



Configuring IPv4 Multicast Layer 3 Switching

This chapter describes how to configure IPv4 multicast Layer 3 switching on the Cisco 7600 series routers.



Note

For complete syntax and usage information for the commands used in this chapter, refer to these publications:

- The Cisco 7600 Series Routers Command References at this URL:
http://www.cisco.com/en/US/products/hw/routers/ps368/prod_command_reference_list.html
- The Release 12.2 publications at this URL:
<http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm>

This chapter consists of these sections:

- [Understanding How IPv4 Multicast Layer 3 Switching Works](#), page 31-1
- [Understanding How IPv4 Bidirectional PIM Works](#), page 31-6
- [Default IPv4 Multicast Layer 3 Switching Configuration](#), page 31-7
- [IPv4 Multicast Layer 3 Switching Configuration Guidelines and Restrictions](#), page 31-7
- [Configuring IPv4 Multicast Layer 3 Switching](#), page 31-9
- [Configuring IPv4 Bidirectional PIM](#), page 31-22

Understanding How IPv4 Multicast Layer 3 Switching Works

These sections describe how IPv4 multicast Layer 3 switching works:

- [IPv4 Multicast Layer 3 Switching Overview](#), page 31-2
- [Multicast Layer 3 Switching Cache](#), page 31-2
- [Layer 3-Switched Multicast Packet Rewrite](#), page 31-3
- [Partially and Completely Switched Flows](#), page 31-3
- [Non-RPF Traffic Processing](#), page 31-5
- [Understanding How IPv4 Bidirectional PIM Works](#), page 31-6

IPv4 Multicast Layer 3 Switching Overview

The Policy Feature Card (PFC) provides Layer 3 switching for IP multicast flows using the hardware replication table and hardware Cisco Express Forwarding (CEF), which uses the forwarding information base (FIB) and the adjacency table on the PFC. In systems with Distributed Forwarding Cards (DFCs), IP multicast flows are Layer 3 switched locally using Multicast Distributed Hardware Switching (MDHS). MDHS uses local hardware CEF and replication tables on each DFC to perform Layer 3 switching and rate limiting of reverse path forwarding (RPF) failures locally on each DFC-equipped switching module.

The PFC and the DFCs support hardware switching of (*,G) state flows. The PFC and the DFCs support rate limiting of non-RPF traffic.

Also termed as hardware switching, Multicast Layer 3 switching forwards IP multicast data packet flows between IP subnets using advanced application-specific integrated circuit (ASIC) switching hardware, which offloads processor-intensive multicast forwarding and replication from network routers.

Layer 3 flows that cannot be hardware switched are still forwarded in the software by routers. Protocol Independent Multicast (PIM) is used for route determination and mcast rate-limiters limit the traffic relayed to the route processor.

The PFC and the DFCs all use the Layer 2 multicast forwarding table to determine on which ports Layer 2 multicast traffic should be forwarded (if any). The multicast forwarding table entries are populated in conjunction with Internet Group Management Protocol (IGMP) snooping (see [Chapter 33, “Configuring IGMP Snooping for IPv4 Multicast Traffic”](#)).

Current implementation of IPV4 multicast in 7600 uses the platform specific distribution mechanism from Route Processor (RP) to Switch Processor (SP). With the introduction of MFIB, MFIB provides support for distribution of the information in a platform independent way to the Switch Processor (SP) and Line cards (LC's). In 12.2(33)SRE, this feature is supported on SUP720, Sup32, RSP720 and compatible DFCs.

For more information on the MDSS (Multicast Distributed Switching Services) implementation used prior to MFIB implementation, see:

http://www.cisco.com/en/US/docs/ios/12_1/switch/configuration/guide/xcdmhc.html

Multicast Layer 3 Switching Cache

This section describes how the PFC and the DFCs maintain Layer 3 switching information in hardware tables.

The PFC and DFC populate the (S,G) or (*,G) flows in the hardware FIB table with the appropriate masks; for example, (S/32, G/32) and (*/0, G/32). The RPF interface and the adjacency pointer information is also stored in each entry. The adjacency table contains the rewrite information and pointers to the multicast expansion table (MET) table. If a flow matches a FIB entry, the RPF check compares the incoming interface/VLAN with the entry. A mismatch is an RPF failure, which can be rate limited if this feature is enabled.

The MSFC updates its multicast routing table and forwards the new information to the PFC whenever it receives traffic for a new flow. In addition, if an entry in the multicast routing table on the MSFC ages out, the MSFC deletes the entry and forwards the updated information to the PFC. In systems with DFCs, flows are populated symmetrically on all DFCs and on the PFC.

The Layer 3 switching cache contains flow information for all active Layer 3-switched flows. After the switching cache is populated, multicast packets identified as belonging to an existing flow can be Layer 3 switched based on the cache entry for that flow. For each cache entry, the PFC maintains a list of outgoing interfaces for the IP multicast group. From this list, the PFC determines onto which VLANs traffic from a given multicast flow should be replicated.

These commands affect the Layer 3 switching cache entries:

- When you clear the multicast routing table using the **clear ip mroute** command, all multicast Layer 3 switching cache entries are cleared.
- When you disable IP multicast routing on the MSFC using the **no ip multicast-routing** command, all multicast Layer 3 switching cache entries on the PFC are purged.

Layer 3-Switched Multicast Packet Rewrite

When a multicast packet is Layer 3 switched from a multicast source to a destination multicast group, the PFC and the DFCs perform a packet rewrite that is based on information learned from the MSFC and stored in the adjacency table.

For example, Server A sends a multicast packet addressed to IP multicast group G1. If there are members of group G1 on VLANs other than the source VLAN, the PFC must perform a packet rewrite when it replicates the traffic to the other VLANs (the router also bridges the packet in the source VLAN).

When the PFC receives the multicast packet, it is (conceptually) formatted as follows:

Layer 2 Frame Header		Layer 3 IP Header				Data	FC S
Destination	Source	Destination	Source	TTL	Checksum		
<i>Group G1 MAC¹</i>	<i>Source A MAC</i>	<i>Group G1 IP</i>	<i>Source A IP</i>	<i>n</i>	<i>calculation1</i>		

1. In this example, Destination B is a member of Group G1.

The PFC rewrites the packet as follows:

- Changes the source MAC address in the Layer 2 frame header from the MAC address of the host to the MAC address of the MSFC (This is the burned-in MAC address of the system. This MAC address will be the same for all outgoing interfaces and cannot be modified.)
- Decrements the IP header Time to Live (TTL) by one and recalculates the IP header checksum

The result is a rewritten IP multicast packet that appears to have been routed. The PFC replicates the rewritten packet onto the appropriate destination VLANs, where it is forwarded to members of IP multicast group G1.

After the PFC performs the packet rewrite, the packet is (conceptually) formatted as follows:

Frame Header		IP Header				Data	FC S
Destination	Source	Destination	Source	TTL	Checksum		
<i>Group G1 MAC</i>	<i>MSFC MAC</i>	<i>Group G1 IP</i>	<i>Source A IP</i>	<i>n-1</i>	<i>calculation2</i>		

Partially and Completely Switched Flows

When at least one outgoing Layer 3 interface for a given flow is hardware switched and at least one outgoing interface is not hardware switched, that flow is considered partially switched. When a partially switched flow is created, all multicast traffic belonging to that flow still reaches the MSFC and is forwarded by software on those outgoing interfaces that are not hardware switched.

