Avaya Communication Manager Network Region Configuration Guide

Communication Manager 2.1 Avaya Labs

ABSTRACT

This application note is a tutorial on Avaya Communication Manager network regions. Two basic configuration examples are covered in detail, along with explanations of the concepts and philosophies that drive each configuration. In addition, this document covers the rules governing network regions, and explains the features related to network regions. The "Avaya IP Telephony Implementation Guide" is a prerequisite for this document, and should be referred to as necessary.

The intent of this document is to provide training on Avaya Communication Manager network regions, and to give guidelines for configuring them.

External posting: www1.avaya.com/enterprise/resourcelibrary/applicationnotes/eclips_general.html.

Application Note

July 2004

COMPAS ID 103244

Table of Contents

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:

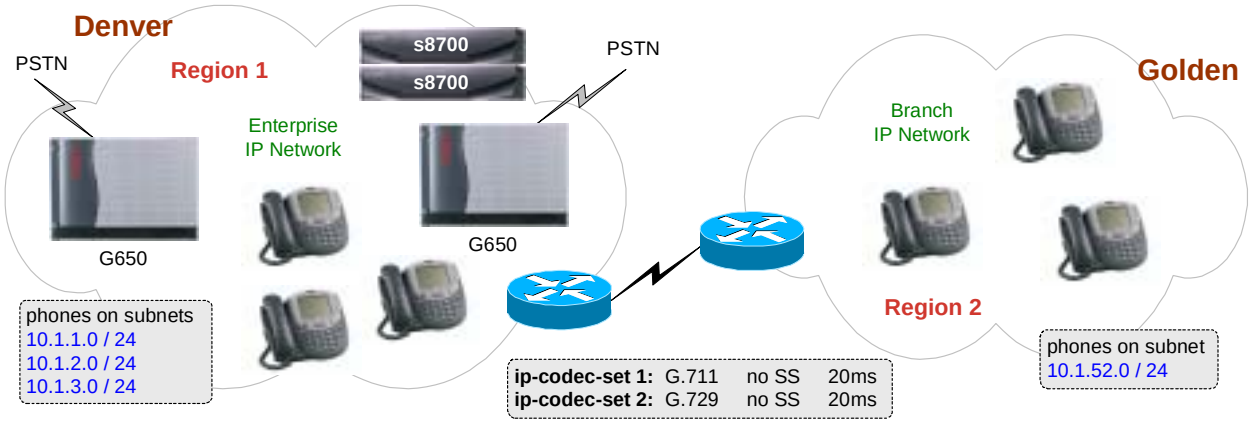
- One group of endpoints requires a different codec set than another group. This could be based on requirements related to bandwidth or encryption.
- Calls between separate groups of endpoints require a different codec set than calls within a single group of endpoints, again based on requirements related 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. The location parameter is used to identify distinct geographic locations, primarily for call routing purposes. In other words, the location parameter is used primarily to insure that calls access the proper PSTN trunks, based on the origin and destination of each call. Call routing in general is beyond the scope of this document, but the examples given here show at a high level how the location parameter is used.

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 gateway 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

                         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

                         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               Home Domain:
    Name: Denver
                               Intra-region IP-IP Direct Audio: yes
AUDIO PARAMETERS               Inter-region IP-IP Direct Audio: yes
   Codec Set: 1                          IP Audio Hairpinning? y
UDP Port Min: 2048
UDP Port Max: 2176                     RTCP Reporting Enabled? y
                              RTCP MONITOR SERVER PARAMETERS
DIFFSERV/TOS PARAMETERS        Use Default Server Parameters? y
 Call Control PHB Value: 46
        Audio PHB Value: 46
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6      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 2048-2176 for audio.
- The DiffServ and 802.1p 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 L2 and L3 priority values for signaling and audio, this implementation uses the same values 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 configuration 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               Home Domain:
    Name: Golden
                               Intra-region IP-IP Direct Audio: yes
AUDIO PARAMETERS               Inter-region IP-IP Direct Audio: yes
   Codec Set: 1                          IP Audio Hairpinning? y
UDP Port Min: 2048
UDP Port Max: 2176                     RTCP Reporting Enabled? y
                              RTCP MONITOR SERVER PARAMETERS
```

