Cisco IOS Optimized Edge Routing Command Reference

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active-probe

Note Effective with Cisco IOS Release 15.0(1)SY, the **active-probe** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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*| **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.
15.0(1)SY	This command was modified. This command was hidden.

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

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
```

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

Note Effective with Cisco IOS Release 15.0(1)SY, the **active-probe address source** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 address source 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.
15.0(1)SY	This command was modified. This command was hidden.

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

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **border** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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.
15.0(1)SY	This command was modified. This command was hidden.

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.

Command	Description
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

Note Effective with Cisco IOS Release 15.0(1)SY, the **clear oer api** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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.
15.0(1)SY	This command was modified. This command was hidden.

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

Note Effective with Cisco IOS Release 15.0(1)SY, the **clear oer border** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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.
15.0(1)SY	This command was modified. This command was hidden.

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 boder {*| *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 the table below.
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.

The table below 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 1: 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

Keyword	Protocol	Port
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.

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 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) andPost 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**| **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) 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.

Release	Modification
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

Note Effective with Cisco IOS Release 15.0(1)SY, the **debug oer api** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 Modes

Privileged EXEC (#)

Command History

Release	Modification
12.4(15)T	This command was introduced.
15.0(1)SY	This command was modified. This command was hidden.

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
```

The table below 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 2: 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

Note Effective with Cisco IOS Release 15.0(1)SY, the **debug oer api** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

Note 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 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.
15.0(1)SY	This command was modified. This command was hidden.

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

Note Effective with Cisco IOS Release 15.0(1)SY, the **debug oer border** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 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.
15.0(1)SY	This command was modified. This command was hidden.

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
```

The table below describes the significant fields shown in the display.

Table 3: 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

Note Effective with Cisco IOS Release 15.0(1)SY, the **debug oer border active-probe** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 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.
15.0(1)SY	This command was modified. This command was hidden.

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
```

The table below describes the significant fields shown in the display.

Table 4: 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

Note Effective with Cisco IOS Release 15.0(1)SY, the **debug oer border learn** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 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.
15.0(1)SY	This command was modified. This command was hidden.

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
```

The table below describes the significant fields shown in the display.

Table 5: 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

Note Effective with Cisco IOS Release 15.0(1)SY, the **debug oer border routes** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 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.

Release	Modification
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.
15.0(1)SY	This command was modified. This command was hidden.

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#
```

The table below describes the significant fields shown in the display.

Table 6: 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
```

The table below describes the significant fields shown in the display.

Table 7: 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

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **debug oer border traceroute reporting** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 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.
15.0(1)SY	This command was modified. This command was hidden.

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
```

The table below describes the significant fields shown in the display.

Table 8: 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

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **debug oer cc** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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 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.
15.0(1)SY	This command was modified. This command was hidden.

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
```

The table below describes the significant fields shown in the display.

Table 9: 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 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
```

The table below describes the significant fields shown in the display.

Table 10: 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 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

Examples

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
```

The table below describes the significant fields shown in the display.

Table 11: 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.

Examples

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
```

The table below describes the significant fields shown in the display.

Table 12: 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.

Examples

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
```

The table below describes the significant fields shown in the display.

Table 13: 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.

Examples

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
```

The table below describes the significant fields shown in the display.

Table 14: 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 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
```

The table below describes the significant fields shown in the display.

Table 15: 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 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
```

The table below describes the significant fields shown in the display.

Table 16: 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 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
```

The table below describes the significant fields shown in the display.

Table 17: 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 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
```

The table below describes the significant fields shown in the display.

Table 18: 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 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
```

The table below describes the significant fields shown in the display.

Table 19: 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 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
```

The table below describes the significant fields shown in the display.

Table 20: 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 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
```

The table below describes the significant fields shown in the display.

Table 21: 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

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

Command Default

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.

Release	Modification
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

Examples

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

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

Examples

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
```

Examples

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.
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.

H through R

holddown

To configure the Optimized Edge Routing (OER) prefix route dampening timer to set the minimum period of time that a new exit must be used before an alternate exit can be selected, use the **holddown** command in OER master controller configuration mode. To return the prefix route dampening timer to the default value, use the **no** form of this command.

holddown *timer*

no holddown

Syntax Description

timer	Specifies the prefix route dampening time period, in seconds. The range for this argument is from 90 to 65535. The default value is 300.

Command Default

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

timer : 300

Command Modes

OER master controller configuration (config-oer-mc)

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 **holddown** command is entered on a master controller. This command is used to configure the prefix route dampening timer to set the minimum period of time that a new exit must be used before an alternate exit can be selected. The master controller puts a prefix in a holddown state during an exit change to isolate the prefix during the transition period to prevent the prefix from flapping because of rapid state changes. OER does not implement policy changes while a prefix is in the holddown state. A prefix will remain in a holddown state for the default or configured time period. When the holddown timer expires, OER will select the best exit based on performance and policy configuration. However, an immediate route change will be triggered if the current exit for a prefix becomes unreachable.

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

Examples

The following example sets the prefix route dampening timer to 120 seconds:

```
Router(config)# oer master
Router(config-oer-mc)# holddown 120
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set holddown	Configures an OER map to set the prefix route dampening timer to the minimum period of time that a new exit must be used before an alternate exit can be selected.

host-address

To configure information about a host device used by an application interface provider to communicate with an Optimized Edge Routing (OER) master controller, use the **host-address**command in OER master controller application interface provider configuration mode. To remove a host application interface device, use the **no** form of this command.

host-address *ip-address* **key-chain** *key-chain-name* [**priority** *value*]

no host-address *ip-address*

Syntax Description

ip-address	IP address of the host device.
key-chain	Specifies the key used as a password to authenticate communication for the host device.
key-chain-name	Name of key chain used as a password for the host device.
priority	(Optional) Sets the priority of the host device.
value	(Optional) A number in the range from 1 to 65535. The lower the number, the higher the priority. The default priority is 65535.

Command Default

A host application interface device is not configured.

Command Modes

OER master controller application interface provider configuration (config-oer-mc-api-provider)

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 host device when multiple host devices are configured. The number 1 assigns the highest priority to any requests from the host device. If you assign a priority, each host device must be assigned a different priority number. If you try to assign the same priority number to two different host devices, an error message is displayed on the console.

Examples

The following example shows how to configure a host application interface device on a master controller. In this example, more than one provider is registered, and a priority is set for each provider. For the single host device configured for provider 1, 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 2.

```
Router(config)# oer master
Router(config-oer-mc)# api provider 1
Router(config-oer-mc-api-provider)# host-address 10.100.2.2 key-chain OER_HOST
Router(config-oer-mc-api-provider)# exit
Router(config-oer-mc)# api provider 2 priority 4000
Router(config-oer-mc-api-provider)# host-address 10.100.2.2 key-chain OER_HOST
priority 3000
Router(config-oer-mc-api-provider)# host-address 10.100.2.2 key-chain OER_HOST
priority 4000
Router(config-oer-mc-api-provider)# end
```

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.
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.

inside bgp

To configure Optimized Edge Routing (OER) to learn the inside prefixes within a network, use the **inside bgp** command in OER Top Talker and Top Delay learning configuration mode. To disable prefix learning of inside prefixes, use the **no** form of this command.

inside bgp

no inside bgp

Syntax Description

This command has no arguments or keywords.

Command Default

No inside prefixes are learned by OER.

Command Modes

OER Top Talker and Top Delay learning 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

This command is used to implement OER Border Gateway Protocol (BGP) inbound optimization by identifying the prefixes within a network (inside prefixes). OER BGP inbound optimization supports best entrance selection for traffic that originates from prefixes outside an autonomous system destined for prefixes inside the autonomous system. External BGP (eBGP) advertisements from an autonomous system to another autonomous system (for example, an Internet service provider [ISP]) can influence the entrance path for traffic entering the network. OER uses eBGP advertisements to manipulate the best entrance selection.

Examples

The following example shows how to configure an OER master controller to automatically learn the inside prefixes in a network:

```
oer master
 learn
 inside bgp
```

Related Commands

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

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

interface (OER)

To configure a border router interface as an Optimized Edge Routing (OER) managed external or internal interface, use the **interface** command in OER managed border router configuration mode. To remove an interface from OER control, use the **no** form of this command.

interface *type number* {**external**| **internal**}

no interface *type number* {**external**| **internal**}

Syntax Description

type	Specifies the type of interface.
number	Specifies the interface or subinterface number.
external	Configures an interface as external. External interfaces are used for active monitoring and traffic forwarding. Entering the external keyword also enters OER border exit interface configuration mode.
internal	Configures an interface as internal. Internal interfaces are used for passive monitoring with NetFlow.

Command Default

No border router interfaces are configured as OER-managed interfaces.

Command Modes

OER managed border router 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.
15.0(1)M	This command was modified. Loopback interfaces are supported as external or internal interfaces.

Usage Guidelines

The **interface** command is entered on a master controller. This command is used to configure external and internal interfaces on border routers to be under OER control. External interfaces are configured as OER managed exit links to forward traffic. External interfaces are used by the master controller to actively monitor prefix and link performance. Internal interfaces are used only for passive performance monitoring with NetFlow.

At least one external and one internal interface must be configured on each border router to allow NetFlow to monitor inbound and outbound traffic. At least two external interfaces are required in an OER managed network. You can configure a maximum of 20 external interfaces for a single master controller in an OER managed network.

In Cisco IOS 15.0(1)M, and later releases, loopback interfaces are supported as external or internal interfaces.

Note PfR does not support Ethernet interfaces that are Layer 2 only, for example, Ethernet switched interfaces.

Configuring an interface as external enters OER Border Exit configuration mode. Under OER border exit interface configuration mode, you can configure maximum link utilization on a per interface basis with the **max-xmit-utilization** command.

Note Entering the **interface** command without the **external** or **internal** keyword, places the router in Global configuration mode and not OER Border Exit configuration mode. The **no** form of this command should be applied carefully so that active interfaces are not removed from the router configuration.

Examples

The following example configures one internal interface and two external interfaces on a border router:

```
Router(config)# oer master
Router(config-oer-mc)# border 10.4.9.6
 key-chain BR-KEY
Router(config-oer-mc-br)# interface FastEthernet0/1 internal

Router(config-oer-mc-br)# interface FastEthernet0/0 external

Router(config-oer-mc-br)# interface Serial 1/0 external
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to establish communication with an OER border router.
local (OER)	Identifies a local interface on an OER border router as the source for communication with an OER master controller.
max-xmit-utilization	Configures maximum utilization on a single OER managed exit link.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

jitter

To specify the threshold jitter value that Optimized Edge Routing (OER) will permit for an exit link, use the **jitter** command in OER master controller configuration mode. To reset the maximum jitter value to its default value, use the **no** form of this command.

jitter threshold *maximum*

no jitter threshold *maximum*

Syntax Description

threshold	Specifies a maximum absolute threshold value for jitter. Jitter is a measure of voice quality.
maximum	Number (in milliseconds) in the range from 1 to 1000, where 1 represents the highest voice quality, and 1000 represents the lowest voice quality. The default value is 30.

Command Default

No jitter values are specified.

Command Modes

OER master controller configuration

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.

Usage Guidelines

The **jitter** command is used to specify the maximum tolerable jitter value permitted on an exit link. Jitter is a measure of voice quality where the lower the jitter value, the better the voice quality. If the jitter value is greater than the user-defined or the default value, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

Another measure of voice quality is the estimated Mean Opinion Score (MOS). Use the **mos** command and the **jitter** command in an OER policy to define voice quality.

Examples

The following example shows how to configure the master controller to search for a new exit link if the jitter threshold value exceeds 20 milliseconds:

```
Router(config)# oer master
Router(config-oer-map)# jitter threshold 20
```

Related Commands

Command	Description
mos	Specifies the threshold and percentage Mean Opinion Score (MOS) values that OER will permit for an exit link.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set jitter	Configures an OER map to set the threshold jitter value that OER will permit for an exit link.

keepalive (OER)

To configure the length of time that an Optimized Edge Routing (OER) master controller will maintain connectivity with an OER border router after no keepalive packets have been received, use the **keepalive** command in OER master controller configuration mode. To return the keepalive timer to the default time interval, use the **no** form of this command.

keepalive [*timer*]

no keepalive

Syntax Description

timer	(Optional) Sets the keepalive time interval, in seconds. The configurable range for this argument is from 0 to 1000. The default time interval is 5.

Command Default

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

timer : 5

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 **keepalive** command is entered on a master controller. The OER master controller sends keepalive packets to border routers to maintain connectivity between the master controller and the border router. If the master controller does not receive keepalive packets from a border router before the keepalive timer expires and this situation happens three times in a row, then the master controller will not maintain the connection.

Examples

The following example sets the keepalive time interval to 10 seconds:

```
Router(config)# oer master
Router(config-oer-mc)# keepalive 10
```

Related Commands

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

learn

To enter OER Top Talker and Top Delay learning configuration mode to configure Optimized Edge Routing (OER) to learn prefixes, use the **learn** command in OER master controller configuration mode. To disable prefix learning, use the **no** form of this command.

learn

no learn

Syntax Description

This command has no keywords or values.

Command Default

No default behavior or values

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 **learn** command is entered on a master controller and is used to enter OER Top Talker and Top Delay learning configuration mode to configure a master controller to learn and optimize prefixes based on the highest throughput or the highest delay. Under the Top Talker and Top Delay learning configuration mode, you can configure prefix learning based on delay and throughput statistics. You can configure the length of the prefix learning period, the interval between prefix learning periods, the number of prefixes to learn, and the prefix learning based on protocol.

Examples

The following example enters OER Top Talker and Top Delay learning configuration mode:

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

Related Commands

Command	Description
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on traffic flow type.
delay	Configures OER to learn prefixes based on the lowest delay.

Command	Description
expire after	Configures the length of time that learned prefixes are kept in the central policy database.
match oer learn	Creates a match clause entry in an OER map to match OER learned prefixes.
max prefix	Sets the maximum number of prefixes that the master controller will monitor or learn.
monitor-period	Sets the time period that an OER master controller learns traffic flows.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
periodic-interval	Sets the time interval between prefix learning periods.
protocol (OER)	Configures an OER master controller to learn Top Talker or Top Delay prefixes based on the protocol type or number.
throughput	Configures OER to learn the top prefixes based on the highest outbound throughput.

link-group

To configure an Optimized Edge Routing (OER) border router exit interface as a member of a link group, use the **link-group** command in OER border exit interface configuration mode. To remove a link group from the interface, use the **no** form of this command.

link-group *link-group-name* [*link-group-name* [*link-group-name*]]

no link-group *link-group-name* [*link-group-name* [*link-group-name*]]

Syntax Description

link-group-name	Name of link group.

Command Default

No link groups are configured for an OER border router exit interface.

Command Modes

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

Command History

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

Usage Guidelines

Link groups are used to define a group of exit links as a preferred set of links or a fallback set of links for OER to use when optimizing a specified traffic class. Up to three link groups can be specified for each interface. Configure this command on a master controller to define the link group for an interface and use the **set link-group** command to define the primary link group and a fallback link group for a specified traffic class in an OER map.

Use the **show oer master link-group** command to view information about configured OER link groups.

Examples

The following example configures one external interface on a border router as a member of the link group named VIDEO, and another external interface as a member of two link groups named VOICE and DATA:

```
Router(config)# oer master
Router(config-oer-mc)# border 10.4.9.6
 key-chain BR-KEY
Router(config-oer-mc-br)# interface Serial 1/0 external
Router(config-oer-mc-br-if)# link-group VIDEO
Router(config-oer-mc-br-if)# exit
Router(config-oer-mc-br)# interface Serial 2/0 external
Router(config-oer-mc-br-if)# link-group VOICE DATA
Router(config-oer-mc-br-if)# exit
Router(config-oer-mc-br)# interface FastEthernet0/1 internal
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to establish communication with an OER border router.
interface (OER)	Configures a border router interface as an OER managed external or internal interface.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set link-group	Specifies a link group for traffic classes defined in an OER policy.
show oer master link-group	Displays information about OER link groups.

list (OER)

To create an Optimized Edge Routing (OER) learn list to specify criteria for learning traffic classes and to enter learn list configuration mode, use the **list** command in OER Top Talker and Top Delay learning configuration mode. To remove the learn list, use the **no** form of this command.

list seq *number* **refname** *refname*

no list seq *number* **refname** *refname*

Syntax Description

seq	Applies a sequence number to a learn list.
number	Number representing a sequence that is used to determine the order in which learn list criteria are applied. The range of sequence numbers that can be entered is from 1 to 65535.
refname	Specifies a reference name for the OER learn list.
refname	Reference name for the learn list. The name must be unique within all the configured OER learn lists.

Command Default

No OER learn lists are created.

Command Modes

OER Top Talker and Top Delay learning configuration (config-oer-mc-learn)

Command History

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

Usage Guidelines

In Cisco IOS Release 12.4(15)T, the learn list configuration mode was introduced. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria for learning traffic classes including prefixes, application definitions, filters, and aggregation parameters can be configured. A traffic class is automatically learned by OER based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different OER policies to be applied to each learn list; in previous releases the traffic classes could not be divided, and an OER policy was applied to all the traffic classes profiled during one learning session.

New **traffic-class** commands were introduced under learn list mode to simplify the learning of traffic classes. Three types of traffic classes--to be automatically learned--can be profiled:

- Traffic classes based on destination prefixes.

- Traffic classes representing custom application definitions using access lists.
- Traffic classes based on a static application mapping name with an optional prefix list filtering to define destination prefixes.

Only one type of **traffic-class** command can be specified per learn list, and the **throughput** and **delay** commands are also mutually exclusive within a learn list.

Examples

The following example shows how to configure a master controller to learn top prefixes based on the highest throughput for a learn list named LEARN_REMOTE_LOGIN_TC that learns Telnet and Secure Shell (SSH) application TCF entries:

```
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)# throughput
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure OER to automatically learn traffic classes.

local (OER)

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **local** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To identify a local interface on an Optimized Edge Routing (OER) border router as the source for communication with an OER master controller, use the **local** command in OER border router configuration mode. To remove the interface from the OER border router configuration and disable border router to master controller communication, use the **no** form of this command.

local *type number*

no local *type number*

Syntax Description

type	Specifies the interface type.
number	Specifies the interface number.

Command Default

No default behavior or values

Command Modes

OER border router configuration (config-oer-br)

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **local** command is configured on an OER border router. This command is used to specify the source interface IP address that will be used for communication between a border router and master controller.

The IP address that is configured for the local interface must also be configured on the master controller with the **border** OER master controller configuration command and the **interface**(OER) OER managed border router configuration command.

The **no** form of this command cannot be entered while the border router process is active. The border router process must first be stopped with the **shutdown**(OER) command. If you stop the border router process to deconfigure the local interface with the **no** form of this command, you must configure another local interface before the border router process will reestablish communication with the master controller.

Examples

The following example configures the FastEthernet 0/0 interface as a local interface:

```
Router(config)# oer border
Router(config-oer-br)# local FastEthernet0/0
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to establish communication with an OER border router.
interface (OER)	Configures a border router interface as an OER managed external or internal interface.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
port (OER)	Configures a dynamic port for communication between an OER master controller and border router.

logging (OER)

Note Effective with Cisco IOS Release 15.0(1)SY, the **logging** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To enable syslog event logging for an Optimized Edge Routing (OER) master controller or an OER border router process, use the **logging** command in OER master controller or OER border router configuration mode. To disable OER event logging, use the **no** form of this command.

logging

no logging

Syntax Description

This command has no keywords or arguments.

Command Default

No default behavior or values

Command Modes

OER border router configuration (config-oer-br) OER master controller configuration (config-oer-mc)

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **logging** command is entered on a master controller or border router. System logging is enabled and configured in Cisco IOS software under global configuration mode. The **logging**command in OER master controller or OER border router configuration mode is used only to enable or disable system logging under OER. OER system logging supports the following message types:

Error Messages --These messages indicate OER operational failures and communication problems that can impact normal OER operation.

Debug Messages --These messages are used to monitor detailed OER operations to diagnose operational or software problems.

Notification Messages --These messages indicate that OER is performing a normal operation.

Warning Messages --These messages indicate that OER is functioning properly, but an event outside of OER may be impacting normal OER operation.

To modify system, terminal, destination, and other system global logging parameters, use the **logging** commands in global configuration mode. For more information about system logging commands, see the *Cisco IOS Configuration Fundamentals Command Reference* , Release 12.4.

12.2(33)SXH

This command is supported only in OER border router configuration mode.

Examples

The following example enables OER system logging on a master controller:

```
Router(config)# oer master
Router(config-oer-mc)# logging
```

The following example enables OER system logging on a border router:

```
Router(config)# oer border
Router(config-oer-br)# logging
```

Related Commands

Command	Description
clear logging	Clears messages from the logging buffer.
clear logging xml	Clears all messages from the XML-specific system message logging (syslog) buffer.
logging buffered	Enables standard system message logging (syslog) to a local buffer and sets the severity level and buffer size for the logging buffer.
logging buffered xml	Enables system message logging (syslog) and sends XML-formatted logging messages to the XML-specific system buffer.
logging console	Limits messages logged to the console based on severity.
logging facility	Configures the syslog facility in which error messages are sent.
logging history	Limits syslog messages sent to the router's history table and the SNMP network management station based on severity.
logging history size	Sets the maximum number of syslog messages that can be stored in the router's syslog history table.
logging host	Logs messages to a syslog server host.

Command	Description
logging monitor	Limits messages logged to the terminal lines (monitors) based on severity.
logging monitor xml	Applies XML formatting to messages logged to the monitor connections.
logging on	Globally controls (enables or disables) system message logging.
logging synchronous	Synchronizes unsolicited messages and debug output with solicited Cisco IOS software output and prompts for a specific console port line, auxiliary port line, or vty.
logging trap	Limits messages sent to the syslog servers based on severity level.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show logging	Displays the state of logging (syslog).
show logging history	Displays information about the system logging history table.
show logging xml	Displays the state of XML-formatted system message logging, followed by the contents of the XML-specific buffer.

loss

To set the relative or maximum packet loss limit that Optimized Edge Routing (OER) will permit for an exit link, use the **loss** command in OER master controller configuration mode. To return the packet loss limit to the default value, use the **no** form of this command.

loss {**relative** *average*| **threshold** *maximum*}

no loss

Syntax Description

relative *average*	Sets a relative percentage of packet loss based on a comparison of short-term and long-term packet loss 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.
threshold *maximum*	Sets absolute packet loss based on packets per million (PPM). The range of values that can be configured for this argument is from 1 to 1000000.

Command Default

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

relative *average* : 100 (10 percent packet loss)

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 **loss** command is used to specify the relative percentage or maximum number of packets that OER will permit to be lost during transmission on an exit link. If packet loss is greater than the user-defined or the default value, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

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

Relative packet loss = ((short-term loss - long-term loss) / long-term loss) * 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 exit link is determined to be out-of-policy. For example, if long-term packet loss is 200 PPM and short-term packet loss is 300 PPM, the relative loss percentage is 50 percent.

The **threshold** keyword is used to configure the absolute maximum packet loss. The maximum value is based on the actual number of PPM that have been lost.

Examples

The following example configures the master controller to search for a new exit link if the difference between long- and short-term measurements (relative packet loss) is greater than 20 percent:

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

The following example configures OER to search for a new exit link when 20,000 packets have been lost:

```
Router(config)# oer master
Router(config-oer-mc)# loss threshold 20000
```

Related Commands

Command	Description
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.
set loss	Configures an OER map to set the relative or maximum packet loss limit that OER will permit for an exit link.

master

Note Effective with Cisco IOS Release 15.0(1)SY, the **master** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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

master *ip-address* **key-chain** *key-name*

no master

Syntax Description

ip-address	IP address of the master controller.
key-chain *key-name*	Specifies the key-chain to authenticate with the master controller.

Command Default

No communication is established between a master controller and border router.

Command Modes

OER border router configuration (config-oer-br)

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **master** command is entered on a border router. This command is used to establish communication between an OER border router and master controller. Communication is established between the border router process and the master controller process to allow the master controller to monitor and control OER exit links. OER communication must also be established on the master controller with the **border** OER master controller 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 a local interface on the border router and must be reachable by the master controller.

By default, passive monitoring in OER observe mode is enabled when communication is established between a master controller and border router. Communication between the master controller and the border router is protected by key-chain authentication. 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 *IP Routing: Protocoll-Independent Configuration Guide*.

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

Examples

The following example defines a key chain named MASTER in global configuration mode and then configures an OER border router to communicate with the OER master controller at 10.4.9.7. The master controller authenticates the border router based on 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 border
Router(config-oer-br)# master 10.4.9.7 key-chain MASTER
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to establish communication with an OER border router.
interface (OER)	Configures a border router interface as an OER managed external or internal interface.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

match ip address (OER)

To reference an extended IP access list or IP prefix as match criteria in an Optimized Edge Routing (OER) map, use the **match ip address**command in OER map configuration mode. To delete the match clause entry, use the **no** form of this command.

match ip address {**access-list** *name*| **prefix-list** *name* **[inside]**}

no match ip address

Syntax Description

access-list *name*	Specifies a named extended access list (created with the **ip access-list** command) as the match criterion in an OER map.
prefix-list *name*	Specifies a prefix list (created with the **ip prefix-list** command) as the match criterion in an OER map.
inside	Specifies an inside prefix.

Command Default

No match is performed.

Command Modes

OER map configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(2)T	Support for matching extended access lists 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 **match ip address**command defines a policy, defined by the **oer-map** command, to a list of prefixes. The **match ip address**command is entered on a master controller in OER map configuration mode. This command is used to configure a named extended access list or IP prefix list as a match criteria in an OER map. Only one match clause can be configured for each OER map sequence. The access list is created with the **ip access-list**command. Only named extended IP access lists are supported. The IP prefix list is created with the **ip prefix-list** command. A prefix can be any IP network number combined with a prefix mask that specifies the prefix length.

The **inside** keyword is used to support OER BGP inbound optimization that supports best entrance selection for traffic that originates from prefixes outside an autonomous system destined for prefixes inside the autonomous system. External BGP (eBGP) advertisements from an autonomous system to an Internet service provider (ISP) can influence the entrance path for traffic entering the network. OER uses eBGP advertisements to manipulate the best entrance selection. Inbound BGP only supports the passive mode which results in some configuration restrictions when using an OER map. The following commands are not supported in an OER map for inbound BGP; **set active-probe**, **set interface**, **set mode monitor**, **set mode verify bidirectional**, **set mos threshold**, **set nexthop**, **set periodic**, **set probe frequency**, and **set traceroute reporting**.

Examples

The following example creates a prefix list named CUSTOMER. The prefix list creates a filter for the 10.4.9.0/24 network. The **match ip address**command configures the prefix list as match criterion in an OER map.

```
Router(config)# ip prefix-list CUSTOMER permit 10.4.9.0/24

Router(config)# oer-map SELECT_EXIT 10
Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set mode select-exit good
```

The following example creates an extended access list named FTP. The named extended access list creates a filter for FTP traffic that is sourced from the 10.1.1.0/24 network. The **match ip address** command configures the access list as match criterion in an OER map. FTP traffic is policy routed to the first in-policy exit.

```
Router(config)# ip access-list extended FTP
Router(config-ext-nacl)# permit tcp 10.1.1.0 0.0.0.255 any eq ftp
Router(config-ext-nacl)# exit

Router(config)# oer-map SELECT_EXIT 10
Router(config-oer-map)# match ip address access-list FTP
Router(config-oer-map)# set mode select-exit good
```

The following example creates a prefix list named INSIDE1. The prefix list creates a filter for the 10.2.2.0/24 network. The **match ip address**command configures the prefix list as match criterion in an OER map.

