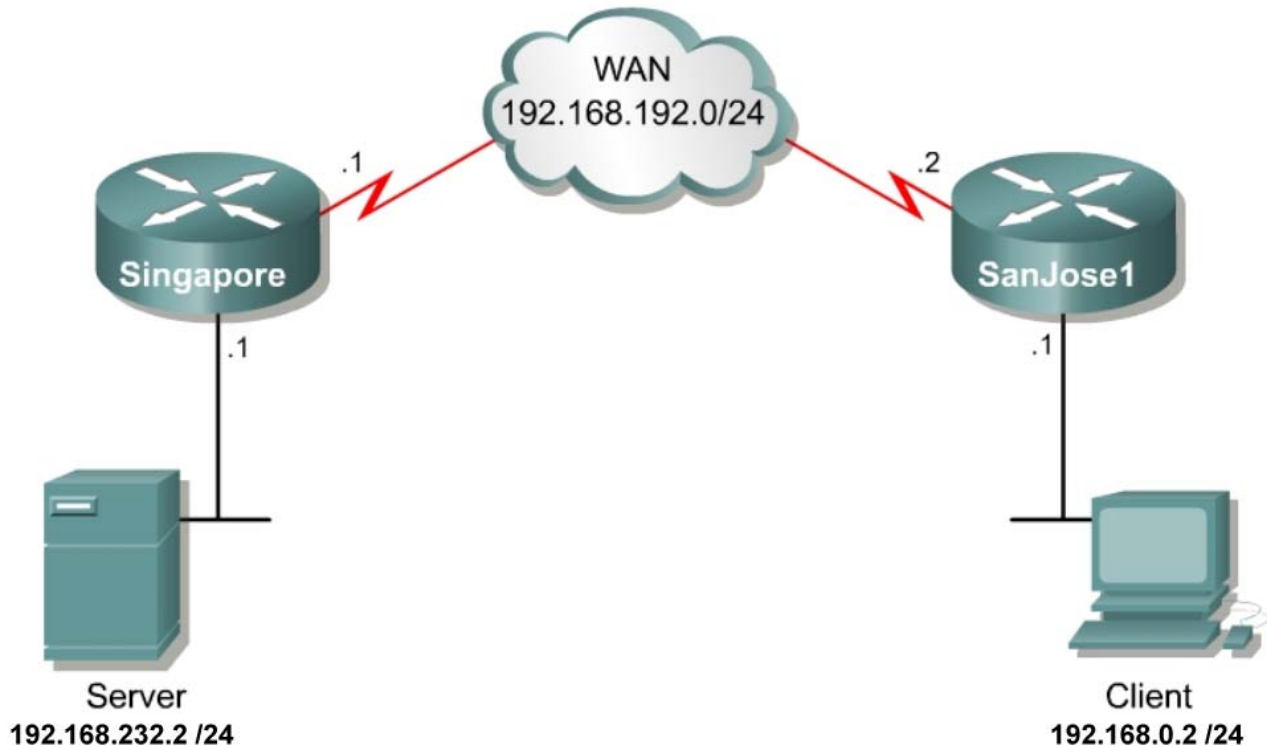


Lab 8.1.10.6 Configuring WRED with CBWFQ



Objective

Class-based weighted fair queuing (CBWFQ) extends the standard WFQ functionality to provide support for user-defined traffic classes. Traffic classes are defined for CBWFQ by using match criteria such as protocols, access control lists (ACLs), and input interfaces. Packets that satisfy the match criteria for a class constitute the traffic for the class. A FIFO queue is reserved for each class and traffic that belongs to a class is directed to the queue for the class.

After a class has been defined according to its match criteria, characteristics can be assigned to each class. To characterize a class, assign a bandwidth, weight, and a maximum packet limit. The bandwidth that is assigned to a class is the guaranteed bandwidth that is delivered to the class during congestion.

In this lab, configure CBWFQ in conjunction with WRED. CBWFQ provides a guaranteed percentage of the output bandwidth and WRED ensures that the TCP traffic is not sent faster than CBWFQ can forward it.

