

Configuring PIM

This chapter describes how to configure the Protocol Independent Multicast (PIM) features on Cisco NX-OS devices in your IPv4 networks.

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About PIM

PIM, which is used between multicast-capable routers, advertises group membership across a routing domain by constructing multicast distribution trees. PIM builds shared distribution trees on which packets from multiple sources are forwarded, as well as source distribution trees on which packets from a single source are forwarded.

Cisco NX-OS supports PIM sparse mode for IPv4 networks (PIM). In PIM sparse mode, multicast traffic is sent only to locations of the network that specifically request it. You can configure PIM to run simultaneously on a router. You can use PIM global parameters to configure rendezvous points (RPs), message packet filtering, and statistics. You can use PIM interface parameters to enable multicast, identify PIM borders, set the PIM hello message interval, and set the designated router (DR) priority.

Note Cisco NX-OS does not support PIM dense mode.

In Cisco NX-OS, multicast is enabled only after you enable the PIM feature on each router and then enable PIM sparse mode on each interface that you want to participate in multicast. You can configure PIM for an IPv4 network . In an IPv4 network, if you have not already enabled IGMP on the router, PIM enables it automatically.

You use the PIM global configuration parameters to configure the range of multicast group addresses to be handled by these distribution modes:

- Any Source Multicast (ASM) provides discovery of multicast sources. It builds a shared tree between sources and receivers of a multicast group and supports switching over to a source tree when a new receiver is added to a group. ASM mode requires that you configure an RP.

For more information about PIM sparse mode and shared distribution trees used by the ASM mode, see RFC 4601.

Note Cisco Nexus® 3550-T does not support the following-

- Cisco Nexus® 3550-T cannot operate as a multicast FHR device.
- Cisco Nexus® 3550-T does not support the formation of source trees (SG-Tree).

Hello Messages

The PIM process begins when the router establishes PIM neighbor adjacencies by sending PIM hello messages to the multicast IPv4 address 224.0.0.13. Hello messages are sent periodically at the interval of 30 seconds. When all neighbors have replied, the PIM software chooses the router with the highest priority in each LAN segment as the designated router (DR). The DR priority is based on a DR priority value in the PIM hello message. If the DR priority value is not supplied by all routers, or the priorities match, the highest IP address is used to elect the DR.

The hello message also contains a hold-time value, which is typically 3.5 times the hello interval. If this hold time expires without a subsequent hello message from its neighbor, the device detects a PIM failure on that link.

The configured hold-time changes may not take effect on first two hellos sent after enabling or disabling PIM on an interface. For the first two hellos sent on the interface, thereafter, the configured hold times will be used. This may cause the PIM neighbor to set the incorrect neighbor timeout value for the initial neighbor setup until a hello with the correct hold time is received.

For added security, you can configure an MD5 hash value that the PIM software uses to authenticate PIM hello messages with PIM neighbors.

Join-Prune Messages

When the DR receives an IGMP membership report message from a receiver for a new group or source, the DR creates a tree to connect the receiver to the source by sending a PIM join message out the interface toward the rendezvous point (ASM mode). The rendezvous point (RP) is the root of a shared tree, which is used by all sources and hosts in the PIM domain in the ASM mode.

When the DR determines that the last host has left a group or source, it sends a PIM prune message to remove the path from the distribution tree.

The routers forward the join or prune action hop by hop up the multicast distribution tree to create (join) or tear down (prune) the path.

Note In this publication, the terms “PIM join message” and “PIM prune message” are used to simplify the action taken when referring to the PIM join-prune message with only a join or prune action.

Join-prune messages are sent as quickly as possible by the software. You can filter the join-prune messages by defining a routing policy.

State Refreshes

PIM requires that multicast entries are refreshed within a 3.5-minute timeout interval. The state refresh ensures that traffic is delivered only to active listeners, and it keeps routers from using unnecessary resources.