```
Router(config)# ip prefix-list INSI
DE1 seq 5 permit 10.2.2.0/24
Router(config)# oer-map INSIDE_PREFIXES 10
Router(config-oer-map)# match ip address prefix-list INSIDE1 inside
Router(config-oer-map)# set as-path prepend 45000
```

Related Commands

Command	Description
ip access-list	Defines an IP access list.
ip prefix-list	Creates an entry in a prefix list.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

match oer learn

To create a match clause entry in an Optimized Edge Routing (OER) map to match OER learned prefixes, use the **match oer learn**command in OER map configuration mode. To delete the match clause entry, use the **no** form of this command.

match oer learn {**delay**| **inside**| **throughput**}

no match oer learn {**delay**| **inside**| **throughput**}

Syntax Description

delay	Specifies prefixes learned based on highest delay.
inside	Specifies prefixes learned based on prefixes that are inside the network.
throughput	Specifies prefixes learned based on highest throughput.

Command Default

No match is performed.

Command Modes

OER map configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(9)T	The **inside** keyword was added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **match oer learn** command is entered on a master controller in OER map configuration mode. OER can be configured to learn prefixes based on delay, inside prefix, or throughput. This command is used to configure OER learned prefixes as match criteria in an OER map. Only one match clause can be configured for each OER map sequence.

Examples

The following example creates an OER map named DELAY that matches traffic learned based on delay. The set clause applies a route control policy that configures OER to actively control this traffic.

```
Router(config)# oer-map DELAY 20
Router(config-oer-map)# match oer learn delay
```

```
Router(config-oer-map)# set mode route control
```

The following example creates an OER map named THROUGHPUT that matches traffic learned based on throughput. The set clause applies a route control policy that configures OER to actively control this traffic.

```
Router(config)# oer-map THROUGHPUT 30

Router(config-oer-map)# match oer learn throughput
Router(config-oer-map)# set mode route control
```

The following example creates an OER map named INSIDE that matches traffic learned based on inside prefixes. The set clause applies a route control policy that configures OER to actively control this traffic.

```
Router(config)# oer-map INSIDE 40

Router(config-oer-map)# match oer learn inside
Router(config-oer-map)# set mode route control
```

Related Commands

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

match traffic-class access-list

To define a match clause using an access list in an Optimized Edge Routing (OER) map to create a traffic class, use the **match traffic-class access-list** command in OER map configuration mode. To remove the match clause, use the **no** form of this command.

match traffic-class access-list *access-list-name*

no match traffic-class access-list

Syntax Description

access-list-name	Name of an access list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.

Command Default

OER traffic classes are not defined using match criteria in an OER map.

Command Modes

OER map configuration (config-oer-map)

Command History

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

Usage Guidelines

The **match traffic-class access-list** command is used to manually configure a traffic class that matches destination prefixes in an access list used in an OER map. Only one access list can be specified, but the access list may contain many access list entries (ACEs) to help define the traffic class.

Note The **match traffic-class access-list**command, the **match traffic-class prefix-list** command, and the **match traffic-class application** commands are all mutually exclusive in an OER map. Only one of these commands can be specified per OER map.

Examples

The following example, starting in global configuration mode, shows how to define a custom traffic class using an access list. Every entry in the access list defines one destination network and can include optional criteria. An OER map is used to match the destination prefixes and create the custom traffic class.

```
Router(config)# ip access-list extended CONFIGURED_TC
Router(config-ext-nacl)# permit tcp any 10.1.1.0 0.0.0.255 eq 500
Router(config-ext-nacl)# permit tcp any 172.16.1.0 0.0.0.255 eq 500 range 700 750
Router(config-ext-nacl)# permit tcp any 172.16.1.0 0.0.0.255 range 700 750
Router(config-ext-nacl)# permit tcp 192.168.0.0 0.0.255.255 10.1.2.0 0.0.0.255 eq 800
```

```
Router(config-ext-nacl)# exit
Router(config)# oer-map ACCESS_MAP 10
Router(config-oer-map)# match traffic-class access-list CONFIGURED_TC
Router(config-oer-map)# end
```

Related Commands

Command	Description
ip access-list	Defines a standard or extended IP access list.
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.

match traffic-class application

To define a match clause using a static application mapping in an Optimized Edge Routing (OER) map to create a traffic class, use the **match traffic-class application** command in OER map configuration mode. To remove the match clause entry, use the **no** form of this command.

match traffic-class application *application-name...* **prefix-list** *prefix-list-name*

no match traffic-class application *application-name* [**prefix-list** *prefix-list-name*]

Syntax Description

application-name	Name of a predefined static application using fixed ports. See the table below. The ellipses show that more than one application keyword can be specified.
prefix-list	Specifies that the traffic flows are matched on the basis of destinations specified in a prefix list.
prefix-list-name	Name of a prefix list (created using the **ip prefix-list** command).

Command Default

OER traffic classes are not defined using match criteria in an OER map.

Command Modes

OER map configuration (config-oer-map)

Command History

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

Usage Guidelines

The **match traffic-class application** command is used manually configure the master controller to profile traffic destined for prefixes defined in an IP prefix list that match one or more applications. The applications are predefined with a protocol--TCP or UDP, or both--and one or more ports and this mapping is shown in the table below. More than one application can be configured as part of the traffic class.

Note The **match traffic-class application** command, the **match traffic-class application nbar** command, the **match traffic-class access-list** command, and the **match traffic-class prefix-list** commands are all mutually exclusive in an OER map. Only one of these commands can be specified per OER map.

The table below displays the keywords that represent the application that can be configured with the **match traffic-class application** command. Replace the *application-name* argument with the appropriate keyword from the table.

Table 22: 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

Keyword	Protocol	Port
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, starting in global configuration mode, shows how to define application traffic classes in an OER map named APP_MAP using predefined Telnet and Secure Shell (SSH) application criteria that are matched with destination prefixes specified in a prefix list, LIST1.

```
Router(config)# ip prefix-list LIST1 permit 10.1.1.0/24
Router(config)# ip prefix-list LIST1 permit 10.1.2.0/24
Router(config)# ip prefix-list LIST1 permit 172.16.1.0/24
Router(config)# oer-map APP_MAP 10
Router(config-oer-map)# match traffic-class application telnet ssh prefix-list LIST1
Router(config-oer-map)# end
```

Related Commands

Command	Description
ip prefix-list	Creates an entry in a prefix list.
match traffic-class application nbar	Defines a match clause using an NBAR application mapping in an OER map to create a traffic class.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

match traffic-class application nbar

To define a match clause using an Network-Based Application Recognition (NBAR) application mapping in an Optimized Edge Routing (OER) map to create a traffic class, use the **match traffic-class application nbar** command in OER map configuration mode. To remove the match clause entry, use the **no** form of this command.

match traffic-class application nbar *nbar-appl-name* [*nbar-appl-name* ...] **prefix-list** *prefix-list-name*

no match traffic-class application nbar [*nbar-appl-name* ...]

Syntax Description

nbar-appl-name	Keyword representing the name of an application identified using NBAR. One application must be specified, but the ellipses show that more than one application keyword can be specified up to a maximum of ten. See the Usage Guidelines section for more details.
prefix-list	Specifies that the traffic flows are matched on the basis of destination prefixes specified in a prefix list.
prefix-list-name	Name of a prefix list (created using the **ip prefix-list** command).

Command Default

OER traffic classes identified using NBAR are not defined using match criteria in an OER map.

Command Modes

OER map configuration (config-oer-map)

Command History

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

Usage Guidelines

The **match traffic-class application nbar** command is used to manually configure the master controller to profile traffic destined for prefixes defined in an IP prefix list that match one or more applications identified using NBAR. More than one application can be configured as part of the traffic class with a maximum of ten applications entered per command line. Enter multiple **match traffic-class application nbar** command statements if you need to specify more than ten applications.

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) andPost 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 **match 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*.

Note The **match traffic-class application nbar** command, the **match traffic-class application** command, the **match traffic-class access-list** command, and the **match traffic-class prefix-list** commands are all mutually exclusive in an OER map. Only one of these commands can be specified per OER map.

Examples

The following example, starting in global configuration mode, shows how to define an application traffic class in an OER map named APP_NBAR_MAP. The traffic class consists of RTP-audio traffic identified using NBAR and matched with destination prefixes specified in a prefix list, LIST1.

The traffic streams that the OER map profiles for the RTP-audio application are:

```
10.1.1.1
10.2.2.1
172.16.1.1
172.17.1.2
```

The traffic classes that are learned for the RTP-audio application are:

```
10.2.2.0/24
172.17.1.0/24
```

Only traffic that matches both the RTP-audio application and the destination prefixes is learned.

```
Router(config)# ip prefix-list LIST1 permit 10.2.1.0/24
Router(config)# ip prefix-list LIST1 permit 10.2.2.0/24
Router(config)# ip prefix-list LIST1 permit 172.17.1.0/24
Router(config)# oer-map APP_NBAR_MAP 10
Router(config-oer-map)# match traffic-class application nbar rtp-audio prefix-list LIST1
Router(config-oer-map)# end
```

Related Commands

Command	Description
ip prefix-list	Creates an entry in a prefix list.
match traffic-class application	Defines a match clause using a static application mapping in an OER map to create a traffic class.

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
traffic-class application nbar	Defines an OER traffic class using an NBAR application mapping.

match traffic-class prefix-list

To define a match clause using a prefix list in an Optimized Edge Routing (OER) map to create a traffic class, use the **match traffic-class prefix-list** command in OER map configuration mode. To remove the match clause, use the **no** form of this command.

match traffic-class prefix-list *prefix-list-name* **[inside]**

no match traffic-class prefix-list

Syntax Description

prefix-list-name	Name of a prefix list.
inside	(Optional) Specifies that the prefix list contains inside prefixes.

Command Default

OER traffic classes are not defined using match criteria in an OER map.

Command Modes

OER map configuration (config-oer-map)

Command History

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

Usage Guidelines

The **match traffic-class prefix-list** command is used to manually configure a traffic class that matches destination prefixes in a prefix list.

Use the optional **inside** keyword to specify prefixes that are within the internal network.

Note The **match traffic-class prefix-list**command, the **match traffic-class access-list** command, and the **match traffic-class application** commands are all mutually exclusive in an OER map. Only one of these commands can be specified per OER map.

Examples

The following example, starting in global configuration mode, shows how to manually configure a traffic class based only on destination prefixes. The traffic class is created using the prefix list, LIST1, in an OER map named PREFIX_MAP. Every entry in the prefix list, LIST1, defines one destination network of the traffic class.

```
Router(config)# ip prefix-list LIST1 permit 10.1.1.0/24
Router(config)# ip prefix-list LIST1 permit 10.1.2.0/24
Router(config)# ip prefix-list LIST1 permit 172.16.1.0/24
```

```
Router(config)# oer-map PREFIX_MAP 10
Router(config-oer-map)# match traffic-class prefix-list LIST1
Router(config-oer-map)# end
```

Related Commands

Command	Description
ip prefix-list	Creates an entry in a prefix list.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

max prefix

To set the maximum number of prefixes that an Optimized Edge Routing (OER) master controller will monitor or learn, use the **max prefix** command in OER master controller configuration mode. To return the master controller to default behavior, use the **no** form of this command.

max prefix total *number* [**learn** *number*]

no max prefix total

Syntax Description

total *number*	Sets the total number of prefixes that the master controller will monitor. The range of values that can be entered for this argument is a number from 1 to 5000.
learn *number*	(Optional) Sets the total number of prefixes that the master controller will learn. The range of values that can be entered for this argument is a number from 1 to 2500.

Command Default

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

total *number* : 5000 **learn** *number*: 2500

Command Modes

OER master controller 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 **max prefix** command is entered on an OER master controller. This command is used to limit the number of prefix that a master controller will monitor and learn to reduce memory and system resource consumption. For more information about memory and system resource consumption, see the *Cisco Optimized Edge Routing CPU and Memory Performance Tests* document.

Note If you configure a lower value for the **total** keyword than the **learn** keyword, the value for the **total** keyword will also set the maximum number of prefixes that a master controller will learn.

Examples

The following example configures OER to monitor a maximum of 3000 prefixes and to learn a maximum of 1500 prefixes:

```
Router(config)# oer master
Router(config-oer-mc)# max prefix total 3000 learn 1500
```

Related Commands

Command	Description
expire after	Configures the length of time that learned prefixes are kept in the central policy database.
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.

max range receive

To set the maximum utilization range for all Optimized Edge Routing (OER) managed entrance links, use the **max range receive** command in OER master controller configuration mode. To return the maximum utilization range for entrance links to the default value, use the **no** form of this command.

max range receive percent *maximum*

no max range receive

Syntax Description

percent	Specifies the maximum utilization range for all OER entrance links as a percentage.
maximum	Maximum utilization range percentage. The range for this argument is from 1 to 100. The default is 20 percent.

Command Default

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

percent *maximum* : 20

Command Modes

OER master controller 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

The **max range receive** command is configured on a master controller. This command is used to set a threshold link utilization range for all entrance interfaces on OER border routers.

OER entrance link range functionality attempts to keep the entrance links within a utilization range, relative to each other to ensure that the traffic load is distributed. The range is specified either as an absolute value in kilobytes per second (kbps) or as a percentage and is configured on the master controller to apply to all the entrance links on border routers managed by the master controller. For example, in an OER-managed network with two entrance links, if the range is specified as 25 percent and the utilization of the first entrance link is 70 percent, then if the utilization of the second entrance link falls to 40 percent, the percentage range between the two entrance links will be more than 25 percent and OER will attempt to move some traffic classes to use the second entrance to even the traffic load.

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 **max range receive** command is configured under OER master controller configuration mode to set a maximum receive range for all OER-managed entrance links. In this example, the receive range between all the entrance links on the border routers must be within 35 percent.

```
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 25000
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.
downgrade bgp	Specifies route downgrade options for an OER managed interface using BGP advertisements.
maximum utilization	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.

maximum utilization receive

To set the maximum utilization on a single Optimized Edge Routing (OER) managed entrance link, use the **maximum utilization receive** command in OER border exit interface configuration mode. To return the maximum utilization on an entrance link to the default value, use the **no** form of this command.

maximum utilization receive {**absolute** *kbps*| **percentage** *bandwidth*}

no maximum utilization receive

Syntax Description

absolute	Sets the maximum utilization on an OER managed entrance link to an absolute value.
kbps	Maximum utilization for an OER managed entrance link in kilobytes per second (kbps). The configurable range for this argument is a number from 1 to 1000000000.
percent	Sets the maximum utilization on an OER managed entrance link to a bandwidth percentage.
bandwidth	Entrance link bandwidth percentage. The range for this argument is from 1 to 100. The default is 75 percent.

Command Default

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

percentage *bandwidth* **: 75** .

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

The **maximum utilization receive** command is entered on a master controller to set the maximum utilization threshold of incoming traffic that can be transmitted over an OER managed entrance link interface. This command is configured on a per entrance link basis. Use this command with the **downgrade bgp** command to configure OER BGP inbound optimization. This command can also be used with the **max range receive** command to configure entrance link load balancing.

If traffic utilization goes above the threshold, OER tries to move the traffic from this entrance link to another underutilized entrance link.

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 **maximum utilization receive** command is configured under OER border exit interface configuration mode to set a maximum threshold value of 25000 kbps for packets received through the entrance link ethernet interface 1/0 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 25000
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.
downgrade bgp	Specifies route downgrade options for an OER managed interface using BGP advertisements.
max range receive	Sets the maximum utilization range for all Optimized Edge Routing (OER) managed entrance links.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

max-range-utilization

To set the maximum utilization range for all Optimized Edge Routing (OER) managed exit links, use the **max-range-utilization** command in OER master controller configuration mode. To return the maximum utilization range to the default value, use the **no** form of this command.

max-range-utilization percent *maximum*

no max-range-utilization

Syntax Description

percent	Specifies the maximum utilization range for all OER exit links as a percentage.
maximum	Maximum utilization range percentage. The range for this argument is from 1 to 100. The default is 20 percent.

Command Default

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

percent *maximum* : 20

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 **max-range-utilization** command is configured on a master controller. This command is used to set a threshold link utilization range for all external interfaces on OER border routers.

OER exit link range functionality attempts to keep the exit links within a utilization range, relative to each other to ensure that the traffic load is distributed. The range is specified as a percentage and is configured on the master controller to apply to all the exit links on border routers managed by the master controller. For example, in an OER-managed network with two exit links, if the range is specified as 25 percent and the utilization of the first exit link is 70 percent, then if the utilization of the second exit link falls to 40 percent, the percentage range between the two exit links will be more than 25 percent and OER will attempt to move some traffic classes to use the second exit to even the traffic load.

Examples

The following example sets the maximum utilization range for OER managed exit links to 25 percent:

```
Router(config)# oer master
Router(config-oer-mc)# max-range-utilization 25
```

Related Commands

Command	Description
max-xmit-utilization	Configures maximum utilization on a single OER managed exit link.
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.

max-xmit-utilization

To set the maximum utilization on a single Optimized Edge Routing (OER) managed exit link, use the **max-xmit-utilization** command in OER border exit interface configuration mode. To return the maximum utilization on an exit link to the default value, use the **no** form of this command.

max-xmit-utilization {**absolute** *kbps*| **percentage** *bandwidth*}

no max-xmit-utilization

Syntax Description

absolute	Sets the maximum utilization on an OER managed exit link to an absolute value.
kbps	Maximum utilization for an OER managed exit link in kilobytes per second (kbps). The configurable range for this argument is a number from 1 to 1000000000.
percentage	Sets the maximum utilization on an OER managed exit link to a bandwidth percentage.
bandwidth	Exit link bandwidth percentage. The range for this argument is from 1 to 100. The default is 75 percent.

Command Default

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

percentage *bandwidth* **: 75**

Command Modes

OER border exit interface 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 max-xmit-utilization command is entered on a master controller and allows you to set the maximum utilization of outbound traffic that can be transmitted over an OER managed exit interface. The maximum utilization threshold can be expressed as an absolute value in kbps or as a percentage. This command is configured on a per exit link basis and cannot be configured on OER internal interfaces; internal interfaces are not used to forward traffic.

If traffic goes above the threshold, OER tries to move the traffic from this exit link to another underutilized exit link.

Examples

The following example sets the maximum exit link utilization to 1000000 kbps on FastEthernet interface 0/0:

```
Router(config-oer-mc-br)# interface FastEthernet0/0 external
Router(config-oer-mc-br-if)# max-xmit-utilization absolute 1000000
```

The following example sets the maximum percentage of exit utilization to 80 percent on serial interface 1/0:

```
Router(config-oer-mc-br)# interface Serial 1/0 external
Router(config-oer-mc-br-if)# max-xmit-utilization percentage 80
```

Related Commands

Command	Description
interface (OER)	Configures a border router interface as an OER managed external or internal interface.
max-range-utilization	Sets the maximum utilization range for all OER managed exit links.
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.

mode (OER)

To configure route monitoring, route control, or route exit selection on an Optimized Edge Routing (OER) master controller, use the **mode** command in OER master controller configuration mode. To return the OER master controller to the default monitoring, control, or exit selection state, use the **no** form of this command.

mode {**monitor** {**active [throughput]| both| fast| passive**}| **route** {**control| metric** {**bgp local-pref** *preference*| **eigrp tag** *community*| **static tag** *value*}| **observe**}| **select-exit** {**best| good**}}

no mode {**monitor| route** {**control| metric** {**bgp| eigrp| static**}| **observe**}| **select-exit**}

Syntax Description

monitor	Enables the configuration of OER monitoring settings.
active	Enables active monitoring.
throughput	(Optional) Enables active monitoring with throughput data from passive monitoring.
both	Enables both active and passive monitoring. This is the default monitoring mode.
fast	Enables continuous active monitoring and passive monitoring.
passive	Enables passive monitoring.
route	Enables the configuration of OER route control policy settings.
control	Enables automatic route control.
metric	Enables the configuration of route control based on the Border Gateway Protocol (BGP) local-preference, EIGRP, or for specific static routes.
bgp local-pref *preference*	Sets the BGP local preference for OER-controlled routes. The value for the preference argument is a number from 1 to 65535.
eigrp tag *community*	Applies a community value to a EIGRP route under OER control. The value for the community argument is a number from 1 to 65535.
static tag *value*	Applies a tag to a static route under OER control. The value for the value argument is a number from 1 to 65535.

observe	Configures OER to passively monitor and report without making any changes. This is the default route control mode.
select-exit	Enables the exit selection based on performance or policy
best	Configures OER to select the best available exit based on performance or policy.
good	Configures OER to select the first exit that is in-policy. This is the default exit selection.

Command Default

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

Monitoring: Both active and passive monitoring is enabled. Route control: Observe mode route control is enabled. Exit Selection: The first in-policy exit is selected.

Command Modes

OER master controller configuration (config-oer-mc)

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	The **fast** and **throughput** keywords were added.
15.0(1)M	This command was modified. The **eigrp** and **tag** keywords and *community* argument were added to support EIGRP route control.
12.2(33)SRE	This command was modified. The **eigrp** and **tag** keywords and *community* argument were added to support EIGRP route control.

Usage Guidelines

The **mode** command is entered on a master controller. This command is used to enable and configure control mode and observe mode settings and is used to configure passive monitoring and active monitoring. A prefix can be monitored both passively and actively.

Observe Mode

Observe mode monitoring is enabled by default. In observe mode, the master controller monitors prefixes and exit links based on default and user-defined policies and then reports the status of the network and the decisions that should be made but does not implement any changes. This mode allows you to verify the effectiveness of this feature before it is actively deployed.

Control Mode

In control mode, the master controller coordinates information from the border routers and makes policy decisions just as it does in observe mode. The master controller monitors prefixes and exits based on default and user-defined policies but then implements changes to optimize prefixes and to select the best exit. In this mode, the master controller gathers performance statistics from the border routers and then transmits commands to the border routers to alter routing as necessary in the OER managed network.

Passive Monitoring

The master controller passively monitors IP prefixes and TCP traffic flows. Passive monitoring is configured on the master controller. Monitoring statistics are gathered on the border routers and then reported back to the master controller. OER uses NetFlow to collect and aggregate passive monitoring statistics on a per prefix basis. No explicit NetFlow configuration is required. NetFlow support is enabled by default when passive monitoring is enabled. OER uses passive monitoring to measure the following information:

Delay --OER measures the average delay of TCP flows for a prefix. Delay is the measurement of the time between the transmission of a TCP synchronization message and receipt of the TCP acknowledgment.

Packet Loss --OER measures packet loss by tracking TCP sequence numbers for each TCP flow. OER estimates packet loss by tracking the highest TCP sequence number. If a subsequent packet is received with a lower sequence number, OER increments the packet loss counter.

Reachability --OER measures reachability by tracking TCP synchronization messages that have been sent repeatedly without receiving a TCP acknowledgment.

Throughput --OER measures outbound throughput for optimized prefixes. Throughput is measured in bits per second (bps).

Note OER passively monitors TCP traffic flows for IP traffic. Passive monitoring of non-TCP sessions is not supported.

Active Monitoring

OER uses Cisco IOS IP Service Level Agreements (SLAs) to enable active monitoring. IP SLAs support is enabled by default. IP SLAs support allows OER to be configured to send active probes to target IP addresses to measure the jitter and delay, determining if a prefix is out-of-policy and if the best exit is selected. The border router collects these performance statistics from the active probe and transmits this information to the master controller. The master controller uses this information to optimize the prefix and select the best available exit based on default and user-defined policies. The **active-probe** command is used to create an active probe.

In Cisco IOS Release 12.4(15)T the **throughput** keyword was added to enable the throughput data from passive mode monitoring to be considered when optimizing UDP traffic for both performance and load balancing. UDP traffic can be optimized only for performance (for example, delay, jitter, and loss) when active monitoring data is available. To enable load balancing of UDP traffic, throughput data from passive monitoring is required.

Fast Failover Monitoring

In Cisco IOS Release 12.4(15)T, a new monitoring mode, fast monitoring, was introduced. Fast monitoring sets the active probes to continuously monitor all the exits (probe-all), and passive monitoring is enabled too. Fast failover monitoring can be used with all types of active probes: ICMP echo, Jitter, TCP connection, and UDP echo. When the **mode monitor fast** command is enabled, the probe frequency can be set to a lower frequency than for other monitoring modes, to allow a faster failover ability. Under fast monitoring with a lower probe frequency, route changes can be performed within 3 seconds of an out-of-policy situation. When an exit becomes OOP under fast monitoring, the select best exit is operational and the routes from the OOP exit are moved to the best in-policy exit. Fast monitoring is a very aggressive mode that incurs a lot of overhead with the continuous probing. We recommend that you use fast monitoring only for performance sensitive traffic.

Optimal Exit Link Selection

The master controller can be configured to select a new exit for an out-of-policy prefix based on performance or policy. You can configure the master controller to select the first in-policy exit by entering the **good** keyword, or you can configure the master controller to select the best exit with the **best** keyword. If the **good** keyword is used and there is no in-policy exit, the prefix is uncontrolled.

Examples

The following example enables both active and passive monitoring:

```
Router(config)# oer master
Router(config-oer-mc)# mode monitor both
```

The following example enables fast failover monitoring:

```
Router(config)# oer master
Router(config-oer-mc)# mode monitor fast
```

The following example configures the master controller to enable active monitoring with throughput data from passive monitoring:

```
Router(config)# oer master
Router(config-oer-mc)# mode monitor active throughput
```

The following example enables control mode:

```
Router(config)# oer master
Router(config-oer-mc)# mode route control
```

The following example configures the master controller to enable control mode and to enable EIGRP route control that applies a community value of 700 to EIGRP routes under OER control:

```
Router(config)# oer master
Router(config-oer-mc)# mode route control
Router(config-oer-mc)# mode route metric eigrp tag 700
```

The following example configures the master controller to select the first in-policy exit:

```
Router(config)# oer master
Router(config-oer-mc)# mode select-exit good
```

Related Commands

Command	Description
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.
set mode	Configures an OER map to configure route monitoring, route control, or exit selection for matched traffic.

monitor-period

To set the time period in which an Optimized Edge Routing (OER) master controller learns traffic flows, use the **monitor-period** command in OER Top Talker and Top Delay learning configuration mode. To return the monitoring period to the default time period, use the **no** form of this command.

monitor-period *minutes*

no monitor-period

Syntax Description

minutes	Sets the prefix learning period, in minutes. The range is from 1 to 1440. The default value is 5.

Command Default

If this command is not configured, or if the **no** form of this command is entered, the default is 5 minutes.

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 **monitor-period** command is configured on a master controller. This command is used to adjust the length of time that a master controller learns traffic flows on border routers. The length of time between monitoring periods is configured with the **periodic-interval**command. The number of prefixes that are learned is configured with the **prefixes** command.

Examples

The following example sets the OER monitoring period to 10 minutes on a master controller:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# monitor-period 10
```

Related Commands

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

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
periodic-interval	Sets the time interval between prefix learning periods.
prefixes	Sets the number of prefixes that OER will learn during a monitoring period.

mos

To specify the threshold and percentage M ean Opinion Score (MOS) values that Optimized Edge Routing (OER) will permit for an exit link, use the **mos** command in OER master controller configuration mode. To reset the threshold and percentage MOS values to their default value, use the **no** form of this command.

mos threshold *minimum* **percent** *percent*

no mos threshold *minimum* **percent** *percent*

Syntax Description

threshold	Specifies a threshold MOS value that represents a minimum voice quality for exit link utilization.
minimum	Number (to two decimal places) in the range from 1.00 to 5.00, where 1.00 represents the lowest voice quality, and 5.00 represents the highest voice quality. The default MOS value is 3.60.
percent	Specifies a percentage value that is compared with the percentage of MOS samples that are below the MOS threshold.
percent	Number, as a percentage.

Command Default

The default MOS value is 3.60.

Command Modes

OER master controller configuration

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.

Usage Guidelines

The **mos** command is used to determine voice quality. The number of MOS samples over a period of time that are below the threshold MOS value are calculated. If the percentage of MOS samples below the threshold is greater than the configured percentage, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

Another measure of voice quality is the jitter value. Use the **mos** command and the **jitter** command in an OER policy to define voice quality.

Examples

The following example shows how to configure the master controller to search for a new exit link if more than 30 percent of the MOS samples are below the MOS threshold of 3.75:

```
Router(config)# oer master
Router(config-oer-map)# mos threshold 3.75 percent 30
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set mos	Configures an OER map to set the maximum MOS value that OER will permit for an exit link.

oer

Note Effective with Cisco IOS Release 15.0(1)SY, the **oer** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To enable a Cisco IOS Optimized Edge Routing (OER) process and configure a router as an OER border router or as an OER master controller, use the **oer** command in global configuration mode. To disable a border router or master controller process and delete the OER configuration from the running configuration file, use the **no** form of this command.

