AVAYA

Avaya Communication Manager Network Region Configuration Guide

Communication Manager 3.0   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.

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Application Note

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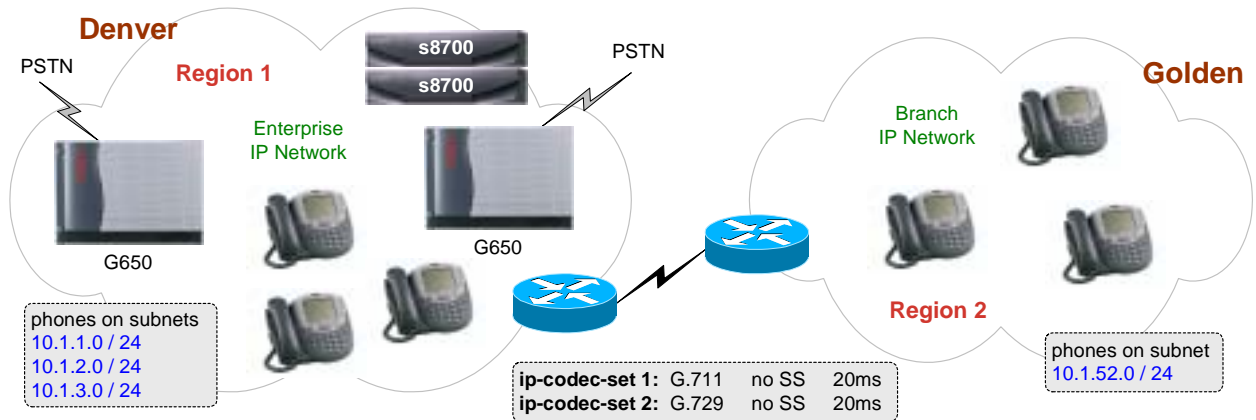
The figure above shows two sites: the main enterprise in Denver CO, and a branch office in Golden CO. All the call server and media resources are located in Denver, while the Golden branch has only stations. The configuration steps are as follows.

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        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
```

- 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
```

- 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.

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
                              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-interface all                                              Page   1

