



## 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.

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

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 the Cisco cBR Series Routers



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

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

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	<p><b>Cisco IOS-XE Release 16.5.1 and Later Releases</b></p> <p>Cisco cBR-8 Supervisor:</p> <ul style="list-style-type: none"> <li>• PID—CBR-SUP-250G</li> <li>• PID—CBR-CCAP-SUP-160G</li> </ul>	<p><b>Cisco IOS-XE Release 16.5.1 and Later Releases</b></p> <p>Cisco cBR-8 CCAP Line Cards:</p> <ul style="list-style-type: none"> <li>• PID—CBR-LC-8D30-16U30</li> <li>• PID—CBR-LC-8D31-16U30</li> <li>• PID—CBR-RF-PIC</li> <li>• PID—CBR-RF-PROT-PIC</li> <li>• PID—CBR-CCAP-LC-40G</li> <li>• PID—CBR-CCAP-LC-40G-R</li> <li>• PID—CBR-CCAP-LC-G2-R</li> <li>• PID—CBR-SUP-8X10G-PIC</li> <li>• PID—CBR-2X100G-PIC</li> </ul> <p>Digital PICs:</p> <ul style="list-style-type: none"> <li>• PID—CBR-DPIC-8X10G</li> <li>• PID—CBR-DPIC-2X100G</li> </ul> <p>Cisco cBR-8 Downstream PHY Module:</p> <ul style="list-style-type: none"> <li>• PID—CBR-D31-DS-MOD</li> </ul> <p>Cisco cBR-8 Upstream PHY Modules:</p> <ul style="list-style-type: none"> <li>• PID—CBR-D31-US-MOD</li> </ul>



**Note** Do not use DPICs (8X10G and 2x100G) to forward IP traffic, as it may cause buffer exhaustion, leading to line card reload.

The only allowed traffic on a DPIC interface is DEPI, UEPI, and GCP traffic from the Cisco cBR-8 router to Remote PHY devices. Other traffic such as DHCP, SSH, and UTSC should flow via another router, since DPICs cannot be used for normal routing.

## 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 addresses 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.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface port-channel** *channel-number*
4. **load-balancing** {flow | vlan}
5. **end**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b> <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b> <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>interface port-channel</b> <i>channel-number</i> <b>Example:</b> Router(config)# interface port-channel 1	Enters interface configuration mode and defines the interface as a port channel.
Step 4	<b>load-balancing</b> {flow   vlan} <b>Example:</b> Router(config-if)# load-balancing flow	Applies a load-balancing method to the specific port channel. <ul style="list-style-type: none"> <li>• If you do not configure this command, the port channel uses the global load-balancing method configured with the <b>port-channel load-balancing vlan-manual</b> command. The global default is flow-based.</li> </ul>
Step 5	<b>end</b> <b>Example:</b> 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

### Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/support">http://www.cisco.com/support</a>

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

Use Cisco Feature Navigator to find information about the 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 the <https://cfmng.cisco.com/> link. An account on the Cisco.com page is not required.



**Note** The following table lists the software release in which a given feature is introduced. 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 Everest 16.6.1	This feature was integrated into Cisco IOS XE Everest 16.6.1 on Cisco cBR Series Converged Broadband Routers.