All Cisco IOS Releases Except Cisco IOS Release 12.2(33)SXH

oer {**border**| **master**}

no oer {**border**| **master**}

Cisco IOS Release 12.2(33)SXH

oer border

no oer border

Syntax Description

border	Designates a router as a border router and enters OER border router configuration mode.
master	Designates a router as a master controller and enters OER master controller configuration mode.

Command Default

OER is not enabled.

Command Modes

Global configuration (config)

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.

Release	Modification
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **oer** command is entered on a router to create a border router or master controller process to enable Cisco IOS OER, which allows you to enable automatic outbound route control and load distribution for multihomed and enterprise networks. Configuring OER allows you to monitor IP traffic flows and then define policies and rules based on link performance and link load distribution to alter routing and improve network performance. An OER managed network consists of the following two components:

Master Controller --The master controller is a single router that coordinates all OER functions within an OER managed network. The master controller monitors outbound traffic flows using active or passive monitoring and then applies default and user-defined policies to alter routing to optimize prefixes and exit links. Most OER administration is centralized on the master controller, which makes all policy decisions and controls the border routers. The master controller is not required to be in the traffic forwarding path. The master controller can support up to 10 border routers and up to 20 OER managed external interfaces.

Border Router --The border router is an enterprise edge router with one or more exit links to an Internet service provider (ISP) or other participating network. The border router participates in prefix monitoring and route optimization by reporting prefix and exit link information to the master controller and then enforcing policy changes received from the master controller. Policy changes are enforced by injected a preferred route into the network. The border router is deployed on the edge of the network, so the border router must be in the forwarding path. A border router process can be enabled on the same router as a master controller process (for example, in a small network where all exit interfaces are managed on a single router).

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.

Disabling a Border Router or a Master Controller

To disable a master controller or border router and completely remove the process configuration from the running configuration file, use the **no** form of this command in Global configuration mode.

To temporarily disable a master controller or border router process, use the **shutdown** command in OER master controller or OER border router configuration mode. Entering the **shutdown** command stops an active master controller or border router process but does not remove any configuration parameters. The **shutdown** command is displayed in the running configuration file when enabled.

Enabling Cisco IOS OER for Load Distribution

When enabling Cisco IOS OER for load distribution, we recommend that you set the interface load calculation on OER managed external interfaces to 30-second intervals with the **load-interval** interface configuration command. The default calculation interval is 300 seconds. The load calculation is configured under interface configuration mode on the border router. This configuration is not required. It is recommended that you allow Cisco IOS OER to respond as quickly as possible to load distribution issues.

Cisco IOS Release 12.2(33)SXH

In Cisco IOS Release 12.2(33)SXH, only the **border** keyword is supported.

Examples

Examples

The following example designates a router as a master controller and enters OER master controller configuration mode:

```
Router(config)# oer master
```

The following is an example of the minimum required configuration on a master controller to create an OER managed network:

A key-chain configuration named OER is defined in global configuration mode.

```
Router(config)# key chain OER
Router(config-keychain)# key 1
Router(config-keychain-key)# key-string CISCO

Router(config-keychain-key)# exit
Router(config-keychain)# exit
```

The master controller is configured to communicate with the 10.4.9.6 border router in OER master controller configuration mode. The communications port number is specified. The key-chain OER is applied to protect communication. Internal and external OER controlled border router interfaces are defined.

```
Router(config)# oer master

Router(config-oer-mc)# port 65535

Router(config-oer-mc)# border 10.4.9.6 key-chain OER
Router(config-oer-mc-br)# interface FastEthernet0/0 external
Router(config-oer-mc-br)# interface FastEthernet0/1 internal
Router(config-oer-mc-br)# exit
```

Examples

The following example designates a router as a border router and enters OER border router configuration mode:

```
Router(config)# oer border
```

The following is an example of the minimum required configuration to configure a border router in an OER managed network:

The key-chain configuration is defined in global configuration mode.

```
Router(config)# key chain OER

Router(config-keychain)# key 1
Router(config-keychain-key)# key-string CISCO
Router(config-keychain-key)# exit

Router(config-keychain)# exit
```

The communications port number is specified. The key-chain OER is applied to protect communication. An interface is identified as the local source interface to the master controller.

```
Router(config)# oer border
Router(config-oer-br)# port 65535

Router(config-oer-br)# local FastEthernet0/0
Router(config-oer-br)# master 10.4.9.4 key-chain OER
Router(config-oer-br)# end
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to configure a border router.
keepalive (OER)	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.
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure OER to learn prefixes.
load-interval	Specifies the time interval for load calculation for the specified interface.
master	Establishes communication with a master controller.
mode (OER)	Configures route monitoring or route control on an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
port (OER)	Configures a dynamic port for communication between an OER master controller and border router.
shutdown (OER)	Stops or starts an OER master controller or an OER border router process.

oer-map

To enter OER map configuration mode to configure an Optimized Edge Routing (OER) map to apply policies to selected IP prefixes, use the **oer-map** command in global configuration mode. To delete the OER map, use the **no** form of this command.

oer-map *map-name* [*sequence-number*]

no oer-map *map-name*

Syntax Description

map-name	Specifies the name or tag for the OER map.
sequence-number	(Optional) Specifies the sequence number for the OER map entry. The configurable range for this argument is from 1 to 65535.

Command Default

No OER maps are created.

Command Modes

Global 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 **oer-map** command is configured on a master controller. The operation of an OER map is similar to the operation of a route-map. An OER map is designed to select IP prefixes or to select OER learn policies using a match clause and then to apply OER policy configurations using a set clause. The OER map is configured with a sequence number like a route-map, and the OER map with the lowest sequence number is evaluated first. The operation of an OER map differs from a route-map at this point. There are two important distinctions:

- Only a single match clause may be configured for each sequence. An error message will be displayed on the console if you attempt to configure multiple match clauses for a single OER map sequence.
- An OER map is not configured with permit or deny statements. However, a permit or deny sequence can be configured for an IP traffic flow by configuring a permit or deny statement in an IP prefix list and then applying the prefix list to the OER map with the **match ip address**(OER) command.

Tip Deny prefixes should be combined in a single prefix list and applied to the OER map with the lowest sequence number.

An OER map can match a prefix or prefix range with the **match ip address** (OER) command. A prefix can be any IP network number combined with a prefix mask that specifies the prefix length. The prefix or prefix range is defined with the **ip prefix-list**command in global configuration mode. Any prefix length can be specified. An OER map can also match OER learned prefixes with the **match oer learn** command. Matching can be configured for prefixes learned based on delay or based on throughput.

The OER map applies the configuration of the set clause after a successful match occurs. An OER set clause can be used to set policy parameters for the backoff timer, packet delay, holddown timer, packet loss, mode settings, periodic timer, resolve settings, and unreachable hosts. See the "Related Commands" section of this command reference page for a complete list of OER set clauses.

Policies that are applied by an OER map do not override global policies configured under OER master controller configuration mode and OER Top Talker and Delay learning configuration mode. Policies are overridden on a per-prefix list basis. If a policy type is not explicitly configured in an OER map, the default or configured values will apply. Policies applied by an OER map take effect after the current policy or operational timer expires. The OER map configuration can be viewed in the output of the **show running-config** command. OER policy configuration can be viewed in the output of the **show oer master policy** command.

Examples

The following example creates an OER map named SELECT_EXIT that matches traffic defined in the IP prefix list named CUSTOMER and sets exit selection to the first in-policy exit when the periodic timer expires. This OER map also sets a resolve policy that sets the priority of link utilization policies to 1 (highest priority) and allows for a 10 percent variance in exit link utilization statistics.

```
Router(config)# ip prefix-list CUSTOMER permit 10.4.9.0/24
Router(config)# oer-map SELECT_EXIT 10
Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set mode select-exit good
Router(config-oer-map)# set resolve utilization priority 1 variance 10
```

The following example creates an OER map named THROUGHPUT that matches traffic learned based on the highest outbound throughput. The set clause applies a relative loss policy that will permit 10 percent packet loss:

```
Router(config)# oer-map THROUGHPUT 20
Router(config-oer-map)# match oer learn throughput
Router(config-oer-map)# set loss relative 10
```

Related Commands

Command	Description
ip prefix-list	Creates an entry in a prefix list.
match ip address (OER)	Creates a prefix list match clause entry in an OER map to apply OER policy settings.
match oer learn	Creates a match clause entry in an OER map to match OER learned prefixes.

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set loss	Configures an OER map to set the relative or maximum packet loss limit that OER will permit for an exit link.
set resolve	Configures an OER map to set policy priority for overlapping policies.
show oer master policy	Displays configured and default policy settings on an OER master controller.

periodic (OER)

To configure Optimized Edge Routing (OER) to periodically select the best exit link, use the **periodic** command in OER master controller configuration mode. To disable periodic exit selection, use the **no** form of this command.

periodic *timer*

no periodic

Syntax Description

timer	Sets the length of time, in seconds, for the periodic timer. The range of configurable values is from180 to 7200.

Command Default

Periodic exit selection is disabled.

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 **periodic** command is entered on a master controller. This command is used to configure the master controller to evaluate and then make policy decisions for OER managed exit links. When the periodic timer expires, the master controller evaluates current exit links based on default or user-defined policies. If all exit links are in-policy, no changes are made. If an exit link is out-of-policy, the affected prefixes are moved to an in-policy exit link. If all exit links are out-of-policy, the master controller will move out-of-policy prefixes to the best available exit links.

The master controller can be configured to select the first in-policy exit when the periodic timer expires, by configuring the **mode** command with the **select-exit good** keywords. The master controller also can be configured to select the best available in-policy exit, by configuring the **mode** command with the **select-exit best**keywords.

The periodic timer is reset to the default or configured value each time the timer expires. 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 periodic timer to 300 seconds. When the periodic timer expires, OER will select either the best exit or the first in-policy exit.

```
Router(config)# oer master
Router(config-oer-mc)# periodic 300
```

Related Commands

Command	Description
mode(OER)	Configures route monitoring or route control on an OER master controller.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set periodic	Configures an OER map to set the time period for the periodic timer.

periodic-interval

To set the time interval between prefix learning periods, use the **periodic-interval**command in OER Top Talker and Top Delay learning configuration mode. To set the time interval between prefix learning periods to the default value, use the **no** form of this command.

periodic-interval *minutes*

no periodic-interval

Syntax Description

minutes	Sets the time interval between prefix learning periods in minutes. The range that can be configured for this argument is from 0 to 10080 minutes.

Command Default

Optimized Edge Routing (OER) uses the following default value if this command is not configured or if the **no** form of this command is entered:

minutes **: 120**

Command Modes

OER Top Talker and Top Delay learning configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(2)T	The range of values that can be entered for the *minutes* argument was changed.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **periodic-interval** command is configured on a master controller. This command is used to adjust the length of time between traffic flow monitoring periods. The length of time of the learning period is configured with the **monitor-period** command. The number of prefixes that are monitored is configured with the **prefixes**command.

Examples

The following example sets the length of time between OER monitoring periods to 20 minutes on a master controller:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# periodic-interval 20
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
monitor-period	Sets the time period in which an OER master controller learns traffic flows.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
prefixes	Sets the number of prefixes that OER will learn during a monitoring period.

policy-rules

To apply a configuration from an Optimized Edge Routing (OER) map to a master controller configuration, use the **policy-rules**command in OER master controller configuration mode. To remove a configuration applied by the **policy-rules** command, use the **no** form of this command.

policy-rules *map-name*

no policy-rules

Syntax Description

map-name	The name of the OER map.

Command Default

No configuration is applied to a master controller from an OER map.

Command Modes

OER master controller configuration

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 **policy-rules** command allows you to select an OER map and apply the configuration under OER master controller configuration mode, providing an improved method to switch between predefined OER maps.

The **policy-rules** command is entered on a master controller. This command is used to apply the configuration from an OER map to a master controller configuration in OER master controller configuration mode.

Reentering this command with a new OER map name will immediately overwrite the previous configuration. This behavior is designed to allow you to quickly select and switch between predefined OER maps.

Examples

The following examples, starting in global configuration mode, show how to configure the **policy-rules** command to apply the OER map named BLUE under OER master controller configuration mode:

```
Router(config)# oer-map BLUE 10
Router(config-oer-map)# match oer learn delay
Router(config-oer-map)# set loss relative 900
Router(config-oer-map)# exit
Router(config)# oer master
Router(config-oer-mc)# policy-rules BLUE
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.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

port (OER)

Note Effective with Cisco IOS Release 15.0(1)SY, the **port** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To optionally configure a dynamic port number for communication between an Optimized Edge Routing (OER) master controller and border router, use the **port** command in OER master controller or OER border router configuration mode. To close the port and disable communication, use the **no** form of this command.

port [*port-number*]

no port

Syntax Description

port-number	(Optional) Specifies the port number. The configurable range for this argument is a number from 1 to 65535.

Command Default

Port 3949 is used for OER communication unless a dynamic port number is configured on both the master controller and the border router. Port configuration is not shown in the running configuration file when port 3949 is used.

Command Modes

OER border router configuration (config-oer-br) OER master controller configuration (config-oer-mc)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.3(11)T	Port 3949 was registered with the Internet Assigned Numbers Authority (IANA) for OER communication. Manual port configuration is not required as of Cisco IOS Release 12.3(11)T.
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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

Communication between a master controller and border router is automatically carried over port 3949 when connectivity is established. Port 3949 is registered with IANA for OER communication. Manual port number configuration is required only if you are running Cisco IOS Release 12.3(8)T or if you need to configure OER communication to use a dynamic port number.

The **port**command is entered on a master controller or a border router. This command is used to specify a dynamic port number to be used for border router and the master controller communication. The same port number must be configured on both the master controller and border router. Closing the port by entering the **no** form of this command disables communication between the master controller and the border router.

Cisco IOS Release 12.2(33)SXH

This command is supported only in OER border router configuration mode.

Examples

The following example opens port 49152 for master controller communication with a border router:

```
Router(config)# oer master
Router(config-oer-mc)# port 49152
```

The following example opens port 49152 for border router communication with a master controller:

```
Router(config)# oer border
Router(config-oer-br)# port 49152
```

The following example closes the default or user-defined port and disables communication between a master controller and border router:

```
Router(config)# oer master
Router(config-oer-mc)# no port
```

Related Commands

Command	Description
border	Enters OER managed border router configuration mode to establish communication with an OER border router.
local (OER)	Identifies a local interface on an OER border router as the source for 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.

prefixes

To set the number of prefixes that OER will learn during a monitoring period, use the **prefixes** command in OER Top Talker and Top Delay learning configuration mode. To return the number of prefixes to the default value, use the **no** form of this command.

prefixes *number*

no prefixes

Syntax Description

number	Sets the number of prefixes that a master controller will learn during a monitoring period. The range is from 1 to 2500. The default is 100.

Command Default

OER uses a default number of 100 prefixes if this command is not configured or if the no form of this command is entered.

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 **prefixes** command is configured on a master controller. This command is used to set the number of prefixes that a master controller will learn during a monitoring period. The length of time of the learning period is configured with the **monitor-period**command. The length of time between monitoring periods is configured with the **periodic-interval**command.

Examples

The following example configures a master controller to learn 200 prefixes during a monitoring period:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# prefixes 200
```

Related Commands

Command	Description
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
monitor-period	Sets the time period in which an OER master controller learns traffic flows.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
periodic-interval	Sets the time interval between prefix learning periods.

protocol (OER)

To configure an Optimized Edge Routing (OER) master controller to learn traffic class entries based on a protocol number or a range of port numbers, use the **protocol** command in OER Top Talker and Top Delay learning configuration mode. To disable port-based prefix learning, use the **no** form of this command.

protocol {*number*| **tcp**| **udp**} [**port** *port-number*| **gt** *port-number*| **lt** *port-number*| **range** *lower-number upper-number*] [**dst**| **src**]

no protocol {*number*| **tcp**| **udp**} [**port** *port-number*| **gt** *port-number*| **lt** *port-number*| **range** *lower-number upper-number*] [**dst**| **src**]

Syntax Description

number	Configures prefix learning based on a specific protocol number. The configurable range for this argument is a number from 1 to 255.
tcp	Configures prefix learning based on the TCP protocol.
udp	Configures prefix learning based on the User Datagram Protocol (UDP) protocol.
port *port-number*	(Optional) Specifies the port number for prefix learning based on protocol. The configurable range for the port-number argument is a number from 1 to 65535.
gt *port-number*	(Optional) Specifies all port numbers greater than the number specified with the port-number argument.
lt *port-number*	(Optional) Specifies all port numbers less than the number specified with the port-number argument.
range *lower-number upper-number*	(Optional) Specifies a range of port numbers. The first number in the range is specified with the lower-number argument. The last number in the range is specified with the upper-number argument. The configurable range for the *lower-number* and *upper-number* arguments is a number from 1 to 65535.
dst	(Optional) Configures prefix learning based on the destination port number.
src	(Optional) Configures prefix learning based on the source port number.

Command Default

No traffic class entries are learned on the basis of a protocol or port number.

Command Modes

OER Top Talker and Top Delay learning configuration

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 **protocol** command is configured on a master controller. This command is used to configure prefix learning based on the specified protocol. This command provides a very granular level of control over prefix learning. Configuring this command allows you to configure the master controller to learn prefixes based on the specified protocol and the specified port number.

Port-based prefix learning allows you to include or exclude traffic streams for a specific protocol or the TCP or UDP port and port range. Traffic can be optimized for a specific application or protocol or to exclude uninteresting traffic, allowing you to focus system resources, thus saving CPU cycles and reducing the amount of memory that is required to monitor prefixes. In cases where traffic streams have to be excluded or included over ports that fall above or below a certain port number, a range of port numbers can be specified.

For a list of Internet Assigned Numbers Association (IANA) assigned port numbers, see the following document:

- http://www.iana.org/assignments/port-numbers

For a list of IANA assigned protocol numbers, see the following document:

- http://www.iana.org/assignments/protocol-numbers

Examples

The following example configures a master controller to learn Enhanced Interior Gateway Protocol (EIGRP) prefixes during the monitoring period:

```
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# protocol 88
```

Related Commands

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

resolve

To set the priority of a policy when multiple overlapping policies are configured, use the **resolve** command in OER master controller configuration mode. To disable the policy priority configuration, use the **no** form of this command.

resolve {**cost priority** *value*| **delay priority** *value* **variance** *percentage*| **jitter priority** *value* **variance** *percentage*| **loss priority** *value* **variance** *percentage*| **mos priority** *value* **variance** *percentage*| **range priority** *value*| **utilization priority** *value* **variance** *percentage*}

no resolve {**cost**| **delay**| **jitter**| **loss**| **mos**| **range**| **utilization**}

Syntax Description

cost	Specifies policy priority settings for cost optimization.
priority *value*	Sets the priority of the policy. The range is from 1 to 10. • The number 1 has the highest priority, and the number 10 has the lowest priority.
delay	Specifies policy priority settings for packet delay.
variance *percentage*	Sets the allowable variance for the policy, as a percentage. The range is from 1 to 100.
jitter	Specifies policy priority settings for jitter.
loss	Specifies policy priority settings for packet loss.
mos	Specifies policy priority settings for the Mean Opinion Score (MOS).
range	Specifies policy priority settings for the range.
utilization	Specifies policy priority settings for exit link utilization.

Command Default

Optimized Edge Routing (OER) uses the following default settings if this command is not configured or if the no form of this command is entered:

- An unreachable prefix: highest priority
- **delay** : 11
- **utilization** : 12

Command Modes

OER master controller configuration (config-oer-mc)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(6)T	This command was modified. The **jitter** and **mos** keywords were added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **resolve** command is entered on a master controller. This command is used to set priority when multiple policies are configured for the same prefix. When this command is configured, the policy with the highest priority will be selected to determine the policy decision.

The **priority** keyword is used to specify the priority value. The number 1 assigns the highest priority to a policy. The number 10 sets the lowest priority. Each policy must be assigned a different priority number. If you try to assign the same priority number to two different policy types, an error message will be displayed on the console. By default, delay has a priority value of 11 and utilization has a priority value of 12. These values can be overridden by specifying a value from 1 to 10.

Note An unreachable prefix will always have the highest priority regardless of any other settings. This is a designed behavior and cannot be overridden because an unreachable prefix indicates an interruption in a traffic flow.

The **variance** keyword is used to set an allowable variance for a user-defined policy. This keyword configures the allowable percentage that an exit link or prefix can vary from the user-defined policy value and still be considered equivalent. For example, if an exit link delay is set to 80 absolute and a 10 percent variance is configured, exit links that have delay values from 80 to 89 percent will be considered equal.

Note Variance cannot be configured for cost or range policies.

Note You must configure an OER active jitter probe for a target prefix using the **active-probe** command for the **resolve jitter**, **resolve loss**, and **resolve mos** commands to function.

Examples

The following example shows how to set the delay policy priority to 1 and the allowable variance percentage to 20 percent:

```
Router(config)# oer master
Router(config-oer-mc)# resolve delay priority 1 variance 20
```

The following example shows how to set the loss policy priority to 2 and the allowable variance percentage to 30 percent:

```
Router(config)# oer master
Router(config-oer-mc)# resolve loss priority 2 variance 30
```

The following example shows how to set the jitter policy priority to 3 and the allowable variance percentage to 5 percent:

```
Router(config)# oer master
Router(config-oer-mc)# resolve jitter priority 3 variance 5
```

The following example shows how to set the MOS policy priority to 4 and the allowable variance percentage to 25 percent:

```
Router(config)# oer master
Router(config-oer-mc)# resolve mos priority 4 variance 25
```

The following example shows how to set the range policy priority to 5:

```
Router(config)# oer master
Router(config-oer-mc)# resolve range priority 5
```

The following example shows how to set the link utilization policy priority to 6 and the allowable variance percentage to 10 percent:

```
Router(config)# oer master
Router(config-oer-mc)# resolve utilization priority 6 variance 10
```

Related Commands

Command	Description
active-probe	Configures an OER active probe for a target prefix.
cost-minimization	Configures cost-based optimization policies on a master controller.
delay	Configures OER to learn prefixes based on the lowest delay.
jitter	Sets the jitter threshold value that OER will permit for an exit link.
loss	Sets the relative or maximum packet loss limit that OER will permit for an exit link.
max-range-utilization	Sets the maximum utilization range for all OER managed exit links
max-xmit-utilization	Configures maximum utilization on a single OER managed exit link.
mode (OER)	Configures route monitoring or route control on an OER master controller.
mos	Sets the MOS threshold value that OER will permit for an exit link.

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show oer master policy	Displays user-defined and default policy settings on an OER master controller.

S through U

set active-probe

To configure an Optimized Edge Routing (OER) map active probe with a forced target assignment, use the **set active-probe** command in OER map configuration mode. To disable the active probe, use the **no** form of this command.

set active-probe *probe-type ip-address* [**target-port** *number*] [**codec** *codec-name*] [**dscp** *value*]

no set active-probe *probe-type ip-address*

Syntax Description

probe-type	Type of probe. Must be one of the following: • **echo** --Uses Internet Control Message Protocol (ICMP) echo (ping) messages. • **jitter** --Uses jitter messages. • **tcp-conn** --Uses TCP connection messages. • **udp-echo** --Uses User Datagram Protocol (UDP) echo messages.
ip-address	Target IP address of a prefix to be monitored using the specified type of probe.
target-port	(Not specified for echo probes.) Specifies the destination port number for the active probe. 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.
number	Port number in the range from 1 to 65535.
codec	(Optional) Only used with the jitter probe type. Specifies the codec value used for Mean Opinion Score (MOS) calculation.
codec-name	Codec value, 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

dscp	(Optional) Sets the Differentiated Services Code Point (DSCP) value.
value	DSCP value.

Command Default

No active probes are configured with a forced target assignment.

Command Modes

OER map configuration

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.
15.0(1)M	This command was modified. The **dscp** keyword and *value* argument were added.
12.2(33)SRE	This command was modified. The **dscp** keyword and *value* argument were added.

Usage Guidelines

Cisco IOS Release 15.0(1)M, 12.2(33)SRE, and Later Releases

If the optional **dscp** keyword and *value* argument are not specified, active probes are created using the DSCP value of the traffic class. For example, the software creates two sets of probes for the following three traffic classes. Traffic class 2 is assigned a probe with a DSCP value of "ef" and the other two traffic classes share a probe with a DSCP value of 0.

- Traffic class 1: 10.1.1.0/24, destination port 23
- Traffic class 2: 10.1.2.0/24, dscp ef
- Traffic class 3: 10.1.2.0/24, destination port 991

If the optional **dscp** keyword and *value* argument is provided, probes are created using the specified DSCP value. For example, if the DSCP value specified for the **set active-probe** command is "cs1", only one probe is created for the three traffic classes.

Examples

The following example shows how to configure an ICMP reply (ping) message probe with a forced target assignment within an OER map. The 10.1.2.10 address is the forced target assignment. A remote responder must also be enabled on the target device.

```
Router(config)# oer-map MAP1 10
Router(config-oer-map)# match ip prefix-list LIST1
Router(config-oer-map)# set active-probe echo 10.1.2.10
```

The following example shows how to configure a TCP connection message probe with a forced target assignment within an PfR map. The 10.1.2.10 address is the forced target assignment, the target port is defined as 29, and the DSCP value is set to ef. A remote responder must be enabled on the target device. This example requires Cisco IOS Release 15.0(1)M, 12.2(33)SRE, or a later release.

```
Router(config)# pfr-map MAP2 10
Router(config-pfr-map)# match ip prefix-list LISTMAP2
Router(config-pfr-map)# set active-probe tcp-conn 10.1.2.10 target-port 29 dscp ef
```

Related Commands

Command	Description
active-probe	Configures an OER active probe for a target prefix.
ip sla monitor responder	Enables the IP SLAs Responder for general IP SLAs operations.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
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.

set backoff

To configure an Optimized Edge Routing (OER) map to set the backoff timer to adjust the time period for prefix policy decisions, use the **set backoff** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

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

no set backoff

Syntax Description

min-timer	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	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) Tme period value 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 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 map 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 **set backoff** command is entered on a master controller in OER map configuration mode. This command is used to configure an OER map to set the transition period that the master controller holds an out-of-policy prefix. The master controller uses a backoff timer to schedule the prefix transition period in which OER holds the out-of-policy prefix before moving the prefix to an in-policy state by selecting an in-policy exit. This command is configured with a minimum and maximum timer value and can be configured with an optional step timer.

Minimum 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.

Maximum Timer --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.

Step Timer --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 creates an OER map named BACKOFF that sets the minimum timer to 400 seconds, the maximum timer to 4000 seconds, and the step timer to 400 seconds for traffic from the prefix list named CUSTOMER:

```
Router(config)# oer-map BACKOFF 70
Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set backoff 400 4000 400
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
periodic (OER)	Sets the backoff timer to adjust the time period for prefix policy decisions.

set delay

To configure an Optimized Edge Routing (OER) map to configure OER to set the delay threshold, use the **set delay** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

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

no set 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.
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.

Command Default

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

relative *percentage* : 500 (50 percent)

Command Modes

OER map 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 **set delay** command is entered on a master controller in OER map configuration mode. This command is configured in an OER map to set the delay threshold as a relative percentage or as an absolute value for match criteria.

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 time 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 long-term delay measurement 100 milliseconds and 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.

If the measured delay of the prefix is higher than the configured delay threshold, then the prefix is out-of-policy. If the short-term delay of the prefix is more than long-term delay by the percentage value configured, then the prefix is out-of-policy.

