



PBR Support for Multiple Tracking Options

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The PBR Support for Multiple Tracking Options feature extends the capabilities of object tracking using Cisco Discovery Protocol (CDP) to allow the policy-based routing (PBR) process to verify object availability by using additional methods. The verification method can be an Internet Control Message Protocol (ICMP) ping, a User Datagram Protocol (UDP) ping, or an HTTP GET request.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see 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 for PBR Support for Multiple Tracking Options”](#) section on page 13.

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Contents

- [Information About PBR Support for Multiple Tracking Options, page 2](#)
- [How to Configure PBR Support for Multiple Tracking Options, page 2](#)
- [Configuration Examples for PBR Support for Multiple Tracking Options, page 9](#)
- [Additional References, page 10](#)
- [Command Reference, page 12](#)
- [Feature Information for PBR Support for Multiple Tracking Options, page 13](#)



Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

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Information About PBR Support for Multiple Tracking Options

To configure the PBR Support for Multiple Tracking Options feature, you should understand the following concepts:

- [Object Tracking, page 2](#)
- [PBR Support for Multiple Tracking Options Feature Design, page 2](#)

Object Tracking

Object tracking is an independent process that monitors objects such as the following:

- State of the line protocol of an interface
- Existence of an entry in the routing table
- Results of a Service Assurance Agent (SAA) operation, such as a ping

Clients such as Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP), Gateway Load Balancing Protocol (GLBP), and (with this feature) PBR can register their interest in specific, tracked objects and then take action when the state of the objects changes.

PBR Support for Multiple Tracking Options Feature Design

The PBR Support for Multiple Tracking Options feature gives PBR access to all the objects that are available through the tracking process. The tracking process provides the ability to track individual objects—such as ICMP ping reachability, routing adjacency, an application running on a remote device, a route in the Routing Information Base (RIB)—or to track the state of an interface line protocol.

Object tracking functions in the following manner. PBR will inform the tracking process that a certain object should be tracked. The tracking process will in turn notify PBR when the state of that object changes.

How to Configure PBR Support for Multiple Tracking Options

The tasks in this section are divided according to the Cisco IOS release that you are running because Cisco IOS Release 12.3(14)T introduced new syntax for IP Service Level Agreements (SLAs). To use this feature, you must be running Cisco IOS Release 12.3(4)T, 12.2(25)S, or a later release. This section contains the following tasks:

- [Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3\(11\)T, 12.2\(25\)S, and Earlier Releases, page 3](#)
- [Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3\(14\)T, 12.2\(33\)SXH, and Later Releases, page 5](#)

Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3(11)T, 12.2(25)S, and Earlier Releases

Perform this task to configure PBR support for multiple tracking options. In this task, a route map is created and configured to verify the reachability of the tracked object.

