QoS Configuration

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Chapter 1 **QoS Configuration**

If you care to use your bandwidth and network resources efficiently, you must pay attention to QoS configuration.

1.1 QoS Overview

1.1.1 QoS Concept

In general, the switch works in best-effort served mode in which the switch treats all flows equally and tries its best to deliver all flows. Thus if congestion occurs all flows have the same chance to be discarded. However, in a real network, different flows have different significances, and the QoS function of the switch can provide different services to different flows based on their own significances, in which the important flows will receive a better service.

As to classify the importance of flows, there are two main ways on the current network:

- The tag in the 802.1Q frame header has two bytes and 3 bits are used to present the priority of the packet. There are 8 priorities, among which 0 means the lowest priority and 7 means the highest priority.

- The DSCP field in IP header of the IP packet uses the bottom 6 bits in the TOS domain of the IP header.

In real network application the edge switch distributes different priorities to different flows based on their significance and then different services will be provided to different flows based on their priorities, which is the way to realize the terminal-to-terminal QoS.

Additionally, you can also configure a switch in a network, enabling the switch to process those packets with specific attributes (according to the MAC layer or the L3 information of packets) specially. This kind of behaviors is called as the one-leap behaviors.

The QoS function of the switch optimizes the usage of limited network bandwidth so that the entire performance of the network is greatly improved.

1.1.2 Terminal-To-Terminal QoS Model

The service model describes a group of terminal-to-terminal QoS abilities, that is, the abilities for a network to transmit specific network communication services from one terminal to another terminal. The QoS software supports two kinds of service models: Best-Effort service and Differentiated service.

1. Best-effort service

The best-effort service is a singular service model. In this service model, an application can send any amount of data at any necessary time without application of permits or aforehand network notification. As to the best-effort service, if allowed, the network can transmit data without any guarantee of reliability, delay or throughput. The QoS of the switch on which the best-effort service is realized is in nature this kind of service, that is, first come and first served (FCFS).

2. Differentiated service

As to the differentiated service, if a special service is to be transmitted in a network, each packet should be specified with a corresponding QoS tag. The switch uses this QoS rule to conduct classification and complete the intelligent queuing. The QoS of the switch provides Strict Priority (SP), Weighted Round Robin (WRR), Deficit Round Robin (DRR) and First-Come-First-Served (FCFS).

1.1.3 Queue Algorithm of QoS

Each queue algorithm is the important basis to realize QoS. The QoS of the switch provides the following algorithms: Strict Priority (SP), Weighted Round Robin (WRR), Deficit Round Robin (DRR) and First-Come-First-Served (FCFS).

1. Strict priority

This algorithm means to first provide service to the flow with the highest priority and after the highest-priority flow comes the service for the next-to-highest flow. This algorithm provides a comparatively good service to those flows with relatively high priority, but its shortage is also explicit that the flows with low priority cannot get service and wait to die.

2. Weighted round robin

Weighted Round Robin (WRR) is an effective solution to the defect of Strict Priority (SP), in which the low-priority queues always die out. WRR is an algorithm that brings each priority queue a certain bandwidth and provides service to each priority queue according to the order from high priority to low priority. After the queue with highest priority has used up all its bandwidth, the system automatically provides service to those queues with next highest priority.

3. First come first served

The First-Come-First-Served queue algorithm, which is shortened as FCFS, provides service to those packets according to their sequence of arriving at a switch, and the packet that first arrives at the switch will be served first.

1.2 QoS Configuration Task List

In general, ONU will try its best to deliver each packet and when congestion occurs all packets have the same chance to be discarded. However, in reality different packets have different importance and the comparatively important packets should get the comparatively good service. QoS is a mechanism to provide different priority services to packets with different importance, in which the network can have its better performance and be used efficiently.

This chapter presents how to set QoS on ONU.

The following are QoS configuration tasks:

- Setting the Global CoS Priority Queue
- Setting the Bandwidth of the CoS Priority Queue
- Setting the Schedule Policy of the CoS Priority Queue
- Setting the Schedule Standard for the CoS Priority Queue
- Setting the Default CoS Value of a Port
- Setting the CoS Priority Queue of a Port
- Establishing the QoS Policy Mapping
- Setting the Description of the QoS Policy Mapping
- Setting the Matchup Data Flow of the QoS Policy Mapping
- Setting the Actions of the Matchup Data Flow of the QoS Policy Mapping
- Applying the QoS Policy on a Port
- Displaying the QoS Policy Mapping Table
- Setting the Rate Limit on a Port

1.3 QoS Configuration Tasks

1.3.1 Setting the Global CoS Priority Queue

The task to set the QoS priority queue is to map 8 CoS values, which are defined by IEEE802.1p, to the priority queues in a switch. This series of switch has 8 priority queues. According to different queues, the switch will take different schedule policies to realize QoS.