                              IP INTERFACES

                                                                Net
ON Type   Slot  Code Sfx Node Name/        Subnet Mask      Gateway Address Rgn VLAN
                         IP-Address
-- ----   ----  ---- --- --------------    ---------------  --------------- --- ----
y  C-LAN  01A04 TN799 D  clan1             255.255.255.0    10 .1  .1  .254  1   n
                         10.1.1.201
y  MEDPRO 01A10 TN2302   medpro1           255.255.255.0    10 .1  .1  .254  1   n
                         10.1.1.202
y  C-LAN  02A04 TN799 D  clan2             255.255.255.0    10 .1  .2  .254  1   n
                         10.1.2.201
y  MEDPRO 02A10 TN2302   medpro2           255.255.255.0    10 .1  .2  .254  1   n
                         10.1.2.202
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. <u>Because network region 1 and network region 2 are connected</u>, per the two tables above, the stations in region 2 can access the MedPros in region 1.
- <u>If the two network regions were not connected</u>, 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, <u>IP phones assigned to a network region using this form</u> 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.
- <u>An IP phone not assigned to a network region using this form</u> 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, <u>but that has no gatekeeper in its region or any connected region</u>, 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
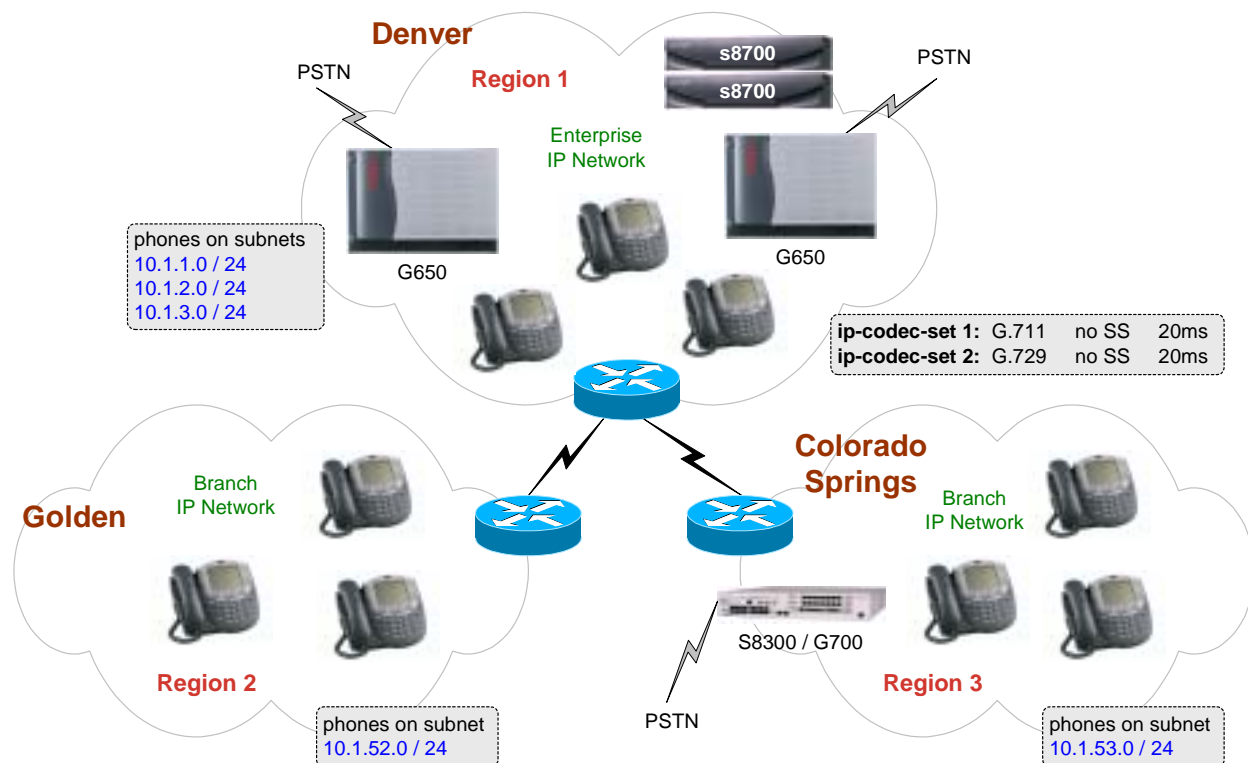
The figure above shows the previous Basic configuration with the Colorado Springs CO branch added. There are two primary differences between the Colorado Springs branch and the Golden branch. First, the Colorado Springs branch is in a different area code, which is one reason why the Avaya G700 Media 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                                  Dynamic CAC
 rgn rgn   set    WAN    WAN-BW-limits  Intervening-regions  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

                                                        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 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       Translations
                                          State?         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 <u>Type</u> 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 <u>transition point</u> are primary controllers. Entries after the <u>transition point</u> 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.

3.6   Configure H.323 Link Bounce Recovery for Each Region

See section 5.

3.7   Configure H.248 Link Bounce Recovery for Each Gateway

See section 5.

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
   -   Any non-IP resource in general
4.   Non-H.248 gateways, also known as port networks (Avaya MCC1, SCC1, G600, G650), are assigned to network regions only for the purposes of IGAR (see section 7).

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, Communication Manager directs that phone to register with a C-LAN in its own network region. As part of the registration process, Communication Manager sends the phone a list of gatekeepers (Alternate Gatekeeper List) with…
     -   All C-LANs in the phone's region.
     -   All C-LANs in regions with a direct-WAN connection 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 sends the GRQ. As part of the registration process, Communication Manager 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 direct-WAN 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 C-LAN that received the GRQ.
     -   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.
    -   For IP-Connect systems, where there is no shared TDM bus between two G650/G600 port networks, the audio has to go IP between the two port networks. Region-X IP phone to region-X MedPro on PN1 via IP to PN2 (see IGC section below) to region-Y MedPro on PN2 to region-Y IP phone.

IP-Connect audio between G650/G600 port networks

An IP-Connect system has G650/G600 port networks 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 port network 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 port networks can be difficult to predict. Depending on which MedPro boards are selected, the two port networks 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 G650/G600 port networks) the first Communication Manager 2.0 implementation selects the MedPro board based solely on usage. On each port network the MedPro board with the least usage at the time of the call is selected.

