



# Configuring Control Plane Policing

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## Restrictions for CoPP

Restrictions for control plane policing (CoPP) include the following:

- Only ingress CoPP is supported. The **system-cpp-policy** policy-map is available on the control plane interface, and only in the ingress direction.
- Only the **system-cpp-policy** policy-map can be installed on the control plane interface.
- The **system-cpp-policy** policy-map and the system-defined classes cannot be modified or deleted.
- Only the **police** action is allowed under the **system-cpp-policy** policy-map. The police rate for system-defined classes must be configured only in packets per second (pps).
- One or more CPU queues are part of each class-map. Where multiple CPU queues belong to one class-map, changing the policer rate of a class-map affects all CPU queues that belong to that class-map. Similarly, disabling the policer in a class-map disables all queues that belong to that class-map. See *Table: System-Defined Values for CoPP* for information about which CPU queues belong to each class-map.
- We recommend not disabling the policer for a system-defined class map, that is, do not configure **no police rate rate pps** command. Doing so affects the overall system health in case of high traffic towards the CPU. Further, even if you disable the policer rate for a system-defined class map, the systems automatically reverts to the default policer rate after system bootup in order to protect the system bring-up process.
- The **show run** command does not display information about classes configured under `system-cpp policy`, when they are left at default values. Use the **show policy-map system-cpp-policy** or the **show policy-map control-plane** commands instead.

You can continue use the **show run** command to display information about custom policies.

- A protocol with a large number of CPU-bound packets may impact other protocols in the same class, as some of these protocols share the same policer. For example, Address Resolution Protocol (ARP) shares 4000 hardware policers with an array of host protocols like Telnet, Internet Control Message Protocol (ICMP), SSH, FTP, and SNMP in the `system-cpp-police-forus` class. If there is an ARP poisoning or an ICMP attack, hardware policers start throttling any incoming traffic that exceeds 4000 packets per second to protect the CPU and the overall integrity of the system. As a result, ARP and ICMP host protocols are dropped, along with any other host protocols that share the same class.
- Starting from Cisco IOS XE Fuji 16.8.1a, the creation of user-defined class-maps is not supported.

## Information About CoPP

This chapter describes how control plane policing (CoPP) works on your device and how to configure it.

### CoPP Overview

The CoPP feature improves security on your device by protecting the CPU from unnecessary traffic and denial of service (DoS) attacks. It can also protect control traffic and management traffic from traffic drops caused by high volumes of other, lower priority traffic.

Your device is typically segmented into three planes of operation, each with its own objective:

- The data plane, to forward data packets.
- The control plane, to route data correctly.
- The management plane, to manage network elements.

You can use CoPP to protect most of the CPU-bound traffic and ensure routing stability, reachability, and packet delivery. Most importantly, you can use CoPP to protect the CPU from a DoS attack.

CoPP uses the modular QoS command-line interface (MQC) and CPU queues to achieve these objectives. Different types of control plane traffic are grouped together based on certain criteria, and assigned to a CPU queue. You can manage these CPU queues by configuring dedicated policers in hardware. For example, you can modify the policer rate for certain CPU queues (traffic-type), or you can disable the policer for a certain type of traffic.

Although the policers are configured in hardware, CoPP does not affect CPU performance or the performance of the data plane. But since it limits the number of packets going to CPU, the CPU load is controlled. This means that services waiting for packets from hardware may see a more controlled rate of incoming packets (the rate being user-configurable).

### System-Defined Aspects of CoPP

When you power-up the device for the first time, the system automatically performs the following tasks:

- Looks for policy-map **system-cpp-policy**. If not found, the system creates and installs it on the control-plane.
- Creates eighteen class-maps under **system-cpp-policy**.

The next time you power-up the device, the system detects the policy and class maps that have already been created.

- Enables all CPU queues by default, with their respective default rate. The default rates are indicated in the table System-Defined Values for CoPP.

The **system-cpp-policy** policy map is a system-default policy map, and normally, you do not have to expressly save it to the startup configuration of the device. But, a *failed* bulk synchronization with a standby device can result in the configuration being erased from the startup configuration. In case this happens, you have to manually save the **system-cpp-policy** policy map to the startup configuration. Use the **show running-config** privileged EXEC command to verify that it has been saved:

```
policy-map system-cpp-policy
```

The following table (System-Defined Values for CoPP) lists the class-maps that the system creates when you load the device. It lists the policer that corresponds to each class-map and one or more CPU queues that are grouped under each class-map. There is a one-to-one mapping of class-maps to policers; and one or more CPU queues map to a class-map. This is followed by another table (CPU Queues and Associated Features), which lists features associated with each CPU queue.

