Multicast Subsecond Convergence

The Multicast Subsecond Convergence feature 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.

Feature Specifications for the Multicast Subsecond Convergence Feature

Feature History	
Release	**Modification**
12.0(22)S	This feature was introduced.
12.2(14)S	This feature was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This feature was integrated into Cisco IOS Release 12.2(15)T
Supported Platforms	
This feature runs on all platforms that support Cisco IOS Release 12.0(22)S, 12.2(14)S, 12.2(15)T, or later releases.	

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Contents

Prerequisites for Multicast Subsecond Convergence

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

Restrictions for Multicast Subsecond Convergence

Routers that use the subsecond designated router (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 Protocol Independent Multicast (PIM) neighbor is disconnected, although this may not be the case.

Information About Multicast Subsecond Convergence

To configure the Multicast Subsecond Convergence feature, you must understand the following concepts:

Benefits of Multicast Subsecond Convergence

- The scalability components improve on the efficiency of handling increases (or decreases) in service users (receivers) and service load (sources or content).
- New algorithms and processes (such as aggregated join messages, which deliver up to 1000 individual messages in a single packet) reduce the time to reach convergence by a factor of 10.
- Multicast subsecond convergence improves service availability for large multicast networks.
- Multicast users such as financial services firms and brokerages receive better quality of service (QoS), because multicast functionality is restored in a fraction of the time previously required.

Multicast Subsecond Convergence Scalability Enhancements

The Multicast Subsecond Convergence feature provides scalability enhancements that improve on the efficiency of handling increases (or decreases) in service users (receivers) and service load (sources or content). Scalability enhancements in this release include the following:

- Improved Internet Group Management Protocol (IGMP) and PIM state maintenance through new timer management techniques
- Improved scaling of the Multicast Source Discovery Protocol (MSDP) Source-Active (SA) cache

The scalability enhancements provide the following benefits:

- Increased potential PIM multicast route (mroute), IGMP, and MSDP SA cache state capacity
- Decreased CPU usage

PIM Router Query Messages

Multicast subsecond convergence allows you to send PIM router query messages (PIM hellos) every few milliseconds. The PIM hello message is used to locate neighboring PIM routers. Before the introduction of this feature, 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.

Reverse Path Forwarding

Unicast Reverse Path Forwarding (RPF) helps to mitigate problems caused by the introduction of malformed or forged IP source addresses into a network by discarding IP packets that lack a verifiable IP source address. Malformed or forged source addresses can indicate denial-of-service (DoS) attacks based on source IP address spoofing.

RPF uses access control lists (ACLs) in determining whether to drop or forward data packets that have malformed or forged IP source addresses. An option in the ACL commands allows system administrators to log information about dropped or forwarded packets. Logging information about forged packets can help in uncovering information about possible network attacks.

Per-interface statistics can help system administrators quickly discover the interface serving as the entry point for an attack on the network.

Triggered RPF Checks

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.

Topology Changes and Multicast Routing Recovery

The Multicast Subsecond Convergence feature set enhances both enterprise and service provider network backbones by providing almost instantaneous recovery of multicast paths after unicast routing recovery. Forwarding performance is unaffected by this new feature and is comparable to previous releases of Cisco 12.0 S software.

Because PIM relies on the unicast routing table to calculate its RPF when a change in the network topology occurs, unicast protocols first need to calculate options for the best paths for traffic, and then multicast can determine the best path.

Multicast subsecond convergence allows multicast protocol calculations to finish almost immediately after the unicast calculations are completed. As a result, multicast traffic forwarding is restored substantially faster after a topology change.

How to Configure Multicast Subsecond Convergence

This section contains the following procedures:

Modifying the Periodic RPF Check Interval

Perform this task to modify the intervals at which periodic RPF checks occur.

RPF Checks

PIM is designed to forward IP multicast traffic using the standard unicast routing table. PIM uses the unicast routing table to decide if the source of the IP multicast packet has arrived on the optimal path from the source. This process, the RPF check, is protocol-independent because it is based on the contents of the unicast routing table and not on any particular routing protocol.