As of Communication Manager 2.0.1, of the two port networks 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 PN1, use the most idle MedPro.
    -   Within the set of MedPros in region X and in PN2, 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 PN1, use the most idle MedPro.
    -   Within the set of MedPros in region Y and in PN2, use the most idle MedPro.
-   Use the port network 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 G650/G600 port networks 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 G650/G600 port network, an audio stream is established between the IP phone and a MedPro on the port network 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 the near-end system's view 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

H.248 Link Bounce Recovery is a feature that preserves calls on a media gateway through periods of lost connectivity between the gateway and its media gateway controller (C-LAN). H.323 Link Bounce Recovery is a feature that preserves a call on an IP phones through periods of lost connectivity between the phone and its gatekeeper (C-LAN). H.323 Link Bounce Recovery requires IP telephone firmware 2.0 or later.

There are several phases to the link bounce recovery process, and each of these phases is described in the sections that follow.
- Detect the outage.
- Attempt to reconnect to the primary call server.
- Failover to a secondary call server.
- Recover to the primary call server.

5.1 Detect the Outage

Media Gateway

A media gateway uses application level keepalives to maintain connectivity with the call server and to detect outages. These keepalives are not configurable, and the sequence of operation is as follows.
- Gateway sends an application level keepalive to the call server once every 14sec.
- Communication Manager responds with an application level keepalive response.
- The above keepalive exchange occurs on the existing H.248 media gateway control link established between the gateway and the C-LAN. The sequence is a TCP message from gateway to C-LAN, followed by a TCP ACK from C-LAN to gateway, followed by a TCP message from C-LAN to gateway, followed by a TCP ACK from gateway to C-LAN, once every 14sec.
- If the communication path between the gateway and C-LAN is disrupted, it takes the gateway approximately 40-60sec to detect the outage, assuming the outage lasts longer than this.

IP Phone

An IP phone uses TCP keepalives to maintain connectivity with the gatekeeper and to detect outages. This TCP keepalive mechanism is described in the "Avaya IP Telephony Implementation Guide" for Communication Manager 3.0, section 4.1, heading "Keepalive Mechanisms." Administration of the keepalive parameters is covered here.

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, it takes a phone 25-45sec to detect an outage, assuming the outage lasts longer than this.

5.2   Attempt to Reconnect to Primary Call Server

After an outage is detected, both the media gateway and the IP phone have a specified amount of time, called the primary search time, during which the gateway or phone attempts to restore connectivity to the primary call server. As the interface to the call server is a C-LAN board, multiple boards can be listed as primary media gateway controllers in the MGC list, or as primary gatekeepers in the Alternate Gatekeeper List. These boards are all part of the same Communication Manager system that is the primary call server. In attempting to restore connectivity to the primary call server, the media gateway or IP phone attempts to connect to one of the C-LAN boards that belong to that call server.

Media Gateway

Configure search timers on gateways.
```
G700:  MG-001-1(configure)# set mgp reset-times primary-search 5
G350/G250:   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 including the LSP(s) in its
    search. 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.

G700:  MG-001-1(configure)# set mgp reset-times total-search 30
G350/G250:   MG-001(super)# set reset-times total-search 30

    Total number of minutes the media gateway tries to contact any controller, including LSPs,
    before resetting. This total search time includes the primary search time.

G700:  MG-001-1(configure)# show mgp recovery   (to verify transition point and timer values)
G350/G250:   MG-001(super)# show recovery


MGP RECOVERY TIMES
--------------------------------
Primary Search  : 5
Total Search    : 30
```

```
Transition Point: 2
```

After a media gateway detects an outage it tries to establish connectivity with one of the primary controllers (C-LANs) in the MGC list for the duration of the primary search time, which is 5min in this example. With a transition point of 2, in this example, the primary controllers are the first two entries in the MGC list (see sections 3.4 and 3.5). If after 5min the gateway has not contacted either of the primary controllers, it includes the LSP in the MGC list in its search. The gateway round robin searches for all controllers in the MGC list for 25min, making the total search time 30min. If after 30 total minutes the gateway has not contacted any controller in its MGC list, it resets itself and starts over.

IP Phone

Configure the primary search time for stations.
```
change system-parameters ip-options                         Page   1 of   2
                          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

AUTOMATIC TRACE ROUTE ON
          Link Failure? y


 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
                             Periodic Registration Timer (min): 20
```

After an IP phone detects an outage, 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 secondary gatekeepers (LSPs and Survivable GK) in its search. The phone's primary search time 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.

