Multicast Subsecond Convergence

Feature History

Release	Modification
12.0(22)S	This feature was introduced.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

This document describes the Multicast Subsecond Convergence feature in Cisco IOS Release 12.1(11b)E and includes the following sections:

Feature Overview

The Multicast Subsecond Convergence feature in Cisco IOS Release 12.1(11b)E comprises a comprehensive set of features and protocol enhancements that provide for improved scalability and convergence in multicast-based services. This feature set provides for the ability to scale to larger services levels and to recover multicast forwarding after service failure in subsecond time frames.

Multicast subsecond convergence allows you to send Protocol Independent Multicast (PIM) router-query messages (PIM hellos) every few milliseconds. In previous releases, you could send the PIM hellos every few seconds. By enabling a router to send PIM hello messages more often, this feature allows the router to discover unresponsive neighbors more quickly. As a result, the router can implement failover or recovery procedures more efficiently.

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. Forwarding performance is unaffected by this new feature and is comparable to previous releases of Cisco IOS software.

Because PIM relies on the unicast routing table to calculate its Reverse Path Forwarding (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.

The scalability enhancements 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

Multicast subsecond convergence provides the ability to trigger a check of RPF changes for mroute states. 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.

Benefits

- 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, because multicast functionality is restored in a fraction of the time previously required.

Restrictions

Routers that use the subsecond DR failover enhancement need to be able to process hello interval information arriving in milliseconds. Routers that are congested or do not have enough CPU cycles to process the hello interval may assume that the PIM neighbor has gone, although this may not be the case.

Related Documents

- *Cisco IOS Release 12.1 Configuration Fundamentals Configuration Guide*

- *Cisco IOS Release 12.1 Configuration Fundamentals Command Reference*

Supported Platforms

- Cisco 3500 series
- Cisco 4000 series
- Cisco 6500 series
- Cisco 7100 series
- Cisco 7200 series
- Cisco 7500 series
- Cisco 7600 series

Determining Platform Support Through Cisco Feature Navigator

Cisco IOS software is packaged in feature sets that are supported on specific platforms. To get updated information regarding platform support for this feature, access Cisco Feature Navigator. Cisco Feature Navigator dynamically updates the list of supported platforms as new platform support is added for the feature.

Cisco Feature Navigator is a web-based tool that enables you to quickly determine which Cisco IOS software images support a specific set of features and which features are supported in a specific Cisco IOS image. You can search by feature or release. Under the release section, you can compare releases side by side to display both the features unique to each software release and the features in common.

To access Cisco Feature Navigator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

http://www.cisco.com/register

Cisco Feature Navigator is updated regularly when major Cisco IOS software releases and technology releases occur. For the most current information, go to the Cisco Feature Navigator home page at the following URL:

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

Availability of Cisco IOS Software Images

Platform support for particular Cisco IOS software releases is dependent on the availability of the software images for those platforms. Software images for some platforms may be deferred, delayed, or changed without prior notice. For updated information about platform support and availability of software images for each Cisco IOS software release, refer to the online release notes or, if supported, Cisco Feature Navigator.

Supported Standards, MIBs, and RFCs

Standards

No new or modified standards are supported by this feature.

MIBs

No new or modified MIBs are supported by this feature.

To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:

http://tools.cisco.com/ITDIT/MIBS/servlet/index

If Cisco MIB Locator does not support the MIB information that you need, you can also obtain a list of supported MIBs and download MIBs from the Cisco MIBs page at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

To access Cisco MIB Locator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

http://www.cisco.com/register

RFCs

No new or modified RFCs are supported by this feature.

Prerequisites

Service providers must have a multicast-enabled core in order to use the Cisco Multicast Subsecond Convergence feature.

Configuration Tasks

See the following sections for configuration tasks for this feature. Each task in the list is identified as either required or optional.

- Modifying the Periodic RPF Check Interval (optional)
- Configuring PIM RPF Failover Intervals (optional)
- Modifying the PIM Router Query Message Interval (optional)
- Verifying Multicast Subsecond Convergence Configurations (optional)

Modifying the Periodic RPF Check Interval

Note Cisco recommends that users keep the default values for this command. The default values allow subsecond RPF failover.

To modify the intervals at which periodic RPF checks occur, use the following command in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# ip multicast rpf interval` *seconds*	Configures the periodic RPF check intervals to occur at a specified interval, in seconds.

Configuring PIM RPF Failover Intervals

Note Cisco recommends that users keep the default values for this command. The default values allow subsecond RPF failover.

