Configuring Basic IP Multicast Routing

Prerequisites for Basic IP Multicast Routing

The following are the prerequisites for configuring basic IP multicast routing:

- You must configure the PIM version and the PIM mode in order to perform IP multicast routing. The switch populates its multicast routing table and forwards multicast packets it receives from its directly connected LANs according to the mode setting. You can configure an interface to be in the PIM dense mode, sparse mode, or sparse-dense mode.
- Enabling PIM on an interface also enables IGMP operation on that interface. (To participate in IP multicasting, the multicast hosts, routers, and multilayer device must have IGMP operating.)

  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.

Restrictions for Basic IP Multicast Routing

The following are the restrictions for IP multicast routing:

- Packets that have a multicast destination IP address and unicast MAC address are dropped.
- For some multicast groups, when more than 8K mroutes are installed in a system, the network may experience higher traffic losses upon switchover of the HA system. This is due to flushing the old multicast forwarding entries before the new entries are updated. As the number of routes increase, more time is required for the entries to be updated in the MFIB. To reduce the traffic loss in this scenario, you should

increase the multicast route-flush timer (using the **ip multicast redundancy routeflush maxtime** command) to a value exceeding the default (30 seconds).

Information About Basic 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 forward incoming IP multicast packets out all interfaces that lead to members of the multicast group. Any host, regardless of whether it is a member of a group, can send to a group. However, only the members of a group receive the message.

Multicast Forwarding Information Base Overview

The 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.

Default IP Multicast Routing Configuration

This table displays the default IP multicast routing configuration.

Table 1: Default IP Multicast Routing Configuration

Feature	Default Setting
Multicast routing	Disabled on all interfaces.
PIM version	Version 2.
PIM mode	No mode is defined.
PIM stub routing	None configured.

Feature	Default Setting
PIM RP address	None configured.
PIM domain border	Disabled.
PIM multicast boundary	None.
Candidate BSRs	Disabled.
Candidate RPs	Disabled.
Shortest-path tree threshold rate	0 kb/s.
PIM router query message interval	30 seconds.

How to Configure Basic IP Multicast Routing

This section provides information about configuring basic IP multicast routing.

Configuring Basic IP Multicast Routing

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

This procedure is required.

Before you begin

You must configure the PIM version and the PIM mode. The switch populates its multicast routing table and forwards multicast packets it receives from its directly connected LANs according to the mode setting.

In populating the multicast routing table, dense-mode interfaces are always added to the table. Sparse-mode interfaces are added to the table only when periodic join messages are received from downstream devices or when there is a directly connected member on the interface. When forwarding from a LAN, sparse-mode operation occurs if there is an RP known for the group. If so, the packets are encapsulated and sent toward the RP. When no RP is known, the packet is flooded in a dense-mode fashion. The multicast source address must be on the directly connected incoming interface (that is part of the same subnet) of the first-hop router for both PIM dense mode and PIM any-source multicast mode. 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.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `> enable`	Enables privileged EXEC mode. Enter your password, if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** `(config)# interface gigabitethernet 1/0/1`	Specifies the Layer 3 interface on which you want to enable multicast routing, and enters interface configuration mode. The specified interface must be one of the following: • A routed port—A physical port that has been configured as a Layer 3 port by entering the **no switchport** interface configuration command. 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. • 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. These interfaces must have IP addresses assigned to them.
Step 4	**ip pim** {**dense-mode** | **sparse-mode** | **sparse-dense-mode**} **Example:** `(config-if)# ip pim sparse-dense-mode`	Enables a PIM mode on the interface. By default, no mode is configured. The keywords have these meanings: • **dense-mode**—Enables dense mode of operation. • **sparse-mode**—Enables sparse mode of operation. If you configure sparse mode, you must also configure an RP. • **sparse-dense-mode**—Causes the interface to be treated in the mode in which the group belongs. Sparse-dense mode is the recommended setting.

	Command or Action	Purpose
		Note To disable PIM on an interface, use the **no ip pim** interface configuration command.
Step 5	**end** **Example:** `(config-if)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring IP Multicast Forwarding

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.

Note 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.

Procedure

	Command or Action	Purpose
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.

	Command or Action	Purpose
Step 3	**ip mfib** **Example:** `Device(config)# ip mfib`	Enables IP multicast forwarding.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring a Static Multicast Route (mroute)

- 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.

Procedure

	Command or Action	Purpose
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 mroute** [**vrf** *vrf-name*] *source-address mask* { **fallback-lookup** {**global** | **vrf** *vrf-name* }[*protocol*] {*rpf-address* | *interface-type interface-number*}} [**distance**] **Example:** `Device(config)# ip mroute 10.1.1.1 255.255.255.255 10.2.2.2`	The source IP address 10.1.1.1 is configured to be reachable through the interface associated with IP address 10.2.2.2.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	(Optional) Verifies your entries.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Optional IP Multicast Routing Features

This section provides information about configuringg optional IP multicast routing features.

