



## Configuring Enhanced Object Tracking

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This chapter describes how to configure enhanced object tracking on the Cisco Industrial Ethernet 2000U Series (IE 2000U) and Connected Grid Switches, hereafter referred to as switch. This feature provides a more complete alternative to the Hot Standby Routing Protocol (HSRP) tracking mechanism, which allows you to track the line-protocol state of an interface. If the line protocol state of an interface goes down, the HSRP priority of the interface is reduced and another HSRP device with a higher priority becomes active. The enhanced object tracking feature separates the tracking mechanism from HSRP and creates a separate, standalone tracking process that can be used by processes other than HSRP. This allows tracking other objects in addition to the interface line-protocol state.

A client process, such as HSRP or Gateway Local Balancing Protocol (GLBP), can register an interest in tracking objects and request notification when the tracked object changes state. This feature increases the availability and speed of recovery of a routing system and decreases outages and outage duration.

For more information about enhanced object tracking and the commands used to configure it, see the [“Related Documents” section on page 4-19](#).

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## Information About Enhanced Object Tracking

Each tracked object has a unique number that is specified in the tracking command-line interface (CLI). Client processes use this number to track a specific object. The tracking process periodically polls the tracked object for value changes and sends any changes (as up or down values) to interested client processes, either immediately or after a specified delay. Several clients can track the same object, and can take different actions when the object changes state.

You can also track a combination of objects in a list by using either a weight threshold or a percentage threshold to measure the state of the list. You can combine objects using Boolean logic. A tracked list with a Boolean “AND” function requires that each object in the list be in an up state for the tracked object to be up. A tracked list with a Boolean “OR” function needs only one object in the list to be in the up state for the tracked object to be up.

## Prerequisites

Your IP network is operational and you can access the destination device.

## Guidelines and Limitations

Although up to 1000 tracked objects can be configured, each tracked object uses CPU resources. The amount of available CPU resources on a switch is dependent upon variables such as traffic load and how other protocols are configured and run. The ability to use 1000 tracked objects is dependent upon the available CPU. Testing should be conducted on site to ensure that the service works under the specific site traffic conditions.

## Default Settings

No type of object tracking is configured.

## Configuring Enhanced Object Tracking Features

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## Tracking Interface Line-Protocol or IP Routing State

You can track either the interface line protocol state or the interface IP routing state.

When you track the IP routing state, these three conditions are required for the object to be up:

- IP routing must be enabled and active on the interface.
- The interface line-protocol state must be up.
- The interface IP address must be known.

If all three of these conditions are not met, the IP routing state is down.

## BEFORE YOU BEGIN

An object must exist before it can be added to a tracked list.

## DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>track <i>object-number</i> interface <i>interface-id</i> line-protocol</b>	(Optional) Create a tracking list to track the line-protocol state of an interface and enter tracking configuration mode. <ul style="list-style-type: none"> <li>The <i>object-number</i> identifies the tracked object. The range is from 1 to 1000.</li> <li>The <b>interface</b> <i>interface-id</i> is the interface being tracked.</li> </ul>
Step 3	<b>delay {up <i>seconds</i> [down <i>seconds</i>]   [up <i>seconds</i>] down <i>seconds</i>}</b>	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 4	<b>exit</b>	Return to global configuration mode.
Step 5	<b>track <i>object-number</i> interface <i>interface-id</i> ip routing</b>	(Optional) Create a tracking list to track the IP routing state of an interface, and enter tracking configuration mode. IP-route tracking tracks an IP route in the routing table and the ability of an interface to route IP packets. <ul style="list-style-type: none"> <li>The <i>object-number</i> identifies the tracked object. The range is from 1 to 1000.</li> <li>The <b>interface</b> <i>interface-id</i> is the interface being tracked.</li> </ul>
Step 6	<b>delay {up <i>seconds</i> [down <i>seconds</i>]   [up <i>seconds</i>] down <i>seconds</i>}</b>	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 7	<b>end</b>	Return to privileged EXEC mode.
Step 8	<b>show track <i>object-number</i></b>	Verify that the specified objects are being tracked.
Step 9	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

## EXAMPLE

This example configures the tracking of an interface line-protocol state and verifies the configuration:

```
Switch(config)# track 33 interface gigabitethernet0/1 line-protocol
Switch(config-track)# end
Switch# show track 33
Track 33
  Interface GigabitEthernet0/1 line-protocol
  Line protocol is Down (hw down)
    1 change, last change 00:18:28
```

## Configuring a Tracked List

You can configure a tracked list of objects with a Boolean expression, a weight threshold, or a percentage threshold. A tracked list contains one or more objects. An object must exist before it can be added to the tracked list.