To configure the intervals at which PIM RPF failover will be triggered by changes in the routing tables, use the following command in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# ip multicast rpf backoff` *minimum maximum*	Configures the minimum and the maximum backoff intervals.

Modifying the PIM Router Query Message Interval

Router query messages are used to elect a PIM designated router. The designated router is responsible for sending IGMP host query messages. By default, multicast routers send PIM router query messages every 30 seconds. To modify this interval, use the following command in interface configuration mode:

	Command	Purpose
Step 1	`Router(config-if)# ip pim query-interval` *period* [**msec**]	Configures the frequency at which multicast routers send PIM router hello messages.

Verifying Multicast Subsecond Convergence Configurations

To display detailed information about and to verify information regarding the Multicast Subsecond Convergence feature, perform the following steps:

Step 1 Enter the **show ip pim interface** command to display information about interfaces configured for PIM:

```
Router# show ip pim interface Ethernet1/0

Address          Interface                Ver/   Nbr    Query  DR     DR
                                          Mode   Count  Intvl  Prior
172.16.1.4       Ethernet1/0              v2/S   1      100 ms 1      172.16.1.4
```

Step 2 Enter the **show ip pim neighbor** command to list the PIM neighbors discovered by the Cisco IOS software:

```
router# show ip pim neighbor

PIM Neighbor Table
Neighbor          Interface                Uptime/Expires    Ver   DR
```

```
Address                                                         Prio/Mode
172.16.1.3        Ethernet1/0              00:03:41/250 msec v2    1 / S
```

Step 3 Enter the **show ip rpf events** command to verify information regarding the last 15 triggered multicast RPF check events:

```
router# show ip rpf events

Last 15 triggered multicast RPF check events

RPF backoff delay: 500 msec
RPF maximum delay: 5 sec

DATE/TIME             BACKOFF    PROTOCOL   EVENT         RPF CHANGES
Mar 7 00:17:07.244    500 msec   Static     Route UP        0
Mar 7 00:16:55.082    500 msec   BGP        Route UP        0
Mar 7 00:16:43.880    500 msec   ISIS       Route UP        0
Mar 7 00:16:32.692    500 msec   ISIS       Route UP        0
Mar 7 00:16:19.712    1000 sec   Static     Route UP        0
Mar 7 00:16:18.212    500 msec   Connected  Route UP        0
Mar 7 00:16:13.140    500 msec   Static     Route UP        0
Mar 7 00:16:08.160    500 msec   Connected  Route UP        0
```

Monitoring and Maintaining Multicast Subsecond Convergence

To monitor and maintain the multicast subsecond convergence feature, use the following EXEC commands, as needed:

Command	Purpose
`Router# show ip pim interface`	Displays information about interfaces configured for PIM.
`Router# show ip pim neighbor`	Lists the PIM neighbors discovered by the Cisco IOS software.
`Router# show ip rpf events`	Displays the last 15 triggered multicast RPF check events.

Configuration Examples

This section provides the following configuration examples:

- Modifying the Periodic RPF Check Interval Example
- Configuring PIM RPF Failover Intervals Example
- Modifying the PIM Router Query Message Interval Example

Modifying the Periodic RPF Check Interval Example

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.

```
Router# show running-config

ip subnet-zero
```

```
!
ip multicast-routing
ip multicast rpf interval 10           -- Periodic RPF check interval
.
.
.
interface Ethernet0/0
 ip address 172.16.2.1 255.255.255.0
.
.
.
ip pim sparse-mode

!
```

Configuring PIM RPF Failover Intervals Example

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** output unless the interval value has been configured to be the nondefault value.

```
Router# show running-config

ip subnet-zero
!
ip multicast-routing
.
.
.
ip multicast rpf backoff 100 2500      -- Triggered RPF backoff values.
!
!

interface Ethernet0/0
 ip address 172.16.2.1 255.255.255.0
.
.
.
ip pim sparse-mode

!
```

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** output unless the interval value has been configured to be the nondefault value.

```
Router# show running-config

ip subnet-zero
!
.
.
.
interface Ethernet0/0
 ip address 172.16.2.1 255.255.255.0
ip pim query-interval 100 msec        -- PIM Hello query interval
```

```
ip pim sparse-mode

!
```

Command Reference

This section documents modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.1 command reference publications.

