Per Interface Mroute State Limit

Last Updated: April 16, 2012

This module describes how to configure the Per Interface Mroute State Limit feature to limit the number of mroute states on a per-interface basis and reduce the risk of a Denial of Service (DoS) attack on the first hop device in an Ethernet to the x (ETTX) deployment, where x means home, building, or campus.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Per Interface Mroute State Limit

IP multicast is enabled and the Protocol Independent Multicast (PIM) interfaces are configured using the tasks described in the "Configuring Basic IP Multicast" module of the *IP Multicast: PIM Configuration Guide*.

Information about Per Interface Mroute State Limit

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Mechanics of Per Interface Mroute State Limiters

The mechanics of per interface mroute state limiters are as follows:

- Each time the state for an mroute is created or deleted and each time an olist member is added or removed, the software searches for a corresponding per interface mroute state limiter that matches the mroute.
- When an mroute is created or deleted, the software searches for a per interface mroute state limiter configured on the incoming (RPF) interface that matches the mroute to be created or deleted. When an olist member is added or removed, the software searches for a per interface mroute state limiter configured on the outgoing interface that matches the mroute to be added or removed.
- A top-down search is performed using the list of configured per interface mroute state limiters. Only per interface mroute state limiters that match the direction of traffic are considered. The first per interface mroute state limiter that matches is used for limiting (sometimes referred to as accounting). A match is found when the ACL permits the mroute state.
- When a match is found, the counter of the per interface mroute state limiter is updated (increased or decreased). If no per interface mroute state limiter is found that matches an mroute, no accounting is performed for the mroute (because there is no counter to update).
- The amount with which to update the counter is called the cost (sometimes referred to as the cost multiplier). The default cost is 1.

Note A per interface mroute state limiter always allows the deletion of an mroute or the removal of an interface from the olist. In those cases, the respective per interface mroute state limiter decreases the counter by the value of the cost multiplier. In addition, RPF changes to an existing mroute are always allowed (in order to not affect existing traffic). However, a per interface mroute state limiter only allows the creation of an mroute or the addition of an mroute olist member if adding the cost does not exceed the maximum number of mroutes permitted.

Tips for Configuring Per Interface Mroute State Limiters

- To ensure that all mroutes are accounted, you can configure a per interface mroute state limiter whose ACL contains a permit-any statement and set the value of zero (0) for maximum entries. Configuring an mroute state limiter in this manner effectively denies all fall through states, which may be a way to prevent a multicast DoS attack in and out of the interface.
- When creating an ACL, remember that, by default, the end of the ACL contains an implicit deny-any statement for everything if it did not find a match before reaching the end.
- An explicit deny statement for a specific mroute in an ACL can be used to specify the state that will not match the ACLwhich will prevent the ACL from being accounted. If an mroute matches a deny statement, the search immediately continues to the next configured mroute state limiter. Configuring an explicit deny statement in an ACL can be more efficient than forcing the mroute to fall through an ACL by using an implicit deny-any statement at the end of the ACL.

How to Configure Per Interface Mroute State Limit

Configuring Per Interface Mroute State Limiters

Perform this task to configure per interface mroute state limiters. Configuring per interface mroute state limiters can be used to prevent DoS attacks or to provide a multicast CAC mechanism to control bandwidth, when all the multicast flows roughly utilize the same amount of bandwidth.

All ACLs to be applied per interface mroute state limiters must be configured prior to beginning this configuration task; otherwise, the limiters are ignored. For information about how to configure ACLs, see the “ Creating an IP Access List and Applying It to an Interface ” module.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip multicast limit** [**connected** | **out** | **rpf**] *access-list max-entries*
5. Repeat Step 4 to configure additional per interface mroute state limiters on this interface.
6. Repeat Steps 3 and Step 4 to configure per interface mroute state limiters on additional interfaces.
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface GigabitEthernet0/0`	Enters interface configuration mode for the specified interface type and number.