These sections describe partially and completely switched flow:

- [Partially Switched Flows, page 31-4](#)
- [Completely Switched Flows, page 31-4](#)

Partially Switched Flows

A flow might be partially switched instead of completely switched in these situations:

- If the router is configured as a member of the IP multicast group on the RPF interface of the multicast source (using the **ip igmp join-group** command).
- During the registering state, if the router is the first-hop router to the source in PIM sparse mode (in this case, the router must send PIM-register messages to the rendezvous point [RP]).
- If the multicast TTL threshold is configured on an outgoing interface for the flow (using the **ip multicast ttl-threshold** command).
- If the multicast helper is configured on the RPF interface for the flow, and multicast to broadcast translation is required.
- If the outgoing interface is a Distance Vector Multicast Routing Protocol (DVMRP) tunnel interface.
- If Network Address Translation (NAT) is configured on an interface and source address translation is required for the outgoing interface.
- Flows are partially switched if any of the outgoing interfaces for a given flow are not Layer 3 switched.

(S,G) flows are partially switched instead of completely switched in these situations:

- (S,G) flows are partially switched if the (S,G) entry has the RPT-bit (R bit) set.
- (S,G) flows are partially switched if the (S,G) entry does not have the SPT bit (T flag) set and the Prune bit (P flag) set.

(*G) flows are partially switched instead of completely switched in these situations:

- (*G) flows are partially switched on the last-hop leaf router if the shared-tree to shortest-path-tree (SPT) threshold is not equal to infinity. This allows the flow to transition from the SPT.
- (*G) flows are partially switched if at least one (S,G) entry has the same RPF as a (*,g) entry but any of these is true:
 - The RPT flag (R bit) is not set.
 - The SPT flag (T bit) is not set.
 - The Prune-flag (P bit) is not set.
- (*G) flows are partially switched if a DVMRP neighbor is detected on the input interface of a (*,G) entry.
- (*G) flows are partially switched if the interface and mask entry is not installed for the RPF-interface of a (*,G) entry and the RPF interface is not a point-to-point interface.

Completely Switched Flows

When all the outgoing interfaces for a given flow are Layer 3 switched, and none of the above situations apply to the flow, that flow is considered completely switched. When a completely switched flow is created, the PFC prevents multicast traffic bridged on the source VLAN for that flow from reaching the MSFC interface in that VLAN, freeing the MSFC of the forwarding and replication load for that flow.

One consequence of a completely switched flow is that multicast statistics on a per-packet basis for that flow cannot be recorded. Therefore, the PFC periodically sends multicast packet and byte count statistics for all completely switched flows to the MSFC. The MSFC updates the corresponding multicast routing table entry and resets the expiration timer for that multicast route.



Note

A (*,G) state is created on the PIM-RP or for PIM-dense mode but is not used for forwarding the flows, and Layer 3 switching entries are not created for these flows.

Non-RPF Traffic Processing

These sections describe non-RPF traffic processing:

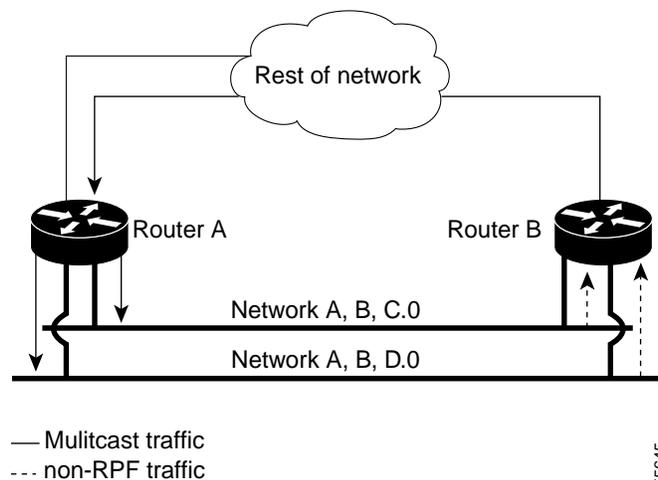
- [Non-RPF Traffic Overview, page 31-5](#)
- [Filtering of RPF Failures for Stub Networks, page 31-6](#)
- [Rate Limiting of RPF Failure Traffic, page 31-6](#)

Non-RPF Traffic Overview

In a redundant configuration where multiple routers connect to the same LAN segment, only one router forwards the multicast traffic from the source to the receivers on the outgoing interfaces (see [Figure 31-1](#)). In this kind of topology, only the PIM designated router (PIM DR) forwards the data in the common VLAN, but the non-PIM DR receives the forwarded multicast traffic. The redundant router (non-PIM DR) must drop this traffic because it has arrived on the wrong interface and fails the RPF check. Traffic that fails the RPF check is called non-RPF traffic.

The Cisco 7600 series router processes non-RPF traffic in hardware on the PFC by filtering (dropping) or rate limiting the non-RPF traffic.

Figure 31-1 Redundant Multicast Router Configuration in a Stub Network



Filtering of RPF Failures for Stub Networks

The PFC and the DFCs support ACL-based filtering of RPF failures for sparse mode stub networks. When you enable the ACL-based method of filtering RPF failures by entering the **mls ip multicast stub** command on the redundant router, the following ACLs automatically download to the PFC and are applied to the interface you specify:

```
access-list 100 permit ip A.B.C.0 0.0.0.255 any
access-list 100 permit ip A.B.D.0 0.0.0.255 any
access-list 100 permit ip any 224.0.0.0 0.0.0.255
access-list 100 permit ip any 224.0.1.0 0.0.0.255
access-list 100 deny ip any 224.0.0.0 15.255.255.255
```

The ACLs filter RPF failures and drop them in hardware so that they are not forwarded to the router.

Use the ACL-based method of filtering RPF failures only in sparse mode stub networks where there are no downstream routers. For dense mode groups, RPF failure packets have to be seen on the router for the PIM assert mechanism to function properly. Use CEF-based or NetFlow-based rate limiting to limit the rate of RPF failures in dense mode networks and sparse mode transit networks.

For information on configuring ACL-based filtering of RPF failures, see the [“Configuring ACL-Based Filtering of RPF Failures”](#) section on page 31-15.

Rate Limiting of RPF Failure Traffic

When you enable rate limiting of packets that fail the RPF check (non-RPF packets), most non-RPF packets are dropped in hardware. According to the multicast protocol specification, the router needs to receive the non-RPF packets for the PIM assert mechanism to function properly, so all non-RPF packets cannot be dropped in hardware.

When a non-RPF packet is received, a NetFlow entry is created for each non-RPF flow.

When the first non-RPF packet arrives, the PFC bridges the packet to the MSFC and to any bridged ports and creates a NetFlow entry that contains source, group, and ingress interface information, after which the NetFlow entry handles all packets for that source and group, sending packets only to bridged ports and not to the MSFC.

