OER Commands

active-probe

To configure an Optimized Edge Routing (OER) active probe for a target prefix, use the **active-probe** command in OER master controller configuration mode. To disable the active probe, use the **no** form of this command.

active-probe {**echo** *ip-address* | **jitter** *ip-address* **target-port** *number* [**codec** *codec-name*] | **tcp-conn** *ip-address* **target-port** *number* | **udp-echo** *ip-address* **target-port** *number*}

no active-probe {**echo** *ip-address* | **jitter** *ip-address* **target-port** *number* | **tcp-conn** *ip-address* **target-port** *number* | **udp-echo** *ip-address* **target-port** *number*}

Syntax Description

echo *ip-address*	Specifies the target IP address of a prefix to actively monitor using Internet Control Message Protocol (ICMP) echo (ping) messages.
jitter *ip-address*	Specifies the target IP address of a prefix to actively monitor using jitter messages. The port number must be specified using the **target-port** keyword, and a remote responder must be configured on the target device with the **ip sla monitor responder** global configuration command. **Note** The **ip sla monitor responder** command was introduced in Cisco IOS Release 12.3(14)T. This command replaces the **rtr responder** command.
target-port *number*	Specifies the destination port number for the active probe. The port number must be in the range from 1 to 65535.
codec *codec-name*	(Optional) Specifies the codec value used for Mean Opinion Score (MOS) calculation. The codec values must be one of the following: • g711alaw—G.711 A Law 64000 bps • g711ulaw—G.711 U Law 64000 bps • g729a—G.729 8000 bps
tcp-conn *ip-address*	Specifies the target IP address of a prefix to actively monitor using TCP connection messages. The port number must be specified using the **target-port** keyword. If a number other than well-known port number 23 is specified, a remote responder with the corresponding port number must be configured on the target device with the **ip sla monitor responder** global configuration command.
udp-echo *ip-address*	Specifies the target IP address of the prefix to actively monitor using User Datagram Protocol (UDP) echo messages. The port number must be specified using the **target-port** keyword, and a remote responder must be configured on the target device with the **ip sla monitor responder** global configuration command.

Command Default

No active probes are configured.

Command Modes

OER master controller configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.3(14)T	The **ip sla monitor responder** command replaced the **rtr responder** command.
12.4(6)T	The **jitter** and **codec** keywords were added to support OER voice traffic optimization.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **active-probe** command is entered on an OER master controller.

This command is used to optionally configure a master controller to command a border router to transmit active probes to a target IP address or prefix. The active probe is used to measure the delay (round-trip response time) of the target prefix to determine the performance of the current exit and to detect if the prefix is out-of-policy. The border router collects these performance statistics from the active probe and transmits this information to the master controller, which uses this information to optimize the prefix and to select the best available exit based on default and user-defined policies. The performance information is applied to the most specific optimized prefix, which includes the active probe host address. If the prefix is optimized and currently using the best in-policy exit link, the master controller does not take any action.

Active Probing requires you to configure a specific host or target address. The target address can also be learned by OER through the NetFlow or Top Talker and Delay learning functionality. Active probes must be sent out of an OER managed external interface, which may or may not be the preferred route for an Optimized Prefix (OP). OER can be configured to use the following four types of active probes:

- ICMP Echo—A ping is sent to the target address. Configuring an ICMP echo probe does not require knowledgeable cooperation from the target device. However, repeated probing could trigger an Intrusion Detection System (IDS) alarm in the target network. If an IDS is configured in a target network that is not under your administrative control, we recommend that you notify the target network administration entity.
- Jitter—A jitter probe is sent to the target address. A target port number must be specified. A remote responder must be enabled on the target device, regardless of the configured port number. An optional codec value can be configured. The codec value is required for Mean Opinion Score (MOS) calculations.
- TCP Connection—A TCP connection probe is sent to the target address. A target port number must be specified. A remote responder must be enabled if TCP messages are configured to use a port number other than TCP well-known port number 23.
- UDP Echo—A UDP echo probe is sent to the target address. A target port number must be specified. A remote responder must be enabled on the target device, regardless of the configured port number.

OER uses Cisco IOS IP Service Level Agreements (SLAs), a standard feature in Cisco IOS software, to command a border router to transmit an active probe to the target address. No explicit IP SLAs configuration is required on the master controller or the border router. Support for IP SLAs is enabled by default when the OER process is created. However, a remote responder must be enabled on the target device when configuring an active probe using UDP echo messages or when configuring an active probe using TCP connection messages that are configured to use a port other than the TCP well-known port number 23. The remote responder is enabled by configuring the **ip sla monitor responder** global configuration command on the target device.

Note For external BGP (eBGP) peering sessions, the IP address of the eBGP peer must be reachable from the border router via a connected route in order for active probes to be generated.

Examples

Active Probe Configuration Examples

The following example configures an active probe using an ICMP reply (ping) message. The 10.4.9.1 address is the target. No explicit configuration is required on the target device.

```
Router(config)# oer master
Router(config-oer-mc)# active-probe echo 10.4.9.1
```

The following example configures an active probe using jitter messages. The 10.4.9.2 address is the target. The target port number must be specified when configuring this type of probe, and a remote responder must also be enabled on the target device. An optional codec value of g711alaw is specified to be used for MOS calculations.

```
Router(config)# oer master
Router(config-oer-mc)# active-probe jitter 10.4.9.2 target-port 1001 codec g711alaw
```

The following example configures an active probe using a TCP connection message. The 10.4.9.3 address is the target. The target port number must be specified when configuring this type of probe.

```
Router(config)# oer master
Router(config-oer-mc)# active-probe tcp-conn 10.4.9.3 target-port 23
```

The following example configures an active probe using UDP messages. The 10.4.9.4 address is the target. The target port number must be specified when configuring this type of probe, and a remote responder must also be enabled on the target device.

```
Router(config)# oer master
Router(config-oer-mc)# active-probe udp-echo 10.4.9.4 target-port 1001
```

Remote Responder Configuration Examples

The following example configures a remote responder on a border router to send IP SLAs control packets in response to UDP active probes. The port number must match the number that is configured for the active probe.

```
Router(config)# ip sla monitor responder type udpEcho port 1001
```

The following example configures a remote responder on a border router to send IP SLAs control packets in response to TCP active probes. The remote responder must be configured only for TCP active probes that use a port number other than well-known port number 23.

```
Router(config)# ip sla monitor responder type tcpConnect port 2002
```

Related Commands

Command	Description
debug oer border	Displays general OER border router debugging information.
debug oer master collector	Displays data collection debugging information for OER monitored prefixes.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
ip sla monitor responder	Enables the IP SLAs Responder for general IP SLAs operations.
show oer border active-probes	Displays connection and status information about active probes on an OER border router.
show oer master active-probes	Displays connection and status information about active probes on an OER master controller.

active-probe address source

To configure an interface on a border router as the source of the active probe, use the **active-probe address source** command in OER border router configuration mode. To configure active probing to use a default exit interface, use the **no** form of this command.

active-probe source address interface *type number*

no active-probe source address interface

Syntax Description

interface *type number*	Specifies the interface type and interface number.

Command Default

The source IP address is used from the default Optimized Edge Routing (OER) external interface that transmits the active probe.

Command Modes

OER border router configuration

Command History

Release	Modification
12.4(2)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **active-probe address source** command allows you to specify the source interface, from which active probes are transmitted. When this command is configured, the primary IP address of the specified interface is used as the active probe source. The active probe source interface IP address must be unique to ensure that the probe reply is routed back to the specified source interface. If the interface is not configured with an IP address, the active probe will not be generated. If the IP address is changed after the interface has been configured as an active probe source, active probing is stopped, and then restarted with the new IP address. If the IP address is removed after the interface has been configured as an active probe source, active probing is stopped and is not restarted until a valid primary IP address is configured.

Note For external Border Gateway Protocol (eBGP) peering sessions, the IP address of the eBGP peer must be reachable from the border router via a connected route in order for active probes to be generated.

Examples

The following example configures the FastEthernet 0/0 interface as the active probe source:

```
Router(config)# oer border
Router(config-oer-border)# active-probe address source FastEthernet 0/0
```

Related Commands

Command	Description
active-probe	Configures an active probe for a target prefix.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

aggregation-type

To configure an Optimized Edge Routing (OER) master controller to aggregate learned prefixes based on the type of traffic flow, use the **aggregation-type** command in OER Top Talker and Top Delay learning configuration mode. To set learned prefix aggregation to the default type, use the **no** form of this command.

aggregation-type {**bgp** | **non-bgp** | **prefix-length** *prefix-mask*}

no aggregation-type

Syntax Description

bgp	Configures the aggregation of learned prefixes based on the Border Gateway Protocol (BGP) routing table.
non-bgp	Configures the aggregation of learned prefixes based on any other protocol. Prefixes specified with this keyword can be learned only if they are not in the BGP routing table.
prefix-length *prefix-mask*	Configures aggregation based on the specified prefix length. The range of values that can be configured for this argument is a prefix mask from 1 to 32.

Command Default

OER uses the following default value if this command is not configured or if the **no** form of this command is entered:

prefix-list *prefix-mask*: 24

Command Modes

OER Top Talker and Top Delay learning configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **aggregation-type** command is entered on a master controller. This command is used to configure OER to aggregate learned prefixes based on the traffic flow type. BGP prefixes or non-BGP prefixes can be aggregated, and traffic flows can be aggregated based on prefix length.

Entering the **bgp** keyword configures the aggregation of learned prefixes based on prefix entries in the BGP routing table. This keyword is used if internal BGP (iBGP) peering is enabled in the OER managed network.

Entering the **non-bgp** keyword configures the aggregation of learned prefixes based on any other routing protocol. Prefix entries that are present in the BGP routing table are ignored when this keyword is entered.

Examples

The following example configures the aggregation of learned BGP prefixes:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# aggregation-type bgp
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

api client

Effective with Cisco IOS Release 12.4(15)T, the **api client** command is replaced by the **api provider** command. See the **api provider** command for more information.

To register an application interface client with an Optimized Edge Routing (OER) master controller and specify a priority value for the application interface client, use the **api client** command in OER master controller configuration mode. To unregister the application interface client and return the priority to the default value, use the **no** form of this command.

api client *client-id* **priority** *value*

no api client *client-id* **priority** *value*

Syntax Description

client-id	Client ID in the range from 0 to 65535. API client IDs in the range of 1 to 100 are reserved for internal Cisco applications.
priority *value*	Specifies the application interface client priority as a number in the range from 1 to 165535. The lower the number, the higher the priority. The default value is 65535. API client priority values in the range of 1 to 100 are reserved for internal Cisco applications.

Command Default

No application interface clients are registered with OER.

Command Modes

OER master controller configuration (config-oer-mc)

Command History

Release	Modification
12.4(6)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T	The **api client** command is replaced by the **api provider** command.

Usage Guidelines

The **api client** command is used to register an API client with OER and specify the priority of the API client.

