Per-Tunnel QoS

Table 1: Feature History

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Release Information</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per-Tunnel QoS</td>
<td>Cisco IOS XE Release 17.2.1r</td>
<td>This feature lets you apply a Quality of Service (QoS) policy on individual tunnels, ensuring that branch offices with smaller throughput are not overwhelmed by larger aggregation sites. This feature is only supported for hub-to-spoke network topologies.</td>
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Information about Per-Tunnel QoS

Overview of Per-Tunnel QoS

Use the Per-tunnel QoS feature to apply a quality of service (QoS) policy on a Cisco IOS XE SD-WAN device hub on a per-tunnel or per-spoke instance in the egress direction.

Per-tunnel QoS can only be applied on hub-to-spoke network topologies. Per-tunnel QoS on a hub lets you shape tunnel traffic to individual spokes. It also differentiates individual data flows going through the tunnel or the spoke for policing.

Benefits of Per-Tunnel QoS

Before the introduction of Per-tunnel QoS feature on Cisco SD-WAN, QoS on a hub could be configured to measure only the aggregate outbound traffic for all spokes. Per-tunnel QoS for Cisco SD-WAN provides the following benefits.

- A QoS policy is configurable on the basis of session groups, thus providing the capability of regulating traffic from hub to spokes at a per-spoke level.
- The hub cannot send excessive traffic to a small spoke and overrun it.
The maximum outbound bandwidth and QoS queue are set up automatically when each spoke registers with an Overlay Management Protocol (OMP) message.

- The amount of outbound hub bandwidth that a “greedy” spoke can consume can be limited; therefore, the traffic can’t monopolize a hub’s resources and starve other spokes.
- Multiple policies (MPoL) are supported. This enables underlay and TLOC extension traffic to coexist with the overlay tunnel traffic.

**Supported Platforms**

**Per-Tunnel QoS for Hub**

The following series of platforms can be configured as hubs for the per-tunnel QoS in Cisco SD-WAN.

- Cisco 1000 Series Aggregation Services Routers
- Cisco 4000 Series Integrated Services Routers
- Cisco Cloud Services Router 1000V Series

**Per-Tunnel QoS for Spokes**

The following series of IOS XE SD-WAN devices can be configured as spokes for per-tunnel QoS in Cisco SD-WAN.

- Cisco 1000 Series Aggregation Services Routers
- Cisco 4000 Series Integrated Services Routers
- Cisco Cloud Services Router 1000V Series

Additionally, all Cisco vEdge devices can be configured as spokes for per-tunnel QoS in Cisco SD-WAN.

- vEdge 100
- vEdge 100b
- vEdge 100m
- vEdge 100wm
- vEdge1000
- vEdge 2000
- vEdge 5000
- vEdge Cloud Router
- Cisco 1000 Series Integrated Services Routers (ISRs)
  - ISR1100-4G
  - ISR1100-6G
  - ISR1100-4GLTENA and ISR1100-4GLTEGB
Limitations for Per-Tunnel QoS

The following restrictions apply to the Per-tunnel QoS feature in Cisco SD-WAN.

• Only hub-to-spoke network topology is supported for configuring per-tunnel QoS. Spoke-to-spoke network topology isn't supported.

• Only Cisco IOS XE SD-WAN devices are supported as hubs for per-tunnel QoS. However, both Cisco IOS XE SD-WAN devices and Cisco vEdge devices are supported as spokes in the hub-to-spoke topology supported for per-tunnel QoS.

• In Cisco IOS XE Release 17.2.1r, per-tunnel QoS can only be configured using the Cisco VPN Interface Ethernet template in Cisco vManage 20.1.1.

• Per-tunnel QoS with loopback WAN for non-binding mode isn't supported on the hub.

• For Per Tunnel QoS hubs, loopback interfaces are supported only when a single loopback interface is bound to a single physical interface.

How Per-Tunnel QoS Works in Hub-to-Spoke Topologies

In Cisco IOS XE Release 17.2, the Per-Tunnel QoS feature is supported on hub-to-spoke network topologies only. Per-tunnel QoS is not supported for spoke-to-spoke topology.

• Per-tunnel QoS is applied to routers with the hub role on a per-session basis.

• Routers that are assigned the spoke role publish the downstream-bandwidth information per TLOC route through OMP.