Modified Commands

- **debug ip mrouting**
- **debug ip pim**
- **ip multicast rpf backoff**
- **ip multicast rpf interval**
- **ip pim query-interval**
- **show ip pim interface**
- **show ip pim neighbor**
- **show ip rpf events**

debug ip mrouting

To display changes to the multicast route (mroute) table, use the **debug ip mrouting** command in privileged EXEC mode. To disable debugging output, use the **no** form of this command.

debug ip mrouting [**vrf** *vrf-name*] [**rpf-events**] [*group*]

no debug ip mrouting [**vrf** *vrf-name*] [**rpf-events**] [*group*]

Syntax Description

vrf	(Optional) Supports the Multicast Virtual Private Network (VPN) routing and forwarding (VRF) instance.
vrf-name	(Optional) Name assigned to the VRF.
rpf-events	(Optional) Checks the Reverse Path Forwarding (RPF) events of a specified group.
group	(Optional) Group name or address to monitor packet activity of a single group.

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
10.2	This command was introduced.
12.2(11)S	The **vrf** keyword and *vrf-name* argument were added.
12.0(22)S	The **rpf-events** keyword was added.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

This command indicates when the router has made changes to the mroute table. Use the **debug ip pim** and **debug ip mrouting** commands consecutively to obtain additional multicast routing information. In addition, use the **debug ip igmp** command to learn why an mroute message is being displayed.

This command generates a substantial amount of output. Use the optional *group* argument to limit the output to a single multicast group.

Examples

The following is sample output from the **debug ip mrouting** command:

```
Router# debug ip mrouting 224.2.0.1

MRT: Delete (10.0.0.0/8, 224.2.0.1)
MRT: Delete (10.4.0.0/16, 224.2.0.1)
MRT: Delete (10.6.0.0/16, 224.2.0.1)
MRT: Delete (10.9.0.0/16, 224.2.0.1)
MRT: Delete (10.16.0.0/16, 224.2.0.1)
MRT: Create (*, 224.2.0.1), if_input NULL
```

```
MRT: Create (224.69.15.0/24, 225.2.2.4), if_input Ethernet0, RPF nbr 224.69.61.15
MRT: Create (224.69.39.0/24, 225.2.2.4), if_input Ethernet1, RPF nbr 0.0.0.0
MRT: Create (10.0.0.0/8, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
MRT: Create (10.4.0.0/16, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
MRT: Create (10.6.0.0/16, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
MRT: Create (10.9.0.0/16, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
MRT: Create (10.16.0.0/16, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
```

The following lines show that multicast IP routes were deleted from the routing table:

```
MRT: Delete (10.0.0.0/8, 224.2.0.1)
MRT: Delete (10.4.0.0/16, 224.2.0.1)
MRT: Delete (10.6.0.0/16, 224.2.0.1)
```

The (*, G) entries are generally created by receipt of an Internet Group Management Protocol (IGMP) host report from a group member on the directly connected LAN or by a Protocol Independent Multicast (PIM) join message (in sparse mode) that this router receives from a router that is sending joins toward the RP. This router will in turn send a join toward the Route Processor (RP) that creates the shared tree (or RP tree).

```
MRT: Create (*, 224.2.0.1), if_input NULL
```

The following lines are an example of creating an (S, G) entry that shows that an IP multicast packet (mpacket) was received on Ethernet interface 0. The second line shows a route being created for a source that is on a directly connected LAN. The RPF means “reverse path forwarding,” whereby the router looks up the source address of the multicast packet in the unicast routing table and determines which interface will be used to send a packet to that source.

```
MRT: Create (224.69.15.0/24, 225.2.2.4), if_input Ethernet0, RPF nbr 224.69.61.15
MRT: Create (224.69.39.0/24, 225.2.2.4), if_input Ethernet1, RPF nbr 224.0.0.0
```

The following lines show that multicast IP routes were added to the routing table. Note the 224.0.0.0 as the RPF, which means the route was created by a source that is directly connected to this router.

```
MRT: Create (10.9.0.0/16, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
MRT: Create (10.16.0.0/16, 224.2.0.1), if_input Ethernet1, RPF nbr 224.0.0.0
```

If the source is not directly connected, the neighbor address shown in these lines will be the address of the router that forwarded the packet to this router.

The shortest path tree state maintained in routers consists of source (S), multicast address (G), outgoing interface (OIF), and incoming interface (IIF). The forwarding information is referred to as the multicast forwarding entry for (S, G).

An entry for a shared tree can match packets from any source for its associated group if the packets come through the proper incoming interface as determined by the RPF lookup. Such an entry is denoted as (*, G). A (*, G) entry keeps the same information a (S, G) entry keeps, except that it saves the rendezvous point address in place of the source address in sparse mode or as 24.0.0.0 in dense mode.

Table 2 describes the significant fields shown in the display.

Table 1 debug ip mrouting Field Descriptions

Field	Description
MRT	Multicast route table.
RPF	Reverse path forwarding.
nbr	Neighbor.