Scenario

Management would like to reduce costs by routing IP voice packets across the WAN. Access-layer switches in the network are marking voice packets with a DSCP of 40. Ensure that these voice packets are guaranteed 40 percent of the available WAN bandwidth.

Step 1

Build and configure the physical topology as shown in the diagram. Before beginning a lab, the configurations on all the routers should be cleared and then reloaded or power cycled to reset their default configurations. Delete the **vlan.dat** and startup configuration files on the switches before reloading them.

Configure the hostnames and interfaces on the routers. Use EIGRP with an AS of 100 as the routing protocol. Confirm connectivity by pinging between the hosts.

```
Router(config)#hostname Singapore
Singapore(config)#interface fastethernet 0/0
Singapore(config-if)#ip address 192.168.232.1 255.255.255.0
Singapore(config-if)#no shutdown
Singapore(config-if)#interface serial 0/0
Singapore(config-if)#ip address 192.168.192.1 255.255.255.0
Singapore(config-if)#clock rate 128000
Singapore(config-if)#no shutdown
Singapore(config-if)#router eigrp 100
Singapore(config-router)#network 192.168.192.0
Singapore(config-router)#network 192.168.232.0
```

```
Router(config)#hostname SanJose1
SanJose1(config)#interface fastethernet 0/0
SanJose1(config-if)#ip address 192.168.0.1 255.255.255.0
SanJose1(config-if)#no shutdown
SanJose1(config-if)#interface serial 0/0
SanJose1(config-if)#ip address 192.168.192.2 255.255.255.0
SanJose1(config-if)#clock rate 128000
SanJose1(config-if)#no shutdown
SanJose1(config-if)#router eigrp 100
SanJose1(config-router)#network 192.168.0.0
SanJose1(config-router)#network 192.168.192.0
```

Step 2

Create a class-map called **VOICE-CLASS** to classify the traffic as the first step in providing QoS. The packets that should receive preferential treatment have already been marked with a DSCP of 40.

```
SanJose1(config)#class-map VOICE-CLASS
SanJose1(config-cmap)#match ip dscp 40
SanJose1(config-cmap)#^Z
```

```
Singapore(config)#class-map VOICE-CLASS
Singapore(config-cmap)#match ip dscp 40
Singapore(config-cmap)#^Z
```

```
Singapore#show class-map
Class Map match-any class-default (id 0)
  Match any
```

```
Class Map match-all VOICE-CLASS (id 1)
  Match ip dscp cs5
```

```
SanJose1#show class-map
Class Map match-any class-default (id 0)
```

Match any

```
Class Map match-all VOICE-CLASS (id 1)
Match ip dscp cs5
```

Step 3

Create a policy called **WAN-POLICY** for the treatment of the traffic within the network through a **policy-map**.

Begin by determining a policy for all traffic that is not voice. An efficient scheme for queuing general traffic is WFQ. This traffic class will be the **class-default**, and will be a catch-all for traffic that has not been specifically classified.

```
SanJose1(config)#policy-map WAN-POLICY
SanJose1(config-pmap)#class class-default
SanJose1(config-pmap-c)#fair-queue
SanJose1(config-pmap-c)^Z

Singapore(config)#policy-map WAN-POLICY
Singapore(config-pmap)#class class-default
Singapore(config-pmap-c)#fair-queue
Singapore(config-pmap-c)^Z
```

Note The name “**class-default**” is not part of a command. Therefore, the autocomplete feature (TAB key) or help key (?) cannot be used to assist entering the command.

```
Singapore#show policy-map
Policy Map WAN-POLICY
Class class-default
Flow based Fair Queueing Max Threshold 64 (packets)
```

```
SanJose1#show policy-map
Policy Map WAN-POLICY
Class class-default
Flow based Fair Queueing Max Threshold 64 (packets)
```

Step 4

Create a policy for the treatment of the voice traffic by allowing 40 percent of the WAN link bandwidth.

```
SanJose1(config)#policy-map WAN-POLICY
SanJose1(config-pmap)#class VOICE-CLASS
SanJose1(config-pmap-c)#bandwidth percent 40
SanJose1(config-pmap-c)^Z

Singapore(config)#policy-map WAN-POLICY
Singapore(config-pmap)#class VOICE-CLASS
Singapore(config-pmap-c)#bandwidth percent 40
Singapore(config-pmap-c)^Z
```

```
Singapore#show policy-map
Policy Map WAN-POLICY
```

```

Class VOICE-CLASS
  Bandwidth 40 (%) Max Threshold 64 (packets)
Class class-default
  Flow based Fair Queueing Max Threshold 64 (packets)

