



## QoS Policies for Link Bundles

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### QoS policies for link bundles

A link bundle QoS policy is a Modular QoS feature that

- applies unified QoS policies across a group of aggregated Ethernet or VLAN interfaces
- ensures consistent bandwidth management, load balancing, and scheduling for all member links, and
- simplifies configuration by allowing a single QoS policy to govern multiple physical links treated as one logical interface.

#### Load balancing on link bundles

Load balancing on link bundles distributes traffic across member links by using Layer 3 routing information. This mechanism includes per-destination load balancing. It ensures that all packets from the same source–destination pair use the same link, preserving packet order and preventing re-sequencing delays when multiple links are available. Per-destination load balancing is only supported on the router, which can distribute packets over any of the links in the bundle.

Layer 3 load balancing for link bundles operates on Ethernet Flow Points (EFPs) associated with the bundle interface. It is based on the IPv4 source and destination addresses in the packet. When IPv4 information is unavailable, the system automatically reverts to the default load balancing that uses the source and destination MAC (SA/DA) fields.

### Usage guidelines for QoS policies on link bundles

#### Applying and inheriting QoS policies

- QoS policies are configured on link bundles in the same manner as they are on individual interfaces.

- When you apply a QoS policy on a bundle (in either ingress or egress direction), the queuing policy is automatically applied to each member interface. The reference bandwidth used for calculating shaper or bandwidth values is derived from the physical member interface, not the aggregate bundle bandwidth.
- The QoS policy applied to the bundle is inherited by all member links. The reference bandwidth used for shaping and scheduling is based on the bandwidth of each physical member interface, not the aggregate bandwidth of the bundle.
- 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 specified in a bundle policy map is not an aggregate rate for all bundle members. The rate applied to the bundle depends on traffic distribution.

For example, if a 10 Mbps shaping policy is applied to a bundle with two member links and all traffic flows through one member, the total shape rate remains 10 Mbps. However, if traffic is balanced evenly across both members, the combined shaping rate becomes 20 Mbps.

- Add bundle members before you apply the QoS policy to the bundle. This action ensures that the QoS policy applies across the bundle and on the new member.

If you add a new member after the policy is applied, and the new member's configuration is incompatible, the policy may fail to propagate and cause configuration errors.

## Troubleshooting queue-limit errors

- When you encounter a queue-limit error, remove the existing QoS policy from the bundle interface. The removal process may take up to ten minutes to take effect, depending on the time elapsed since the error occurred. To monitor progress, check the **Retries performed** information in the syslog message.
- If a queue-limit error occurs, the syslog lists only one interface, even if multiple interfaces are affected. Review **operations** in the syslog to determine the number of affected interfaces.

```
Router#Aug 17 09:56:37.417 PDT: BM-DISTRIB[1156]:
%L2-BM-4-ERR_OP_RETRY_THRESHOLD :
Exceeded threshold for the number of retries for 4 operations on members.
First (and error) FortyGigE0/0/0/34 ('DPA_QOSEA' detected the 'warning'
condition 'Invalid Queue Limit.
Value should be in range 614400-390070272 bytes or equivalent value in usec or
msec based on the service rate of the queue'),
retries performed for 10 hrs 16 mins
```

```
Router#Aug 17 10:06:40.388 PDT: BM-DISTRIB[1156]:
%L2-BM-4-ERR_OP_RETRY_THRESHOLD :
Exceeded threshold for the number of retries for 4 operations on members.
First (and error) FortyGigE0/0/0/34 ('DPA_QOSEA' detected the 'warning'
condition 'Invalid Queue Limit.
Value should be in range 614400-390070272 bytes or equivalent value in
usec or msec based on the service rate of the queue'),
retries performed for 10 hrs 26 mins
```

## Managing statistics and bundle changes

When you remove a member interface from a bundle, the total bundle statistics change because the counters associated with the detached link are lost. Always capture statistics before removing member links to ensure accurate reporting.

- Classification resources (TCAM or MAP) and counters are allocated per bundle interface.

- Queuing resources (VOQs) and counters are allocated per bundle member interface.

## Configuring policing and queuing parameters

- You can apply a policing policy on either the bundle's main interface or a bundle subinterface. You cannot apply it to both at the same time.
- Configure Committed Information Rate (CIR) and Peak Information Rate (PIR) values using percentage units only. You cannot use absolute values on bundle interfaces.
- Policers and their counters are allocated to each bundle interface. They are not allocated to individual member links.
- You can apply the queuing policy on the bundle's main interface or on its subinterface. You cannot apply it to both interfaces simultaneously.
- You can apply classification and marking policies on the bundle main interface or on its subinterface. You cannot apply these policies to both interfaces at the same time.

# Restrictions for QoS policies on link bundles

## Interface and link bundling

- Link bundling is supported only on Ethernet interfaces. Other interface types cannot participate in a bundle.
- Each bundle must contain only physical links. You cannot add subinterfaces or virtual interfaces to a link bundle.
- All links within a bundle must run the same bundling protocol—either IEEE 802.3ad (LACP) or EtherChannel (non-LACP). Mixing protocols within a single bundle is not supported.

## QoS shaping and accounting

- QoS shapers on bundle interfaces support only relative, percentage-based configurations. Absolute shaper values are not supported.
- Ethernet link bundles do not support MAC-level accounting. To collect traffic statistics, use higher-layer QoS counters instead.

## Scalability limits

- Each bundle can include a maximum of 64 Ethernet links.
- The maximum number of link bundles supported is 128.

# Configure QoS policies on link bundles

## Before you begin

When you attach a QoS policy to a bundle interface, the policy is enforced on each member interface. Complete these prerequisites before you begin this procedure.

- Prepare your class and policy definitions.

For more information on how to configure class maps and policy maps, see *Classify Packets to Identify Specific Traffic* in the *Modular QoS Configuration Guide for Cisco 8000 Series Router*.

- Create the link bundle.

## Procedure

**Step 1** Configure an Ethernet link bundle and attach the traffic policy to it.

### Example:

```
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
```

This running configuration example shows how a queuing 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-nc1
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
!
```

**Step 2** Verify that the bundle status is up.

**Example:**

```

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

```

**Step 3**

Verify the bundle statistics.

**Example:**

```

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-nc1
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
```

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