To support the PIM assert mechanism, the PFC periodically forwards a percentage of the non-RPF flow packets to the MSFC.

The first packets for directly connected sources in PIM sparse mode are also rate-limited and are processed by the CPU.

Rate limiting of RPF failures is enabled by default.

Understanding How IPv4 Bidirectional PIM Works

The PFC3 supports hardware forwarding of IPv4 bidirectional PIM groups. To support IPv4 bidirectional PIM groups, the PFC3 implements a new mode called designated forwarder (DF) mode. The designated forwarder is the router elected to forward packets to and from a segment for a IPv4 bidirectional PIM group. In DF mode, the supervisor engine accepts packets from the RPF and from the DF interfaces.

When the supervisor engine is forwarding IPv4 bidirectional PIM groups, the RPF interface is always included in the outgoing interface list of (*,G) entry, and the DF interfaces are included depending on IGMP/PIM joins.

If the route to the RP becomes unavailable, the group is changed to dense mode. Should the RPF link to the RP become unavailable, the IPv4 bidirectional PIM flow is removed from the hardware FIB.

For information on configuring IPv4 bidirectional PIM, see the [“Configuring IPv4 Bidirectional PIM” section on page 31-22](#).

Default IPv4 Multicast Layer 3 Switching Configuration

[Table 31-1](#) shows the default IP multicast Layer 3 switching configuration.

Table 31-1 Default IP Multicast Layer 3 Switching Configuration

Feature	Default Value
ACL for stub networks	Disabled on all interfaces
Installing of directly connected subnet entries	Enabled globally
Multicast routing	Disabled globally
PIM routing	Disabled on all interfaces
IP multicast Layer 3 switching	Enabled when multicast routing is enabled and PIM is enabled on the interface

Internet Group Management Protocol (IGMP) snooping is enabled by default on all VLAN interfaces. If you disable IGMP snooping on an interface, multicast Layer 3 flows are still switched by the hardware. Bridging of the flow on an interface with IGMP snooping disabled causes flooding to all forwarding interfaces of the VLAN. For details on configuring IGMP snooping, see [Chapter 33, “Configuring IGMP Snooping for IPv4 Multicast Traffic.”](#)

IPv4 Multicast Layer 3 Switching Configuration Guidelines and Restrictions

These sections describe IP Multicast Layer 3 switching configuration restrictions:

- [Restrictions, page 31-7](#)
- [Unsupported Features, page 31-8](#)

Restrictions

IP multicast Layer 3 switching is not provided for an IP multicast flow in the following situations:

- For IP multicast groups that fall into the range 224.0.0.* (where * is in the range 0 to 255), which is used by routing protocols. Layer 3 switching is supported for groups 225.0.0.* through 239.0.0.* and 224.128.0.* through 239.128.0.*.



Note Groups in the 224.0.0.* range are reserved for routing control packets and must be flooded to all forwarding ports of the VLAN. These addresses map to the multicast MAC address range 01-00-5E-00-00-xx, where xx is in the range 0–0xFF.

- For PIM auto-RP multicast groups (IP multicast group addresses 224.0.1.39 and 224.0.1.40).
- For packets with IP options. However, packets in the flow that do not specify IP options are hardware switched.
- For source traffic received on tunnel interfaces (such as MBONE traffic).
- If a (S,G) entry for sparse mode does not have the SPT-bit, RPT-bit, or Pruned flag set.
- A (*,G) entry is not hardware switched if at least one (S,G) entry has an RPF different from the (*,G) entry's RPF and the (S,G) is not hardware switched.
- If the ingress interface of a (S,G) or (*,G) entry is null, except if the (*,G) entry is a IPv4 bidirectional PIM entry and the router is the RP for the group.
- For IPv4 bidirectional PIM entries when a DF interface or RPF interface is a tunnel.
- Supervisor Engine 32 does not support egress multicast replication and cannot detect the multicast replication mode.
- In a MFIB implementation, **ip multicast rate-limit** command that limits the number of data packets in either direction is not supported in hardware configurations.
- In a MFIB implementation, **ip multicast ttl-threshold command** is not supported in hardware configurations.
- In a MFIB implementation, Network Address Translation (NAT) is not supported in hardware configurations.
- Following MDSS commands are invalid after MFIB IPv4 implementation:
 - **debug mdss [vrf <vrf-name>] [all | error | events | mdt | p2p | packet]**
 - **mls ip multicast [vrf <name>] connected {config command - global and interface-level}**
 - **mls ip multicast consistency-check {config command - global and interface-level}**
 - **show mls ip multicast consistency-check**
 - **show mls ip multicast rp-mapping**
- Following commands are deprecated post MFIB implementation:
 - **mls ip multicast non-rpf aging fast**
 - **mls ip multicast non-rpf aging global**
 - **ip multicast replication-mode egress**
 - **mls ip multicast replication-mode ingress**
 - **mls ip multicast flow-stat timer**

Unsupported Features

If you enable IP multicast Layer 3 switching, IP accounting for Layer 3 interfaces does not report accurate values. The **show ip accounting** command is not supported.

Multicast streaming is not supported across DMVPN on Cat6500 and 7600. Only multicast packets from the local control plane such as routing protocols are supported.

Configuring IPv4 Multicast Layer 3 Switching

These sections describe how to configure IP multicast Layer 3 switching:

- [Source-Specific Multicast with IGMPv3, IGMP v3lite, and URD, page 31-9](#)
- [Enabling IPv4 Multicast Routing Globally, page 31-9](#)
- [Enabling IPv4 PIM on Layer 3 Interfaces, page 31-10](#)
- [Enabling IP Multicast Layer 3 Switching on Layer 3 Interfaces, page 31-11](#)
- [Configuring the Replication Mode, page 31-11](#)
- [Enabling Local Egress Replication, page 31-13](#)
- [Configuring the Layer 3 Switching Global Threshold, page 31-14](#)
- [Enabling Installation of Directly Connected Subnets, page 31-15](#)
- [Specifying the Flow Statistics Message Interval, page 31-15](#)
- [Configuring IPv4 Bidirectional PIM, page 31-22](#)
- [Setting the IPv4 Bidirectional PIM Scan Interval, page 31-23](#)
- [Configuring ACL-Based Filtering of RPF Failures, page 31-15](#)
- [Validating the Rate-Limiter Status, page 31-16](#)
- [Displaying IPv4 Multicast Layer 3 Hardware Switching Summary, page 31-17](#)
- [Displaying the IPv4 Multicast Routing Table, page 31-20](#)
- [Displaying IPv4 Multicast Layer 3 Switching Statistics, page 31-21](#)
- [Displaying IPv4 Bidirectional PIM Information, page 31-24](#)
- [Using IPv4 Debug Commands, page 31-25](#)

**Note**

When you are in configuration mode you can enter EXEC mode commands by entering the **do** keyword before the EXEC mode command.

Source-Specific Multicast with IGMPv3, IGMP v3lite, and URD

For complete information and procedures about source-specific multicast with IGMPv3, IGMP v3lite, and URL Rendezvous Directory (URD), refer to this URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/fipr_c/ipept3/1cfssm.htm

Enabling IPv4 Multicast Routing Globally

You must enable IP multicast routing globally before you can enable IP multicast Layer 3 switching on Layer 3 interfaces.