- You configure a Boolean expression to specify calculation by using either “AND” or “OR” operators.
- When you measure the tracked list state by a weight threshold, you assign a weight number to each object in the tracked list. The state of the tracked list is determined by whether or not the threshold was met. The state of each object is determined by comparing the total weight of all objects against a threshold weight for each object.
- When you measure the tracked list by a percentage threshold, you assign a percentage threshold to all objects in the tracked list. The state of each object is determined by comparing the assigned percentages of each object to the list.

### Configuring a Tracked List with a Boolean Expression

Configuring a tracked list with a Boolean expression enables calculation by using either “AND” or “OR” operators. For example, when tracking two interfaces using the “AND” operator, *up* means that both interfaces are up, and *down* means that either interface is down.

#### BEFORE YOU BEGIN

An object must exist before it can be added to a tracked list.

#### DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>track</b> <i>track-number</i> <b>list boolean</b> { <b>and</b>   <b>or</b> }	Configure a tracked list object, and enter tracking configuration mode. The <i>track-number</i> can be from 1 to 1000. <ul style="list-style-type: none"> <li>• <b>boolean</b>—Specify the state of the tracked list based on a Boolean calculation.</li> <li>• <b>and</b>—Specify that the list is up if all objects are up or down if one or more objects are down.</li> <li>• <b>or</b>—Specify that the list is up if one object is up or down if all objects are down.</li> </ul>
Step 3	<b>object</b> <i>object-number</i> [ <b>not</b> ]	Specify the object to be tracked. The range is from 1 to 1000. The keyword <b>not</b> negates the state of the object, which means that when the object is up, the tracked list detects the object as down.
Step 4	<b>delay</b> { <b>up</b> <i>seconds</i> [ <b>down</b> <i>seconds</i> ]   [ <b>up</b> <i>seconds</i> ] <b>down</b> <i>seconds</i> }	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 5	<b>end</b>	Return to privileged EXEC mode.

	Command	Purpose
Step 6	<b>show track</b> <i>object-number</i>	Verify that the specified objects are being tracked.
Step 7	<b>copy running-config</b> <b>startup-config</b>	(Optional) Save your entries in the configuration file.

Use the **no track** *track-number* global configuration command to delete the tracked list.

## EXAMPLE

This example configures track list 4 with a Boolean AND expression that contains two objects with one object state negated. If the list is up, the list detects that object 2 is down:

```
Switch(config)# track 4 list boolean and
Switch(config-track)# object 1
Switch(config-track)# object 2 not
Switch(config-track)# exit
```

## Configuring a Tracked List with a Weight Threshold

To track by weight threshold, configure a tracked list of objects, specify that weight is used as the threshold, and configure a weight for each of its objects. The state of each object is determined by comparing the total weight of all objects that are up against a threshold weight for each object.

You cannot use the Boolean “NOT” operator in a weight threshold list.

## BEFORE YOU BEGIN

An object must exist before it can be added to a tracked list.

## DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>track</b> <i>track-number</i> <b>list</b> <b>threshold weight</b>	Configure a tracked list object and enter tracking configuration mode. The <i>track-number</i> can be from 1 to 1000. <ul style="list-style-type: none"> <li><b>threshold</b>—Specify the state of the tracked list based on a threshold.</li> <li><b>weight</b>—Specify that the threshold is based on weight.</li> </ul>
Step 3	<b>object</b> <i>object-number</i> [ <b>weight</b> <i>weight-number</i> ]	Specify the object to be tracked. The range is from 1 to 1000. <ul style="list-style-type: none"> <li><b>weight</b> <i>weight-number</i>—(Optional) Specify a threshold weight for the object. The range is from 1 to 255.</li> </ul>
Step 4	<b>threshold weight</b> { <b>up</b> <i>number</i>   <b>[down</b> <i>number</i> ]}	Specify the threshold weight. <ul style="list-style-type: none"> <li><b>up</b> <i>number</i>—The valid range is from 1 to 255.</li> <li><b>down</b> <i>number</i>—(Optional) The range depends on the number selected for the <b>up</b> <i>number</i>. If you configure the <b>up</b> <i>number</i> as 25, the range shown for the down number is 0 to 24.</li> </ul>

	Command	Purpose
Step 5	<b>delay</b> { <b>up</b> <i>seconds</i> [ <b>down</b> <i>seconds</i> ]   [ <b>up</b> <i>seconds</i> ] <b>down</b> <i>seconds</i> }	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 6	<b>end</b>	Return to privileged EXEC mode.
Step 7	<b>show track</b> <i>object-number</i>	Verify that the specified objects are being tracked.
Step 8	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

Use the **no track** *track-number* global configuration command to delete the tracked list.

