QoS Switch / Router Templates
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<tr>
<th>Author</th>
<th>Version</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V1.0</td>
<td>2/27/2014</td>
<td>Initial template only covering Layer 3 Router template</td>
</tr>
<tr>
<td></td>
<td>V2.0</td>
<td>3/03/2014</td>
<td>Added overview of QoS and Layer 2 template</td>
</tr>
</tbody>
</table>
QoS Overview

All Core switches should have Quality of Service classification and marking configured so that the WAN devices are able to allocate bandwidth to the most important applications during congestion. Switches contain hardware which can do this in real-time with no CPU overhead. Routers typically use 10-15% of their CPU to do this so it should always be performed on a switch where possible.

The policy marks traffic using DSCP markings as follows:

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>DSCP</th>
<th>Layer 2 Queue / Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice and Routing (EIGRP, OSPF)</td>
<td>EF</td>
<td>Egress queue 1 Threshold 3</td>
</tr>
<tr>
<td>VoIP Signaling</td>
<td>CS3</td>
<td>Egress queue 2 Threshold 3</td>
</tr>
<tr>
<td>Video</td>
<td>AF41</td>
<td>Egress queue 3 Threshold 3</td>
</tr>
<tr>
<td>Normal Traffic (intranet, etc.)</td>
<td>CS1</td>
<td>Egress queue 4 Threshold 1</td>
</tr>
<tr>
<td>Backup</td>
<td>0(BE)</td>
<td></td>
</tr>
</tbody>
</table>

Every time a policy is applied to an interface it uses some TCAM (Ternary Content Addressable Memory) memory. It uses less memory to apply the policy to each VLAN and configure each port to perform QoS on a per VLAN basis. The end result is the same but the memory use is less. On switches with high numbers of ports the TCAM can be exceeded if this is not done so it is best to always apply the QoS policies on a VLAN basis. On switches with 24 ports it could be applied either way but it is important to try and do things the same way as much as possible to make updates easier.

So, each interface should have:
Interface FastEthernet 0/1
Mls qos vlan-based

And each VLAN interface (SVI) should have the policy applied.
Interface VLAN100
service-policy in MARK_ALL_PACKETS

Cisco Catalyst Series SRR Layer 2 Queue / Threshold Priorities

Once QoS is activated for classification and marking, queuing is also activated on the 3560/3570 switches. The defaults are terrible and drop a lot of packets so we need to add some configuration to correctly queue the packets entering and leaving the switch. This is particularly important on a switch with a mixture of 100/1000Mb lines to avoid packets arriving at 1000Mb/s causing congestion on a 100Mb egress port. Ingress queuing is also active as it is recommended for Telepresence even though the reality is that it is extremely unlikely to ever be needed, the switch would have to have more than 32Gb/s arriving inbound to congest the bus.

The 3560/3570 has 4 egress queues each of which can have 3 different thresholds at which packets are dropped, so it is possible to have up to 12 different priorities. The idea is that you specify which packets go into which queue, each queue has a different priority. Queue 1 is configured as a priority queue so it is always serviced as soon as a packet arrives in it. Queue 2 is serviced next followed by Queue 3, then Queue 4.
So, if more traffic is being sent to an interface than the interface’s line speed, the packets in Queue 4 will be dropped first.

The concept of thresholds is that threshold 3 is the best, followed by 2 then 1, so packets using Queue 2 Threshold 2 (Q2T2) will be dropped before Queue 2 Threshold 3 (Q2T3).

In a bid to create maximum confusion, Cisco has designated Q2 as the Priority Queue for ingress queuing and Q1 as less important. There are only two queues for ingress queuing.

These lines map the decimal values of the DSCPs we use to the appropriate Queue/Threshold.

```plaintext
mls qos srr-queue output dscp-map queue 1 threshold 3 32 46
mls qos srr-queue output dscp-map queue 2 threshold 2 28 34
mls qos srr-queue output dscp-map queue 2 threshold 3 24 26 48
```
mls qos srr-queue output dscp-map queue 3 threshold 3 8 16 20
mls qos srr-queue output dscp-map queue 4 threshold 1 0

These lines map COS values to each Queue/Threshold. This is not normally needed as we don’t use COS, it is a precaution in case the policy is not applied on some interfaces.

mls qos srr-queue output cos-map queue 1 threshold 3 4 5
mls qos srr-queue output cos-map queue 2 threshold 3 3 6 7
mls qos srr-queue output cos-map queue 3 threshold 3 2
mls qos srr-queue output cos-map queue 4 threshold 3 0 1

These commands set the actual amount of buffers used for each Queue/Threshold:
mls qos queue-set output 1 threshold 1 100 100 100 149
mls qos queue-set output 1 threshold 2 100 540 100 600
mls qos queue-set output 1 threshold 3 100 100 100 600
mls qos queue-set output 1 threshold 4 100 170 100 250

