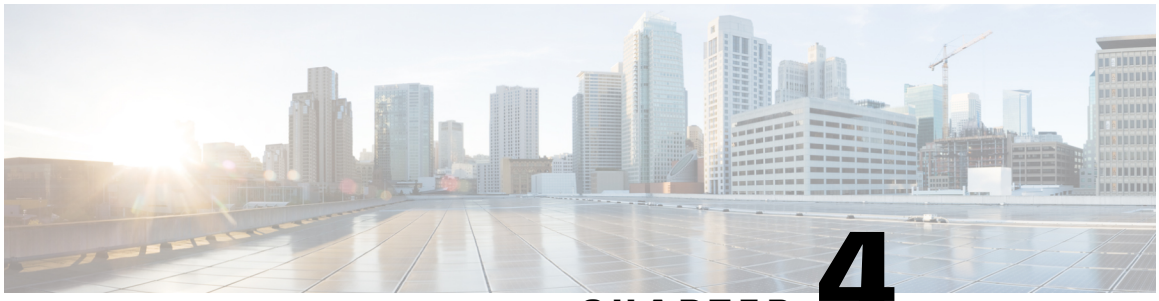
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for CGMP

Release	Modification
Cisco IOS 15.0(2)EX1	This feature was introduced.



CHAPTER 4

Configuring PIM

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring PIM

Prerequisites for Configuring PIM Stub Routing

The PIM stub routing feature supports multicast routing between the distribution layer and the access layer. It supports two types of PIM interfaces, uplink PIM interfaces, and PIM passive interfaces. A routed interface

configured with the PIM passive mode does not pass or forward PIM control traffic, it only passes and forwards IGMP traffic.

- Before configuring PIM stub routing, you must have IP multicast routing configured on both the stub router and the central router. You must also have PIM mode (dense-mode, sparse-mode, or dense-sparse-mode) configured on the uplink interface of the stub router.
- The PIM stub router does not route the transit traffic between the distribution routers. Unicast (EIGRP) stub routing enforces this behavior. You must configure unicast stub routing to assist the PIM stub router behavior.
- Only directly connected multicast (IGMP) receivers and sources are allowed in the Layer 2 access domains. The PIM protocol is not supported in access domains.
- The redundant PIM stub router topology is not supported.

Restrictions for PIM

Restrictions for Configuring Auto-RP and BSR

The following are restrictions for configuring Auto-RP and BSR (if used in your network configuration):

- If your network is all Cisco routers and multilayer switches, you can use either Auto-RP or BSR.
- If you have non-Cisco routers in your network, you must use BSR.
- If you have Cisco PIMv1 and PIMv2 routers and multilayer switches and non-Cisco routers, you must use both Auto-RP and BSR. If your network includes routers from other vendors, configure the Auto-RP mapping agent and the BSR on a Cisco PIMv2 device. Ensure that no PIMv1 device is located in the path a between the BSR and a non-Cisco PIMv2 device.

Note There are two approaches to using PIMv2. You can use Version 2 exclusively in your network or migrate to Version 2 by employing a mixed PIM version environment.

- Because bootstrap messages are sent hop-by-hop, a PIMv1 device prevents these messages from reaching all routers and multilayer switches in your network. Therefore, if your network has a PIMv1 device in it and only Cisco routers and multilayer switches, it is best to use Auto-RP.
- If you have a network that includes non-Cisco routers, configure the Auto-RP mapping agent and the BSR on a Cisco PIMv2 router or multilayer switch. Ensure that no PIMv1 device is on the path between the BSR and a non-Cisco PIMv2 router.
- If you have non-Cisco PIMv2 routers that need to interoperate with Cisco PIMv1 routers and multilayer switches, both Auto-RP and a BSR are required. We recommend that a Cisco PIMv2 device be both the Auto-RP mapping agent and the BSR.

Information About PIM

PIM is protocol-independent: regardless of the unicast routing protocols used to populate the unicast routing table, PIM uses this information to perform multicast forwarding instead of maintaining a separate multicast routing table.

PIM is defined in RFC 2362, *Protocol-Independent Multicast-Sparse Mode (PIM-SM): Protocol Specification*. PIM is defined in these Internet Engineering Task Force (IETF) Internet drafts:

- *Protocol Independent Multicast (PIM): Motivation and Architecture*
- *Protocol Independent Multicast (PIM), Dense Mode Protocol Specification*
- *Protocol Independent Multicast (PIM), Sparse Mode Protocol Specification*
- *draft-ietf-idmr-igmp-v2-06.txt, Internet Group Management Protocol, Version 2*
- *draft-ietf-pim-v2-dm-03.txt, PIM Version 2 Dense Mode*

PIM Versions

PIMv2 includes these improvements over PIMv1:

- A single, active rendezvous point (RP) exists per multicast group, with multiple backup RPs. This single RP compares to multiple active RPs for the same group in PIMv1.
- A bootstrap router (BSR) provides a fault-tolerant, automated RP discovery and distribution function that enables routers and multilayer switches to dynamically learn the group-to-RP mappings.
- Sparse mode and dense mode are properties of a group, as opposed to an interface.

Note We strongly recommend using sparse-dense mode as opposed to either sparse mode or dense mode only.

- PIM join and prune messages have more flexible encoding for multiple address families.
- A more flexible hello packet format replaces the query packet to encode current and future capability options.
- Register messages sent to an RP specify whether they are sent by a border router or a designated router.
- PIM packets are no longer inside IGMP packets; they are standalone packets.

PIMv1 and PIMv2 Interoperability

To avoid misconfiguring multicast routing on your switch, review the information in this section.

The Cisco PIMv2 implementation provides interoperability and transition between Version 1 and Version 2, although there might be some minor problems.

You can upgrade to PIMv2 incrementally. PIM Versions 1 and 2 can be configured on different routers and multilayer switches within one network. Internally, all routers and multilayer switches on a shared media

network must run the same PIM version. Therefore, if a PIMv2 device detects a PIMv1 device, the Version 2 device downgrades itself to Version 1 until all Version 1 devices have been shut down or upgraded.

PIMv2 uses the BSR to discover and announce RP-set information for each group prefix to all the routers and multilayer switches in a PIM domain. PIMv1, together with the Auto-RP feature, can perform the same tasks as the PIMv2 BSR. However, Auto-RP is a standalone protocol, separate from PIMv1, and is a proprietary Cisco protocol. PIMv2 is a standards track protocol in the IETF.

Note We recommend that you use PIMv2. The BSR function interoperates with Auto-RP on Cisco routers and multilayer switches.

When PIMv2 devices interoperate with PIMv1 devices, Auto-RP should have already been deployed. A PIMv2 BSR that is also an Auto-RP mapping agent automatically advertises the RP elected by Auto-RP. That is, Auto-RP sets its single RP on every router or multilayer switch in the group. Not all routers and switches in the domain use the PIMv2 hash function to select multiple RPs.

Dense-mode groups in a mixed PIMv1 and PIMv2 region need no special configuration; they automatically interoperate.

Sparse-mode groups in a mixed PIMv1 and PIMv2 region are possible because the Auto-RP feature in PIMv1 interoperates with the PIMv2 RP feature. Although all PIMv2 devices can also use PIMv1, we recommend that the RPs be upgraded to PIMv2. To ease the transition to PIMv2, we recommend:

- Using Auto-RP throughout the region.
- Configuring sparse-dense mode throughout the region.

If Auto-RP is not already configured in the PIMv1 regions, configure Auto-RP.

PIM Modes

PIM can operate in dense mode (DM), sparse mode (SM), or in sparse-dense mode (PIM DM-SM), which handles both sparse groups and dense groups at the same time.

PIM DM

PIM DM builds source-based multicast distribution trees. In dense mode, a PIM DM router or multilayer switch assumes that all other routers or multilayer switches forward multicast packets for a group. If a PIM DM device receives a multicast packet and has no directly connected members or PIM neighbors present, a prune message is sent back to the source to stop unwanted multicast traffic. Subsequent multicast packets are not flooded to this router or switch on this pruned branch because branches without receivers are pruned from the distribution tree, leaving only branches that contain receivers.

When a new receiver on a previously pruned branch of the tree joins a multicast group, the PIM DM device detects the new receiver and immediately sends a graft message up the distribution tree toward the source. When the upstream PIM DM device receives the graft message, it immediately puts the interface on which the graft was received into the forwarding state so that the multicast traffic begins flowing to the receiver.

PIM-SM

PIM-SM uses shared trees and shortest-path-trees (SPTs) to distribute multicast traffic to multicast receivers in the network. In PIM-SM, a router or multilayer switch assumes that other routers or switches do not forward multicast packets for a group, unless there is an explicit request for the traffic (join message). When a host joins a multicast group using IGMP, its directly connected PIM-SM device sends PIM join messages toward the root, also known as the rendezvous point (RP). This join message travels router-by-router toward the root, constructing a branch of the shared tree as it goes.

The RP keeps track of multicast receivers. It also registers sources through register messages received from the source's first-hop router (designated router [DR]) to complete the shared tree path from the source to the receiver. When using a shared tree, sources must send their traffic to the RP so that the traffic reaches all receivers.

Prune messages are sent up the distribution tree to prune multicast group traffic. This action permits branches of the shared tree or SPT that were created with explicit join messages to be torn down when they are no longer needed.

When the number of PIM-enabled interfaces exceeds the hardware capacity and PIM-SM is enabled with the SPT threshold is set to **infinity**, the switch does not create (source, group (S, G)) entries in the multicast routing table for the some directly connected interfaces if they are not already in the table. The switch might not correctly forward traffic from these interfaces.

PIM Stub Routing

The PIM stub routing feature, available in all software images, reduces resource usage by moving routed traffic closer to the end user.

Note The IP Base image contains only PIM stub routing. The IP Services image contains complete multicast routing. On a switch running the IP Base image, if you try to configure a VLAN interface with PIM dense-mode, sparse-mode, or dense-sparse-mode, the configuration is not allowed.

In a network using PIM stub routing, the only allowable route for IP traffic to the user is through a switch that is configured with PIM stub routing. PIM passive interfaces are connected to Layer 2 access domains, such as VLANs, or to interfaces that are connected to other Layer 2 devices. Only directly connected multicast (IGMP) receivers and sources are allowed in the Layer 2 access domains. The PIM passive interfaces do not send or process any received PIM control packets.

When using PIM stub routing, you should configure the distribution and remote routers to use IP multicast routing and configure only the switch as a PIM stub router. The switch does not route transit traffic between distribution routers. You also need to configure a routed uplink port on the switch. The switch uplink port cannot be used with SVIs. If you need PIM for an SVI uplink port, you should upgrade to the IP services feature set.

Note You must also configure EIGRP stub routing when configuring PIM stub routing on the switch.

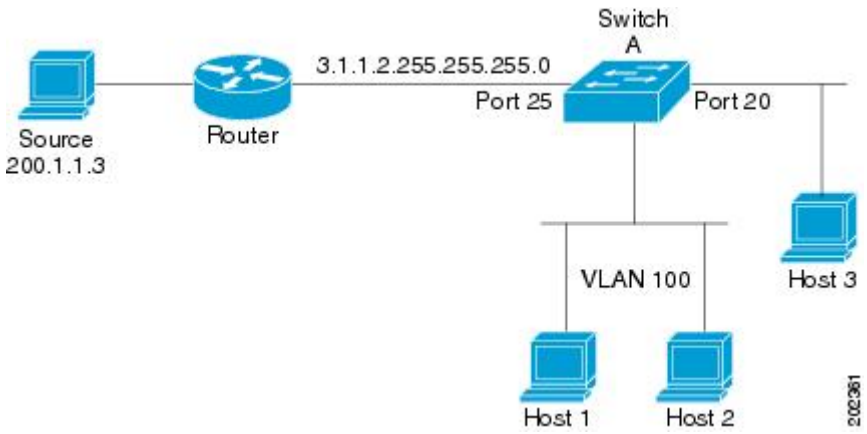
The redundant PIM stub router topology is not supported. The redundant topology exists when there is more than one PIM router forwarding multicast traffic to a single access domain. PIM messages are blocked, and the PIM asset and designated router election mechanisms are not supported on the PIM passive interfaces.

Only the nonredundant access router topology is supported by the PIM stub feature. By using a nonredundant topology, the PIM passive interface assumes that it is the only interface and designated router on that access domain.