## EXAMPLE

This example configures track list 4 to track by weight threshold. If object 1 and object 2 are down, then track list 4 is up because object 3 satisfies the up threshold value of 30. But if object 3 is down, both objects 1 and 2 must be up in order to satisfy the threshold weight.

```
Switch(config)# track 4 list threshold weight
Switch(config-track)# object 1 weight 15
Switch(config-track)# object 2 weight 20
Switch(config-track)# object 3 weight 30
Switch(config-track)# threshold weight up 30 down 10
Switch(config-track)# exit
```

This configuration can be useful if object 1 and object 2 represent two small bandwidth connections and object 3 represents one large bandwidth connection. The configured **down 10** value means that once the tracked object is up, it will not go down until the threshold value is equal to or lower than 10, which in this example means that all connections are down.

## Configuring a Tracked List with a Percentage Threshold

To track by percentage threshold, configure a tracked list of objects, specify that a percentage will be used as the threshold, and specify a percentage for all objects in the list. The state of the list is determined by comparing the assigned percentage of each object to the list.

You cannot use the Boolean “NOT” operator in a percentage threshold list.

## BEFORE YOU BEGIN

An object must exist before it can be added to a tracked list.

## DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>track</b> <i>track-number</i> <b>list threshold percentage</b>	Configure a tracked list object and enter tracking configuration mode. The <i>track-number</i> can be from 1 to 1000. <ul style="list-style-type: none"> <li><b>threshold</b>—Specify the state of the tracked list based on a threshold.</li> <li><b>percentage</b>—Specify that the threshold is based on percentage.</li> </ul>

	Command	Purpose
Step 3	<b>object</b> <i>object-number</i>	Specify the object to be tracked. The range is from 1 to 1000. <b>Note</b> An object must exist before you can add it to a tracked list.
Step 4	<b>threshold percentage</b> { <b>up</b> <i>number</i>   [ <b>down</b> <i>number</i> ] }	Specify the threshold percentage. <ul style="list-style-type: none"> <li><b>up</b> <i>number</i>—The valid range is from 1 to 100.</li> <li><b>down</b> <i>number</i>—(Optional) The range depends on the number selected for the <b>up</b> <i>number</i>. If you configure the <b>up</b> <i>number</i> as 25, the range shown for the down number is 0 to 24.</li> </ul>
Step 5	<b>delay</b> { <b>up</b> <i>seconds</i> [ <b>down</b> <i>seconds</i> ]   [ <b>up</b> <i>seconds</i> ] <b>down</b> <i>seconds</i> }	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 6	<b>end</b>	Return to privileged EXEC mode.
Step 7	<b>show track</b> <i>object-number</i>	Verify that the specified objects are being tracked.
Step 8	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

Use the **no track** *track-number* global configuration command to delete the tracked list.

## EXAMPLE

This example configures tracked list 4 with three objects and specified percentages to measure the state of the list:

```
Switch(config)# track 4 list threshold percentage
Switch(config-track)# object 1
Switch(config-track)# object 2
Switch(config-track)# object 3
Switch(config-track)# threshold percentage up 51 down 10
Switch(config-track)# exit
```

## Configuring HSRP Object Tracking

Follow this procedure to configure the Hot Standby Router Protocol (HSRP) to track an object and change the Hot Standby priority on the basis of the state of the object.

### BEFORE YOU BEGIN

An object must exist before it can be added to a tracked list.

## DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>track</b> <i>object-number</i> { <b>interface</b> <i>interface-id</i> { <b>line-protocol</b>   <b>ip routing</b> }   <b>ip route</b> <i>ip-address/prefix-length</i> { <b>metric threshold</b>   <b>reachability</b> }   <b>list</b> { <b>boolean</b> { <b>and</b>   <b>or</b> } }   { <b>threshold</b> { <b>weight</b>   <b>percentage</b> } } }	<p>(Optional) Create a tracking list to track the configured state and enter tracking configuration mode.</p> <ul style="list-style-type: none"> <li>• The <i>object-number</i> range is from 1 to 1000.</li> <li>• Enter <b>interface</b> <i>interface-id</i> to select an interface to track.</li> <li>• Enter <b>line-protocol</b> to track the interface line protocol state or enter <b>ip routing</b> to track the interface IP routing state.</li> <li>• Enter <b>ip route</b> <i>ip-address/prefix-length</i> to track the state of an IP route.</li> <li>• Enter <b>metric threshold</b> to track the threshold metric or enter <b>reachability</b> to track if the route is reachable.</li> </ul> <p>The default up threshold is 254 and the default down threshold is 255.</p> <ul style="list-style-type: none"> <li>• Enter <b>list</b> to track objects grouped in a list. Configure the list as described on the previous pages. <ul style="list-style-type: none"> <li>– For <b>boolean</b>, see the “Configuring a Tracked List with a Boolean Expression” section on page 4-4</li> <li>– For <b>threshold weight</b>, see the “Configuring a Tracked List with a Weight Threshold” section on page 4-5</li> <li>– For <b>threshold percentage</b>, see the “Configuring a Tracked List with a Percentage Threshold” section on page 4-6</li> </ul> </li> </ul> <p><b>Note</b> Repeat this step for each interface to be tracked.</p>
Step 3	<b>exit</b>	Return to global configuration mode.
Step 4	<b>interface</b> <i>interface-id</i>	Enter interface configuration mode.
Step 5	<b>standby</b> [ <i>group-number</i> ] <b>ip</b> [ <i>ip-address</i> [ <b>secondary</b> ]]	<p>Create (or enable) the HSRP group by using its number and virtual IP address.</p> <ul style="list-style-type: none"> <li>• (Optional) <i>group-number</i>—Enter a group number on the interface for which HSRP is being enabled. The range is 0 to 255; the default is 0. If there is only one HSRP group, you do not need to enter a group number.</li> <li>• (Optional on all but one interface) <i>ip-address</i>—Specify the virtual IP address of the hot standby router interface. You must enter the virtual IP address for at least one of the interfaces; it can be learned on the other interfaces.</li> <li>• (Optional) <b>secondary</b>—Specify that the IP address is a secondary hot standby router interface. If this keyword is omitted, the configured address is the primary IP address.</li> </ul>



	Command	Purpose
Step 6	<b>standby</b> [ <i>group-number</i> ] <b>track</b> <i>object-number</i> [ <b>decrement</b> [ <i>priority-decrement</i> ]]	Configure HSRP to track an object and change the hot standby priority based on the state of the object. <ul style="list-style-type: none"> <li>(Optional) <i>group-number</i>—Enter the group number to which the tracking applies.</li> <li><i>object-number</i>—Enter a number representing the object to be tracked. The range is from 1 to 1000; the default is 1.</li> <li>(Optional) <b>decrement</b> <i>priority-decrement</i>—Specify the amount by which the hot standby priority for the router is decremented (or incremented) when the tracked object goes down (or comes back up). The range is from 1 to 255; the default is 10.</li> </ul>
Step 7	<b>end</b>	Return to privileged EXEC mode.
Step 8	<b>show standby</b>	Verify the standby router IP address and tracking states.
Step 9	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

## EXAMPLE

In the following example, the tracking process is configured to track the line-protocol state of GigabitEthernet interface 1/0/0. HSRP on GigabitEthernet interface 0/0/0 then registers with the tracking process to be informed of any changes to the line-protocol state of GigabitEthernet interface 1/0/0. If the line protocol on GigabitEthernet interface 1/0/0 goes down, the priority of the HSRP group is reduced by 10.

### Router A:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 line-protocol
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.21 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10
```

### Router B:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 line-protocol
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.22 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10
```

In the following example, the tracking process is configured to track the IP-routing capability of GigabitEthernet interface 1/0/0. HSRP on GigabitEthernet interface 0/0/0 then registers with the tracking process to be informed of any changes to the IP-routing state of GigabitEthernet interface 1/0/0. If the IP-routing state on GigabitEthernet interface 1/0/0 goes down, the priority of the HSRP group is reduced by 10.

If both serial interfaces are operational, Router A will be the HSRP active router because it has the higher priority. However, if IP on GigabitEthernet interface 1/0/0 in Router A fails, the HSRP group priority will be reduced and Router B will take over as the active router, thus maintaining a default virtual gateway service to hosts on the 10.1.0.0 subnet.

#### Router A:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 ip routing
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.21 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10
```

#### Router B:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 ip routing
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.22 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10
```

## Configuring Other Tracking Characteristics

You can also use the enhanced object tracking for tracking other characteristics.

- You can track the reachability of an IP route by using the **track ip route reachability** global configuration command.
- You can use the **track ip route metric threshold** global configuration command to determine if a route is above or below threshold.
- You can use the **track resolution** global configuration command to change the metric resolution default values for routing protocols.
- You can use the **track timer** tracking configuration command to configure the tracking process to periodically poll tracked objects.

