



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 load sharing.

Feature History for the PBR Recursive Next Hop Feature

Release	Modification
12.0(28)S	This feature was introduced.
12.3(14)T	This feature was integrated into Cisco IOS Release 12.3(14)T.

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How to Configure PBR Recursive Next Hop

This section contains the following procedures:

- [Setting the Recursive Next-Hop IP Address, page 2](#) (required)
- [Verifying the Recursive Next-Hop Configuration, page 4](#) (optional)

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 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 next-hop recursive** command followed by a **set interface null0** configuration.

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

Prerequisites

If load sharing is required, CEF load sharing should be configured for per-packet or per-destination load sharing. Load balancing should be done over all equal-cost routes to the subnet that have been configured by the **set next-hop recursive** command.

This functionality should be available in centralized and distributed systems.

Restrictions

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

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **access-list permit** *source*
4. **route-map** *map-tag*
5. **set ip next-hop** *ip-address*
6. **set ip next-hop recursive** *ip-address*
7. **match ip address** *access-list-number*
8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	<pre>enable</pre> <p>Example: Router> enable</p>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	<pre>configure terminal</pre> <p>Example: Router# configure terminal</p>	<p>Enters global configuration mode.</p>
Step 3	<pre>access-list permit source</pre> <p>Example: Router(config)# access-list permit 10.60.0.0 0.0.255.255</p>	<p>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.</p>
Step 4	<pre>route-map map-tag</pre> <p>Example: Router(config)# route-map abccomp</p>	<p>Enables policy routing and enters route-map configuration mode.</p>
Step 5	<pre>set ip next-hop ip-address</pre> <p>Example: Router(config-route-map)# set ip next-hop 10.10.1.1</p>	<p>Sets a next-hop router IP address.</p> <p>Note Set this IP address separately from the next-hop recursive router configuration.</p>
Step 6	<pre>set ip next-hop recursive ip-address</pre> <p>Example: Router(config-route-map)# set ip next-hop recursive 10.20.3.3</p>	<p>Sets a recursive next-hop IP address.</p> <p>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.</p>
Step 7	<pre>match ip address access-list-number</pre> <p>Example: Router(config-route-map)# match ip address 101</p>	<p>Sets an access list to be matched.</p>
Step 8	<pre>exit</pre> <p>Example: Router(config-route-map)# exit</p>	<p>Exits global configuration mode.</p>

Verifying the Recursive Next-Hop Configuration

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

SUMMARY STEPS

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

DETAILED STEPS

Step 1 **show running-config | beg abccomp**

Use this command to verify the IP addresses for a next-hop and recursive next-hop IP address, for example:

```
Router# show running-config | beg 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 is met, the recursive IP
address is set.
  set ip next-hop 10.1.1.1 10.2.2.2 10.4.4.4
```

Step 2 **show route-map abccomp**

Use this command to display the route-maps, for 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
```

Configuration Examples for PBR Recursive Next Hop

This section provides the following configuration example:

- [Recursive Next-Hop IP Address: Example, page 4](#)

Recursive Next-Hop IP Address: Example

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
```

Additional References

The following sections provide references related to the PBR Recursive Next Hop feature.

Related Documents

Related Topic	Document Title
IP routing commandss: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	Cisco IOS IP Command Reference, Volume 2 of 4: Routing Protocols , Release 12.3T
Policy-based routing overview and configuration	“ Configuring Policy-Based Routing ” chapter in the <i>Cisco IOS Quality of Service Solutions Configuration Guide</i> , Release 12.2

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

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 modified commands only.

- [set ip next-hop](#)
- [show route-map](#)

set ip next-hop

To indicate where to output packets that pass a match clause of a route map for policy routing, use the **set ip next-hop** command in route-map configuration mode. To delete an entry, use the **no** form of this command.

```
set ip next-hop { ip-address [...ip-address] | recursive ip-address }
```

```
no set ip next-hop ip-address [...ip-address]
```

Syntax Description		
	<i>ip-address</i>	IP address of the next hop to which packets are output. It must be the address of an adjacent router.
	recursive	IP address of the recursive next-hop router.
	<i>ip-address</i>	Note The next-hop IP address must be assigned separately from the recursive next-hop IP address.