Cisco IOS Release 12.4(15)T

In Cisco IOS Release 12.4(15)T and later releases, the **api client** command is replaced by the **api provider** command. The **api client** command is currently supported for backwards compatibility, but support may be removed in a future Cisco IOS software release.

Examples

The following example shows how to register an application interface client with the OER master controller and specify a priority value of 500 for the application interface client:

```
Router(config)# oer master
Router(config-oer-mc)# api client 101 priority 500
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

api provider

To register an application interface provider with an Optimized Edge Routing (OER) master controller and enter OER master controller application interface provider configuration mode, use the **api provider** command in OER master controller configuration mode. To unregister the application interface provider, use the **no** form of this command.

api provider *provider-id* [**priority** *value*]

no api provider *provider-id*

Syntax Description

provider-id	A number in the range from 1 to 65535 representing the ID assigned to the provider. API provider IDs in the range of 1 to 100 are reserved for internal Cisco applications.
priority	(Optional) Sets the priority of the provider.
value	(Optional) A number in the range from 1 to 65535. The lower the number, the higher the priority. The default priority is 65535. API provider priority values in the range of 1 to 100 are reserved for internal Cisco applications.

Command Default

An application interface provider is not registered with an OER master controller.

Command Modes

OER master controller configuration (config-oer-mc)

Command History

Release	Modification
12.4(15)T	This command was introduced.

Usage Guidelines

The OER application interface defines the mode of communication and messaging between applications and the network for the purpose of optimizing the traffic associated with the applications. A provider is defined as an entity outside the network in which the router configured as an OER master controller exists, for example, an ISP, or a branch office of the same company. The provider has one or more host devices running one or more applications that use the OER application interface to communicate with an OER master controller. A provider must be registered with an OER master controller before an application on a host device can interface with OER. Use the **api provider** command to register the provider, and use the **host-address** command to configure a host device. After registration, a host device in the provider network can initiate a session with an OER master controller. The OER application interface provides an automated method for networks to be aware of applications and provides application-aware performance routing.

Use the optional **priority** keyword to specify a priority value for the provider when multiple providers are registered with OER. The number 1 assigns the highest priority to any requests through the application interface. If you assign a priority, each provider must be assigned a different priority number. If you try to assign the same priority number to two different providers, an error message is displayed on the console.

Note API provider IDs and API priority values in the range of 1 to 100 are reserved for internal Cisco applications.

Use the **show oer api provider** command to view information about the currently registered providers. Use the **show oer master policy** command with the **dynamic** keyword to display information about policies created dynamically by an application using the OER application interface.

Examples

The following example shows how to register a provider on a master controller. In this example, more than one provider is configured, so the priority is set for each provider. For the single host device configured for provider 101, no priority is set and the default priority value of 65535 is assigned, giving this host device a lower priority than each of the host devices configured for provider 102.

```
Router(config)# oer master
Router(config-oer-mc)# api provider 101
Router(config-oer-mc-api-provider)# host-address 10.1.2.2 key-chain OER_HOST
Router(config-oer-mc-api-provider)# exit
Router(config-oer-mc)# api provider 102 priority 4000
Router(config-oer-mc-api-provider)# host-address 10.2.2.2 key-chain OER_HOST
priority 3000
Router(config-oer-mc-api-provider)# host-address 10.2.2.3 key-chain OER_HOST
priority 4000
Router(config-oer-mc-api-provider)# end
```

Related Commands

Command	Description
host-address	Configures information about a host device used by an application interface provider to communicate with an OER master controller.
oer master	Enables an OER process and configures a router as an OER master controller.
show oer api provider	Displays information about application interface providers registered with OER.
show oer master policy	Displays policy settings on an OER master controller.

application define

To configure a user-defined custom application to be monitored by Optimized Edge Routing (OER), use the **application define** command in OER master controller configuration mode. To remove the definition of a user-defined custom application to be monitored by OER, use the **no** form of this command.

application define *application-name* {**access-list** *access-list-name* | **nbar**}

no application define *application-name*

Syntax Description

application-name	Name of the user-defined custom application.
access-list	Defines an application using an access list.
access-list-name	Name of an access list.
nbar	Defines a user-defined custom application to be identified using Network-Based Application Recognition (NBAR).

Command Default

No custom-defined applications are defined for use with OER.

Command Modes

OER master controller configuration (config-oer-mc)

Command History

Release	Modification
12.4(15)T	This command was introduced.
12.4(20)T	The **nbar** keyword was added.

Usage Guidelines

The **application define** command allows a user-defined custom application to be defined on the master controller as an application that can be used in OER configuration to create a traffic class that can be measured and controlled using OER techniques. An access list can be used to define the traffic flows to create a custom application.

In Cisco IOS Release 12.4(20)T, the ability to define a custom application to be identified using NBAR, was introduced. NBAR includes many defined applications but a Packet Description Language Module (PDLM) can be used to add a new protocol to the list of supported NBAR applications. A PDLM uses a mapping of static TCP and UDP port numbers to create a custom application. The application defined by a PDLM file must be recognized on an OER border router and configured on the master controller using the **application define** command. The OER master controller makes a request to the border router to determine if the application is supported. Use the **show oer master nbar application** command to check if the application is supported on each border router.

To display defined applications use the **show oer master defined** or the **show oer border defined** commands.

Examples

The following example, starting in global configuration mode, shows how to define a custom application named ACCESS_DEFINE using an access list. The access list is configured to identify all TCP traffic from any destination or source and from a destination port number of 500.

```
Router(config)# ip access-list ACCESS_DEFINE
Router(config-ext-nacl)# permit tcp any any 500
Router(config-ext-nacl)# exit
Router(config)# oer master
Router(config-oer-mc)# application define APP_ACCESS access-list ACCESS_DEFINE
Router(config-oer-mc)# end
```

The following example, starting in global configuration mode, shows how to define a custom application named APP_NBAR1 to be identified using NBAR and used in OER configuration to create a traffic class that can be measured and controlled using OER techniques. This example requires a Cisco IOS Release 12.4(20)T image.

```
Router(config)# oer master
Router(config-oer-mc)# application define APP_NBAR1 nbar
Router(config-oer-mc)# end
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show oer border defined	Displays all applications that are defined to be monitored by an OER border router.
show oer master defined	Displays all applications that are defined on an OER master controller.
show oer master nbar application	Displays information about the status of an application identified using NBAR for each OER border router.

backoff

To set the backoff timer to adjust the time period for prefix policy decisions, use the **backoff** command in OER master controller configuration mode. To set the backoff timer to the default value, use the **no** form of this command.

backoff *min-timer max-timer* [*step-timer*]

no backoff

Syntax Description

min-timer	Sets the minimum value for the backoff timer in seconds. The configurable time period for this argument is from 180 to 7200. The default timer value is 300.
max-timer	Sets the maximum value for the backoff timer in seconds. The configurable time period for this argument is from 180 to 7200. The default timer value is 3000.
step-timer	(Optional) Sets the value of the time period for the step timer in seconds. The step timer is used to add time to the out-of-policy waiting period each time the backoff timer expires and Optimized Edge Routing (OER) is unable to find an in-policy exit. The configurable time period for this argument is from 180 to 7200. The default timer value is 300.

Command Default

OER uses the following default values if this command is not configured or if the **no** form of this command is entered:

min-timer: 300
max-timer: 3000
step-timer: 300

Command Modes

OER master controller configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **backoff** command is entered on an OER master controller. This command is used to adjust the transition period that the master controller holds an out-of-policy prefix. The master controller waits for the transition period before making an attempt to find an in-policy exit. This command is configured with a minimum and maximum timer value and can be configured with an optional step timer.

The *min-timer* argument is used to set the minimum transition period in seconds. If the current prefix is in-policy when this timer expires, no change is made and the minimum timer is reset to the default or configured value. If the current prefix is out-of-policy, OER will move the prefix to an in-policy and reset the minimum timer to the default or configured value.

The *max-timer* argument is used to set the maximum length of time OER holds an out-of-policy prefix when there are no OER controlled in-policy prefixes. If all OER controlled prefixes are in an out-of-policy state and the value from the *max-timer* argument expires, OER will select the best available exit and reset the minimum timer to the default or configured value.

The *step-timer* argument allows you to optionally configure OER to add time each time the minimum timer expires until the maximum time limit has been reached. If the maximum timer expires and all OER managed exits are out-of-policy, OER will install the best available exit and reset the minimum timer.

Configuring a new timer value will immediately replace the existing value if the new value is less than the time remaining. If the new value is greater than the time remaining, the new timer value will be used when the existing timer value expires.

Examples

The following example sets the minimum timer to 400 seconds, the maximum timer to 4000 seconds, and the step timer to 400 seconds:

```
Router(config)# oer master
Router(config-oer-mc)# backoff 400 4000 400
```

Related Commands

Command	Description
oer	Enable an OER process and configure a router as an OER border router or as an OER master controller.
set backoff	Configures an OER map to set the backoff timer to adjust the time period for prefix policy decisions.

border

To enter OER managed border router configuration mode to establish communication with an Optimized Edge Routing (OER) border router, use the **border** command in OER master controller configuration mode. To disable communication with the specified border router, use the **no** form of this command.

border *ip-address* [**key-chain** *key-name*]

no border *ip-address*

Syntax Description

ip-address	Specifies the IP address of the border router.
key-chain *key-name*	(Optional) Specifies the key used to authenticate communication between the border router and the master controller. The authentication key must be specified during the initial configuration to establish communication but is not required to enter OER managed border router configuration mode.

Command Default

Border key-chain configuration is required during initial configuration. Once configured, the **key-chain** keyword is optional.

Passive monitoring in OER observe mode is enabled by default when communication is established between an OER border router and master controller.

Command Modes

OER master controller configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **border** command is entered on a master controller. This command is used to establish communication between a master controller and border router. Communication is established between the master controller and border router processes to allow the master controller to monitor and control prefixes and exit links. Communication must also be established on the border router with the **master** OER border configuration command.

At least one border router must be configured to enable OER. A maximum of ten border routers can be configured to communicate with a single master controller. The IP address that is used to specify the border router must be assigned to an interface physically located on the border router and must be reachable by the master controller.

Communication between the master controller and the border router is protected by key-chain authentication. The authentication key must be configured on both the master controller and the border router before communication can be established. The key-chain configuration is defined in global configuration mode on both the master controller and the border router before key-chain authentication is enabled for master controller to border router communication. For more information about key

management in Cisco IOS software, see the "Managing Authentication Keys" section in the "Configuring IP Protocol-Independent Features" chapter of the *Cisco IOS IP Routing Protocols Configuration Guide*, Release 12.4.

When the **border** command is entered, the router enters OER managed border router configuration mode. Local interfaces must be defined as internal or as external with the **interface** (OER) OER managed border router configuration command. A single OER master controller can support up to 20 interfaces.