```

```

SanJose1#show policy-map
Policy Map WAN-POLICY
Class VOICE-CLASS
  Bandwidth 40 (%) Max Threshold 64 (packets)
Class class-default
  Flow based Fair Queueing Max Threshold 64 (packets)

```

Step 5

Use the WRED method of congestion avoidance by adding the **random-detect** command to the policy map of both routers. If the 40 percent of bandwidth that is configured for **VOICE-CLASS** traffic is exceeded, the default behavior is to drop any packets that cannot be immediately accommodated in the queue.

```

SanJose1(config)#policy-map WAN-POLICY
SanJose1(config-pmap)#class VOICE-CLASS
SanJose1(config-pmap-c)#random-detect

Singapore(config)#policy-map WAN-POLICY
Singapore(config-pmap)#class VOICE-CLASS
Singapore(config-pmap-c)#random-detect

```

Note: This step is included as a demonstration of how to provide WRED functionality by using the Modular QoS CLI. WRED is designed to work with TCP streams that respond to dropped packets by reducing their transmission rate. Voice uses UDP and is incapable of adjusting its rate. Voice networks should be designed to avoid packet loss.

```

Singapore#show policy-map
Policy Map WAN-POLICY
Class VOICE-CLASS
  Bandwidth 40 (%)
    exponential weight 9
    class      min-threshold    max-threshold    mark-probability
    -----
    0          -                -                1/10
    1          -                -                1/10
    2          -                -                1/10
    3          -                -                1/10
    4          -                -                1/10
    5          -                -                1/10
    6          -                -                1/10
    7          -                -                1/10
    rsvp       -                -                1/10

Class class-default
  Flow based Fair Queueing Max Threshold 64 (packets)

```

```

SanJose1#show policy-map
Policy Map WAN-POLICY
Class VOICE-CLASS
  Bandwidth 40 (%)

```

```

exponential weight 9
class      min-threshold      max-threshold      mark-probability
-----
0          -                  -                  1/10
1          -                  -                  1/10
2          -                  -                  1/10
3          -                  -                  1/10
4          -                  -                  1/10
5          -                  -                  1/10
6          -                  -                  1/10
7          -                  -                  1/10
rsvp       -                  -                  1/10

```

```

Class class-default
  Flow based Fair Queueing Max Threshold 64 (packets)

```

Step 6

Use the **show policy-map** command to verify the policy map specifics..

```

SanJose1#show policy-map
Policy Map WAN-POLICY
Class VOICE-CLASS
  Bandwidth 40 (%)
    exponential weight 9
    class      min-threshold      max-threshold      mark-probability
    -----
    0          -                  -                  1/10
    1          -                  -                  1/10
    2          -                  -                  1/10
    3          -                  -                  1/10
    4          -                  -                  1/10
    5          -                  -                  1/10
    6          -                  -                  1/10
    7          -                  -                  1/10
    rsvp       -                  -                  1/10

Class class-default
  Flow based Fair Queueing Max Threshold 64 (packets)

```

SanJose1#

```

Singapore#show policy-map
Policy Map WAN-POLICY
Class VOICE-CLASS
  Bandwidth 40 (%)
    exponential weight 9
    class      min-threshold      max-threshold      mark-probability
    -----
    0          -                  -                  1/10
    1          -                  -                  1/10
    2          -                  -                  1/10
    3          -                  -                  1/10
    4          -                  -                  1/10
    5          -                  -                  1/10
    6          -                  -                  1/10
    7          -                  -                  1/10
    rsvp       -                  -                  1/10

Class class-default
  Flow based Fair Queueing Max Threshold 64 (packets)