Restrictions

Cisco recommends that users keep the default values for the **ip rpf interval** command. The default values allow subsecond RPF failover. The default interval at which periodic RPF checks occur is 10 seconds.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip multicast rpf interval** *seconds* [**list** *access-list* | **route-map** *route-map*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip multicast rpf interval** *seconds* [**list** *access-list* | **route-map** *route-map*] **Example:** `Router(config)# ip multicast rpf interval 10`	Configures the periodic RPF check intervals to occur at a specified interval, in seconds.

What to Do Next

Proceed to the "Configuring PIM RPF Failover Intervals" section on page 5 to configure the intervals at which PIM RPF failover will be triggered by changes in the routing tables. Proceed to the "Modifying the PIM Router Query Message Interval" section on page 6 to modify the interval at which IGMP host query messages are sent. Proceed to the "Verifying Multicast Subsecond Convergence Configurations" section on page 7 to display information about and to verify information regarding the Multicast Subsecond Convergence feature.

Configuring PIM RPF Failover Intervals

Perform this task to configure the intervals at which PIM RPF failover will be triggered by changes in the routing tables.

RPF Failover

In an unstable unicast routing environment that uses triggered RPF checks, the environment could be constantly triggering RPF checks, which places a burden on the resources of the router. To avoid this problem, use the **ip multicast rpf backoff** command to prevent a second triggered RPF check from occurring for the length of time configured. That is, the PIM "backs off" from another triggered RPF check for a minimum amount of milliseconds as configured by the user.

If the backoff period expires without further routing table changes, PIM then scans for routing changes and accordingly establishes multicast RPF changes. However, if more routing changes occur during the backoff period, PIM doubles the backoff period to avoid overloading the router with PIM RPF changes while the routing table is still converging.

Restrictions

Cisco recommends that users keep the default values for the **ip multicast rpf backoff** command. The default values allow subsecond RPF failover.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip multicast rpf backoff** *minimum maximum* [**disable**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip multicast rpf backoff** *minimum maximum* [**disable**] **Example:** `Router(config)# ip multicast rpf backoff 100 2500`	Configures the minimum and the maximum backoff intervals.

What to Do Next

Proceed to the "Modifying the PIM Router Query Message Interval" section on page 6 to modify the interval at which IGMP host query messages are sent. Proceed to the "Verifying Multicast Subsecond Convergence Configurations" section on page 7 to display information about and to verify information regarding the Multicast Subsecond Convergence feature.

Modifying the PIM Router Query Message Interval

Perform this task to modify the PIM router query message interval.

PIM Router Query Messages

Router query (hello) 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.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot/port*
4. **ip pim query-interval** *period* [**msec**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type slot/port* **Example:** `Router(config)# interface ethernet 1/0`	Specifies the interface and enters interface configuration mode.
Step 4	**ip pim query-interval** *period* [**msec**] **Example:** `Router(config-if)# ip pim query-interval 45`	Configures the frequency at which multicast routers send PIM router query messages.

What to Do Next

Proceed to the "Verifying Multicast Subsecond Convergence Configurations" section on page 7 to display information about and to verify information regarding the Multicast Subsecond Convergence feature.

Verifying Multicast Subsecond Convergence Configurations

Perform this task to display detailed information about and to verify information regarding the Multicast Subsecond Convergence feature.

SUMMARY STEPS

1. **enable**
2. **show ip pim interface** *type number*
3. **show ip pim neighbor**
4. **show ip rpf events**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip pim interface** *type number* **Example:** `Router# show ip pim interface ethernet 1/0`	(Optional) Displays information about interfaces configured for PIM.
Step 3	**show ip pim neighbor** **Example:** `Router# show ip pim neighbor`	(Optional) Displays the PIM neighbors discovered by the Cisco IOS software.
Step 4	**show ip rpf events** **Example:** `Router# show ip rpf events`	(Optional) Displays information regarding the last 15 triggered multicast RPF check events.

