Control Plane Policing

The Control Plane Policing feature allows you to configure a quality of service (QoS) filter that manages the traffic flow of control plane packets to protect the control plane of routers and switches against reconnaissance and denial-of-service (DoS) attacks. In this way, the control plane (CP) can help maintain packet forwarding and protocol states despite an attack or heavy traffic load on the router or switch.

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for Control Plane Policing

Input Rate-Limiting Support

Input rate-limiting is performed in silent (packet discard) mode. Silent mode enables a router to silently discard packets using policy maps applied to input control plane traffic with the **service-policy input** command. For more information, see the “Input Rate-Limiting and Silent Mode Operation” section.

MQC Restrictions

The Control Plane Policing feature requires the Modular QoS CLI (MQC) to configure packet classification and traffic policing. All restrictions that apply when you use the MQC to configure traffic policing also apply when you configure control plane policing.

Match Criteria Support

Only the extended IP access control lists (ACLs) classification (match) criteria is supported.

Information About Control Plane Policing

Benefits of Control Plane Policing

Configuring the Control Plane Policing feature on your Cisco router or switch provides the following benefits:

- Protection against DoS attacks at infrastructure routers and switches
- QoS control for packets that are destined to the control plane of Cisco routers or switches
- Ease of configuration for control plane policies
- Better platform reliability and availability

Control Plane Terms to Understand

On the router, the following terms are used for the Control Plane Policing feature:

- Control plane—A collection of processes that run at the process level on the Route Processor (RP). These processes collectively provide high-level control for most Cisco IOS XE functions. The traffic sent to or sent by the control plane is called control traffic.
- Forwarding plane—A device that is responsible for high-speed forwarding of IP packets. Its logic is kept simple so that it can be implemented by hardware to do fast packet-forwarding. It punts packets that require complex processing (for example, packets with IP options) to the RP for the control plane to process them.

Control Plane Policing Overview

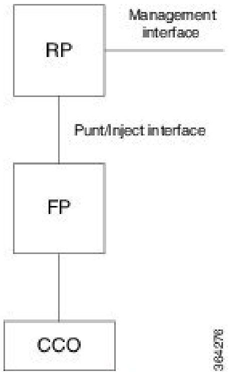
To protect the control plane on a router from DoS attacks and to provide fine-control over the traffic to the control plane, the Control Plane Policing feature treats the control plane as a separate entity with its own interface for ingress (input) and egress (output) traffic. This interface is called the punt or inject interface, and it is similar to a physical interface on the router. Along this interface, packets are punted from the forwarding plane to the RP (in the input direction) and injected from the RP to the forwarding plane (in the output direction). A set of quality of service (QoS) rules can be applied on this interface (in the input direction) in order to achieve CoPP.

These QoS rules are applied only after the packet has been determined to have the control plane as its destination. You can configure a service policy (QoS policy map) to prevent unwanted packets from progressing after a specified rate limit has been reached; for example, a system administrator can limit all TCP/TELNET packets that are destined for the control plane.

You can use the **platform qos-feature copp-mpls enable** command to enable the Control Plane Policing feature on the device for MPLS explicit null scenario, control packets destined to the device is punted to proper control CPU Q. If CoPP-MPLS remains disabled, then self destined control packets like BGP, LDP, telnet and so on, that are MPLS explicit null tagged are not classified by CoPP and is punted to HOST_Q instead of CFM_Q/CONTROL_Q.

Note The command **platform qos-feature copp-mpls enable** is supported only on Cisco ASR 920 platform.

Figure 1: Abstract Illustration of a Router with a Single RP and Forwarding Plane



The figure provides an abstract illustration of the router with a single RP and forwarding plane. Packets that are destined to the control plane come in through the carrier card and then go through the forwarding plane before being punted to the RP. When an input QoS policy map is configured on the control plane, the forwarding plane performs the QoS action (for example, a transmit or drop action) before punting packets to the RP in order to achieve the best protection of the control plane in the RP.

Note The figure is not applicable to the RSP3 module.

Note As mentioned in this section, the control plane interface is directly connected to the RP, so all traffic through the control plane interface to or from the control-plane is not subject to the CoPP function performed by the forwarding plane.

Supported Protocols

The following table lists the protocols supported on Control Plane Policing feature.

