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Document Conventions

This document uses the following conventions:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>^ or Ctrl</td>
<td>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.)</td>
</tr>
<tr>
<td>bold font</td>
<td>Commands and keywords and user-entered text appear in <strong>bold</strong> font.</td>
</tr>
<tr>
<td>Italic font</td>
<td>Document titles, new or emphasized terms, and arguments for which you supply values are in <em>italic</em> font.</td>
</tr>
<tr>
<td>Courier font</td>
<td>Terminal sessions and information the system displays appear in <strong>courier</strong> font.</td>
</tr>
<tr>
<td>Bold Courier font</td>
<td>Bold Courier font indicates text that the user must enter.</td>
</tr>
<tr>
<td>[x]</td>
<td>Elements in square brackets are optional.</td>
</tr>
<tr>
<td>...</td>
<td>An ellipsis (three consecutive nonbolded periods without spaces) after a syntax element indicates that the element can be repeated.</td>
</tr>
<tr>
<td></td>
<td>A vertical line, called a pipe, indicates a choice within a set of keywords or arguments.</td>
</tr>
<tr>
<td>[x</td>
<td>y]</td>
</tr>
</tbody>
</table>
### Document Conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{x</td>
<td>y}</td>
</tr>
<tr>
<td>[x {y</td>
<td>z}]</td>
</tr>
<tr>
<td>string</td>
<td>A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.</td>
</tr>
<tr>
<td>&lt; &gt;</td>
<td>Nonprinting characters such as passwords are in angle brackets.</td>
</tr>
<tr>
<td>[ ]</td>
<td>Default responses to system prompts are in square brackets.</td>
</tr>
<tr>
<td>!, #</td>
<td>An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.</td>
</tr>
</tbody>
</table>

### Reader Alert Conventions

This document may use 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

Before installing or upgrading the device, refer to the device release notes.

• Cisco Catalyst 3650 Switch documentation, located at:
  http://www.cisco.com/go/cat3650_docs

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

• Error Message Decoder, located at:
  https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi

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:


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.
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 device 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 device 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

<table>
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<tr>
<th>Mode</th>
<th>Access Method</th>
<th>Prompt</th>
<th>Exit Method</th>
<th>About This Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>User EXEC</td>
<td>Begin a session using Telnet, SSH, or console.</td>
<td>Device&gt;</td>
<td>Enter <em>logout</em> or <em>quit</em>.</td>
<td>Use this mode to • Change terminal settings. • Perform basic tests. • Display system information.</td>
</tr>
<tr>
<td>Privileged EXEC</td>
<td>While in user EXEC mode, enter the <em>enable</em> command.</td>
<td>Device#</td>
<td>Enter <em>disable</em> to exit.</td>
<td>Use this mode to verify commands that you have entered. Use a password to protect access to this mode.</td>
</tr>
<tr>
<td>Global configuration</td>
<td>While in privileged EXEC mode, enter the <em>configure</em> command.</td>
<td>Device(config)#</td>
<td>To exit to privileged EXEC mode, enter <em>exit</em> or <em>end</em>, or press Ctrl-Z.</td>
<td>Use this mode to configure parameters that apply to the entire device.</td>
</tr>
<tr>
<td>VLAN configuration</td>
<td>While in global configuration mode, enter the <em>vlan vlan-id</em> command.</td>
<td>Device(config-vlan)#</td>
<td>To exit to global configuration mode, enter the <em>exit</em> command. To return to privileged EXEC mode, press Ctrl-Z or enter <em>end</em>.</td>
<td>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 device startup configuration file.</td>
</tr>
<tr>
<td>Interface configuration</td>
<td>While in global configuration mode, enter the <em>interface</em> command (with a specific interface).</td>
<td>Device(config-if)#</td>
<td></td>
<td>Use this mode to configure parameters for the Ethernet ports.</td>
</tr>
</tbody>
</table>
### 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 ?`

---

**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. | `Device(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. |
### DETAILED STEPS

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<th>Purpose</th>
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<td><strong>Step 1</strong> help</td>
<td>Obtains a brief description of the help system in any command mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# help</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> abbreviated-command-entry ?</td>
<td>Obtains a list of commands that begin with a particular character string.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# di? dir disable disconnect</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> abbreviated-command-entry &lt;Tab&gt;</td>
<td>Completes a partial command name.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# sh conf&lt;tab&gt;</td>
<td></td>
</tr>
<tr>
<td>Device# show configuration</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ?</td>
<td>Lists all commands available for a particular command mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# ?</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> command ?</td>
<td>Lists the associated keywords for a command.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# show ?</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> command keyword ?</td>
<td>Lists the associated arguments for a keyword.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# cdp holdtime ?</td>
<td></td>
</tr>
<tr>
<td>&lt;10-255&gt; Length of time (in sec) that receiver must keep this packet</td>
<td></td>
</tr>
</tbody>
</table>

### Understanding Abbreviated Commands

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

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

Device# 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 device.

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Meaning</th>
<th>How to Get Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Ambiguous command: &quot;show con&quot;</td>
<td>You did not enter enough characters for your device to recognize the command.</td>
<td>Reenter the command followed by a question mark (?) without any space between the command and the question mark. The possible keywords that you can enter with the command appear.</td>
</tr>
<tr>
<td>% Incomplete command.</td>
<td>You did not enter all of the keywords or values required by this command.</td>
<td>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.</td>
</tr>
<tr>
<td>% Invalid input detected at '^' marker.</td>
<td>You entered the command incorrectly. The caret (^) marks the point of the error.</td>
<td>Enter a question mark (?) to display all of the commands that are available in this command mode. The possible keywords that you can enter with the command appear.</td>
</tr>
</tbody>
</table>

Configuration Logging

You can log and view changes to the device 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 device 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

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
</tr>
<tr>
<td>terminal history [size number-of-lines]</td>
<td>Changes the number of command lines that the device records during the current terminal session in privileged EXEC mode. You can configure the size from 0 to 256.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# terminal history size 200</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>Ctrl-P or use the up arrow key</td>
<td>Recalls commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>Ctrl-N or use the down arrow key</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>show history</td>
<td>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.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>terminal no history</td>
<td>Disables the feature during the current terminal session in privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>Device# terminal no history</td>
<td>Disables the feature during the current terminal session in privileged EXEC mode.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>terminal editing</td>
<td>Reenables the enhanced editing mode for the current terminal session in privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# terminal editing</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>terminal no editing</td>
<td>Disables the enhanced editing mode for the current terminal session in privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# terminal no editing</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Editing Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl-B or use the left arrow key</td>
<td>Moves the cursor back one character.</td>
</tr>
<tr>
<td>Ctrl-F or use the right arrow key</td>
<td>Moves the cursor forward one character.</td>
</tr>
<tr>
<td>Ctrl-A</td>
<td>Moves the cursor to the beginning of the command line.</td>
</tr>
<tr>
<td>Ctrl-E</td>
<td>Moves the cursor to the end of the command line.</td>
</tr>
<tr>
<td>Esc B</td>
<td>Moves the cursor back one word.</td>
</tr>
<tr>
<td>Esc F</td>
<td>Moves the cursor forward one word.</td>
</tr>
<tr>
<td>Ctrl-T</td>
<td>Transposes the character to the left of the cursor with the character located at the cursor.</td>
</tr>
<tr>
<td><strong>Delete</strong> or <strong>Backspace</strong> key</td>
<td>Erases the character to the left of the cursor.</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Ctrl-D</strong></td>
<td>Deletes the character at the cursor.</td>
</tr>
<tr>
<td><strong>Ctrl-K</strong></td>
<td>Deletes all characters from the cursor to the end of the command line.</td>
</tr>
<tr>
<td><strong>Ctrl-U</strong> or <strong>Ctrl-X</strong></td>
<td>Deletes all characters from the cursor to the beginning of the command line.</td>
</tr>
<tr>
<td><strong>Ctrl-W</strong></td>
<td>Deletes the word to the left of the cursor.</td>
</tr>
<tr>
<td><strong>Esc D</strong></td>
<td>Deletes from the cursor to the end of the word.</td>
</tr>
<tr>
<td><strong>Esc C</strong></td>
<td>Capitalizes at the cursor.</td>
</tr>
<tr>
<td><strong>Esc L</strong></td>
<td>Changes the word at the cursor to lowercase.</td>
</tr>
<tr>
<td><strong>Esc U</strong></td>
<td>Capitalizes letters from the cursor to the end of the word.</td>
</tr>
<tr>
<td><strong>Ctrl-V</strong> or <strong>Esc Q</strong></td>
<td>Designates a particular keystroke as an executable command, perhaps as a shortcut.</td>
</tr>
<tr>
<td><strong>Return</strong> key</td>
<td>Scrolls down a line or screen on displays that are longer than the terminal screen can display.</td>
</tr>
</tbody>
</table>

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

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

**SUMMARY STEPS**

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>access-list</td>
<td>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.</td>
</tr>
<tr>
<td>Example:</td>
<td>access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.22.35 255.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# $t tcp 10.15.22.25 255.255.255.0 131.108.1.20 255.255.255.0 eq</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# $15.22.25 255.255.255.0 10.15.22.35 255.255.255.0 eq 45</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Ctrl-A</td>
<td>Checks the complete syntax. The dollar sign ($) appears at the end of the line to show that the line has been scrolled to the right.</td>
</tr>
<tr>
<td>Example:</td>
<td>access-list 101 permit tcp 10.15.22.25 255.255.255.0 10.15.25</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Return key</td>
<td>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.</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>`{show</td>
<td>more} command</td>
</tr>
</tbody>
</table>

#### Example:

```text
Device# 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
```

### Accessing the CLI

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

To debug the standby switch, use the `session standby ios` privileged EXEC command from the active switch to access the IOS console of the standby switch. To debug a specific stack member, use the `session switch stack-member-number` privileged EXEC command from the active switch to access the diagnostic shell of the stack member. For more information about these commands, see the switch command reference.

### 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 device console or connect a PC to the Ethernet management port and then power on the device, as described in the hardware installation guide that shipped with your device.

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

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

- Connect the device 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 device hardware installation guide.

- Use any Telnet TCP/IP or encrypted Secure Shell (SSH) package from a remote management station. The device must have network connectivity with the Telnet or SSH client, and the device must have an enable secret password configured.
  - The device supports up to 16 simultaneous Telnet sessions. Changes made by one Telnet user are reflected in all other Telnet sessions.
  - The device 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.
Using the Web Graphical User Interface

- Prerequisites for Using the Web GUI, page 13
- Information About Using The Web GUI, page 13
- Connecting the Console Port of the Device, page 15
- Logging On to the Web GUI, page 15
- Enabling Web and Secure Web Modes, page 15
- Configuring the Device Web GUI, page 16

Prerequisites for Using the Web GUI

- The GUI must be used on a PC running Windows 7, Windows XP SP1 (or later releases), or Windows 2000 SP4 (or later releases).
- The device GUI is compatible with Microsoft Internet Explorer version 10.x, Mozilla Firefox 20.x, or Google Chrome 26.x.

Information About Using The Web GUI

A web browser, or graphical user interface (GUI), is built into each device.

You can use either the service port interface or the management interface to access the GUI. We recommend that you use the service-port interface. Click Help at the top of any page in the GUI to display online help. You might need to disable your browser's pop-up blocker to view the online help.

Web GUI Features

The device web GUI supports the following:

The Configuration Wizard—After initial configuration of the IP address and the local username/password or auth via the authentication server (privilege 15 needed), the wizard provides a method to complete the initial
wireless configuration. Start the wizard through Configuration -> Wizard and follow the nine-step process to configure the following:

- Admin Users
- SNMP System Summary
- Management Port
- Wireless Management
- RF Mobility and Country code
- Mobility configuration
- WLANs
- 802.11 Configuration
- Set Time

The Monitor tab:

- Displays summary details of device, clients, and access points.
- Displays all radio and AP join statistics.
- Displays air quality on access points.
- Displays list of all Cisco Discovery Protocol (CDP) neighbors on all interfaces and the CDP traffic information.
- Displays all rogue access points based on their classification-friendly, malicious, ad hoc, classified, and unclassified.

The Configuration tab:

- Enables you to configure the device for all initial operation using the web Configuration Wizard. The wizard allows you to configure user details, management interface, and so on.
- Enables you to configure the system, internal DHCP server, management, and mobility management parameters.
- Enables you to configure the device, WLAN, and radios.
- Enables you to configure and set security policies on your device.
- Enables you to access the device operating system software management commands.

The Administration tab enables you to configure system logs.
Connecting the Console Port of the Device

Before You Begin

Before you can configure the device for basic operations, you need to connect it to a PC that uses a VT-100 terminal emulation program (such as HyperTerminal, ProComm, Minicom, or Tip).

Step 1
Connect one end of a null-modem serial cable to the device's RJ-45 console port and the other end to your PC's serial port.

Step 2
Plug the AC power cord into the device and a grounded 100 to 240 VAC, 50/60-Hz electrical outlet. Turn on the power supply. The bootup script displays operating system software initialization (code download and power-on self-test verification) and basic configuration. If the device passes the power-on self-test, the bootup script runs the configuration wizard, which prompts you for basic configuration input.

Step 3
Enter yes. Proceed with basic initial setup configuration parameters in the CLI setup wizard. Specify the IP address for the service port which is the gigabitethernet 0/0 interface.

After entering the configuration parameters in the configuration wizard, you can access the Web GUI. Now, the device is configured with the IP address for service port.

Logging On to the Web GUI

Enter the device IP address in your browser’s address bar. For a secure connection, enter https://ip-address. For a less secure connection, enter http://ip-address.

Enabling Web and Secure Web Modes

Step 1
Choose Configuration > Switch > Management > Protocol Management > HTTP-HTTPS.

The HTTP-HTTPS Configuration page appears.

Step 2
To enable web mode, which allows users to access the device GUI using "http://ip-address," choose Enabled from the HTTP Access drop-down list. Otherwise, choose Disabled. Web mode (HTTP) is not a secure connection.
Step 3 To enable secure web mode, which allows users to access the device GUI using "https://ip-address," choose Enabled from the HTTPS Access drop-down list. Otherwise, choose Disabled. Secure web mode (HTTPS) is a secure connection.

Step 4 Choose to track the device in the IP Device Tracking check box.

Step 5 Choose to enable the trust point in the Enable check box.

Step 6 Choose the trustpoints from the Trustpoints drop-down list.

Step 7 Enter the amount of time, in seconds, before the web session times out due to inactivity in the HTTP Timeout-policy (1 to 600 sec) text box. The valid range is from 1 to 600 seconds.

Step 8 Enter the server life time in the Server Life Time (1 to 86400 sec) text box. The valid range is from 1 to 86400 seconds.

Step 9 Enter the maximum number of connection requests that the server can accept in the Maximum number of Requests (1 to 86400) text box. The valid range is from 1 to 86400 connections.

Step 10 Click Apply.

Step 11 Click Save Configuration.

Configuring the Device Web GUI

The configuration wizard enables you to configure basic settings on the device. You can run the wizard after you receive the device from the factory or after the device has been reset to factory defaults. The configuration wizard is available in both GUI and CLI formats.

Step 1 Connect your PC to the service port and configure an IPv4 address to use the same subnet as the device. The device is loaded with IOS XE image and the service port interface is configured as gigabitethernet 0/0.

Step 2 Start Internet Explorer 10 (or later), Firefox 2.0.0.11 (or later), or Google Chrome on your PC and enter the management interface IP address on the browser window. The management interface IP address is same as the gigabitethernet 0/0 (also known as service port interface). When you log in for the first time, you need to enter HTTP username and password. By default, the username is admin and the password is cisco. You can use both HTTP and HTTPS when using the service port interface. HTTPS is enabled by default and HTTP can also be enabled.

When you log in for the first time, the Accessing Cisco Switch <Model Number> <Hostname> page appears.

Step 3 On the Accessing Cisco Switch page, click the Wireless Web GUI link to access device web GUI Home page.

Step 4 Choose Configuration > Wizard to perform all steps that you need to configure the device initially. The Admin Users page appears.

Step 5 On the Admin Users page, enter the administrative username to be assigned to this device in the User Name text box and the administrative password to be assigned to this device in the Password and Confirm Password text boxes. Click Next.

The default username is admin and the default password is cisco. You can also create a new administrator user for the device. You can enter up to 24 ASCII characters for username and password.
The SNMP System Summary page appears.

**Step 6**

On the SNMP System Summary page, enter the following SNMP system parameters for the device, and click Next:

- Customer-definable device location in the Location text box.
- Customer-definable contact details such as phone number with names in the Contact text box.
- Choose enabled to send SNMP notifications for various SNMP traps or disabled not to send SNMP notifications for various SNMP traps from the SNMP Global Trap drop-down list.
- Choose enabled to send system log messages or disabled not to send system log messages from the SNMP Logging drop-down list.

**Note** The SNMP trap server, must be reachable through the distribution ports (and not through the gigabitethernet0/0 service or management interface).

The Management Port page appears.

**Step 7**

In the Management Port page, enter the following parameters for the management port interface (gigabitethernet 0/0) and click Next.

- Interface IP address that you assigned for the service port in the IP Address text box.
- Network mask address of the management port interface in the Netmask text box.
- The IPv4 Dynamic Host Configuration Protocol (DHCP) address for the selected port in the IPv4 DHCP Server text box.

The Wireless Management page appears.

**Step 8**

In the Wireless Management page, enter the following wireless interface management details, and click Next.

- Choose the interface—VLAN, or Ten Gigabit Ethernet from the Select Interface drop-down list.
- VLAN tag identifier, or 0 for no VLAN tag in the VLAN id text box.
- IP address of wireless management interface where access points are connected in the IP Address text box.
- Network mask address of the wireless management interface in the Netmask text box.
- DHCP IPv4 IP address in the IPv4 DHCP Server text box.

When selecting VLAN as interface, you can specify the ports as –Trunk or Access ports from the selected list displayed in the Switch Port Configuration text box.

The RF Mobility and Country Code page appears.

**Step 9**

In the RF Mobility and Country Code page, enter the RF mobility domain name in the RF Mobility text box, choose current country code from the Country Code drop-down list, and click Next. From the GUI, you can select only one country code.

**Note** Before configuring RF grouping parameters and mobility configuration, ensure that you refer to the relevant conceptual content and then proceed with the configuration.

The Mobility Configuration page with mobility global configuration settings appears.

**Step 10**

In the Mobility Configuration page, view and enter the following mobility global configuration settings, and click Next.

- Choose Mobility Controller or Mobility Agent from the Mobility Role drop-down list:
• If Mobility Agent is chosen, enter the mobility controller IP address in the Mobility Controller IP Address text box and mobility controller IP address in the Mobility Controller Public IP Address text box.

• If Mobility Controller is chosen, then the mobility controller IP address and mobility controller public IP address are displayed in the respective text boxes.

• Displays mobility protocol port number in the Mobility Protocol Port text box.

• Displays the mobility switch peer group name in the Mobility Switch Peer Group Name text box.

• Displays whether DTLS is enabled in the DTLS Mode text box.

  DTLS is a standards-track Internet Engineering Task Force (IETF) protocol based on TLS.

• Displays mobility domain identifier for 802.11 radios in the Mobility Domain ID for 802.11 radios text box.

• The amount of time (in seconds) between each ping request sent to an peer device in the Mobility Keepalive Interval (1-30) sec text box.

  Valid range is from 1 to 30 seconds, and the default value is 10 seconds.

• Number of times a ping request is sent to an peer device before the peer is considered to be unreachable in the Mobility Keepalive Count (3-20) text box.

  The valid range is from 3 to 20, and the default value is 3.

• The DSCP value that you can set for the mobility device in the Mobility Control Message DSCP Value (0-63) text box.

  The valid range is 0 to 63, and the default value is 0.

• Displays the number of mobility switch peer group member configured in the Switch Peer Group Members Configured text box.

The WLANs page appears.

**Step 11**

In the WLANs page, enter the following WLAN configuration parameters, and click Next.

• WLAN identifier in the WLAN ID text box.

• SSID of the WLAN that the client is associated with in the SSID text box.

• Name of the WLAN used by the client in the Profile Name text box.

The 802.11 Configuration page appears.

**Step 12**

In the 802.11 Configuration page, check either one or both 802.11a/n/ac and 802.11b/g/n check boxes to enable the 802.11 radios, and click Next.

The Set Time page appears.

**Step 13**

In the Set Time page, you can configure the time and date on the device based on the following parameters, and click Next.

• Displays current timestamp on the device in the Current Time text box.

• Choose either Manual or NTP from the Mode drop-down list.

  On using the NTP server, all access points connected to the device, synchronizes its time based on the NTP server settings available.
• Choose date on the device from the Year, Month, and Day drop-down list.
• Choose time from the Hours, Minutes, and Seconds drop-down list.
• Enter the time zone in the Zone text box and select the offset setting required when compared to the current time configured on the device from the Offset drop-down list.

The **Save Wizard** page appears.

**Step 14**

In the **Save Wizard** page, you can review the configuration settings performed on the device using these steps, and if you wish to change any configuration value, click **Previous** and navigate to that page. You can save the device configuration created using the wizard only if a success message is displayed for all the wizards. If the **Save Wizard** page displays errors, you must recreate the wizard for initial configuration of the device.
Configuring IGMP

- Finding Feature Information, page 21
- Restrictions for Configuring IGMP, page 21
- Information About IGMP, page 22
- How to Configure IGMP, page 34
- Monitoring IGMP, page 78
- Configuration Examples for IGMP, page 81
- Where to Go Next for IGMP, page 86
- Additional References, page 87
- Feature History and Information for IGMP, page 88

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.

Restrictions for Configuring IGMP

The following are the restrictions for configuring IGMP:

- The device supports IGMP Versions 1, 2, and 3.

Note

For IGMP Version 3, only IGMP Version 3 BISS (Basic IGMPv3 Snooping Support) is supported.
Information About IGMP

Internet Group Management Protocol (IGMP) is used to dynamically register individual hosts in a multicast group on a particular LAN. Enabling PIM on an interface also enables IGMP. IGMP provides a means to automatically control and limit the flow of multicast traffic throughout your network with the use of special multicast queriers and hosts.

To participate in IP multicasting, multicast hosts, routers, and multilayer devices 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.

Hosts identify group memberships by sending IGMP messages to their local multicast device. Under IGMP, devices listen to IGMP messages and periodically send out queries to discover which groups are active or inactive on a particular subnet.

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.

IP Multicast Group Addresses

IP multicast traffic uses group addresses, which are class D addresses. The high-order bits of a Class D address are 1110. Therefore, host group addresses can be in the range 224.0.0.0 through 239.255.255.255. Multicast addresses in the range 224.0.0.0 to 224.0.0.255 are reserved for use by routing protocols and other network control traffic. The address 224.0.0.0 is guaranteed not to be assigned to any group.

IGMP packets are sent using these IP multicast group addresses:

- IGMP general queries are destined to the address 224.0.0.1 (all systems on a subnet).
- IGMP group-specific queries are destined to the group IP address for which the device is querying.
- IGMP group membership reports are destined to the group IP address for which the device is reporting.
IGMP Version 2 (IGMPv2) leave messages are destined to the address 224.0.0.2 (all multicast routers on a subnet). In some old host IP stacks, leave messages might be destined to the group IP address rather than to the all-routers address.

Related Topics

- Configuring the Device as a Member of a Group (CLI), on page 34
- Example: Configuring the Device as a Member of a Multicast Group, on page 81

IGMP Versions

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

IGMP Version 3

The device supports IGMP version 3. The following are considerations for the device and IGMP version 3:

- An IGMPv3 device supports Basic IGMPv3 Snooping Support (BISS), which includes support for the snooping features on IGMPv1 and IGMPv2 switches and for IGMPv3 membership report messages. BISS constrains the flooding of multicast traffic when your network includes IGMPv3 hosts. It constrains traffic to approximately the same set of ports as the IGMP snooping feature on IGMPv2 or IGMPv1 hosts.

- The device supports IGMPv3 snooping based only on the destination multicast IP address. It does not support snooping based on a source IP address or proxy report.

- IGMPv3 join and leave messages are not supported on devices running IGMP filtering or Multicast VLAN registration (MVR).
An IGMPv3 device can receive messages from and forward messages to a device running the Source Specific Multicast (SSM) feature.

**IGMP Version Differences**

There are three versions of IGMP, as defined by Request for Comments (RFC) documents of the Internet Engineering Task Force (IETF). IGMPv2 improves over IGMPv1 by adding the ability for a host to signal desire to leave a multicast group and IGMPv3 improves over IGMPv2 mainly by adding the ability to listen to multicast originating from a set of source IP addresses only.

**Table 4: IGMP Versions**

<table>
<thead>
<tr>
<th>IGMP Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGMPv1</td>
<td>Provides the basic query-response mechanism that allows the multicast device to determine which multicast groups are active and other processes that enable hosts to join and leave a multicast group. RFC 1112 defines the IGMPv1 host extensions for IP multicasting.</td>
</tr>
<tr>
<td>IGMPv2</td>
<td>Extends IGMP, allowing such capabilities as the IGMP leave process, group-specific queries, and an explicit maximum response time field. IGMPv2 also adds the capability for devices to elect the IGMP querier without dependence on the multicast protocol to perform this task. RFC 2236 defines IGMPv2.</td>
</tr>
<tr>
<td>IGMPv3</td>
<td>Provides for source filtering, which enables a multicast receiver host to signal to a device which groups it wants to receive multicast traffic from, and from which sources this traffic is expected. In addition, IGMPv3 supports the link local address 224.0.0.22, which is the destination IP address for IGMPv3 membership reports; all IGMPv3-capable multicast devices must listen to this address. RFC 3376 defines IGMPv3.</td>
</tr>
</tbody>
</table>

*Note*

By default, enabling a PIM on an interface enables IGMPv2 on that device. IGMPv2 was designed to be as backward compatible with IGMPv1 as possible. To accomplish this backward compatibility, RFC 2236 defined special interoperability rules. If your network contains legacy IGMPv1 hosts, you should be familiar with these operability rules. For more information about IGMPv1 and IGMPv2 interoperability, see RFC 2236, Internet Group Management Protocol, Version 2.
**Devices That Run IGMPv1**

IGMPv1 devices send IGMP queries to the “all-hosts” multicast address of 224.0.0.1 to solicit multicast groups with active multicast receivers. The multicast receivers also can send IGMP reports to the device to notify it that they are interested in receiving a particular multicast stream. Hosts can send the report asynchronously or in response to the IGMP queries sent by the device. If more than one multicast receiver exists for the same multicast group, only one of these hosts sends an IGMP report message; the other hosts suppress their report messages.

In IGMPv1, there is no election of an IGMP querier. If more than one device on the segment exists, all the devices send periodic IGMP queries. IGMPv1 has no special mechanism by which the hosts can leave the group. If the hosts are no longer interested in receiving multicast packets for a particular group, they simply do not reply to the IGMP query packets sent from the device. The device continues sending query packets. If the device does not hear a response in three IGMP queries, the group times out and the device stops sending multicast packets on the segment for the group. If the host later wants to receive multicast packets after the timeout period, the host simply sends a new IGMP join to the device, and the device begins to forward the multicast packet again.

If there are multiple devices on a LAN, a designated router (DR) must be elected to avoid duplicating multicast traffic for connected hosts. PIM devices follow an election process to select a DR. The PIM device with the highest IP address becomes the DR.

The DR is responsible for the following tasks:

- Sending PIM register and PIM Join and Prune messages toward the rendezvous point (RP) to inform it about host group membership.
- Sending IGMP host-query messages.
- Sending host-query messages by default every 60 seconds in order to keep the IGMP overhead on hosts and networks very low.

**Devices That Run IGMPv2**

IGMPv2 improves the query messaging capabilities of IGMPv1.

The query and membership report messages in IGMPv2 are identical to the IGMPv1 messages with two exceptions:

- IGMPv2 query messages are broken into two categories: general queries (identical to IGMPv1 queries) and group-specific queries.
- IGMPv1 membership reports and IGMPv2 membership reports have different IGMP type codes.

IGMPv2 also enhances IGMP by providing support for the following capabilities:

- Querier election process--Provides the capability for IGMPv2 devices to elect the IGMP querier without having to rely on the multicast routing protocol to perform the process.
- Maximum Response Time field--A new field in query messages permits the IGMP querier to specify the maximum query-response time. This field permits the tuning of the query-response process to control response burstiness and to fine-tune leave latencies.
- Group-Specific Query messages--Permits the IGMP querier to perform the query operation on a specific group instead of all groups.
- Leave-Group messages--Provides hosts with a method of notifying devices on the network that they wish to leave the group.
Unlike IGMPv1, in which the DR and the IGMP querier are typically the same device, in IGMPv2 the two functions are decoupled. The DR and the IGMP querier are selected based on different criteria and may be different devices on the same subnet. The DR is the device with the highest IP address on the subnet, whereas the IGMP querier is the device with the lowest IP address.

Query messages are used to elect the IGMP querier as follows:

1. When IGMPv2 devices start, they each multicast a general query message to the all-systems group address of 224.0.0.1 with their interface address in the source IP address field of the message.

2. When an IGMPv2 device receives a general query message, the device compares the source IP address in the message with its own interface address. The device with the lowest IP address on the subnet is elected the IGMP querier.

3. All devices (excluding the querier) start the query timer, which is reset whenever a general query message is received from the IGMP querier. If the query timer expires, it is assumed that the IGMP querier has gone down, and the election process is performed again to elect a new IGMP querier.

By default, the timer is two times the query interval.

**Devices Running IGMPv3**

IGMPv3 adds support for source filtering, which enables a multicast receiver host to signal to a device which groups it wants to receive multicast traffic from, and from which sources this traffic is expected. This membership information enables the software to forward traffic only from those sources from which receivers requested the traffic.

IGMPv3 supports applications that explicitly signal sources from which they want to receive traffic. With IGMPv3, receivers signal membership to a multicast group in the following two modes:

- **INCLUDE mode**—In this mode, the receiver announces membership to a group and provides a list of IP addresses (the INCLUDE list) from which it wants to receive traffic.

- **EXCLUDE mode**—In this mode, the receiver announces membership to a group and provides a list of IP addresses (the EXCLUDE list) from which it does not want to receive traffic. In other words, the host wants to receive traffic only from sources whose IP addresses are not listed in the EXCLUDE list. To receive traffic from all sources, like in the case of the Internet Standard Multicast (ISM) service model, a host expresses EXCLUDE mode membership with an empty EXCLUDE list.

IGMPv3 is the industry-designated standard protocol for hosts to signal channel subscriptions in an SSM network environment. For SSM to rely on IGMPv3, IGMPv3 must be available in the network stack portion of the operating systems running on the last hop devices and hosts and be used by the applications running on those hosts.

In IGMPv3, hosts send their membership reports to 224.0.0.22; all IGMPv3 devices, therefore, must listen to this address. Hosts, however, do not listen or respond to 224.0.0.22; they only send their reports to that address. In addition, in IGMPv3, there is no membership report suppression because IGMPv3 hosts do not listen to the reports sent by other hosts. Therefore, when a general query is sent out, all hosts on the wire respond.

**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.

**IGMP Join and Leave Process**

**IGMP Join Process**

When a host wants to join a multicast group, the host sends one or more unsolicited membership reports for the multicast group it wants to join. The IGMP join process is the same for IGMPv1 and IGMPv2 hosts.

In IGMPv3, the join process for hosts proceeds as follows:

- When a host wants to join a group, it sends an IGMPv3 membership report to 224.0.0.22 with an empty EXCLUDE list.
- When a host wants to join a specific channel, it sends an IGMPv3 membership report to 224.0.0.22 with the address of the specific source included in the INCLUDE list.
- When a host wants to join a group excluding particular sources, it sends an IGMPv3 membership report to 224.0.0.22 excluding those sources in the EXCLUDE list.

**Note**

If some IGMPv3 hosts on a LAN wish to exclude a source and others wish to include the source, then the device will send traffic for the source on the LAN (that is, inclusion trumps exclusion in this situation).

**IGMP Leave Process**

The method that hosts use to leave a group varies depending on the version of IGMP in operation.

**IGMPv1 Leave Process**

There is no leave-group message in IGMPv1 to notify the devices on the subnet that a host no longer wants to receive the multicast traffic from a specific group. The host simply stops processing traffic for the multicast group and ceases responding to IGMP queries with IGMP membership reports for the group. As a result, the only way IGMPv1 devices know that there are no longer any active receivers for a particular multicast group on a subnet is when the devices stop receiving membership reports. To facilitate this process, IGMPv1 devices associate a countdown timer with an IGMP group on a subnet. When a membership report is received for the group on the subnet, the timer is reset. For IGMPv1 devices, this timeout interval is typically three times the query interval (3 minutes). This timeout interval means that the device may continue to forward multicast traffic onto the subnet for up to 3 minutes after all hosts have left the multicast group.

**IGMPv2 Leave Process**

IGMPv2 incorporates a leave-group message that provides the means for a host to indicate that it wishes to stop receiving multicast traffic for a specific group. When an IGMPv2 host leaves a multicast group, if it was the last host to respond to a query with a membership report for that group, it sends a leave-group message to the all-devices multicast group (224.0.0.2).
IGMPv3 Leave Process

IGMPv3 enhances the leave process by introducing the capability for a host to stop receiving traffic from a particular group, source, or channel in IGMP by including or excluding sources, groups, or channels in IGMPv3 membership reports.

IGMP Snooping

Layer 2 devices can use IGMP snooping to constrain the flooding of multicast traffic by dynamically configuring Layer 2 interfaces so that multicast traffic is forwarded to only those interfaces associated with IP multicast devices. As the name implies, IGMP snooping requires the LAN device to snoop on the IGMP transmissions between the host and the router and to keep track of multicast groups and member ports. When the device receives an IGMP report from a host for a particular multicast group, the device adds the host port number to the forwarding table entry; when it receives an IGMP Leave Group message from a host, it removes the host port from the table entry. It also periodically deletes entries if it does not receive IGMP membership reports from the multicast clients.

Note

For more information on IP multicast and IGMP, see RFC 1112 and RFC 2236.

The multicast router (which could be a device with the IP services feature set on the active device) sends out periodic general queries to all VLANs. All hosts interested in this multicast traffic send join requests and are added to the forwarding table entry. The device creates one entry per VLAN in the IGMP snooping IP multicast forwarding table for each group from which it receives an IGMP join request.

The device supports IP multicast group-based bridging, instead of MAC-address based groups. With multicast MAC address-based groups, if an IP address being configured translates (aliases) to a previously configured MAC address or to any reserved multicast MAC addresses (in the range 224.0.0.xxx), the command fails. Because the device uses IP multicast groups, there are no address aliasing issues.

The IP multicast groups learned through IGMP snooping are dynamic. However, you can statically configure multicast groups by using the `ip igmp snooping vlan vlan-id static ip_address interface interface-id` global configuration command. If you specify group membership for a multicast group address statically, your setting supersedes any automatic manipulation by IGMP snooping. Multicast group membership lists can consist of both user-defined and IGMP snooping-learned settings.

You can configure an IGMP snooping querier to support IGMP snooping in subnets without multicast interfaces because the multicast traffic does not need to be routed.

If a port spanning-tree, a port group, or a VLAN ID change occurs, the IGMP snooping-learned multicast groups from this port on the VLAN are deleted.

Related Topics

- Enabling or Disabling IGMP Snooping on a Device (CLI), on page 57
- Examples: Configuring IGMP Snooping, on page 81

Joining a Multicast Group

When a host connected to the device wants to join an IP multicast group and it is an IGMP version 2 client, it sends an unsolicited IGMP join message, specifying the IP multicast group to join. Alternatively, when the device receives a general query from the router, it forwards the query to all ports in the VLAN. IGMP version
1 or version 2 hosts wanting to join the multicast group respond by sending a join message to the device. The device CPU creates a multicast forwarding-table entry for the group if it is not already present. The CPU also adds the interface where the join message was received to the forwarding-table entry. The host associated with that interface receives multicast traffic for that multicast group.

**Figure 1: Initial IGMP Join Message**

Router A sends a general query to the device, which forwards the query to ports 2 through 5, which are all members of the same VLAN. Host 1 wants to join multicast group 224.1.2.3 and multicasts an IGMP membership report (IGMP join message) to the group. The device CPU uses the information in the IGMP report to set up a forwarding-table entry that includes the port numbers connected to Host 1 and to the router.

**Table 5: IGMP Snooping Forwarding Table**

<table>
<thead>
<tr>
<th>Destination Address</th>
<th>Type of Packet</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>224.1.2.3</td>
<td>IGMP</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

The device hardware can distinguish IGMP information packets from other packets for the multicast group. The information in the table tells the switching engine to send frames addressed to the 224.1.2.3 multicast IP address that are not IGMP packets to the router and to the host that has joined the group.

If another host (for example, Host 4) sends an unsolicited IGMP join message for the same group, the CPU receives that message and adds the port number of Host 4 to the forwarding table. Because the forwarding
Table directs IGMP messages only to the CPU, the message is not flooded to other ports on the device. Any known multicast traffic is forwarded to the group and not to the CPU.

**Figure 2: Second Host Joining a Multicast Group**

![Second Host Joining a Multicast Group](image)

**Table 6: Updated IGMP Snooping Forwarding Table**

<table>
<thead>
<tr>
<th>Destination Address</th>
<th>Type of Packet</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>224.1.2.3</td>
<td>IGMP</td>
<td>1, 2, 5</td>
</tr>
</tbody>
</table>

**Related Topics**

- Configuring the Device as a Member of a Group (CLI), on page 34
- Example: Configuring the Device as a Member of a Multicast Group, on page 81

**Leaving a Multicast Group**

The router sends periodic multicast general queries, and the device forwards these queries through all ports in the VLAN. Interested hosts respond to the queries. If at least one host in the VLAN wants to receive multicast traffic, the router continues forwarding the multicast traffic to the VLAN. The device forwards multicast group traffic only to those hosts listed in the forwarding table for that IP multicast group maintained by IGMP snooping.

When hosts want to leave a multicast group, they can silently leave, or they can send a leave message. When the device receives a leave message from a host, it sends a group-specific query to learn if any other devices connected to that interface are interested in traffic for the specific multicast group. The device then updates the forwarding table for that MAC group so that only those hosts interested in receiving multicast traffic for the group are listed in the forwarding table. If the router receives no reports from a VLAN, it removes the group for the VLAN from its IGMP cache.
Immediate Leave

The device uses IGMP snooping Immediate Leave to remove from the forwarding table an interface that sends a leave message without the device sending group-specific queries to the interface. The VLAN interface is pruned from the multicast tree for the multicast group specified in the original leave message. Immediate Leave ensures optimal bandwidth management for all hosts on a switched network, even when multiple multicast groups are simultaneously in use.

Immediate Leave is only supported on IGMP version 2 hosts. IGMP version 2 is the default version for the device.

Note: You should only use the Immediate Leave feature on VLANs where a single host is connected to each port. If Immediate Leave is enabled in VLANs where more than one host is connected to a port, some hosts might inadvertently be dropped.

IGMP Configurable-Leave Timer

You can configure the time that the device waits after sending a group-specific query to determine if hosts are still interested in a specific multicast group. The IGMP leave response time can be configured from 100 to 5000 milliseconds. The timer can be set either globally or on a per-VLAN basis. The VLAN configuration of the leave time overrides the global configuration.

Related Topics

Configuring the IGMP Leave Timer (CLI), on page 65

IGMP Report Suppression

Note: IGMP report suppression is supported only when the multicast query has IGMPv1 and IGMPv2 reports. This feature is not supported when the query includes IGMPv3 reports.

The device uses IGMP report suppression to forward only one IGMP report per multicast router query to multicast devices. When IGMP report suppression is enabled (the default), the device sends the first IGMP report from all hosts for a group to all the multicast routers. The device does not send the remaining IGMP reports for the group to the multicast routers. This feature prevents duplicate reports from being sent to the multicast devices.

If the multicast router query includes requests only for IGMPv1 and IGMPv2 reports, the device forwards only the first IGMPv1 or IGMPv2 report from all hosts for a group to all the multicast routers.

If the multicast router query also includes requests for IGMPv3 reports, the device forwards all IGMPv1, IGMPv2, and IGMPv3 reports for a group to the multicast devices.

If you disable IGMP report suppression, all IGMP reports are forwarded to the multicast routers.
IGMP Snooping and Device Stacks

IGMP snooping functions across the device stack; that is, IGMP control information from one device is distributed to all devices in the stack. Regardless of the stack member through which IGMP multicast data enters the stack, the data reaches the hosts that have registered for that group.

If a device in the stack fails or is removed from the stack, only the members of the multicast group that are on that device will not receive the multicast data. All other members of a multicast group on other devices in the stack continue to receive multicast data streams. However, multicast groups that are common for both Layer 2 and Layer 3 (IP multicast routing) might take longer to converge if the active device is removed.

IGMP Filtering and Throttling Overview

In some environments, for example, metropolitan or multiple-dwelling unit (MDU) installations, you might want to control the set of multicast groups to which a user on a device port can belong. You can control the distribution of multicast services, such as IP/TV, based on some type of subscription or service plan. You might also want to limit the number of multicast groups to which a user on a device port can belong.

With the IGMP filtering feature, you can filter multicast joins on a per-port basis by configuring IP multicast profiles and associating them with individual device ports. An IGMP profile can contain one or more multicast groups and specifies whether access to the group is permitted or denied. If an IGMP profile denying access to a multicast group is applied to a device port, the IGMP join report requesting the stream of IP multicast traffic is dropped, and the port is not allowed to receive IP multicast traffic from that group. If the filtering action permits access to the multicast group, the IGMP report from the port is forwarded for normal processing. You can also set the maximum number of IGMP groups that a Layer 2 interface can join.

IGMP filtering controls only group-specific query and membership reports, including join and leave reports. It does not control general IGMP queries. IGMP filtering has no relationship with the function that directs the forwarding of IP multicast traffic. The filtering feature operates in the same manner whether CGMP or MVR is used to forward the multicast traffic.

IGMP filtering applies only to the dynamic learning of IP multicast group addresses, not static configuration.

With the IGMP throttling feature, you can set the maximum number of IGMP groups that a Layer 2 interface can join. If the maximum number of IGMP groups is set, the IGMP snooping forwarding table contains the maximum number of entries, and the interface receives an IGMP join report, you can configure an interface to drop the IGMP report or to replace the randomly selected multicast entry with the received IGMP report.

Note

IGMPv3 join and leave messages are not supported on devices running IGMP filtering.

Related Topics

Configuring the IGMP Throttling Action (CLI), on page 50
Examples: Configuring Filtering and Throttling, on page 82

Default IGMP Configuration

This table displays the default IGMP configuration for the device.
Table 7: Default IGMP Configuration

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

Default IGMP Snooping Configuration

This table displays the default IGMP snooping configuration for the device.

Table 8: Default IGMP Snooping Configuration

<table>
<thead>
<tr>
<th>Feature</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGMP snooping</td>
<td>Enabled globally and per VLAN</td>
</tr>
<tr>
<td>Multicast routers</td>
<td>None configured</td>
</tr>
<tr>
<td>IGMP snooping Immediate Leave</td>
<td>Disabled</td>
</tr>
<tr>
<td>Static groups</td>
<td>None configured</td>
</tr>
<tr>
<td>TCN(^1) flood query count</td>
<td>2</td>
</tr>
<tr>
<td>TCN query solicitation</td>
<td>Disabled</td>
</tr>
<tr>
<td>IGMP snooping querier</td>
<td>Disabled</td>
</tr>
<tr>
<td>IGMP report suppression</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

\(^1\) TCN = Topology Change Notification

Default IGMP Filtering and Throttling Configuration

This table displays the default IGMP filtering and throttling configuration for the device.
### How to Configure IGMP

#### Configuring the Device as a Member of a Group (CLI)

You can configure the device as a member of a multicast group and discover multicast reachability in a network. If all the multicast-capable routers and multilayer devices 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](image)

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

---

**Table 9: Default IGMP Filtering Configuration**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGMP filters</td>
<td>None applied.</td>
</tr>
<tr>
<td>IGMP maximum number of IGMP groups</td>
<td>No maximum set.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>When the maximum number of groups is in the forwarding table, the default IGMP throttling action is to deny the IGMP report.</td>
</tr>
<tr>
<td>IGMP profiles</td>
<td>None defined.</td>
</tr>
<tr>
<td>IGMP profile action</td>
<td>Deny the range addresses.</td>
</tr>
</tbody>
</table>
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>enable</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device&gt; <strong>enable</strong>&lt;br&gt;Enables privileged EXEC mode.&lt;br&gt;• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device# <strong>configure terminal</strong>&lt;br&gt;Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>interface interface-id</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config)# <strong>interface gigabitethernet 1/0/1</strong>&lt;br&gt;Specifies the Layer 3 interface on which you want to enable multicast routing, and enters interface configuration mode.&lt;br&gt;The specified interface must be one of the following:&lt;br&gt;• A routed port—A physical port that has been configured as a Layer 3 port by entering the <strong>no switchport</strong> interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see <strong>Example: Interface Configuration as a Routed Port</strong>, on page 83.&lt;br&gt;• An SVI—A VLAN interface created by using the <strong>interface vlan vlan-id</strong> global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see <strong>Example: Interface Configuration as an SVI</strong>, on page 83.&lt;br&gt;These interfaces must have IP addresses assigned to them.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>ip igmp join-group group-address</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config-if)# <strong>ip igmp join-group 225.2.2.2</strong>&lt;br&gt;Configures the device to join a multicast group.&lt;br&gt;By default, no group memberships are defined.&lt;br&gt;For <strong>group-address</strong>, specify the multicast IP address in dotted decimal notation.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>end</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config-if)# <strong>end</strong>&lt;br&gt;Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### Controlling Access to IP Multicast Group (CLI)

The device sends IGMP host-query messages to find which multicast groups have members on attached local networks. The device 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.

To limit the number of joins on the interface, configure the port for the filter which associates with the IGMP profile.

This procedure is optional.

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip igmp profile`
4. `permit`
5. `exit`
6. `interface interface-id`
7. `ip igmp filter filter_number`
8. `end`
9. `show ip igmp interface [interface-id]`

---

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 6</strong></td>
<td>show ip igmp interface [interface-id]</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# show ip igmp interface</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>copy running-config startup-config</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# copy running-config startup-config</td>
</tr>
</tbody>
</table>

(Optional) Saves your entries in the configuration file.
**DETAILLED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

| **Step 2**              | configure terminal                                                     |
| **Example:**            |                                                                         |
| Device# configure terminal |                                                                     |

| **Step 3**              | ip igmp profile                                                        |
| **Example:**            | Enters an IGMP filter profile number from 1 to 4294967295.             |
| Device(config)# ip igmp profile 10 | For additional information about configuring IGMP filter profiles, see Configuring IGMP Profiles (CLI), on page 45. |

| **Step 4**              | permit                                                                  |
| **Example:**            | Enters an IGMP profile configuration action. The following IGMP profile configuration actions are supported: |
| Device(config-igmp-profile)# |                                                             |
| permit 229.9.9.0 | • deny—Matching IP addresses are denied. |
| no               | • exit—Exits from the IGMP profile configuration mode.                |
| permit           | • no—Negates a command or set its defaults.                        |
| range            | • permit—Matching addresses are permitted.                          |

| **Step 5**              | exit                                                                    |
| **Example:**            |                                                                         |
| Device(config-igmp-profile)# | exit                                                                 |

| **Step 6**              | interface interface-id                                                 |
| **Example:**            |                                                                         |
| Device(config)# interface gigabitethernet 1/0/1 | Specifies the interface to be configured, and enters interface configuration mode. |

| **Step 7**              | ip igmp filter filter_number                                           |
| **Example:**            |                                                                         |
| Device(config-if)# ip igmp filter 10 | Specifies the IGMP filter profile number. For additional information about applying IGMP filter profiles, see Applying IGMP Profiles (CLI), on page 47. |
### Modifying the IGMP Host-Query Message Interval (CLI)

The device 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 device 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 device elects a PIM designated router (DR) for the LAN (subnet). The DR is the router or multilayer device 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. `enable`
2. `configure terminal`
3. `interface interface-id`
4. `ip igmp query-interval seconds`
5. `end`
6. `show ip igmp interface [interface-id]`
7. `copy running-config startup-config`

---

**Related Topics**

Example: Controlling Access to Multicast Groups, on page 81
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>enable</strong></td>
<td>Enables privileged EXEC mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>configure terminal</strong></td>
<td>Enters the global configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>interface interface-id</strong></td>
<td>Specifies the Layer 3 interface on which you want to enable multicast routing, and enters interface configuration mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# interface gigabitethernet 1/0/1</td>
<td></td>
</tr>
</tbody>
</table>

- A routed port—A physical port that has been configured as a Layer 3 port by entering the `no switchport` interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83.

- An SVI—A VLAN interface created by using the `interface vlan` `vlan-id` global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83.

These interfaces must have IP addresses assigned to them.

<table>
<thead>
<tr>
<th>Step 4</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ip igmp query-interval seconds</strong></td>
<td>Configures the frequency at which the designated router sends IGMP host-query messages.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>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 65535.</td>
<td></td>
</tr>
<tr>
<td><strong>Device(config-if)# ip igmp query-interval 75</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 5</th>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>end</strong></td>
<td>Returns to privileged EXEC mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# end</td>
<td></td>
</tr>
</tbody>
</table>
### Purpose

**Show IP IGMP Interface**

Verifies your entries.