## Configuring IP SLAs Object Tracking

Cisco IOS IP Service Level Agreements (IP SLAs) is a network performance measurement and diagnostics tool that uses active monitoring by generating traffic to measure network performance. Cisco IP SLAs operations collects real-time metrics that you can use for network troubleshooting, design, and analysis.

For more information about Cisco IP SLAs on the switch, see the “Configuring Cisco IOS IP SLAs Operations” chapter in the *System Management Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches*. For IP SLAs command information see the *Cisco IOS IP SLAs Command Reference*.

Object tracking of IP SLAs operations allows clients to track the output from IP SLAs objects and use this information to trigger an action. Every IP SLAs operation maintains an SNMP operation return-code value, such as *OK* or *OverThreshold*, that can be interpreted by the tracking process. You can track two aspects of IP SLAs operation:

- State
  - If the return code is OK, the track state is up.
  - If the return code is not OK, the track state is down.
- Reachability
  - If the return code is OK or OverThreshold, reachability is up.
  - If the return code is not OK, reachability is down.

**Note**

The **rtr** command used in previous Cisco IOS releases to configure IP SLAs operations is replaced by the **ip sla** command.

**BEFORE YOU BEGIN**

Configure an IP SLAs operation as described in the “Configuring Cisco IOS IP SLAs Operations” chapter in the *System Management Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches*.

**DETAILED STEPS**

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>track object-number ip sla operation-number state</b>	Enter tracking configuration mode to track the state of an IP SLAs operation. <ul style="list-style-type: none"> <li>• The <i>object-number</i> range is from 1 to 1000.</li> <li>• The <i>operation-number</i> range is from 1 to 2147483647.</li> </ul>
Step 3	<b>delay {up seconds [down seconds]   [up seconds] down seconds}</b>	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 4	<b>exit</b>	Return to global configuration mode.
Step 5	<b>track object-number ip sla operation-number reachability</b>	Enter tracking configuration mode to track the reachability of an IP SLAs IP host. <ul style="list-style-type: none"> <li>• The <i>object-number</i> range is from 1 to 1000.</li> <li>• The <i>operation-number</i> range is from 1 to 2147483647.</li> </ul>
Step 6	<b>delay {up seconds [down seconds]   [up seconds] down seconds}</b>	(Optional) Specify a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 7	<b>end</b>	Return to privileged EXEC mode.
Step 8	<b>show track object-number</b>	Display tracking information to verify the configuration.
Step 9	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

## EXAMPLE

The following example shows how to configure the tracking process to track the state of IP SLAs operation 2:

```
Switch(config)# track 1 ip sla 2 state
```

The following example shows how to configure the tracking process to track the reachability of IP SLAs operation 3:

```
Switch(config)# track 2 ip sla 3 reachability
```

## Configuring Static Routing Support

Static routing support using enhanced object tracking provides the ability for the switch to use ICMP pings to identify when a preconfigured static route or a DHCP route goes down. When tracking is enabled, the system tracks the state of the route and informs the client when that state changes. Static route object tracking uses Cisco IP SLAs to generate ICMP pings to monitor the state of the connection to the primary gateway.

For more information about Cisco IP SLAs support on the switch, the “Configuring Configuring Cisco IOS IP SLAs Operations” chapter in the *System Management Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches*.

You use this process to configure static route object tracking:

- 
- |               |  |
|---------------|--|
| <b>Step 1</b> | Configure a primary interface for static routing or for DHCP.  |
| <b>Step 2</b> | Configure an IP SLAs agent to ping an IP address using a primary interface and a track object to monitor the state of the agent. |
| <b>Step 3</b> | Configure a default static default route using a secondary interface. This route is used only if the primary route is removed.   |
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## Configuring a Primary Interface for Static Routing

Follow this procedure to configure a primary interface for static routing.

### BEFORE YOU BEGIN

An interface can have one primary IP address and multiple secondary IP addresses. Packets generated by the Cisco IOS software always use the primary IP address. Therefore, all routers and access servers on a segment should share the same primary network number.

If any router on a network segment uses a secondary address, all other devices on that same segment must also use a secondary address from the same network or subnet. Inconsistent use of secondary addresses on a network segment can very quickly cause routing loops.

## DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>interface</b> <i>interface-id</i>	Select a primary or secondary interface and enter interface configuration mode.
Step 3	<b>description</b> <i>string</i>	Add a description to the interface.
Step 4	<b>ip address</b> <i>ip-address mask</i> [secondary]	Set the primary or secondary IP address for the interface.
Step 5	<b>exit</b>	Return to global configuration mode.

