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## **A Sample Configuration of AutoQoS for VoIP on Cisco 3825/2811 Routers and Catalyst 4503/3750 Switches to Support Avaya Communication Manager and the Avaya IP Telephones - Issue 1.0**

### **Abstract**

These Application Notes describe the procedures to configure the AutoQoS features for VoIP on the Cisco Routers and Catalyst Switches. The AutoQoS features provide QoS service for the Avaya S87xx Series servers running Avaya Communication Manager software and the Avaya IP Telephones using a Cisco network infrastructure. These Application Notes also apply to other Avaya Servers running Avaya Communication Manager software.

# 1. Introduction

Cisco IOS Software offers a portfolio of QoS features that enable customer networks to prioritize the VoIP traffic in the packet switched network. Implementing QoS for VoIP requires extensive knowledge of QoS and has been a complicated job for most network administrators. Cisco AutoQoS dramatically simplifies QoS deployment by automating Cisco IOS QoS features for voice traffic with a minimum manual configuration. It simplifies and automates the Modular QoS CLI (MQC) definition of traffic classes, and the creation and configuration of traffic policies (Cisco AutoQoS generates traffic classes and policy maps CLI templates). Therefore, when AutoQoS is configured at the interface or PVC, the traffic receives the required QoS treatment automatically. In-depth knowledge of the underlying technologies, service policies, link efficiency mechanisms, and QoS recommendations for voice requirements are not required to configure AutoQoS.

The AutoQoS features can be applied to the VoIP at both Layer 2 (CoS) and Layer 3 (IP Precedence or Differentiated Services Code Point (DSCP)) level. The following table<sup>1</sup> lists the Cisco router and switch platforms and the minimum IOS images that are currently supporting AutoQoS

|          | Platforms                                                                                                                                                                                                                                                                                                                                                | Software                                                                                                                                                                               |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Switches | Cisco Catalyst 2970 Series Switch<br>Cisco Catalyst 3560 Series Switch<br>Cisco Catalyst 3750 Series Switch                                                                                                                                                                                                                                              | Cisco IOS Software Release 12.2(25)SE<br>Release 12.2(25)SE<br>Release 12.2(20)EX                                                                                                      |
|          | Cisco Catalyst 4500 Series Switch                                                                                                                                                                                                                                                                                                                        | Release 12.1(19)E                                                                                                                                                                      |
|          | Cisco Catalyst 6500 Series Switch                                                                                                                                                                                                                                                                                                                        | Cisco Catalyst Operating System 7.5.1                                                                                                                                                  |
| Routers  | Cisco 800 Series Router<br>Cisco 1700 Series Modular Access Router<br>Cisco 1800 Series Integrated Services Router<br>Cisco 2600XM Series Router<br>Cisco 2800 Series Integrated Services Router<br>Cisco 3700 Series Multiservice Access Router<br>Cisco 3800 Series Integrated Services Router<br>Cisco 7200 Series Router<br>Cisco 7301 Series Router | Release 12.4(2)T<br>Release 12.3(14)T<br>Release 12.3(8)T<br>Release 12.2(15)T<br>Release 12.3(11)T<br>Release 12.2(15)T<br>Release 12.3(11)T<br>Release 12.2(15)T<br>Release 12.3(7)T |

**Table 1. Cisco Hardware and Software Supporting AutoQoS**

These Application Notes also apply to other Avaya Servers running Avaya Communication Manager software.

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<sup>1</sup> Automation for Quality of Service Deployments: Cisco AutoQoS

[http://cisco.com/en/US/tech/tk543/tk759/tk879/technologies\\_white\\_paper0900aecd803228e0.shtml](http://cisco.com/en/US/tech/tk543/tk759/tk879/technologies_white_paper0900aecd803228e0.shtml)

The following network diagram was used for VoIP AutoQoS verification.

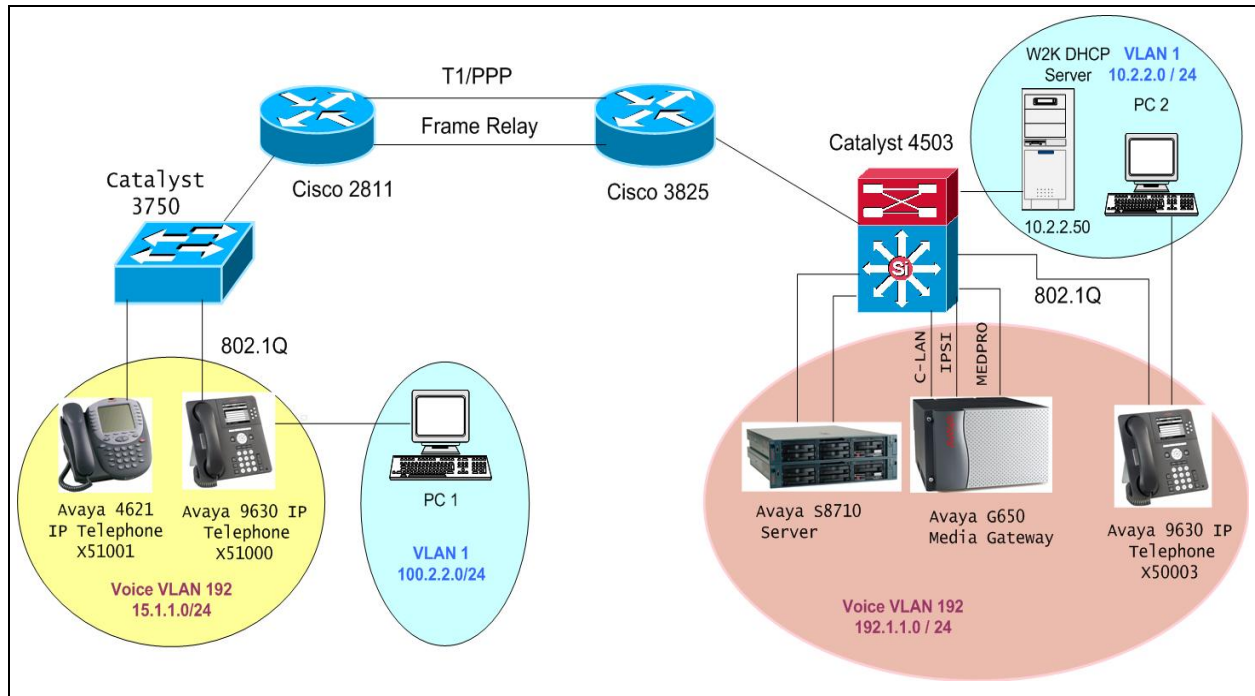


**Figure 1: AutoQoS for VoIP Network Diagram**

## 2. Equipment and Software Validated

The following equipment and software were used for the sample configuration provided:

| Equipment                   | Software             |
|-----------------------------|----------------------|
| Avaya Communication Manager | R014x.00.1.731.2     |
| Avaya 9620 IP Telephone     | S1.5                 |
| Avaya 4621 IP Telephone     | R2.8                 |
| Windows 2000 DHCP Server    | W2K Server with SP 2 |
| Cisco 3825 Router           | IOS 12.4(15)T1       |
| Cisco 2811 Router           | IOS 12.4(8b)         |
| Cisco Catalyst 4503 Switch  | IOS 12.2(37)SG       |

### 3. AutoQoS Implementation Consideration

#### Prerequisites for AutoQoS – VoIP

- Enable Cisco Express Forwarding feature using command **ip cef**. This is a global command and only needs to be entered once.
- Ensure that no QoS policies (service policies) are attached to the interface. This feature cannot be configured if a QoS policy (service policy) is attached to the interface.
- To include Simple Network Management Protocol (SNMP) traps (monitored events), the SNMP server must be enabled.