**Copy Running-Config Startup-Config**

(Optional) Saves your entries in the configuration file.

### Changing the IGMP Query Timeout for IGMPv2 (CLI)

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

This procedure is optional.

### SUMMARY STEPS

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

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface interface-id</td>
<td>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:</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface gigabitethernet 1/0/1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip igmp querier-timeout seconds</td>
<td>Specifies the IGMP query timeout. The default is 60 seconds (twice the query interval). The range is 60 to 300.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# ip igmp querier-timeout 120</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# end</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> show ip igmp interface [interface-id]</td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# show ip igmp interface</td>
<td></td>
</tr>
</tbody>
</table>
Changing the Maximum Query Response Time for IGMPv2 (CLI)

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

**SUMMARY STEPS**

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> <code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: <code>Device&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> <code>configure terminal</code></td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: <code>Device# configure terminal</code></td>
<td></td>
</tr>
</tbody>
</table>
### Configuring IGMP

#### Changing the Maximum Query Response Time for IGMPv2 (CLI)

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 3 | `interface interface-id` | 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. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83.  
  - An SVI—A VLAN interface created by using the `interface vlan vlan-id` global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83.  
These interfaces must have IP addresses assigned to them. |
| Step 4 | `ip igmp query-max-response-time seconds` | Changes the maximum query response time advertised in IGMP queries. The default is 10 seconds. The range is 1 to 25. |
| Step 5 | `end` | Returns to privileged EXEC mode. |
| Step 6 | `show ip igmp interface [interface-id]` | Verifies your entries. |
| Step 7 | `copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |
Configuring the Device as a Statically Connected Member (CLI)

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 device accepts the multicast packets in addition to forwarding them. Accepting the multicast packets prevents the device from fast switching.

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface interface-id</td>
<td>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:</td>
</tr>
<tr>
<td>Example:</td>
<td>• A routed port—A physical port that has been configured as a Layer 3 port by entering the no switchport interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to</td>
</tr>
<tr>
<td>Device(config)# interface gigabitethernet 1/0/1</td>
<td></td>
</tr>
</tbody>
</table>
Configuring IGMP Profiles (CLI)

To configure an IGMP profile, use the `ip igmp profile` global configuration command with a profile number to create an IGMP profile and to enter IGMP profile configuration mode. From this mode, you can specify the parameters of the IGMP profile to be used for filtering IGMP join requests from a port. When you are in IGMP profile configuration mode, you can create the profile by using these commands:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>ip igmp static-group group-address</code></td>
<td>Configures the device as a statically connected member of a group.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# ip igmp static-group 239.100.100.101</td>
</tr>
<tr>
<td><code>end</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# end</td>
</tr>
<tr>
<td><code>show ip igmp interface [interface-id]</code></td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# show ip igmp interface gigabitethernet 1/0/1</td>
</tr>
<tr>
<td><code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# copy running-config startup-config</td>
</tr>
</tbody>
</table>

These interfaces must have IP addresses assigned to them.

- An SVI—A VLAN interface created by using the `interface vlan vlan-id` global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83.

By default, this feature is disabled.
• deny—Specifies that matching addresses are denied; this is the default.
• exit—Exits from igmp-profile configuration mode.
• no—Negates a command or returns to its defaults.
• permit—Specifies that matching addresses are permitted.
• range—Specifies a range of IP addresses for the profile. You can enter a single IP address or a range with a start and an end address.

The default is for the device to have no IGMP profiles configured. When a profile is configured, if neither the permit nor deny keyword is included, the default is to deny access to the range of IP addresses.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip igmp profile profile number
4. permit | deny
5. range ip multicast address
6. end
7. show ip igmp profile profile number
8. copy running-config startup-config

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>

Example:

Device> enable

• Enter your password if prompted.

| Step 2 | configure terminal | Enters the global configuration mode. |

Example:

Device# configure terminal

| Step 3 | ip igmp profile profile number | Assigns a number to the profile you are configuring, and enters IGMP profile configuration mode. The profile number range is 1 to 4294967295. |

Example:

Device(config)# ip igmp profile 3

Note: To delete a profile, use the no ip igmp profile profile number global configuration command.
### Applying IGMP Profiles (CLI)

To control access as defined in an IGMP profile, use the `ip igmp filter` interface configuration command to apply the profile to the appropriate interfaces. You can apply IGMP profiles only to Layer 2 access ports; you cannot apply IGMP profiles to routed ports or SVIs. You cannot apply profiles to ports that belong to an EtherChannel port group. You can apply a profile to multiple interfaces, but each interface can have only one profile applied to it.

---

**Step 4**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>`permit</td>
<td>deny`</td>
</tr>
</tbody>
</table>

**Example:**

```
Device(config-igmp-profile)# permit
```

**Step 5**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>range ip multicast address</code></td>
<td>Enters the IP multicast address or range of IP multicast addresses to which access is being controlled. If entering a range, enter the low IP multicast address, a space, and the high IP multicast address. You can use the <code>range</code> command multiple times to enter multiple addresses or ranges of addresses.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device(config-igmp-profile)# range 229.9.9.0
```

**Note**

To delete an IP multicast address or range of IP multicast addresses, use the `no range ip multicast address` IGMP profile configuration command.

**Step 6**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>end</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device(config-igmp-profile)# end
```

**Step 7**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show ip igmp profile profile number</code></td>
<td>Verifies the profile configuration.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device# show ip igmp profile 3
```

**Step 8**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device# copy running-config startup-config
```
SUMMARY STEPS

1. enable
2. configure terminal
3. interface interface-id
4. ip igmp filter profile number
5. end
6. show running-config interface interface-id
7. copy running-config startup-config

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface interface-id</td>
<td>Specifies the physical interface, and enters interface configuration mode. The interface must be a Layer 2 port that does not belong to an EtherChannel port group.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface gigabitethernet1/0/1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip igmp filter profile number</td>
<td>Applies the specified IGMP profile to the interface. The range is 1 to 4294967295.</td>
</tr>
<tr>
<td>Example:</td>
<td>• To remove a profile from an interface, use the no ip igmp filter profile number interface configuration command.</td>
</tr>
<tr>
<td>Device(config-if)# ip igmp filter 321</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config-if)# end</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> show running-config interface interface-id</td>
<td>Verifies the configuration.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show running-config interface</td>
<td></td>
</tr>
</tbody>
</table>
### Setting the Maximum Number of IGMP Groups (CLI)

You can set the maximum number of IGMP groups that a Layer 2 interface can join by using the `ip igmp max-groups` interface configuration command. Use the `no` form of this command to set the maximum back to the default, which is no limit.

This restriction can be applied to Layer 2 ports only; you cannot set a maximum number of IGMP groups on routed ports or SVIs. You also can use this command on a logical EtherChannel interface but cannot use it on ports that belong to an EtherChannel port group.

Beginning in privileged EXEC mode, follow these steps to set the maximum number of IGMP groups in the forwarding table:

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `interface interface-id`
4. `ip igmp max-groups number`
5. `end`
6. `show running-config interface interface-id`
7. `copy running-config startup-config`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

**Step 7**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device# copy running-config startup-config
```
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface interface-id</td>
<td>Specifies the interface to be configured, and enters interface configuration mode. The interface can be a Layer 2 port that does not belong to an EtherChannel group or a EtherChannel interface.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# interface gigabitethernet1/0/2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip igmp max-groups number</td>
<td>Sets the maximum number of IGMP groups that the interface can join. The range is 0 to 4294967294. The default is to have no maximum set.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# ip igmp max-groups 20</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> The device supports a maximum number of 4096 Layer 2 IGMP groups and 2048 Layer 3 IGMP groups.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# end</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> show running-config interface interface-id</td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# show running-config interface gigabitethernet1/0/1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# copy running-config startup-config</td>
<td></td>
</tr>
</tbody>
</table>

### Configuring the IGMP Throttling Action (CLI)

After you set the maximum number of IGMP groups that a Layer 2 interface can join, you can configure an interface to replace the existing group with the new group for which the IGMP report was received by using the **ip igmp max-groups action replace** interface configuration command. Use the **no** form of this command to return to the default, which is to drop the IGMP join report.

Follow these guidelines when configuring the IGMP throttling action:
• This restriction can be applied only to Layer 2 ports. You can use this command on a logical EtherChannel interface but cannot use it on ports that belong to an EtherChannel port group.

• When the maximum group limitation is set to the default (no maximum), entering the `ip igmp max-groups action {deny | replace}` command has no effect.

• If you configure the throttling action and set the maximum group limitation after an interface has added multicast entries to the forwarding table, the forwarding-table entries are either aged out or removed, depending on the throttling action.

  ◦ If you configure the throttling action as `deny`, the entries that were previously in the forwarding table are not removed but are aged out. After these entries are aged out and the maximum number of entries is in the forwarding table, the device drops the next IGMP report received on the interface.

  ◦ If you configure the throttling action as `replace`, the entries that were previously in the forwarding table are removed. When the maximum number of entries is in the forwarding table, the device replaces a randomly selected entry with the received IGMP report.

To prevent the device from removing the forwarding-table entries, you can configure the IGMP throttling action before an interface adds entries to the forwarding table.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface interface-id`
4. `ip igmp max-groups action {deny | replace}`
5. `end`
6. `show running-config interface interface-id`
7. `copy running-config startup-config`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: <code>Device&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td>Example: <code>Device# configure terminal</code></td>
<td></td>
</tr>
</tbody>
</table>
### Configuring the IGMP Throttling Action (CLI)

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>interface interface-id</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config)# interface gigabitethernet 1/0/1</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>**ip igmp max-groups action {deny</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>end</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config-if)# end</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td><strong>show running-config interface interface-id</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device# show running-config interface gigabitethernet1/0/1</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td><strong>copy running-config startup-config</strong>&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device# copy running-config startup-config</td>
</tr>
</tbody>
</table>

**Related Topics**

- IGMP Filtering and Throttling Overview, on page 32
- Examples: Configuring Filtering and Throttling, on page 82
Configuring the Device to Forward Multicast Traffic in the Absence of Directly Connected IGMP Hosts

Perform this optional task to configure the device to forward multicast traffic in the absence of directly connected IGMP hosts.

SUMMARY STEPS

1. enable
2. configure terminal
3. interface type number
4. Do one of the following:
   - ip igmp join-group group-address
   - ip igmp static-group {* | group-address [source source-address]}
5. end
6. show ip igmp interface [interface-type interface-number]

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 interface type number</td>
<td>Enters interface configuration mode.</td>
</tr>
<tr>
<td>Example: Device(config)# interface gigabitethernet 1</td>
<td></td>
</tr>
<tr>
<td>Step 4 Do one of the following:</td>
<td>The first sample shows how to configure an interface on the device to join the specified group.</td>
</tr>
<tr>
<td>• ip igmp join-group group-address</td>
<td>• With this method, the device accepts the multicast packets in addition to forwarding them. Accepting the multicast packets prevents the device from fast switching.</td>
</tr>
<tr>
<td>• ip igmp static-group {*</td>
<td>group-address [source source-address]}</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Example:</td>
<td>The second example shows how to configure static group membership entries on an interface.</td>
</tr>
<tr>
<td>Device(config-if)# ip igmp join-group 225.2.2.2</td>
<td>• With this method, the device does not accept the packets itself, but only forwards them. Hence, this method allows fast switching.</td>
</tr>
<tr>
<td>Example:</td>
<td>The outgoing interface appears in the IGMP cache, but the device itself is not a member, as evidenced by lack of an &quot;L&quot; (local) flag</td>
</tr>
<tr>
<td>Device(config-if)# ip igmp static-group 225.2.2.2</td>
<td>in the multicast route entry.</td>
</tr>
</tbody>
</table>

**Step 5**

| end                                                                               | Returns to privileged EXEC mode.                                                                                                                                                             |
| Example:                                                                         |                                                                                                                                                                                         |
| Device(config-if)# end                                                            |                                                                                                                                                                                         |

**Step 6**

| show ip igmp interface [interface-type interface-number]                          | (Optional) Displays multicast-related information about an interface.                                                                                                                      |
| Example:                                                                         |                                                                                                                                                                                         |
| Device# show ip igmp interface                                                    |                                                                                                                                                                                         |

**Related Topics**

Example: Configuring the Device to Forward Multicast Traffic in the Absence of Directly Connected IGMP Hosts, on page 84

**Controlling Access to an SSM Network Using IGMP Extended Access Lists**

Perform this optional task to control access to an SSM network by using an IGMP extended access list that filters SSM traffic based on source address, group address, or both.
SUMMARY STEPS

1. enable
2. configure terminal
3. ip multicast-routing [distributed]
4. ip pim ssm {default | range access-list}
5. ip access-list extended access-list -name
6. deny igmp source source-wildcard destination destination-wildcard [igmp-type] [precedence precedence] [tos tos] [log] [time-range time-range-name] [fragments]
7. permit igmp source source-wildcard destination destination-wildcard [igmp-type] [precedence precedence] [tos tos] [log] [time-range time-range-name] [fragments]
8. exit
9. interface type number
10. ip igmp access-group access-list
11. ip pim sparse-mode
12. Repeat Steps 1 through 11 on all interfaces that require access control of SSM channel membership.
13. ip igmp version 3
14. Repeat Step 13 on all host-facing interfaces.
15. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>ip multicast-routing [distributed]</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# ip multicast-routing distributed</td>
</tr>
<tr>
<td></td>
<td>Enables IP multicast routing.</td>
</tr>
<tr>
<td></td>
<td>• The distributed keyword is required for IPv4 multicast..</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>ip pim ssm {default</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# ip pim ssm default</td>
</tr>
<tr>
<td></td>
<td>Configures SSM service.</td>
</tr>
<tr>
<td></td>
<td>• The default keyword defines the SSM range access list as 232/8.</td>
</tr>
</tbody>
</table>
### Purpose

- The range keyword specifies the standard IP access list number or name that defines the SSM range.

### Command or Action

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><code>ip access-list extended access-list-name</code></td>
<td>Specifies an extended named IP access list.</td>
</tr>
<tr>
<td>6</td>
<td><code>deny igmp source source-wildcard destination destination-wildcard [igmp-type] [precedence precedence] [tos tos] [log] [time-range time-range-name] [fragments]</code></td>
<td>(Optional) Filters the specified source address or group address from the IGMP report, thereby restricting hosts on a subnet from membership to the (S, G) channel.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config)# ip access-list extended mygroup</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td><code>permit igmp source source-wildcard destination destination-wildcard [igmp-type] [precedence precedence] [tos tos] [log] [time-range time-range-name] [fragments]</code></td>
<td>Allows a source address or group address in an IGMP report to pass the IP access list.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-ext-nacl)# deny igmp host 10.1.2.3 any</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><code>exit</code></td>
<td>Exits the current configuration session and returns to global configuration mode.</td>
</tr>
<tr>
<td>9</td>
<td><code>interface type number</code></td>
<td>Selects an interface that is connected to hosts on which IGMPv3 can be enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config)# interface ethernet 0</td>
<td></td>
</tr>
<tr>
<td><strong>Step</strong></td>
<td><strong>Command or Action</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>---------</td>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Step 10</td>
<td>ip igmp access-group <em>access-list</em></td>
<td>Applies the specified access list to IGMP reports.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# ip igmp access-group mygroup</td>
<td></td>
</tr>
<tr>
<td>Step 11</td>
<td>ip pim sparse-mode</td>
<td>Enables PIM-SM on the interface.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# ip pim sparse-mode</td>
<td></td>
</tr>
<tr>
<td>Step 12</td>
<td>Repeat Steps 1 through 11 on all interfaces that require access control of SSM channel membership.</td>
<td>--</td>
</tr>
<tr>
<td>Step 13</td>
<td>ip igmp version 3</td>
<td>Enables IGMPv3 on this interface. The default version of IGMP is IGMP version 2. Version 3 is required by SSM.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# ip igmp version 3</td>
<td></td>
</tr>
<tr>
<td>Step 14</td>
<td>Repeat Step 13 on all host-facing interfaces.</td>
<td>--</td>
</tr>
<tr>
<td>Step 15</td>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-if)# end</td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

- Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 84
- Example: Denying All States for a Group G, on page 85
- Example: Denying All States for a Source S, on page 85
- Example: Permitting All States for a Group G, on page 85
- Example: Permitting All States for a Source S, on page 86
- Example: Filtering a Source S for a Group G, on page 86

**How to Configure IGMP Snooping**

**Enabling or Disabling IGMP Snooping on a Device (CLI)**

By default, IGMP snooping is globally enabled on the device. When globally enabled or disabled, it is also enabled or disabled in all existing VLAN interfaces. IGMP snooping is by default enabled on all VLANs, but can be enabled and disabled on a per-VLAN basis.
Global IGMP snooping overrides the VLAN IGMP snooping. If global snooping is disabled, you cannot enable VLAN snooping. If global snooping is enabled, you can enable or disable VLAN snooping.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip igmp snooping`
4. `end`
5. `copy running-config startup-config`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; <code>enable</code></td>
<td><strong>Purpose</strong> Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# <code>configure terminal</code></td>
<td><strong>Note</strong> Globally enables IGMP snooping in all existing VLAN interfaces.</td>
</tr>
<tr>
<td></td>
<td>To globally disable IGMP snooping on all VLAN interfaces, use the <code>no ip igmp snooping</code> global configuration command.</td>
</tr>
<tr>
<td><strong>Step 3</strong> ip igmp snooping</td>
<td>Globally enables IGMP snooping in all existing VLAN interfaces.</td>
</tr>
<tr>
<td>Example: Device(config)# <code>ip igmp snooping</code></td>
<td><strong>Note</strong> To globally disable IGMP snooping on all VLAN interfaces, use the <code>no ip igmp snooping</code> global configuration command.</td>
</tr>
<tr>
<td><strong>Step 4</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device(config)# <code>end</code></td>
<td><strong>Purpose</strong> Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Step 5</strong> copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td>Example: Device# <code>copy running-config startup-config</code></td>
<td><strong>Related Topics</strong> IGMP Snooping, on page 28</td>
</tr>
</tbody>
</table>
Enabling or Disabling IGMP Snooping on a VLAN Interface (CLI)

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip igmp snooping vlan vlan-id`
4. `end`
5. `copy running-config startup-config`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

| Step 2 configure terminal | Enters the global configuration mode. |
| **Example:** Device# configure terminal | |

| Step 3 ip igmp snooping vlan vlan-id | Enables IGMP snooping on the VLAN interface. The VLAN ID range is 1 to 1001 and 1006 to 4094. |
| **Example:** Device(config)# ip igmp snooping vlan 7 | IGMP snooping must be globally enabled before you can enable VLAN snooping. |

**Note** To disable IGMP snooping on a VLAN interface, use the `no ip igmp snooping vlan vlan-id` global configuration command for the specified VLAN number.

| Step 4 end | Returns to privileged EXEC mode. |
| **Example:** Device(config)# end | |

| Step 5 copy running-config startup-config | (Optional) Saves your entries in the configuration file. |
| **Example:** Device# copy running-config startup-config | |
Setting the Snooping Method (CLI)

Multicast-capable router ports are added to the forwarding table for every Layer 2 multicast entry. The device learns of the ports through one of these methods:

- Snooping on IGMP queries
- Statically connecting to a multicast router port using the `ip igmp snooping mrouter` global configuration command

Beginning in privileged EXEC mode, follow these steps to alter the method in which a VLAN interface accesses a multicast router:

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip igmp snooping vlan vlan-id mrouter interface {GigabitEthernet | Port-Channel | TenGigabitEthernet}`
4. `end`
5. `show ip igmp snooping`
6. `copy running-config startup-config`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** | enable | Enables privileged EXEC mode.  
Example:  
Device> enable |
| **Step 2** | configure terminal | Enters the global configuration mode.  
Example:  
Device# configure terminal |
| **Step 3** | `ip igmp snooping vlan vlan-id mrouter interface {GigabitEthernet | Port-Channel | TenGigabitEthernet}` | Enables IGMP snooping on a VLAN. The VLAN ID range is 1 to 1001 and 1006 to 4094.  
Example:  
Device(config)# ip igmp snooping vlan 1 mrouter interface GigabitEthernet1/0/3 |
### Configuring IGMP Snooping

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><code>end</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# end</code></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><code>show ip igmp snooping</code></td>
<td>Verifies the configuration.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device# show ip igmp snooping</code></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device# copy running-config startup-config</code></td>
<td></td>
</tr>
</tbody>
</table>

### Configuring a Multicast Router Port (CLI)

To add a multicast router port (add a static connection to a multicast router), use the `ip igmp snooping vlan mrouter` global configuration command on the device.

**Note**

Static connections to multicast routers are supported only on device ports.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip igmp snooping vlan vlan-id mrouter interface interface-id`
4. `end`
5. `show ip igmp snooping mrouter [vlan vlan-id]`
6. `copy running-config startup-config`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### How to Configure IGMP Snooping

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>ip igmp snooping vlan <em>vlan-id</em> mrouter interface <em>interface-id</em></td>
<td>Specifies the multicast router VLAN ID and the interface to the multicast router.</td>
</tr>
<tr>
<td>Example:</td>
<td>• The VLAN ID range is 1 to 1001 and 1006 to 4094.</td>
</tr>
<tr>
<td>Device(config)# ip igmp snooping vlan 5 mrouter interface gigabitethernet1/0/1</td>
<td>• The interface can be a physical interface or a port channel. The port-channel range is 1 to 128.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>To remove a multicast router port from the VLAN, use the <strong>no ip igmp snooping vlan <em>vlan-id</em> mrouter interface <em>interface-id</em></strong> global configuration command.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# end</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>show ip igmp snooping mrouter [vlan <em>vlan-id</em>]</td>
<td>Verifies that IGMP snooping is enabled on the VLAN interface.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show ip igmp snooping mrouter vlan 5</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# copy running-config startup-config</td>
<td></td>
</tr>
</tbody>
</table>

### Configuring a Host Statically to Join a Group (CLI)

Hosts or Layer 2 ports normally join multicast groups dynamically, but you can also statically configure a host on an interface.
SUMMARY STEPS

1. enable
2. configure terminal
3. `ip igmp snooping vlan vlan-id static ip_address interface interface-id`
4. end
5. `show ip igmp snooping groups`
6. `copy running-config startup-config`

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  • Enter your password if prompted. |
| Example:          |         |
| Device> enable    |         |
| **Step 2** configure terminal | Enters the global configuration mode. |
| Example:          |         |
| Device# configure terminal |         |
| **Step 3** `ip igmp snooping vlan vlan-id static ip_address interface interface-id` | Statically configures a Layer 2 port as a member of a multicast group:  
  • `vlan-id` is the multicast group VLAN ID. The range is 1 to 1001 and 1006 to 4094.  
  • `ip-address` is the group IP address.  
  • `interface-id` is the member port. It can be a physical interface or a port channel (1 to 128).  
  
  **Note** To remove the Layer 2 port from the multicast group, use the `no ip igmp snooping vlan vlan-id static mac-address interface interface-id` global configuration command. |
| Example:          |         |
| Device(config)# ip igmp snooping vlan 105 static 230.0.0.1 interface gigabitethernet1/0/1 |         |
| **Step 4** end | Returns to privileged EXEC mode. |
| Example:          |         |
| Device(config)# end |         |
Enabling IGMP Immediate Leave (CLI)

When you enable IGMP Immediate Leave, the device immediately removes a port when it detects an IGMP Version 2 leave message on that port. You should only use the Immediate-Leave feature when there is a single receiver present on every port in the VLAN.

Note

Immediate Leave is supported only on IGMP Version 2 hosts. IGMP Version 2 is the default version for the device.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip igmp snooping vlan vlan-id immediate-leave
4. end
5. show ip igmp snooping vlan vlan-id
6. copy running-config startup-config

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action | Purpose
--- | ---
**Step 2** | **configure terminal**  
Example:  
Device# configure terminal
**Purpose**  
Enters the global configuration mode.

**Step 3** | **ip igmp snooping vlan vlan-id immediate-leave**  
Example:  
Device(config)# ip igmp snooping vlan 21 immediate-leave
**Purpose**  
Enables IGMP Immediate Leave on the VLAN interface.  
**Note**  
To disable IGMP Immediate Leave on a VLAN, use the **no ip igmp snooping vlan vlan-id immediate-leave** global configuration command.

**Step 4** | **end**  
Example:  
Device(config)# end
**Purpose**  
Returns to privileged EXEC mode.

**Step 5** | **show ip igmp snooping vlan vlan-id**  
Example:  
Device# show ip igmp snooping vlan 21
**Purpose**  
Verifies that Immediate Leave is enabled on the VLAN interface.

**Step 6** | **copy running-config startup-config**  
Example:  
Device# copy running-config startup-config
**Purpose**  
(Optional) Saves your entries in the configuration file.

---

### Configuring the IGMP Leave Timer (CLI)

Follow these guidelines when configuring the IGMP leave timer:

- You can configure the leave time globally or on a per-VLAN basis.
- Configuring the leave time on a VLAN overrides the global setting.
- The default leave time is 1000 milliseconds.
- The IGMP configurable leave time is only supported on hosts running IGMP Version 2. IGMP version 2 is the default version for the device.
- The actual leave latency in the network is usually the configured leave time. However, the leave time might vary around the configured time, depending on real-time CPU load conditions, network delays and the amount of traffic sent through the interface.
### SUMMARY STEPS

1. enable
2. configure terminal
3. `ip igmp snooping last-member-query-interval` *time*
4. `ip igmp snooping vlan` *vlan-id* `last-member-query-interval` *time*
5. `end`
6. `show ip igmp snooping`
7. `copy running-config startup-config`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; <code>enable</code></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# <code>configure terminal</code></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><code>ip igmp snooping last-member-query-interval</code> <em>time</em></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# <code>ip igmp snooping last-member-query-interval 1000</code></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><code>ip igmp snooping vlan</code> <em>vlan-id</em> <code>last-member-query-interval</code> <em>time</em></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# <code>ip igmp snooping vlan 210 last-member-query-interval 1000</code></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><code>end</code></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# <code>end</code></td>
</tr>
</tbody>
</table>
### Configuring IGMP

**How to Configure IGMP Snooping**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 6</strong></td>
<td></td>
</tr>
<tr>
<td><code>show ip igmp snooping</code></td>
<td>(Optional) Displays the configured IGMP leave time.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device# show ip igmp snooping</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td></td>
</tr>
<tr>
<td><code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device# copy running-config startup-config</code></td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

IGMP Configurable-Leave Timer, on page 31

### Configuring the IGMP Robustness-Variable (CLI)

Use the following procedure to configure the IGMP robustness variable on the device.

The robustness variable is the integer used by IGMP snooping during calculations for IGMP messages. The robustness variable provides fine tuning to allow for expected packet loss.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip igmp snooping robustness-variable count`
4. `ip igmp snooping vlan vlan-id robustness-variable count`
5. `end`
6. `show ip igmp snooping`
7. `copy running-config startup-config`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>ip igmp snooping robustness-variable count</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# ip igmp snooping robustness-variable 3</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>ip igmp snooping vlan vlan-id robustness-variable count</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)#ip igmp snooping vlan 100 robustness-variable 3</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>end</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# end</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>show ip igmp snooping</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# show ip igmp snooping</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>copy running-config startup-config</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# copy running-config startup-config</td>
</tr>
</tbody>
</table>

**Configuring the IGMP Last Member Query Count (CLI)**

To configure the number of times the device sends IGMP group-specific or group-source-specific (with IGMP version 3) query messages in response to receiving a group-specific or group-source-specific leave message, use this command.

---

**IP Multicast Routing Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)**
### SUMMARY STEPS

1. enable
2. configure terminal
3. `ip igmp snooping last-member-query-count count`
4. `ip igmp snooping vlan vlan-id last-member-query-count count`
5. end
6. show ip igmp snooping
7. copy running-config startup-config

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
              • Enter your password if prompted. |
| **Example:**  
Device> enable | |
| **Step 2** configure terminal | Enters the global configuration mode. |
| **Example:**  
Device# configure terminal | |
| **Step 3** `ip igmp snooping last-member-query-count count` | Configures the IGMP last member query count. The range is 1 to 7 messages. The default is 2 messages. |
| **Example:**  
Device(config)# ip igmp snooping last-member-query-count 3 | |
| **Step 4** `ip igmp snooping vlan vlan-id last-member-query-count count` | (Optional) Configures the IGMP last member query count on the VLAN interface. The range is 1 to 7 messages.  
**Note** Configuring the last member query count on a VLAN overrides the globally configured timer. |
| **Example:**  
Device(config)# ip igmp snooping vlan 100 last-member-query-count 3 | |
| **Step 5** end | Returns to privileged EXEC mode. |
| **Example:**  
Device(config)# end | |
### Configuring TCN-Related Commands

#### Controlling the Multicast Flooding Time After a TCN Event (CLI)

You can control the time that multicast traffic is flooded after a topology change notification (TCN) event by using the `ip igmp snooping tcn flood query count` global configuration command. This command configures the number of general queries for which multicast data traffic is flooded after a TCN event. Some examples of TCN events are when the client changed its location and the receiver is on same port that was blocked but is now forwarding, and when a port went down without sending a leave message.

If you set the TCN flood query count to 1 by using the `ip igmp snooping tcn flood query count` command, the flooding stops after receiving 1 general query. If you set the count to 7, the flooding continues until 7 general queries are received. Groups are relearned based on the general queries received during the TCN event.

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip igmp snooping tcn flood query count count`
4. `end`
5. `show ip igmp snooping`
6. `copy running-config startup-config`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Step 6</strong> show ip igmp snooping</td>
<td>(Optional) Displays the configured IGMP last member query count.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# show ip igmp snooping</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# copy running-config startup-config</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action | Purpose
--- | ---
**Example:**
Device> `enable`

- Enter your password if prompted.

**Step 2**
**configure terminal**

- Enters the global configuration mode.

**Example:**
Device# `configure terminal`

**Step 3**
**ip igmp snooping tcn flood query count** `count`

- Specifies the number of IGMP general queries for which the multicast traffic is flooded. The range is 1 to 10. By default, the flooding query count is 2.

**Example:**
Device(config)# `ip igmp snooping tcn flood query count 3`

**Note**
To return to the default flooding query count, use the `no ip igmp snooping tcn flood query count` global configuration command.

**Step 4**
**end**

- Returns to privileged EXEC mode.

**Example:**
Device(config)# `end`

**Step 5**
**show ip igmp snooping**

- Verifies the TCN settings.

**Example:**
Device# `show ip igmp snooping`

**Step 6**
**copy running-config startup-config**

- (Optional) Saves your entries in the configuration file.

**Example:**
Device# `copy running-config startup-config`

---

**Recovering from Flood Mode (CLI)**

When a topology change occurs, the spanning-tree root sends a special IGMP leave message (also known as global leave) with the group multicast address 0.0.0.0. However, when you enable the `ip igmp snooping tcn query solicit` global configuration command, the device sends the global leave message whether or not it is the spanning-tree root. When the router receives this special leave, it immediately sends general queries, which expedite the process of recovering from the flood mode during the TCN event. Leaves are always sent if the device is the spanning-tree root regardless of this configuration command. By default, query solicitation is disabled.
### SUMMARY STEPS

1. enable  
2. configure terminal  
3. ip igmp snooping tcn query solicit  
4. end  
5. show ip igmp snooping  
6. copy running-config startup-config  

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>enable</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>ip igmp snooping tcn query solicit</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# ip igmp snooping tcn query solicit</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>end</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# end</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>show ip igmp snooping</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# show ip igmp snooping</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td><strong>copy running-config startup-config</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# copy running-config startup-config</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Sends an IGMP leave message (global leave) to speed the process of recovering from the flood mode caused during a TCN event. By default, query solicitation is disabled.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>To return to the default query solicitation, use the no ip igmp snooping tcn query solicit global configuration command.</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>Verifies the TCN settings.</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
</tbody>
</table>
Disabling Multicast Flooding During a TCN Event (CLI)

When the device receives a TCN, multicast traffic is flooded to all the ports until 2 general queries are received. If the device has many ports with attached hosts that are subscribed to different multicast groups, this flooding might exceed the capacity of the link and cause packet loss. You can use the `ip igmp snooping tcn flood` interface configuration command to control this operation function.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. interface interface-id
4. no ip igmp snooping tcn flood
5. end
6. show ip igmp snooping
7. copy running-config startup-config

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 interface interface-id</td>
<td>Specifies the interface to be configured, and enters interface</td>
</tr>
<tr>
<td>Example:</td>
<td>configuration mode.</td>
</tr>
<tr>
<td>Device(config)# interface gigabitethernet</td>
<td></td>
</tr>
<tr>
<td>1/0/1</td>
<td></td>
</tr>
<tr>
<td>Step 4 no ip igmp snooping tcn flood</td>
<td>Disables the flooding of multicast traffic during a spanning-tree TCN</td>
</tr>
<tr>
<td>Example:</td>
<td>event. By default, multicast flooding is enabled on an interface.</td>
</tr>
<tr>
<td>Device(config-if)# no ip igmp snooping tcn</td>
<td>Note To re-enable multicast flooding on an interface, use the `ip</td>
</tr>
<tr>
<td></td>
<td>igmp snooping tcn flood` interface configuration command.</td>
</tr>
</tbody>
</table>
Configuring the IGMP Snooping Querier (CLI)

Follow these guidelines when configuring the IGMP snooping querier:

- Configure the VLAN in global configuration mode.
- Configure an IP address on the VLAN interface. When enabled, the IGMP snooping querier uses the IP address as the query source address.
- If there is no IP address configured on the VLAN interface, the IGMP snooping querier tries to use the configured global IP address for the IGMP querier. If there is no global IP address specified, the IGMP querier tries to use the VLAN device virtual interface (SVI) IP address (if one exists). If there is no SVI IP address, the device uses the first available IP address configured on the device. The first IP address available appears in the output of the `show ip interface` privileged EXEC command. The IGMP snooping querier does not generate an IGMP general query if it cannot find an available IP address on the device.
- The IGMP snooping querier supports IGMP Versions 1 and 2.
- When administratively enabled, the IGMP snooping querier moves to the nonquerier state if it detects the presence of a multicast router in the network.
- When it is administratively enabled, the IGMP snooping querier moves to the operationally disabled state under these conditions:
  - IGMP snooping is disabled in the VLAN.
  - PIM is enabled on the SVI of the corresponding VLAN.
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip igmp snooping querier`
4. `ip igmp snooping querier address ip_address`
5. `ip igmp snooping querier query-interval interval-count`
6. `ip igmp snooping querier tcn query [count count | interval interval]`
7. `ip igmp snooping querier timer expiry timeout`
8. `ip igmp snooping querier version version`
9. `end`
10. `show ip igmp snooping vlan vlan-id`
11. `copy running-config startup-config`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> <code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; <code>enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> <code>configure terminal</code></td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# <code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> <code>ip igmp snooping querier</code></td>
<td>Enables the IGMP snooping querier.</td>
</tr>
<tr>
<td>Example: Device(config)# <code>ip igmp snooping querier</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> <code>ip igmp snooping querier address ip_address</code></td>
<td>(Optional) Specifies an IP address for the IGMP snooping querier. If you do not specify an IP address, the querier tries to use the global IP address configured for the IGMP querier. <strong>Note</strong> The IGMP snooping querier does not generate an IGMP general query if it cannot find an IP address on the device.</td>
</tr>
<tr>
<td>Example: Device(config)# <code>ip igmp snooping querier address 172.16.24.1</code></td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 5</td>
<td><code>ip igmp snooping querier query-interval interval-count</code></td>
<td>(Optional) Sets the interval between IGMP queriers. The range is 1 to 18000 seconds.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>Device(config)# ip igmp snooping querier query-interval 30</td>
</tr>
<tr>
<td>Step 6</td>
<td>`ip igmp snooping querier tcn query [count count</td>
<td>(Optional) Sets the time between Topology Change Notification (TCN) queries. The count range is 1 to 10. The interval range is 1 to 255 seconds.</td>
</tr>
<tr>
<td></td>
<td>interval interval]</td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Device(config)# ip igmp snooping querier tcn query interval 20</td>
<td></td>
</tr>
<tr>
<td>Step 7</td>
<td><code>ip igmp snooping querier timer expiry timeout</code></td>
<td>(Optional) Sets the length of time until the IGMP querier expires. The range is 60 to 300 seconds.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>Device(config)# ip igmp snooping querier timer expiry 180</td>
</tr>
<tr>
<td>Step 8</td>
<td><code>ip igmp snooping querier version version</code></td>
<td>(Optional) Selects the IGMP version number that the querier feature uses. Select 1 or 2.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>Device(config)# ip igmp snooping querier version 2</td>
</tr>
<tr>
<td>Step 9</td>
<td><code>end</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>Device(config)# end</td>
</tr>
<tr>
<td>Step 10</td>
<td><code>show ip igmp snooping vlan vlan-id</code></td>
<td>(Optional) Verifies that the IGMP snooping querier is enabled on the VLAN interface. The VLAN ID range is 1 to 1001 and 1006 to 4094.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>Device# show ip igmp snooping vlan 30</td>
</tr>
<tr>
<td>Step 11</td>
<td><code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>Device# copy running-config startup-config</td>
</tr>
</tbody>
</table>
Disabling IGMP Report Suppression (CLI)

**Note**
IGMP report suppression is supported only when the multicast query has IGMPv1 and IGMPv2 reports. This feature is not supported when the query includes IGMPv3 reports.

IGMP report suppression is enabled by default. When it is enabled, the device forwards only one IGMP report per multicast router query. When report suppression is disabled, all IGMP reports are forwarded to the multicast routers.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. no ip igmp snooping report-suppression
4. end
5. show ip igmp snooping
6. copy running-config startup-config

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>enable</td>
<td>Enters privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Disables IGMP report suppression.</td>
</tr>
<tr>
<td>no ip igmp snooping report-suppression</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>To re-enable IGMP report suppression, use the ip igmp snooping report-suppression global configuration command.</td>
</tr>
<tr>
<td>Device(config)# no ip igmp snooping report-suppression</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>end</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# end</td>
<td></td>
</tr>
</tbody>
</table>
### Monitoring IGMP

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 10: Commands for Displaying System and Network Statistics**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ping [group-name</td>
<td>group-address]</td>
</tr>
<tr>
<td>show ip igmp filter</td>
<td>Displays IGMP filter information.</td>
</tr>
<tr>
<td>show ip igmp groups [type-number</td>
<td>detail ]</td>
</tr>
<tr>
<td>show ip igmp interface [type number]</td>
<td>Displays multicast-related information about an interface.</td>
</tr>
<tr>
<td>show ip igmp membership [ name/group address</td>
<td>all</td>
</tr>
<tr>
<td>show ip igmp profile [ profile_number]</td>
<td>Displays IGMP profile information.</td>
</tr>
<tr>
<td>show ip igmp ssm-mapping [ hostname/IP address ]</td>
<td>Displays IGMP SSM mapping information.</td>
</tr>
</tbody>
</table>
### Command and Purpose

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>show ip igmp static-group [class-map [interface [type ]]]</td>
<td>Displays static group information.</td>
</tr>
<tr>
<td>show ip igmp vrf</td>
<td>Displays the selected VPN routing/forwarding instance by name.</td>
</tr>
</tbody>
</table>

### Displaying IGMP Snooping Information

You can display IGMP snooping information for dynamically learned and statically configured router ports and VLAN interfaces. You can also display MAC address multicast entries for a VLAN configured for IGMP snooping.

#### Table 11: Commands for Displaying IGMP Snooping Information

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>show ip igmp snooping detail</td>
<td>Displays the operational state information.</td>
</tr>
<tr>
<td>show ip igmp snooping groups [ count</td>
<td>Displays multicast table information for the device or about a specific parameter:</td>
</tr>
<tr>
<td>[vlan vlan-id [A.B.C.D</td>
<td>count ] ]</td>
</tr>
<tr>
<td></td>
<td>• vlan—Displays group information by VLAN ID.</td>
</tr>
<tr>
<td>show ip igmp snooping igmpv2-tracking</td>
<td>Displays the IGMP snooping tracking.</td>
</tr>
<tr>
<td>Note</td>
<td>This command displays group and IP address entries only for wireless multicast IGMP joins and not for wired IGMP joins. Wireless IP multicast must be enabled for this command to display.</td>
</tr>
<tr>
<td>show ip igmp snooping mrouter [vlan vlan-id]</td>
<td>Displays information on dynamically learned and manually configured multicast router interfaces.</td>
</tr>
<tr>
<td>Note</td>
<td>When you enable IGMP snooping, the device automatically learns the interface to which a multicast router is connected. These are dynamically learned interfaces.</td>
</tr>
<tr>
<td>(Optional) Enter vlan vlan-id to display information for a single VLAN.</td>
<td></td>
</tr>
</tbody>
</table>
### Displaying IGMP Filtering and Throttling Configuration

You can display IGMP profile characteristics, and you can display the IGMP profile and maximum group configuration for all interfaces on the device or for a specified interface. You can also display the IGMP throttling configuration for all interfaces on the device or for a specified interface.

**Table 12: Commands for Displaying IGMP Filtering and Throttling Configuration**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show ip igmp profile [profile number]</code></td>
<td>Displays the specified IGMP profile or all the IGMP profiles defined on the device.</td>
</tr>
<tr>
<td><code>show running-config [interface interface-id]</code></td>
<td>Displays the configuration of the specified interface or the configuration of all interfaces on the device, including (if configured) the maximum number of IGMP groups to which an interface can belong and the IGMP profile applied to the interface.</td>
</tr>
</tbody>
</table>
Configuration Examples for IGMP

Example: Configuring the Device as a Member of aMulticast Group

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

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

Related Topics

- Configuring the Device as a Member of a Group (CLI), on page 34
- Joining a Multicast Group, on page 28
- Configuring the Device as a Member of a Group (CLI), on page 34
- IP Multicast Group Addresses, on page 22

Example: Controlling Access to Multicast Groups

To limit the number of joins on the interface, configure the port for filter which associates with the IGMP profile.

```
Device# configure terminal
Device(config)# ip igmp profile 10
Device(config-igmp-profile)# ?
IGMP profile configuration commands:
deny matching addresses are denied
exit Exit from igmp profile configuration mode
no Negate a command or set its defaults
permit matching addresses are permitted
range add a range to the set
Device(config-igmp-profile)# range 172.16.5.1
Device(config-igmp-profile)# exit
Device(config)# interface gigabitEthernet 2/0/10
Device(config-if)# ip igmp filter 10
```

Related Topics

- Controlling Access to IP Multicast Group (CLI), on page 36

Examples: Configuring IGMP Snooping

This example shows how to enable a static connection to a multicast router:

```
Device# configure terminal
Device(config)# ip igmp snooping vlan 200 mrouter interface gigabitethernet1/0/2
```
This example shows how to statically configure a host on a port:

```
Device# configure terminal
Device(config)# ip igmp snooping vlan 105 static 224.2.4.12 interface gigabitethernet1/0/1
Device(config)# end
```

This example shows how to enable IGMP Immediate Leave on VLAN 130:

```
Device# configure terminal
Device(config)# ip igmp snooping vlan 130 immediate-leave
Device(config)# end
```

This example shows how to set the IGMP snooping querier source address to 10.0.0.64:

```
Device# configure terminal
Device(config)# ip igmp snooping querier 10.0.0.64
Device(config)# end
```

This example shows how to set the IGMP snooping querier maximum response time to 25 seconds:

```
Device# configure terminal
Device(config)# ip igmp snooping querier query-interval 25
Device(config)# end
```

This example shows how to set the IGMP snooping querier timeout to 60 seconds:

```
Device# configure terminal
Device(config)# ip igmp snooping querier timer expiry 60
Device(config)# end
```

This example shows how to set the IGMP snooping querier feature to Version 2:

```
Device# configure terminal
Device(config)# no ip igmp snooping querier version 2
Device(config)# end
```

Related Topics

- Enabling or Disabling IGMP Snooping on a Device (CLI), on page 57
- IGMP Snooping, on page 28

Examples: Configuring Filtering and Throttling

This example shows how to create IGMP profile 4 allowing access to the single IP multicast address and how to verify the configuration. If the action was to deny (the default), it would not appear in the `show ip igmp profile` output display:

```
Device(config)# ip igmp profile 4
Device(config-igmp-profile)# permit
Device(config-igmp-profile)# range 229.9.9.0
Device(config-igmp-profile)# end
Device# show ip igmp profile 4
IGMP Profile 4
  permit
    range 229.9.9.0 229.9.9.0
```
This example shows how to apply IGMP profile 4 to a port:

Device(config)# interface gigabitethernet1/0/2
Device(config-if)# ip igmp filter 4
Device(config-if)# end

This example shows how to limit to 25 the number of IGMP groups that a port can join:

Device(config)# interface gigabitethernet1/0/2
Device(config-if)# ip igmp max-groups 25
Device(config-if)# end

Related Topics
Configuring the IGMP Throttling Action (CLI), on page 50
IGMP Filtering and Throttling Overview, on page 32

Example: Interface Configuration as a Routed Port

This example shows how to configure an interface on the device as a routed port. This configuration is required on the interface for several IP multicast routing configuration procedures that require running the no switchport command.

Device(config)# interface GigabitEthernet1/0/9
Device(config-if)# description interface to be use as routed port
Device(config-if)# no switchport
Device(config-if)# ip address 20.20.20.1 255.255.255.0
Device(config-if)# ip pim sparse-dense-mode
Device(config-if)# ip igmp join-group 224.1.2.3 source 15.15.15.2
Device(config-if)# end
Device(config)# show run interface gigabitEthernet 1/0/9
Current configuration : 166 bytes
! interface GigabitEthernet1/0/9
 no switchport
 ip address 20.20.20.1 255.255.255.0
 ip pim sparse-dense-mode
 ip igmp static-group 224.1.2.3 source 15.15.15.2
end

Example: Interface Configuration as an SVI

This example shows how to configure an interface on the device as an SVI. This configuration is required on the interface for several IP multicast routing configuration procedures that require running the no switchport command.

Device(config)# interface vlan 150
Device(config-if)# ip address 20.20.20.1 255.255.255.0
Device(config-if)# ip pim sparse-dense-mode
Device(config-if)# ip igmp join-group 224.1.2.3 source 15.15.15.2
Device(config-if)# end
Device(config)# configure terminal
Device(config)# ip igmp snooping vlan 20 static 224.1.2.3
terface gigabitEthernet 1/0/9
Example: Configuring the Device to Forward Multicast Traffic in the Absence of Directly Connected IGMP Hosts

The following example shows how to configure a device to forward multicast traffic in the absence of directly connected IGMP hosts using the `ip igmp join-group` command. With this method, the device accepts the multicast packets in addition to forwarding them. Accepting the multicast packets prevents the device from fast switching.

In this example, Fast Ethernet interface 0/0/0 on the device is configured to join the group 225.2.2.2:

```plaintext
interface FastEthernet0/0/0
ip igmp join-group 225.2.2.2
```

The following example shows how to configure a device to forward multicast traffic in the absence of directly connected IGMP hosts using the `ip igmp static-group` command. With this method, the device does not accept the packets itself, but only forwards them. Hence, this method allows fast switching. The outgoing interface appears in the IGMP cache, but the device itself is not a member, as evidenced by lack of an “L” (local) flag in the multicast route entry.

In this example, static group membership entries for group 225.2.2.2 are configured on Fast Ethernet interface 0/1/0:

```plaintext
interface FastEthernet0/1/0
ip igmp static-group 225.2.2.2
```

Related Topics

- Configuring the Device to Forward Multicast Traffic in the Absence of Directly Connected IGMP Hosts, on page 53

Controlling Access to an SSM Network Using IGMP Extended Access Lists

This section contains the following configuration examples for controlling access to an SSM network using IGMP extended access lists:

Note

Keep in mind that access lists are very flexible: there are many combinations of permit and deny statements one could use in an access list to filter multicast traffic. The examples in this section simply provide a few examples of how it can be done.

Related Topics

- Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 54
Example: Denying All States for a Group G

The following example shows how to deny all states for a group G. In this example, Fast Ethernet interface 0/0/0 is configured to filter all sources for SSM group 232.2.2.2 in IGMPv3 reports, which effectively denies this group.

```
ip access-list extended test1
deny igmp any host 232.2.2.2
permit igmp any any
!
interface FastEthernet0/0/0
ip igmp access-group test1
```

Related Topics

Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 54

Example: Denying All States for a Source S

The following example shows how to deny all states for a source S. In this example, Gigabit Ethernet interface 1/1/0 is configured to filter all groups for source 10.2.1.32 in IGMPv3 reports, which effectively denies this source.

```
ip access-list extended test2
deny igmp host 10.2.1.32 any
permit igmp any any
!
interface GigabitEthernet1/1/0
ip igmp access-group test2
```

Related Topics

Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 54

Example: Permitting All States for a Group G

The following example shows how to permit all states for a group G. In this example, Gigabit Ethernet interface 1/2/0 is configured to accept all sources for SSM group 232.1.1.10 in IGMPv3 reports, which effectively accepts this group altogether.

```
ip access-list extended test3
permit igmp any host 232.1.1.10
!
interface GigabitEthernet1/2/0
ip igmp access-group test3
```

Related Topics

Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 54
Example: Permitting All States for a Source S

The following example shows how to permit all states for a source S. In this example, Gigabit Ethernet interface 1/2 is configured to accept all groups for source 10.6.23.32 in IGMPv3 reports, which effectively accepts this source altogether.

```
ip access-list extended test4
    permit igmp host 10.6.23.32 any

interface GigabitEthernet1/2/0
    ip igmp access-group test4
```

Related Topics

- Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 54

Example: Filtering a Source S for a Group G

The following example shows how to filter a particular source S for a group G. In this example, Gigabit Ethernet interface 0/3/0 is configured to filter source 232.2.2.2 for SSM group 232.2.30.30 in IGMPv3 reports.

```
ip access-list extended test5
    deny igmp host 10.4.4.4 host 232.2.30.30
    permit igmp any any

interface GigabitEthernet0/3/0
    ip igmp access-group test5
```

Related Topics

- Controlling Access to an SSM Network Using IGMP Extended Access Lists, on page 54

Where to Go Next for IGMP

You can configure the following:

- Wireless Multicast
- PIM
- SSM
- IP Multicast Routing
- Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
- Multicast Subsecond Convergence
- IP Multicast Load Splitting across Equal-Cost Paths
- SSM Channel Based Filtering for Multicast
- PIM Dense Mode State Refresh
• IGMP State Limit

## Additional References

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>For complete syntax and usage information for the commands used in this chapter.</td>
<td><em>IP Multicast Routing Command Reference (Catalyst 3650 Switches)</em></td>
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### Error Message Decoder

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<tr>
<td>To help you research and resolve system error messages in this release, use the Error Message Decoder tool.</td>
<td><a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a></td>
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### Standards and RFCs

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<td>Host Extensions for IP Multicasting</td>
</tr>
<tr>
<td>RFC 2236</td>
<td>Internet Group Management Protocol, Version 2</td>
</tr>
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### MIBs

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<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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Technical Assistance

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<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
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Feature History and Information for IGMP

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<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
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</table>
Configuring IGMP Proxy

- Finding Feature Information, page 89
- Prerequisites for IGMP Proxy, page 89
- Information about IGMP Proxy, page 90
- How to Configure IGMP Proxy, page 92
- Configuration Examples for IGMP Proxy, page 96
- Where to Go Next for IGMP Proxy, page 97
- Additional References, page 98
- Feature History and Information for IGMP Proxy, page 99

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 IGMP Proxy

- All devices on the IGMP UDL have the same subnet address. If all devices on the UDL cannot have the same subnet address, the upstream device must be configured with secondary addresses to match all of the subnets to which the downstream devices are attached.
- IP multicast is enabled and the PIM interfaces are configured.
Use the following guidelines when configuring PIM interfaces for IGMP proxy:

- Use PIM sparse mode (PIM-SM) when the interface is operating in a sparse-mode region and you are running static RP, bootstrap (BSR), or Auto-RP with the Auto-RP listener capability.

- Use PIM sparse-dense mode when the interface is running in a sparse-dense mode region and you are running Auto-RP without the Auto-RP listener capability.

- Use PIM dense mode (PIM-DM) when the interface is operating in dense mode and is, thus, participating in a dense-mode region.

- Use PIM-DM with the proxy-register capability when the interface is receiving source traffic from a dense-mode region that needs to reach receivers that are in a sparse-mode region.

### Information about IGMP Proxy

**IGMP Proxy**

An IGMP proxy enables hosts in a unidirectional link routing (UDLR) environment that are not directly connected to a downstream router to join a multicast group sourced from an upstream network.

The figure below illustrates a sample topology that shows two UDLR scenarios:

- Traditional UDL routing scenario--A UDL device with directly connected receivers.
- IGMP proxy scenario--UDL device without directly connected receivers.

**Note**

IGMP UDLs are needed on the upstream and downstream devices.

**Note**

Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.
**Scenario 1--Traditional UDLR Scenario (UDL Device with Directly Connected Receivers)**

For scenario 1, no IGMP proxy mechanism is needed. In this scenario, the following sequence of events occurs:

1. User 2 sends an IGMP membership report requesting interest in group G.
2. Router B receives the IGMP membership report, adds a forwarding entry for group G on LAN B, and proxies the IGMP report to Router A, which is the UDLR upstream device.
3. The IGMP report is then proxied across the Internet link.
4. Router A receives the IGMP proxy and maintains a forwarding entry on the unidirectional link.

**Scenario 2--IGMP Proxy Scenario (UDL Device without Directly Connected Receivers)**

For scenario 2, the IGMP proxy mechanism is needed to enable hosts that are not directly connected to a downstream device to join a multicast group sourced from an upstream network. In this scenario, the following sequence of events occurs:

1. User 1 sends an IGMP membership report requesting interest in group G.
2. Router C sends a PIM Join message hop-by-hop to the RP (Router B).
3. Router B receives the PIM Join message and adds a forwarding entry for group G on LAN B.
4. Router B periodically checks its mroute table and proxies the IGMP membership report to its upstream UDL device across the Internet link.
Router A creates and maintains a forwarding entry on the unidirectional link (UDL).

In an enterprise network, it is desirable to be able to receive IP multicast traffic via satellite and forward the traffic throughout the network. With unidirectional link routing (UDLR) alone, scenario 2 would not be possible because receiving hosts must be directly connected to the downstream device, Router B. The IGMP proxy mechanism overcomes this limitation by creating an IGMP report for (\( \ast, G \)) entries in the multicast forwarding table. To make this scenario functional, you must enable IGMP report forwarding of proxied (\( \ast, G \)) multicast static route (mroute) entries (using the `ip igmp mroute-proxy` command) and enable the mroute proxy service (using the `ip igmp proxy-service` command) on interfaces leading to PIM-enabled networks with potential members.

Because PIM messages are not forwarded upstream, each downstream network and the upstream network have a separate domain.

Related Topics
- Configuring the Upstream UDL Device for IGMP UDLR, on page 92
- Configuring the Downstream UDL Device for IGMP UDLR with IGMP Proxy Support, on page 93
- Example: IGMP Proxy Configuration, on page 96

How to Configure IGMP Proxy

Configuring the Upstream UDL Device for IGMP UDLR

Perform this task to configure the upstream UDL device for IGMP UDLR.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `interface type number`
4. `ip igmp unidirectional-link`
5. `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device&gt; enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td>Example:</td>
<td><strong>Enters global configuration mode.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Device# configure terminal</strong></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>interface type number</strong></td>
</tr>
<tr>
<td>Example:</td>
<td><strong>Enters interface configuration mode.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>For the type and number arguments, specify the interface to be used as the UDL on the upstream device.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Device(config)# interface gigabitethernet 1/0/0</strong></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>ip igmp unidirectional-link</strong></td>
</tr>
<tr>
<td>Example:</td>
<td><strong>Configures IGMP on the interface to be unidirectional for IGMP UDLR.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Device(config-if)# ip igmp unidirectional-link</strong></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>end</strong></td>
</tr>
<tr>
<td>Example:</td>
<td><strong>Ends the current configuration session and returns to privileged EXEC mode.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Device(config-if)# end</strong></td>
</tr>
</tbody>
</table>

**Related Topics**

- IGMP Proxy, on page 90
- Example: IGMP Proxy Configuration, on page 96

**Configuring the Downstream UDL Device for IGMP UDLR with IGMP Proxy Support**

Perform this task to configure the downstream UDL device for IGMP UDLR with IGMP proxy support.
### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface type number**
4. **ip igmp unidirectional-link**
5. **exit**
6. **interface type number**
7. **ip igmp mroute-proxy type number**
8. **exit**
9. **interface type number**
10. **ip igmp helper-address udl interface-type interface-number**
11. **ip igmp proxy-service**
12. **end**
13. **show ip igmp interface**
14. **show ip igmp udlr**

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface type number</td>
<td>Enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# interface</td>
<td>• For the type and number arguments, specify the interface to be used</td>
</tr>
<tr>
<td>gigabitethernet 0/0/0</td>
<td>as the UDL on the downstream device for IGMP UDLR.</td>
</tr>
<tr>
<td><strong>Step 4</strong> ip igmp unidirectional-link</td>
<td>Configures IGMP on the interface to be unidirectional for IGMP UDLR.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# ip igmp</td>
<td></td>
</tr>
<tr>
<td>unidirectional-link</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>-------</td>
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</tr>
<tr>
<td>5</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# exit</td>
</tr>
<tr>
<td>6</td>
<td>interface  type number</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface</td>
</tr>
<tr>
<td></td>
<td>gigabitethernet 1/0/0</td>
</tr>
<tr>
<td>7</td>
<td>ip igmp mrouteproxy  type number</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip igmp mrouteproxy loopback 0</td>
</tr>
<tr>
<td>8</td>
<td>exit</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# exit</td>
</tr>
<tr>
<td>9</td>
<td>interface  type number</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface loopback 0</td>
</tr>
<tr>
<td>10</td>
<td>ip igmp helper-address udl</td>
</tr>
<tr>
<td></td>
<td>interface-type  interface-number</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip igmp helper-address udl gigabitethernet 0/0/0</td>
</tr>
<tr>
<td>11</td>
<td>ip igmp proxy-service</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>- When the mrouteproxy service is enabled, the device periodically checks the static mroute table for (*, G) forwarding entries that match interfaces configured with the ip igmp mroute-proxy command (see Step 7) based on the IGMP query interval. Where there is a match, one IGMP report is created and received on this interface.</td>
</tr>
<tr>
<td><strong>Step 12</strong> end</td>
<td>Ends the current configuration session and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The <code>ip igmp proxy-service</code> command is intended to be used with the <code>ip igmp helper-address</code> (UDL) command.</td>
</tr>
<tr>
<td></td>
<td>- In this example, the <code>ip igmp proxy-service</code> command is configured on loopback interface 0 to enable the forwarding of IGMP reports out the interface for all groups on interfaces registered through the <code>ip igmp mroute-proxy</code> command (see Step 7).</td>
</tr>
<tr>
<td><strong>Step 13</strong> show ip igmp interface</td>
<td>(Optional) Displays multicast-related information about an interface.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 14</strong> show ip igmp udlr</td>
<td>(Optional) Displays UDLR information for directly connected multicast groups on interfaces that have a UDL helper address configured.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

IGMP Proxy, on page 90
Example: IGMP Proxy Configuration, on page 96

**Configuration Examples for IGMP Proxy**

**Example: IGMP Proxy Configuration**

The following example shows how to configure the upstream UDL device for IGMP UDLR and the downstream UDL device for IGMP UDLR with IGMP proxy support.
Upstream Device Configuration

interface gigabitethernet 0/0/0
ip address 10.1.1.1 255.255.255.0
ip pim dense-mode
!
interface gigabitethernet 1/0/0
ip address 10.2.1.1 255.255.255.0
ip pim dense-mode
ip igmp unidirectional-link
!
interface gigabitethernet 2/0/0
ip address 10.3.1.1 255.255.255.0

Downstream Device Configuration

ip pim rp-address 10.5.1.1 5
access-list 5 permit 239.0.0.0 0.255.255.255
!
interface loopback 0
ip address 10.7.1.1 255.255.255.0
ip pim dense-mode
ip igmp helper-address udl ethernet 0
ip igmp proxy-service
!
interface gigabitethernet 0/0/0
ip address 10.2.1.2 255.255.255.0
ip pim dense-mode
ip igmp unidirectional-link
!
interface gigabitethernet 1/0/0
ip address 10.5.1.1 255.255.255.0
ip pim sparse-mode
ip igmp mrouteproxy loopback 0
!
interface gigabitethernet 2/0/0
ip address 10.6.1.1 255.255.255.0

Related Topics

Configuring the Upstream UDL Device for IGMP UDLR, on page 92
Configuring the Downstream UDL Device for IGMP UDLR with IGMP Proxy Support, on page 93
IGMP Proxy, on page 90

Where to Go Next for IGMP Proxy

You can configure the following:

- IGMP
- PIM
- SSM
- IP Multicast Routing
- Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
• Multicast Subsecond Convergence
• IP Multicast Load Splitting across Equal-Cost Paths
• SSM Channel Based Filtering for Multicast
• PIM Dense Mode State Refresh
• IGMP State Limit

Additional References

The following sections provide references related to customizing IGMP.

Related Documents

<table>
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<tr>
<th>Related Topic</th>
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<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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<tr>
<td>Cisco IOS IP SLAs commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
</tr>
<tr>
<td>Overview of the IP multicast technology area</td>
<td>“IP Multicast Technology Overview” module</td>
</tr>
<tr>
<td>Basic IP multicast concepts, configuration tasks, and examples</td>
<td>“Configuring Basic IP Multicast” or “Configuring IP Multicast in IPv6 Networks” module</td>
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Standards and RFCs

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<tr>
<td>RFC 3376</td>
<td>Internet Group Management Protocol, Version 3</td>
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MIBs

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<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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Feature History and Information for IGMP Proxy

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Constraining IP Multicast in Switched Ethernet

- Finding Feature Information, page 101
- Prerequisites for Constraining IP Multicast in a Switched Ethernet Network, page 101
- Information About IP Multicast in a Switched Ethernet Network, page 102
- How to Constrain Multicast in a Switched Ethernet Network, page 104
- Configuration Examples for Constraining IP Multicast in a Switched Ethernet Network, page 107
- Where to Go Next for Constraining IP Multicast in Switched Ethernet, page 108
- Additional References, page 108
- Feature History and Information for Constraining IP Multicast in a Switched Ethernet Network, page 109

Finding Feature Information

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Prerequisites for Constraining IP Multicast in a Switched Ethernet Network

Before using the tasks in this module, you should be familiar with the concepts described in the "IP Multicast Technology Overview" module.
IP Multicast Traffic and Layer 2 Switches

The default behavior for a Layer 2 switch is to forward all multicast traffic to every port that belongs to the destination LAN on the switch. This behavior reduces the efficiency of the switch, whose purpose is to limit traffic to the ports that need to receive the data. This behavior requires a constraining mechanism to reduce unnecessary multicast traffic, which improves switch performance.

Cisco Group Management Protocol (CGMP), Router Group Management Protocol (RGMP), and IGMP snooping efficiently constrain IP multicast in a Layer 2 switching environment.

- CGMP and IGMP snooping are used on subnets that include end users or receiver clients.
- RGMP is used on routed segments that contain only routers, such as in a collapsed backbone.
- RGMP and CGMP cannot interoperate. However, Internet Group Management Protocol (IGMP) can interoperate with CGMP and RGMP snooping.

CGMP on Catalyst Switches for IP Multicast

CGMP is a Cisco-developed protocol used on device connected to Catalyst switches to perform tasks similar to those performed by IGMP. CGMP is necessary for those Catalyst switches that do not distinguish between IP multicast data packets and IGMP report messages, both of which are addressed to the same group address at the MAC level. The switch can distinguish IGMP packets, but would need to use software on the switch, greatly impacting its performance.

You must configure CGMP on the multicast device and the Layer 2 switches. The result is that, with CGMP, IP multicast traffic is delivered only to those Catalyst switch ports that are attached to interested receivers. All other ports that have not explicitly requested the traffic will not receive it unless these ports are connected to a multicast router. Multicast router ports must receive every IP multicast data packet.

Using CGMP, when a host joins a multicast group, it multicasts an unsolicited IGMP membership report message to the target group. The IGMP report is passed through the switch to the router for normal IGMP processing. The router (which must have CGMP enabled on this interface) receives the IGMP report and processes it as it normally would, but also creates a CGMP Join message and sends it to the switch. The Join message includes the MAC address of the end station and the MAC address of the group it has joined.

The switch receives this CGMP Join message and then adds the port to its content-addressable memory (CAM) table for that multicast group. All subsequent traffic directed to this multicast group is then forwarded out the port for that host.

The Layer 2 switches are designed so that several destination MAC addresses could be assigned to a single physical port. This design allows switches to be connected in a hierarchy and also allows many multicast destination addresses to be forwarded out a single port.

The device port also is added to the entry for the multicast group. Multicast device must listen to all multicast traffic for every group because IGMP control messages are also sent as multicast traffic. The rest of the multicast traffic is forwarded using the CAM table with the new entries created by CGMP.

Related Topics

Enabling CGMP, on page 104
IGMP Snooping

IGMP snooping is an IP multicast constraining mechanism that runs on a Layer 2 LAN switch. IGMP snooping requires the LAN switch to examine, or "snoop," some Layer 3 information (IGMP Join/Leave messages) in the IGMP packets sent between the hosts and the router. When the switch receives the IGMP host report from a host for a particular multicast group, the switch adds the port number of the host to the associated multicast table entry. When the switch hears the IGMP Leave group message from a host, the switch removes the table entry of the host.

Because IGMP control messages are sent as multicast packets, they are indistinguishable from multicast data at Layer 2. A switch running IGMP snooping must examine every multicast data packet to determine if it contains any pertinent IGMP control information. IGMP snooping implemented on a low-end switch with a slow CPU could have a severe performance impact when data is sent at high rates. The solution is to implement IGMP snooping on high-end switches with special application-specific integrated circuits (ASICs) that can perform the IGMP checks in hardware. CGMP is a better option for low-end switches without special hardware.

Router-Port Group Management Protocol (RGMP)

CGMP and IGMP snooping are IP multicast constraining mechanisms designed to work on routed network segments that have active receivers. They both depend on IGMP control messages that are sent between the hosts and the routers to determine which switch ports are connected to interested receivers.

Switched Ethernet backbone network segments typically consist of several routers connected to a switch without any hosts on that segment. Because routers do not generate IGMP host reports, CGMP and IGMP snooping will not be able to constrain the multicast traffic, which will be flooded to every port on the VLAN. Routers instead generate Protocol Independent Multicast (PIM) messages to Join and Prune multicast traffic flows at a Layer 3 level.

Router-Port Group Management Protocol (RGMP) is an IP multicast constraining mechanism for router-only network segments. RGMP must be enabled on the routers and on the Layer 2 switches. A multicast router indicates that it is interested in receiving a data flow by sending an RGMP Join message for a particular group. The switch then adds the appropriate port to its forwarding table for that multicast group—similar to the way it handles a CGMP Join message. IP multicast data flows will be forwarded only to the interested router ports. When the router no longer is interested in that data flow, it sends an RGMP Leave message and the switch removes the forwarding entry.

If there are any routers that are not RGMP-enabled, they will continue to receive all multicast data.

Related Topics
- Configuring IP Multicast in a Layer 2 Switched Ethernet Network, on page 105
- RGMP Configuration Example, on page 107
How to Constrain Multicast in a Switched Ethernet Network

Configuring Switches for IP Multicast

If you have switching in your multicast network, consult the documentation for the switch you are working with for information about how to configure IP multicast.

Configuring IGMP Snooping

No configuration is required on the router. Consult the documentation for the switch you are working with to determine how to enable IGMP snooping and follow the provided instructions.

Enabling CGMP

CGMP is a protocol used on devices connected to Catalyst switches to perform tasks similar to those performed by IGMP. CGMP is necessary because the Catalyst 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.

Note

- CGMP should be enabled only on 802 or ATM media, or LAN emulation (LANE) over ATM.
- CGMP should be enabled only on devices connected to Catalyst switches.

SUMMARY STEPS

1. enable
2. configure terminal
3. interface type number
4. ip cgmp [proxy | router-only]
5. end
6. clear ip cgmp [interface-type interface-number]

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>
### Purpose

**Command or Action**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td><code>interface type number</code></td>
<td>Selects an interface that is connected to hosts on which IGMPv3 can be enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config)# interface ethernet 1</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>`ip cgmp [proxy</td>
<td>router-only]`</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-if)# ip cgmp proxy</td>
<td>• The <code>proxy</code> keyword enables the CGMP proxy function. When enabled, any device that is not CGMP-capable will be advertised by the proxy router. The proxy router advertises the existence of other non-CGMP-capable devices by sending a CGMP Join message with the MAC address of the non-CGMP-capable device and group address of 0000.0000.0000.</td>
</tr>
<tr>
<td>Step 5</td>
<td><code>end</code></td>
<td>Ends the current configuration session and returns to EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-if)# end</td>
<td></td>
</tr>
<tr>
<td>Step 6</td>
<td><code>clear ip cgmp [interface-type interface-number]</code></td>
<td>(Optional) Clears all group entries from the caches of Catalyst switches.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device# clear ip cgmp</td>
<td></td>
</tr>
</tbody>
</table>

### Related Topics

- CGMP on Catalyst Switches for IP Multicast, on page 102
  *Example: CGMP Configuration, on page 107*

### Configuring IP Multicast in a Layer 2 Switched Ethernet Network

Perform this task to configure IP multicast in a Layer 2 Switched Ethernet network using RGMP.
SUMMARY STEPS

1. enable
2. configure terminal
3. interface type number
4. ip rgmp
5. end
6. debug ip rgmp
7. show ip igmp interface

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>interface type number</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# interface ethernet 1</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>ip rgmp</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# ip rgmp</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>end</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# end</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>debug ip rgmp</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# debug ip rgmp</td>
</tr>
</tbody>
</table>
## Configuration Examples for Constraining IP Multicast in a Switched Ethernet Network

### Example: CGMP Configuration

The following example is for a basic network environment where multicast source(s) and multicast receivers are in the same VLAN. The desired behavior is that the switch will constrain the multicast forwarding to those ports that request the multicast stream.

A 4908G-L3 router is connected to the Catalyst 4003 on port 3/1 in VLAN 50. The following configuration is applied on the GigabitEthernet1 interface. Note that there is no `ip multicast-routing` command configured because the router is not routing multicast traffic across its interfaces.

```plaintext
interface GigabitEthernet1
  ip address 192.168.50.11 255.255.255.0
  ip pim dense-mode
  ip cgmp
```

### RGMP Configuration Example

The following example shows how to configure RGMP on a router:

```plaintext
ip multicast-routing
ip pim sparse-mode
interface ethernet 0
  ip rgmp
```

### Related Topics

- Enabling CGMP, on page 104
- CGMP on Catalyst Switches for IP Multicast, on page 102
- Configuring IP Multicast in a Layer 2 Switched Ethernet Network, on page 105
Where to Go Next for Constraining IP Multicast in Switched Ethernet

You can configure the following:

- IGMP
- PIM
- SSM
- IP Multicast Routing
- Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
- Multicast Subsecond Convergence
- IP Multicast Load Splitting across Equal-Cost Paths
- SSM Channel Based Filtering for Multicast
- PIM Dense Mode State Refresh
- IGMP State Limit

Additional References

The following sections provide references related to constraining IP multicast in a switched Ethernet network.

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
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<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>Cisco IOS IP SLAs commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
</tr>
<tr>
<td>IGMP snooping</td>
<td>The &quot;IGMP Snooping&quot; module of the IP Multicast: IGMP Configuration Guide</td>
</tr>
<tr>
<td>RGMP</td>
<td>The &quot;Configuring Router-Port Group Management Protocol&quot; module of the IP Multicast: IGMP Configuration Guide</td>
</tr>
</tbody>
</table>
Constraining IP Multicast in Switched Ethernet

MIBs

<table>
<thead>
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<th>MIB</th>
<th>MIBs Link</th>
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<tr>
<td>None</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases,</td>
</tr>
<tr>
<td></td>
<td>and feature sets, use Cisco MIB Locator found at the following URL:</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>

Technical Assistance

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</thead>
<tbody>
<tr>
<td>Technical Assistance Center (TAC) home page, containing 30,000 pages of</td>
<td></td>
</tr>
<tr>
<td>searchable technical content, including links to products, technologies,</td>
<td></td>
</tr>
<tr>
<td>solutions, technical tips, and tools. Registered Cisco.com users can</td>
<td></td>
</tr>
<tr>
<td>log in from this page to access even more content.</td>
<td><a href="http://www.cisco.com/public/support/tac/home.shtml">http://www.cisco.com/public/support/tac/home.shtml</a></td>
</tr>
</tbody>
</table>

Feature History and Information for Constraining IP Multicast in a Switched Ethernet Network

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
</tr>
</tbody>
</table>
Configuring PIM

- Finding Feature Information, page 111
- Prerequisites for Configuring PIM, page 111
- Restrictions for Configuring PIM, page 112
- Restrictions for Configuring Auto-RP, page 112
- Restrictions for Configuring Auto-RP and BSR, page 113
- Information About PIM, page 113
- How to Configure PIM, page 124
- Monitoring PIM, page 155
- Troubleshooting PIMv1 and PIMv2 Interoperability Problems, page 156
- Configuration Examples for PIM, page 156
- Where to Go Next for PIM, page 160
- Additional References, page 160
- Feature History and Information for PIM, page 162

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

The following are the prerequisites for configuring PIM and PIM stub routing:
• 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 sparse-dense-mode) configured on the uplink interface of the stub router.

• Before configuring PIM stub routing, you must also configure either Enhanced Interior Gateway Routing Protocol (EIGRP) stub routing or Open Shortest Path First (OSPF) stub routing on the device. 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.

Note
For information about EIGRP or OSPF configurations, see the Catalyst 3650 Routing Configuration Guide, Release 3SE.

Restrictions for Configuring PIM

The following are the restrictions for configuring PIM:

• PIM
  • PIM is not supported when running the LAN Base feature set.

• PIM stub routing
  • The IP Services image contains complete multicast routing.
  • In a network using PIM stub routing, the only allowable route for IP traffic to the user is through a device that is configured with PIM stub routing.
  • The redundant PIM stub router topology is not supported. Only the nonredundant access router topology is supported by the PIM stub feature.
  • 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.

Restrictions for Configuring Auto-RP

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

• Auto-RP is not supported when running the LAN Base feature set.

• 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.
Restrictions for Auto-RP Enhancement

The simultaneous deployment of Auto-RP and bootstrap router (BSR) is not supported.

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 devices, 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 devices 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 devices in your network. Therefore, if your network has a PIMv1 device in it and only Cisco routers and multilayer devices, 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 device. 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 devices, 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

Protocol-Independent Multicast (PIM) is called protocol-independent because 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 can leverage whichever unicast routing protocols are used to populate the unicast routing table, including EIGRP, OSPF, BGP, or static routes. PIM uses this unicast routing information to perform the multicast forwarding function, so it is IP protocol independent. Although PIM is called a multicast routing protocol, it actually uses the unicast routing table to perform the reverse path forwarding (RPF) check function instead of building up a completely independent multicast routing table. PIM does not send and receive multicast routing updates between routers as the other routing protocols do.

PIM is defined in RFC 4601, 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
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 devices 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 device, 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 devices within one network. Internally, all routers and multilayer devices 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 devices 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.
We recommend that you use PIMv2. The BSR function inter-operates with Auto-RP on Cisco routers and multilayer devices.

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 device in the group. Not all routers and devices 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 inter-operates 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 device assumes that all other routers or multilayer devices 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 device 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 device assumes that other routers or devices 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 device 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 device might not correctly forward traffic from these interfaces.

**Multicast Source Discovery Protocol (MSDP)**

Multicast Source Discovery Protocol (MSDP) is used for inter-domain source discovery when PIM-SM is used. Each PIM administrative domain has its own RP. In order for the RP in one domain to signal new sources to the RP in the other domain, MSDP is used.

When RP in a domain receives a PIM register message for a new source, with MSDP configured it sends a new source-active (SA) message to all its MSDP peers in other domains. Each intermediate MSDP peer floods this SA message away from the originating RP. The MSDP peers install this SA message in their MSDP sa-cache. If the RPs in other domains have any join requests for the group in the SA message (indicated by the presence of a (*,G) entry with non empty outgoing interface list), the domain is interested in the group, and the RP triggers an (S,G) join toward the source.

**PIM Stub Routing**

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

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.

In a network using PIM stub routing, the only allowable route for IP traffic to the user is through a device 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 device as a PIM stub router. The device does not route transit traffic between distribution routers. You also need to configure a routed uplink port on the device. The device 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.

You must also configure EIGRP stub routing when configuring PIM stub routing on the device. For information about this procedure, refer to the *Catalyst 3850 IP Routing Configuration Guide*.

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.

In the following figure, Device 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 3: PIM Stub Router Configuration**

![Diagram of PIM Stub Router Configuration]

**Related Topics**

- Enabling PIM Stub Routing (CLI), on page 124
- Example: Enabling PIM Stub Routing, on page 156

**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 (device) with the IGMP helper feature.

You can configure a stub router (device) with the **ip igmp helper help-address** interface configuration command to enable the device 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.

For complete syntax and usage information for the **ip igmp helper-address** command, see the *IP Multicast Command Reference, Cisco IOS XE Release 3SE (Catalyst 3850 Switches)*.

**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 device in the network. For Auto-RP to work, you configure a Cisco router or multilayer device as the mapping agent. It uses IP multicast to learn which routers or devices 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 device 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 devices automatically discover which RP to use for the groups that they support. If a router or device 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 device 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 (CLI), on page 129
- Example: Configuring Auto-RP, on page 157

### The Role of Auto-RP in a PIM Network

Auto-RP automates the distribution of group-to-rendezvous point (RP) mappings in a PIM network. To make Auto-RP work, a device must be designated as an RP mapping agent, which receives the RP announcement messages from the RPs and arbitrates conflicts. The RP mapping agent then sends the consistent group-to-RP mappings to all other devices by way of dense mode flooding.

Thus, all routers automatically discover which RP to use for the groups they support. The Internet Assigned Numbers Authority (IANA) has assigned two group addresses, 224.0.1.39 and 224.0.1.40, for Auto-RP.

The mapping agent receives announcements of intention to become the RP from Candidate-RPs. The mapping agent then announces the winner of the RP election. This announcement is made independently of the decisions by the other mapping agents.

**Related Topics**
- Configuring Sparse Mode with Auto-RP, on page 146
- Example: Sparse Mode with Auto-RP, on page 158
IP Multicast Boundary

As shown in the figure, address scoping defines domain boundaries so that domains with RPs that have the same IP address do not leak into each other. Scoping is performed on the subnet boundaries within large domains and on the boundaries between the domain and the Internet.

Figure 4: Address Scoping at Boundaries

You can set up an administratively scoped boundary on an interface for multicast group addresses using the `ip multicast boundary` command with the `access-list` argument. A standard access list defines the range of addresses affected. When a boundary is set up, 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 Internet Assigned Numbers Authority (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 be reused in domains administered by different organizations. They would be considered local, not globally unique.

You can configure the `filter-autorp` keyword to examine and filter Auto-RP discovery and announcement messages at the administratively scoped boundary. Any Auto-RP group range announcements from the Auto-RP packets that are denied by the boundary access control list (ACL) are removed. An Auto-RP group range announcement is permitted and passed by the boundary only if all addresses in the Auto-RP group range are permitted by the boundary ACL. If any address is not permitted, the entire group range is filtered and removed from the Auto-RP message before the Auto-RP message is forwarded.

Auto-RP Benefits

Auto-RP uses IP multicast to automate the distribution of group-to-RP mappings to all Cisco routers and multilayer devices 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 device in a PIM network, which can cause connectivity problems.
Benefits of Auto-RP in a PIM Network

- Auto-RP allows any change to the RP designation to be configured only on the devices that are RPs, not on the leaf routers.
- Auto-RP offers the ability to scope the RP address within a domain.

PIM v2 BSR

PIMv2 BSR (Bootstrap Router) is another method to distribute group-to-RP mapping information to all PIM routers and multilayer devices in the network. It eliminates the need to manually configure RP information in every router and device 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 devices 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 devices 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 devices, which store the RP information in the BSR message in their local RP cache. The routers and devices select the same RP for a given group because they all use a common RP hashing algorithm.

Related Topics

- Configuring Candidate BSRs (CLI), on page 141
- Example: Configuring Candidate BSRs, on page 159

Multicast Forwarding and Reverse Path Check

With unicast routing, routers and multilayer devices 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 device 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
A multicast packet, the router or multilayer device uses a reverse path forwarding (RPF) check on the packet as follows:

1. The router or multilayer device 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.

---

**Note**

DVMRP is not supported on the device.

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 device 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 device forwards the packet to all port in the outgoing port list.

![Figure 5: RPF Check](image)

<table>
<thead>
<tr>
<th>Network</th>
<th>Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>151.10.0.0/16</td>
<td>Gigabit Ethernet 1/0/1</td>
</tr>
<tr>
<td>198.14.32.0/32</td>
<td>Gigabit Ethernet 1/0/3</td>
</tr>
<tr>
<td>204.1.16.0/24</td>
<td>Gigabit Ethernet 1/0/4</td>
</tr>
</tbody>
</table>

**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 device 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 device 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 device.

---

**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 6: 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 devices 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:
A receiver joins a group; leaf Router C sends a join message toward the RP.

The RP puts a link to Router C in its outgoing interface list.

A source sends data; Router A encapsulates the data in a register message and sends it to the RP.

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.

When data arrives natively (unencapsulated) at the RP, it sends a register-stop message to Router A.

By default, reception of the first data packet prompts Router C to send a join message toward the source.

When Router C receives data on (S, G), it sends a prune message for the source up the shared tree.

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 (CLI), on page 151.

**Default PIM Routing Configuration**

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

*Table 14: Default Multicast Routing Configuration*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multicast routing</td>
<td>Disabled on all interfaces.</td>
</tr>
<tr>
<td>PIM version</td>
<td>Version 2.</td>
</tr>
<tr>
<td>PIM mode</td>
<td>No mode is defined.</td>
</tr>
<tr>
<td>PIM stub routing</td>
<td>None configured.</td>
</tr>
<tr>
<td>PIM RP address</td>
<td>None configured.</td>
</tr>
<tr>
<td>PIM domain border</td>
<td>Disabled.</td>
</tr>
<tr>
<td>PIM multicast boundary</td>
<td>None.</td>
</tr>
<tr>
<td>Candidate BSRs</td>
<td>Disabled.</td>
</tr>
<tr>
<td>Candidate RPs</td>
<td>Disabled.</td>
</tr>
<tr>
<td>Shortest-path tree threshold rate</td>
<td>0 kb/s.</td>
</tr>
</tbody>
</table>
How to Configure PIM

Enabling PIM Stub Routing (CLI)

This procedure is optional.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface interface-id`
4. `ip pim passive`
5. `end`
6. `show ip pim interface`
7. `show ip igmp groups detail`
8. `show ip mroute`
9. `show running-config`
10. `copy running-config startup-config`

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device&gt; enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device# configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td><code>interface interface-id</code></td>
<td>Specifies the interface on which you want to enable PIM stub routing,</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>and enters interface configuration mode.</td>
</tr>
<tr>
<td><code>Device(config)# interface</code></td>
<td>The specified interface must be one of the following:</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| gigabitethernet 1/0/1                | • A routed port—A physical port that has been configured as a Layer 3 port by entering the `no switchport` interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83.  
• An SVI—A VLAN interface created by using the `interface vlan vlan-id` global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83. |
| Step 4 ip pim passive                | Configures the PIM stub feature on the interface.                                                                                                                                                     |
| Example:                            | Device(config-if)# ip pim passive                                                                                                                                                                     |
| Step 5 end                           | Returns to privileged EXEC mode.                                                                                                                                                                      |
| Example:                            | Device(config-if)# end                                                                                                                                                                              |
| Step 6 show ip pim interface         | (Optional) Displays the PIM stub that is enabled on each interface.                                                                                                                                   |
| Example:                            | Device# show ip pim interface                                                                                                                                                                         |
| Step 7 show ip igmp groups detail    | (Optional) Displays the interested clients that have joined the specific multicast source group.                                                                                                       |
| Example:                            | Device# show ip igmp groups detail                                                                                                                                                                    |
| Step 8 show ip mroute                | (Optional) Displays the IP multicast routing table.                                                                                                                                                |
| Example:                            | Device# show ip mroute                                                                                                                                                                              |
### Configuring PIM

### 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 (CLI)](page127).

- **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 (CLI)](page129)
  - [Adding Auto-RP to an Existing Sparse-Mode Cloud (CLI)](page131)
  - [Preventing Join Messages to False RPs (CLI)](page134)
  - [Filtering Incoming RP Announcement Messages (CLI)](page134)

- **Using a standards track protocol in the Internet Engineering Task Force (IETF)**
  
  For information about this procedure, see [Configuring PIMv2 BSR](page136).

#### 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](page114).
Manually Assigning an RP to Multicast Groups (CLI)

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.

RP s 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 device responds to the group as dense and uses the dense-mode PIM techniques. This procedure is optional.

SUMMARY STEPS

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ip pim rp-address ip-address [access-list-number] [override]</td>
<td>Configures the address of a PIM RP.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# ip pim rp-address</td>
<td></td>
</tr>
</tbody>
</table>

Note: If there is no RP configured for a group, the device treats the group as dense, using the dense-mode PIM techniques.
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.

### Step 4

**access-list** *access-list-number* {deny | permit} *source* [source-wildcard]

**Example:**
```
Device(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 5

**end**

**Example:**
```
Device(config)# end
```

Returns to privileged EXEC mode.

### Step 6

**show running-config**

**Example:**
```
Device# show running-config
```

Verifies your entries.

### Step 7

**copy running-config startup-config**

**Example:**
```
Device# copy running-config startup-config
```

(Optional) Saves your entries in the configuration file.
**Setting Up Auto-RP in a New Internetwork (CLI)**

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

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> <code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; <code>enable</code></td>
<td></td>
</tr>
<tr>
<td>**Step 2<code> show running-config</code></td>
<td>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 <code>ip pim rp-address</code> global configuration command.</td>
</tr>
<tr>
<td>Example: Device# <code>show running-config</code></td>
<td></td>
</tr>
</tbody>
</table>

**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...
### Configuring a Rendezvous Point

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>configured RPs. Assume that it is desirable to use a second RP for the local groups.</td>
<td></td>
</tr>
</tbody>
</table>

**Step 3**  
**configure terminal**  
**Example:**  
Device# configure terminal

**Step 4**  
**ip pim send-rp-announce**  
**interface-id scope ttl group-list access-list-number**  
**interval seconds**  
**Example:**  
Device(config)# ip pim send-rp-announce gigabitethernet 1/0/5 scope 20 group-list 10 interval 120

**Step 5**  
**access-list access-list-number {deny | permit} source [source-wildcard]**  
**Example:**  
Device(config)# access-list 10  
permit 10.10.0.0

**Step 6**  
**ip pim send-rp-discovery scope ttl**  
**Example:**  
Device(config)# ip pim send-rp-discovery scope 50

### Configure 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.

### 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.

### Finds a device 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.
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 7 ( \text{end} )</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# end</td>
<td></td>
</tr>
<tr>
<td>Step 8 ( \text{show running-config} )</td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show running-config</td>
<td></td>
</tr>
<tr>
<td>Step 9 ( \text{show ip pim rp mapping} )</td>
<td>Displays active RPs that are cached with associated multicast routing entries.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show ip pim rp mapping</td>
<td></td>
</tr>
<tr>
<td>Step 10 ( \text{show ip pim rp} )</td>
<td>Displays the information cached in the routing table.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show ip pim rp</td>
<td></td>
</tr>
<tr>
<td>Step 11 ( \text{copy running-config startup-config} )</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# copy running-config</td>
<td></td>
</tr>
<tr>
<td>startup-config</td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

- Auto-RP, on page 117
- Example: Configuring Auto-RP, on page 157

**Adding Auto-RP to an Existing Sparse-Mode Cloud (CLI)**

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> show running-config</td>
<td>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 <strong>ip pim rp-address</strong> global configuration command.</td>
</tr>
<tr>
<td>Example: Device# show running-config</td>
<td><strong>Note</strong> This step is not required for spare-dense-mode environments.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Step 3</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip pim send-rp-announce interface-id scope ttl group-list access-list-number interval seconds</td>
<td>Configures another PIM device to be the candidate RP for local groups.</td>
</tr>
<tr>
<td></td>
<td>- For interface-id, enter the interface type and number that identifies the RP address. Valid interfaces include physical ports, port channels, and VLANs.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
</tbody>
</table>
| `Device(config)# ip pim send-rp-announce gigabitethernet 1/0/5 scope 20 group-list 10 interval 120` | - 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 5**

| access-list access-list-number {deny | permit} source [source-wildcard] | Creates a standard access list, repeating the command as many times as necessary. |
|-----------------------------------|----------------------------------------------------------------------------------|
| **Example:**                      |                                                                                  |
| `Device(config)# access-list 10 permit 224.0.0.0 15.255.255.255` | - 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 6**

| ip pim send-rp-discovery scope ttl | Finds a device 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. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(config)# ip pim send-rp-discovery scope 50</code></td>
<td><em>Note</em> To remove the device as the RP-mapping agent, use the <code>no ip pim send-rp-discovery</code> global configuration command.</td>
</tr>
</tbody>
</table>

**Step 7**

<table>
<thead>
<tr>
<th>end</th>
<th>Returns to privileged EXEC mode.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(config)# end</code></td>
<td></td>
</tr>
</tbody>
</table>

**Step 8**

<table>
<thead>
<tr>
<th>show running-config</th>
<th>Verifies your entries.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device# show running-config</code></td>
<td></td>
</tr>
</tbody>
</table>
### Configuring PIM

#### Configuring a Rendezvous Point

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 9</strong> show ip pim rp mapping</td>
<td>Displays active RPs that are cached with associated multicast routing entries.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# show ip pim rp mapping</td>
<td></td>
</tr>
</tbody>
</table>

| **Step 10** show ip pim rp            | Displays the information cached in the routing table.                                     |
| **Example:**                          |                                                                                           |
| Device# show ip pim rp                |                                                                                           |

| **Step 11** copy running-config startup-config | (Optional) Saves your entries in the configuration file.                                    |
| **Example:**                              |                                                                                           |
| Device# copy running-config startup-config|                                                                                           |

---

### Preventing Join Messages to False RPs (CLI)

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 devices 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.

This procedure is optional.

**Related Topics**

- Example: Preventing Join Messages to False RPs, on page 159

### Filtering Incoming RP Announcement Messages (CLI)

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 ip pim rp-announce-filter rp-list access-list-number group-list access-list-number</td>
<td>Filters incoming RP announcement messages.</td>
</tr>
<tr>
<td>Example: Device(config)# ip pim rp-announce-filter rp-list 10 group-list 14</td>
<td>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.</td>
</tr>
<tr>
<td>Step 4 access-list access-list-number {deny</td>
<td>permit} source [source-wildcard]</td>
</tr>
<tr>
<td>Example: Device(config)# access-list 10 permit 10.8.1.0 255.255.224.0</td>
<td>• 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 devices the mapping agent accepts candidate RP announcements (rp-list ACL).</td>
</tr>
</tbody>
</table>
### Command or Action

- Create an access list that specifies the range of multicast groups from which to accept or deny (group-list ACL).
- 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.

### Purpose

**Step 5**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device(config)## end
```

**Step 6**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>show running-config</td>
<td>Verifies your entries.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device## show running-config
```

**Step 7**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
</tbody>
</table>

**Example:**

```
Device## copy running-config startup-config
```

### Related Topics

**Example: Filtering Incoming RP Announcement Messages**, on page 158

### 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 (CLI)

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 7: Constraining PIMv2 BSR Messages**

This procedure is optional.

**SUMMARY STEPS**

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td><code>Device&gt; enable</code></td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

### Purpose

**Step 2**

**configure terminal**

Enters the global configuration mode.

**Example:**

Device# configure terminal

**Step 3**

**interface interface-id**

Specifies the interface to be configured, 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. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see **Example: Interface Configuration as a Routed Port**, on page 83

- **An SVI** — A VLAN interface created by using the `interface vlan vlan-id` global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see **Example: Interface Configuration as an SVI**, on page 83

These interfaces must have IP addresses assigned to them.

**Step 4**

**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 device 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 5**

**end**

Returns to privileged EXEC mode.

**Example:**

Device(config)# end

**Step 6**

**show running-config**

Verifies your entries.

**Example:**

Device# show running-config

**Step 7**

**copy running-config startup-config**

(Optional) Saves your entries in the configuration file.

**Example:**

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>access-list <code>access-list-number</code> deny <code>source</code> [source-wildcard]</td>
<td>Creates a standard access list, repeating the command as many times as necessary.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# access-list 12 deny 224.0.1.39 access-list 12 deny 224.0.1.40</td>
<td></td>
</tr>
</tbody>
</table>

- 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.
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>• (Optional) For <code>source-wildcard</code>, 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.</td>
<td>The access list is always terminated by an implicit deny statement for everything.</td>
</tr>
<tr>
<td><strong>Step 4</strong> <code>interface interface-id</code></td>
<td>Specifies the interface to be configured, and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# <code>interface gigabitethernet 1/0/1</code></td>
<td>The specified interface must be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• A routed port—A physical port that has been configured as a Layer 3 port by entering the <code>no switchport</code> interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83</td>
</tr>
<tr>
<td></td>
<td>• An SVI—A VLAN interface created by using the <code>interface vlan vlan-id</code> global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83</td>
</tr>
<tr>
<td>These interfaces must have IP addresses assigned to them.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> <code>ip multicast boundary access-list-number</code></td>
<td>Configures the boundary, specifying the access list you created in Step 2.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# <code>ip multicast boundary 12</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> <code>end</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# <code>end</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> <code>show running-config</code></td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# <code>show running-config</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> <code>copy running-config startup-config</code></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
</tbody>
</table>
Related Topics

Example: Defining the IP Multicast Boundary to Deny Auto-RP Information, on page 158

### Configuring Candidate BSRs (CLI)

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

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong> <code>ip pim bsr-candidate interface-id hash-mask-length [priority]</code></td>
<td>Configures your device to be a candidate BSR.</td>
</tr>
</tbody>
</table>
Purpose

For **interface-id**, enter the interface on this device 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.

Step 4

**end**

Returns to privileged EXEC mode.

Example:

Device(config-if)# end

Step 5

**show running-config**

Verifies your entries.

Example:

Device# show running-config

Step 6

**copy running-config startup-config**

(Optional) Saves your entries in the configuration file.

Example:

Device# copy running-config startup-config

Related Topics

PIM v2 BSR, on page 120

Example: Configuring Candidate BSRs, on page 159

Configuring the Candidate RPs (CLI)

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:

- For **interface-id**, enter the interface on this device 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.

Step 4

**end**

Returns to privileged EXEC mode.

Example:

Device(config-if)# end

Step 5

**show running-config**

Verifies your entries.

Example:

Device# show running-config

Step 6

**copy running-config startup-config**

(Optional) Saves your entries in the configuration file.

Example:

Device# copy running-config startup-config

Related Topics

PIM v2 BSR, on page 120

Example: Configuring Candidate BSRs, on page 159

Configuring the Candidate RPs (CLI)

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:
**SUMMARY STEPS**

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip pim rp-candidate interface-id [group-list access-list-number]</td>
<td>Configures your device to be a candidate RP.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip pim rp-candidate gigabitethernet 1/0/5 group-list 10</td>
<td>• For <em>interface-id</em>, 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 <em>group-list access-list-number</em>, enter an IP standard access list number from 1 to 99. If no group-list is specified, the device is a candidate RP for all groups.</td>
</tr>
<tr>
<td><strong>Step 4</strong> access-list access-list-number {deny</td>
<td>permit} source [source-wildcard]</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Device(config)# access-list 10 permit 239.0.0.0 0.255.255.255 | • 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 5** end | Returns to privileged EXEC mode. |
| **Example:** |         |
| Device(config-if)# end |         |
| **Step 6** show running-config | Verifies your entries |
| **Example:** |         |
| Device# show running-config |         |
| **Step 7** copy running-config startup-config | (Optional) Saves your entries in the configuration file |
| **Example:** |         |
| Device# copy running-config startup-config |         |

**Related Topics**

Example: Configuring Candidate RPs, on page 159

**Configuring Auto-RP and BSR for the Network (CLI)**

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 devices, both Auto-RP and a BSR are required. We recommend that a Cisco PIMv2 router or multilayer device 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 126
  - Configuring Candidate BSRs (CLI), on page 141

• 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

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>On any Cisco device, displays available RP mappings and metrics:</td>
</tr>
<tr>
<td>show ip pim rp [hostname or IP address</td>
<td>mapping [hostname or IP address</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# show ip pim rp mapping</td>
</tr>
<tr>
<td></td>
<td>On any Cisco device, displays available RP mappings and metrics:</td>
</tr>
<tr>
<td></td>
<td>• (Optional) For the hostname, specify the IP name of the group about which to display RPs.</td>
</tr>
<tr>
<td></td>
<td>• (Optional) For the IP address, specify the IP address of the group about which to display RPs.</td>
</tr>
<tr>
<td></td>
<td>• (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).</td>
</tr>
<tr>
<td></td>
<td>• (Optional) Use the metric keyword to display the RP RPF metric.</td>
</tr>
</tbody>
</table>

| Step 2 | show ip pim rp-hash group |
| Example: | Device# show ip pim rp-hash 239.1.1.1 |
| On a PIMv2 router or multilayer device, 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. |
Configuring Sparse Mode with Auto-RP

Before You Begin

- An interface configured in sparse-dense mode is treated in either sparse mode or dense mode of operation, depending on the mode in which the multicast group operates. You must decide how to configure your interfaces.

- All access lists that are needed when Auto-RP is configured should be configured prior to beginning the configuration task.

Note

- If a group has no known RP and the interface is configured to be sparse-dense mode, the interface is treated as if it were in dense mode, and data is flooded over the interface. To avoid this data flooding, configure the Auto-RP listener and then configure the interface as sparse mode.

- When configuring Auto-RP, you must either configure the Auto-RP listener feature (Step 5) and specify sparse mode (Step 7) or specify sparse-dense mode (Step 8).

- When you configure sparse-dense mode, dense mode failover may result in a network dense-mode flood. To avoid this condition, use PIM sparse mode with the Auto-RP listener feature.

Follow this procedure to configure auto-rendezvous point (Auto-RP). Auto-RP can also be optionally used with anycast RP.
SUMMARY STEPS

1. enable
2. configure terminal
3. ip multicast-routing [distributed]
4. Either perform Steps 5 through 7 or perform Steps 6 and 8.
5. ip pim autorp listener
6. interface type number
7. ip pim sparse-mode
8. ip pim sparse-dense-mode
9. exit
10. Repeat Steps 1 through 9 on all PIM interfaces.
11. ip pim send-rp-announce {interface-type interface-number | ip-address} scope ttl-value [group-list access-list] [interval seconds] [bidir]
12. ip pim send-rp-discovery [interface-type interface-number] scope ttl-value [interval seconds]
13. ip pim rp-announce-filter rp-list access-list group-list access-list
14. no ip pim dm-fallback
15. interface type number
16. ip multicast boundary access-list [filter-autorp]
17. end
18. show ip pim autorp
19. show ip pim rp [mapping] [rp-address]
20. show ip igmp groups [group-name | group-address | interface-type interface-number] [detail]
21. show ip mroute [group-address | group-name] [source-address | source-name] [interface-type interface-number] [summary] [count] [active kbps]

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>ip multicast-routing [distributed]</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Enables IP multicast routing.</td>
</tr>
</tbody>
</table>
### Configuring Sparse Mode with Auto-RP

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong> Device(config)# ip multicast-routing</td>
<td>Use the <strong>distributed</strong> keyword to enabled Multicast Distributed Switching.</td>
</tr>
</tbody>
</table>

**Step 4** Either perform Steps 5 through 7 or perform Steps 6 and 8. --

**Step 5** `ip pim autorp listener`  
**Example:** Device(config)# ip pim autorp listener  
Causes IP multicast traffic for the two Auto-RP groups 224.0.1.39 and 224.0.1.40 to be PIM dense mode flooded across interfaces operating in PIM sparse mode.  
- Skip this step if you are configuring sparse-dense mode in Step 8.

**Step 6** `interface type number`  
**Example:** Device(config)# interface Gigabitethernet 1/0/0  
Selects an interface that is connected to hosts on which PIM can be enabled.

**Step 7** `ip pim sparse-mode`  
**Example:** Device(config-if)# ip pim sparse-mode  
Enables PIM sparse mode on an interface. When configuring Auto-RP in sparse mode, you must also configure the Auto-RP listener in the next step.  
- Skip this step if you are configuring sparse-dense mode in Step 8.

**Step 8** `ip pim sparse-dense-mode`  
**Example:** Device(config-if)# ip pim sparse-dense-mode  
Enables PIM sparse-dense mode on an interface.  
- Skip this step if you configured sparse mode in Step 7.

**Step 9** `exit`  
**Example:** Device(config-if)# exit  
Exits interface configuration mode and returns to global configuration mode.

**Step 10** Repeat Steps 1 through 9 on all PIM interfaces. --

**Step 11** `ip pim send-rp-announce {interface-type interface-number | ip-address} scope ttl-value [group-list access-list] [interval seconds] [bidir]`  
**Example:** Device(config)# ip pim send-rp-announce loopback0 scope 31 group-list 5  
Sends RP announcements out all PIM-enabled interfaces.  
- Perform this step on the RP device only.  
- Use the `interface-type` and `interface-number` arguments to define which IP address is to be used as the RP address.  
- Use the `ip-address` argument to specify a directly connected IP address as the RP address.
### Command or Action

<table>
<thead>
<tr>
<th>Step 12</th>
<th>ip pim send-rp-discovery [interface-type interface-number] scope ttl-value [interval seconds]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# ip pim send-rp-discovery loopback 1 scope 31</td>
</tr>
</tbody>
</table>

**Purpose**

Configures the device to be an RP mapping agent.

- Perform this step on RP mapping agent devices or on combined RP/RP mapping agent devices.

**Note**

Auto-RP allows the RP function to run separately on one device and the RP mapping agent to run on one or multiple devices. It is possible to deploy the RP and the RP mapping agent on a combined RP/RP mapping agent device.

- Use the optional `interface-type` and `interface-number` arguments to define which IP address is to be used as the source address of the RP mapping agent.

- Use the `scope` keyword and `ttl-value` argument to specify the Time-to-Live (TTL) value in the IP header of Auto-RP discovery messages.

- Use the optional `interval` keyword and `seconds` argument to specify the interval at which Auto-RP discovery messages are sent.

**Note**

Lowering the interval at which Auto-RP discovery messages are sent from the default value of 60 seconds results in more frequent floodings of the group-to-RP mappings. In some network environments, the disadvantages of lowering the interval (more control packet overhead) may outweigh the advantages (more frequent group-to-RP mapping updates).

- The example shows limiting the Auto-RP discovery messages to 31 hops on loopback interface 1.

<table>
<thead>
<tr>
<th>Step 13</th>
<th>ip pim rp-announce-filter rp-list access-list group-list access-list</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# ip pim rp-announce-filter rp-list 1 group-list 2</td>
</tr>
</tbody>
</table>

**Purpose**

Filters incoming RP announcement messages sent from candidate RPs (C-RPs) to the RP mapping agent.

- Perform this step on the RP mapping agent only.

**Note**

If the `ip-address` argument is configured for this command, the RP-announce message will be sourced by the interface to which this IP address is connected (that is, the source address in the IP header of the RP-announce message is the IP address of that interface).

- This example shows that the interface is enabled with a maximum of 31 hops. The IP address by which the device wants to be identified as RP is the IP address associated with loopback interface 0. Access list 5 describes the groups for which this device serves as RP.
### Command or Action

<table>
<thead>
<tr>
<th>Step 14</th>
<th><strong>no ip pim dm-fallback</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Device(config)# no ip pim dm-fallback</code></td>
</tr>
</tbody>
</table>

(Optional) Prevents PIM dense mode fallback.

- Skip this step if all interfaces have been configured to operate in PIM sparse mode.

**Note**  The **no ip pim dm-fallback** command behavior is enabled by default if all the interfaces are configured to operate in PIM sparse mode (using the **ip pim sparse-mode** command).

<table>
<thead>
<tr>
<th>Step 15</th>
<th><strong>interface type number</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Device(config)# interface gigabitethernet 1/0/0</code></td>
</tr>
</tbody>
</table>

Selects an interface that is connected to hosts on which PIM can be enabled.

<table>
<thead>
<tr>
<th>Step 16</th>
<th><strong>ip multicast boundary access-list [filter-autorp]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Device(config-if)# ip multicast boundary 10 filter-autorp</code></td>
</tr>
</tbody>
</table>

Configures an administratively scoped boundary.

- Perform this step on the interfaces that are boundaries to other devices.
- The access list is not shown in this task.
- An access list entry that uses the **deny** keyword creates a multicast boundary for packets that match that entry.

<table>
<thead>
<tr>
<th>Step 17</th>
<th>end</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Device(config-if)# end</code></td>
</tr>
</tbody>
</table>

Returns to global configuration mode.

<table>
<thead>
<tr>
<th>Step 18</th>
<th><strong>show ip pim autorp</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Device# show ip pim autorp</code></td>
</tr>
</tbody>
</table>

(Optional) Displays the Auto-RP information.

<table>
<thead>
<tr>
<th>Step 19</th>
<th><strong>show ip pim rp [mapping] [rp-address]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><code>Device# show ip pim rp mapping</code></td>
</tr>
</tbody>
</table>

(Optional) Displays RPs known in the network and shows how the device learned about each RP.

| Step 20 | **show ip igmp groups [group-name | group-address| interface-type interface-number] [detail]** |
|---------|------------------------------------------------|
| **Example:** | `Device# show ip igmp groups` |

(Optional) Displays the multicast groups having receivers that are directly connected to the device and that were learned through Internet Group Management Protocol (IGMP).

- A receiver must be active on the network at the time that this command is issued in order for receiver information to be present on the resulting display.
### Command or Action

**Step 21**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>`show ip mroute [group-address</td>
<td>group-name]`</td>
</tr>
<tr>
<td>`[source-address</td>
<td>source-name] [interface-type interface-number] [summary] [count] [active kbps]`</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device# show ip mroute cbone-audio</code></td>
<td></td>
</tr>
</tbody>
</table>

#### Related Topics

- **The Role of Auto-RP in a PIM Network**, on page 118
- **Example: Sparse Mode with Auto-RP**, on page 158

### Delaying the Use of PIM Shortest-Path Tree (CLI)

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 device 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. `enable`
2. `configure terminal`
3. `access-list access-list-number {deny | permit} source [source-wildcard]`
4. `ip pim spt-threshold {kbps | infinity} [group-list access-list-number]`
5. `end`
6. `show running-config`
7. `copy running-config startup-config`
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Creates a standard access list.</td>
</tr>
<tr>
<td>`access-list access-list-number {deny</td>
<td>permit} source [source-wildcard]`</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# access-list 16 permit 225.0.0.0 0.255.255.255</td>
<td>The <code>deny</code> keyword denies access if the conditions are matched.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Specifies the threshold that must be reached before moving to shortest-path tree (spt).</td>
</tr>
<tr>
<td>`ip pim spt-threshold {kbps</td>
<td>infinity} [group-list access-list-number]`</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip pim spt-threshold infinity group-list 16</td>
<td><strong>Specify infinity</strong> if you want all sources for the specified group to use the shared tree, never switching to the source tree.</td>
</tr>
<tr>
<td></td>
<td><strong>(Optional)</strong> For <code>group-list access-list-number</code>, 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.</td>
</tr>
</tbody>
</table>
### Step 5
**Command or Action**: `end`

**Purpose**: Returns to privileged EXEC mode.

**Example:**
```
Device(config)# end
```

### Step 6
**Command or Action**: `show running-config`

**Purpose**: Verifies your entries.

**Example:**
```
Device# show running-config
```

### Step 7
**Command or Action**: `copy running-config startup-config`

**Purpose**: (Optional) Saves your entries in the configuration file.

**Example:**
```
Device# copy running-config startup-config
```

---

## Modifying the PIM Router-Query Message Interval (CLI)

PIM routers and multilayer devices 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. `enable`
2. `configure terminal`
3. `interface interface-id`
4. `ip pim query-interval seconds`
5. `end`
6. `show ip igmp interface [interface-id]`
7. `copy running-config startup-config`
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>enable</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
</tbody>
</table>

| **Step 2**        | Enters the global configuration mode. |
| configure terminal| **Example:** |
| Device# configure terminal |

| **Step 3**        | Specifies the interface to be configured, and enters interface configuration mode. |
| interface interface-id | **Example:** |
| Device(config)# interface gigabitethernet 1/0/1 |

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. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83

- An SVI—A VLAN interface created by using the interface vlan vlan-id global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83

These interfaces must have IP addresses assigned to them.

| **Step 4**        | Configures the frequency at which the device sends PIM router-query messages. |
| ip pim query-interval seconds | **Example:** |
| Device(config-if)# ip pim query-interval 45 |

The default is 30 seconds. The range is 1 to 65535.

| **Step 5**        | Returns to privileged EXEC mode. |
| end               | **Example:** |
| Device(config-if)# end |
Purpose

Command or Action | Purpose
---|---
**Step 6** |  
show ip igmp interface [interface-id] | Verifies your entries.

**Example:**

Device# show ip igmp interface

**Step 7** |  
copy running-config startup-config | (Optional) Saves your entries in the configuration file.

**Example:**

Device# copy running-config startup-config

---

**Monitoring PIM**

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

*Table 15: PIM Monitoring Commands*

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>show ip pim all-vrfs tunnel [tunnel tunnel_number</td>
<td>verbose]</td>
</tr>
<tr>
<td>show ip pim autorp</td>
<td>Displays global auto-RP information.</td>
</tr>
<tr>
<td>show ip pim boundary</td>
<td>Displays information about mroutes filtered by administratively scoped IPv4 multicast boundaries configured on an interface.</td>
</tr>
<tr>
<td>show ip pim interface</td>
<td>Displays information about interfaces configured for Protocol Independent Multicast (PIM).</td>
</tr>
<tr>
<td>show ip pim neighbor</td>
<td>Displays the PIM neighbor information.</td>
</tr>
<tr>
<td>show ip pim tunnel [tunnel</td>
<td>verbose]</td>
</tr>
<tr>
<td>show ip pim vrf [ word</td>
<td>all-vrfs</td>
</tr>
</tbody>
</table>
Monitoring RP Mapping

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

Table 16: RP Mapping Monitoring Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show ip pim bsr</code></td>
<td>Displays information about the elected BSR.</td>
</tr>
<tr>
<td><code>show ip pim bsr-router</code></td>
<td>Displays information about the BSRv2.</td>
</tr>
<tr>
<td>`show ip pim rp [hostname or IP address</td>
<td>mapping [hostname or IP address]</td>
</tr>
<tr>
<td><code>show ip pim rp-hash hostname or IP group address</code></td>
<td>Displays the RP that was selected for the specified group.</td>
</tr>
</tbody>
</table>

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.

```
Device(config)# ip multicast-routing distributed
Device(config)# interface GigabitEthernet3/0/25
Device(config-if)# no switchport
Device(config-if)# ip address 3.1.1.2 255.255.255.0
Device(config-if)# ip pim sparse-dense-mode
Device(config-if)# exit
Device(config)# interface vlan100
Device(config-if)# ip pim passive
```
Configuring PIM

Example: Verifying PIM Stub Routing

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

```
Device# 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
```

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:

```
Device(config)# access-list 1 permit 225.2.2.2 0.0.0.0
Device(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 device serves as RP:

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

Related Topics

- Enabling PIM Stub Routing (CLI), on page 124
- PIM Stub Routing, on page 116
Example: Sparse Mode with Auto-RP

The following example configures sparse mode with Auto-RP:

```plaintext
ip multicast-routing
ip pim autorp listener
ip pim send-rp-discovery Loopback0 scope 16 group-list 1
ip pim send-rp-discovery Loopback1 scope 16
no ip pim dm-fallback
access-list 1 permit 239.254.2.0 0.0.0.255
access-list 1 permit 239.254.3.0 0.0.0.255
access-list 10 permit 224.0.1.39
access-list 10 permit 224.0.1.40
access-list 10 permit 239.254.2.0 0.0.0.255
access-list 10 permit 239.254.3.0 0.0.0.255
```

Related Topics

- The Role of Auto-RP in a PIM Network, on page 118
- Configuring Sparse Mode with Auto-RP, on page 146

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:

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

Related Topics

- Defining the IP Multicast Boundary (CLI), on page 139

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:

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

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

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.

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

Example: Configuring Candidate RPs

This example shows how to configure the device 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.

```
Device(config)# ip pim rp-candidate gigabitethernet1/0/2 group-list 4
Device(config)# access-list 4 permit 239.0.0.0 0.255.255.255
```
Where to Go Next for PIM

You can configure the following:

- IGMP
- Wireless Multicast
- SSM
- IP Multicast Routing
- Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
- Multicast Subsecond Convergence
- IP Multicast Load Splitting across Equal-Cost Paths
- SSM Channel Based Filtering for Multicast
- PIM Dense Mode State Refresh
- IGMP State Limit

Additional References

Related Documents

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<tr>
<td>PIM is defined in RFC 4601 and in these Internet Engineering Task Force (IETF) Internet drafts.</td>
<td>• Protocol Independent Multicast (PIM): Motivation and Architecture</td>
</tr>
<tr>
<td></td>
<td>• Protocol Independent Multicast (PIM), Dense Mode Protocol Specification</td>
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<tr>
<td></td>
<td>• Protocol Independent Multicast (PIM), Sparse Mode Protocol Specification</td>
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<tr>
<td></td>
<td>• draft-ietf-idmr-igmp-v2-06.txt, Internet Group Management Protocol, Version 2</td>
</tr>
<tr>
<td></td>
<td>• draft-ietf-pim-v2-dm-03.txt, PIM Version 2 Dense Mode</td>
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</table>

For complete syntax and usage information for the commands used in this chapter. | IP Multicast Routing Command Reference (Catalyst 3650 Switches) |
### Related Topic

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<td>IP Multicast Routing Command Reference (Catalyst 3650 Switches)</td>
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<tr>
<td>Open Shortest Path First (OSPF) stub routing</td>
<td>IP Routing: OSPF Configuration Guide, Cisco IOS XE 3SE (Catalyst 3650 Switches)</td>
</tr>
<tr>
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<td>Cisco IOS IP SLAs commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
</tr>
<tr>
<td>Overview of the IP multicast technology area</td>
<td>&quot; IP Multicast Technology Overview &quot; module</td>
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<tr>
<td>Concepts, tasks, and examples for configuring an IP multicast network using PIM</td>
<td>&quot;Configuring a Basic IP Multicast Network &quot; module</td>
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### Error Message Decoder

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<th>Description</th>
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<tr>
<td>To help you research and resolve system error messages in this release, use the Error Message Decoder tool.</td>
<td><a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a></td>
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<td>All supported MIBs for this release.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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Technical Assistance

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<th>Link</th>
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<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
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Feature History and Information for PIM

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<tr>
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<th>Modification</th>
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<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
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CHAPTER 7

Configuring PIM MIB Extension for IP Multicast

• Finding Feature Information, page 163
• Information About PIM MIB Extension for IP Multicast, page 163
• How to Configure PIM MIB Extension for IP Multicast, page 164
• Configuration Examples for PIM MIB Extensions, page 166
• Additional References, page 166

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.

Information About PIM MIB Extension for IP Multicast

PIM MIB Extensions for SNMP Traps for IP Multicast

Protocol Independent Multicast (PIM) is an IP multicast routing protocol used for routing multicast data packets to multicast groups. RFC 2934 defines the PIM MIB for IPv4, which describes managed objects that enable users to remotely monitor and configure PIM using Simple Network Management Protocol (SNMP).

PIM MIB extensions introduce the following new classes of PIM notifications:

• neighbor-change--This notification results from the following conditions:
  • A router’s PIM interface is disabled or enabled (using the ip pim command in interface configuration mode)
  • A router's PIM neighbor adjacency expires (defined in RFC 2934)
Benefits of PIM MIB Extensions

PIM MIB extensions:

- Allow users to identify changes in the multicast topology of their network by detecting changes in the RP mapping.
- Provide traps to monitor the PIM protocol on PIM-enabled interfaces.
- Help users identify routing issues when multicast neighbor adjacencies expire on a multicast interface.
- Enable users to monitor RP configuration errors (for example, errors due to flapping in dynamic RP allocation protocols like Auto-RP).

How to Configure PIM MIB Extension for IP Multicast

Enabling PIM MIB Extensions for IP Multicast

Perform this task to enable PIM MIB extensions for IP multicast.

Note

- The pimInterfaceVersion object was removed from RFC 2934 and, therefore, is no longer supported in software.
- The following MIB tables are not supported in Cisco software:
  - pimIpMRoutetable
  - pimIpMRoutenextHopTable

Related Topics

- Enabling PIM MIB Extensions for IP Multicast, on page 164
- Example Enabling PIM MIB Extensions for IP Multicast, on page 166
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `snmp-server enable traps pim [neighbor-change | rp-mapping-change | invalid-pim-message]`
4. `snmp-server host host-address [traps | informs] community-string pim`

### DETAILED STEPS

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<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
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<tr>
<td><strong>Step 1</strong></td>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>`snmp-server enable traps pim [neighbor-change</td>
<td>rp-mapping-change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <code>neighbor-change</code> --This keyword enables notifications indicating when a device’s PIM interface is disabled or enabled, or when a device’s PIM neighbor adjacency expires.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <code>rp-mapping-change</code> --This keyword enables notifications indicating a change in RP mapping information due to either Auto-RP messages or BSR messages.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <code>invalid-pim-message</code> --This keyword enables notifications for monitoring invalid PIM protocol operations (for example, when a device receives a join or prune message for which the RP specified in the packet is not the RP for the multicast group or when a device receives a register message from a multicast group for which it is not the RP).</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# snmp-server enable traps pim neighbor-change</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>`snmp-server host host-address [traps</td>
<td>informs] community-string pim`</td>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# snmp-server host 10.10.10.10 traps public pim</td>
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</tbody>
</table>
Configuration Examples for PIM MIB Extensions

Example Enabling PIM MIB Extensions for IP Multicast

The following example shows how to configure a router to generate notifications indicating that a PIM interface of the router has been enabled. The first line configures PIM traps to be sent as SNMP v2c traps to the host with IP address 10.0.0.1. The second line configures the router to send the neighbor-change class of trap notification to the host.

```
snmp-server host 10.0.0.1 traps version 2c public pim
snmp-server enable traps pim neighbor-change
interface ethernet0/0
  ip pim sparse-dense-mode
```

Related Topics

- Enabling PIM MIB Extensions for IP Multicast, on page 164
- PIM MIB Extensions for SNMP Traps for IP Multicast, on page 163

Additional References

Related Documents

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<tr>
<td>draft-kouvelas-pim-bidir-new-00.txt</td>
<td>A New Proposal for Bi-directional PIM</td>
</tr>
<tr>
<td>RFC 1112</td>
<td>Host Extensions for IP Multicasting</td>
</tr>
<tr>
<td>RFC 1918</td>
<td>Address Allocation for Private Internets</td>
</tr>
<tr>
<td>RFC 2770</td>
<td>GLOP Addressing in 233/8</td>
</tr>
<tr>
<td>RFC 3569</td>
<td>An Overview of Source-Specific Multicast (SSM)</td>
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# MIBs

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<tr>
<th>MIB</th>
<th>MIBs Link</th>
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<tbody>
<tr>
<td>No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.</td>
<td>To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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# Technical Assistance

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<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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Configuring MSDP

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- Prerequisites for Using MSDP to Interconnect Multiple PIM-SM Domains, page 169
- Information About Using MSDP to Interconnect Multiple PIM-SM Domains, page 170
- How to Use MSDP to Interconnect Multiple PIM-SM Domains, page 184
- Configuration Examples for Using MSDP to Interconnect Multiple PIM-SM Domains, page 209
- Where to Go Next for MSDP, page 212
- Additional References, page 213
- Feature History and Information for Multicast Source Discovery Protocol, page 214

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 Using MSDP to Interconnect Multiple PIM-SM Domains

Before you configure MSDP, the addresses of all MSDP peers must be known in Border Gateway Protocol (BGP).
Information About Using MSDP to Interconnect Multiple PIM-SM Domains

Benefits of Using MSDP to Interconnect Multiple PIM-SM Domains

- Allows a rendezvous point (RP) to dynamically discover active sources outside of its domain.
- Introduces a more manageable approach for building multicast distribution trees between multiple domains.

Use of MSDP to Interconnect Multiple PIM-SM Domains

MSDP is a mechanism to connect multiple PIM-SM domains. The purpose of MSDP is to discover multicast sources in other PIM domains. The main advantage of MSDP is that it reduces the complexity of interconnecting multiple PIM-SM domains by allowing PIM-SM domains to use an interdomain source tree (rather than a common shared tree). When MSDP is configured in a network, RPs exchange source information with RPs in other domains. An RP can join the interdomain source tree for sources that are sending to groups for which it has receivers. The RP can do that because it is the root of the shared tree within its domain, which has branches to all points in the domain where there are active receivers. When a last-hop device learns of a new source outside the PIM-SM domain (through the arrival of a multicast packet from the source down the shared tree), it then can send a join toward the source and join the interdomain source tree.

If the RP either has no shared tree for a particular group or a shared tree whose outgoing interface list is null, it does not send a join to the source in another domain.

When MSDP is enabled, an RP in a PIM-SM domain maintains MSDP peering relationships with MSDP-enabled devices in other domains. This peering relationship occurs over a TCP connection, where primarily a list of sources sending to multicast groups is exchanged. MSDP uses TCP (port 639) for its peering connections. As with BGP, using point-to-point TCP peering means that each peer must be explicitly configured. The TCP connections between RPs, moreover, are achieved by the underlying routing system. The receiving RP uses the source lists to establish a source path. If the multicast sources are of interest to a domain that has receivers, multicast data is delivered over the normal, source-tree building mechanism provided by PIM-SM. MSDP is also used to announce sources sending to a group. These announcements must originate at the RP of the domain.

MSDP depends on BGP or multiprotocol BGP (MBGP) for interdomain operation. We recommended that you run MSDP on RPs sending to global multicast groups.

The figure illustrates MSDP operating between two MSDP peers. PIM uses MSDP as the standard mechanism to register a source with the RP of a domain.
Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

**Figure 8: MSDP Running Between RP Peers**

When MSDP is implemented, the following sequence of events occurs:

1. When a PIM designated device (DR) registers a source with its RP as illustrated in the figure, the RP sends a Source-Active (SA) message to all of its MSDP peers.

The DR sends the encapsulated data to the RP only once per source (when the source goes active). If the source times out, this process happens again when it goes active again. This situation is different from the periodic SA message that contains all sources that are registered to the originating RP. Those SA messages are MSDP control packets, and, thus, do not contain encapsulated data from active sources.
1. The SA message identifies the source address, the group that the source is sending to, and the address or the originator ID of the RP, if configured.

2. Each MSDP peer that receives the SA message floods the SA message to all of its peers downstream from the originator. In some cases (such as the case with the RPs in PIM-SM domains B and C in the figure), an RP may receive a copy of an SA message from more than one MSDP peer. To prevent looping, the RP consults the BGP next-hop database to determine the next hop toward the originator of the SA message. If both MBGP and unicast BGP are configured, MBGP is checked first, and then unicast BGP. That next-hop neighbor is the RPF-peer for the originator. SA messages that are received from the originator on any interface other than the interface to the RPF peer are dropped. The SA message flooding process, therefore, is referred to as peer-RPF flooding. Because of the peer-RPF flooding mechanism, BGP or MBGP must be running in conjunction with MSDP.

(M)BGP is not required in MSDP mesh group scenarios. For more information about MSDP mesh groups, see the Configuring an MSDP Mesh Group, on page 193 section.

(M)BGP is not required in default MSDP peer scenarios or in scenarios where only one MSDP peer is configured. For more information, see the Configuring a Default MSDP Peer, on page 192 section.

1. When an RP receives an SA message, it checks to see whether there are any members of the advertised groups in its domain by checking to see whether there are interfaces on the group’s (*, G) outgoing interface list. If there are no group members, the RP does nothing. If there are group members, the RP sends an (S, G) join toward the source. As a result, a branch of the interdomain source tree is constructed across autonomous system boundaries to the RP. As multicast packets arrive at the RP, they are then forwarded down its own shared tree to the group members in the RP’s domain. The members’ DRs then have the option of joining the rendezvous point tree (RPT) to the source using standard PIM-SM procedures.

2. The originating RP continues to send periodic SA messages for the (S, G) state every 60 seconds for as long as the source is sending packets to the group. When an RP receives an SA message, it caches the SA message. Suppose, for example, that an RP receives an SA message for (172.16.5.4, 228.1.2.3) from originating RP 10.5.4.3. The RP consults its mroutetable and finds that there are no active members for group 228.1.2.3, so it passes the SA message to its peers downstream of 10.5.4.3. If a host in the domain then sends a join to the RP for group 228.1.2.3, the RP adds the interface toward the host to the outgoing interface list of its (*, 224.1.2.3) entry. Because the RP caches SA messages, the device will have an entry for (172.16.5.4, 228.1.2.3) and can join the source tree as soon as a host requests a join.

In all current and supported software releases, caching of MSDP SA messages is mandatory and cannot be manually enabled or disabled. By default, when an MSDP peer is configured, the `ip multicast cache-sa-state` command will automatically be added to the running configuration.

**MSDP Message Types**

There are four basic MSDP message types, each encoded in their own Type, Length, and Value (TLV) data format.
**SA Messages**

SA messages are used to advertise active sources in a domain. In addition, these SA messages may contain the initial multicast data packet that was sent by the source.

SA messages contain the IP address of the originating RP and one or more (S, G) pairs being advertised. In addition, the SA message may contain an encapsulated data packet.

---

**Note**

For more information about SA messages, see the SA Message Origination Receipt and Processing, on page 174 section.

---

**SA Request Messages**

SA request messages are used to request a list of active sources for a specific group. These messages are sent to an MSDP SA cache that maintains a list of active (S, G) pairs in its SA cache. Join latency can be reduced by using SA request messages to request the list of active sources for a group instead of having to wait up to 60 seconds for all active sources in the group to be readvertised by originating RPs.

---

**Note**

For more information about SA request messages, see the Requesting Source Information from MSDP Peers, on page 199 section.

---

**SA Response Messages**

SA response messages are sent by the MSDP peer in response to an SA request message. SA response messages contain the IP address of the originating RP and one or more (S, G) pairs of the active sources in the originating RP’s domain that are stored in the cache.

---

**Note**

For more information about SA response messages, see the Controlling the Response to Outgoing SA Request Messages from MSDP Peers Using SA Request Filters, on page 200 section.

---

**Keepalive Messages**

Keepalive messages are sent every 60 seconds in order to keep the MSDP session active. If no keepalive messages or SA messages are received for 75 seconds, the MSDP session is reset.

---

**Note**

For more information about keepalive messages, see the Adjusting the MSDP Keepalive and Hold-Time Intervals, on page 190 section.
SA Message Origination Receipt and Processing

The section describes SA message origination, receipt, and processing in detail.

SA Message Origination

SA messages are triggered by an RP (assuming MSDP is configured) when any new source goes active within a local PIM-SM domain. A local source is a source that is directly connected to the RP or is the first-hop DR that has registered with it. An RP originates SA messages only for local sources in its PIM-SM domain; that is, for local sources that register with it.

A local source is denoted by the A flag being set in the (S,G) mroute entry on the RP (which can be viewed in the output of the `show ip mroute` command). This flag indicates that the source is a candidate for advertisement by the RP to other MSDP peers.

When a source is in the local PIM-SM domain, it causes the creation of (S,G) state in the RP. New sources are detected by the RP either by the receipt of a register message or the arrival of the first (S,G) packet from a directly connected source. The initial multicast packet sent by the source (either encapsulated in the register message or received from a directly connected source) is encapsulated in the initial SA message.

SA Message Receipt

SA messages are only accepted from the MSDP RPF peer that is in the best path back toward the originator. The same SA message arriving from other MSDP peers must be ignored or SA loops can occur. Deterministically selecting the MSDP RPF peer for an arriving SA message requires knowledge of the MSDP topology. However, MSDP does not distribute topology information in the form of routing updates. MSDP infers this information by using (M)BGP routing data as the best approximation of the MSDP topology for the SA RPF check mechanism. An MSDP topology, therefore, must follow the same general topology as the BGP peer topology. Besides a few exceptions (such as default MSDP peers and MSDP peers in MSDP mesh groups), MSDP peers, in general should also be (M)BGP peers.

How RPF Check Rules Are Applied to SA Messages

The rules that apply to RPF checks for SA messages are dependent on the BGP peerings between the MSDP peers:

- **Rule 1**: Applied when the sending MSDP peer is also an interior (M)BGP peer.
- **Rule 2**: Applied when the sending MSDP peer is also an exterior (M)BGP peer.
- **Rule 3**: Applied when the sending MSDP peer is not an (M)BGP peer.

RPF checks are not performed in the following cases:

- If the sending MSDP peer is the only MSDP peer, which would be the case if only a single MSDP peer or a default MSDP peer is configured.
- If the sending MSDP peer is a member of a mesh group.
- If the sending MSDP peer address is the RP address contained in the SA message.
How the Software Determines the Rule to Apply to RPF Checks

The software uses the following logic to determine which RPF rule to apply to RPF checks:

- Find the (M)BGP neighbor that has the same IP address as the sending MSDP peer.
  - If the matching (M)BGP neighbor is an internal BGP (iBGP) peer, apply Rule 1.
  - If the matching (M)BGP neighbor is an external BGP (eBGP) peer, apply Rule 2.
  - If no match is found, apply Rule 3.

The implication of the RPF check rule selection is as follows: The IP address used to configure an MSDP peer on a device must match the IP address used to configure the (M)BGP peer on the same device.

Rule 1 of RPF Checking of SA Messages in MSDP

Rule 1 of RPF checking in MSDP is applied when the sending MSDP peer is also an i(M)BGP peer. When Rule 1 is applied, the RPF check proceeds as follows:

1. The peer searches the BGP Multicast Routing Information Base (MRIB) for the best path to the RP that originated the SA message. If a path is not found in the MRIB, the peer then searches the Unicast Routing Information Base (URIB). If a path is still not found, the RPF check fails.

2. If the previous search succeeds (that is, the best path is found), the peer then determines the address of the BGP neighbor for this best path, which will be the address of the BGP neighbor that sent the peer the path in BGP update messages.

Note
The BGP neighbor address is not the same as the next-hop address in the path. Because i(M)BGP peers do not update the next-hop attribute of a path, the next-hop address usually is not the same as the address of the BGP peer that sent us the path.

Note
The BGP neighbor address is not necessarily the same as the BGP ID of the peer that sent the peer the path.

1. If the IP address of the sending MSDP peer is the same as the BGP neighbor address (that is, the address of the BGP peer that sent the peer the path), then the RPF check succeeds; otherwise it fails.

Implications of Rule 1 of RPF Checking on MSDP

The MSDP topology must mirror the (M)BGP topology. In general, wherever there is an i(M)BGP peer connection between two devices, an MSDP peer connection should be configured. More specifically, the IP address of the far-end MSDP peer connection must be the same as the far-end i(M)BGP peer connection. The addresses must be the same because the BGP topology between i(M)BGP peers inside an autonomous system is not described by the AS path. If it were always the case that i(M)BGP peers updated the next-hop address in the path when sending an update to another i(M)BGP peer, then the peer could rely on the next-hop address to describe the i(M)BGP topology (and hence the MSDP topology). However, because the default behavior...
for i(M)BGP peers is to not update the next-hop address, the peer cannot rely on the next-hop address to describe the (M)BGP topology (MSDP topology). Instead, the i(M)BGP peer uses the address of the i(M)BGP peer that sent the path to describe the i(M)BGP topology (MSDP topology) inside the autonomous system.

**Tip**
Care should be taken when configuring the MSDP peer addresses to make sure that the same address is used for both i(M)BGP and MSDP peer addresses.

**Rule 2 of RPF Checking of SA Messages in MSDP**

Rule 2 of RPF checking in MSDP is applied when the sending MSDP peer is also an e(M)BGP peer. When Rule 2 is applied, the RPF check proceeds as follows:

1. The peer searches the BGP MRIB for the best path to the RP that originated the SA message. If a path is not found in the MRIB, the peer then searches the URIB. If a path is still not found, the RPF check fails.
2. If the previous search succeeds (that is, the best path is found), the peer then examines the path. If the first autonomous system in the best path to the RP is the same as the autonomous system of the e(M)BGP peer (which is also the sending MSDP peer), then the RPF check succeeds; otherwise it fails.

**Implications of Rule 2 of RPF Checking on MSDP**

The MSDP topology must mirror the (M)BGP topology. In general, wherever there is an e(M)BGP peer connection between two devices, an MSDP peer connection should be configured. As opposed to Rule 1, the IP address of the far-end MSDP peer connection does not have to be the same as the far-end e(M)BGP peer connection. The reason that the addresses do not have to be identical is that BGP topology between two e(M)BGP peers is not described by the AS path.

**Rule 3 of RPF Checking of SA Messages in MSDP**

Rule 3 of RPF checking is applied when the sending MSDP peer is not a (M)BGP peer at all. When Rule 3 is applied, the RPF check proceeds as follows:

1. The peer searches the BGP MRIB for the best path to the RP that originated the SA message. If a path is not found in the MRIB, the peer then searches the URIB. If a path is still not found, the RPF check fails.
2. If the previous search succeeds (that is, the best path to the RP that originated the SA message is found), the peer then searches the BGP MRIB for the best path to the MSDP peer that sent the SA message. If a path is not found in the MRIB, the peer then searches the URIB. If a path is still not found, the RPF check fails.

**Note**
The autonomous system of the MSDP peer that sent the SA is the origin autonomous system, which is the last autonomous system in the AS path to the MSDP peer.

1. If the first autonomous system in the best path to the RP is the same as the autonomous system of the sending MSDP peer, then the RPF check succeeds; otherwise it fails.
SA Message Processing

The following steps are taken by an MSDP peer whenever it processes an SA message:

1. Using the group address G of the (S, G) pair in the SA message, the peer locates the associated (*, G) entry in the mroute table. If the (*, G) entry is found and its outgoing interface list is not null, then there are active receivers in the PIM-SM domain for the source advertised in the SA message.

2. The MSDP peer then creates an (S, G) entry for the advertised source.

3. If the (S, G) entry did not already exist, the MSDP peer immediately triggers an (S, G) join toward the source in order to join the source tree.

4. The peer then floods the SA message to all other MSDP peers with the exception of:
   - The MSDP peer from which the SA message was received.
   - Any MSDP peers that are in the same MSDP mesh group as this device (if the peer is a member of a mesh group).

Note

SA messages are stored locally in the device’s SA cache.

MSDP Peers

Like BGP, MSDP establishes neighbor relationships with other MSDP peers. MSDP peers connect using TCP port 639. The lower IP address peer takes the active role of opening the TCP connection. The higher IP address peer waits in LISTEN state for the other to make the connection. MSDP peers send keepalive messages every 60 seconds. The arrival of data performs the same function as the keepalive message and keeps the session from timing out. If no keepalive messages or data is received for 75 seconds, the TCP connection is reset.

Related Topics
- Configuring an MSDP Peer, on page 184
- Shutting Down an MSDP Peer, on page 186
- Example: Configuring an MSDP Peer, on page 209

MSDP MD5 Password Authentication

The MSDP MD5 password authentication feature is an enhancement to support Message Digest 5 (MD5) signature protection on a TCP connection between two MSDP peers. This feature provides added security by protecting MSDP against the threat of spoofed TCP segments being introduced into the TCP connection stream.

Related Topics
- Configuring MSDP MD5 Password Authentication Between MSDP Peers, on page 187
- Example: Configuring MSDP MD5 Password Authentication, on page 209
How MSDP MD5 Password Authentication Works

Developed in accordance with RFC 2385, the MSDP MD5 password authentication feature is used to verify each segment sent on the TCP connection between MSDP peers. The `ip msdp password peer` command is used to enable MD5 authentication for TCP connections between two MSDP peers. When MD5 authentication is enabled between two MSDP peers, each segment sent on the TCP connection between the peers is verified. MD5 authentication must be configured with the same password on both MSDP peers; otherwise, the connection between them will not be made. Configuring MD5 authentication causes the Cisco IOS software to generate and verify the MD5 digest of every segment sent on the TCP connection.

Benefits of MSDP MD5 Password Authentication

- Protects MSDP against the threat of spoofed TCP segments being introduced into the TCP connection stream.
- Uses the industry-standard MD5 algorithm for improved reliability and security.

SA Message Limits

The `ip msdp sa-limit` command is used to limit the overall number of SA messages that a device can accept from specified MSDP peers. When the `ip msdp sa-limit` command is configured, the device maintains a per-peer count of SA messages stored in the SA cache and will ignore new messages from a peer if the configured SA message limit for that peer has been reached.

The `ip msdp sa-limit` command was introduced as a means to protect an MSDP-enabled device from denial of service (DoS) attacks. We recommended that you configure SA message limits for all MSDP peerings on the device. An appropriately low SA limit should be configured on peerings with a stub MSDP region (for example, a peer that may have some further downstream peers but that will not act as a transit for SA messages across the rest of the Internet). A high SA limit should be configured for all MSDP peerings that act as transits for SA messages across the Internet.

MSDP Keepalive and Hold-Time Intervals

The `ip msdp keepalive` command is used to adjust the interval at which an MSDP peer will send keepalive messages and the interval at which the MSDP peer will wait for keepalive messages from other peers before declaring them down.

Once an MSDP peering session is established, each side of the connection sends a keepalive message and sets a keepalive timer. If the keepalive timer expires, the local MSDP peer sends a keepalive message and restarts its keepalive timer; this interval is referred to as the keepalive interval. The `keepalive-interval` argument is used to adjust the interval for which keepalive messages will be sent. The keepalive timer is set to the value specified for the `keepalive-interval` argument when the peer comes up. The keepalive timer is reset to the value of the `keepalive-interval` argument whenever an MSDP keepalive message is sent to the peer and reset when the timer expires. The keepalive timer is deleted when an MSDP peering session is closed. By default, the keepalive timer is set to 60 seconds.
The value specified for the `keepalive-interval` argument must be less than the value specified for the `holdtime-interval` argument and must be at least one second.

The hold-time timer is initialized to the value of the `hold-time-interval` argument whenever an MSDP peering connection is established, and is reset to the value of the `hold-time-interval` argument whenever an MSDP keepalive message is received. The hold-time timer is deleted whenever an MSDP peering connection is closed. By default, the hold-time interval is set to 75 seconds.

Use the `hold-time-interval` argument to adjust the interval at which the MSDP peer will wait for keepalive messages from other peers before declaring them down.

**MSDP Connection-Retry Interval**

You can adjust the interval at which all MSDP peers will wait after peering sessions are reset before attempting to reestablish the peering sessions. This interval is referred to as the connection-retry interval. By default, MSDP peers will wait 30 seconds after the session is reset before attempting to reestablish sessions with other peers. The modified configured connection-retry interval applies to all MSDP peering sessions on the device.

**Default MSDP Peers**

In most scenarios, an MSDP peer is also a BGP peer. If an autonomous system is a stub or nontransit autonomous system, and particularly if the autonomous system is not multihomed, there is little or no reason to run BGP to its transit autonomous system. A static default route at the stub autonomous system, and a static route pointing to the stub prefixes at the transit autonomous system, is generally sufficient. But if the stub autonomous system is also a multicast domain and its RP must peer with an RP in the neighboring domain, MSDP depends on the BGP next-hop database for its peer-RPF checks. You can disable this dependency on BGP by defining a default peer from which to accept all SA messages without performing the peer-RPF check. A default MSDP peer must be a previously configured MSDP peer.

A stub autonomous system also might want to have MSDP peerings with more than one RP for the sake of redundancy. For example, SA messages cannot just be accepted from multiple default peers, because there is no RPF check mechanism. Instead, SA messages are accepted from only one peer. If that peer fails, SA messages are then accepted from the other peer. The underlying assumption here, of course, is that both default peers are sending the same SA messages.

The figure illustrates a scenario where default MSDP peers might be used. In the figure, a customer that owns Device B is connected to the Internet through two Internet service providers (ISPs), one that owns Device A and the other that owns Device C. They are not running BGP or MBGP between them. In order for the customer to learn about sources in the ISP domain or in other domains, Device B identifies Device A as its default MSDP peer. Device B advertises SA messages to both Device A and Device C, but accepts SA messages either from Device A only or Device C only. If Device A is the first default peer in the configuration, it will be used if it is up and running. Only if Device A is not running will Device B accept SA messages from Device C.

The ISP will also likely use a prefix list to define which prefixes it will accept from the customer device. The customer will define multiple default peers, each having one or more prefixes associated with it.

The customer has two ISPs to use. The customer defines both ISPs as default peers. As long as the first default peer identified in the configuration is up and running, it will be the default peer and the customer will accept all SA messages it receives from that peer.
Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

### Figure 9: Default MSDP Peer Scenario

Device B advertises SAs to Device A and Device C, but uses only Device A or Device C to accept SA messages. If Device A is first in the configuration, it will be used if it is up and running. Only when Device A is not running will Device B accept SAs from Device C. This is the behavior without a prefix list.

If you specify a prefix list, the peer will be a default peer only for the prefixes in the list. You can have multiple active default peers when you have a prefix list associated with each. When you do not have any prefix lists, you can configure multiple default peers, but only the first one is the active default peer as long as the device has connectivity to this peer and the peer is alive. If the first configured peer goes down or the connectivity to this peer goes down, the second configured peer becomes the active default, and so on.

**Related Topics**
- Configuring a Default MSDP Peer, on page 192
- Example: Configuring a Default MSDP Peer, on page 210

### MSDP Mesh Groups

An MSDP mesh group is a group of MSDP speakers that have fully meshed MSDP connectivity between one another. In other words, each of the MSDP peers in the group must have an MSDP peering relationship (MSDP connection) to every other MSDP peer in the group. When an MSDP mesh group is configured between a group of MSDP peers, SA message flooding is reduced. Because when an MSDP peer in the group receives...
an SA message from another MSDP peer in the group, it assumes that this SA message was sent to all the other MSDP peers in the group. As a result, it is not necessary for the receiving MSDP peer to flood the SA message to the other MSDP peers in the group.

Related Topics

- Configuring an MSDP Mesh Group, on page 193
- Example: Configuring MSDP Mesh Groups, on page 212

Benefits of MSDP Mesh Groups

• Optimizes SA flooding--MSDP mesh groups are particularly useful for optimizing SA flooding when two or more peers are in a group.

• Reduces the amount of SA traffic across the Internet--When MSDP mesh groups are used, SA messages are not flooded to other mesh group peers.

• Eliminates RPF checks on arriving SA messages--When an MSDP mesh group is configured, SA messages are always accepted from mesh group peers.

SA Origination Filters

By default, an RP that is configured to run MSDP will originate SA messages for all local sources for which it is the RP. Local sources that register with an RP, therefore, will be advertised in SA messages, which in some cases is not desirable. For example, if sources inside a PIM-SM domain are using private addresses (for example, network 10.0.0.0/8), you should configure an SA origination filter to restrict those addresses from being advertised to other MSDP peers across the Internet.

To control what sources are advertised in SA messages, you can configure SA origination filters on an RP. By creating SA origination filters, you can control the sources advertised in SA messages as follows:

• You can configure an RP to prevent the device from advertising local sources in SA messages. The device will still forward SA messages from other MSDP peers in the normal fashion; it will just not originate any SA messages for local sources.

• You can configure the device to only originate SA messages for local sources sending to specific groups that match (S, G) pairs defined in the extended access list. All other local sources will not be advertised in SA messages.

• You can configure the device to only originate SA messages for local sources sending to specific groups that match AS paths defined in an AS-path access list. All other local sources will not be advertised in SA messages.

• You can configure the device to only originate SA messages for local sources that match the criteria defined in the route map. All other local sources will not be advertised in SA messages.

• You configure an SA origination filter that includes an extended access list, an AS-path access list, and route map, or a combination thereof. In this case, all conditions must be true before any local sources are advertised in SA messages.
Use of Outgoing Filter Lists in MSDP

By default, an MSDP-enabled device forwards all SA messages it receives to all of its MSDP peers. However, you can prevent SA messages from being forwarded to MSDP peers by creating outgoing filter lists. Outgoing filter lists apply to all SA messages, whether locally originated or received from another MSDP peer, whereas SA origination filters apply only to locally originated SA messages. For more information about enabling a filter for MSDP SA messages originated by the local device, see the Controlling SA Messages Originated by an RP for Local Sources, on page 195 section.

By creating an outgoing filter list, you can control the SA messages that a device forwards to a peer as follows:

• You can filter all outgoing SA messages forwarded to a specified MSDP peer by configuring the device to stop forwarding its SA messages to the MSDP peer.

• You can filter a subset of outgoing SA messages forwarded to a specified MSDP peer based on (S, G) pairs defined in an extended access list by configuring the device to only forward SA messages to the MSDP peer that match the (S, G) pairs permitted in an extended access list. The forwarding of all other SA messages to the MSDP peer will be stopped.

• You can filter a subset of outgoing SA messages forwarded to a specified MSDP peer based on match criteria defined in a route map by configuring the device to only forward SA messages that match the criteria defined in the route map. The forwarding of all other SA messages to the MSDP peer will be stopped.

• You can filter a subset of outgoing SA messages from a specified peer based on the announcing RP address contained in the SA message by configuring the device to filter outgoing SA messages based on their origin, even after an SA message has been transmitted across one or more MSDP peers. The forwarding of all other SA messages to the MSDP peer will be stopped.

• You can configure an outgoing filter list that includes an extended access list, a route map, and either an RP access list or an RP route map. In this case, all conditions must be true for the MSDP peer to forward the outgoing SA message.

Caution

Arbitrary filtering of SA messages can result in downstream MSDP peers being starved of SA messages for legitimate active sources. Care, therefore, should be taken when using these sorts of filters. Normally, outgoing filter lists are used only to reject undesirable sources, such as sources using private addresses.

Use of Incoming Filter Lists in MSDP

By default, an MSDP-enabled device receives all SA messages sent to it from its MSDP peers. However, you can control the source information that a device receives from its MSDP peers by creating incoming filter lists.

By creating incoming filter lists, you can control the incoming SA messages that a device receives from its peers as follows:

• You can filter all incoming SA messages from a specified MSDP peer by configuring the device to ignore all SA messages sent to it from the specified MSDP peer.

• You can filter a subset of incoming SA messages from a specified peer based on (S, G) pairs defined in an extended access list by configuring the device to only receive SA messages from the MSDP peer that
match the (S, G) pairs defined in the extended access list. All other incoming SA messages from the MSDP peer will be ignored.

• You can filter a subset of incoming SA request messages from a specified peer based on match criteria defined in a route map by configuring the device to only receive SA messages that match the criteria defined in the route map. All other incoming SA messages from the MSDP peer will be ignored.

• You can filter a subset of incoming SA messages from a specified peer based on both (S, G) pairs defined in an extended access list and on match criteria defined in a route map by configuring the device to only receive incoming SA messages that both match the (S, G) pairs defined in the extended access list and match the criteria defined in the route map. All other incoming SA messages from the MSDP peer will be ignored.

• You can filter a subset of incoming SA messages from a specified peer based on the announcing RP address contained in the SA message by configuring the device to filter incoming SA messages based on their origin, even after the SA message may have already been transmitted across one or more MSDP peers.

• You can configure an incoming filter list that includes an extended access list, a route map, and either an RP access list or an RP route map. In this case, all conditions must be true for the MSDP peer to receive the incoming SA message.

⚠️ Caution

Arbitrary filtering of SA messages can result in downstream MSDP peers being starved of SA messages for legitimate active sources. Care, therefore, should be taken when using these sorts of filters. Normally, incoming filter lists are used only to reject undesirable sources, such as sources using private addresses.

### TTL Thresholds in MSDP

The time-to-live (TTL) value provides a means to limit the number of hops a packet can take before being dropped. The `ip multicast ttl-threshold` command is used to specify a TTL for data-encapsulated SA messages sent to specified MSDP peers. By default, multicast data packets in SA messages are sent to an MSDP peer, provided the TTL value of the packet is greater than 0, which is standard TTL behavior.

In general, a TTL-threshold problem can be introduced by the encapsulation of a source’s initial multicast packet in an SA message. Because the multicast packet is encapsulated inside of the unicast SA message (whose TTL is 255), its TTL is not decremented as the SA message travels to the MSDP peer. Furthermore, the total number of hops that the SA message traverses can be drastically different than a normal multicast packet because multicast and unicast traffic may follow completely different paths to the MSDP peer and hence the remote PIM-SM domain. As a result, encapsulated packets can end up violating TTL thresholds. The solution to this problem is to configure a TTL threshold that is associated with any multicast packet that is encapsulated in an SA message sent to a particular MSDP peer using the `ip multicast ttl-threshold` command. The `ip msdp ttl-threshold` command prevents any multicast packet whose TTL in the IP header is less than the TTL value specified for the `ttl-value` argument from being encapsulated in SA messages sent to that peer.

### SA Request Messages

You can configure a noncaching device to send SA request messages to one or more specified MSDP peers.
If an noncaching RP has an MSDP peer that is caching SAs, you can reduce the join latency for a noncaching peer by enabling the noncaching peer to send SA request messages. When a host requests a join to a particular group, the noncaching RP sends an SA request message to its caching peers. If a peer has cached source information for the group in question, it sends the information to the requesting RP with an SA response message. The requesting RP uses the information in the SA response but does not forward the message to any other peers. If a noncaching RP receives an SA request, it sends an error message back to the requestor.

In all current and supported software releases, caching of MSDP SA messages is mandatory and cannot be manually enabled or disabled. By default, when an MSDP peer is configured, the configured commands are automatically added to the running configuration.

SA Request Filters

By default, a device honors all outgoing SA request messages from its MSDP peers; that is, it sends cached source information to requesting MSDP peers in SA response messages. You can control the outgoing SA request messages that a device will honor from specified peers by creating an SA request filter. An SA request filter controls the outgoing SA requests that the device will honor from MSDP peers as follows:

- You can filter all SA request messages from a specified peer by configuring the device to ignore all SA requests from the specified MSDP peer.
- You can filter a subset of SA request messages from a specified peer based on groups defined in a standard access list by configuring the device to honor only SA request messages from the MSDP peer that match the groups defined in a standard access list. SA request messages from the specified peer for other groups will be ignored.

How to Use MSDP to Interconnect Multiple PIM-SM Domains

The first task is required; all other tasks are optional.

Configuring an MSDP Peer

By enabling an MSDP peer, you implicitly enable MSDP.

Before You Begin

- IP multicast routing must be enabled and PIM-SM must be configured.
- With the exception of a single MSDP peer, default MSDP peer, and MSDP mesh group scenarios, all MSDP peers must be configured to run BGP prior to being configured for MSDP.
### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. `ip msdp peer \{peer-name|peer-address\} [connect-source type number] [remote-as as-number]`
4. `ip msdp description \{peer-name|peer-address\} text`
5. **end**

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 1 | `enable` | Enables privileged EXEC mode.  
  * Enter your password if prompted. |
| Example: | Device> enable | |
| Step 2 | `configure terminal` | Enters global configuration mode. |
| Example: | Device# configure terminal | |
| Step 3 | `ip msdp peer \{peer-name|peer-address\} [connect-source type number] [remote-as as-number]` | Enables MSDP and configures an MSDP peer as specified by the DNS name or IP address.  
**Note** The device that is selected to be configured as an MSDP peer is also usually a BGP neighbor. If it is not, see the Configuring a Default MSDP Peer, on page 192 section or the Configuring an MSDP Mesh Group, on page 193 section.  
  * If you specify the `connect-source` keyword, the primary address of the specified local interface *type* and *number* values are used as the source IP address for the TCP connection. The `connect-source` keyword is recommended, especially for MSDP peers on a border that peer with a device inside of a remote domain. |
| Example: | Device(config)# ip msdp peer 192.168.1.2 connect-source loopback0 | |
| Step 4 | `ip msdp description \{peer-name|peer-address\} text` | (Optional) Configures a description for a specified peer to make it easier to identify in a configuration or in `show` command output. |
| Example: | Device(config)# ip msdp description 192.168.1.2 router at customer a | |
| Step 5 | `end` | Exits global configuration mode and returns to privileged EXEC mode. |
| Example: | Device(config)# end | |
Shutting Down an MSDP Peer

Perform this optional task to shut down an MSDP peer.

If you are configuring several MSDP peers and you do not want any of the peers to go active until you have finished configuring all of them, you can shut down each peer, configure each peer, and later bring each peer up. You might also want to shut down an MSDP session without losing the configuration for that MSDP peer.

When an MSDP peer is shut down, the TCP connection is terminated and not restarted until the peer is brought back up using the `no ip msdp shutdown` command (for the specified peer).

Related Topics

MSDP Peers, on page 177
Example: Configuring an MSDP Peer, on page 209

Before You Begin

MSDP is running and the MSDP peers must be configured.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip msdp shutdown {peer-name | peer-address}`
4. Repeat Step 3 to shut down additional MSDP peers.
5. `end`

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
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<tbody>
<tr>
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<td><strong>Example:</strong></td>
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<td><code>Device&gt; enable</code></td>
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<td><strong>Step 2</strong></td>
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<tr>
<td><code>configure terminal</code></td>
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<tr>
<td><strong>Example:</strong></td>
<td></td>
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<tr>
<td><code>Device# configure terminal</code></td>
<td></td>
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</tbody>
</table>
### Purpose

**Command or Action**

**Step 3**

| ip msdp shutdown {peer-name | peer-address} |

**Example:**