## EXAMPLE

This example configures Ethernet 1 as a primary interface:

```
Switch(config)# interface Ethernet 1
Switch(config-if)# description primary
Switch(config-if)# ip address 172.16.16.1 255.255.240.0
Switch(config-if)# exit
```

## Configuring a Primary Interface for DHCP

The following procedure configures a primary interface for DHCP.

## BEFORE YOU BEGIN

The **ip dhcp client** command must be configured before the **ip address dhcp** command is configured on an interface. The **ip dhcp client** command is checked only when an IP address is acquired from DHCP. If the **ip dhcp client** command is specified after an IP address has been acquired from DHCP, the **ip dhcp client** command will not take effect until the next time the router acquires an IP address from DHCP.

## DETAILED STEPS

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>interface</b> <i>interface-id</i>	Select a primary or secondary interface and enter interface configuration mode.
Step 3	<b>description</b> <i>string</i>	Add a description to the interface.
Step 4	<b>ip dhcp client route track</b> <i>number</i>	Configure the DHCP client to associate any added routes with the specified track number. Valid numbers are from 1 to 500.
Step 5	<b>ip address dhcp</b>	Acquire an IP address on an Ethernet interface from DHCP.
Step 6	<b>exit</b>	Return to global configuration mode.
Step 7	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

**EXAMPLE**

The following example configures DHCP on an Ethernet interface and associates tracked object 123 with routes generated from this interface:

```
interface ethernet 0/0
 ip dhcp client route track 123
 ip address dhcp
```

**Configuring a Cisco IP SLAs Monitoring Agent and Track Object****BEFORE YOU BEGIN**

After you schedule an operation, you cannot modify the configuration of the operation. To modify the configuration of the operation after it is scheduled, you must first delete the IP SLAs operation (using the **no ip sla** command) and then reconfigure the operation with the new operation parameters.

**DETAILED STEPS**

<b>Step 1</b>	<b>configure terminal</b>	Enter global configuration mode.
<b>Step 2</b>	<b>ip sla operation-number</b>	Begin configuring a Cisco IP SLAs operation and enter IP SLA configuration mode.
<b>Step 3</b>	<b>icmp-echo</b> {destination-ip-address   destination hostname [source- ipaddr {ip-address   hostname source-interface interface-id]}	Configure a Cisco IP SLAs end-to-end ICMP echo response time operation and enter IP SLAs ICMP echo configuration mode.
<b>Step 4</b>	<b>timeout milliseconds</b>	Set the amount of time for which the operation waits for a response from its request packet.
<b>Step 5</b>	<b>frequency seconds</b>	Set the rate at which the operation is sent into the network.
<b>Step 6</b>	<b>threshold milliseconds</b>	Set the rising threshold (hysteresis) that generates a reaction event and stores history information for the operation.
<b>Step 7</b>	<b>exit</b>	Exit IP SLAs ICMP echo configuration mode.
<b>Step 8</b>	<b>ip sla schedule operation-number</b> [life {forever   seconds}] <b>start-time time</b>   <b>pending</b>   <b>now</b>   <b>after time</b> [ageout seconds] [recurring]	Configure the scheduling parameters for a single IP SLAs operation.
<b>Step 9</b>	<b>track object-number ip sla operation-number</b> {state   reachability}	Track the state of a Cisco IOS IP SLAs operation and enter tracking configuration mode.
<b>Step 10</b>	<b>end</b>	Return to privileged EXEC mode.
<b>Step 11</b>	<b>show track object-number</b>	Display tracking information to verify the configuration.
<b>Step 12</b>	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

**EXAMPLE**

This example configures an IP SLAs operation for tracking:

```
Switch# configure terminal
Switch(config)# ip sla 3
```

```
Switch(config-ip-sla)# icmp-echo 172.29.139.134 source-ip 172.29.139.132
Switch(config-ip-sla-echo)# frequency 300
Switch(config-ip-sla-echo)# exit
Switch(config)# ip sla schedule 10 life forever start-time now
Switch(config)# track 2 ip sla 3 reachability
Switch(config)# end
```

## Configuring a Routing Policy and Default Route

Follow these steps to configure a routing policy for backup static routing by using object tracking.

### BEFORE YOU BEGIN

Review the [“Configuring Static Routing Support”](#) section on page 4-12.