```

Singapore#

Use the **show running-config** command to see the full structure of the policy map in the configuration file.

```
Singapore#show running-config
Building configuration...

Current configuration : 755 bytes
!
< Output omitted >

!
!
class-map match-all VOICE-CLASS
  match ip dscp cs5
!
!
policy-map WAN-POLICY
  class VOICE-CLASS
    bandwidth percent 40
    random-detect
  class class-default
    fair-queue
!
--More--
```

< Output omitted >

```
SanJose1#show running-config
Building configuration...

Current configuration : 837 bytes
!
< Output omitted >

!
!
class-map match-all VOICE-CLASS
  match ip dscp cs5
!
!
policy-map WAN-POLICY
  class VOICE-CLASS
    bandwidth percent 40
    random-detect
  class class-default
    fair-queue
!
--More--
```

< Output omitted >

Step 7

Complete the configuration of QoS by using the MQC to apply the policy to an interface. First, remove WFQ from the serial interface. Apply the policy to the outgoing serial interface on each router with the **service-policy** command.

```
SanJose1(config)#interface serial 0/0
SanJose1(config)#no fair-queue
SanJose1(config-if)#service-policy output WAN-POLICY
```

```
Singapore(config)#interface serial 0/0
Singapore(config)#no fair-queue
Singapore(config-if)#service-policy output WAN-POLICY
```

```
Singapore#show policy-map interface serial 0/0 output
Serial0/0
```

Service-policy output: WAN-POLICY

```
Class-map: VOICE-CLASS (match-all)
  0 packets, 0 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: ip dscp cs5
  Queueing
    Output Queue: Conversation 41
    Bandwidth 40 (%)
    (pkts matched/bytes matched) 0/0
    (depth/total drops/no-buffer drops) 0/0/0
    exponential weight: 9
    mean queue depth: 0
```

class	Transmitted pkts/bytes	Random drop pkts/bytes	Tail drop pkts/bytes	Minimum thresh	Maximum thresh	Mark prob
0	0/0	0/0	0/0	20	40	1/10
1	0/0	0/0	0/0	22	40	1/10
2	0/0	0/0	0/0	24	40	1/10
3	0/0	0/0	0/0	26	40	1/10
4	0/0	0/0	0/0	28	40	1/10
5	0/0	0/0	0/0	30	40	1/10
6	0/0	0/0	0/0	32	40	1/10
7	0/0	0/0	0/0	34	40	1/10
rsvp	0/0	0/0	0/0	36	40	1/10

```
Class-map: class-default (match-any)
  13 packets, 894 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: any
  Queueing
    Flow Based Fair Queueing
    Maximum Number of Hashed Queues 32
    (total queued/total drops/no-buffer drops) 0/0/0
```

```
SanJose1#show policy-map interface serial 0/0 output
Serial0/0
```

Service-policy output: WAN-POLICY

```
Class-map: VOICE-CLASS (match-all)
  0 packets, 0 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: ip dscp cs5
  Queueing
    Output Queue: Conversation 265
    Bandwidth 40 (%)
```

```

(pkts matched/bytes matched) 0/0
(depth/total drops/no-buffer drops) 0/0/0
exponential weight: 9
mean queue depth: 0

```

class	Transmitted pkts/bytes	Random drop pkts/bytes	Tail drop pkts/bytes	Minimum thresh	Maximum thresh	Mark prob
0	0/0	0/0	0/0	20	40	1/10
1	0/0	0/0	0/0	22	40	1/10
2	0/0	0/0	0/0	24	40	1/10
3	0/0	0/0	0/0	26	40	1/10
4	0/0	0/0	0/0	28	40	1/10
5	0/0	0/0	0/0	30	40	1/10
6	0/0	0/0	0/0	32	40	1/10
7	0/0	0/0	0/0	34	40	1/10
rsvp	0/0	0/0	0/0	36	40	1/10

```

Class-map: class-default (match-any)
  41 packets, 2550 bytes
  5 minute offered rate 0 bps, drop rate 0 bps
  Match: any
  Queueing
    Flow Based Fair Queueing
    Maximum Number of Hashed Queues 256
  (total queued/total drops/no-buffer drops) 0/0/0

```

Step 8

Which **show** commands are used to verify the following?

1. Configuration of the class-map.
2. Policy is correctly applied to the interface.