

1 Introduction

A network region is a group of IP endpoints that share common characteristics and resources. Every IP endpoint on an Avaya Communication Manager system belongs to a network region. By default all IP endpoints are in network region 1, and if left as such they would all share the same characteristics defined by network region 1, and use the same resources. But in many cases this is not sufficient, and multiple network regions should be configured. The most common of these cases are as follows:

- One group of endpoints requires a different codec set than another group. This could be based on requirements related to bandwidth or encryption.
- Calls between separate groups of endpoints require a different codec set than calls within a single group of endpoints, again based on requirements related to bandwidth or encryption.
- Specific C-LAN or MedPro or other resources must be accessible to only a specific group of endpoints.
- One group of endpoints requires a different UDP port range or QoS parameters than another group.
- One group of endpoints reports to a different VoIP Monitoring Manager server than another group.

As many of these concepts are best understood in context, this document provides two detailed configuration examples that apply these principles.

Somewhat related to network regions is the concept of locations. Communication Manager uses this concept to identify distinct geographic locations, primarily for call routing purposes. Port networks are assigned to a location on the **cabinet** form. Media gateways are assigned to a location on the **media-gateway** form. A traditional station attached to a port network inherits the location of the port network. A traditional station attached to a media gateway inherits the location of the media gateway. An IP station is not physically attached to a port network or media gateway, so it is assigned to a location based on its network region, as specified on the **ip-network-region** form.

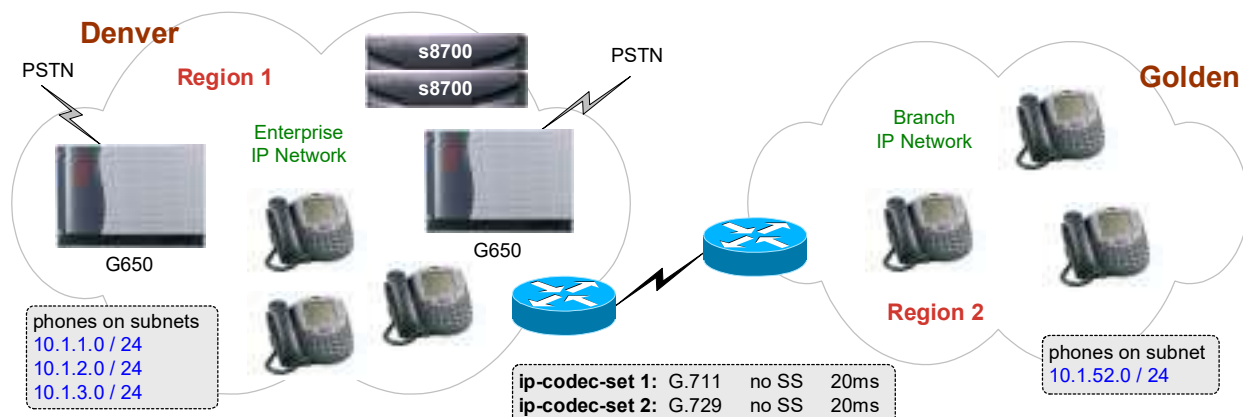
A location is associated with geography, whereas a network region is associated with network topology. It is possible that within a single location there could be multiple network regions. For example, within a single corporate campus, which would be one location, there could be multiple network regions – one for each building, or perhaps even one for each floor of a building. However, the opposite would rarely be true. There would hardly ever be one network region that spans multiple locations.

In most cases the location identifier on the **cabinet** or **media-gateway** form should match what is on the **ip-network-region** form. In other words, if network region 5 is configured as being in location 5 on the **ip-network-region** form, a port network or gateway administered for network region 5 should also be administered for location 5 on the **cabinet** or **media-gateway** form, in most cases.

The most significant use of the location concept is for E911 calls. If a station in location 5 dials 911, it must be routed out a trunk in location 5 so that local public safety services, and not public safety services in a different city, respond to the emergency. A trunk in location 5 is attached to a port network or media gateway in location 5. There are other applications of the location concept, but in general it is used to route calls to the proper PSTN trunks.