If a CoS priority queue is set in global mode, the mapping of CoS priority queue on all ports will be affected. When priority queues are set on a L2 port, the priority queues can only work on this L2 port.

Enter the following privileged mode and run the following commands one by one to set a global CoS priority queue.

Command	Purpose
configure	Enters the global configuration mode.
[**no**] **cos map** *quid cos1..cosn* **(1~8)**	Sets a CoS priority queue. **quid** stands for the ID of a CoS priority queue. **cos1…cosn** stands for the IEEE802.1p-defined CoS value.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.2 Setting the Bandwidth of the CoS Priority Queue

The bandwidth of priority queue means the bandwidth distribution ratio of each priority queue, which is set when the schedule policy of the CoS priority queue is set to WRR/DRR. This series of switches has 8 priority queues in total.

If this command is run, the bandwidth of all priority queues on all interfaces are affected. This command validates only when the queue schedule policy is set to WRR or DRR. This command decides the bandwidth weight of the CoS priority queue when the WRR/DRR schedule policy is used.

Run the following commands one by one to set the bandwidth of the CoS priority queue.

Command	Purpose
configure	Enters the global configuration mode.
[**no**] **scheduler weight bandwidth** *weight1...weightn* **(1~8)**	Sets the bandwidth of the CoS priority queue**..** **weight1…weightn** stand for the weights of 8 CoS priority queues of WRR/DRR.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.3 Setting the Schedule Policy of the CoS Priority Queue

A switch has many output queues on each of its port. This series of switches has 8 priority queues. The output queues can adopt the following three schedule modes:

- SP (Sheer Priority): In this algorithm, only when the high-priority queue is null can the packets in the low-priority queue be forwarded, and if there are packets in the high-priority queue these packets will be unconditionally forwarded.
- FCFS: First come first served
- WRR (Weighted Round Robin): In this mode, the bandwidth of each queue is distributed with a certain weight and then bandwidth distribution is conducted

according to the weight of each queue. The bandwidth in this mode takes packet as its unit.

- DRR(Deficit Round Robin):In this mode, the bandwidth of each queue is distributed with a certain weight and then bandwidth distribution is conducted according to the weight of each queue. The bandwidth in this mode takes byte as its unit.

After this command is configured, the schedule mode of the interface is set to the designated value.

Enter the following configuration mode and set the schedule policy of CoS priority queue.

Command	Purpose
configure	Enters the global configuration mode.
[**no**] **scheduler policy** { **sp** | **fcfs | wrr | drr** }	Sets the schedule policy of the CoS priority queue. **sp** means to use the SP schedule policy. **fcfs** to use the FCFS schedule policy. **Wrr** means to use the WRR schedule policy. **drr** means to use the DRR schedule policy.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.4 Setting the Schedule Standard for the CoS Priority Queue

The schedule benchmark of priority queue is the scale standard of bandwidth distribution ratio of different priority queues when the schedule policy of the CoS priority queue is set to WRR/DRR. There are mainly two standards:

- packet-count: means that the occupied bandwidth is expressed by the number of packets.
- byte-count: means that the occupied bandwidth is expressed by the size of packet.
- latency: means that the occupied bandwidth is expressed by the transmitted time segment.

This switch series supports the **packet-count a**nd **byte-count** schedule standards. Wrr is based on packet-count, while drr is based on byte-count.

1.3.5 Setting the Default CoS Value of a Port

If the port of a switch receives a data frame without tag, the switch will add a default CoS priority to it. Setting the default CoS value of a port is to set the untagged default CoS value, which is received by the port, to a designated value.

Enter the privilege mode and set the default CoS value fir a port according to the following steps:

Command	Purpose
configure	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **cos default** *cos* **(0~7)**	配置端口收到的无标签帧的CoS值。 cos为对应的cos值。
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.
write	Saves the settings.

