



CHAPTER 17

Configuring Policy-Based Routing

This chapter describes how to configure policy-based routing on the Cisco NX-OS device.

This chapter includes the following sections:

- [Information About Policy-Based Routing, page 17-1](#)
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Information About Policy-Based Routing

Policy-based routing allows you to configure a defined policy for IPv4 and IPv6 traffic flows, lessening reliance on routes derived from routing protocols. All packets received on an interface with policy-based routing enabled are passed through enhanced packet filters or route maps. The route maps dictate the policy, determining where to forward packets.

Route maps are composed of match and set statements that you can mark as permit or deny. You can interpret the statements as follows:

- If the packets match any route map statements, all the set statements are applied. One of these actions involves choosing the next hop.
- If a statement is marked as deny, the packets that meet the match criteria are sent back through the normal forwarding channels and destination-based routing is performed.
- If the statement is marked as permit and the packets do not match any route-map statements, the packets are sent back through the normal forwarding channels and destination-based routing is performed.

For more information, see the [“Route Maps” section on page 16-2](#).

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Policy-based routing includes the following features:

- Source-based routing—Routes traffic that originates from different sets of users through different connections across the policy routers.
- Quality of Service (QoS)—Differentiates traffic by setting the precedence or type of service (ToS) values in the IP packet headers at the periphery of the network and leveraging queuing mechanisms to prioritize traffic in the core or backbone of the network (see the *Cisco Nexus 7000 Series NX-OS Quality of Service Configuration Guide, Release 5.x*).
- Load sharing—Distributes traffic among multiple paths based on the traffic characteristics.

This section includes the following topics:

- [Policy Route Maps, page 17-2](#)
- [Set Criteria for Policy-Based Routing, page 17-2](#)

Policy Route Maps

Each entry in a route map contains a combination of match and set statements. The match statements define the criteria for whether appropriate packets meet the particular policy (that is, the conditions to be met). The set clauses explain how the packets should be routed once they have met the match criteria.

You can mark the route-map statements as permit or deny. If the statement is marked as a deny, the packets that meet the match criteria are sent back through the normal forwarding channels (destination-based routing is performed). If the statement is marked as permit and the packets meet the match criteria, all the set clauses are applied. If the statement is marked as permit and the packets do not meet the match criteria, those packets are also forwarded through the normal routing channel.



Note

Policy routing is specified on the interface that receives the packets, not on the interface from which the packets are sent.

Set Criteria for Policy-Based Routing

The set criteria in a route map is evaluated in the order listed in the route map. Set criteria specific to route maps used for policy-based routing are as follows:

1. List of interfaces through which the packets can be routed—If more than one interface is specified, the first interface that is found to be up is used for forwarding the packets.
2. List of specified IP addresses—The IP address can specify the adjacent next-hop router in the path toward the destination to which the packets should be forwarded. The first IP address associated with a currently up connected interface is used to route the packets.



Note

You can optionally configure the set criteria for next-hop addresses to load balance traffic across up to 16 IP addresses. In this case, Cisco NX-OS sends all traffic for each IP flow to a particular IP next-hop address.

3. List of default interfaces—If there is no explicit route available to the destination address of the packet being considered for policy routing, the route map routes it to the first up interface in the list of specified default interfaces.

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4. List of default next-hop IP addresses—Route to the interface or the next-hop address specified by this set statement only if there is no explicit route for the destination address of the packet in the routing table.



Note You can optionally configure the set criteria for the default next-hop addresses to load balance traffic across a maximum of 16 IP addresses. In this case, Cisco NX-OS sends all traffic for each IP flow to a particular IP next-hop address.

If the packets do not meet any of the defined match criteria, those packets are routed through the normal destination-based routing process.

Licensing Requirements for Policy-Based Routing

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	Policy-based routing requires an Enterprise Services license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the <i>Cisco NX-OS Licensing Guide</i> .

Prerequisites for Policy-Based Routing

Policy-based routing has the following prerequisites:

- Install the correct license.
- You must enable policy-based routing (see the “[Enabling the Policy-Based Routing Feature](#)” section on page 17-4).
- Assign an IP address on the interface and bring the interface up before you apply a route map on the interface for policy-based routing.
- If you configure VDCs, install the Advanced Services license and enter the desired VDC (see the *Cisco NX-OS Virtual Device Context Configuration Guide*).

Guidelines and Limitations for Policy-Based Routing

Policy-based routing has the following configuration guidelines and limitations:

- A policy-based routing route map can have only one match or set statement per route-map statement.
- A **match** command cannot refer to more than one ACL in a single route-map statement/clause.
- Policy-based routing is not supported with inbound traffic on FEX ports.
- An ACL used in a policy-based routing route map cannot include a deny statement.
- The same route map can be shared among different interfaces for policy-based routing as long as the interfaces belong to the same virtual routing and forwarding (VRF) instance.
- Setting a tunnel interface or an IP address via a tunnel interface as a next hop in a policy-based routing policy is not supported.