Related Commands

Command	Description
debug ip dvmrp	Displays information on DVMRP packets received and sent.
debug ip igmp	Displays IGMP packets received and sent, and IGMP host-related events.
debug ip packet	Displays general IP debugging information and IPSO security transactions.
debug ip pim	Displays all PIM announcements received.
debug ip sd	Displays all SD announcements received.

debug ip pim

To display Protocol Independent Multicast (PIM) packets received and sent, and to display PIM-related events, use the **debug ip pim** command in privileged EXEC mode. To disable debugging output, use the **no** form of this command.

debug ip pim [**vrf** *vrf-name*] [*group* | **df** [*rp-address*]] [**hello**]

no debug ip pim [**vrf** *vrf-name*] [*group* | **df** [*rp-address*]] [**hello**]

Syntax Description

vrf	(Optional) Supports the Multicast Virtual Private Network (VPN) routing and forwarding (VRF) instance.
vrf-name	(Optional) Name assigned to the VRF.
group	(Optional) The group name or address to monitor the packet activity of a single group.
df	(Optional) When bidirectional PIM is used, displays all designated forwarder (DF) election messages.
rp-address	(Optional) The rendezvous point IP address.
hello	(Optional) Enables you to send PIM hello messages to be sent every few milliseconds.

Defaults

All PIM packets are displayed.

Command Modes

Privileged EXEC

Command History

Release	Modification
10.2	This command was introduced.
12.1(2)T	The **df** keyword was added.
12.0(22)S	The **vrf** keyword, *vrf-name* argument, and **hello** keyword were added.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

PIM uses Internet Group Management Protocol (IGMP) packets to communicate with routers and advertise reachability information.

Use this command with the **debug ip igmp** and **debug ip mrouting** commands to display additional multicast routing information.

Examples

The following is sample output from the **debug ip pim** command:

```
Router# debug ip pim 224.2.0.1

PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
```

```
PIM: Received Join/Prune on Tunnel0 from 10.3.84.1
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
PIM: Received RP-Reachable on Ethernet1 from 172.16.20.31
PIM: Update RP expiration timer for 224.2.0.1
PIM: Forward RP-reachability packet for 224.2.0.1 on Tunnel0
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
PIM: Prune-list (10.221.196.51/32, 224.2.0.1)
PIM: Set join delay timer to 2 seconds for (10.221.0.0/16, 224.2.0.1) on Ethernet1
PIM: Received Join/Prune on Ethernet1 from 172.16.37.6
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
PIM: Received Join/Prune on Tunnel0 from 10.3.84.1
PIM: Join-list: (*, 224.2.0.1) RP 172.16.20.31
PIM: Add Tunnel0 to (*, 224.2.0.1), Forward state
PIM: Join-list: (10.0.0.0/8, 224.2.0.1)
PIM: Add Tunnel0 to (10.0.0.0/8, 224.2.0.1), Forward state
PIM: Join-list: (10.4.0.0/16, 224.2.0.1)
PIM: Prune-list (172.16.84.16/28, 224.2.0.1) RP-bit set RP 172.16.84.16
PIM: Send Prune on Ethernet1 to 172.16.37.6 for (172.16.84.16/28, 224.2.0.1), RP
PIM: For RP, Prune-list: 10.9.0.0/16
PIM: For RP, Prune-list: 10.16.0.0/16
PIM: For RP, Prune-list: 10.49.0.0/16
PIM: For RP, Prune-list: 10.84.0.0/16
PIM: For RP, Prune-list: 10.146.0.0/16
PIM: For 10.3.84.1, Join-list: 172.16.84.16/28
PIM: Send periodic Join/Prune to RP via 172.16.37.6 (Ethernet1)
```

The following lines appear periodically when PIM is running in sparse mode and indicate to this router the multicast groups and multicast sources in which other routers are interested:

```
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
PIM: Received Join/Prune on Ethernet1 from 172.16.37.33
```

The following lines appear when an RP message is received and the RP timer is reset. The expiration timer sets a checkpoint to make sure the RP still exists. Otherwise, a new RP must be discovered.

```
PIM: Received RP-Reachable on Ethernet1 from 172.16.20.31
PIM: Update RP expiration timer for 224.2.0.1
PIM: Forward RP-reachability packet for 224.2.0.1 on Tunnel0
```

The prune message in the following line states that this router is not interested in the Source-Active (SA) information. This message tells an upstream router to stop forwarding multicast packets from this source.

```
PIM: Prune-list (10.221.196.51/32, 224.2.0.1)
```