Prerequisites

This task requires the networking device to be running Cisco IOS Release 12.3(11)T, 12.2(25)S, or prior releases.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **rtr operation-number**
4. **type echo protocol protocol-type target [source-ipaddr ip-address]**
5. **exit**
6. **rtr schedule operation-number [life {forever | seconds}] [start-time {hh:mm[:ss] [month day | day month] | pending | now | after hh:mm:ss}] [ageout seconds]**
7. **track object-number rtr entry-number [reachability]**
8. **delay {up seconds [down seconds] | [up seconds] down seconds}**
9. **exit**
10. **interface type number**
11. **ip address ip-address mask [secondary]**
12. **ip policy route-map map-tag**
13. **exit**
14. **route-map map-tag [permit | deny] [sequence-number]**
15. **set ip next-hop verify-availability [next-hop-address sequence track object]**
16. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<p>rtr <i>operation-number</i></p> <p>Example: Router(config)# rtr 1</p>	Enters SAA RTR configuration mode and configures an SAA operation.
Step 4	<p>type echo protocol <i>protocol-type target</i> [source-ipaddr <i>ip-address</i>]</p> <p>Example: Router(config-rtr)# type echo protocol ipicmp echo 10.1.1.10</p>	Configures an SAA end-to-end echo response time probe operation.
Step 5	<p>exit</p> <p>Example: Router(config-rtr)# exit</p>	Exits SAA RTR configuration mode and returns the router to global configuration mode.
Step 6	<p>rtr schedule <i>operation-number</i> [life {forever <i>seconds</i>}] [start-time {<i>hh:mm[:ss]</i> [<i>month day</i> <i>day month</i>] pending now after <i>hh:mm:ss</i>}] [ageout <i>seconds</i>]</p> <p>Example: Router(config)# rtr schedule 1 life forever start-time now</p>	Configures the time parameters for the SAA operation.
Step 7	<p>track <i>object-number</i> rtr <i>entry-number</i> [reachability]</p> <p>Example: Router(config)# track 123 rtr 1 reachability</p>	Tracks the reachability of a Response Time Reporter (RTR) object and enters tracking configuration mode.
Step 8	<p>delay {up <i>seconds</i> [down <i>seconds</i>] [up <i>seconds</i>] down <i>seconds</i>}</p> <p>Example: Router(config-track)# delay up 60 down 30</p>	(Optional) Specifies a period of time (in seconds) to delay communicating state changes of a tracked object.
Step 9	<p>exit</p> <p>Example: Router(config-track)# exit</p>	Exits tracking configuration mode and returns the router to global configuration mode.
Step 10	<p>interface <i>type number</i></p> <p>Example: Router(config)# interface ethernet 0</p>	Specifies an interface type and number and enters interface configuration mode.
Step 11	<p>ip address <i>ip-address mask</i> [secondary]</p> <p>Example: Router(config-if)# ip address 10.1.1.11 255.0.0.0</p>	<p>Specifies a primary or secondary IP address for an interface.</p> <ul style="list-style-type: none"> See the “Configuring IPv4 Addresses” chapter of the <i>Cisco IOS IP Addressing Services Configuration Guide</i> for information on configuring IPv4 addresses.

	Command or Action	Purpose
Step 12	<code>ip policy route-map map-tag</code> Example: Router(config-if)# ip policy route-map alpha	Enables policy routing and identifies a route map to be used for policy routing.
Step 13	<code>exit</code> Example: Router(config-if)# exit	Exits interface configuration mode and returns the router to global configuration mode.
Step 14	<code>route-map map-tag [permit deny]</code> <code>[sequence-number]</code> Example: Router(config)# route-map alpha	Specifies a route map and enters route-map configuration mode.
Step 15	<code>set ip next-hop verify-availability</code> <code>[next-hop-address sequence track object]</code> Example: Router(config-route-map)# set ip next-hop verify-availability 10.1.1.1 10 track 123	Configures the route map to verify the reachability of the tracked object.
Step 16	<code>end</code> Example: Router(config-route-map)# end	Exits route-map configuration mode and returns the router to privileged EXEC mode.

Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3(14)T, 12.2(33)SXH, and Later Releases

Perform this task to configure PBR support for multiple tracking options. In this task, a route map is created and configured to verify the reachability of the tracked object.

Prerequisite

This task requires the networking device to be running Cisco IOS Release 12.3(14)T, 12.2(33)SXH, or a later release.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `ip sla monitor operation-number`
4. `type echo protocol ipIcmpEcho {destination-ip-address | destination-hostname} [source-ipaddr {ip-address | hostname} | source-interface interface-name]`
5. `exit`