If after 5min-30sec the IP phone has not contacted any of the primary gatekeepers, it includes secondary gatekeepers (LSPs and Survivable GK) in the Alternate Gatekeeper List in its search. The phone round robin searches for all gatekeepers for approximately 5min longer in this case, for a total search time of approximately 10-11min (not configurable). If after 10-11 total minutes the phone has not contacted any gatekeeper in the Alternate Gatekeeper List, it resets itself and starts over.

Call States Upon Successful Reconnection to Primary Call Server

With the correct administration, call states and features are preserved through intermittent outages. If a media gateway loses contact with the primary call server and then restores connectivity before the primary search time expires, all call states and functions are preserved. There are no call features during the outage, but the features are restored upon recovery.

If the outage is a network outage that disrupts audio, there is no audio during the outage, but the audio is restored upon recovery, assuming the call is not terminated during the outage. Audio can be disrupted by a network outage, but not terminated. The endpoints involved in the audio exchange continue to transmit audio until terminated by call signaling or by a user going on-hook.

Depending on transitions that take place during the outage, such as users hanging up or attempting to access features, the call server and the media gateway may need to synchronize their states upon recovery. These principles apply to IP phones as well.

Configure the call server timers.

```
change system-parameters ip-options                          Page   1 of   2
                        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

AUTOMATIC TRACE ROUTE ON
          Link Failure? y



 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
                                 Periodic Registration Timer (min): 20
```

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 set to 5min…
-   In the event of communication disruption 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 disruption.
-   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 a disruption.

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 LLDT functions very similarly to the H.248 LLDT.

5.3   Failover to Secondary Call Server – Connection Preservation

When a media gateway or IP phone transitions from one call server to another – primary call server to secondary LSP or Survivable GK, for example – the call states are lost. In other words, the secondary server has no record of any call that originated while the gateway or phone was registered to the primary server. However, any established call remains up, without call features, until the call is terminated. This is known as connection preservation.

Media Gateway

In the case of a media gateway, suppose there are two established calls: one from a DCP set on the gateway to an IP phone, and another from a TDM trunk on the gateway to an IP phone. If an outage (link loss) occurs between the gateway and the C-LAN after these calls are established, the calls remain up for the duration of the primary search time, but with no call features. When the primary search time expires, the gateway registers with an LSP and notifies the LSP of the existing connections on the gateway. The LSP has no record of any calls correlating to these connections, so the LSP cannot provide any features to these calls that were established on the primary call server. However, the connections remain up until the calls are terminated by a user or some other normal method.

H.248 media gateway connection preservation upon failover to secondary call server is a new feature in Communication Manager 3.0.

IP Phone

What about the IP phones in the above example? If the media gateways and IP phones are located in the same remote office, the phones are likely to experience a similar link loss to their respective C-LANs. Connection preservation also applies to IP phones, but the behavior is different than that of gateways. From call establishment to link loss to primary search time expiration, a phone behaves the same as a gateway – an active call stays up, but without call features. However, a phone does not register with a different call server while there is an active call, even after the primary search time expires. The phone waits until the user terminates the call, and then registers with an LSP or Survivable GK.

Audio

As stated previously, only call signaling or local call termination (user going on-hook) can terminate audio transmission. Outages only disrupt the audio stream for the duration of the outage. This is true whether an endpoint reconnects to the primary server after a short outage, fails over from primary to LSP, or recovers from LSP back to primary.

5.4 Recover to Primary Call Server – Connection Preservation

Connection preservation applies to recovery, just as it does to failover. However, the recovery mechanism is different than the failover mechanism. Failover is dictated by the primary search time, as described in the previous section. Recovery is dictated by media gateway recovery rules, and these rules only apply when a media gateway recovers from an LSP to the primary call server.

Media Gateway

While a media gateway is registered to an LSP, the gateway continuously tries to register with the primary call server, on a 30sec interval. In addition to this regular interval attempt, the gateway attempts a registration whenever the call count on the gateway transitions to zero. Each recovery registration attempt contains two pieces of information: 1) that the media gateway is currently registered to an LSP; and 2) the current call count on the media gateway.