```
DIFFSERV/TOS PARAMETERS           Use Default Server Parameters? y
 Call Control PHB Value: 46
        Audio PHB Value: 46
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6      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
```

- 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. Assuming all the media gateway resources (MedPros) in Denver are assigned to network region 1 (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.
- If there were a MedPro in Denver assigned to network region 2 (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
 rgn rgn      codec-set  direct-WAN  WAN-BW-limits  Intervening-regions
 1   1           1
 1   2           2           y             :NoLimit
```

- When endpoints in source network region 1 talk to endpoints in destination region 1, use codec set 1.
- When endpoints in source network region 1 talk to endpoints in destination region 2, use codec set 2.
- The remaining parameters are for call admission control (CAC), which is covered in section 6.

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
 rgn rgn      codec-set  direct-WAN  WAN-BW-limits  Intervening-regions
 2   1           2           y             :NoLimit
 2   2           1
```

2.3 Assign Endpoints to Network Regions

Create node names for C-LAN and MedPro boards.

```
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
```

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

```
list ip-interfaces

                                  IP INTERFACES


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

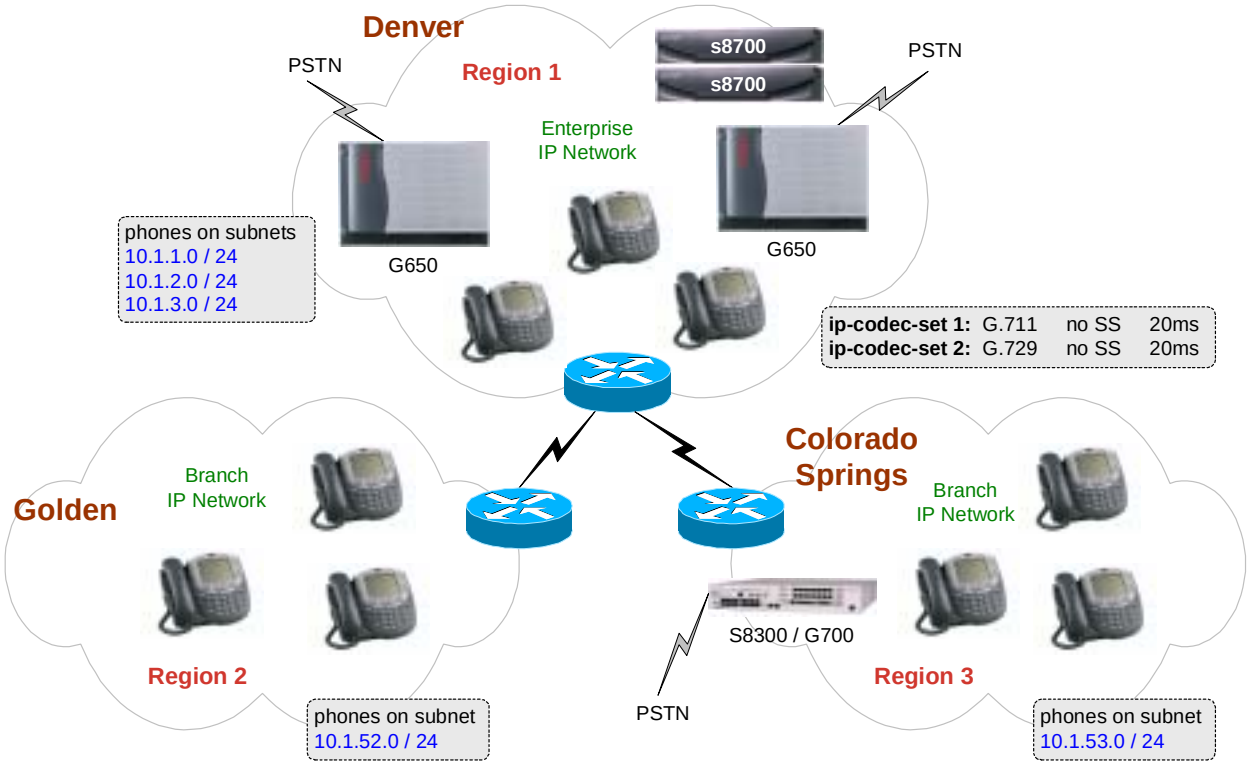
Assign IP phones to the proper network regions.

```
change ip-network-map                                        Page   1 of  32

                        IP ADDRESS MAPPING


                                                                  Emergency
                                      Subnet                      Location
 From IP Address  (To IP Address   or Mask)  Region    VLAN     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 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 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.**

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               Home Domain:
    Name: Colorado Springs
                              Intra-region IP-IP Direct Audio: yes
AUDIO PARAMETERS              Inter-region IP-IP Direct Audio: yes
   Codec Set: 1                         IP Audio Hairpinning? y
UDP Port Min: 2048
UDP Port Max: 2176                     RTCP Reporting Enabled? y
                               RTCP MONITOR SERVER PARAMETERS
DIFFSERV/TOS PARAMETERS         Use Default Server Parameters? n
 Call Control PHB Value: 46                 Server IP Address: 10 .1  .53 .200
        Audio PHB Value: 46                       Server Port: 5005
802.1P/Q PARAMETERS                  RTCP Report Period(secs): 5
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6     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 gateway 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
 rgn rgn      codec-set  direct-WAN  WAN-BW-limits  Intervening-regions
 3   1           2           y             :NoLimit
 3   2           2           n                              1
 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

                                                                 Emergency
                                        Subnet                   Location
 From IP Address  (To IP Address   or Mask)  Region    VLAN    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 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 LSPs

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       Translations
                                              State?         Updated
 1        colospgs-lsp    10 .1  .53 .220 in-service/idle 0:30 1/5/2004
 2                           .   .   .    out-of-service
```