In the following line, a second router on the network wants to override the prune message that the upstream router just received. The timer is set at a random value so that if additional routers on the network still want to receive multicast packets for the group, only one will actually send the message. The other routers will receive the join message and then suppress sending their own message.

```
PIM: Set join delay timer to 2 seconds for (10.221.0.0/16, 224.2.0.1) on Ethernet1
```

In the following line, a join message is sent toward the RP for all sources:

```
PIM: Join-list: (*, 224.2.0.1) RP 172.16.20.31
```

In the following lines, the interface is being added to the outgoing interface (OIF) of the (*, G) and (S, G) multicast route (mroute) table entry so that packets from the source will be forwarded out that particular interface:

```
PIM: Add Tunnel0 to (*, 224.2.0.1), Forward state
PIM: Add Tunnel0 to (10.0.0.0/8, 224.2.0.1), Forward state
```

The following line appears in sparse mode only. There are two trees on which data may be received: the RP tree and the source tree. In dense mode there is no RP. After the source and the receiver have discovered one another at the RP, the first-hop router for the receiver will usually join to the source tree rather than the RP tree.

```
PIM: Prune-list (172.16.84.16/28, 224.2.0.1) RP-bit set RP 172.16.84.16
```

The send prune message in the next line shows that a router is sending a message to a second router saying that the first router should no longer receive multicast packets for the (S, G). The RP at the end of the message indicates that the router is pruning the RP tree and is most likely joining the source tree, although the router may not have downstream members for the group or downstream routers with members of the group. The output shows the specific sources from which this router no longer wants to receive multicast messages.

```
PIM: Send Prune on Ethernet1 to 172.16.37.6 for (172.16.84.16/28, 224.2.0.1), RP
```

The following lines indicate that a prune message is sent toward the RP so that the router can join the source tree rather than the RP tree:

```
PIM: For RP, Prune-list: 10.9.0.0/16
PIM: For RP, Prune-list: 10.16.0.0/16
PIM: For RP, Prune-list: 10.49.0.0/16

In the following line, a periodic message is sent toward the RP. The default period is
once per minute. Prune and join messages are sent toward the RP or source
rather than directly to the RP or source. It is the responsibility of the next hop router
to take proper action with this message, such as continuing to forward it to the
next router in the tree.

PIM: Send periodic Join/Prune to RP via 172.16.37.6 (Ethernet1)
```

Table 2 describes the significant fields shown in the display.

Table 2 debug ip mcache Field Descriptions

Field	Description
PIM	Protocol Independent Multicast (PIM)
10.221.196.51/32	Host route with 32 bits of mask.

Related Commands

Command	Description
debug ip dvmrp	Displays information on DVMRP packets received and sent.
debug ip igmp	Displays IGMP packets received and sent, and displays IGMP host-related events.
debug ip igrp transactions	Displays transaction information on IGRP routing transactions.
debug ip mrouting	Displays changes to the IP multicast routing table.
debug ip sd	Displays all SD announcements received.

ip multicast rpf backoff

To configure the intervals at which Protocol Independent Multicast (PIM) Reverse Path Forwarding (RPF) failover will be triggered by changes in the routing tables, use the **ip multicast rpf backoff** command in global configuration mode. To set the triggered RPF check to the default values, use the **no** form of this command.

ip multicast rpf backoff *minimum maximum* [**disable**]

no ip multicast rpf backoff *minimum maximum* [**disable**]

Syntax Description

minimum	The minimum configured backoff T interval. The backoff interval is reset to the number of milliseconds (ms) configured by the minimum argument if a backoff interval has expired without any routing changes.
maximum	The maximum amount of time, in milliseconds, allowed for a backoff interval. The maximum length of time that is allowed is 5000 ms.
disable	(Optional) Turns off the triggered RPF check function.

Defaults

This command is enabled by default.

Minimum backoff default is 500 ms.

Maximum backoff default is 5000 ms.

Command Modes

Global configuration

Command History

Release	Modification
12.0(22)S	This command was introduced.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

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 router. To avoid this problem, the **ip multicast rpf backoff** command prevents 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 router with PIM RPF changes while the routing table is still converging.

Note Cisco recommends that users keep the default values for this command. The default values allow subsecond RPF failover.

The *maximum* argument is used to configure the maximum backoff interval. The backoff time is reset to time configured by the *minimum* argument if an entire backoff interval has expired without routing changes.

The *maximum* argument default allows the RPF change behavior to be backward-compatible, allowing a 5-second RPF check interval in case of frequent route changes and a 500-ms RPF check interval in stable networks with only unplanned routing changes. In previous software releases, PIM polled the routing tables for changes every 5 seconds.