Enabling a Border Router and Master Controller Process on the Same Router

A Cisco router can be configured to perform in dual operation and run a master controller process and border router process on the same router. However, this router will use more memory than a router that is configured to run only a border router process. This factor should be considered when selecting a router for dual operation.

Examples

The following example defines a key chain named MASTER in global configuration mode and then configures a master controller to communicate with the 10.4.9.6 border router. The master controller authenticates the border router using the defined key CISCO.

```
Router(config)# key chain MASTER
Router(config-keychain)# key 1
Router(config-keychain-key)# key-string CISCO
Router(config-keychain-key)# exit
Router(config-keychain)# exit
Router(config)# oer master
Router(config-oer-mc)# port 65535
Router(config-oer-mc)# logging
Router(config-oer-mc)# border 10.4.9.6 key-chain MASTER
Router(config-oer-mc-br)# interface FastEthernet0/0 external
Router(config-oer-mc-br)# interface FastEthernet0/1 internal
```

Related Commands

Command	Description
interface (OER)	Configures a border router interface as an OER-controlled external or internal interface.
keepalive	Configures the length of time that an OER master controller will maintain connectivity with an OER border router after no keepalive packets have been received.
key	Identifies an authentication key on a key chain.
key chain (IP)	Enables authentication for routing protocols.
key-string (authentication)	Specifies the authentication string for a key.
master	Establishes communication with an OER master controller.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

clear oer api

To reset the Optimized Exit Routing (OER) application program interface (API) sessions between the border router and master controller, use the **clear oer api** command in privileged EXEC mode.

clear oer api {***** | **session-id** *api-session-id*}

Syntax Description

*****	Clears all the OER API sessions.
session-id	Specifies the identifier of the session.
api-session-id	API session identifier. The value range is from 1 to 65535.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
15.0(1)M	This command was introduced in a release earlier than Cisco IOS Release 15.0(1)M.
12.2(33)SRC	This command was integrated into a release earlier than Cisco IOS Release 12.2(33)SRC.
12.2(33)SXI	This command was integrated into a release earlier than Cisco IOS Release 12.2(33)SXI.
Cisco IOS XE Release 2.1	This command was implemented on the Cisco ASR 1000 Series Aggregation Services Routers.

Examples

The following example shows how to reset the OER API sessions between the border router and master controller:

```
Router# clear oer api session-id 2
```

Related Commands

Command	Description
oer	Enables a Cisco IOS OER process and configures a router as an OER border router or as an OER master controller.

clear oer border

To reset a connection between a border router and the master controller, use the **clear oer border** command in privileged EXEC mode.

clear oer border *

Syntax Description

*	Clears a connection between a border router and the master controller.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **clear oer border** command is entered on a border router. The border router and master controller will automatically reestablish communication after this command is entered.

Examples

The following example resets a connection between a border router and a master controller:

```
Router# clear oer border *
```

Related Commands

Command	Description
oer	Enable an OER process and configure a router as an OER border router or as an OER master controller.

clear oer master

To reset an Optimized Edge Routing (OER) master controller process and all active border router connections, use the **clear oer master** command in privileged EXEC mode.

clear oer master *

Syntax Description

*	Clears the master controller process and all active border router connections.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **clear oer master** command is entered on a master controller. The master controller will restart all configured and default processes and reestablish communication with active border routers after this command is entered.

Examples

The following example resets the master controller process and all active border router connections:

```
Router# clear oer master *
```

Related Commands

Command	Description
oer	Enable an OER process and configure a router as an OER border router or as an OER master controller.

clear oer master appl tcp

To reset an Optimized Edge Routing (OER) master controller applications and all active TCP protocol connections, use the **clear oer master appl tcp** command in privileged EXEC mode.

clear oer master appl tcp {*min-port max-port* {**dst** | **src**} | **dst** | **src**}

Syntax Description

min-port	Minimum port. The value range is from 1 to 65535.
max-port	Maximum port. The value range is from 1 to 65535.
dst	Specifies the application based on the destination port.
src	Specifies the application based on the source port.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
15.0(1)M	This command was introduced in a release earlier than Cisco IOS Release 15.0(1)M.
12.2(33)SRC	This command was integrated into a release earlier than Cisco IOS Release 12.2(33)SRC.
12.2(33)SXI	This command was integrated into a release earlier than Cisco IOS Release 12.2(33)SXI.
Cisco IOS XE Release 2.1	This command was implemented on the Cisco ASR 1000 Series Aggregation Services Routers.

Examples

The following example shows how to reset the OER master controller applications and all active TCP protocol connections:

```
Router# clear oer master appl tcp 2 5 dst
```

Related Commands

Command	Description
oer	Enables a Cisco IOS OER process and configures a router as an OER border router or as an OER master controller.

clear oer master border

To reset an active border router connection or all connections with a master controller, use the **clear oer master border** command in privileged EXEC mode.

clear oer master border {***** | *ip-address*}

Syntax Description

*****	Specifies all active border router connections.
ip-address	Specifies a single border router connection.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **clear oer master border** command is entered on a master controller.

Examples

The following example resets all border router connections to the master controller:

```
Router# clear oer master border *
```

The following example resets a single border router connection to the master controller:

```
Router# clear oer master border 10.4.9.6
```

Related Commands

Command	Description
oer	Enable an OER process and configure a router as an OER border router or as an OER master controller.

clear oer master prefix

To clear Optimized Edge Routing (OER) controlled prefixes from the master controller database, use the **clear oer master prefix** command in privileged EXEC mode.

clear oer master prefix {***** | *prefix* | **inside *** | **learned** [**inside**]}

Syntax Description

*****	Clears all prefixes.
prefix	Clears a single prefix or prefix range. The prefix address and mask are entered with this argument.
inside	Clears inside prefixes.
learned	Clears learned prefixes.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(9)T	The **inside** keyword was added to support OER Border Gateway Protocol (BGP) inbound optimization.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **clear oer master prefix** command is entered on a master controller.

Examples

The following example clears learned prefixes:

```
Router# clear oer master prefix learned
```

The following example clears all inside prefixes:

```
Router# clear oer master prefix inside *
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

clear oer master traffic-class

To clear Optimized Edge Routing (OER) controlled traffic classes from the master controller database, use the **clear oer master traffic-class** command in privileged EXEC mode.

clear oer master traffic-class [**access-list** *access-list-name* | **application** *application-name* [*prefix*] | **inside** | **learned** [**delay** | **inside** | **list** *list-name* | **throughput**] | **prefix** *prefix* | **prefix-list** *prefix-list-name*]

Syntax Description

access-list	(Optional) Clears information about traffic classes defined by an access list.
access-list-name	(Optional) Name of access list.
application	(Optional) Clears information about traffic classes defined by an application.
application-name	(Optional) Name of a predefined static application using fixed ports. See Table 8.
prefix	(Optional) An IP address and bit length mask representing a prefix to be cleared.
inside	(Optional) Clears information about inside traffic classes.
learned	(Optional) Clears information about learned traffic classes.
delay	(Optional) Clears information about learned traffic classes defined using delay.
list	(Optional) Clears information about learned traffic classes defined in an OER learn list.
list-name	(Optional) Name of OER learn list.
throughput	(Optional) Clears information about learned traffic classes defined using throughput.
prefix	(Optional) Clears information about traffic classes defined by a prefix.
prefix-list	(Optional) Clears information about traffic classes defined by a prefix list.
prefix-list-name	(Optional) Name of prefix list.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.4(15)T	This command was introduced.

Usage Guidelines

The **clear oer master traffic-class** command is entered on a master controller. In Cisco IOS Release 12.4(20)T, and later releases, to clear OER-controlled traffic classes defined by an application identified using Network-Based Application Recognition (NBAR) from the master controller database, use the **clear oer master traffic-class application nbar** command.

Table 8 displays the keywords that represent the application that can be configured with the **clear oer master traffic-class** command. Replace the *application-name* argument with the appropriate keyword from the table.

Table 8 Static Application List Keywords

Keyword	Protocol	Port
cuseeme	TCP UDP	7648 7649 7648 7649 24032
dhcp (Client)	UDP/TCP	68
dhcp (Server)	UDP/TCP	67
dns	UDP/TCP	53
finger	TCP	79
ftp	TCP	20 21
gopher	TCP/UDP	70
http	TCP/UDP	80
httpssl	TCP	443
imap	TCP/UDP	143 220
irc	TCP/UDP	194
kerberos	TCP/UDP	88 749
l2tp	UDP	1701
ldap	TCP/UDP	389
mssql	TCP	1443
nfs	TCP/UDP	2049
nntp	TCP/UDP	119
notes	TCP/UDP	1352
ntp	TCP/UDP	123
pcany	UDP TCP	22 5632 65301 5631
pop3	TCP/UDP	110
pptp	TCP	17233
simap	TCP/UDP	585 993 (Preferred)
sirc	TCP/UDP	994
sldap	TCP/UDP	636
smtp	TCP	25
snntp	TCP/UDP	563
spop3	TCP/UDP	123
ssh	TCP	22
telnet	TCP	23

Examples

The following example shows how to clear traffic classes defined by the Secure Shell (SSH) application and the 10.1.1.0/24 prefix:

```
Router# clear oer master traffic-class application ssh 10.1.1.0/24
```

The following example shows how to clear traffic classes that were learned:

```
Router# clear oer master traffic-class learned
```

Related Commands

Command	Description
clear oer master traffic-class application nbar	Clears OER-controlled traffic classes defined by an application identified using NBAR from the master controller database.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

clear oer master traffic-class application nbar

To clear Optimized Edge Routing (OER) controlled traffic classes defined by an application identified using Network-Based Application Recognition (NBAR) from the master controller database, use the **clear oer master traffic-class application nbar** command in privileged EXEC mode.

clear oer master traffic-class application nbar [*nbar-appl-name* [*prefix*]]

Syntax Description

nbar-appl-name	(Optional) Keyword representing the name of an application identified using NBAR. See the Usage Guidelines section for more details.
prefix	(Optional) An IP address and bit length mask representing a prefix to be cleared.

Command Default

All OER-controlled traffic classes defined by applications identified using NBAR are cleared.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.4(20)T	This command was introduced.

Usage Guidelines

The **clear oer master traffic-class application nbar** command is entered on a master controller. To clear all other types of OER-controlled traffic classes from the master controller database, use the **clear oer master traffic-class** command.

NBAR is capable of identifying applications based on the following three types of protocols:

- Non-UDP and Non-TCP IP protocols—For example, Generic Routing Encapsulation (GRE), and Internet Control Message Protocol (ICMP).
- TCP and UDP protocols that use statically assigned port numbers—For example, CU-SeeMe desktop video conference (CU-SeeMe-Server) and Post Office Protocol over Transport Layer Security (TLS) and Secure Sockets Layer (SSL) server (SPOP3-Server).
- TCP and UDP protocols that dynamically assign port numbers and require stateful inspection—For example, Real-Time Transport Protocol audio streaming (RTP-audio) and BitTorrent File Transfer Traffic (BitTorrent).

Use the **clear oer master traffic-class application nbar ?** command to determine if an application can be identified using NBAR and replace the *nbar-appl-name* argument with the appropriate keyword from the screen display.

The list of applications identified using NBAR and available for profiling OER or Performance Routing traffic classes is constantly evolving. For lists of many of the NBAR applications defined using static or dynamically assigned ports, see the "Using Performance Routing to Profile the Traffic Classes" module.

For more details about NBAR, see the "Classifying Network Traffic Using NBAR" section of the *Cisco IOS Quality of Service Solutions Configuration Guide*.

If the *prefix* argument is specified, only the OER-controlled traffic class that matches the application specified by the *nbar-appl-name* argument and the destination prefix specified by the *prefix* argument are cleared. If the *prefix* argument is not specified, all OER-controlled traffic classes that match the application specified by the *nbar-appl-name* argument, regardless of the destination prefix, are cleared.

Examples

The following example shows how to determine the keyword that represents an application identified using NBAR in order to clear the OER traffic classes defined by the application:

```
Router# clear oer master traffic-class application nbar ?
```

The following example shows how to clear OER traffic classes defined by the RTP-audio application that is identified using NBAR and the 10.1.1.0/24 prefix:

```
Router# clear oer master traffic-class application nbar rtp-audio 10.1.1.0/24
```

The following example shows how to clear all OER traffic classes defined by applications identified using NBAR:

```
Router# clear oer master traffic-class application nbar
```

Related Commands

Command	Description
clear oer master traffic-class	Clears OER-controlled traffic classes from the master controller database.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

cost-minimization

To configure cost-based optimization policies on a master controller, use the **cost-minimization** command in OER border exit interface configuration mode. To disable a cost-based optimization policy, use the **no** form of this command.

cost-minimization {**calc** {**combined** | **separate** | **sum**} | **discard** [**daily**] {**absolute** *number* | **percent** *percentage*} | **end day-of-month** *day* [**offset** [**-**] *hh:mm*] | **fixed fee** [*cost*] | **nickname** *name* | **sampling period** *minutes* [**rollup** *minutes*] | **summer-time** *start end* [*offset*] | **tier** *percentage* **fee** *fee*}

no cost-minimization {**calc** | **discard** | **end day-of-month** *day* [**offset** [**-**] *hh:mm*] | **fixed fee** [*cost*] | **nickname** | **sampling period** | **summer-time** | **tier** *percentage*}

Syntax Description

calc	Specifies how the fee is calculated.
combined	Specifies billing based on combined egress and ingress rollup samples.
separate	Specifies billing based on separate egress and ingress rollup samples.
sum	Specifies billing based on egress and ingress rollup samples that are added and then combined.
discard	Specifies how often rollup samples are discarded.
daily	(Optional) Specifies a daily rather than monthly rollup period.
absolute *number*	Specifies an absolute number of rollup samples to be discarded. The value that can be entered for the *number* argument is a number from 1 to 1440.
percent *percentage*	Specifies a percentage of roll up samples to be discarded. The value that can be entered for the *percentage* argument is a number from 1 to 99.
end day-of-month *day*	Specifies the end billing date.
offset [**-**] *hh:mm*	(Optional) Specifies an offset in hours and minutes, allowing you to compensate for time zone differences. The optional "**-**" keyword is used to allow for negative hours and minutes to be specified when the time zone is ahead of UTC.
fixed fee	Specifies a nonusage based fixed fee.
cost	(Optional) Specifies the cost for the fixed fee.
nickname *name*	Specifies a nickname for the cost structure.
sampling period *minutes*	Specifies the sampling period in minutes. The value that can be entered for the *minutes* argument is a number from 1 to 1440.
rollup *minutes*	(Optional) Specifies that samples are rolled up at the interval specified for the *minutes* argument. The value that can be entered for the *minutes* argument is a number from 1 to 1440. The minimum number that can be entered must be equal to or greater than the number that is entered for the sampling period.
summer-time	Specifies the start and end of summer time.
start	The start period is entered in following format: the week number or the words first or last, the day represented by the first three letters of the day, the month represented by the first three letters of the month, and hh:mm. For example, 1 Sun Apr 00:00.

end	The end period is entered in following format: the week number or the words first or last, the day represented by the first three letters of the day, the month represented by the first three letters of the month, and hh:mm. For example, 4 Sun Oct 23:59.
offset	(Optional) The *offset* argument allows for an offset in minutes from 1 to 120 to allow for up to two additional hours to be added in the spring and subtracted in the fall.
tier	Specifies a cost tier.
percentage	A percentage of capacity for a cost tier.
fee *fee*	Specifies the fee associated with a cost tier.

Command Default

No cost-based optimization policies are configured.

Command Modes

OER border exit interface configuration (config-oer-mc-br-if)

Command History

Release	Modification
12.3(14)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T9	This command was modified. The calculation of the MTLU algorithm is modified to allow for more efficient bandwidth utilization while minimizing the link cost.

Usage Guidelines

The **cost-minimization** command is configured on a master controller. Cost-based optimization allows you to configure link policies based on the Internet service provider (ISP) financial cost of each exit link in your network. The **cost-minimization** command allows you to configure the master controller to send traffic over exit links that provide the most cost-effective bandwidth utilization, while still maintaining the desired performance characteristics.

Examples

The following example, starting in global configuration mode, configures cost-based optimization on a master controller. Cost optimization configuration is applied under the external interface configuration. A policy for a tiered billing cycle is configured. Calculation is configured separately for egress and ingress samples. The time interval between sampling is set to 10 minutes. These samples are configured to be rolled up every 60 minutes. In this example, summer time is configured to start the second week in March on a Sunday at 2 in the morning plus one hour, and end on Sunday in the first week in November at 2 in the morning minus one hour. The last day of the billing cycle is on the 30th day of the month with an offset of 5 hours added to UTC to adjust for the time zone.

```
Router(config)# oer master
Router(config-oer-mc)# border 10.5.5.55 key-chain key
Router(config-oer-mc-br)# interface Ethernet 0/0 external
Router(config-oer-mc-br-if)# cost-minimization nickname ISP1
Router(config-oer-mc-br-if)# cost-minimization summer-time 2 Sun Mar 02:00
1 Sun Nov 02:00 60
Router(config-oer-mc-br-if)# cost-minimization end day-of-month 30 offset 23:59
Router(config-oer-mc-br-if)# cost-minimization calc separate
```

```
Router(config-oer-mc-br-if)# cost-minimization sampling period 10 rollup 60
Router(config-oer-mc-br-if)# cost-minimization tier 100 fee 1000
Router(config-oer-mc-br-if)# cost-minimization tier 90 fee 900
Router(config-oer-mc-br-if)# cost-minimization tier 80 fee 800
```

Related Commands

Command	Description
debug oer master cost-minimization	Displays debugging information for cost-based optimization policies.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
resolve	Sets the priority of a policy when multiple overlapping policies are configured.
show oer master cost-minimization	Displays the status of cost-based optimization policies.

count

To set the number of traffic classes to be learned by a learn list during an Optimized Edge Routing (OER) learn session, use the **count** command in learn list configuration mode. To reset the number of traffic classes to be learned by a learn list to the default values, use the **no** form of this command.

count *number* **max** *max-number*

no count *number* **max** *max-number*

Syntax Description

number	Number representing the number of traffic classes to be learned by a learn list during an OER learn session. The range of numbers is from 1 to 100. the default is 50.
max	Specifies the maximum number of traffic classes to be learned by an OER learn list (over all OER learning sessions).
max-number	Number representing the maximum number of traffic classes to be learned for an OER learn list. The range of numbers is from 1 to 100. The default is 100.

Command Default

If this command is not configured, the number of traffic classes to be learned by a learn list during an OER learn session is set to the default value.

Command Modes

Learn list configuration (config-oer-mc-learn-list)

Command History

Release	Modification
12.4(15)T	This command was introduced.

Usage Guidelines

Use this command to set the number of traffic classes that a border router sends to the master controller for a learn list during an OER learn session. An overall maximum number of traffic classes for a learn list can also be configured.

Examples

In the following example, the number of traffic classes to be learned in the first learn list (remote login traffic class) session is set to 50, and the maximum number of traffic classes to be learned for all sessions of the first learn list is set to 90. The second traffic class for file transfer traffic is configured with a maximum number of traffic classes set to 80, with 40 traffic classes set to be learned in a single session. Starting in global configuration mode, application traffic classes are defined using two OER learn lists, LEARN_REMOTE_LOGIN_TC and LEARN_FILE_TRANSFER_TC. The remote login traffic class is configured using keywords representing Telnet and Secure Shell (SSH) traffic and the resulting prefixes are aggregated to a prefix length of 24. The file transfer traffic class is configured using a keyword that represents FTP and is also aggregated to a prefix length of 24. A prefix-list is applied to the file transfer

traffic class to permit traffic from the 10.0.0.0/8 prefix. The master controller is configured to learn the top prefixes based on highest outbound throughput for the filtered traffic and the resulting traffic classes are added to the OER application database.

```
Router(config)# ip prefix-list INCLUDE_10_NET 10.0.0.0/8
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# list seq 10 refname LEARN_REMOTE_LOGIN_TC
Router(config-oer-mc-learn-list)# count 50 max 90
Router(config-oer-mc-learn-list)# traffic-class application telnet ssh
Router(config-oer-mc-learn-list)# aggregation-type prefix-length 24
Router(config-oer-mc-learn-list)# throughput
Router(config-oer-mc-learn-list)# exit
Router(config-oer-mc-learn)# list seq 20 refname LEARN_FILE_TRANSFER_TC
Router(config-oer-mc-learn-list)# count 40 max 80
Router(config-oer-mc-learn-list)# traffic-class application ftp filter INCLUDE_10_NET
Router(config-oer-mc-learn-list)# aggregation-type prefix-length 24
Router(config-oer-mc-learn-list)# throughput
Router(config-oer-mc-learn-list)# end
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure OER to automatically learn traffic classes.
list (OER)	Creates an OER learn list to specify criteria for learning traffic classes and enters learn list configuration mode.

debug oer api

To display Optimized Edge Routing (OER) application interface debugging information, use the **debug oer api** command in privileged EXEC mode. To stop the display of OER application interface debugging information, use the **no** form of this command.

debug oer api [**detail**]

no debug oer api

Syntax Description

detail	(Optional) Displays detailed application interface debugging information.

Command Default

Detailed OER application interface debugging messages are not displayed.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.4(15)T	This command was introduced.