Enter the node name, and the IP address automatically populates. The Service State? and Translations Updated columns change when the LSP is contacted. After entering the LSP node name(s), execute **save translation**. This downloads the translation to the LSP(s).

Add Colorado Springs LSP to its network region.

```
change ip-network-region 3                                     Page   2 of  19
                               IP NETWORK REGION

 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:
                                                 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.
- 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 search timers on G700.

```
MG-001-1(configure)# set mgp reset-times primary-search 5
```

In the event of an outage, such as a WAN outage, this is the number of minutes the media gateway tries to re-connect to one of the primary controllers before going to the LSP. The customer's tolerance to the outage is the key factor in determining the primary search time. 5min is a good minimum. The maximum depends on how long the customer is willing to be without service before going to the LSP.

```
MG-001-1(configure)# set mgp reset-times total-search 30
```

Total number of minutes media gateway tries to contact any controller, including LSPs, before resetting.

```
MG-001-1(configure)# show mgp recovery   (to verify transition point and timer values)

MGP RECOVERY TIMES
-------------------------------
Primary Search  : 5
Total Search    : 30
Transition Point: 2
```

In this scenario, after the media gateway loses contact with its media gateway controller it tries to establish connectivity with one of the two primary controllers (first two entries in the MGC list) for 5 minutes. If after 5 minutes the gateway has not contacted either of the primary controllers, it includes the LSP in its search. The gateway round robin searches for all three controllers for 25 minutes, making the total search time 30 minutes. If after 30 total minutes the gateway has not contacted any controller in its MGC list, it resets itself and starts over.

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:
                                                 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 search timers on G350.

```
MG-001(super)# set reset-times primary-search 5
```

In the event of an outage, such as a WAN outage, this is the number of minutes the media gateway tries to re-connect to one of the primary controllers before going to the LSP. The customer's tolerance to the outage is the key factor in determining the primary search time. 5min is a good minimum. The maximum depends on how long the customer is willing to be without service before going to the LSP.

```
MG-001(super)# set reset-times total-search 30
```

Total number of minutes media gateway tries to contact any controller, including LSPs, before resetting.