6. **ip sla monitor schedule** *operation-number* [**life** {**forever** | *seconds*}] [**start-time** {*hh:mm[:ss]* | *month day* | *day month*} | **pending** | **now** | **after** *hh:mm:ss*] [**ageout** *seconds*] [**recurring**]
7. **track** *object-number* **rtr** *entry-number* [**reachability** | **state**]
8. **delay** {**up** *seconds* [**down** *seconds*] | [**up** *seconds*] **down** *seconds*}
9. **exit**
10. **interface** *type number*
11. **ip address** *ip-address mask* [**secondary**]
12. **ip policy route-map** *map-tag*
13. **exit**
14. **route-map** *map-tag* [**permit** | **deny**] [*sequence-number*]
15. **set ip next-hop verify-availability** [*next-hop-address sequence* **track** *object*]
16. **end**
17. **show track** *object-number*
18. **show route-map** [*map-name* | **all** | **dynamic**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.
Step 3	ip sla monitor <i>operation-number</i> Example: Router(config)# ip sla monitor 1	Starts a Cisco IOS IP Service Level Agreement (SLA) operation configuration and enters IP SLA monitor configuration mode.
Step 4	type echo protocol ipIcmpEcho { <i>destination-ip-address</i> <i>destination-hostname</i> } [source-ipaddr { <i>ip-address</i> <i>hostname</i> } source-interface <i>interface-name</i>] Example: Router(config-sla-monitor)# type echo protocol ipIcmpEcho 10.1.1.1	Configures an IP SLA Internet Control Message Protocol (ICMP) echo probe operation.
Step 5	exit Example: Router(config-sla-monitor)# exit	Exits IP SLA monitor configuration mode and returns the router to global configuration mode.

	Command or Action	Purpose
Step 6	<pre>ip sla monitor schedule operation-number [life {forever seconds}] [start-time {hh:mm[:ss] [month day day month] pending now after hh:mm:ss}] [ageout seconds] [recurring]</pre> <p>Example: Router(config)# ip sla monitor schedule 1 life forever start-time now</p>	<p>Configures the scheduling parameters for a single Cisco IOS IP SLA operation.</p> <ul style="list-style-type: none"> In this example, the time parameters for the IP SLA operation are configured.
Step 7	<pre>track object-number rtr entry-number [reachability state]</pre> <p>Example: Router(config)# track 123 rtr 1 reachability</p>	<p>Tracks the reachability of a Response Time Reporter (RTR) object and enters tracking configuration mode.</p>
Step 8	<pre>delay {up seconds [down seconds] [up seconds] down seconds}</pre> <p>Example: Router(config-track)# delay up 60 down 30</p>	<p>(Optional) Specifies a period of time, in seconds, to delay communicating state changes of a tracked object.</p>
Step 9	<pre>exit</pre> <p>Example: Router(config-track)# exit</p>	<p>Exits tracking configuration mode and returns the router to global configuration mode.</p>
Step 10	<pre>interface type number</pre> <p>Example: Router(config)# interface serial 2/0</p>	<p>Specifies an interface type and number and enters interface configuration mode.</p>
Step 11	<pre>ip address ip-address mask [secondary]</pre> <p>Example: Router(config-if)# ip address 192.168.1.1 255.255.255.0</p>	<p>Specifies a primary or secondary IP address for an interface.</p> <ul style="list-style-type: none"> See the “Configuring IPv4 Addresses” chapter of the <i>Cisco IOS IP Addressing Services Configuration Guide</i> for information on configuring IPv4 addresses. In this example, the IP address of the incoming interface is specified. This is the interface on which policy routing is to be enabled.
Step 12	<pre>ip policy route-map map-tag</pre> <p>Example: Router(config-if)# ip policy route-map alpha</p>	<p>Enables policy routing and identifies a route map to be used for policy routing.</p>
Step 13	<pre>exit</pre> <p>Example: Router(config-if)# exit</p>	<p>Exits interface configuration mode and returns the router to global configuration mode.</p>
Step 14	<pre>route-map map-tag [permit deny] [sequence-number]</pre> <p>Example: Router(config)# route-map alpha</p>	<p>Specifies a route map and enters route-map configuration mode.</p>