The fundamental configuration steps are shown in two configuration examples: **Basic** and **Basic Plus Media Gateway and LSP**. These configuration examples, along with the rules and feature descriptions that follow them, should give the administrator a substantial toolset to design a network region architecture that meets the specific enterprise requirements.

2 Basic Configuration



The figure above shows two sites: the main enterprise in Denver CO, and a branch office in Golden CO. All the call server and media resources are located in Denver, while the Golden branch has only stations. The configuration steps are as follows.

2.1 Configure CODEC Sets

Create codec set for LAN audio. Most common and recommended shown.				
change ip-codec-set 1			Page	1 of 2
IP Codec Set				
Codec Set: 1				
Audio	Silence	Frames	Packet	
Codec	Suppression	Per Pkt	Size(ms)	
1: G.711MU	n	2	20	
2:				

Create compressed codec set for WAN audio. Most common and recommended shown.				
change ip-codec-set 2			Page	1 of 2
IP Codec Set				
Codec Set: 2				
Audio	Silence	Frames	Packet	
Codec	Suppression	Per Pkt	Size(ms)	
1: G.729	n	2	20	
2:				

In the two **Basic** examples covered in this document, bandwidth is the primary factor in configuring codec sets. However, encryption could also be a factor, especially for calls to remote sites where public service provider facilities are used to transport the audio and no other form of encryption is used across the public link.

2.2 Configure Network Regions

Create network region for Denver.	
change ip-network-region 1	Page 1 of 19
IP NETWORK REGION	
Region: 1	
Location: 1	Authoritative Domain:
Name: Denver	
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: 2175	
DIFFSERV/TOS PARAMETERS	RTCP Reporting Enabled? y
Call Control PHB Value: 46	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: 6	
Audio 802.1p Priority: 6	
Video 802.1p Priority: 5	AUDIO RESOURCE RESERVATION PARAMETERS
H.323 IP ENDPOINTS	RSVP Enabled? n
H.323 Link Bounce Recovery? y	
Idle Traffic Interval (sec): 20	
Keep-Alive Interval (sec): 5	
Keep-Alive Count: 5	

- This configuration assumes Location 1 has already been configured (using the **locations** form) and designated as the location code for Denver.
- The enterprise network in Denver consists entirely of 10/100/1000 switched Ethernet, and therefore network region 1 uses codec set 1 (the LAN codec set).
- The MedPro boards and VoIP media modules in this network region use the UDP port range 2048-2175 for RTP audio and RTCP control.
- The DiffServ and 802.1p priority values for signaling and audio are applied to various server/gateway components (ie, C-LANs, MedPros, VoIP modules) and stations in network region 1. Although it is possible to use different priority values for signaling and audio, this implementation uses the same L2 value and same L3 value for both. The appropriate Ethernet switches and routers are configured to give priority to these values.
- By default calls within network region 1, and calls from network region 1 to other network regions, are allowed to go direct IP-IP (shuffled).
- By default RTCP reporting to the VoIP Monitoring Manager is enabled. The default server parameters are configured on the **system-parameters ip-options** form. If endpoints in this network region were to report to a server other than the default, entering 'n' after Use Default Server Parameters? would reveal additional parameters to configure.
- H.323 Link Bounce Recovery administration is covered separately in section 5.

Create network region for Golden.	
change ip-network-region 2	Page 1 of 19
IP NETWORK REGION	
Region: 2	
Location: 1	Authoritative Domain:
Name: Golden	
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: 2175	
DIFFSERV/TOS PARAMETERS	RTCP Reporting Enabled? y
Call Control PHB Value: 46	RTCP MONITOR SERVER PARAMETERS