You likely do not need to change the defaults of the **ip multicast rpf backoff** command unless you have frequent route changes in your router (for example, on a dial-in router). Changing the defaults can allow you to reduce the maximum RPF check interval for faster availability of IP multicast on newly established routes or to increase the maximum RPF check interval to reduce the CPU load caused by the RPF check.

Examples

The following example configures the minimum backoff interval at 100 ms and the maximum backoff interval at 2500 ms:

```
Router(config)# ip multicast rpf backoff 100 2500
```

ip multicast rpf interval

To modify the intervals at which periodic Reverse Path Forwarding (RPF) checks occur, use the **ip multicast rpf interval** command in global configuration mode. To return to the default interval, use the **no** form of this command.

ip multicast rpf interval *seconds* [**list** {*access-list*} | **route-map** {*route-map*}]

no ip multicast rpf interval *seconds* [**list** {*access-list*} | **route-map** {*route-map*}]

Syntax Description

seconds	The number of seconds at which the interval is configured.
list	(Optional) Use an access list to configure multiple instances of this command.
access-list	(Optional) Access list.
route-map	(Optional) Use a route map to configure multiple instances of this command.
route-map	(Optional) Route map.

Defaults

This command is enabled by default.

The default interval value is 10 seconds.

Command Modes

Global configuration

Command History

Release	Modification
12.0(22)S	This command was introduced.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

You can configure multiple instances of this command by using an access list or a route map.

Note Cisco recommends that users keep the default values for this command. The default values allow subsecond RPF failover.

Examples

The following example sets the periodic RPF check interval to 10 seconds:

```
ip multicast rpf interval 10
```

The following example sets a periodic RPF check interval of 3 seconds for groups that are defined by access list 10:

```
ip multicast rpf interval 3 list 10
```

The following example sets a periodic RPF check interval of 2 seconds for groups that are defined by the route map named map:

```
ip multicast rpf interval 2 route-map map
```

Related Commands

Command	Description
ip igmp query-interval	Configures the frequency at which the Cisco IOS software sends IGMP host hello messages.

ip pim query-interval

To configure the frequency of Protocol Independent Multicast (PIM) hellos, use the **ip pim query-interval** command in interface configuration mode. To return to the default interval, use the **no** form of this command.

ip pim query-interval *period* [**msec**]

no ip pim query-interval

Syntax Description

period	The number of seconds or milliseconds (ms) that can be configured for the query interval: • The interval range, in seconds, is from 1 to 65535. • The interval range, in milliseconds, is from 1 to 65535.
msec	Interval, in milliseconds, at which periodic PIM hello messages are sent. If the **msec** keyword is not used along with the *period* argument, the interval range is assumed to be in seconds.

Defaults

This command is enabled by default.

The PIM hello messages are sent every 30 seconds.

Command Modes

Interface configuration

Command History

Release	Modification
10.0	This command was introduced.
12.0(22)S	This command was updated with the **msec** keyword, which allows you to specify the interval between PIM hello messages in milliseconds.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

Routers configured for IP multicast send PIM hello messages to determine which router will be the designated router for each LAN segment (subnet). The designated router sends IGMP host-query messages to all hosts on the directly connected LAN. When operating in sparse mode, the designated router sends source registration messages to the Route Processor (RP). The designated router is the router with the largest IP address.

Examples

The following example changes the PIM hello interval to 45 seconds:

```
interface tunnel 0
 ip pim query-interval 45
```

The following example changes the PIM hello interval to 100 milliseconds:

```
interface Ethernet1/0
```

```
ip address 172.16.1.3 255.255.255.0
ip pim query-interval 100 msec
```

Related Commands

Command	Description
ip igmp query-interval	Configures the frequency at which the Cisco IOS software sends IGMP host query messages.

show ip pim interface

To display information about interfaces configured for Protocol Independent Multicast (PIM), use the **show ip pim interface** command in EXEC mode.

show ip pim interface [*type number*] [**df** | **count**] [*rp-address*] [**detail**]

Syntax Description

type number	(Optional) Interface type and number. A space is not required between the values.
df	(Optional) When bidirectional PIM (bidir-PIM) is used, displays the IP address of the elected designated forwarder (DF) for each rendezvous point of an interface.
count	(Optional) Number of packets received and sent out the interface.
rp-address	(Optional) RP IP address.
detail	(Optional) PIM details of each interface.

Defaults

If no interface is specified, all interfaces are displayed.