For complete information and procedures, refer to these publications:

- *Cisco IOS IP and IP Routing Configuration Guide*, Release 12.2, at this URL:
http://www.cisco.com/en/US/docs/ios/12_2/iproute/command/reference/fiprrp_r.html
- *Cisco IOS IP and IP Routing Command Reference*, Release 12.1, at this URL:

http://www.cisco.com/en/US/docs/ios/12_1/iproute/command/reference/ip_r.html

To enable IP multicast routing globally, perform this task:

Command	Purpose
Router(config)# ip multicast-routing	Enables IP multicast routing globally.
Router(config)# no ip multicast-routing	Disables IP multicast routing globally.

This example shows how to enable multicast routing globally:

```
Router(config)# ip multicast-routing
Router(config)#
```

Enabling IPv4 PIM on Layer 3 Interfaces

You must enable PIM on the Layer 3 interfaces before IP multicast Layer 3 switching functions on those interfaces.

To enable IP PIM on a Layer 3 interface, perform this task:

	Command	Purpose
Step 1	Router(config)# interface {{vlan vlan_ID} {type ¹ slot/port}}	Selects an interface to configure.
Step 2	Router(config-if)# ip pim {dense-mode sparse-mode sparse-dense-mode}	Enables IP PIM on a Layer 3 interface.
	Router(config-if)# no ip pim [dense-mode sparse-mode sparse-dense-mode]	Disables IP PIM on a Layer 3 interface.

1. *type* = ethernet, fastethernet, gigabitethernet, or tengigabitethernet

This example shows how to enable PIM on an interface using the default mode (**sparse-dense-mode**):

```
Router(config-if)# ip pim
Router(config-if)#
```

This example shows how to enable PIM sparse mode on an interface:

```
Router(config-if)# ip pim sparse-mode
Router(config-if)#
```

Enabling IP Multicast Layer 3 Switching Globally

To enable hardware switching of multicast routes globally on your system, perform this task:

	Command	Purpose
Step 1	Router(config)# mls ip multicast	Globally enables hardware switching of multicast routes.
Step 2	Router# show platform software multicast ip	Displays brief information about the packet flows in the system.

This example shows how to globally enable hardware switching of multicast routes:

```
Router(config)# mls ip multicast
```

```
Router(config)# show platform software multicast ip
(40.0.0.2, 232.0.1.4) Incoming interface: Lspvif0, Packets Switched: 119954142
Hardware switched outgoing interfaces:
GigabitEthernet3/6
Total hardware switched flows: 1
```

Enabling IP Multicast Layer 3 Switching on Layer 3 Interfaces

IP multicast Layer 3 switching is enabled by default on the Layer 3 interface when you enable PIM on the interface. Perform this task only if you disabled IP multicast Layer 3 switching on the interface and you want to reenabling it.

PIM can be enabled on any Layer 3 interface, including VLAN interfaces.



Note

You must enable PIM on all participating Layer 3 interfaces before IP multicast Layer 3 switching will function. For information on configuring PIM on Layer 3 interfaces, see the [“Enabling IPv4 PIM on Layer 3 Interfaces”](#) section on page 31-10.

To enable IP multicast Layer 3 switching on a Layer 3 interface, perform this task:

	Command	Purpose
Step 1	Router(config)# interface {{vlan vlan_ID} {type ¹ slot/port}}	Selects an interface to configure.
Step 2	Router(config-if)# mls ip multicast	Enables IP multicast Layer 3 switching on a Layer 3 interface.
Step 3	Router(config-if)# no mls ip multicast	Disables IP multicast Layer 3 switching on a Layer 3 interface.

1. *type* = ethernet, fastethernet, gigabitethernet, or tengigabitethernet

This example shows how to enable IP multicast Layer 3 switching on a Layer 3 interface:

```
Router(config-if)# mls ip multicast
Router(config-if)#
```

Configuring the Replication Mode



Note

Supervisor Engine 32 supports only ingress replication mode.

The Supervisor Engine 720 supports the **egress** keyword. Support for the **egress** keyword is called “Multicast Enhancement - Replication Mode Detection” in the release notes and Feature Navigator.

By default, a Supervisor Engine 720 automatically detects the replication mode based on the module types installed in the system. If all modules are capable of egress replication, the system uses egress-replication mode. If the supervisor engine detects modules that are not capable of egress replication, the replication mode automatically changes to ingress replication. You can override this action by entering the ip multicast hardware-switching replication-mode **egress** command so that the

system continues to work in egress-replication mode even if there are fabric-enabled modules installed that do not support egress replication (for example, OSMs). You can also configure the system to operate only in ingress-replication mode.

If the system is functioning in automatic detection mode, and you install a module that cannot perform egress replication, the following occurs:

- The system reverts to ingress mode
- A system log is generated
- A system reload occurs to revert to the old configuration

If the system is functioning in forced egress mode, a system log is created that will display the presence of modules that are not capable of egress replication mode.

**Note**

If you configure forced egress mode in a system that has fabric-enabled modules that are not capable of egress replication, you must make sure that these modules are not sourcing or receiving multicast traffic.

During a change from egress- to ingress-replication mode, traffic interruptions may occur because the shortcuts will be purged and reinstalled. To avoid interruptions in traffic forwarding, enter the `ip multicast hardware-switching replication-mode ingress` command in global configuration mode. This command forces the system to operate in ingress-replication mode.

The `no` form of the `ip multicast hardware-switching replication-mode ingress` command restores the system to automatic detection mode.

To enable IP multicast Layer 3 switching, perform this task:

	Command	Purpose
Step 1	Router(config)# <code>ip multicast hardware-switching replication-mode [egress ingress]</code>	Specifies the replication mode.
Step 2	Router# <code>show platform software multicast ip capability</code>	Displays the configured replication mode.
Step 3	Router# <code>show platform software multicast ip summary</code>	Displays the replication mode and if automatic detection is enabled or disabled.

This example shows how to enable the replication mode:

```
Router (config)# ip multicast hardware-switching replication-mode egress
Router# show platform software multicast ip capability
Current System HW Replication Mode : Egress
Auto-detection of Replication Mode : ON
```

```
Slot Replication-Capability Replication-Mode
  2 Egress                      Egress
  3 Egress                      Egress
  4 Egress                      Egress
  6 Egress                      Egress
Router#
```

```
Router# show platform software multicast ip summary
```

```
IPv6 Multicast Netflow SC summary on Slot[7]:
Shortcut Type          Shortcut count
-----+-----
(S, G)                  0
```

```

IPv6 Multicast FIB SC summary on Slot[7]:
Shortcut Type                Shortcut count
-----+-----
(*, G/128)                   0
(*, G/m)                     0
Router (config)#

```

Enabling Local Egress Replication



Note Supervisor Engine 32 supports only ingress replication mode.

With a Supervisor Engine 720, you can unconditionally enable local egress replication. This feature is called “Multicast enhancement - egress replication performance improvement” in the release notes and Feature Navigator.

