Flow-Based per Port-Channel Load Balancing

The Flow-Based per Port-Channel Load Balancing feature allows different flows of traffic over a Ten Gigabit EtherChannel (GEC) interface to be identified based on the packet header and then mapped to the different member links of the port channel. This feature enables you to apply flow-based load balancing and VLAN-manual load balancing to specific port channels.

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 http://tools.cisco.com/ITDIT/CFN/. An account on http://www.cisco.com/ is not required.

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Hardware Compatibility Matrix for Cisco cBR Series Routers

Note The hardware components introduced in a given Cisco IOS-XE Release are supported in all subsequent releases unless otherwise specified.

Table 1: Hardware Compatibility Matrix for the Cisco cBR Series Routers

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	**Cisco IOS-XE Release 3.15.0S and Later Releases** Cisco cBR-8 Supervisor: • PID—CBR-SUP-250G • PID—CBR-CCAP-SUP-160G • PID—CBR-CCAP-SUP-60G[1] • PID—CBR-SUP-8X10G-PIC	**Cisco IOS-XE Release 3.15.0S and Later Releases** Cisco cBR-8 CCAP Line Cards: • PID—CBR-LC-8D30-16U30 • PID—CBR-LC-8D31-16U30 • PID—CBR-RF-PIC • PID—CBR-RF-PROT-PIC Cisco cBR-8 Downstream PHY Modules: • PID—CBR-D30-DS-MOD • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D30-US-MOD

[1] Effective with Cisco IOS-XE Release 3.17.0S, CBR-CCAP-SUP-60G supports 8 cable line cards. The total traffic rate is limited to 60 Gbps, the total number of downstream service flows is limited to 72268, and downstream unicast low-latency flow does not count against the limits.

Restrictions for Flow-Based per Port-Channel Load Balancing

- Supports up to 64 Ten GEC interfaces.
- Supports up to 8 member links per Ten GEC interface.
- dot1q L2VPN is not supported over a port-channel with load-balancing vlan configured.

Information About Flow-Based per Port-Channel Load Balancing

Flow-Based Load Balancing

Flow-based load balancing identifies different flows of traffic based on the key fields in the data packet. For example, IPv4 source and destination IP addressees can be used to identify a flow. The various data traffic flows are then mapped to the different member links of a port channel. After the mapping is done, the data traffic for a flow is transmitted through the assigned member link. The flow mapping is dynamic and changes when there is any change in the state of a member link to which a flow is assigned. The flow mappings can also change if member links are added to or removed from the GEC interface. Multiple flows can be mapped to each member link.

Buckets for Flow-Based Load Balancing

Load balancing dynamically maps traffic flows to the member links of a Ten GEC interface through the concept of buckets. The various defined traffic flows are mapped to the buckets and the buckets are evenly distributed among the member links. Each port channel maintains 16 buckets, with one active member link associated with each bucket. All traffic flows mapped to a bucket use the member link to which the bucket is assigned.

The router creates the buckets-to-member links mappings when you apply flow-based load balancing to a port channel and the port channel has at least one active member link. The mappings are also created when the first member link is added, or comes up, and the load-balancing method is set to flow-based.

When a member link goes down or is removed from a port channel, the buckets associated with that member link are redistributed among the other active member links in a round-robin fashion. When a member link comes up or is added to a port channel, some of the buckets associated with other links are assigned to this link.

If you change the load-balancing method, the bucket-to-member link mappings for flow-based load balancing are deleted. The mappings are also deleted if the port channel is deleted or the last member link in the port channel is deleted or goes down.

Load Balancing on Port Channels

GEC interfaces can use either dynamic flow-based load balancing or VLAN-manual load balancing. You can configure the load-balancing method globally for all port channels or directly on specific port channels. The global configuration applies only to those port channels for which you have not explicitly configured load balancing. The port-channel configuration overrides the global configuration.

Flow-based load balancing is enabled by default at the global level. You must explicitly configure VLAN load balancing or the load-balancing method is flow-based.

The table below lists the load-balancing method that is applied to port channels based on the configuration:

Table 2: Flow-Based Load Balancing Configuration Options

Global Configuration	Port-Channel Configuration	Load Balancing Applied
Not configured	Not configured	Flow-based
	Flow-based	Flow-based
	VLAN-manual	VLAN-manual
VLAN-manual	Not configured	VLAN-manual
	Flow-based	Flow-based
	VLAN-manual	VLAN-manual

The table below lists the configuration that results if you change the global load-balancing method.

Table 3: Results When Global Configuration Changes

Port-Channel Configuration	Global Configuration		Action Taken at Port-Channel
—	From	To	—
Not configured	Not configured	VLAN-manual	Changed from flow-based to VLAN-manual
	VLAN-manual	Not configured	Changed from VLAN-manual to flow-based
Configured	Any	Any	No change

The table below lists the configuration that results if you change the port-channel load-balancing method.