Command Modes

EXEC

Command History

Release	Modification
10.0	This command was introduced.
11.2(11)GS	This command was integrated into Cisco IOS Release 11.2(11)GS.
12.0(5)T	The flag "H" was added in the output display to indicate that an outgoing interface is hardware-switched in the case of IP multicast Multilayer Switching (MLS).
12.0(18)ST	This command was integrated into Cisco IOS Release 12.0(18)ST.
12.1(2)T	The **df** keyword and *rp-address* argument were added.
12.1(5)T	The **detail** keyword was added.
12.0(22)S	The command output changed to show when the query interval is set to milliseconds.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

This command works only on interfaces that are configured for PIM. Use the **show ip pim interface count** command to display switching counts for Multicast Distributed Switching (MDS) and other fast-switching statistics. For more information on MDS, refer to the "Configuring Multicast Distributed Switching" chapter in the *Cisco IOS Release 12.1 Switching Services Configuration Guide*.

Examples

The following is sample output from the **show ip pim interface** command:

```
Router# show ip pim interface Ethernet1/0
```

```
Address          Interface                Ver/   Nbr    Query  DR     DR
                                          Mode   Count  Intvl  Prior
172.16.1.4       Ethernet1/0              v2/S   1      100 ms 1      172.16.1.4
```

The following is sample output from the **show ip pim interface** command when the **count** keyword is specified:

```
Router# show ip pim interface count

Address          Interface          FS  Mpackets In/Out
172.30.121.35    Ethernet0          *   548305239/13744856
172.30.121.35    Serial0.33         *   8256/67052912
198.92.12.73     Serial0.1719       *   219444/862191
```

The following are sample outputs from the **show ip pim interface** command when the **df** keyword is specified:

```
Router# show ip pim interface df

Interface          RP               DF Winner        Metric          Uptime
Ethernet3/3        10.10.0.2        10.4.0.2         0               00:03:49
                   10.10.0.3        10.4.0.3         0               00:01:49
                   10.10.0.5        10.4.0.4         409600          00:01:49
Ethernet3/4        10.10.0.2        10.5.0.2         0               00:03:49
                   10.10.0.3        10.5.0.2         409600          00:02:32
                   10.10.0.5        10.5.0.2         435200          00:02:16
Loopback0          10.10.0.2        10.10.0.2        0               00:03:49
                   10.10.0.3        10.10.0.2        409600          00:02:32
                   10.10.0.5        10.10.0.2        435200          00:02:16

Router# show ip pim interface Ethernet3/3 df 10.10.0.3

Designated Forwarder election for Ethernet3/3, 10.4.0.2, RP 10.10.0.3
  State                          Non-DF
  Offer count is                 0
  Current DF ip address          10.4.0.3
  DF winner up time              00:02:33
  Last winner metric preference  0
  Last winner metric             0
```

Table 3 describes the significant fields shown in the displays.

Table 3 show ip pim interface Field Descriptions

Field	Description
Address	Interface IP address of the router.
Interface	Interface type and number that is configured to run PIM.
Mode	Multicast mode in which the Cisco IOS software is operating. This mode can be dense mode or sparse mode. DVMRP indicates that a Distance Vector Multicast Routing Protocol tunnel is configured.
Nbr Count	Number of PIM neighbors that have been discovered through this interface. If the neighbor count is 1 for a DVMRP tunnel, the neighbor is active (receiving probes and reports).
Query Interval	Frequency (in seconds or milliseconds) of PIM hellos, as set by the **ip pim query-interval** interface configuration command. The default is 30 seconds.
DR	IP address of the designated router on a network.

Table 3 show ip pim interface Field Descriptions (continued)

Field	Description
FS	An asterisk (*) in this column indicates that fast switching is enabled.
Mpackets In/Out	Number of packets into and out of the interface since the box has been up.
RP	IP address of the RP.
DF Winner	IP address of the elected DF.
Metric	Unicast routing metric to the RP announced by the DF.
Uptime	Length of time the RP has been up (in days and hours). If less than one day, time is expressed in hours:minutes:seconds.
State	Indicates whether the specified interface is an elected DF.
Offer count is	Number of PIM DF election offer messages that the router has sent out the interface during the current election interval.
Current DF ip address	IP address of the current DF.
DF winner up time	Length of time the current DF has been up (in days and hours). If less than one day, time is expressed in hours:minutes:seconds.
Last winner metric preference	The preference value used for selecting the unicast routing metric to the RP announced by the DF.
Last winner metric	Unicast routing metric to the RP announced by the DF.

