

Key Hardware Resources for QoS

QoS implementations rely on various hardware resources to support efficient packet processing and traffic management.

See the table to know more about the key hardware resources that QoS utilizes.

Table 1: Key Hardware Resources that QoS Uses

Resource	Details
Switches and Routers	Switches and routers are fundamental networking devices that play a crucial role in QoS. They are responsible for forwarding traffic based on QoS policies and handling tasks such as packet classification, queuing, and scheduling.
Network Processors	Specialized hardware components designed to handle the processing and forwarding of network traffic. They typically offer high-speed packet processing capabilities, including packet classification, traffic shaping, and queuing tasks.
Traffic Shaper Devices	Hardware devices that regulate the outgoing traffic rate to meet specified bandwidth limits. They typically incorporate algorithms and buffers to shape the traffic flow and smooth out bursts or peaks in network utilization.
Application-Specific Integrated Circuits (ASICs)	ASICs are custom-designed integrated circuits tailored for specific networking tasks. They offer hardware acceleration for essential QoS functions such as packet classification, marking, queuing, and shaping, enabling high-performance and low-latency processing.
Line Cards	Components in networking devices such as switches and routers. They contain the necessary hardware resources, including ASICs, memory, and interfaces, to handle the packet processing and traffic management functions for specific ports or interfaces.

Resource	Details
Memory	Memory resources, including volatile (for example, RAM) and non-volatile (for example, flash memory), are essential for storing and managing QoS-related data, such as traffic classification rules, queuing parameters, and packet buffers.
Interfaces	Network interfaces, such as Ethernet ports or WAN interfaces, are hardware components that connect networking devices to the network. These interfaces often have QoS-related features, such as traffic shaping capabilities or support for differentiated services code points (DSCPs), enabling efficient packet processing and traffic management.

Regardless of whether you're setting up your network and plan to implement QoS or already managing your network and using QoS, it's essential to plan for these resources so you don't run out of them while, for example, deploying topologies for high-scale requirements. An essential part of this implementation is monitoring the availability of QoS resources.

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View Packet Processing and Traffic Management Resources

Table 2: Feature History Table

Feature Name	Release Information	Feature Description
View Packet Processing and Traffic Management Resources	Release 7.11.1	You can now view the utilization of some packet processing and traffic management resources, such as policer banks and connectors. Insights into their consumption and availability help you prevent or mitigate an Out of Resource (OOR) situation, thus ensuring optimal QoS operations with minimal impact on network performance. The feature introduces the following changes: **CLI:** **show controllers npu resources qos** **YANG:** • ~~Cisco-IOS-XR-fretta-bcm-dpa-qos-resources-oper~~ • `Cisco-IOS-XR-5500-qos-oper` • ~~Cisco-IOS-XR-fretta-bcm-dpa-qos-ratepolicer-resources-oper~~ • ~~Cisco-IOS-XR-fretta-bcm-dpa-qos-egresources-oper~~ (see GitHub, YANG Data Models Navigator)

QoS utilizes hardware resources to classify, mark, and shape traffic. Given that these resources are limited, you require immediate access to information such as their consumption and availability, especially if you plan to implement high-scale setups. Without such information, you may run out of resources, and tracking down the impacted hardware resources could prove challenging.

From Release 7.11.1 onwards, you can view the utilization of some packet processing and traffic management resources by running the **show controllers npu resources qos** command. Packet processing and traffic management resources are crucial components of QoS implementations, helping ensure that network traffic is prioritized, managed, and controlled effectively. You can use this data to troubleshoot Out of Resource (OOR) situations by quickly identifying the exhausted resources or prevent OOR conditions by appropriately modifying their allocation.

Run the **show controllers npu resources qos** command to view the information listed in the table. To best use this information and plan the grouping of multiple resources for specific QoS tasks, you could initially add one policy and check how much of these resources QoS utilizes.