Audio PHB Value: 46 Video PHB Value: 26 802.1P/Q PARAMETERS Call Control 802.1p Priority: 6 Audio 802.1p Priority: 6 Video 802.1p Priority: 5 H.323 IP ENDPOINTS H.323 Link Bounce Recovery? y Idle Traffic Interval (sec): 20 Keep-Alive Interval (sec): 5 Keep-Alive Count: 5	Use Default Server Parameters? y AUDIO RESOURCE RESERVATION PARAMETERS RSVP Enabled? n
<ul style="list-style-type: none"> - Golden uses location code 1 in this case, same as Denver, for simplicity. One reason for this is that because there are no local PSTN trunks at the Golden office, a separate location code would serve little purpose. Another reason is that Golden and Denver have the same area codes, so it is acceptable to have calls from Golden access the Denver PSTN trunks for external calls. Furthermore, 911 calls originating from Golden are forwarded to a Public Safety Answer Point (PSAP) in Denver, which may or may not be an issue depending on inter-city arrangements for public safety services. - The Golden branch network consists of 10/100 switched Ethernet. <u>Assuming all the media resources (MedPros) in Denver are assigned to network region 1</u> (more common case), network region 2 uses codec set 1 (LAN codec set). This is because calls within region 2 stay in the Golden branch network and do not traverse the WAN link. When a station in region 2 accesses a MedPro in region 1, this inter-region connectivity is configured to use codec set 2 (WAN codec set), as shown below. - <u>If there were a MedPro in Denver assigned to network region 2</u> (less common case), all of network region 2 would have to use codec set 2 to support the cases where a region-2 station and a region-2 MedPro would exchange audio across the WAN link. - In this case there is no reason to have network region 2 use different UDP ports or QoS values than network region 1. - There is also no reason to prevent direct IP-IP calls within or between regions. - The Golden office is not large enough to report to a different VoIP Monitoring Manager server. 	

Configure Denver and Golden network regions to use WAN codec set for calls between regions.							
change ip-network-region 1				Page 3 of 19			
Inter Network Region Connection Management							
src	dst	codec	direct	Dynamic CAC			
rgn	rgn	set	WAN	WAN-BW-limits	Intervening-regions	Gateway	IGAR
1	1	1					
1	2	2	y	:NoLimit			n
<div><div>-</div>When endpoints in source network region 1 talk to endpoints in destination region 1, use codec set 1.</div> <div><div>-</div>When endpoints in source network region 1 talk to endpoints in destination region 2, use codec set 2.</div>							

Region1-to-region2 connectivity configured on network region 1 carries over to network region 2.								
display ip-network-region 2				Page 3 of 19				
Inter Network Region Connection Management								
src	dst	codec	direct	Dynamic CAC				
rgn	rgn	set	WAN	WAN-BW-limits	Intervening-regions	Gateway	IGAR	
2	1	2	y	:NoLimit			n	
2	2	1						

2.3 Assign Endpoints to Network Regions

Create node names for C-LAN and MedPro boards.

```
change node-names ip
```

Name	IP Address	IP NODE NAMES
clan1	10 .1 .1 .201	
medpro1	10 .1 .1 .202	
clan2	10 .1 .2 .201	
medpro2	10 .1 .2 .202	

Assign C-LAN and MedPro boards to network region 1.

```
list ip-interface all
```

Page 1

ON	Type	Slot	Code	Sfx	Node Name/ IP-Address	Subnet Mask	Gateway Address	Net Rgn	VLAN
y	C-LAN	01A04	TN799	D	clan1 10.1.1.201	255.255.255.0	10 .1 .1 .254	1	n
y	MEDPRO	01A10	TN2302		medpro1 10.1.1.202	255.255.255.0	10 .1 .1 .254	1	n
y	C-LAN	02A04	TN799	D	clan2 10.1.2.201	255.255.255.0	10 .1 .2 .254	1	n
y	MEDPRO	02A10	TN2302		medpro2 10.1.2.202	255.255.255.0	10 .1 .2 .254	1	n
n						255.255.255.0	.	.	n

- Configurations are made using the **change ip-interface <slot#>** command. This screen capture shows the **list** command output.
- All C-LANs and MedPros are in network region 1. Because network region 1 and network region 2 are connected, per the two tables above, the stations in region 2 can access the MedPros in region 1.
- If the two network regions were not connected, the region-2 stations would not be able to access the region-1 MedPros, and would require MedPro/VoIP resources in their own region.