**Table 1: System-Defined Values for CoPP**

| Class Maps Names                    | Policer Index (Policer No.)       | CPU queues (Queue No.)   |
|-------------------------------------|-----------------------------------|--|
| system-cpp-police-data              | WK_CPP_POLICE_DATA(0)             | WK_CPU_Q_ICMP_GEN(3)<br>WK_CPU_Q_BROADCAST(12)<br>WK_CPU_Q_ICMP_REDIRECT(6)  |
| system-cpp-police-l2-control        | WK_CPP_POLICE_L2_CONTROL(1)       | WK_CPU_Q_L2_CONTROL(1)   |
| system-cpp-police-routing-control   | WK_CPP_POLICE_ROUTING_CONTROL(2)  | WK_CPU_Q_ROUTING_CONTROL(4)<br>WK_CPU_Q_LOW_LATENCY (27)   |
| system-cpp-police-punt-webauth      | WK_CPP_POLICE_PUNT_WEBAUTH(7)     | WK_CPU_Q_PUNT_WEBAUTH(22)  |
| system-cpp-police-topology-control  | WK_CPP_POLICE_TOPOLOGY_CONTROL(8) | WK_CPU_Q_TOPOLOGY_CONTROL(15)  |
| system-cpp-police-multicast         | WK_CPP_POLICE_MULTICAST(9)        | WK_CPU_Q_TRANSIT_TRAFFIC(18)<br>WK_CPU_Q_MCAST_DATA(30)  |
| system-cpp-police-sys-data          | WK_CPP_POLICE_SYS_DATA(10)        | WK_CPU_Q_OPENFLOW (13)<br>WK_CPU_Q_CRYPTO_CONTROL(23)<br>WK_CPU_Q_EXCEPTION(24)<br>WK_CPU_Q_EGR_EXCEPTION(28)<br>WK_CPU_Q_NFL_SAMPLED_DATA(26)<br>WK_CPU_Q_GOLD_PKT(31)<br>WK_CPU_Q_RPF_FAILED(19) |
| system-cpp-police-dot1x-auth        | WK_CPP_POLICE_DOT1X(11)           | WK_CPU_Q_DOT1X_AUTH(0)   |
| system-cpp-police-protocol-snooping | WK_CPP_POLICE_PR(12)              | WK_CPU_Q_PROTO_SNOOPING(16)  |

| Class Maps Names                         | Policer Index (Policer No.)          | CPU queues (Queue No.)   |
|--|--------------------------------------|--|
| system-cpp-police-dhcp-snooping          | WK_CPP_DHCP_SNOOPING(6)              | WK_CPU_Q_DHCP_SNOOPING(17)   |
| system-cpp-police-sw-forward             | WK_CPP_POLICE_SW_FWD<br>(13)         | WK_CPU_Q_SW_FORWARDING_Q(14)<br>WK_CPU_Q_LOGGING(21)<br>WK_CPU_Q_L2_LVX_DATA_PACK (11) |
| system-cpp-police-forus                  | WK_CPP_POLICE_FORUS(14)              | WK_CPU_Q_FORUS_ADDR_RESOLUTION(5)<br>WK_CPU_Q_FORUS_TRAFFIC(2)                         |
| system-cpp-police- multicast-end-station | WK_CPP_POLICE_MULTICAST_SNOOPING(15) | WK_CPU_Q_MCAST_END_STA<br>TION_SERVICE(20)   |
| system-cpp-default                       | WK_CPP_POLICE_DEFAULT_POLICER(16)    | WK_CPU_Q_INTER_FED_TRAFFIC(7)<br>WK_CPU_Q_EWLC_CONTROL(9)<br>WK_CPU_Q_EWLC_DATA(10)    |
| system-cpp-police-stackwise-virt-control | WK_CPP_STACKWISE_VIRTUAL_CONTROL(16) | WK_CPU_Q_STACKWISE_VIRTUAL_CONTROL<br>(29)   |
| system-cpp-police-l2lvx-control          | WK_CPP_<br>L2_LVX_CONT_PACK(4)       | WK_CPU_Q_L2_LVX_CONT_PACK(8)   |
| system-cpp-police-high-rate-app          | WK_CPP_HIGH_RATE_APP(18)             | WK_CPU_Q_HIGH_RATE_APP(23)   |
| system-cpp-police-system-critical        | WK_CPP_SYSTEM_CRITICAL(3)            | WK_CPU_Q_SYSTEM_CRITICAL(25)   |

The following table lists the CPU queues and the feature(s) associated with each CPU queue.

**Table 2: CPU Queues and Associated Features**

| CPU queues (Queue No.) | Feature(s)                            |
|------------------------|---------------------------------------|
| WK_CPU_Q_DOT1X_AUTH(0) | IEEE 802.1x Port-Based Authentication |

| CPU queues (Queue No.)    | Feature(s)   |
|---------------------------|--|
| WK_CPU_Q_L2_CONTROL(1)    | Dynamic Trunking Protocol (DTP)<br>VLAN Trunking Protocol (VTP)<br>Port Aggregation Protocol (PAgP)<br>Client Information Signaling Protocol (CISP)<br>Message session relay protocol<br>Multiple VLAN Registration Protocol (MVRP)<br>Metropolitan Mobile Network (MMN)<br>Link Level Discovery Protocol (LLDP)<br>UniDirectional Link Detection (UDLD)<br>Link Aggregation Control Protocol (LACP)<br>Cisco Discovery Protocol (CDP)<br>Spanning Tree Protocol (STP) |
| WK_CPU_Q_FORUS_TRAFFIC(2) | Host such as Telnet, Pingv4 and Pingv6, and<br>SNMP<br>Keepalive / loopback detection<br>Initiate-Internet Key Exchange (IKE) protocol<br>(IPSec)  |
| WK_CPU_Q_ICMP_GEN(3)      | ICMP - destination unreachable<br>ICMP-TTL expired   |