This command sets the percentages of buffers used across the queues.
mls qos queue-set output 1 buffers 16 28 36 20

These commands apply similar parameters for the ingress queuing.
Allocate the bandwidth and buffers for each Queue.
mls qos srr-queue input bandwidth 70 30
mls qos srr-queue input threshold 1 50 80
mls qos srr-queue input buffers 70 30
mls qos srr-queue input priority-queue 2 bandwidth 30

Map the DSCPs to each queue:
mls qos srr-queue input dscp-map queue 1 threshold 1 0 10 14
mls qos srr-queue input dscp-map queue 1 threshold 2 8 16 20
mls qos srr-queue input dscp-map queue 1 threshold 3 26 28 24
mls qos srr-queue input dscp-map queue 2 threshold 1 32 34
mls qos srr-queue input dscp-map queue 2 threshold 3 46 48

On each individual interface, configure:
srr-queue bandwidth share 1 65 30 5 – Configures the Queue bandwidth percentages
priority-queue out – enables the priority queue.
QoS / Shaping – Switch Side

Switch QoS Template

mls qos
mls qos srr-queue input bandwidth 70 30
mls qos srr-queue input threshold 1 50 80
mls qos srr-queue input buffers 70 30
mls qos srr-queue input priority-queue 2 bandwidth 30
mls qos srr-queue input dscp-map queue 1 threshold 1 0 10 14
mls qos srr-queue input dscp-map queue 1 threshold 2 8 16 20
mls qos srr-queue input dscp-map queue 1 threshold 3 26 28 24
mls qos srr-queue input dscp-map queue 2 threshold 1 32 34
mls qos srr-queue input dscp-map queue 2 threshold 3 46 48
mls qos srr-queue output cos-map queue 1 threshold 3 4 5
mls qos srr-queue output cos-map queue 3 threshold 3 2
mls qos srr-queue output cos-map queue 4 threshold 3 0 1
mls qos srr-queue output dscp-map queue 1 threshold 3 32 46
mls qos srr-queue output dscp-map queue 2 threshold 2 28 34
mls qos srr-queue output dscp-map queue 2 threshold 3 24 26 48
mls qos srr-queue output dscp-map queue 3 threshold 3 8 16 20
mls qos srr-queue output dscp-map queue 4 threshold 1 0
mls qos queue-set output 1 threshold 1 100 100 100 149
mls qos queue-set output 1 threshold 2 100 540 100 600
mls qos queue-set output 1 threshold 3 100 100 100 600
mls qos queue-set output 1 threshold 4 100 170 100 250
mls qos queue-set output 1 buffers 16 28 36 20!

ip access-list extended CLASS_BACKUP
  permit tcp any gt 1023 any eq 1556 13722 13724 13782 13783
  permit tcp any eq 1556 13722 13724 13782 13783 any gt 1023
ip access-list extended CLASS_VIDEO
  permit udp any gt 1023 any range 2326 2487
  permit udp any range 2326 2487 any gt 1023
ip access-list extended CLASS_VOIP
  permit udp any gt 1023 any eq 2427
  permit udp any eq 2427 any gt 1023
ip access-list extended CLASS_VOIP_CONTROL
  permit tcp any gt 1023 any range 5060 5061
  permit tcp any range 5060 5061 any gt 1023
  permit udp any gt 1023 any eq 2427
  permit udp any eq 2427 any gt 1023
  permit udp any gt 1023 any eq 1719
  permit udp any eq 1719 any gt 1023
  permit udp any gt 1023 any range 5060 5061
  permit udp any range 5060 5061 any gt 1023
!

class-map match-any BACKUP
  match access-group name CLASS_BACKUP
class-map match-any VIDEO
  match access-group name CLASS_VIDEO
class-map match-any VOIP
  match access-group name CLASS_VOIP
class-map match-any VOIP_CONTROL
  match access-group name CLASS_VOIP_CONTROL
policy-map MARK_ALL_PACKETS
  class BACKUP
    set ip dscp default
  class VIDEO
    set ip dscp af41
  class VOIP
    set ip dscp ef
  class VOIP_CONTROL
    set ip dscp cs3
  class class-default
    set ip dscp CS1
!
interface GigabitEthernet 0/1
  description TRUNK PORT
  switchport trunk encapsulation dot1q
  switchport mode trunk
  mls qos vlan-based
  srr-queue bandwidth share 1 65 30 5
  priority-queue out
!
interface GigabitEthernet 0/2
  description to Router
  switchport access vlan X
  switchport mode access
  mls qos vlan-based
  srr-queue bandwidth share 1 65 30 5
  priority-queue out
  spanning-tree portfast
!
interface Vlan110
  desc DHCP-110
  ip address <SwitchIP> 255.255.255.0
  service-policy input MARK_ALL_PACKETS
  no shutdown
QoS / Shaping – Router Side

Pre-requisites

- IOS 15.x – 12.4 has issues calculating percentage remaining for QoS MQC templates
  - Recommended version - advipservicesk9-151.4.M7
  - If converged Data / Voice Router IP Toll Free white list must be added to configuration.
- Consult Cisco Performance Tables to ensure router can handle throughput.
  - Take Mbps column divide in half for actual throughput with services / duplexed traffic.