```
MG-001(super)# show recovery   (to verify transition point and timer values)

RECOVERY TIMES
--------------------------------
Primary Search  : 5
Total Search    : 30
Transition Point: 2
```

In this scenario, after the media gateway loses contact with its media gateway controller it tries to establish connectivity with one of the two primary controllers (first two entries in the MGC list) for 5 minutes. If after 5 minutes the gateway has not contacted either of the primary controllers, it includes the LSP in its search. The gateway round robin searches for all three controllers for 25 minutes, making the total search time 30 minutes. If after 30 total minutes the gateway has not contacted any controller in its MGC list, it resets itself and starts over.

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.

4 Network Region Rules

The preceding **Basic** configuration examples covered many "rules" for network region configuration. These and other additional rules are summarized here.

Assigning endpoints to network regions
1. IP boards – primarily C-LAN and MedPro boards – are assigned to network regions using the **ip-interface(s)** form. VAL boards can also be assigned to network regions, but there is no present use for it; leave as default region 1. 2. IP phones are explicitly assigned to network regions using the **ip-network-map** form, or, in the absence of this configuration, implicitly inherit the network region of the gatekeeper to which they register. 3. Traditional telephony resources are not assigned to network regions. These include: - Analog and DCP stations - Analog and digital trunks - Non-H.248 gateways, also known as port networks (Avaya MCC1, SCC1, G600, G650 Media Gateways) - Any non-IP resource in general

Allocation of network region resources
1. Any IP phone can register with any C-LAN, but the order is as follows: - If an IP phone is assigned to a network region using the **ip-network-map** form, Avaya Communication Manager (CM) directs that phone to register with a C-LAN in its own network region. As part of the registration process, Avaya CM sends the phone a list of gatekeepers (Alternate Gatekeeper List) with… - All C-LANs in the phone's region. - All C-LANs in all regions connected to the phone's region. - All LSPs in the phone's region. - The Survivable GK Node Name on a per phone basis, as administered on the **station** form. - If an IP phone is <u>not</u> assigned to a network region using the **ip-network-map** form, it inherits the network region of the C-LAN to which it registers. As part of the registration process, Avaya CM sends an Alternate Gatekeeper List with… - All C-LANs only in that network region (not connected regions). - All LSPs in that network region. - The Survivable GK Node Name on a per phone basis, as administered on the **station** form. - If an IP phone is assigned to a network region using the **ip-network-map** form, but there are no available C-LANs in the phone's network region or any connected region, the phone may still register with a different C-LAN in some other network region. However, the Alternate Gatekeeper List is limited to… - Only the specific CLAN that received the registration. - All LSPs in the phone's region. - The Survivable GK Node Name on a per phone basis, as administered on the **station** form. **This is a very rare scenario and should only occur under unanticipated failure conditions.** 2. On a per call basis, an IP phone is allocated audio resources (MedPro and VoIP) from its own network region first, and then from connected regions. IP phones are not allocated audio resources from disjointed network regions.

Intra- and inter-region calls
1. Intra-region calls, and inter-region calls between connected regions: - With direct IP-IP audio enabled, regardless of how audio hairpinning is configured, audio streams go directly from IP phone to IP phone. - With audio hairpinning enabled, but direct IP-IP audio disabled, audio streams go from IP phone to MedPro/VoIP to IP phone. - With both direct IP-IP audio and audio hairpinning disabled, audio streams go from IP phone to MedPro/VoIP to internal TDM bus to MedPro/VoIP to IP phone. 2. Inter-region calls between disjointed regions: - Audio streams go from region-X IP phone to region-X MedPro to internal TDM bus to region-Y MedPro to region-Y IP phone. - Since two H.248 media gateways (G700, G350) can never share a TDM bus, the audio has to go IP between the two gateways. This also holds true for IP-Connect systems where the audio has to go from one G600/650 to another G600/650.

IP-Connect audio between G600/650 media gateways
An IP-Connect system has G600/650 media gateways that are connected via IP instead of TDM. Therefore, the audio for a call from a traditional station or trunk on G650-1 to a traditional station or trunk on G650-2 has to go via IP from one gateway to the other. This is done through MedPro boards. If all MedPros on all G650s are in the same network region, there is no issue. However, if each G650 has MedPros in various network regions, the IP audio connection between gateways can be difficult to predict. Depending on which MedPro boards are selected, the two gateways could talk using an intra-region codec set or an inter-region codec set. This dilemma also applies to calls between an IP phone and a traditional station or trunk. The IP phone is directed to establish its audio stream with a MedPro on the G650 terminating the station or trunk. Depending on which network region that MedPro is in, the codec set can vary. **Inter-Gateway Communication (IGC)** For IGC traffic (between G600/650 gateways) the first Avaya CM 2.0 implementation selects the MedPro board based solely on usage. On each gateway the MedPro board with the least usage at the time of the call is selected. As of Avaya CM 2.0.1, of the two gateways involved in the communication exchange, MedPro pair selection takes place as follows: - Prefer a pair of MedPros that are from the same region. - Prefer region 1 to 1 before region 2-2, 3-3, ... 250-250. - Within the set of MedPros in region X and in gateway-1, use the most idle MedPro. - Within the set of MedPros in region X and in gateway-2, use the most idle MedPro. - If no same region Medpros are available, - Prefer region 1 to 2 before region 1-3, 1-4, ... 1-250, 2-3, 2-4, ... 2-250. - Within the set of MedPros in region X and in gateway-1, use the most idle MedPro. - Within the set of MedPros in region Y and in gateway-2, use the most idle MedPro. - Use the gateway with the MedPro in the lowest numbered network region as the basis. For example, G650-1 has MedPros in network regions 1, 3, and 5, while G650-2 has MedPros in network regions 1, 5, 7, and 9. The rirst choice is region 1-1. The next choice is region 5-5. Then the choices are 1-5, 1-7, 1-9, 3-1, 3-5, 3-7, 3-9, 5-1, 5-7, 5-9. The most preferred available pair is used. Beyond providing predictability for IGC traffic, this new targeted behavior allows the administrator to effectively specify an IGC network region. For example, if all G600/650 gateways had a MedPro in

network region 1, and no stations or trunks were assigned to that region, then region 1 would effectively be the IGC network region, because region 1-1 is the first preference for IGC traffic. This would provide logical separation of IGC traffic. To take this example further, the region-1 MedPros could be placed on a separate network reserved solely for IGC traffic, thus providing physical separation of IGC traffic.

Traditional Station/Trunk Calls

When an IP phone is communicating with a traditional station or trunk on a G600/650 gateway, an audio stream is established between the IP phone and a MedPro on the gateway where the traditional station or trunk is terminated.

- The first preference is to select a MedPro that is in the same network region as the IP phone.
- If no MedPro is available in the same network region as the IP phone, then a MedPro in a connected region is randomly selected.

IP-Trunks

In general, the far end of an IP trunk is assigned to a network region via the Far-end Network Region parameter in the **signaling-group** form. In most cases this means that the entire system at the far end of the IP trunk is considered to be in the network region specified here, **as defined in the near-end system**. Suppose network region 2 is specified here. Then, as far as the local (near-end) system is concerned, the far-end system is in network region 2. The far-end system, however, has no concept of network region 2. In fact, the far-end system could be a non-Avaya system that has no concept of network regions at all.

5 H.248 and H.323 Link Bounce Recovery

In sections 3.4 and 3.5 the G700 and G350 search timer configurations are explained. These timers are related to H.248 Link Bounce Recovery, which is a feature that preserves calls on individual media gateways through periods of lost connectivity.

H.323 Link Bounce Recovery is a feature that preserves single calls on individual IP phones through periods of lost connectivity between the phone and its current gatekeeper.

Configure the call server timers.