Usage Guidelines

The **debug oer api** command is used to display messages about any configured OER application interface providers or host devices. The OER application interface defines the mode of communication and messaging between applications and the network for the purpose of optimizing the traffic associated with the applications. A provider is defined as an entity outside the network in which the router configured as an OER master controller exists, for example, an ISP, or a branch office of the same company. The provider has one or more host devices running one or more applications that use the OER application interface to communicate with an OER master controller. A provider must be registered with an OER master controller before an application on a host device can interface with OER. Use the **api provider** command to register the provider, and use the **host-address** command to configure a host device. After registration, a host device in the provider network can initiate a session with an OER master controller. The application interface provides an automated method for networks to be aware of applications and provides application-aware performance routing.

Caution When the **detail** keyword is entered, the amount of detailed output to be displayed can utilize a considerable amount of system resources. Use the **detail** keyword with caution in a production network.

Examples

The following example enables the display of OER application interface debugging messages and the output shows that an OER policy failed due to a prefix that is not found:

```
Router# debug oer api

OER api debugging is on
```

```
*May 26 01:04:07.278: OER API: Data set id received 5, data set len 9, host ip 10.3.3.3,
session id 1, requies2
*May 26 01:04:07.278: OER API: Received get current policy, session id 1 request id 22
*May 26 01:04:07.278: OER API: Recvd Appl with Prot 256 DSCP 0 SrcPrefix 0.0.0.0/0
SrcMask 0.0.0.0
*May 26 01:04:07.278: OER API:  DstPrefix 10.2.0.0/24 DstMask 255.255.255.0 Sport_min 0
Sport_max 0 Dport_mi0
*May 26 01:04:07.278: OER API: get prefix policy failed - prefix not found
*May 26 01:04:07.278: OER API: Get curr policy cmd received. rc 0
*May 26 01:04:07.278: OER API: Received send status response, status 0, session id 1,
request id 22, sequence0
*May 26 01:04:07.278: OER API: rc for data set 0
```

Table 9 describes the significant fields shown in the display. The content of the debugging messages depends on the commands that are subsequently entered at the router prompt.

Table 9 debug oer api Field Descriptions

Field	Description
OER api debugging is on	Shows that application interface debugging is enabled.
OER API	Displays an OER application interface message.

Related Commands

Command	Description
api provider	Registers an application interface provider with an OER master controller and enters OER master controller application interface provider configuration mode.
host-address	Configures information about a host device used by an application interface provider to communicate with an OER master controller.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show oer api provider	Displays information about application interface providers registered with OER.

debug oer api client

Effective with Cisco IOS Release 12.4(15)T, the **debug oer api client** command is replaced by the **debug oer api** command. See the **debug oer api** command for more information.

To display Optimized Edge Routing (OER) application interface client debugging information for master controller and border router communication, use the **debug oer api client** command in privileged EXEC mode. To stop the display of OER application interface debugging information, use the **no** form of this command.

debug oer api client [**detail**]

no debug oer api client [**detail**]

Syntax Description

detail	(Optional) Displays detailed information.

Command Default

No OER application interface debugging messages are enabled.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.4(6)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T	The **debug oer api client** command is replaced by the **debug oer api** command.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer api client** command can be entered on a master controller. This command is used to display messages about a configured OER application interface client. When the **detail** keyword is entered, the amount of detailed output to be displayed can utilize a considerable amount of system resources. Use the **detail** keyword with caution in a production network.

Cisco IOS Release 12.4(15)T

In Cisco IOS Release 12.4(15)T and later releases, the **debug oer api client** command is replaced by the **debug oer api** command. The **debug oer api client** command is currently supported for backwards compatibility, but support may be removed in a future Cisco IOS software release.

Examples

The following example enables the display of OER application interface client debugging messages:

```
Router# debug oer api client

API Client debugging enabled
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer border

To display general OER border router debugging information, use the **debug oer border** command in privileged EXEC mode. To stop the display of OER debugging information, use the **no** form of this command.

debug oer border

no debug oer border

Syntax Description

This command has no arguments or keywords.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer border** command is entered on a border router. This command is used to display debugging information about the OER border process, controlled routes and monitored prefixes.

Examples

The following example displays general OER debugging information:

```
Router# debug oer border

*May  4 22:32:33.695: OER BR: Process Message, msg 4, ptr 33272128, value  140
*May  4 22:32:34.455: OER BR: Timer event, 0
```

Table 10 describes the significant fields shown in the display.

Table 10 debug oer border Field Descriptions

Field	Description
OER BR:	Indicates debugging information for OER Border process.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer border active-probe

To display debugging information for active probes configured on the local border router, use the **debug oer border active-probe** command in privileged EXEC mode. To stop the display of debug event information, use the **no** form of this command.

debug oer border active-probe

no debug oer border active-probe

Syntax Description

This command has no arguments or keywords.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer border active-probe** command is entered on a master controller. This command is used to display the status and results of active probes that are configured on the local border router.

Examples

The following example enables the display of active-probe debug information on a border router:

```
Router# debug oer border active-probe

*May  4 23:47:45.633: OER BR ACTIVE PROBE: Attempting to retrieve Probe
Statistics.
      probeType = echo, probeTarget = 10.1.5.1, probeTargetPort = 0
      probeSource = Default, probeSourcePort = 0, probeNextHop = Default
      probeIfIndex = 13
*May  4 23:47:45.633: OER BR ACTIVE PROBE: Completed retrieving Probe
Statistics.
      probeType = echo, probeTarget = 10.1.5.1, probeTargetPort = 0
      probeSource = Default, probeSourcePort = 0, probeNextHop = 10.30.30.2
      probeIfIndex = 13, SAA index = 15
*May  4 23:47:45.633: OER BR ACTIVE PROBE: Completions 11, Sum of rtt 172,
Max rtt 36, Min rtt 12
*May  4 23:47:45.693: OER BR ACTIVE PROBE: Attempting to retrieve Probe
Statistics.
      probeType = echo, probeTarget = 10.1.4.1, probeTargetPort = 0
      probeSource = Default, probeSourcePort = 0, probeNextHop = Default
```

```
      probeIfIndex = 13
*May  4 23:47:45.693: OER BR ACTIVE PROBE: Completed retrieving Probe
Statistics.
      probeType = echo, probeTarget = 10.1.4.1, probeTargetPort = 0
      probeSource = Default, probeSourcePort = 0, probeNextHop = 10.30.30.2
      probeIfIndex = 13, SAA index = 14
```

Table 11 describes the significant fields shown in the display.

Table 11 debug oer border active-probe Field Descriptions

Field	Description
OER BR ACTIVE PROBE:	Indicates debugging information for OER active probes on a border router.
Statistics	The heading for OER active probe statistics.
probeType	The active probe type. The active probe types that can be displayed are ICMP, TCP, and UDP.
probeTarget	The target IP address of the active probe.
probeTargetPort	The target port of the active probe.
probeSource	The source IP address of the active probe. Default is displayed for a locally generated active probe.
probeSourcePort	The source port of the active probe.
probeNextHop	The next hop for the active probe.
probeIfIndex	The active probe source interface index.
SAA index	The IP SLAs collection index number.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer border learn

To display debugging information about learned prefixes on the local border router, use the **debug oer border learn** command in privileged EXEC mode. To stop the display of debug event information, use the **no** form of this command.

debug oer border learn [**top** *number*]

no debug oer border learn [**top** *number*]

Syntax Description

top *number*	(Optional) Displays debugging information about the top delay or top throughput prefixes. The number of top delay or throughput prefixes can be specified. The range of prefixes that can be specified is a number from 1 to 65535.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer border learn** command is entered on a border router. This command is used to display debugging information about prefixes learned on the local border router.

Examples

The following example enables the display of active-probe debug information on a border router:

```
Router# debug oer border learn

*May  4 22:51:31.971: OER BR LEARN: Reporting prefix 1: 10.1.5.0, throughput 201
*May  4 22:51:31.971: OER BR LEARN: Reporting 1 throughput learned prefixes
*May  4 22:51:31.971: OER BR LEARN: State change, new STOPPED, old STARTED, reason Stop
Learn
```

Table 12 describes the significant fields shown in the display.

Table 12 debug oer border learn Field Descriptions

Field	Description
OER BR LEARN:	Indicates debugging information for the OER border router learning process.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer border routes

To display debugging information for OER-controlled or monitored routes on the local border router, use the **debug oer border routes** command in privileged EXEC mode. To stop the display of debug event information, use the **no** form of this command.

debug oer border routes {**bgp** | **eigrp** [**detail**] | **piro** [**detail**] | **static**}

no debug oer border routes {**bgp** | **eigrp** | **static** | **piro**}

Syntax Description

bgp	Displays debugging information for BGP routes.
eigrp	Displays debugging information for EIGRP routes.
detail	(Optional) Displays detailed debugging information. This keyword applies only to EIGRP or PIRO routes.
static	Displays debugging information for static routes.
piro	Displays debugging information for Protocol Independent Route Optimization (PIRO) routes.

Command Default

No debugging is enabled.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.
12.4(24)T	This command was modified. The **piro** keyword was added to support the Protocol Independent Route Optimization (PIRO) feature.
15.0(1)M	This command was modified. The **eigrp** keyword was added to support EIGRP route control.
12.2(33)SRE	This command was modified. The **eigrp** keyword was added to support EIGRP route control and the **piro** keyword was added to support the PIRO feature.

Usage Guidelines

The **debug oer border routes** command is entered on a border router. This command is used to display the debugging information about OER-controlled or monitored routes on the local border router.

In Cisco IOS Release 12.4(24)T, 12.2(33)SRE, and later releases, PIRO introduced the ability for OER to search for a parent route—an exact matching route, or a less specific route—in any IP Routing Information Base (RIB). If a parent route for the traffic class exists in the RIB, policy-based routing is used to control the prefix.

In Cisco IOS Release 15.0(1)M, 12.2(33)SRE, and later releases, EIGRP route control introduced the ability for OER to search for a parent route—an exact matching route, or a less specific route—in the EIGRP routing table. If a parent route for the traffic class exists in the EIGRP routing table, temporary EIGRP routes are injected and identified by adding a configurable extended community tag value.

Examples

The following example enables the display of active-probe debug information on a border router:

```
Router# debug oer border routes bgp

*May  4 22:35:53.239: OER BGP: Control exact prefix 10.1.5.0/24
*May  4 22:35:53.239: OER BGP: Walking the BGP table for 10.1.5.0/24
*May  4 22:35:53.239: OER BGP: Path for 10.1.5.0/24 is now under OER control
*May  4 22:35:53.239: OER BGP: Setting prefix 10.1.5.0/24 as OER net#
```

Table 13 describes the significant fields shown in the display.

Table 13 debug oer border routes Field Descriptions

Field	Description
OER BGP:	Indicates debugging information for OER-controlled BGP routes.
OER STATIC:	Indicates debugging information for OER-controlled Static routes. (Not displayed in the example output.)

The following example enables the display of detailed debugging information for PIRO routes and shows that the parent route for the prefix 10.1.1.0 is found in the RIB and a route map is created to control the application. Note that detailed border PBR debugging is also active. This example requires Cisco IOS Release 12.4(24)T, 12.2(33)SRE, or a later release.