Router QoS Template

Search and replace the following:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;LANIP&gt;</td>
<td>LAN IP address (added via IP-Plan)</td>
<td>(ex: 10.253.0.1)</td>
</tr>
<tr>
<td>&lt;LANIPMASK&gt;</td>
<td>LAN subnet address normal (added via IP-Plan)</td>
<td>(ex: 255.255.255.0)</td>
</tr>
<tr>
<td>&lt;WANIP&gt;</td>
<td>WAN IP address (added via ISP)</td>
<td>(ex: 62.157.91.123)</td>
</tr>
<tr>
<td>&lt;WANSUBNET&gt;</td>
<td>WAN subnet address (added via ISP)</td>
<td>(ex: 255.255.255.248)</td>
</tr>
<tr>
<td>&lt;WANBW&gt;</td>
<td>WAN bandwidth speed in Kbps</td>
<td>(ex for 10M line 10000)</td>
</tr>
<tr>
<td>&lt;LANIF&gt;</td>
<td>Interface name of WAN card</td>
<td>(ex: Gigabitethernet0/0)</td>
</tr>
<tr>
<td>&lt;QOSWANBW&gt;</td>
<td>lines &lt;10Mb use WAN Bandwidth in bps x0.85</td>
<td>(ex: 2Mb = 1700000)</td>
</tr>
<tr>
<td>&lt;WANBWBPS&gt;</td>
<td>WAN bandwidth speed in bps</td>
<td>(ex: for 10M line 1000000)</td>
</tr>
<tr>
<td>&lt;1%QOSWANBW&gt;</td>
<td>&lt;QOSWANBW&gt; *0.01</td>
<td>(ex: for 10M line 1000000)</td>
</tr>
</tbody>
</table>

```
ip access-list extended gdoi
remark GDOI Protocol
permit udp any any eq 848
!
!
class-map match-any GDOI
  match access-group name gdoi

class-map match-any VoIP
description VoIP RTP Traffic
  match ip dscp ef

class-map match-any Control
description VoIP Control Traffic
  match ip dscp af31
  match ip dscp cs3

class-map match-any VideoConf
description Video Conferencing
  match ip dscp af41

class-map match-any Normal
description Normal Traffic
  match ip dscp cs1

!
!
policy-map CHILD_POLICY
class VoIP
  priority percent 30
class Control
  bandwidth remaining percent 10
class GDOI
  bandwidth remaining percent 10
class VideoConf
```
bandwidth remaining percent 25
class Normal
  bandwidth remaining percent 24
class class-default
  bandwidth remaining percent 1
  fair-queue
  random-detect dscp-based

policy-map SHAPE_TRAFFIC_FROM_WAN
  class class-default
    shape average <QOSWANBW> <1%QOSWANBW>
    service-policy CHILD_POLICY

policy-map SHAPE_TRAFFIC_TO_WAN
  class class-default
    shape average <WANBWBPS> <1%WANBWBPS>
    bandwidth <WANBW>
    service-policy CHILD_POLICY

interface <WANIF>
  ip address <WANIP> <WANSUBNET>
  bandwidth <WANBW>
  load-interval 30
  no cdp enable
  service-policy output SHAPE_TRAFFIC_TO_WAN
  no shutdown

interface <LANIF>
  ip address <LANIP> <LANIPMASK>
  load-interval 30
  service-policy output SHAPE_TRAFFIC_FROM_WAN
  no shutdown

IP Toll Fraud White List Template

voice service voip
  ip address trusted list
    ipv4 172.26.2.1 255.255.255.255
    ipv4 172.26.2.17 255.255.255.255
    ipv4 172.26.2.2 255.255.255.255
    ipv4 172.26.2.3 255.255.255.255
    ipv4 172.26.4.1 255.255.255.255
    ipv4 172.26.4.17 255.255.255.255
    ipv4 172.26.4.2 255.255.255.255
    ipv4 172.27.254.228 255.255.255.255
    fax protocol t38 nse force version 0 ls-redundancy 0 hs-redundancy 0 fallback cisco
    h323
    call preserve
    modem passthrough nse codec g711ulaw
    modem relay latency 100