	Command or Action	Purpose
Step 15	<pre>set ip next-hop verify-availability [next-hop-address sequence track object]</pre> <p>Example: Router(config-route-map)# set ip next-hop verify-availability 10.1.1.1 10 track 123</p>	<p>Configures the route map to verify the reachability of the tracked object.</p> <ul style="list-style-type: none"> In this example, the policy is configured to forward packets received on serial interface 2/0 to 10.1.1.1 if that device is reachable.
Step 16	<pre>end</pre> <p>Example: Router(config-route-map)# end</p>	<p>Exits route-map configuration mode and returns the router to privileged EXEC mode.</p>
Step 17	<pre>show track object-number</pre> <p>Example: Router# show track 123</p>	<p>(Optional) Displays tracking information.</p> <ul style="list-style-type: none"> Use this command to verify the configuration. See the display output in the “Examples” section of this task.
Step 18	<pre>show route-map [map-name all dynamic]</pre> <p>Example: Router# show route-map alpha</p>	<p>(Optional) Displays route map information.</p> <ul style="list-style-type: none"> In this example, information about the route map named alpha is displayed. See the display output in the “Examples” section of this task.

Examples

The following output from the **show track** command shows that the tracked object 123 is reachable.

```
Router# show track 123

Track 123
  Response Time Reporter 1 reachability
  Reachability is Up
    2 changes, last change 00:00:33
  Delay up 60 secs, down 30 secs
  Latest operation return code: OK
  Latest RTT (millisecs) 20
  Tracked by:
    ROUTE-MAP 0
```

The following output from the **show route-map** command shows information about the route map named alpha that was configured in the task.

```
Router# show route-map alpha

route-map alpha, permit, sequence 10
  Match clauses:
  Set clauses:
    ip next-hop verify-availability 10.1.1.1 10 track 123 [up]
  Policy routing matches: 0 packets, 0 bytes
```

Configuration Examples for PBR Support for Multiple Tracking Options

This section provides the following configuration examples:

- [Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3\(11\)T, 12.2\(25\)S, and Earlier Releases: Example, page 9](#)
- [Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3\(14\)T, 12.2\(33\)SXH, and Later Releases: Example, page 10](#)

Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3(11)T, 12.2(25)S, and Earlier Releases: Example

In the following example, object tracking is configured for PBR on routers that are running Cisco IOS Release 12.3(11)T, 12.2(25)S, or earlier releases.

The configured policy is that packets received on Ethernet interface 0, should be forwarded to 10.1.1.1 only if that device is reachable (responding to pings). If 10.1.1.1 is not up, then the packets should be forwarded to 10.2.2.2. If 10.2.2.2 is also not reachable, then the policy routing fails and the packets are routed according to the routing table.

Two Response Time Reporters (RTRs) are configured to ping the remote devices. The RTRs are then tracked. Policy routing will monitor the state of the tracked RTRs and make forwarding decisions based on their state.

```
! Define and start the RTRs.
rtr 1
  type echo protocol ipicmpecho 10.1.1.1
rtr schedule 1 start-time now life forever
!
rtr 2
  type echo protocol ipicmpecho 10.2.2.2
rtr schedule 2 start-time now life forever
!
! Track the RTRs.
track 123 rtr 1 reachability
track 124 rtr 2 reachability
!
! Enable policy routing on the incoming interface.
interface ethernet 0
  ip address 10.4.4.4 255.255.255.0
  ip policy route-map beta
!
! 10.1.1.1 is via this interface.
interface ethernet 1
  ip address 10.1.1.254 255.255.255.0
!
! 10.2.2.2 is via this interface.
interface ethernet 2
  ip address 10.2.2.254 255.255.255.0
!
! Define a route map to set the next-hop depending on the state of the tracked RTRs.
route-map beta
  set ip next-hop verify-availability 10.1.1.1 10 track 123
  set ip next-hop verify-availability 10.2.2.2 20 track 124
```

Configuring PBR Support for Multiple Tracking Options in Cisco IOS Release 12.3(14)T, 12.2(33)SXH, and Later Releases: Example

In the following example, object tracking is configured for PBR on routers running Cisco IOS Release 12.3(14)T, 12.2(33)SXH, and later releases.