| CPU queues (Queue No.)            | Feature(s)   |
|-----------------------------------|--|
| WK_CPU_Q_ROUTING_CONTROL(4)       | Routing Information Protocol version 1 (RIPv1)<br>RIPv2<br>Interior Gateway Routing Protocol (IGRP)<br>Border Gateway Protocol (BGP)<br>PIM-UDP<br>Virtual Router Redundancy Protocol (VRRP)<br>Hot Standby Router Protocol version 1 (HSRPv1)<br>HSRPv2<br>Gateway Load Balancing Protocol (GLBP)<br>Label Distribution Protocol (LDP)<br>Web Cache Communication Protocol (WCCP)<br>Routing Information Protocol next generation (RIPng)<br>Open Shortest Path First (OSPF)<br>Open Shortest Path First version 3(OSPFv3)<br>Enhanced Interior Gateway Routing Protocol (EIGRP)<br>Enhanced Interior Gateway Routing Protocol version 6 (EIGRPv6)<br>DHCPv6<br>Protocol Independent Multicast (PIM)<br>Protocol Independent Multicast version 6 (PIMv6)<br>Hot Standby Router Protocol next generation (HSRPng)<br>IPv6 control<br>Generic Routing Encapsulation (GRE) keepalive<br>Network Address Translation (NAT) punt<br>Intermediate System-to-Intermediate System (IS-IS) |
| WK_CPU_Q_FORUS_ADDR_RESOLUTION(5) | Address Resolution Protocol (ARP)<br>IPv6 neighbor advertisement and neighbor solicitation   |
| WK_CPU_Q_ICMP_REDIRECT(6)         | Internet Control Message Protocol (ICMP) redirect  |

| CPU queues (Queue No.)                 | Feature(s)   |
|--|--|
| WK_CPU_Q_INTER_FED_TRAFFIC(7)          | Layer 2 bridge domain inject for internal communication.   |
| WK_CPU_Q_L2_LVX_CONT_PACK(8)           | Exchange ID (XID) packet   |
| WK_CPU_Q_EWLC_CONTROL(9)               | Embedded Wirelss Controller (eWLC) [Control and Provisioning of Wireless Access Points (CAPWAP) (UDP 5246)]  |
| WK_CPU_Q_EWLC_DATA(10)                 | eWLC data packet (CAPWAP DATA, UDP 5247)   |
| WK_CPU_Q_L2_LVX_DATA_PACK(11)          | Unknown unicast packet punted for map request.   |
| WK_CPU_Q_BROADCAST(12)                 | All types of broadcast   |
| WK_CPU_Q_OPENFLOW(13)                  | Learning cache overflow (Layer 2 + Layer 3)  |
| WK_CPU_Q_CONTROLLER_PUNT(14)           | Data - access control list (ACL) Full<br>Data - IPv4 options<br>Data - IPv6 hop-by-hop<br>Data - out-of-resources / catch all<br>Data - Reverse Path Forwarding (RPF) incomplete<br>Glean packet |
| WK_CPU_Q_TOPOLOGY_CONTROL(15)          | Spanning Tree Protocol (STP)<br>Resilient Ethernet Protocol (REP)<br>Shared Spanning Tree Protocol (SSTP)  |
| WK_CPU_Q_PROTO_SNOOPING(16)            | Address Resolution Protocol (ARP) snooping for Dynamic ARP Inspection (DAI)  |
| WK_CPU_Q_DHCP_SNOOPING(17)             | DHCP snooping  |
| WK_CPU_Q_TRANSIT_TRAFFIC(18)           | This is used for packets punted by NAT, which need to be handled in the software path.   |
| WK_CPU_Q_RPF_FAILED(19)                | Data – mRPF (multicast RPF) failed   |
| WK_CPU_Q_MCAST_END_STATION_SERVICE(20) | Internet Group Management Protocol (IGMP) / Multicast Listener Discovery (MLD) control   |
| WK_CPU_Q_LOGGING(21)                   | Access control list (ACL) logging  |
| WK_CPU_Q_PUNT_WEBAUTH(22)              | Web Authentication   |

| CPU queues (Queue No.)                 | Feature(s)  |
|--|---|
| WK_CPU_Q_HIGH_RATE_APP(23)             | Wired Application Visibility and Control (WDAVC) traffic<br>Network-Based Application Recognition (NBAR) traffic<br>Encrypted Traffic Analytics (ETA) for traffic analysis and classification |
| WK_CPU_Q_EXCEPTION(24)                 | IKE indication<br>IP learning violation<br>IP port security violation<br>IP Static address violation<br>IPv6 scope check<br>Remote Copy Protocol (RCP) exception<br>Unicast RPF fail          |
| WK_CPU_Q_SYSTEM_CRITICAL(25)           | Media Signaling/ Wireless Proxy ARP   |
| WK_CPU_Q_NFL_SAMPLED_DATA(26)          | Netflow sampled data and Media Services Proxy (MSP)   |
| WK_CPU_Q_LOW_LATENCY(27)               | Bidirectional Forwarding Detection (BFD), Precision Time Protocol (PTP)   |
| WK_CPU_Q_EGR_EXCEPTION(28)             | Egress resolution exception   |
| WK_CPU_Q_STACKWISE_VIRTUAL_CONTROL(29) | Front side stacking protocols, namely SVL   |
| WK_CPU_Q_MCAST_DATA(30)                | Data - (S,G) creation<br>Data - local joins<br>Data - PIM Registration<br>Data - SPT switchover<br>Data - Multicast   |
| WK_CPU_Q_GOLD_PKT(31)                  | Gold  |

## User-Configurable Aspects of CoPP

You can perform these tasks to manage control plane traffic:



**Note** All `system-cpp-policy` configurations must be saved so they are retained after reboot.



### Enable or Disable a Policer for CPU Queues

Enable a policer for a CPU queue, by configuring a policer action (in packets per second) under the corresponding class-map, within the `system-cpp-policy` policy-map.

Disable a policer for CPU queue, by removing the policer action under the corresponding class-map, within the `system-cpp-policy` policy-map.



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**Note** If a default policer is already present, carefully consider and control its removal; otherwise the system may see a CPU hog or other anomalies, such as control packet drops.

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### Change the Policer Rate

You can do this by configuring a policer rate action (in packets per second), under the corresponding class-map, within the `system-cpp-policy` policy-map.