1.3.6 Setting the CoS Priority Queue of a Port

When a priority queue is set on a L2 port, the priority queue will be used by the L2 port; otherwise, you should conduct the configuration of a global CoS priority queue.

Enter the privilege mode and run the following commands to set the default CoS value of a port:

Command	Purpose
configure	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **cos map** *quid cos1..cosn* **(1~8)**	Sets the CoS priority queue. **quid** stands for the ID of a CoS priority queue. **cos1…cosn** stands for the IEEE802.1p-defined CoS value.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.7 Establishing the QoS Policy Mapping

Flow classification means to identify a class of packets with certain attributes by applying a certain regulation and take designated actions towards to these packets.

The IP access list and the MAC access list which are used to match up with the data flows can be configured only one regulation, or the configuration will fail. When the action in the regulation is **permit**, the regulation is used to differentiate the data flows; when the action in the regulation is **deny**, the regulation has no function. The port ID in the IP access list must be a certain value and cannot be a range.

You can establish a QoS policy according to the following procedure. During configuration, you can set all the parameters of the QoS policy, that is, **description**, **classify** and **action**, or one or two of them. In the following section you can also edit the policy.

Enter the privileged mode and then run the following commands to establish a new QoS policy mapping.

Command	Purpose
configure	Enters the global configuration mode.
[no]policy-map *name*	Enters the configuration mode of QoS policy map. **name** stands for the name of the policy.
description description-text	Sets the description of the QoS policy. **description-text** stands for the text to describe the policy.
[**no**]**classify** {**ip** *access-list-name* | **dscp** *dscp-value* | **mac** *mac-access-name* | **vlan** *vlan-id* | **cos** ***cos-value*** **| any** }	Configures the data flow of the QoS policy map**.** **access-list-name** stands for the name of the IP access list. **dscp** means to designate the **diffserv** field in the IP packet. **mac-access-name** stands for the name of the MAC access list. **vlan-id** stands for the ID of the matched VLAN. **cos** stands for the matched CoS value. **any** means to match any data flow.
action{**bandwidth** *max-band* | **cos** ***cos-value*** **| dscp** *dscp-value* | **redirect** *interface-id* | **drop | stat | monitor** }	Configures the data flow policy of the QoS policy map. **max-band** stands for the highest bandwidth allowably occupied by a data flow. **cos-value** means to set the CoS field of the matchup flow to **cos-value**. **dscp-value** means to set the DSCP field of the matchup flow to **dscp-value**. **interface-id** means to redirect the egress port of the matched flow. **drop** means to discard the configured packets. **stat** means a switch collects the statistics of the corresponding matchup flows. **monitor** means to transmit a packet to the mirror port.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.8 Setting the Description of the QoS Policy Mapping

Enter the privileged mode and run the following commands to set the description of a QoS policy mapping. This settings will replace the previous settings.

Command	Purpose
configure	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of QoS policy map. **name** stands for the name of the policy.
description description-text	Sets the description of the QoS policy. **description-text** stands for the text to describe the policy.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.9 Setting the Matchup Data Flow of the QoS Policy Mapping

The classification rule of the QoS data flow means the filtration rule configured by the administrator according to management requirements. It can be simple, for example, flows with different priorities can be identified by the ToS field of the IP packet's header, or complicated, for example, the packets can be classified according to the related information about the comprehensive link layer, the network layer and the transmission layer, such as the MAC address, the source address of IP, the destination address or the port ID of the application. In general, the classification standard is limited in the header of an encapsulated packet. It is rare to use the content of a packet as the classification standard.

Enter the policy configuration mode, set the matchup data flow of policy and replace the previous settings with this data flow according to the following steps:

Command	Purpose
configure	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. **name** stands for the name of the policy.
[**no**]**classify** {**ip** *access-list-name* **| dscp** *dscp-value* | **mac** *mac-access-name* **| vlan** *vlan-id* **| cos** ***cos-value*** **| any** }	Configures the matchup data flow of the QoS policy map**.** **access-list-name** stands for the name of the IP access list. **dscp-value** stands for the **diffserv** field in the IP packet. **Mac-access-name** stands for the name of

	the MAC access list. **vlan-id** stands for the ID of the matched VLAN. **cos** stands for the matched CoS value. **any** means to match any data flow.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.10 Setting the Actions of the Matchup Data Flow of the QoS Policy Mapping

The actions to define the data flow mean to take corresponding actions to a data flow with compliance of the filtration rule, which include bandwidth limit, drop, update, etc.