Defaults This command is disabled by default.

Command Modes Route-map configuration

Command History	Release	Modification
	11.0	This command was introduced.
	12.0(28)S	The recursive keyword was added.
	12.3(14)T	This command was integrated into Cisco IOS Release 12.3(14)T.

Usage Guidelines An ellipsis (...) in the command syntax indicates that your command input can include multiple values for the *ip-address* argument.

Use the **ip policy route-map** interface configuration command, the **route-map** global configuration command, and the **match** and **set** route-map configuration commands to define the conditions for policy routing packets. The **ip policy route-map** command identifies a route map by name. Each **route-map** command has a list of **match** and **set** commands associated with it. The **match** commands specify the *match criteria*—the conditions under which policy routing occurs. The **set** commands specify the *set actions*—the particular routing actions to perform if the criteria enforced by the **match** commands are met.

If the interface associated with the first next hop specified with the **set ip next-hop** command is down, the optionally specified IP addresses are tried in turn.

The set clauses can be used in conjunction with one another. They are evaluated in the following order:

1. **set ip next-hop**
2. **set interface**
3. **set ip default next-hop**
4. **set default interface**



Note

The **set ip next-hop** and **set ip default next-hop** are similar commands but have a different order of operations. Configuring the **set ip next-hop** command causes the system to use policy routing first and then use the routing table. Configuring the **set ip default next-hop** command causes the system to use the routing table first and then policy route the specified next hop.

Examples

In the following example, packets with a Level 3 length of 3 to 50 bytes are output to the router at IP address 10.14.2.2:

```
interface serial 0
  ip policy route-map thataway
!
route-map thataway
  match length 3 50
  set ip next-hop 10.14.2.2
```

In the following example, the IP address of 10.3.3.3 is set as the recursive next-hop address:

```
route-map map_recurse
  set ip next-hop recursive 10.3.3.3
```

Related Commands

Command	Description
ip policy route-map	Identifies a route map to use for policy routing on an interface.
match ip address	Distributes any routes that have a destination network number address that is permitted by a standard or extended access list, and performs policy routing on packets.
match length	Bases policy routing on the Level 3 length of a packet.
route-map (IP)	Defines the conditions for redistributing routes from one routing protocol into another, or enables policy routing.
set default interface	Indicates where to output packets that pass a match clause of a route map for policy routing and have no explicit route to the destination.
set interface	Indicates where to output packets that pass a match clause of route map for policy routing.
set ip default next-hop verify-availability	Indicates where to output packets that pass a match clause of a route map for policy routing and for which the Cisco IOS software has no explicit route to a destination.

show route-map

To display static and dynamic route maps, use the **show route-map** command in privileged EXEC mode.

```
show route-map [map-name | dynamic [dynamic-map-name | application [application-name]] | all]
```

Syntax Description		
	<i>map-name</i>	(Optional) Name of a specific route map.
	dynamic	(Optional) Displays dynamic route map information.
	<i>dynamic-map-name</i>	(Optional) Name of a specific dynamic route map.
	application	(Optional) Displays dynamic route maps based on applications.
	<i>application-name</i>	(Optional) Name of a specific application.
	all	(Optional) Displays all static and dynamic route maps.

Command Modes	
	Privileged EXEC

Command History	Release	Modification
	10.0	This command was introduced.
	12.0(22)S	An additional counter collect policy routing statistic was integrated in Cisco IOS Release 12.0(22)S.
	12.2(15)T	An additional counter collect policy routing statistic was integrated in Cisco IOS Release 12.2(15)T.
	12.3(7)T	The dynamic , application , and all keywords were added.
	12.0(28)S	The support for recursive next-hop clause was added.
	12.3(14)T	The support for recursive next-hop clause was integrated in Release 12.3(14)T.

