OER BGP Inbound Optimization

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Optimized Edge Routing (OER) Border Gateway Protocol (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) can influence the entrance path for traffic entering the network. OER uses eBGP advertisements to manipulate the best entrance selection.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for OER BGP Inbound Optimization" section on page 29.

Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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

Prerequisites for OER BGP Inbound Optimization

- Before implementing OER prefix monitoring, you need to understand and configure a basic OER-managed network. See the *Cisco IOS Optimized Edge Routing Configuration Guide*, Release 12.4T for more details.
- BGP peering must be configured in the network.

Information About OER BGP Inbound Optimization

To configure OER BGP inbound optimization, you should understand the following concepts:

OER Inside Prefixes

An OER inside prefix is defined as a public IP prefix assigned to a company. An OER outside prefix is defined as a public IP prefix assigned outside the company. Companies advertise the inside prefixes over the Internet using an Internet service provider (ISP) and receive advertisements for outside prefixes from an ISP.

OER Inbound Optimization Using BGP

A network advertises reachability of its inside prefixes to the Internet using eBGP advertisements to its ISPs. If the same prefix is advertised to more than one ISP, then the network is multihoming. OER BGP inbound optimization works best with multihomed networks, but it can also be used with a network that has multiple connections to the same ISP. To implement BGP inbound optimization, OER manipulates eBGP advertisements to influence the best entrance selection for traffic bound for inside prefixes. The benefit of implementing the best entrance selection is limited to a network that has more than one ISP connection.

OER can use four methods to influence the best entrance selection of an inside prefix into the network:

- Withdraw—Prevent prefix advertisement.
- Autonomous system number prepend.
- Autonomous system number community prepend.
- Local preference community.

Withdraw

OER can prevent the advertisement of an inside prefix in eBGP over an OER external interface. When the inside prefix advertisement is withdrawn, an external autonomous system such as an ISP will remove the route from the routing information base (RIB). The link over that interface is no longer considered an entrance for the withdrawn inside prefix. Prefix traffic will be distributed over the other entrances

where the inside prefix is still advertised. If OER prevents the advertisement of an inside prefix over every link except one, then there is only a single entrance into the network for the withdrawn inside prefix.

If OER withdraws an inside prefix from eBGP on an OER external interface, Reverse Path Forwarding (RPF) checking at an ISP may drop all packets exiting the OER external interface that use the withdrawn inside prefix. Another issue that must be considered is that if OER withdraws an inside prefix, then that entrance is no longer available if an outage occurs on other entrances. Summary routes can be configured in the network to handle both these issues.

Autonomous System Number Prepend

After OER selects a best entrance for an inside prefix, extra autonomous system hops are prepended to the inside prefix BGP advertisement over the other entrances. The extra autonomous system hops on the other entrances increase the probability that the best entrance will be used for the inside prefix. If you use this method of inbound optimization and a change is made to an autonomous system, you must issue a soft outbound reconfiguration using the **clear ip bgp** command.

Autonomous System Number Community Prepend

After OER selects a best entrance for an inside prefix, a BGP prepend community is attached to the inside prefix BGP advertisement from the network to another autonomous system such as an 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. There are some issues, for example, not all ISPs support the BGP prepend community, ISP policies may ignore or modify the autonomous system hops, and a transit ISP may filter the autonomous system path.

Local Preference BGP Community

Within a BGP autonomous system, the Local_Pref attribute is included in all update messages between BGP peers. If there are several paths to the same destination, the Local_Pref attribute with the highest value indicates the preferred outbound path from the local autonomous system. The highest ranking route is advertised to internal peers. The Local_Pref value is not forwarded to external peers.

After OER selects a best entrance for an inside prefix, a local preference BGP community is attached to the inside prefix when advertised from the network to another autonomous system such as an ISP over the best entrance (OER external interface). The ISP advertises the inside prefix within the ISP network using the specified Local_Pref value. BGP will choose the path with the highest Local_Pref value because Local_Pref is the highest priority method for selecting a route, and this method ensures that the best entrance can be enforced within the ISP.