```
Router# debug oer border routes piro detail

Feb 21 00:20:44.431: PIRO: Now calling ip_get_route
Feb 21 00:20:44.431: PFR PIRO: Parent lookup found parent 10.1.1.0, mask 255.255.255.0,
nexthop 10.1.1.0 for network 10.1.1.0/24
...
Feb 21 00:22:46.771: PFR PIRO: Parent lookup found parent 10.1.1.0, mask 255.255.255.0,
nexthop 10.1.1.0 for network 10.1.1.0/24
Feb 21 00:22:46.771: PFR PIRO: Control Route, 10.1.1.0/24, NH 0.0.0.0, IF Ethernet4/2
Feb 21 00:22:46.771: PIRO: Now calling ip_get_route
Feb 21 00:22:46.771: PIRO: Now calling ip_get_route
Feb 21 00:22:46.771: PFR PIRO: Parent lookup found parent 10.1.1.0, mask 255.255.255.0,
nexthop 10.1.1.0 for network 10.1.1.0/24
Feb 21 00:22:46.771: OER BR PBR(det): control app: 10.1.1.0/24, nh 0.0.0.0, if
Ethernet4/2,ip prot 256, dst opr 0, src opr 0, 0 0 0 0, src net 0.0.0.0/0, dscp 0/0
Feb 21 00:22:46.771: OER BR PBR(det): Create rmap 6468E488
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) T 10.1.1.0/24 EVENT Track
start
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) N 10.1.1.0/24 Adding track
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) N 10.1.1.0/24 QP Schedule
query
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) T 10.1.1.0/24 EVENT Query
found route
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) N 10.1.1.0/24 Adding route
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) R 10.1.1.0/24  d=0 p=0 ->
Updating
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) R 10.1.1.0/24  d=110 p=1 ->
Et4/2 40.40.40.2 40 Notifying
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: Adding to client notification queue
```

```
Feb 21 00:22:46.775: PfR-RIB RIB_RWATCH: (default:ipv4:base) W 10.1.1.0/24 c=0x15 Client
notified reachable
Feb 21 00:22:46.779: PFR PIRO: Route update rwinfo 680C8E14, network 10.1.1.0, mask_len 24
event Route Up
Feb 21 00:22:46.779: OER BR PBR(det): PIRO Path change notify for prefix:10.1.1.0,
masklen:24, reason:1
```

Table 14 describes the significant fields shown in the display.

Table 14 debug oer border routes Field Descriptions

Field	Description
PFR PIRO	Indicates debugging information for Performance Routing-controlled PIRO activities.
OER BR PBR	Indicates debugging information about policy-based routing activities on the border router.
PfR-RIB RIB_RWATCH	Indicates debugging information about RIB activities.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer border traceroute reporting

To display debugging information for traceroute probes on the local border router, use the **debug oer border traceroute reporting** command in privileged EXEC mode. To stop the display of debug event information, use the **no** form of this command.

debug oer border traceroute reporting [**detail**]

no debug oer border traceroute reporting [**detail**]

Syntax Description

detail	(Optional) Displays detailed traceroute debug information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(14)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer border traceroute reporting** command is entered on a border router. This command is used to display the debugging information about traceroute probes sourced on the local border router.

Examples

The following example enables the display of active-probe debug information on a border router:

```
Router# debug oer border traceroute reporting

May 19 03:46:23.807: OER BR TRACE(det): Received start message: msg1 458776,
msg2 1677787648, if index 19, host addr 100.1.2.1, flags 1, max ttl 30,
protocol 17, probe delay 0
May 19 03:46:26.811: OER BR TRACE(det): Result msg1 458776,
msg2 1677787648 num hops 30 sent May 19 03:47:20.919: OER BR TRACE(det):
Received start message: msg1 524312, msg2 1677787648, if index 2,
host addr 100.1.2.1, flags 1, max ttl 30, protocol 17, probe delay 0
May 19 03:47:23.923: OER BR TRACE(det): Result msg1 524312,
msg2 1677787648 num hops 3 sent
```

Table 15 describes the significant fields shown in the display.

Table 15 debug oer border traceroute reporting Field Descriptions

Field	Description
OER BR TRACE:	Indicates border router debugging information for traceroute probes.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer cc

To display OER communication control debugging information for master controller and border router communication, use the **debug oer cc** command in privileged EXEC mode. To stop the display of OER debugging information, use the **no** form of this command.

debug oer cc [**detail**]

no debug oer cc [**detail**]

Syntax Description

detail	(Optional) Displays detailed information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer cc** command can be entered on a master controller on a border router. This command is used to display messages exchanged between the master controller and the border router. These messages include control commands, configuration commands, and monitoring information. Enabling this command will cause very detailed output to be displayed and can utilize a considerable amount of system resources. This command should be enabled with caution in a production network.

Examples

The following example enables the display of OER communication control debugging messages:

```
Router# debug oer cc

*May  4 23:03:22.527: OER CC: ipflow prefix reset received: 10.1.5.0/24
```

Table 16 describes the significant fields shown in the display.

Table 16 debug oer cc Field Descriptions

Field	Description
OER CC:	Indicates debugging information for OER communication messages.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master border

To display debugging information for OER border router events on an OER master controller, use the **debug oer master border** command in privileged EXEC mode. To stop border router event debugging, use the **no** form of this command.

debug oer master border [*ip-address*]

no debug oer master border

Syntax Description

ip-address	(Optional) Specifies the IP address of a border router.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master border** command is entered on a master controller. The output displays information related to the events or updates from one or more border routers.

Examples

The following example shows the status of 2 border routers. Both routers are up and operating normally.

```
Router# debug oer master border

OER Master Border Router debugging is on
Router#
1d05h: OER MC BR 10.4.9.7: BR I/F update, status UP, line 1 index 1, tx bw 10000
0, rx bw 100000, time, tx ld 0, rx ld 0, rx rate 0 rx bytes 3496553, tx rate 0,
tx bytes 5016033
1d05h: OER MC BR 10.4.9.7: BR I/F update, status UP, line 1 index 2, tx bw 10000
0, rx bw 100000, time, tx ld 0, rx ld 0, rx rate 0 rx bytes 710149, tx rate 0, t
x bytes 1028907
1d05h: OER MC BR 10.4.9.6: BR I/F update, status UP, line 1 index 2, tx bw 10000
0, rx bw 100000, time, tx ld 0, rx ld 0, rx rate 0 rx bytes 743298, tx rate 0, t
x bytes 1027912
1d05h: OER MC BR 10.4.9.6: BR I/F update, status UP, line 1 index 1, tx bw 10000
0, rx bw 100000, time, tx ld 0, rx ld 0, rx rate 0 rx bytes 3491383, tx rate 0,
tx bytes 5013993
```

Table 17 describes the significant fields shown in the display.

Table 17 debug oer master border Field Descriptions

Field	Description
OER MC BR *ip-address*:	Indicates debugging information for a border router process. The *ip-address* identifies the border router.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master collector

To display data collection debugging information for OER monitored prefixes, use the **debug oer master collector** command in privileged EXEC mode. To disable the display of this debugging information, use the **no** form of this command.

debug oer master collector {**active-probes** [**detail** [**trace**]] | **netflow**}

no debug oer master collector {**active-probes** [**detail** [**trace**]] | **netflow**}

Syntax Description

active-probes	Displays aggregate active probe results for a given prefix on all border routers that are executing the active probe.
detail	(Optional) Displays the active probe results from each target for a given prefix on all border routers that are executing the active probe.
trace	(Optional) Displays aggregate active probe results and historical statistics for a given prefix on all border routers that are executing the active probe.
netflow	Displays information about the passive (NetFlow) measurements received by the master controller for prefixes monitored from the border router.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master collector** command is entered on a master controller. The output displays data collection information for monitored prefixes.

Examples

debug oer master collector active-probes Example

The following example displays aggregate active probe results for the 10.1.0.0/16 prefix on all border routers that are configured to execute this active probe:

```
Router# debug oer master collector active-probes

*May  4 22:34:58.221: OER MC APC: Probe Statistics Gathered for prefix 10.1.0.0/16 on all
exits,notifying the PDP
*May  4 22:34:58.221: OER MC APC: Summary Exit Data (pfx 10.1.0.0/16, bdr 10.2.2.2, if 13,
nxtHop Default):savg delay 13, lavg delay 14, sinits 25, scompletes 25
*May  4 22:34:58.221: OER MC APC: Summary Prefix Data: (pfx 10.1.0.0/16) sloss 0, lloss 0,
sunreach 25, lunreach 25, savg raw delay 15, lavg raw delay 15, sinits 6561, scompletes
6536, linits 6561, lcompletes 6536
*May  4 22:34:58.221: OER MC APC: Active OOP check done
```

Table 18 describes the significant fields shown in the display.

Table 18 debug oer master collector active-probes Field Descriptions

Field	Description
OER MC APC:	Indicates debugging information for active probes from the r OER master collector.

debug oer master collector active-probes detail Example

The following example displays aggregate active probe results from each target for the 10.1.0.0/16 prefix on all border routers that are configured to execute this active probe:

```
Router# debug oer master collector active-probes detail

*May  4 22:36:21.945: OER MC APC: Rtrv Probe Stats: BR 10.2.2.2, Type echo,
Tgt 10.1.1.1,TgtPt 0, Src Default, SrcPt 0, NxtHp Default, Ndx 13
*May  4 22:36:22.001: OER MC APC: Remote stats received: BR 10.2.2.2, Type
echo, Tgt 10.15.1, TgtPt 0, Src Default, SrcPt 0, NxtHp Default, Ndx 13
*May  4 22:36:22.313: OER MC APC: Perf data point (pfx 10.1.0.0/16, bdr
10.2.2.2, if 13, xtHop Default):  avg delay 20, loss 0, unreach 0,
initiations 2, completions 2, delay sum40, ldelay max 20, ldelay min 12
*May  4 22:36:22.313: OER MC APC: Perf data point (pfx 10.1.0.0/16, bdr
10.2.2.2, if 13, xtHop Default):  avg delay 20, loss 0, unreach 0,
initiations 2, completions 2, delay sum40, ldelay max 20, ldelay min 12
*May  4 22:36:22.313: OER MC APC: Probe Statistics Gathered for prefix
10.1.0.0/16 on al exits, notifying the PDP
*May  4 22:36:22.313: OER MC APC: Active OOP check done
```

Table 19 describes the significant fields shown in the display.

Table 19 debug oer master collector active-probes detail Field Descriptions

Field	Description
OER MC APC:	Indicates debugging information for active probes from the r OER master collector.

debug oer master collector active-probes detail trace Example

The following example displays aggregate active probe results and historical statistics from each target for the 10.1.0.0/16 prefix on all border routers that are configured to execute this active probe:

```
Router# debug oer master collector active-probes detail trace

*May  4 22:40:33.845: OER MC APC: Rtrv Probe Stats: BR 10.2.2.2, Type echo,
Tgt 10.1.5.1, TgtPt 0, Src Default, SrcPt 0, NxtHp Default, Ndx 13
*May  4 22:40:33.885: OER MC APC: Remote stats received: BR 10.2.2.2, Type
echo, Tgt 10.1.5.1, TgtPt 0, Src Default, SrcPt 0, NxtHp Default, Ndx 13
*May  4 22:40:34.197: OER MC APC: Remote stats received: BR 10.2.2.2, Type
echo, Tgt 10.1.2.1, TgtPt 0, Src Default, SrcPt 0, NxtHp Default, Ndx 13
*May  4 22:40:34.197: OER MC APC: Updating Probe (Type echo Tgt 10.1.2.1
TgtPt 0) Total Completes 1306, Total Attempts 1318
*May  4 22:40:34.197: OER MC APC: All stats gathered for pfx 10.1.0.0/16
Accumulating Stats
*May  4 22:40:34.197: OER MC APC: Updating Curr Exit Ref (pfx 10.1.0.0/16,
bdr 10.2.2.2, if 13, nxtHop Default) savg delay 17, lavg delay 14, savg loss
0, lavg loss 0, savg unreach 0, lavg unreach 0
*May  4 22:40:34.197: OER MC APC: Probe Statistics Gathered for prefix
```

```
10.1.0.0/16 on all exits, notifying the PDP
*May  4 22:40:34.197: OER MC APC: Active OOP check done
```

Table 20 describes the significant fields shown in the display.

Table 20 debug oer master collector active-probes detail trace Field Descriptions

Field	Description
OER MC APC:	Indicates debugging information for active probes from the r OER master collector.

debug oer master collector netflow Example

The following example displays passive monitoring results for the 10.1.5.0/24 prefix:

```
Router# debug oer master collector netflow

*May  4 22:31:45.739: OER MC NFC: Rcvd  egress update from BR 10.1.1.2
  prefix 10.1.5.0/24  Interval 75688  delay_sum 0  samples 0  bytes 20362  pkts 505  flows
359  pktloss 1 unreach 0
*May  4 22:31:45.739: OER MC NFC: Updating exit_ref; BR 10.1.1.2 i/f Et1/0, s_avg_delay
655, l_avg_delay 655, s_avg_pkt_loss 328, l_avg_pkt_loss 328, s_avg_flow_unreach 513,
l_avg_flow_unreach 513
*May  4 22:32:07.007: OER MC NFC: Rcvd ingress update from BR 10.1.1.3
  prefix 10.1.5.0/24  Interval 75172  delay_sum 42328  samples 77  bytes 22040  pkts 551
flows 310  pktloss 0 unreach 0
```

Table 21 describes the significant fields shown in the display.

Table 21 debug oer master collector netflow Field Descriptions

Field	Description
OER MC NFC:	Indicates debugging information for the OER master collector from passive monitoring (NetFlow).

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master cost-minimization

To display debugging information for cost-based optimization policies, use the **debug oer master cost-minimization** command in privileged EXEC mode. To disable the display of this debugging information, use the **no** form of this command.

debug oer master cost-minimization [**detail**]

no debug oer master cost-minimization [**detail**]

Syntax Description

detail	(Optional) Displays detailed information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(14)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master cost-minimization** command is entered on a master controller. The output displays debugging information for cost-minimization policies.

Examples

The following example displays detailed cost optimization policy debug information:

```
Router# debug oer master cost-minimization detail

OER Master cost-minimization Detail debugging is on
*May 14 00:38:48.839: OER MC COST: Momentary target utilization for exit 10.1.1.2 i/f
Ethernet1/0 nickname ISP1 is 7500 kbps, time_left 52889 secs, cumulative 16 kb, rollup
period 84000 secs, rollup target 6000 kbps, bw_capacity 10000 kbps
*May 14 00:38:48.839: OER MC COST: Cost OOP check for border 10.1.1.2, current util: 0
target util: 7500 kbps
*May 14 00:39:00.199: OER MC COST: ISP1 calc separate rollup ended at 55 ingress Kbps
*May 14 00:39:00.199: OER MC COST: ISP1 calc separate rollup ended at 55 egress bytes
*May 14 00:39:00.199: OER MC COST: Target utilization for nickname ISP1 set to 6000,
rollups elapsed 4, rollups left 24
*May 14 00:39:00.271: OER MC COST: Momentary target utilization for exit 10.1.1.2 i/f
Ethernet1/0 nickname ISP1 is 7500 kbps, time_left 52878 secs, cumulative 0 kb, rollup
period 84000 secs, rollup target 6000 kbps, bw_capacity 10000 kbps
*May 14 00:39:00.271: OER MC COST: Cost OOP check for border 10.1.1.2, current util: 0
target util: 7500 kbps
```

Table 22 describes the significant fields shown in the display.

Table 22 debug oer master cost-minimization detail Field Descriptions

Field	Description
OER MC COST:	Indicates debugging information for cost-based optimization on the master controller.

Related Commands

Command	Description
cost-minimization	Configures cost-based optimization policies on a master controller.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show oer master cost-minimization	Displays the status of cost-based optimization policies.

debug oer master exit

To display debug event information for OER managed exits, use the **debug oer master exit** command in privileged EXEC mode. To stop the display of debug event information, use the **no** form of this command.

debug oer master exit [**detail**]

no debug oer master exit [**detail**]

Syntax Description

detail	Displays detailed OER managed exit information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master exit** command is entered on a master controller. This command is used to display debugging information for master controller exit selection processes.

Examples

The following example shows output form the **debug oer master exit** command, entered with the **detail** keyword:

```
Router# debug oer master exit detail

*May  4 11:26:51.539: OER MC EXIT: 10.1.1.1, intf Fa4/0 INPOLICY
*May  4 11:26:52.195: OER MC EXIT: 10.2.2.3, intf Se2/0 INPOLICY
*May  4 11:26:55.515: OER MC EXIT: 10.1.1.2, intf Se5/0 INPOLICY
*May  4 11:29:14.987: OER MC EXIT: 7 kbps should be moved from 10.1.1.1, intf Fa4/0
*May  4 11:29:35.467: OER MC EXIT: 10.1.1.1, intf Fa4/0 in holddown state so skip OOP
check
*May  4 11:29:35.831: OER MC EXIT: 10.2.2.3, intf Se2/0 in holddown state so skip OOP
check
*May  4 11:29:39.455: OER MC EXIT: 10.1.1.2, intf Se5/0 in holddown state so skip OOP
check
```

Table 23 describes the significant fields shown in the display.

Table 23 debug oer master exit detail Field Descriptions

Field	Description
OER MC EXIT:	Indicates OER master controller exit event.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master learn

To display debug information for OER master controller learning events, use the **debug oer master learn** command in privileged EXEC mode. To stop the display of debug information, use the **no** form of this command.

debug oer master learn

no debug oer master learn

Syntax Description

This command has no arguments or keywords.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master learn** command is entered on a master controller. This command is used to display debugging information for master controller learning events.

Examples

The following example shows output from the **debug oer master learn** command. The output an shows OER Top Talker debug events. The master controller is enabling prefix learning for new border router process:

```
Router# debug oer master learn

06:13:43: OER MC LEARN: Enable type 3, state 0
06:13:43: OER MC LEARN: OER TTC: State change, new RETRY, old DISABLED, reason TT start
06:13:43: OER MC LEARN: OER TTC: State change, new RETRY, old DISABLED, reason TT start
request
06:13:43: OER MC LEARN: OER TTC: State change, new RETRY, old DISABLED, reason T
T start request
06:14:13: OER MC LEARN: TTC Retry timer expired
06:14:13: OER MC LEARN: OER TTC: State change, new STARTED, old RETRY, reason At
 least one BR started
06:14:13: %OER_MC-5-NOTICE: Prefix Learning STARTED
06:14:13: OER MC LEARN: MC received BR TT status as enabled
06:14:13: OER MC LEARN: MC received BR TT status as enabled
06:19:14: OER MC LEARN: OER TTC: State change, new WRITING DATA, old STARTED, reason
Updating DB
06:19:14: OER MC LEARN: OER TTC: State change, new SLEEP, old WRITING DATA, reason
Sleep state
```

Table 24 describes the significant fields shown in the display.

Table 24 debug oer master learn Field Descriptions

Field	Description
OER MC LEARN:	Indicates OER master controller learning events.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master prefix

To display debug events related to prefix processing on an OER master controller, use the **debug oer master prefix** command in privileged EXEC mode. To disable the display of debug information, use the **no** form of this command.

debug oer master prefix [*prefix* | **appl**] [**detail**]

no debug oer master prefix [*prefix* | **appl**] [**detail**]

Syntax Description

prefix	(Optional) Specifies a single prefix or prefix range. The prefix address and mask are entered with this argument.
appl	(Optional) Displays information about prefixes used by applications monitored and controlled by an OER master controller.
detail	(Optional) Displays detailed OER prefix processing information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master prefix** command is entered on a master controller. This command displays debugging information related to prefix monitoring and processing.

Examples

The following example shows the master controller searching for the target of an active probe after the target has become unreachable.

```
Router# debug oer master prefix

OER Master Prefix debugging is on
06:01:28: OER MC PFX 10.4.9.0/24: APC last target deleted for prefix, no targets
 left assigned and running
06:01:38: OER MC PFX 10.4.9.0/24: APC Attempting to probe all exits
06:02:59: OER MC PFX 10.4.9.0/24: APC last target deleted for prefix, no targets
 left assigned and running
06:03:08: OER MC PFX 10.4.9.0/24: APC Attempting to probe all exits
06:04:29: OER MC PFX 10.4.9.0/24: APC last target deleted for prefix, no targets
 left assigned and running
06:04:39: OER MC PFX 10.4.9.0/24: APC Attempting to probe all exits
06:05:59: OER MC PFX 10.4.9.0/24: APC last target deleted for prefix, no targets
 left assigned and running
06:06:09: OER MC PFX 10.4.9.0/24: APC Attempting to probe all exits
```

Table 25 describes the significant fields shown in the display.

Table 25 debug oer master prefix Field Descriptions

Field	Description
OER MC PFX *ip-address*:	Indicates debugging information for OER monitored prefixes. The *ip-address* identifies the prefix.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master prefix-list

To display debug events related to prefix-list processing on an OER master controller, use the **debug oer master prefix-list** command in privileged EXEC mode. To disable the display of debug information, use the **no** form of this command.

debug oer master prefix-list *list-name* [**detail**]

no debug oer master prefix-list *list-name*

Syntax Description

list-name	Specifies a single prefix or prefix range. The prefix address and mask are entered with this argument.
detail	(Optional) Displays detailed OER prefix-list processing information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(11)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master prefix-list** command is entered on a master controller. This command displays debugging information related to prefix-list processing.

Examples

The following example shows output from the **debug oer master prefix-list** command.