• Overlay and underlay tunnels share the same QoS policy and the bandwidth remaining is configurable for both underlay and overlay tunnels.

• The bandwidth remaining ratio is automatically calculated on each session based on the remote downstream bandwidth.

Configure Per-Tunnel QoS

Configure Per Tunnel QoS Using Cisco vManage

To configure per-tunnel QoS, perform the following tasks in the order specified.

Step 1: Configure QoS Map

A QoS map can be added to a localized data policy. For more details on the various QoS parameters, see QoS parameters section in the Policies Guide. To configure QoS map:

1. In Cisco vManage, navigate to Configuration > Policies.

2. Click the Localized Policy tab and then click Add Policy.
3. From the list type shown in the left pane, choose **Class Map**. A list displays existing class maps. Choose a class map from the list and click **Next**.

   OR

   To create a new class map:
   a. Click **Add New Class Map**.
   b. Enter a name for the class map.
   c. From the **Queue** drop-down menu, choose a number (from 0-7).
   d. Click **Save** and then click **Next**.

4. Click the **Add QoS Map** drop-down menu and choose **Create New**.

5. Provide a name and description for the map.

6. Click **Add Queue** and enter the requested details and click **Save Queue**.

7. Click **Save Policy** to save the localized policy with QoS configured.

**Step 2: Select the QoS Map to be Added to the Feature Template**

Per-tunnel QoS can only be configured through the Cisco VPN Interface Ethernet template. To enable per-tunnel QoS on other WAN interface types, use the global CLI add-on template.

1. In Cisco vManage, navigate to **Configuration > Templates**.
2. Click the **Feature** tab and then click **Add Template**.
3. Choose a device from the list on the left. Feature templates applicable to the device are shown in the right pane.
4. Choose the **Cisco VPN Interface Ethernet** template.
5. Enter a name and description for the feature template.
6. Choose the **ACL/QoS** option.
7. Enter the requested details.
   - **Shaping Rate**: Select Global from the drop-down list and enter a shaping rate in kbps.
   - **QoS Map**: Select Global from the drop-down list and enter the name of the QoS map that you want to include in the feature template.
8. Click **Save**.

**Step 3: Attach the Localized QoS Policy and the Feature Template to the Device Template**

1. Attach the localized policy created in Step 1 to the device template.
2. Attach the feature template created in Step 2 to the device template. See **Create Device Templates from Feature Templates** for more details.
Ensure that you attach the localized policy and the feature template to the same device template.

**Step 4 Configure Hub Role for Per-Tunnel QoS**

1. In Cisco vManage, navigate to Configuration > Templates.
2. Click the Feature tab. All the features templates are listed.
3. Choose the Cisco VPN Interface template that you want to add per-tunnel QoS policy to. Click the Options icon (…) in the same row as the template and choose Edit.
   
   Alternatively, you can create a new Cisco VPN Interface Ethernet template following the instructions in the previous sections and then proceed with the steps below.
4. When the template opens, click the Tunnel option at the top of the page.
5. From the Tunnel Interface drop-down list, choose Global and select the On radio button.
   
   A new set of fields display below the Tunnel Interface option. These new fields are specific to per-tunnel QoS and display only when you select the On radio button.
6. From the QoS drop-down list, choose Global and select the On radio button.
   
   The Per-tunnel Aggregator field displays after you set Per-Tunnel QoS to On. If this field is set to Off, which is the default behavior, it means that the device selected in the template is assigned the spoke role. If the field is set to On, it means that the device is assigned the hub role.
7. Select Global from the Per-tunnel Aggregator drop-down list and select the On radio button. The device has now been assigned the role of a hub.
   
   When you select the On option, the Tunnel Bandwidth Percent field displays.
8. You can either leave the Tunnel Bandwidth Percent value at default (50) or select Global from the drop-down to enter a value based on your network requirement.
   
   The remaining fields under the Tunnel section are not specific to per-tunnel QoS. You can either leave the values at default or enter values specific to your network.
9. Click Update. The feature template updates with per-tunnel QoS configuration.

**Step 5: Configure Spoke Role for Per-Tunnel QoS**

1. In Cisco vManage, navigate to Configuration > Templates.
2. Click the Feature tab. All the features templates are listed.
3. Choose the Cisco VPN Interface Template that you want to add the per-tunnel QoS policy to. Click the Options icon (…) in the same row as the template and from the drop-down menu, choose Edit.
   