Assign IP phones to the proper network regions.

```
change ip-network-map
```

Page 1 of 32

From IP Address	(To IP Address	Subnet or Mask)	Region	VLAN	Emergency Location Extension
10 .1 .1 .1	10 .1 .1 .254		1	n	
10 .1 .2 .1	10 .1 .2 .254		1	n	
10 .1 .3 .1	10 .1 .3 .254		1	n	
10 .1 .52 .1	10 .1 .52 .254		2	n	
.	.	.		n	

- As part of the registration process, IP phones assigned to a network region using this form receive the addresses of all gatekeepers (ie, C-LANs and S8300s) in their own network region, plus all direct-WAN connected regions. This constitutes the **Alternate Gatekeeper List**.
- IP phones in network region 1 receive the addresses of both region-1 C-LANs.
- IP phones in network region 2 also receive the addresses of both region-1 C-LANs, because region 2 is direct-WAN connected to region 1.
- An IP phone not assigned to a network region using this form inherits the network region of the

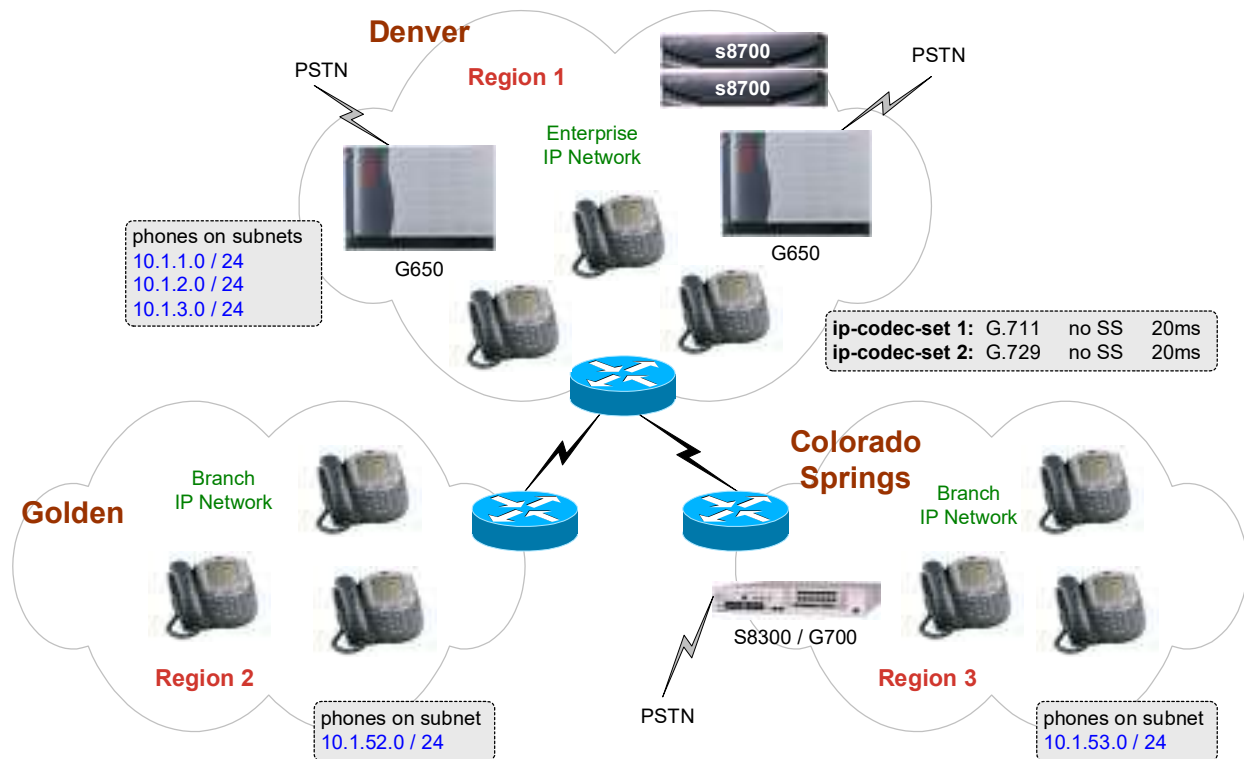
gatekeeper to which it registers, and only receives a list of gatekeepers in that network region (not connected regions).