Related Commands

Command	Description
ip pim	Enables PIM on an interface.
show ip pim neighbor	Lists the PIM neighbors discovered by the Cisco IOS software.

show ip pim neighbor

To list the Protocol Independent Multicast (PIM) neighbors discovered by the Cisco IOS software, use the **show ip pim neighbor** command in EXEC mode.

show ip pim neighbor [*type number*]

Syntax Description

type	(Optional) Interface type.
number	(Optional) Interface number.

Command Modes

EXEC

Command History

Release	Modification
10.0	This command was introduced.
12.0(22)S	The command output was updated.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

Use this command to determine which routers on the LAN are configured for PIM.

Examples

The following is sample output from the **show ip pim neighbor** command:

```
Router# show ip pim neighbor

PIM Neighbor Table
Neighbor          Interface               Uptime/Expires    Ver   DR
Address                                                           Prio/Mode
172.16.1.3        Ethernet1/0             00:03:41/250 msec v2    1 / S
```

Table 4 describes the significant fields shown in the display.

Table 4 show ip pim neighbor Field Descriptions

Field	Description
Neighbor Address	IP address of the PIM neighbor.
Interface	Interface type and number on which the neighbor is reachable.
Uptime/Expires	Uptime shows how long (in hours:minutes:seconds) the entry has been in the PIM neighbor table. Expires shows how long (in hours:minutes:seconds or milliseconds) until the entry will be removed from the IP multicast routing table.

Table 4 show ip pim neighbor Field Descriptions (continued)

Field	Description
Ver	PIM protocol version.
DR Prio/Mode	DR = DR priority S = Sparse mode B = Bidir

Related Commands

Command	Description
ip pim state-refresh disable	Disables the processing and forwarding of PIM Dense Mode State Refresh feature control messages on a PIM router.
ip pim state-refresh origination-interval	Configures the origination of and the interval for the PIM Dense Mode State Refresh feature control messages on a PIM router.
show ip pim interface	Displays information about interfaces configured for PIM.

show ip rpf events

To display the last 15 triggered multicast Reverse Path Forwarding (RPF) check events, use the **show ip rpf events** command in EXEC mode.

show ip rpf events

Syntax Description

This command has no arguments or keywords.

Command Modes

EXEC

Command History

Release	Modification
12.0(22)S	This command was introduced.
12.1(11b)E	This feature was integrated into Cisco IOS Release 12.1(11b)E.

Usage Guidelines

Use this command to determine the most recent triggered multicast RPF check events.

Examples

The following is sample output from the **show ip rpf events** command:

```
router# show ip rpf events

Last 15 triggered multicast RPF check events

RPF backoff delay: 500 msec
RPF maximum delay: 5 sec

DATE/TIME             BACKOFF    PROTOCOL   EVENT         RPF CHANGES
Mar 7 00:17:07.244    500 msec   Static     Route UP        0
Mar 7 00:16:55.082    500 msec   BGP        Route UP        0
Mar 7 00:16:43.880    500 msec   ISIS       Route UP        0
Mar 7 00:16:32.692    500 msec   ISIS       Route UP        0
Mar 7 00:16:19.712    1000 sec   Static     Route UP        0
Mar 7 00:16:18.212    500 msec   Connected  Route UP        0
Mar 7 00:16:13.140    500 msec   Static     Route UP        0
Mar 7 00:16:08.160    500 msec   Connected  Route UP        0
```

The following is sample output from the **show ip rpf events** command when the **ip multicast rpf backoff** command is used with the **disable** keyword, disabling the triggered RPF check function:

```
Router# show ip rpf events

Last 15 triggered multicast RPF check events

Note:Triggered RPF disabled!

RPF backoff delay:50 msec
RPF maximum delay:2 sec

DATE/TIME             BACKOFF    PROTOCOL   EVENT         RPF CHANGES
Sep 4 06:25:31.707    500 msec   Connected  Route UP        0
```

```
Sep 4 06:25:30.099    500 msec   Connected  Route UP        0
```

Table 5 describes the significant fields shown in the display.

Table 5 show ip rpf events Field Descriptions

Field	Description
RPF backoff delay	The configured amount of time (in milliseconds) allowed for the initial backoff delay.
RPF maximum delay	The maximum configured amount of time (in seconds) allowed for a backoff delay.
Date/Time	The date and time (in hours:minutes:seconds) an RPF event occurred.
Backoff	The actual backoff delay (in milliseconds) after which the RPF check was done.
Protocol	The protocol that triggered the RPF check.
Event	This RPF check was caused by a route that went up or down, or was modified.
RPF Changes	The number of multicast routes that were affected by the RPF change.