   OR
   
   Create a new Cisco VPN Interface Ethernet template following the instructions in the previous sections and then proceed with the steps below.
4. When the template opens, click Tunnel at the top of the page.
5. From the Tunnel Interface drop-down list, choose **Global** and select the **On** radio button.

A new set of fields display below the Tunnel Interface option. These new fields are specific to per-tunnel QoS and display only when you select the On radio button.

6. From the Per-tunnel QoS drop-down list, choose **Global** and select the **On** radio button.

The Per-tunnel Aggregator field displays after you set Per-Tunnel QoS to On. This field is set to off by default. If this field is set to **Off**, it means that the device selected in the template is assigned the spoke role.

7. The downstream bandwidth needs to be configured for the device to effectively take the spoke role. To configure the downstream bandwidth, click the **Basic Configuration** tab at the top of the page.

8. Scroll down to the Bandwidth Downstream Field and choose **Global** from the drop-down list.

9. Enter a value for the downstream bandwidth and click **Update** at the bottom of the page.

Configure Per Tunnel QoS Using CLI

This topic shows the task flow for configuring per-tunnel QoS using CLI templates with the help of examples.

**Example: Create QoS MaP**

```plaintext
class-map match-any SDWAN_underlay
  match any
!
class-map match-all Queue0
  match qos-group 0
!
class-map match-all Queue1
  match qos-group 1
!
class-map match-all Queue3
  match qos-group 3
!
policy-map qos_policy_4class_cedge
  class Queue0
    priority level 1
    police rate percent 25
  class Queue1
    bandwidth remaining ratio 20
  class Queue3
    bandwidth remaining ratio 15
  class class-default
    bandwidth remaining ratio 40
!
```

**Example: Apply a QoS Map to an Ethernet Interface**

```plaintext
policy-map per_tunnel_qos_policy_GigabitEthernet0/0/1
  class SDWAN_underlay
    bandwidth remaining percent 50
    service-policy qos_policy_4class_cedge
!
policy-map shape_GigabitEthernet0/0/1
  class class-default
    shape average 10000000
    service-policy qos_policy_4class_cedge_GigabitEthernet0/0/1
!
```
interface GigabitEthernet0/0/1
  service-policy output shape GigabitEthernet0/0/1
!

Example: Configure a Device as a Hub

sdwan
interface GigabitEthernet0/0/1
tunnel-interface
  encapsulation ipsec
  color public-internet restrict
tunnel-qos hub
exit
exit

Example: Configure a Device as a Spoke

sdwan
interface GigabitEthernet0/0/2
tunnel-interface
  encapsulation ipsec
  color public-internet restrict
tunnel-qos spoke
exit
  bandwidth-downstream 50000
exit

Verify Per-Tunnel QoS Configuration

Run the show sdwan running-config command to verify the per-tunnel QoS configuration on a Cisco IOS XE SD-WAN device configured as a hub.

Device# show sdwan running-config
class-map match-any Queue0
  match qos-group 0
!
class-map match-any Queue1
  match qos-group 1
!
class-map match-any Queue3
  match qos-group 3
!
class-map match-any SDWAN_underlay
  match any

policy-map per_tunnel_qos_policy_GigabitEthernet0/0/1
class SDWAN_underlay
  bandwidth remaining percent 50
  service-policy qos_policy_4class_cedge
!

! policy-map qos_policy_4class_cedge
class Queue0
  priority level 1
  police rate percent 25
!
!
class Queue1
  bandwidth remaining ratio 20
Monitor Per-Tunnel QoS

Use the following monitoring commands to monitor the performance of per-tunnel QoS.

- **show platform software qos template** — Displays the child templates used for per-tunnel QoS
• **show platform software sdwan qos policy** —Displays per-tunnel QoS policy instance parameters like policy template, bandwidth, and bandwidth remaining-ratio

• **show platform software sdwan qos target** —Displays per-tunnel QoS policy target database per sd-wan session and tunnel interface

• **show policy-map interface GigabitEthernet 0/0/1** —Displays the statistics status and the configured policy maps on the specified interface

• **show policy-map multipoint Tunnel 10 100.64.254.2** —Displays the per-tunnel QoS statistics on the tunnel ID specified