Configuring Enhanced Object Tracking

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Restrictions for Enhanced Object Tracking

All tracking configurations must be reconfigured on all Layer 3 subinterfaces after a device reloads. All reload operations on the device must be allowed to complete, so that all Layer 3 subinterfaces are active, before the tracking configuration are reconfigured.

Information About Enhanced Object Tracking

The following sections provide information about enhanced object tracking.

Enhanced Object Tracking Overview

Before the introduction of the Enhanced Object Tracking feature, Hot Standby Router Protocol (HSRP) had a simple tracking mechanism that allowed you to track the interface line-protocol state only. If the line-protocol state of the interface went down, the HSRP priority of the router was reduced, allowing another HSRP router with a higher priority to become 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 feature allows the tracking of other objects in addition to the interface line-protocol state.

A client process such as HSRP, Virtual Router Redundancy Protocol (VRRP), or Gateway Load Balancing Protocol (GLBP), can register its interest in tracking objects and then be notified when the tracked object changes state.

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.

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.

Tracked Lists

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.

Tracking Other 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.

Use the **show track** privileged EXEC command to verify enhanced object tracking configuration.

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.

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 and reachability. For state, if the return code is OK, the track state is up; if the return code is not OK, the track state is down. For reachability, if the return code is OK or OverThreshold, reachability is up; if not OK, reachability is down.

Static Route Object Tracking

Static routing support using enhanced object tracking provides the ability for the device to use ICMP pings to identify when a pre-configured 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.

How to Configure Enhanced Object Tracking

The following sections provide configuration information about enhanced object tracking.

Configuring Tracking for Line State Protocol or IP Routing State on an Interface

Follow these steps to track the line-protocol state or IP routing state of an interface:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**track** *object-number* **interface** *interface-id* **line-protocol** **Example:** `Device(config)# track 33 interface gigabitethernet 1/0/1 line-protocol`	(Optional) Creates a tracking list to track the line-protocol state of an interface and enter tracking configuration mode. • The object-number identifies the tracked object and can be from 1 to 500. • The**interface** interface-id is the interface being tracked.
Step 4	**delay** { *object-number* **up** *seconds* [**down** *seconds*] | [**up** *seconds*] **down** *seconds*}	(Optional) Specifies 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	**exit**	Returns to global configuration mode.
Step 6	**track** *object-number* **interface** *interface-id* **ip routing** **Example:** `Device(config)# track 33 interface gigabitethernet 1/0/1 ip routing`	(Optional) Creates 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. • The object-number identifies the tracked object and can be from 1 to 500. • The**interface** interface-id is the interface being tracked.
Step 7	**delay** { *object-number* **up** *seconds* [**down** *seconds*] | [**up** *seconds*] **down** *seconds*}	(Optional) Specifies a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.
Step 8	**end**	Returns to privileged EXEC mode.
Step 9	**show track***object-number*	Verifies that the specified objects are being tracked.

Configuring Tracked Lists

The following sections provide configuration information about tracked lists.

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.

Follow these steps to configure a tracked list of objects by using a weight threshold and to configure a weight for each object:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**track** *track-number* **list threshold** {**weight**} **Example:** `Device(config)# track 4 list threshold weight`	Configures a tracked list object, and enters tracking configuration mode. The track-number can be from 1 to 500. • **threshold—**Specifies the state of the tracked list based on a threshold. • **weight—** Specifies that the threshold is based on weight.
Step 4	**object** *object-number* [**weight** *weight-number*] **Example:** `Device(config)#object 2 weight 15`	Specifies the object to be tracked. The range is from 1 to 500. The optional**weight***weight-number* specifies the threshold weight for the object. The range is from 1 to 255. **Note** An object must exist before you can add it to a tracked list.
Step 5	**threshold weight** {**up** *number* | [**down** *number*]} **Example:** `Device(config-track)# threshold weight up 30 down 10`	(Optional) Specifies the threshold weight. • **up***number*—The range is from 1 to 255. • **down***number*—(Optional)The range depends on the number selected for the **up***number*. If you configure the **up***number* as 25, the range shown for the down number is 0 to 24.
Step 6	**delay** { **up** *seconds* [**down** *seconds*] | [**up** *seconds*] **down** *seconds*}	(Optional) Specifies a period of time in seconds to delay communicating state changes of a tracked object. The range is from 1 to 180 seconds.

	Command or Action	Purpose
Step 7	**end**	Returns to privileged EXEC mode.
Step 8	**show track** *object-number*	Verify that the specified objects are being tracked.
Step 9	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

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.