#### Restrictions for the AutoQoS

Currently there are some restrictions on implementing AutoQoS for VoIP on router WAN interfaces. Refer the **Appendix A** for details.

#### Design Considerations

Generally to meet the VoIP requirement, the AutoQoS takes the interface type and bandwidth into consideration when implementing the following QoS features:

- Low Latency Queueing (LLQ) – Priority Queueing (PQ)  
The LLQ is applied to the voice packets to meet the latency requirements
- Compressed real-time protocol (cRTP)  
With cRTP, the 40-byte IP header of the voice packet is reduced from 2 to 4 bytes, thereby reducing voice bandwidth requirements. The cRTP must be applied at both ends of a network link.
- Link Fragmentation and Interleaving (LFI)  
LFI is used to reduce the jitter of voice packets by preventing voice packets from getting delayed behind large data packets in a queue. LFI must be applied at both ends of a network link.

Basically, there are two key commands required to make the AutoQoS feature work correctly on the routers' WAN interfaces. These commands are:

- **Bandwidth kb** – This command defines the bandwidth that will be used on the router's serial interface. The AutoQoS feature will use this information to determine how to configure the other QoS related parameters, such as fragmentation and RTP compression.
- **Auto qos voip trust** – This command enables the AutoQoS feature on the router's interface. The key word **trust** is necessary because it instructs the router to perform the QoS functions based the incoming packets' DSCP or IP Precedence value.

To make sure that the AutoQoS feature can work correctly, configure it in this order: Enter the **bandwidth** command first followed by the **auto qos voip trust** command.

**Very Important** -- Do not change the interface's bandwidth after the AutoQoS feature is enabled on that interface, since the AutoQoS feature cannot dynamically adjust the configurations based on the new bandwidth settings. If the interface's bandwidth has to be changed, do the following:

- Use **no auto qos voip trust** command to disable the AutoQoS feature on the interface.
- Use **bandwidth** command to change the bandwidth.
- Enter **auto qos voip trust** again to enable it.

After the AutoQoS feature is enabled, the router's IOS will automatically generate complete configurations based on the interface type and its bandwidth. The configuration happens automatically in the background without the user noticing. The command **show run** can be used to review the configuration. Refer to the **Appendix B** for a complete listing of the QoS configuration generated by the AutoQoS feature for WAN interfaces used in these Application Notes.

## 4. Configure the Cisco 3825 and 2811 Routers

The AutoQoS feature consists of two configuration phases, completed in the following order:

- Auto-Discovery (data collection)  
Auto-Discovery phase uses network-based application recognition (NBAR)-based protocol discovery to detect the applications on the network and perform statistical analysis on the network traffic.
- AutoQoS template generation and installation  
This phase generates templates from the data collected during the Auto-Discovery phase and installs the templates on the interface. Then these templates are used as the basis for creating the class maps and policy maps for the network. After the class maps and policy maps are created, they are then installed on the interface.

### Enabling the Auto-Discovery Phase

The Auto-Discovery phase uses NBAR to detect network applications and protocols as they leave an interface, collect data from the offered traffic, and perform statistical analysis. The information collected will be used to build the AutoQoS templates. Even though there is no time requirement for this phase, users should leave enough time for the router to collect data in order to record the VoIP traffic conditions, including the network peak time. To simulate real network conditions, some background data was injected into the network in the lab-testing environment.

There are some restrictions for using the **auto discovery qos** command:

- The **auto discovery qos** command is not supported on sub-interfaces.
- Do not change the bandwidth of the interface when using the **auto discovery qos** command.
- All previously attached policies must be removed from the interface.

Compared to the bandwidth offered by Ethernet interfaces, the WAN interfaces offer much less bandwidth and definitely become a bottleneck on the router. To cover the most common WAN infrastructure used by enterprise customers, these Application Notes will address the AutoQoS feature configurations for VoIP based on the following three WAN topologies: T1, PPP, and Frame Relay for low speed links. Note the interface or PVC is classified as low-speed link if its bandwidth is less than or equal to 768 kbps based on Cisco implementations. In this configuration, Avaya Communication Manager and the Avaya IP Telephones are configured to mark the VoIP packets with proper CoS and DSCP values. Cisco switches and routers will be responsible for scheduling the traffic based on their CoS/DSCP values.

Since the AutoQoS feature configurations are identical for both the Cisco 3825 and 2811 routers, except for the T1 clocking source, only the configuration for the Cisco 2811 router is presented here.

#### 4.1. Enable the Auto-Discovery Phase on Router Interface

To begin discovering and collecting data for configuring the AutoQoS feature, use the **auto discovery qos** command in interface configuration mode. To stop this feature, use the **no** form for this command. The following example shows how to enable the Auto-Discovery phase of the AutoQoS on the Cisco 2811 router's serial interface. In this example, the bandwidth has been specified as 720 kbps, although this is optional. The **command auto discovery qos trust** is used on the interface. Since all VoIP packets from the Avaya S8710 Servers and the Avaya IP Telephones are pre-marked with DSCP values defined on the ip-network-region form, the key word **trust** is used in this auto discovery command. Note that the word **trust** (optional) is used to indicate that the DSCP markings of a packet are trusted (that is, relied on) for classification of the voice, video, and data traffic.

##### Auto-Discovery Configuration – Fractional T1 (720kbs) PPP

```
Router2811(config)# ip cef --- globally enable Cisco express forwarding

Router2811(config)# interface serial0/0/0
Router2811(config-if)# ip address 16.1.1.1 255.255.255.0
Router2811(config-if)# encapsulation ppp
Router2811(config-if)# bandwidth 720 --- define the interface speed 720 kb
Router2811(config-if)# auto discovery qos trust
Router2811(config-if)# exit
```

##### Auto-Discovery Configuration – Low-Speed Frame Relay Interface (720kbs PVC)

```
Router2811(config)# interface serial0/0/0
Router2811(config-if)# encapsulation frame-relay
Router2811(config-if)# exit
Router2811(config)# interface serial0/0/0.1 point-to-point
Router2811(config-if)# bandwidth 720 --- define the interface speed 512 kb
Router2811(config-if)# frame-relay interface-dlci 115
```

```
Router2811(config-fr-dlci)# auto discovery qos trust
Router2811(config-if)# exit
```

The following is output from the auto discovery command.

```
Router2811#show auto discovery qos
FastEthernet0/0
AutoQoS Discovery enabled for trusted DSCP
Discovery up time: 3 days, 57 minutes
AutoQoS Class information:
Class Voice:
  Recommended Minimum Bandwidth: 89 Kbps/<1% (PeakRate)
  Detected DSCPs and data:
  DSCP value      AverageRate      PeakRate      Total
                  (kbps/%)         (kbps/%)      (bytes)
  -----
  46/ef           73/<1           89/<1         2419084332
Class Interactive Video:
  No data found.
Class Signaling:
  Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate)
  Detected DSCPs and data:
  DSCP value      AverageRate      PeakRate      Total
                  (kbps/%)         (kbps/%)      (bytes)
  -----
  26/af31         0/0             4/<1          23328
Class Streaming Video:
  No data found.
Class Transactional:
  No data found.
Class Bulk:
  No data found.
Class Scavenger:
  No data found.
Class Management:
  No data found.
Class Routing:
  Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate)
  Detected DSCPs and data:
  DSCP value      AverageRate      PeakRate      Total
                  (kbps/%)         (kbps/%)      (bytes)
  -----
  48/cs6          0/0             1/<1          18107
Class Best Effort:
  Current Bandwidth Estimation: 0 Kbps/0% (AverageRate)
  Detected DSCPs and data:
  DSCP value      AverageRate      PeakRate      Total
                  (kbps/%)         (kbps/%)      (bytes)
  -----
  0/default       0/0             66/<1         10049417
Suggested AutoQoS Policy for the current uptime:
!
class-map match-any AutoQoS-Voice-Trust
  match ip dscp ef
!
```

```

policy-map AutoQoS-Policy-Fa0/0-Trust
  class AutoQoS-Voice-Trust
    priority percent 1
  class class-default
    fair-queue

```

#### Serial0/0/0.1

AutoQoS Discovery enabled for trusted DSCP  
Discovery up time: 2 minutes, 57 seconds

AutoQoS Class information:

Class Voice:

Recommended Minimum Bandwidth: 95 Kbps/13% (PeakRate)

Detected DSCPs and data:

| DSCP value   | AverageRate<br>(kbps/%) | PeakRate<br>(kbps/%) | Total<br>(bytes) |
|--------------|-------------------------|----------------------|------------------|
| -----        | -----                   | -----                | -----            |
| <b>46/ef</b> | <b>68/9</b>             | <b>95/13</b>         | <b>1519898</b>   |

Class Interactive Video:

No data found.