Examples

show route-map Command with No Keywords Specified Example

The following is sample output from the **show route-map** command:

```
Router# show route-map

route-map sid, permit, sequence 10
Match clauses:
  tag 1 2
Set clauses:
  metric 5
route-map sid, permit, sequence 20
Match clauses:
  tag 3 4
Set clauses:
  metric 6
Policy routing matches: 0 packets; 0 bytes
```

The following example shows MPLS-related route map information:

```
Router# show route-map
```

```

route-map OUT, permit, sequence 10
Match clauses:
  ip address (access-lists): 1
Set clauses:
  mpls label
Policy routing matches: 0 packets, 0 bytes

route-map IN, permit, sequence 10
Match clauses:
  ip address (access-lists): 2
  mpls label
Set clauses:
Policy routing matches: 0 packets, 0 bytes

```

Table 1 describes the significant fields shown in the display.

Table 1 show route-map Field Descriptions

Field	Description
route-map	Name of the route map.
permit	Indicates that the route is redistributed as controlled by the set actions.
sequence	Number that indicates the position a new route map is to have in the list of route maps already configured with the same name.
Match clauses tag	Match criteria—conditions under which redistribution is allowed for the current route map.
Set clauses metric	Set actions—the particular redistribution actions to perform if the criteria enforced by the match commands are met.
Policy routing matches	Number of packets and bytes that have been filtered by policy routing.

show route-map Command with Dynamic Route Map Specified Example

The following is sample output from the **show route-map** command when entered with the **dynamic** keyword:

```

Router# show route-map dynamic

route-map AAA-02/06/04-14:01:26.619-1-AppSpec, permit, sequence 0, identifier 1137954548
  Match clauses:
    ip address (access-lists): PBR#1 PBR#2
  Set clauses:
  Policy routing matches: 0 packets, 0 bytes
route-map AAA-02/06/04-14:01:26.619-1-AppSpec, permit, sequence 1, identifier 1137956424
  Match clauses:
    ip address (access-lists): PBR#3 PBR#4
  Set clauses:
  Policy routing matches: 0 packets, 0 bytes
route-map AAA-02/06/04-14:01:26.619-1-AppSpec, permit, sequence 2, identifier 1124436704
  Match clauses:
    ip address (access-lists): PBR#5 PBR#6
    length 10 100
  Set clauses:
    ip next-hop 7.1.1.1
    ip gateway 7.1.1.1
  Policy routing matches: 0 packets, 0 bytes
Current active dynamic routemaps = 1

```

The following is sample output from the **show route-map** command when entered with the **dynamic** and **application** keywords:

```
Router# show route-map dynamic application
```

```
Application - AAA
  Number of active routemaps = 1
```

When you specify an application name, only dynamic routes for that application are shown. The following is sample output from the **show route-map** command when entered with the **dynamic** and **application** keywords and the AAA application name:

```
Router# show route-map dynamic application AAA
```

```
AAA
  Number of active rmaps = 2
AAA-02/06/04-14:01:26.619-1-AppSpec
AAA-02/06/04-14:34:09.735-2-AppSpec
```

```
Router# show route-map dynamic AAA-02/06/04-14:34:09.735-2-AppSpec
```

```
route-map AAA-02/06/04-14:34:09.735-2-AppSpec, permit, sequence 0, identifier 1128046100
  Match clauses:
    ip address (access-lists): PBR#7 PBR#8
  Set clauses:
    Policy routing matches: 0 packets, 0 bytes
route-map AAA-02/06/04-14:34:09.735-2-AppSpec, permit, sequence 1, identifier 1141277624
  Match clauses:
    ip address (access-lists): PBR#9 PBR#10
  Set clauses:
    Policy routing matches: 0 packets, 0 bytes
route-map AAA-02/06/04-14:34:09.735-2-AppSpec, permit, sequence 2, identifier 1141279420
  Match clauses:
    ip address (access-lists): PBR#11 PBR#12
    length 10 100
  Set clauses:
    ip next-hop 7.1.1.1
    ip gateway 7.1.1.1
    Policy routing matches: 0 packets, 0 bytes
Current active dynamic routemaps = 2
```

In the following example, a recursive route-map has been configured for the route-map named *abccomp*:

```
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
```

Related Commands

Command	Description
redistribute (IP)	Redistributes routes from one routing domain into another routing domain.
route-map (IP)	Defines the conditions for redistributing routes from one routing protocol into another, or enables policy routing.

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