To maintain the PIM state, the last-hop DR sends join-prune messages once per minute. State creation applies to (*, G) state as follows:

- (*, G) state creation example—An IGMP (*, G) report triggers the DR to send a (*, G) PIM join message toward the RP.

If the state is not refreshed, the PIM software tears down the distribution tree by removing the forwarding paths in the multicast outgoing interface list of the upstream routers.

Rendezvous Points

A rendezvous point (RP) is a router that you select in a multicast network domain that acts as a shared root for a multicast shared tree. You can configure as many RPs as you like, and you can configure them to cover different group ranges.

Static RP

You can statically configure an RP for a multicast group range. You must configure the address of the RP on every router in the domain.

You can define static RPs for the following reasons:

- To configure routers with the Anycast-RP address
- To manually configure an RP on a device

Note Cisco Nexus® 3550-T only supports and validates Static-RP.

PIM Register Messages

PIM register messages are unicast to the RP by designated routers (DRs) that are directly connected to multicast sources. The PIM register message has the following functions:

- To notify the RP that a source is actively sending to a multicast group.
- To deliver multicast packets sent by the source to the RP for delivery down the shared tree.

The DR continues to send PIM register messages to the RP until it receives a Register-Stop message from the RP. The RP sends a Register-Stop message in either of the following cases:

- The RP has no receivers for the multicast group being transmitted.
- The RP has joined the SPT to the source but has not started receiving traffic from the source.

The PIM triggered register is enabled by default.

You can use the **ip pim register-source** command to configure the IP source address of register messages when the IP source address of a register message is not a uniquely routed address to which the RP can send packets. This situation might occur if the source address is filtered so that the packets sent to it are not forwarded or if the source address is not unique to the network. In these cases, the replies sent from the RP to the source address will fail to reach the DR, resulting in Protocol Independent Multicast sparse mode (PIM-SM) protocol failures.

The following example shows how to configure the IP source address of the register message to the loopback 3 interface of a DR:

```
ip pim register-source loopback 3
```



Note There is no RPF check done for all the multicast routes installed in the Cisco Nexus 3550-T hardware. Any packet hitting the entry is flooded to all the programed receivers, irrespective of the incoming interface.



Note In Cisco NX-OS, PIM register messages are rate limited to avoid overwhelming the RP.

Designated Routers

In PIM ASM mode, the software chooses a designated router (DR) from the routers on each network segment. The DR is responsible for forwarding multicast data for specified groups and sources on that segment.

The DR for each LAN segment is determined as described in the Hello messages.

In ASM mode, the DR is responsible for unicasting PIM register packets to the RP. When a DR receives an IGMP membership report from a directly connected receiver, the shortest path is formed to the RP, which may or may not go through the DR. The result is a shared tree that connects all sources transmitting on the same multicast group to all receivers of that group.



Note Cisco Nexus 3550-T does not forward multicast packets to the designated router if there is no direct receiver connected to the Cisco Nexus 3550-T hardware.



Note PIM-BIDIR mode is not supported in Cisco Nexus 3550-T.

Note ASM Switchover from Shared Tree to Source Tree is not supported in the Cisco Nexus 3550-T 10.1(2t) release.

Prerequisites for PIM

- You are logged onto the device.
- For global commands, you are in the correct virtual routing and forwarding (VRF) mode. The default configuration mode shown in the examples in this chapter applies to the default VRF.

Note Cisco Nexus 3550-T - 10.1(2t) release, supports only default VRF.

Guidelines and Limitations for PIM

PIM has the following guidelines and limitations:

Note In ***Cisco Nexus 3550-T - 10.1(2t) release***, PIM is supported only default VRF.