Class Signaling:

No data found.

Class Streaming Video:

No data found.

Class Transactional:

No data found.

Class Bulk:

No data found.

Class Scavenger:

No data found.

Class Management:

No data found.

Class Routing:

Recommended Minimum Bandwidth: 0 Kbps/0% (AverageRate)

Detected DSCPs and data:

| DSCP value | AverageRate<br>(kbps/%) | PeakRate<br>(kbps/%) | Total<br>(bytes) |
|------------|-------------------------|----------------------|------------------|
| -----      | -----                   | -----                | -----            |
| 48/cs6     | 0/0                     | 0/0                  | 210              |

Class Best Effort:

Current Bandwidth Estimation: 0 Kbps/0% (AverageRate)

Detected DSCPs and data:

| DSCP value | AverageRate<br>(kbps/%) | PeakRate<br>(kbps/%) | Total<br>(bytes) |
|------------|-------------------------|----------------------|------------------|
| -----      | -----                   | -----                | -----            |
| 0/default  | 0/0                     | 0/0                  | 1530             |

Suggested AutoQoS Policy for the current uptime:

```

!
class-map match-any AutoQoS-Voice-Trust
  match ip dscp ef
!
policy-map AutoQoS-Policy-Se0/0/0.1-Trust
  class AutoQoS-Voice-Trust
    priority percent 13
  class class-default
    fair-queue

```

## 4.2. Enable AutoQoS on Router

To install the quality-of-service (QoS) class maps and policy maps created by the AutoQoS feature, use the **auto qos voip** command in interface configuration mode. To remove the QoS policies, use the **no** form of this command.

**auto qos voip [trust]**

**no auto qos**

The class maps and policy maps are generated on the basis of the data collected during the Auto-Discovery phase of the AutoQoS feature. The key word **trust** indicates that the router will give the voice traffic priority based on the DSCP values from the packets. The following is a configuration showing the AutoQoS feature enabled on the serial interface.

```
Router2811(config)# ip cef
forwarding
```

*--- globally enable Cisco express*

### AutoQoS Configuration – Fractional T1 (720kbs) PPP

```
Router2811(config)# interface serial0/0/0
```

```
Router2811(config-if)# bandwidth 720
```

*--- define the interface speed 720 kb*

```
Router2811(config-if)# ip address 16.1.1.1 255.255.255.0
```

```
Router2811(config-if)# encapsulation ppp
```

```
Router2811(config-if)# auto qos voip trust
```

*--- enable AutoQoS on interface*

```
Router2811(config-if)# exit
```

### AutoQoS Configuration – Low-Speed Frame Relay Interface (720kbs PVC)

```
Router2811(config)# interface Serial0/0/0
```

```
Router2811(config-if)# encapsulation frame-relay
```

```
Router2811(config-if)# exit
```

```
Router2811(config)# interface Serial0/0/0.1 point-to-point
```

*--- define a point-to-point interface*

```
Router2811(config-if)# bandwidth 720
```

*--- define the interface speed 720 kb*

```
Router2811(config-if)# ip address 115.1.1.1 255.255.255.0
```

```
Router2811(config-if)# frame-relay interface-dlci 115
```

*--- assigns a DLCI 115 to this  
Frame-relay interface*

```
Router2811(config-fr-dlci)# auto qos voip trust
```

*--- enable AutoQoS on this pvc*

```
Router2811(config-if)# exit
```

The **show auto qos** command can be used to verify the contents of the interface configurations, policy maps, and class maps created by the AutoQoS feature. The following is sample output from the AutoQoS command.

**- Output for ppp encapsulation**

```
Router2811#show auto qos
!
policy-map AutoQoS-Policy-Trust
class AutoQoS-VoIP-RTP-Trust
priority percent 70
class AutoQoS-VoIP-Control-Trust
bandwidth percent 5
class class-default
fair-queue
!
FastEthernet0/0 -
!
interface FastEthernet0/0
service-policy output AutoQoS-Policy-Trust

interface Serial0/0/0
service-policy output AutoQoS-Policy-Trust
```

**- Output for frame-relay encapsulation**

```
Router2811#show auto qos
!
policy-map AutoQoS-Policy-Trust
class AutoQoS-VoIP-RTP-Trust
priority percent 70
class AutoQoS-VoIP-Control-Trust
bandwidth percent 5
class class-default
fair-queue
!
FastEthernet0/0 -
!
interface FastEthernet0/0
service-policy output AutoQoS-Policy-Trust

Serial0/0/0.1: DLCI 115 -
!
interface Serial0/0/0
frame-relay traffic-shaping
```

```

!
interface Serial0/0/0.1 point-to-point
 frame-relay interface-dlci 115
  class AutoQoS-FR-Se0/0/0-115
 frame-relay ip rtp header-compression
!
map-class frame-relay AutoQoS-FR-Se0/0/0-115
 frame-relay cir 720000
 frame-relay bc 7200
 frame-relay be 0
 frame-relay mincir 720000
 frame-relay fragment 900
 service-policy output AutoQoS-Policy-Trust

```

**Note:** the AutoQoS feature is enabled at serial interface for PPP or HDLC, but is enabled at PVC for the Frame Relay.

## 5. Configure the Cisco Catalyst 4503 and 3750 Switches

### 5.1. Configure AutoQoS on Cisco Catalyst 4503 Switch

The Catalyst 4503 switch with a layer 3 Super Engine installed can prioritize the VoIP traffic based on the incoming packets' CoS or DSCP value. The AutoQoS feature can be enabled on the switch's interfaces. By default, AutoQoS is disabled on all interfaces. When the AutoQoS feature on the first interface is enabled, these automatic actions occur:

- QoS is globally enabled (**qos** global configuration command).
- DBL (Dynamic Buffer Limiting) is enabled globally (qos dbl global configuration command).
- When the **auto qos voip trust** interface configuration command is used, the ingress classification on the specified interface is set to trust the CoS label received in the packet header if the specified interface is configured as Layer 2 (and is set to trust DSCP if the interface is configured as Layer 3).

```

qos
qos dbl
qos map dscp 24 25 26 27 28 29 30 31 to tx-queue 4
qos map dscp 32 33 34 35 36 37 38 39 to tx-queue 4
qos map cos 3 to dscp 26

```

**Note:** Since Avaya products do not work with the Cisco CDP protocol, the command **no cdp enable** should be used to disable the CDP protocol on the switch ports that are connected to Avaya devices.