Defining the IP Multicast Boundary

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

This procedure is optional.

Procedure

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

Step 3	**access-list** *access-list-number* **deny** *source* [*source-wildcard*]
	Example:
	`Device(config)#`
	`access-list 12 deny 224.0.1.39`
	`access-list 12 deny 224.0.1.40`
		Creates a standard access list, repeating the command as many times as necessary.
		• For *access-list-number*, the range is 1 to 99.
		• The **deny** keyword denies access if the conditions are matched.
		• For *source*, enter multicast addresses 224.0.1.39 and 224.0.1.40, which carry Auto-RP information.
		• (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore.
		The access list is always terminated by an implicit deny statement for everything.

Step 4	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 1/0/1`	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. • An SVI—A VLAN interface created by using the **interface vlan** *vlan-id* global configuration command. These interfaces must have IP addresses assigned to them.
Step 5	**ip multicast boundary** *access-list-number* **Example:** `Device(config-if)# ip multicast boundary 12`	Configures the boundary, specifying the access list you created in Step 2.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 7	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 8	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring sdr Listener Support

This section provides information about configuring sdr listener support.

Enabling sdr Listener Support

By default, the device does not listen to session directory advertisements. This procedure is optional.

Procedure

	Command or Action	Purpose
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	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be enabled for sdr, 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.

	Command or Action	Purpose
		• 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. These interfaces must have IP addresses assigned to them.
Step 4	**ip sap listen** **Example:** `Device(config-if)# ip sap listen`	Enables the device software to listen to session directory announcements.
Step 5	**end** **Example:** `Device(config-if)# 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.

Limiting How Long an sdr Cache Entry Exists

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

This procedure is optional.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sap cache-timeout** *minutes* **Example:** `Device(config)# ip sap cache-timeout 30`	Limits how long a Session Announcement Protocol (SAP) cache entry stays active in the cache. By default, entries are never deleted from the cache. For *minutes*, the range is 1 to 1440 minutes (24 hours).
Step 4	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 6	**show ip sap** **Example:** `Device# show ip sap`	Displays the SAP cache.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Monitoring and Maintaining Basic 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 2: Commands for Clearing Caches, Tables, and Databases

Command	Purpose
clear ip igmp group {**group** [*hostname* | *IP address*] | **vrf** *name* **group** [*hostname* | *IP address*] }	Deletes entries from the IGMP cache.
clear ip mroute { ***** | [*hostname* | *IP address*] | **vrf** *name* **group** [*hostname* | *IP address*] }	Deletes entries from the IP multicast routing table.
clear ip sap [*group-address* | **"***session-name***"**]	Deletes the Session Directory Protocol Version 2 cache or an sdr cache entry.

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 3: Commands for Displaying System and Network Statistics

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

Command	Purpose
show ip pim rp [*group-name* | *group-address*]	Displays the RP routers associated with a sparse-mode multicast group. This command is available in all software images.
show ip rpf {*source-address* | *name*}	Displays how the 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.

Configuration Examples for Basic IP Multicast Routing

This section provides configuration examples for Basic IP Multicast Routing.

Example: Configuring an IP Multicast Boundary

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

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

Example: Responding to mrinfo Requests

The software answers mrinfo requests sent by mrouted systems and Cisco routers and multilayer . 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 itself, as in this example:

```
# mrinfo
  171.69.214.27 (mm1-7kd.cisco.com) [version cisco 11.1] [flags: PMS]:
  171.69.214.27 -> 171.69.214.26 (mm1-r7kb.cisco.com) [1/0/pim/querier]
  171.69.214.27 -> 171.69.214.25 (mm1-45a.cisco.com) [1/0/pim/querier]
  171.69.214.33 -> 171.69.214.34 (mm1-45c.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 (mm1-45e.cisco.com) [1/0/pim]
  171.69.214.18 -> 171.69.214.19 (mm1-45c.cisco.com) [1/0/pim]
  171.69.214.18 -> 171.69.214.17 (mm1-45a.cisco.com) [1/0/pim]
```

Additional References for Basic IP Multicast Routing

Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	See the IP Multicast Routing Commands section of the*Command Reference (Catalyst 9400 Series Switches)*

Feature History and Information for Basic IP Multicast Routing

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 4: Feature Information for Basic IP Multicast Routing

Feature Name	Release	Modification
Basic IP Multicast Routing	Cisco IOS XE Everest 16.6.1	This feature was introduced.