Configuring Modular QoS on Link Bundles

A link bundle is a group of one or more ports that are aggregated together and treated as a single link. This module describes QoS on link bundles.

Feature History for Configuring Modular QoS on Link Bundles on Cisco IOS XR Software

<table>
<thead>
<tr>
<th>Release</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release 3.8.0</td>
<td>The QoS on Link Bundles feature was introduced.</td>
</tr>
</tbody>
</table>

- Link Bundling Overview, page 1
- Load Balancing, page 2
- QoS and Link Bundling, page 2
- QoS for POS link bundling, page 3
- Additional References, page 4

Link Bundling Overview

The Link Bundling feature allows you to group multiple point-to-point links together into one logical link and provide higher bidirectional bandwidth, redundancy, and load balancing between two routers. A virtual interface is assigned to the bundled link. The component links can be dynamically added and deleted from the virtual interface.

The virtual interface is treated as a single interface on which one can configure an IP address and other software features used by the link bundle. Packets sent to the link bundle are forwarded to one of the links in the bundle.

A link bundle is simply a group of ports that are bundled together and act as a single link. The advantages of link bundles are as follows:

- Multiple links can span several line cards and SPAs to form a single interface. Thus, the failure of a single link does not cause a loss of connectivity.
- Bundled interfaces increase bandwidth availability, because traffic is forwarded over all available members of the bundle. Therefore, traffic can move onto another link if one of the links within a bundle fails. You can add or remove bandwidth without interrupting packet flow. For example, you can upgrade
from an OC-48c PLIM modular services card to an OC-192 PLIM modular services card without interrupting traffic.

All links within a bundle must be of the same type. For example, a bundle can contain all Ethernet interfaces, or it can contain all POS interfaces, but it cannot contain Ethernet and POS interfaces at the same time. Cisco IOS XR software supports these methods of forming bundles of Ethernet and POS interfaces:

- **IEEE 802.3ad**—Standard technology that employs a Link Aggregation Control Protocol (LACP) to ensure that all the member links in a bundle are compatible. Links that are incompatible or have failed are automatically removed from a bundle.

- **EtherChannel or POS Channel**—Cisco proprietary technology that allows the user to configure links to join a bundle, but has no mechanisms to check whether the links in a bundle are compatible. (EtherChannel applies to Ethernet interfaces and POS Channel applies to POS interfaces.)

### Load Balancing

Load balancing is supported on all links in the bundle. Load balancing function is a forwarding mechanism to distribute traffic over multiple links based on Layer 3 routing information in the router. There are two types of load balancing schemes:

- **Per-Destination Load Balancing**
- **Per-Packet Load Balancing**

When a traffic stream arrives at the router, per-packet load balancing allows the traffic to be evenly distributed among multiple equal cost links. Per-packet schemes make routing decision based on round-robin techniques, regardless of the individual source-destination hosts.

Only Per-Destination Load Balancing is supported.

Per-destination load balancing allows the router to distribute packets over one of the links in the bundle to achieve load sharing. The scheme is realized through a hash calculating based on the source-destination address and user sessions.

When the per-destination load balancing is enabled, all packets for a certain source-destination pair will 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.

### QoS and Link Bundling

All Quality of Service (QoS) features, currently supported on Layer 3 physical interfaces, are also supported on all Link Bundle interfaces. All QoS features currently supported on Layer 3 physical sub interfaces are also supported on bundle VLANs.

QoS is configured on Link Bundles in primarily the same way that it is configured on individual interfaces. However, there are some important restrictions that should be noted:

- Parameters for QoS actions can only be specified as percentages.
- WRED and queue limit parameters can only be configured in time units.
- A policer rate limit greater than 16 GB per class cannot be configured.
Layer 2 QoS is not supported for bundles.

These guidelines describe the characteristics of QoS behavior on bundle interfaces:

- QoS features are configured only on the Link Bundle interfaces, never on individual members.

- For egress QoS policies, a unique set of queues defined by the policy are assigned to each physical interface on each linecard hosting a member link. As a result, for queuing actions (e.g. shaping), egress QoS policy acts on the bandwidth provided by the individual member interfaces. This means that the actual shape rate experienced by a traffic class may be less than the configured value (as a percentage of the bundle bandwidth), if its traffic is not load-balanced evenly across all member links. For policer actions, egress QoS policy acts on the aggregate bandwidth provided by the interfaces on that linecard.

- For ingress QoS policies, a single set of queues defined by the policy are assigned on each linecard hosting a member link. As a result, ingress QoS policy acts on the aggregate bandwidth provided by the interfaces on that linecard.

### QoS for POS link bundling

For POS link bundles, percentage-based bandwidth is supported for policers and output queues. Time-based queue limit is supported for output queues.

### Input QoS Policy setup

For input QoS, queuing is not supported and thus bandwidth is used for policer only. As a member link is added or removed from a bundle with input QoS configured, the aggregate bundle bandwidth for that affected line card will change. One input QoS policy instance is assigned for each SIP 700 line card that is part of the POS link bundle.

### Output QoS Policy setup

When a member link is added to a bundle with output QoS configured, the policy-map of the bundle is applied to the member link.

Example 2 shows the output QoS policy supported on POS link bundles.

Example 2: Output QoS policy supported on POS link bundles

```
policy-map out-sample
  class voice
    priority level 1
    police rate percent 10
  class premium
    bandwidth percent 30
    queue-limit 100 ms
  class class-default
    queue-limit 100 ms
```
Additional References

These sections provide references related to implementing QoS on Link Bundles.

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial system bootup and configuration</td>
<td><em>Cisco IOS XR Getting Started Guide for the Cisco CRS Router</em></td>
</tr>
<tr>
<td>Link Bundling</td>
<td>&quot;Configuring Link Bundling on Cisco IOS XR Software&quot; module of <em>Cisco IOS XR Interface and Hardware Component Configuration Guide for the Cisco CRS Router</em></td>
</tr>
<tr>
<td>Master command reference</td>
<td><em>Cisco CRS Router Master Command Listing</em></td>
</tr>
<tr>
<td>QoS commands</td>
<td><em>Cisco IOS XR Modular Quality of Service Command Reference for the Cisco CRS Router</em></td>
</tr>
<tr>
<td>User groups and task IDs</td>
<td>&quot;Configuring AAA Services on Cisco IOS XR Software&quot; module of <em>Cisco IOS XR System Security Configuration Guide</em></td>
</tr>
</tbody>
</table>

Standards

<table>
<thead>
<tr>
<th>Standards</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
<td>—</td>
</tr>
</tbody>
</table>

MIBs

<table>
<thead>
<tr>
<th>MIBs</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: <a href="http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml">http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml</a></td>
</tr>
</tbody>
</table>
**RFCs**

<table>
<thead>
<tr>
<th>RFCs</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.</td>
<td>—</td>
</tr>
</tbody>
</table>

**Technical Assistance**

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>