When setting a policer rate, note that the rate you set is automatically converted to the nearest multiple of 200. For instance, if you set the policer rate of a CPU queue 100 pps, the system changes it to 200; or if set the policer rate to 650, the system changes it to 600. See *Example: Setting the Default Policer Rates for All CPU Queues* in this chapter, for sample output that displays this behavior.

### Set Policer Rates to Default

Set the policer for CPU queues to their default values, by entering the `cpp system-default` command in global configuration mode.

## Upgrading or Downgrading the Software Version

### Software Version Upgrades and CoPP

When you upgrade the software version on your device, the system checks and make the necessary updates as required for CoPP (For instance, it checks for the `system-cpp-policy` policy map and creates it if missing). You may also have to complete certain tasks before or after the upgrade activity. This is to ensure that any configuration updates are reflected correctly and CoPP continues to work as expected. Depending on the method you use to upgrade the software, upgrade-related tasks may be optional or recommended in some scenarios, and mandatory in others.

The system actions and user actions for an upgrade, are described here. Also included, are any release-specific caveats.

#### System Actions for an Upgrade

When you upgrade the software version on your device, the system performs these actions. This applies to all upgrade methods:

- If the device did not have a `system-cpp-policy` policy map before upgrade, then on upgrade, the system creates a default policy map.
- If the device had a `system-cpp-policy` policy map before upgrade, then on upgrade, the system does not re-generate the policy.

### User Actions for an Upgrade

User actions for an upgrade – depending on upgrade method:

| Upgrade Method       | Condition | Action Time and Action  | Purpose                                   |
|----------------------|-----------|---|---|
| Regular <sup>1</sup> | None      | <b>After upgrade (required)</b><br>Enter the <b>cpp system-default</b> command in global configuration mode | To get the latest, default policer rates. |

<sup>1</sup> Refers to a software upgrade method that involves a reload of the switch. Can be install or bundle mode.

## Software Version Downgrades and CoPP

The system actions and user actions for a downgrade, are described here.

### System Actions for a Downgrade

When you downgrade the software version on your device, the system performs these actions. This applies to all downgrade methods:

- The system retains the `system-cpp-policy` policy map on the device, and installs it on the control plane.

### User Actions for a Downgrade

User actions for a downgrade:

| Upgrade Method       | Condition | Action Time and Action | Purpose        |
|----------------------|-----------|------------------------|----------------|
| Regular <sup>2</sup> | None      | No action required     | Not applicable |

<sup>2</sup> Refers to a software upgrade method that involves a reload of the switch. Can be install or bundle mode.

If you downgrade the software version and then upgrade, the system action and user actions that apply are the same as those mentioned for upgrades.

## How to Configure CoPP

### Enabling a CPU Queue or Changing the Policer Rate

The procedure to enable a CPU queue and change the policer rate of a CPU queue is the same. Follow these steps:

#### Procedure

|               | Command or Action                | Purpose   |
|---------------|----------------------------------|---|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b> | Enables privileged EXEC mode.<br>• Enter your password if prompted. |

|               | Command or Action  | Purpose   |
|---------------|--|---|
|               | Device> <b>enable</b>  |   |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br>Device# <b>configure terminal</b>  | Enters global configuration mode.   |
| <b>Step 3</b> | <b>policy-map <i>policy-map-name</i></b><br><b>Example:</b><br>Device (config)# <b>policy-map</b><br><b>system-cpp-policy</b><br>Device (config-pmap)#   | Enters the policy map configuration mode.   |
| <b>Step 4</b> | <b>class <i>class-name</i></b><br><b>Example:</b><br>Device (config-pmap)# <b>class</b><br><b>system-cpp-police-protocol-snooping</b><br>Device (config-pmap-c)#   | Enters the class action configuration mode.<br>Enter the name of the class that corresponds to the CPU queue you want to enable. See table <i>System-Defined Values for CoPP</i> .  |
| <b>Step 5</b> | <b>police rate <i>rate</i> <i>pps</i></b><br><b>Example:</b><br>Device (config-pmap-c)# <b>police rate 100</b><br><b>pps</b><br>Device (config-pmap-c-police)#   | Specifies an upper limit on the number of incoming packets processed per second, for the specified traffic class.<br><b>Note</b> The rate you specify is applied to all CPU queues that belong to the class-map you have specified. |
| <b>Step 6</b> | <b>exit</b><br><b>Example:</b><br>Device (config-pmap-c-police)# <b>exit</b><br>Device (config-pmap-c)# <b>exit</b><br>Device (config-pmap)# <b>exit</b><br>Device (config)#                                     | Returns to the global configuration mode.   |
| <b>Step 7</b> | <b>control-plane</b><br><b>Example:</b><br>Device (config)# <b>control-plane</b><br>Device (config-cp)#  | Enters the control plane (config-cp) configuration mode   |
| <b>Step 8</b> | <b>service-policy input <i>policy-name</i></b><br><b>Example:</b><br>Device (config)# <b>control-plane</b><br>Device (config-cp)# <b>service-policy input</b><br><b>system-cpp-policy</b><br>Device (config-cp)# | Installs system-cpp-policy in FED. This command is required for you to see the FED policy. Not configuring this command will lead to an error.  |

|                | Command or Action   | Purpose   |
|----------------|---|---|
| <b>Step 9</b>  | <b>end</b><br><b>Example:</b><br><br>Device(config-cp)# <b>end</b>  | Returns to the privileged EXEC mode.  |
| <b>Step 10</b> | <b>show policy-map control-plane</b><br><b>Example:</b><br><br>Device# <b>show policy-map control-plane</b> | Displays all the classes configured under <code>system-cpp policy</code> , the rates configured for the various traffic types, and statistics |

