



## Configuring Modular QoS on Link Bundles

This chapter covers the following topics:

- [QoS on Link Bundles, on page 1](#)

### QoS on Link Bundles

A bundle is a group of one or more ports that are aggregated together and treated as a single link. The router supports Ethernet interfaces and VLAN interfaces (bundle sub-interfaces) bundles. All QoS features currently supported on physical interfaces, are also supported on all link bundle interfaces. Applying QoS on bundle members is not supported.

#### Restrictions for Link Bundles

- Only Ethernet link bundling is supported.
- A bundle interface can only contain physical interface.
- All links within a single bundle must be configured either to run 802.3ad (LACP) or Etherchannel (non-LACP). Mixed links within a single bundle are not supported.
- MAC accounting is not supported on Ethernet link bundles.
- Maximum number of links supported in each link bundle is 64.
- The maximum number of link bundles supported is 128.

### Load Balancing

Load balancing function is a forwarding mechanism to distribute traffic over multiple links based on Layer 3 routing information in the router. Per-destination load balancing is only supported on the router, where the router is allowed to distribute packets over one of the links in the bundle. When the per-destination load balancing is enabled, all packets for a certain source-destination pair go through the same link, though there are multiple links available. In other words, per-destination load balancing can ensure that packets for a certain source-destination pair could arrive in order.

### Layer 3 Load Balancing on Link Bundles

Layer 3 load balancing for link bundles is done on Ethernet Flow Points (EFPs) and is based on the IPv4 source and destination addresses in the packet. When Layer 3 service-specific load balancing is configured, all egress bundles are load balanced based on the IPv4 source and destination addresses. When packets do not have IPv4 addresses, default load-balancing (based on the MAC SA/DA fields in the packet header) is used.

## Configure QoS on Link Bundles

QoS is configured on link bundles in the same way that it is configured on individual interfaces.

### Guidelines

- When a QoS policy is applied on a bundle in the egress direction, it's also applied at each member interface.
- When a QoS policy is applied on a bundle (ingress direction), it's replicated at each NPU core.
- If a QoS policy is not applied to a bundle interface, both the ingress and egress traffic use the default queue of the per link member port.
- The shape rate that is specified in the bundle policy-map is not an aggregate for all bundle members. The shape rate applied to the bundle depends on the load balancing of the links. For example, if a policy map with a shape rate of 10 Mbps is applied to a bundle with two member links, and if the traffic is always load-balanced to the same member link, then an overall rate of 10 Mbps applies to the bundle. However, if the traffic is load-balanced evenly between the two links, the overall shape rate for the bundle becomes 20 Mbps.
- If a member is deleted from a bundle, the total bundle statistics changes because the statistics that belongs to the detached link is lost.
- The QoS policy that is applied on bundle is inherited to all its member links and the reference bandwidth that is used to calculate shaper/bandwidth is applied as per the physical member interface bandwidth, and not the bundle as a whole.

### Configuration Example

You have to accomplish the following to complete the QoS configuration on link bundles:



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**Note** The policy works only if it is applied on the ingress direction. The egress is supported on COS, DEI and MPLS exp marking. So the below policy may not work when it is applied on egress.

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1. Creating a class-map
2. Creating a policy-map and specifying the respective class-map
3. Specifying the action type for the traffic
4. Creating a link bundle

Refer [Attach a Traffic Policy to an Interface](#) for details on step 1, 2 and 3.

## 5. Applying traffic policy to the link bundle

```
/* Configure Ether-Bundle and apply traffic policy */
Router(config)# interface Bundle-Ether 12000
Router(config-if)# mtu 9100
Router(config-if)# service-policy input ingress
Router(config-if)# service-policy output egress
Router(config-if)# ipv4 address 100.12.0.0 255.255.255.254
Router(config-if)# bundle maximum-active links 64
Router(config-if)# commit
```

### Running Configuration

This example shows how a traffic policy is applied on an Ethernet link bundle. The policy is applied to all interfaces that are members of the Ethernet link bundle.

```
/* Policy-map */

policy-map ingress
  class inet4-classifier-af1
    set qos-group 1
  !
  class inet4-classifier-af2
    set qos-group 2
  !
  class inet4-classifier-af3
    set qos-group 3
  !
  class inet4-classifier-af4
    set qos-group 4
  !
  class inet4-classifier-bel
    set qos-group 5
  !
  class inet4-classifier-ncl
    set qos-group 6
  !
  class class-default
  !
end-policy-map
!

/* Ether Bundle */
interface Bundle-Ether12000
  mtu 9100
  service-policy input ingress
  service-policy output egress
  ipv4 address 100.12.0.0 255.255.255.254
  load-interval 30
  flow ipv4 monitor FMM-V4 sampler SM ingress
  flow ipv6 monitor FMM-V6 sampler SM ingress
  flow mpls monitor FMM-MPLS sampler SM ingress
  ipv4 access-group IPV4ACL_101 ingress
  ipv6 access-group IPV6ACL_101 ingress
!
```