```
change system-parameters ip-options
                          IP-OPTIONS SYSTEM PARAMETERS

 IP MEDIA PACKET PERFORMANCE THRESHOLDS
    Roundtrip Propagation Delay (ms)    High: 800      Low: 400
                    Packet Loss (%)     High: 40       Low: 15
                    Ping Test Interval (sec): 20
    Number of Pings Per Measurement Interval: 10

 RTCP MONITOR SERVER
                   Default Server IP Address: 192.168.100.100
                         Default Server Port: 5005
             Default RTCP Report Period(secs): 5

 IP DTMF TRANSMISSION MODE
      Intra-System IP DTMF Transmission Mode: in-band-g711
      Inter-System IP DTMF: See Signaling Group Forms

 H.248 MEDIA GATEWAY                 H.323 IP ENDPOINT
  Link Loss Delay Timer (min): 6      Link Loss Delay Timer (min): 6
                                        Primary Search Time (sec): 330
```

- The H.248 Link Loss Delay Timer is the number of minutes that the call server preserves the call states for a media gateway after connectivity to that gateway is lost. With the link loss delay timer set to 6min and the primary search time (see sections 3.4 and 3.5) set to 5min…
  - In the event of communication interruption between a gateway and its controller, if the gateway restores connectivity to one of the primary controllers within 5min, the call server remembers the call states that were present for any stations and/or trunks on that gateway before the interruption.
  - If connectivity is not restored within 5min, the call states are discarded shortly after. The extra minute in the link loss delay timer is to provide a buffer, because the call server and media gateway do not necessarily start their respective timers at the same time after an interruption.
- The H.323 Link Loss Delay Timer is the number of minutes that the call server preserves the call state for an IP phone after connectivity to that phone is lost. The H.323 Primary Search Time is the length of time the phone attempts to restore connectivity to one of the primary gatekeepers (C-LANs) in the Alternate Gatekeeper List before including the backup gatekeepers (LSPs and Survivable GK) in its search. It is set to be 30sec longer than the media gateway's primary search time to allow the gateway to register with the LSP first and activate it. The H.323 timers function very similarly to the H.248 timers.
- H.323 Link Bounce Recovery requires IP telephone firmware 2.0 and later.
- Call states are never preserved across separate servers, such as when the media gateway or IP phone moves from the primary call server to an LSP or Survivable GK.

The configuration procedures for the G700 and G350 search timers are explained in sections 3.4 and 3.5. The IP phone timer configurations are explained below.

Configure IP phone TCP keepalive timers for H.323 Link Bounce Recovery.

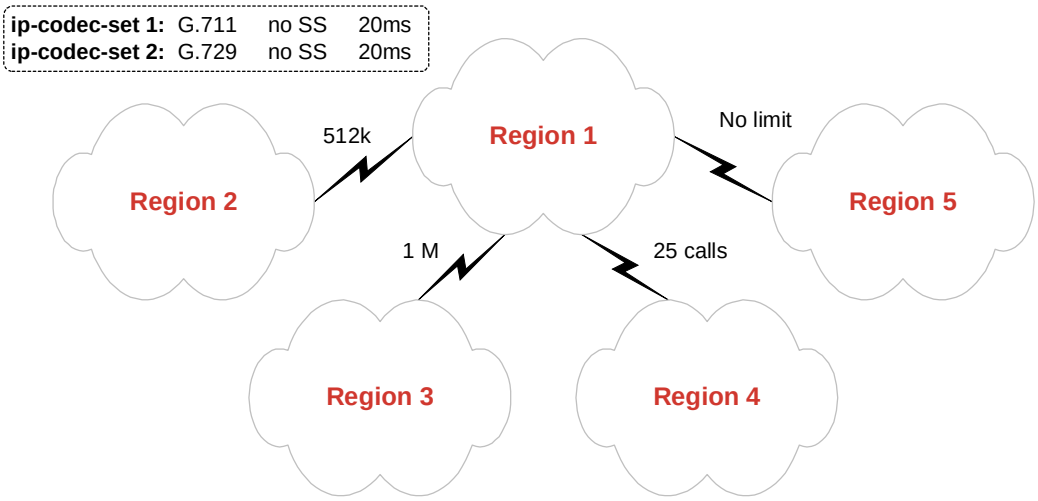
```
change ip-network-region 1                                    Page   1 of  19
                              IP NETWORK REGION
  Region: 1
Location: 1                Home Domain:
    Name: Denver
                                Intra-region IP-IP Direct Audio: yes
AUDIO PARAMETERS                Inter-region IP-IP Direct Audio: yes
   Codec Set: 1                           IP Audio Hairpinning? y
UDP Port Min: 2048
UDP Port Max: 2176                     RTCP Reporting Enabled? y
                                RTCP MONITOR SERVER PARAMETERS
DIFFSERV/TOS PARAMETERS          Use Default Server Parameters? y
 Call Control PHB Value: 46
        Audio PHB Value: 46
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
        Audio 802.1p Priority: 6      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
```