Based on the information contained in the recovery registration attempt, and the media gateway recovery rule administered on the **media-gateway** and **system-parameters mg-recovery-rule** forms, the primary Communication Manager server determines whether or not to accept the media gateway's registration. The gateway remains on the LSP until the primary server accepts its registration, at which time the gateway terminates its link to the LSP. The gateway continuously sends recovery registration

attempts to the primary call server until accepted. There are four conditions for accepting a media gateway's recovery registration.

Accept media gateway recovery registration immediately.

```
change system-parameters mg-recovery-rule 1                   Page   1 of   1
              SYSTEM PARAMETERS MEDIA GATEWAY AUTOMATIC RECOVERY RULE
 Recovery Rule Number: 1
 Rule Name:
 Migrate H.248 MG to primary: immediately
 Minimum time of network stability: 3
 WARNING: The MG shall be migrated at the first possible opportunity. The MG may
 be migrated with a number of active calls.  These calls shall have their talk
 paths preserved, but no additional processing of features shall be honored.
 The user must hang up in order to regain access to all features.
```

- Recovery Rule Number is an index.
- Rule Name is an arbitrary descriptor.
- Migrate H.248 MG to primary indicates the rule to be applied. If this field is empty the rule is disabled, which means that automatic recovery is disabled. Recovery must happen manually by either resetting the gateway or resetting the LSP.
- Minimum time of network stability has a range of 3-15min, and it indicates how long the primary call server should wait before accepting a recovery registration. It is meant to prevent registration thrashing (continuously changing back and forth between primary and LSP) during network flapping conditions. The primary call server keeps track of this network stability time by counting sequential 30sec interval registration attempts by the media gateway. If a 30sec interval attempt does not arrive, the counter is restarted.
- In this case, after the network has been stable for 3min, the primary call server accepts the recovery registration immediately.

Accept media gateway recovery registration when there are no active calls on the gateway.

```
change system-parameters mg-recovery-rule 1                   Page   1 of   1
              SYSTEM PARAMETERS MEDIA GATEWAY AUTOMATIC RECOVERY RULE
 Recovery Rule Number: 1
 Rule Name:
 Migrate H.248 MG to primary: 0-active-calls
 Minimum time of network stability: 3
 WARNING:  The MG shall only be migrated when there are no active calls.
```

After the network has been stable for 3min, the primary call server accepts the recovery registration as soon as there are no active calls on the media gateway.

Accept media gateway recovery registration at a specified time window.

```
change system-parameters mg-recovery-rule 1                   Page   1 of   1
              SYSTEM PARAMETERS MEDIA GATEWAY AUTOMATIC RECOVERY RULE
 Recovery Rule Number: 1
 Rule Name:
 Migrate H.248 MG to primary: time-day-window
 Minimum time of network stability: 3
 WARNING: MG may be migrated with a number of active calls.  These calls shall
 have their talk paths preserved, but no additional processing of features
 shall be honored.  The user must hang up in order to regain access to all
 features.  Valid registrations shall only be accepted during these intervals.



                              Time of Day
 Day of Week  00                    12                    23
  Sunday           x x
```

```
 Monday            x x
 Tuesday           x x
 Wednesday         x x
 Thursday          x x
 Friday            x x
 Saturday          x x
 NOTE: set 'Migrate H.248 MG to primary' to Blank to disable rule.
```

After the network has been stable for 3min, the primary call server accepts the recovery registration on any day during the 01:00 and 02:00 hours. The time is the media gateway's time as determined by **location** administration.

Accept media gateway recovery registration at a specified time window AND when there are no active calls on the gateway.

```
change system-parameters mg-recovery-rule 1                    Page   1 of   1
                SYSTEM PARAMETERS MEDIA GATEWAY AUTOMATIC RECOVERY RULE
 Recovery Rule Number: 1
 Rule Name:
 Migrate H.248 MG to primary: time-window-OR-0-active-calls
 Minimum time of network stability: 3
 WARNING: The MG shall be migrated at ANY time when there are no active calls,OR
 the MG may be migrated with a number of active calls when a registration is
 received during the specified intervals.  These calls shall have their talk
 paths preserved, but no additional processing of features shall be honored.s.


                               Time of Day
 Day of Week  00                        12                        23
 Sunday            x x
 Monday            x x
 Tuesday           x x
 Wednesday         x x
 Thursday          x x
 Friday            x x
 Saturday          x x
 NOTE: set 'Migrate H.248 MG to primary' to Blank to disable rule.
```

After the network has been stable for 3min, the primary call server accepts the recovery registration as soon as there are no active calls on the media gateway, or on any day during the 01:00 and 02:00 hours. The time is the media gateway's time as determined by **location** administration.