Examples

This section contains the following output examples:

- Sample Output for the show ip pim interface Command
- Sample Output for the show ip pim neighbor Command
- Sample Output for the show ip rpf events Command

Sample Output for the show ip pim interface Command

The following output examples displays information about PIM-configured Ethernet interface 1/0:

```
Router# show ip pim interface Ethernet 1/0

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
```

Sample Output for the show ip pim neighbor Command

The following example output displays 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
```

Sample Output for the show ip rpf events Command

The following example output displays 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 03:24:10.505    500 msec   Static     Route UP        0
Mar 7 03:23:11.804    1000 sec   BGP        Route UP        3
Mar 7 03:23:10.796    500 msec   ISIS       Route UP        0
Mar 7 03:20:10.420    500 msec   ISIS       Route Down      3
Mar 7 03:19:51.072    500 msec   Static     Route Down      0
Mar 7 02:46:32.464    500 msec   Connected  Route UP        3
Mar 7 02:46:24.052    500 msec   Static     Route Down      0
Mar 7 02:46:10.200    1000 sec   Connected  Route UP        3
Mar 7 02:46:09.060    500 msec   OSPF       Route UP        3
Mar 7 02:46:07.416    500 msec   OSPF       Route Down      0
Mar 7 02:45:50.423    500 msec   EIGRP      Route UP        3
Mar 7 02:45:09.679    500 msec   EIGRP      Route Down      0
Mar 7 02:45:06.322    500 msec   EIGRP      Route Down      2
Mar 7 02:33:09.424    500 msec   Connected  Route UP        0
Mar 7 02:32:28.307    500 msec   BGP        Route UP        3
```

Configuration Examples for Multicast Subsecond Convergence

This section provides the following configuration examples

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

!
```

Additional References

For additional information related to Multicast Subsecond Convergence, see the following sections:

Related Documents

Related Topic	Document Title
Basic configuration tasks for Release 12.2	*Cisco IOS Configuration Fundamentals Configuration Guide*, Release 12.2
Basic configuration commands for Release 12.2	*Cisco IOS Configuration Fundamentals Command Reference*, Release 12.2 T
IP configuration tasks for Release 12.2	*Cisco IOS IP Configuration Guide*, Release 12.2
IP Multicast configuration tasks for Release 12.2	"IP Multicast" chapter in the *Cisco IOS IP Configuration Guide*, Release 12.2
IP Multicast commands for release 12.2	*Cisco IOS IP Command Reference, Volume 3 of 3: Multicast*, Release 12.2 T
Basic configuration tasks for Release 12.0	*Cisco IOS Release 12.0 Configuration Fundamentals Configuration Guide*
Basic configuration commands for Release 12.0	*Cisco IOS Release 12.0 Configuration Fundamentals Command Reference*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing standards has not been modified by this feature.	To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco.com at the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

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

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing standards has not been modified by this feature.	—

Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/public/support/tac/home.shtml

Command Reference

This section documents new and modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.2 T command reference publications.

- **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.
12.0(22)S	The **rpf-events** keyword was added.
12.2(14)S	The **vrf** keyword and *vrf-name* argument were added.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.

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 1 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.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.

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.
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 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.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.

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, use the **ip multicast rpf backoff** command to prevent a second triggered RPF check from occurring for the length of time configured. That is, the PIM "backs off" from another triggered RPF check for a minimum amount of milliseconds as configured by the user.

If the backoff period expires without further routing table changes, PIM then scans for routing changes and accordingly establishes multicast RPF changes. However, if more routing changes occur during the backoff period, PIM doubles the backoff period to avoid overloading the 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 need not 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:

```
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. The default is 10 seconds.
list	(Optional) The interval of periodic RPF checks for an access list.
access-list	(Optional) Access list.
route-map	(Optional) The interval of periodic RPF checks for a route map.
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.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.

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) hello messages, 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	Specifies the 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.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.