### DETAILED STEPS

Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>access-list</b> <i>access-list-number</i>	Define an extended IP access list. Configure any optional characteristics.
Step 3	<b>route-map</b> <i>map-tag</i> [ <b>permit</b>   <b>deny</b> ] [ <i>sequence-number</i> ]	Enter route-map configuration mode and define conditions for redistributing routes from one routing protocol to another.
Step 4	<b>match ip address</b> { <i>access-list number</i>   <i>access-list name</i> }	Distribute any routes that have a destination network number address that is permitted by a standard or extended access list or performs policy routing on packets. You can enter multiple numbers or names.
Step 5	<b>set ip next-hop dynamic dhcp</b>	For DHCP networks only. Set the next hop to the gateway that was most recently learned by the DHCP client.
Step 6	<b>set interface</b> <i>interface-id</i>	For static routing networks only. Indicate where to send output packets that pass a match clause of a route map for policy routing.
Step 7	<b>exit</b>	Exit route-map configuration mode.
Step 8	<b>ip local policy route-map</b> <i>map-tag</i>	Identify a route map to use for local policy routing.
Step 9	<b>ip route</b> <i>prefix mask</i> { <i>ip-address</i>   <i>interface-id</i> [ <i>ip-address</i> ]} [ <i>distance</i> ] [ <i>name</i> ] [ <b>permanent</b>   <b>track</b> <i>track-number</i> ] [ <i>tag tag</i> ]	For static routing networks only. Establish static routes. Entering <b>track track-number</b> specifies that the static route is installed only if the configured track object is up.
Step 10	<b>end</b>	Return to privileged EXEC mode.
Step 11	<b>show ip route track table</b>	Display information about the IP route track table.
Step 12	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

### EXAMPLE

The following example configures a routing policy for backup static routing by using object tracking:

```
interface ethernet 0
  description primary-link
  ip address 209.165.202.129 255.255.255.255
```

```

interface ethernet 1
  description backup-link
  ip address 209.165.200.225 255.255.255.255

ip sla monitor 1
  type echo protocol ipIcmpEcho 172.16.23.7
  timeout 1000
  frequency 3
  threshold 2

ip sla monitor schedule 1 life forever start-time now
track 123 ip sla 1 reachability

access list 101 permit icmp any host 172.16.23.7 echo
route map MY-LOCAL-POLICY permit 10
  match ip address 101
  set ip next-hop 10.1.1.242
  set interface null 0
!
ip local policy route-map MY-LOCAL-POLICY

ip route 0.0.0.0 0.0.0.0 10.1.1.242 track 123
ip route 0.0.0.0 0.0.0.0 10.2.2.125 254

```

## Verifying Configuration

Command	Purpose
<b>show ip route track table</b>	Display information about the IP route track table.
<b>show track</b> [ <i>object-number</i> ]	Display information about the all tracking lists or the specified list.
<b>show track brief</b>	Display a single line of tracking information output.
<b>show track interface</b> [ <i>brief</i> ]	Display information about tracked interface objects.
<b>show track ip</b> [ <i>object-number</i> ] [ <i>brief</i> ] <b>route</b>	Display information about tracked IP-route objects.
<b>show track resolution</b>	Display the resolution of tracked parameters.
<b>show track timers</b>	Display tracked polling interval timers.

## Configuration Example

This example configures the tracking of an interface line-protocol state and verifies the configuration:

```

Switch(config)# track 33 interface gigabitethernet0/1 line-protocol
Switch(config-track)# end
Switch# show track 33
Track 33
  Interface GigabitEthernet0/1 line-protocol
  Line protocol is Down (hw down)
    1 change, last change 00:18:28

```



This example configures track list 4 with a Boolean AND expression that contains two objects with one object state negated. If the list is up, the list detects that object 2 is down:

```
Switch(config)# track 4 list boolean and
Switch(config-track)# object 1
Switch(config-track)# object 2 not
Switch(config-track)# exit
```

This example configures track list 4 to track by weight threshold. If object 1 and object 2 are down, then track list 4 is up because object 3 satisfies the up threshold value of 30. But if object 3 is down, both objects 1 and 2 must be up in order to satisfy the threshold weight.

```
Switch(config)# track 4 list threshold weight
Switch(config-track)# object 1 weight 15
Switch(config-track)# object 2 weight 20
Switch(config-track)# object 3 weight 30
Switch(config-track)# threshold weight up 30 down 10
Switch(config-track)# exit
```

This configuration can be useful if object 1 and object 2 represent two small bandwidth connections and object 3 represents one large bandwidth connection. The configured **down 10** value means that once the tracked object is up, it will not go down until the threshold value is equal to or lower than 10, which in this example means that all connections are down.

