



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.

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Prerequisites for Multicast Subsecond Convergence

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

Restrictions for Multicast Subsecond Convergence

Devices that use the subsecond designated router (DR) failover enhancement must be able to process hello interval information arriving in milliseconds. Devices that are congested or do not have enough CPU cycles to process the hello interval can assume that the Protocol Independent Multicast (PIM) neighbor is disconnected, although this may not be the case.

Information About Multicast Subsecond Convergence

Benefits of Multicast Subsecond Convergence

- The scalability components improve on the efficiency of handling increases (or decreases) in service users (receivers) and service load (sources or content).

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

Multicast Subsecond Convergence Scalability Enhancements

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

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

The scalability enhancements provide the following benefits:

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

PIM Router Query Messages

Multicast subsecond convergence allows you to send PIM router query messages (PIM hellos) every few milliseconds. The PIM hello message is used to locate neighboring PIM devices. Before the introduction of this feature, the device could send the PIM hellos only every few seconds. By enabling a device to send PIM hello messages more often, this feature allows the device to discover unresponsive neighbors more quickly. As a result, the device can implement failover or recovery procedures more efficiently.

Reverse Path Forwarding

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

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

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

RPF Checks

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

Triggered RPF Checks

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

RPF Failover

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

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

Topology Changes and Multicast Routing Recovery

The Multicast Subsecond Convergence feature set enhances both enterprise and service provider network backbones by providing almost instantaneous recovery of multicast paths after unicast routing recovery.

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

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

How to Configure Multicast Subsecond Convergence

Modifying the Periodic RPF Check Interval

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



Note Cisco recommends that you do *not* change the default values for the **ip rpf interval** command. The default values allow subsecond RPF failover. The default interval at which periodic RPF checks occur is 10 seconds.

SUMMARY STEPS

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

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	ip multicast rpf interval <i>seconds</i> [list <i>access-list</i> route-map <i>route-map</i>] Example: Device(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, on page 4](#) 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, on page 5](#) to modify the interval at which IGMP host query messages are sent. Proceed to the [Verifying Multicast Subsecond Convergence Configurations](#) to display information about and to verify information regarding the Multicast Subsecond Convergence feature.

Configuring PIM RPF Failover Intervals

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



Note Cisco recommends that you do *not* modify the default values for the **ip multicast rpf backoff** command. The default values allow subsecond RPF failover.

SUMMARY STEPS

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

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	ip multicast rpf backoff <i>minimum maximum</i> [disable] Example: Device(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, on page 5](#) to modify the interval at which IGMP host query messages are sent. Proceed to the *Verifying Multicast Subsecond Convergence Configurations* 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.

SUMMARY STEPS

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

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	interface <i>type slot / subslot / port</i> Example: Device(config)# interface gigabitethernet 1/0/0	Specifies the interface and enters interface configuration mode.
Step 4	ip pim query-interval <i>period [msec]</i> Example: Device(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* to display and verify information about 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

DETAILED STEPS

Procedure

Step 1 enable

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 `show ip pim interface` *type number*

Use this command to display information about interfaces configured for PIM.

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

Example:

```
Device# show ip pim interface GigabitEthernet 1/0/0
Address      Interface          Ver/   Nbr   Query  DR    DR
              Mode              Count  Intvl Prior
172.16.1.4   GigabitEthernet1/0/0 v2/S   1     100 ms 1     172.16.1.4
```

Step 3 `show ip pim neighbor`

Use this command to display the PIM neighbors discovered by the Cisco IOS XE software.

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

Example:

```
Device# show ip pim neighbor
PIM Neighbor Table
Neighbor      Interface          Uptime/Expires   Ver  DR
Address      Prio/Mode
172.16.1.3   GigabitEthernet1/0/0 00:03:41/250 msec v2   1 / S
```

Configuration Examples for Multicast Subsecond Convergence

Example Modifying the Periodic RPF Check Interval

In the following example, the `ip multicast rpf interval` has been set to 10 seconds. This command does not show up in `show running-config` output unless the interval value has been configured to be the nondefault value.

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

Example Configuring PIM RPF Failover Intervals

In the following example, the **ip multicast rpf backoff** command has been configured with a minimum backoff interval value of 100 and a maximum backoff interval value of 2500. This command does not show up in **show running-config** command output unless the interval value has been configured to be the nondefault value.

```
!
ip multicast-routing
.
.
.
ip multicast rpf backoff 100 2500
!
!
interface Ethernet0/0
 ip address 172.16.2.1 255.255.255.0
.
.
ip pim sparse-mode
!
```

Modifying the PIM Router Query Message Interval Example

In the following example, the **ip pim query-interval** command has been set to 100 milliseconds. This command does not show up in **show running-config** command output unless the interval value has been configured to be the nondefault value.

```
!
interface gigabitethernet0/0/1
 ip address 172.16.2.1 255.255.255.0
 ip pim query-interval 100 msec
 ip pim sparse-mode
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS IP Multicast commands	Cisco IOS IP Multicast Command Reference

MIBs

MIB	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 locate and download MIBs for selected platforms, Cisco IOS XE releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

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

Feature Information for Multicast Subsecond Convergence

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <https://cfng.cisco.com/>. An account on Cisco.com is not required.

Table 1: Feature Information for Multicast Subsecond Convergence

Feature Name	Releases	Feature Information
Multicast Subsecond Convergence	12.0(22)S 12.2(14)S 12.2(15)T Cisco IOS XE Release 2.1 15.0(1)S Cisco IOS XE Release 3.1.0SG Cisco IOS XE Release 3.2SE	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. The following commands were introduced or modified: 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.