- Only PIM-ASM mode is supported in the Cisco Nexus® 3550-T switches.
- ***Cisco Nexus 3550-T - 10.1(2t) release*** does not support AutoRP or BSR configuration.
- Below configuration is recommended since {Vrf,S,G} Routes are not supported –
  - Configure **ip pim spt-threshold infinity**
  - Disable PIM-SSM.
  - Even though IGMPv3 snooping is Enabled, {S,G} received from IGMPv3 are not installed in the Cisco Nexus 3550-T - 10.1(2t) release.
- RPF check is not implemented in hardware – hence RPF-failed packet received is forwarded to installed {*,G} route oiflist. Though hardware check is implemented to avoid forward the packet back on incoming L3 port.
- Cisco Nexus® 3550-T switch does cut-through forwarding; hence there is no MTU- check implemented. Hardware buffering is not designed for jumbo packets and packets beyond regular MTU size 1516 is not supported.
- L3 Multicast lookup is not enabled on Trunk ports.
- L3 Multicast has the following scale numbers:
  - L2MCAST - 768 system-wide shared with MAC tabel - {vlan,MAC}

- EntriesL3MCAST - 384 system-wide {vrf,G,*} Entries only

- L3 multicast result cannot contain trunk ports as an OIF. Any entry computed to install with Trunk-port OIF is not installed in h/w.
- L3 Multicast lookup miss packets are not punted to SUP. Hence, Cisco Nexus® 3550-T switch cannot act as FHR; though if {*,G} tree is already installed it will forward multicast along that path.
- When L3 lookup is done; even the L2 domain multicast receivers receive packets with decremented TTL.
- Cisco Nexus® 3550-T platform switches does not support MSDP.
- For most Cisco Nexus devices, RPF failure traffic is dropped and sent to the CPU at a very low rate to trigger PIM asserts. Cisco Nexus® 3550-T switches, do not check for RPF failure and all traffic is forwarded according to the installed route.
- For first-hop source detection in most Cisco Nexus devices, traffic coming from the first hop is detected based on the source subnet check, and multicast packets are copied to the CPU only if the source belongs to the local subnet. The Cisco Nexus® 3550-T switches do not support FHR function, cannot detect First-hop traffic, hence no multicast packets are sent to the supervisor to learn the local multicast source.
- Cisco NX-OS PIM do not interoperate with any version of PIM dense mode or PIM Sparse Mode version 1.

Guidelines and Limitations for Hello Messages

The following guidelines and limitations apply to Hello Messages:

- Default values for the PIM hello interval are recommended and should not be modified.

Guidelines and Limitations for Rendezvous Points

The following guidelines and limitations apply to Rendezvous Points (RP):

- Cisco Nexus 3550-T - 10.1(2t) release can only operate as a static RP.

Default Settings

This table lists the default settings for PIM parameters.

Table 1: Default PIM Parameters

Parameters	Default
Use shared trees only	Disabled
Flush routes on restart	Disabled
Log neighbor changes	Disabled

Parameters	Default
Auto-RP message action	Disabled **Note** **Do Not Enable** Auto-RP message action since, BSR is not available in Cisco Nexus 3550-T - 10.1(2t) release.
BSR message action	Disabled **Note** **Do not Enable** BSR message action since, BSR is not available in Cisco Nexus 3550-T - 10.1(2t) release.
PIM sparse mode	Disabled
Designated router priority	1
Hello authentication mode	Disabled
Domain border	Disabled **Note** **Do not Enable** since Domain border is not available in Cisco Nexus 3550-T - 10.1(2t) release.

Note Cisco Nexus 3550-T - 10.1(2t) release does not support any policy configuration, hence it is disabled.

Configuring PIM

Note Cisco NX-OS supports only PIM sparse mode version 2. In this publication, "PIM" refers to PIM sparse mode version 2.

You can configure separate ranges of addresses in the PIM domain using the multicast distribution modes described in the table below.

Multicast Distribution Mode	Requires RP Configuration	Description
ASM	Yes	Any source multicast
RPF routes for multicast	No	RPF routes for multicast

Note RPF check is not supported in Cisco Nexus 3550-T - 10.1(2t) release and the Multicast packets are flooded irrespective of RPF failure to programed receivers.