## Disabling a CPU Queue

Follow these steps to disable a CPU queue:

### Procedure

|               | Command or Action  | Purpose  |
|---------------|--|--|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br><br>Device> <b>enable</b>  | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>   |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br><br>Device# <b>configure terminal</b>  | Enters global configuration mode.  |
| <b>Step 3</b> | <b>policy-map <i>policy-map-name</i></b><br><b>Example:</b><br><br>Device(config)# <b>policy-map</b><br><b>system-cpp-policy</b><br>Device(config-pmap)#           | Enters the policy map configuration mode.  |
| <b>Step 4</b> | <b>class <i>class-name</i></b><br><b>Example:</b><br><br>Device(config-pmap)# <b>class</b><br><b>system-cpp-police-protocol-snooping</b><br>Device(config-pmap-c)# | Enters the class action configuration mode.<br>Enter the name of the class that corresponds to the CPU queue you want to disable. See the table, <i>System-Defined Values for CoPP</i> . |
| <b>Step 5</b> | <b>no police rate <i>rate</i> pps</b><br><b>Example:</b><br><br>Device(config-pmap-c)# <b>no police rate</b><br><b>100 pps</b>                                     | Disables incoming packet processing for the specified traffic class.<br><br><b>Note</b> This disables all CPU queues that belong to the class-map you have specified.                    |

|               | Command or Action   | Purpose   |
|---------------|---|---|
| <b>Step 6</b> | <b>end</b><br><b>Example:</b><br><br>Device(config-pmap-c)# <b>end</b>                                      | Returns to the privileged EXEC mode.  |
| <b>Step 7</b> | <b>show policy-map control-plane</b><br><b>Example:</b><br><br>Device# <b>show policy-map control-plane</b> | Displays all the classes configured under <code>system-cpp policy</code> and the rates configured for the various traffic types and statistics. |

## Setting the Default Policer Rates for All CPU Queues

Follow these steps to set the policer rates for all CPU queues to their default rates:

### Procedure

|               | Command or Action  | Purpose  |
|---------------|--|--|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br><br>Device> <b>enable</b>  | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul> |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br><br>Device# <b>configure terminal</b>  | Enters global configuration mode.  |
| <b>Step 3</b> | <b>cpp system-default</b><br><b>Example:</b><br><br>Device(config)# <b>cpp system-default</b><br>Defaulting CPP : Policer rate for all classes will be set to their defaults | Sets the policer rates for all the classes to the default rate.  |
| <b>Step 4</b> | <b>end</b><br><b>Example:</b><br><br>Device(config)# <b>end</b>  | Returns to the privileged EXEC mode.   |
| <b>Step 5</b> | <b>show platform hardware fed switch {switch-number} qos que stats internal cpu policer</b><br><b>Example:</b>   | Displays the rates configured for the various traffic types.   |

|  | Command or Action  | Purpose |
|--|--|---------|
|  | Device# <code>show platform hardware fed switch 1 qos que stat internal cpu policer</code> |         |

## Configuration Examples for CoPP

### Example: Enabling a CPU Queue or Changing the Policer Rate of a CPU Queue

This example shows how to enable a CPU queue or to change the policer rate of a CPU queue. Here the `class system-cpp-police-protocol-snooping` CPU queue is enabled with the policer rate of 2000 pps.

```
Device> enable
Device# configure terminal
Device(config)# policy-map system-cpp-policy
Device(config-pmap)# class system-cpp-police-protocol-snooping
Device(config-pmap-c)# police rate 2000 pps
Device(config-pmap-c-police)# end
```

```
Device# show policy-map control-plane
```

```
Control Plane
```

```
Service-policy input: system-cpp-policy
```

```
<output truncated>
```

```
Class-map: system-cpp-police-dot1x-auth (match-any)
 0 packets, 0 bytes
 5 minute offered rate 0000 bps, drop rate 0000 bps
Match: none
police:
  rate 1000 pps, burst 244 packets
  conformed 0 bytes; actions:
    transmit
  exceeded 0 bytes; actions:
    drop
```

```
Class-map: system-cpp-police-protocol-snooping (match-any)
 0 packets, 0 bytes
 5 minute offered rate 0000 bps, drop rate 0000 bps
Match: none
police:
  rate 2000 pps, burst 488 packets
  conformed 0 bytes; actions:
    transmit
  exceeded 0 bytes; actions:
    drop
```

```
<output truncated>
```

```
Class-map: class-default (match-any)
```

```
0 packets, 0 bytes
5 minute offered rate 0000 bps, drop rate 0000 bps
Match: any
```

## Example: Disabling a CPU Queue

This example shows how to disable a CPU queue. Here the **class system-cpp-police-protocol-snooping** CPU queue is disabled.

```
Device> enable
Device# configure terminal
Device(config)# policy-map system-cpp-policy
Device(config-pmap)# class system-cpp-police-protocol-snooping
Device(config-pmap-c)# no police rate 100 pps
Device(config-pmap-c)# end
```

```
Device# show running-config | begin system-cpp-policy
```

```
policy-map system-cpp-policy
class system-cpp-police-data
  police rate 200 pps
class system-cpp-police-sys-data
  police rate 100 pps
class system-cpp-police-sw-forward
  police rate 1000 pps
class system-cpp-police-multicast
  police rate 500 pps
class system-cpp-police-multicast-end-station
  police rate 2000 pps
class system-cpp-police-punt-webauth
class system-cpp-police-l2-control
class system-cpp-police-routing-control
  police rate 500 pps
class system-cpp-police-control-low-priority
class system-cpp-police-wireless-priority1
class system-cpp-police-wireless-priority2
class system-cpp-police-wireless-priority3-4-5
class system-cpp-police-topology-control
class system-cpp-police-dot1x-auth
class system-cpp-police-protocol-snooping
class system-cpp-police-forus
class system-cpp-default
```

<output truncated>

## Example: Setting the Default Policer Rates for All CPU Queues

This example shows how to set the policer rates for all CPU queues to their default and then verify the setting.



