PBR Recursive Next Hop

The PBR Recursive Next Hop feature enhances route maps to enable configuration of a recursive next-hop IP address that is used by policy-based routing (PBR). The recursive next-hop IP address is installed in the routing table and can be a subnet that is not directly connected. If the recursive next-hop IP address is not available, packets are routed using a default route.

Because Cisco Express Forwarding (CEF) or process switching provides the infrastructure, the benefit of this feature is the CEF loadsharing.

- Finding Feature Information, on page 1
- Restrictions for PBR Recursive Next Hop, on page 1
- Information About PBR Recursive Next-Hop, on page 2
- How to Configure PBR Recursive Next Hop, on page 2
- Configuration Examples for PBR Recursive Next Hop, on page 6
- Additional References for PBR Recursive Next Hop , on page 6
- Feature Information for PBR Recursive Next Hop, on page 7

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for PBR Recursive Next Hop

If there are multiple equal-cost routes to the subnet that have been configured by the **set next-hop recursive** command, load balancing will occur only if all the adjacencies to the routes are resolved. If any of the adjacencies have not been resolved, load balancing will not occur and only one of the routes whose adjacency is resolved will be used. If none of the adjacencies are resolved, then the packets will be processed, resulting in the resolution of at least one of the adjacencies, leading to the programming of the adjacency in the hardware. Policy based routing relies on routing protocols or other means to resolve all adjacencies and as a result, load balancing occurs.

PBR Recursive Next Hope for IPv6 does not support load sharing.

Information About PBR Recursive Next-Hop

PBR Recursive Next Hop Overview

The PBR Recursive Next Hop feature enhances route maps to enable configuration of a recursive next-hop IP address that is used by policy-based routing (PBR). The recursive next-hop IP address is installed in the routing table and can be a subnet that is not directly connected. If the recursive next-hop IP address is not available, packets are routed using a default route.

PBR Recursive Next Hop for IPv6 also supports non-directly connected next hop. The recursive next hop specified can be a host address or a subnet address. The routing table is looked up to get the next hop based on the longest match of addresses. Only one such recursive next hop is supported per route map entry.

How to Configure PBR Recursive Next Hop

Setting the Recursive Next-Hop IP Address

The infrastructure provided by CEF or process switching performs the recursion to the next-hop IP address. The configuration sequence, which affects routing, is as follows:

1. Next-hop
2. Next-hop recursive
3. Interface
4. Default next-hop
5. Default interface

If both a next-hop address and a recursive next-hop IP address are present in the same route-map entry, the next hop is used. If the next hop is not available, the recursive next hop is used. If the recursive next hop is not available and no other IP address is present, the packet is routed using the default routing table; it is not dropped. If the packet is supposed to be dropped, use the **set ip next-hop**command with the **recursive** keyword, followed by a **set interface null0** configuration.

Perform this task to set the IP address for the recursive next-hop router.

Before you begin

If loadsharing is required, CEF loadsharing should be configured for per-packet or per-destination loadsharing. Loadbalancing should be done over all equal-cost routes to the subnet that has been configured by the **set ip next-hop recursive**command.

This functionality should be available in centralized and distributed systems.

Note Only one recursive next-hop IP address is supported per route-map entry.

>

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **access-list** *access-list-number* {**deny** | **permit**} *source*[*source-wildcard*] [**log**]
4. **route-map** *map-tag*
5. Do one of the following:
   - **set ip next-hop** *ip-address*
   - **set ipv6 next-hop** *ip-address*
6. Do one of the following:
   - **set ip next-hop** {*ip-address* [*...ip-address*] | **recursive** *ip-address*}
   - **set ipv6 next-hop** {*ipv6-address* [*...ipv6-address*] | **recursive** *ipv6-address*}
7. Do one of the following:
   - **match ip address** *access-list-number*
   - **match ipv6 address** {**prefix-list** *prefix-list-name* |*access-list-name*}
8. **end**

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	**access-list** *access-list-number* {**deny**	**permit**} *source*[*source-wildcard*] [**log**] **Example:** `Router(config)# access-list 101 permit 10.60.0.0 0.0.255.255`	Configures an access list. The example configuration permits any source IP address that falls within the 10.60.0.0. 0.0.255.255 subnet.
Step 4	**route-map** *map-tag* **Example:**	Enables policy routing and enters route-map configuration mode.

	Command or Action	Purpose
	`Router(config)# route-map abccomp`	

Step 5	Do one of the following:
	• **set ip next-hop** *ip-address*
	• **set ipv6 next-hop** *ip-address*
	Example:
	`Router(config-route-map)# set ip next-hop 10.10.1.1`
	Example:
	`Router(config-route-map)# set ipv6 next-hop 2001:DB8:2003:1::95`
		Sets a next-hop router IPv4 or IPv6 address.
		Note Set this IPv4/IPv6 address separately from the next-hop recursive router configuration.

Step 6	Do one of the following:
	• **set ip next-hop** {*ip-address* [*...ip-address*] | **recursive** *ip-address*}
	• **set ipv6 next-hop** {*ipv6-address* [*...ipv6-address*] | **recursive** *ipv6-address*}
	Example:
	`Router(config-route-map)# set ip next-hop recursive 10.20.3.3`
	Example:
	`Router(config-route-map)# set ipv6 next-hop recursive 2001:DB8:2003:2::95`
		Sets a recursive next-hop IPv4/IPv6 address.
		Note This configuration does not ensure that packets get routed using the recursive IP address if an intermediate IP address is a shorter route to the destination.