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- Using a prefix-list as a match criteria is not supported. Do not use a prefix-list in a policy-based routing route-map.
- Beginning with Cisco NX-OS Release 5.2(4), policy-based routing and WCCPv2 are supported on the same interface. However, policy-based routing with statistics and WCCPv2 is supported on the same interface only if bank chaining is disabled.

Default Settings

Table 17-1 lists the default settings for policy-based routing parameters.

Table 17-1 Default Policy-based Routing Parameters

Parameters	Default
Policy-based routing	Disabled

Configuring Policy-Based Routing

This section includes the following topics:

- [Enabling the Policy-Based Routing Feature, page 17-4](#)
- [Configuring a Route Policy, page 17-5](#)



Note

If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

Enabling the Policy-Based Routing Feature

You must enable the policy-based routing feature before you can configure a route policy.

BEFORE YOU BEGIN

Ensure that you are in the correct VDC (or use the **switchto vdc** command).

SUMMARY STEPS

1. **configure terminal**
2. **feature pbr**
3. (Optional) **show feature**
4. (Optional) **copy running-config startup-config**

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DETAILED STEPS

	Command	Purpose
Step 1	<code>configure terminal</code> Example: switch# <code>configure terminal</code> switch(config)#	Enters configuration mode.
Step 2	<code>feature pbr</code> Example: switch(config)# <code>feature pbr</code>	Enables the policy-based routing feature.
Step 3	<code>show feature</code> Example: switch(config)# <code>show feature</code>	(Optional) Displays enabled and disabled features.
Step 4	<code>copy running-config startup-config</code> Example: switch(config)# <code>copy running-config startup-config</code>	(Optional) Saves this configuration change.

Use the **no feature pbr** command to disable the policy-based routing feature and remove all associated configuration.

Command	Purpose
<code>no feature pbr</code> Example: switch(config)# <code>no feature pbr</code>	Disables policy-based routing and removes all associated configuration.

Configuring a Route Policy

You can use route maps in policy-based routing to assign routing policies to the inbound interface. See the [“Configuring Route Maps” section on page 16-13](#).

SUMMARY STEPS

1. `configure terminal`
2. `interface type slot/port`
3. `ip policy route-map map-name`
or
`ipv6 policy route-map map-nam`
4. (Optional) `exit`
5. (Optional) `exit`
6. (Optional) `copy running-config startup-config`

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DETAILED STEPS

	Command	Purpose
Step 1	<code>configure terminal</code> Example: switch# <code>configure terminal</code> switch(config)#	Enters configuration mode.
Step 2	<code>interface type slot/port</code> Example: switch(config)# <code>interface ethernet 1/2</code> switch(config-if)#	Enters interface configuration mode.
Step 3	<code>ip policy route-map map-name</code> Example: switch(config-if)# <code>ip policy route-map Testmap</code>	Assigns a route map for IPv4 policy-based routing to the interface.
	<code>ipv6 policy route-map map-name</code> Example: switch(config-if)# <code>ipv6 policy route-map TestIPv6map</code>	Assigns a route map for IPv6 policy-based routing to the interface.
Step 4	<code>exit</code> Example: switch(config-route-map)# <code>exit</code>	(Optional) Exits route-map configuration mode.
Step 5	<code>exit</code> Example: switch(config)# <code>exit</code>	(Optional) Exits global configuration mode.
Step 6	<code>copy running-config startup-config</code> Example: switch# <code>copy running-config startup-config</code>	(Optional) Saves this configuration change.

This example shows how to add a route map to an interface:

```
switch# configure terminal
switch(config)# interface ethernet 1/2
switch(config-if)# ip policy route-map Testmap
switch(config-if)# exit
switch(config)# copy running-config startup-config
```

You can configure the following optional match parameters for route maps in route-map configuration mode:

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Command	Purpose
<pre>match ip address access-list-name name [name...]</pre> <p>Example: switch(config-route-map)# match ip address access-list-name ACL1</p>	Matches an IPv4 address against one or more IP access control lists (ACLs). This command is used for policy-based routing and is ignored by route filtering or redistribution.
<pre>match ipv6 address access-list-name name [name...]</pre> <p>Example: switch(config-route-map)# match ipv6 address access-list-name ACLv6</p>	Matches an IPv6 address against one or more IPv6 ACLs. This command is used for policy-based routing and is ignored by route filtering or redistribution.
<pre>match length min max</pre> <p>Example: switch(config-route-map)# match length 64 1500</p>	Matches against the length of the packet. This command is used for policy-based routing.
<pre>match mac-list maclist [...maclist]</pre> <p>Example: switch(config-route-map)# match mac-list MacList10</p>	Matches against a list of MAC addresses. This command is used for policy-based routing.
<pre>match metric metric-value [+ deviation-number] [...metric-value [+ deviation-number]</pre> <p>Example: switch(config-route-map)# match metric 10</p>	Matches against the routing protocol metric. This command is used for policy-based routing.
<pre>match vlan vlan-range</pre> <p>Example: switch(config-route-map)# match vlan 64</p>	Matches against the VLAN ID of the packet. This command is used for policy-based routing.