	Command or Action	Purpose
Step 4	**ip multicast limit** [**connected** | **out** | **rpf**] *access-list max-entries* **Example:** `Device(config-if)# ip multicast limit 15 100`	Configures per interface mroute state limiters.
Step 5	Repeat Step 4 to configure additional per interface mroute state limiters on this interface.	--
Step 6	Repeat Steps 3 and Step 4 to configure per interface mroute state limiters on additional interfaces.	--
Step 7	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

Monitoring Per Interface Mroute State Limiters and Bandwidth-Based Multicast CAC Policies

Perform this optional task to monitor per interface mroute state limiters and bandwidth-based multicast CAC policies.

SUMMARY STEPS

1. **enable**
2. **debug ip mrouting limits** [*group-address*]
3. **show ip multicast limit** *type number*
4. **clear ip multicast limit** [*type number*]

DETAILED STEPS

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **debug ip mrouting limits** [*group-address*]

Displays debugging information about configured per interface mroute state limiters and bandwidth-based multicast CAC policies.

The following output is from the **debug ip mrouting limits** command. The output displays the following events:

- An mroute state being created and the corresponding per interface mroute state limiter counter being increased by the default cost of 1 on incoming Ethernet interface 1/0.
- An mroute olist member being removed from the olist and the corresponding per interface mroute limiter being decreased by the default cost of 1 on outgoing Ethernet interface 1/0.
- An mroute being denied by the per interface mroute state limiter because the maximum number of mroute states has been reached.
- An mroute state being created and the corresponding per interface mroute state limiter counter being increased by the cost of 2 on incoming Ethernet interface 1/0.
- An mroute olist member being removed from the olist and the corresponding per interface mroute limiter being decreased by a cost of 2 on outgoing Ethernet interface 1/0.

Example:

```
device# debug ip mrouting limits

MRL(0): incr-ed acl ‘rpf-list’ to (13 < max 32), [n:0,p:0], (main) GigabitEthernet0/0,
(10.41.0.41, 225.30.200.60)
MRL(0): decr-ed acl ‘out-list’ to (10 < max 32), [n:0,p:0], (main) GigabitEthernet0/0, (*,
225.40.202.60)
MRL(0): Add mroute (10.43.0.43, 225.30.200.60) denied for GigabitEthernet0/2, acl std-list, (16 =
max 16)
MRL(0): incr-ed limit-acl `rpf-list' to (12 < max 32), cost-acl 'cost-list' cost 2, [n:0,p:0],
(main) GigabitEthernet0/0, (10.41.0.41, 225.30.200.60)
MRL(0): decr-ed limit-acl `out-list' to (8 < max 32), cost-acl 'cost-list'' cost 2, [n:0,p:0],
(main) GigabitEthernet0/0, (*, 225.40.202.60)
```

Step 3 **show ip multicast limit** *type number*

Displays counters related to mroute state limiters configured on the interfaces on the router.

For each per interface mroute state limiter shown in the output, the following information is displayed:

- The direction of traffic that the per mroute state limiter is limiting.
- The ACL referenced by the per interface mroute state limiter that defines the IP multicast traffic being limited.
- Statistics, enclosed in parenthesis, which track the current number of mroutes being limited less the configured limit. Each time the state for an mroute is created or deleted and each time an outgoing interface list (olist) member is added or removed, the counters for matching per interface mroute state limiters are increased or decreased accordingly.
- The exceeded counter, which tracks the total number of times that the limit configured for the per interface mroute state limiter has been exceeded. Each time an mroute is denied due to the configured limit being reached, the exceeded counter is increased by a value of 1.

The following is sample output from the **show ip multicast limit** command with the *type number* arguments. In this example, information about mroute state limiters configured on Gigabit Ethernet interface 0/0 is displayed.

Example:

```
Device# show ip multicast limit GigabitEthernet 0/0

Interface GigabitEthernet 0/0
 Multicast Access Limits
out acl out-list (1 < max 32) exceeded 0
rpf acl rpf-list (6 < max 32) exceeded 0
con acl conn-list (0 < max 32) exceeded 0
```

Step 4 **clear ip multicast limit** [*type number*]

Resets the exceeded counter for per interface mroute state limiters.