Examples

The following example creates an OER map named DELAY that sets the absolute maximum delay threshold to 2000 milliseconds for traffic from the prefix list named CUSTOMER:

```
Router(config)# oer-map DELAY 80
Router(config-oer-map)# match ip address prefix-list CUSTOMER

Router(config-oer-map)# set delay threshold 2000
```

Related Commands

Command	Description
delay	Configures configure prefix delay parameters.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

set holddown

To configure an OER map to set the prefix route dampening timer for the minimum period of time in which a new exit must be used before an alternate exit can be selected, use the **set holddown** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set holddown *timer*

no set holddown

Syntax Description

timer	Sets the prefix route dampening time period, in seconds. The range for this argument is from 90 to 65535. The default value is 300.

Command Default

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

timer : 300 seconds

Command Modes

OER map configuration (config-oer-map)

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 **set holddown** command is entered on a master controller in OER map configuration mode. This command is used to configure the prefix route dampening timer for the minimum period of time in which a new exit must be used before an alternate exit can be selected. The master controller puts a prefix in a holddown state during an exit change to isolate the prefix during the transition period, preventing the prefix from flapping because of rapid state changes. OER does not implement policy changes while a prefix is in the holddown state. A prefix will remain in a holddown state for the default or configured time period. When the holddown timer expires, OER will select the best exit based on performance and policy configuration. However, an immediate route change will be triggered if the current exit for a prefix becomes unreachable.

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 is reset.

Examples

The following example creates an OER map named HOLDDOWN that sets the holddown timer to 120 seconds for traffic from the prefix list named CUSTOMER:

```
Router(config)# oer-map HOLDDOWN 10
Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set holddown 120
```

Related Commands

Command	Description
holddown	Configures the prefix route dampening timer to set the minimum period of time that a new exit must be used before an alternate exit can be selected.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

set interface (OER)

To configure an Optimized Edge Routing (OER) map to send packets that match prefixes in an access list on OER border routers to the null interface, use the **set interface** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set interface null0

no set interface null0

Syntax Description

null0	Specifies that packets will be sent to the null interface, which means that the packets are discarded.

Command Default

No packets are send to the null interface.

Command Modes

OER map configuration

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.

Usage Guidelines

The **set interface** command is entered on a master controller in OER map configuration mode. This command can be used for OER black hole filtering if the border routers detect a denial-of-service (DoS) attack by directing packets to the null interface. The null interface is a virtual network interface that is similar to the loopback interface. Whereas traffic to the loopback interface is directed to the router itself, traffic sent to the null interface is discarded. This interface is always up and can never forward or receive traffic; encapsulation always fails. The null interface functions similarly to the null devices available on most operating systems. Null interfaces are used as a low-overhead method of discarding unnecessary network traffic.

Examples

The following example shows how to configure an OER map named BLACK_HOLE_MAP that directs packets to the null interface. To use this configuration for a DoS attack, leave the access list empty until an attack is detected and add the prefix or prefixes that are determined to be the source of the attack. Subsequent packets received from the specified prefix or prefixes will be discarded.

```
Router(config)# oer-map black-hole-map 10
Router(config-oer-map)# match ip address access-list black-hole-list
Router(config-oer-map)# set interface null0
```

Related Commands

Command	Description
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
set next-hop (OER)	Configures an OER map to send packets that match prefixes in an access list on OER border routers to the specified next hop.

set jitter

To configure an Optimized Edge Routing (OER) map to set the maximum jitter value that OER will permit for an exit link, use the **set jitter** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set jitter threshold *maximum*

no set jitter threshold *maximum*

Syntax Description

threshold	Specifies a maximum absolute threshold value for jitter. Jitter is a measure of voice quality.
maximum	Number (in milliseconds) in the range from 1 to 1000, where 1 represents the highest voice quality, and 1000 represents the lowest voice quality. The default value is 30.

Command Default

No jitter values are specified.

Command Modes

OER map configuration

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.

Usage Guidelines

The **set jitter** command is entered on a master controller in OER map configuration mode. This command is used to specify the maximum tolerable jitter value permitted on an exit link. Jitter is a measure of voice quality where the lower the jitter value, the higher the voice quality. If the jitter value is greater than the user-defined or the default value, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

Another measure of voice quality is the estimated Mean Opinion Score (MOS). Use the **set mos** command and the **set jitter** command in an OER map to define voice quality.

Examples

The following example shows how to configure an OER map named JITTER that sets the threshold jitter value. If the jitter threshold value exceeds 20 milliseconds, the master controller searches for a new exit link.

```
Router(config)# oer-map JITTER 10
Router(config-oer-map)# set jitter threshold 20
```

Related Commands

Command	Description
jitter	Specifies the threshold jitter value that OER will permit for an exit link.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
set mos	Configures an OER map to specify the threshold and percentage Mean Opinion Score (MOS) values that OER will permit for an exit link.

set link-group

To specify a link group for traffic classes defined in an Optimized Edge Routing (OER) policy, use the **set link-group** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set link-group *link-group-name* [**fallback** *link-group-name*]

no set link-group *link-group-name*

Syntax Description

link-group-name	Name of link group.
fallback	(Optional) Specifies a fallback link group to be used if the primary link group is out-of-policy (OOP).

Command Default

No link groups are specified for a traffic class.

Command Modes

OER map configuration (config-oer-map)

Command History

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

Usage Guidelines

The **set link-group** command is entered on a master controller in OER map configuration mode. This command is used to define a link group for the traffic class matched in an OER map.

Introduced in Cisco IOS Release 12.4(15)T, link groups are used to define a group of exit links as a preferred set of links or a fallback set of links for OER to use when optimizing traffic classes specified in an OER policy. Up to three link groups can be specified for each interface. Use the **link-group** command to define the link group for an interface and use the **set link-group** command to define the primary link group and a fallback link group for a specified traffic class in an OER map.

Use the **show oer master link-group** command to view information about configured OER link groups.

Examples

The following example shows how to configure an OER map named link_video_map that configures OER to create a traffic class that matches an access list named video_list. The traffic class is configured to use a link group named video as the primary link group, and a fallback group named voice. The video link group may be a set of high bandwidth links that are preferred for video traffic.

```
Router(config)# oer-map link_video_map 10
Router(config-oer-map)# match ip address access-list video_list
Router(config-oer-map)# set link-group video fallback voice
```

Related Commands

Command	Description
link-group	Configures an OER border router exit interface as a member of a link group.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
show oer master link-group	Displays information about OER link groups.

set loss

To configure an OER map to set the relative or maximum packet loss limit that OER will permit for an exit link, use the **set loss**command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set loss {**relative** *average*| **threshold** *maximum*}

no set loss

Syntax Description

relative *average*	Sets a relative percentage of packet loss based on a comparison of short-term and long-term packet loss 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.
threshold *maximum*	Sets absolute packet loss based on packets per million (PPM). The range of values that can be configured for this argument is from 1 to 1000000.

Command Default

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

relative *average* : 100 (10 percent)

Command Modes

OER map 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 **set loss** command is entered on a master controller in OER map configuration mode. This command is used to configure an OER map to set the relative percentage or maximum number of packets that OER will permit to be lost during transmission on an exit link. If packet loss is greater than the user-defined or the default value, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

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

Relative packet loss = ((short-term loss - long-term loss) / long-term loss) * 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 exit link is determined to be out-of-policy. For example, if long-term packet loss is 200 PPM and short-term packet loss is 300 PPM, the relative loss percentage is 50 percent.

The **threshold** keyword is used to configure the absolute maximum packet loss. The maximum value is based on the actual number of PPM that have been lost.

Examples

The following example creates an OER map named LOSS that sets the relative percentage of acceptable packet loss for traffic from the prefix list named CUSTOMER to a 20 percent relative percentage. If the packet loss on the current exit link exceeds 20 percent, the master controller will search for a new exit.

```
Router(config)# oer-map LOSS 10
Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set loss relative 200
```

Related Commands

Command	Description
loss	Sets the relative or maximum packet loss limit that OER will permit for an exit link.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

set mode

To configure an Optimized Edge Routing (OER) map to configure route monitoring, route control, or exit selection for matched traffic, use the **set mode** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set mode {**monitor** {**active [throughput]| both| fast| passive**}| **route** {**control| observe**}| **select-exit** {**best| good**}}

no set mode {**monitor| route** {**control| observe**}| **select-exit**}

Syntax Description

monitor	Enables the configuration of OER monitoring settings.
active	Enables active monitoring.
throughput	(Optional) Enables active monitoring with throughput data from passive monitoring.
both	Enables both active and passive monitoring.
fast	Enables continuous active monitoring and passive monitoring.
passive	Enables passive monitoring.
route	Enables the configuration of OER route control policy settings.
control	Enables automatic route control.
observe	Configures OER to passively monitor and report without making any changes.
select-exit	Enables the exit selection based on performance or policy.
best	Configures OER to select the best available exit based on performance or policy.
good	Configures OER to select the first exit that is in-policy.

Command Default

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

Monitoring: Both active and passive monitoring is enabled. Route control: Observe mode route control is enabled. Exit Selection: The first in-policy exit is selected.

Command Modes

OER map 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.
12.4(15)T	The **fast** and **throughput** keywords were added.

Usage Guidelines

The **set mode** command is entered on a master controller in OER map configuration mode. This command is used to configure an OER map to enable and configure control mode and observe mode settings, passive monitoring and active monitoring, and exit link selection for traffic that is configured as match criteria.

Observe Mode

Observe mode monitoring is enabled by default. In observe mode, the master controller monitors prefixes and exit links based on default and user-defined policies and then reports the status of the network and the decisions that should be made but does not implement any changes. This mode allows you to verify the effectiveness of this feature before it is actively deployed.

Control Mode

In control mode, the master controller coordinates information from the border routers and makes policy decisions just as it does in observe mode. The master controller monitors prefixes and exits based on default and user-defined policies but then implements changes to optimize prefixes and to select the best exit. In this mode, the master controller gathers performance statistics from the border routers and then transmits commands to the border routers to alter routing as necessary in the OER managed network.

Passive Monitoring

The master controller passively monitors IP prefixes and TCP traffic flows. Passive monitoring is configured on the master controller. Monitoring statistics are gathered on the border routers and then reported back to the master controller. OER uses NetFlow to collect and aggregate passive monitoring statistics on a per prefix basis. No explicit NetFlow configuration is required. NetFlow support is enabled by default when passive monitoring is enabled. OER uses passive monitoring to measure the following information:

Delay --OER measures the average delay of TCP flows for a prefix. Delay is the measurement of the time between the transmission of a TCP synchronization message and receipt of the TCP acknowledgement.

Packet Loss --OER measures packet loss by tracking TCP sequence numbers for each TCP flow. OER estimates packet loss by tracking the highest TCP sequence number. If a subsequent packet is received with a lower sequence number, OER increments the packet loss counter.

Reachability --OER measures reachability by tracking TCP synchronization messages that have been sent repeatedly without receiving a TCP acknowledgement.

Throughput --OER measures outbound throughput for optimized prefixes. Throughput is measured in bits per second (bps).

Note OER passively monitors TCP traffic flows for IP traffic. Passive monitoring of non-TCP sessions is not supported.

Active Monitoring

OER uses Cisco IOS IP Service Level Agreements (SLAs) to enable active monitoring. IP SLAs support is enabled by default. IP SLAs support allows OER to be configured to send active probes to target IP addresses to measure the jitter and delay, determining if a prefix is out-of-policy and if the best exit is selected. The border router collects these performance statistics from the active probe and transmits this information to the master controller. The master controller uses this information to optimize the prefix and select the best available exit based on default and user-defined policies. The **active-probe** command is used to create an active probe.

In Cisco IOS Release 12.4(15)T the **throughput** keyword was added to enable the throughput data from passive mode monitoring to be considered when optimizing UDP traffic for both performance and load-balancing. UDP traffic can be optimized only for performance (for example, delay, jitter, and loss) when active monitoring data is available. To enable load-balancing of UDP traffic, throughput data from passive monitoring is required.

Fast Failover Monitoring

In Cisco IOS Release 12.4(15)T, a new monitoring mode, fast monitoring, was introduced. Fast monitoring sets the active probes to continuously monitor all the exits (probe-all), and passive monitoring is enabled too. Fast failover monitoring can be used with all types of active probes: ICMP echo, Jitter, TCP connection, and UDP echo. When the **mode monitor fast** command is enabled, the probe frequency can be set to a lower frequency than for other monitoring modes, to allow a faster failover ability. Under fast monitoring with a lower probe frequency, route changes can be performed within 3 seconds of an out-of-policy situation. When an exit becomes OOP under fast monitoring, the select best exit is operational and the routes from the OOP exit are moved to the best in-policy exit. Fast monitoring is a very aggressive mode that incurs a lot of overhead with the continuous probing. We recommend that you use fast monitoring only for performance sensitive traffic.

Optimal Exit Link Selection

The master controller can be configured to select a new exit for an out-of-policy prefix based on performance or policy. You can configure the master controller to select the first in-policy exit by entering the **good** keyword, or you can configure the master controller to select the best exit with the **best** keyword. If the **good** keyword is used and there is no in-policy exit, the prefix is uncontrolled.

Examples

The following example creates an OER map named OBSERVE that configures OER to observe and report but not control traffic from the prefix list named CUSTOMER:

```
Router(config)# oer-map OBSERVE 80

Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set mode route observe
```

Related Commands

Command	Description
mode (OER)	Configures route monitoring or route control on an OER master controller

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

set mos

To configure an Optimized Edge Routing (OER) map to set the threshold and percentage Mean Opinion Score (MOS) values that OER) will permit for an exit link, use the **set mos** command in OER map configuration mode. To reset the threshold MOS values to their default value, use the **no** form of this command.

set mos threshold *minimum* **percentage** *percent*

no set mos threshold *minimum* **percentage** *percent*

Syntax Description

threshold	Specifies a threshold MOS value that represents a minimum voice quality for exit link utilization.
minimum	Number (to two decimal places) in the range from 1.00 to 5.00. The number 1.00 represents the lowest voice quality, and the number 5.00 represents the highest voice quality. The default MOS value is 3.60.
percentage	Specifies a percentage value that is compared with the percentage of MOS samples that are below the MOS threshold.
percent	Number, as a percentage.

Command Default

The default MOS value is 3.60.

Command Modes

OER map configuration

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.

Usage Guidelines

The **set mos** command is entered on a master controller in OER map configuration mode and used to determine voice quality. The number of MOS samples over a period of time that are below the threshold MOS value are calculated. If the percentage of MOS samples below the threshold is greater than the configured percentage, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

Another measure of voice quality is the jitter value. Use the **set mos** command and the **set jitter** command in an OER map to define voice quality.

Examples

The following example creates an OER map named MOS that configures the master controller to search for a new exit link if more than 30 percent of the MOS samples are below the MOS threshold of 3.80.

```
Router(config)# oer-map MOS 10
Router(config-oer-map)# match ip address prefix-list LIST1
Router(config-oer-map)# set mos threshold 3.80 percent 30
```

Related Commands

Command	Description
mos	Configures the maximum mos value that OER will permit for an exit link.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

set next-hop (OER)

To configure an Optimized Edge Routing (OER) map to send packets that match prefixes in an access list on OER border routers to the specified next hop, use the **set next-hop** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set next-hop *ip-address*

no set next-hop *ip-address*

Syntax Description

ip-address	IP address of the next hop to which the packets will be sent.

Command Default

No packets are sent to the next hop.

Command Modes

OER map configuration

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.

Usage Guidelines

This command can be used for OER sinkhole filtering if the border routers detect a denial-of-service (DoS) attack by directing packets to the specified next hop. The packets may be saved, analyzed, or discarded at the next hop.

Examples

The following example shows how to configure an OER map named SINKHOLE_MAP that directs packets to the specified next hop. Use this configuration in preparation for a DoS attack, leave the access list empty until an attack is detected and add the prefix or prefixes that are determined to be the source of the attack. Subsequent packets received from the specified prefix or prefixes will be sent to the specified next hop.

```
Router(config)# oer-map SINKHOLE_MAP 10
Router(config-oer-map)# match ip address access-list SINKHOLE-LIST
Router(config-oer-map)# set next-hop 10.20.24.3
```

Related Commands

Command	Description
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

Command	Description
set interface	Configures an OER map to send packets that match prefixes in an access list on OER border routers to the null interface.

set periodic

To configure an Optimized Edge Routing (OER) map to set the time period for the periodic timer, use the **set periodic** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set periodic *timer*

no set periodic

Syntax Description

timer	Length of time set for the periodic timer, in seconds. The value for the timer argument is from 180 to 7200.

Command Default

No default behavior or values

Command Modes

OER map 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 **set periodic**command is entered on a master controller in OER map configuration mode. This command is used to configure an OER map to configure OER to periodically select the best exit based on the periodic timer value for traffic that is configured as match criteria in an OER map. When this timer expires, OER will automatically select the best exit, regardless if the current exit is in-policy or out-of-policy. The periodic timer is reset when the new exit is selected.

Examples

The following example creates an OER map named PERIODIC that sets the periodic timer to 300 seconds for traffic from the prefix list named CUSTOMER. When the timer expires, OER will select the best exit.

```
Router(config)# oer-map PERIODIC 80

Router(config-oer-map)# match ip address prefix-list CUSTOMER
Router(config-oer-map)# set periodic 300
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
periodic (OER)	Configures OER to periodically select the best exit.

set probe

To set the frequency of an Optimized Edge Routing (OER) active probe, use the **set probe** command in OER map configuration mode. To reset the frequency of an OER active probe to its default value, use the **no** form of this command.

set probe {**frequency** *seconds*| **packets** *packet-count*}

no set probe {**frequency** *seconds*| **packets** *packet-count*}

Syntax Description

frequency	Sets the frequency of an active probe.
seconds	Number of seconds in the range from 4 to 60. The default is 60.
packets	Specifies the number of probe packets for a jitter probe.
packet-count	Number of probe packets in the range from 1 to 255. The default is 100.

Command Default

The default active probe frequency is 60 seconds.

The default number of packets probe is 100.

Command Modes

OER map configuration (config-oer-map)

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 minimum number of seconds was lowered from 4 seconds to 2 second to support the fast failover monitoring mode.
12.4(24)T	This command was modified. The **packets** keyword and the *packet-count* argument were added.

Usage Guidelines

The **set probe** command is entered on a master controller in OER map configuration mode. This command is used within an OER map configuration to set the frequency of the active probes. Unless the default frequency of 60 seconds is used, configuring the **set probe** command will increase the frequency of the probes. Increased probe frequency results in a lower response time of OER. The frequency can be increased for a number of policies, but if all active probes are set to an increased frequency, an Intrusion Detection Service (IDS) may be triggered.

In Cisco IOS Release 12.4(15)T, a new monitoring mode, fast monitoring, was introduced. Fast monitoring sets the active probes to continuously monitor all the exits (probe-all), and passive monitoring is enabled too. Fast failover monitoring can be used with all types of active probes: ICMP echo, Jitter, TCP connection, and UDP echo. When the **set mode monitor fast** command is enabled, the probe frequency can be set to a lower frequency than for other monitoring modes, to allow a faster failover ability. The minimum number of seconds was lowered from 4 seconds to 2 second to support the fast failover monitoring mode. Under fast monitoring with a lower probe frequency, route changes can be performed within 3 seconds of an out-of-policy situation.

n Cisco IOS Release 12.4(24)T, the ability to configure the number of probe packets for jitter probes was introduced. Using the **packets** keyword and the *packet-count* argument the number of packets per jitter probe can be set. The new keyword is supported under OER map configuration mode only, not at a global level. The new keyword applies only to jitter probes and the configuration affects global probes and forced probes for all traffic classes.

Examples

The following example shows how to set the frequency of an active probe to be 10 seconds using an OER map named PROBE:

```
Router(config)# oer-map PROBE 10
Router(config-oer-map)# set probe frequency 10
```

The following example shows how to set the frequency of an active probe to be 2 seconds using an OER map named FAST after the fast failover monitoring mode is enabled:

```
Router(config)# oer-map FAST 10
Router(config-oer-map)# set mode monitor fast
Router(config-oer-map)# set probe frequency 2
```

The following example shows how to set the number of probe packets for a jitter probe at 33 packets using an OER map named JITTER:

```
Router(config)# oer-map JITTER
Router(config-oer-map)# set probe packets 33
```

Related Commands

Command	Description
active-probe	Configures an OER active probe for a target prefix.
set mode (OER)	Configures an OER map to configure route monitoring, route control, or exit selection for matched traffic.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

set resolve

To configure an OER map to set policy priority for overlapping policies, use the **set resolve** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set resolve {**cost priority** *value*| **delay priority** *value* **variance** *percentage*| **jitter priority** *value* **variance** *percentage*| **loss priority** *value* **variance** *percentage*| **mos priority** *value* **variance** *percentage*| **range priority** *value*| **utilization priority** *value* **variance** *percentage*}

no set resolve {**cost**| **delay**| **jitter**| **loss**| **mos**| **range**| **utilization**}

Syntax Description

cost	Specifies policy priority settings for cost optimization.
delay	Specifies policy priority settings for packet delay.
jitter	Specifies policy priority settings for jitter.
loss	Specifies policy priority settings for packet loss.
mos	Specifies policy priority settings for Mean Opinion Score (MOS).
range	Specifies policy priority settings for range.
utilization	Specifies policy priority settings for exit link utilization.
priority *value*	Sets the priority of the policy. The configurable range for this argument is from 1 to 10. The number 1 has the highest priority, and the number 10 has the lowest priority.
variance *percentage*	Sets the allowable variance for the policy, as a percentage. The configurable range of this argument is from 1 to 100.

Command Default

None

Command Modes

OER map configuration

Command History

Release	Modification
12.3(8)T	This command was introduced.

Release	Modification
12.4(6)T	The **jitter** and **mos** keywords were added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **set resolve**command is entered on a master controller in OER map configuration mode. This command is used to set priority when multiple policies are configured for the same prefix. When this command is configured, the policy with the highest priority will be selected to determine the policy decision.

The **priority** keyword is used to specify the priority value. The number 1 assigns the highest priority to the policy. The number 10 sets the lowest priority. Each policy must be assigned a different priority number. If you try to assign the same priority number to two different policy types, an error message will be displayed on the console.

The **variance** keyword is used to set an allowable variance for a user-defined policy. This keyword configures the allowable percentage that an exit link or prefix can vary from the user-defined policy value and still be considered equivalent. For example, if exit link delay is set to 80 percent and a 10 percent variance is configured, exit links that delay values from 80 to 89 percent will be considered equal.

Note Variance cannot be set for cost or range policies.

Examples

The following example creates an OER map named RESOLVE that sets the priority for delay policies to 1 for traffic learned based on highest outbound throughput. The variance is set to allow a 10 percent difference in delay statistics before a prefix is determined to be out-of-policy.

```
Router(config)# oer-map RESOLVE 10

Router(config-oer-map)# match oer learn throughput
Router(config-oer-map)# set resolve delay priority 1 variance 10
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
resolve	Sets the priority of a policy when multiple overlapping policies are configured.

set traceroute reporting

To configure an Optimized Edge Routing (OER) map to enable traceroute reporting, use the **set traceroute reporting** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set traceroute reporting [**policy** {**delay**| **loss**| **unreachable**}]

no set traceroute reporting [**policy** {**delay**| **loss**| **unreachable**}]

Syntax Description

policy	(Optional) Configures policy-based traceroute reporting.
delay	(Optional) Configures traceroute reporting based on delay policies.
loss	(Optional) Configures traceroute reporting based on packet loss policies.
unreachable	(Optional) Configures traceroute reporting based on reachability policies.

Command Default

Traceroute reporting is not enabled using an OER map.

Command Modes

OER map 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 **set traceroute reporting** command is entered on a master controller in OER map configuration mode. This command is used to enable continuous and policy-based traceroute probing. Traceroute probing allows you to monitor prefix performance on a hop-by-hop basis. Delay, loss, and reachability measurements are gathered for each hop from the probe source to the target prefix.

The following types of traceroute reporting are configured with this command:

Continuous --A traceroute probe is triggered for each new probe cycle. Entering this command without any keywords enables continuous reporting. The probe is sourced from the current exit of the prefix.

Policy based --A traceroute probe is triggered automatically when a prefix goes into an out-of-policy state. Entering this command with the **policy** keyword enables policy based traceroute reporting. Policy based traceroute probes are configured individually for delay, loss, and reachability policies. The monitored prefix is sourced from a match clause in an OER map. Policy based traceroute reporting stops when the prefix returns to an in-policy state.

The **show oer master prefix** command is used to display traceroute probe results. An on-demand traceroute probe can be initiated when entering the **show oer master prefix** command with the **current** and **now** keywords. The **set traceroute reporting** command does not have to be configured to initiate an on-demand traceroute probe.

Examples

The following example, starting in global configuration mode, enables continuous traceroute probing for prefixes that are learned based on delay:

```
Router(config)# oer-map TRACE 10
Router(config-oer-map)# match oer learn delay

Router(config-oer-map)# set traceroute reporting
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.
show oer master prefix	Displays the status of monitored prefixes.
traceroute probe-delay	Sets the time interval between traceroute probe cycles.

set unreachable

To configure an OER map to set the maximum number of unreachable hosts, use the **set unreachable** command in OER map configuration mode. To delete the set clause entry, use the **no** form of this command.

set unreachable {**relative** *average*| **threshold** *maximum*}

no set unreachable

Syntax Description

relative *average*	Sets a relative percentage of unreachable hosts based on a comparison of short-term and long-term percentages. The range of values that can be configured for this argument is a number from 1 to a 1000. Each increment represents one tenth of a percent.
threshold *maximum*	Sets the absolute maximum number of unreachable hosts based on flows per million (fpm). The range of values that can be configured for this argument is from 1 to 1000000.

Command Default

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

relative *average* : 50 (5 percent)

Command Modes

OER map 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 **set unreachable** command is entered on a master controller in OER map configuration mode. This command is used to set the relative percentage or the absolute maximum number of unreachable hosts, based on flows per million, that OER will permit from an OER managed exit link. If the absolute number or relative percentage of unreachable hosts is greater than the user-defined or the default value, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

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

Relative percentage of unreachable hosts = ((short-term percentage - long-term percentage) / long-term percentage) * 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 exit link is determined to be out-of-policy. For example, if 10 hosts are unreachable during the long-term measurement and 12 hosts are unreachable during short-term measurement, the relative percentage of unreachable hosts is 20 percent.

The t**hreshold** keyword is used to configure the absolute maximum number of unreachable hosts. The maximum value is based on the actual number of hosts that are unreachable based on fpm.

Examples

The following example creates an OER map named UNREACHABLE that configures the master controller to search for a new exit link when the difference between long and short term measurements (relative percentage) is greater than 10 percent for traffic learned based on highest delay:

```
Router(config)# oer-map UNREACHABLE 10
Router(config-oer-map)# match oer learn delay
Router(config-oer-map)# set unreachable relative 100
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
oer-map	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes.

show oer api client

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **show oer api client** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

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

To display information about Optimized Edge Routing (OER) application interface clients, use the **show oer api client** command in privileged EXEC mode.

show oer api client [detail]

Syntax Description

detail	(Optional) Displays detailed prefix information about the specified prefix or all prefixes.

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 **show oer api client** command is replaced by the **show oer api provider** 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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer api client** command is entered on a master controller. This command is used to display the number of prefixes added by the application interface client, the sequence numbers of policies added by the application interface client, and the client ID. The **detail** keyword is used to display more detailed information about the application interface client.

Cisco IOS Release 12.4(15)T

In Cisco IOS Release 12.4(15)T and later releases, the **show oer api client** command is replaced by the **show oer api provider** command. The **show 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 shows the status of a monitored prefix:

```
Router# show oer api client
OER Prefix Stats:
  Dly: Delay in ms
  EBw: Egress Bandwidth
  IBw: Ingress Bandwidth
Prefix      State     Curr BR   CurrI/F  Dly   EBw   IBw
----------------------------------------------------------
10.1.5.0/24 INPOLICY  10.1.1.2  Et1/0     19     1     1
```

The table below describes the significant fields shown in the display.