PIM Configuration Tasks

The following steps configure PIM .

Procedure

	Command or Action	Purpose
Step 1	Select the range of multicast groups that you want to configure in each multicast distribution mode.	
Step 2	Enable PIM.	
Step 3	Follow the configuration steps for the multicast distribution modes that you selected in Step 1.	
Step 4		

Enabling the PIM Feature

Before you can access the PIM commands, you must enable the PIM feature.

Before you begin

Ensure that you have installed the Enterprise Services license.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**feature pim** **Example:** `switch(config)# feature pim`	Enables PIM. By default, PIM is disabled.
Step 3	(Optional) **show running-configuration pim** **Example:** `switch(config)# show running-configuration pim`	Shows the running-configuration information for PIM.

	Command or Action	Purpose
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Configuring PIM Sparse Mode Parameters

You configure PIM sparse mode on every device interface that you want to participate in a sparse mode domain. You can configure the sparse mode parameters described in the table below.

Table 2: PIM Sparse Mode Parameters

Parameter	Description
Global to the device	
Register rate limit	Configures the IPv4 register rate limit in packets per second. The range is from 1 to 65,53 is no limit.
Initial holddown period	Configures the IPv4 initial holddown period in seconds. This holddown period is the time MRIB to come up initially. If you want faster convergence, enter a lower value. The range 210. Specify 0 to disable the holddown period. The default is 210.
Per device interface	
PIM sparse mode	Enables PIM on an interface.
Designated router priority	Sets the designated router (DR) priority that is advertised in PIM hello messages on this i multi-access network with multiple PIM-enabled routers, the router with the highest DR pr as the DR router. If the priorities match, the software elects the DR with the highest IP ad originates PIM register messages for the directly connected multicast sources and sends PIM toward the rendezvous point (RP) for directly connected receivers. Values range from 1 to The default is 1.
Designated router delay	Delays participation in the designated router (DR) election by setting the DR priority that PIM hello messages to 0 for a specified period. During this delay, no DR changes occur, a switch is given time to learn all of the multicast states on that interface. After the delay per correct DR priority is sent in the hello packets, which retriggers the DR election. Values r 0xffff seconds.

Parameter	Description
Hello authentication mode	Enables an MD5 hash authentication key, or password, in PIM hello messages on the interfac directly connected neighbors can authenticate each other. The PIM hello messages are IPsec en the Authentication Header (AH) option. You can enter an unencrypted (cleartext) key or one values followed by a space and the MD5 authentication key: • 0—Specifies an unencrypted (cleartext) key • 3—Specifies a 3-DES encrypted key • 7—Specifies a Cisco Type 7 encrypted key The authentication key can be up to 16 characters. The default is disabled.
Hello interval	Configures the interval at which hello messages are sent in milliseconds. The range is from 1 18724286. The default is 30000. **Note** See the *Cisco Nexus® 3550-T Verified Scalability Guide* for the verified range of this parame associated PIM neighbor scale.

Configuring PIM Sparse Mode Parameters

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	(Optional) **ip pim register-rate-limit** *rate* **Example:** `switch(config)# ip pim register-rate-limit 1000`	Configures the rate limit in packets per second. The range is from 1 to 65,535. The default is no limit.
Step 3	(Optional) **ip pim spt-threshold infinity group-list** *route-map-name* **Example:** `switch(config)# ip pim spt-threshold infinity group-list my_route-map-name`	Creates the IPv4 PIM (*, G) state only, for the group prefixes defined in the specified route map. Cisco NX-OS Release 3.1 supports up to 1000 route-map entries, and Cisco NX-OS releases prior to 3.1 support up to 500 route-map entries. **Note** The **ip pim use-shared-tree-only group-list** command performs the same function as the **ip pim spt-threshold infinity group-list** command. You can choose to use either command to implement this step.