When a gateway with active calls transitions from an LSP back to the primary call server, the connections are preserved just as they were in the transition from primary to LSP. Once again, one call server (the primary) cannot provide features for a call that originated on another call server (the LSP). Therefore, for the duration of such a call, there are no call features.

IP Phone

When there are no more media gateways registered to an LSP – all gateways on that LSP have recovered to the primary call server – the LSP automatically unregisters all IP stations registered to that LSP. This causes the IP stations to recover to the primary call server. As is the case with failover, an IP phone does not register with a different call server while there is an active call. The phone waits until the user terminates the call, and then registers with the primary call server.

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 – Communication Manager keeps track of the bandwidth consumed across both inter-region connections – 1 to 2 and 2 to 3.

Simple Cases
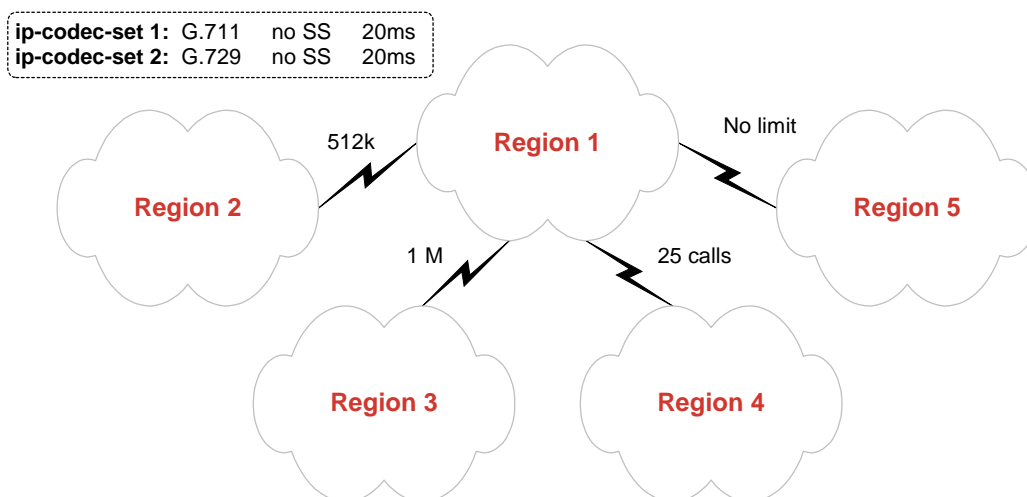
The figure above shows a simple hub-spoke network region topology. The WAN link between network regions 1 and 2 has 512k reserved for VoIP. The WAN link between network regions 1 and 3 has 1M reserved for VoIP. The link between network regions 1 and 4 is one where the 7-byte L2 overhead assumption would 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 administration for each network region is 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    IGAR
 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.

```
change 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        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.
- Communication Manager keeps track of the bandwidth or call limits between all adjacent regions.

Configure inter-region connectivity for network region 3.

```
change 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    IGAR
 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.

```
change 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    IGAR
 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.