Table 3: Packet Processing and Traffic Management Resources and their Details

Resource	Type	More About This Resource	Important Because
Policer	Packet Processing	The number of policers that are allocated and that you can create. The total number of policer banks is inversely proportional to the class map size.	Helps you determine the ingress policy map scale based on available policer bank resources.
Egress QoS Map Information	Packet Processing	The resources used in creating traffic class and drop precedence (or discard class) maps for egress traffic.	Displays counters for L2 and L3 pools, helping you tune your policy map configurations at the ingress or egress based on the existing policy parameters and optimize the available pool usage.

Resource	Type	More About This Resource	Important Because
Connectors	Traffic Management	The number of NPU connectors or Fabric Access Processors (FAPs) used.	The connector resource dictates the number of VOQs you can create. The egress policy map scale is bound to VOQ availability and, in turn, connector availability. It also tells you, among others: • the **Reserved** number of normal and low rate connector sets for internal VOQ creation; internal VOQs are used for punting and recycling operations. • the **Per Interface** counter which indicates the number of connectors used per interface or VOQ. **Note** By default, two connector regions per core are reserved for low connectors, which support lower traffic shaping rates.
Rate Profile	Traffic Management	The rate profile pool used. Interfaces with different line rates and policies with significantly differing shaper and queue lengths use rate profiles.	Helps you tune your egress policy parameters, such as shaper value and queue length, to optimize the available rate profile hardware resources.
Egress Queue (EGQ) Profile	Traffic Management	The number of egress queue maps used. They are consumed when you create egress policies with priority marking.	Helps you tune your egress policy parameters such as egress queue map to optimize the available hardware resources .

Resource	Type	More About This Resource	Important Because
VOQ	Traffic Management	The number of Virtual Output Queues (VOQs) used at a global level from a common pool.	Tells you the number of VOQs consumed (**Used**), the number of VOQs remaining (**Free**), and the **Total** number of VOQs available.

Verification

```
Router#show controllers npu resources qos all instance all location 0/0/CPU0

========================================================================
QoS TM Connectors Information For Location: 0/0/CPU0

System information for NPU 0:
Core 0:
                               Used(   %)       Free      Total   Reserved        Per
Interface Consumption
    Normal Connector Set:        384(  0%)      59008      59392       6144
             16
   Lowrate connector Set:          0(  0%)          0          0

Core 1:
                               Used(   %)       Free      Total   Reserved        Per
Interface Consumption
    Normal Connector Set:        384(  0%)      59008      59392       6144
             16
   Lowrate connector Set:          0(  0%)          0          0

========================================================================
QoS TM Rate Profile Information:
Note: - This is a global resource and shared across all LCs

                               Used(   %)       Free      Total     Reserved      Highest
 Used
                                  3(  5%)         56         59            5
  3

========================================================================
QoS TM EGQ Profile Information For Location: 0/0/CPU0

System information for NPU 0:
Core 0:
                               Used(   %)       Free      Total
                                  8(100%)          0          8

Core 1:
                               Used(   %)       Free      Total
                                  8(100%)          0          8

========================================================================
QoS PP Policer Banks Information For Location: 0/0/CPU0

System information for NPU 0:
Core 0:
                               Used(   %)       Free      Total         Class-map size
      Policer Banks info:         0(  0%)        218        218                   32
```

```
Core 1:
                                Used(   %)       Free      Total          Class-map size
      Policer Banks info:          0(  0%)        218        218                      32

========================================================================
QoS PP Egress QoS Map Information For Location: 0/0/CPU0

System information for NPU 0:      Used(   %)       Free      Total
         L2 Profile Pool:             0(  0%)         14         14
         L3 Profile Pool:             0(  0%)          3          3

========================================================================
QoS VOQ Information For Location: 0/0/CPU0

Note:- This is a global resources shared by all NPUs

                                Used(   %)       Free      Total
               VOQ info:        175(  1%)      11984      12159
```