- H.323 Link Bounce Recovery can be enabled or disabled.
- The Idle Traffic Interval is the number of seconds between regular TCP keepalives sent by the phone to the gatekeeper (normal condition). The "Avaya IP Telephony Implementation Guide" calls this the regular interval with regular keepalives.
- The Keep-Alive Interval is the number of seconds between TCP keepalives after a regular TCP keepalive gets no response (failure condition). The "Avaya IP Telephony Implementation Guide" calls this the retry interval with retry keepalives.
- The Keep-Alive Count is the number of retry keepalives sent before the phone goes looking for another gatekeeper.
- As configured here, an outage of 25-45sec between the phone and its current gatekeeper results in the phone searching for another gatekeeper. If a call happens to be up during this outage, it remains up until the H.323 Link Loss Delay Timer expires, although the audio might be disrupted by the outage. If the phone re-establishes connectivity to one of the primary gatekeepers in the Alternate Gatekeeper List before that timer expires, the call continues uninterrupted.
- Again, H.323 Link Bounce Recovery requires IP telephone firmware 2.0 and later.

6 Call Admission Control

Call Admission Control (CAC) is a feature that allows a limit to be set on the bandwidth consumption or number of calls between network regions. The primary use of this feature is to prevent WAN links from being overloaded with too many calls. This is done by setting either a bandwidth limit or a number-of-calls limit between network regions, as follows:

- Bandwidth consumption is calculated using the methodology explained in the "Avaya IP Telephony Implementation Guide."
- The L2 overhead is assumed to be 7 bytes, which is the most common L2 overhead size for WAN protocols.
- The calculated bandwidth consumption is rounded up to the nearest whole number.
- The calculated bandwidth consumption takes into account the actual codec being used for each individual call. It does not assume that all calls use the same codec.
- If the administrator chooses not to have the call server calculate the bandwidth consumption, he/she may enter in a manual limit for the number of calls. However, this manually entered limit is adhered to regardless of the codec being used. Therefore, the administrator must be certain that either all calls use the same codec, or that the manual limit takes into account the highest possible bandwidth consumption for the specified inter-region codec set.
- If a call between two network regions traverses an intervening network region – call from 1 to 3 actually goes 1 to 2 to 3 – the call server keeps track of the bandwidth consumed across both inter-region connections – 1 to 2 and 2 to 3.



The figure above shows a simple hub-spoke network region topology. The WAN link between network regions 1 and 2 has 512k reserved for VoIP. The WAN link between network regions 1 and 3 has 1M reserved for VoIP. The link between network regions 1 and 4 is one where the 7-byte L2 overhead assumption would not hold, such as an MPLS or VPN link. In this case the administration is such that all inter-region calls with a termination point in region 4 use the G.729 codec at 20ms. Therefore, it is feasible to set a limit on the number of inter-region calls to region 4, knowing exactly how much bandwidth that codec consumes with the MPLS or VPN overhead added. Finally, the link between network regions 1 and 5 requires no limit, either because there are very few endpoints in region 5 or because there is practically unlimited bandwidth to region 5.

The **ip-network-region** form configurations for each network region are shown below.

Configure inter-region connectivity for network region 1.