```
Router# debug oer master prefix-list

23:02:16.283: OER MC PFX 10.1.5.0/24: Check PASS REL loss: loss 0, policy 10%, notify TRUE
23:02:16.283: OER MC PFX 10.1.5.0/24: Passive REL loss in-policy
23:02:16.283: OER MC PFX 10.1.5.0/24: Check PASS REL delay: delay 124, policy 50%, notify
TRUE
23:02:16.283: OER MC PFX 10.1.5.0/24: Passive REL delay in policy
23:02:16.283: OER MC PFX 10.1.5.0/24: Prefix not OOP
23:02:16.283: OER MC PFX 10.1.5.0/24: Check PASS REL unreachable: unreachable 0, policy
50%, notify TRUE
23:02:16.283: OER MC PFX 10.1.5.0/24: Passive REL unreachable in-policy
23:02:16.283: OER MC PFX 10.1.5.0/24: Check PASS REL loss: loss 0, policy 10%, notify TRUE
23:02:16.283: OER MC PFX 10.1.5.0/24: Passive REL loss in policy
```

Table 26 describes the significant fields shown in the display.

Table 26 debug oer master prefix-list Field Descriptions

Field	Description
OER MC PFX *ip-address*:	Indicates debugging information for OER monitored prefixes. The *ip-address* identifies the prefix.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master process

To display debug information about the OER master controller process, use the **debug oer master process** command in privileged EXEC mode. To stop displaying debug information, use the **no** form of this command.

debug oer master process

no debug oer master process

Syntax Description

This command has no arguments or keywords.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

Usage Guidelines

The **debug oer master process** command is entered on a master controller.

Examples

The following sample debug output for a master controller process:

```
Router# debug oer master process

01:12:00: OER MC PROCESS: Main msg type 15, ptr 0, value 0
```

Table 27 describes the significant fields shown in the display.

Table 27 debug oer master process Field Descriptions

Field	Description
OER MC PROCESS:	Indicates a master controller master process debugging message.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

debug oer master traceroute reporting

To display debug information about traceroute probes, use the **debug oer master traceroute reporting** command in privileged EXEC mode. To stop displaying debug information, use the **no** form of this command.

debug oer master traceroute reporting [**detail**]

no debug oer master traceroute reporting [**detail**]

Syntax Description

detail	(Optional) Displays detailed information.

Command Default

No debugging messages are enabled.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(14)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **debug oer master traceroute reporting** command is entered on a master controller. This command is used to display traceroute events on a master controller.

Examples

The following sample debug output for a master controller process:

```
Router# debug oer master traceroute reporting detail

*May 12 18:55:14.239: OER MC TRACE: sent start message msg1 327704, msg2 167838976, if
index 2, host add 10.1.5.2, flags 1, max ttl 30, protocol 17
*May 12 18:55:16.003: OER MC TRACE: sent start message msg1 393240, msg2 167838976, if
index 2, host add 10.1.5.2, flags 1, max ttl 30, protocol 17
master#
*May 12 18:55:17.303: OER MC TRACE: Received result: msg_id1 327704, prefix 10.1.5.0/24,
hops 4, flags 1
*May 12 18:55:19.059: OER MC TRACE: Received result: msg_id1 393240, prefix 10.1.5.0/24,
hops 4, flags 1
```

Table 28 describes the significant fields shown in the display.

Table 28 debug oer master traceroute reporting detail Field Descriptions

Field	Description
OER MC PROCESS:	Indicates master controller debugging information for traceroute probes.

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

delay (OER)

To set a delay threshold for an Optimized Edge Routing (OER) policy, or to configure OER traffic class learning based on highest delay times, use the **delay** command in master controller, Top Talker and Top Delay learning, or learn list configuration mode. To reset the delay values to their default, use the **no** form of this command.

Master Controller Configuration Mode

delay {**relative** *percentage* | **threshold** *maximum*}

no delay

Top Talker and Top Delay Learning and Learn List Configuration Modes

delay

no delay

Syntax Description

relative *percentage*	Sets a relative delay policy based on a comparison of short-term and long-term delay percentages. The range of values that can be configured for this argument is a number from 1 to 1000. Each increment represents one tenth of a percent. The default is 500 (50 percent)
threshold *maximum*	Sets the absolute maximum delay time, in milliseconds. The range of values that can be configured for this argument is from 1 to 10000. The default is 5000.

Command Default

Master Controller Configuration Mode

OER uses the default value if this command is not configured or if the **no** form of this command is entered.

Top Talker and Top Delay Learning and Learn List Configuration Modes

None

Command Modes

Learn list configuration (config-oer-mc-learn-list)
Master controller configuration (config-oer-mc)
Top Talker and Top Delay learning configuration (config-oer-mc-learn)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T	Support for the OER learn list configuration mode was added to this command.

Usage Guidelines

Configuring in Master Controller Configuration Mode

Use the **delay** command entered in OER master controller configuration mode to set the delay threshold for a traffic class within an OER policy as a relative percentage or as an absolute value. If the configured delay threshold is exceeded, then the traffic class is out-of-policy.

The **relative** keyword is used to configure a relative delay percentage. The relative delay percentage is based on a comparison of short-term and long-term measurements. The short-term measurement reflects the delay percentage within a 5-minute period. The long-term measurement reflects the delay percentage within a 60-minute period. The following formula is used to calculate this value:

Relative delay measurement = ((short-term measurement – long-term measurement) / long-term measurement) * 100

The master controller measures the difference between these two values as a percentage. If the percentage exceeds the user-defined or default value, the delay percentage is determined to be out-of-policy. For example, if the long-term delay measurement is 100 milliseconds and the short-term delay measurement is 120 milliseconds, the relative delay percentage is 20 percent.

The **threshold** keyword is used to configure the absolute maximum delay period in milliseconds.

Configuring in Top Talker and Top Delay Learning and Learn List Configuration Modes

Use the **delay** command under the Top Talker and Top Delay learning or learn list configuration mode to enable traffic class learning based on the highest delay time. OER measures the delay for optimized prefixes when this command is enabled, and the master controller creates a list of traffic classes based on the highest delay time.

Examples

Master Controller Configuration Mode Example

The following example shows how to set a 20 percent relative delay threshold:

```
Router(config)# oer master
Router(config-oer-mc)# delay relative 200
```

Top Talker and Top Delay Learning Configuration Mode Example

The following example shows how to configure a master controller to learn traffic classes based on the highest delay times:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# delay
```

Learn List Configuration Mode Example

The following example shows how to configure a master controller to learn traffic classes based on the highest delay times for a learn list named LEARN_REMOTE_LOGIN_TC for Telnet and Secure Shell (ssh) application traffic classes:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# list seq 10 refname LEARN_REMOTE_LOGIN_TC
Router(config-oer-mc-learn-list)# traffic-class application telnet ssh
Router(config-oer-mc-learn-list)# aggregation-type prefix-length 24
Router(config-oer-mc-learn-list)# delay
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure OER to automatically learn traffic classes.
list (OER)	Creates an OER learn list to specify criteria for learning traffic classes and enters learn list configuration mode.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set delay	Configures an OER map to configure OER to learn prefixes based on the lowest delay.

downgrade bgp

To specify route downgrade options for an Optimized Edge Routing (OER) managed interface using Border Gateway Protocol (BGP) advertisements, use the **downgrade bgp** command in OER border exit interface configuration mode. To remove the route downgrade options, use the **no** form of this command.

downgrade bgp community *community-number*

no downgrade bgp community

Syntax Description

community	Specifies a BGP community number that will be added to the BGP advertisement.
community-number	BGP community number entered in AA:NN format. The community format consists of a 4-byte value. The first two bytes represent the autonomous system number, and the trailing two bytes represent a user-defined network number. A number in the range from 1 to 65535 can be entered each 2-byte value.

Command Default

No route downgrade options are specified.

Command Modes

OER border exit interface configuration

Command History

Release	Modification
12.4(9)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

Use the **downgrade bgp** command to attach a BGP prepend community to an inside prefix BGP advertisement from the network to another autonomous system such as an Internet Service Provider (ISP). The BGP prepend community will increase the number of autonomous system hops in the advertisement of the inside prefix from the ISP to its peers. Autonomous system prepend BGP community is the preferred method to be used for OER BGP inbound optimization because there is no risk of the local ISP filtering the extra autonomous system hops.

Examples

The following example shows how to enforce an entrance link selection for learned inside prefixes using the BGP autonomous system number community prepend technique. The **downgrade bgp** command is configured under OER border exit interface configuration mode to add the BGP community number 3:1 to BGP advertisements to packets that travel through this entrance link on the border router.

```
Router> enable
Router# configure terminal
Router(config)# oer master
Router(config-oer-mc)# max range receive percent 35
Router(config-oer-mc)# border 10.1.1.2 key-chain oer
Router(config-oer-mc-br)# interface ethernet1/0 external
```

```
Router(config-oer-mc-br-if)# maximum utilization receive absolute 2500
Router(config-oer-mc-br-if)# downgrade bgp community 3:1
Router(config-oer-mc-br-if)# exit
Router(config-oer-mc-br)# exit
Router(config-oer-mc)# exit
Router(config)# oer-map INSIDE_LEARN 10
Router(config-oer-map)# match oer learn inside
Router(config-oer-map)# set delay threshold 400
Router(config-oer-map)# set resolve delay priority 1
Router(config-oer-map)# set mode route control
Router(config-oer-map)# end
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to establish communication with an OER border router.
max range receive	Sets the maximum utilization range for all OER managed entrance links.
maximum utilization receive	Sets the maximum utilization on a single OER managed entrance link.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

expire after

To set the length of time that Optimized Edge Routing (OER) learned prefixes are kept in the central policy database, use the **expire after** command in OER Top Talker and Top Delay learning configuration mode. To disable the expiration timer and restore default behavior, use the **no** form of this command.

expire after {**session** *number* | **time** *minutes*}

no expire after

Syntax Description

session *number*	Configures a session-based expiration timer. A number from 1 to 65535 can be entered. Each increment represents one monitoring period.
time *minutes*	Configures a time-based expiration timer. A number from 1 to 65535 can be entered. This argument is entered in minutes.

Command Default

New prefixes are not learned if router memory utilization is greater than 90 percent. Inactive prefixes are removed (oldest first) from the central policy database as memory is needed.

Command Modes

OER Top Talker and Top Delay learning configuration

Command History

Release	Modification
12.3(14)T	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **expire after** command is entered on an OER master controller in OER Top Talker and Top Delay learning configuration mode. This command is used to configure a session or time-based expiration period for learned prefixes. Each session is equal to one monitoring period plus a periodic interval time that separates monitoring periods. The time-based expiration timer is configured in minutes.

Examples

The following example configures learned prefixes to be removed from the central policy database after 100 monitoring periods:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# expire after session 100
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.

Command	Description
max prefix	Sets the maximum number of prefixes that the master controller will monitor or learn.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.