```
Device(config)# ip msdp shutdown 192.168.1.3
```

**Purpose**

Administratively shuts down the specified MSDP peer.

**Step 4**

Repeat Step 3 to shut down additional MSDP peers.

**Step 5**

| end |

**Example:**

```
Device(config)# end
```

Exits global configuration mode and returns to privileged EXEC mode.

---

### Related Topics

- MSDP Peers, on page 177
- Example: Configuring an MSDP Peer, on page 209

---

### Configuring MSDP MD5 Password Authentication Between MSDP Peers

Perform this optional task to configure MSDP MD5 password authentication between MSDP peers.

#### SUMMARY STEPS

1. enable
2. configure terminal
3. ip msdp password peer {peer-name | peer-address} [encryption-type] string
4. exit
5. show ip msdp peer [peer-address | peer-name]

#### DETAILED STEPS

| Command or Action | Purpose |

**Step 1**

| enable |

**Example:**

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.
<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong></td>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Step 3** | `ip msdp password peer {peer-name | peer-address} [encryption-type] string` | Enables MD5 password encryption for a TCP connection between two MSDP peers.  
**Note** MD5 authentication must be configured with the same password on both MSDP peers; otherwise, the connection between them will not be made.  
• If you configure or change the password or key, which is used for MD5 authentication between two MSDP peers, the local device does not disconnect the existing session after you configure the password. You must manually disconnect the session to activate the new or changed password. |
| **Example:** Device(config)# ip msdp password peer 10.32.43.144 0 test | |
| **Step 4** | `exit` | Exits global configuration mode and returns to privileged EXEC mode. |
| **Example:** Device(config)# exit | |
| **Step 5** | `show ip msdp peer [peer-address | peer-name]` | (Optional) Displays detailed information about MSDP peers.  
**Note** Use this command to verify whether MD5 password authentication is enabled on an MSDP peer. |
| **Example:** Device# show ip msdp peer | |

**Related Topics**
- MSDP MD5 Password Authentication, on page 177
- Example: Configuring MSDP MD5 Password Authentication, on page 209

**Troubleshooting Tips**
If a device has a password configured for an MSDP peer but the MSDP peer does not, a message such as the following will appear on the console while the devices attempt to establish an MSDP session between them:

```
%TCP-6-BADAUTH: No MD5 digest from [peer's IP address]:11003 to [local router's IP address]:179
```
Similarly, if the two devices have different passwords configured, a message such as the following will appear on the console:

```
%TCP-6-BADAUTH: Invalid MD5 digest from [peer's IP address]:11004 to [local router's IP address]:179
```

The **debug ip tcp transactions** command is used to display information on significant TCP transactions such as state changes, retransmissions, and duplicate packets. In the context of monitoring or troubleshooting MSDP MD5 password authentication, use the **debug ip tcp transactions** command to verify that the MD5 password is enabled and that the keepalive message is received by the MSDP peer.

### Preventing DoS Attacks by Limiting the Number of SA Messages Allowed in the SA Cache from Specified MSDP Peers

Perform this optional (but highly recommended) task to limit the overall number of SA messages that the device can accept from specified MSDP peers. Performing this task protects an MSDP-enabled device from distributed denial-of-service (DoS) attacks.

**Note**

We recommend that you perform this task for all MSDP peerings on the device.

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip msdp sa-limit {peer-address | peer-name} sa-limit`
4. Repeat Step 3 to configure SA limits for additional MSDP peers.
5. `exit`
6. `show ip msdp count [as-number]`
7. `show ip msdp peer {peer-address | peer-name}`
8. `show ip msdp summary`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

#### Step 3
- **Command**: `ip msdp sa-limit {peer-address | peer-name} sa-limit

**Example:**
```
Device(config)# ip msdp sa-limit 192.168.10.1 100
```

**Purpose**: Limits the number of SA messages allowed in the SA cache from the specified MSDP.

#### Step 4
- **Action**: Repeat Step 3 to configure SA limits for additional MSDP peers.

**Purpose**: --

#### Step 5
- **Command**: `exit

**Example:**
```
Device(config)# exit
```

**Purpose**: Exits global configuration mode and returns to privileged EXEC mode.

#### Step 6
- **Command**: `show ip msdp count [as-number]

**Example:**
```
Device# show ip msdp count
```

**Purpose**: (Optional) Displays the number of sources and groups originated in MSDP SA messages and the number of SA messages from an MSDP peer in the SA cache.

#### Step 7
- **Command**: `show ip msdp peer [peer-address | peer-name]

**Example:**
```
Device# show ip msdp peer
```

**Purpose**: (Optional) Displays detailed information about MSDP peers.

**Note**: The output of this command displays the number of SA messages received from MSDP peers that are stored in the cache.

#### Step 8
- **Command**: `show ip msdp summary

**Example:**
```
Device# show ip msdp summary
```

**Purpose**: (Optional) Displays MSDP peer status.

**Note**: The output of this command displays a per-peer "SA Count" field that displays the number of SAs stored in the cache.

---

### Adjusting the MSDP Keepalive and Hold-Time Intervals

Perform this optional task to adjust the interval at which an MSDP peer will send keepalive messages and the interval at which the MSDP peer will wait for keepalive messages from other peers before declaring them down. By default, it may take as long as 75 seconds for an MSDP peer to detect that a peering session with another MSDP peer has gone down. In network environments with redundant MSDP peers, decreasing the hold-time interval can expedite the reconvergence time of MSDP peers in the event that an MSDP peer fails.
We recommend that you do not change the command defaults for the `ip msdp keepalive` command, because the command defaults are in accordance with RFC 3618, *Multicast Source Discovery Protocol*. If your network environment requires that you modify the defaults, you must configure the same time values for the `keepalive-interval` and `hold-time-interval` arguments on both ends of the MSDP peering session.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip msdp keepalive {peer-address | peer-name} keepalive-interval hold-time-interval`
4. Repeat Step 3 to adjust the keepalive message interval for additional MSDP peers.
5. `exit`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> `ip msdp keepalive {peer-address</td>
<td>peer-name} keepalive-interval hold-time-interval`</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip msdp keepalive 10.1.1.3 40 55</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> Repeat Step 3 to adjust the keepalive message interval for additional MSDP peers.</td>
<td>--</td>
</tr>
<tr>
<td><strong>Step 5</strong> <code>exit</code></td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>
Adjusting the MSDP Connection-Retry Interval

Perform this optional task to adjust the interval at which MSDP peers will wait after peering sessions are reset before attempting to reestablish the peering sessions. In network environments where fast recovery of SA messages is required, such as in trading floor network environments, you may want to decrease the connection-retry interval to a time value less than the default value of 30 seconds.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. ip msdp timer connection-retry-interval
4. exit

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Enters your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 ip msdp timer connection-retry-interval</td>
<td>Configures the interval at which MSDP peers will wait after peering sessions are reset before attempting to reestablish the peering sessions.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# ip msdp timer 45</td>
<td></td>
</tr>
<tr>
<td>Step 4 exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Configuring a Default MSDP Peer

Perform this optional task to configure a default MSDP peer.
Before You Begin
An MSDP default peer must be a previously configured MSDP peer. Before configuring a default MSDP peer, you must first configure an MSDP peer.

SUMMARY STEPS
1. enable
2. configure terminal
3. ip msdp default-peer {peer-address | peer-name} [prefix-list list]
4. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip msdp default-peer {peer-address</td>
<td>peer-name} [prefix-list list]</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip msdp default-peer 192.168.1.3</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Related Topics
Default MSDP Peers, on page 179
Example: Configuring a Default MSDP Peer, on page 210

Configuring an MSDP Mesh Group
Perform this optional task to configure an MSDP mesh group.
You can configure multiple mesh groups per device.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. `ip msdp mesh-group mesh-name {peer-address | peer-name}`
4. Repeat Step 3 to add MSDP peers as members of the mesh group.
5. exit

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> `ip msdp mesh-group mesh-name {peer-address</td>
<td>peer-name}`</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip msdp mesh-group peermesh</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> All MSDP peers on a device that participate in a mesh group must be fully meshed with all other MSDP peers in the group. Each MSDP peer on each device must be configured as a peer using the <code>ip msdp peer</code> command and also as a member of the mesh group using the <code>ip msdp mesh-group</code> command.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> Repeat Step 3 to add MSDP peers as members of the mesh group.</td>
<td>--</td>
</tr>
<tr>
<td><strong>Step 5</strong> exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

- MSDP Mesh Groups, on page 180
Controlling SA Messages Originated by an RP for Local Sources

Perform this task to control SA messages originated by an RP by enabling a filter to restrict which registered sources are advertised in SA messages.

Note
For best practice information related to configuring MSDP SA message filters, see the Multicast Source Discovery Protocol SA Filter Recommendations tech note.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip msdp redistribute [list access-list] [asn as-access-list] [route-map map-name]
4. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** | enable
| **Example:** | Device> enable |
| | Enables privileged EXEC mode.
| | • Enter your password if prompted. |
| **Step 2** | configure terminal
| **Example:** | Device# configure terminal |
| | Enters global configuration mode. |
| **Step 3** | ip msdp redistribute [list access-list] [asn as-access-list] [route-map map-name]
| **Example:** | Device(config)# ip msdp redistribute route-map customer-sources |
| | Enables a filter for MSDP SA messages originated by the local device.
| | **Note** The ip msdp redistribute command can also be used to advertise sources that are known to the RP but not registered. However, it is strongly recommended that you not originate advertisements for sources that have not registered with the RP. |
| **Step 4** | exit
| **Example:** | Device(config)# exit |
| | Exits global configuration mode and returns to privileged EXEC mode. |
Controlling the Forwarding of SA Messages to MSDP Peers Using Outgoing Filter Lists

Perform this optional task to control the forwarding of SA messages to MSDP peers by configuring outgoing filter lists.

For best practice information related to configuring MSDP SA message filters, see the Multicast Source Discovery Protocol SA Filter Recommendations tech note.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip msdp sa-filter out {peer-address | peer-name} [list access-list] [route-map map-name] [rp-list access-list] [rp-route-map map-name]
4. Repeat Step 3 to configure outgoing filter lists for additional MSDP peers.
5. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>ip msdp sa-filter out {peer-address</td>
<td>peer-name} [list access-list] [route-map map-name] [rp-list access-list</td>
</tr>
<tr>
<td>Example:</td>
<td>rp-route-map map-name]</td>
<td>Device(config)# ip msdp sa-filter out 192.168.1.5 peerone</td>
</tr>
<tr>
<td>Step 4</td>
<td>Repeat Step 3 to configure outgoing filter lists for additional MSDP peers.</td>
<td>--</td>
</tr>
</tbody>
</table>
### Controlling the Receipt of SA Messages from MSDP Peers Using Incoming Filter Lists

Perform this optional task to control the receipt of incoming SA messages from MSDP peers.

#### Note
For best practice information related to configuring MSDP SA message filters, see the Multicast Source Discovery Protocol SA Filter Recommendations tech note.

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip msdp sa-filter in {peer-address | peer-name} [list access-list] [route-map map-name] [rp-list access-list | rp-route-map map-name]`
4. Repeat Step 3 to configure incoming filter lists for additional MSDP peers.
5. `exit`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><code>enable</code> Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><code>configure terminal</code> Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
</tr>
</tbody>
</table>
Using TTL Thresholds to Limit the Multicast Data Sent in SA Messages

Perform this optional task to establish a time to live (TTL) threshold to limit the multicast data sent in SA messages.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip msdp ttl-threshold {peer-address | peer-name} ttl-value
4. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>
## Configuring MSDP

### Requesting Source Information from MSDP Peers

Perform this optional task to enable a device to request source information from MSDP peers.

**Note**

Because SA caching is enabled by default and cannot be explicitly enabled or disabled in earlier Cisco software releases, performing this task is seldom needed.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip msdp sa-request {peer-address | peer-name}`
4. Repeat Step 3 to specify that the device send SA request messages to additional MSDP caching peers.
5. `exit`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>`ip msdp ttl-threshold {peer-address</td>
<td>peer-name} ttl-value`</td>
</tr>
<tr>
<td></td>
<td><code>Example:</code></td>
<td>- By default, multicast data packets in SA messages are sent to an MSDP peer, provided the TTL value of the packet is greater than 0, which is standard TTL behavior.</td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# ip msdp ttl-threshold 192.168.1.5 8</code></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><code>exit</code></td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><code>Example:</code></td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# exit</code></td>
<td></td>
</tr>
</tbody>
</table>
Controlling the Response to Outgoing SA Request Messages from MSDP Peers Using SA Request Filters

Perform this optional task to control the outgoing SA request messages that the device will honor from MSDP peers.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip msdp filter-sa-request {peer-address | peer-name} [list access-list]`
4. Repeat Step 3 to configure SA request filters for additional MSDP peers.
5. `exit`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><code>enable</code></td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device&gt; enable</code></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><code>configure terminal</code></td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device# configure terminal</code></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>`ip msdp sa-request {peer-address</td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device(config)# ip msdp sa-request 192.168.10.1</code></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Repeat Step 3 to specify that the device send SA request messages to additional MSDP caching peers.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><code>exit</code></td>
</tr>
<tr>
<td>Example:</td>
<td><code>Device(config)# exit</code></td>
</tr>
</tbody>
</table>
## Including a Bordering PIM Dense Mode Region in MSDP

Perform this optional task to configure a border device to send SA messages for sources active in a PIM dense mode (PIM-DM) region.

You can have a device that borders a PIM-SM region and a PIM-DM region. By default, sources in the PIM-DM domain are not included in MSDP. You can configure this border device to send SA messages for sources active in the PIM-DM domain. If you do so, it is very important to also configure the `ip msdp redistribute` command to control what local sources from the PIM-DM domain are advertised. Not configuring this command can result in the (S, G) state remaining long after a source in the PIM-DM domain has stopped sending. For configuration information, see the Controlling SA Messages Originated by an RP for Local Sources, on page 195 section.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip msdp border sa-address type number`
4. `exit`

---

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Step 3</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>`ip msdp filter-sa-request {peer-address</td>
<td>peer-name} [list access-list]`</td>
</tr>
<tr>
<td><strong>Note</strong> Only one SA request filter can be configured per MSDP peer.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# ip msdp filter sa-request 172.31.2.2 list 1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Step 4</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeat Step 3 to configure SA request filters for additional MSDP peers.</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Step 5</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><code>exit</code></td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enables privileged EXEC mode.</td>
</tr>
<tr>
<td>enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>enters global configuration mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>configures the device on the border between a PIM-SM and PIM-DM domain to originate SA messages for active sources in the PIM-DM domain.</td>
</tr>
<tr>
<td>ip msdp border sa-address type number</td>
<td>• The IP address of the interface is used as the originator ID, which is the RP field in the SA message.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# ip msdp border sa-address gigabitethernet0/0/0</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>exit</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# exit</td>
</tr>
</tbody>
</table>

## Configuring an Originating Address Other Than the RP Address

Perform this optional task to allow an MSDP speaker that originates an SA message to use the IP address of its interface as the RP address in the SA message.

You can also change the originator ID for any one of the following reasons:

- If you configure multiple devices in an MSDP mesh group for Anycast RP.
- If you have a device that borders a PIM-SM domain and a PIM-DM domain. If a device borders a PIM-SM domain and a PIM-DM domain and you want to advertise active sources within the PIM-DM domain, configure the RP address in SA messages to be the address of the originating device’s interface.

**Before You Begin**

MSDP is enabled and the MSDP peers are configured. For more information about configuring MSDP peers, see the Configuring an MSDP Peer, on page 184 section.
SUMMARY STEPS

1. enable
2. configure terminal
3. ip msdp originator-id type number
4. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>ip msdp originator-id type number</td>
<td>Configures the RP address in SA messages to be the address of the originating device’s interface.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# ip msdp originator-id ethernet 1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Monitoring MSDP

Perform this optional task to monitor MSDP SA messages, peers, state, and peer status.
SUMMARY STEPS

1. enable
2. debug ip msdp [peer-address | peer-name] [detail] [routes]
3. debug ip msdp resets
4. show ip msdp count [as-number]
5. show ip msdp peer [peer-address | peer-name]
6. show ip msdp sa-cache [group-address | source-address | group-name | source-name] [as-number]
7. show ip msdp summary

DETAILED STEPS

Step 1  enable

Example:

Device# enable
Enables privileged EXEC mode.
• Enter your password if prompted.

Step 2  debug ip msdp [peer-address | peer-name] [detail] [routes]
Use this command to debug MSDP activity.

Use the optional peer-address or peer-name argument to specify for which peer debug events are logged.

The following is sample output from the debug ip msdp command:

Example:

Device# debug ip msdp
MSDP debugging is on
Device#
MSDP: 224.150.44.254: Received 1388-byte message from peer
MSDP: 224.150.44.254: SA TLV, len: 1388, ec: 115, RP: 172.31.3.92
MSDP: 224.150.44.254: Peer RPF check passed for 172.31.3.92, used EMBGP peer
MSDP: 224.150.44.250: Forward 1388-byte SA to peer
MSDP: 224.150.44.254: Received 1028-byte message from peer
MSDP: 224.150.44.254: SA TLV, len: 1028, ec: 85, RP: 172.31.3.92
MSDP: 224.150.44.254: Peer RPF check passed for 172.31.3.92, used EMBGP peer
MSDP: 224.150.44.250: Forward 1028-byte SA to peer
MSDP: 224.150.44.254: Received 1388-byte message from peer
MSDP: 224.150.44.254: SA TLV, len: 1388, ec: 115, RP: 172.31.3.111
MSDP: 224.150.44.254: Peer RPF check passed for 172.31.3.111, used EMBGP peer
MSDP: 224.150.44.250: Forward 1388-byte SA to peer
MSDP: 224.150.44.254: Received 56-byte message from peer
MSDP: 224.150.44.250: SA TLV, len: 56, ec: 4, RP: 192.168.76.241
MSDP: 224.150.44.254: Peer RPF check passed for 192.168.76.241, used EMBGP peer
MSDP: 224.150.44.254: Forward 56-byte SA to peer
MSDP: 224.150.44.254: Received 116-byte message from peer
MSDP: 224.150.44.254: SA TLV, len: 116, ec: 9, RP: 172.31.3.111
MSDP: 224.150.44.254: Peer RPF check passed for 172.31.3.111, used EMBGP peer
MSDP: 224.150.44.250: Forward 116-byte SA to peer
MSDP: 224.150.44.254: Received 32-byte message from peer
MSDP: 224.150.44.254: SA TLV, len: 32, ec: 2, RP: 172.31.3.78
MSDP: 224.150.44.254: Peer RPF check passed for 172.31.3.78, used EMBGP peer
MSDP: 224.150.44.250: Forward 32-byte SA to peer

Step 3  **debug ip msdp resets**
Use this command to debug MSDP peer reset reasons.

*Example:*

```
Device# debug ip msdp resets
```

Step 4  **show ip msdp count [as-number]**
Use this command to display the number of sources and groups originated in MSDP SA messages and the number of SA messages from an MSDP peer in the SA cache. The `ip msdp cache-sa-state` command must be configured for this command to produce any output.

The following is sample output from the **show ip msdp count** command:

*Example:*

```
Device# show ip msdp count
SA State per Peer Counters, <Peer>: <# SA learned>
  192.168.4.4: 8
SA State per ASN Counters, <asn>: <# sources>/<# groups>
  Total entries: 8
    : 8/8
```

Step 5  **show ip msdp peer [peer-address | peer-name]**
Use this command to display detailed information about MSDP peers.

Use the optional `peer-address` or `peer-name` argument to display information about a particular peer.

The following is sample output from the **show ip msdp peer** command:

*Example:*

```
Device# show ip msdp peer 192.168.4.4
MSDP Peer 192.168.4.4 (?), AS 64512 (configured AS)
  Connection status:
    State: Up, Resets: 0, Connection source: Loopback0 (2.2.2.2)
    Uptime(Downtime): 00:07:55, Messages sent/received: 8/18
    Output messages discarded: 0
    Connection and counters cleared 00:08:55 ago
  SA Filtering:
    Input (S,G) filter: none, route-map: none
    Input RP filter: none, route-map: none
    Output (S,G) filter: none, route-map: none
    Output RP filter: none, route-map: none
  SA-Requests:
    Input filter: none
    Peer ttl threshold: 0
    SAs learned from this peer: 8
    Input queue size: 0, Output queue size: 0
    MD5 signature protection on MSDP TCP connection: not enabled
```

Step 6  **show ip msdp sa-cache [group-address | source-address | group-name | source-name] [as-number]**
Use this command to display the (S, G) state learned from MSDP peers.

The following is sample output from the **show ip msdp sa-cache** command:
Clearing MSDP Connections Statistics and SA Cache Entries

Example:

```
Device# show ip msdp sa-cache
MSDP Source-Active Cache - 8 entries
(10.44.44.5, 239.232.1.0), RP 192.168.4.4, BGP/AS 64512, 00:01:20/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.1), RP 192.168.4.4, BGP/AS 64512, 00:01:20/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.2), RP 192.168.4.4, BGP/AS 64512, 00:01:19/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.3), RP 192.168.4.4, BGP/AS 64512, 00:01:19/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.4), RP 192.168.4.4, BGP/AS 64512, 00:01:19/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.5), RP 192.168.4.4, BGP/AS 64512, 00:01:19/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.6), RP 192.168.4.4, BGP/AS 64512, 00:01:19/00:05:32, Peer 192.168.4.4
(10.44.44.5, 239.232.1.7), RP 192.168.4.4, BGP/AS 64512, 00:01:19/00:05:32, Peer 192.168.4.4
```

Step 7 show ip msdp summary

Use this command to display MSDP peer status.

The following is sample output from the `show ip msdp summary` command:

```
Example:
Device# show ip msdp summary
MSDP Peer Status Summary
Peer Address  AS  State  Uptime/Reset SA  Peer Name
         Downtime Count Count
192.168.4.4  4  Up  00:08:05  0  8  ?
```

Clearing MSDP Connections Statistics and SA Cache Entries

Perform this optional task to clear MSDP connections, statistics, and SA cache entries.

**SUMMARY STEPS**

1. **enable**
2. **clear ip msdp peer** [peer-address | peer-name]
3. **clear ip msdp statistics** [peer-address | peer-name]
4. **clear ip msdp sa-cache** [group-address]

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>
### Configuring MSDP

**Enabling SNMP Monitoring of MSDP**

Perform this optional task to enable Simple Network Management Protocol (SNMP) monitoring of MSDP.

**Before You Begin**

- SNMP and MSDP is configured on your devices.
- In each PIM-SM domain there should be a device that is configured as the MSDP speaker. This device must have SNMP and the MSDP MIB enabled.

**Note**

- All MSDP-MIB objects are implemented as read-only.
- The Requests table is not supported in Cisco’s implementation of the MSDP MIB.
- The msdpEstablished notification is not supported in Cisco’s implementation of the MSDP MIB.

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong> clear ip msdp peer [peer-address</td>
<td>peer-name]</td>
</tr>
<tr>
<td>Example: Device# clear ip msdp peer</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> clear ip msdp statistics [peer-address</td>
<td>peer-name]</td>
</tr>
<tr>
<td>Example: Device# clear ip msdp statistics</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> clear ip msdp sa-cache [group-address]</td>
<td>Clears SA cache entries.</td>
</tr>
</tbody>
</table>
| Example: Device# clear ip msdp sa-cache | • If the clear ip msdp sa-cache is specified with the optional group-address argument or source-address argument, all SA cache entries are cleared.  
• Use the optional group-address argument to clear all SA cache entries associated with a specific group. |
SUMMARY STEPS

1. enable
2. snmp-server enable traps msdp
3. snmp-server host host [traps | informs] [version {1 | 2c | 3 [auth | priv | noauth]}] community-string [udp-port port-number] msdp
4. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> snmp-server enable traps msdp</td>
<td>Enables the sending of MSDP notifications for use with SNMP.</td>
</tr>
<tr>
<td>Example: Device# snmp-server enable traps msdp</td>
<td>Note: The snmp-server enable traps msdp command enables both traps and informs.</td>
</tr>
<tr>
<td><strong>Step 3</strong> snmp-server host host [traps</td>
<td>informs] [version {1</td>
</tr>
<tr>
<td>Example: Device# snmp-server host examplehost msdp</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device(config)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Troubleshooting Tips

You can compare the results of MSDP MIB notifications to the output from the software by using the show ip msdp summary and show ip msdp peer commands on the appropriate device. You can also compare the results of these commands to the results from SNMP Get operations. You can verify SA cache table entries using the show ip msdp sa-cache command. Additional troubleshooting information, such as the local address of the connection, the local port, and the remote port, can be obtained using the output from the debug ip msdp command.
Configuration Examples for Using MSDP to Interconnect Multiple PIM-SM Domains

Example: Configuring an MSDP Peer

The following example shows how to establish MSDP peering connections between three MSDP peers:

Device A

```plaintext
! interface Loopback 0
  ip address 10.220.8.1 255.255.255.255
! ip msdp peer 10.220.16.1 connect-source Loopback0
ip msdp peer 10.220.32.1 connect-source Loopback0
!
```

Device B

```plaintext
! interface Loopback 0
  ip address 10.220.16.1 255.255.255.255
! ip msdp peer 10.220.8.1 connect connect-source Loopback0
ip msdp peer 10.220.32.1 connect connect-source Loopback0
!
```

Device C

```plaintext
! interface Loopback 0
  ip address 10.220.32.1 255.255.255.255
! ip msdp peer 10.220.8.1 connect 10.220.8.1 connect-source Loopback0
ip msdp peer 10.220.16.1 connect 10.220.16.1 connect-source Loopback0
!
```

Related Topics

MSDP Peers, on page 177
Configuring an MSDP Peer, on page 184
Shutting Down an MSDP Peer, on page 186

Example: Configuring MSDP MD5 Password Authentication

The following example shows how to enable MD5 password authentication for TCP connections between two MSDP peers:

Device A

```plaintext
! ip msdp peer 10.3.32.154
```
Example: Configuring a Default MSDP Peer

The figure illustrates a scenario where default MSDP peers might be used. In the figure, a customer that owns Device B is connected to the internet through two ISPs, one that owns Device A and the other that owns Device C. They are not running (M)BGP between them. In order for the customer to learn about sources in the ISP domain or in other domains, Device B identifies Device A as its default MSDP peer. Device B advertises SA messages to both Device A and Device C, but accepts SA messages either from Device A only or Device C only. If Device A is the first default peer in the configuration, it will be used if it is up and running. Only if Device A is not running will Device B accept SA messages from Device C.

The ISP will also likely use a prefix list to define which prefixes it will accept from the customer device. The customer will define multiple default peers, each having one or more prefixes associated with it.

The customer has two ISPs to use. The customer defines both ISPs as default peers. As long as the first default peer identified in the configuration is up and running, it will be the default peer and the customer will accept all SA messages it receives from that peer.
Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

**Figure 10: Default MSDP Peer Scenario**

Device B advertises SAs to Device A and Device C, but uses only Device A or Device C to accept SA messages. If Device A is first in the configuration file, it will be used if it is up and running. Only when Device A is not running will Device B accept SAs from Device C. This is the behavior without a prefix list.

If you specify a prefix list, the peer will be a default peer only for the prefixes in the list. You can have multiple active default peers when you have a prefix list associated with each. When you do not have any prefix lists, you can configure multiple default peers, but only the first one is the active default peer as long as the device has connectivity to this peer and the peer is alive. If the first configured peer goes down or the connectivity to this peer goes down, the second configured peer becomes the active default, and so on.

The following example shows a partial configuration of Device A and Device C in the figure. Each of these ISPs may have more than one customer using default peering, like the customer in the figure. In that case, they may have similar configurations. That is, they will only accept SAs from a default peer if the SA is permitted by the corresponding prefix list.

**Device A Configuration**

```
ip msdp default-peer 10.1.1.1
ip msdp default-peer 10.1.1.1 prefix-list site-b ge 32
ip prefix-list site-b permit 10.0.0.0/8
```
Device C Configuration

ip msdp default-peer 10.1.1.1 prefix-list site-b ge 32
ip prefix-list site-b permit 10.0.0.0/8

Related Topics

Configuring a Default MSDP Peer, on page 192
Default MSDP Peers, on page 179

Example: Configuring MSDP Mesh Groups

The following example shows how to configure three devices to be fully meshed members of an MSDP mesh group:

Device A Configuration

ip msdp peer 10.2.2.2
ip msdp peer 10.3.3.3
ip msdp mesh-group test-mesh-group 10.2.2.2
ip msdp mesh-group test-mesh-group 10.3.3.3

Device B Configuration

ip msdp peer 10.1.1.1
ip msdp peer 10.3.3.3
ip msdp mesh-group test-mesh-group 10.1.1.1
ip msdp mesh-group test-mesh-group 10.3.3.3

Device C Configuration

ip msdp peer 10.1.1.1
ip msdp peer 10.2.2.2
ip msdp mesh-group test-mesh-group 10.1.1.1
ip msdp mesh-group test-mesh-group 10.2.2.2

Related Topics

Configuring an MSDP Mesh Group, on page 193
MSDP Mesh Groups, on page 180

Where to Go Next for MSDP

You can configure the following:

• IGMP
• PIM
• SSM
• IP Multicast Routing
• Service Discovery Gateway
You can also review the following IP Multicast Optimization processes for your configuration:

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
- Multicast Subsecond Convergence
- IP Multicast Load Splitting across Equal-Cost Paths
- SSM Channel Based Filtering for Multicast
- PIM Dense Mode State Refresh
- IGMP State Limit

### Additional References

#### Related Documents

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<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>IPv6 addressing and connectivity</td>
<td>IPv6 Configuration Guide</td>
</tr>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
</tr>
<tr>
<td>IP multicast commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
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<tr>
<td>IPv6 commands</td>
<td>Cisco IOS IPv6 Command Reference</td>
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<tr>
<td>Cisco IOS IPv6 features</td>
<td>Cisco IOS IPv6 Feature Mapping</td>
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#### Standards and RFCs

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<th>Standard/RFC</th>
<th>Title</th>
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<td>RFCs for IPv6</td>
<td>IPv6 RFCs</td>
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</table>

#### MIBs

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<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>
Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support and Documentation website provides online resources to</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
<tr>
<td>download documentation, software, and tools. Use these resources to install</td>
<td></td>
</tr>
<tr>
<td>and configure the software and to troubleshoot and resolve technical</td>
<td></td>
</tr>
<tr>
<td>issues with Cisco products and technologies. Access to most tools on the</td>
<td></td>
</tr>
<tr>
<td>Cisco Support and Documentation website requires a Cisco.com user ID and</td>
<td></td>
</tr>
<tr>
<td>password.</td>
<td></td>
</tr>
</tbody>
</table>

Feature History and Information for Multicast Source Discovery Protocol

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
</tr>
</tbody>
</table>
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• Finding Feature Information, page 215
• Prerequisites for Configuring Wireless Multicast, page 215
• Restrictions for Configuring Wireless Multicast, page 216
• Information About Wireless Multicast, page 216
• How to Configure Wireless Multicast, page 217
• Monitoring Wireless Multicast, page 226
• Where to Go Next for Wireless Multicast, page 227
• Additional References, page 228

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 Wireless Multicast

• The IP multicast routing must be enabled and the PIM version and PIM mode must be configured. The default routes should be available in the device. After performing these tasks, the device can then forward multicast packets and can populate its multicast routing table.

• To participate in IP multicasting, the multicast hosts, routers, and multilayer switches must have IGMP operating.

• When enabling multicast mode on the , a CAPWAP multicast group address should also be configured. Access points listen to the CAPWAP multicast group using IGMP.
Restrictions for Configuring Wireless Multicast

The following are the restrictions for configuring IP multicast routing:

- Access points in monitor mode, sniffer mode, or rogue detector mode do not join the CAPWAP multicast group address.
- The CAPWAP multicast group configured on the should be different for different devices.
- Multicast routing should not be enabled for the management interface.

Information About Wireless Multicast

If the network supports packet multicasting, the multicast method that the device uses can be configured. The device performs multicasting in two modes:

- Unicast mode—The device unicasts every multicast packet to every access point associated to the device. This mode is inefficient but might be required on networks that do not support multicasting.
- Multicast mode—The device sends multicast packets to a CAPWAP multicast group. This method reduces overhead on the device processor and shifts the work of packet replication to the network, which is much more efficient than the unicast method.

When the multicast mode is enabled and the device receives a multicast packet from the wired LAN, the device encapsulates the packet using CAPWAP and forwards the packet to the CAPWAP multicast group address. The device always uses the management VLAN for sending multicast packets. Access points in the multicast group receive the packet and forward it to all the BSSIDs mapped to the VLAN on which clients receive multicast traffic.

The device supports all the capabilities of v1 including Multicast Listener Discovery (MLD) v1 snooping but the v2 and v3 capabilities are limited. This feature keeps track of and delivers IPv6 multicast flows to the clients that request them. To support IPv6 multicast, global multicast mode should be enabled.

Internet Group Management Protocol (IGMP) snooping is introduced to better direct multicast packets. When this feature is enabled, the device snooping gathers IGMP reports from the clients, processes them, creates unique multicast group IDs (MGIDs) based on the Layer 3 multicast address and the VLAN number, and sends the IGMP reports to the IGMP querier. The device then updates the access point MGID table on the access point with the client MAC address. When the device receives multicast traffic for a particular multicast group, it forwards it to all the access points, but only those access points that have active clients listening or subscribed to that multicast group send multicast traffic on that particular WLAN. IP packets are forwarded with an MGID that is unique for an ingress VLAN and the destination multicast group. Layer 2 multicast packets are forwarded with an MGID that is unique for the ingress VLAN.

MGID is a 14-bit value filled in the 16-bit reserved field of wireless information in CAPWAP header. The remaining 2 bits should be set to zero.

Related Topics

- Configuring Wireless Multicast-MCMC Mode (CLI), on page 217
- Configuring Wireless Multicast-MCUC Mode (CLI), on page 218
Information About Multicast Optimization

Multicast used to be based on the group of the multicast addresses and the VLAN as one entity, MGID. With the VLAN group, duplicate packets might increase. Using the VLAN group feature, every client listens to the multicast stream on a different VLAN. As a result, the device creates different MGIDs for each multicast address and VLAN. Therefore, in a worst case situation, the upstream router sends one copy for each VLAN, which results in as many copies as the number of VLANs in the group. Because the WLAN remains the same for all clients, multiple copies of the multicast packet are sent over the wireless network. To suppress the duplication of a multicast stream on the wireless medium between the device and the access points, the multicast optimization feature can be used.

Multicast optimization enables you to create a multicast VLAN that can be used for multicast traffic. One of the VLANs in the device can be configured as a multicast VLAN where multicast groups are registered. The clients are allowed to listen to a multicast stream on the multicast VLAN. The MGID is generated using the multicast VLAN and multicast IP addresses. If multiple clients on different VLANs of the same WLAN are listening to a single multicast IP address, a single MGID is generated. The device makes sure that all multicast streams from the clients on this VLAN group always go out on the multicast VLAN to ensure that the upstream router has one entry for all the VLANs of the VLAN group. Only one multicast stream hits the VLAN group even if the clients are on different VLANs. Therefore, the multicast packets that are sent out over the network is just one stream.

Related Topics
Configuring IP Multicast VLAN for WLAN (CLI), on page 225

How to Configure Wireless Multicast

Configuring Wireless Multicast-MCMC Mode (CLI)

SUMMARY STEPS

1. enable
2. configure terminal
3. wireless multicast
4. ap capwap multicast ipaddr
5. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>wireless multicast</td>
<td>Enables the multicast traffic for wireless clients. The default value is disable. Add no in the command to disable the multicast traffic for wireless clients.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# wireless multicast</td>
<td></td>
</tr>
<tr>
<td>Device(config)# no wireless multicast</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>ap capwap multicast ipaddr</td>
<td>Enables the forwarding mode in multicast. Add no in the command to disable the multicast mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# ap capwap multicast 231.1.1</td>
<td></td>
</tr>
<tr>
<td>Device(config)# no ap capwap multicast 231.1.1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>end</td>
<td>Exits the configuration mode. Alternatively, press Ctrl-Z to exit the configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# end</td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

Information About Wireless Multicast, on page 216

**Configuring Wireless Multicast-MCUC Mode (CLI)**

**SUMMARY STEPS**

1. enable
2. configure terminal
3. wireless multicast
4. no ap capwap multicast ipaddr
5. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### Configuring Wireless Multicast

**Related Topics**
- Information About Wireless Multicast, on page 216

### Configuring IPv6 Snooping (CLI)

**SUMMARY STEPS**

1. enable
2. configure terminal
3. ipv6 mld snooping

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>

---

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td>Step 3 wireless multicast</td>
<td>Enables the multicast traffic for wireless clients and enables mDNS bridging. The default value is disable. Add no in the command to disable the multicast traffic for wireless clients and disable mDNS bridging.</td>
</tr>
<tr>
<td>Step 4 no ap capwap multicast ipaddr</td>
<td>Enables forwarding mode in multicast. Add no in the command to disable the multicast mode.</td>
</tr>
<tr>
<td>Step 5 end</td>
<td>Exits the configuration mode. Alternatively, press Ctrl-Z to exit the configuration mode.</td>
</tr>
</tbody>
</table>
### Configuring IPv6 Snooping Policy (CLI)

#### SUMMARY STEPS

1. enable
2. configure terminal
3. ipv6 snooping policy *policy-name*
4. security-level guard
5. device-role node
6. protocol {dhcp | ndp}

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>• Enter your password if prompted.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>ipv6 mld snooping</td>
<td>Enables MLD snooping.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# ipv6 mld snooping</td>
<td></td>
</tr>
</tbody>
</table>
Configuring Wireless Multicast

Configuring Layer 2 Port as Multicast Router Port (CLI)

### SUMMARY STEPS

1. enable
2. configure terminal
3. ipv6 mld snooping vlan \( vlan-id \) mrouter interface Port-channel \( port-channel-interface-number \)

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>enable</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring RA Guard (CLI)

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ipv6 nd raguard policy policy-name`
4. `trusted-port`
5. `device-role {host | monitor | router | switch}`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device&gt;</code> <code>enable</code></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td><code>configure terminal</code></td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device&gt;</code> <code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td><code>ipv6 nd raguard policy policy-name</code></td>
<td>Configures a policy for RA Guard.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device(config)# ipv6 nd raguard policy myraguardpolicy</code></td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td><code>trusted-port</code></td>
<td>Sets up a trusted port.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><code>Device(config-nd-raguard)# trusted-port</code></td>
<td></td>
</tr>
</tbody>
</table>
### Configuring Wireless Multicast

#### Configuring Non-IP Wireless Multicast (CLI)

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `wireless multicast non-ip`
4. `wireless multicast non-ip vlanid`
5. `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td></td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>wireless multicast non-ip</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# wireless multicast non-ip</td>
</tr>
<tr>
<td></td>
<td>Enables non-IP multicast in all VLANs. Default value is enable.</td>
</tr>
<tr>
<td></td>
<td>Wireless multicast must be enabled for the traffic to pass. Add <code>no</code> in the command to disable the non-IP multicast in all VLANs.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>wireless multicast non-ip vlanid</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# wireless multicast non-ip 5</td>
</tr>
<tr>
<td></td>
<td>Enables non-IP multicast per VLAN. Default value is enable. Both wireless multicast and wireless multicast non-IP must be enabled for traffic to pass. Add <code>no</code> in the command to disable the non-IP multicast per VLAN.</td>
</tr>
</tbody>
</table>
### Configuring Wireless Broadcast (CLI)

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `wireless broadcast`
4. `wireless broadcast vlan vlanid`
5. `end`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**        | **enable**
| Example:          | `Device> enable`
|                   | Enables privileged EXEC mode.
|                   | • Enter your password if prompted. |
| **Step 2**        | `configure terminal`
| Example:          | `Device# configure terminal`
|                   | Enters global command mode. |
| **Step 3**        | `wireless broadcast`
| Example:          | `Device(config)# wireless broadcast`
|                   | Enables broadcast packets for wireless clients. Default value is disable. Enabling `wireless broadcast` enables broadcast traffic for each VLAN. Add `no` in the command to disable broadcasting packets. |
|                   | `Device(config)# no wireless broadcast`
| **Step 4**        | `wireless broadcast vlan vlanid`
| Example:          | `Device(config)# wireless broadcast vlan 3`
|                   | Enables broadcast packets for single VLAN. Default value is `enable`. Wireless broadcast must be enabled for broadcasting. Add `no` in the command to disable the broadcast traffic for each VLAN. |
|                   | `Device(config)# no wireless broadcast vlan 3` |
## Configuring IP Multicast VLAN for WLAN (CLI)

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `wlan wlan_name`
4. `shutdown`
5. `ip multicast vlan {vlan_name vlan_id}`
6. `no shutdown`
7. `end`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device&gt; <code>enable</code></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global command mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device# <code>configure terminal</code></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Enters the configuration mode to configure various parameters in the WLAN.</td>
</tr>
<tr>
<td><code>wlan wlan_name</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# <code>wlan test 1</code></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Disables WLAN.</td>
</tr>
<tr>
<td><code>shutdown</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-wlan)# <code>shutdown</code></td>
</tr>
</tbody>
</table>
### Configuring Wireless Multicast

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 5</strong></td>
<td>Configures multicast VLAN for WLAN. Add <code>no</code> in the command to disable the multicast VLAN for WLAN.</td>
</tr>
<tr>
<td><code>ip multicast vlan {vlan_name vlan_id}</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(config-wlan)# ip multicast vlan 5</code></td>
<td></td>
</tr>
<tr>
<td><code>Device(config-wlan)# no ip multicast vlan 5</code></td>
<td></td>
</tr>
</tbody>
</table>

| **Step 6** | Enables the disabled WLAN. |
| `no shutdown` | |
| **Example:** | |
| `Device(config-wlan)# no shutdown` | |

| **Step 7** | Exits the configuration mode. Alternatively, press `Ctrl-Z` to exit the configuration mode. |
| `end` | |
| **Example:** | |
| `Device(config)# end` | |

### Related Topics
- [Information About Multicast Optimization](#) on page 217

### Monitoring Wireless Multicast

**Table 17: Commands for Monitoring Wireless Multicast**

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show wireless multicast</code></td>
<td>Displays the multicast status and IP multicast mode, each VLAN's broadcast and non-IP multicast status. Also displays the mDNS bridging state.</td>
</tr>
<tr>
<td><code>show wireless multicast group summary</code></td>
<td>Displays all (Source, Group and VLAN) lists and the corresponding MGID value.</td>
</tr>
<tr>
<td><code>show wireless multicast [source source] group group vlan vlanid</code></td>
<td>Displays details of the given (S,G,V) and shows all of the clients associated with it and their MC2UC status.</td>
</tr>
<tr>
<td><code>show ip igmp snooping wireless mcast-spi-count</code></td>
<td>Displays statistics of the number of multicast SPIs per MGID sent between IOS and the Wireless Controller Module.</td>
</tr>
<tr>
<td><code>show ip igmp snooping wireless mgid</code></td>
<td>Displays the MGID mappings.</td>
</tr>
</tbody>
</table>
### Commands

<table>
<thead>
<tr>
<th>Commands</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show ip igmp snooping igmpv2-tracking</code></td>
<td>Displays the client-to-SGV mappings and SGV-to-client mappings.</td>
</tr>
<tr>
<td><code>show ip igmp snooping querier vlan vlanid</code></td>
<td>Displays IGMP querier information for the specified VLAN.</td>
</tr>
<tr>
<td><code>show ip igmp snooping querier detail</code></td>
<td>Displays detailed IGMP querier information of all the VLANs.</td>
</tr>
<tr>
<td><code>show ipv6 mld snooping querier vlan vlanid</code></td>
<td>Displays MLD querier information for the specified VLAN.</td>
</tr>
<tr>
<td><code>show ipv6 mld snooping wireless mgid</code></td>
<td>Displays MGIDs for IPv6 multicast group.</td>
</tr>
</tbody>
</table>

## Where to Go Next for Wireless Multicast

You can configure the following:

- IGMP
- PIM
- SSM
- IP Multicast Routing
- Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
- Multicast Subsecond Convergence
- IP Multicast Load Splitting across Equal-Cost Paths
- SSM Channel Based Filtering for Multicast
- PIM Dense Mode State Refresh
- IGMP State Limit
# Additional References

## Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>For complete syntax and usage information for the commands used in this chapter.</td>
<td><em>IP Multicast Routing Command Reference (Catalyst 3650 Switches)</em></td>
</tr>
</tbody>
</table>

## Error Message Decoder

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>To help you research and resolve system error messages in this release, use the Error Message Decoder tool.</td>
<td><a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a></td>
</tr>
</tbody>
</table>

## Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>All supported MIBs for this release.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>
## Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
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</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
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</table>
Configuring SSM

- Finding Feature Information, page 231
- Prerequisites for Configuring SSM, page 231
- Restrictions for Configuring SSM, page 232
- Information About SSM, page 233
- How to Configure SSM, page 237
- Monitoring SSM, page 245
- Configuration Examples for Source Specific Multicast, page 246
- Where to Go Next for SSM, page 247
- Additional References, page 247
- Feature History and Information for SSM, page 249

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 (CLI), on page 256.
• Enable PIM sparse mode. For information about this procedure, see How to Configure PIM, on page 124.

• Configure SSM. For information about this procedure, see Configuring SSM (CLI).

• 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 devices.

• 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 devices.
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.

This section describes how to configure source-specific multicast (SSM). For a complete description of the SSM commands in this section, refer to the *[IP Multicast Command Reference](#)*. To locate documentation for other commands that appear in this chapter, use the command reference master index, or search online.

**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 device 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)

**Related Topics**

- Configuring Source Specific Multicast, on page 237
- SSM with IGMPv3 Example, on page 246

**How SSM Differs from Internet Standard Multicast**

The standard 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 proved to be reliable, extensive, and efficient. However, they are bound to the complexity and functionality 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. With SSM, this information is provided by receivers through the source addresses relayed to the last-hop devices by IGMPv3. SSM is an incremental
response to the issues associated with ISM and is intended to coexist in the network with the protocols developed for ISM. In general, SSM provides IP multicast service for applications that utilize SSM.

ISM service is described in RFC 1112. This 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 will 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. Traffic for one (S, G) channel consists of datagrams with an IP unicast source address S and the multicast group address G as the IP destination address. Systems will receive this traffic by becoming members of the (S, G) channel. 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 utilizes IGMP INCLUDE mode membership reports, which are supported only in IGMP Version 3.

SSM can coexist with the ISM service by applying the SSM delivery model to a configured subset of the IP multicast group address range. The Internet Assigned Numbers Authority (IANA) has reserved the address range from 232.0.0.0 through 232.255.255.255 for SSM applications and protocols. The software allows SSM configuration for an arbitrary subset of the IP multicast address range from 224.0.0.0 through 239.255.255.255. When an SSM range is defined, an existing IP multicast receiver application will not receive any traffic when it tries to use addresses in the SSM range unless the application is modified to use explicit (S, G) channel subscription or is SSM-enabled through a URL Rendezvous Directory (URD).

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.
Benefits of Source Specific Multicast

**IP Multicast Address Management Not Required**

In the ISM service, applications must acquire a unique IP multicast group address because traffic distribution is based only on the IP multicast group address used. If two applications with different sources and receivers use the same IP multicast group address, then receivers of both applications will receive traffic from the senders of both applications. Even though the receivers, if programmed appropriately, can filter out the unwanted traffic, this situation would cause generally unacceptable levels of unwanted traffic.

Allocating a unique IP multicast group address for an application is still a problem. Most short-lived applications use mechanisms like Session Description Protocol (SDP) and Session Announcement Protocol (SAP) to get a random address, a solution that does not work well with a rising number of applications in the Internet. The best current solution for long-lived applications is described in RFC 2770, but this solution suffers from the restriction that each autonomous system is limited to only 255 usable IP multicast addresses.

In SSM, traffic from each source is forwarded between routers in the network independent of traffic from other sources. Thus different sources can reuse multicast group addresses in the SSM range.

**Denial of Service Attacks from Unwanted Sources Inhibited**

In SSM, multicast traffic from each individual source will be transported across the network only if it was requested (through IGMPv3, IGMP v3lite, or URD memberships) from a receiver. In contrast, ISM forwards traffic from any active source sending to a multicast group to all receivers requesting that multicast group. In Internet broadcast applications, this ISM behavior is highly undesirable because it allows unwanted sources to easily disturb the actual Internet broadcast source by simply sending traffic to the same multicast group. This situation depletes bandwidth at the receiver side with unwanted traffic and thus disrupts the undisturbed reception of the Internet broadcast. In SSM, this type of denial of service (DoS) attack cannot be made by simply sending traffic to a multicast group.

**Easy to Install and Manage**

SSM is easy to install and provision in a network because it does not require the network to maintain which active sources are sending to multicast groups. This requirement exists in ISM (with IGMPv1, IGMPv2, or IGMPv3).

The current standard solutions for ISM service are PIM-SM and MSDP. Rendezvous point (RP) management in PIM-SM (including the necessity for Auto-RP or BSR) and MSDP is required only for the network to learn about active sources. This management is not necessary in SSM, which makes SSM easier than ISM to install and manage, and therefore easier than ISM to operationally scale in deployment. Another factor that contributes to the ease of installation of SSM is the fact that it can leverage preexisting PIM-SM networks and requires only the upgrade of last hop routers to support IGMPv3, IGMP v3lite, or URD.

**Ideal for Internet Broadcast Applications**

The three benefits previously described make SSM ideal for Internet broadcast-style applications for the following reasons:

- The ability to provide Internet broadcast services through SSM without the need for unique IP multicast addresses allows content providers to easily offer their service (IP multicast address allocation has been a serious problem for content providers in the past).
- The prevention against DoS attacks is an important factor for Internet broadcast services because, with their exposure to a large number of receivers, they are the most common targets for such attacks.
- The ease of installation and operation of SSM makes it ideal for network operators, especially in those cases where content needs to be forwarded between multiple independent PIM domains (because there is no need to manage MSDP for SSM between PIM domains).

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.

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 11: 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:

```
IN A source-address-2
IN A source-address-n
```

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

### How to Configure SSM

For a complete description of the source-specific multicast (SSM) commands in this section, see the *IP Multicast Command Reference, Cisco IOS XE Release 3SE (Catalyst 3850 Switches)*. To locate documentation for other commands that appear in this chapter, use the command reference master index, or search online.

### Configuring Source Specific Multicast

This section describes how to configure Source Specific Multicast (SSM).
Before You Begin

If you want to use an access list to define the SSM range, configure the access list before you reference the access list in the `ip pim ssm` command.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip multicast-routing [distributed]`
4. `ip pim ssm {default | range access-list}`
5. `interface type number`
6. `ip pim sparse-mode`
7. Repeat Steps 1 through 6 on every interface that uses IP multicast.
8. `ip igmp version 3`
9. Repeat Step 8 on all host-facing interfaces.
10. `end`
11. `show ip igmp groups [group-name | group-address | interface-type interface-number] [detail]`
12. `show ip mroute`  

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> <code>ip multicast-routing [distributed]</code></td>
<td>Enables IP multicast routing.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip multicast-routing</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> `ip pim ssm {default</td>
<td>range access-list}`</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip pim ssm default</td>
<td></td>
</tr>
</tbody>
</table>

**Example:**

```
Device> enable
```

- Enter your password if prompted.

```
Device# configure terminal
```

Enters global configuration mode.

```
Device(config)# ip multicast-routing
```

- Use the `distributed` keyword to enable Multicast Distributed Switching.

```
Device(config)# ip pim ssm default
```

- The `default` keyword defines the SSM range access list as 232/8.
- The `range` keyword specifies the standard IP access list number or name that defines the SSM range.
<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>interface</strong> type number</td>
<td>Selects an interface that is connected to hosts on which IGMPv3 can be enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# interface gigabitethernet 1/0/0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ip pim sparse-mode</td>
<td>Enables PIM on an interface. You must use sparse mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip pim sparse-mode</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Repeat Steps 1 through 6 on every interface that uses IP multicast.</td>
<td>--</td>
</tr>
<tr>
<td>8</td>
<td>ip igmp version 3</td>
<td>Enables IGMPv3 on this interface. The default version of IGMP is set to Version 2. Version 3 is required by SSM.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# ip igmp version 3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Repeat Step 8 on all host-facing interfaces.</td>
<td>--</td>
</tr>
<tr>
<td>10</td>
<td>end</td>
<td>Ends the current configuration session and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config-if)# end</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><strong>show ip igmp groups</strong> [group-name</td>
<td>(Optional) Displays the multicast groups having receivers that are directly connected to the device and that were learned through IGMP.</td>
</tr>
<tr>
<td></td>
<td>group-address</td>
<td>[interface-type interface-number] [detail]</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# show ip igmp groups</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>show ip mroute</td>
<td>(Optional) Displays the contents of the IP mroute table.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# show ip mroute</td>
<td>• This command displays whether a multicast group is configured for SSM service or a source-specific host report has been received.</td>
</tr>
</tbody>
</table>

**Related Topics**

SSM Components Overview, on page 233
SSM with IGMPv3 Example, on page 246
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 (CLI)

The following procedure describes how to configure static SSM mapping.

**SUMMARY STEPS**

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

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

| **Step 2**                             |                                                                          |
| configure terminal                     | Enters the global configuration mode.                                   |
| Example:                               |                                                                          |
| Device# configure terminal             |                                                                          |

| **Step 3**                             |                                                                          |
| ip igmp ssm-map enable                 | Enables SSM mapping for groups in the configured SSM range.              |
| Example:                               | By default, this command enables DNS-based SSM mapping.                  |
| Device{config}# ip igmp ssm-map enable |                                                                          |

<p>| <strong>Step 4</strong>                             |                                                                          |
| no ip igmp ssm-map query dns           | (Optional) Disables DNS-based SSM mapping.                               |</p>
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td><strong>Note</strong> Disable DNS-based SSM mapping if you only want to rely on static SSM mapping. By default, the <code>ip igmp ssm-map</code> global configuration command enables DNS-based SSM mapping.</td>
</tr>
<tr>
<td>Device(config)# no ip igmp ssm-map dns</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Configures static SSM mapping. The ACL supplied for <code>access-list</code> defines the groups to be mapped to the source IP address entered for the <code>source-address</code>. <strong>Note</strong> 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 device determines the source addresses associated with the group by using each configured <code>ip igmp ssm-map static</code> command. The device associates up to 20 sources per group.</td>
</tr>
<tr>
<td><strong>ip igmp ssm-map static</strong> <code>access-list</code> <code>source-address</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# <code>ip igmp ssm-map static 11 172.16.8.11</code></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Repeat Step 4 to configure additional static SSM mappings, if required.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>end</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# <code>end</code></td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td><strong>show running-config</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# <code>show running-config</code></td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td><strong>copy running-config startup-config</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# <code>copy running-config startup-config</code></td>
</tr>
</tbody>
</table>

**Related Topics**

- Configuring Static SSM Mapping (CLI), on page 240
- Configuring Static SSM Mapping (CLI), on page 240
Configuring DNS-Based SSM Mapping (CLI)

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 1 | enable | Enables privileged EXEC mode.  
- Enter your password if prompted. |
| Example: | Device> enable |
| Step 2 | configure terminal | Enters the global configuration mode. |
| Example: | Device# configure terminal |
| Step 3 | `ip igmp ssm-map enable` | Enables SSM mapping for groups in a configured SSM range. |
| Example: | Device(config)# ip igmp ssm-map enable |
| Step 4 | `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. |
<p>| Example: | Device(config)# ip igmp ssm-map |</p>
<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>query dns</td>
<td>Note: Use this command to reenable DNS-based SSM mapping if DNS-based SSM mapping is disabled.</td>
</tr>
<tr>
<td></td>
<td>ip domain multicast <em>domain-prefix</em></td>
<td>(Optional) Changes the domain prefix used by the device for DNS-based SSM mapping. By default, the device uses the <em>ip-addr.arpa</em> domain prefix.</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config)# ip domain multicast ssm-map.cisco.com</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ip name-server <em>server-address1 [server-address2... server-address6]</em></td>
<td>Specifies the address of one or more name servers to use for name and address resolution.</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config)# ip name-server 172.16.1.111 172.16.1.2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Repeat Step 5 to configure additional DNS servers for redundancy, if required.</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example: Device(config)# end</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>show running-config</td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td></td>
<td>Example: Device# show running-config</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td></td>
<td>Example: Device# copy running-config startup-config</td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**
- Configuring DNS-Based SSM Mapping (CLI), on page 242
- Configuring DNS-Based SSM Mapping (CLI), on page 242
- Configuring Static Traffic Forwarding with SSM Mapping (CLI), on page 244
Configuring Static Traffic Forwarding with SSM Mapping (CLI)

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

SUMMARY STEPS

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>interface type number</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface gigabitethernet 1/0/1</td>
<td>Selects an interface on which to statically forward traffic for a multicast group using SSM mapping, and enters interface configuration mode.</td>
</tr>
<tr>
<td></td>
<td>The specified interface must be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• A routed port—A physical port that has been configured as a Layer 3 port by entering the no switchport interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83</td>
</tr>
<tr>
<td></td>
<td>• An SVI—A VLAN interface created by using the interface vlan vlan-id global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83</td>
</tr>
</tbody>
</table>
These interfaces must have IP addresses assigned to them.

**Note** Static forwarding of traffic with SSM mapping works with either DNS-based SSM mapping or statically configured SSM mapping.

### Command or Action

**Step 4**  
`ip igmp static-group group-address source ssm-map`

**Example:**
```
Device(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.

### Command or Action

**Step 5**  
`end`

**Example:**
```
Device(config-if)# end
```

- Returns to privileged EXEC mode.

### Command or Action

**Step 6**  
`show running-config`

**Example:**
```
Device# show running-config
```

- Verifies your entries.

### Command or Action

**Step 7**  
`copy running-config startup-config`

**Example:**
```
Device# copy running-config startup-config
```

- (Optional) Saves your entries in the configuration file.

### Related Topics

- Configuring DNS-Based SSM Mapping (CLI), on page 242

### Monitoring SSM

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

**Table 18: Commands for Monitoring SSM**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show ip igmp groups detail</code></td>
<td>Displays the (S, G) channel subscription through IGMPv3.</td>
</tr>
<tr>
<td>Command</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>show ip mroute</td>
<td>Displays whether a multicast group supports SSM service or whether a source-specific host report was received.</td>
</tr>
</tbody>
</table>

## Monitoring SSM Mapping

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

### Table 19: SSM Mapping Monitoring Commands

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>show ip igmp ssm-mapping</td>
<td>Displays information about SSM mapping.</td>
</tr>
<tr>
<td>show ip igmp ssm-mapping group-address</td>
<td>Displays the sources that SSM mapping uses for a particular group.</td>
</tr>
<tr>
<td>show ip igmp groups [group-name</td>
<td>group-address</td>
</tr>
<tr>
<td>show host</td>
<td>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.</td>
</tr>
<tr>
<td>debug ip igmp group-address</td>
<td>Displays the IGMP packets received and sent and IGMP host-related events.</td>
</tr>
</tbody>
</table>

## Configuration Examples for Source Specific Multicast

### SSM with IGMPv3 Example

The following example shows how to configure a router (running IGMPv3) for SSM:

```
ip multicast-routing
!
interface GigabitEthernet3/1/0
 ip address 172.21.200.203 255.255.255.0
description backbone interface
 ip pim sparse-mode
!
interface GigabitEthernet3/2/0
 ip address 131.108.1.2 255.255.255.0
 ip pim sparse-mode
description ethernet connected to hosts
 ip igmp version 3
```
! ip pim ssm default

Related Topics
- SSM Components Overview, on page 233
- Configuring Source Specific Multicast, on page 237

Where to Go Next for SSM

You can configure the following:
- IGMP
- Wireless Multicast
- PIM
- IP Multicast Routing
- Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:
- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
- Multicast Subsecond Convergence
- IP Multicast Load Splitting across Equal-Cost Paths
- SSM Channel Based Filtering for Multicast
- PIM Dense Mode State Refresh
- IGMP State Limit

Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>For complete syntax and usage information for the commands used in this chapter.</td>
<td>IP Multicast Routing Command Reference (Catalyst 3650 Switches)</td>
</tr>
</tbody>
</table>
| Platform-independent configuration information | • IP Multicast: PIM Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)  
• IP Multicast: IGMP Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)  
• IP Multicast: Multicast Optimization Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3650 Switches) |
Error Message Decoder

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>To help you research and resolve system error messages in this release, use the Error Message Decoder tool.</td>
<td><a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a></td>
</tr>
</tbody>
</table>

Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
</table>

MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>All supported MIBs for this release.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>

Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
</tr>
</tbody>
</table>
### Feature History and Information for SSM

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
</tr>
</tbody>
</table>
CHAPTER 11

Configuring IP Multicast Routing

- Finding Feature Information, page 251
- Prerequisites for Configuring IP Multicast Routing, page 251
- Restrictions for Configuring IP Multicast Routing, page 252
- Information About IP Multicast Routing, page 252
- How to Configure Basic IP Multicast Routing, page 256
- Monitoring and Maintaining IP Multicast Routing, page 268
- Configuration Examples for IP Multicast Routing, page 272
- Where to Go Next for IP Multicast, page 272
- Additional References, page 273
- Feature History and Information for IP Multicast, page 274

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 IP Multicast Routing

The following are the prerequisites for configuring IP multicast routing:

- To use the IP multicast routing feature on the device, the device or active device must be running the IP Services feature set.
- You must enable IP multicast routing and configure the PIM version and PIM mode on the device. After performing these tasks, the device can then forward multicast packets and can populate its multicast routing table.
To participate in IP multicasting, the multicast hosts, routers, and multilayer device must have IGMP operating.

Restrictions for Configuring IP Multicast Routing

The following are the restrictions for configuring IP multicast routing:

- IP multicast routing is not supported on devices running the LAN Base feature set.
- You cannot have a device stack containing a mix of Catalyst 3850 and Catalyst 3650 devices.

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 devices 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.

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 devices) on that LAN to track the multicast groups of which hosts are members.
- Protocol-Independent Multicast (PIM) protocol is used among routers and multilayer devices to track which multicast packets to forward to each other and to their directly connected LANs.

Note

The device does not support the Distance Vector Multicast Routing Protocol (DVMRP) nor the Cisco Group Management Protocol (CGMP).
The following figure shows where the Cisco-supported protocols for the device operate within the IP multicast environment.

*Figure 12: 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 device forwards the unmatched packet in hardware based upon the MAC address table. If the destination MAC address is not in the MAC address table, the device floods the packet to the all port in the same VLAN as the receiving port.

**Related Topics**

Configuring Basic IP Multicast Routing (CLI), on page 256

**Multicast Forwarding Information Base Overview**

The device uses the Multicast Forwarding Information Base (MFIB) architecture and the Multicast Routing Information Base (MRIB) for IP multicast.

The MFIB architecture provides both modularity and separation between the multicast control plane (Protocol Independent Multicast [PIM] and Internet Group Management Protocol [IGMP]) and the multicast forwarding plane (MFIB). This architecture is used in Cisco IOS IPv6 multicast implementations.

MFIB itself is a multicast routing protocol independent forwarding engine; that is, it does not depend on PIM or any other multicast routing protocol. It is responsible for:

- Forwarding multicast packets
- Registering with the MRIB to learn the entry and interface flags set by the control plane
- Handling data-driven events that must be sent to the control plane
- Maintaining counts, rates, and bytes of received, dropped, and forwarded multicast packets
The MRIB is the communication channel between MRIB clients. Examples of MRIB clients are PIM, IGMP, the multicast routing (mroute) table, and the MFIB.

Related Topics

Configuring IP Multicast Forwarding (CLI), on page 258

Multicast Group Concept

Multicast is based on the concept of a group. An arbitrary group of receivers expresses an interest in receiving a particular data stream. This group does not have any physical or geographical boundaries. The hosts can be located anywhere on the Internet. Hosts that are interested in receiving data flowing to a particular group must join the group using IGMP. Hosts must be a member of the group to receive the data stream.

Related Topics

Configuring an IP Multicast Boundary (CLI), on page 265
Example: Configuring an IP Multicast Boundary, on page 272

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 device. 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 13: 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.

Related Topics
- Configuring an IP Multicast Boundary (CLI), on page 265
- Example: Configuring an IP Multicast Boundary, on page 272

Multicast Routing and Device Stacks

For all multicast routing protocols, the entire stack appears as a single router to the network and operates as a single multicast router.

In a device stack, the active device performs these functions:

- It is responsible for completing the IP multicast routing functions of the stack. It fully initializes and runs the IP multicast routing protocols.
- It builds and maintains the multicast routing table for the entire stack.
- It is responsible for distributing the multicast routing table to all stack members.

The stack members perform these functions:

- They act as multicast routing standby devices and are ready to take over if there is a active device failure. If the active device fails, all stack members delete their multicast routing tables. The newly elected active device starts building the routing tables and distributes them to the stack members.
- They do not build multicast routing tables. Instead, they use the multicast routing table that is distributed by the active device.
Default Multicast Routing Configuration

This table describes the default multicast routing configuration for the device.

Table 20: Default Multicast Routing Configuration

<table>
<thead>
<tr>
<th>Feature</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multicast routing</td>
<td>Disabled on all interfaces.</td>
</tr>
</tbody>
</table>

How to Configure Basic IP Multicast Routing

Configuring Basic IP Multicast Routing (CLI)

You must enable IP multicast routing and configure the PIM version and mode. After performing these tasks, the software can then forward multicast packets, and the device can populate its multicast routing table.

You can configure an interface to be in PIM dense mode, sparse mode, or sparse-dense mode. The device 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 a rendezvous point (RP) known for the group. An RP acts as the meeting place for sources and receivers of multicast data. If an RP exists, 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.

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

This procedure is required.
SUMMARY STEPS

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

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip multicast-routing</td>
<td>Enables IP multicast routing.</td>
</tr>
<tr>
<td>Example: Device(config)# ip multicast-routing</td>
<td>IP multicast routing is supported with Multicast Forwarding Information Base (MFIB) and Multicast Routing Information Base (MRIB).</td>
</tr>
<tr>
<td><strong>Step 4</strong> interface interface-id</td>
<td>Specifies the Layer 3 interface on which you want to enable multicast routing, and enters interface configuration mode.</td>
</tr>
<tr>
<td>Example: Device(config)# interface gigabitethernet 1/0/1</td>
<td>The specified interface must be one of the following:</td>
</tr>
<tr>
<td></td>
<td>• A routed port—A physical port that has been configured as a Layer 3 port by entering the no switchport interface configuration command. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83</td>
</tr>
<tr>
<td></td>
<td>• An SVI—A VLAN interface created by using the interface vlan vlan-id global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the</td>
</tr>
</tbody>
</table>
### Purpose

**Command or Action**  
VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83  
These interfaces must have IP addresses assigned to them.

### Step 5

**Command or Action**  
*ip pim {dense-mode | sparse-mode | sparse-dense-mode}*

**Example:**

```
Device(config-if)# ip pim sparse-dense-mode
```

**Purpose**  
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.
- **state-refresh**—PM dense mode state-refresh configuration.

### Step 6

**Command or Action**  
*end*

**Example:**

```
Device(config-if)# end
```

**Purpose**  
Returns to privileged EXEC mode.

### Step 7

**Command or Action**  
*show running-config*

**Example:**

```
Device# show running-config
```

**Purpose**  
Verifies your entries.

### Step 8

**Command or Action**  
*copy running-config startup-config*

**Example:**

```
Device# copy running-config startup-config
```

**Purpose**  
(Optional) Saves your entries in the configuration file.

### Related Topics

Cisco’s Implementation of IP Multicast Routing, on page 252

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## Configuring IP Multicast Forwarding (CLI)

You can use the following procedure to configure IPv4 Multicast Forwarding Information Base (MFIB) interrupt-level IP multicast forwarding of incoming packets or outgoing packets on the device.
After you have enabled IP multicast routing by using the `ip multicast-routing` command, IPv4 multicast forwarding is enabled. Because IPv4 multicast forwarding is enabled by default, you can use the `no` form of the `ip mfib` command to disable IPv4 multicast forwarding.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. ip mfib
4. exit
5. show running-config
6. copy running-config startup-config

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enables IP multicast forwarding.</td>
</tr>
<tr>
<td><code>ip mfib</code></td>
<td>Enables IP multicast forwarding.</td>
</tr>
<tr>
<td>Example:</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Device(config)# ip mfib</td>
<td>Device(config)# exit</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td><code>show running-config</code></td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show running-config</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring a Static Multicast Route (mroute) (CLI)

You can use the following procedure to configure static mroutes. Static mroutes are similar to unicast static routes but differ in the following ways:

- Static mroutes are used to calculate RPF information, not to forward traffic.
- Static mroutes cannot be redistributed.

Static mroutes are strictly local to the device on which they are defined. Because Protocol Independent Multicast (PIM) does not have its own routing protocol, there is no mechanism to distribute static mroutes throughout the network. Consequently, the administration of static mroutes tends to be more complicated than the administration of unicast static routes.

When static mroutes are configured, they are stored on the device in a separate table referred to as the static mroute table. When configured, the `ip mroute` command enters a static mroute into the static mroute table for the source address or source address range specified for the source-address and mask arguments. Sources that match the source address or that fall in the source address range specified for the source-address argument will RPF to either the interface associated with the IP address specified for the `rpf-address` argument or the local interface on the device specified for the `interface-type` and `interface-number` arguments. If an IP address is specified for the `rpf-address` argument, a recursive lookup is done from the unicast routing table on this address to find the directly connected neighbor.

If there are multiple static mroutes configured, the device performs a longest-match lookup of the mroute table. When the mroute with the longest match (of the source-address) is found, the search terminates and the information in the matching static mroute is used. The order in which the static mroutes are configured is not important.

The administrative distance of an mroute may be specified for the optional distance argument. If a value is not specified for the distance argument, the distance of the mroute defaults to zero. If the static mroute has the same distance as another RPF source, the static mroute will take precedence. There are only two exceptions to this rule: directly connected routes and the default unicast route.
### SUMMARY STEPS

1. enable
2. configure terminal
3. ip mroute [vrf vrf-name] source-address mask { fallback-lookup {global | vrf vrf-name }[ protocol ] {rpf-address | interface-type interface-number} } [distance]
4. exit
5. show running-config
6. copy running-config startup-config

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip mroute [vrf vrf-name] source-address mask { fallback-lookup {global</td>
<td>vrf vrf-name }[ protocol ] {rpf-address</td>
</tr>
<tr>
<td>Example: Device(configure)# ip mroute 10.1.1.1 255.255.255.255 10.2.2.2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> exit</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device(config)# exit</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> show running-config</td>
<td>(Optional) Verifies your entries.</td>
</tr>
<tr>
<td>Example: Device# show running-config</td>
<td></td>
</tr>
</tbody>
</table>
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 (CLI)

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

This procedure is optional.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. interface interface-id
4. ip sap listen
5. end
6. show running-config
7. copy running-config startup-config
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface interface-id</td>
<td>Specifies the interface to be enabled for sdr, and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# interface gigabitethernet 1/0/1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> ip sap listen</td>
<td>Enables the device software to listen to session directory announcements.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# ip sap listen</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config-if)# end</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action | Purpose
--- | ---
**Step 6** | show running-config
**Example:**
Device# show running-config
Verifies your entries.

**Step 7** | copy running-config startup-config
**Example:**
Device# copy running-config startup-config
(Optional) Saves your entries in the configuration file.

---

#### Limiting How Long an sdr Cache Entry Exists (CLI)
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. `enable`
2. `configure terminal`
3. `ip sap cache-timeout minutes`
4. `end`
5. `show running-config`
6. `show ip sap`
7. `copy running-config startup-config`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** | enable
**Example:**
Device> enable
Enables privileged EXEC mode.
- Enter your password if prompted. |
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>ip sap cache-timeout minutes</td>
<td>Limits how long a Session Announcement Protocol (SAP) cache entry stays active in the cache.</td>
</tr>
<tr>
<td>Example:</td>
<td>By default, entries are never deleted from the cache.</td>
</tr>
<tr>
<td>Device(config)# ip sap cache-timeout 30</td>
<td>For minutes, the range is 1 to 1440 minutes (24 hours).</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# end</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>show running-config</td>
<td>Verifies your entries.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show running-config</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>show ip sap</td>
<td>Displays the SAP cache.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# show ip sap</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td><strong>Purpose</strong></td>
</tr>
<tr>
<td>copy running-config startup-config</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# copy running-config startup-config</td>
<td></td>
</tr>
</tbody>
</table>

**Configuring an IP Multicast Boundary (CLI)**

This procedure is optional.
SUMMARY STEPS

1. enable
2. configure terminal
3. access-list {access-list-number 1-99 | access-list-number 100-199 | access-list-number 1300-1999 | access-list-number 2000-2699 | dynamic-extended | rate-limit}
4. interface interface-id
5. ip multicast boundary access-list-number
6. end
7. show running-config
8. copy running-config startup-config

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> access-list {access-list-number 1-99</td>
<td>access-list-number 100-199</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# access-list 99 permit any</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> interface interface-id</td>
<td>Specifies the interface to be configured, and enters interface configuration mode.</td>
</tr>
</tbody>
</table>
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. You will also need to enable IP PIM sparse-dense-mode on the interface, and join the interface as a statically connected member to an IGMP static group. For a configuration example, see Example: Interface Configuration as a Routed Port, on page 83

- **An SVI**—A VLAN interface created by using the `interface vlan vlan-id` global configuration command. You will also need to enable IP PIM sparse-dense-mode on the VLAN, join the VLAN as a statically connected member to an IGMP static group, and then enable IGMP snooping on the VLAN, the IGMP static group, and physical interface. For a configuration example, see Example: Interface Configuration as an SVI, on page 83

These interfaces must have IP addresses assigned to them.

### Step 5

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>ip multicast boundary</code></td>
<td>Configures the boundary, specifying the access list you created in Step 2.</td>
</tr>
<tr>
<td><code>access-list-number</code></td>
<td>Additional command options include:</td>
</tr>
<tr>
<td></td>
<td>- For <code>access-list-number</code>, the ranges are as follows:</td>
</tr>
<tr>
<td></td>
<td>- access-list-number 1—99 (IP standard access list)</td>
</tr>
<tr>
<td></td>
<td>- access-list-number 100—199 (IP extended access list)</td>
</tr>
<tr>
<td></td>
<td>- access-list-number 1300—1999 (IP standard access list - expanded range)</td>
</tr>
<tr>
<td></td>
<td>- access-list-number 2000—2699 (IP extended access list - expanded range)</td>
</tr>
<tr>
<td></td>
<td>- <strong>Word</strong>—IP named access list.</td>
</tr>
<tr>
<td></td>
<td>- <strong>filter-autorp</strong>—Filter AutoRP packet contents.</td>
</tr>
<tr>
<td></td>
<td>- <strong>in</strong>—Restrict (s,g) creation when this interface is the RPF.</td>
</tr>
<tr>
<td></td>
<td>- <strong>out</strong>—Restrict interface addition to outgoing list.</td>
</tr>
</tbody>
</table>

### Step 6

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>end</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

### Step 7

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>show running-config</code></td>
<td>Verifies your entries.</td>
</tr>
</tbody>
</table>
### Purpose

**Command or Action**

<table>
<thead>
<tr>
<th>Step 8</th>
<th>copy running-config startup-config</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td>Device# copy running-config startup-config</td>
</tr>
<tr>
<td>Purpose</td>
<td>(Optional) Saves your entries in the configuration file.</td>
</tr>
</tbody>
</table>

### What to Do Next

Proceed to the other supported IP multicast routing procedures.

### Related Topics

- Multicast Boundaries, on page 254
- Multicast Group Concept, on page 254
- Example: Configuring an IP Multicast Boundary, on page 272

### Monitoring and Maintaining IP Multicast Routing

### Clearing Caches, Tables, and Databases

You can remove all contents of a particular cache, table, or database. Clearing a cache, table, or database might be necessary when the contents of the particular structure are or suspected to be invalid.

You can use any of the privileged EXEC commands in the following table to clear IP multicast caches, tables, and databases.

**Table 21: Commands for Clearing Caches, Tables, and Databases**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>clear ip igmp group {group [hostname</td>
<td>IP address]</td>
</tr>
<tr>
<td>clear ip mfib { counters [group</td>
<td>source]</td>
</tr>
<tr>
<td>clear ip mrm {status-report [source ] }</td>
<td>IP multicast routing clear commands.</td>
</tr>
<tr>
<td>clear ip mroute { *</td>
<td>[hostname</td>
</tr>
</tbody>
</table>
### Command

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>clear ip msdp { peer</td>
<td>sa-cache</td>
</tr>
<tr>
<td>clear ip multicast { limit</td>
<td>redundancy statistics }</td>
</tr>
<tr>
<td>clear ip pim { df [ int</td>
<td>rp rp address ]</td>
</tr>
<tr>
<td>clear ip sap [ group-address</td>
<td>&quot;session-name&quot;]</td>
</tr>
</tbody>
</table>

### Displaying System and Network Statistics

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 22: Commands for Displaying System and Network Statistics**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ping [ group-name</td>
<td>group-address ]</td>
</tr>
<tr>
<td>show ip igmp filter</td>
<td>Displays IGMP filter information.</td>
</tr>
<tr>
<td>show ip igmp groups [ type-number</td>
<td>detail ]</td>
</tr>
<tr>
<td>show ip igmp interface [ type number ]</td>
<td>Displays multicast-related information about an interface.</td>
</tr>
<tr>
<td>show ip igmp membership [ name/group address</td>
<td>all</td>
</tr>
<tr>
<td>show ip igmp profile [ profile_number ]</td>
<td>Displays IGMP profile information.</td>
</tr>
<tr>
<td>Command</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td><code>show ip igmp ssm-mapping [hostname/IP address]</code></td>
<td>Displays IGMP SSM mapping information.</td>
</tr>
<tr>
<td><code>show ip igmp static-group [class-map [interface [type]]]</code></td>
<td>Displays static group information.</td>
</tr>
<tr>
<td><code>show ip igmp vrf</code></td>
<td>Displays the selected VPN Routing/Forwarding instance by name.</td>
</tr>
<tr>
<td><code>show ip mfib [type number]</code></td>
<td>Displays the IP multicast forwarding information base.</td>
</tr>
<tr>
<td>`show ip mrrib {client</td>
<td>route</td>
</tr>
<tr>
<td>`show ip mrm {interface</td>
<td>manager</td>
</tr>
<tr>
<td>`show ip mrroute [group-name</td>
<td>group-address] [source] [count</td>
</tr>
<tr>
<td>`show ip msdp [count</td>
<td>peer</td>
</tr>
<tr>
<td>`show ip multicast [interface</td>
<td>limit</td>
</tr>
<tr>
<td>`show ip pim interface [type number] [count</td>
<td>detail</td>
</tr>
<tr>
<td><code>show ip pim all-vrf {tunnel}</code></td>
<td>Display all VRFs.</td>
</tr>
<tr>
<td><code>show ip pim autorp</code></td>
<td>Display global auto-RP information.</td>
</tr>
<tr>
<td><code>show ip pim boundary [type number]</code></td>
<td>Displays boundary information.</td>
</tr>
<tr>
<td><code>show ip pim bsr-router</code></td>
<td>Display bootstrap router information (version 2).</td>
</tr>
<tr>
<td><code>show ip pim interface [type number]</code></td>
<td>Displays PIM interface information.</td>
</tr>
<tr>
<td><code>show ip pim mdt [bgp]</code></td>
<td>Displays multicast tunnel information.</td>
</tr>
<tr>
<td><code>show ip pim neighbor [type number]</code></td>
<td>Lists the PIM neighbors discovered by the device. This command is available in all software images.</td>
</tr>
<tr>
<td>`show ip pim rp [group-name</td>
<td>group-address]`</td>
</tr>
</tbody>
</table>
### Monitoring IP Multicast Routing

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

**Table 23: Commands for Monitoring IP Multicast Routing**

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>mrinfo { [hostname</td>
<td>address]</td>
</tr>
<tr>
<td>mstat { [hostname</td>
<td>address]</td>
</tr>
</tbody>
</table>

**Command Parameters**

- **show ip pim rp-hash [group-name | group-address]**
  - Displays the RP to be chosen based upon the group selected.

- **show ip pim tunnel [ tunnel | verbose ]**
  - Displays the registered tunnels.

- **show ip pim vrf name**
  - Displays VPN routing and forwarding instances.

- **show ip rpf {source-address | name}**
  - Displays how the device is doing Reverse-Path Forwarding (that is, from the unicast routing table, DVMRP routing table, or static mroutes).
  - Command parameters include:
    - *Host name or IP address*—IP name or group address.
    - *Select*—Group-based VRF select information.
    - *vrf*—Selects VPN Routing/Forwarding instance.

- **show ip sap [group | "session-name" | detail]**
  - Displays the Session Announcement Protocol (SAP) Version 2 cache.
  - Command parameters include:
    - *A.B.C.D*—IP group address.
    - *WORD*—Session name (in double quotes).
    - *detail*—Session details.
### Command

| 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:

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

**Related Topics**

- Configuring an IP Multicast Boundary (CLI), on page 265
- Multicast Boundaries, on page 254
- Multicast Group Concept, on page 254

#### Example: Responding to mrinfo Requests

The software answers mrinfo requests sent by mrouted systems and Cisco routers and multilayer devices. The software returns information about neighbors through DVMRP tunnels and all the routed interfaces. This information includes the metric (always set to 1), the configured TTL threshold, the status of the interface, and various flags. You can also use the `mrinfo` privileged EXEC command to query the router or device itself, as in this example:

```
Device# mrinfo
171.69.214.27 (mml-7kd.cisco.com) [version cisco 11.1] [flags: PMS]:
171.69.214.27 -> 171.69.214.26 (mml-r7kb.cisco.com) [1/0/pim/querier]
171.69.214.27 -> 171.69.214.25 (mml-45a.cisco.com) [1/0/pim/querier]
171.69.214.33 -> 171.69.214.34 (mml-45c.cisco.com) [1/0/pim]
171.69.214.137 -> 0.0.0.0 [1/0/pim/querier/down/leaf]
171.69.214.203 -> 0.0.0.0 [1/0/pim/querier/down/leaf]
171.69.214.18 -> 171.69.214.20 (mml-45e.cisco.com) [1/0/pim]
171.69.214.18 -> 171.69.214.19 (mml-45c.cisco.com) [1/0/pim]
171.69.214.18 -> 171.69.214.17 (mml-45a.cisco.com) [1/0/pim]
```

### Where to Go Next for IP Multicast

You can configure the following:

- IGMP
• Wireless Multicast
• PIM
• SSM
• Service Discovery Gateway

You can also review the following IP Multicast Optimization processes for your configuration:
• Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
• Multicast Subsecond Convergence
• IP Multicast Load Splitting across Equal-Cost Paths
• SSM Channel Based Filtering for Multicast
• PIM Dense Mode State Refresh
• IGMP State Limit

Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>For complete syntax and usage information for the commands used in this chapter.</td>
<td>IP Multicast Routing Command Reference (Catalyst 3650 Switches)</td>
</tr>
<tr>
<td>For information on configuring the Multicast Source Discovery Protocol (MSDP).</td>
<td>Routing Command Reference (Catalyst 3650 Switches)</td>
</tr>
</tbody>
</table>

Error Message Decoder

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>To help you research and resolve system error messages in this release, use the Error Message Decoder tool.</td>
<td><a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a></td>
</tr>
</tbody>
</table>

Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1112</td>
<td>Host Extensions for IP Multicasting</td>
</tr>
<tr>
<td>RFC 2236</td>
<td>Internet Group Management Protocol, Version 2</td>
</tr>
</tbody>
</table>
### Standard/RFC

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
</table>

### MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>All supported MIBs for this release.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>

### Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
</tr>
</tbody>
</table>

### Feature History and Information for IP Multicast

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
</tr>
</tbody>
</table>
Configuring the Service Discovery Gateway

- Finding Feature Information, page 275
- Restrictions for Configuring the Service Discovery Gateway, page 275
- Information about the Service Discovery Gateway and mDNS, page 276
- How to Configure the Service Discovery Gateway, page 279
- Monitoring Service Discovery Gateway, page 287
- Configuration Examples, page 287
- Where to Go Next for Configuring Services Discovery Gateway, page 289
- Additional References, page 290
- Feature History and Information for Services Discovery Gateway, page 291

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.

Restrictions for Configuring the Service Discovery Gateway

The following are restrictions for configuring the Service Discovery Gateway:

- The Service Discovery Gateway does not support topologies with multiple hops. All network segments must be connected directly to it. The Service Discovery Gateway can learn services from all connected segments to build its cache and respond to requests acting as a proxy.
Information about the Service Discovery Gateway and mDNS

mDNS

mDNS was defined to achieve zero configuration, with zero configuration being defined as providing the following features:

- **Addressing**—Allocating IP addresses to hosts
- **Naming**—Using names to refer to hosts instead of IP addresses
- **Service discovery**—Finding services automatically on the network

With mDNS, network users no longer have to assign IP addresses, assign host names, or type in names to access services on the network. Users only need to ask to see what network services are available, and choose from a list.

With mDNS, **addressing** is accomplished through the use of DHCP/DHCPv6 or IPv4 and IPv6 Link Local scoped addresses. The benefit of zero-configuration occurs when no infrastructure services such as DHCP or DNS are present and self-assigned link-local addressing can be used. The client can then select a random IPv4 address in the link-local range (169.254.0.0/24) or use its IPv6 link-local address (FE80::/10) for communication.

With mDNS, **naming** (name-to-address translation on a local network using mDNS) queries are sent over the local network using link-local scoped IP multicast. Because these DNS queries are sent to a multicast address (IPv4 address 224.0.0.251 or IPv6 address FF02::FB), no single DNS server with global knowledge is required to answer the queries. When a service or device sees a query for any service it is aware of, it provides a DNS response with the information from its cache.

With mDNS, **service discovery** is accomplished by browsing. An mDNS query is sent out for a given service type and domain, and any device that is aware of matching services replies with service information. The result is a list of available services for the user to choose from.

The mDNS protocol (mDNS-RFC), together with DNS Service Discovery (DNS-SD-RFC) achieves the zero-configuration addressing, naming, and service discovery.

mDNS-SD

Multicast DNS Service Discovery (mDNS-SD) uses DNS protocol semantics and multicast over well-known multicast addresses to achieve zero configuration service discovery. DNS packets are sent to and received on port 5353 using a multicast address of 224.0.0.251 and its IPv6 equivalent FF02::FB.

Because mDNS uses a link-local multicast address, its scope is limited to a single physical or logical LAN. If the networking reach needs to be extended to a distributed campus or to a wide-area environment consisting of many different networking technologies, mDNS gateway is implemented. An mDNS gateway provides a transport for mDNS packets across Layer 3 boundaries by filtering, caching, and redistributing services from one Layer 3 domain to another.

**mDNS-SD Considerations for Wireless Clients**

- mDNS packets can be sent out of Layer 3 interfaces that might not have an IP address.
• Packets with mDNS multicast IP and multicast MAC are sent on a multicast CAPWAP tunnel, if multicast-multicast mode is enabled. A multicast CAPWAP tunnel is a special CAPWAP tunnel used for reducing the number of copies of multicast packet that are required to be generated for each AP CAPWAP tunnel. Sending packets on the multicast CAPWAP tunnel requires the outer IP header to be destined to the multicast CAPWAP tunnel's address, which all APs are subscribed to.

• All mDNS packet handling is done at a foreign switch for roamed clients. A foreign switch is the new switch that a roamed wireless client is actually attached to, which is called the point of attachment.

Service Discovery Gateway

The Service Discovery Gateway feature enables multicast Domain Name System (mDNS) to operate across Layer 3 boundaries (different subnets). An mDNS gateway provides transport for service discovery across Layer 3 boundaries by filtering, caching, and redistributing services from one Layer 3 domain (subnet) to another. Prior to implementation of this feature, mDNS was limited in scope to within a subnet because of the use of link-local scoped multicast addresses. This feature enhances Bring Your Own Device (BYOD).

Related Topics

  Configuring the Service List (CLI), on page 279
  Example: Creating a Service-List, Applying a Filter and Configuring Parameters, on page 288
  Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
  Example: Specify Alternative Source Interface for Outgoing mDNS Packets, on page 287
  Example: Redistribute Service Announcements, on page 287
  Example: Disable Bridging of mDNS Packets to Wireless Clients, on page 288
  Example: Enabling mDNS Gateway and Redistributing Services, on page 288
  Example: Global mDNS Configuration, on page 289
  Example: Interface mDNS Configuration, on page 289

mDNS Gateway and Subnets

You need to enable an mDNS gateway for service discovery to operate across subnets. You can enable mDNS gateway for a device or for an interface.

Note

you need to configure service routing globally before configuring at the interface level.

After the device or interface is enabled, you can redistribute service discovery information across subnets. You can create service policies and apply filters on either incoming service discovery information (called IN-bound filtering) or outgoing service discovery information (called OUT-bound filtering).

Note

If redistribution is enabled globally, global configuration is given higher priority than interface configuration.
For example, if the mDNS gateway functionality is enabled on the router in this figure, then service information can be sent from one subnet to another and vice-versa. For example, the printer and fax service information being advertised in the network with IP address 192.0.2.6 are redistributed to the network with IP address 198.51.100.4. The printer and fax service information in the network with IP address 192.0.2.6 is learned by mDNS-enabled hosts and devices in the other network.

*Figure 14: Sample Networking Scenario*

![Sample Networking Scenario Diagram]

**Filtering**

After configuring the mDNS gateway and subnets, you can filter services that you want to redistribute. While creating a service list, the `permit` or `deny` command options are used:

- The `permit` command option allows you to permit or transport specific service list information.
- The `deny` option allows you to deny service list information that is available to be transported to other subnets.

You need to include a sequence number when using the `permit` or `deny` command option. The same service list name can be associated with multiple sequence numbers and each sequence number will be mapped to a rule.

**Note**

If no filters are configured, then the default action is to deny service list information to be transported through the device or interface.

Query is another option provided when creating service lists. You can create queries using a service list. If you want to browse for a service, then active queries can be used. This function is helpful to keep the records refreshed in the cache.

**Note**

Active queries can only be used globally and cannot be used at the interface level.

A service end-point (such as a printer or fax) sends unsolicited announcements when a service starts up. After that, it sends unsolicited announcements whenever a network change event occurs (such as an interface coming up or going down). The device always respond to queries.

After creating a service list and using the `permit` or `deny` command options, you can filter using match statements (commands) based on `service-instance`, `service-type`, or `message-type` (announcement or query).
Related Topics

- Configuring the Service List (CLI), on page 279
- Example: Creating a Service-List, Applying a Filter and Configuring Parameters, on page 288
- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
- Example: Specify Alternative Source Interface for Outgoing mDNS Packets, on page 287
- Example: Redistribute Service Announcements, on page 287
- Example: Disable Bridging of mDNS Packets to Wireless Clients, on page 288
- Example: Enabling mDNS Gateway and Redistributing Services, on page 288
- Example: Global mDNS Configuration, on page 289
- Example: Interface mDNS Configuration, on page 289

How to Configure the Service Discovery Gateway

Configuring the Service List (CLI)

This procedure describes how to create a service list, apply a filter for the service list, and configure parameters for the service list name.