Supported Protocols	Criteria	Match	Queue#
TFTP - Trivial FTP	IP/Port Match	permit udp 64.202.160.0 0.0.1.255 eq 69 any permit udp 64.202.160.0 0.0.1.255 any eq 69	NQ_CPU_HOST_Q
TELNET	IP/Port Match	permit tcp 169.223.252.0 0.0.3.255 host 169.223.253.1 eq telnet permit tcp 169.223.252.0 0.0.3.255 eq telnet host 169.223.253.1	NQ_CPU_CONTROL_Q
NTP - Network Time Protocol	IP/Port Match	permit udp 169.223.252.0 0.0.3.255 host 169.223.253.1 eq ntp permit udp 169.223.252.0 0.0.3.255 eq ntp host 169.223.253.1	NQ_CPU_HOST_Q
FTP - File Transfer Protocol	IP/Port Match	permit tcp host <FTP server> eq ftp <loopback block> permit tcp host <FTP server> <loopback block> eq ftp	NQ_CPU_HOST_Q
SNMP - Simple Network Management Protocol	IP/Port Match	permit udp 169.223.252.0 0.0.3.255 host 169.223.253.1 eq snmp permit udp 169.223.252.0 0.0.3.255 eq snmp host 169.223.253.1	NQ_CPU_HOST_Q
TACACS - Terminal Access Controller Access-Control System	IP/Port Match	permit tcp 169.223.252.0 0.0.3.255 host 169.223.253.1 eq tacacs permit tcp 169.223.252.0 0.0.3.255 eq tacacs host 169.223.253.1 permit udp 169.223.252.0 0.0.3.255 host 169.223.253.1 eq tacacs permit udp 169.223.252.0 0.0.3.255 eq tacacs host 169.223.253.1	NQ_CPU_HOST_Q

Supported Protocols	Criteria	Match	Queue#
FTP-DATA	IP/Port Match	permit tcp any any eq 20 permit tcp any eq 20 any permit udp any any eq 20 permit udp any eq 20 any	NQ_CPU_HOST_Q
HTTP - Hypertext Transfer Protocol	IP/Port Match	permit tcp any any eq www permit tcp any eq www any	NQ_CPU_HOST_Q
WCCP - Web Cache Communication Protocol	IP/Port Match	IP access list copp-system-acl-wccp 10 permit udp any eq 2048 any eq 2048	NQ_CPU_HOST_Q
BGP - Border Gateway Protocol	IP/Port Match	permit tcp 169.223.252.0 0.0.3.255 host 169.223.253.1 eq bgp permit tcp 169.223.252.0 0.0.3.255 eq bgp host 169.223.253.1	NQ_CPU_CFM_Q
SSH - Secure Shell	IP/Port Match	permit udp [remote vty mgmt subnet] 0.0.0.255 any eq 22 permit udp [remote vty mgmt subnet] 0.0.0.255 eq 22 any permit tcp [remote vty mgmt subnet] 0.0.0.255 any eq 22 permit tcp [remote vty mgmt subnet] 0.0.0.255 eq 22 any	NQ_CPU_HOST_Q
ICMP - Internet Control Message Protocol	Protocol Match	access-list 110 permit icmp any 169.223.253.1	NQ_CPU_HOST_Q

Supported Protocols	Criteria	Match	Queue#
ISAKMP - Internet Security Association and Key Management Protocol	IP/Port Match	permit udp any host x.x.x.x eq isakmp permit udp any eq isakmp host x.x.x.x permit udp any host x.x.x.x eq non500-isakmp permit udp any eq non500-isakmp host x.x.x.x	NQ_CPU_HOST_Q
SAA - Service Assurance Agent	IP/Port Match	permit icmp host 10.2.2.4 host 10.1.1.1	NQ_CPU_HOST_Q
DHCP - Dynamic Host Configuration Protocol	IP/Port Match	permit udp host 0.0.0.0 host 255.255.255.255 eq bootps permit udp any eq bootps any eq bootps permit udp host 0.0.0.0 host 255.255.255.255 eq bootpc permit udp any eq bootpc any eq bootpc	NQ_CPU_HOST_Q
DNS - Domain Name System	IP/Port Match	permit udp host <DNS server> eq domain any permit udp host <DNS server> any eq domain permit tcp host <DNS server> eq domain any permit tcp host <DNS server> any eq domain	NQ_CPU_HOST_Q
DLSw - Data-Link Switching	IP/Port Match	permit any any eq 2065 permit any eq 2065 any	NQ_CPU_HOST_Q
LDP - Label Distribution Protocol	IP/Port Match	permit tcp any any eq 646 permit tcp any eq 646 any permit udp any any eq 646 permit udp any eq 646 any	NQ_CPU_CFM_Q