Table 4: Results When Port-Channel Configuration Changes

Port-Channel Configuration	Global Configuration		Action Taken at Port-Channel
—	From	To	—

Port-Channel Configuration	Global Configuration		Action Taken at Port-Channel
Not configured	Not configured	VLAN-manual	Changed from flow-based to VLAN-manual
	Not configured	Flow-based	No action taken
	VLAN-manual	Flow-based	Changed from VLAN-manual to flow-based
	VLAN-manual	Not configured	Changed from VLAN-manual to flow-based
	Flow-based	VLAN-manual	Changed from flow-based to VLAN-manual
	Flow-based	Not configured	No action taken
Configured	Not configured	VLAN-manual	No action taken
	Not configured	Flow-based	Changed from VLAN-manual to flow-based
	VLAN-manual	Flow-based	Changed from VLAN-manual to flow-based
	VLAN-manual	Not configured	No action taken
	Flow-based	VLAN-manual	Changed from flow-based to VLAN-manual
	Flow-based	Not configured	Changed from flow-based to VLAN-manual

How to Enable Flow-Based per Port-Channel Load Balancing

Configuring Load Balancing on a Port Channel

To configure load balancing on a port channel, perform the following steps. Repeat these steps for each GEC interface.

Before You Begin

If you have already configured your desired load-balancing method globally and want to use that method for all port channels, you need not perform this task. To configure load balancing globally, use the **port-channel load-balancing vlan-manual** command. If you do not configure the global command, flow-based load balancing is applied to all port channels.

Procedure

	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	**interface port-channel** *channel-number* **Example:** `Router(config)# interface port-channel 1`	Enters interface configuration mode and defines the interface as a port channel.
Step 4	**load-balancing** {**flow** | **vlan**} **Example:** `Router(config-if)# load-balancing flow`	Applies a load-balancing method to the specific port channel. • If you do not configure this command, the port channel uses the global load-balancing method configured with the **port-channel load-balancing vlan-manual** command. The global default is flow-based.
Step 5	**end** **Example:** `Router(config-if)# end`	Exits configuration mode.

Verifying Load Balancing Configuration on a Ten GEC Interface

- **show running-config interface port-channel** *channel-number* —Displays the port channel configuration.

Following is a sample output of this command:

```
Router# show running-config interface port-channel 62
Building configuration...

Current configuration : 108 bytes
!
interface Port-channel62
 ip address 12.1.1.1 255.255.255.0
 ipv6 address 2001:12:1:1::1/64
 mpls
```

- **show etherchannel load-balancing —** Displays the load balancing method applied to each port channel.

  The following is a sample output of this command:

```
Router# show etherchannel load-balancing

EtherChannel Load-Balancing Method:
Global LB Method: flow-based

  Port-Channel:                       LB Method
    Port-channel62                 :  flow-based
    Port-channel63                 :  flow-based
```

- **show interfaces port-channel** *channel-number* **etherchannel —**Displays the bucket distribution currently in use.

  The following is a sample output for an interface with load balancing set to flow-based:

```
Router(config)# show interface port-channel 62 etherchannel

 All IDBs List contains 8 configured interfaces
  Port: TenGigabitEthernet4/1/0 (index: 0)
  Port: TenGigabitEthernet4/1/1 (index: 1)
  Port: TenGigabitEthernet4/1/2 (index: 2)
  Port: TenGigabitEthernet4/1/3 (index: 3)
  Port: TenGigabitEthernet4/1/4 (index: 4)
  Port: TenGigabitEthernet4/1/5 (index: 5)
  Port: TenGigabitEthernet4/1/6 (index: 6)
  Port: TenGigabitEthernet4/1/7 (index: 7)

 Active Member List contains 8 interfaces
  Port: TenGigabitEthernet4/1/0
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/1
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/2
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/3
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/4
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/5
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/6
    LACP Mode: Active

  Port: TenGigabitEthernet4/1/7
    LACP Mode: Active

 Passive Member List contains 0 interfaces
 Load-Balancing method applied: flow-based
```

```
Bucket Information for Flow-Based LB:
Interface:                                Buckets
   TenGigabitEthernet4/1/0:
                           Bucket 0 , Bucket 1
   TenGigabitEthernet4/1/1:
                           Bucket 2 , Bucket 3
   TenGigabitEthernet4/1/2:
                           Bucket 4 , Bucket 5
   TenGigabitEthernet4/1/3:
                           Bucket 6 , Bucket 7
   TenGigabitEthernet4/1/4:
                           Bucket 8 , Bucket 9
   TenGigabitEthernet4/1/5:
                           Bucket 10, Bucket 11
   TenGigabitEthernet4/1/6:
                           Bucket 12, Bucket 13
   TenGigabitEthernet4/1/7:
                           Bucket 14, Bucket 15
```

Configuration Examples for Flow-Based per Port-Channel Load Balancing

Example: Flow-Based Load Balancing

The following example shows a configuration where flow-based load balancing is configured on port-channel 2 while the VLAN-manual method is configured globally:

```
!
no aaa new-model
port-channel load-balancing vlan-manual
ip source-route
.
.
.
interface Port-channel2
 ip address 10.0.0.1 255.255.255.0
 no negotiation auto
 load-balancing flow
!
interface Port-channel2.10
 ip rsvp authentication key 11223344
 ip rsvp authentication
!
interface Port-channel2.50
 encapsulation dot1Q 50
!
interface TenGigabitEthernet4/1/0
 no ip address
 negotiation auto
 cdp enable
 channel-group 2
!
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature Information for Flow-Based per Port-Channel Load Balancing

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note The table below 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.

Table 5: Feature Information for Flow-Based per Port-Channel Load Balancing

Feature Name	Releases	Feature Information
Flow-Based per Port-Channel Load Balancing	Cisco IOS-XE Release 3.15.0S	This feature was introduced on the Cisco cBR Series Converged Broadband Routers.