Table 23: show oer api client Field Descriptions

Field	Description
Prefix	IP address and prefix length.
State	Status of the prefix.
Curr BR	Border router from which these statistics were gathered.
Curr I/F	Current exit link interface on the border router.
Dly	Delay in milliseconds.
EBw	Egress bandwidth.
IBw	Ingress bandwidth.

The following output shows the detailed status of a monitored prefix:

```
Router# show oer api client detail

Prefix: 10.1.1.0/26
   State: DEFAULT*      Time Remaining: @7
   Policy: Default
   Most recent data per exit
   Border          Interface           PasSDly  PasLDly  ActSDly  ActLDly
  *10.2.1.1        Et1/0                   181      181      250      250
   10.2.1.2        Et2/0                     0        0      351      351
   10.3.1.2        Et3/0                     0        0       94      943
   Latest Active Stats on Current Exit:
   Type     Target          TPort Attem Comps      DSum     Min     Max     Dly
   echo     10.1.1.1            N     2     2       448     208     240     224
   echo     10.1.1.2            N     2     2       488     228     260     244
   echo     10.1.1.3            N     2     2       568     268     300     284
```

```
Prefix performance history records
 Current index 2, S_avg interval(min) 5, L_avg interval(min) 60
Age       Border          Interface       OOP/RteChg Reasons
Pas: DSum  Samples  DAvg  PktLoss Unreach    Ebytes    Ibytes      Pkts   Flows
Act: Dsum Attempts  DAvg    Comps Unreach
00:00:03  10.1.1.1        Et1/0
        0        0     0        0       0         0         0         0       0
     1504        6   250        6       0
```

The table below describes the significant fields shown in the display.

Table 24: show oer api client detail Field Descriptions

Field	Description
Prefix	IP address and prefix length.
State	Status of the prefix.
Time Remaining	Time remaining in the current prefix learning cycle.
Policy	The state that the prefix is in. Possible values are Default, In-policy, Out-of-policy, Choose, and Holddown.
Most recent data per exit	Border router exit link statistics for the specified prefix. The asterisk (*) character indicates the exit that is being used.
Latest Active Stats on Current Exit	Active probe statistics. This field includes information about the probe type, target IP address, port number, and delay statistics.
Type	The type of active probe. Possible types are ICMP echo, TCP connect, or UDP echo. The example uses default ICMP echo probes (default TCP), so no port number is displayed.
Prefix performance history records	Displays border router historical statistics. These statistics are updated about once a minute and stored for 1 hour.

Related Commands

Command	Description
api client	Configures an OER application interface client.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

show oer api provider

To display information about application interface providers registered with Optimized Edge Routing (OER), use the **show oer api provider** command in privileged EXEC mode.

show oer api provider [detail]

Syntax Description

detail	(Optional) Displays detailed information about application interface providers.

Command Default

Detailed information about API providers is not displayed.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer api provider** command is entered on a master controller. This command is used to display application interface provider and host information including the ID of each configured provider, the priority of the provider and the host (if configured), and the IP addresses of each configured host device. The **detail**keyword is used to display more detailed information.

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.

Examples

The following example shows information about configured application interface providers and host devices:

```
Router# show oer api provider
API Version: Major 2, Minor 0
  Provider id 1, priority 4000
   Host ip 172.17.1.1, priority 4001
   Host ip 10.1.2.2, priority 3001
  Provider id 2, priority 20
  Provider id 3, priority 10
```

The table below describes the significant fields shown in the display.

Table 25: show oer api provider Field Descriptions

Field	Description
API Version, Major, Minor	Version number of the application interface with major and minor releases.
Provider id	ID number of an application interface provider.
priority	The priority assigned to the policies of a provider or of a host
Host ip	IP address of a host device.

The following example shows detailed information about configured application interface providers and host devices:

```
Router# show oer api provider detail
API Version: Major 2, Minor 0
  Provider id 1001, priority 65535
   Host ip 10.3.3.3, priority 65535
    Session id 9, Version Major 2, Minor 0
    Num pfx created 2, Num policies created 2
    Last active connection time (sec) 00:00:01
    Policy ids : 101, 102,
   Host ip 10.3.3.4, priority 65535
    Session id 10, Version Major 2, Minor 0
    Num pfx created 1, Num policies created 1
    Last active connection time (sec) 00:00:03
    Policy ids : 103,
  Provider id 2001, priority 65535
   Host ip 172.19.198.57, priority 65535
    Session id 11, Version Major 2, Minor 0
    Num pfx created 0, Num policies created 0
    All Prefix report enabled
    All exit report enabled
```

The table below describes the significant fields shown in the display that are different from the table above.

Table 26: show oer api provider detail Field Descriptions

Field	Description
Session id	Session ID automatically allocated by OER when an application interface provider initiates a session.
Num pfx	Number of traffic classes created by the application interface provider application.
Num policies created	Number of policies dynamically created by the application interface provider application.
Last active connection time	Time, in seconds, since the last active connection from the application interface provider.

Field	Description
Policy ids	IDs assigned to each policy dynamically created by the application interface provider application.
All Prefix report enabled	Traffic class reports from the OER master controller are enabled for the application interface provider.
All exit report enabled	Exit link reports from the OER master controller are enabled for the application interface provider.

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.
debug oer api provider	Displays OER application interface debugging information.
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 border

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **show oer border** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display information about an Optimized Edge Routing (OER) border router connection and OER controlled interfaces, use the **show oer border** command in privileged EXEC mode.

show oer border

Syntax Description

This command has no arguments or keywords.

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border** command is entered on an OER border router. The output displays information about the border router, the status of the master controller connection, and border router interfaces.

Examples

The following example shows the status of a border router:

```
Router# show oer border
OER BR 10.1.1.3 ACTIVE, MC 10.1.1.1 UP/DOWN: UP 00:57:55,
  Auth Failures: 0
  Conn Status: SUCCESS, PORT: 3949
  Exits
  Et0/0           INTERNAL
  Et1/0           EXTERNAL
```

The table below describes the significant fields shown in the display.

Table 27: show oer border Field Descriptions

Field	Description
OER BR	Displays the IP address and the status of the local border router (ACTIVE or DISABLED).
MC	Displays the IP address of the master controller, the connection status (UP or DOWN), the length of time that connection with master controller has been active, and the number of authentication failures that have occurred between the border router and master controller.
Exits	Displays OER managed exit interfaces on the border router. This field displays the interface type, number, and OER status (EXTERNAL or INTERNAL).
Auth Failures	Displays the number of authentication failures.
Conn Status	Displays the connection status. This field displays "SUCCESS" or "FAILED".
PORT	Displays the TCP port number used to communicate with the master controller.

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 active-probes

Note Effective with Cisco IOS Release 15.0(1)SY, the **show oer border active-probes** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display connection status and information about active probes on an Optimized Edge Routing (OER) border router, use the **show oer border active-probes**command in privileged EXEC mode.

show oer border active-probes

Syntax Description

This command has no arguments or keywords.

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border active-probes** command is entered on a border router. This command displays the target active-probe assignment for a given prefix and the current probing status, including the border router or border routers that are executing the active probes.

Examples

The following example shows three active probes, each configured for a different prefix. The target port, source IP address, and exit interface are displayed in the output.

```
Router# show oer border active-probes
        OER Border active-probes
Type      = Probe Type
Target    = Target IP Address
TPort     = Target Port
Source    = Send From Source IP Address
Interface = Exit interface
Att       = Number of Attempts
Comps   = Number of completions
```

```
N - Not applicable
Type     Target          TPort Source          Interface          Att   Comps
udp-echo 10.4.5.1           80 10.0.0.1        Et1/0                1       0
tcp-conn 10.4.7.1           33 10.0.0.1        Et1/0                1       0
echo     10.4.9.1            N 10.0.0.1        Et1/0                2       2
```

The table below describes the significant fields shown in the display.

Table 28: show oer border active-probes Field Descriptions

Field	Description
Type	The active probe type.
Target	The target IP address.
TPort	The target port.
Source	The source IP address.
Interface	The OER managed exit interface.
ATT	The number of attempts.
Comps	The number successfully completed attempts.

Related Commands

Command	Description
active-probe	Configures active probes to monitor an OER controlled prefixes.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

show oer border defined application

To display information about user-defined applications used in Optimized Edge Routing (OER), use the **show oer border defined application** command in privileged EXEC mode.

show oer border defined application

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer border defined application**command is entered on an OER border router. This command displays all user-defined applications that are defined on the master controller. To define a custom application to be used by OER, use the **application define** command on the OER master controller.

To display the same information on the OER master controller, use the **show oer master defined application**command.

Examples

The following partial output shows information about the user-defined application definitions configured for use with OER:

```
Router# show oer border defined application
OER Defined Applications:
Name                    Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
--------------------------------------------------------------------------------
telnet                        1 defa  tcp       23-23     1-65535 0.0.0.0/0
telnet                        1 defa  tcp     1-65535       23-23 0.0.0.0/0
ftp                           2 defa  tcp       21-21     1-65535 0.0.0.0/0
ftp                           2 defa  tcp     1-65535       21-21 0.0.0.0/0
cuseeme                       4 defa  tcp   7648-7648     1-65535 0.0.0.0/0
cuseeme                       4 defa  tcp   7649-7649     1-65535 0.0.0.0/0
dhcp                          5 defa  udp       68-68       67-67 0.0.0.0/0
dns                           6 defa  tcp       53-53     1-65535 0.0.0.0/0
dns                           6 defa  tcp     1-65535       53-53 0.0.0.0/0
dns                           6 defa  udp       53-53     1-65535 0.0.0.0/0
dns                           6 defa  udp     1-65535       53-53 0.0.0.0/0
finger                        7 defa  tcp       79-79     1-65535 0.0.0.0/0
finger                        7 defa  tcp     1-65535       79-79 0.0.0.0/0
gopher                        8 defa  tcp       70-70     1-65535 0.0.0.0/0
.
.
.
```

The table below describes the significant fields shown in the display.

Table 29: show oer border defined application Field Descriptions

Field	Description
Name	Application Name
Appl_ID	Application ID
Dscp	Differentiated Services Code Point (DSCP) value
Prot	Protocol
SrcPort	Source port number for the traffic class
DstPort	Destination port number for the traffic class
SrcPrefix	IP address of the traffic class source

Related Commands

Command	Description
application define	Defines a user-defined application to be monitored by OER.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show oer master defined application	Displays information about user-defined application definitions used in OER.

show oer border passive applications

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **show oer border passive applications** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display the list of application traffic classes monitored by Optimized Edge Routing (OER), use the **show oer border passive applications** command in privileged EXEC mode.

show oer border passive applications

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

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.
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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border passive applications** command is entered on a border router. This command displays a list of application traffic classes monitored by the border router using NetFlow passive monitoring.

Examples

The following example displays an application traffic class monitored by a border router:

```
Router# show oer border passive applications
OER Passive monitored Appl:
 + - monitor more specific
 Prefix         /Mask  Prot  Dscp   SrcPort          DstPort         Appl_ID
10.1.3.0        /24     17     ef   [1, 65535]       [3000, 4000]     1
```

The table below describes the significant fields shown in the display.

Table 30: show oer border passive applications Field Descriptions

Field	Description
Prefix	IP address.
/Mask	Prefix length.
Prot	Application protocol number.
Dscp	Differentiated Services Code Point (DSCP) value.
SrcPort	Source application port number, a single port number, or a range of port numbers.
DstPort	The destination application port, a single port number, or a range of port numbers.
Appl_ID	Unique ID that identifies an application traffic class.

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 passive cache

Note Effective with Cisco IOS Release 15.0(1)SY, the **show oer border passive cache** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display passive measurement information collected by NetFlow for Optimized Edge Routing (OER) monitored prefixes and traffic flows, use the **show oer border passive cache** command in privileged EXEC mode.

show oer border passive cache learned [**application**| **traffic-class**]

Syntax Description

learned	Displays measurement information about monitored learned prefixes.
application	(Optional) Displays measurement information about monitored learned prefixes for an application traffic class.
traffic-class	(Optional) Displays flow cache information about monitored learned prefixes for an OER traffic class.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(9)T	The **applications** and **application** keywords were added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T	The **traffic-class** keyword was added.
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.
15.0(1)M	This command was modified. The **applications**and **prefix** keywords were removed.

Release	Modification
12.2(33)SRE	This command was modified. The **applications**and **prefix** keywords were removed.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border passive cache** command is entered on a border router. This command displays real-time prefix information collected from the border router through NetFlow passive monitoring.

Entering the **learned** keyword displays learned prefixes. A maximum of five host addresses and five ports are collected for each prefix. The output will also show the throughput in bytes and the delay in milliseconds. If the **application** keyword is entered, the output displays information about learned prefixes that match other application criteria such as Differentiated Services Code Point (DSCP) value, protocol, or port number. The **traffic-class** keyword when used with the **learned** keyword displays cache information about monitored learned prefixes for an OER traffic class.

Examples

The following example displays passive monitoring information about learned prefixes:

```
Router# show oer border passive cache learned
 OER Learn Cache:
    State is enabled
    Measurement type: throughput, Duration: 2 min
    Aggregation type: prefix-length, Prefix length: 24
    4096 oer-flows per chunk,
    22 chunks allocated, 32 max chunks,
    1 allocated records, 90111 free records, 8913408 bytes allocated
Prefix         Mask     Pkts  B/Pk  Delay Samples   Active
Host1          Host2          Host3          Host4          Host5
dport1         dport2         dport3         dport4         dport5
10.1.5.0        /24      17K    46    300      2     45.1
10.1.5.2       10.1.5.3       0.0.0.0        0.0.0.0        0.0.0.0
1024           80             0              0              0
```

The table below describes the significant fields shown in the display.

Table 31: show oer border passive cache learned Field Descriptions

Field	Description
State is...	Displays OER prefix learning status. The output displays enabled or disabled.
Measurement type	Displays how the prefix is learned. The output displays throughput, delay, or both throughput and delay.
Duration	Displays the duration of the learning period in minutes.
Aggregation type	Displays the aggregation type. The output displays BGP, non-BGP, or prefix-length.

Field	Description
... oer-flows per chunk	Displays number of flow records per memory chunk.
... chunks allocated	Number of memory chunks allocated.
... allocated records	Number of records currently allocated in the learn cache.
Prefix	IP address and port of the learned prefix.
Mask	The prefix length as specified in a prefix mask.
Pkts B/Pk	The number of packets and bytes per packet.
Delay Samples	The number of delay samples that NetFlow has collected.
Active	The time for which the flow has been active.

The following example uses the **learned** and **application** keywords to display measurement information about monitored application traffic classes that have been learned by OER. In this example for voice traffic, the voice application traffic is identified by the User Datagram Protocol (UDP) protocol, a DSCP value of ef, and port numbers in the range from 3000 to 4000.

```
Router# show oer border passive cache learned application
OER Learn Cache:
    State is enabled
    Measurement type: throughput, Duration: 2 min
    Aggregation type: prefix-length, Prefix length: 24
    4096 oer-flows per chunk,
    8 chunks allocated, 32 max chunks,
    5 allocated records, 32763 free records, 4588032 bytes allocated
Prefix         Mask     Pkts  B/Pk  Delay Samples   Active
Prot  Dscp  SrcPort          DstPort
Host1          Host2          Host3          Host4          Host5
dport1         dport2         dport3         dport4         dport5
10.1.3.0        /24     873     28      0      0      13.3
17      ef [1, 65535]       [3000, 4000]
10.1.3.1       0.0.0.0        0.0.0.0        0.0.0.0        0.0.0.0
3500            0              0              0              0
10.1.1.0        /24    7674     28      0      0      13.4
17      ef [1, 65535]       [3000, 4000]
10.1.1.1       0.0.0.0        0.0.0.0        0.0.0.0        0.0.0.0
3600            0              0              0              0
```

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 passive learn

Note Effective with Cisco IOS Release 15.0(1)SY, the **show oer border passive learn** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display the configured, learned parameters to be used with passive measurement information collected by NetFlow for Optimized Edge Routing (OER) learned traffic flows, use the **show oer border passive learn** command in privileged EXEC mode.

show oer border passive learn

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC (#)

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.
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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border passive learn** command is entered on a border router. This command displays configured parameters including filter and aggregate application information collected from the border router through NetFlow passive monitoring.

Examples

The following example displays passive monitoring information about learned traffic flows:

```
Router# show oer border passive learn
OER Border Learn Configuration :
    State is enabled
    Measurement type: throughput, Duration: 2 min
    Aggregation type: prefix-length, Prefix length: 24
    No port protocol config
 Traffic Class Filter List:
   List: SrcPrefix       SrcMask DstPrefix       DstMask
         Prot  DSCP  sport_opr sport_range    dport_opr dport_range     Grant
```

```
      1: 0.0.0.0         0       10.1.0.0        16
         17      ef  0         [1, 65535]      0        [1, 65535]      Permit
 Traffic Class Aggregate List:
   List: Prot  DSCP  sport_opr sport_range    dport_opr dport_range     Grant
      1: 17      ef  0         [1, 65535]      7        [3000, 4000]    Permit
 Keys:  protocol dscp DstPort
```

The table below describes the significant fields shown in the display.

Table 32: show oer border passive applications Field Descriptions

Field	Description
State is	Displays OER prefix learning status. The output displays enabled or disabled.
Measurement type	Displays how the prefix is learned. The output displays either throughput or delay.
Duration	Displays the duration of the learning period in minutes.
Aggregation type	Displays the aggregation type. The output displays BGP, non-BGP, or prefix-length.
No port protocol config	Indicates that no port protocol has been configured.
Traffic Class Filter List	Section showing the traffic class filter parameters.
Traffic Class Aggregate List	Section showing the traffic class aggregation parameters.
Keys	Parameters contained in the key list.

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 passive prefixes

Note Effective with Cisco IOS Release 15.0(1)SY, the **show oer border passive prefixes** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display information about passive monitored prefixes, use the **show oer border passive prefixes** command in Privileged EXEC mode.

show oer border passive prefixes

Syntax Description

This command has no arguments or keywords.

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border passive prefixes** command is entered on a border router. The output of this command displays prefixes monitored by NetFlow on the border router. The prefixes displayed in the output are monitored by the master controller.

Examples

The following example shows a prefix that is passively monitored by NetFlow:

```
Router# show oer border passive prefixes

OER Passive monitored prefixes:
Prefix         Mask   Match Type
10.1.5.0       /24     exact
```

The table below describes the significant fields shown in the display.

Table 33: show oer border passive prefixes Field Descriptions

Field	Description
Prefix	IP address of the learned prefix.
Mask	The prefix length as specified in a prefix mask.
Match Type	Type of prefix being monitored. The prefix can be exact or nonexact.

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 routes

Note Effective with Cisco IOS Release 15.0(1)SY, the **show oer border routes** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display information about Optimized Edge Routing (OER)-controlled routes, use the **show oer border routes** command in privileged EXEC mode.

show oer border routes {**bgp**| **cce**| **eigrp** [**parent**]| **rwatch**| **static**}

Syntax Description

bgp	Displays information for OER routes controlled by Border Gateway Protocol (BGP).
eigrp	Displays information for OER routes controlled by Enhanced Interior Gateway Routing Protocol (EIGRP).
parent	Displays information for EIGRP parent routes.
cce	Displays information for OER routes controlled by Common Classification Engine (CCE).
rwatch	Displays information for OER routes that are being watched in the Routing Information Base (RIB).
static	Displays information for OER routes controlled by static routes.

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.
12.4(20)T	The **cce** keyword was added.

Release	Modification
12.4(24)T	The **rwatch** keyword was added.
15.0(1)M	This command was modified. The **eigrp** and **parent** keywords were added to support EIGRP route control.
12.2(33)SRE	This command was modified. The **eigrp** and **parent** keywords were added to support EIGRP route control.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **show oer border routes** command is entered on a border router. This command is used to display information about OER-controlled routes on a border router. You can display information about BGP or static routes.

In Cisco IOS Release 12.4(20)T, the **cce** keyword was added to display information about OER-controlled traffic classes that are identified using Network-Based Application Recognition (NBAR).

Examples

The following example displays BGP learned routes on a border router:

```
Router# show oer border routes bgp
OER BR 10.1.1.2 ACTIVE, MC 10.1.1.3 UP/DOWN: UP 00:10:08,
   Auth Failures: 0
   Conn Status: SUCCESS, PORT: 3949
BGP table version is 12, local router ID is 10.10.10.2
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
OER Flags: C - Controlled, X - Excluded, E - Exact, N - Non-exact, I - Injected
    Network          Next Hop        OER    LocPrf Weight Path
*> 10.1.0.0/16      10.40.40.2      CE                0 400 600 i
```

The table below describes the significant fields shown in the display.

Table 34: show oer border routes bgp Field Descriptions

Field	Description
C-Controlled	Indicates the monitored prefix is currently under OER control.
X-Excluded	Indicates the monitored prefix is controlled by a different border router.
E - Exact	Indicates that an exact prefix indicates is controlled, but more specific routes are not.
N - Non-exact	Indicates that the prefix and all more specific routes are under OER control.

Field	Description
I - Injected	Indicates that the prefix is injected into the BGP routing table. If a less specific prefix exists in the BGP table and OER has a more specific prefix configured, then BGP will inject the new prefix and OER will flag it as I-Injected.
XN	Indicates that the prefix and all more specific prefixes are under the control of another border router, and, therefore, this prefix is excluded. (Not shown in the example output.
CNI	Indicates that the prefix is injected, and this prefix and all more specific prefixes are under OER control.
CEI	Indicates that the specific prefix is injected and under OER control.
CN	Indicates that the prefix and all more specific prefixes are under OER control.
CE	Indicates that the specific prefix is under OER control.
Network	The IP address and prefix mask.
Next Hop	The next hop of the prefix.
OER	Type of OER control.
LocPrf	The BGP local preference value.
Weight	The weight of the route.
Path	The BGP path type.

The following example displays OER-controlled routes identified using NBAR:

```
Router# show oer border routes cce
Class-map oer-class-acl-oer_cce#2-stile-telnet, permit, sequence 0, mask 24
  Match clauses:
    ip address (access-list): oer_cce#2
    stile: telnet
  Set clauses:
    ip next-hop 10.1.3.2
    interface Ethernet2/3
  Statistic:
    Packet-matched: 60
```

The table below describes the significant fields shown in the display.

Table 35: show oer border routes cce Field Descriptions

Field	Description
Class-map	Indicates the name OER map used to control the OER traffic classes.
Match clauses	Indicates the match criteria being applied to the traffic classes.
ip address (access-list)	Name of access list used to match the destination prefixes of the controlled traffic classes identified using NBAR.
stile	Protocol being controlled.
Set clauses	Indicates the set criteria being applied to the matched traffic classes.
ip next-hop	IP address of the next hop to which the controlled traffic is sent. The next hop should be to a noncontrolling router.
interface	Interface name and number through which the controlled traffic is sent. If this is an ingress interface, the border router is not controlling the traffic classes. If this is an egress interface of the border router, the route is being controlled.
Statistic	Displays statistics such as number of packets matched.

The following example, available in Cisco IOS Release 15.0(10M, 12.2(33)SRE, and later releases, displays EIGRP-controlled routes on a border router with information about the parent route that exists in the EIGRP routing table. In this example, the output shows that prefix 10.1.2.0/24 is being controlled by OER. This command is used to show parent route lookup and route changes to existing parent routes when the parent route is identified from the EIGRP routing table.

```
Router# show oer border routes eigrp
Flags: C - Controlled by oer, X - Path is excluded from control,
       E - The control is exact, N - The control is non-exact
Flags Network            Parent             Tag
CE    10.1.2.0/24        10.0.0.0/8         5000
```

In this example, the **parent** keyword is used and more details are shown about the parent route lookup.

```
Router# show oer border routes eigrp parent
Network            Gateway            Intf       Flags
10.0.0.0/8         10.40.40.2         Ethernet4  1
Child Networks
Network            Flag
```

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 master

To display information about an Optimized Edge Routing (OER) master controller, use the **show oer master** command in privileged EXEC mode.

show oer master

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.3(11)T	The protocol field was added to the output of this command under the "Learn Settings" heading.
12.3(14)T	The trace probe delay field was added to the output of this command under the "Global Settings" heading.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **show oer master** command is entered on a master controller. The output of this command displays information about the status of the OER managed network; the output includes information about the master controller, the border routers, OER managed interfaces, and default and user-defined policy settings.

Examples

The following example displays the status of an OER managed network on a master controller:

```
Router# show oer master

OER state: ENABLED and ACTIVE
  Conn Status: SUCCESS, PORT: 3949
  Number of Border routers: 2
  Number of Exits: 2
  Number of monitored prefixes: 10 (max 5000)
Border           Status   UP/DOWN             AuthFail
10.4.9.7         ACTIVE   UP       02:54:40          0
10.4.9.6         ACTIVE   UP       02:54:40          0
Global Settings:
  max-range-utilization percent 20
  mode route metric bgp local-pref 5000
  mode route metric static tag 5000
  trace probe delay 1000
  logging
Default Policy Settings:
  backoff 300 3000 300
  delay relative 50
  holddown 300
```

```
  periodic 0
  mode route control
  mode monitor both
  mode select-exit best
  loss relative 10
  unreachable relative 50
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
Learn Settings:
  current state : SLEEP
  time remaining in current state : 4567 seconds
  throughput
  delay
  no protocol
  monitor-period 10
  periodic-interval 20
  aggregation-type bgp
  prefixes 100
  expire after time 720
```

The table below describes the significant fields shown in the display.

Table 36: show oer master Field Descriptions

Field	Description
OER state	Indicates the status of the master controller. The state will be either “Enabled” or “Disabled” and “Active” or “Inactive.”
Conn Status	Indicates the state of the connection between the master controller and the border router. The state is displayed as “SUCCESS” to indicate as successful connection. The state is displayed as “CLOSED” if there is no connection.
PORT:	Displays the port number that is used for communication between the master controller and the border router.
Number of Border routers:	Displays the number of border router that peer with the master controller.
Number of Exits:	Displays the number of exit interfaces under OER control.
Number of monitored prefixes:	Displays the number prefixes that are actively or passively monitored.
Border	Displays the IP address of the border router.
Status	Indicates the status of the border router. This field displays either “ACTIVE” or “INACTIVE.”
UP/DOWN	Displays the connection status. The output displays “DOWN” or “UP.” “UP” is followed by the length of time that the connection has been in this state.

Field	Description
AuthFail	Displays the number of authentication failures between the master controller and the border router.
Global Settings:	Displays the configuration of global OER master controller settings.
Default Policy Settings:	Displays default OER master controller policy settings.
Learn Settings:	Display OER learning settings.

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 master active-probes

To display connection and status information about active probes on an Optimized Edge Routing (OER) master controller, use the **show oer master active-probes** command in privileged EXEC mode.

show oer master active-probes [**appl**| **forced**]

Syntax Description

appl	(Optional) Filters the output display that active probes generate for application traffic configured with the OER Application-Aware Routing: PBR feature.
forced	(Optional) Filters the output display that active probes generate for voice traffic configured with a forced target assignment.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(2)T	Support for the **appl** keyword was introduced in Cisco IOS Release 12.4(2)T.
12.4(6)T	Support for the **forced** keyword was introduced in Cisco IOS Release 12.4(6)T.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **show oer master active-probes** command is entered on a master controller. This command is used to display the status of active probes. The output from this command displays the active probe type and destination, the border router that is the source of the active probe, the target prefixes that are used for active probing, and whether the probe was learned or configured. Entering the **appl** keyword filters the output to display information about applications optimized by the master controller. Entering the **forced** keyword filters the output to display information about voice traffic that is configured with a forced target assignment optimized by the master controller.