**Note** For some CPU queues, the `default rate` and the `set rate` values will not be the same, even if you set the default rate for all classes. This is because the set rate is rounded off to the nearest multiple of 200. This behavior is controlled by the clock speed of your device. In the sample output below, the default and set rate values for `DHCP Snooping` and `NFL SAMPLED DATA` display this difference.

## Example: Setting the Default Policer Rates for All CPU Queues

```

Device> enable
Device# configure terminal
Device(config)# cpp system-default
Defaulting CPP : Policer rate for all classes will be set to their defaults
Device(config)# end

Device# show platform hardware fed switch 1 qos queue stats internal cpu policer

```

## CPU Queue Statistics

| QId | PlcIdx | Queue Name               | Enabled | (default)<br>Rate | (set)<br>Rate | Queue<br>Drop(Bytes) | Queue<br>Drop(Frames) |
|-----|--------|--------------------------|---------|-------------------|---------------|----------------------|-----------------------|
| 0   | 11     | DOT1X Auth               | Yes     | 1000              | 1000          | 0                    | 0                     |
| 1   | 1      | L2 Control               | Yes     | 2000              | 2000          | 0                    | 0                     |
| 2   | 14     | Forus traffic            | Yes     | 4000              | 4000          | 0                    | 0                     |
| 3   | 0      | ICMP GEN                 | Yes     | 600               | 600           | 0                    | 0                     |
| 4   | 2      | Routing Control          | Yes     | 5400              | 5400          | 0                    | 0                     |
| 5   | 14     | Forus Address resolution | Yes     | 4000              | 4000          | 0                    | 0                     |
| 6   | 0      | ICMP Redirect            | Yes     | 600               | 600           | 0                    | 0                     |
| 7   | 16     | Inter FED Traffic        | Yes     | 2000              | 2000          | 0                    | 0                     |
| 8   | 4      | L2 LVX Cont Pack         | Yes     | 1000              | 1000          | 0                    | 0                     |
| 9   | 16     | EWLC Control             | Yes     | 2000              | 2000          | 0                    | 0                     |
| 10  | 16     | EWLC Data                | Yes     | 2000              | 2000          | 0                    | 0                     |
| 11  | 13     | L2 LVX Data Pack         | Yes     | 1000              | 1000          | 0                    | 0                     |
| 12  | 0      | BROADCAST                | Yes     | 600               | 600           | 0                    | 0                     |
| 13  | 10     | Openflow                 | Yes     | 100               | 200           | 0                    | 0                     |
| 14  | 13     | Sw forwarding            | Yes     | 1000              | 1000          | 0                    | 0                     |
| 15  | 8      | Topology Control         | Yes     | 13000             | 13000         | 0                    | 0                     |
| 16  | 12     | Proto Snooping           | Yes     | 2000              | 2000          | 0                    | 0                     |
| 17  | 6      | DHCP Snooping            | Yes     | 500               | 400           | 0                    | 0                     |
| 18  | 9      | Transit Traffic          | Yes     | 500               | 400           | 0                    | 0                     |
| 19  | 10     | RPF Failed               | Yes     | 100               | 200           | 0                    | 0                     |
| 20  | 15     | MCAST END STATION        | Yes     | 2000              | 2000          | 0                    | 0                     |
| 21  | 13     | LOGGING                  | Yes     | 1000              | 1000          | 0                    | 0                     |
| 22  | 7      | Punt Webauth             | Yes     | 1000              | 1000          | 0                    | 0                     |
| 23  | 18     | High Rate App            | Yes     | 13000             | 13000         | 0                    | 0                     |
| 24  | 10     | Exception                | Yes     | 100               | 200           | 0                    | 0                     |



|    |    |                       |     |      |      |   |   |
|----|----|-----------------------|-----|------|------|---|---|
| 25 | 3  | System Critical       | Yes | 1000 | 1000 | 0 | 0 |
| 26 | 10 | NFL SAMPLED DATA      | Yes | 100  | 200  | 0 | 0 |
| 27 | 2  | Low Latency           | Yes | 5400 | 5400 | 0 | 0 |
| 28 | 10 | EGR Exception         | Yes | 100  | 200  | 0 | 0 |
| 29 | 5  | Stackwise Virtual OOB | Yes | 8000 | 8000 | 0 | 0 |
| 30 | 9  | MCAST Data            | Yes | 500  | 400  | 0 | 0 |
| 31 | 10 | Gold Pkt              | Yes | 100  | 200  | 0 | 0 |

\* NOTE: CPU queue policer rates are configured to the closest hardware supported value