There are some issues, for example, not all ISPs support the BGP Local_Pref community, ISPs do not usually advertise BGP Local_Pref communities to each other, and each provider must apply the same default Local_Pref value to a prefix regardless of the origin of the advertisement.

How to Configure OER BGP Inbound Optimization

To optimize traffic routing, subsets of the total traffic must be identified in the OER learn phase, and these traffic subsets are named traffic class flows (TCF) entries. To configure OER BGP inbound optimization the OER master controller can either be configured to automatically learn the TCF entries, or the TCF entries can be manually configured. After the inside prefixes are identified and monitored, a policy can be applied to determine the best entrance for the inside prefixes. This section contains the following tasks:

Configuring OER to Automatically Learn Inside Prefixes

Perform this task to configure an OER master controller to automatically learn inside prefixes to be used as TCF entries to be entered in the Monitored Traffic Class (MTC) list. This task is configured at the master controller. The **learn** command is entered in OER master controller configuration mode and is required to enter OER Top Talker and Top Delay configuration mode. This task configures prefix learning of the inside prefixes (prefixes within the network). Optional configuration parameters such as learning period timers, maximum number of prefixes, and an expiration time for MTC list entries are also shown.

Prerequisites

Before configuring this task, BGP peering for internal and external BGP neighbors must be configured.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **oer master**
4. **learn**
5. **inside bgp**
6. **aggregation-type** {**bgp** | **non-bgp** | **prefix-length** *prefix-mask*}
7. **monitor-period** *minutes*
8. **periodic-interval** *minutes*
9. **prefixes** *number*
10. **expire after** {**session** *number* | **time** *minutes*}
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**oer master** **Example:** `Router(config)# oer master`	Enters OER master controller configuration mode to configure a router as a master controller and to configure global operations and policies.
Step 4	**learn** **Example:** `Router(config-oer-mc)# learn`	Enters OER Top Talker and Top Delay learning configuration mode to configure prefix learning policies and timers.
Step 5	**inside bgp** **Example:** `Router(config-oer-mc-learn)# inside bgp`	Learns prefixes inside the network.
Step 6	**aggregation-type** {**bgp** | **non-bgp** | **prefix-length**} *prefix-mask* **Example:** `Router(config-oer-mc-learn)# aggregation-type bgp`	(Optional) Configures a master controller to aggregate learned prefixes based on traffic flow type. • The **bgp** keyword configures prefix aggregation based on entries in the BGP routing table. This keyword is used if iBGP peering is enabled in the internal network. • The **non-bgp** keyword configures learned prefix aggregation based on static routes. Entries in the BGP routing table are ignored when this keyword is entered. • The **prefix-length** keyword 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. • If this command is not specified, the default aggregation is performed based on a /24 prefix length. • The example configures BGP prefix aggregation.

	Command or Action	Purpose
Step 7	**monitor-period** *minutes* **Example:** `Router(config-oer-mc-learn)# monitor-period 10`	(Optional) Sets the time period that an OER master controller learns traffic flows. • The default learning period is 5 minutes. • 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. • The example sets the length of each monitoring period to 10 minutes.
Step 8	**periodic-interval** *minutes* **Example:** `Router(config-oer-mc-learn)# periodic-interval 20`	(Optional) Sets the time interval between prefix learning periods. • By default, the interval between prefix learning periods is 120 minutes. • The example sets the time interval between monitoring periods to 20 minutes.
Step 9	**prefixes** *number* **Example:** `Router(config-oer-mc-learn)# prefixes 200`	(Optional) Sets the number of prefixes that the master controller will learn during the monitoring period. • By default, the top 100 traffic flows are learned. • The example configures a master controller to learn 200 prefixes during each monitoring period.
Step 10	**expire after** {**session** *number* | **time** *minutes*} **Example:** `Router(config-oer-mc-learn)# expire after session 100`	(Optional) Sets the length of time that learned prefixes are kept in the central policy database. • The **session** keyword configures learned prefixes to be removed after the specified number of monitoring periods have occurred. • The **time** keyword configures learned prefixes to be removed after the specified time period. The time value is entered in minutes. • The example configures learned prefixes to be removed after 100 monitoring periods.
Step 11	**end** **Example:** `Router(config-oer-mc-learn)# end`	Exits OER Top Talker and Top Delay learning configuration mode, and enters privileged EXEC mode.