Enter the privileged mode and run the following commands to set the action of a policy, matching up the data flow. The action will replace the previous settings.

Command	Purpose
configure	Enters the global configuration mode.
[**no**]**policy-map** *name*	Enters the configuration mode of the QoS policy map. **name** stands for the name of the policy.
action {**bandwidth** *max-band* | **cos** *cos-value* **| dscp** *dscp-value* | **vlanID** *vlanid-value* | **redirect** *interface-id* **| drop | stat | monitor** }	Configures the data flow policy of a QoS policy map. **max-band** stands for the highest bandwidth allowably occupied by a data flow. **cos-value** means to set the CoS field of the matchup flow to **cos-value**. **dscp-value** means to set the DSCP field of the matchup flow to **dscp-value**. **vlanid-value** means to set the vlanID field of the matchup flow to **vlanid-value**. **interface-id** stands for the egress port for matching up the flow. **drop** means to discard the configured packets. **stat** means a switch collects the statistics of the corresponding matchup flows. **monitor** means to transmit a packet to the mirror port.
Exit	Goes back to the global configuration mode.
Exit	Goes back to the EXEC mode.

1.3.11 Applying the QoS Policy on a Port

The QoS policy can be applied to a port; multiple QoS policies can be applied to the same port and the same QoS policy can also be applied to multiple ports. On the same port, the priorities of the policies which are earlier applied than those of the policies which are later applied. If a packet is set to have two policies and the actions are contradicted, the actions of the firstly matched policies will be first applied. After a QoS policy is applied on a port, the switch adds a policy to this port by default to block other data flows, which are not allowed to pass through. When all policies on a port are deleted, the switch will automatically remove the default blockage policy from a port.

Enter the following privileged mode and run the following commands to apply the QoS policy.

Command	Purpose
configure	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **qos policy** *name* { **ingress**|**egress**}	Applies the QoS policy on a port. **name** stands for the name of QoS policy mapping. ***ingress*** means to exert an influence on the ingress. ***egress*** means to exert an influence on the egress.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.3.12 Displaying the QoS Policy Mapping Table

You can run the **show** command to display all or some designated QoS policy maps.

Run the following command in privileged mode to display the QoS policy mapping table.

Command	Purpose
show policy-map [*policy-map-name*]	Displays all or some designated QoS policy maps. **policy-map-name** stands for the name of QoS mapping table.

1.3.13 Configuring Rate Limit on a Port

Through configuration the flow rates at the ingress and the egress can be limited.

Enter the privileged mode and run the following commands to limit the rate of a port.

Command	Purpose

configure	Enters the global configuration mode.
interface g0/1	Enters the to-be-configured port.
[**no**] **switchport rate-limit** *band* **(1~1000)** { ingress|egress}	Configures the rate limit for a port. *band* means to limit the flow rate. *ingress* means to exert an influence on the ingress. *egress* means to exert an influence on the egress.
exit	Goes back to the global configuration mode.
exit	Goes back to the EXEC mode.