=====  
CPU Queue Policer Statistics  
=====

| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
|----------------|----------------|----------------|----------------|----------------|
| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
| 0              | 0              | 0              | 0              | 0              |
| 1              | 0              | 0              | 0              | 0              |
| 2              | 0              | 0              | 0              | 0              |
| 3              | 0              | 0              | 0              | 0              |
| 4              | 0              | 0              | 0              | 0              |
| 5              | 0              | 0              | 0              | 0              |
| 6              | 0              | 0              | 0              | 0              |
| 7              | 0              | 0              | 0              | 0              |
| 8              | 0              | 0              | 0              | 0              |
| 9              | 0              | 0              | 0              | 0              |
| 10             | 0              | 0              | 0              | 0              |
| 11             | 0              | 0              | 0              | 0              |
| 12             | 0              | 0              | 0              | 0              |
| 13             | 0              | 0              | 0              | 0              |
| 14             | 0              | 0              | 0              | 0              |
| 15             | 0              | 0              | 0              | 0              |
| 16             | 0              | 0              | 0              | 0              |
| 17             | 0              | 0              | 0              | 0              |
| 18             | 0              | 0              | 0              | 0              |

=====  
Second Level Policer Statistics  
=====

|    |          |        |   |   |
|----|----------|--------|---|---|
| 20 | 52772252 | 688073 | 0 | 0 |
| 21 | 0        | 0      | 0 | 0 |

=====  
Policer Index Mapping and Settings  
-----

| =====<br>----- | =====<br>----- | =====<br>-----            | =====<br>----- | =====<br>----- |
|----------------|----------------|---------------------------|----------------|----------------|
| =====<br>----- | =====<br>----- | =====<br>-----            | =====<br>----- | =====<br>----- |
| =====<br>----- | =====<br>----- | =====<br>-----            | =====<br>----- | =====<br>----- |
| level-2        | :              | level-1                   | (default)      | (set)          |
| PlcIndex       | :              | PlcIndex                  | rate           | rate           |
| 20             | :              | 1 2 8                     | 13000          | 13000          |
| 21             | :              | 0 4 7 9 10 11 12 13 14 15 | 6000           | 6000           |

=====  
Second Level Policer Config  
=====

| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
|----------------|----------------|----------------|----------------|----------------|
| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
| =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- | =====<br>----- |
| QId            | level-1        | level-2        | Queue Name     | level-2        |
|                | PlcIdx         | PlcIdx         |                | Enabled        |
| 0              | 11             | 21             | DOT1X Auth     | Yes            |
| 1              | 1              | 20             | L2 Control     | Yes            |
| 2              | 14             | 21             | Forus traffic  | Yes            |

## Example: Setting the Default Policer Rates for All CPU Queues

|    |    |    |                          |     |
|----|----|----|--------------------------|-----|
| 3  | 0  | 21 | ICMP GEN                 | Yes |
| 4  | 2  | 20 | Routing Control          | Yes |
| 5  | 14 | 21 | Forus Address resolution | Yes |
| 6  | 0  | 21 | ICMP Redirect            | Yes |
| 7  | 16 | -  | Inter FED Traffic        | No  |
| 8  | 4  | 21 | L2 LVX Cont Pack         | Yes |
| 9  | 19 | -  | EWLC Control             | No  |
| 10 | 16 | -  | EWLC Data                | No  |
| 11 | 13 | 21 | L2 LVX Data Pack         | Yes |
| 12 | 0  | 21 | BROADCAST                | Yes |
| 13 | 10 | 21 | Openflow                 | Yes |
| 14 | 13 | 21 | Sw forwarding            | Yes |
| 15 | 8  | 20 | Topology Control         | Yes |
| 16 | 12 | 21 | Proto Snooping           | Yes |
| 17 | 6  | -  | DHCP Snooping            | No  |
| 18 | 13 | 21 | Transit Traffic          | Yes |
| 19 | 10 | 21 | RPF Failed               | Yes |
| 20 | 15 | 21 | MCAST END STATION        | Yes |
| 21 | 13 | 21 | LOGGING                  | Yes |
| 22 | 7  | 21 | Punt Webauth             | Yes |
| 23 | 18 | -  | High Rate App            | No  |
| 24 | 10 | 21 | Exception                | Yes |
| 25 | 3  | -  | System Critical          | No  |
| 26 | 10 | 21 | NFL SAMPLED DATA         | Yes |
| 27 | 2  | 20 | Low Latency              | Yes |
| 28 | 10 | 21 | EGR Exception            | Yes |
| 29 | 5  | -  | Stackwise Virtual OOB    | No  |
| 30 | 9  | 21 | MCAST Data               | Yes |
| 31 | 3  | -  | Gold Pkt                 | No  |

## CPP Classes to queue map

```

=====
PlcIdx CPP Class                               : Queues
-----
0      system-cpp-police-data                   : ICMP GEN/BROADCAST/ICMP Redirect/
10     system-cpp-police-sys-data                : Openflow/Exception/EGR Exception/NFL
SAMPLED DATA/Gold Pkt/RPF Failed/
13     system-cpp-police-sw-forward             : Sw forwarding/LOGGING/L2 LVX Data Pack/
9      system-cpp-police-multicast              : Transit Traffic/MCAST Data/
15     system-cpp-police-multicast-end-station  : MCAST END STATION /
7      system-cpp-police-punt-webauth           : Punt Webauth/
1      system-cpp-police-l2-control             : L2 Control/
2      system-cpp-police-routing-control        : Routing Control/Low Latency/
3      system-cpp-police-system-critical         : System Critical/
4      system-cpp-police-l2lvx-control          : L2 LVX Cont Pack/
8      system-cpp-police-topology-control       : Topology Control/
11     system-cpp-police-dot1x-auth             : DOT1X Auth/
12     system-cpp-police-protocol-snooping     : Proto Snooping/
6      system-cpp-police-dhcp-snooping         : DHCP Snooping/
14     system-cpp-police-forus                  : Forus Address resolution/Forus traffic/
5      system-cpp-police-stackwise-virt-control : Stackwise Virtual OOB/
16     system-cpp-default                       : Inter FED Traffic/ EWLC Data/
18     system-cpp-police-high-rate-app          : High Rate App/
19     system-cpp-police-ewlc-control           : EWLC Control/
20     system-cpp-police-ios-routing            : L2 Control/ Topology Control/ Routing
Control/ Low Latency/
21     system-cpp-police-ios-feature            : ICMP GEN/ BROADCAST/ ICMP Redirect/ L2
LVX Cont Pack/ Proto Snooping/ Punt Webauth/ MCAST Data/ Transit Traffic/ DOT1X Auth/ Sw
forwarding/ LOGGING/ L2 LVX Data Pack/ Forus traffic/ Forus Address resolution/ MCAST END
STATION / Openflow/ Exception/ EGR Exception/ NFL SAMPLED DATA/ RPF Failed/