Step 7	Do one of the following:
	• **match ip address** *access-list-number*
	• **match ipv6 address** {**prefix-list** *prefix-list-name* |*access-list-name*}
	Example:
	`Router(config-route-map)# match ip address 101`
	Example:
	`Router(config-route-map)# match ipv6 address kmd`
		Sets an access list to be matched.

Step 8	**end** **Example:** `Router(config-route-map)# end`	Exits route-map configuration mode and returns to privileged EXEC mode.

Verifying the Recursive Next-Hop Configuration

To verify the recursive next-hop configuration, perform the following steps.

SUMMARY STEPS

1. **show running-config** | **begin abccomp**
2. **show route-map** *map-name*

DETAILED STEPS

Step 1 show running-config | begin abccomp

Use this command to verify the IPv4/IPv6 addresses for a next-hop and recursive next-hop IPv4/IPv6 address as listed in the following examples:

Example:

```
Router# show running-config | begin abccomp
route-map abccomp permit 10
 match ip address 101 ! Defines the match criteria for an access list.
 set ip next-hop recursive 10.3.3.3 ! If the match criteria are met, the recursive IP  address is
set.
 set ip next-hop 10.1.1.1 10.2.2.2 10.4.4.4
```

```
Router# show running-config | begin abccomp
route-map abccomp permit 10
 match ip address kmd! Defines the match criteria for an access list.
 set ipv6 next-hop recursive 2001:DB8:3000:1 ! If the match criteria are met, the recursive IPv6
address is set.
 set ipv6 next-hop 2001:DB8:3000:1 2001:DB8:4000:1 2001:DB8:5000:1
```

Step 2 show route-map *map-name*

Use this command to display the route maps, for example:

Example:

```
Router# show route-map abccomp
route-map abccomp, permit, sequence 10
 Match clauses:
  ip address (access-lists): 101
 Set clauses:
  ip next-hop recursive 10.3.3.3
  ip next-hop 10.1.1.1 10.2.2.2 10.4.4.4
 Policy routing matches: 0 packets, 0 bytes
```

```
Router# show route-map abccomp
route-map abccomp, permit, sequence 10
 Match clauses:
  ipv6 address (access-lists): kmd
 Set clauses:
  ipv6 next-hop recursive 2001:DB8:3000:1
  ipv6 next-hop 2001:DB8:3000:1 2001:DB8:4000:1 2001:DB8:5000:1
 Policy routing matches: 0 packets, 0 bytes
```

Configuration Examples for PBR Recursive Next Hop

Example: Recursive Next-Hop IP Address

The following example shows the configuration of IP address 10.3.3.3 as the recursive next-hop router:

```
route-map abccomp
 set ip next-hop 10.1.1.1
 set ip next-hop 10.2.2.2
 set ip next-hop recursive 10.3.3.3
 set ip next-hop 10.4.4.4
```

The following example shows the configuration of IPv6 address 2001:DB8:2003:1::95 as the recursive next-hop router:

```
route-map abccomp
 set ipv6 next-hop 2001:DB8:2003:1::95
 set ipv6 next-hop 2001:DB8:2004:3::96
 set ipv6 next-hop recursive 2001:DB8:2005:2::95
 set ipv6 next-hop 2001:DB8:2006:1::95
```

Additional References for PBR Recursive Next Hop

Related Documents

Related Topic	Document Title
Cisco IOS master command list, all releases	Cisco IOS Master Command List, All Releases
IP routing protocol-independent commands: complete command syntax, command mode, defaults, usage guidelines, and examples	Cisco IOS IP Routing: Protocol-Independent Command Reference
Performing basic system management	*Basic System Management Configuration Guide*
Changing the maximum number of paths	"BGP Multipath Load Sharing for Both eBGP and iBGP in an MPLS-VPN" module in the *BGP Configuration Guide*
BGP route map configuration tasks and configuration examples.	"Connecting to a Service Provider Using External BGP" module in the *BGP Configuration Guide*
BGP communities and route maps.	"BGP Cost Community" module in the *BGP Configuration Guide*
IPv6 Policy-Based Routing	"IPv6 Policy-Based Routing " module in the *IP Routing: Protocol-Independent Configuration Guide*

RFCs

RFC	Title
RFC 791	*Internet Protocol*
RFC 1219	*Variable-Length Subnet Masks*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for PBR Recursive Next Hop

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.

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Table 1: Feature Information for PBR Recursive Next Hop

Feature Name	Releases	Feature Information
PBR Recursive Next Hop	Cisco IOS XE Release 2.2	The PBR Recursive Next Hop feature enhances route maps to enable configuration of a recursive next-hop IP address that is used by policy-based routing (PBR). The following commands were modified by this feature: **set ip next-hop**, **show route-map**.
PBR Recursive Next Hop for IPv6	Cisco IOS XE Release 3.12S	The PBR Recursive Next Hop IPv6 feature enhances route maps to enable configuration of a recursive next-hop IPv6 address that is used by policy-based routing (PBR). No new commands were introduced or modified.