SUMMARY STEPS

1. enable
2. configure terminal
3. service-list mdns-sd service-list-name {deny sequence-number | permit sequence-number | query}
4. match message-type {announcement | any | query}
5. match service-instance {LINE}
6. match service-type {LINE}
7. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> service-list mdns-sd service-list-name {deny sequence-number</td>
<td>permit sequence-number</td>
</tr>
<tr>
<td>Example: Device(config)# service-list mdns-sd sl1 permit 3</td>
<td>• Create a service list and apply a filter on the service list according to the permit or deny option applied to the sequence number.</td>
</tr>
<tr>
<td>Device(config)# service-list mdns-sd sl4 query</td>
<td>• Create a service list and associate a query for the service list name if the query option is used.</td>
</tr>
<tr>
<td><strong>Step 4</strong> match message-type {announcement</td>
<td>any</td>
</tr>
<tr>
<td>Example: Device(config-mdns-sd-sl)# match message-type announcement</td>
<td>• announcement</td>
</tr>
<tr>
<td></td>
<td>• any</td>
</tr>
<tr>
<td></td>
<td>• query</td>
</tr>
<tr>
<td>These commands configure the parameters for the service list name that is created in step 2.</td>
<td></td>
</tr>
<tr>
<td>If the match message-type is an announcement, then the service list rule only allows service advertisements or announcements for the device. If the match message-type is a query, then only a query from the client for a certain service in the network is allowed.</td>
<td></td>
</tr>
<tr>
<td>Multiple service maps of the same name with different sequence numbers can be created and the evaluation of the filters will be ordered on the sequence number. Service lists are an ordered sequence of individual statements, each one has a permit or deny result. Evaluation of service list consists of a list scan, in a predetermined order, and an evaluation of the criteria of each statement that matches. A list scan is stopped once the first statement match is found and an action permit/deny associated with the statement match is performed. The default action after scanning through the entire list is to deny.</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> You cannot use the match command if you have used the query option in the previous step. The match command can be used only for the permit or deny option.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> match service-instance { LINE }</td>
<td>(Optional) Sets the service instance to match.</td>
</tr>
</tbody>
</table>
### Command or Action | Purpose
--- | ---
**Example:**
Device(config-mdns-sd-sl)##
match service-instance servInst
| This command configures the parameters for the service list name that is created in step 2. **Note** You cannot use the `match` command if you have used the `query` option in the previous step. The `match` command can be used only for the `permit` or `deny` option.

**Step 6** match service-type \{LINE \}
**Example:**
Device(config-mdns-sd-sl)# match service-type _ipp._tcp
| (Optional) Sets the value of the mDNS service type string to match. This command configures the parameters for the service list name that is created in step 2. **Note** You cannot use the `match` command if you have used the `query` option in the previous step. The `match` command can be used only for the `permit` or `deny` option.

**Step 7** end
**Example:**
Device(config-mdns-sd-sl)# end
| Returns to privileged EXEC mode.

### What to Do Next
Proceed to enable the mDNS gateway and redistribution of services.

### Related Topics
- Service Discovery Gateway, on page 277
- Filtering, on page 278
- Example: Creating a Service-List, Applying a Filter and Configuring Parameters, on page 288
Configuring Service List (GUI)

SUMMARY STEPS

1. Choose **Configuration > Controller > mDNS > Service List.**
2. Click **Create Service.**
3. In the **Service List Name** text box, enter the service list name.
4. From the **Service rule** drop-down list, choose from the following options:
   - **permit**—permits the service list.
   - **deny**—denies the service list.
5. In the **Sequence number** text box, enter the priority of the rule.
6. From the **Message type** drop-down list, choose the message type to match from the following options:
   - **announcement**—The service list rule allows only service advertisements or announcements for the device.
   - **query**—The service list rule allows only a query from the client for a service in the network.
   - **any**—The service list rule allows any type of message.
7. In the **Service instance** text box, enter the service instance to match.
8. In the **Custom** text box, enter the mDNS service type string to match.
9. Click **Apply.**
10. Click **Save Configuration.**

DETAILED STEPS

**Step 1** Choose **Configuration > Controller > mDNS > Service List.**
**Step 2** Click **Create Service.**
The **Service List > Create Service** page is displayed.
**Step 3** In the **Service List Name** text box, enter the service list name.
**Step 4** From the **Service rule** drop-down list, choose from the following options:
   - **permit**—permits the service list.
   - **deny**—denies the service list.
**Step 5** In the **Sequence number** text box, enter the priority of the rule.
   A rule with a lower sequence number is selected first and the service announcement or query is allowed or denied accordingly. You define the sequence number as per your network requirements.
**Step 6** From the **Message type** drop-down list, choose the message type to match from the following options:
   - **announcement**—The service list rule allows only service advertisements or announcements for the device.
   - **query**—The service list rule allows only a query from the client for a service in the network.
**any**—The service list rule allows any type of message.

Multiple service maps of the same name with different sequence numbers can be created and the evaluation of the filters will be ordered on the sequence number. Service lists are an ordered sequence of individual statements, each one has a permit or deny result. Evaluation of service list consists of a list scan, in a predetermined order, and an evaluation of the criteria of each statement that matches. A list scan is stopped once the first statement match is found and an action permit/deny associated with the statement match is performed. The default action after scanning through the entire list is to deny.

**Step 7**
In the **Service instance** text box, enter the service instance to match.

**Step 8**
In the **Custom** text box, enter the mDNS service type string to match.

The **Learned Service** box shows the services that are added after enabling the learned service type configured by navigating to **Configuration > Controller > mDNS > Global**. For example, _roap._tcp.local. The **Selected Service** box shows the learned service that you have selected for an mDNS service.

**Step 9**
Click **Apply**.

**Step 10**
Click **Save Configuration**.

### What to Do Next
Proceed to enable the mDNS gateway and redistribution of services.

### Enabling mDNS Gateway and Redistributing Services (CLI)

After enabling mDNS gateway for a device, you can apply filters (apply IN-bound filtering or OUT-bound filtering) and active queries by using **service-policy** and **service-policy-query** commands, respectively. You can redistribute services and service announcements using the **redistribute mdns-sd** command, and set some part of the system memory for cache using the **cache-memory-max** command.

**Note**
By default, mDNS gateway is disabled on all interfaces.

### SUMMARY STEPS

1. enable
2. configure terminal
3. service-routing mdns-sd
4. service-policy service-policy-name {IN | OUT}
5. redistribute mdns-sd
6. cache-memory-max cache-config-percentage
7. service-policy-query service-list-query-name service-list-query-periodicity
8. exit
9. wireless multicast
10. no wireless mdns-bridging
11. end
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters the global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> service-routing mdns-sd</td>
<td>Enables mDNS gateway functionality for a device and enters multicast DNS configuration (config-mdns) mode.</td>
</tr>
<tr>
<td>Example: Device (config)# service-routing mdns-sd</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> This command enables the mDNS function globally.</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> Enter the service-routing mdns-sd source-interface if-name command in either global-config or interface-config mode, to specify an alternate source interface for outgoing mDNS packets, so its IP address can be used when there is none configured on the outgoing interface.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> service-policy service-policy-name {IN</td>
<td>OUT}</td>
</tr>
<tr>
<td>Example: Device (config-mdns)# service-policy serv-poll IN</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> redistribute mdns-sd</td>
<td>(Optional) Redistributes services or service announcements across subnets.</td>
</tr>
<tr>
<td>Example: Device (config-mdns)# redistribute mdns-sd</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> If redistribution is enabled globally, global configuration is given higher priority than interface configuration.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> cache-memory-max cache-config-percentage</td>
<td>(Optional) Sets some part of the system memory (in percentage) for cache.</td>
</tr>
<tr>
<td>Example: Device (config-mdns)# cache-memory-max 20</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong> By default, 10 percent of the system memory is set aside for cache. You can override the default value by using this command.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> service-policy-query service-list-query-name service-list-query-periodicity</td>
<td>(Optional) Configures service list-query periodicity.</td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
</tr>
<tr>
<td>Device (config-mdns)# service-policy-query sl-query1 100</td>
</tr>
</tbody>
</table>

### Step 8

#### exit

(Optional) Returns to global configuration mode.

**Example:**

Device (config-mdns)# exit

### Step 9

#### wireless multicast

(Optional) Enables wireless Ethernet multicast support.

**Example:**

Device (config)# wireless multicast

### Step 10

#### no wireless mdns-bridging

(Optional) Disables bridging of mDNS packets to wireless clients.

**Example:**

Device (config)# no wireless mdns-bridging

### Step 11

#### end

Returns to privileged EXEC mode.

**Example:**

Device(config)# end

### Related Topics

- Service Discovery Gateway, on page 277
- Filtering, on page 278
- Example: Specify Alternative Source Interface for Outgoing mDNS Packets, on page 287
- Example: Redistribute Service Announcements, on page 287
- Example: Disable Bridging of mDNS Packets to Wireless Clients, on page 288
- Example: Enabling mDNS Gateway and Redistributing Services, on page 288
- Example: Global mDNS Configuration, on page 289
- Example: Interface mDNS Configuration, on page 289
Enabling Multicast DNS Gateway (GUI)

SUMMARY STEPS

1. Choose Configuration > Controller > mDNS > Global.
2. Select the mDNS gateway check box.
3. From the Learn Service drop-down list, choose from the following options:
   - **Enable**— Allows the device to learn all the announced services. It is used to learn services by enabling all announcement/queries by using Service Policy IN of type GUI-permit-all and in Service Policy OUT of type GUI-deny-all.
   - **Disable**— Denies all the traffics IN and OUT. It is used to deny services by disabling all announcement/queries by using Service Policy IN of type GUI-deny-all and in Service Policy OUT of type GUI-deny-all.
   - **Custom**— You can set your own IN and OUT policy. It allows you to define a custom service list.
4. Click **Apply**.
5. Click **Save Configuration**.

DETAILED STEPS

**Step 1**

Choose Configuration > Controller > mDNS > Global.
The Global Service Rules page is displayed.

**Step 2**

Select the mDNS gateway check box.

**Step 3**

From the Learn Service drop-down list, choose from the following options:
   - **Enable**— Allows the device to learn all the announced services. It is used to learn services by enabling all announcement/queries by using Service Policy IN of type GUI-permit-all and in Service Policy OUT of type GUI-deny-all.
   - **Disable**— Denies all the traffics IN and OUT. It is used to deny services by disabling all announcement/queries by using Service Policy IN of type GUI-deny-all and in Service Policy OUT of type GUI-deny-all.
   - **Custom**— You can set your own IN and OUT policy. It allows you to define a custom service list.

**Step 4**

Click **Apply**.

**Step 5**

Click **Save Configuration**.
### Monitoring Service Discovery Gateway

#### Table 24: Monitoring Service Discovery Gateway

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>`show mdns requests [detail</td>
<td>name record-name</td>
</tr>
<tr>
<td>`show mdns cache [interface type number</td>
<td>name record-name [type record-type]]</td>
</tr>
<tr>
<td>`show mdns statistics {all</td>
<td>service-list list-name</td>
</tr>
</tbody>
</table>

#### Configuration Examples

**Example: Specify Alternative Source Interface for Outgoing mDNS Packets**

The following example displays how to specify an alternate source interface for outgoing mDNS packets, so its IP address can be used when there is none configured on the outgoing interface.

```
Device(config)# service-routing mdns-sd
Device(config-mdns)# source-interface if-name
```

**Related Topics**
- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
- Service Discovery Gateway, on page 277
- Filtering, on page 278

**Example: Redistribute Service Announcements**

The following example displays how to redistribute service announcements received on one interface over all the interfaces or over a specific interface.

```
Device(config)# service-routing mdns-sd
Device(config-mdns)# redistribute mdns-sd if-name
```

**Related Topics**
- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
- Service Discovery Gateway, on page 277
Example: Disable Bridging of mDNS Packets to Wireless Clients

The following example displays how to disable bridging of mDNS packets to wireless clients.

Device(config)# wireless multicast
Device(config)# no wireless mdns-bridging

Related Topics
- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
- Service Discovery Gateway, on page 277
- Filtering, on page 278

Example: Creating a Service-List, Applying a Filter and Configuring Parameters

The following example shows the creation of a service-list sl1. The `permit` command option is being applied on sequence number 3 and all services with message-type announcement are filtered and available for transport across various subnets associated with the device.

Device# configure terminal
Device(config)# service-list mdns-sd sl1 permit 3
Device(config-mdns-sl)# match message-type announcement
Device(config-mdns)# exit

Related Topics
- Configuring the Service List (CLI), on page 279
- Service Discovery Gateway, on page 277
- Filtering, on page 278

Example: Enabling mDNS Gateway and Redistributing Services

The following example shows how to enable an mDNS gateway for a device and enable redistribution of services across subnets. IN-bound filtering is applied on the service-list serv-pol1. Twenty percent of system memory is made available for cache and service-list-query periodicity is configured at 100 seconds.

Device# configure terminal
Device# service-routing mdns-sd
Device(config-mdns)# service-policy serv-pol1 IN
Device(config-mdns)# redistribute mdns-sd
Device(config-mdns)# cache-memory-max 20
Device(config-mdns)# service-policy-query sl-query1 100
Device(config-mdns)# exit

Related Topics
- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
Example: Global mDNS Configuration

The following example displays how to globally configure mDNS.

```
Device# configure terminal
Device(config)# service-list mdns-sd mypermit-all permit 10
Device(config-mdns-sd-s1)# exit
Device(config)# service-list mdns-sd querier query
Device(config-mdns-sd-s1)# service-type _dns._udp
Device(config-mdns-sd-s1)# end
Device# configure terminal
Device(config)# service-routing mdns-sd
Device(config-mdns)# service-policy mypermit-all IN
Device(config-mdns)# service-policy mypermit-all OUT
```

Related Topics

- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
- Service Discovery Gateway, on page 277
- Filtering, on page 278

Example: Interface mDNS Configuration

The following example displays how to configure mDNS for an interface.

```
Device(config)# interface Vlan136
Device(config-if)# description *** Mgmt VLAN ***
Device(config-if)# ip address 9.7.136.10 255.255.255.0
Device(config-if)# ip helper-address 9.1.0.100
Device(config-if)# service-routing mdns-sd
Device(config-if-mdns-sd)# service-policy mypermit-all IN
Device(config-if-mdns-sd)# service-policy mypermit-all OUT
Device(config-if-mdns-sd)# service-policy-query querier 60
```

Related Topics

- Enabling mDNS Gateway and Redistributing Services (CLI), on page 283
- Service Discovery Gateway, on page 277
- Filtering, on page 278

Where to Go Next for Configuring Services Discovery Gateway

You can configure the following:

- IGMP
- Wireless Multicast
• PIM
• SSM
• IP Multicast Routing

You can also review the following IP Multicast Optimization processes for your configuration:

• Optimizing PIM Sparse Mode in a Large IP Multicast Deployment
• Multicast Subsecond Convergence
• IP Multicast Load Splitting across Equal-Cost Paths
• SSM Channel Based Filtering for Multicast
• PIM Dense Mode State Refresh
• IGMP State Limit

Additional References

Related Documents

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<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<td>Configuring DNS</td>
<td>IP Addressing: DNS Configuration Guide, Cisco IOS XE Release 3SE</td>
</tr>
<tr>
<td>DNS conceptual information</td>
<td>'Information About DNS' section in IP Addressing: DNS Configuration Guide, Cisco IOS XE Release 3SE</td>
</tr>
<tr>
<td>Platform-independent configuration information</td>
<td>IP Addressing: DNS Configuration Guide, Cisco IOS XE Release 3SE</td>
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Error Message Decoder

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<td>To help you research and resolve system error messages in this release, use the Error Message Decoder tool.</td>
<td><a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a></td>
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Standards and RFCs

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<td>DNS-Based Service Discovery</td>
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<td>Multicast</td>
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### MIBs

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<th>MIBs Link</th>
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<td>All supported MIBs for this release.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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### Technical Assistance

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<tr>
<td>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.</td>
<td><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></td>
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### Feature History and Information for Services Discovery Gateway

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<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
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CHAPTER 13

IP Multicast Optimization: Optimizing PIM Sparse Mode in a Large IP Multicast Deployment

• Finding Feature Information, page 293
• Prerequisites for Optimizing PIM Sparse Mode in a Large IP Multicast Deployment, page 293
• Information About Optimizing PIM Sparse Mode in a Large IP Multicast Deployment, page 294
• How to Optimize PIM Sparse Mode in a Large IP Multicast Deployment, page 297
• Configuration Examples for Optimizing PIM Sparse Mode in a Large Multicast Deployment, page 299
• Additional References, page 300
• Feature History and Information for Optimizing PIM Sparse Mode in a Large IP Multicast Deployment, page 300

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 Optimizing PIM Sparse Mode in a Large IP Multicast Deployment

• You must have PIM sparse mode running in your network.
• If you plan to use a group list to control to which groups the shortest-path tree (SPT) threshold applies, you must have configured your access list before performing the task.
Information About Optimizing PIM Sparse Mode in a Large IP Multicast Deployment

PIM Registering Process

IP multicast sources do not use a signaling mechanism to announce their presence. Sources just send their data into the attached network, as opposed to receivers that use Internet Group Management Protocol (IGMP) to announce their presence. If a source sends traffic to a multicast group configured in PIM sparse mode (PIM-SM), the Designated Router (DR) leading toward the source must inform the rendezvous point (RP) about the presence of this source. If the RP has downstream receivers that want to receive the multicast traffic (natively) from this source and has not joined the shortest path leading toward the source, then the DR must send the traffic from the source to the RP. The PIM registering process, which is individually run for each (S, G) entry, accomplishes these tasks between the DR and RP.

The registering process begins when a DR creates a new (S, G) state. The DR encapsulates all the data packets that match the (S, G) state into PIM register messages and unicasts those register messages to the RP. If an RP has downstream receivers that want to receive register messages from a new source, the RP can either continue to receive the register messages through the DR or join the shortest path leading toward the source. By default, the RP will join the shortest path, because delivery of native multicast traffic provides the highest throughput. Upon receipt of the first packet that arrives natively through the shortest path, the RP will send a register-stop message back to the DR. When the DR receives this register-stop message, it will stop sending register messages to the RP.

If an RP has no downstream receivers that want to receive register messages from a new source, the RP will not join the shortest path. Instead, the RP will immediately send a register-stop message back to the DR. When the DR receives this register-stop message, it will stop sending register messages to the RP.

Once a routing entry is established for a source, a periodic reregistering takes place between the DR and RP. One minute before the multicast routing table state times out, the DR will send one dataless register message to the RP each second that the source is active until the DR receives a register-stop message from the RP. This action restarts the timeout time of the multicast routing table entry, typically resulting in one reregistering exchange every 2 minutes. Reregistering is necessary to maintain state, to recover from lost state, and to keep track of sources on the RP. It will take place independently of the RP joining the shortest path.

PIM Version 1 Compatibility

If an RP is running PIM Version 1, it will not understand dataless register messages. In this case, the DR will not send dataless register messages to the RP. Instead, approximately every 3 minutes after receipt of a register-stop message from the RP, the DR encapsulates the incoming data packets from the source into register messages and sends them to the RP. The DR continues to send register messages until it receives another register-stop message from the RP. The same behavior occurs if the DR is running PIM Version 1.

When a DR running PIM Version 1 encapsulates data packets into register messages for a specific (S, G) entry, the entry is process-switched, not fast-switched or hardware-switched. On platforms that support these faster paths, the PIM registering process for an RP or DR running PIM Version 1 may lead to periodic out-of-order packet delivery. For this reason, we recommend upgrading your network from PIM Version 1 to PIM Version 2.
PIM Designated Router

Devices configured for IP multicast send PIM hello messages to determine which device will be the designated router (DR) for each LAN segment (subnet). The hello messages contain the device's IP address, and the device with the highest IP address becomes the DR.

The DR sends Internet Group Management Protocol (IGMP) host query messages to all hosts on the directly connected LAN. When operating in sparse mode, the DR sends source registration messages to the rendezvous point (RP).

By default, multicast devices send PIM router query messages every 30 seconds. By enabling a device to send PIM hello messages more often, the device can discover unresponsive neighbors more quickly. As a result, the device can implement failover or recovery procedures more efficiently. It is appropriate to make this change only on redundant devices on the edge of the network.

PIM Sparse-Mode Register Messages

Dataless register messages are sent at a rate of one message per second. Continuous high rates of register messages might occur if a DR is registering bursty sources (sources with high data rates) and if the RP is not running PIM Version 2.

By default, PIM sparse-mode register messages are sent without limiting their rate. Limiting the rate of register messages will limit the load on the DR and RP, at the expense of dropping those register messages that exceed the set limit. Receivers may experience data packet loss within the first second in which packets are sent from bursty sources.

Preventing Use of Shortest-Path Tree to Reduce Memory Requirement

Understanding PIM shared tree and source tree will help you understand how preventing the use of the shortest-path tree can reduce memory requirements.
PIM Shared Tree and Source Tree - Shortest-Path Tree

By default, members of a multicast group receive data from senders to the group across a single data distribution tree rooted at the rendezvous point (RP). This type of distribution tree is called shared tree, as shown in the figure. Data from senders is delivered to the RP for distribution to group members joined to the shared tree.

Figure 15: Shared Tree versus Source Tree (Shortest-Path Tree)

If the data rate warrants, leaf routers on the shared tree may initiate a switch to the data distribution tree rooted at the source. This type of distribution tree is called a shortest-path tree (SPT) or source tree. By default, the software switches to a source tree upon receiving the first data packet from a source.

The following process describes the move from shared tree to source tree in more detail:

1. Receiver joins a group; leaf Router C sends a Join message toward the RP.
2. The RP puts the link to Router C in its outgoing interface list.
3. Source sends data; Router A encapsulates data in a register message and sends it to the RP.
4. The RP forwards data down the shared tree to Router C and sends a Join message toward the source. At this point, data may arrive twice at Router C, once encapsulated and once natively.
5. When data arrives natively (through multicast) at the RP, the RP 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 router 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.

**Benefit of Preventing or Delaying the Use of the Shortest-Path Tree**

The switch from shared to source tree happens upon the arrival of the first data packet at the last hop device (Router C in *Benefit of Preventing or Delaying the Use of the Shortest-Path Tree*, on page 297). This switch occurs because the `ip pim spt-threshold` command controls that timing, and its default setting is 0 kbps.

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

You can configure when a PIM leaf device 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 device triggers a PIM Join message toward the source to construct a source tree (shortest-path tree). If the `infinity` keyword is specified, all sources for the specified group use the shared tree, never switching to the source tree.

---

**How to Optimize PIM Sparse Mode in a Large IP Multicast Deployment**

**Optimizing PIM Sparse Mode in a Large Deployment**

Consider performing this task if your deployment of IP multicast is large.

Steps 3, 5, and 6 in this task are independent of each other and are therefore considered optional. Any one of these steps will help optimize PIM sparse mode. If you are going to perform Step 5 or 6, you must perform Step 4. Step 6 applies only to a designated router; changing the PIM query interval is only appropriate on redundant routers on the edge of the PIM domain.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip pim register-rate-limit rate`
4. `ip pim spt-threshold {kbps|infinity} [group-list access-list]`
5. `interface type number`
6. `ip pim query-interval period [msec]`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Example: Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 ip pim register-rate-limit rate</td>
<td>(Optional) Sets a limit on the maximum number of PIM sparse mode register messages sent per second for each (S, G) routing entry.</td>
</tr>
<tr>
<td>Example: Router(config)# ip pim register-rate-limit 10</td>
<td>• Use this command to limit the number of register messages that the designated router (DR) will allow for each (S, G) entry.</td>
</tr>
<tr>
<td></td>
<td>• By default, there is no maximum rate set.</td>
</tr>
<tr>
<td></td>
<td>• Configuring this command will limit the load on the DR and RP at the expense of dropping those register messages that exceed the set limit.</td>
</tr>
<tr>
<td></td>
<td>• Receivers may experience data packet loss within the first second in which register messages are sent from bursty sources.</td>
</tr>
<tr>
<td>Step 4 ip pim spt-threshold [kbps] infinity</td>
<td>[group-list access-list]</td>
</tr>
<tr>
<td>Example: Router(config)# ip pim spt-threshold infinity group-list 5</td>
<td>• The default value is 0, which causes the router to join the SPT immediately upon the first data packet it receives.</td>
</tr>
<tr>
<td></td>
<td>• Specifying the infinity keyword causes the router never to move to the shortest-path tree; it remains on the shared tree. This keyword applies to a multicast environment of &quot;many-to-many&quot; communication.</td>
</tr>
<tr>
<td></td>
<td>• The group list is a standard access list that controls which groups the SPT threshold applies to. If a value of 0 is specified or the group list is not used, the threshold applies to all groups.</td>
</tr>
<tr>
<td></td>
<td>• In the example, group-list 5 is already configured to permit the multicast groups 239.254.2.0 and 239.254.3.0: access-list 5 permit 239.254.2.0 0.0.0.255 access-list 5 permit 239.254.3.0 0.0.0.255</td>
</tr>
<tr>
<td>Step 5 interface type number</td>
<td>Configures an interface.</td>
</tr>
<tr>
<td>Example: Router(config)# interface ethernet 0</td>
<td>• If you do not want to change the default values of the PIM SPT threshold or the PIM query interval, do not perform this step; you are done with this task.</td>
</tr>
<tr>
<td>Step 6 ip pim query-interval period [msec]</td>
<td>(Optional) Configures the frequency at which multicast routers send PIM router query messages.</td>
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### Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
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<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>• Perform this step only on redundant routers on the edge of a PIM domain.</td>
</tr>
<tr>
<td></td>
<td>• The default query interval is 30 seconds.</td>
</tr>
<tr>
<td></td>
<td>• The <code>period</code> argument is in seconds unless the <code>msec</code> keyword is specified.</td>
</tr>
<tr>
<td></td>
<td>• Set the query interval to a smaller number of seconds for faster convergence, but keep in mind the trade-off between faster convergence and higher CPU and bandwidth usage.</td>
</tr>
</tbody>
</table>

### Related Topics

- Optimizing PIM Sparse Mode in a Large IP Multicast Deployment Example, on page 299

### Configuration Examples for Optimizing PIM Sparse Mode in a Large Multicast Deployment

#### Optimizing PIM Sparse Mode in a Large IP Multicast Deployment Example

The following example shows how to:

- Set the query interval to 1 second for faster convergence.
- Configure the router to never move to the SPT but to remain on the shared tree.
- Set a limit of 10 PIM sparse mode register messages sent per second for each (S, G) routing entry.

```plaintext
interface ethernet 0
  ip pim query-interval 1
  
  !
  ip pim spt-threshold infinity
  ip pim register-rate-limit 10
  
```

### Related Topics

- Optimizing PIM Sparse Mode in a Large Deployment, on page 297
Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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<tr>
<td>Cisco IOS IP SLAs commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
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<td>PIM Sparse Mode concepts and configuration</td>
<td>&quot;Configuring Basic IP Multicast&quot; module or</td>
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<td>&quot;Configuring IP Multicast in IPv6 Networks&quot; module</td>
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MIBs

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<td>To locate and download MIBs for selected platforms, Cisco IOS XE releases,</td>
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<td>for existing MIBs has not been modified by these features.</td>
<td>and feature sets, use Cisco MIB Locator found at the following URL:</td>
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Technical Assistance

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<tr>
<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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Feature History and Information for Optimizing PIM Sparse Mode in a Large IP Multicast Deployment

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<td>Cisco IOS XE 3.3SE</td>
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CHAPTER 14

IP Multicast Optimization: Multicast Subsecond Convergence

• Finding Feature Information, page 303
• Prerequisites for Multicast Subsecond Convergence, page 303
• Restrictions for Multicast Subsecond Convergence, page 304
• Information About Multicast Subsecond Convergence, page 304
• How to Configure Multicast Subsecond Convergence, page 306
• Configuration Examples for Multicast Subsecond Convergence, page 310
• Additional References, page 311
• Feature History and Information for Multicast Subsecond Convergence, page 312

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 Multicast Subsecond Convergence

Service providers must have a multicast-enabled core in order to use the Cisco Multicast Subsecond Convergence feature.
Restrictions for Multicast Subsecond Convergence

Devices that use the subsecond designated router (DR) failover enhancement must be able to process hello interval information arriving in milliseconds. Devices that are congested or do not have enough CPU cycles to process the hello interval can assume that the Protocol Independent Multicast (PIM) neighbor is disconnected, although this may not be the case.

Information About Multicast Subsecond Convergence

Benefits of Multicast Subsecond Convergence

- The scalability components improve on the efficiency of handling increases (or decreases) in service users (receivers) and service load (sources or content).
- New algorithms and processes (such as aggregated join messages, which deliver up to 1000 individual messages in a single packet) reduce the time to reach convergence by a factor of 10.
- Multicast subsecond convergence improves service availability for large multicast networks.
- Multicast users such as financial services firms and brokerages receive better quality of service (QoS), because multicast functionality is restored in a fraction of the time previously required.

Multicast Subsecond Convergence Scalability Enhancements

The Multicast Subsecond Convergence feature provides scalability enhancements that improve on the efficiency of handling increases (or decreases) in service users (receivers) and service load (sources or content). Scalability enhancements in this release include the following:

- Improved Internet Group Management Protocol (IGMP) and PIM state maintenance through new timer management techniques
- Improved scaling of the Multicast Source Discovery Protocol (MSDP) Source-Active (SA) cache

The scalability enhancements provide the following benefits:

- Increased potential PIM multicast route (mroute), IGMP, and MSDP SA cache state capacity
- Decreased CPU usage

PIM Router Query Messages

Multicast subsecond convergence allows you to send PIM router query messages (PIM hellos) every few milliseconds. The PIM hello message is used to locate neighboring PIM devices. Before the introduction of this feature, the device could send the PIM hellos only every few seconds. By enabling a device to send PIM hello messages more often, this feature allows the device to discover unresponsive neighbors more quickly. As a result, the device can implement failover or recovery procedures more efficiently.

Reverse Path Forwarding

Unicast Reverse Path Forwarding (RPF) helps to mitigate problems caused by the introduction of malformed or forged IP source addresses into a network by discarding IP packets that lack a verifiable IP source address. Malformed or forged source addresses can indicate denial-of-service (DoS) attacks based on source IP address spoofing.

RPF uses access control lists (ACLs) in determining whether to drop or forward data packets that have malformed or forged IP source addresses. An option in the ACL commands allows system administrators to log information about dropped or forwarded packets. Logging information about forged packets can help in uncovering information about possible network attacks.

Per-interface statistics can help system administrators quickly discover the interface serving as the entry point for an attack on the network.

RPF Checks

PIM is designed to forward IP multicast traffic using the standard unicast routing table. PIM uses the unicast routing table to decide if the source of the IP multicast packet has arrived on the optimal path from the source. This process, the RPF check, is protocol-independent because it is based on the contents of the unicast routing table and not on any particular routing protocol.

Triggered RPF Checks

Multicast subsecond convergence provides the ability to trigger a check of RPF changes for mroutestate. This check is triggered by unicast routing changes. By performing a triggered RPF check, users can set the periodic RPF check to a relatively high value (for example, 10 seconds) and still fail over quickly.

The triggered RPF check enhancement reduces the time needed for service to be restored after disruption, such as for single service events (for example, in a situation with one source and one receiver) or as the service scales along any parameter (for example, many sources, many receivers, and many interfaces). This enhancement decreases in time-to-converge PIM (mroute), IGMP, and MSDP (SA cache) states.

RPF Failover

In an unstable unicast routing environment that uses triggered RPF checks, the environment could be constantly triggering RPF checks, which places a burden on the resources of the device. To avoid this problem, use the `ip multicast rpf backoff` command to prevent a second triggered RPF check from occurring for the length
of time configured. That is, the PIM “backs off” from another triggered RPF check for a minimum amount of milliseconds as configured by the user.

If the backoff period expires without further routing table changes, PIM then scans for routing changes and accordingly establishes multicast RPF changes. However, if more routing changes occur during the backoff period, PIM doubles the backoff period to avoid overloading the device with PIM RPF changes while the routing table is still converging.

Related Topics
- Configuring PIM RPF Failover Intervals, on page 307
- Example Configuring PIM RPF Failover Intervals, on page 311

Topology Changes and Multicast Routing Recovery

The Multicast Subsecond Convergence feature set enhances both enterprise and service provider network backbones by providing almost instantaneous recovery of multicast paths after unicast routing recovery.

Because PIM relies on the unicast routing table to calculate its RPF when a change in the network topology occurs, unicast protocols first need to calculate options for the best paths for traffic, and then multicast can determine the best path.

Multicast subsecond convergence allows multicast protocol calculations to finish almost immediately after the unicast calculations are completed. As a result, multicast traffic forwarding is restored substantially faster after a topology change.

How to Configure Multicast Subsecond Convergence

Modifying the Periodic RPF Check Interval

Perform this optional task to modify the intervals at which periodic RPF checks occur.

Note
Cisco recommends that you do not change the default values for the `ip rpf interval` command. The default values allow subsecond RPF failover. The default interval at which periodic RPF checks occur is 10 seconds.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip multicast rpf interval seconds [list access-list | route-map route-map]`
### Detailed Steps

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td><code>ip multicast rpf interval</code></td>
<td>Configures the periodic RPF check intervals to occur at a specified interval, in seconds.</td>
</tr>
<tr>
<td>`seconds [list access-list</td>
<td></td>
</tr>
<tr>
<td><code>route-map route-map]</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# ip multicast rpf interval 10</td>
<td></td>
</tr>
</tbody>
</table>

**Related Topics**

- RPF Checks, on page 305
- Example Modifying the Periodic RPF Check Interval, on page 310

### Configuring PIM RPF Failover Intervals

Perform this optional task to configure the intervals at which PIM RPF failover will be triggered by changes in the routing tables.

**Note**

Cisco recommends that you do **not** modify the default values for the `ip multicast rpf backoff` command. The default values allow subsecond RPF failover.

### Summary Steps

1. `enable`
2. `configure terminal`
3. `ip multicast rpf backoff minimum maximum [disable]`
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Configures the minimum and the maximum backoff intervals.</td>
</tr>
<tr>
<td><code>ip multicast rpf backoff minimum maximum [disable]</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# ip multicast rpf backoff 100 2500</td>
</tr>
</tbody>
</table>

### Related Topics
- RPF Failover, on page 305
- Example Configuring PIM RPF Failover Intervals, on page 311

## Modifying the PIM Router Query Message Interval

Perform this task to modify the PIM router query message interval.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface type slot / subslot / port`
4. `ip pim query-interval period [msec]`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
</tr>
</tbody>
</table>
## Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
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<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>interface type slot / subslot / port</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# interface gigabitethernet 1/0/0</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>ip pim query-interval period [msec]</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config-if)# ip pim query-interval 45</td>
</tr>
</tbody>
</table>

### Related Topics

- PIM Router Query Messages, on page 304
- Modifying the PIM Router Query Message Interval Example, on page 311

## Verifying Multicast Subsecond Convergence Configurations

Perform this task to display detailed information about and to verify information regarding the Multicast Subsecond Convergence feature.

### SUMMARY STEPS

1. **enable**
2. **show ip pim interface** *type number*
3. **show ip pim neighbor**

### DETAILED STEPS

#### Step 1

**enable**

**Example:**

Device> enable

Enables privileged EXEC mode.

- Enter your password if prompted.
Configuration Examples for Multicast Subsecond Convergence

Example Modifying the Periodic RPF Check Interval

In the following example, the `ip multicast rpf interval` has been set to 10 seconds. This command does not show up in `show running-config` output unless the interval value has been configured to be the nondefault value.

```
!
ip multicast-routing
ip multicast rpf interval 10

interface Ethernet0/0
ip address 172.16.2.1 255.255.255.0

ip pim sparse-mode
```

Related Topics
- Modifying the Periodic RPF Check Interval, on page 306
- RPF Checks, on page 305
Example Configuring PIM RPF Failover Intervals

In the following example, the `ip multicast rpf backoff` command has been configured with a minimum backoff interval value of 100 and a maximum backoff interval value of 2500. This command does not show up in `show running-config` command output unless the interval value has been configured to be the nondefault value.

```plaintext
! ip multicast-routing

ip multicast rpf backoff 100 2500
!
interface Ethernet0/0
  ip address 172.16.2.1 255.255.255.0
  !
  ip pim sparse-mode
!
```

Related Topics

- Configuring PIM RPF Failover Intervals, on page 307
- RPF Failover, on page 305

Modifying the PIM Router Query Message Interval Example

In the following example, the `ip pim query-interval` command has been set to 100 milliseconds. This command does not show up in `show running-config` command output unless the interval value has been configured to be the nondefault value.

```plaintext
! interface gigabitethernet0/0/1
  ip address 172.16.2.1 255.255.255.0
  ip pim query-interval 100 msec
  ip pim sparse-mode
!
```

Related Topics

- Modifying the PIM Router Query Message Interval, on page 308
- PIM Router Query Messages, on page 304

Additional References

Related Documents

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<tr>
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<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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<td>Cisco IOS IP SLAs commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
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### Feature History and Information for Multicast Subsecond Convergence

<table>
<thead>
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<th>Related Topic</th>
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<tbody>
<tr>
<td>PIM Sparse Mode concepts and configuration</td>
<td>&quot;Configuring Basic IP Multicast&quot; module or &quot;Configuring IP Multicast in IPv6 Networks&quot; module</td>
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### MIBs

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<th>MIBs Link</th>
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<tr>
<td>No new or modified MIBs are supported by these features, and support for existing MIBs has not been modified by these features.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
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### Technical Assistance

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<th>Description</th>
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<tbody>
<tr>
<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
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### Feature History and Information for Multicast Subsecond Convergence

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<tr>
<th>Release</th>
<th>Modification</th>
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<tbody>
<tr>
<td>Cisco IOS XE 3.3SE</td>
<td>This feature was introduced.</td>
</tr>
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</table>
CHAPTER 15

IP Multicast Optimization: IP Multicast Load Splitting across Equal-Cost Paths

- Finding Feature Information, page 313
- Prerequisites for IP Multicast Load Splitting across Equal-Cost Paths, page 313
- Information About IP Multicast Load Splitting across Equal-Cost Paths, page 314
- How to Load Split IP Multicast Traffic over ECMP, page 324
- Configuration Examples for Load Splitting IP Multicast Traffic over ECMP, page 331
- Additional References, page 332
- Feature History and Information for Load Splitting IP Multicast Traffic over ECMP, page 333

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 Load Splitting across Equal-Cost Paths

IP multicast is enabled on the device using the tasks described in the “Configuring Basic IP Multicast” module of the IP Multicast: PIM Configuration Guide.
Information About IP Multicast Load Splitting across Equal-Cost Paths

Load Splitting Versus Load Balancing

Load splitting and load balancing are not the same. Load splitting provides a means to randomly distribute (*, G) and (S, G) traffic streams across multiple equal-cost reverse path forwarding (RPF) paths, which does not necessarily result in a balanced IP multicast traffic load on those equal-cost RPF paths. By randomly distributing (*, G) and (S, G) traffic streams, the methods used for load splitting IP multicast traffic attempt to distribute an equal amount of traffic flows on each of the available RPF paths not by counting the flows, but, rather, by making a pseudorandom decision. These methods are collectively referred to as equal-cost multipath (ECMP) multicast load splitting methods and result in better load-sharing in networks where there are many traffic streams that utilize approximately the same amount of bandwidth.

If there are just a few (S, G) or (*, G) states flowing across a set of equal-cost links, the chance that they are well balanced is quite low. To overcome this limitation, precalculated source addresses--for (S, G) states or rendezvous point (RP) addresses for (*, G) states, can be used to achieve a reasonable form of load balancing. This limitation applies equally to the per-flow load splitting in Cisco Express Forwarding (CEF) or with EtherChannels: As long as there are only a few flows, those methods of load splitting will not result in good load distribution without some form of manual engineering.

Default Behavior for IP Multicast When Multiple Equal-Cost Paths Exist

By default, for Protocol Independent Multicast sparse mode (PIM-SM), Source Specific Multicast (PIM-SSM), bidirectional PIM (bidir-PIM), and PIM dense mode (PIM-DM) groups, if multiple equal-cost paths are available, Reverse Path Forwarding (RPF) for IPv4 multicast traffic is based on the PIM neighbor with the highest IP address. This method is referred to as the highest PIM neighbor behavior. This behavior is in accordance with RFC 2362 for PIM-SM, but also applies to PIM-SSM, PIM-DM, and bidir-PIM.

The figure illustrates a sample topology that is used in this section to explain the default behavior for IP multicast when multiple equal-cost paths exist.
Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

**Figure 16: Default Behavior for IP Multicast When Multiple Equal-Cost Paths Exist**

In the figure, two sources, S1 and S2, are sending traffic to IPv4 multicast groups, G1 and G2. Either PIM-SM, PIM-SSM, or PIM-DM can be used in this topology. If PIM-SM is used, assume that the default of 0 for the `ip pim spt-threshold` command is being used on Device 2, that an Interior Gateway Protocol (IGP) is being run, and that the output of the `show ip route` command for S1 and for S2 (when entered on Device 2) displays serial interface 0 and serial interface 1 on Device 1 as equal-cost next-hop PIM neighbors of Device 2.

Without further configuration, IPv4 multicast traffic in the topology illustrated in the figure would always flow across one serial interface (either serial interface 0 or serial interface 1), depending on which interface has the higher IP address. For example, suppose that the IP addresses configured on serial interface 0 and serial interface 1 on Device 1 are 10.1.1.1 and 10.1.2.1, respectively. Given that scenario, in the case of PIM-DMM Device 2 would always send PIM join messages towards 10.1.2.1 and would always receive IPv4 multicast traffic on serial interface 1 for all sources and groups shown in the figure. In the case of PIM-DM, Device 2 would always receive IP multicast traffic on serial Interface 1, only that in this case, PIM join messages are not used in PIM-DM; instead Device 2 would prune the IP multicast traffic across serial interface 0 and would receive it through serial interface 1 because that interface has the higher IP address on Device 1.

IPv4 RPF lookups are performed by intermediate multicast device to determine the RPF interface and RPF neighbor for IPv4 (*,G) and (S, G) multicast routes (trees). An RPF lookup consists of RPF route-selection and route-path-selection. RPF route-selection operates solely on the IP unicast address to identify the root of the multicast tree. For (*, G) routes (PIM-SM and Bidir-PIM), the root of the multicast tree is the RP address for the group G; for (S, G) trees (PIM-SM, PIM-SSM and PIM-DM), the root of the multicast tree is the source S. RPF route-selection finds the best route towards the RP or source in the routing information base (RIB), and, if configured (or available), the Distance Vector Multicast Routing Protocol (DVMRP) routing table, the Multiprotocol Border Gateway Protocol (MBGP) routing table or configured static mroutes. If the resulting route has only one available path, then the RPF lookup is complete, and the next-hop device and interface of the route become the RPF neighbor and RPF interface of this multicast tree. If the route has more than one path available, then route-path-selection is used to determine which path to choose.

For IP multicast, the following route-path-selection methods are available:
All methods but the default method of route-path-selection available in IP multicast enable some form of ECMP multicast load splitting.

- **Highest PIM neighbor**—This is the default method; thus, no configuration is required. If multiple equal-cost paths are available, RPF for IPv4 multicast traffic is based on the PIM neighbor with the highest IP address; as a result, without configuration, ECMP multicast load splitting is disabled by default.

- **ECMP multicast load splitting method based on source address**—You can configure ECMP multicast load splitting using the `ip multicast multipath` command. Entering this form of the `ip multicast multipath` command enables ECMP multicast load splitting based on source address using the S-hash algorithm. For more information, see the ECMP Multicast Load Splitting Based on Source Address Using the S-Hash Algorithm, on page 317 section.

- **ECMP multicast load splitting method based on source and group address**—You can configure ECMP multicast load splitting using the `ip multicast multipath` command with the `s-g-hash` and `basic` keywords. Entering this form of the `ip multicast multipath` command enables ECMP multicast load splitting based on source and group address using the basic S-G-hash algorithm. For more information, see the ECMP Multicast Load Splitting Based on Source and Group Address Using the Basic S-G-Hash Algorithm, on page 317 section.

- **ECMP multicast load splitting method based on source, group, and next-hop address**—You can configure ECMP multicast load splitting using the `ip multicast multipath` command with the `s-g-hash` and `next-hop-based` keywords. Entering this form of the command enables ECMP multicast load splitting based on source, group, and next-hop address using the next-hop-based S-G-hash algorithm. For more information, see the ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address, on page 319 section.

The default behavior (the highest PIM neighbor behavior) does not result in any form of ECMP load-splitting in IP multicast, but instead selects the PIM neighbor that has the highest IP address among the next-hop PIM neighbors for the available paths. A next hop is considered to be a PIM neighbor when it displays in the output of the `show ip pim neighbor` command, which is the case when PIM hello messages have been received from it and have not timed out. If none of the available next hops are PIM neighbors, then simply the next hop with the highest IP address is chosen.

**Methods to Load Split IP Multicast Traffic**

In general, the following methods are available to load split IP multicast traffic:

- You can enable ECMP multicast load splitting based on source address, based on source and group address, or based on source, group, and next-hop address. After the equal-cost paths are recognized, ECMP multicast load splitting operates on a per (S, G) basis, rather than a per packet basis as in unicast traffic.

- Alternative methods to load split IP multicast are to consolidate two or more equal-cost paths into a generic routing encapsulation (GRE) tunnel and allow the unicast routing protocol to perform the load splitting, or to load split across bundle interfaces, such as Fast or Gigabit EtherChannel interfaces, Multilink PPP (MLPPP) link bundles, or Multilink Frame Relay (FR.16) link bundles.
Overview of ECMP Multicast Load Splitting

By default, ECMP multicast load splitting of IPv4 multicast traffic is disabled. ECMP multicast load splitting can be enabled using the `ip multicast multipath` command.

**ECMP Multicast Load Splitting Based on Source Address Using the S-Hash Algorithm**

ECMP multicast load splitting traffic based on source address uses the S-hash algorithm, enabling the RPF interface for each (*, G) or (S, G) state to be selected among the available equal-cost paths, depending on the RPF address to which the state resolves. For an (S, G) state, the RPF address is the source address of the state; for a (*, G) state, the RPF address is the address of the RP associated with the group address of the state.

When ECMP multicast load splitting based on source address is configured, multicast traffic for different states can be received across more than just one of the equal-cost interfaces. The method applied by IPv4 multicast is quite similar in principle to the default per-flow load splitting in IPv4 CEF or the load splitting used with Fast and Gigabit EtherChannels. This method of ECMP multicast load splitting, however, is subject to polarization.

**Related Topics**

- Enabling ECMP Multicast Load Splitting Based on Source Address, on page 325
- Example Enabling ECMP Multicast Load Splitting Based on Source Address, on page 331

**ECMP Multicast Load Splitting Based on Source and Group Address Using the Basic S-G-Hash Algorithm**

ECMP multicast load splitting based on source and group address uses a simple hash, referred to as the basic S-G-hash algorithm, which is based on source and group address. The basic S-G-hash algorithm is predictable because no randomization is used in coming up with the hash value. The S-G-hash mechanism, however, is subject to polarization because for a given source and group, the same hash is always picked irrespective of the device this hash is being calculated on.

**Note**

The basic S-G-hash algorithm ignores bidir-PIM groups.

**Related Topics**

- Enabling ECMP Multicast Load Splitting Based on Source and Group Address, on page 328
- Example Enabling ECMP Multicast Load Splitting Based on Source and Group Address, on page 332

**Predictability As a By-Product of Using the S-Hash and Basic S-G-Hash Algorithms**

The method used by ECMP multicast load splitting in IPv4 multicast allows for consistent load splitting in a network where the same number of equal-cost paths are present in multiple places in a topology. If an RP address or source addresses are calculated once to have flows split across N paths, then they will be split across those N paths in the same way in all places in the topology. Consistent load splitting allows for predictability, which, in turn, enables load splitting of IPv4 multicast traffic to be manually engineered.
Polarization As a By-Product of Using the S-Hash and Basic S-G-Hash Algorithms

The hash mechanism used in IPv4 multicast to load split multicast traffic by source address or by source and group address is subject to a problem usually referred to as polarization. A by-product of ECMP multicast load splitting based on source address or on source and group address, polarization is a problem that prevents routers in some topologies from effectively utilizing all available paths for load splitting.

The figure illustrates a sample topology that is used in this section to explain the problem of polarization when configuring ECMP multicast load splitting based on source address or on source and group address.

Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

In the topology illustrated in the figure, notice that Router 7 has two equal-cost paths towards the sources, S1 to S10, through Router 5 and Router 6. For this topology, suppose that ECMP multicast load splitting is enabled with the `ip multicast multipath` command on all routers in the topology. In that scenario, Router 7 would apply equal-cost load splitting to the 10 (S, G) states. The problem of polarization in this scenario would affect Router 7 because that router would end up choosing serial interface 0 on Router 5 for sources S1 to S5 and serial interface 1 on Router 6 for sources S6 to S10. The problem of polarization, furthermore, would also affect Router 5 and Router 6 in this topology. Router 5 has two equal-cost paths for S1 to S5 through serial interface 0 on Router 1 and serial interface 1 on Router 2. Because Router 5 would apply the same hash algorithm to select which of the two paths to use, it would end up using just one of these two upstream paths for sources S1 to S5; that is, either all the traffic would flow across Router 1 and Router 5 or across Router 2 and Router 5. It would be impossible in this topology to utilize Router 1 and Router 5 and Router 2 and Router 5 for load splitting. Likewise, the polarization problem would apply to Router 3 and Router 6 and Router 4 and Router 6; that is, it would be impossible in this topology to utilize both Router 3 and Router 6 and Router 4 and Router 6 for load splitting.
ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address

Configuring ECMP multicast load splitting based on source, group, and next-hop address enables a more complex hash, the next-hop-based S-G-hash algorithm, which is based on source, group, and next-hop address. The next-hop-based S-G-hash algorithm is predictable because no randomization is used in calculating the hash value. Unlike the S-hash and basic S-G-hash algorithms, the hash mechanism used by the next-hop-based S-G-hash algorithm is not subject to polarization.

**Note**
The next-hop-based S-G-hash algorithm in IPv4 multicast is the same algorithm used in IPv6 ECMP multicast load splitting, which, in turn, utilizes the same hash function used for PIM-SM bootstrap device (BSR).

The next-hop-based hash mechanism does not produce polarization and also maintains better RPF stability when paths fail. These benefits come at the cost that the source or RP IP addresses cannot be used to reliably predict and engineer the outcome of load splitting when the next-hop-based S-G-hash algorithm is used. Because many customer networks have implemented equal-cost multipath topologies, the manual engineering of load splitting, thus, is not a requirement in many cases. Rather, it is more of a requirement that the default behavior of IP multicast be similar to IP unicast; that is, it is expected that IP multicast use multiple equal-cost paths on a best-effort basis. Load splitting for IPv4 multicast, therefore, could not be enabled by default because of the anomaly of polarization.

**Note**
Load splitting for CEF unicast also uses a method that does not exhibit polarization and likewise cannot be used to predict the results of load splitting or engineer the outcome of load splitting.

The next-hop-based hash function avoids polarization because it introduces the actual next-hop IP address of PIM neighbors into the calculation, so the hash results are different for each device, and in effect, there is no problem of polarization. In addition to avoiding polarization, this hash mechanism also increases stability of the RPF paths chosen in the face of path failures. Consider a device with four equal-cost paths and a large number of states that are load split across these paths. Suppose that one of these paths fails, leaving only three available paths. With the hash mechanism used by the polarizing hash mechanisms (the hash mechanism used by the S-hash and basic S-G-hash algorithms), the RPF paths of all states would likely reconverge and thus change between those three paths, especially those paths that were already using one of those three paths. These states, therefore, may unnecessarily change their RPF interface and next-hop neighbor. This problem exists simply because the chosen path is determined by taking the total number of paths available into consideration by the algorithm, so once a path changes, the RPF selection for all states is subject to change too. For the next-hop-based hash mechanism, only the states that were using the changed path for RPF would need to reconverge onto one of the three remaining paths. The states that were already using one of those paths would not change. If the fourth path came back up, the states that initially used it would immediately reconverge back to that path without affecting the other states.

**Note**
The next-hop-based S-G-hash algorithm ignores bidir-PIM groups.

**Related Topics**

Enabling ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address, on page 329
Effect of ECMP Multicast Load Splitting on PIM Neighbor Query and Hello Messages for RPF Path Selection

If load splitting of IP multicast traffic over ECMP is not enabled and there are multiple equal-cost paths towards an RP or a source, IPv4 multicast will first elect the highest IP address PIM neighbor. A PIM neighbor is a device from which PIM hello (or PIMv1 query) messages are received. For example, consider a device that has two equal-cost paths learned by an IGP or configured through two static routes. The next hops of these two paths are 10.1.1.1 and 10.1.2.1. If both of these next-hop devices send PIM hello messages, then 10.1.2.1 would be selected as the highest IP address PIM neighbor. If only 10.1.1.1 sends PIM hello messages, then 10.1.1.1 would be selected. If neither of these devices sends PIM hello messages, then 10.1.2.1 would be selected. This deference to PIM hello messages allows the construction of certain types of dynamic failover scenarios with only static multicast routes (mroutes); it is otherwise not very useful.

Note

For more information about configuring static mroutes, see the Configuring Multiple Static Mroutes in Cisco IOS configuration note on the Cisco IOS IP multicast FTP site, which is available at: ftp://ftpeng.cisco.com/ipmulticast/config-notes/static-mroutes.txt.

When load splitting of IP multicast traffic over ECMP is enabled, the presence of PIM hello message from neighbors is not considered; that is, the chosen RPF neighbor does not depend on whether or not PIM hello messages are received from that neighbor—it only depends on the presence or absence of an equal-cost route entry.

Effect of ECMP Multicast Loading Splitting on Assert Processing in PIM-DM and DF Election in Bidir-PIM

The ip multicast multipath command only changes the RPF selection on the downstream device; it does not have an effect on designated forwarder (DF) election in bidir-PIM or the assert processing on upstream devices in PIM-DM.

The figure illustrates a sample topology that is used in this section to explain the effect of ECMP multicast load splitting on assert processing in PIM-DM and DF election in bidir-PIM.
Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

**Figure 18: ECMP Multicast Load Splitting and Assert Processing in PIM-DM and DF Election in Bidir-PIM**

In the figure, Device 2 has two equal-cost paths to S1 and S2 and the RP addresses on Device 1. Both paths are across Gigabit Ethernet interface 1/0/0: one path towards Device 3 and one path towards Device 4. For PIM-SM and PIM-SSM (*, G) and (S, G) RPF selection, there is no difference in the behavior of Device 2 in this topology versus Device 2 in the topology illustrated in the figure. There is, however, a difference when using PIM-DM or bidir-PIM.

If PIM-DM is used in the topology illustrated in the figure, Device 3 and Device 4 would start flooding traffic for the states onto Gigabit Ethernet interface 1/0/0 and would use the PIM assert process to elect one device among them to forward the traffic and to avoid traffic duplication. As both Device 3 and Device 4 would have the same route cost, the device with the higher IP address on Gigabit Ethernet interface 1/0/0 would always win the assert process. As a result, if PIM-DM is used in this topology, traffic would not be load split across Device 3 and Device 4.

If bidir-PIM is used in the topology illustrated in the figure, a process called DF election would take place between Device 2, Device 3, and Device 4 on Gigabit Ethernet interface 1/0/0. The process of DF election would elect one device for each RP to forward traffic across Gigabit Ethernet interface 1/0/0 for any groups using that particular RP, based on the device with the highest IP address configured for that interface. Even if multiple RPs are used (for example one for G1 and another one for G2), the DF election for those RPs would always be won by the device that has the higher IP address configured on Gigabit Ethernet interface 1/0/0 (either Device 3 or Device 4 in this topology). The election rules used for DF election are virtually the same as the election rules used for the PIM assert process, only the protocol mechanisms to negotiate them are more refined for DF election (in order to return the results more expediently). As a result, when bidir-PIM is used in this topology, load splitting would always occur across Gigabit Ethernet interface 1/0/0.

The reason that ECMP multicast load splitting does influence the RPF selection but not the assert process in PIM-DM or DF election in bidir-PIM is because both the assert process and DF election are cooperative processes that need to be implemented consistently between participating devices. Changing them would require some form of protocol change that would also need to be agreed upon by the participating devices. RPF selection is a purely device local policy and, thus, can be enabled or disabled without protocol changes individually on each device.
For PIM-DM and bidir-PIM, configuring ECMP multicast load splitting with the `ip multicast multipath` command is only effective in topologies where the equal-cost paths are not upstream PIM neighbors on the same LAN, but rather neighbors on different LANs or point-to-point links.

**Effect of ECMP Multicast Load Splitting on the PIM Assert Process in PIM-SM and PIM-SSM**

There are also cases where ECMP multicast load splitting with the `ip multicast multipath` command can become ineffective due to the PIM assert process taking over, even when using PIM-SM with (*, G) or (S, G) forwarding or PIM-SSM with (S, G) forwarding.

The figure illustrates a sample topology that is used in this section to explain the effect of ECMP multicast load splitting on the PIM assert process in PIM-SM and PIM-SSM.

![Figure 19: ECMP Multicast Load Splitting and the PIM Assert Process in PIM-SM and PIM-SSM](image)

In the topology illustrated in the figure, if both Device 2 and Device 5 are Cisco devices and are consistently configured for ECMP multicast load splitting with the `ip multicast multipath` command, then load splitting would continue to work as expected; that is, both devices would have Device 3 and Device 4 as equal-cost next hops and would sort the list of equal-cost paths in the same way (by IP address). When applying the multipath hash function, for each (S, G) or (*, G) state, they would choose the same RPF neighbor (either Device 3 or Device 4) and send their PIM joins to this neighbor.

If Device 5 and Device 2 are inconsistently configured with the `ip multicast multipath` command, or if Device 5 is a third-party device, then Device 2 and Device 5 may choose different RPF neighbors for some (*, G) or (S, G) states. For example Device 2 could choose Device 3 for a particular (S, G) state or Device 5 could choose Device 4 for a particular (S, G) state. In this scenario, Device 3 and Device 4 would both start to forward traffic for that state onto Gigabit Ethernet interface 1/0/0, see each other’s forwarded traffic, and—and to avoid traffic duplication—start the assert process. As a result, for that (S, G) state, the device with the higher IP address for Gigabit Ethernet interface 1/0/0 would forward the traffic. However, both Device 2 and Device 5 would be tracking the winner of the assert election and would send their PIM joins for that state to this assert winner, even if this assert winner is not the same device as the one that they calculated in their RPF selection.
For PIM-SM and PIM-SSM, therefore, the operation of ECMP multicast load splitting can only be guaranteed when all downstream devices on a LAN are consistently configured Cisco devices.

**ECMP Multicast Load Splitting and Reconvergence When Unicast Routing Changes**

When unicast routing changes, all IP multicast routing states reconverge immediately based on the available unicast routing information. Specifically, if one path goes down, the remaining paths reconverge immediately, and if the path comes up again, multicast forwarding will subsequently reconverge to the same RPF paths that were used before the path failed. Reconvergence occurs whether load splitting of IP multicast traffic over ECMP is configured or not.

**Use of BGP with ECMP Multicast Load Splitting**

ECMP multicast load splitting works with RPF information learned through BGP in the same way as with RPF information learned from other protocols: It chooses one path out of the multiple paths installed by the protocol. The main difference with BGP is that it only installs a single path, by default. For example, when a BGP speaker learns two identical external BGP (eBGP) paths for a prefix, it will choose the path with the lowest device ID as the best path. The best path is then installed in the IP routing table. If BGP multipath support is enabled and the eBGP paths are learned from the same neighboring AS, instead of picking the single best path, BGP installs multiple paths in the IP routing table. By default, BGP will install only one path to the IP routing table.

To leverage ECMP multicast load splitting for BGP learned prefixes, you must enable BGP multipath. Once configured, when BGP installs the remote next-hop information, RPF lookups will execute recursively to find the best next hop towards that BGP next hop (as in unicast). If for example there is only a single BGP path for a given prefix, but there are two IGP paths to reach that BGP next hop, then multicast RPF will correctly load split between the two different IGP paths.

**Use of ECMP Multicast Load Splitting with Static Mroutes**

If it is not possible to use an IGP to install equal cost routes for certain sources or RPs, static routes can be configured to specify the equal-cost paths for load splitting. You cannot use static mroutes to configure equal-cost paths because the software does not support the configuration of one static mroute per prefix. There are some workarounds for this limitation using recursive route lookups but the workarounds cannot be applied to equal-cost multipath routing.

---

**Note**

For more information about configuring static mroutes, see the Configuring Multiple Static Mroutes in Cisco IOS configuration note on the Cisco IOS IP multicast FTP site at ftp://ftpeng.cisco.com/ipmulticast/config-notes/static-mroutes.txt.

You can specify only static mroutes for equal-cost multipaths in IPv4 multicast; however, those static mroutes would only apply to multicast, or you can specify that the equal-cost multipaths apply to both unicast and multicast routing. In IPv6 multicast, there is no such restriction. Equal-cost multipath mroutes can be configured for static IPv6 mroutes that apply to only unicast routing, only multicast routing, or both unicast and multicast routing.
Alternative Methods of Load Splitting IP Multicast Traffic

Load splitting of IP multicast traffic can also be achieved by consolidating multiple parallel links into a single tunnel over which the multicast traffic is then routed. This method of load splitting is more complex to configure than ECMP multicast load splitting. One such case where configuring load splitting across equal-cost paths using GRE links can be beneficial is the case where the total number of (S, G) or (*) G) states is so small and the bandwidth carried by each state so variable that even the manual engineering of the source or RP addresses cannot guarantee the appropriate load splitting of the traffic.

Note
With the availability of ECMP multicast load splitting, tunnels typically only need to be used if per-packet load sharing is required.

IP multicast traffic can also be used to load split across bundle interfaces, such as Fast or Gigabit EtherChannel interfaces, MLPPP link bundles or Multilink Frame Relay (FRF.16) bundles. GRE or other type of tunnels can also constitute such forms of Layer 2 link bundles. Before using such an Layer 2 mechanism, it is necessary to understand how unicast and multicast traffic is load split.

Before load splitting IP multicast traffic across equal-cost paths over a tunnel, you must configure CEF per-packet load balancing or else the GRE packets will not be load balanced per packet.

How to Load Split IP Multicast Traffic over ECMP

Enabling ECMP Multicast Load Splitting

Perform the following tasks to load split IP multicast traffic across multiple equal-cost paths, based on source address.

If two or more equal-cost paths from a source are available, unicast traffic will be load split across those paths. However, by default, multicast traffic is not load split across multiple equal-cost paths. In general, multicast traffic flows down from the RPF neighbor. According to PIM specifications, this neighbor must have the highest IP address if more than one neighbor has the same metric.

Configuring load splitting with the `ip multicast multipath` command causes the system to load split multicast traffic across multiple equal-cost paths based on source address using the S-hash algorithm. When the `ip multicast multipath` command is configured and multiple equal-cost paths exist, the path in which multicast traffic will travel is selected based on the source IP address. Multicast traffic from different sources will be load split across the different equal-cost paths. Load splitting will not occur across equal-cost paths for multicast traffic from the same source sent to different multicast groups.

Note
The `ip multicast multipath` command load splits the traffic and does not load balance the traffic. Traffic from a source will use only one path, even if the traffic far outweighs traffic from other sources.
Prerequisites for IP Multicast Load Splitting - ECMP

- You must have an adequate number of sources (at least more than two sources) to enable ECMP multicast load splitting based on source address.
- You must have multiple paths available to the RP to configure ECMP multicast load splitting.

**Note** Use the `show ip route` command with either the IP address of the source for the `ip-address` argument or the IP address of the RP to validate that there are multiple paths available to the source or RP, respectively. If you do not see multiple paths in the output of the command, you will not be able to configure ECMP multicast load splitting.

- When using PIM-SM with shortest path tree (SPT) forwarding, the T-bit must be set for the forwarding of all (S, G) states.
- Before configuring ECMP multicast load splitting, it is best practice to use the `show ip rpf` command to validate whether sources can take advantage of IP multicast multipath capabilities.
- BGP does not install multiple equal-cost paths by default. Use the `maximum-paths` command to configure multipath (for example in BGP). For more information, see the Use of BGP with ECMP Multicast Load Splitting, on page 323 section.

Restrictions

- If two or more equal-cost paths from a source are available, unicast traffic will be load split across those paths. However, by default, multicast traffic is not load split across multiple equal-cost paths. In general, multicast traffic flows down from the RPF neighbor. According to PIM specifications, this neighbor must have the highest IP address if more than one neighbor has the same metric.
- The `ip multicast multipath` command does not support configurations in which the same PIM neighbor IP address is reachable through multiple equal-cost paths. This situation typically occurs if unnumbered interfaces are used. Use different IP addresses for all interfaces when configuring the `ip multicast multipath` command.
- The `ip multicast multipath` command load splits the traffic and does not load balance the traffic. Traffic from a source will use only one path, even if the traffic far outweighs traffic from other sources.

Enabling ECMP Multicast Load Splitting Based on Source Address

Perform this task to enable ECMP multicast load splitting of multicast traffic based on source address (using the S-hash algorithm) to take advantage of multiple paths through the network. The S-hash algorithm is predictable because no randomization is used in calculating the hash value. The S-hash algorithm, however, is subject to polarization because for a given source, the same hash is always picked irrespective of the device on which the hash is being calculated.
Enable ECMP multicast load splitting on the device that is to be the receiver for traffic from more than one incoming interfaces, which is opposite to unicast routing. From the perspective of unicast, multicast is active on the sending device connecting to more than one outgoing interfaces.

**Before You Begin**

- You must have an adequate number of sources (at least more than two sources) to enable ECMP multicast load splitting based on source address.

- You must have multiple paths available to the RP to configure ECMP multicast load splitting.

**Note** Use the `show ip route` command with either the IP address of the source for the `ip-address` argument or the IP address of the RP to validate that there are multiple paths available to the source or RP, respectively. If you do not see multiple paths in the output of the command, you will not be able to configure ECMP multicast load splitting.

- When using PIM-SM with shortest path tree (SPT) forwarding, the T-bit must be set for the forwarding of all (S, G) states.

- Before configuring ECMP multicast load splitting, it is best practice to use the `show ip rpf` command to validate whether sources can take advantage of IP multicast multipath capabilities.

- BGP does not install multiple equal-cost paths by default. Use the `maximum-paths` command to configure multipath (for example in BGP). For more information, see the Use of BGP with ECMP Multicast Load Splitting, on page 323 section.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip multicast multipath`
4. Repeat step 3 on all the devices in a redundant topology.
5. `exit`
6. `show ip rpf source-address [group-address]`
7. `show ip route ip-address`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> <code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device&gt; <code>enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><code>show ip route ip-address</code></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip multicast multipath</td>
<td>Enables ECMP multicast load splitting based on source address using the S-hash algorithm.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# ip multicast multipath</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> Repeat step 3 on all the devices in a redundant topology.</td>
<td>--</td>
</tr>
<tr>
<td><strong>Step 5</strong> exit</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device(config)# exit</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> show ip rpf source-address [group-address]</td>
<td>(Optional) Displays the information that IP multicast routing uses to perform the RPF check.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# show ip rpf 10.1.1.2</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> show ip route ip-address</td>
<td>(Optional) Displays the current state of the IP routing table.</td>
</tr>
<tr>
<td><strong>Example:</strong> Device# show ip route 10.1.1.2</td>
<td></td>
</tr>
</tbody>
</table>
Enabling ECMP Multicast Load Splitting Based on Source and Group Address

Perform this task to enable ECMP multicast load splitting of multicast traffic based on source and group address (using the basic S-G-hash algorithm) to take advantage of multiple paths through the network. The basic S-G-hash algorithm is predictable because no randomization is used in calculating the hash value. The basic S-G-hash algorithm, however, is subject to polarization because for a given source and group, the same hash is always picked irrespective of the device on which the hash is being calculated.

The basic S-G-hash algorithm provides more flexible support for ECMP multicast load splitting than the the S-hash algorithm. Using the basic S-G-hash algorithm for load splitting, in particular, enables multicast traffic from devices that send many streams to groups or that broadcast many channels, such as IPTV servers or MPEG video servers, to be more effectively load split across equal-cost paths.

Note
Enable ECMP multicast load splitting on the device that is to be the receiver for traffic from more than one incoming interfaces, which is opposite to unicast routing. From the perspective of unicast, multicast is active on the sending device connecting to more than one outgoing interfaces.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip multicast multipath s-g-hash basic
4. Repeat Step 3 on all the devices in a redundant topology.
5. exit
6. show ip rpf source-address [group-address]
7. show ip route ip-address

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Enables ECMP multicast load splitting based on source and group address using the basic S-G-hash algorithm.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# ip multicast multipath s-g-hash basic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Because this command changes the way an RPF neighbor is selected, it must be configured consistently on all devices in a redundant topology to avoid looping.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Repeat Step 3 on all the devices in a redundant topology.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# exit</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>(Optional) Displays the information that IP multicast routing uses to perform the RPF check.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# show ip rpf 10.1.1.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Use this command to verify RPF selection so as to ensure that IP multicast traffic is being properly load split.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>(Optional) Displays the current state of the IP routing table.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# show ip route 10.1.1.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Use this command to verify that there multiple paths available to a source or RP for ECMP multicast load splitting.</td>
</tr>
<tr>
<td></td>
<td>- For the <em>ip-address</em> argument, enter the IP address of a source to validate that there are multiple paths available to the source (for shortest path trees) or the IP address of an RP to validate that there are multiple paths available to the RP (for shared trees).</td>
</tr>
</tbody>
</table>

**Related Topics**

- ECMP Multicast Load Splitting Based on Source and Group Address Using the Basic S-G-Hash Algorithm, on page 317  
- Example Enabling ECMP Multicast Load Splitting Based on Source and Group Address, on page 332

**Enabling ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address**

Perform this task to enable ECMP multicast load splitting of multicast traffic based on source, group, and next-hop address (using the next-hop-based S-G-hash algorithm) to take advantage of multiple paths through the network. The next-hop-based S-G-hash algorithm is predictable because no randomization is used in calculating the hash value. Unlike the S-hash and basic S-G-hash algorithms, the hash mechanism used by the next-hop-based S-G-hash algorithm is not subject to polarization.
The next-hop-based S-G-hash algorithm provides more flexible support for ECMP multicast load splitting than S-hash algorithm and eliminates the polarization problem. Using the next-hop-based S-G-hash algorithm for ECMP multicast load splitting enables multicast traffic from devices that send many streams to groups or that broadcast many channels, such as IPTV servers or MPEG video servers, to be more effectively load split across equal-cost paths.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip multicast multipath s-g-hash next-hop-based
4. Repeat Steps 1 through 3 on all the routers in a redundant topology.
5. end
6. show ip rpf source-address [group-address]
7. show ip route ip-address

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ip multicast multipath s-g-hash next-hop-based</td>
<td>Enables ECMP multicast load splitting based on source, group, and next-hop-address using the next-hop-based S-G-hash algorithm.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Because this command changes the way an RPF neighbor is selected, it must be configured consistently on all routers in a redundant topology to avoid looping.</td>
</tr>
<tr>
<td>Router(config)# ip multicast multipath s-g-hash next-hop-based</td>
<td>Note: Be sure to enable the ip multicast multipath command on the router that is supposed to be the receiver for traffic from more than one incoming interfaces, which is opposite to unicast routing. From the perspective of unicast, multicast is active on the sending router connecting to more than one outgoing interfaces.</td>
</tr>
<tr>
<td><strong>Step 4</strong> Repeat Steps 1 through 3 on all the routers in a redundant topology.</td>
<td>--</td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Exits global configuration mode and returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### Configuration Examples for Load Splitting IP Multicast Traffic over ECMP

#### Example Enabling ECMP Multicast Load Splitting Based on Source Address

The following example shows how to enable ECMP multicast load splitting on a router based on source address using the S-hash algorithm:

```
ip multicast multipath
```

**Related Topics**

- Enabling ECMP Multicast Load Splitting Based on Source Address, on page 325
- ECMP Multicast Load Splitting Based on Source Address Using the S-Hash Algorithm, on page 317
Example Enabling ECMP Multicast Load Splitting Based on Source and Group Address

The following example shows how to enable ECMP multicast load splitting on a router based on source and group address using the basic S-G-hash algorithm:

```
ip multicast multipath s-g-hash basic
```

Related Topics

- Enabling ECMP Multicast Load Splitting Based on Source and Group Address, on page 328
- ECMP Multicast Load Splitting Based on Source and Group Address Using the Basic S-G-Hash Algorithm, on page 317

Example Enabling ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address

The following example shows how to enable ECMP multicast load splitting on a router based on source, group, and next-hop address using the next-hop-based S-G-hash algorithm:

```
ip multicast multipath s-g-hash next-hop-based
```

Related Topics

- Enabling ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address, on page 329
- ECMP Multicast Load Splitting Based on Source Group and Next-Hop Address, on page 319

Additional References

### Related Documents

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<tr>
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<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Commands List, All Releases</td>
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<td>Cisco IOS IP Multicast commands</td>
<td>Cisco IOS IP Multicast Command Reference</td>
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### Standards and RFCs

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MIBs

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Technical Assistance

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Feature History and Information for Load Splitting IP Multicast Traffic over ECMP

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Feature History and Information for Load Splitting IP Multicast Traffic over ECMP
CHAPTER 16

IP Multicast Optimization: SSM Channel Based Filtering for Multicast

• Finding Feature Information, page 335
• Finding Feature Information, page 335
• Prerequisites for SSM Channel Based Filtering for Multicast Boundaries, page 336
• Information About the SSM Channel Based Filtering for Multicast Boundaries Feature, page 336
• How to Configure SSM Channel Based Filtering for Multicast Boundaries, page 337
• Configuration Examples for SSM Channel Based Filtering for Multicast Boundaries, page 338
• Additional References, page 340
• Feature History and Information for SSM Channel Based Filtering for Multicast Boundaries, page 340

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.

Finding Feature Information

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Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Prerequisites for SSM Channel Based Filtering for Multicast Boundaries

IP multicast is enabled on the device using the tasks described in the "Configuring Basic IP Multicast" module of the IP Multicast: PIM Configuration Guide.

Information About the SSM Channel Based Filtering for Multicast Boundaries Feature

Rules for Multicast Boundaries

The SSM Channel Based Filtering for Multicast Boundaries feature expands the ip multicast boundary command for control plane filtering support. More than one ip multicast boundary command can be applied to an interface.

The following rules govern the ip multicast boundary command:

- One instance of the in and out keywords can be configured on an interface.
- The in and out keywords can be used for standard or extended access lists.
- Only standard access lists are permitted with the use of the filter-autorp keyword or no keyword.
- A maximum of three instances of a command will be allowed on an interface: one instance of in, one instance of out, and one instance of filter-autorp or no keyword.
- When multiple instances of the command are used, the filtering will be cumulative. If a boundary statement with no keyword exists with a boundary statement with the in keyword, both access lists will be applied on the in direction and a match on either one will be sufficient.
- All instances of the command apply to both control and data plane traffic.
- Protocol information on the extended access list is parsed to allow reuse and filtering for consistency. An (S,G) operation will be filtered by an extended access list under all conditions stated above for keywords if the access list filters (S,G) traffic for all protocols.

Related Topics

  - Configuring Multicast Boundaries, on page 337
  - Configuring the Multicast Boundaries Permitting and Denying Traffic Example, on page 338
  - Configuring the Multicast Boundaries Permitting Traffic Example, on page 339
  - Configuring the Multicast Boundaries Denying Traffic Example, on page 339

Benefits of SSM Channel Based Filtering for Multicast Boundaries

- This feature allows input on the source interface.
The access control capabilities are the same for SSM and Any Source Multicast (ASM).

How to Configure SSM Channel Based Filtering for Multicast Boundaries

Configuring Multicast Boundaries

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list {standard|extended} access-list-name**
4. **permit protocol host address host address**
5. **deny protocol host address host address**
6. Repeat Step 4 or Step 5 as needed.
7. **interface type interface-number port-number**
8. **ip multicast boundary access-list-name [in|out | filter-autorp]**

DETAILED STEPS

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<th>Command or Action</th>
<th>Purpose</th>
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<td><strong>Step 1</strong></td>
<td>enable</td>
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<tr>
<td>Example:</td>
<td>Device&gt; enable</td>
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<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>ip access-list {standard</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# ip access-list 101</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>permit protocol host address host address</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-ext-nacl)# permit ip host 181.1.2.201 host 232.1.1.11</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>deny protocol host address host address</strong> &lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config-acl-nacl)# deny ip host 181.1.2.203 host 232.1.1.1</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Repeat Step 4 or Step 5 as needed.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td><strong>interface type interface-number port-number</strong>&lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config)# interface gigabitethernet 2/3/0</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td><strong>ip multicast boundary access-list-name [in out] filter-autorp</strong>&lt;br&gt;&lt;br&gt;<strong>Example:</strong>&lt;br&gt;Device(config-if)# ip multicast boundary acc grp1 out</td>
</tr>
</tbody>
</table>

**Related Topics**
- Rules for Multicast Boundaries, on page 336
- Configuring the Multicast Boundaries Permitting and Denying Traffic Example, on page 338
- Configuring the Multicast Boundaries Permitting Traffic Example, on page 339
- Configuring the Multicast Boundaries Denying Traffic Example, on page 339

**Configuration Examples for SSM Channel Based Filtering for Multicast Boundaries**

**Configuring the Multicast Boundaries Permitting and Denying Traffic Example**

The following example permits outgoing traffic for (181.1.2.201, 232.1.1.1) and (181.1.2.202, 232.1.1.1) and denies all other (S,G)s.

```
configure terminal
ip access-list extended acc_grpl
permit ip host 0.0.0.0 232.1.1.1 0.0.0.255
permit ip host 181.1.2.201 host 232.1.1.1
permit udp host 181.1.2.202 host 232.1.1.1
permit ip host 181.1.2.202 host 232.1.1.1
deny igmp host 181.2.3.303 host 232.1.1.1
```
Configuring the Multicast Boundaries Permitting Traffic Example

The following example permits outgoing traffic for (192.168.2.201, 232.1.1.5) and 192.168.2.202, 232.1.1.5).

```
interface gigabitethernet 2/3/0
ip multicast boundary acc_grp1 out

configure terminal
ip access-list extended acc_grp6
permit ip host 0.0.0.0 232.1.1.1 5.0.0.255
deny udp host 192.168.2.201 host 232.1.1.5
permit ip host 192.168.2.201 host 232.1.1.5
deny pim host 192.168.2.201 host 232.1.1.5
permit ip host 192.168.2.202 host 232.1.1.5
deny igmp host 192.2.3.303 host 232.1.1.1
interface gigabitethernet 2/3/0
ip multicast boundary acc_grp6 out
```

Configuring the Multicast Boundaries Denying Traffic Example

The following example denies a group-range that is announced by the candidate RP. Because the group range is denied, no pim auto-rp mappings are created.

```
configure terminal
ip access-list standard acc_grp10
deny 225.0.0.0 0.255.255.255
permit any
access-list extended acc_grp12
permit pim host 181.1.2.201 host 232.1.1.5
deny udp host 181.1.2.201 host 232.1.1.5
permit pim host 181.1.2.203 0.0.0.255 host 227.7.7.7
permit ip host 181.1.2.203 0.0.0.255 host 227.7.7.7
permit ip host 181.1.2.201 host 232.1.1.7
ip access-list extended acc_grp13
deny ip host 181.1.2.201 host 232.1.1.8
permit ip any any
interface gigabitethernet 2/3/0
ip multicast boundary acc_grp10 filter-autorp
ip multicast boundary acc_grp12 out
ip multicast boundary acc_grp13 in
```

Related Topics

- Configuring Multicast Boundaries, on page 337
- Rules for Multicast Boundaries, on page 336
Additional References

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MIBs

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Feature History and Information for SSM Channel Based Filtering for Multicast Boundaries

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CHAPTER 17

IP Multicast Optimization: PIM Dense Mode State Refresh

- Finding Feature Information, page 341
- Prerequisite for PIM Dense Mode State Refresh, page 341
- Restrictions on PIM Dense Mode State Refresh, page 342
- Information About PIM Dense Mode State Refresh, page 342
- How to Configure PIM Dense Mode State Refresh, page 343
- Configuration Examples for PIM Dense Mode State Refresh, page 345
- Additional References, page 345
- Feature History and Information for PIM Dense Mode State Refresh, page 347

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.

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Prerequisite for PIM Dense Mode State Refresh

- You must have PIM dense mode enabled on an interface before configuring the PIM Dense Mode State Refresh feature.
Restrictions on PIM Dense Mode State Refresh

- All routers in a PIM dense mode network must run a software release that supports the PIM Dense Mode State Refresh feature to process and forward state refresh control messages.
- The origination interval for the state refresh control message must be the same for all PIM routers on the same LAN. Specifically, the same origination interval must be configured on each router interface that is directly connected to the LAN.

Information About PIM Dense Mode State Refresh

PIM Dense Mode State Refresh Overview

The PIM Dense Mode State Refresh feature is an extension of the PIM Version 2 multicast routing architecture. PIM dense mode builds source-based multicast distribution trees that operate on a flood and prune principle. Multicast packets from a source are flooded to all areas of a PIM dense mode network. PIM routers that receive multicast packets and have no directly connected multicast group members or PIM neighbors send a prune message back up the source-based distribution tree toward the source of the packets. As a result, subsequent multicast packets are not flooded to pruned branches of the distribution tree. However, the pruned state in PIM dense mode times out approximately every 3 minutes and the entire PIM dense mode network is reflooded with multicast packets and prune messages. This reflooding of unwanted traffic throughout the PIM dense mode network consumes network bandwidth.

The PIM Dense Mode State Refresh feature keeps the pruned state in PIM dense mode from timing out by periodically forwarding a control message down the source-based distribution tree. The control message refreshes the prune state on the outgoing interfaces of each router in the distribution tree.

Related Topics
- Configuring PIM Dense Mode State Refresh, on page 343
- Originating Processing and Forwarding PIM Dense Mode State Refresh Control Messages Example, on page 345
- Processing and Forwarding PIM Dense Mode State Refresh Control Messages Example, on page 345

Benefits of PIM Dense Mode State Refresh

The PIM Dense Mode State Refresh feature keeps the pruned state in PIM dense mode from timing out, which saves network bandwidth by greatly reducing the reflooding of unwanted multicast traffic to pruned branches of the PIM dense mode network. This feature also enables PIM routers in a PIM dense mode multicast network to recognize topology changes (sources joining or leaving a multicast group) before the default 3-minute state refresh timeout period.
How to Configure PIM Dense Mode State Refresh

Configuring PIM Dense Mode State Refresh

There are no configuration tasks for enabling the PIM Dense Mode State Refresh feature. By default, all PIM routers that are running a Cisco IOS XE software release that supports the PIM Dense Mode State Refresh feature automatically process and forward state refresh control messages.

To disable the processing and forwarding of state refresh control messages on a PIM router, use the `ip pim state-refresh disable` global configuration command. To enable state refresh again if it has been disabled, use the `no ip pim state-refresh disable` global configuration command.

The origination of state refresh control messages is disabled by default. To configure the origination of the control messages on a PIM router, use the following commands beginning in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
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<tbody>
<tr>
<td>Router(config)# interface type number</td>
<td>Specifies an interface and places the router in interface configuration mode.</td>
</tr>
<tr>
<td>Router(config-if)# ip pim state-refresh origination-interval [interval]</td>
<td>Configures the origination of the PIM Dense Mode State Refresh control message. Optionally, you can configure the number of seconds between control messages by using the <code>interval</code> argument. The default interval is 60 seconds. The interval range is 1 second to 100 seconds.</td>
</tr>
</tbody>
</table>

Related Topics

- PIM Dense Mode State Refresh Overview, on page 342
- Originating Processing and Forwarding PIM Dense Mode State Refresh Control Messages Example, on page 345
- Processing and Forwarding PIM Dense Mode State Refresh Control Messages Example, on page 345

Verifying PIM Dense Mode State Refresh Configuration

Use the `show ip pim interface [type number] detail` and the `show ip pim neighbor [interface]` commands to verify that the PIM Dense Mode State Refresh feature is configured correctly. The following output of the `show ip pim interface [type number] detail` command indicates that processing, forwarding, and origination of state refresh control messages is enabled.

```
Router# show ip pim interface fastethernet 0/1/0 detail
FastEthernet0/1/0 is up, line protocol is up
Internet address is 172.16.8.1/24
Multicast switching:process
Multicast packets in/out:0/0
Multicast boundary:not set
Multicast TTL threshold:0
PIM:enabled
```
PIM version: 2, mode: dense
PIM DR: 172.16.8.1 (this system)
PIM neighbor count: 0
PIM Hello/Query interval: 30 seconds
PIM State-Refresh processing: enabled
PIM State-Refresh origination: enabled, interval: 60 seconds
PIM NBMA mode: disabled
PIM ATM multipoint signalling: disabled
PIM domain border: disabled
Multicast Tagswitching: disabled

The S in the Mode field of the following `show ip pim neighbor` command output indicates that the neighbor has the PIM Dense Mode State Refresh feature configured.

```
Router# show ip pim neighbor
PIM Neighbor Table
Address   Interface Uptime/Expires Ver   DR Priority/Mode
172.16.5.1 Ethernet1/1 00:09:03/00:01:41 v2 1 / B S
```

### Monitoring and Maintaining PIM DM State Refresh

Following are the PIM Dense Mode State Refresh control messages that are sent and received by a PIM router after the `debug ip pim` privileged EXEC command is configured for multicast group 239.0.0.1:

```
Router# debug ip pim 239.0.0.1
*Mar 1 00:25:10.416:PIM:Originating refresh message for (172.16.8.3,239.0.0.1)
*Mar 1 00:25:10.416:PIM:Send SR on GigabitEthernet1/1/0 for (172.16.8.3,239.0.0.1) TTL=9

The following output from the `show ip mroute` command displays the resulting prune timer changes for GigabitEthernet interface1/0/0 and multicast group 239.0.0.1. (The following output assumes that the `debug ip pim` privileged EXEC command has already been configured on the router.) In the first output from the `show ip mroute` command, the prune timer reads 00:02:06. The debug messages indicate that a PIM Dense Mode State Refresh control message is received and sent on Ethernet interface 1/0, and that other PIM Dense Mode State Refresh routers were discovered. In the second output from the `show ip mroute` command, the prune timer has been reset to 00:02:55.

```
Router# show ip mroute 239.0.0.1
(172.16.8.3, 239.0.0.1), 00:09:50/00:02:06, flags:PT
  Incoming interface:GigabitEthernet1/1/0, RPF nbr 172.16.5.2
  Outgoing interface list:
    GigabitEthernet1/0/0, Prune/Dense, 00:09:43/00:02:06

Router# show ip mroute 239.0.0.1
(172.16.8.3, 239.0.0.1), 00:10:01/00:02:55, flags:PT
  Incoming interface:GigabitEthernet1/1/0, RPF nbr 172.16.5.2
  Outgoing interface list:
    GigabitEthernet1/0/0, Prune/Dense, 00:09:55/00:02:55
```

**Monitoring and Maintaining PIM DM State Refresh**
Configuration Examples for PIM Dense Mode State Refresh

Originating Processing and Forwarding PIM Dense Mode State Refresh Control Messages Example

The following example is for a PIM router that is originating, processing, and forwarding PIM Dense Mode State Refresh control messages on Fast Ethernet interface 0/1/0 every 60 seconds:

```
ip multicast-routing distributed
interface FastEthernet0/1/0
  ip address 172.16.8.1 255.255.255.0
  ip pim state-refresh origination-interval 60
  ip pim dense-mode
```

Related Topics
- Configuring PIM Dense Mode State Refresh, on page 343
- PIM Dense Mode State Refresh Overview, on page 342

Processing and Forwarding PIM Dense Mode State Refresh Control Messages Example

The following example is for a PIM router that is just processing and forwarding PIM Dense Mode State Refresh control messages on Fast Ethernet interface 1/1/0:

```
ip multicast-routing
interface FastEthernet1/1/0
  ip address 172.16.7.3 255.255.255.0
  ip pim dense-mode
```

Related Topics
- Configuring PIM Dense Mode State Refresh, on page 343
- PIM Dense Mode State Refresh Overview, on page 342

Additional References

Related Documents

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<th>Related Topic</th>
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<td>The PIM Dense Mode State Refresh feature is an extension of the PIM Version 2 multicast routing architecture</td>
<td>“Configuring Basic IP Multicast” module</td>
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### Standards

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<td><a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a></td>
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Feature History and Information for PIM Dense Mode State Refresh

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IP Multicast Optimization: IGMP State Limit

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- Prerequisites for IGMP State Limit, page 349
- Restrictions for IGMP State Limit, page 350
- Information About IGMP State Limit, page 350
- How to Configure IGMP State Limit, page 351
- Configuration examples for IGMP State Limit, page 354
- Additional References, page 356
- Feature History and Information for IGMP State Limit, page 357

Finding Feature Information

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Prerequisites for IGMP State Limit

- IP multicast is enabled and the Protocol Independent Multicast (PIM) interfaces are configured using the tasks described in the "Configuring Basic IP Multicast" module of the IP Multicast: PIM Configuration Guide.

- ALL ACLs must be configured. For information, see the see the "Creating an IP Access List and Applying It to an Interface " module of the Security Configuration Guide: Access Control Lists guide.
Restrictions for IGMP State Limit

You can configure only one global limit per device and one limit per interface.

Information About IGMP State Limit

IGMP State Limit

The IGMP State Limit feature allows for the configuration of IGMP state limiters, which impose limits on mroute states resulting from IGMP membership reports (IGMP joins) on a global or per interface basis. Membership reports exceeding the configured limits are not entered into the IGMP cache. This feature can be used to prevent DoS attacks or to provide a multicast CAC mechanism in network environments where all the multicast flows roughly utilize the same amount of bandwidth.

Note

IGMP state limiters impose limits on the number of mroute states resulting from IGMP, IGMP v3lite, and URL Rendezvous Directory (URD) membership reports on a global or per interface basis.

Related Topics

Configuring Global IGMP State Limiters, on page 351
Configuring IGMP State Limiters Example, on page 354

IGMP State Limit Feature Design

• Configuring IGMP state limiters in global configuration mode specifies a global limit on the number of IGMP membership reports that can be cached.

• Configuring IGMP state limiters in interface configuration mode specifies a limit on the number of IGMP membership reports on a per interface basis.

• Use ACLs to prevent groups or channels from being counted against the interface limit. A standard or an extended ACL can be specified. A standard ACL can be used to define the (*, G) state to be excluded from the limit on an interface. An extended ACLs can be used to define the (S, G) state to be excluded from the limit on an interface. An extended ACL also can be used to define the (*, G) state to be excluded from the limit on an interface, by specifying 0.0.0.0 for the source address and source wildcard--referred to as (0, G)--in the permit or deny statements that compose the extended access list.

• You can only configure one global limit per device and one limit per interface.

Mechanics of IGMP State Limiters

The mechanics of IGMP state limiters are as follows:
Each time a router receives an IGMP membership report for a particular group or channel, the Cisco IOS software checks to see if either the limit for the global IGMP state limiter or the limit for the per interface IGMP state limiter has been reached.

If only a global IGMP state limiter has been configured and the limit has not been reached, IGMP membership reports are honored. When the configured limit has been reached, subsequent IGMP membership reports are then ignored (dropped) and a warning message in one of the following formats is generated:

- %IGMP-6-IGMP_GROUP_LIMIT: IGMP limit exceeded for <group (*, group address)> on <interface type number> by host <ip address>
- %IGMP-6-IGMP_CHANNEL_LIMIT: IGMP limit exceeded for <channel (source address, group address)> on <interface type number> by host <ip address>

If only per interface IGMP state limiters are configured, then each limit is only counted against the interface on which it was configured.

If both a global IGMP state limiter and per interface IGMP state limiters are configured, the limits configured for the per interface IGMP state limiters are still enforced but are constrained by the global limit.

How to Configure IGMP State Limit

Configuring IGMP State Limiters

Note

IGMP state limiters impose limits on the number of mroute states resulting from IGMP, IGMP v3-lite, and URD membership reports on a global or per interface basis.

Configuring Global IGMP State Limiters

Perform this optional task to configure one global IGMP state limiter per device.

SUMMARY STEPS

1. enable
2. configure terminal
3. ip igmp limit  number
4. end
5. show ip igmp groups
# DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
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<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>enable</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><strong>Device&gt; enable</strong></td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><strong>Device# configure terminal</strong></td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>ip igmp limit number</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><strong>Device(config)# ip igmp limit 150</strong></td>
</tr>
<tr>
<td></td>
<td>Configures a global limit on the number of mroute states resulting</td>
</tr>
<tr>
<td></td>
<td>from IGMP membership reports (IGMP joins).</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>end</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><strong>Device(config-if)# end</strong></td>
</tr>
<tr>
<td></td>
<td>Ends the current configuration session and returns to privileged</td>
</tr>
<tr>
<td></td>
<td>EXEC mode.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>show ip igmp groups</strong></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><strong>Device# show ip igmp groups</strong></td>
</tr>
<tr>
<td></td>
<td>(Optional) Displays the multicast groups with receivers that are</td>
</tr>
<tr>
<td></td>
<td>directly connected to the device and that were learned through IGMP.</td>
</tr>
</tbody>
</table>

**Related Topics**
- IGMP State Limit, on page 350
- Configuring IGMP State Limiters Example, on page 354

## Configuring Per Interface IGMP State Limiters

Perform this optional task to configure a per interface IGMP state limiter.
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `interface type number`
4. `ip igmp limit number [except access-list]`
5. Do one of the following:
   - `exit`
   - `end`
6. `show ip igmp interface [type number]`
7. `show ip igmp groups`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
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<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><code>enable</code>&lt;br&gt;Enables privileged EXEC mode.&lt;br&gt;<strong>Example:</strong>&lt;br&gt;<code>Device&gt; enable</code>&lt;br&gt;• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><code>configure terminal</code>&lt;br&gt;Enters global configuration mode.&lt;br&gt;<strong>Example:</strong>&lt;br&gt;<code>Device# configure terminal</code></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><code>interface type number</code>&lt;br&gt;Enters interface configuration mode.&lt;br&gt;<strong>Example:</strong>&lt;br&gt;<code>Device(config)# interface GigabitEthernet0/0</code>&lt;br&gt;• Specify an interface that is connected to hosts.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><code>ip igmp limit number [except access-list]</code>&lt;br&gt;Configures a per interface limit on the number of mroutes states created as a result of IGMP membership reports (IGMP joins).&lt;br&gt;<strong>Example:</strong>&lt;br&gt;<code>Device(config-if)# ip igmp limit 100</code></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Do one of the following:&lt;br&gt;• <code>exit</code>&lt;br&gt;• <code>end</code>&lt;br&gt;• (Optional) Ends the current configuration session and returns to global configuration mode. Repeat steps 3 and 4 to configure a per interface limiter on another interface.&lt;br&gt;• Ends the current configuration session and returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>
### Step 6
**show ip igmp interface** `[type number]`

**Example:**
```
Device# show ip igmp interface
```

(Optional) Displays information about the status and configuration of IGMP and multicast routing on interfaces.

### Step 7
**show ip igmp groups**

**Example:**
```
Device# show ip igmp groups
```

(Optional) Displays the multicast groups with receivers that are directly connected to the device and that were learned through IGMP.

---

### Configuration examples for IGMP State Limit

#### Configuring IGMP State Limiters Example

The following example shows how to configure IGMP state limiters to provide multicast CAC in a network environment where all the multicast flows roughly utilize the same amount of bandwidth.

This example uses the topology illustrated in the figure.
Although the following illustration and example uses routers in the configuration, any device (router or switch) can be used.

**Figure 20: IGMP State Limit Example Topology**

In this example, a service provider is offering 300 Standard Definition (SD) TV channels. Each SD channel utilizes approximately 4 Mbps.

The service provider must provision the Gigabit Ethernet interfaces on the PE router connected to the Digital Subscriber Line Access Multiplexers (DSLAMs) as follows: 50% of the link’s bandwidth (500 Mbps) must be available to subscribers of the Internet, voice, and video on demand (VoD) service offerings while the remaining 50% (500 Mbps) of the link’s bandwidth must be available to subscribers of the SD channel offerings.

Because each SD channel utilizes the same amount of bandwidth (4 Mbps), per interface IGMP state limiters can be used to provide the necessary CAC to provision the services being offered by the service provider. To determine the required CAC needed per interface, the total number of channels is divided by 4 (because each channel utilizes 4 Mbps of bandwidth). The required CAC needed per interface, therefore, is as follows:

\[
\frac{500\text{Mbps}}{4\text{Mbps}} = 125 \text{ mroutes}
\]

Once the required CAC is determined, the service provider uses the results to configure the per IGMP state limiters required to provision the Gigabit Ethernet interfaces on the PE router. Based on the network's CAC requirements, the service provider must limit the SD channels that can be transmitted out a Gigabit Ethernet interface (at any given time) to 125. Configuring a per interface IGMP state limit of 125 for the SD channels provisions the interface for 500 Mbps of bandwidth, the 50% of the link's bandwidth that must always be available (but never exceeded) for the SD channel offerings.
The following configuration shows how the service provider uses a per interface mroute state limiter to provision interface Gigabit Ethernet 0/0/0 for the SD channels and Internet, Voice, and VoD services being offered to subscribers:

```
interface GigabitEthernet0/0/0
description --- Interface towards the DSLAM ---

ip igmp limit 125
```

**Related Topics**

- Configuring Global IGMP State Limiters, on page 351
- IGMP State Limit, on page 350

## Additional References

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### MIBs

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<tr>
<td>No new or modified MIBs are supported by this feature, and support for existing standards has not been modified by this feature.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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### Technical Assistance

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<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
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