DFC-equipped modules with dual switch-fabric connections host two packet replication engines, one per fabric connection. Each replication engine is responsible for forwarding packets to and from the interfaces associated with the switch-fabric connections. The interfaces that are associated with a switch-fabric connection are considered to be “local” from the perspective of the packet replication engine.

You can prevent redundant replication of multicast packets across the switch-fabric connection by entering a command that instructs the two replication engines on these modules to forward packets only to local interfaces which are associated with the switch-fabric connection that the replication engine supports.

When you enable this feature, the multicast expansion table (MET) for each replication engine is populated with the local Layer 3 interfaces only. This action prevents replication for interfaces that are not supported by the replication engine (nonlocal interfaces) and increases replication performance.

Local egress replication is supported with the following software configuration and hardware:

- IPv4 egress replication mode
- Dual fabric-connection DFC-equipped modules
- Layer 3-routed interfaces and subinterfaces that are not part of a port channel

The local egress replication feature is not supported for the following internal VLANs:

- Egress internal VLAN
- Partial-shortcut internal VLAN
- Internal VLAN for Multicast VPN Multicast Distribution Tree (MDT) tunnel
- Point-to-point tunnel internal VLAN
- QoS internal VLAN



Note The local egress replication feature is not supported with IPv6 multicast or in a system that has a mix of IPv4 and IPv6 multicast enabled.

To enable local egress replication, perform this task:

	Command	Purpose
Step 1	Router(config)# mls ip multicast egress local	Enables local egress replication. Note This command requires a system reset for the configuration to take effect.
Step 2	Router # reload	Reloads the system.
Step 3	Router# show platform software multicast ip capability	Displays the configured replication mode.

This example shows how to enable local egress replication:

```
Router (config)# mls ip multicast egress local
Router (config)# exit
Router # reload
Router # show platform software multicast ip capability
Current System HW Replication Mode : Egress
Auto-detection of Replication Mode : ON

Slot Replication-Capability Replication-Mode
 2 Egress Egress
 3 Egress Egress
 4 Egress Egress
 6 Egress Egress
```

Configuring the Layer 3 Switching Global Threshold

You can configure a global multicast rate threshold (specified in packets per second) below which all multicast traffic is routed by the MSFC. This configuration prevents creation of switching cache entries for low-rate Layer 3 flows.



Note

This command does not affect flows that are already being routed. To apply the threshold to existing routes, clear the route and let it reestablish.

To configure the Layer 3 switching threshold, perform this task:

Command	Purpose
Router(config)# mls ip multicast threshold pps	Configures the IP MMLS threshold.
Router(config)# no mls ip multicast threshold	Reverts to the default IP MMLS threshold.

This example shows how to configure the Layer 3 switching threshold to 10 packets per second:

```
Router(config)# mls ip multicast threshold 10
Router(config)#
```

Enabling Installation of Directly Connected Subnets

In PIM sparse mode, a first-hop router that is the designated router for the interface may need to encapsulate the source traffic in a PIM register message and unicast it to the rendezvous point. To prevent new sources for the group from being learned in the routing table, the (*,G) flows should remain as completely hardware-switched flows. When (subnet/mask, 224/4) entries are installed in the hardware, the FIB allows both (*,G) flows to remain completely hardware-switched flows, and new, directly connected sources to be learned correctly. The installation of directly connected subnets is enabled globally by default. One (subnet/mask, 224/4) is installed per PIM-enabled interface.

To view FIB entries, enter the **show platform software multicast ip connected** command.

To enable installation of directly connected subnets, perform this task:

Command	Purpose
Router(config)# mls ip multicast connected	Enables installation of directly connected subnets.
Router(config)# no mls ip multicast connected	Disables installation of directly connected subnets.

This example shows how to enable installation of directly connected subnets:

```
Router(config)# mls ip multicast connected
Router(config)#
```

Specifying the Flow Statistics Message Interval

By default, the supervisor engine forwards flow statistics messages to the MSFC every 25 seconds. The messages are forwarded in batches, and each batch of messages contains statistics for 25 percent of all flows. If you leave the interval at the default of 25 seconds, it will take 100 seconds to forward statistics for all flows to the MSFC.

To specify how often flow statistics messages forwarded from the supervisor engine to the MSFC, perform this task:

Command	Purpose
Router(config)# mls ip multicast flow-stat-timer num	Specifies how the supervisor engine forwards flow statistics messages to the MSFC.
Router(config)# no mls ip multicast flow-stat-timer num	Restores the default.

This example shows how to configure the supervisor engine to forward flow statistics messages to the MSFC every 10 seconds:

```
Router(config)# mls ip multicast flow-stat-timer 10
Router(config)#
```

Configuring ACL-Based Filtering of RPF Failures

When you configure ACL-based filtering of RPF failures, ACLs that filter RPF failures in hardware are downloaded to the hardware-based ACL engine and applied on the interface you specify.

To enable ACL-based filtering of RPF failures on an interface, perform this task:

	Command	Purpose
Step 1	Router(config)# interface {{vlan vlan_ID} {type ¹ slot/port} {port-channel number}}	Selects an interface to configure.
Step 2	Router(config-if)# mls ip multicast stub	Enables ACL-based filtering of RPF failures on an interface.
	Router(config-if)# no mls ip multicast stub	Disables ACL-based filtering of RPF failures on an interface.

1. *type* = ethernet, fastethernet, gigabitethernet, or tengigabitethernet

Validating the Rate-Limiter Status

To validate the rater-limiter status, perform this task:

Command	Purpose
Router# show mls rate-limit i RPF	Displays RPF failure rate-limiting information with the current state of the rate limiter.

This example shows how to display RPF failure rate-limiting information:

```

Router# show mls rate-limit | i RPF
IP RPF FAILURE          100      10
Router-1# sh mls rate-limit usage

```

	Rate Limiter Type	Packets/s	Burst
Layer3 Rate Limiters:			
RL# 0: Free	-	-	-
RL# 1: Free	-	-	-
RL# 2: Free	-	-	-
RL# 3: Free	-	-	-
RL# 4: Free	-	-	-
RL# 5: Used			
	MCAST DFLT ADJ	10	10
RL# 6: Used			
	IP RPF FAILURE	100	10
	ICMP UNREAC. NO-ROUTE	100	10
	ICMP UNREAC. ACL-DROP	100	10
	IP ERRORS	100	10
RL# 7: Used			
	ACL VACL LOG	2000	1
RL# 8: Rsvd for capture	-	-	-
Layer2 Rate Limiters:			
RL# 9: Reserved			
RL#10: Reserved			
RL#11: Free	-	-	-
RL#12: Free	-	-	-

```

Router-1# sh mls rate-limit
Sharing Codes: S - static, D - dynamic
Codes dynamic sharing: H - owner (head) of the group, g - guest of the group