Table 2 shows the switch port assignment.

| Switch interface    | Connected device                               |
|---------------------|------------------------------------------------|
| GigabitEthernet 2/1 | Router 7206 interface fastethernet 0/0         |
| FastEthernet 3/7    | S8700 Media Server primary network interface   |
| FastEthernet 3/8    | S8700 Media Server secondary network interface |
| FastEthernet 3/9    | CLAN                                           |
| FastEthernet 3/10   | MEDPRO                                         |
| FastEthernet 3/11   | IP Telephone 1                                 |

**Table 2. Catalyst 4503 Switch Interfaces Assignment**

There are four VLANs being used in this configuration: VLAN 1 for data, VLAN 2 for S8710 server control network and VLAN 192 for voice. VLAN 4 is used to connect to the router 3825 (uplink) for routing proposes only. CDP can be disabled globally by using command **no cdp run**.

```

interface GigabitEthernet2/1  -- interface to router 3825
switchport access vlan 4
auto qos voip trust          -- enable AutoQoS on this interface
!
interface FastEthernet3/7
description S8710-Server1
no cdp enable                -- disable cdp on this interface
switchport access vlan 192
auto qos voip trust
!
interface FastEthernet3/8
description S8710-Server2
no cdp enable
switchport access vlan 192
auto qos voip trust
!
interface FastEthernet3/9
description CLAN
no cdp enable
switchport access vlan 192
auto qos voip trust
!
interface FastEthernet3/10
description Medpro
no cdp enable
switchport access vlan 192
auto qos voip trust

```

```

!
interface FastEthernet3/11          -- interface connect to IP telephone
description IP Telephone 50003
no cdp enable                       -- disable CDP on this interface
switchport trunk encapsulation dot1q -- enable 802.1Q trunk on this interface
switchport trunk allowed vlan 192
switchport mode trunk
auto qos voip trust                -- enable AutoQoS for this interface
!
interface Vlan1
ip address 100.2.2.1 255.255.255.0
!
interface Vlan4
ip address 14.1.1.2 255.255.255.0
!
interface Vlan192
ip address 192.168.1.1 255.255.255.0
!
router rip
network 14.0.0.0
network 100.2.0.0
network 192.168.1.0

```

The following are the outputs generated from AutoQoS command for interface GigabitEthernet2/1 (uplink to router 3825) and interface FastEthernet 3/11 (Avaya IP telephone 9630).

```

interface GigabitEthernet2/1
  switchport access vlan 4
  qos trust cos
  auto qos voip trust
  tx-queue 3
  priority high
  shape percent 33
  service-policy output AutoQoS-voip-policy

interface FastEthernet3/11
  switchport trunk encapsulation dot1q
  switchport trunk allowed vlan 192
  switchport mode trunk
  qos trust cos
  auto qos voip trust
  tx-queue 3
  priority high
  shape percent 33
  service-policy output AutoQoS-voip-policy

```

Refer to **Appendix B** for complete configurations generated by the command **set port qos AutoQoS trust cos** for this switch.

## 5.2. Configure the Cisco Catalyst 3750 Switch

Catalyst 3750 switches can prioritize the VoIP traffic based on the incoming packets' CoS/DSCP values. The AutoQoS feature is enabled at the interface level.

- Use command **auto qos voip trust** to enable the AutoQoS feature on this interface and trust CoS/DSCP values from incoming packets.

**Note:** if the switch interface is configured as a switch port, the switch will trust the incoming packet's CoS value. If the switch interface is configured as a routed port, the switch will trust the incoming packet's DSCP value. Use command **no switch port** at interface level to disable switching function on the interface. In this configuration, the interface *fastethernt1/0/23* is configured as a routed port since this interface is connected to router port.

```
Catalyst3750# ip cef distributed           -- enable ip cef
Catalyst3750# ip routing                  -- enable ip routing
Catalyst3750(config)# VLAN 192           -- create VLAN 192 for voice on the switch. VLAN 1
                                         already exists as default.
Catalyst3750(config-vlan)# name voice-vlan

Interface vlan 192
ip address 15.1.1.1 255.255.255.0        -- assign IP address for voice VLAN interface

Interface FastEthernt1/0/23
Description connect to router 2811
no switch port                          -- make this interface as a routed port
ip address 115.1.1.2 255.255.255.0      -- disable cdp on this interface
auto qos voip trust                     -- enable AutoQoS on this interface

Interface FastEthernt1/0/15
Description connect to 96300 IP Telephone
no cdp enable                           -- disable cdp on this interface
switchport trunk encapsulation dot1q    -- set switch port io 802.1Q encapsulation
switchport trunk native VLAN 1          -- set vlan 1 as native vlan (no-tag)
switchport trunk allowed vlan 192       -- allow voice vlan on this port
switchport mode trunk                   -- set switch port in trunk mode
spanning-tree portfast                  -- disable spanning-tree on this port
auto qos voip trust                     -- enable AutoQoS voip on this interface

Interface FastEthernt1/0/16
Description connect to 4621 IP Telephone
no cdp enable                           -- disable cdp on this interface
switchport trunk encapsulation dot1q    -- set switch port io 802.1Q encapsulation
switchport trunk native VLAN 1          -- set vlan 1 as native vlan (no-tag)
switchport trunk allowed vlan 192       -- allow voice vlan on this port
spanning-tree portfast                  -- disable spanning-tree on this port
```

## 6. Configure Avaya Communication Manager

Cisco uses the following CoS/DSCP mappings for signaling and audio traffic. Based on the incoming packet's CoS/DSCP values, the VoIP signaling and audio packets are sent to different egress queues. In order to take advantage of the AutoQoS feature with these settings, Avaya Communication Manager and the Avaya IP Telephones should be configured with the following QoS settings to match the settings on Cisco Catalyst switches and routers.

|                  | CoS      | DSCP                   |
|------------------|----------|------------------------|
| <b>Signaling</b> | <b>3</b> | <b>26 (AF31 class)</b> |
| <b>Audio</b>     | <b>5</b> | <b>46 (EF class)</b>   |

**Table 3. CoS and DSCP Values for S8700 Media Server and IP Telephones**

The settings are required based on Catalyst switches and routers QoS-Queue mapping from the Cisco configuration guide. Refer to **Appendix C** for details.

Using the **change-ip-network-region 1** form to configure the QoS value as follows:

|                                   |                                      |              |
|-----------------------------------|--------------------------------------|--------------|
| <b>change ip-network-region 1</b> |                                      | Page 1 of 19 |
| IP NETWORK REGION                 |                                      |              |
| Region: 1                         |                                      |              |
| Location:                         | Authoritative Domain: avaya.com      |              |
| Name:                             |                                      |              |
| MEDIA PARAMETERS                  | Intra-region IP-IP Direct Audio: yes |              |
| Codec Set: 1                      | Inter-region IP-IP Direct Audio: yes |              |
| UDP Port Min: 2048                | IP Audio Hairpinning? y              |              |
| UDP Port Max: 65535               |                                      |              |
| DIFFSERV/TOS PARAMETERS           | RTCP Reporting Enabled? y            |              |
| Call Control PHB Value: 26        | RTCP MONITOR SERVER PARAMETERS       |              |
| Audio PHB Value: 46               | Use Default Server Parameters? y     |              |
| Video PHB Value: 26               |                                      |              |
| 802.1P/Q PARAMETERS               |                                      |              |
| Call Control 802.1p Priority: 3   |                                      |              |
| Audio 802.1p Priority: 5          |                                      |              |
| Video 802.1p Priority: 5          | AUDIO RESOURCE RESERVATION           |              |
| PARAMETERS                        | RSVP Enabled? n                      |              |
| H.323 IP ENDPOINTS                |                                      |              |
| H.323 Link Bounce Recovery? y     |                                      |              |
| Idle Traffic Interval (sec): 20   |                                      |              |
| Keep-Alive Interval (sec): 5      |                                      |              |
| Keep-Alive Count: 5               |                                      |              |

The QoS values configured in this form will apply to C-LAN, MEDPRO, and Avaya IP Telephones once the ip-network-map is configured on the system. In the following configuration, the IP network ranges 15.1.1.1 – 254 and 192.168.1.1-254 are mapped to ip-network-region 1 with vlan 192 (voice vlan).

|                       |  |                |  |                 |  |        |  |      |  |                              |  |
|-----------------------|--|----------------|--|-----------------|--|--------|--|------|--|------------------------------|--|
| change ip-network-map |  |                |  |                 |  |        |  |      |  | Page 1 of 32                 |  |
| IP ADDRESS MAPPING    |  |                |  |                 |  |        |  |      |  |                              |  |
| From IP Address       |  | (To IP Address |  | Subnet or Mask) |  | Region |  | VLAN |  | Emergency Location Extension |  |
| 15 .1 .1 .1           |  | 15 .1 .1 .254  |  |                 |  | 1      |  | 192  |  |                              |  |
| 192.168.1 .1          |  | 192.168.1 .254 |  |                 |  | 1      |  | 192  |  |                              |  |
| . . . . .             |  | n              |  |                 |  |        |  |      |  |                              |  |

Use command **display cabinet 1** to verify that the G650 Media Gateway is configured in network region 1.

|                                       |              |                      |           |         |  |
|---------------------------------------|--------------|----------------------|-----------|---------|--|
| display cabinet 1                     |              |                      |           | CABINET |  |
| CABINET DESCRIPTION                   |              |                      |           |         |  |
| Cabinet: 1                            |              |                      |           |         |  |
| Cabinet Layout: G650-rack-mount-stack |              |                      |           |         |  |
| Cabinet Type: expansion-portnetwork   |              |                      |           |         |  |
| Location: 1                           |              | IP Network Region: 1 |           |         |  |
| Rack:                                 | Room:        | Floor:               | Building: |         |  |
| CARRIER DESCRIPTION                   |              |                      |           |         |  |
| Carrier                               | Carrier Type | Number               |           |         |  |
| E                                     | not-used     | PN                   | 01        |         |  |
| D                                     | not-used     | PN                   | 01        |         |  |
| C                                     | not-used     | PN                   | 01        |         |  |
| B                                     | not-used     | PN                   | 01        |         |  |
| A                                     | G650-port    | PN                   | 01        |         |  |

Use command **change ipserver-interface 1** to assign the QoS values to the IPSI as shown in **Table 3**.

|                                                            |                                  |
|------------------------------------------------------------|----------------------------------|
| <b>change ipserver-interface 1</b>                         | Page 1 of 1                      |
| IP SERVER INTERFACE (IPSI) ADMINISTRATION - PORT NETWORK 1 |                                  |
| <b>IP Control? y</b>                                       | <b>Socket Encryption? y</b>      |
| Ignore Connectivity in Server Arbitration? n               | Enable QoS? y                    |
| Primary IPSI                                               | QoS Parameters                   |
| -----                                                      | -----                            |
| Location: 1A01                                             | <b>Call Control 802.1p: 3</b>    |
| Host: 1.1.1.7                                              | <b>Call Control DiffServ: 26</b> |
| DHCP ID: ipsi-A01a                                         |                                  |

Keep in mind, with the default CoS and DSCP settings, the call control traffic does not get the same priority as the audio traffic does. The switches and routers use the strict priority queue (Low Latency Queuing) to serve the VoIP bearer traffic, and use the Class-Based Weighted Fair Queuing (CBWFQ) to serve the control traffic with minimum bandwidth guarantees. In reality, depending on the network condition, the VoIP bearer traffic might get through, but the control traffic probably gets dropped either by switches or routers when the congestions occur. If this is the case, one way to fix this problem is to put the call control traffic into the same queue as the bearer traffic by changing the call control's CoS and DSCP values to 5 and 46. Considering the importance of the call control and the little bandwidth it requires, it would be a good practice to implement this without impacting the voice quality. Lab testing has proved it works for this situation. Customers should make the decisions whether or not to implement this based on their network condition.

## 7. Verification Steps

The following steps have been used to verify the AutoQoS feature.

- Enable the AutoQoS feature on switches and routers and make phone calls between IP telephone extensions 51000 and 50001. Verify that the call quality is good.
- Inject background data between the Catalyst 4503 and 3750 switches up to the line speed of T1 link. Make a call between the extension 51000 and extension 50001 and verify the call is good quality.
- The following commands also show the AutoQoS feature status on the switches and routers.

### From the Cisco 3825 router

```
Router2811#show auto qos
!
policy-map AutoQoS-Policy-Trust
class AutoQoS-VoIP-RTP-Trust
priority percent 70
class AutoQoS-VoIP-Control-Trust
bandwidth percent 5
class class-default
fair-queue
!
FastEthernet0/0 -
!
interface FastEthernet0/0
service-policy output AutoQoS-Policy-Trust

Serial0/0/0.1: DLCI 115 -
!
interface Serial0/0/0
frame-relay traffic-shaping
!
interface Serial0/0/0.1 point-to-point
frame-relay interface-dlci 115
class AutoQoS-FR-Se0/0/0-115
frame-relay ip rtp header-compression
!
map-class frame-relay AutoQoS-FR-Se0/0/0-115
frame-relay cir 720000
frame-relay bc 7200
```

```
frame-relay be 0
frame-relay mincir 720000
frame-relay fragment 900
service-policy output AutoQoS-Policy-Trust
```

```
Router2811#show class-map
```

```
Class Map match-any class-default (id 0)
  Match any
```

```
Class Map match-any AutoQoS-VoIP-RTP-Trust (id 1)
  Match ip dscp ef (46)
```

```
Class Map match-any AutoQoS-VoIP-Control-Trust (id 2)
  Match ip dscp cs3 (24)
  Match ip dscp af31 (26)
```

```
Router2811#show policy-map interface
```

```
FastEthernet0/0
```

**Service-policy output: AutoQoS-Policy-Trust**

Class-map: AutoQoS-VoIP-RTP-Trust (match-any)

51904 packets, 11107456 bytes

5 minute offered rate 0 bps, drop rate 0 bps

**Match: ip dscp ef (46)**

**51904 packets, 11107456 bytes**

5 minute rate 0 bps

Queueing

Strict Priority

Output Queue: Conversation 264

Bandwidth 70 (%)

Bandwidth 70000 (kbps) Burst 1750000 (Bytes)

(pkts matched/bytes matched) 1/214

(total drops/bytes drops) 0/0

Class-map: AutoQoS-VoIP-Control-Trust (match-any)

5374 packets, 417437 bytes

5 minute offered rate 0 bps, drop rate 0 bps

Match: ip dscp cs3 (24)

0 packets, 0 bytes

5 minute rate 0 bps

**Match: ip dscp af31 (26)**

**5374 packets, 417437 bytes**

**5 minute rate 0 bps**

Queueing

Output Queue: Conversation 265  
Bandwidth 5 (%)  
Bandwidth 5000 (kbps)Max Threshold 64 (packets)  
(pkts matched/bytes matched) 0/0  
(depth/total drops/no-buffer drops) 0/0/0

Class-map: class-default (match-any)  
8474 packets, 640855 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

**Serial0/0/0.1: DLCI 115 -**

**Service-policy output: AutoQoS-Policy-Trust**

Class-map: AutoQoS-VoIP-RTP-Trust (match-any)

77716 packets, 15854668 bytes  
5 minute offered rate 0 bps, drop rate 0 bps  
**Match: ip dscp ef (46)**  
**77716 packets, 15854668 bytes**  
**5 minute offered rate 0 bps, drop rate 0 bps**  
Match: ip dscp ef (46)  
77716 packets, 15854668 bytes  
5 minute rate 0 bps  
Queueing  
Strict Priority  
Output Queue: Conversation 72  
Bandwidth 70 (%)  
Bandwidth 504 (kbps) Burst 12600 (Bytes)  
(pkts matched/bytes matched) 77716/15854668  
(total drops/bytes drops) 0/0

Class-map: AutoQoS-VoIP-Control-Trust (match-any)  
3 packets, 297 bytes  
5 minute offered rate 0 bps, drop rate 0 bps  
Match: ip dscp cs3 (24)  
0 packets, 0 bytes  
5 minute rate 0 bps  
**Match: ip dscp af31 (26)**  
**3 packets, 297 bytes**  
**5 minute rate 0 bps**  
Queueing

Output Queue: Conversation 73  
Bandwidth 5 (%)  
Bandwidth 36 (kbps)Max Threshold 64 (packets)  
(pkts matched/bytes matched) 3/297  
(depth/total drops/no-buffer drops) 0/0/0

Class-map: class-default (match-any)  
7781 packets, 442375 bytes  
5 minute offered rate 0 bps, drop rate 0 bps  
Match: any  
Queueing  
Flow Based Fair Queueing  
Maximum Number of Hashed Queues 64  
(total queued/total drops/no-buffer drops) 0/0/0

#### **From the Catalyst 3750 Switch:**

Catalyst3750#**show auto qos**  
**FastEthernet1/0/15**  
**auto qos voip trust**

**FastEthernet1/0/16**  
**auto qos voip trust**

**FastEthernet1/0/23**  
**auto qos voip trust**

Catalyst3750#**show mls qos interface fa1/0/15**  
FastEthernet1/0/15  
**trust state: trust cos**  
**trust mode: trust cos**  
trust enabled flag: ena  
COS override: dis  
default COS: 0  
DSCP Mutation Map: Default DSCP Mutation Map  
Trust device: none  
**qos mode: port-based**

Catalyst3750#**show mls qos interface fa1/0/23**  
FastEthernet1/0/23  
**trust state: trust dscp**

```
trust mode: trust dscp
trust enabled flag: ena
COS override: dis
default COS: 0
DSCP Mutation Map: Default DSCP Mutation Map
Trust device: none
qos mode: port-based
```

## 8. Conclusion

The AutoQoS feature for VoIP simplifies the QoS implementation and speeds up the provisioning of QoS technology over a Cisco network. Avaya Communication Manager Software and the Avaya IP Telephones can take advantage of AutoQoS feature on the Cisco switches and routers to provide customers a quality VoIP communications in this environment.

## 9. Additional References

1. **Cisco AutoQoS White Paper** (AutoQoS for VoIP),  
[http://cisco.com/en/US/tech/tk543/tk759/technologies\\_white\\_paper09186a00801348bc.shtml](http://cisco.com/en/US/tech/tk543/tk759/technologies_white_paper09186a00801348bc.shtml)
2. **Catalyst 3750 Switch Software Configuration Guide, 12.2(37)SE**,  
[http://cisco.com/en/US/products/hw/switches/ps5023/products\\_configuration\\_guide\\_book09186a00808082fb.html](http://cisco.com/en/US/products/hw/switches/ps5023/products_configuration_guide_book09186a00808082fb.html)
3. **Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide, 12.2(25)SG**,  
<http://cisco.com/en/US/docs/switches/lan/catalyst4500/12.2/25sg/configuration/guide/Diagnost.html>
4. **Administrator Guide for Avaya Communication Manager, Document ID: 03-300509, Issue 3.1, February 2007**  
[http://support.avaya.com/elmodocs2/comm\\_mgr/r4\\_0/pdfs/03\\_300509\\_3\\_1.pdf](http://support.avaya.com/elmodocs2/comm_mgr/r4_0/pdfs/03_300509_3_1.pdf)

# Appendix A

## Restrictions for AutoQoS — VoIP<sup>2</sup>

### *General Restrictions*

- The AutoQoS — VoIP feature is supported on the following interfaces, data-link connection identifiers (DLCIs), and permanent virtual circuits (PVCs) only:

- Serial interfaces with PPP or High-Level Data Link Control (HDLC)
- Frame Relay DLCIs in point-to-point subinterfaces only
- ATM PVCs

The AutoQoS — VoIP feature is supported on low-speed ATM PVCs in point-to-point subinterfaces only. The AutoQoS — VoIP feature is supported on high-speed ATM PVCs in any type of subinterface.



---

**Note** An ATM PVC is classified as low-speed if its bandwidth is less than or equal to 768 kbps; an ATM PVC is classified as high-speed if its bandwidth is greater than 768 kbps

---

- Frame Relay-to-ATM Interworking links

#### Serial Interface Restrictions

- For a serial interface with a low-speed link, Multilink PPP (MLP) is configured automatically. The serial interface must have an IP address. When MLP is configured, this IP address is removed and put on the MLP bundle. To ensure that the traffic goes through the low-speed link, the following conditions must be met:

- The AutoQoS - VoIP feature must be configured at the *both* ends of the link.
- The amount of bandwidth configured must be the same on *both* ends of the link.

#### Frame Relay DLCI Restrictions

---

<sup>2</sup> Cisco IOS Quality of Service Solutions Configuration Guide, Release 12.4

- The AutoQoS — VoIP feature cannot be configured on a Frame Relay DLCI if a map class is attached to the DLCI.
- If a Frame Relay DLCI is already assigned to one subinterface, the AutoQoS — VoIP feature cannot be configured from a different subinterface.
- For low-speed Frame Relay DLCIs configured for use on Frame Relay-to-ATM networks, MLP over Frame Relay (MLPoFR) is configured automatically. The subinterface must have an IP address.

When MLPoFR is configured, this IP address is removed and put on the MLP bundle. The AutoQoS — VoIP feature must also be configured on the ATM side of the network.

- For low-speed Frame Relay DLCIs with Frame Relay-to-ATM Interworking, the AutoQoS — VoIP feature cannot be configured if a virtual template is already configured for the DLCI.

#### ATM PVC Restrictions

- For a low-speed ATM PVC, the AutoQoS — VoIP feature cannot be configured if a virtual template is already configured for the ATM PVC.
- For low-speed ATM PVCs, MLP over ATM (MLPoATM) is configured automatically. The subinterface must have an IP address.

When MLPoATM is configured, this IP address is removed and put on the MLP bundle. The AutoQoS — VoIP feature must also be configured on the ATM side of the network.

## Appendix B

### -- AutoQoS generated configurations for Catalyst 4503

| Catalyst 4503                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |       |                                       |                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------|-------------------|
| Mod                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Ports | Card Type                             | Model             |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2     | Supervisor IV 1000BaseX (GBIC)        | WS-X4515          |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 48    | 10/100/1000BaseT (RJ45)V, Cisco/IEEE  | WS-X4548-GB-RJ45V |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 34    | 10/100BaseTX (RJ45), 1000BaseX (GBIC) | WS-X4232-GB-RJ    |
| Catalyst IOS 12.2<37>SG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |                                       |                   |
| <pre>-- Configurations generated by the AutoQoS -- on the switch port  qos qos dbl qos map dscp 24 25 26 27 28 29 30 31 to tx-queue 4 qos map dscp 32 33 34 35 36 37 38 39 to tx-queue 4 qos map cos 3 to dscp 26 qos map cos 5 to dscp 46  policy-map AutoQoS-voip-policy class class-default   dbl  interface GigabitEthernet2/1 description -- to cisco 3825 -- switchport access vlan 4 qos trust cos auto qos voip trust tx-queue 3   priority high   shape percent 33 service-policy output AutoQoS-voip-policy ! interface FastEthernet3/9 description -- to CLAN -- switchport access vlan 192 qos trust cos auto qos voip trust tx-queue 3</pre> |       |                                       |                   |

```

    priority high
    shape percent 33
    service-policy output AutoQoS-voip-policy
    !
interface FastEthernet3/10
    description -- to Medpro --
    switchport access vlan 192
    qos trust cos
    auto qos voip trust
    tx-queue 3
    priority high
    shape percent 33
    service-policy output AutoQoS-voip-policy
    !

interface FastEthernet3/11
    description -- to IP telephone 50003 --
    switchport trunk encapsulation dot1q
    switchport trunk allowed vlan 192
    switchport mode trunk
    qos trust cos
    auto qos voip trust
    tx-queue 3
    priority high
    shape percent 33
    no cdp enable
    service-policy output AutoQoS-voip-policy