Follow these steps to configure a tracked list of objects by using a percentage threshold:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**track** *track-number* **list threshold** {**percentage**} **Example:** `Device(config)# track 4 list threshold percentage`	Configures a tracked list object, and enters tracking configuration mode. The track-number can be from 1 to 500. • **threshold—**Specifies the state of the tracked list based on a threshold. • **percentage—** Specifies that the threshold is based on percentage.
Step 4	**object** *object-number* **Example:**	Specifies the object to be tracked. The range is from 1 to 500.

	Command or Action	Purpose
	`Device(config)# object 1`	**Note** An object must exist before you can add it to a tracked list.
Step 5	**threshold percentage** {**up** *number* | [**down***number*]} **Example:** `Device(config)# threshold percentage up 51 down 10`	(Optional) Specifies the threshold percentage. • **up***number*—The range is from 1 to 100. • **down***number*—(Optional)The range depends on the number selected for the **up***number*. If you configure the **up***number* as 25, the range shown for the down number is 0 to 24.
Step 6	**delay** { **up** *seconds* [**down** *seconds*] | [**up** *seconds*] **down** *seconds*}	(Optional) Specifies 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	**end**	Returns to privileged EXEC mode.
Step 8	**show track** *object-number*	Verify that the specified objects are being tracked.
Step 9	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring HSRP Object Tracking

Follow these steps to configure a standby HSRP group to track an object and change the HSRP priority based on the object state:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**track** *object-number* {**interface** *interface-id* {**line-protocol** | **ip routing**} | **ip route** *ip address/prefix-length* {**metric threshold** | **reachability**} **list** {**boolean** {**and** | **or**}} | {**threshold** {**weight** | **percentage**}}}	(Optional) Create a tracking list to track the configured state and enter tracking configuration mode. • The object-number identifies the tracked object and can be from 1 to 500. • Enter**interface** *interface-id* to select an interface to track. • Enter**line-protocol** to track the interface line protocol state or enter **ip routing** to track the interface IP routing state . • Enter**ip route** *ip-address/prefix-length* to track the state of an IP route. • Enter**metric threshold** to track the threshold metric or enter **reachability** to track if the route is reachable. The default up threshold is 254 and the default down threshold is 255. • Enter **list** to track objects grouped in a list. **Note** Repeat this step for each interface to be tracked.
Step 4	**exit**	Return to global configuration mode.
Step 5	**interface** { *interface-id*	Enter interface configuration mode.
Step 6	**standby** [*group-number*] **ip** [*ip-address* **secondary**]]	Creates (or enables) the HSRP group by using its number and virtual IP address. • (Optional) *group-number*—Enters 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. • (Optional on all but one interface) *ip-address*—Specifies 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. • (Optional) **secondary**—Specifies that the IP address is a secondary hot standby router interface. If this keyword is

	Command or Action	Purpose
		omitted, the configured address is the primary IP address.
Step 7	**standby** [*group-number*] **track** [*object-number* [**decrement** *priority-decrement*]]	Configures HSRP to track an object and change the hot standby priority based on the state of the object. • (Optional) *group-number*—Enters the group number to which the tracking applies. • *object-number*—Enters a number representing the object to be tracked. The range is from 1 to 500; the default is 1. • (Optional) **secondary**—Specifies that the IP address is a secondary hot standby router interface. If this keyword is omitted, the configured address is the primary IP address. • (Optional) **decrement** *priority-decrement*—Specifies 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.
Step 8	**end**	Returns to privileged EXEC mode.
Step 9	**show standby**	Verifies the standby router IP address and tracking states.
Step 10	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring IP SLAs Object Tracking

Follow these steps to track the state of an IP SLAs operation or the reachability of an IP SLAs IP host:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:**	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**track** *object-number* **ip sla** *operation-number* {**state** | **reachability**} **Example:** `Device(config)# track 2 ip sla 123 state`	Enters tracking configuration mode to track the state of an IP SLAs operation. • *object-number* range is from 1 to 500. • *operation-number* range is from 1 to 2147483647.
Step 4	**delay** { **up***seconds* [**down** *seconds*] | [**up** *seconds*] **down** *seconds*}	(Optional) Specifies 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	**end**	Returns to privileged EXEC mode.
Step 6	**show track** *object-number*	Verifies that the specified objects are being tracked.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Static Route Object Tracking

The following sections provide configuration information about static route object tracking.