The PIM stub feature is enforced in the IP Base image. If you upgrade to a higher software version, the PIM stub configuration remains until you reconfigure the interfaces.

In the following figure, the Switch A routed uplink port 25 is connected to the router and PIM stub routing is enabled on the VLAN 100 interfaces and on Host 3. This configuration allows the directly connected hosts to receive traffic from multicast source 200.1.1.3.

Figure 2: PIM Stub Router Configuration



Related Topics

Enabling PIM Stub Routing, on page 45
Example: Enabling PIM Stub Routing, on page 71
Example: Verifying PIM Stub Routing, on page 71

IGMP Helper

PIM stub routing moves routed traffic closer to the end user and reduces network traffic. You can also reduce traffic by configuring a stub router (switch) with the IGMP helper feature.

You can configure a stub router (switch) with the **igmp helper help-address** interface configuration command to enable the switch to send reports to the next-hop interface. Hosts that are not directly connected to a downstream router can then join a multicast group sourced from an upstream network. The IGMP packets from a host wanting to join a multicast stream are forwarded upstream to the next-hop device when this feature is configured. When the upstream central router receives the helper IGMP reports or leaves, it adds or removes the interfaces from its outgoing interface list for that group.

Auto-RP

The PIM-SM protocols require the presence of a rendezvous point (RP) in the network. An RP acts as the meeting place for sources and receivers of multicast data. If a static RP configuration is used, then the

configuration needs to be applied on all the routers in the multicast network. To automate this process, the Auto-RP protocol was devised.

This Cisco proprietary feature eliminates the need to manually configure the RP information in every router and multilayer switch in the network. For Auto-RP to work, you configure a Cisco router or multilayer switch as the mapping agent. It uses IP multicast to learn which routers or switches in the network are possible candidate RPs to receive candidate RP announcements. Candidate RPs periodically send multicast RP-announce messages to a particular group or group range to announce their availability.

Mapping agents listen to these candidate RP announcements and use the information to create entries in their group-to-RP mapping caches. Only one mapping cache entry is created for any group-to-RP range received, even if multiple candidate RPs are sending RP announcements for the same range. As the RP-announce messages arrive, the mapping agent selects the router or switch with the highest IP address as the active RP and stores this RP address in the group-to-RP mapping cache.

Mapping agents periodically multicast the contents of their group-to-RP mapping caches. Thus, all routers and switches automatically discover which RP to use for the groups that they support. If a router or switch fails to receive RP-discovery messages and the group-to-RP mapping information expires, it changes to a statically configured RP that was defined with the **ip pim rp-address** global configuration command. If no statically configured RP exists, the router or switch changes the group to dense-mode operation.

Multiple RPs serve different group ranges or serve as hot backups of each other.

Related Topics

Setting Up Auto-RP in a New Internetwork, on page 50

Adding Auto-RP to an Existing Sparse-Mode Cloud, on page 52

Example: Configuring Auto-RP, on page 72

Example: Defining the IP Multicast Boundary to Deny Auto-RP Information, on page 72

Example: Filtering Incoming RP Announcement Messages, on page 72

Auto-RP Benefits

Auto-RP uses IP multicast to automate the distribution of group-to-RP mappings to all Cisco routers and multilayer switches in a PIM network. Auto-RP has these benefits:

- Easy to use multiple RPs within a network to serve different group ranges.
- Provides load splitting among different RPs and arrangement of RPs according to the location of group participants.
- Avoids inconsistent, manual RP configurations on every router and multilayer switch in a PIM network, which can cause connectivity problems.

Follow these guidelines when configuring Auto-RP:

- If you configure PIM in sparse mode or sparse-dense mode and do not configure Auto-RP, you must manually configure an RP.
- If routed interfaces are configured in sparse mode, Auto-RP can still be used if all devices are configured with a manual RP address for the Auto-RP groups.
- If routed interfaces are configured in sparse mode and you enter the **ip pim autorp listener** global configuration command, Auto-RP can still be used even if all devices are not configured with a manual RP address for the Auto-RP groups.

PIM v2 BSR

PIMv2 BSR (Bootstrap Router) is another method to distribute group-to-RP mapping information to all PIM routers and multilayer switches in the network. It eliminates the need to manually configure RP information in every router and switch in the network. However, instead of using IP multicast to distribute group-to-RP mapping information, BSR uses hop-by-hop flooding of special BSR messages to distribute the mapping information.

The BSR is elected from a set of candidate routers and switches in the domain that have been configured to function as BSRs. The election mechanism is similar to the root-bridge election mechanism used in bridged LANs. The BSR election is based on the BSR priority of the device contained in the BSR messages that are sent hop-by-hop through the network. Each BSR device examines the message and forwards out all interfaces only the message that has either a higher BSR priority than its BSR priority or the same BSR priority, but with a higher BSR IP address. Using this method, the BSR is elected.

The elected BSR sends BSR messages with a TTL of 1. Neighboring PIMv2 routers or multilayer switches receive the BSR message and multicast it out all other interfaces (except the one on which it was received) with a TTL of 1. In this way, BSR messages travel hop-by-hop throughout the PIM domain. Because BSR messages contain the IP address of the current BSR, the flooding mechanism enables candidate RPs to automatically learn which device is the elected BSR.

Candidate RPs send candidate RP advertisements showing the group range for which they are responsible to the BSR, which stores this information in its local candidate-RP cache. The BSR periodically advertises the contents of this cache in BSR messages to all other PIM devices in the domain. These messages travel hop-by-hop through the network to all routers and switches, which store the RP information in the BSR message in their local RP cache. The routers and switches select the same RP for a given group because they all use a common RP hashing algorithm.

Related Topics

Configuring Candidate BSRs, on page 61

Example: Configuring Candidate BSRs, on page 73

Multicast Forwarding and Reverse Path Check

With unicast routing, routers and multilayer switches forward traffic through the network along a single path from the source to the destination host whose IP address appears in the destination address field of the IP packet. Each router and switch along the way makes a unicast forwarding decision, using the destination IP address in the packet, by looking up the destination address in the unicast routing table and forwarding the packet through the specified interface to the next hop toward the destination.

With multicasting, the source is sending traffic to an arbitrary group of hosts represented by a multicast group address in the destination address field of the IP packet. To decide whether to forward or drop an incoming multicast packet, the router or multilayer switch uses a reverse path forwarding (RPF) check on the packet as follows:

1. The router or multilayer switch examines the source address of the arriving multicast packet to decide whether the packet arrived on an interface that is on the reverse path back to the source.
2. If the packet arrives on the interface leading back to the source, the RPF check is successful and the packet is forwarded to all interfaces in the outgoing interface list (which might not be all interfaces on the router).
3. If the RPF check fails, the packet is discarded.

Some multicast routing protocols, such as DVMRP, maintain a separate multicast routing table and use it for the RPF check. However, PIM uses the unicast routing table to perform the RPF check.

The following figure shows port 2 receiving a multicast packet from source 151.10.3.21. The following table shows that the port on the reverse path to the source is port 1, not port 2. Because the RPF check fails, the multilayer switch discards the packet. Another multicast packet from source 151.10.3.21 is received on port 1, and the routing table shows this port is on the reverse path to the source. Because the RPF check passes, the switch forwards the packet to all port in the outgoing port list

Figure 3: RPF Check

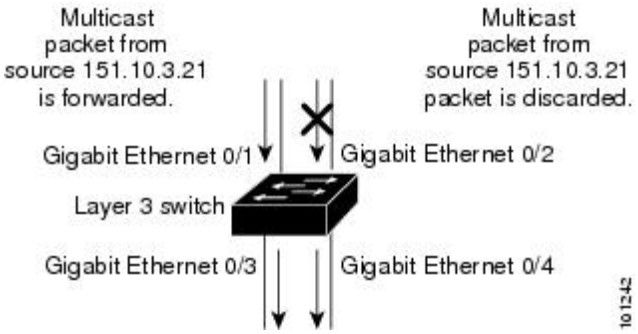


Table 6: Routing Table Example for an RPF Check

Network	Port
151.10.0.0/16	Gigabit Ethernet 1/0/1
198.14.32.0/32	Gigabit Ethernet 1/0/3
204.1.16.0/24	Gigabit Ethernet 1/0/4

PIM uses both source trees and RP-rooted shared trees to forward datagrams. The RPF check is performed differently for each:

- If a PIM router or multilayer switch has a source-tree state (that is, an (S, G) entry is present in the multicast routing table), it performs the RPF check against the IP address of the source of the multicast packet.
- If a PIM router or multilayer switch has a shared-tree state (and no explicit source-tree state), it performs the RPF check on the RP address (which is known when members join the group).

Sparse-mode PIM uses the RPF lookup function to decide where it needs to send joins and prunes:

- (S, G) joins (which are source-tree states) are sent toward the source.
- (*,G) joins (which are shared-tree states) are sent toward the RP.

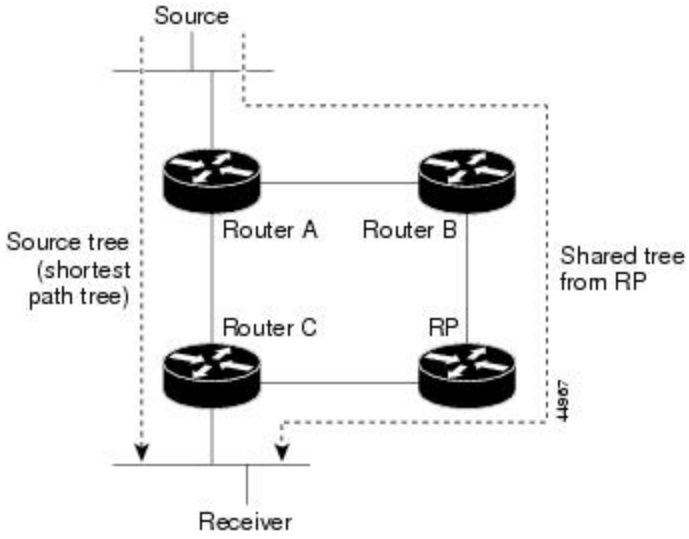
Note DVMRP is not supported on the switch.

PIM Shared Tree and Source Tree

By default, members of a group receive data from senders to the group across a single data-distribution tree rooted at the RP.

The following figure shows this type of shared-distribution tree. Data from senders is delivered to the RP for distribution to group members joined to the shared tree.

Figure 4: Shared Tree and Source Tree (Shortest-Path Tree)



If the data rate warrants, leaf routers (routers without any downstream connections) on the shared tree can use the data distribution tree rooted at the source. This type of distribution tree is called a shortest-path tree or source tree. By default, the software switches to a source tree upon receiving the first data packet from a source.

This process describes the move from a shared tree to a source tree:

1. A receiver joins a group; leaf Router C sends a join message toward the RP.
2. The RP puts a link to Router C in its outgoing interface list.
3. A source sends data; Router A encapsulates the data in a register message and sends it to the RP.
4. The RP forwards the data down the shared tree to Router C and sends a join message toward the source. At this point, data might arrive twice at Router C, once encapsulated and once natively.
5. When data arrives natively (unencapsulated) at the RP, it sends a register-stop message to Router A.
6. By default, reception of the first data packet prompts Router C to send a join message toward the source.
7. When Router C receives data on (S, G), it sends a prune message for the source up the shared tree.
8. The RP deletes the link to Router C from the outgoing interface of (S, G). The RP triggers a prune message toward the source.

Join and prune messages are sent for sources and RPs. They are sent hop-by-hop and are processed by each PIM device along the path to the source or RP. Register and register-stop messages are not sent hop-by-hop.

They are sent by the designated router that is directly connected to a source and are received by the RP for the group.

Multiple sources sending to groups use the shared tree.

You can configure the PIM device to stay on the shared tree. You can configure the PIM device to stay on the shared tree. For more information, see Delaying the Use of PIM Shortest-Path Tree, on page 66.

Related Topics

Delaying the Use of PIM Shortest-Path Tree, on page 66

Default PIM Routing Configuration

This table displays the default PIM routing configuration for the switch.

Table 7: Default Multicast Routing Configuration

Feature	Default Setting
Multicast routing	Disabled on all interfaces.
PIM version	Version 2.
PIM mode	No mode is defined.
PIM stub routing	None configured.
PIM RP address	None configured.
PIM domain border	Disabled.
PIM multicast boundary	None.
Candidate BSRs	Disabled.
Candidate RPs	Disabled.
Shortest-path tree threshold rate	0 kb/s.
PIM router query message interval	30 seconds.

How to Configure PIM

Enabling PIM Stub Routing

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip pim passive**
4. **end**
5. **show ip pim interface**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface on which you want to enable PIM stub routing, and enters interface configuration mode.
Step 3	**ip pim passive** **Example:** `Switch(config-if)# ip pim passive`	Configures the PIM stub feature on the interface. **Note** To disable PIM stub routing on an interface, use the **no ip pim passive** interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip pim interface** **Example:** `Switch# show ip pim interface`	(Optional) Displays the PIM stub that is enabled on each interface.

	Command or Action	Purpose
Step 6	**show running-config** **Example:** `Switch# show running-config`	(Optional) Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

PIM Stub Routing, on page 39
Example: Enabling PIM Stub Routing, on page 71
Example: Verifying PIM Stub Routing, on page 71

Configuring a Rendezvous Point

You must have a rendezvous point (RP), if the interface is in sparse-dense mode and if you want to handle the group as a sparse group. You can use several methods, as described in these sections:

- Manual assignment

  For information about this procedure, see Manually Assigning an RP to Multicast Groups, on page 48

- As a standalone, Cisco-proprietary protocol separate from PIMv1

  For information about these procedures, see the following sections:

  - Setting Up Auto-RP in a New Internetwork, on page 50
  - Adding Auto-RP to an Existing Sparse-Mode Cloud, on page 52
  - Preventing Join Messages to False RPs, on page 55
  - Filtering Incoming RP Announcement Messages, on page 55

- Using a standards track protocol in the Internet Engineering Task Force (IETF)

  For information about this procedure, see Configuring PIMv2 BSR, on page 57

Note You can use Auto-RP, BSR, or a combination of both, depending on the PIM version that you are running and the types of routers in your network. For information about working with different PIM versions in your network, see PIMv1 and PIMv2 Interoperability, on page 37.

Manually Assigning an RP to Multicast Groups

If the rendezvous point (RP) for a group is learned through a dynamic mechanism (such as Auto-RP or BSR), you need not perform this task for that RP.

Senders of multicast traffic announce their existence through register messages received from the source first-hop router (designated router) and forwarded to the RP. Receivers of multicast packets use RPs to join a multicast group by using explicit join messages.

Note RPs are not members of the multicast group; they serve as a *meeting place* for multicast sources and group members.

You can configure a single RP for multiple groups defined by an access list. If there is no RP configured for a group, the multilayer switch responds to the group as dense and uses the dense-mode PIM techniques.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **ip pim rp-address** *ip-address* [*access-list-number*] [**override**]
3. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip pim rp-address** *ip-address* [*access-list-number*] [**override**] **Example:** `Switch(config)# ip pim rp-address`	Configures the address of a PIM RP. By default, no PIM RP address is configured. You must configure the IP address of RPs on all routers and multilayer switches (including the RP). **Note** If there is no RP configured for a group, the switch treats the group as dense, using the dense-mode PIM techniques.

	Command or Action	Purpose
	`10.1.1.1 20 override`	A PIM device can be an RP for more than one group. Only one RP address can be used at a time within a PIM domain. The access list conditions specify for which groups the device is an RP. • For *ip-address*, enter the unicast address of the RP in dotted-decimal notation. • (Optional) For *access-list-number*, enter an IP standard access list number from 1 to 99. If no access list is configured, the RP is used for all groups. • (Optional) The **override** keyword indicates that if there is a conflict between the RP configured with this command and one learned by Auto-RP or BSR, the RP configured with this command prevails. **Note** To remove an RP address, use the **no ip pim rp-address ip-address** [*access-list-number*] [**override**] global configuration command.
Step 3	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 25 permit 10.5.0.1 255.224.0.0`	Creates a standard access list, repeating the command as many times as necessary. • For *access-list-number*, enter the access list number specified in Step 2. • The **deny** keyword denies access if the conditions are matched. • The **permit** keyword permits access if the conditions are matched. • For *source*, enter the multicast group address for which the RP should be used. • (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. The access list is always terminated by an implicit deny statement for everything.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Setting Up Auto-RP in a New Internetwork

If you are setting up Auto-RP in a new internetwork, you do not need a default RP because you configure all the interfaces for sparse-dense mode.

Note Omit Step 3 in the following procedure, if you want to configure a PIM router as the RP for the local group.

SUMMARY STEPS

1. **show running-config**
2. **configure terminal**
3. **ip pim send-rp-announce** *interface-id* **scope** *ttl* **group-list** *access-list-number* **interval** *seconds*
4. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
5. **ip pim send-rp-discovery scope** *ttl*
6. **end**
7. **show running-config**
8. **show ip pim rp mapping**
9. **show ip pim rp**
10. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show running-config** **Example:** `Switch# show running-config`	Verifies that a default RP is already configured on all PIM devices and the RP in the sparse-mode network. It was previously configured with the **ip pim rp-address** global configuration command. **Note** This step is not required for spare-dense-mode environments. The selected RP should have good connectivity and be available across the network. Use this RP for the global groups (for example, 224.x.x.x and other global groups). Do not reconfigure the group address range that this RP serves. RPs dynamically discovered through Auto-RP take precedence over statically configured RPs. Assume that it is desirable to use a second RP for the local groups.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 3	**ip pim send-rp-announce** *interface-id* **scope** *ttl* **group-list** *access-list-number* **interval** *seconds* **Example:** `Switch(config)# ip pim send-rp-announce gigabitethernet 1/0/5 scope 20 group-list 10 interval 120`	Configures another PIM device to be the candidate RP for local groups. • For *interface-id*, enter the interface type and number that identifies the RP address. Valid interfaces include physical ports, port channels, and VLANs. • For **scope** *ttl*, specify the time-to-live value in hops. Enter a hop count that is high enough so that the RP-announce messages reach all mapping agents in the network. There is no default setting. The range is 1 to 255. • For **group-list** *access-list-number*, enter an IP standard access list number from 1 to 99. If no access list is configured, the RP is used for all groups. • For **interval** *seconds*, specify how often the announcement messages must be sent. The default is 60 seconds. The range is 1 to 16383.
Step 4	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 10 permit 10.10.0.0`	Creates a standard access list, repeating the command as many times as necessary. • For *access-list-number*, enter the access list number specified in Step 3. • The **deny** keyword denies access if the conditions are matched. • The **permit** keyword permits access if the conditions are matched. • For *source*, enter the multicast group address range for which the RP should be used. • (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. **Note** Recall that the access list is always terminated by an implicit deny statement for everything.
Step 5	**ip pim send-rp-discovery scope** *ttl* **Example:** `Switch(config)# ip pim send-rp-discovery scope 50`	Finds a switch whose connectivity is not likely to be interrupted, and assign it the role of RP-mapping agent. For **scope** *ttl*, specify the time-to-live value in hops to limit the RP discovery packets. All devices within the hop count from the source device receive the Auto-RP discovery messages. These messages tell other devices which group-to-RP mapping to use to avoid conflicts (such as overlapping group-to-RP ranges). There is no default setting. The range is 1 to 255.
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config**	Verifies your entries.

	Command or Action	Purpose
	Example: `Switch# show running-config`	
Step 8	**show ip pim rp mapping** **Example:** `Switch# show ip pim rp mapping`	Displays active RPs that are cached with associated multicast routing entries.
Step 9	**show ip pim rp** **Example:** `Switch# show ip pim rp`	Displays the information cached in the routing table.
Step 10	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Auto-RP, on page 40
Example: Configuring Auto-RP, on page 72
Example: Defining the IP Multicast Boundary to Deny Auto-RP Information, on page 72
Example: Filtering Incoming RP Announcement Messages, on page 72

Adding Auto-RP to an Existing Sparse-Mode Cloud

This section contains suggestions for the initial deployment of Auto-RP into an existing sparse-mode cloud to minimize disruption of the existing multicast infrastructure.

This procedure is optional.

SUMMARY STEPS

1. **show running-config**
2. **configure terminal**
3. **ip pim send-rp-announce** *interface-id* **scope** *ttl* **group-list** *access-list-number* **interval** *seconds*
4. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
5. **ip pim send-rp-discovery scope** *ttl*
6. **end**
7. **show running-config**
8. **show ip pim rp mapping**
9. **show ip pim rp**
10. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show running-config** **Example:** `Switch# show running-config`	Verifies that a default RP is already configured on all PIM devices and the RP in the sparse-mode network. It was previously configured with the **ip pim rp-address** global configuration command. **Note** This step is not required for spare-dense-mode environments. The selected RP should have good connectivity and be available across the network. Use this RP for the global groups (for example, 224.x.x.x and other global groups). Do not reconfigure the group address range that this RP serves. RPs dynamically discovered through Auto-RP take precedence over statically configured RPs. Assume that it is desirable to use a second RP for the local groups.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 3	**ip pim send-rp-announce** *interface-id* **scope** *ttl* **group-list** *access-list-number* **interval** *seconds* **Example:** `Switch(config)# ip pim send-rp-announce gigabitethernet 1/0/5 scope 20 group-list 10 interval 120`	Configures another PIM device to be the candidate RP for local groups. • For *interface-id*, enter the interface type and number that identifies the RP address. Valid interfaces include physical ports, port channels, and VLANs. • For **scope** *ttl*, specify the time-to-live value in hops. Enter a hop count that is high enough so that the RP-announce messages reach all mapping agents in the network. There is no default setting. The range is 1 to 255. • For **group-list** *access-list-number*, enter an IP standard access list number from 1 to 99. If no access list is configured, the RP is used for all groups. • For **interval** *seconds*, specify how often the announcement messages must be sent. The default is 60 seconds. The range is 1 to 16383.

	Command or Action	Purpose
		Note To remove the PIM device configured as the candidate RP, use the **no ip pim send-rp-announce** interface-id global configuration command.
Step 4	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 10 permit 224.0.0.0 15.255.255.255`	Creates a standard access list, repeating the command as many times as necessary. • For *access-list-number*, enter the access list number specified in Step 3. • The **deny** keyword denies access if the conditions are matched. • The **permit** keyword permits access if the conditions are matched. • For *source*, enter the multicast group address range for which the RP should be used. • (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. Recall that the access list is always terminated by an implicit deny statement for everything.
Step 5	**ip pim send-rp-discovery scope** *ttl* **Example:** `Switch(config)# ip pim send-rp-discovery scope 50`	Finds a switch whose connectivity is not likely to be interrupted, and assigns it the role of RP-mapping agent. For **scope** *ttl*, specify the time-to-live value in hops to limit the RP discovery packets. All devices within the hop count from the source device receive the Auto-RP discovery messages. These messages tell other devices which group-to-RP mapping to use to avoid conflicts (such as overlapping group-to-RP ranges). There is no default setting. The range is 1 to 255. **Note** To remove the switch as the RP-mapping agent, use the **no ip pim send-rp-discovery** global configuration command.
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 8	**show ip pim rp mapping** **Example:** `Switch# show ip pim rp mapping`	Displays active RPs that are cached with associated multicast routing entries.
Step 9	**show ip pim rp**	Displays the information cached in the routing table.

	Command or Action	Purpose
	Example: `Switch# show ip pim rp`	
Step 10	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Auto-RP, on page 40
Example: Configuring Auto-RP, on page 72
Example: Defining the IP Multicast Boundary to Deny Auto-RP Information, on page 72
Example: Filtering Incoming RP Announcement Messages, on page 72

Preventing Join Messages to False RPs

Determine whether the **ip pim accept-rp** command was previously configured throughout the network by using the **show running-config** privileged EXEC command. If the **ip pim accept-rp** command is not configured on any device, this problem can be addressed later. In those routers or multilayer switches already configured with the **ip pim accept-rp** command, you must enter the command again to accept the newly advertised RP.

To accept all RPs advertised with Auto-RP and reject all other RPs by default, use the **ip pim accept-rp auto-rp** global configuration command.

If all interfaces are in sparse mode, use a default-configured RP to support the two well-known groups 224.0.1.39 and 224.0.1.40. Auto-RP uses these two well-known groups to collect and distribute RP-mapping information. When this is the case and the **ip pim accept-rp auto-rp** command is configured, another **ip pim accept-rp** command accepting the RP must be configured as follows:

```
Switch(config)# ip pim accept-rp 172.10.20.1 1
Switch(config)# access-list 1 permit 224.0.1.39
Switch(config)# access-list 1 permit 224.0.1.40
```

Related Topics

Example: Preventing Join Messages to False RPs, on page 73

Filtering Incoming RP Announcement Messages

You can add configuration commands to the mapping agents to prevent a maliciously configured router from masquerading as a candidate RP and causing problems.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **ip pim rp-announce-filter rp-list** *access-list-number* **group-list** *access-list-number*
3. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip pim rp-announce-filter rp-list** *access-list-number* **group-list** *access-list-number* **Example:** `Switch(config)# ip pim rp-announce-filter rp-list 10 group-list 14`	Filters incoming RP announcement messages. Enter this command on each mapping agent in the network. Without this command, all incoming RP-announce messages are accepted by default. For **rp-list** *access-list-number*, configure an access list of candidate RP addresses that, if permitted, is accepted for the group ranges supplied in the **group-list** *access-list-number* variable. If this variable is omitted, the filter applies to all multicast groups. If more than one mapping agent is used, the filters must be consistent across all mapping agents to ensure that no conflicts occur in the group-to-RP mapping information. **Note** To remove a filter on incoming RP announcement messages, use the **no ip pim rp-announce-filter rp-list** *access-list-number* [**group-list** *access-list-number*] global configuration command.
Step 3	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 10 permit 10.8.1.0 255.255.224.0`	Creates a standard access list, repeating the command as many times as necessary. • For *access-list-number*, enter the access list number specified in Step 2. • The **deny** keyword denies access if the conditions are matched. • The **permit** keyword permits access if the conditions are matched. • Create an access list that specifies from which routers and multilayer switches the mapping agent accepts candidate RP announcements (rp-list ACL). • Create an access list that specifies the range of multicast groups from which to accept or deny (group-list ACL).

	Command or Action	Purpose
		• For *source*, enter the multicast group address range for which the RP should be used. • (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. The access list is always terminated by an implicit deny statement for everything.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Example: Filtering Incoming RP Announcement Messages, on page 72

Configuring PIMv2 BSR

The process for configuring PIMv2 BSR may involve the following optional tasks:

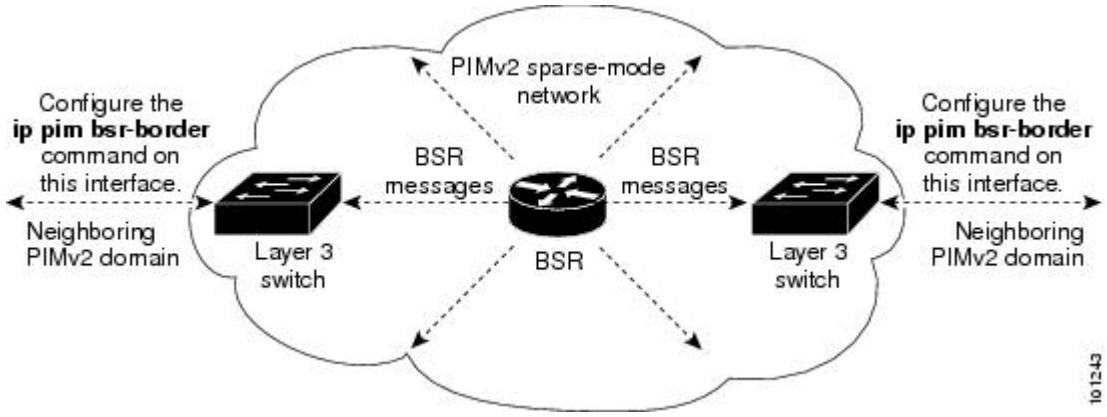
- Defining the PIM domain border
- Defining the IP multicast boundary
- Configuring candidate BSRs
- Configuring candidate RPs

Defining the PIM Domain Border

As IP multicast becomes more widespread, the chance of one PIMv2 domain bordering another PIMv2 domain increases. Because two domains probably do not share the same set of RPs, BSR, candidate RPs, and candidate BSRs, you need to constrain PIMv2 BSR messages from flowing into or out of the domain. Allowing messages to leak across the domain borders could adversely affect the normal BSR election mechanism and elect a single BSR across all bordering domains and comingle candidate RP advertisements, resulting in the election of RPs in the wrong domain.

This figure displays how you can configure the PIM domain border by using the **ip pim bsr-border** command.

Figure 5: Constraining PIMv2 BSR Messages



This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip pim bsr-border**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be configured, and enters interface configuration mode.
Step 3	**ip pim bsr-border** **Example:** `Switch(config-if)# ip pim bsr-border`	Defines a PIM bootstrap message boundary for the PIM domain. Enter this command on each interface that connects to other bordering PIM domains. This command instructs the switch to neither send nor receive PIMv2 BSR messages on this interface. **Note** To remove the PIM border, use the **no ip pim bsr-border** interface configuration command.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Defining the IP Multicast Boundary

You define a multicast boundary to prevent Auto-RP messages from entering the PIM domain. You create an access list to deny packets destined for 224.0.1.39 and 224.0.1.40, which carry Auto-RP information.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **access-list** *access-list-number* **deny** *source* [*source-wildcard*]
3. **interface** *interface-id*
4. **ip multicast boundary** *access-list-number*
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

Step 2	**access-list** *access-list-number* **deny** *source* [*source-wildcard*]
	
	Example:
	`Switch(config)#`
	`access-list 12 deny 224.0.1.39`
	`access-list 12 deny 224.0.1.40`
		Creates a standard access list, repeating the command as many times as necessary.
		• For *access-list-number*, the range is 1 to 99.
		• The **deny** keyword denies access if the conditions are matched.
		• For *source*, enter multicast addresses 224.0.1.39 and 224.0.1.40, which carry Auto-RP information.
		• (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore.
		
		The access list is always terminated by an implicit deny statement for everything.

Step 3	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be configured, and enters interface configuration mode.
Step 4	**ip multicast boundary** *access-list-number* **Example:** `Switch(config-if)# ip multicast boundary 12`	Configures the boundary, specifying the access list you created in Step 2. **Note** To remove the boundary, use the **no ip multicast boundary** interface configuration command.

	Command or Action	Purpose
Step 5	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Candidate BSRs

You can configure one or more candidate BSRs. The devices serving as candidate BSRs should have good connectivity to other devices and be in the backbone portion of the network.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **ip pim bsr-candidate** *interface-id hash-mask-length* [*priority*]
3. **end**
4. **show running-config**
5. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.

	Command or Action	Purpose
Step 2	**ip pim bsr-candidate** *interface-id hash-mask-length* [*priority*] **Example:** `Switch(config)# ip pim bsr-candidate gigabitethernet 1/0/3 28 100`	Configures your switch to be a candidate BSR. • For *interface-id*, enter the interface on this switch from which the BSR address is derived to make it a candidate. This interface must be enabled with PIM. Valid interfaces include physical ports, port channels, and VLANs. • For *hash-mask-length*, specify the mask length (32 bits maximum) that is to be ANDed with the group address before the hash function is called. All groups with the same seed hash correspond to the same RP. For example, if this value is 24, only the first 24 bits of the group addresses matter. • (Optional) For *priority*, enter a number from 0 to 255. The BSR with the larger priority is preferred. If the priority values are the same, the device with the highest IP address is selected as the BSR. The default is 0. **Note** To remove this device as a candidate BSR, use the **no ip pim bsr-candidate** global configuration command.
Step 3	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 4	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 5	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

PIM v2 BSR, on page 42
Example: Configuring Candidate BSRs, on page 73

Configuring the Candidate RPs

You can configure one or more candidate RPs. Similar to BSRs, the RPs should also have good connectivity to other devices and be in the backbone portion of the network. An RP can serve the entire IP multicast address space or a portion of it. Candidate RPs send candidate RP advertisements to the BSR. When deciding which devices should be RPs, consider these options:

- In a network of Cisco routers and multilayer switches where only Auto-RP is used, any device can be configured as an RP.
- In a network that includes only Cisco PIMv2 routers and multilayer switches and with routers from other vendors, any device can be used as an RP.
- In a network of Cisco PIMv1 routers, Cisco PIMv2 routers, and routers from other vendors, configure only Cisco PIMv2 routers and multilayer switches as RPs.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **ip pim rp-candidate** *interface-id* [**group-list** *access-list-number*]
3. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip pim rp-candidate** *interface-id* [**group-list** *access-list-number*] **Example:** `Switch(config)# ip pim rp-candidate gigabitethernet 1/0/5 group-list 10`	Configures your switch to be a candidate RP. • For *interface-id*, specify the interface whose associated IP address is advertised as a candidate RP address. Valid interfaces include physical ports, port channels, and VLANs. • (Optional) For **group-list** *access-list-number*, enter an IP standard access list number from 1 to 99. If no group-list is specified, the switch is a candidate RP for all groups. **Note** To remove this device as a candidate RP, use the **no ip pim rp-candidate** interface-id global configuration command.

	Command or Action	Purpose
Step 3	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 10 permit 239.0.0.0 0.255.255.255`	Creates a standard access list, repeating the command as many times as necessary. • For *access-list-number*, enter the access list number specified in Step 2. • The **deny** keyword denies access if the conditions are matched. The **permit** keyword permits access if the conditions are matched. • For *source*, enter the number of the network or host from which the packet is being sent. • (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. The access list is always terminated by an implicit deny statement for everything.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file

Related Topics

Example: Configuring Candidate RPs, on page 74

Configuring Auto-RP and BSR for the Network

If there are only Cisco devices in your network (no routers from other vendors), there is no need to configure a BSR. Configure Auto-RP in a network that is running both PIMv1 and PIMv2.

If you have non-Cisco PIMv2 routers that need to interoperate with Cisco PIMv1 routers and multilayer switches, both Auto-RP and a BSR are required. We recommend that a Cisco PIMv2 router or multilayer switch be both the Auto-RP mapping agent and the BSR.

If you must have one or more BSRs, we have these recommendations:

- Configure the candidate BSRs as the RP-mapping agents for Auto-RP. For information about these procedures, see:
  - Configuring a Rendezvous Point, on page 47
  - Configuring Candidate BSRs, on page 61
- For group prefixes advertised through Auto-RP, the PIMv2 BSR mechanism should not advertise a subrange of these group prefixes served by a different set of RPs. In a mixed PIMv1 and PIMv2 domain, backup RPs should serve the same group prefixes. This prevents the PIMv2 DRs from selecting a different RP from those PIMv1 DRs, due to the longest match lookup in the RP-mapping database.

Before You Begin

Beginning in privileged EXEC mode, follow these steps to verify the consistency of group-to-RP mappings. This procedure is optional.

SUMMARY STEPS

1. **show ip pim rp** [*hostname* or *IP address* | **mapping** [*hostname* or *IP address* | **elected** | **in-use**] | **metric** [*hostname* or *IP address*]]
2. **show ip pim rp-hash** *group*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**show ip pim rp** [*hostname* or *IP address* | **mapping** [*hostname* or *IP address* | **elected** | **in-use**] | **metric** [*hostname* or *IP address*]] **Example:** `Switch# show ip pim rp mapping`	On any Cisco device, displays available RP mappings and metrics: • (Optional) For the *hostname*, specify the IP name of the group about which to display RPs. • (Optional) For the *IP address*, specify the IP address of the group about which to display RPs. • (Optional) Use the **mapping** keyword to display all group-to-RP mappings of which the Cisco device is aware (either configured or learned from Auto-RP). • (Optional) Use the **metric** keyword to display the RP RPF metric.
Step 2	**show ip pim rp-hash** *group* **Example:** `Switch# show ip pim rp-hash 239.1.1.1`	On a PIMv2 router or multilayer switch, confirms that the same RP is the one that a PIMv1 system chooses. For *group*, enter the group address for which to display RP information.

Delaying the Use of PIM Shortest-Path Tree

The change from shared to source tree happens when the first data packet arrives at the last-hop router. This change occurs because the **ip pim spt-threshold** global configuration command controls that timing.

The shortest-path tree requires more memory than the shared tree but reduces delay. You might want to postpone its use. Instead of allowing the leaf router to immediately move to the shortest-path tree, you can specify that the traffic must first reach a threshold.

You can configure when a PIM leaf router should join the shortest-path tree for a specified group. If a source sends at a rate greater than or equal to the specified kbps rate, the multilayer switch triggers a PIM join message toward the source to construct a source tree (shortest-path tree). If the traffic rate from the source drops below the threshold value, the leaf router switches back to the shared tree and sends a prune message toward the source.

You can specify to which groups the shortest-path tree threshold applies by using a group list (a standard access list). If a value of 0 is specified or if the group list is not used, the threshold applies to all groups.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
3. **ip pim spt-threshold** {*kbps* | **infinity**} [**group-list** *access-list-number*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 2	**access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*] **Example:** `Switch(config)# access-list 16 permit 225.0.0.0 0.255.255.255`	Creates a standard access list. • For *access-list-number*, the range is 1 to 99. • The **deny** keyword denies access if the conditions are matched. • The **permit** keyword permits access if the conditions are matched. • For *source*, specify the multicast group to which the threshold will apply.

	Command or Action	Purpose
		• (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. The access list is always terminated by an implicit deny statement for everything.
Step 3	**ip pim spt-threshold** {*kbps* | **infinity**} [**group-list** *access-list-number*] **Example:** `Switch(config)# ip pim spt-threshold infinity group-list 16`	Specifies the threshold that must be reached before moving to shortest-path tree (spt). • For *kbps*, specify the traffic rate in kilobits per second. The default is 0 kbps. **Note** Because of switch hardware limitations, 0 kbps is the only valid entry even though the range is 0 to 4294967. • Specify **infinity** if you want all sources for the specified group to use the shared tree, never switching to the source tree. • (Optional) For **group-list** *access-list-number*, specify the access list created in Step 2. If the value is 0 or if the group list is not used, the threshold applies to all groups. **Note** To return to the default setting, use the **no ip pim spt-threshold** {**kbps** | **infinity**} global configuration command.
Step 4	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

PIM Shared Tree and Source Tree, on page 44

Modifying the PIM Router-Query Message Interval

PIM routers and multilayer switches send PIM router-query messages to find which device will be the designated router (DR) for each LAN segment (subnet). The DR is responsible for sending IGMP host-query messages to all hosts on the directly connected LAN.

With PIM DM operation, the DR has meaning only if IGMPv1 is in use. IGMPv1 does not have an IGMP querier election process, so the elected DR functions as the IGMP querier. With PIM-SM operation, the DR is the device that is directly connected to the multicast source. It sends PIM register messages to notify the RP that multicast traffic from a source needs to be forwarded down the shared tree. In this case, the DR is the device with the highest IP address.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip pim query-interval** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be configured, and enters interface configuration mode.
Step 3	**ip pim query-interval** *seconds* **Example:** `Switch(config-if)# ip pim query-interval 45`	Configures the frequency at which the switch sends PIM router-query messages. The default is 30 seconds. The range is 1 to 65535. **Note** To return to the default setting, use the **no ip pim query-interval** [**seconds**] interface configuration command.

	Command or Action	Purpose
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show ip igmp interface** [*interface-id*] **Example:** `Switch# show ip igmp interface`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Monitoring PIM

Use the privileged EXEC commands in the following table to monitor your PIM configurations.

Table 8: PIM Monitoring Commands

Command	Purpose
show ip pim all-vrfs tunnel [**tunnel** *tunnel_number* | **verbose**]	Displays all VRFs.
show ip pim autorp	Displays global auto-RP information.
show ip pim boundary	Displays information about mroutes filtered by administratively scoped IPv4 multicast boundaries configured on an interface.
show ip pim interface	Displays information about interfaces configured for Protocol Independent Multicast (PIM).
show ip pim mdt [**bgp**]	Displays details about the Border Gateway Protocol (BGP) advertisement of the route distinguisher (RD) for the multicast distribution tree (MDT) default group.
show ip pim neighbor	Displays the PIM neighbor information.

Command	Purpose
show ip pim tunnel [**tunnel** | **verbose**]	Displays information about Protocol Independent Multicast (PIM) tunnel interfaces
show ip pim vrf { **word** { **all-vrfs** | **autorp** | **boundary** | **bsr-router** | **interface** | **mdt** | **neighbor** | **rp** | **rp-hash** | **tunnel** } }	Displays the VPN routing/forwarding instance.
show ip igmp groups detail	Displays the interested clients that have joined the specific multicast source group.
show ip igmp snooping mroute	Verifies that the multicast stream forwards from the source to the interested clients.

Monitoring RP Mapping

Use the privileged EXEC commands in the following table to monitor RP mapping.

Table 9: RP Mapping Monitoring Commands

Command	Purpose
show ip pim bsr	Displays information about the elected BSR.
show ip pim bsr-router	Displays information about the BSRv2.
show ip pim rp [*hostname* or *IP address* | **mapping** [*hostname* or *IP address* | **elected** [*hostname* or *IP address*] | **in-use** [*hostname* or *IP address*]] | **metric** [*hostname* or *IP address*]]	Displays how the switch learns of the RP (through the BSR or the Auto-RP mechanism).
show ip pim rp-hash *hostname* or *IP group address*	Displays the RP that was selected for the specified group.

Troubleshooting PIMv1 and PIMv2 Interoperability Problems

When debugging interoperability problems between PIMv1 and PIMv2, check these in the order shown:

1. Verify RP mapping with the **show ip pim rp-hash** privileged EXEC command, making sure that all systems agree on the same RP for the same group.
2. Verify interoperability between different versions of DRs and RPs. Make sure that the RPs are interacting with the DRs properly (by responding with register-stops and forwarding decapsulated data packets from registers).

Configuration Examples for PIM

Example: Enabling PIM Stub Routing

In this example, IP multicast routing is enabled, Switch A PIM uplink port 25 is configured as a routed uplink port with **spare-dense-mode** enabled. PIM stub routing is enabled on the VLAN 100 interfaces and on Gigabit Ethernet port 20.

```
Switch(config)# ip multicast-routing distributed
Switch(config)# interface GigabitEthernet3/0/25
Switch(config-if)# no switchport
Switch(config-if)# ip address 3.1.1.2 255.255.255.0
Switch(config-if)# ip pim sparse-dense-mode
Switch(config-if)# exit
Switch(config)# interface vlan100
Switch(config-if)# ip pim passive
Switch(config-if)# exit
Switch(config)# interface GigabitEthernet3/0/20
Switch(config-if)# ip pim passive
Switch(config-if)# exit
Switch(config)# interface vlan100
Switch(config-if)# ip address 100.1.1.1 255.255.255.0
Switch(config-if)# ip pim passive
Switch(config-if)# exit
Switch(config)# interface GigabitEthernet3/0/20
Switch(config-if)# no switchport
Switch(config-if)# ip address 10.1.1.1 255.255.255.0
Switch(config-if)# ip pim passive
Switch(config-if)# end
```

Related Topics

Enabling PIM Stub Routing, on page 45

PIM Stub Routing, on page 39

Example: Verifying PIM Stub Routing

To verify that PIM stub is enabled for each interface, use the **show ip pim interface** privileged EXEC command:

```
Switch# show ip pim interface
Address Interface Ver/ Nbr Query DR DR
Mode Count Intvl Prior
3.1.1.2 GigabitEthernet3/0/25 v2/SD 1 30 1 3.1.1.2
100.1.1.1 Vlan100 v2/P 0 30 1 100.1.1.1
10.1.1.1 GigabitEthernet3/0/20 v2/P 0 30 1 10.1.1.1
```

Related Topics

Enabling PIM Stub Routing, on page 45

PIM Stub Routing, on page 39

Example: Manually Assigning an RP to Multicast Groups

This example shows how to configure the address of the RP to 147.106.6.22 for multicast group 225.2.2.2 only:

```
Switch(config)# access-list 1 permit 225.2.2.2 0.0.0.0
Switch(config)# ip pim rp-address 147.106.6.22 1
```

Example: Configuring Auto-RP

This example shows how to send RP announcements out all PIM-enabled interfaces for a maximum of 31 hops. The IP address of port 1 is the RP. Access list 5 describes the group for which this switch serves as RP:

```
Switch(config)# ip pim send-rp-announce gigabitethernet1/0/1 scope 31 group-list 5
Switch(config)# access-list 5 permit 224.0.0.0 15.255.255.255
```

Related Topics

Setting Up Auto-RP in a New Internetwork, on page 50
Adding Auto-RP to an Existing Sparse-Mode Cloud, on page 52
Auto-RP, on page 40

Example: Defining the IP Multicast Boundary to Deny Auto-RP Information

This example shows a portion of an IP multicast boundary configuration that denies Auto-RP information:

```
Switch(config)# access-list 1 deny 224.0.1.39
Switch(config)# access-list 1 deny 224.0.1.40
Switch(config)# access-list 1 permit all
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# ip multicast boundary 1
```

Related Topics

Setting Up Auto-RP in a New Internetwork, on page 50
Adding Auto-RP to an Existing Sparse-Mode Cloud, on page 52
Auto-RP, on page 40

Example: Filtering Incoming RP Announcement Messages

This example shows a sample configuration on an Auto-RP mapping agent that is used to prevent candidate RP announcements from being accepted from unauthorized candidate RPs:

```
Switch(config)# ip pim rp-announce-filter rp-list 10 group-list 20
Switch(config)# access-list 10 permit host 172.16.5.1
Switch(config)# access-list 10 permit host 172.16.2.1
Switch(config)# access-list 20 deny 239.0.0.0 0.0.255.255
```

```
Switch(config)# access-list 20 permit 224.0.0.0 15.255.255.255
```

The mapping agent accepts candidate RP announcements from only two devices, 172.16.5.1 and 172.16.2.1. The mapping agent accepts candidate RP announcements from these two devices only for multicast groups that fall in the group range of 224.0.0.0 to 239.255.255.255. The mapping agent does not accept candidate RP announcements from any other devices in the network. Furthermore, the mapping agent does not accept candidate RP announcements from 172.16.5.1 or 172.16.2.1 if the announcements are for any groups in the 239.0.0.0 through 239.255.255.255 range. This range is the administratively scoped address range.

Related Topics

Setting Up Auto-RP in a New Internetwork, on page 50
Adding Auto-RP to an Existing Sparse-Mode Cloud, on page 52
Auto-RP, on page 40
Filtering Incoming RP Announcement Messages, on page 55

Example: Preventing Join Messages to False RPs

If all interfaces are in sparse mode, use a default-configured RP to support the two well-known groups 224.0.1.39 and 224.0.1.40. Auto-RP uses these two well-known groups to collect and distribute RP-mapping information. When this is the case and the **ip pim accept-rp auto-rp** command is configured, another **ip pim accept-rp** command accepting the RP must be configured as follows:

```
Switch(config)# ip pim accept-rp 172.10.20.1 1
Switch(config)# access-list 1 permit 224.0.1.39
Switch(config)# access-list 1 permit 224.0.1.40
```

Related Topics

Preventing Join Messages to False RPs, on page 55

Example: Configuring Candidate BSRs

This example shows how to configure a candidate BSR, which uses the IP address 172.21.24.18 on a port as the advertised BSR address, uses 30 bits as the hash-mask-length, and has a priority of 10.

```
Switch(config)# interface gigabitethernet1/0/2
Switch(config-if)# ip address 172.21.24.18 255.255.255.0
Switch(config-if)# ip pim sparse-dense-mode
Switch(config-if)# ip pim bsr-candidate gigabitethernet1/0/2 30 10
```

Related Topics

Configuring Candidate BSRs, on page 61
PIM v2 BSR, on page 42

Example: Configuring Candidate RPs

This example shows how to configure the switch to advertise itself as a candidate RP to the BSR in its PIM domain. Standard access list number 4 specifies the group prefix associated with the RP that has the address identified by a port. That RP is responsible for the groups with the prefix 239.

```
Switch(config)# ip pim rp-candidate gigabitethernet1/0/2 group-list 4
Switch(config)# access-list 4 permit 239.0.0.0 0.255.255.255
```

Related Topics

Configuring the Candidate RPs, on page 63

Where to Go Next

You can configure the following for your IP multicast configuration:

- IGMP feature support
- SSM feature support
- IP Multicast Routing

Additional References

Related Documents

Related Topic	Document Title
PIM is defined in RFC 4601 and in these Internet Engineering Task Force (IETF) Internet drafts.	• *Protocol Independent Multicast (PIM): Motivation and Architecture* • *Protocol Independent Multicast (PIM), Dense Mode Protocol Specification* • *Protocol Independent Multicast (PIM), Sparse Mode Protocol Specification* • *draft-ietf-idmr-igmp-v2-06.txt, Internet Group Management Protocol, Version 2* • *draft-ietf-pim-v2-dm-03.txt, PIM Version 2 Dense Mode*
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-XR Switch IP Multicast Command Reference*

Standards and RFCs

Standard/RFC	Title
RFC 4601	*Protocol-Independent Multicast-Sparse Mode (PIM-SM): Protocol Specification*

MIBs

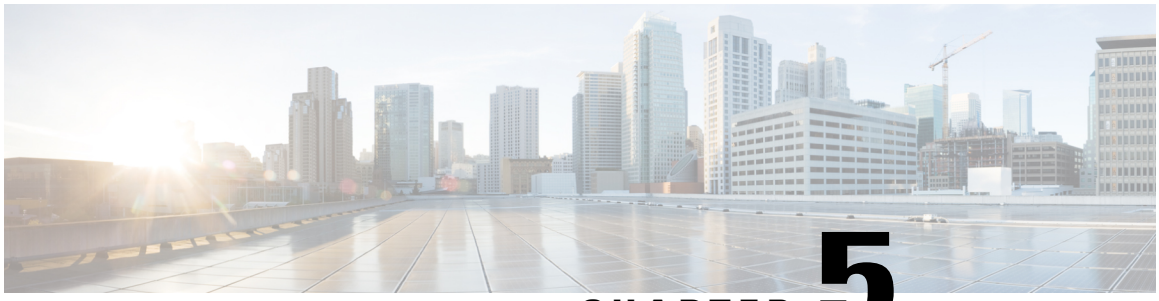
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for PIM

Release	Modification
Cisco IOS 15.0(2)EX1	This feature was introduced.



CHAPTER 5

Configuring SSM

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring SSM

The following are the prerequisites for configuring source-specific multicast (SSM) and SSM mapping:

- Before you configure SSM mapping, you must perform the following tasks:
  - Enable IP multicast routing. For information about this procedure, see Configuring Basic IP Multicast Routing
  - Enable PIM sparse mode. For information about this procedure, see How to Configure PIM, on page 45

- Configure SSM. For information about this procedure, see Configuring SSM, on page 82

- Before you configure static SSM mapping, you must configure access control lists (ACLs) that define the group ranges to be mapped to source addresses.
- Before you can configure and use SSM mapping with DNS look ups, you must be able to add records to a running DNS server. If you do not already have a DNS server running, you need to install one.

Note You can use a product such as *Cisco Network Registrar* to add records to a running DNS server.

Restrictions for Configuring SSM

The following are the restrictions for configuring SSM:

- To run SSM with IGMPv3, SSM must be supported in the Cisco IOS router, the host where the application is running, and the application itself.
- The SSM mapping feature does not have all the benefits of full SSM. Because SSM mapping takes a group join from a host and identifies this group with an application associated with one or more sources, it can only support one such application per group. Full SSM applications can still share the same group as in SSM mapping.
- Enable IGMPv3 carefully on the last hop router when you rely solely on SSM mapping as a transition solution for full SSM. When you enable both SSM mapping and IGMPv3 and the hosts already support IGMPv3 (but not SSM), the hosts send IGMPv3 group reports. SSM mapping does not support these IGMPv3 group reports, and the router does not correctly associate sources with these reports.
- Existing applications in a network predating SSM do not work within the SSM range unless they are modified to support (S, G) channel subscriptions. Therefore, enabling SSM in a network can cause problems for existing applications if they use addresses within the designated SSM range.
- IGMPv3 uses new membership report messages that might not be correctly recognized by older IGMP snooping switches.
- Address management is still necessary to some degree when SSM is used with Layer 2 switching mechanisms. Cisco Group Management Protocol (CGMP), IGMP snooping, or Router-Port Group Management Protocol (RGMP) support only group-specific filtering, not (S, G) channel-specific filtering. If different receivers in a switched network request different (S, G) channels sharing the same group, they do not benefit from these existing mechanisms. Instead, both receivers receive all (S, G) channel traffic and filter out the unwanted traffic on input.

  Because SSM can re-use the group addresses in the SSM range for many independent applications, this situation can lead to decreased traffic filtering in a switched network. For this reason, it is important to use random IP addresses from the SSM range for an application to minimize the chance for re-use of a single address within the SSM range between different applications. For example, an application service providing a set of television channels should, even with SSM, use a different group for each television (S, G) channel. This setup guarantees that multiple receivers to different channels within the same application service never experience traffic aliasing in networks that include Layer 2 switches.
- In PIM-SSM, the last hop router continues to periodically send (S, G) join messages if appropriate (S, G) subscriptions are on the interfaces. Therefore, as long as receivers send (S, G) subscriptions, the

shortest path tree (SPT) state from the receivers to the source is maintained, even if the source does not send traffic for longer periods of time (or even never).

The opposite situation occurs with PIM-SM, where (S, G) state is maintained only if the source is sending traffic and receivers are joining the group. If a source stops sending traffic for more than 3 minutes in PIM-SM, the (S, G) state is deleted and only reestablished after packets from the source arrive again through the RPT (rendezvous point tree). Because no mechanism in PIM-SSM notifies a receiver that a source is active, the network must maintain the (S, G) state in PIM-SSM as long as receivers are requesting receipt of that channel.

Information About SSM

The source-specific multicast (SSM) feature is an extension of IP multicast in which datagram traffic is forwarded to receivers from only those multicast sources that the receivers have explicitly joined. For multicast groups configured for SSM, only SSM distribution trees (no shared trees) are created.

SSM Components Overview

SSM is a datagram delivery model that best supports one-to-many applications, also known as broadcast applications. SSM is a core networking technology for the Cisco implementation of IP multicast solutions targeted for audio and video broadcast application environments. The switch supports the following components that support SSM implementation:

- Protocol independent multicast source-specific mode (PIM-SSM)

  PIM-SSM is the routing protocol that supports the implementation of SSM and is derived from PIM sparse mode (PIM-SM).

- Internet Group Management Protocol version 3 (IGMPv3)

SSM and Internet Standard Multicast (ISM)

The current IP multicast infrastructure in the Internet and many enterprise intranets is based on the PIM-SM protocol and Multicast Source Discovery Protocol (MSDP). These protocols have the limitations of the Internet Standard Multicast (ISM) service model. For example, with ISM, the network must maintain knowledge about which hosts in the network are actively sending multicast traffic.

The ISM service consists of the delivery of IP datagrams from any source to a group of receivers called the multicast host group. The datagram traffic for the multicast host group consists of datagrams with an arbitrary IP unicast source address (S) and the multicast group address (G) as the IP destination address. Systems receive this traffic by becoming members of the host group. Membership in a host group simply requires signaling the host group through IGMP version 1, 2, or 3.

In SSM, delivery of datagrams is based on (S, G) channels. In both SSM and ISM, no signaling is required to become a source. However, in SSM, receivers must subscribe or unsubscribe to (S, G) channels to receive or not receive traffic from specific sources. In other words, receivers can receive traffic only from (S, G) channels to which they are subscribed, whereas in ISM, receivers need not know the IP addresses of sources from which they receive their traffic. The proposed standard approach for channel subscription signaling uses IGMP and includes modes membership reports, which are supported only in IGMP version 3.

SSM IP Address Range

SSM can coexist with the ISM service by applying the SSM delivery model to a configured subset of the IP multicast group address range. Cisco IOS software allows SSM configuration for the IP multicast address range of 224.0.0.0 through 239.255.255.255. When an SSM range is defined, existing IP multicast receiver applications do not receive any traffic when they try to use an address in the SSM range (unless the application is modified to use an explicit (S, G) channel subscription).

SSM Operations

An established network, in which IP multicast service is based on PIM-SM, can support SSM services. SSM can also be deployed alone in a network without the full range of protocols required for interdomain PIM-SM (for example, MSDP, Auto-RP, or bootstrap router [BSR]) if only SSM service is needed.

If SSM is deployed in a network already configured for PIM-SM, only the last-hop routers support SSM. Routers that are not directly connected to receivers do not require support for SSM. In general, these not-last-hop routers must only run PIM-SM in the SSM range and might need additional access control configuration to suppress MSDP signalling, registering, or PIM-SM shared tree operations from occurring within the SSM range.

Use the **ip pim ssm** global configuration command to configure the SSM range and to enable SSM. This configuration has the following effects:

- For groups within the SSM range, (S, G) channel subscriptions are accepted through IGMPv3 include-mode membership reports.
- PIM operations within the SSM range of addresses change to PIM-SSM, a mode derived from PIM-SM. In this mode, only PIM (S, G) join and prune messages are generated by the router, and no (S, G) rendezvous point tree (RPT) or (*, G) RPT messages are generated. Incoming messages related to RPT operations are ignored or rejected, and incoming PIM register messages are immediately answered with register-stop messages. PIM-SSM is backward-compatible with PIM-SM unless a router is a last-hop router. Therefore, routers that are not last-hop routers can run PIM-SM for SSM groups (for example, if they do not yet support SSM).
- No MSDP source-active (SA) messages within the SSM range are accepted, generated, or forwarded.

IGMPv3 Host Signalling

In IGMPv3, hosts signal membership to last hop routers of multicast groups. Hosts can signal group membership with filtering capabilities with respect to sources. A host can either signal that it wants to receive traffic from all sources sending to a group except for some specific sources (called exclude mode), or that it wants to receive traffic only from some specific sources sending to the group (called include mode).

IGMPv3 can operate with both Internet Standard Multicast (ISM) and Source Specific Multicast (SSM). In ISM, both exclude and include mode reports are applicable. In SSM, only include mode reports are accepted by the last-hop router. Exclude mode reports are ignored.

SSM Mapping

In a typical set-top box (STB) deployment, each TV channel uses one separate IP multicast group and has one active server host sending the TV channel. A single server can send multiple TV channels, but each to a different group. In this network environment, if a router receives an IGMPv1 or IGMPv2 membership report for a particular group, the report addresses the well-known TV server for the TV channel associated with the multicast group.

When SSM mapping is configured, if a router receives an IGMPv1 or IGMPv2 membership report for a particular group, the router translates this report into one or more channel memberships for the well-known sources associated with this group.

When the router receives an IGMPv1 or IGMPv2 membership report for a group, the router uses SSM mapping to determine one or more source IP addresses for the group. SSM mapping then translates the membership report as an IGMPv3 report and continues as if it had received an IGMPv3 report. The router then sends PIM joins and continues to be joined to these groups as long as it continues to receive the IGMPv1 or IGMPv2 membership reports, and the SSM mapping for the group remains the same.

SSM mapping enables the last hop router to determine the source addresses either by a statically configured table on the router or through a DNS server. When the statically configured table or the DNS mapping changes, the router leaves the current sources associated with the joined groups.

Static SSM Mapping

With static SSM mapping, you can configure the last hop router to use a static map to determine the sources that are sending to groups. Static SSM mapping requires that you configure ACLs to define group ranges. After configuring the ACLs to define group ranges, you can then map the groups permitted by those ACLs to sources by using the **ip igmp ssm-map static** global configuration command.

You can configure static SSM mapping in smaller networks when a DNS is not needed or to locally override DNS mappings. When configured, static SSM mappings take precedence over DNS mappings.