```

**-- AutoQoS generated configurations for Catalyst 3750**

| <b>Catalyst 3750</b>                                                                                                                                                                                                                                                                                                                                     |              |                     |                    |                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------|--------------------|-------------------|
| <b>Switch</b>                                                                                                                                                                                                                                                                                                                                            | <b>Ports</b> | <b>Model</b>        | <b>SW Version</b>  | <b>SW Image</b>   |
| -----                                                                                                                                                                                                                                                                                                                                                    | -----        | -----               | -----              | -----             |
| <b>* 1</b>                                                                                                                                                                                                                                                                                                                                               | <b>26</b>    | <b>WS-C3750-24P</b> | <b>12.2(25)SEA</b> | <b>C3750-I5-M</b> |
| <p>-- Configurations generated by the AutoQoS on the switch interface</p> <pre> mls qos map cos-dscp 0 8 16 26 32 46 48 56 mls qos srr-queue input bandwidth 90 10 mls qos srr-queue input threshold 1 8 16 mls qos srr-queue input threshold 2 34 66 mls qos srr-queue input buffers 67 33 mls qos srr-queue input cos-map queue 1 threshold 2 1 </pre> |              |                     |                    |                   |

```

mls qos srr-queue input cos-map queue 1 threshold 3 0
mls qos srr-queue input cos-map queue 2 threshold 1 2
mls qos srr-queue input cos-map queue 2 threshold 2 4 6 7
mls qos srr-queue input cos-map queue 2 threshold 3 3 5
mls qos srr-queue input dscp-map queue 1 threshold 2 9 10 11 12 13 14 15
mls qos srr-queue input dscp-map queue 1 threshold 3 0 1 2 3 4 5 6 7
mls qos srr-queue input dscp-map queue 1 threshold 3 32
mls qos srr-queue input dscp-map queue 2 threshold 1 16 17 18 19 20 21 22 23
mls qos srr-queue input dscp-map queue 2 threshold 2 33 34 35 36 37 38 39 48
mls qos srr-queue input dscp-map queue 2 threshold 2 49 50 51 52 53 54 55 56
mls qos srr-queue input dscp-map queue 2 threshold 2 57 58 59 60 61 62 63
mls qos srr-queue input dscp-map queue 2 threshold 3 24 25 26 27 28 29 30 31
mls qos srr-queue input dscp-map queue 2 threshold 3 40 41 42 43 44 45 46 47
mls qos srr-queue output cos-map queue 1 threshold 3 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 4
mls qos srr-queue output cos-map queue 4 threshold 2 1
mls qos srr-queue output cos-map queue 4 threshold 3 0
mls qos srr-queue output dscp-map queue 1 threshold 3 40 41 42 43 44 45 46 47
mls qos srr-queue output dscp-map queue 2 threshold 3 24 25 26 27 28 29 30 31
mls qos srr-queue output dscp-map queue 2 threshold 3 48 49 50 51 52 53 54 55
mls qos srr-queue output dscp-map queue 2 threshold 3 56 57 58 59 60 61 62 63
mls qos srr-queue output dscp-map queue 3 threshold 3 16 17 18 19 20 21 22 23
mls qos srr-queue output dscp-map queue 3 threshold 3 32 33 34 35 36 37 38 39
mls qos srr-queue output dscp-map queue 4 threshold 1 8
mls qos srr-queue output dscp-map queue 4 threshold 2 9 10 11 12 13 14 15
mls qos srr-queue output dscp-map queue 4 threshold 3 0 1 2 3 4 5 6 7
mls qos queue-set output 1 threshold 1 138 138 92 138
mls qos queue-set output 1 threshold 2 138 138 92 400
mls qos queue-set output 1 threshold 3 36 77 100 318
mls qos queue-set output 1 threshold 4 20 50 67 400
mls qos queue-set output 2 threshold 1 149 149 100 149
mls qos queue-set output 2 threshold 2 118 118 100 235
mls qos queue-set output 2 threshold 3 41 68 100 272
mls qos queue-set output 2 threshold 4 42 72 100 242
mls qos queue-set output 1 buffers 10 10 26 54
mls qos queue-set output 2 buffers 16 6 17 61
mls qos

interface FastEthernet1/0/1
description – to cisco 2811 --
no switchport
ip address 115.1.1.2 255.255.255.0
srr-queue bandwidth share 10 10 60 20
srr-queue bandwidth shape 10 0 0 0

```

```

mls qos trust dscp
auto qos voip trust

interface FastEthernet1/0/2
description – to Avaya IP telephone --
switchport trunk encapsulation dot1q
switchport trunk allowed vlan 192
switchport mode trunk
switchport voice vlan 192
srr-queue bandwidth share 10 10 60 20
srr-queue bandwidth shape 10 0 0 0
mls qos trust cos
auto qos voip trust
spanning-tree portfast

```

### **-- AutoQoS complete configurations for the Cisco 3825 and 2811 Routers**

Since the Cisco 2811 router generates the same configurations as the Cisco 3825 router does, the table below is only for the Avaya IP Telephones and Avaya Server platforms running Avaya Communication Manager software.

|                                                  |                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Interface                                        | T1 (Fractional T1 720kb) with PPP encapsulation                                                                                                                                                                                                                                                                             |
| IOS                                              | IOS 12.4(8)b                                                                                                                                                                                                                                                                                                                |
| Global configuration                             | <b>ip cef</b>                                                                                                                                                                                                                                                                                                               |
| Route interface level configuration              | <b>bandwidth 720</b><br><b>auto qos voip trust</b>                                                                                                                                                                                                                                                                          |
| Topology                                         | <b>Point-to-point ppp (720 kb)</b>                                                                                                                                                                                                                                                                                          |
| Configurations generated by the Auto qos command | class-map match-any AutoQoS-Voice-Trust<br>match ip dscp ef<br>class-map match-any AutoQoS-VoIP-RTP-Trust<br>match ip dscp ef<br>class-map match-any AutoQoS-VoIP-Control-Trust<br>match ip dscp cs3<br>match ip dscp af31<br>!<br>policy-map AutoQoS-Policy-Fa2/0-Trust<br>class AutoQoS-Voice-Trust<br>priority percent 1 |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <pre> class class-default   fair-queue policy-map AutoQoS-Policy-Trust class AutoQoS-VoIP-RTP-Trust   priority percent 70 class AutoQoS-VoIP-Control-Trust   bandwidth percent 5 class class-default   fair-queue ! interface Serial0/0/0   bandwidth 720   no ip address   encapsulation ppp   auto qos voip trust   no fair-queue   ppp multilink   ppp multilink group 2001100115 ! interface Multilink2001100115   bandwidth 720   ip address 16.1.1.2 255.255.255.0   ip tcp header-compression iphc-format   ppp multilink   ppp multilink interleave   ppp multilink group 2001100115   ppp multilink fragment delay 10   service-policy output AutoQoS-Policy-Trust   ip rtp header-compression iphc-format  interface FastEthernet2/0 description – to Catalyst 4503 -- ip address 14.1.1.1 255.255.255.0 duplex auto speed auto auto qos auto discovery qos trust service-policy output AutoQoS-Policy-Fa2/0-Trust ! </pre> |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Topology Interface                    | Frame Relay (720kb pvc)<br>Fast Series                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Results generated by Auto qos command | <pre> class-map match-any AutoQoS-Voice-Trust match ip dscp ef class-map match-any AutoQoS-VoIP-RTP-Trust match ip dscp ef class-map match-any AutoQoS-VoIP-Control-Trust match ip dscp cs3 match ip dscp af31 ! policy-map AutoQoS-Policy-Fa2/0-Trust class AutoQoS-Voice-Trust priority percent 1 class class-default fair-queue policy-map AutoQoS-Policy-Trust class AutoQoS-VoIP-RTP-Trust priority percent 70 class AutoQoS-VoIP-Control-Trust bandwidth percent 5 class class-default fair-queue ! interface Serial0/0/0 no ip address encapsulation frame-relay frame-relay traffic-shaping ! interface Serial0/0/0.1 point-to-point bandwidth 720 ip address 16.1.1.2 255.255.255.0 frame-relay interface-dlci 115 class AutoQoS-FR-Se0/0/0-115 auto qos voip trust frame-relay ip rtp header-compression ! map-class frame-relay AutoQoS-FR-Se0/0/0-115 frame-relay cir 720000 frame-relay bc 7200 frame-relay be 0 frame-relay mincir 720000 frame-relay fragment 900 service-policy output AutoQoS-Policy-Trust ! </pre> |