- An IP phone assigned to a network region using this form, but that has no gatekeeper in its region or any connected region, can still register with a C-LAN in some other region, but it receives no Alternate Gatekeeper List – it is limited to that one C-LAN. **This is a very rare scenario and should only occur under unanticipated failure conditions.**

2.4 Configure H.323 Link Bounce Recovery for Each Region

See section 5.

3 Basic Plus Media Gateway and LSP



The figure above shows the previous Basic configuration with the Colorado Springs CO branch added. There are two primary differences between the Colorado Springs branch and the Golden branch. First, the Colorado Springs branch is in a different area code, which is one reason why the Avaya G700 Media Gateway is there – to terminate local PSTN trunks. And second, the Colorado Springs branch is a larger branch with more critical functions, which is one reason why the Avaya S8300 Local Survivable Processor (LSP) is there – to provide survivability if the connection to Denver is lost.

Although the Golden branch is shown without the G700 and S8300 LSP, they could be deployed there. The requirements for local PSTN access and survivability determine whether or not a gateway and LSP are needed. In this hypothetical example, the Golden branch can get by using the Denver PSTN trunks, so it does not have a G700. The Golden branch also does not require survivability, perhaps because the WAN link from Golden to Denver is extremely reliable, or because redundancy is built into the WAN link, or simply because the Golden branch functions are not critical enough to warrant the expense.

The additional configuration steps are as follows.

3.1 Configure Network Regions

Create network region for Colorado Springs.	
change ip-network-region 3	Page 1 of 19
IP NETWORK REGION	
Region: 3	
Location: 3	Authoritative Domain:
Name: Colorado Springs	
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: 2175	
DIFFSERV/TOS PARAMETERS	RTCP Reporting Enabled? y
Call Control PHB Value: 46	RTCP MONITOR SERVER PARAMETERS
Audio PHB Value: 46	Use Default Server Parameters? n
Video PHB Value: 26	Server IP Address: 10 .1 .53 .200
802.1P/Q PARAMETERS	Server Port: 5005
Call Control 802.1p Priority: 6	RTCP Report Period(secs): 5
Audio 802.1p Priority: 6	
Video 802.1p Priority: 5	AUDIO RESOURCE RESERVATION PARAMETERS
H.323 IP ENDPOINTS	RSVP Enabled? n
H.323 Link Bounce Recovery? y	
Idle Traffic Interval (sec): 20	
Keep-Alive Interval (sec): 5	
Keep-Alive Count: 5	

- This configuration assumes Location 3 has already been configured (using the **locations** form) and designated as the location code for Colorado Springs. Using this code, local calls from the Colorado Springs branch can be routed to the local PSTN trunk(s). Also, 911 calls from the Colorado Springs branch can be sent to a local PSAP.
- The distinct location code also allows for advanced call routing. For example, calls from Denver users to external Colorado Springs customers can be routed internally to Colorado Springs and out a PSTN trunk at that branch, thus bypassing the toll.
- The Colorado Springs branch network consists of 10/100 switched Ethernet, so codec set 1 is used in network region 3. Colorado Springs also has local media resources (VoIP modules in G700 gateway), so there is no need to traverse the WAN link to access a MedPro board.
- There is no reason to have network region 3 use different UDP ports or QoS values than network regions 1 and 2.
- There is also no reason to prevent direct IP-IP calls within or between regions.
- The Colorado Springs office is large enough to report to a different VoIP Monitoring Manager server, which is located in Colorado Springs.

Configure inter-region connectivity between Colorado Springs and other regions.	
change ip-network-region 3	Page 3 of 19
Inter Network Region Connection Management	
src dst	codec direct
rgn rgn	set WAN WAN-BW-limits Intervening-regions Dynamic CAC Gateway IGAR
3 1	2 y :NoLimit n
3 2	2 n 1 n
3 3	1

- When endpoints in source network region 3 talk to endpoints in destination region 1, use codec set 2.
- When endpoints in source network region 3 talk to endpoints in destination region 2, use codec set 2, and go through region 1 as an intervening region.
- When endpoints in source network region 3 talk to endpoints in destination region 3, use codec set 1.