Related Topics

Configuring Static SSM Mapping, on page 84

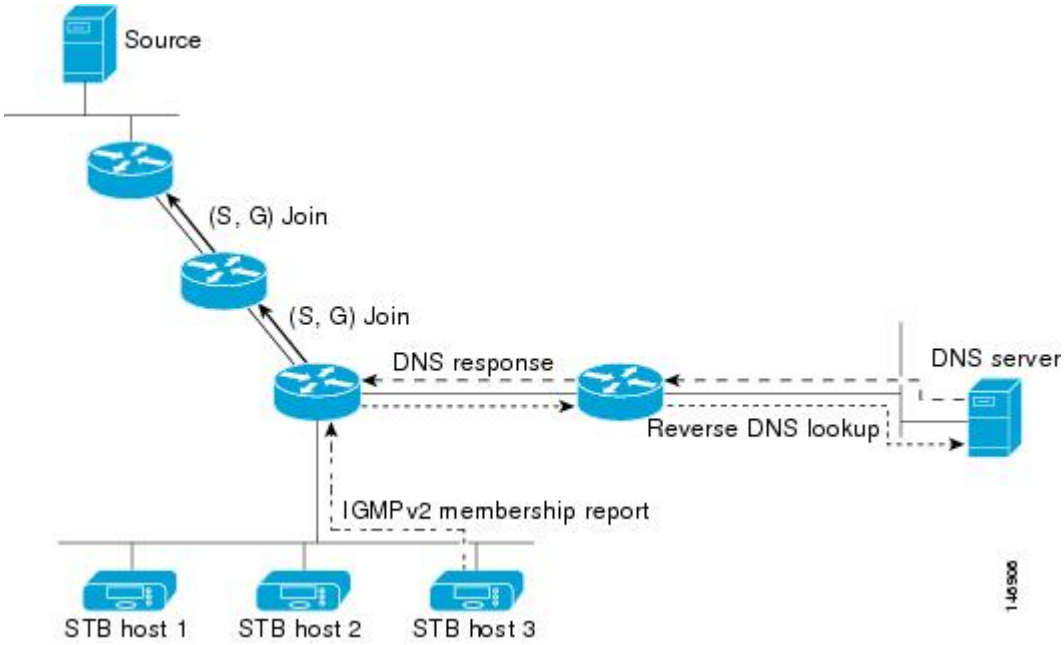
Configuring Static Traffic Forwarding with SSM Mapping, on page 87

DNS-Based SSM Mapping

You can use DNS-based SSM mapping to configure the last hop router to perform a reverse DNS lookup to determine sources sending to groups. When DNS-based SSM mapping is configured, the router constructs a domain name that includes the group address and performs a reverse lookup into the DNS. The router looks up IP address resource records and uses them as the source addresses associated with this group. SSM mapping supports up to 20 sources for each group. The router joins all sources configured for a group.

The following figure displays DNS-based SSM mapping.

Figure 6: DNS-Based SSM Mapping



The SSM mapping mechanism that enables the last hop router to join multiple sources for a group can provide source redundancy for a TV broadcast. In this context, the last hop router provides redundancy using SSM mapping to simultaneously join two video sources for the same TV channel. However, to prevent the last hop router from duplicating the video traffic, the video sources must use a server-side switchover mechanism. One video source is active, and the other backup video source is passive. The passive source waits until an active source failure is detected before sending the video traffic for the TV channel. Thus, the server-side switchover mechanism ensures that only one of the servers is actively sending video traffic for the TV channel.

To look up one or more source addresses for a group that includes G1, G2, G3, and G4, you must configure these DNS records on the DNS server:

```
G4.G3.G2.G1 [multicast-domain] [timeout] IN A source-address-1
 IN A source-address-2
 IN A source-address-n
```

See your DNS server documentation for more information about configuring DNS resource records.

Related Topics

Configuring DNS-Based SSM Mapping, on page 85

How to Configure SSM

Configuring SSM

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **ip pim ssm** [**default** | **range** *access-list*]
3. **interface** *type number*
4. **ip pim** {**sparse-mode** | **sparse-dense-mode**}
5. **ip igmp version 3**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip pim ssm** [**default**	**range** *access-list*] **Example:** `Switch(config)# ip pim ssm range 20`	Defines the SSM range of IP multicast addresses.
Step 3	**interface** *type number* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Selects an interface that is connected to hosts on which IGMPv3 can be enabled, and enters the interface configuration mode.
Step 4	**ip pim** {**sparse-mode**	**sparse-dense-mode**} **Example:** `Switch(config-if)# ip pim sparse-dense-mode`	Enables PIM on an interface. You must use either sparse mode or sparse-dense mode.
Step 5	**ip igmp version 3** **Example:** `Switch(config-if)# ip igmp version 3`	Enables IGMPv3 on this interface. The default version of IGMP is set to Version 2.

Configuring Source Specific Multicast Mapping

The Source Specific Multicast (SSM) mapping feature supports SSM transition when supporting SSM on the end system is impossible or unwanted due to administrative or technical reasons. You can use SSM mapping

to leverage SSM for video delivery to legacy STBs that do not support IGMPv3 or for applications that do not use the IGMPv3 host stack.

Configuring Static SSM Mapping

The following procedure describes how to configure static SSM mapping.

SUMMARY STEPS

1. **configure terminal**
2. **ip igmp ssm-map enable**
3. **no ip igmp ssm-map query dns**
4. **ip igmp ssm-map static** *access-list source-address*
5. Repeat Step 4 to configure additional static SSM mappings, if required.
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip igmp ssm-map enable** **Example:** `Switch(config)# ip igmp ssm-map enable`	Enables SSM mapping for groups in the configured SSM range. **Note** By default, this command enables DNS-based SSM mapping.
Step 3	**no ip igmp ssm-map query dns** **Example:** `Switch(config)# no ip igmp ssm-map dns`	(Optional) Disables DNS-based SSM mapping. **Note** Disable DNS-based SSM mapping if you only want to rely on static SSM mapping. By default, the **ip igmp ssm-map** global configuration command enables DNS-based SSM mapping.
Step 4	**ip igmp ssm-map static** *access-list source-address* **Example:** `Switch(config)# ip igmp ssm-map static`	Configures static SSM mapping. The ACL supplied for *access-list* defines the groups to be mapped to the source IP address entered for the *source-address*.

	Command or Action	Purpose
	`11 172.16.8.11`	**Note** You can configure additional static SSM mappings. If additional SSM mappings are configured and the router receives an IGMPv1 or IGMPv2 membership report for a group in the SSM range, the switch determines the source addresses associated with the group by using each configured **ip igmp ssm-map static** command. The switch associates up to 20 sources per group.
Step 5	Repeat Step 4 to configure additional static SSM mappings, if required.	—
Step 6	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 8	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Static SSM Mapping, on page 81

Configuring DNS-Based SSM Mapping

To configure DNS-based SSM mapping, you need to create a DNS server zone or add records to an existing zone. If the routers that are using DNS-based SSM mapping are also using DNS for other purposes, you should use a normally configured DNS server. If DNS-based SSM mapping is the only DNS implementation being used on the router, you can configure a false DNS setup with an empty root zone or a root zone that points back to itself.

SUMMARY STEPS

1. **configure terminal**
2. **ip igmp ssm-map enable**
3. **ip igmp ssm-map query dns**
4. **ip domain multicast** *domain-prefix*
5. **ip name-server** *server-address1* [*server-address2... server-address6*]
6. Repeat Step 5 to configure additional DNS servers for redundancy, if required.
7. **end**
8. **show running-config**
9. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip igmp ssm-map enable** **Example:** `Switch(config)# ip igmp ssm-map enable`	Enables SSM mapping for groups in a configured SSM range.
Step 3	**ip igmp ssm-map query dns** **Example:** `Switch(config)# ip igmp ssm-map query dns`	(Optional) Enables DNS-based SSM mapping. By default, the **ip igmp ssm-map** command enables DNS-based SSM mapping. Only the **no** form of this command is saved to the running configuration. **Note** Use this command to reenable DNS-based SSM mapping if DNS-based SSM mapping is disabled.
Step 4	**ip domain multicast** *domain-prefix* **Example:** `Switch(config)# ip domain multicast ssm-map.cisco.com`	(Optional) Changes the domain prefix used by the switch for DNS-based SSM mapping. By default, the switch uses the *ip-addr.arpa* domain prefix.
Step 5	**ip name-server** *server-address1* [*server-address2... server-address6*] **Example:** `Switch(config)# ip name-server`	Specifies the address of one or more name servers to use for name and address resolution.

	Command or Action	Purpose
	`172.16.1.111 172.16.1.2`	
Step 6	Repeat Step 5 to configure additional DNS servers for redundancy, if required.	—
Step 7	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 8	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 9	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

DNS-Based SSM Mapping, on page 81

Configuring Static Traffic Forwarding with SSM Mapping

Use static traffic forwarding with SSM mapping to statically forward SSM traffic for certain groups.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *type number*
3. **ip igmp static-group** *group-address* **source ssm-map**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *type number* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Selects an interface on which to statically forward traffic for a multicast group using SSM mapping, and enters interface configuration mode. **Note** Static forwarding of traffic with SSM mapping works with either DNS-based SSM mapping or statically configured SSM mapping.
Step 3	**ip igmp static-group** *group-address* **source ssm-map** **Example:** `Switch(config-if)# ip igmp static-group 239.1.2.1 source ssm-map`	Configures SSM mapping to statically forward a (S, G) channel from the interface. Use this command if you want to statically forward SSM traffic for certain groups. Use DNS-based SSM mapping to determine the source addresses of the channels.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Static SSM Mapping, on page 81

Monitoring SSM

Use the privileged EXEC commands in the following table to monitor SSM.

Table 10: Commands for Monitoring SSM

Command	Purpose
show ip igmp groups detail	Displays the (S, G) channel subscription through IGMPv3.
show ip mroute	Displays whether a multicast group supports SSM service or whether a source-specific host report was received.

Monitoring SSM Mapping

Use the privileged EXEC commands in the following table to monitor SSM mapping.

Table 11: SSM Mapping Monitoring Commands

Command	Purpose
show ip igmp ssm-mapping	Displays information about SSM mapping.
show ip igmp ssm-mapping *group-address*	Displays the sources that SSM mapping uses for a particular group.
show ip igmp groups [*group-name* | *group-address* | *interface-type interface-number*] [**detail**]	Displays the multicast groups with receivers that are directly connected to the router and that were learned through IGMP.
show host	Displays the default domain name, the style of name lookup service, a list of name server hosts, and the cached list of hostnames and addresses.
debug ip igmp *group-address*	Displays the IGMP packets received and sent and IGMP host-related events.

Where to Go Next

You can configure the following for your IP multicast configuration:

- IGMP feature support

- PIM feature support
- IP Multicast Routing

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	*Catalyst 2960-XR Switch IP Multicast Command Reference*

Standards and RFCs

Standard/RFC	Title
—	—

MIBs

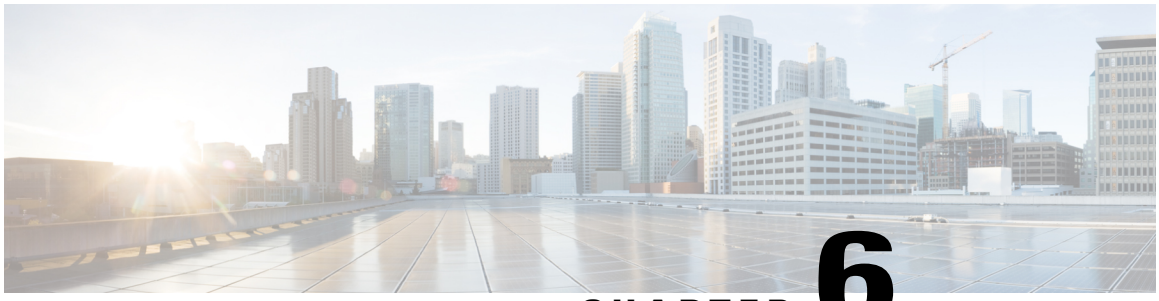
MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for SSM

Release	Modification
Cisco IOS 15.0(2)EX1	This feature was introduced.



CHAPTER 6

Configuring IP Multicast Routing

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for IP Multicast Routing

You must enable basic IP multicast routing and configure the PIM version and the PIM mode. Then the software can forward multicast packets, and the switch can populate its multicast routing table.

You can configure an interface to be in PIM dense mode, sparse mode, or sparse-dense mode. The switch populates its multicast routing table and forwards multicast packets it receives from its directly connected LANs according to the mode setting. You must enable PIM in one of these modes for an interface to perform IP multicast routing. Enabling PIM on an interface also enables IGMP operation on that interface.

Note If you enable PIM on multiple interfaces, when most of these interfaces are not on the outgoing interface list, and IGMP snooping is disabled, the outgoing interface might not be able to sustain line rate for multicast traffic because of the extra replication.