```

Rate Limiter Type	Status	Packets/s	Burst	Sharing
MCAST NON RPF	Off	-	-	-
MCAST DFLT ADJ	On	10	10	Not sharing
MCAST DIRECT CON	Off	-	-	-
ACL BRIDGED IN	Off	-	-	-
ACL BRIDGED OUT	Off	-	-	-
IP FEATURES	Off	-	-	-
ACL VACL LOG	On	2000	1	Not sharing
CEF RECEIVE	Off	-	-	-
CEF GLEAN	Off	-	-	-
MCAST PARTIAL SC	On	100000	100	Not sharing
IP RPF FAILURE	On	100	10	Group:0 S
TTL FAILURE	Off	-	-	-
ICMP UNREAC. NO-ROUTE	On	100	10	Group:0 S
ICMP UNREAC. ACL-DROP	On	100	10	Group:0 S
ICMP REDIRECT	Off	-	-	-
MTU FAILURE	Off	-	-	-
MCAST IP OPTION	Off	-	-	-
UCAST IP OPTION	Off	-	-	-
LAYER_2 PDU	Off	-	-	-
LAYER_2 PT	Off	-	-	-
DHCP Snooping IN	Off	-	-	-
DHCP Snooping OUT	Off	-	-	-
ARP Inspection	Off	-	-	-
LAYER_2 PORTSEC	Off	-	-	-
LAYER_2 MiniProto	Off	-	-	-
IP ERRORS	On	100	10	Group:0 S
CAPTURE PKT	Off	-	-	-
MCAST IGMP	Off	-	-	-
MCAST IPv6 DIRECT CON	Off	-	-	-
MCAST IPv6 ROUTE CNTL	Off	-	-	-
MCAST IPv6 *G M BRIDG	Off	-	-	-
MCAST IPv6 SG BRIDGE	Off	-	-	-
MCAST IPv6 DFLT DROP	Off	-	-	-
MCAST IPv6 SECOND. DR	Off	-	-	-
MCAST IPv6 *G BRIDGE	Off	-	-	-
MCAST IPv6 MLD	Off	-	-	-
IP ADMIS. ON L2 PORT	Off	-	-	-
LAYER_2 MACSEC	Off	-	-	-
MCAST IPv4 PIM	Off	-	-	-

Router-1#

Displaying IPv4 Multicast Layer 3 Hardware Switching Summary



Note

The **show interface statistics** command does not display hardware-switched packets, only packets switched by software.

The **show ip pim interface count** command displays the IP multicast Layer 3 switching enable state on IP PIM interfaces and the number of packets received and sent on the interface.

To display IP multicast Layer 3 switching information for an IP PIM Layer 3 interface, perform one of these tasks:

Command	Purpose
Router# show ip pim interface [{vlan <i>vlan_ID</i> } { <i>type</i> ¹ <i>slot/port</i> } {port-channel <i>number</i> }] count	Displays IP multicast Layer 3 switching enable state information for all MSFC IP PIM Layer 3 interfaces.
Router# show ip interface	Displays the IP multicast Layer 3 switching enable state on the Layer 3 interfaces.

1. *type* = **ethernet**, **fastethernet**, **gigabithernet**, or **tengigabithernet**

These examples show how to display the IP PIM configuration of the interfaces:

```
Router# show ip pim interface count

State:* - Fast Switched, D - Distributed Fast Switched
        H - Hardware Switching Enabled
Address      Interface          FS  Mpackets In/Out
10.15.1.20   GigabitEthernet4/8 * H 952/4237130770
10.20.1.7    GigabitEthernet4/9 * H 1385673757/34
10.25.1.7    GigabitEthernet4/10* H 0/34
10.11.1.30   FastEthernet6/26   * H 0/0
10.37.1.1    FastEthernet6/37   * H 0/0
1.22.33.44   FastEthernet6/47   * H 514/68
```

The “*” flag indicates that this interface can be fast switched and the “H” flag indicates that this interface is hardware switched. The “In” flag indicates the number of multicast packet bytes that have been received on the interface. The “Out” flag indicates the number of multicast packet bytes that have been forwarded from this interface.

```
Router# show ip mroute count
IP Multicast Statistics
56 routes using 28552 bytes of memory
13 groups, 3.30 average sources per group
Forwarding Counts:Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second
Other counts:Total/RPF failed/Other drops(OIF-null, rate-limit etc)

Group:224.2.136.89, Source count:1, Group pkt count:29051
  Source:132.206.72.28/32, Forwarding:29051/-278/1186/0, Other:85724/8/56665
Router#
```



Note

The -tive counter means that the outgoing interface list of the corresponding entry is NULL, and this indicates that this flow is still active.

This example shows how to display the IP multicast Layer 3 switching configuration of interface VLAN 10:

```
Router# show ip interface vlan 10
Vlan10 is up, line protocol is up
  Internet address is 10.0.0.6/8
  Broadcast address is 255.255.255.255
  Address determined by non-volatile memory
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Multicast reserved groups joined: 224.0.0.1 224.0.0.2 224.0.0.13 224.0.0.10
  Outgoing access list is not set
  Inbound access list is not set
```

```

Proxy ARP is enabled
Security level is default
Split horizon is enabled
ICMP redirects are always sent
ICMP unreachable are never sent
ICMP mask replies are never sent
IP fast switching is enabled
IP fast switching on the same interface is disabled
IP Flow switching is disabled
IP CEF switching is enabled
IP Fast switching turbo vector
IP Normal CEF switching turbo vector
IP multicast fast switching is enabled
IP multicast distributed fast switching is disabled
IP route-cache flags are Fast, CEF
Router Discovery is disabled
IP output packet accounting is disabled
IP access violation accounting is disabled
TCP/IP header compression is disabled
RTP/IP header compression is disabled
Probe proxy name replies are disabled
Policy routing is disabled
Network address translation is disabled
WCCP Redirect outbound is disabled
WCCP Redirect exclude is disabled
BGP Policy Mapping is disabled
IP multicast multilayer switching is enabled
IP mls switching is enabled
Router#

```

This example shows how to display the IP multicast Layer 3 switching configuration of Gigabit Ethernet interface 1/2:

```

Router# show interfaces gigabitEthernet 1/2
GigabitEthernet1/2 is up, line protocol is up (connected)
  Hardware is C6k 1000Mb 802.3, address is 0001.c9db.2441 (bia 0001.c9db.2441)
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
  Last clearing of "show interface" counters 00:05:13
  ...
  Input queue: 0/2000/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue :0/40 (size/max)
  5 minute input rate 10000 bits/sec, 1 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    284 packets input, 113104 bytes, 0 no buffer
    Received 284 broadcasts (284 multicast)
    0 runts, 41 giants, 0 throttles
    41 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 input packets with dribble condition detected
    198 packets output, 14732 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
Router#

```

Displaying the IPv4 Multicast Routing Table

The **show ip mroute** command displays the IP multicast routing table.

To display the IP multicast routing table, perform this task:

Command	Purpose
Router# show ip mroute partical-sc [hostname group_number]	Displays the IP multicast routing table and the hardware-switched interfaces.