Examples

The following example shows the status of configured and running active probes:

```
Router# show oer master active-probes
        OER Master Controller active-probes
```

```
Border   = Border Router running this Probe
State    = Un/Assigned to a Prefix
Prefix   = Probe is assigned to this Prefix
Type     = Probe Type
Target   = Target Address
TPort    = Target Port
How      = Was the probe Learned or Configured
N - Not applicable
The following Probes exist:
State      Prefix             Type     Target          TPort How
Assigned   10.1.1.1/32       echo     10.1.1.1           N Lrnd
Assigned   10.1.4.0/24       echo     10.1.4.1           N Lrnd
Assigned   10.1.2.0/24       echo     10.1.2.1           N Lrnd
Assigned   10.1.4.0/24       udp-echo 10.1.4.1       65534 Cfgd
Assigned   10.1.3.0/24       echo     10.1.3.1           N Cfgd
Assigned   10.1.2.0/24       tcp-conn 10.1.2.1          23 Cfgd
The following Probes are running:
Border          State    Prefix             Type     Target          TPort
192.168.2.3     ACTIVE   10.1.4.0/24       udp-echo 10.1.4.1       65534
172.16.1.1      ACTIVE   10.1.2.0/24       tcp-conn 10.1.2.1          23
```

The table below describes the significant fields shown in the display.

Table 37: show oer master active-probes Field Descriptions

Field	Description
The following Probes exist:	Displays the status of configured active probes.
State	Displays the status of the active probe. The output displays “Assigned” or “Unassigned.”
Prefix	Displays the prefix and prefix mask of the target active probe.
Type	Displays the type of active probe. The output displays “echo,” “jitter,” “tcp-conn,” or “udp-echo.”
Target	Displays the target IP address for the active probe.
TPort	Displays the target port for the active probe.
How	Displays how the active probe was created. The output will indicate the probe is configured or learned.
The following Probes are running:	Displays the status of active probes that are running.
Border	Displays the IP address of the border router.

The following example shows the status of configured and running active probes when a jitter probe has been configured:

```
Router# show oer master active-probes

OER Master Controller active-probes
Border   = Border Router running this Probe
State    = Un/Assigned to a Prefix
Prefix   = Probe is assigned to this Prefix
Type     = Probe Type
```

```
Target   = Target Address
TPort    = Target Port
How      = Was the probe Learned or Configured
N - Not applicable
The following Probes exist:
State      Prefix             Type        Target      TPort How    codec
Assigned   10.1.1.0/24      jitter      10.1.1.10       2000 Cfgd g711ulaw
Assigned   10.1.1.0/24        echo       10.1.1.2          N Lrnd        N
The following Probes are running:
Border          State     Prefix            Type     Target          TPort
10.1.1.2         ACTIVE   10.1.1.0/24     jitter     10.1.1.10        2000
10.1.1.2         ACTIVE   10.1.1.0/24       echo     10.1.1.6            N
10.2.2.3         ACTIVE   10.1.1.0/24     jitter     10.1.1.10        2000
10.2.2.3         ACTIVE   10.1.1.0/24       echo     10.1.1.6            N
10.1.1.1         ACTIVE   10.1.1.0/24     jitter     10.1.1.10        2000
10.1.1.1         ACTIVE   10.1.1.0/24       echo     10.1.1.6            N
```

The table below describes the significant fields shown in the display that are different from those in the table above.

Table 38: show oer master active-probes (jitter and MOS) Field Descriptions

Field	Description
codec	Displays the codec value configured for MOS calculation. Codec values can be one of the following: g711alaw, g711ulaw, or g729a.

Related Commands

Command	Description
active-probe	Configures active probes to monitor an OER controlled prefixes.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

show oer master appl

To display information about application traffic classes monitored and controlled by an Optimized Edge Routing (OER) master controller, use the **show oer master appl** command in privileged EXEC mode.

{**show oer master appl** [**access-list** *name*] **[detail]** [**learned** [**delay**| **throughput**]]| [**tcp**| **udp**] [*protocol-number*] [*min-port max-port*] [**dst**| **src**] [**detail**| **policy**]}

Syntax Description

access-list *name*	(Optional) Filters the output based on the specified named extended access list.
detail	(Optional) Displays detailed information.
learned	(Optional) Displays information about learned application traffic classes.
delay	(Optional) Displays information about applications learned using delay as the learning criterion.
throughput	(Optional) Displays information about applications learned using throughput as the learning criterion.
tcp	(Optional) Filters the output based on TCP traffic.
udp	(Optional) Filters the output based on User Datagram Protocol (UDP) traffic.
protocol-number	(Optional) Filters the output based on the specified protocol number.
min-port max-port	(Optional) Filters the output based on the specified port number or range of port numbers.
dst	(Optional) Filters the output based on the destination port number.
src	(Optional) Filters the output based on the source port number.
policy	(Optional) Displays the policy for the application or port number.

Command Modes

Privileged EXEC

Command History

Release	Modification
12.4(2)T	This command was introduced.
12.4(9)T	The **learned**, **delay**, and **throughput** keywords were added.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

The **show oer master appl** command is entered on an OER master controller. This command is used to display information about application traffic classes that are configured for monitoring and optimization.

Examples

The following example shows TCP application traffic filtered based on port 80 (HTTP):

```
Router# show oer master appl tcp 80 80 dst policy
Prefix              Appl Prot       Port                    Port Type       Policy
--------------------------------------------------------------------------------
10.1.0.0/16         tcp             [80, 80]                dst             20
10.1.1.0/24         tcp             [80, 80]                dst             10
```

The table below describes the significant fields shown in the display.

Table 39: show oer master appl Field Descriptions

Field	Description
Prefix	IP address of the monitored prefix that carries the application traffic.
Appl Prot	Application protocol.
Port	Application port number.
Port Type	Source or destination application port number.
Policy	Application policy number.

The following example shows information about learned application traffic classes:

```
Router# show oer master appl learned
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
Prefix                Prot Port [src][dst]/ApplId        DSCP Source Prefix
                          State     Time Curr BR         CurrI/F         Protocol
```

```
                        PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                        ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                        ActSJit  ActPMOS
--------------------------------------------------------------------------------
100.1.0.0/16           tcp [1, 65535] [80, 80]          defa 0.0.0.0/0
                       DEFAULT*       87 U              U               U
Router# show oer master appl tcp 80 80 dst
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
Prefix                Prot Port [src][dst]/ApplId        DSCP Source Prefix
                          State     Time Curr BR         CurrI/F         Protocol
                        PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                        ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                        ActSJit  ActPMOS
--------------------------------------------------------------------------------
100.1.0.0/16           tcp [1, 65535] [80, 80]          defa 0.0.0.0/0
                       DEFAULT*       52 U              U               U
```

The table below describes the significant fields shown in the display that are different from those in the table above.

Table 40: show oer master appl learned Field Descriptions

Field	Description
ApplId	ID of the application.
DSCP	Differentiated Services Code Point (DSCP) value.
Source Prefix	IP address of the application source.
State	Current state of the application traffic class flow.
Time	Time, in seconds, between probe messages.
Curr BR	IP address of the border router through which the prefix associated with this application traffic class is being currently routed.
CurrI/F	Interface of the border router through which the prefix associated with this application traffic class is being currently routed.
Proto	Protocol.

The following example shows information about application traffic classes learned using delay as the learning criterion:

```
Router# show oer master appl learned delay
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
```

```
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
Prefix                Prot Port [src][dst]               DSCP Source Prefix
                          State     Time Curr BR         CurrI/F         Proto
                        PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                        ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                        ActSJit  ActPMOS
--------------------------------------------------------------------------------
10.1.3.0/24            udp [1, 65535] [3000, 4000]         ef 0.0.0.0/0
                      INPOLICY*      @70 1.1.1.2         Et0/0            PBR
                              U        U        0        0        0        0
                              3        4        0        0        1        0
                              N        N
```

The following example shows information about application traffic classes learned using throughput as the learning criterion:

```
Router# show oer master appl learned throughput
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
Prefix                Prot Port [src][dst]               DSCP Source Prefix
                          State     Time Curr BR         CurrI/F         Proto
                        PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                        ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                        ActSJit  ActPMOS
--------------------------------------------------------------------------------
10.1.1.0/24            udp [1, 65535] [3000, 4000]         ef 0.0.0.0/0
                      INPOLICY*      @70 1.1.1.2         Et0/0            PBR
                              U        U        0        0        0        0
                             11        7        0        0        1        0
                              N        N
```

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 master border

To display the status of connected Optimized Edge Routing (OER) border routers, use the **show oer master border**command in privileged EXEC mode.

show oer master border [*ip-address*] [**detail| report| topology**]

Syntax Description

ip-address	(Optional) Specifies the IP address of a single border router.
detail	(Optional) Displays detailed border router information.
report	(Optional) Displays border router related link reports.
topology	(Optional) Displays the status of the policy based routing (PBR) requirement.

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.
12.4(15)T	This command was modified. The **topology**keyword was added, and the **show oer master border** command output was enhanced to include the status of the PBR requirement.

Usage Guidelines

The **show oer master border**command and all the keywords are entered on a master controller. The output of this command shows the status of connections with border routers.

Examples

The following example displays the status of border router connections with a master controller:

```
Router# show oer master border
OER state: ENABLED and ACTIVE
  Conn Status: SUCCESS, PORT: 3949
  Version: 2.2
  Number of Border routers: 3
  Number of Exits: 3
  Number of monitored prefixes: 1 (max 5000)
  Max prefixes: total 5000 learn 2500
  Prefix count: total 1, learn 0, cfg 1
```

```
  PBR Requirements met
  Nbar Status: Inactive
Border           Status   UP/DOWN             AuthFail  Version
10.165.201.5     ACTIVE   UP       00:05:29          0  2.2
10.165.201.6     ACTIVE   UP       00:05:29          0  2.2
10.165.201.7     ACTIVE   UP       00:05:29          0  2.2
```

The table below describes the significant fields shown in the display. All the other fields in the output are self-explanatory.

Table 41: show oer master border Field Descriptions

Field	Description
Border	Displays the IP address of the border router.
Status	Displays the status of the border router. The output displays “ACTIVE” or “INACTIVE.”
UP/DOWN	Displays the connection status and the length of time that the connection has been up. The output displays “DOWN” or “UP.” The up time is displayed in weeks, days, hours, minutes, and seconds.
AuthFail	Displays the number of authentication failures between the master controller and the border router.
Version	Displays the version for all of the border routers configured on the master controller.

The following example displays detailed information about border router connections with a master controller:

```
Router# show oer master border detail
Border           Status   UP/DOWN             AuthFail  Version
10.1.1.2         ACTIVE   UP       14:03:40          0  3.0
 Et2/0           EXTERNAL UP
 Et0/0           INTERNAL UP
 Et1/0           EXTERNAL UP

 External            Capacity      Max BW   BW Used    Load Status           Exit Id
 Interface            (kbps)       (kbps)    (kbps)    (%)
 ---------       --  --------      ------   -------    ---- ------           -------
 Et2/0           Tx       800         600       226      28 UP                     2
                 Rx                   800         0       0
 Et1/0           Tx       800         600        97      12 UP                     1
                 Rx                   800        55       6
```

The table below describes the significant fields shown in the display.

Table 42: show oer master border detail Field Descriptions

Field	Description
Border	Displays the IP address of the border router.
Status	Displays the status of the border router. The output displays “ACTIVE” or “INACTIVE.”

Field	Description
UP/DOWN	Displays the connection status and the length of time that the connection has been up. The output displays "DOWN" or "UP." The up time is displayed in weeks, days, hours, minutes, and seconds.
AuthFail	Displays the number of authentication failures between the master controller and the border router.
External Interface	Displays the external OER controlled interface.
Capacity	Displays the capacity of the interface in kilobytes per second.
Max BW	Displays the maximum usable bandwidth in kilobytes per second as configured on the interface.
BW Used	Displays the amount of bandwidth in use in kilobytes per second.
Load	Displays the amount of bandwidth in use as a percentage of the total capacity of the interface.
Status	Displays the status of the link.
Exit Id	Displays the ID number assigned by the master controller to identify the exit.
Tx	Displays the percentage of interface utilization in the outbound direction.
Rx	Displays the percentage of interface utilization in the inbound direction.

The following example displays if the PBR requirement for the application control by OER is met or not:

```
Router# show oer master border topology
LocalBR         LocalEth          RemoteBR        RemoteEth       nbar_type
--------------------------------------------------------------------------------
10.165.201.4    Ethernet0/0       10.165.202.2    Ethernet0/0     Directly Connected
10.165.201.4    Ethernet0/0       10.165.201.3    Ethernet0/0     Directly Connected
10.165.201.3    Ethernet0/0       10.165.201.4    Ethernet0/0     Directly Connected
10.165.201.3    Ethernet0/0       10.165.201.3    Ethernet0/0     Directly Connected
10.165.201.2    Ethernet0/0       10.165.201.4    Ethernet0/0     Directly Connected
10.165.201.2    Ethernet0/0       10.165.201.2    Ethernet0/0     Directly Connected
PBR Requirements met
```

The table below describes the significant fields shown in the display.

Table 43: show oer master border topology Field Descriptions

Field	Description
LocalBR	Displays the local border router.
LocalEth	Displays the local interface connection for the local border router.
RemoteBR	Displays the remote border router that is connected with the local border router.
RemoteEth	Displays the remote interface connection for the remote border router.
nbar_type	Displays the type of NBAR connection for each of the border routers. Three types of connection status are available: Directly Connected, One-How-Away Neighbor, and Not Connected.

The following example displays the border router link report:

```
Router# show oer master border report
Border           Status   UP/DOWN              AuthFail  Version
10.165.202.132   ACTIVE   UP       00:05:54           0  2.2
10.165.202.131   ACTIVE   UP       00:05:57           0  2.2
10.165.202.130   ACTIVE   UP       00:06:00           0  2.2
10.165.202.129   ACTIVE   UP       00:06:03           0  2.2
```

The table below describes the significant fields shown in the display.

Table 44: show oer master report detail Field Descriptions

Field	Description
Border	Displays the IP address of the border router.
Status	Displays the status of the border router. The output displays “ACTIVE” or “INACTIVE.”
UP/DOWN	Displays the connection status and the length of time that the connection has been up. The output displays “DOWN” or “UP.” The up time is displayed in weeks, days, hours, minutes, and seconds.
AuthFail	Displays the number of authentication failures between the master controller and the border router.
Status	Displays the status of the link.

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 master cost-minimization

To display the status of cost-based optimization policies, use the **show oer master cost-minimization** command in privileged EXEC mode.

show oer master cost-minimization {**billing-history**| **border** *ip-address* [*interface*]| **nickname** *name*}

Syntax Description

billing-history	Deploys the billing history
border *ip-address*	Displays information for a single border router.
interface	(Optional) Displays information for only the specified interface.
nickname *name*	Displays information for the service provider. A nickname must be configured before output will be displayed.

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 **show oer master cost-minimization** command is entered on a master controller. The output of this command shows the status of cost-based policies.

Examples

The following example displays the billing history for cost policies:

```
Router# show oer master cost-minimization billing-history
Billing History for the past three months
        ISP2 on 10.1.1.2         Ethernet0/0
  80-percent on 10.1.1.1         Ethernet0/0
                 Mon1                   Mon2                   Mon3
Nickname     SustUtil       Cost   SustUtil       Cost   SustUtil       Cost
----------    ------------------    ------------------   ------------------
      ISP2        ---NA---      1737222676 1737222676        ---NA---
80-percent        ---NA---      1737231684 1737231684        ---NA---
----------    ------------------    ------------------   ------------------
Total Cost                     0           3474454360                     0
```

The table below describes the significant fields shown in the display.

Table 45: show oer master cost-minimization billing-history Field Descriptions

Field	Description
Nickname	The nickname assigned to the service provider.
SustUtil	The sustained utilization of the exit link.
Cost	The financial cost of the link.
Total Cost	The total financial cost for the month.

The following example displays cost optimization information only for Ethernet 1/0:

```
Router# show oer master cost-minimization border 10.1.1.2 Ethernet1/0

 Nickname  : ispname         Border: 10.1.1.2         Interface: Et1/0
 Calc type : Combined
 Start Date: 20
 Fee       : Tier Based
             Tier1 : 100, fee: 10000
             Tier2 : 90, fee: 9000
 Period    : Sampling 22, Rollup 1400
 Discard   : Type Percentage, Value 22
 Rollup Information:
 Total           Discard         Left            Collected
 60              13              36              0
 Current Rollup Information:
   MomentaryTgtUtil:         7500 Kbps    CumRxBytes:            38669
  StartingRollupTgt:         7500 Kbps    CumTxBytes:            39572
   CurrentRollupTgt:         7500 Kbps    TimeRemain:         09:11:01
 Rollup Utilization (Kbps):
 Egress/Ingress Utilization Rollups (Descending order)
 1   : 0           2   : 0
```

The table below describes the significant fields shown in the display.

Table 46: show oer master cost-minimization border Field Descriptions

Field	Description
Nickname	Nickname of the service provider.
Border	IP address of the border router.
Interface	Interface for which the cost policy is configured.
Calc type	Displays the configured billing method.
Start Date	Displays the starting date of the billing period.
Fee	Displays the billing type (fixed or tiered) and the billing configuration.
Period	Displays the sampling and rollup configuration.

Field	Description
Discard	Displays the discard configuration, type, and value.
Rollup Information	Displays rollup statistics.
Current Rollup Information	Displays rollup statistics for the current sampling cycle.
Rollup Utilization	Displays rollup utilization statistics in kilobytes per second.

The following example displays cost optimization information for the specified service provider:

```
Router# show oer master cost-minimization nickname ISP1

 Nickname  : ISP1            Border: 10.1.1.2         Interface: Et1/0
 Calc type : Combined
 Start Date: 20
 Fee       : Tier Based
             Tier1 : 100, fee: 10000
             Tier2 : 90, fee: 9000
 Period    : Sampling 22, Rollup 1400
 Discard   : Type Percentage, Value 22
 Rollup Information:
 Total           Discard         Left            Collected
 60              13              36              0
 Current Rollup Information:
   MomentaryTgtUtil:         7500 Kbps    CumRxBytes:            38979
  StartingRollupTgt:         7500 Kbps    CumTxBytes:            39692
   CurrentRollupTgt:         7500 Kbps    TimeRemain:         09:10:49
 Rollup Utilization (Kbps):
 Egress/Ingress Utilization Rollups (Descending order)
 1   : 0            2   : 0
```

Related Commands

Command	Description
cost-minimization	Configures cost-based optimization policies on a master controller.
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.

show oer master defined application

To display information about user-defined application definitions used in Optimized Edge Routing (OER), use the **show oer master defined application** command in privileged EXEC mode.

show oer master defined application

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer master defined application**command is entered on an OER master controller. This command displays all applications that are user-defined. To define a custom application to be used by OER, use the **application define** command on the OER master controller.

To display the same information on an OER border router, use the **show oer border defined application**command.

Examples

The following partial example output shows information about the user-defined applications configured for use with OER:

```
Router# show oer master defined application
OER Defined Applications:
Name                    Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
--------------------------------------------------------------------------------
telnet                        1 defa  tcp       23-23     1-65535 0.0.0.0/0
telnet                        1 defa  tcp     1-65535       23-23 0.0.0.0/0
ftp                           2 defa  tcp       21-21     1-65535 0.0.0.0/0
ftp                           2 defa  tcp     1-65535       21-21 0.0.0.0/0
cuseeme                       4 defa  tcp   7648-7648     1-65535 0.0.0.0/0
cuseeme                       4 defa  tcp   7649-7649     1-65535 0.0.0.0/0
cuseeme                       4 defa  tcp     1-65535   7648-7648 0.0.0.0/0
dhcp                          5 defa  udp       68-68       67-67 0.0.0.0/0
dns                           6 defa  tcp       53-53     1-65535 0.0.0.0/0
dns                           6 defa  tcp     1-65535       53-53 0.0.0.0/0
dns                           6 defa  udp       53-53     1-65535 0.0.0.0/0
dns                           6 defa  udp     1-65535       53-53 0.0.0.0/0
finger                        7 defa  tcp       79-79     1-65535 0.0.0.0/0
finger                        7 defa  tcp     1-65535       79-79 0.0.0.0/0
gopher                        8 defa  tcp       70-70     1-65535 0.0.0.0/0
.
.
.
```

The table below describes the significant fields shown in the display.

Table 47: show oer master defined application Field Descriptions

Field	Description
Name	Application Name
Appl_ID	Application ID
Dscp	Differentiated Services Code Point (DSCP) value
Prot	Protocol
SrcPort	Source port number for the traffic class
DstPort	Destination port number for the traffic class
SrcPrefix	IP address of the traffic class source

Related Commands

Command	Description
application define	Defines a user-defined application to be monitored by OER.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
show oer border defined application	Displays information about user-defined application definitions used in OER.

show oer master learn list

To display configuration information about Optimized Edge Routing (OER) learn lists, use the **show oer master learn list** command in privileged EXEC mode.

show oer master learn list [*list-name*]

Syntax Description

list-name	(Optional) Name of learn list.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer master learn list** command is entered on an OER master controller. This command is used to display configuration information about learn lists. In Cisco IOS Release 12.4(15)T, the learn list configuration mode was introduced. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria for learning traffic classes including prefixes, application definitions, filters, and aggregation parameters can be configured. A traffic class is automatically learned by OER based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different OER policies to be applied to each learn list; in previous releases, the traffic classes could not be divided, and an OER policy was applied to all the traffic classes profiled during one learning session.

Examples

The following example shows how to display configuration information about two learn lists, LIST1 and LIST2:

```
Router# show oer master learn list
Learn-List LIST1 10
   Configuration:
    Application: ftp
    Aggregation-type: bgp
    Learn type: thruput
    Policies assigned: 8 10
   Stats:
    Application Count: 0
    Application Learned:
 Learn-List LIST2 20
   Configuration:
    Application: telnet
    Aggregation-type: prefix-length 24
    Learn type: thruput
    Policies assigned: 5 20
   Stats:
    Application Count: 2
    Application Learned:
```

```
Appl Prefix 10.1.5.0/24 telnet
Appl Prefix 10.1.5.16/28 telnet
```

The table below describes the significant fields shown in the display.

Table 48: show oer master learn list Field Descriptions

Field	Description
Learn-List	Identifies the OER learn list name and sequence number.
Application	Application protocol.
Aggregation-type	Type of TCF aggregation.
Learn type	Throughput or delay.
Policies assigned	Application policy number.
Application Count	Number of applications learned.
Application Learned	Type of application that is learned.

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 master link-group

To display information about Optimized Edge Routing (OER) link groups, use the **show oer master link-group** command in privileged EXEC mode.

show oer master link-group [*link-group-name*]

Syntax Description

link-group-name	(Optional) Name of link group.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer master link-group** command is entered on an OER master controller. This command is used to display information about link groups including the link group name, the border router and the interface on the border router that is the exit link, and the ID of the exit link.

Introduced in Cisco IOS Release 12.4(15)T, link groups are used to define a group of exit links as a preferred set of links or a fallback set of links for OER to use when optimizing a specified traffic class. Up to three link groups can be specified for each interface. Use the **link-group** command to define the link group for an interface and use the **set link-group** command to define the primary link group and a fallback link group for a specified traffic class in an OER map.

Examples

The following example displays information about all configured link groups:

```
Router# show oer master link-group
link group video
  Border           Interface       Exit id
  192.168.1.2      Serial2/0       1
 link group voice
  Border           Interface       Exit id
  192.168.1.2      Serial2/0       1
  192.168.1.2      Serial3/0       2
  192.168.3.2      Serial4/0       4
 link group data
  Border           Interface       Exit id
  192.168.3.2      Serial3/0       3
```

The table below describes the significant fields shown in the display.

Table 49: show oer master link-group Field Descriptions

Field	Description
link group	Name of the link group.
Border	IP address of the border router on which the exit link exists.
Interface	Type and number of the interface on the border router that is the exit link.
Exit id	ID number of the exit link.

The following example displays information only about the link group named voice:

```
Router# show oer master link-group voice
link group voice
  Border          Interface       Exit id
  192.168.1.2     Serial2/0       1
  192.168.1.2     Serial3/0       2
  192.168.3.2     Serial4/0       4
```

Related Commands

Command	Description
link-group	Configures an OER border router exit interface as a member of a link group.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set link-group	Specifies a link group for traffic classes defined in an OER policy.

show oer master nbar application

To display information about the status of an application identified using Network-Based Application Recognition (NBAR) for each Optimized Edge Routing (OER) border router, use the **show oer master nbar application** command in privileged EXEC mode.

show oer master nbar application

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer master nbar application**command is entered on an OER master controller. This command is used to verify the validity of an application that is identified using NBAR at each OER border router. If the NBAR application is not supported on one or more border routers, then all the traffic classes related to that NBAR application are marked inactive and cannot be optimized using OER.

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) andPost 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).

The list of applications identified using NBAR and available for profiling of 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* .

Examples

The following partial output shows information about the status of a number of applications identified using NBAR at three OER border routers. In this example, applications based on BGP, BitTorrent, and HTTP protocols are valid at all three OER border routers and traffic classes for these applications are active. While applications such as ConnectionLess Network Service (CLNS) and KaZaA are invalid on at least one border router, all traffic classes based on these application are marked inactive.

```
Router# show oer master nbar application
NBAR Appl                  10.1.1.4        10.1.1.2        10.1.1.3
-------------------------------------------------------------------
aarp                        Invalid         Invalid         Invalid
appletalk                   Invalid         Invalid         Invalid
arp                         Invalid         Invalid         Invalid
bgp                           Valid           Valid           Valid
bittorrent                    Valid           Valid           Valid
bridge                      Invalid         Invalid         Invalid
bstun                       Invalid         Invalid         Invalid
cdp                         Invalid         Invalid         Invalid
citrix                      Invalid         Invalid         Invalid
clns                          Valid         Invalid         Invalid
clns_es                     Invalid         Invalid         Invalid
clns_is                     Invalid         Invalid         Invalid
cmns                        Invalid         Invalid         Invalid
compressedtcp               Invalid         Invalid         Invalid
cuseeme                     Invalid         Invalid         Invalid
decnet                      Invalid         Invalid         Invalid
decnet_node                 Invalid         Invalid         Invalid
decnet_router-l1            Invalid         Invalid         Invalid
decnet_router-l2            Invalid         Invalid         Invalid
dhcp                        Invalid         Invalid         Invalid
directconnect               Invalid         Invalid         Invalid
dlsw                        Invalid         Invalid         Invalid
dns                         Invalid         Invalid         Invalid
edonkey                     Invalid         Invalid         Invalid
egp                         Invalid         Invalid         Invalid
eigrp                       Invalid         Invalid         Invalid
exchange                    Invalid         Invalid         Invalid
fasttrack                   Invalid         Invalid         Invalid
finger                      Invalid         Invalid         Invalid
ftp                         Invalid         Invalid         Invalid
gnutella                    Invalid         Invalid         Invalid
Morpheus                    Invalid         Invalid         Invalid
gopher                      Invalid         Invalid         Invalid
gre                         Invalid         Invalid         Invalid
h323                        Invalid         Invalid         Invalid
http                          Valid           Valid           Valid
icmp                        Invalid         Invalid         Invalid
imap                        Invalid         Invalid         Invalid
ip                          Invalid         Invalid         Invalid
ipinip                      Invalid         Invalid         Invalid
ipsec                       Invalid         Invalid         Invalid
ipv6                        Invalid         Invalid         Invalid
ipx                         Invalid         Invalid         Invalid
irc                         Invalid         Invalid         Invalid
kazaa2                        Valid         Invalid           Valid
.
.
.
```

The table below describes the significant fields shown in the display.

Table 50: show oer master nbar application Field Descriptions

Field	Description
Appl	Application Name
10.1.1.4	IP address of an OER border router
10.1.1.2	IP address of an OER border router

Field	Description
10.1.1.3	IP address of an OER 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.
show oer master traffic-class application nbar	Displays information about application traffic classes that are identified using NBAR and are monitored and controlled by an OER master controller.

show oer master policy

To display policy settings on an Optimized Edge Routing (OER) master controller, use the **show oer master policy** command in privileged EXEC mode.

show oer master policy {*sequence-number*| *policy-name*| **default**| **dynamic**}

Syntax Description

sequence-number	Displays only the specified OER map sequence.
policy-name	Displays only the specified OER map name.
default	Displays the default policy information.
dynamic	Displays dynamic policy information.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.4(6)T	The output was modified to display the active probe frequency, if configured.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T	The **dynamic** keyword was added to support the OER application interface.