3.2 Assign Endpoints to Network Regions

Add Colorado Springs IP phones to the **ip-network-map** form.

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
10 .1 .1 .1	10 .1 .1 .254		1	n	
10 .1 .2 .1	10 .1 .2 .254		1	n	
10 .1 .3 .1	10 .1 .3 .254		1	n	
10 .1 .52 .1	10 .1 .52 .254		2	n	
10 .1 .53 .1	10 .1 .53 .254		3	n	
.	.	.		n	

- Because network region 3 is direct-WAN connected to network region 1, IP phones in region 3 receive an Alternate Gatekeeper List with the addresses of both region-1 C-LANs.
- When LSPs are present, IP phones also receive in the Alternate Gatekeeper List the addresses of all LSPs in their own network region (not connected regions). Therefore, IP phones in region 3 receive the address of the LSP in region 3. LSP configuration is shown below.

3.3 Configure LSP

Create node name for Colorado Springs LSP.

change node-names ip

IP NODE NAMES

Name	IP Address
clan1	10 .1 .1 .201
medpro1	10 .1 .1 .202
clan2	10 .1 .2 .201
medpro2	10 .1 .2 .202
colospgs-lsp	10 .1 .53 .220

Create LSP entry for Colorado Springs.

change lsp Page 1 of 16

LOCAL SURVIVABLE PROCESSOR				
Number	Name	IP Address	Service State?	Translations Updated
1	colospgs-lsp	10 .1 .53 .220	in-service/idle	0:30 8/25/2005
2		.	out-of-service	

Enter the node name, and the IP address automatically populates. Service State? indicates whether or not the LSP is registered. Translations Updated is the last time the Communication Manager translations were sent to the LSP. After entering the LSP node name(s), execute **save translation lsp**. This downloads the Communication Manager translation file to all LSPs.

Add Colorado Springs LSP to its network region.

change ip-network-region 3 Page 2 of 19

IP NETWORK REGION

INTER-GATEWAY ALTERNATE ROUTING

Incoming LDN Extension:

Conversion To Full Public Number - Delete: Insert:

Maximum Number of Trunks to Use:

LSP NAMES IN PRIORITY ORDER

1 **colospgs-lsp**
2

3.4 Configure Avaya G700 Media Gateway

Add media gateway for Colorado Springs.

```
add media-gateway 1
                                MEDIA GATEWAY
      Number: 1                  IP Address:
      Type: g700                 FW Version/HW Vintage:
      Name: colospgs-mg          MAC Address:
      Serial No: <serial #>      Encrypt Link? y
      Network Region: 3          Location: 3
      Registered? n              Controller IP Address:
      Recovery Rule: 1           Site Data: Colorado Springs
      Slot   Module Type        Name
      V1:
      V2:
      V3:
      V4:

      V8:
      V9:
```

- Select the media gateway type (g700), give the media gateway a name (no **node-names ip** entry required), and specify the media gateway's serial number, network region, and location. The serial # is shown in the output of **show system** from the G700 mgp CLI. In almost all cases, the gateway's location code is the same as the network region's location code.
- This media gateway is in network region 3 and location 3, which are the region and location for Colorado Springs. Local calls from the Colorado Springs branch can be routed through the PSTN trunk(s) on this media gateway.
- All other fields automatically populate when the media gateway registers, except for Recovery Rule, which is part of H.248 Link Bounce Recovery and is covered in section 5.4.
- The Controller IP Address belongs to the C-LAN or LSP to which the gateway is currently registered.

Configure media gateway controller (MGC) list on G700.

```
MG-001-1(configure)# set mgc list 10.1.1.201, 10.1.2.201, 10.1.53.220
```

```
MG-001-1(configure)# show mgc list (to verify mgc list)
```

```
CONFIGURED MGC HOST
```

```
-----
```

```
10.1.1.201
10.1.2.201
10.1.53.220
-- Not Available --
```

```
MG-001-1(configure)# set mgp reset-times transition-point 2
```

Entries in the MGC list up to the transition point are primary controllers. Entries after the transition point are LSPs. In this case there are two primary controllers and one LSP.

Configure QoS parameters on G700.