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You can configure the following optional set parameters for route maps in route-map configuration mode:

Command	Purpose
<pre>set ip next-hop address1 [address2...] {load-share peer-address}</pre> <p>Example: switch(config-route-map)# set ip next-hop 192.0.2.1</p>	<p>Sets the IPv4 next-hop address for policy-based routing. This command uses the first valid next-hop address if multiple addresses are configured.</p> <p>Use the optional load-share keyword to load balance traffic across a maximum of 16 next-hop addresses.</p>
<pre>set ip default next-hop address1 [address2...] {load-share}</pre> <p>Example: switch(config-route-map)# set ip default next-hop 192.0.2.2</p>	<p>Sets the IPv4 next-hop address for policy-based routing when there is no explicit route to a destination. This command uses the first valid next-hop address if multiple addresses are configured.</p> <p>Use the optional load-share keyword to load balance traffic across a maximum of 16 next-hop addresses.</p>
<pre>set ipv6 next-hop address1 [address2...] {load-share peer-address}</pre> <p>Example: switch(config-route-map)# set ipv6 next-hop 2001:0DB8::1</p>	<p>Sets the IPv6 next-hop address for policy-based routing. This command uses the first valid next-hop address if multiple addresses are configured.</p> <p>Use the optional load-share keyword to load balance traffic across a maximum of 16 next-hop addresses.</p>
<pre>set ipv6 default next-hop address1 [address2...]</pre> <p>Example: switch(config-route-map)# set ipv6 default next-hop 2001:0DB8::2</p>	<p>Sets the IPv6 next-hop address for policy-based routing when there is no explicit route to a destination. This command uses the first valid next-hop address if multiple addresses are configured.</p>
<pre>set interface {null0 tunnel-te}</pre> <p>Example: switch(config-route-map)# set interface null0</p>	<p>Sets the interface used for routing. Use the null0 interface to drop packets. Use the tunnel-te interface to forward packets on the MPLS TE tunnel.</p>
<pre>set vrf vrf-name</pre> <p>Example: switch(config-route-map)# set vrf MainVRF</p>	<p>Sets the VRF for next-hop resolution.</p>

Cisco NX-OS routes the packet as soon as it finds a next hop and an interface.

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Verifying the Policy-Based Routing Configuration

To display policy-based routing configuration information, perform one of the following tasks:

Command	Purpose
show [ip ipv6] policy [name]	Displays information about an IPv4 or IPv6 policy.
show route-map [name] pbr-statistics	Displays policy statistics.

Use the **route-map map-name pbr-statistics** to enable policy statistics. Use the **clear route-map map-name pbr-statistics** to clear these policy statistics

Configuration Examples for Policy-Based Routing

This example shows how to configure a simple route policy on an interface:

```
feature pbr
ip access-list pbr-sample
  permit tcp host 10.1.1.1 host 192.168.2.1 eq 80
!
route-map pbr-sample
  match ip address pbr-sample
  set ip next-hop 192.168.1.1
!
route-map pbr-sample pbr-statistics

interface ethernet 1/2
  ip policy route-map pbr-sample
```

The following output verifies this configuration:

```
n7000# show route-map pbr-sample

route-map pbr-sample, permit, sequence 10
Match clauses:
  ip address (access-lists): pbr-sample
Set clauses:
  ip next-hop 192.168.1.1

n7000# show route-map pbr-sample pbr-statistics

route-map pbr-sample, permit, sequence 10
Policy routing matches: 84 packets

Default routing: 233 packets
```

Related Topics

The following topics can give more information on Policy Based Routing:

- [Chapter 16, “Configuring Route Policy Manager”](#)

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Additional References

For additional information related to implementing IP, see the following sections:

- [Related Documents](#), page 17-10
- [Standards](#), page 17-10

Related Documents

Related Topic	Document Title
Policy-based routing CLI commands	<i>Cisco Nexus 7000 Series NX-OS Unicast Routing Command Reference, Release 5.x</i>
VDCs and VRFs	<i>Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide, Release 5.x</i>

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.	—

Feature History for Policy-Based Routing

[Table 17-2](#) lists the release history for this feature.

Table 17-2 Feature History for Policy-Based Routing

Feature Name	Releases	Feature Information
Policy-based routing	5.2(4)	Added support for policy-based routing and WCCPv2 on the same interface if bank chaining is disabled.
Interfaces	5.2(1)	Added support for set interface route-map command.
IPv6 policies	4.2(1)	Added support for IPv6 policies.
Policy-based routing	4.0(1)	This feature was introduced.