**Note:** RTP header-compression and packet fragmentation have been added on low-speed link for fractional T1 PPP and Frame Relay interfaces automatically. A PPP Multilink Virtual Interface has been created for both low-speed T1 interfaces.

## Appendix C

### Default QoS Configuration and CoS/DSCP Mappings for the Catalyst 4503 and 3750 Switches

#### *Catalyst 4500*<sup>3</sup>

| Feature                                       | Default Value                                                                                                                                                             |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Global QoS configuration                      | Disabled                                                                                                                                                                  |
| Interface QoS configuration (port based)      | Enabled when QoS is globally enabled                                                                                                                                      |
| Interface CoS value                           | 0                                                                                                                                                                         |
| Interface DSCP value                          | 0                                                                                                                                                                         |
| CoS to DSCP map (DSCP set from CoS values)    | CoS 0 = DSCP 0<br>CoS 1 = DSCP 8<br>CoS 2 = DSCP 16<br>CoS 3 = DSCP 24<br>CoS 4 = DSCP 32<br>CoS 5 = DSCP 40<br>CoS 6 = DSCP 48<br>CoS 7 = DSCP 56                        |
| DSCP to CoS map (CoS set from DSCP values)    | DSCP 0-7 = CoS 0<br>DSCP 8-15 = CoS 1<br>DSCP 16-23 = CoS 2<br>DSCP 24-31 = CoS 3<br>DSCP 32-39 = CoS 4<br>DSCP 40-47 = CoS 5<br>DSCP 48-55 = CoS 6<br>DSCP 56-63 = CoS 7 |
| Marked-down DSCP from DSCP map (Policed-DSCP) | Marked-down DSCP value equals original DSCP value (no markdown)                                                                                                           |
| Policers                                      | None                                                                                                                                                                      |
| Policy maps                                   | None                                                                                                                                                                      |
| Transmit queue sharing                        | 1/4 of the link bandwidth                                                                                                                                                 |
| Transmit queue size                           | 1/4 of the transmit queue entries for the port. The transmit queue size of a port depends on the type of port,                                                            |

<sup>3</sup> Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide, 12.2(25)SG

|                              |                                                                                                                                               |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|                              | ranging from 240 packets per transmit queue to 1920 packets per transmit queue.                                                               |
| Transmit queue shaping       | None                                                                                                                                          |
| DCSP-to-Transmit queue map   | DSCP 0-15 Queue 1<br>DSCP 16-31 Queue 2<br>DSCP 32-47 Queue 3<br>DSCP 48-63 Queue 4                                                           |
| High priority transmit queue | Disabled                                                                                                                                      |
| With QoS disabled            |                                                                                                                                               |
| Interface trust state        | Trust DSCP                                                                                                                                    |
| With QoS enabled             | With QoS enabled and all other QoS parameters at default values, QoS sets IP DSCP to zero and Layer 2 CoS to zero in all traffic transmitted. |
| Interface trust state        | Untrusted                                                                                                                                     |

## Catalyst 3750<sup>4</sup>

### Traffic Types, Packet Labels, and Queues

|                          | <b>VoIP<sup>1</sup><br/>Data<br/>Traffic</b> | <b>VoIP<br/>Control<br/>Traffic</b> | <b>Routing<br/>Protocol<br/>Traffic</b> | <b>STP<br/>BPDU<br/>Traffic</b> | <b>Real-<br/>Time<br/>Video<br/>Traffic</b> | <b>All Other Traffic</b>      |
|--------------------------|----------------------------------------------|-------------------------------------|-----------------------------------------|---------------------------------|---------------------------------------------|-------------------------------|
| DSCP                     | 46                                           | 24, 26                              | 48                                      | 56                              | 34                                          | -                             |
| CoS                      | 5                                            | 3                                   | 6                                       | 7                               | 4                                           | -                             |
| CoS-to-Ingress Queue Map | 2, 3, 4, 5, 6, 7 (queue 2)                   |                                     |                                         |                                 |                                             | 0, 1 (queue 1)                |
| CoS-to-Egress Queue Map  | 5 (queue 1)                                  | 3, 6, 7 (queue 2)                   |                                         |                                 | 4 (queue 3)                                 | 2 (queue 3)<br>0, 1 (queue 4) |

<sup>1</sup> VoIP = voice over IP

<sup>4</sup> Catalyst 3750 Switch Software Configuration Guide, 12.2(37)SE

[Table 34-3](#) shows the generated AutoQoS configuration for the ingress queues.

| Table 34-3 AutoQoS Configuration for the Ingress Queues |              |                  |                          |                     |
|---------------------------------------------------------|--------------|------------------|--------------------------|---------------------|
| Ingress Queue                                           | Queue Number | CoS-to-Queue Map | Queue Weight (Bandwidth) | Queue (Buffer) Size |
| SRR shared                                              | 1            | 0, 1             | 81 percent               | 67 percent          |
| Priority                                                | 2            | 2, 3, 4, 5, 6, 7 | 19 percent               | 33 percent          |

[Table 34-4](#) shows the generated AutoQoS configuration for the egress queues.

| Table 34-4 AutoQoS Configuration for the Egress Queues |              |                  |                          |                                               |                                               |
|--------------------------------------------------------|--------------|------------------|--------------------------|-----------------------------------------------|-----------------------------------------------|
| Egress Queue                                           | Queue Number | CoS-to-Queue Map | Queue Weight (Bandwidth) | Queue (Buffer) Size for Gigabit-Capable Ports | Queue (Buffer) Size for 10/100 Ethernet Ports |
| Priority (shaped)                                      | 1            | 5                | 10 percent               | 16 percent                                    | 10 percent                                    |
| SRR shared                                             | 2            | 3, 6, 7          | 10 percent               | 6 percent                                     | 10 percent                                    |
| SRR shared                                             | 3            | 2, 4             | 60 percent               | 17 percent                                    | 26 percent                                    |
| SRR shared                                             | 4            | 0, 1             | 20 percent               | 61 percent                                    | 54 percent                                    |

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