```
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
 1   1     1
 1   2     2       y        512:Kbits
 1   3     2       y          1:Mbits
 1   4     2       y         25:Calls
 1   5     2       y           :NoLimit
```

- Connectivity from network region 1 to all the other regions is configured per the diagram above.
- All the inter-region connections use the WAN codec set.

Configure inter-region connectivity for 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
 2   1     2       y        512:Kbits
 2   2     1
 2   3     2       n                          1
 2   4     2       n                          1
 2   5     2       n                          1
```

- Network region 2 connects to regions 3, 4, and 5 via intervening region 1.
- Avaya CM keeps track of the bandwidth or call limits between all adjacent regions.

Configure inter-region connectivity for network region 3.

```
display ip-network-region 3                                    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
 3   1     2       y          1:Mbits
 3   2     2       n                          1
 3   3     1
 3   4     2       n                          1
 3   5     2       n                          1
```

Configure inter-region connectivity for network region 4.

```
display ip-network-region 4                                    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
 4   1     2       y         25:Calls
 4   2     2       n                          1
 4   3     2       n                          1
 4   4     1
 4   5     2       n                          1
```

Configure inter-region connectivity for network region 5.

```
display ip-network-region 5                                    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
 5   1     2       y           :NoLimit
 5   2     2       n                          1
 5   3     2       n                          1
 5   4     2       n                          1
 5   5     1
```