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 Internet Group Management Protocol (IGMP)hello messages to all hosts on the directly connected LAN. When operating in sparse mode, the designated router sends source registration messages to the Rendezvous point (RP). The designated router is the router with the highest 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 [**vrf** *vrf-name*] [*type number*] [**df** | **count**] [*rp-address*] [**detail**]

Syntax Description

vrf	(Optional) Supports the Multicast Virtual Private Network (VPN) routing and forwarding (VRF) instance. A space is not required between the values.
vrf-name	(Optional) Name assigned to the VRF.
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 (RP) of an interface.
count	(Optional) Number of packets received and sent out the interface.
rp-address	(Optional) RP IP address.
detail	(Optional) Displays 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.
12.0(23)S	The **vrf** keyword and *vrf-name* argument were added.
12.2(13)T	The **vrf** keyword and *vrf-name* argument were added.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.

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 12.0 Switching Services Configuration Guide*.

Examples

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

```
Router# show ip pim interface

Address          Interface          Mode    Neighbor  Query     DR
                                            Count     Interval
192.168.37.6      Ethernet0          Dense   2         30        192.168.37.33
192.168.36.129    Ethernet1          Dense   2         30        192.168.36.131
10.1.37.2         Tunnel0            Dense   1         30        224.0.0.0
```

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

```
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. Note that serial lines do not have designated routers, so the IP address would be shown as 224.0.0.0.
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.

The following is sample output from the **show ip pim interface** command with the **detail** keyword for Fast Ethernet interface 0/1:

```
Router# show ip pim interface fastethernet 0/1 detail

FastEthernet0/1 is up, line protocol is up
  Internet address is 172.16.8.1/24
  Multicast switching:process
  Multicast packets in/out:0/0
  Multicast boundary:not set
  Multicast TTL threshold:0
  PIM:enabled
    PIM version:2, mode:dense
    PIM DR:172.16.8.1 (this system)
    PIM neighbor count:0
    PIM Hello/Query interval:30 seconds
```