MG-001-1 (configure)# **set qos control remote**
This command causes the media gateway to download all the QoS parameters from the call server's **ip-network-region** form for this gateway's region.

MG-001-1 (configure)# **show qos-rtcp** (to verify QoS parameters)

PARAMETERS IN EFFECT: -- Downloaded --

QOS PARAMETERS	LOCALLY SET	DOWNLOADED
-----	-----	-----
Signal 802 Priority:	7	6
Signal DSCP :	34	46
Bearer 802 Priority:	6	6
Bearer BBE DSCP :	43	43
Bearer EF DSCP :	46	46
Minimum RTP Port :	2048	2048
Maximum RTP Port :	65535	3028
RSVP PARAMETERS	LOCALLY SET	DOWNLOADED
-----	-----	-----
State :	Enabled	Disabled
Retry on Failure :	Yes	Yes
Retry Delay(secs) :	15	15
Service Profile :	Guaranteed	Guaranteed
RTCP MON PARAMETERS	LOCALLY SET	DOWNLOADED
-----	-----	-----
State :	Enabled	Enabled
IP Address :	0.0.0.0	10.1.53.200
Listening Port :	5005	5005
Report Period(secs):	5	5

Note that the downloaded values match the values in the **ip-network-region** form for region 3.

3.5 Configure Avaya G350 Media Gateway

Although the Avaya G350 Media Gateway is not a feasible option for this scenario for capacity reasons, the configurations for the G350 are shown for reference.

Add media gateway for Colorado Springs.

add media-gateway 1

```

                                MEDIA GATEWAY
Number: 1                      IP Address:
  Type: g350                   FW Version/HW Vintage:
  Name: colospgs-mg           MAC Address:
  Serial No: <serial #>       Encrypt Link? y
Network Region: 3             Location: 3
Registered? n                 Controller IP Address:
Recovery Rule: none           Site Data: Colorado Springs
Slot  Module Type              Name
V1:
V2:
V3:
V4:
V5:
V6:
V7:
V8:
```

V9:

The primary difference between administering a G700 and a G350 is that the Type field is different. All else is practically the same, and the media gateway's serial # is still obtained via the output of **show system** from the G350 CLI.

Configure media gateway controller (MGC) list on G350.

```
MG-001(super)# set mgc list 10.1.1.201, 10.1.2.201, 10.1.53.220
```

```
MG-001(super)# show mgc list (to verify mgc list)
```

```
CONFIGURED MGC HOST
```

```
-----
```

```
10.1.1.201
```

```
10.1.2.201
```

```
10.1.53.220
```

```
-- Not Available --
```

```
MG-001(super)# set reset-times transition-point 2
```

Entries in the MGC list up to the transition point are primary controllers. Entries after the transition point are LSPs. In this case there are two primary controllers and one LSP.

Configure QoS parameters on G350.

```
MG-001(super)# set qos control remote
```

This command causes the media gateway to download all the QoS parameters from the call server's **ip-network-region** form for this gateway's region.

```
MG-001(super)# show qos-rtcp (to verify QoS parameters)
```

```
PARAMETERS IN EFFECT: -- Downloaded --
```

QOS PARAMETERS	LOCALLY SET	DOWNLOADED
-----	-----	-----
Signal 802 Priority:	7	6
Signal DSCP :	34	46
Bearer 802 Priority:	6	6
Bearer BBE DSCP :	43	43
Bearer EF DSCP :	46	46
Minimum RTP Port :	2048	2048
Maximum RTP Port :	65535	3028
 RSVP PARAMETERS	 LOCALLY SET	 DOWNLOADED
-----	-----	-----
State :	Enabled	Disabled
Retry on Failure :	Yes	Yes
Retry Delay(secs) :	15	15
Service Profile :	Guaranteed	Guaranteed
 RTCP MON PARAMETERS	 LOCALLY SET	 DOWNLOADED
-----	-----	-----
State :	Enabled	Enabled
IP Address :	0.0.0.0	10.1.53.200
Listening Port :	5005	5005
Report Period(secs):	5	5

Note that the downloaded values match the values in the **ip-network-region** form for region 3.