This example shows how to display the IP multicast routing table:

```
Router# show ip mroute 230.13.13.1
IP Multicast Routing Table
Flags:D - Dense, S - Sparse, s - SSM Group, C - Connected, L - Local,
      P - Pruned, R - RP-bit set, F - Register flag, T - SPT-bit set,
      J - Join SPT, M - MSDP created entry, X - Proxy Join Timer Running
      A - Advertised via MSDP, U - URD, I - Received Source Specific Host
      Report
Outgoing interface flags:H - Hardware switched
Timers:Uptime/Expires
Interface state:Interface, Next-Hop or VCD, State/Mode

(*, 230.13.13.1), 00:16:41/00:00:00, RP 10.15.1.20, flags:SJC
  Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20
  Outgoing interface list:
  GigabitEthernet4/9, Forward/Sparse-Dense, 00:16:41/00:00:00, H

(*, 230.13.13.2), 00:16:41/00:00:00, RP 10.15.1.20, flags:SJC
  Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD
  Outgoing interface list:
  GigabitEthernet4/9, Forward/Sparse-Dense, 00:16:41/00:00:00, H

(10.20.1.15, 230.13.13.1), 00:14:31/00:01:40, flags:CJT
  Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD
  Outgoing interface list:
  GigabitEthernet4/9, Forward/Sparse-Dense, 00:14:31/00:00:00, H
(132.206.72.28, 224.2.136.89), 00:14:31/00:01:40, flags:CJT
  Incoming interface:GigabitEthernet4/8, RPF nbr 10.15.1.20, RPF-MFD
  Outgoing interface list:Null
Router#
```



Note

The RPF-MFD flag indicates that the flow is completely switched by the hardware. The H flag indicates the flow is switched by the hardware on the outgoing interface.

Displaying IPv4 Multicast Layer 3 Switching Statistics

The **show platform software multicast ip** command displays detailed information about IP multicast Layer 3 switching.

To display detailed IP multicast Layer 3 switching information, perform one of these tasks:

Command	Purpose
Router# show platform software multicast ip group <i>group-id</i>	Displays IP multicast Layer 3 switching group information.
Router# show platform software multicast ip interface [gigabitethernet <i>1-6</i> port-channel <i>1-256</i> tengigabitethernet <i>1-6</i> vlan <i>1-4094</i>] source <i>A.B.C.D.</i>]	Displays IP multicast Layer 3 switching details for all interfaces.
Router# show platform software multicast ip source <i>source-ip</i>	Displays IP multicast Layer 3 switching source information.
Router# show platform software multicast ip summary	Displays a summary of IP multicast Layer 3 switching information.
Router# show platform software multicast ip statistics [group <i>group-id</i>]	Displays IP multicast Layer 3 switching statistics.

This example shows how to display information on a specific IP multicast Layer 3 switching entry:

```
Router# show platform software multicast ip group 232.0.1.4
Multicast hardware switched flows:

(40.0.0.2, 232.0.1.4) Incoming interface: GigabitEthernet3/2/1, Packets Switched: 8069027
Hardware switched outgoing interfaces:
    Tunnel10

Total hardware switched flows: 1

PE1-7600
```

This example shows how to display IP multicast group information:

```
Router# show platform software multicast ip source 40.0.0.2
Multicast hardware switched flows:

(40.0.0.2, 232.0.1.4) Incoming interface: GigabitEthernet3/2/1, Packets Switched: 8778143
Hardware switched outgoing interfaces:
    Tunnel10

Total hardware switched flows: 1

Router#
```

This example shows how to display IP multicast Layer 3 switching information for gigabitethernet interface 3/2/1:

```
Router# show platform software multicast ip interface gigabitethernet 3/2/1
Multicast hardware switched flows:

(40.0.0.2, 232.0.1.4) Incoming interface: GigabitEthernet3/2/1, Packets Switched: 8206582
Hardware switched outgoing interfaces:
    Tunnel10

Total hardware switched flows: 1
```

This example shows how to display the IP multicast Layer 3 switching statistics:

```
Router# show platform software multicast ip statistics group 232.0.1.4
```

```
MLS Multicast Operation Status:
MLS Multicast configuration and state:
  Router Mac: 00e0.b0ff.7b00, Router IP: 33.0.33.24
  MLS multicast operating state: ACTIVE
  Shortcut Request Queue size 4
  Maximum number of allowed outstanding messages: 1
  Maximum size reached from feQ: 3096
  Feature Notification sent: 1
  Feature Notification Ack received: 1
  Unsolicited Feature Notification received: 0
  MSM sent: 205170
  MSM ACK received: 205170
  Delete notifications received: 0
  Flow Statistics messages received: 35211

MLS Multicast statistics:
  Flow install Ack: 996508
  Flow install Nack: 1
  Flow update Ack: 1415959
  Flow update Nack: 0
  Flow delete Ack: 774953
  Complete flow install Ack: 958469
```

```
Router#
```

Configuring IPv4 Bidirectional PIM

These sections describe how to configure IPv4 bidirectional protocol independent multicast (PIM):

- [Enabling IPv4 Bidirectional PIM Globally, page 31-22](#)
- [Configuring the Rendezvous Point for IPv4 Bidirectional PIM Groups, page 31-23](#)
- [Setting the IPv4 Bidirectional PIM Scan Interval, page 31-23](#)
- [Displaying IPv4 Bidirectional PIM Information, page 31-24](#)

Enabling IPv4 Bidirectional PIM Globally

To enable IPv4 bidirectional PIM, perform this task:

Command	Purpose
Router(config)# ip pim bidir-enable	Enables IPv4 bidirectional PIM globally on the router.
Router(config)# no ip pim bidir-enable	Disables IPv4 bidirectional PIM globally on the router.

This example shows how to enable IPv4 bidirectional PIM on the router:

```
Router(config)# ip pim bidir-enable
Router(config)#
```

Configuring the Rendezvous Point for IPv4 Bidirectional PIM Groups

To statically configure the rendezvous point for an IPv4 bidirectional PIM group, perform this task:

	Command	Purpose
Step 1	<code>Router(config)# ip pim rp-address ip_address access_list [override]</code>	Statically configures the IP address of the rendezvous point for the group. When you specify the override option, the static rendezvous point is used.
Step 2	<code>Router(config)# access-list access-list permit deny ip_address</code>	Configures an access list.
Step 3	<code>Router(config)# ip pim send-rp-announce type number scope ttl_value [group-list access-list] [interval seconds] [bidir]</code>	Configures the system to use Auto-RP to configure groups for which the router will act as a rendezvous point (RP).
Step 4	<code>Router(config)# ip access-list standard access-list-name permit deny ip_address</code>	Configures a standard IP access list.
Step 5	<code>Router(config)# mls ip multicast</code>	Enables MLS IP multicast.

This example shows how to configure a static rendezvous point for an IPv4 bidirectional PIM group:

```
Router(config)# ip pim rp-address 10.0.0.1 10 bidir override
Router(config)# access-list 10 permit 224.1.0.0 0.0.255.255
Router(config)# ip pim send-rp-announce Loopback0 scope 16 group-list c21-rp-list-0 bidir
Router(config)# ip access-list standard c21-rp-list-0 permit 230.31.31.1 0.0.255.255
```

Setting the IPv4 Bidirectional PIM Scan Interval

You can specify the interval between the IPv4 bidirectional PIM RP Reverse Path Forwarding (RPF) scans.

To set the IPv4 bidirectional PIM RP RPF scan interval, perform this task:

Command	Purpose
<code>Router(config)# mls ip multicast bidir gm-scan-interval interval</code>	Specifies the IPv4 bidirectional PIM RP RPF scan interval; valid values are from 1 to 1000 seconds. The default is 10 seconds.
<code>Router(config)# no mls ip multicast bidir gm-scan-interval</code>	Restores the default.