Supported Protocols	Criteria	Match	Queue#
RADIUS - Remote Authentication Dial In User Service	IP/Port Match	permit udp 64.202.160.0 0.0.1.255 eq 1645 any permit udp 64.202.160.0 0.0.1.255 any eq 1645 permit udp 64.202.160.0 0.0.1.255 eq 1646 any permit udp 64.202.160.0 0.0.1.255 any eq 1646 permit udp 64.202.160.0 0.0.1.255 eq 1812 any permit udp 64.202.160.0 0.0.1.255 any eq 1812 permit udp 64.202.160.0 0.0.1.255 eq 1813 any permit udp 64.202.160.0 0.0.1.255 any eq 1813 permit tcp 64.202.160.0 0.0.1.255 eq 1645 any permit tcp 64.202.160.0 0.0.1.255 any eq 1645 permit tcp 64.202.160.0 0.0.1.255 eq 1646 any permit tcp 64.202.160.0 0.0.1.255 any eq 1646 permit tcp 64.202.160.0 0.0.1.255 eq 1812 any permit tcp 64.202.160.0 0.0.1.255 any eq 1812 permit tcp 64.202.160.0 0.0.1.255 eq 1813 any permit tcp 64.202.160.0 0.0.1.255 any eq 1813	NQ_CPU_HOST_Q
HSRP - Hot Standby Router Protocol	IP/Port Match	permit udp any 224.0.0.0/24 eq 1985 permit udp any eq 1985 224.0.0.0/24	NQ_CPU_HOST_Q

Input Rate-Limiting and Silent Mode Operation

A router is automatically enabled to silently discard packets when you configure input policing on control plane traffic using the **service-policy input** *policy-map-name* command.

Rate-limiting (policing) of input traffic from the control plane is performed in silent mode. In silent mode, a router that is running Cisco IOS XE software operates without receiving any system messages. If a packet that is entering the control plane is discarded for input policing, you do not receive an error message.

How to Use Control Plane Policing

Defining Control Plane Services

Perform this task to define control plane services, such as packet rate control and silent packet discard for the RP.

Before you begin

Before you enter control-plane configuration mode to attach an existing QoS policy to the control plane, you must first create the policy using MQC to define a class map and policy map for control plane traffic.

- Platform-specific restrictions, if any, are checked when the service policy is applied to the control plane interface.
- Input policing does not provide any performance benefits. It simply controls the information that is entering the device.

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **configure terminal**

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 **control-plane**

Example:

```
Device(config)# control-plane
```

Enters control-plane configuration mode (which is a prerequisite for defining control plane services).

Step 4 **service-policy** [**input** |**output**] *policy-map-name*

Example:

```
Device(config-cp)# service-policy input control-plane-policy
```

Attaches a QoS service policy to the control plane.

- **input**—Applies the specified service policy to packets received on the control plane.
- *policy-map-name*—Name of a service policy map (created using the **policy-map** command) to be attached.

Step 5 **end**

Example:

```
Device(config-cp)# end
```

(Optional) Returns to privileged EXEC mode.

Verifying Control Plane Services

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2 **show policy-map control-plane** [**all**] [**input** |**output** [**class** *class-name*]]

Example:

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

Displays information about the control plane.

- **all**—(Optional) Displays service policy information about all QoS policies used on the CP.
- **input**—(Optional) Displays statistics for the attached input policy.
- **class** *class-name*—(Optional) Specifies the name of the traffic class whose configuration and statistics are displayed.

Step 3 **exit**

Example:

```
Device# exit
```

(Optional) Exits privileged EXEC mode.

Examples

The following example shows that the policy map TEST is associated with the control plane.

```
Router# show policy-map control-plane
Control Plane

Service-policy input: copp-ftp

Class-map: copp-ftp (match-any)
2234 packets, 223400 bytes
5 minute offered rate 0000 bps, drop rate 0000 bps
Match: access-group name copp-ftp
police:
cir 10000000 bps, be 312500 bytes
conformed 2234 packets, 223400 bytes; actions:
transmit
exceeded 0 packets, 0 bytes; actions:
drop
conformed 0000 bps, exceeded 0000 bps

Class-map: class-default (match-any)
0 packets, 0 bytes
5 minute offered rate 0000 bps, drop rate 0000 bps
Match: any
```

Configuring Control Plane Policing to Mitigate Denial-of-Service Attacks

Apply control plane policing (CoPP) to ICMP packets to mitigate denial of service (DoS) attacks.

Procedure

Step 1 **enable**

Example:

```
Device> enable
```

Enables privileged EXEC mode.

Step 2 **configure terminal**

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 **access-list** *access-list-number* **permit** *protocol* {**tcd** | **udp**} {**any** | **host** {*source-addr* | *name*}} **eq** *port number* {**any** | **host** {*source-addr* | *name*}} **eq** *port number*

Example:

```
Device(config)# access-list 111 permit udp any eq 1699 any eq 1698
```

Configures an access list for filtering frames by UDP protocol and matches only packets with a given port number.