Configuring a Primary Interface for Static Routing

Follow these steps to configure a primary interface for static routing:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id*	Selects a primary or secondary interface and enters interface configuration mode.
Step 4	**description** *string*	Adds a description to the interface.
Step 5	**ip address** *ip-address mask* [**secondary**]	Sets the primary or secondary IP address for the interface.
Step 6	**exit**	Returns to global configuration mode.

Configuring a Primary Interface for DHCP

Follow these steps to configure a primary interface for DHCP:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id*	Selects a primary or secondary interface and enters interface configuration mode.
Step 4	**description** *string*	Adds a description to the interface.
Step 5	**ip dhcp client route track** *number*	Configures the DCHP client to associate any added routes with the specified track number. Valid numbers are from 1 to 500.
Step 6	**exit**	Returns to global configuration mode.

Configuring IP SLAs Monitoring Agent

You can 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.

Follow these steps to configure network monitoring with Cisco IP SLAs:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip sla** *operation number*	Begins configuring a Cisco IP SLAs operation and enters IP SLA configuration mode.
Step 4	**icmp-echo** { *destination ip-address* | *destination hostname* [**source - ipaddr** {*ip-address* | *hostname* **source-interface** *interface-id*]	Configures a Cisco IP SLAs end-to-end ICMP echo response time operation and enter IP SLAs ICMP echo configuration mode.
Step 5	**timeout** *milliseconds*	Sets the amount of time for which the operation waits for a response from its request packet.
Step 6	**frequency** *seconds*	Sets the rate at which the operation is sent into the network.
Step 7	**threshold** *milliseconds*	Sets the rising threshold (hysteresis) that generates a reaction event and stores history information for the operation.
Step 8	**exit**	Exits IP SLAs ICMP echo configuration mode.
Step 9	**ip sla schedule** *operation-number* [**life** {**forever** | *seconds*}] **start-time** *time* | **pending** | **now** | **after** *time*] **ageout** *seconds*] [**recurring**] **Example:** `Device(config)# track 2 200 state`	Configures the scheduling parameters for a single IP SLAs operation. • *object-number* range is from 1 to 500. • *operation-number* range is from 1 to 2147483647.
Step 10	**track** *object-number* **rtr** *operation-number* **state reachability**	Tracks the state of a Cisco IOS IP SLAs operation and enter tracking configuration mode.
Step 11	**end**	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 12	**show track** *object-number*	Verifies that the specified objects are being tracked.
Step 13	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring a Routing Policy and a Default Route

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

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**access-list** *access-list-number*	Defines an extended IP access list. Configure any optional characteristics.
Step 4	**route-map** *map tag* [**permit** | **deny**] [*sequence-number*]	Enters route-map configuration mode and define conditions for redistributing routes from one routing protocol to another.
Step 5	**match ip address** {*access-list number* [**permit**|**deny**] [*sequence-number*]	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 6	**set ip next-hop dynamic dhcp**	For DHCP networks only. Sets the next hop to the gateway that was most recently learned by the DHCP client.
Step 7	**set interface** *interface-id*	For static routing networks only. Indicates where to send output packets that pass a match clause of a route map for policy routing.

	Command or Action	Purpose
Step 8	**exit**	Returns to global configuration mode.
Step 9	**ip local policy route-map** *map tag*	Identifies a route map to use for local policy routing.
Step 10	**ip route** *prefix mask* {*ip address* | *interface-id* [*ip address*]} [*distance*] [*name*] [**permanent** | **track** *track-number*] [*tag tag*]	For static routing networks only. Establishes static routes. Entering **track***track-number* specifies that the static route is installed only if the configured track object is up.
Step 11	**end**	Returns to privileged EXEC mode.
Step 12	**show ip route track table**	Displays information about the IP route track table.
Step 13	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Monitoring Enhanced Object Tracking

Use the privileged EXEC or user EXEC commands in the table below, to display enhanced object tracking information.

Table 1: Commands for Displaying Tracking Information

Command	Purpose
show ip route track table	Displays information about the IP route tr
show track [*object-number*]	Displays information about the all trackin
show track brief	Displays VTP status and configuration fo
show track interface [brief]	Displays information about tracked interf
show track ip [*object-number*] [**brief**] **route**	Displays information about tracked IP-rou
show track resolution	Displays the resolution of tracked parame
show track timer	Displays tracked polling interval timers.

Feature History for Enhanced Object Tracking

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Everest 16.5.1a	Enhanced Object Tracking	Enhanced object tracking allows advanced tracking compared to HSRP that allows interface line-protocol state tracking only. Support for this feature was introduced only on the C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Fuji 16.8.1a	Enhanced Object Tracking	Support for this feature was introduced only on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn.