Configure Modular QoS on Link Bundles

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.

• Only relative (percentage-based) shaper values can be configured. You cannot configure absolute values

• 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 isonly 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 goes 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's configured on individual interfaces.

Guidelines

- When you apply a QoS policy on a bundle (ingress or egress direction), the queuing policy is applied at each member interface. The reference bandwidth that is used to calculate shaper or bandwidth values is applied as per the physical member interface bandwidth.

- 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 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.

- 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 a QoS policy exists and you add a new member later, the policy may not apply on the bundle if the member interface has an incompatible configuration. This scenario may result in errors.

- **Queue-limit error:**

  - If you experience a queue-limit error, remove the existing QoS policy from the link bundle interfaces. However, this removal may take up to ten minutes to come into effect, depending on the time lapsed since the error displayed. To see the time lapsed, check the **retries performed** information in the subsequent syslog.

  - When you encounter an invalid queue-limit error, the syslog lists only one interface, though the error may occur across multiple interfaces. To know the number of affected interfaces, see **operations** in the syslog.

  For example:

  ```
  RP/0/RP0/CPU0: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

RP/0/RP0/CPU0: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
```

- The QoS policy applied on bundle is inherited to all its member links and the reference bandwidth used to calculate shaper/bandwidth is applied as per the physical member interface bandwidth, and not the bundle as a whole.

- Classification resources (TCAM/MAP) and counters are allocated per bundle interface, not per member.

- The policing policy can be applied on bundle main interface or sub interface, but not on both.

- Policer committed information rates (CIR) and peak information rates (PIR) can be configured only in percent units.

- Policers and policer counters are allocated per bundle interface but not per member.

- The queuing policy can be applied on bundle main or bundle sub interface, but not on both.

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

- The classification and marking policies can be applied on the bundle main or the bundle sub interface, but not on both.

Configuration Example

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

1. Creating a class-map

2. Creating a policy-map and specifying the respective class-map

3. Specifying the action type for the traffic

   Refer Attach a Traffic Policy to an Interface for details on step 1, 2 and 3.

4. Creating a link bundle

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 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-be1
  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

!
```

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-be1
  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
```

Related Topics

- QoS on Link Bundles, on page 1