The configured policy is that packets received on Ethernet interface 0, should be forwarded to 10.1.1.1 only if that device is reachable (responding to pings). If 10.1.1.1 is not up, then the packets should be forwarded to 10.2.2.2. If 10.2.2.2 is also not reachable, then the policy routing fails and the packets are routed according to the routing table.

Two RTRs are configured to ping the remote devices. The RTRs are then tracked. Policy routing will monitor the state of the tracked RTRs and make forwarding decisions based on their state.

```
! Define and start the RTRs.
ip sla monitor 1
  type echo protocol ipicmpecho 10.1.1.1
ip sla monitor schedule 1 start-time now life forever
!
ip sla monitor 2
  type echo protocol ipicmpecho 10.2.2.2
ip sla monitor schedule 2 start-time now life forever
!
! Track the RTRs.
track 123 rtr 1 reachability
track 124 rtr 2 reachability
!
! Enable policy routing on the incoming interface.
interface ethernet 0
  ip address 10.4.4.4 255.255.255.0
  ip policy route-map beta
!
! 10.1.1.1 is via this interface.
interface ethernet 1
  ip address 10.1.1.254 255.255.255.0
!
! 10.2.2.2 is via this interface.
interface ethernet 2
  ip address 10.2.2.254 255.255.255.0
!
! Define a route map to set the next-hop depending on the state of the tracked RTRs.
route-map beta
  set ip next-hop verify-availability 10.1.1.1 10 track 123
  set ip next-hop verify-availability 10.2.2.2 20 track 124
```

Additional References

The following sections provide references related to the PBR Support for Multiple Tracking Options feature.

Related Documents

Related Topic	Document Title
Object tracking within Cisco IOS software	“Configuring Enhanced Object Tracking” chapter of the <i>Cisco IOS IP Application Services Configuration Guide</i>
Configuring IP addresses	“Configuring IPv4 Addresses” chapter of the <i>Cisco IOS IP Addressing Services Configuration Guide</i>

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIB	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

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<p>http://www.cisco.com/techsupport</p>

Command Reference

The following commands are introduced or modified in the feature or features documented in this module. For information about these commands, see the *Cisco IOS IP Routing Protocols Command Reference* at http://www.cisco.com/en/US/docs/ios/iproute/command/reference/irp_book.html. For information about all Cisco IOS commands, use the Command Lookup Tool at <http://tools.cisco.com/Support/CLILookup> or the *Cisco IOS Master Command List, All Releases*, at http://www.cisco.com/en/US/docs/ios/mcl/allreleasemcl/all_book.html.

- **set ip next-hop verify-availability**

Feature Information for PBR Support for Multiple Tracking Options

Table 1 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/jsp/index.jsp>. An account on Cisco.com is not required.



Note

Table 1 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 1 Feature Information for PBR Support for Multiple Tracking Options

Feature Name	Releases	Feature Information
PBR Support for Multiple Tracking Options	12.3(4)T 12.2(25)S 12.2(33)SXH	<p>The PBR Support for Multiple Tracking Options feature extends the capabilities of object tracking using Cisco Discovery Protocol (CDP) to allow the policy-based routing (PBR) process to verify object availability by using additional methods. The verification method can be an Internet Control Message Protocol (ICMP) ping, a User Datagram Protocol (UDP) ping, or an HTTP GET request.</p> <p>Due to syntax changes for IP SLAs, a new task and configuration example were introduced in the Cisco IOS Release 12.2(33)SXH.</p> <p>The following commands were introduced or modified by this feature: set ip next-hop verify-availability.</p>

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