	Command or Action	Purpose
Step 4	(Optional) [**ip** | **ipv4**] **routing multicast holddown** *holddown-period* **Example:** `switch(config)# ip routing multicast holddown 100`	Configures the initial holddown period in seconds. The range is from 90 to 210. Specify 0 to disable the holddown period. The default is 210.
Step 5	(Optional) **show running-configuration pim** **Example:** `switch(config)# show running-configuration pim`	Displays PIM running-configuration information.

Step 6	**interface** *interface*
	Example:
	`switch(config)# interface ethernet 1/1`
	`switch(config-if)#`
		Enters interface configuration mode.

Step 7	**ip pim sparse-mode** **Example:** `switch(config-if)# ip pim sparse-mode`	Enables PIM sparse mode on this interface. The default is disabled.
Step 8	(Optional) **ip pim dr-priority** *priority* **Example:** `switch(config-if)# ip pim dr-priority 192`	Sets the designated router (DR) priority that is advertised in PIM hello messages. Values range from 1 to 4294967295. The default is 1.
Step 9	(Optional) **ip pim dr-delay** *delay* **Example:** `switch(config-if)# ip pim dr-delay 3`	Delays participation in the designated router (DR) election by setting the DR priority that is advertised in PIM hello messages to 0 for a specified period. During this delay, no DR changes occur, and the current switch is given time to learn all of the multicast states on that interface. After the delay period expires, the correct DR priority is sent in the hello packets, which retriggers the DR election. Values range from 3 to 0xffff seconds. **Note** This command delays participation in the DR election only upon bootup or following an IP address or interface state change. It is intended for use with multicast-access Layer 3 interfaces only.
Step 10	(Optional) **ip pim hello-authentication ah-md5** *auth-key* **Example:** `switch(config-if)# ip pim hello-authentication ah-md5 my_key`	Enables an MD5 hash authentication key in PIM hello messages. You can enter an unencrypted (cleartext) key or one of these values followed by a space and the MD5 authentication key:

	Command or Action	Purpose
		• 0—Specifies an unencrypted (cleartext) key • 3—Specifies a 3-DES encrypted key • 7—Specifies a Cisco Type 7 encrypted key The key can be up to 16 characters. The default is disabled.
Step 11	(Optional) **ip pim hello-interval** *interval* **Example:** `switch(config-if)# ip pim hello-interval 25000`	Configures the interval at which hello messages are sent in milliseconds. The range is from 1000 to 18724286. The default is 30000. **Note** The minimum value is 1 millisecond.
Step 12	(Optional) **show ip pim interface** [*interface* | **brief**] **Example:** `switch(config-if)# show ip pim interface`	Displays PIM interface information.
Step 13	(Optional) **copy running-config startup-config** **Example:** `switch(config-if)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Configuring ASM

To configure ASM mode, you configure sparse mode and the RP selection method, where you indicate the distribution mode and assign the range of multicast groups.

Configuring Static RPs

You can configure an RP statically by configuring the RP address on every router that will participate in the PIM domain.



Note We recommend that the RP address uses the loopback interface and also the interface with the RP address must have **ip pim sparse-mode** enabled.

Configuring Static RPs

Before you begin

Ensure that you have installed the Enterprise Services license and enabled PIM.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**ip pim rp-address** *rp-address* **Example:** `switch(config)# ip pim rp-address 192.0.2.33`	Configures a PIM static RP address for a multicast groups. You can specify a prefix-list policy name for the static RP address. The mode is ASM.
Step 3	(Optional) **show ip pim group-range** [*ip-prefix*] **Example:** `switch(config)# show ip pim group-range`	Displays PIM RP information.
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Configuring Shared Trees Only for ASM

You can configure shared trees only on the last-hop router for Any Source Multicast (ASM) groups, which means that the router never switches over from the shared tree to the SPT when a receiver joins an active group.

Note The Cisco Nexus® 3550-T supports shared-tree feature only.

Configuring Message Filtering

You can configure filtering of the PIM messages described in the table below.