The following example shows how to reset exceeded counters for per interface mroute state limiters configured on Gigabit Ethernet interface 0/0:

Example:

```
Device# clear ip multicast limit interface GigabitEthernet 0/0
```

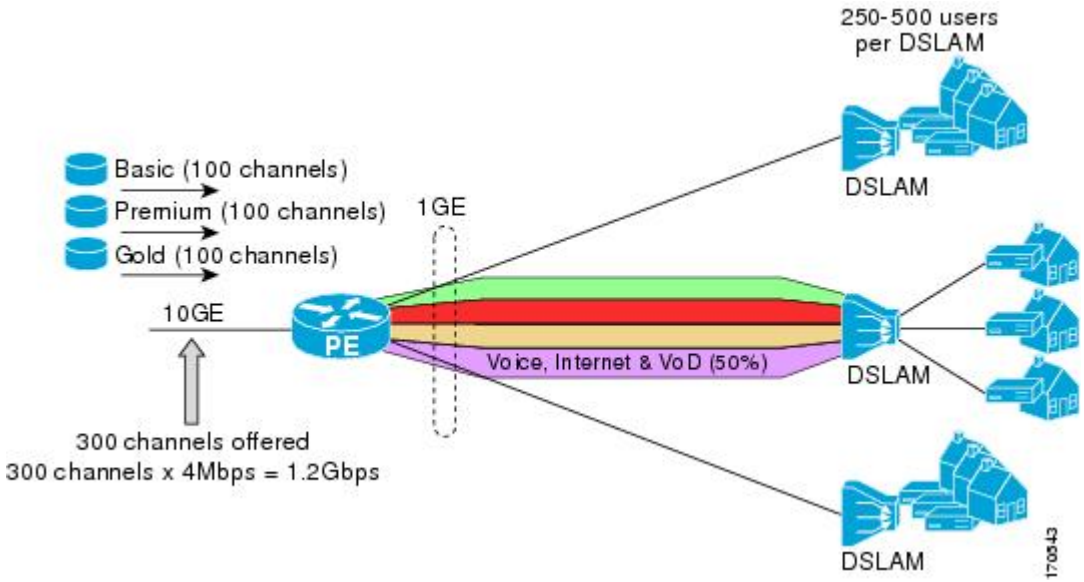
Configuration Examples for Per Interface Mroute State Limit

Example Configuring Per Interface Mroute State Limiters

The following example shows how to configure per interface mroute state limiters to provide multicast CAC in a network environment where all the multicast flows roughly utilize the same amount of bandwidth.

This example uses the topology illustrated in the figure.

Figure 1 Per Interface Mroute State Limit Example Topology



In this example, a service provider is offering 300 SD TV channels. The SD channels are being offered to customers in three service bundles (Basic, Premium, and Gold), which are available to customers on a subscription basis. Each bundle offers 100 channels to subscribers, and each channel utilizes approximately 4 Mbps of bandwidth.

The service provider must provision the Gigabit Ethernet interfaces on the PE device connected to DSLAMs as follows: 50% of the link's bandwidth (500 Mbps) must be available to subscribers of their

Internet, voice, and VoD service offerings while the remaining 50% (500 Mbps) of the link's bandwidth must be available to subscribers of their SD channel bundle service offerings.

For the 500 Mbps of the link's bandwidth that must always be available to (but must never be exceeded by) the subscribers of the SD channel bundles, the interface must be further provisioned as follows:

- 60% of the bandwidth must be available to subscribers of the basic service (300 Mbps).
- 20% of the bandwidth must be available to subscribers of the premium service (100 Mbps).
- 20% of the bandwidth must be available to subscribers of the gold service (100 Mbps).