Usage Guidelines

The **show oer master policy** command is entered on a master controller. The output of this command displays default policy and policies configured with an OER map.

In Cisco IOS Release 12.4(15)T, an OER application interface was introduced. 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. The OER application interface allows applications running on a host device in the provider network to dynamically create policies to influence the existing traffic classes, or specify new traffic class criteria. The **dynamic** keyword displays the policies dynamically created by an application interface provider application.

Examples

The following example displays default policy and policies configured in an OER map named CUSTOMER. The asterisk(*) character is displayed next to policy settings that override default settings.

```
Router# show oer master policy
* Overrides Default Policy Setting
Default Policy Settings:
  backoff 300 3000 300
  delay relative 50
  holddown 300
  periodic 0
  mode route control
  mode monitor both
  mode select-exit best
  loss relative 10
  unreachable relative 50
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
oer-map CUSTOMER 10
  match ip prefix-lists: NAME
  backoff 300 3000 300
  delay relative 50
  holddown 300
  periodic 0
  mode route control
  mode monitor both
  mode select-exit best
  loss relative 10
  unreachable relative 50
 *resolve utilization priority 1 variance 10
 *resolve delay priority 11 variance 20
 *probe frequency 30
oer-map CUSTOMER 20
  match ip prefix-lists:
  match oer learn delay
  backoff 300 3000 300
  delay relative 50
  holddown 300
  periodic 0
 *mode route control
  mode monitor both
  mode select-exit best
  loss relative 10
  unreachable relative 50
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
```

The table below describes the significant fields shown in the display.

Table 51: show oer master policy Field Descriptions

Field	Description
Default Policy Settings:	Displays OER default configuration settings under this heading.
oer-map...	Displays the OER map name and sequence number. The policy settings applied in the OER map are displayed under this heading.

The following example displays dynamic policies created by applications using the OER application interface. The asterisk(*) character is displayed next to policy settings that override default settings.

```
Router# show oer master policy dynamic
Dynamic Policies:

  proxy id 10.3.3.3
  sequence no. 18446744069421203465, provider id 1001, provider priority 65535
    host priority 65535, policy priority 101, Session id 9
  backoff 90 90 90
  delay relative 50
  holddown 90
  periodic 0
  probe frequency 56
  mode route control
  mode monitor both
  mode select-exit good
  loss relative 10
  jitter threshold 20
  mos threshold 3.60 percent 30
  unreachable relative 50
  next-hop not set
  forwarding interface not set
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20

  proxy id 10.3.3.3
  sequence no. 18446744069421269001, provider id 1001, provider priority 65535
    host priority 65535, policy priority 102, Session id 9
  backoff 90 90 90
  delay relative 50
  holddown 90
  periodic 0
  probe frequency 56
  mode route control
  mode monitor both
  mode select-exit good
  loss relative 10
  jitter threshold 20
  mos threshold 3.60 percent 30
  unreachable relative 50
  next-hop not set
  forwarding interface not set
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20

  proxy id 10.3.3.4
  sequence no. 18446744069421334538, provider id 1001, provider priority 65535
    host priority 65535, policy priority 103, Session id 10
  backoff 90 90 90
  delay relative 50
  holddown 90
  periodic 0
  probe frequency 56
  mode route control
  mode monitor both
  mode select-exit good
  loss relative 10
  jitter threshold 20
  mos threshold 3.60 percent 30
  unreachable relative 50
  next-hop not set
  forwarding interface not set
  resolve delay priority 11 variance 20
  resolve utilization priority 12 variance 20
```

The table below describes the significant fields shown in the display.

Table 52: show oer master policy dynamic Field Descriptions

Field	Description
Dynamic Policies:	Displays OER dynamic policy configurations under this heading.
proxy id	IP address of the host application interface device that created the policy.
sequence no.	Number indicating the sequence in which the policy was run.
provider id	ID number of the application interface provider.
provider priority	The priority assigned to the application interface provider. If a priority has not been configured, the default priority is 65535.
host priority	The priority assigned to the host application interface device. If a priority has not been configured, the default priority is 65535.
policy priority	The priority assigned to the policy.
Session id	ID number of the application interface provider session.

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 master prefix

To display the status of monitored prefixes, use the **show oer master prefix** command in privileged EXEC mode.

show oer master prefix [**detail**| **inside [detail]**| **learned** [**delay**| **inside**| **throughput**]| *prefix* [**detail**| **policy**| **report**| **traceroute** [*exit-id*| *border-address*| **current**] **[now]**]]

Syntax Description

detail	(Optional) Displays detailed prefix information about the specified prefix or all prefixes.
inside	(Optional) Displays detailed prefix information about inside prefixes.
learned	(Optional) Displays information about learned prefixes.
delay	(Optional) Displays information about learned prefixes based on delay.
throughput	(Optional) Displays information about learned prefixes based on throughput.
prefix	(Optional) Specifies the prefix, entered as an IP address and bit length mask.
policy	(Optional) Displays policy information for the specified prefix.
report	(Optional) Displays detailed performance information and information about report requests from Optimized Edge Routing (OER) application interface providers for the specified prefix.
traceroute	(Optional) Displays path information from traceroute probes.
exit-id	(Optional) Displays path information based on the OER assigned exit ID.
border-address	(Optional) Display path information sourced from the specified border router.
current	(Optional) Displays traceroute probe statistics from the most recent traceroute probe.
now	(Optional) Initiates a new traceroute probe and displays the statistics that are returned.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.3(8)T	This command was introduced.
12.3(14)T	Support for traceroute reporting was added.
12.4(6)T	The output was modified to support jitter and MOS reporting.
12.4(9)T	The **inside** keyword was added to support OER BGP inbound optimization.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.
12.4(15)T	This command was modified. The **report** keyword was added to support the Performance Routing - Application Interface feature.
12.4(24)T	This command was modified. The output was modified to support the Protocol Independent Route Optimization (PIRO) feature.
15.0(1)M	This command was modified. The output was modified to support EIGRP route control.
12.2(33)SRE	This command was modified. The output was modified to support EIGRP route control and the PIRO feature.

Usage Guidelines

The **show oer master prefix** command is entered on a master controller. This command is used to display the status of monitored prefixes. The output from this command includes information about the source border router, current exit interface, prefix delay, and egress and ingress interface bandwidth. The output can be filtered to display information for only a single prefix, learned prefixes, inside prefixes, and prefixes learned based on delay or throughput.

The **traceroute** keyword is used to display traceroute probe results. The output generated by this keyword provides hop by hop statistics to the probe target network. The output can be filtered to display information only for the exit ID (OER assigns an ID number to each exit interface) or for the specified border router. The **current** keyword displays traceroute probe results from the most recent traceroute probe. The **now** keyword initiates a new traceroute probe and displays the results.

Examples

The following example shows the status of a monitored prefix:

```
Router# show oer master prefix
OER Prefix Stats:
  Dly: Delay in ms
  EBw: Egress Bandwidth
  IBw: Ingress Bandwidth
Prefix       State     Curr BR   CurrI/F  Dly   EBw   IBw
```

```
-----------------------------------------------------------
10.1.5.0/24 INPOLICY  10.1.1.2  Et1/0     19     1     1
```

The table below describes the significant fields shown in the display.

Table 53: show oer master prefix Field Descriptions

Field	Description
Prefix	IP address and prefix length.
State	Status of the prefix.
Curr BR	Border router from which these statistics were gathered.
Curr I/F	Current exit link interface on the border router.
Dly	Delay in milliseconds.
EBw	Egress bandwidth.
IBw	Ingress bandwidth.

The following output shows the detailed status of a monitored prefix:

```
Router# show oer master prefix detail

Prefix: 10.1.1.0/26
   State: DEFAULT*      Time Remaining: @7
   Policy: Default
   Most recent data per exit
   Border          Interface           PasSDly  PasLDly  ActSDly  ActLDly
  *10.2.1.1        Et1/0                   181      181      250      250
   10.2.1.2        Et2/0                     0        0      351      351
   10.3.1.2        Et3/0                     0        0       94      943
   Latest Active Stats on Current Exit:
   Type     Target          TPort Attem Comps      DSum     Min     Max     Dly
   echo     10.1.1.1            N     2     2       448     208     240     224
   echo     10.1.1.2            N     2     2       488     228     260     244
   echo     10.1.1.3            N     2     2       568     268     300     284
Prefix performance history records
 Current index 2, S_avg interval(min) 5, L_avg interval(min) 60
Age       Border          Interface       OOP/RteChg Reasons
Pas: DSum  Samples  DAvg  PktLoss Unreach    Ebytes    Ibytes      Pkts   Flows
Act: Dsum Attempts  DAvg    Comps Unreach
00:00:03  10.1.1.1        Et1/0
        0        0     0        0       0         0         0         0       0
     1504        6   250        6       0
```

The table below describes the significant fields shown in the display.

Table 54: show oer master prefix detail Field Descriptions

Field	Description
Prefix	IP address and prefix length.
State	Status of the prefix.

Field	Description
Time Remaining	Time remaining in the current prefix learning cycle.
Policy	The state that the prefix is in. Possible values are Default, In-policy, Out-of-policy, Choose, and Holddown.
Most recent data per exit	Border router exit link statistics for the specified prefix. The asterisk (*) character indicates the exit that is being used.
Latest Active Stats on Current Exit	Active probe statistics. This field includes information about the probe type, target IP address, port number, and delay statistics.
Type	The type of active probe. Possible types are ICMP echo, TCP connect, or UDP echo. The example uses default ICMP echo probes (default TCP), so no port number is displayed.
Prefix performance history records	Displays border router historical statistics. These statistics are updated about once a minute and stored for 1 hour.

The following example shows prefix statistics from a traceroute probing:

```
Router# show oer master prefix 10.1.5.0/24 traceroute
* - current exit, + - control more specific
Ex - Exit ID, Delay in msec
--------------------------------------------------------------------------------
Path for Prefix: 10.1.5.0/24         Target: 10.1.5.2
Exit ID: 2, Border: 10.1.1.3         External Interface: Et1/0
Status: DONE, How Recent: 00:00:08 minutes old
Hop  Host            Time(ms) BGP
1    10.1.4.2        8        0
2    10.1.3.2        8        300
3    10.1.5.2        20       50
--------------------------------------------------------------------------------
Exit ID: 1, Border: 10.1.1.2         External Interface: Et1/0
Status: DONE, How Recent: 00:00:06 minutes old
Hop  Host            Time(ms) BGP
1    0.0.0.0         3012     0
2    10.1.3.2        12       100
3    10.1.5.2        12       50
--------------------------------------------------------------------------------
```

The table below describes the significant fields shown in the display.

Table 55: show oer master prefix traceroute Field Descriptions

Field	Description
Path for Prefix	Specified IP address and prefix length.
Target	Traceroute probe target.

Field	Description
Exit ID	OER assigned exit ID.
Status	Status of the traceroute probe.
How Recent	Time since last traceroute probe.
Hop	Hop number of the entry.
Host	IP address of the entry.
Time	Time, in milliseconds, for the entry.
BGP	BGP autonomous system number for the entry.

The following example shows prefix statistics including Jitter and MOS percentage values when the Jitter probe is configured for the 10.1.5.0 prefix:

```
Router# show oer master prefix 10.1.5.0/24
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter, MOS - Mean Opinion Score,
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
Prefix                  State     Time Curr BR         CurrI/F         Protocol
                      PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                      ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                     %ActSJit %ActPMOS
--------------------------------------------------------------------------------
10.1.1.0/24          DEFAULT*       @3 10.1.1.1         Et5/0           U
                            U        U        0        0        0        0
                            6        6   400000   400000       17        1
                         1.45       25
```

The table below describes the significant fields shown in the display that are different from the show oer master prefix Field Descriptions table and the show oer master prefix detail Field Descriptions table.

Table 56: show oer master prefix (Jitter and MOS) Field Descriptions

Field	Description
Protocol	Protocol: U (UDP).
PasSDly	Delay, in milliseconds, in short-term statistics from passive probe monitoring. If no statistics are reported, it displays U for unknown.
PasLDly	Delay, in milliseconds, in long-term statistics from passive probe monitoring. If no statistics are reported, it displays U for unknown.
PasSUn	Number of passively monitored short-term unreachable packets in flows-per-million.

Field	Description
PasLUn	Number of passively monitored long-term unreachable packets in flows-per-million.
PasSLos	Number of passively monitored short-term lost packets in packets-per-million.
PasLLos	Number of passively monitored long-term lost packets in packets-per-million.
ActSDly	Number of actively monitored short-term delay packets.
ActLDly	Number of actively monitored long-term delay packets.
ActSUn	Number of actively monitored short-term unreachable packets in flows-per-million.
ActLUn	Number of actively monitored long-term unreachable packets in flows-per-million.
ActSJit	Number of actively monitored short-term jitter packets.
ActPMOS	Number of actively monitored MOS packets with a percentage below threshold.

The following example shows detailed prefix statistics when Jitter or MOS are configured as a priority:

```
Router# show oer master prefix 10.1.1.0/24 detail
Prefix: 10.1.1.0/24
   State: DEFAULT*    Time Remaining: @9
   Policy: Default
   Most recent data per exit
   Border          Interface         PasSDly  PasLDly  ActSDly  ActLDly
  *10.1.1.1        Et5/0                   0        0        6        6
   10.2.2.3        Et2/0                   0        0        7        7
   10.1.1.2        Et0/0                   0        0       14       14
   Most recent voice data per exit
   Border          Interface         ActSJit  ActPMOS
  *10.1.1.1        Et5/0                2.00        0
   10.2.2.3        Et2/0                2.01       20
   10.1.1.2        Et0/0                4.56       50
   Latest Active Stats on Current Exit:
   Type     Target          TPort Attem Comps    DSum     Min      Max      Dly
   udpJit   10.1.1.8         2000     2     2       8       4        4        4
   udpJit   10.1.1.7         3000     2     2      20       4       16       10
   udpJit   10.1.1.6         4000     2     2       8       4        4        4
   echo     10.1.1.4            N     2     0       0       0        0        0
   echo     10.1.1.3            N     2     0       0       0        0        0
   Latest Voice Stats on Current Exit:
   Type     Target          TPort     Codec Attem Comps  JitSum      MOS
   udpJit   10.1.1.8         2000  g711alaw     2     2    2.34     4.56
   udpJit   10.1.1.7         3000  g711ulaw     2     2    2.56     4.11
   udpJit   10.1.1.6         4000     g729a     2     2    1.54     3.57
```

```
   udpJit   10.1.1.5         4500      none     2     2    1.76      NA
Prefix performance history records
 Current index 3, S_avg interval(min) 5, L_avg interval(min) 60
Age       Border          Interface       OOP/RteChg Reasons
Pas: DSum  Samples  DAvg  PktLoss  Unreach   Ebytes   Ibytes     Pkts    Flows
Act: Dsum Attempts  DAvg    Comps  Unreach   Jitter LoMOSCnt    MOSCn
00:00:07  10.1.1.1        Et5/0
        0        0     0        0        0     5920        0      148        1
       36       10     6        6        4        2        1        1
00:01:07  10.1.1.1        Et5/0
        0        0     0        0        0    12000    12384      606       16
       36       10     6        6        4        3        0        1
00:02:07  10.1.1.1        Et5/0
        0        0     0        0        0   409540    12040      867        9
       36       10     6        6        4       15        1        1
```

The table below describes the significant fields shown in the display that are different from the show oer master prefix detail Field Descriptions table.

Table 57: show oer master prefix detail (Jitter or MOS Priority) Field Descriptions

Field	Description
Codec	Displays the codec value configured for MOS calculation. Codec values can be one of the following: g711alaw, g711ulaw, or g729a.
JitSum	Summary of jitter.
MOS	MOS value.
Jitter	Jitter value.
LoMOSCnt	MOS-low count.

The following example shows prefix statistics including information about application interface provider report requests for the 10.1.1.0 prefix:

```
Router# show oer master prefix 10.1.1.0/24 report
Prefix Performance Report Request
   Created by: Provider 1001, Host 10.3.3.3, Session 9
   Last report sent 3 minutes ago, context 589855, frequency 4 min

Prefix Performance Report Request
   Created by: Provider 1001, Host 10.3.3.4, Session 10
   Last report sent 1 minutes ago, context 655372, frequency 3 min

OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied

Prefix                  State     Time Curr BR         CurrI/F         Protocol
                      PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                      ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                      ActSJit  ActPMOS  ActSLos  ActLLos
--------------------------------------------------------------------------------
10.1.1.0/24             INPOLICY       0 10.3.3.3        Et4/3           BGP
```

```
                         N        N        N        N        N        N
                       138      145        0        0        N        N
                         N        N
```

The table below describes the significant fields shown in the display that are different from the show oer master prefix Field Descriptions, show oer master prefix detail Field Descriptions and show oer master prefix (Jitter and MOS) Field Descriptions tables.

Table 58: show oer master prefix report Field Descriptions

Field	Description
Provider	Application interface provider ID.
Host	IP address of a host device in the application interface provider network.
Session	Session number automatically allocated by OER when an application interface provider initiates a session.
Last report sent	The number of minutes since a report was sent to the application interface provider.
ActSLos	Number of actively monitored short-term lost packets in packets-per-million.
ActLDly	Number of actively monitored long-term lost packets in packets-per-million.

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). The following example shows that the protocol displayed for the prefix 10.1.0.0 is RIB-PBR, which means that the parent route for the traffic class exists in the RIB and policy-based routing is used to control the prefix.

```
Router# show oer master prefix 10.1.0.0
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
Prefix                  State     Time Curr BR         CurrI/F         Protocol
                      PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                      ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                      ActSJit  ActPMOS  ActSLos  ActLLos
--------------------------------------------------------------------------------
10.1.0.0/24          INPOLICY        0 10.11.1.3       Et1/0           RIB-PBR
                          129      130        0        0      214      473
                            U        U        0        0       33        3
                            N        N
```

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. In this example, the protocol displayed for the prefix 10.1.0.0 is EIGRP and this means that the parent route for the traffic class exists in the EIGRP routing table and OER is controlling the prefix.

```
Router# show oer master prefix 10.1.0.0
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
Prefix                  State     Time Curr BR         CurrI/F         Protocol
                      PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos
                      ActSDly  ActLDly   ActSUn   ActLUn      EBw      IBw
                      ActSJit  ActPMOS
--------------------------------------------------------------------------------
10.1.0.0/16           DEFAULT*      @69 10.1.1.1        Gi1/22          EIGRP
                            U        U        0        0        0        0
                            U        U        0        0       22        8
                            N        N
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set traceroute reporting	Configures an OER map to enable traceroute reporting.
traceroute probe-delay	Sets the time interval between traceroute probe cycles.

show oer master traffic-class

To display information about traffic classes that are monitored and controlled by an Optimized Edge Routing (OER) master controller, use the **show oer master traffic-class** command in privileged EXEC mode.

show 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*] **[active] [passive] [status] [detail]**

Syntax Description

access-list	(Optional) Displays information about traffic classes defined by an access list.
access-list-name	(Optional) Name of an access list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.
application	(Optional) Displays information about application traffic classes.
application-name	(Optional) Name of a predefined static application using fixed ports. See the table below.
prefix	(Optional) An IP address and bit length mask representing a prefix to be cleared.
inside	(Optional) Displays information about inside traffic classes.
learned	(Optional) Displays information about learned traffic classes.
delay	(Optional) Displays information about learned traffic classes defined using delay.
list	(Optional) Displays information about learned traffic classes defined in an OER learn list.
list-name	(Optional) Name of an OER learn list.
throughput	(Optional) Displays information about learned traffic classes defined using throughput.
prefix	(Optional) Displays information about traffic classes defined by a specified destination prefix.
prefix-list	(Optional) Displays information about traffic classes defined by a prefix list.

prefix-list-name	(Optional) Name of a prefix list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.
active	(Optional) Displays active performance monitoring information only.
passive	(Optional) Displays passive performance monitoring information only.
status	(Optional) Displays status information only.
detail	(Optional) Displays detailed information.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.4(15)T	This command was introduced.
12.2(33)SXI4	This command was integrated into Cisco IOS Release 12.2(33)SXI4.

Usage Guidelines

The **show oer master traffic-class** command is entered on an OER master controller. This command is used to display information about traffic classes that are configured for monitoring and optimization. In Cisco IOS Release 12.4(15)T, new **traffic-class** and **match traffic-class**commands were introduced to simplify the learning of traffic classes. In Cisco IOS Release 12.4(20)T, the ability to identify a traffic class using Network Based Application Recognition (NBAR) was introduced. Four types of traffic classes can be automatically learned using a **traffic-class**command in a learn list, or manually configured using a **match traffic-class**command in an OER map:

- Traffic classes based on destination prefixes.
- Traffic classes representing custom application definitions using access lists.
- Traffic classes based on a static application mapping name with an optional prefix list filtering to define destination prefixes.
- Traffic classes based on an NBAR-identified application mapping name with an optional prefix list filtering to define destination prefixes.

If none of the **active**, **passive**, or **status** keywords is specified, then the output will display the active, passive, and status information for the traffic classes. To restrict the amount of output, you can specify one or two of the **active**, **passive**, or **status** keywords, but the order of the keywords is important. If you specify the **active** keyword first then the **passive** or **status** keywords can be entered, if you specify the **passive** keyword first, then only the **status** keyword can be entered. The **status** keyword can be entered only by itself; the **active** and **passive** keywords are not accepted if they follow the **status** keyword. The optional **detail** keyword will display detailed output for the traffic classes.

To display information about traffic classes identified using NBAR, use the **show oer master traffic-class application nbar**command.

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

Table 59: 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

Keyword	Protocol	Port
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 information about traffic classes destined for the 10.1.1.0/24 prefix:

```
Router# show oer master traffic-class
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied

DstPrefix                   Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
           Flags              State     Time             CurrBR  CurrI/F Protocol
         PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos      EBw      IBw
         ActSDly  ActLDly   ActSUn   ActLUn  ActSJit  ActPMOS  ActSLos  ActLLos
--------------------------------------------------------------------------------
10.1.1.0/24               N defa    N           N           N N
               #          OOPOLICY       32         10.11.1.3    Et1/0      BGP
               N        N        N        N        N        N        N      IBwN
             130      134        0        0        N        N
```

The following example of the **show oer master traffic-class** command with the **inside** keyword shows information about traffic classes:

```
Router# show oer master traffic-class inside
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
```

```
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied

DstPrefix (inside)  Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
           Flags             State     Time            CurrBR  CurrI/F Protocol
         PasSDly  PasLDly   PasSUn   PasLUn  PasSLos  PasLLos      EBw      IBw
         ActSDly  ActLDly   ActSUn   ActLUn  ActSJit  ActPMOS  ActSLos  ActLLos
--------------------------------------------------------------------------------
10.0.0.0/16                N    N    N           N          N N
                           DEFAULT*       0                 U                 U
```

The table below describes the significant fields shown in the display.

Table 60: show oer master traffic-class Field Descriptions

Field	Description
DstPrefix	Destination IP address and prefix length for the traffic class.
Appl_ID	Application ID.
Dscp	Differentiated Services Code Point (DSCP) value.
Prot	Protocol.
SrcPort	Source port number for the traffic class.
DstPort	Destination port number for the traffic class.
SrcPrefix	IP address of the traffic class source.
Flags	Special characteristics for the traffic class.
State	Current state of the traffic class.
Time	Time, in seconds, between monitoring messages.
Curr BR	IP address of the border router through which this traffic class is being currently routed.
CurrI/F	Interface of the border router through which this traffic class is being currently routed.
Protocol	Protocol. A value of U means unknown; there is no measurement data.
PasSDly	Passive monitoring short term delay in milliseconds.
PasLDly	Passive monitoring long term delay in milliseconds.
PasSUn	Number of passively monitored short-term unreachable packets in flows per million.

Field	Description
PasLUn	Number of passively monitored long-term unreachable packets in flows per million.
PasSLos	Number of passively monitored short-term lost packets in packets per million.
PasLLos	Number of passively monitored long-term lost packets in packets per million.
EBw	Egress bandwidth.
IBw	Ingress bandwidth.
ActSDly	Active monitoring short-term delay in milliseconds.
ActLDly	Active monitoring long-term delay in milliseconds.
ActSUn	Number of actively monitored short-term unreachable packets in flows per million.
ActLUn	Number of actively monitored long-term unreachable packets in flows per million.
ActSJit	Number of actively monitored short-term jitter packets.
ActPMOS	Number of actively monitored Mean Opinion Score (MOS) packets with a percentage below threshold.
ActSLos	Number of actively monitored short-term packets lost.
ActLLos	Number of actively monitored long-term packets lost.

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 master traffic-class application nbar	Displays information about application traffic classes that are identified using NBAR and are monitored and controlled by an OER master controller.

show oer master traffic-class application nbar

To display information about application traffic classes that are identified using Network-Based Application Recognition (NBAR) and are monitored and controlled by an Optimized Edge Routing (OER) master controller, use the **show oer master traffic-class application nbar** command in privileged EXEC mode.

show oer master traffic-class application nbar *nbar-appl-name* [*prefix*] [[**active passive status**]| **detail**]

Syntax Description

nbar-appl-name	Name of a dynamic application identified using NBAR. See the Usage Guidelines section for more details.
prefix	(Optional) An IP address and bit length mask representing a prefix.
active	(Optional) Displays active performance monitoring information only.
passive	(Optional) Displays passive performance monitoring information only.
status	(Optional) Displays status information only.
detail	(Optional) Displays detailed information.

Command Modes

Privileged EXEC (#)

Command History

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

Usage Guidelines

The **show oer master traffic-class application nbar** command is entered on an OER master controller. This command is used to display information about application traffic classes that are identified using NBAR. To display information about traffic classes defined using static application mapping, use the **show oer master traffic-class** command.

The optional **detail** keyword will display detailed output for the NBAR application traffic classes. If the **detail** keyword is not specified, and if none of the **active**, **passive**, or **status** keywords is specified, then the output will display the active, passive, and status information for the traffic classes. To restrict the amount of output, specify just one or two of the **active**, **passive**, or **status** keywords. If specified, the **active**, **passive**, or **status** keywords must be specified in the order shown in the syntax.

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), 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).

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 displayed. 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 displayed.

Examples

The following example shows information about traffic classes consisting of Real-time Transport Protocol streaming audio (RTP-audio) traffic:

```
Router# show oer master traffic-class application nbar rtp-audio
OER Prefix Statistics:
 Pas - Passive, Act - Active, S - Short term, L - Long term, Dly - Delay (ms),
 P - Percentage below threshold, Jit - Jitter (ms),
 MOS - Mean Opinion Score
 Los - Packet Loss (packets-per-million), Un - Unreachable (flows-per-million),
 E - Egress, I - Ingress, Bw - Bandwidth (kbps), N - Not applicable
 U - unknown, * - uncontrolled, + - control more specific, @ - active probe all
 # - Prefix monitor mode is Special, & - Blackholed Prefix
 % - Force Next-Hop, ^ - Prefix is denied
DstPrefix           Appl_ID Dscp Prot     SrcPort     DstPort SrcPrefix
           Flags             State     Time            CurrBR  CurrI/F Protocol
         PasSDly  PasLDly   PasSUn   PasLUn      EBw      IBw
         ActSDly  ActLDly   ActSUn   ActLUn  ActSJit  ActPMOS
--------------------------------------------------------------------------------
100.1.1.0/28      RTP-Audio defa    N           N           N 0.0.0.0/0
                          DEFAULT*      461         101.1.1.2    Et1/0        U
             U        U        0        0        1        2
           150      130        0        0       15        0
100.1.1.16/28     RTP-Audio defa    N           N           N 0.0.0.0/0
                          DEFAULT*      461         101.1.1.2    Et1/0        U
             U        U        0        0        1        2
           250      200        0        0       30        0
```

The table below describes the significant fields shown in the display.

Table 61: show oer master traffic-class Field Descriptions

Field	Description
DstPrefix	Destination IP address and prefix length for the traffic class.

Field	Description
Appl_ID	Application ID. The application can be a static application or an NBAR identified application.
Dscp	Differentiated Services Code Point (DSCP) value.
Prot	Protocol.
SrcPort	Source port number for the traffic class.
DstPort	Destination port number for the traffic class.
SrcPrefix	IP address of the traffic class source.
Flags	Special characteristics for the traffic class, see the key above for details.
State	Current state of the traffic class.
Time	Time, in seconds, between monitoring messages.
Curr BR	IP address of the border router through which this traffic class is being currently routed.
CurrI/F	Interface of the border router through which this traffic class is being currently routed.
Protocol	Protocol. If the traffic class is being controlled by OER this field displays on of the following: BGP, STATIC, or CCE. A value of U means unknown; OER is not controlling the traffic class.
PasSDly	Passive monitoring short term delay in milliseconds.
PasLDly	Passive monitoring long term delay in milliseconds.
PasSUn	Number of passively monitored short term unreachable packets in flows-per-million.
PasLUn	Number of passively monitored long term unreachable packets in flows-per-million.
PasSLos	Number of passively monitored short term lost packets in packets-per-million.
PasLLos	Number of passively monitored long term lost packets in packets-per-million.
EBw	Egress bandwidth.

Field	Description
IBw	Ingress bandwidth.
ActSDly	Active monitoring short term delay in milliseconds.
ActLDly	Active monitoring long term delay in milliseconds.
ActSUn	Number of actively monitored short term unreachable packets in flows-per-million.
ActLUn	Number of actively monitored long term unreachable packets in flows-per-million.
ActSJit	Number of actively monitored short term jitter packets.
ActPMOS	Number of actively monitored Mean Opinion Score (MOS) packets with a percentage below threshold.

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 master traffic-class	Displays information about traffic classes that are monitored and controlled by an OER master controller.

show oer proxy

> **Note** Effective with Cisco IOS Release 15.0(1)SY, the **show oer proxy** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To display Optimized Edge Routing (OER) proxy information, use the **show oer proxy** command in privileged EXEC mode.

show oer proxy

Syntax Description

This command has no arguments or keywords.

Command Modes

Privileged EXEC (#)

Command History

Release	Modification
12.2(33)SRB	This command was introduced.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI.
12.4(24)T	This command was integrated into Cisco IOS Release 12.4(24)T.
15.0(1)SY	This command was modified. This command was hidden.

Examples

The following is sample output from the **show oer proxy** command:

```
Router# show oer proxy

OER PROXY 0.0.0.0 DISABLED, MC 0.0.0.0 UP/DOWN: DOWN
  Conn Status: NOT OPEN, Port 3949
```

The table below describes the significant fields shown in the display.

Table 62: show oer proxy Field Descriptions

Field	Description
OER PROXY	Displays the IP address and the status of the OER proxy.
MC	Displays the IP address of the master controller (MC).

Field	Description
UP/DOWN	Displays the connection status: UP or DOWN.
Conn Status	Displays the connection status: OPEN or NOT OPEN.
Port	Displays the TCP port number used to communicate with the master controller.

Related Commands

Command	Description
show oer api	Displays information about OER application interface clients.

shutdown (OER)

Note Effective with Cisco IOS Release 15.0(1)SY, the **shutdown** command is hidden. Although this command is still available in Cisco IOS software, the CLI interactive Help does not display it if you attempt to view it by entering a question mark at the command line. This command will be completely removed in a future release.

To stop an Optimized Edge Routing (OER) master controller or OER border router process without removing the OER process configuration, use the **shutdown** command in OER master controller or OER border router configuration mode. To start a stopped OER process, use the **no** form of this command.

shutdown

no shutdown

Syntax Description

This command has no arguments or keywords.

Command Default

No master controller or border router is stopped.

Command Modes

OER border router configuration (config-oer-br) OER master controller configuration (config-oer-mc)

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.
15.0(1)SY	This command was modified. This command was hidden.

Usage Guidelines

The **shutdown** command is entered on a master controller or border router. Entering the **shutdown** command stops an active master controller or border router process but does not remove any configuration parameters. The **shutdown**command is displayed in the running configuration file when enabled. To disable a master controller or border router and completely remove the process configuration from the running configuration file, use the **no oer master** or **no oer border** command in global configuration mode.

Cisco IOS Release 12.2(33)SXH

This command is supported only in OER border router configuration mode.

Examples

The following example stops an active OER border router session:

```
Router(config)# oer border
Router(config-oer-br)# shutdown
```

The following example starts an inactive OER master controller session:

```
Router(config)# oer master
Router(config-oer-mc)# no shutdown
```

Related Commands

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

throughput

To configure Optimized Edge Routing (OER) to learn the top prefixes based on the highest outbound throughput, use the **throughput** command in Top Talker and Top Delay learning configuration mode or learn list configuration mode. To disable learning based on outbound throughput, use the **no** form of this command.

throughput

no throughput

Syntax Description

This command has no arguments or keywords.

Command Default

None

Command Modes

Learn list configuration (config-oer-mc-learn-list) 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 learn list configuration mode was added to this command.

Usage Guidelines

The **throughput** command is entered on a master controller. The master controller creates a list of prefixes based on the highest outbound throughput. This command is used to configure a master controller to learn prefixes based on the highest outbound packet throughput. When this command is enabled, OER will learn the top prefixes across all border routers according to the highest outbound throughput.

Examples

Examples

The following example shows how to configure a master controller to learn the top prefixes based on the highest outbound throughput:

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

Examples

The following example shows how to configure a master controller to learn top prefixes based on the highest throughput for a learn list named LEARN_REMOTE_LOGIN_TC that learns Telnet and Secure Shell (SSH) application TCF entries:

```
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)# throughput
```

Related Commands

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

traceroute probe-delay

To set the time interval between traceroute probe cycles, use the **traceroute probe-delay**command in Optimized Edge Routing (OER) master controller configuration mode. To set the interval between probes to the default value, use the **no** form of this command.

traceroute probe-delay *milliseconds*

no traceroute probe-delay *milliseconds*

Syntax Description

milliseconds	Configures the time interval, in milliseconds, between traceroute probes. The configurable range for this argument is a number from 0 to 65535.

Command Default

The following value is used when this command is not configured or the **no** form is entered:

milliseconds : 1000

Command Modes

OER master controller 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 **traceroute probe-delay** command is entered on a master controller. This command is used to set the delay interval between traceroute probes.

Continuous and policy based traceroute reporting is configured with the **set traceroute reporting** OER map configuration mode command. The time interval between traceroute probes is configured with the **traceroute probe-delay** command in OER master controller configuration mode. On-demand traceroute probes are triggered by entering the **show oer master prefix** command with the **current** and **now** keywords.

Examples

The following example, which starts in global configuration mode, sets the delay interval between traceroute probes to 10000 milliseconds:

```
Router(config)# oer master
Router(config-oer-mc)# traceroute probe-delay 10000
```

Related Commands

Command	Description
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.
set traceroute reporting	Configures an OER map to enable traceroute reporting.
show oer master prefix	Displays the status of monitored prefixes.

traffic-class access-list

To define an Optimized Edge Routing (OER) application traffic class using an access list applied to learned traffic flows, use the **traffic-class access-list** command in learn list configuration mode. To disable the definition of OER learned traffic flows into application traffic classes using an access list, use the **no** form of this command.

traffic-class access-list *access-list-name* [**filter** *prefix-list-name*]

no traffic-class access-list

Syntax Description

access-list-name	Name of an access list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.
filter	(Optional) Specifies that the traffic flows are filtered on the basis of a prefix list.
prefix-list-name	(Optional) Name of a prefix list (created using the **ip prefix-list** command).

Command Default

OER application traffic classes are not defined using an access list.

Command Modes

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

Command History

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

Usage Guidelines

The **traffic-class access-list** command is used to configure the master controller to automatically learn application traffic defined in an access list. Only one access list can be specified, but the access list may contain many access list entries (ACEs) to help define the traffic class parameters.

In Cisco IOS Release 12.4(15)T, the learn list configuration mode was introduced. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria for learning traffic classes including prefixes, application definitions, filters, and aggregation parameters can be configured. A traffic class is automatically learned by OER based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different OER policies to be applied to each learn list; in previous releases the traffic classes could not be divided, and an OER policy was applied to all the traffic classes.

Note The **traffic-class access-list** command, the **traffic-class application** command, and the **traffic-class prefix-list** commands are all mutually exclusive in an OER learn list. Only one of these commands can be specified per OER learn list.

Examples

The following example, starting in global configuration mode, shows how to define a custom application traffic class using an access list. Every entry in the access list defines one application, and the destination network of the traffic class is determined by the specified aggregation method. After the access list is configured, the master controller automatically learns the defined application traffic based on highest throughput. A prefix list may be used to filter the traffic flows by destination prefix.

```
Router(config)# ip access-list extended USER_DEFINED_TC
Router(config-ext-nacl)# permit tcp any any 500
Router(config-ext-nacl)# permit tcp any any range 700 750
Router(config-ext-nacl)# permit udp 10.1.1.1 0.0.0.0 any
Router(config-ext-nacl)# permit ip any any dscp ef
Router(config-ext-nacl)# exit
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# list seq 10 refname LEARN_USER_DEFINED_TC
Router(config-oer-mc-learn-list)# traffic-class access-list USER_DEFINED_TC
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
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on the type of traffic flow.
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
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.

traffic-class aggregate

To aggregate Optimized Edge Routing (OER) learned traffic flows into application traffic classes using an access list, use the **traffic-class aggregate** command in OER Top Talker and Top Delay learning configuration mode. To disable the aggregation of OER learned traffic flows into application traffic classes using an access list, use the **no** form of this command.

traffic-class aggregate access-list *access-list-name*

no traffic-class aggregate access-list *access-list-name*

Syntax Description

access-list	Specifies that an IP access list is to be used to aggregate the OER learned traffic flows into application traffic classes.
access-list-name	Name of the access list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.

Command Default

OER learned traffic flows are not aggregated into application traffic classes using an access list.

Command Modes

OER Top Talker and Top Delay learning 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

The **traffic-class aggregate** command can be used with the **traffic-class filter** and **traffic-class keys** commands to configure the master controller to automatically learn defined application traffic. Only one access list can be specified, but the access list may contain many access list entries (ACEs) to help define the traffic class parameters.

Note The **traffic-class aggregate** command is different from the **aggregation-type** command that aggregates learned prefixes based on the type of traffic flow. The **traffic-class aggregate** command introduces the ability to use an access list to aggregate learned traffic flows to create an application traffic class. Both commands can be used in the same configuration.

Examples

The following example, starting in global configuration mode, configures the master controller to automatically learn defined application traffic. In this example, two access lists are created to identify and define voice traffic in the network. Using the **traffic-class aggregate** and the **traffic-class filter** commands with the access lists, only voice traffic with a Differentiated Services Code Point (DSCP) bit set to ef, a User Datagram Protocol (UDP), and a destination port in the range of 3000 to 4000 is learned and added to the OER application database on the master controller.

```
Router(config)# ip access-list extended voice-filter-acl
Router(config-ext-nacl)# permit udp any 10.1.0.0 0.0.255.255 dscp ef

Router(config-ext-nacl)# exit
Router(config)# ip access-list extended voice-agg-acl
Router(config-ext-nacl)# permit udp any any range 3000 4000 dscp ef

Router(config-ext-nacl)# exit
Router(config)# oer master

Router(config-oer-master)# learn

Router(config-oer-master-learn)# aggregation-type prefix-length 24

Router(config-oer-master-learn)# throughput

Router(config-oer-master-learn)# traffic-class filter access-list voice-filter-acl

Router(config-oer-master-learn)# traffic-class aggregate access-list voice-agg-acl
Router(config-oer-master-learn)# traffic-class keys protocol dport dscp
Router(config-oer-master-learn)# end
```

Related Commands

Command	Description
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on the type of traffic flow.
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.
traffic-class filter	Filters uninteresting traffic from OER learned traffic flows using an access list.
traffic-class keys	Specifies a key list used by an OER border router to aggregate the traffic flows into learned application classes.

traffic-class application

To define an Optimized Edge Routing (OER) traffic class using a predefined static application, use the **traffic-class application** command in learn list configuration mode. To remove the definition of an OER learned traffic class using a predefined static application, use the **no** form of this command.

traffic-class application *application-name* [**filter** *prefix-list-name*]

no traffic-class application *application-name* [**filter** *prefix-list-name*]

Syntax Description

application-name	Name of a predefined static application using fixed ports. See the table below.
filter	(Optional) Specifies that the traffic flows are filtered on the basis of a prefix list.
prefix-list-name	(Optional) Name of a prefix list (created using the **ip prefix-list** command).

Command Default

OER traffic classes are not defined using a static application mapping.

Command Modes

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

Command History

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

Usage Guidelines

The **traffic-class application** command is used to configure the master controller to automatically learn traffic using a keyword that represents an application. OER maps the application keyword to a protocol--TCP or UDP, or both--and one or more ports and this mapping is shown in the table below. More than one application can be configured as part of the traffic class.

In Cisco IOS Release 12.4(15)T, the learn list configuration mode was introduced. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria for learning traffic classes including prefixes, application definitions, filters, and aggregation parameters can be configured. A traffic class is automatically learned by OER based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different OER policies to be applied to each learn list; in previous releases, the traffic classes could not be divided, and an OER policy was applied to all the traffic classes.

Note The **traffic-class access-list** command, the **traffic-class application** command, the **traffic-class application nbar** command, and the **traffic-class prefix-list** commands are all mutually exclusive in an OER learn list. Only one of these commands can be specified per OER learn list.

The table below displays the keywords that represent the application that can be configured with the **traffic-class application** command. Replace the *application-name* argument with the appropriate keyword from the table.

Table 63: 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

Keyword	Protocol	Port
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, starting in global configuration mode, shows how to define application traffic classes using two OER learn lists, LEARN_REMOTE_LOGIN_TC and LEARN_FILE_TRANSFER_TC. The number of traffic classes to be learned in both learn list sessions is set to 50, and the maximum number of traffic classes to be learned for all sessions of the learn list is set to 90. 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 to be passively and actively monitored.

```
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 50 max 90
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
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on the type of traffic flow.
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
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.
traffic-class application nbar	Defines an OER traffic class using an NBAR application mapping.

traffic-class application nbar

To define an Optimized Edge Routing (OER) traffic class using an Network-Based Application Recognition (NBAR) application mapping, use the **traffic-class application nbar** command in learn list configuration mode. To remove the definition of an OER learned traffic class using an application identified using NBAR, use the **no** form of this command.

traffic-class application nbar *nbar-appl-name* [*nbar-appl-name* ...] [**filter** *prefix-list-name*]

no traffic-class application nbar [*nbar-appl-name* ...]

Syntax Description

nbar-appl-name	Keyword representing the name of a dynamic application identified using NBAR. One application must be specified, but the ellipses show that more than one application keyword can be specified, up to a maximum of ten. See the Usage Guidelines section for more details.
filter	(Optional) Specifies that the traffic flows are filtered on the basis of a prefix list.
prefix-list-name	(Optional) Name of a prefix list (created using the **ip prefix-list** command).

Command Default

OER traffic classes are not defined using an NBAR application mapping.

Command Modes

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

Command History

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

Usage Guidelines

The **traffic-class application nbar** command is used to configure the master controller to automatically learn traffic using a keyword that represents an application that can be identified using NBAR. More than one application can be configured as part of the traffic class with a maximum of ten applications entered per command line. Enter multiple **traffic-class application nbar** command statements if you need to specify more than ten applications.

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) andPost 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 **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 of 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* .

In Cisco IOS Release 12.4(15)T, the learn list configuration mode was introduced. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria for learning traffic classes including prefixes, application definitions, filters, and aggregation parameters can be configured. A traffic class is automatically learned by OER based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different OER policies to be applied to each learn list; in previous releases, the traffic classes could not be divided, and an OER policy was applied to all the traffic classes.

Note The **traffic-class access-list** command, the **traffic-class application** command, the **traffic-class application nbar** command, and the **traffic-class prefix-list** commands are all mutually exclusive in an OER learn list. Only one of these commands can be specified per OER learn list.

Examples

The following example, starting in global configuration mode, shows how to define application traffic classes identified by using NBAR and two OER learn lists, LEARN_VOICE_TC and LEARN_VIDEO_TC. The number of traffic classes to be learned in both learn list sessions is 50, and the maximum number of traffic classes to be learned for all sessions of the learn list is 90.

The Voice over IP (VoIP) traffic class is configured using keywords representing RTP-Audio and the resulting prefixes are aggregated to a prefix length of 24. The video traffic class is configured using a keyword that represents RTP-video and is also aggregated to a prefix length of 24. A prefix list is applied to the video traffic class to match traffic for the destination prefix of 10.0.0.0/8. The master controller is configured to learn the top prefixes based on highest outbound throughput for the learned traffic, and the resulting traffic classes are added to the OER application database.

The traffic streams that the learn list profiles for both the RTP-audio and the RTP-video applications are:

```
10.1.1.1
10.1.2.1
20.1.1.1
20.1.2.1
```

The traffic classes that are learned for each application are:

```
10.1.1.0/24 rtp-audio
10.1.2.0/24 rtp-audio
20.1.1.0/24 rtp-audio
20.1.2.0/24 rtp-audio
```

```
10.1.1.0/24 rtp-video
10.1.2.0/24 rtp-video
```

The difference in traffic classes learned is due to the optional INCLUDE_10_NET prefix list that only includes RTP-video application traffic with a destination prefix that matches the prefix 10.0.0.0/8.

```
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_VOICE_TC
Router(config-oer-mc-learn-list)# count 50 max 90
Router(config-oer-mc-learn-list)# traffic-class application nbar rtp-audio
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_VIDEO_TC
Router(config-oer-mc-learn-list)# count 50 max 90
Router(config-oer-mc-learn-list)# traffic-class application nbar rtp-video
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
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on the type of traffic flow.
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
list (OER)	Creates an OER learn list to specify criteria for learning traffic classes and enters learn list configuration mode.
match traffic-class application nbar	Defines a match clause using an NBAR application mapping in an OER map to create a traffic class.
oer	Enables an OER process and configures a router as an OER border router or as an OER master controller.

traffic-class filter

To filter uninteresting traffic from Optimized Edge Routing (OER) learned traffic flows using an access list, use the **traffic-class filter** command in OER Top Talker and Top Delay learning configuration mode. To disable the filtering of OER learned traffic flows using an access list, use the **no** form of this command.

traffic-class filter access-list *access-list-name*

no traffic-class filter access-list *access-list-name*

Syntax Description

access-list	Specifies that an IP access list is to be used to filter uninteresting traffic from OER learned traffic flows.
access-list-name	Name of the access list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.

Command Default

Uninteresting traffic is not filtered from OER traffic flows using an access list.

Command Modes

OER Top Talker and Top Delay learning 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

OER is used to optimize the performance of selected traffic flows in your network. While defining the selected traffic flows, this command is used to filter out traffic that you are not interested in optimizing.

The **traffic-class filter** command can be used with the **traffic-class aggregate** and **traffic-class keys** commands to configure the master controller to automatically learn defined application traffic. Only one access list can be specified, but the access list may contain many access list entries (ACEs) to help define the traffic class parameters.

Examples

The following example, starting in global configuration mode, configures the master controller to automatically learn defined application traffic. In this example, two access lists are created to identify and define voice traffic in the network. Using the **traffic-class aggregate** and the **traffic-class filter** commands with the access lists, only voice traffic with a Differentiated Services Code Point (DSCP) bit set to ef, a User Datagram

Protocol (UDP), and a destination port in the range of 3000 to 4000 is learned and added to the OER application database on the master controller.

```
Router(config)# ip access-list extended voice-filter-acl
Router(config-ext-nacl)# permit udp any 10.1.0.0 0.0.255.255 dscp ef

Router(config-ext-nacl)# exit
Router(config)# ip access-list extended voice-agg-acl
Router(config-ext-nacl)# permit udp any any range 3000 4000 dscp ef

Router(config-ext-nacl)# exit
Router(config)# oer master

Router(config-oer-master)# learn

Router(config-oer-master-learn)# aggregation-type prefix-length 24

Router(config-oer-master-learn)# throughput

Router(config-oer-master-learn)# traffic-class filter access-list voice-filter-acl

Router(config-oer-master-learn)# traffic-class aggregate access-list voice-agg-acl
Router(config-oer-master-learn)# traffic-class keys dscp protocol dport
Router(config-oer-master-learn)# end
```

Related Commands

Command	Description
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on the type of traffic flow.
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.
traffic-class aggregate	Aggregates OER learned traffic flows into application traffic classes using an access list.
traffic-class keys	Specifies a key list used by an OER border router to aggregate the traffic flows into learned application classes.

traffic-class keys

To specify a key list of fields in the traffic flows that an Optimized Edge Routing (OER) border router uses to aggregate traffic flows into application traffic classes, use the **traffic-class keys** command in OER Top Talker and Top Delay learning configuration mode. To remove the key list, use the **no** form of this command.

traffic-class keys [**default**| [**dscp**] [**protocol** [**dport**] [**sport**]]]

no traffic-class keys [**default**| [**dscp**] [**protocol** [**dport**] [**sport**]]]

Syntax Description

default	(Optional) Aggregates the traffic flows into application traffic classes on the basis of protocol and destination port.
dscp	(Optional) Aggregates the traffic flows into application traffic classes on the basis of Differentiated Services Code Point (DSCP) value.
protocol	(Optional) Aggregates the traffic flows into application traffic classes on the basis of the protocol.
dport	(Optional) Aggregates the traffic flows into application traffic classes on the basis of the destination port.
sport	(Optional) Aggregates the traffic flows into application traffic classes on the basis of the source port.

Command Default

No OER traffic class key lists are created.

Command Modes

OER Top Talker and Top Delay learning 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

The **traffic-class keys** command can be used with the **traffic-class filter** and **traffic-class aggregate** commands to configure the master controller to automatically learn defined application traffic. This command is used only if the **traffic-class aggregate** command is not configured or returns no matches.

Examples

In this following task, the **traffic-class filter** command references an access list that is used to filter out unwanted traffic, and an access list with aggregation criteria aggregates the traffic into subsets of traffic classes using the **traffic-class aggregate** command. Traffic class keys are specified with the **traffic-class keys** command, but they will be used only if the traffic class aggregation access list does not have any matches. Usually traffic class keys are specified when there is no traffic class aggregation. In this example, only voice traffic with a DSCP bit set to ef, a User Datagram Protocol (UDP), and a destination port in the range of 3000 to 4000 is learned and added to the OER application database on the master controller.

```
Router(config)# ip access-list extended voice-filter-acl
Router(config-ext-nacl)# permit udp any 10.1.0.0 0.0.255.255 dscp ef

Router(config-ext-nacl)# exit
Router(config)# ip access-list extended voice-agg-acl
Router(config-ext-nacl)# permit udp any any range 3000 4000 dscp ef

Router(config-ext-nacl)# exit
Router(config)# oer master

Router(config-oer-master)# learn

Router(config-oer-master-learn)# aggregation-type prefix-length 24

Router(config-oer-master-learn)# throughput

Router(config-oer-master-learn)# traffic-class filter access-list voice-filter-acl

Router(config-oer-master-learn)# traffic-class aggregate access-list voice-agg-acl
Router(config-oer-master-learn)# traffic-class keys dscp protocol dport
Router(config-oer-master-learn)# end
```

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.
traffic-class aggregate	Aggregates OER learned traffic flows into application traffic classes using an access list.
traffic-class filter	Filters uninteresting traffic from OER learned traffic flows using an access list.

traffic-class prefix-list

To define an Optimized Edge Routing (OER) traffic class using a prefix list applied to learned traffic classes, use the **traffic-class prefix-list** command in learn list configuration mode. To disable the definition of OER learned traffic flows into traffic classes using a prefix list, use the **no** form of this command.

traffic-class prefix-list *prefix-list-name* **[inside]**

no traffic-class prefix-list

Syntax Description

prefix-list-name	Name of a prefix list. Names cannot contain either a space or quotation marks and must begin with an alphabetic character to distinguish them from numbered access lists.
inside	(Optional) Specifies that the prefix list contains inside prefixes.

Command Default

OER application traffic classes are not defined using a prefix list.

Command Modes

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

Command History

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

Usage Guidelines

The **traffic-class prefix-list** command is used to configure the master controller to automatically learn traffic based only on destination prefixes. Use the optional **inside** keyword to specify prefixes that are within the internal network.

In Cisco IOS Release 12.4(15)T, the learn list configuration mode was introduced. Learn lists are a way to categorize learned traffic classes. In each learn list, different criteria for learning traffic classes including prefixes, application definitions, filters, and aggregation parameters can be configured. A traffic class is automatically learned by OER based on each learn list criteria, and each learn list is configured with a sequence number. The sequence number determines the order in which learn list criteria are applied. Learn lists allow different OER policies to be applied to each learn list; in previous releases the traffic classes could not be divided, and an OER policy was applied to all the traffic classes.

Note The **traffic-class prefix-list** command, the **traffic-class application** command, and the **traffic-class access-list** commands are all mutually exclusive in an OER learn list. Only one of these commands can be specified per OER learn list.

Examples

The following example, starting in global configuration mode, shows how to define traffic classes based only on destination prefixes for a learn list named LEARN_PREFIX_TC. The traffic classes are created using the prefix list, LEARN_LIST1, in which every entry in the prefix list defines one destination network of a traffic class. After the prefix list is configured, the master controller automatically learns the traffic classes based on the highest throughput.

```
Router(config)# ip prefix-list LEARN_LIST1 permit seq 10 10.0.0.0/8
Router(config)# ip prefix-list LEARN_LIST1 permit seq 20 172.16.0.0/16
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# list seq 10 refname LEARN_PREFIX_TC
Router(config-oer-mc-learn-list)# aggregation-type prefix-length 24
Router(config-oer-mc-learn-list)# traffic-class prefix-list LEARN_LIST1
Router(config-oer-mc-learn-list)# throughput
Router(config-oer-mc-learn-list)# end
```

Related Commands

Command	Description
aggregation-type	Configures an OER master controller to aggregate learned prefixes based on the type of traffic flow.
learn	Enters OER Top Talker and Top Delay learning configuration mode to configure prefixes for OER to learn.
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.

unreachable

To set the relative percentage or maximum number of unreachable hosts that Optimized Edge Routing (OER) permits from an OER-managed exit link, use the **unreachable** command in OER master controller configuration mode. To return the maximum number of unreachable hosts to the default value, use the **no** form of this command.

unreachable {**relative** *average*| **threshold** *maximum*}

no unreachable

Syntax Description

relative *average*	Sets a relative percentage of unreachable hosts based on a comparison of short-term and long-term percentages. The range of values that can be configured for this argument is a number from 1 to a 1000. Each increment represents one tenth of a percent.
threshold *maximum*	Sets the absolute maximum number of unreachable hosts based on flows per million (fpm). The range of values that can be configured for this argument is from 1 to 1000000.

Command Default

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

relative *average* : 50 (5 percent)

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 **unreachable** command entered on a master controller. This command is used to specify the relative percentage or the absolute maximum number of unreachable hosts, based on fpm, that OER will permit from an OER-managed exit link. If the absolute number or relative percentage of unreachable hosts is greater than the user-defined or the default value, OER determines that the exit link is out-of-policy and searches for an alternate exit link.

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

Relative percentage of unreachable hosts = ((short-term percentage - long-term percentage) / long-term percentage) * 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 exit link is determined to be out-of-policy. For example, if 10 hosts are unreachable during the long-term measurement and 12 hosts are unreachable during short-term measurement, the relative percentage of unreachable hosts is 20 percent.

The **threshold** keyword is used to configure the absolute maximum number of unreachable hosts. The maximum value is based on the actual number of hosts that are unreachable based on fpm.

Examples

The following example configures the master controller to search for a new exit link when the difference between long- and short-term measurements (relative percentage) is greater than 10 percent:

```
Router(config)# oer master
Router(config-oer-mc)# unreachable relative 100
```

The following example configures OER to search for a new exit link when 10,000 hosts are unreachable:

```
Router(config)# oer master
Router(config-oer-mc)# unreachable threshold 10000
```

Related Commands

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