Table 3: PIM Message Filtering

Message Type	Description
Global to the Device	
Log Neighbor changes	Enables syslog messages that list the neighbor state changes to be generated. The default is disabled.

Configuring Message Filtering

Before you begin

Ensure that you have installed the Enterprise Services license and enabled PIM.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	(Optional) **ip pim log-neighbor-changes** **Example:** `switch(config)# ip pim log-neighbor-changes`	Enables syslog messages that list the neighbor state changes to be generated. The default is disabled.
Step 3	(Optional) **show run pim** **Example:** `switch(config-if)# show run pim`	Displays PIM configuration commands.
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config-if)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Restarting the PIM Processes

When routes are flushed, they are removed from the Multicast Routing Information Base (MRIB) and the Multicast Forwarding Information Base (MFIB).

When you restart PIM, the following tasks are performed:

- The PIM database is deleted.
- The MRIB and MFIB are unaffected and forwarding of traffic continues.
- The multicast route ownership is verified through the MRIB.

- Periodic PIM join and prune messages from neighbors are used to repopulate the database.

Restarting the PIM Process

Before you begin

Ensure that you have installed the Enterprise Services license and enabled PIM.

Procedure

	Command or Action	Purpose
Step 1	**restart pim** **Example:** `switch# restart pim`	Restarts the PIM process. **Note** Traffic loss might occur during the restart process.

Step 2	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 3	**ip pim flush-routes** **Example:** `switch(config)# ip pim flush-routes`	Removes routes when the PIM process is restarted. By default, routes are not flushed.
Step 4	(Optional) **show running-configuration pim** **Example:** `switch(config)# show running-configuration pim`	Displays the PIM running-configuration information, including the **flush-routes** command.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Verifying the PIM Configuration

To display the PIM configuration information, perform one of the following tasks.

Command	Description
show ip mroute [*ip-address*] [**detail** | **summary**]	Displays the IP multicast routing table. The **detail** option displays detailed route attr The **summary** option displays route counts packet rates. **Note** This command also displays multicast cour for Cisco Nexus® 3550-T switches, if the multicast heavy template is enabled. See sa outputs below.
show ip pim group-range [*ip-prefix*]	Displays the learned or configured group ra and modes. For similar information, see the **ip pim rp** command.
show ip pim interface [*interface* | **brief**]	Displays information by the interface.
show ip pim neighbor [**interface** *interface* | *ip-prefix*]	Displays neighbors by the interface.
show ip pim oif-list *group* [*source*]	Displays all the interfaces in the outgoing in (OIF) list.
show ip pim route [*source* | *group* [*source*]]	Displays information for each multicast rou including interfaces on which a PIM join fo (*, G) has been received.
show ip pim rp [*ip-prefix*]	Displays rendezvous points (RPs) known t software, how they were learned, and their ranges. For similar information, see the **sho pim group-range** command.
show running-config pim	Displays the running-configuration informa
show startup-config pim	Displays the startup-configuration informa
show ip pim [**detail**]	Displays pim details information.

Displaying Statistics

You can display and clear PIM statistics by using the commands in this section.

Displaying PIM Statistics

You can display the PIM statistics and memory usage using these commands.

Command	Description
show ip pim policy statistics	Displays policy statistics for register, RP, and join-prune message policies.
show ip pim statistics	Displays global statistics.

Clearing PIM Statistics

You can clear the PIM statistics using these commands.

Command	Description
clear ippim interface statistics *interface*	Clears counters for the specified interface.
clear ip pim policy statistics	Clears policy counters for register, RP, and join-prune message policies.
clear ip pim statistics	Clears global counters handled by the PIM process.

Related Documents

Related Topic	Document Title

Standards

MIBs

MIBs	MIBs Link
MIBs related to PIM	To locate and download supported MIBs, go to the follow ftp://ftp.cisco.com/pub/mibs/supportlists/nexus9000/Nexus9000MIBSupportList.html