Because each SD channel utilizes the same amount of bandwidth (4 Mbps), per interface mroute state limiters can be used to provide the necessary CAC to provision the services being offered by the service provider. To determine the required CAC needed per interface, the number of channels for each bundle is divided by 4 (because each channel utilizes 4 Mbps of bandwidth). The required CAC needed per interface, therefore, is as follows:

- Basic Services: 300 / 4 = 75
- Premium Services: 100 / 4 = 25
- Gold Services: 100 / 4 = 25

Once the required CAC required per SD channel bundle is determined, the service provider uses the results to configure the mroute state limiters required to provision the Gigabit Ethernet interfaces on the PE device for the services being offered to subscribers behind the DSLAMs:

- For the Basic Services bundle, the service provider must limit the number of Basic Service SD channels that can be transmitted out a Gigabit Ethernet interface (at any given time) to 75. Configuring an mroute state limit of 75 for the SD channels offered in the Basic Service bundle provisions the interface for 300 Mbps of bandwidth (the 60% of the link's bandwidth that must always be available to [but never exceeded by] the subscribers of the Basic Services bundle).
- For the Premium Services bundle, the service provider must limit the number of Premium Service SD channels that can be transmitted out a Gigabit Ethernet interface (at any given time) to 25. Configuring an mroute state limit of 25 for the SD channels offered in the Premium Service bundle provisions the interface for 100 Mbps of bandwidth (the 20% of the link's bandwidth that must always be available to [but never exceeded by] the subscribers of the Premium Service bundle).
- For the Gold Services bundle, the service provider must limit the number of Gold Service SD channels that can be transmitted out a Gigabit Ethernet interface (at any given time) to 25. Configuring an mroute state limit of 25 for the SD channels offered in the Gold Service bundle provisions the interface for 100 Mbps of bandwidth (the 20% of the link's bandwidth that must always be available to [but never exceeded by] the subscribers of the Gold Service bundle).

The service provider then configures three ACLs to be applied to per interface mroute state limiters. Each ACL defines the SD channels for each SD channel bundle to be limited on an interface:

- acl-basic--The ACL that defines the SD channels offered in the basic service.
- acl-premium--The ACL that defines the SD channels offered in the premium service.
- acl-gold--The ACL that defines the SD channels offered in the gold service.

These ACLs are then applied to per interface mroute state limiters configured on the PE device's Gigabit Ethernet interfaces.

For this example, three per interface mroute state limiters are configured on Gigabit Ethernet interface 0/0 to provide the multicast CAC needed to provision the interface for the SD channel bundles being offered to subscribers:

- An mroute state limit of 75 for the SD channels that match acl-basic.
- An mroute state limit of 25 for the SD channels that match acl-premium.

- An mroute state limit of 25 for the SD channels that match acl-gold.

The following configuration shows how the service provider uses per interface mroute state limiters to provision Gigabit Ethernet interface 0/0 for the SD channel bundles and Internet, Voice, and VoD services being offered to subscribers:

```
interface GigabitEthernet0/0
description --- Interface towards the DSLAM ---
.
.
.
ip multicast limit out acl-basic 75
ip multicast limit out acl-premium 25
ip multicast limit out acl-gold 25
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*
IP multicast commands	*Cisco IOS IP Multicast Command Reference*

Standards and RFCs

Standard/RFC	Title
No new or modified standards or RFCs are supported by this feature.	--

MIBs

MIB	MIBs Link
No new or modified MIBs are supported by this feature.	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Per Interface Mroute State Limit

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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Table 1 Feature Information for Per Interface Mroute State Limit

Feature Name	Releases	Feature Information
Per Interface Mroute State Limit	Cisco IOS XE Release 2.1 12.3(14)T 12.2(33)SRB 12.2(33)SXI 15.1(1)SG Cisco IOX XE Release 3.3.0SG	The Per Interface Mroute State Limit feature provides the capability to limit the number of mroute states on an interface for different ACL-classified sets of multicast traffic. This feature can be used to prevent DoS attacks, or to provide a multicast CAC mechanism in network environments where all the multicast flows roughly utilize the same amount of bandwidth. The following commands were introduced or modified: **clear ip multicast limit**, **debug ip mrouting limits**, **ip multicast limit**, **show ip multicast limit**.