Step 4 **class-map [match-any | match-all | type]** *class-map-name*

Example:

```
Device(config)# class-map match-any MyClassMap
```

Creates a class-map and enters QoS class-map configuration mode.

Step 5 **match access-group** [*access-list-index* | *access-group-name*]

Example:

```
Device(config-cmap)# match access-group 111
```

Specifies access groups to apply to an identity policy. The range of valid values is 1-2799.

Step 6 **exit**

Example:

```
Device(config-cmap)# exit
```

Exits QoS class-map configuration mode and returns to global configuration mode.

Step 7 **policy-map** *policy-map-name*

Example:

```
Device(config)# policy-map Policy1
```

Specifies a service policy and enters QoS policy-map configuration mode.

Step 8 **class** [*class-map-name* | *class-default*]

Example:

```
Device(config-pmap)# class MyClassMap
```

Enters QoS policy-map class configuration more

Step 9 **police** {*rate-bps* | **cir** {*cir-bps* | **percent** *percent*}} [**bc** *burst-bytes*] [**conform-action** | **exceed-action** | **violate-action**]*action*] [ ]

Example:

```
police cir 10000000 bc 8000 pir 12000000 be 8000 conform-action transmit exceed-action
transmit violate-action drop
```

Configure a traffic policer based on the traffic rate or committed information rate (CIR). By default, no policer is defined.

- *rate-bps*—Specifies average traffic rate in bits per second (b/s). The range is 64000 to 10000000000. Supply an optional postfix (K, M, G). Decimal point is allowed.
- **cir**—Specifies a committed information rate (CIR).
- *cir-bps*—Specifies a CIR in bits per second (b/s). The range is 64000 to 10000000000. Supply an optional postfix (K, M, G). Decimal point is allowed.
- **be** *burst-bytes*—(Optional) Specifies the conformed burst (be) or the number of acceptable burst bytes. The range is 8000 to 16000000.
- **conform-action** *action*— (Optional) Specifies action to take on packets that conform to the specified rate limit.
- **pir** *pir-bps*—(Optional) Specifies the peak information rate (PIR).

Note **cir percent** *percent* option is not supported on the router.

Step 10 **exit**

Example:

```
Device(config-pmap-c-police)# exit
```

Exits policy-map class police configuration mode

Step 11 **exit**

Example:

```
Device(config-pmap-c)# exit
```

Exits policy-map class configuration mode

Step 12 **exit**

Example:

```
Device(config-pmap)# exit
```

Exits policy-map configuration mode

Step 13 **control-plane**

Example:

```
Device(config)# control-plane
```

Enters control plane configuration mode.

Step 14 **service-policyinput** *policy-map-name*

Example:

```
Device(config-cp)# service-policy input Policy1
```

Attaches a policy map to a control plane.

Step 15 **exit**

Example:

```
Device(config-cp)# exit
```

Exits control plane configuration mode and returns to global configuration mode.

Step 16 **exit**

Example:

```
Device(config)# exit
```

Exits global configuration mode returns to privileged EXEC mode.

Configuration Examples for Control Plane Policing

Example: Configuring Control Plane Policing on Input Telnet Traffic

```
! Rate-limit all other Telnet traffic.
Device(config)# access-list 140 permit tcp any any eq telnet


! Define class-map "telnet-class."
Device(config)# class-map telnet-class
Device(config-cmap)# match access-group 140
Device(config-cmap)# exit
Device(config)# policy-map control-plane-in
Device(config-pmap)# class telnet-class
Device(config-pmap-c)# police 80000 conform transmit exceed drop
Device(config-pmap-c)# exit
Device(config-pmap)# exit

! Define aggregate control plane service for the active route processor.
Device(config)# control-plane
Device(config-cp)# service-policy input control-plane-in
Device(config-cp)# end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book.html

Standards and RFCs

Standard/RFC	Title
No specific Standards and RFCs are supported by the features in this document.	—

MIBs

MIB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Control Plane Policing

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for Control Plane Policing

Feature Name	Releases	Feature Information
Control Plane Policing	Cisco IOS XE Release 3.14.0S	This feature was introduced on the Cisco ASR 920 Series Aggregation Services Router (ASR-920-12CZ-A, ASR-920-12CZ-D, ASR-920-4SZ-A, ASR-920-4SZ-D, ASR-920-10SZ-PD, ASR-920-24SZ-IM, ASR-920-24SZ-M, ASR-920-24TZ-M).