What to Do Next

This section shows how to configure automatic prefix learning for inside prefixes. To configure specific prefixes for monitoring and optimization, see the "Manually Selecting Inside Prefixes for OER Monitoring" section on page 7. To apply an OER policy to the learned prefixes, see the "Applying a Policy to Learned Inside Prefixes" section on page 8.

Manually Selecting Inside Prefixes for OER Monitoring

Perform this task to manually select inside prefixes for monitoring. An IP prefix list is created to define the inside prefix or prefix range. The prefix list is then imported into the central policy database by configuring a match clause in an OER map. The following IP prefix list configuration options are supported:

- An exact prefix (/32)
- A specific prefix length and any subset (for example, a /24 under a /16)
- A specific prefix and all more specific routes (le 32)
- All prefixes (0.0.0.0/0)

Manually Excluding Prefixes

An IP prefix list with a deny statement is used to configure the master controller to exclude a prefix or prefix length. Deny prefix list sequences should be applied in the lowest oer map sequences for best performance.

OER Map Operation

The operation of an OER map is similar to the operation of a route-map. An OER map is configured to select an IP prefix list or OER learn policy 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.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* | **permit** *network/length*} [**le** *le-value*]
4. **oer-map** *map-name sequence-number*
5. **match ip address prefix-list** *name* [**inside**]
6. **end**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router> enable`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

	Command or Action	Purpose
Step 3	**ip prefix-list** *list-name* [**seq** *seq-value*] {**deny** *network/length* | **permit** *network/length*} [**le** *le-value*] **Example:** `Router(config)# ip prefix-list INSIDE_PREFIXES seq 20 permit 192.168.1.0/24`	Creates a prefix list to manually select prefixes for monitoring. • A master controller can monitor and control an exact prefix of any length including the default route. The master controller acts only on the configured prefix. • The example creates an IP prefix list for OER to monitor and control the exact prefix, 192.168.1.0/24
Step 4	**oer-map map-name** *sequence-number* **Example:** `Router(config)# oer-map INSIDE_MAP 10`	Enters OER map configuration mode to create or configure an OER map. • OER map operation is similar to that of route maps. • Only a single match clause can be configured for each OER map sequence. • Common and deny sequences should be applied to lowest oer-map sequence for best performance. • The example creates an OER map named INSIDE_MAP.
Step 5	**match ip address prefix-list** *name* [**inside**] **Example:** `Router(config-oer-map)# match ip address prefix-list INSIDE_PREFIXES inside`	Creates a prefix list match clause entry in an oer-map to apply OER policies. • This command supports IP prefix lists only. • The example creates a match clause to use the prefix list INSIDE_PREFIXES to specify that inside prefixes must be matched.
Step 6	**end** **Example:** `Router(config-oer-map)# end`	Exits OER map configuration mode and returns to privileged EXEC mode.

What to Do Next

This section shows how to configure manual prefix learning for inside prefixes. To apply an OER policy to the configured prefixes, see the "Applying a Policy to Configured Inside Prefixes" section on page 11.

Applying a Policy to Learned Inside Prefixes

Perform this task to apply a policy to learned inside prefix TCF entries from the MTC list. The policy is configured using an OER map and contains some set clauses.

Note Policies applied in an OER map do not override global policy configurations.