1.4 QoS Configuration Example

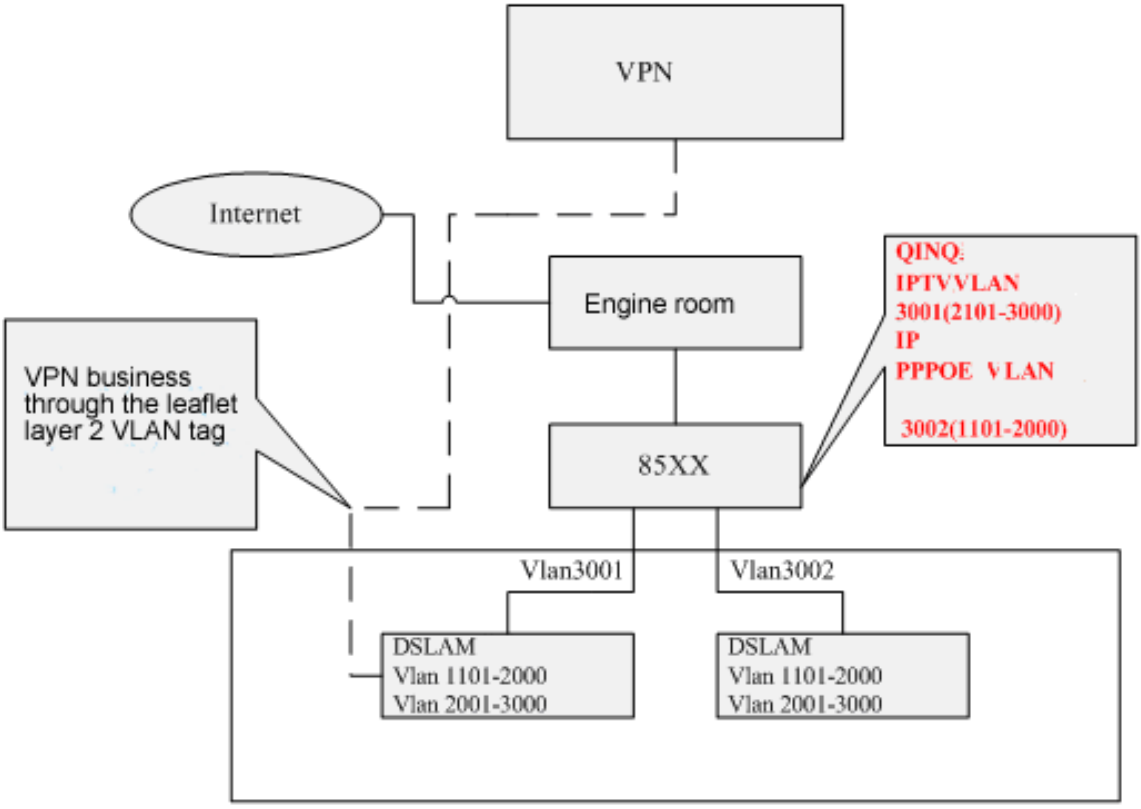
1.4.1 Example for Applying the QoS Policy on a Port

After you have set on a port a policy that the CoS value of the packet is set to 2 and apply it, you have to set another policy to allow all data flows to pass through, or all data flows will be hindered. See the following example:

ip access-list extended ipacl
permit ip 192.168.20.2 255.255.255.255 192.168.20.210 255.255.255.255
policy-map any
classify any
policy-map pmap
classify ip ipacl
action cos 2
interface GigaEthernet0/2
  qos policy pmap ingress
  qos policy any ingress (pay attention to the order of applying the two policies)

1.4.2 Example for Applying the QoS Policy on a Port

Network environment:



Function requirements:

A flexible QINQ-based features, the same QINQ port need to package the outer tag. IP network the business VLAN1101-2000, need to package label for 3002; IPTV business VLAN2101-3000, you need to package label for 3001; QINQ port need to the permeability flyer tier business VLAN3101-4000 supports VPN service. The second line the mouth of the G2 / 1 and G2 / 2 and G2 / 3 aggregation port.撤消修改

QinQ is configured in LS24GE GigaEthernet2 / 1,2 / 2,2 / 3 polymerization as the next even port connected to the GigaEthernet2/16 as the mouth. The relevant configuration is as follows:

```
policy-map          pppoe
        classify ivlan 1101 - 2000
        action vlanID 3002
!
policy-map          iptv
        classify ivlan 2101 – 3000
        action vlanID 3001
!
interface Port-aggregator1
 switchport mode trunk
 switchport pvid 2
 switchport trunk vlan-untagged 3001，3002
!

interface GigaEthernet 2/1
```

```
        switchport mode trunk
        switchport pvid 2
        switchport trunk vlan-untagged 3001，3002
        aggregator-group 1 mode static
        qos policy iptv ingress
        qos policy pppoe ingress
!
interface GigaEthernet 2/2
        switchport mode trunk
        switchport pvid 2
        switchport trunk vlan-untagged 3001，3002
        aggregator-group 1 mode static
        qos policy iptv ingress
        qos policy pppoe ingress
!
interface GigaEthernet 2/3
        switchport mode trunk
        switchport pvid 2
        switchport trunk vlan-untagged 3001，3002
        aggregator-group 1 mode static
        qos policy iptv ingress
        qos policy pppoe ingress
!!
interface GigaEthernet2/16
      switchport mode dot1q-tunnel-uplink
      switchport pvid 3
switchport trunk vlan-untagged 2

!
dot1q-tunnel
```

vlan 1-3, 3000-3002，3101 - 4000