```

## Monitoring CoPP

Use these commands to display policer settings, such as, traffic types and policer rates (user-configured and default rates) for CPU queues:

| Command   | Purpose  |
|---|--|
| <b>show policy-map control-plane</b>  | Displays the rates configured for the various traffic types                    |
| <b>show policy-map system-cpp-policy</b>  | Displays all the classes configured under system-cpp policy, and policer rates |
| <b>show platform hardware fed switch {switch-number} qos que stats internal cpu policer</b> | Displays the rates configured for the various traffic types                    |
| <b>show platform software fed {switch-number} qos policy target status</b>                  | Displays information about policy status and the target port type.             |

## Feature History for CoPP

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

| Release                      | Feature                              | Feature Information  |
|------------------------------|--------------------------------------|--|
| Cisco IOS XE Everest 16.5.1a | Control Plane Policing (CoPP) or CPP | <p>The CoPP feature improves security on your device by protecting the CPU from unnecessary traffic, or DoS traffic, and by prioritizing control plane and management traffic.</p> <p>The feature provides CLI configuration options to enable and disable CPU queues, to change the policer rate, set policer rates to default, and to create user-defined class-maps (with filters) and add them to policy map <code>system-cpp-policy</code>.</p> |

| Release                     | Feature   | Feature Information   |
|-----------------------------|---|---|
| Cisco IOS XE Everest 16.6.1 | Changes in system-defined values for CoPP                     | <p>These new system-defined classes were introduced:</p> <ul style="list-style-type: none"> <li>• system-cpp-police-stackwise-virt-control</li> <li>• system-cpp-police-l2lvx-control</li> </ul> <p>These new CPU queues were added to the existing <code>system-cpp-default</code> class:</p> <ul style="list-style-type: none"> <li>• WK_CPU_Q_UNUSED (7)</li> <li>• WK_CPU_Q_EWLC_CONTROL(9)</li> <li>• WK_CPU_Q_EWLC_DATA(10)</li> </ul> <p>CPU queue WK_CPU_Q_L2_LVX_DATA_PACK (11) was added to class <code>system-cpp-police-sw-forward</code>.</p> <p>CPU queue WK_CPU_Q_SGT_CACHE_FULL(27) is no longer available.</p> |
| Cisco IOS XE Everest 16.6.4 | Change in the system behavior for policer rates that are set. | For some CPU queues, the default rate and the set rate values will not be the same, even if you set the default rate for all classes. This is because the set rate is rounded off to the nearest multiple of 200.   |

| Release                         | Feature  | Feature Information  |
|---------------------------------|--|--|
| Cisco IOS XE Fuji 16.8.1a       | Removal of support for user-defined class-maps and changes in system-defined values for CoPP | <ul style="list-style-type: none"> <li>Starting from this release, the creation of user-defined class-maps is not supported.</li> <li>This new system-defined class was introduced: <code>system-cpp-police-dhcp-snooping</code></li> <li>This new CPU queue was added to the existing <code>system-cpp-default</code> class: <code>WK_CPU_Q_INTER_FED_TRAFFIC</code></li> <li>These CPU queues are no longer available: <ul style="list-style-type: none"> <li><code>WK_CPU_Q_SHOW_FORWARD</code></li> <li><code>WK_CPU_Q_UNUSED</code></li> </ul> </li> <li>The default policer rate (pps) for some CPU queues has changed: <ul style="list-style-type: none"> <li>The default rate for <code>WK_CPU_Q_EXCEPTION(24)</code> was changed to 100</li> <li>The default rate for all the CPU queues under <code>system-cpp-default</code> was increased to 2000.</li> <li>The default rate for all the CPU queues under <code>system-cpp-police-forus</code> was increased to 4000.</li> </ul> </li> </ul> |
| Cisco IOS XE Fuji 16.9.1        | Changes in system-defined values for CoPP  | <p>Starting with this release, eighteen system-defined classes are created under <code>system-cpp-policy</code>.</p> <p>These new system-defined classes were introduced:</p> <ul style="list-style-type: none"> <li><code>system-cpp-police-high-rate-app</code></li> <li><code>system-cpp-police-system-critical</code></li> </ul> <p>CPU queue <code>WK_CPU_Q_OPENFLOW (13)</code> was added to class <code>system-cpp-police-sys-data</code>.</p> <p>CPU queue <code>WK_CPU_Q_LEARNING_CACHE_OVFL(13)</code> is no longer available.</p>   |
| Cisco IOS XE Fuji 16.9.4        | Deprecation of system-defined class map  | This system-defined class map was deprecated: <code>system-cpp-police-control-low-priority</code>  |
| Cisco IOS XE Gibraltar 16.11.1c | Control Plane Policing (CoPP) or CPP   | The feature was introduced on the C9300L models of the series.   |

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to <https://cfmg.cisco.com>.