In populating the multicast routing table, dense-mode interfaces are always added to the table. Sparse-mode interfaces are added to the table only when periodic join messages are received from downstream devices or when there is a directly connected member on the interface. When forwarding from a LAN, sparse-mode operation occurs if there is an RP known for the group. If so, the packets are encapsulated and sent toward the RP. When no RP is known, the packet is flooded in a dense-mode fashion. If the multicast traffic from a specific source is sufficient, the receiver's first-hop router might send join messages toward the source to build a source-based distribution tree.

Restrictions for IP Multicast Routing

The following are the restrictions for IP multicast routing:

- The switch supports homogeneous stacking, but does not support mixed stacking.

Information About IP Multicast Routing

IP multicasting is an efficient way to use network resources, especially for bandwidth-intensive services such as audio and video. IP multicast routing enables a host (source) to send packets to a group of hosts (receivers) anywhere within the IP network by using a special form of IP address called the IP multicast group address.

The sending host inserts the multicast group address into the IP destination address field of the packet, and IP multicast routers and multilayer switches forward incoming IP multicast packets out all interfaces that lead to members of the multicast group. Any host, regardless of whether it is a member of a group, can send to a group. However, only the members of a group receive the message.

Multicast Boundaries

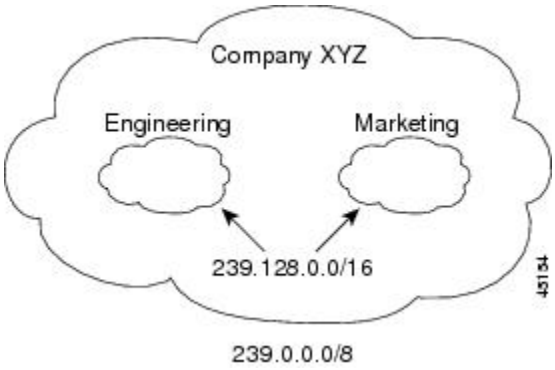
Administratively-scoped boundaries can be used to limit the forwarding of multicast traffic outside of a domain or subdomain. This approach uses a special range of multicast addresses, called administratively-scoped addresses, as the boundary mechanism. If you configure an administratively-scoped boundary on a routed interface, multicast traffic whose multicast group addresses fall in this range cannot enter or exit this interface, which provides a firewall for multicast traffic in this address range.

Note Multicast boundaries and TTL thresholds control the scoping of multicast domains; however, TTL thresholds are not supported by the switch. You should use multicast boundaries instead of TTL thresholds to limit the forwarding of multicast traffic outside of a domain or a subdomain.

The following figure shows that Company XYZ has an administratively-scoped boundary set for the multicast address range 239.0.0.0/8 on all routed interfaces at the perimeter of its network. This boundary prevents any multicast traffic in the range 239.0.0.0 through 239.255.255.255 from entering or leaving the network. Similarly,

the engineering and marketing departments have an administratively-scoped boundary of 239.128.0.0/16 around the perimeter of their networks. This boundary prevents multicast traffic in the range of 239.128.0.0 through 239.128.255.255 from entering or leaving their respective networks.

Figure 7: Administratively-Scoped Boundaries



You can define an administratively-scoped boundary on a routed interface for multicast group addresses. A standard access list defines the range of addresses affected. When a boundary is defined, no multicast data packets are allowed to flow across the boundary from either direction. The boundary allows the same multicast group address to be reused in different administrative domains.

The IANA has designated the multicast address range 239.0.0.0 to 239.255.255.255 as the administratively-scoped addresses. This range of addresses can then be reused in domains administered by different organizations. The addresses would be considered local, not globally unique.

Default IP Multicast Routing Configuration

This table displays the default IP multicast routing configuration.

Table 12: Default IP Multicast Routing Configuration

Feature	Default Setting
Multicast routing	Disabled on all interfaces.
PIM version	Version 2.
PIM mode	No mode is defined.
PIM stub routing	None configured.
PIM RP address	None configured.
PIM domain border	Disabled.
PIM multicast boundary	None.
Candidate BSRs	Disabled.

Feature	Default Setting
Candidate RPs	Disabled.
Shortest-path tree threshold rate	0 kb/s.
PIM router query message interval	30 seconds.

How to Configure Basic IP Multicast Routing

Configuring Basic IP Multicast Routing

By default, multicast routing is disabled, and there is no default mode setting.

This procedure is required.

SUMMARY STEPS

1. **configure terminal**
2. **ip multicast-routing distributed**
3. **interface** *interface-id*
4. **ip pim version** [**1** | **2**]
5. **ip pim** {**dense-mode** | **sparse-mode** | **sparse-dense-mode**}
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip multicast-routing distributed** **Example:** `Switch(config)# ip multicast-routing distributed`	Enables IP multicast distributed switching **Note** To disable multicasting, use the **no ip multicast-routing distributed** global configuration command.

	Command or Action	Purpose
Step 3	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitethernet 1/0/1`	Specifies the Layer 3 interface on which you want to enable multicast routing, and enters interface configuration mode. The specified interface must be one of the following: • A routed port—A physical port that has been configured as a Layer 3 port by entering the **no switchport** interface configuration command. • An SVI—A VLAN interface created by using the **interface vlan** *vlan-id* global configuration command. These interfaces must have IP addresses assigned to them.
Step 4	**ip pim version** [**1** | **2**] **Example:** `Switch(config-if)# ip pim version 2`	Configures the PIM version on the interface. By default, Version 2 is enabled and is the recommended setting. An interface in PIMv2 mode automatically downgrades to PIMv1 mode if that interface has a PIMv1 neighbor. The interface returns to Version 2 mode after all Version 1 neighbors are shut down or upgraded. **Note** To return to the default PIM version, use the **no ip pim version** interface configuration command.
Step 5	**ip pim** {**dense-mode** | **sparse-mode** | **sparse-dense-mode**} **Example:** `Switch(config-if)# ip pim sparse-dense-mode`	Enables a PIM mode on the interface. By default, no mode is configured. The keywords have these meanings: • **dense-mode—**Enables dense mode of operation. • **sparse-mode—**Enables sparse mode of operation. If you configure sparse mode, you must also configure an RP. • **sparse-dense-mode—**Causes the interface to be treated in the mode in which the group belongs. Sparse-dense mode is the recommended setting. **Note** To disable PIM on an interface, use the **no ip pim** interface configuration command.
Step 6	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.

	Command or Action	Purpose
Step 8	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring an IP Multicast Boundary

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **access-list** {*access-list-number* | **deny** | **permit** *source* [*source-wildcard*] }
3. **interface** *interface-id*
4. **ip multicast boundary** *access-list-number*
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**access-list** {*access-list-number* | **deny** | **permit** *source* [*source-wildcard*] } **Example:** `Switch(config)# access-list 99 permit any`	Creates a standard access list, repeating the command as many times as necessary. • For *access-list-number*, the range is 1 to 99. • The **deny** keyword denies access if the conditions are matched. The **permit** keyword permits access if the conditions are matched. • For *source*, enter the number of the network or host from which the packet is being sent.

	Command or Action	Purpose
		• (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore. The access list is always terminated by an implicit deny statement for everything.
Step 3	**interface** *interface-id* **Example:** `Switch(config)# interface gigabitEthernet1/0/1`	Specifies the interface to be configured, and enters interface configuration mode.
Step 4	**ip multicast boundary** *access-list-number* **Example:** `Switch(config-if)# ip multicast boundary 99`	Configures the boundary, specifying the access list you created in Step 2. **Note** To remove the boundary, use the **no ip multicast boundary** interface configuration command.
Step 5	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Related Topics

Example: Configuring an IP Multicast Boundary, on page 103

Configuring sdr Listener Support

The MBONE is the small subset of Internet routers and hosts that are interconnected and capable of forwarding IP multicast traffic. Other multimedia content is often broadcast over the MBONE. Before you can join a multimedia session, you need to know what multicast group address and port are being used for the session, when the session is going to be active, and what sort of applications (audio, video, and so forth) are required on your workstation. The MBONE Session Directory Version 2 (sdr) tool provides this information. This freeware application can be downloaded from several sites on the World Wide Web, one of which is http://www.video.ja.net/mice/index.html.

SDR is a multicast application that listens to a well-known multicast group address and port for Session Announcement Protocol (SAP) multicast packets from SAP clients, which announce their conference sessions. These SAP packets contain a session description, the time the session is active, its IP multicast group addresses, media format, contact person, and other information about the advertised multimedia session. The information in the SAP packet is displayed in the SDR Session Announcement window.

Enabling sdr Listener Support

By default, the switch does not listen to session directory advertisements.

Beginning in privileged EXEC mode, follow these steps to enable the switch to join the default session directory group (224.2.127.254) on the interface and listen to session directory advertisements. This procedure is optional.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip sap listen**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Switch(config)# interface`	Specifies the interface to be enabled for sdr, and enters interface configuration mode.

	Command or Action	Purpose
	gigabitethernet 1/0/1	
Step 3	**ip sap listen** **Example:** `Switch(config-if)# ip sap listen`	Enables the switch software to listen to session directory announcements. **Note** To disable sdr support, use the **no ip sdr listen** interface configuration command.
Step 4	**end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Limiting How Long an sdr Cache Entry Exists

By default, entries are never deleted from the sdr cache. You can limit how long the entry remains active so that if a source stops advertising SAP information, old advertisements are not unnecessarily kept.

This procedure is optional.

SUMMARY STEPS

1. **configure terminal**
2. **ip sap cache-timeout** *minutes*
3. **end**
4. **show running-config**
5. **show ip sap**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Switch# configure terminal`	Enters the global configuration mode.
Step 2	**ip sap cache-timeout** *minutes* **Example:** `Switch(config)# ip sap cache-timeout 30`	Limits how long a Session Announcement Protocol (SAP) cache entry stays active in the cache. By default, entries are never deleted from the cache. For *minutes*, the range is 1 to 1440 minutes (24 hours).
Step 3	**end** **Example:** `Switch(config)# end`	Returns to privileged EXEC mode.
Step 4	**show running-config** **Example:** `Switch# show running-config`	Verifies your entries.
Step 5	**show ip sap** **Example:** `Switch# show ip sap`	Displays the SAP cache.
Step 6	**copy running-config startup-config** **Example:** `Switch# copy running-config startup-config`	(Optional) Saves your entries in the configuration file. To return to the default setting, use the **no ip sdr cache-timeout** global configuration command. To delete the entire cache, use the **clear ip sdr** privileged EXEC command. To display the session directory cache, use the **show ip sdr** privileged EXEC command.

Monitoring IP Multicast Routing

You can use the privileged EXEC commands in the following table to monitor IP multicast routers, packets, and paths.

Table 13: Commands for Monitoring IP Multicast Routing

Command	Purpose
mrinfo [*hostname* | *address*] [*source-address* | *interface*] **mrinfo** { [*hostname* | *address*] | **vrf** }	Queries a multicast router or multilayer switch about which neighboring multicast devices are peering with it.
mstat *source* [*destination*] [*group*] **mstat** { [*hostname* | *address*] | **vrf** }	Displays IP multicast packet rate and loss information.
mtrace *source* [*destination*] [*group*] **mtrace** { [*hostname* | *address*] | **vrf** }	Traces the path from a source to a destination branch for a multicast distribution tree for a given group.

Configuration Examples for IP Multicast Routing

Example: Configuring an IP Multicast Boundary

This example shows how to set up a boundary for all administratively-scoped addresses:

```
Switch(config)# access-list 1 deny 239.0.0.0 0.255.255.255
Switch(config)# access-list 1 permit 224.0.0.0 15.255.255.255
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# ip multicast boundary 1
```

Related Topics

Configuring an IP Multicast Boundary, on page 98

Where to Go Next

You can configure the following for your IP multicast configuration:

- IGMP feature support
- CGMP feature support
- PIM feature support
- SSM feature support

Additional References

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this book.	*Catalyst 2960-XR Switch IP Multicast Command Reference*

Standards and RFCs

Standard/RFC	Title
RFC 1112	*Host Extensions for IP Multicasting*
RFC 2236	*Internet Group Management Protocol, Version 2*
RFC 4601	*Protocol-Independent Multicast-Sparse Mode (PIM-SM): Protocol Specification*

MIBs

MIB	MIBs Link
All supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History and Information for IP Multicast Routing

Release	Modification
Cisco IOS 15.0(2)EX1	This feature was introduced.

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