SUMMARY STEPS

1. **enable**
2. **configure terminal**

3. **oer-map** *map-name sequence-number*
4. **match oer learn** {**delay** | **inside** | **throughput**}
5. **set delay** {**relative** *percentage* | **threshold** *maximum*}
6. **set loss** {**relative** *average* | **threshold** *maximum*}
7. **set unreachable** {**relative** *average* | **threshold** *maximum*}
8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**oer-map** *map-name sequence-number* **Example:** `Router(config)# oer-map INSIDE_LEARN 10`	Enters OER map configuration mode to configure an OER map to apply policies to selected IP prefixes. • Only one match clause can be configured for each OER map sequence. • Deny sequences are first defined in an IP prefix list and then applied with a **match** command. • The example creates an OER map named INSIDE_LEARN.
Step 4	**match oer learn** {**delay** | **inside** | **throughput**} **Example:** `Router(config-oer-map)# match oer learn inside`	Creates a match clause entry in an OER map to match OER learned prefixes. • Prefixes can be configured to learn prefixes that are inside prefixes or prefixes based on lowest delay, or highest outbound throughput. • Only a single match clause can be configured for each OER map sequence. • The example creates a match clause entry that matches traffic learned using inside prefixes.

	Command or Action	Purpose
Step 5	**set delay** {**relative** *percentage* | **threshold** *maximum*} **Example:** `Router(config-oer-map)# set delay threshold 2000`	Creates a set clause entry to configure the delay threshold. • The delay threshold can be configured 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 **threshold** keyword is used to configure the absolute maximum delay period in milliseconds. • The example creates a set clause that sets the absolute maximum delay threshold to 2000 milliseconds for traffic that is matched in the same OER map sequence.
Step 6	**set loss** {**relative** *average* | **threshold** *maximum*} **Example:** `Router(config-oer-map)# set loss relative 200`	Creates a set clause entry to configure the relative or maximum packet loss limit that the master controller will permit for an exit link. • This command is used to configure an OER map to configure 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, the master controller determines that the exit link is out-of-policy. • 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 **threshold** keyword is used to configure the absolute maximum packet loss. The maximum value is based on the actual number of packets per million that have been lost. • The example creates a set clause that configures the relative percentage of acceptable packet loss to less than 20 percent for traffic that is matched in the same OER map sequence.

	Command or Action	Purpose
Step 7	**set unreachable** {**relative** *average* | **threshold** *maximum*} **Example:** `Router(config-oer-map)# set unreachable relative 100`	Creates a set clause entry to configure the maximum number of unreachable hosts. • This command is used to specify the relative percentage or the absolute maximum number of unreachable hosts, based on flows per million, that a master controller 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, the master controller 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 **threshold** keyword is used to configure the absolute maximum number of unreachable hosts based on fpm. • The example creates a set clause entry that configures the master controller to search for a new exit link when the relative percentage of unreachable hosts is equal to or greater than 10 percent for traffic learned based on highest delay.
Step 8	**end** **Example:** `Router(config-oer-map)# end`	(Optional) Exits OER map configuration mode and returns to privileged EXEC mode.

Applying a Policy to Configured Inside Prefixes

Perform this task to apply a policy to configured inside prefix TCF entries from the MTC list. The policies are configured using an OER map. This task contains prefix list configuration with different criteria in the set clauses.

Note Policies applied in an OER map do not override global policy configurations.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **oer-map** *map-name sequence-number*
4. **match ip address prefix-list** *prefix-list-name* [**inside**]
5. **set delay** {**relative** *percentage* | **threshold** *maximum*}
6. **set loss** {**relative** *average* | **threshold** *maximum*}
7. **set unreachable** {**relative** *average* | **threshold** *maximum*}

8. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**oer-map map-name** *sequence-number* **Example:** `Router(config)# oer-map INSIDE_CONFIGURE 10`	Enters OER map configuration mode to create or configure an OER map. • OER map operation is similar to that of route maps. • Only a single match clause can be configured for each OER map sequence. • Common and deny sequences should be applied to lowest oer-map sequence for best performance. • The example creates an OER map named INSIDE_CONFIGURE.
Step 4	**match ip address prefix-list** *name* [**inside**] **Example:** `Router(config-oer-map)# match ip address prefix-list INSIDE_PREFIXES inside`	Creates a prefix list match clause entry in an OER map to apply OER policies. • This command supports IP prefix lists only. • The example creates a match clause entry using the prefix list INSIDE_PREFIXES that specifies inside prefixes.
Step 5	**set delay** {**relative** *percentage* | **threshold** *maximum*} **Example:** `Router(config-oer-map)# set delay threshold 2000`	Creates a set clause entry to configure the delay threshold. • The delay threshold can be configured 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 **threshold** keyword is used to configure the absolute maximum delay period in milliseconds. • The example creates a set clause that sets the absolute maximum delay threshold to 2000 milliseconds for traffic that is matched in the same OER map sequence.

	Command or Action	Purpose
Step 6	**set loss** {**relative** *average* | **threshold** *maximum*} **Example:** `Router(config-oer-map)# set loss relative 200`	Creates a set clause entry to configure the relative or maximum packet loss limit that the master controller will permit for an exit link. • This command is used to configure an OER map to configure 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, the master controller determines that the exit link is out-of-policy. • 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 **threshold** keyword is used to configure the absolute maximum packet loss. The maximum value is based on the actual number of packets per million that have been lost. • The example creates a set clause that configures the relative percentage of acceptable packet loss to less than 20 percent for traffic that is matched in the same OER map sequence.
Step 7	**set unreachable** {**relative** *average* | **threshold** *maximum*} **Example:** `Router(config-oer-map)# set unreachable relative 100`	Creates a set clause entry to configure the maximum number of unreachable hosts. • This command is used to specify the relative percentage or the absolute maximum number of unreachable hosts, based on flows per million, that a master controller 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, the master controller 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 **threshold** keyword is used to configure the absolute maximum number of unreachable hosts based on fpm. • The example creates a set clause entry that configures the master controller to search for a new exit link when the relative percentage of unreachable hosts is equal to or greater than 10 percent for traffic learned based on highest delay.
Step 8	**end** **Example:** `Router(config-oer-map)# end`	Exits OER map configuration mode and returns to privileged EXEC mode.

Configuration Examples for OER BGP Inbound Optimization

This section contains the following configuration examples:

Configuring OER to Automatically Learn Inside Prefixes: Example

The following example shows how to configure OER to automatically learn prefixes inside the network:

```
Router> enable
Router# configure terminal
Router(config)# oer master
Router(config-oer-mc)# learn
Router(config-oer-mc-learn)# inside bgp
Router(config-oer-mc-learn)# aggregation-type bgp
Router(config-oer-mc-learn)# monitor-period 10
Router(config-oer-mc-learn)# periodic-interval 20
Router(config-oer-mc-learn)# prefixes 500
Router(config-oer-mc-learn)# end
```

Manually Selecting Inside Prefixes for OER Monitoring: Example

The following example shows how to manually configure OER to learn prefixes inside the network using an OER map:

```
Router> enable
Router# configure terminal
Router(config)# ip prefix-list INSIDE_PREFIXES seq 20 permit 192.168.1.0/24
Router(config)# oer-map INSIDE_MAP 10
Router(config-oer-map)# match ip address prefix-list INSIDE_PREFIXES inside
Router(config-oer-map)# end
```

Applying a Policy to Learned Inside Prefixes: Example

The following example shows how to apply an OER policy to learned inside prefixes:

```
Router> enable
Router# configure terminal
Router(config)# oer-map INSIDE_LEARN 10
Router(config-oer-map)# match oer learn inside
Router(config-oer-map)# set delay threshold 2000
Router(config-oer-map)# set loss relative 200
Router(config-oer-map)# set unreachable relative 100
Router(config-oer-map)# end
```