This example configures tracked list 4 with three objects and specified percentages to measure the state of the list:

```
Switch(config)# track 4 list threshold percentage
Switch(config-track)# object 1
Switch(config-track)# object 2
Switch(config-track)# object 3
Switch(config-track)# threshold percentage up 51 down 10
Switch(config-track)# exit
```

In the following example, the tracking process is configured to track the line-protocol state of GigabitEthernet interface 1/0/0. HSRP on GigabitEthernet interface 0/0/0 then registers with the tracking process to be informed of any changes to the line-protocol state of GigabitEthernet interface 1/0/0. If the line protocol on GigabitEthernet interface 1/0/0 goes down, the priority of the HSRP group is reduced by 10.

#### Router A:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 line-protocol
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.21 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10
```

#### Router B:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 line-protocol
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.22 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10
```

In the following example, the tracking process is configured to track the IP-routing capability of GigabitEthernet interface 1/0/0. HSRP on GigabitEthernet interface 0/0/0 then registers with the tracking process to be informed of any changes to the IP-routing state of GigabitEthernet interface 1/0/0. If the IP-routing state on GigabitEthernet interface 1/0/0 goes down, the priority of the HSRP group is reduced by 10.

If both serial interfaces are operational, Router A will be the HSRP active router because it has the higher priority. However, if IP on GigabitEthernet interface 1/0/0 in Router A fails, the HSRP group priority will be reduced and Router B will take over as the active router, thus maintaining a default virtual gateway service to hosts on the 10.1.0.0 subnet.

#### Router A:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 ip routing
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.21 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 110
Device(config-if)# standby 1 track 100 decrement 10
```

#### Router B:

```
Device(config)# track 100 interface GigabitEthernet1/0/0 ip routing
!
Device(config)# interface GigabitEthernet0/0/0
Device(config-if)# ip address 10.1.0.22 255.255.0.0
Device(config-if)# standby 1 preempt
Device(config-if)# standby 1 ip 10.1.0.1
Device(config-if)# standby 1 priority 105
Device(config-if)# standby 1 track 100 decrement 10
```

The following example shows how to configure the tracking process to track the state of IP SLAs operation 2:

```
Switch(config)# track 1 ip sla 2 state
```

The following example shows how to configure the tracking process to track the reachability of IP SLAs operation 3:

```
Switch(config)# track 2 ip sla 3 reachability
```

This example configures Ethernet 1 as a primary interface:

```
Switch(config)# interface Ethernet 1
Switch(config-if)# description primary
Switch(config-if)# ip address 172.16.16.1 255.255.240.0
Switch(config-if)# exit
```

The following example configures DHCP on an Ethernet interface and associates tracked object 123 with routes generated from this interface:

```
interface ethernet 0/0
 ip dhcp client route track 123
 ip address dhcp
```

This example configures an IP SLAs operation for tracking:

```
Switch# configure terminal
Switch(config)# ip sla 3
Switch(config-ip-sla)# icmp-echo 172.29.139.134 source-ip 172.29.139.132
Switch(config-ip-sla-echo)# frequency 300
```

```
Switch(config-ip-sla-echo)# exit
Switch(config)# ip sla schedule 10 life forever start-time now
Switch(config)# track 2 ip sla 3 reachability
Switch(config)# end
```

The following example configures a routing policy for backup static routing by using object tracking:

```
interface ethernet 0
  description primary-link
  ip address 209.165.202.129 255.255.255.255

interface ethernet 1
  description backup-link
  ip address 209.165.200.225 255.255.255.255

ip sla monitor 1
  type echo protocol ipIcmpEcho 172.16.23.7
  timeout 1000
  frequency 3
  threshold 2

ip sla monitor schedule 1 life forever start-time now
track 123 ip sla 1 reachability

access list 101 permit icmp any host 172.16.23.7 echo
route map MY-LOCAL-POLICY permit 10
  match ip address 101
  set ip next-hop 10.1.1.242
  set interface null 0
!
ip local policy route-map MY-LOCAL-POLICY

ip route 0.0.0.0 0.0.0.0 10.1.1.242 track 123
ip route 0.0.0.0 0.0.0.0 10.2.2.125 254
```

## Related Documents

- [IP Application Services Configuration Guide, Cisco IOS Release 15M&T](#)
- [System Management Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches](#)
- [IP SLAs Configuration Guide, Cisco IOS Release 15M&T](#)
- [Cisco IOS IP SLAs Command Reference](#)
- [Reliable Static Routing Backup Using Object Tracking](#)

## Feature History

Platform	First Supported Release
IE 2000U	Cisco IOS Release 15.0(2)EH
CGS 2520	12.2(53)EX
Ethernet Switch Module (ESM) for CGR 2010	12.2(53)EX