## Verification

- Verify that the bundle status is UP.

```
router# show bundle bundle-ether 1200
Wed Dec 16 19:55:49.974 PST
```

```
Bundle-Ether12000
  Status: Up
  Local links <active/standby/configured>: 35 / 0 / 35
  Local bandwidth <effective/available>: 3500000000 (3500000000) kbps
  MAC address (source): ea3b.745f.c4b0 (Chassis pool)
  Inter-chassis link: No
  Minimum active links / bandwidth: 1 / 1 kbps
  Maximum active links: 64
  Wait while timer: 2000 ms
  Load balancing: Default
  LACP: Operational
    Flap suppression timer: Off
    Cisco extensions: Disabled
    Non-revertive: Disabled
  mLACP: Not configured
  IPv4 BFD: Not configured
```

Port	Device	State	Port ID	B/W, kbps
Hu0/4/0/0	Local	Active	0x8000, 0x0009	100000000
Link is Active				
Hu0/4/0/1	Local	Active	0x8000, 0x000a	100000000
Link is Active				
- - -				
- - -				
Hu0/4/0/35	Local	Active	0x8000, 0x002b	100000000
Link is Active				

- Verify the bundle statistics:

```
router# show policy-map interface bundle-ether 12000
```

```
Bundle-Ether12000 input: ingress
```

```
Class inet4-classifier-af1
  Classification statistics (packets/bytes) (rate - kbps)
    Matched : 4647401962/21236124455654 26403040
    Transmitted : 4647401962/21236124455654 26403040
    Total Dropped : 0/0 0
Class inet4-classifier-af2
  Classification statistics (packets/bytes) (rate - kbps)
    Matched : 4502980177/20576584333939 25571493
    Transmitted : 4502980177/20576584333939 25571493
    Total Dropped : 0/0 0
Class inet4-classifier-af3
  Classification statistics (packets/bytes) (rate - kbps)
    Matched : 4647404125/21236213667880 26389086
    Transmitted : 4647404125/21236213667880 26389086
    Total Dropped : 0/0 0
Class inet4-classifier-af4
  Classification statistics (packets/bytes) (rate - kbps)
    Matched : 9291188840/42456120548683 52771168
    Transmitted : 9291188840/42456120548683 52771168
    Total Dropped : 0/0 0
Class inet4-classifier-bel
```

```

Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 4647413429/21235847852686      26393414
Transmitted                      : 4647413429/21235847852686      26393414
Total Dropped                    : 0/0                          0
Class inet4-classifier-ncl
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 9294887621/42473100149807      52778258
Transmitted                      : 9294887621/42473100149807      52778258
Total Dropped                    : 0/0                          0

Class class-default
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 0/0                          0
Transmitted                      : 0/0                          0
Total Dropped                    : 0/0                          0

```

Bundle-Ether12000 output: egress

```

Class c1
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 16665494532/75878118942463      8760591
Transmitted                      : 16655834643/75834136022017      8760591
Total Dropped                    : 9659889/43982920446          0
Queueing statistics
Queue ID                        : None (Bundle)
Taildropped(packets/bytes)      : 9659889/43982920446

Class c2
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 16665421959/75877849543188      8718687
Transmitted                      : 16665421959/75877849543188      8718687
Total Dropped                    : 0/0                          0
Queueing statistics
Queue ID                        : None (Bundle)
Taildropped(packets/bytes)      : 0/0

Class c3
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 16665247833/75877509455458      8703470
Transmitted                      : 16665187414/75877234624197      8703470
Total Dropped                    : 60419/274831261                0
Queueing statistics
Queue ID                        : None (Bundle)
Taildropped(packets/bytes)      : 60419/274831261

Class c4
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 33330896131/151755393012945      17470745
Transmitted                      : 33330745421/151754709368565      17470745
Total Dropped                    : 150710/683644380                0
Queueing statistics
Queue ID                        : None (Bundle)
Taildropped(packets/bytes)      : 150710/683644380

Class c5
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 16878910340/76849791869834      8833394
Transmitted                      : 16878849464/76849514633309      8833394
Total Dropped                    : 60876/277236525                0
Queueing statistics
Queue ID                        : None (Bundle)
Taildropped(packets/bytes)      : 60876/277236525

Class c6
Classification statistics          (packets/bytes)      (rate - kbps)
Matched                          : 33330898844/151756094112925      17456785
Transmitted                      : 33330752668/151755427708382      17456785
Total Dropped                    : 146176/666404543                0
Queueing statistics

```

```

Queue ID                               : None (Bundle)
Taildropped(packets/bytes)             : 146176/666404543
Class c7
  Classification statistics              (packets/bytes)      (rate - kbps)
  Matched                               : 244106/79922040      74
  Transmitted                           : 244106/79922040      74
  Total Dropped                         : 0/0                  0
Queueing statistics
Queue ID                               : None (Bundle)
Taildropped(packets/bytes)             : 0/0
Class class-default
  Classification statistics              (packets/bytes)      (rate - kbps)
  Matched                               : 267075066180/1215993441123215 139917482
  Transmitted                           : 267075066180/1215993441123215 139917482
  Total Dropped                         : 0/0                  0
Queueing statistics
Queue ID                               : None (Bundle)
Taildropped(packets/bytes)             : 0/0

```

## Related Topics

- [QoS on Link Bundles, on page 1](#)

## Associated Commands

- bundle maximu-active links
- interface Bundle-Ether