This example shows how to set the IPv4 bidirectional PIM RP RPF scan interval:

```
Router(config)# mls ip multicast bidir gm-scan-interval 30
Router(config)#
```

Displaying IPv4 Bidirectional PIM Information

To display IPv4 bidirectional PIM information, perform one of these tasks:

Command	Purpose
Router# <code>show ip pim rp mapping [in-use]</code>	Displays mappings between PIM groups and rendezvous points and shows learned rendezvous points in use.
Router# <code>show mls ip multicast bidir</code>	Displays IPv4 bidirectional PIM information.
Router# <code>show ip mroute</code>	Displays information about the multicast routing table.

This example shows how to display information about the PIM group and rendezvous point mappings:

```
Router# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent
Group(s) 230.31.0.0/16
  RP 60.0.0.60 (?), v2v1, bidir
    Info source:60.0.0.60 (?), elected via Auto-RP
    Uptime:00:03:47, expires:00:02:11
  RP 50.0.0.50 (?), v2v1, bidir
    Info source:50.0.0.50 (?), via Auto-RP
    Uptime:00:03:04, expires:00:02:55
  RP 40.0.0.40 (?), v2v1, bidir
    Info source:40.0.0.40 (?), via Auto-RP
    Uptime:00:04:19, expires:00:02:38
```

This example shows how to display information in the IP multicast routing table that is related to IPv4 bidirectional PIM:

```
Router# show ip mroute bidirectional
(*, 225.1.3.0), 00:00:02/00:02:57, RP 3.3.3.3, flags:BC
  Bidir-Upstream:GigabitEthernet2/1, RPF nbr 10.53.1.7, RPF-MFD
  Outgoing interface list:
    GigabitEthernet2/1, Bidir-Upstream/Sparse-Dense, 00:00:02/00:00:00,H
    Vlan30, Forward/Sparse-Dense, 00:00:02/00:02:57, H

(*, 225.1.2.0), 00:00:04/00:02:55, RP 3.3.3.3, flags:BC
  Bidir-Upstream:GigabitEthernet2/1, RPF nbr 10.53.1.7, RPF-MFD
  Outgoing interface list:
    GigabitEthernet2/1, Bidir-Upstream/Sparse-Dense, 00:00:04/00:00:00,H
    Vlan30, Forward/Sparse-Dense, 00:00:04/00:02:55, H

(*, 225.1.4.1), 00:00:00/00:02:59, RP 3.3.3.3, flags:BC
  Bidir-Upstream:GigabitEthernet2/1, RPF nbr 10.53.1.7, RPF-MFD
  Outgoing interface list:
    GigabitEthernet2/1, Bidir-Upstream/Sparse-Dense, 00:00:00/00:00:00,H
    Vlan30, Forward/Sparse-Dense, 00:00:00/00:02:59, H
```

This example shows how to display information related to a specific multicast route. In the output below, the arrow in the margin points to information about a partial short cut:

```
Router# show ip mroute 239.1.1.2 4.4.4.4
IP Multicast Routing Table
Flags:D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
T - SPT-bit set, J - Join SPT, M - MSDP created entry,
X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
U - URD, I - Received Source Specific Host Report, Z - Multicast Tunnel
```

```

        Y - Joined MDT-data group, y - Sending to MDT-data group
Outgoing interface flags:H - Hardware switched
Timers:Uptime/Expires
Interface state:Interface, Next-Hop or VCD, State/Mode

(4.4.4.4, 239.1.1.2), 1d02h/00:03:20, flags:FTZ
Incoming interface:Loopback0, RPF nbr 0.0.0.0, Partial-SC
Outgoing interface list:
    Vlan10, Forward/Sparse-Dense, 1d02h/00:02:39 (ttl-threshold 5)

```

This example shows how to display the entries for a specific multicast group address:

```

Router# show platform software multicast ip group 232.0.1.4
Multicast hardware switched flows:

(40.0.0.2, 232.0.1.4) Incoming interface: Lspvif0, Packets Switched: 120181613
Hardware switched outgoing interfaces:
GigabitEthernet3/6

Total hardware switched flows: 1

```

Using IPv4 Debug Commands

Table 31-2 describes IPv4 multicast Layer 3 switching debug commands that you can use to troubleshoot IP multicast Layer 3 switching problems.



Note The old debug commands will not be available.

Table 31-2 IP Multicast Layer 3 Switching Debug Commands

Command	Description
[no] debug ip multicast hardware-switching {control group-name error A.B.C.D event A.B.C.D ha-error A.B.C.D ha-event A.B.C.D}	Displays IP multicast Layer 3 switching events.
debug platform software multicast [all assert]	Displays all the log events, packet information, and assert events.
debug platform software multicast	Displays the multicast debugging information.
debug platform software multicast ha l2-ss0 [all error event pak]	Displays the layer 2 high availability multicast shortcuts debugging errors, events and packet information.
debug platform software multicast lc	Displays the layer 2 line card multicast events.
debug platform software multicast cgmp [event pak]	Displays the cgmp debugging event and packet information.
debug platform software multicast ha [error event]	Displays the high availability multicast shortcuts debugging errors and events.
debug platform software multicast ip hal [error event pak timer]	Displays the multicast hal error, event, timer and packet information.
debug platform software multicast igmp [event pak]	Displays the igmp debugging event and packet information.
debug platform software multicast mld [event pak]	Displays the events and packet information for mld debugging.

Table 31-2 IP Multicast Layer 3 Switching Debug Commands (continued)

Command	Description
<code>debug platform software multicast mrouter [event pak]</code>	Displays the multicast router events and packet information.
<code>debug platform software multicast msc [error event pak]</code>	Displays the multicast shortcut debugging information.
<code>debug platform software multicast rgmp [event pak]</code>	Displays the multicast rgmp debugging information.
<code>debug platform software multicast rpdf [error event]</code>	Displays the multicast bidirectional df debugging information.
<code>debug platform software multicast titan [error event]</code>	Displays the multicast titan debugging information.
<code>debug platform software multicast ipv6 [cmfib hal]</code>	Displays the MFIB IPv6 platform code debugging and multicast HAL IPv6 debug command information.
<code>debug platform software multicast ip cmfib [error event stats]</code>	Displays the multicast ip cmfib errors, shortcut events, and export the hardware statistics information.
<code>debug platform software multicast ip cmfib error [A.B.C.D pending]</code>	Displays the source or group IP address and the mfib IPv4 pending entry error information.
<code>debug platform software multicast ip cmfib event [A.B.C.D ctrl hwapi mdt pending table]</code>	Displays the source or group IP address, mfib IPv4 ctrl entries events, mfib hw-api events, mfib IPv4 table events, mfib IPv4 pending entry events, and mfib IPv4 table events.
<code>debug platform software multicast ipv6 cmfib [error event stats]</code>	Displays the multicast ipv6 mfib errors, shortcut events, and hardware statistics export information.
<code>debug platform software multicast ipv6 hal [error event]</code>	Displays the multicast ipv6 hal errors and events.