```
  PIM State-Refresh processing:enabled
  PIM State-Refresh origination:enabled, interval:60 seconds
   PIM NBMA mode:disabled
   PIM ATM multipoint signalling:disabled
   PIM domain border:disabled
Multicast Tagswitching:disabled
```

Table 4 describes the significant fields shown in the display.

Table 4 show ip pim interface detail Field Descriptions

Field	Description
Internet address	IP address of the specified interface.
Multicast switching:	The type of multicast switching enabled on the interface: process, fast, or distributed.
Multicast boundary:	Indicates whether an administratively scoped boundary is configured.
Multicast TTL threshold:	The time-to-live (TTL) threshold of multicast packets being forwarded out the interface.
PIM:	Indicates whether PIM is enabled or disabled.
PIM version:	Indicates whether PIM version 1 or version 2 is configured.
PIM mode:	Indicates whether PIM sparse mode, dense mode, or sparse-dense mode is configured.
PIM DR:	The IP address of the DR.
PIM State-Refresh processing:	Indicates whether the processing of PIM state refresh control messages is enabled.
PIM State-Refresh origination:	Indicates whether the origination of the PIM state refresh control messages is enabled.
interval:	Indicates the configured interval for the origination of the PIM state refresh control messages. The available interval range is from 4 to 100 seconds.
PIM NBMA mode:	Indicates whether the interface is enabled for nonbroadcast multiaccess (NBMA) mode.
PIM ATM multipoint signalling:	Indicates whether the interface is enabled for ATM multipoint signaling.
PIM domain border:	Indicates whether the interface is enabled as a PIM domain border.
Multicast Tagswitching:	Indicates whether multicast tag switching is enabled.

Related Commands

Command	Description
ip pim	Enables PIM on an interface.
ip pim query-interval	Configures the frequency of PIM router query messages.
ip pim state-refresh disable	Disables the processing and forwarding of PIM dense mode state refresh control messages on a PIM router.

Command	Description
ip pim state-refresh origination-interval	Configures the origination of and the interval for PIM dense mode state refresh control messages on a PIM router.
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 [**vrf** *vrf-name*] **neighbor** [*interface-type interface-number*]

Syntax Description

vrf	(Optional) Supports the Multicast Virtual Private Network (VPN) routing and forwarding (VRF) instance.
vrf-name	(Optional) Name assigned to the VRF.
interface-type	(Optional) Interface type.
interface-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 to display the PIM protocol version.
12.0(23)S	The **vrf** keyword and *vrf-name* argument were added.
12.2(13)T	The **vrf** keyword and *vrf-name* argument were added.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.

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 5 describes the significant fields shown in the display.

Table 5 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.

Table 5 show ip pim neighbor Field Descriptions (continued)

Field	Description
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 in milliseconds) until the entry will be removed from the IP multicast routing table.
Ver	PIM protocol version.
DR Prio/Mode	Priority and Mode of the Designated Router (DR) Possible Modes are S (Sparse mode) or B (Bidirectional mode).

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.
12.2(14)S	This command was integrated into Cisco IOS Release 12.2(14)S.
12.2(15)T	This command was integrated into Cisco IOS Release 12.2(15)T.

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 03:24:10.505    500 msec   Static     Route UP        0
Mar 7 03:23:11.804    1000 sec   BGP        Route UP        3
Mar 7 03:23:10.796    500 msec   ISIS       Route UP        0
Mar 7 03:20:10.420    500 msec   ISIS       Route Down      3
Mar 7 03:19:51.072    500 msec   Static     Route Down      0
Mar 7 02:46:32.464    500 msec   Connected  Route UP        3
Mar 7 02:46:24.052    500 msec   Static     Route Down      0
Mar 7 02:46:10.200    1000 sec   Connected  Route UP        3
Mar 7 02:46:09.060    500 msec   OSPF       Route UP        3
Mar 7 02:46:07.416    500 msec   OSPF       Route Down      0
Mar 7 02:45:50.423    500 msec   EIGRP      Route UP        3
Mar 7 02:45:09.679    500 msec   EIGRP      Route Down      0
Mar 7 02:45:06.322    500 msec   EIGRP      Route Down      2
Mar 7 02:33:09.424    500 msec   Connected  Route UP        0
Mar 7 02:32:28.307    500 msec   BGP        Route UP        3
```

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 6 describes the significant fields shown in the display.

Table 6 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.

Glossary

convergence—Speed and ability of a group of internetworking devices running a specific routing protocol to agree on the topology of an internetwork after a change in that topology.

DR—designated router. OSPF router that generates link-state advertisements (LSAs) for a multiaccess network and has other special responsibilities in running Open Shortest Path First (OSPF). Each multiaccess OSPF network that has at least two attached routers has a designated router that is elected by the OSPF Hello protocol. The designated router enables a reduction in the number of adjacencies required on a multiaccess network, which in turn reduces the amount of routing protocol traffic and the size of the topological database.

Internet Group Management Protocol (IGMP)—Internet Group Management Protocol. Used by IP hosts to report their multicast group memberships to an adjacent multicast router.

MBONE—multicast backbone. Multicast backbone of the Internet. MBONE is a virtual multicast network composed of multicast LANs and the point-to-point tunnels that interconnect them.

multicast—Single packets copied by the network and sent to a specific subset of network addresses. These addresses are specified in the Destination Address Field.

multicast address—Single address that refers to multiple network devices. Synonymous with group address.

Multicast Source Discovery Protocol (MSDP)—A mechanism to connect multiple Protocol Independent Multicast sparse mode (PIM-SM) domains. MSDP allows multicast sources for a group to be known to all rendezvous points in different domains.

PIM—Protocol Independent Multicast. Multicast routing architecture that allows the addition of IP multicast routing on existing IP networks. PIM is unicast routing protocol independent and can be operated in two modes: dense and sparse.

Reverse Path Forwarding (RPF)—Multicasting technique in which a multicast datagram is forwarded out of all but the receiving interface if the receiving interface is the one used to forward unicast datagrams to the source of the multicast datagram.

Note Refer to the *Internetworking Terms and Acronyms* for terms not included in this glossary.