Applying a Policy to Configured Inside Prefixes: Example

The following example shows how to create an OER map named INSIDE_CONFIGURE and apply an OER policy to manually configured inside prefixes:

```
Router> enable
Router# configure terminal
Router(config)# oer-map INSIDE_CONFIGURE 10
Router(config-oer-map)# match ip address prefix-list INSIDE_PREFIXES inside
Router(config-oer-map)# set delay threshold 2000
Router(config-oer-map)# set loss relative 200
Router(config-oer-map)# set unreachable relative 100
Router(config-oer-map)# end
```

Where to Go Next

For an overview of the OER technology and more details about implementing OER, see the *Cisco IOS Optimized Edge Routing Configuration Guide*, Release 12.4T.

Additional References

The following sections provide references related to OER BGP inbound optimization.

Related Documents

Related Topic	Document Title
OER configuration concepts, tasks, and examples	*Cisco IOS Optimized Edge Routing Configuration Guide*, Release 12.4T
Cisco OER commands: complete command syntax, command mode, command history, defaults, usage guidelines and examples	*Cisco IOS Optimized Edge Routing Command Reference*, Release 12.4T
IP Routing Protocol commands	*Cisco IOS IP Routing Protocols Command Reference*, Release 12.4T
IP Routing Protocol configuration tasks	*Cisco IOS IP Routing Protocols Configuration Guide*, Release 12.4

Standards

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

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

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

Technical Assistance

Description	Link
The Cisco Technical Support & Documentation website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Command Reference

This section documents new and modified commands only.

- **clear oer master prefix**
- **inside bgp**
- **match ip address (OER)**
- **match oer learn**
- **show oer master prefix**

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.

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.

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.

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.
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.

Defaults

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.

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.

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 INSIDE1 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.

Defaults

No default behavior or values

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.

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.

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** | **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.
traceroute	(Optional) Displays path information from traceroute probes.
exit-id	(Optional) Displays path information based on the Optimized Edge Routing (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.

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
```

Table 1 describes the significant fields shown in the display.

Table 1 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
```

Table 2 describes the significant fields shown in the display.

Table 2 show oer master prefix 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.

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
------------------------------------------------------------------------------
```

Table 3 describes the significant fields shown in the display.

Table 3 show oer master prefix traceroute Field Descriptions

Field	Description
Path for Prefix	Specified IP address and prefix length.
Target	Traceroute probe target.
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
```

Table 4 describes the significant fields shown in the display that are different from Table 1 on page 24 and Table 2 on page 25.

Table 4 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.

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
```

Table 5 describes the significant fields shown in the display that are different from Table 2 on page 25.

Table 5 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.

Table 5 show oer master prefix detail (Jitter or MOS Priority) Field Descriptions (continued)

Field	Description
Jitter	Jitter value.
LoMOSCnt	MOS-low count.

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.

Feature Information for OER BGP Inbound Optimization

Table 6 lists the release history for this feature.

For information on a feature in this technology that is not documented here, see the "Cisco IOS Optimized Edge Routing Feature Roadmap."

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

Cisco IOS software images are specific to a Cisco IOS software release, a feature set, and a platform. Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at http://www.cisco.com/go/fn. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

Note Table 6 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 6 Feature Information for OER BGP Inbound Optimization

Feature Name	Releases	Feature Information
OER BGP Inbound Optimization	12.4(9)T	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 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. The following sections provide information about this feature: • OER Inside Prefixes, page 2 • OER Inbound Optimization Using BGP, page 2 • Configuring OER to Automatically Learn Inside Prefixes, page 4 • Manually Selecting Inside Prefixes for OER Monitoring, page 7 • Applying a Policy to Learned Inside Prefixes, page 8 • Applying a Policy to Configured Inside Prefixes, page 11 The following commands were introduced or modified by this feature: **clear oer master prefix**, **inside bgp**, **match ip address (OER)**, **match oer learn**, **show oer master prefix**.