```
change 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    IGAR
 5   1    2      y             :NoLimit
 5   2    2      n                               1
 5   3    2      n                               1
 5   4    2      n                               1
 5   5    1
```

Virtual Network Region for Shared WAN

Shared WAN services such as Frame Relay, ATM, and MPLS provide a shared network cloud with a single access point per site, as shown below.
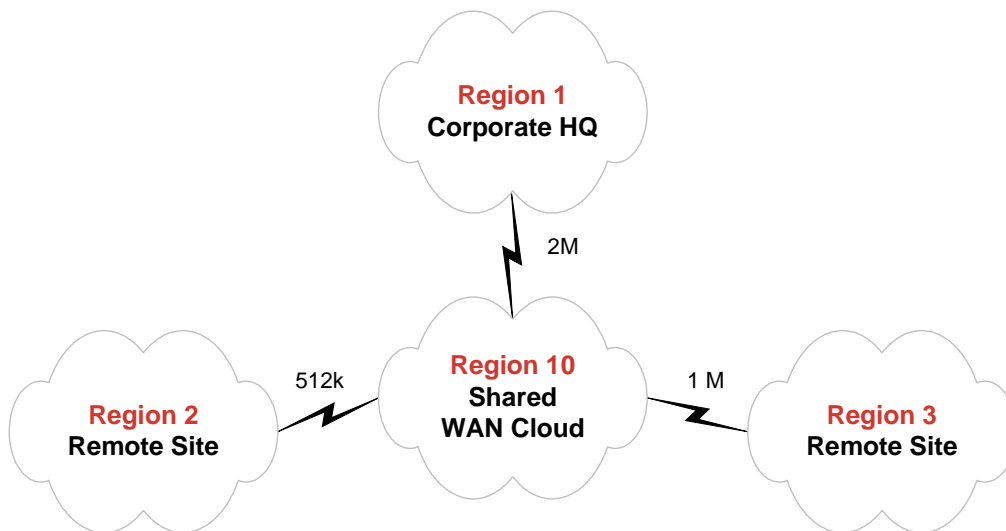
Network regions 1, 2, and 3 are actual sites. Network region 10 is not an actual site, but represents the shared WAN cloud. As such, network region 10 is a virtual region, sometimes referred to as a "ghost" region. This is necessary for accurate CAC calculation, since each site has a single access connection into the WAN cloud. By having regions 1, 2, and 3 all connect to region 10 (the intervening region), the actual access bandwidth can be represented correctly and accounted for accurately. A call between any two sites deducts bandwidth on two different access links.

As of Communication Manager 3.0, this virtual region introduces a slight complication. With previous releases of Communication Manager, an IP phone receives an Alternate Gatekeeper List containing all C-LANs in the phone's region, plus all other connected regions, whether connected direct-WAN or via intervening regions. As of Communication Manager 3.0, the Alternate Gatekeeper List contains C-LANs in the phone's region, plus all direct-WAN connected regions. Regions more than one hop away – those requiring one or more intervening regions – are now excluded for reasons that follow.

Suppose that the remote sites only have IP phones and media gateways – no C-LANs. Prior to Communication Manager 3.0, phones at remote sites (regions 2 and 3) could register to C-LANs at corporate HQ (region 1) and receive an Alternate Gatekeeper List with all C-LANs in region 1. This

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configuration does not work with Communication Manager 3.0 because region 1 is not direct-WAN connected to regions 2 or 3. A change is required with Communication Manager 3.0, and that is to assign all shared C-LANs to region 10 (although the C-LANs are still physically located at corporate HQ). By doing this, all remote sites have access to region-10 C-LANs and receive an Alternate Gatekeeper List with only region-10 C-LANs.

A side effect and an advantage to this is that if there are corporate users in region 1, the region-1 C-LANs they use are not shared with remote site users. This segregation of resources is an advantage for troubleshooting and maintenance purposes. Also, in large systems with many interconnected regions and many C-LANs, rather than all IP phones getting an Alternate Gatekeeper List with all C-LANs in the system plus LSPs and/or Survivable Gatekeepers, they receive a list of only a few core C-LANs plus a few backup C-LANs plus LSPs and/or survivable gatekeepers. C-LAN resource management and Alternate Gatekeeper List size management are the two primary reasons why only direct-WAN connected regions are used to populate the Alternate Gatekeeper List as of Communication Manager 3.0.

7 Inter-Gateway Alternate Routing (IGAR)

Inter-Gateway Alternate Routing (IGAR) is a mechanism new to Communication Manager 3.0 that allows IP-connected gateways and port networks to communicate with each other over the PSTN. IGAR only applies to audio connections between IP-connected gateways and port networks within the same Communication Manager system. IGAR must not be confused with IP trunking, which is a method used to communicate between two distinct Communication Manager systems. With the addition of IGAR there are four methods of connecting gateways and port networks:
- Direct connect link between port networks.
- Center Stage PNC or ATM PNC solution for port networks.
- IP connectivity between gateways and port networks.
- IGAR for gateways and port networks.

IGAR allows one gateway or port network to call another gateway or port network, and thus establish audio connectivity between the two over the PSTN. The primary intent of IGAR is an overflow for CAC. The "basic plus media gateway and LSP" configuration covered in section 3 is used here to illustrate IGAR.
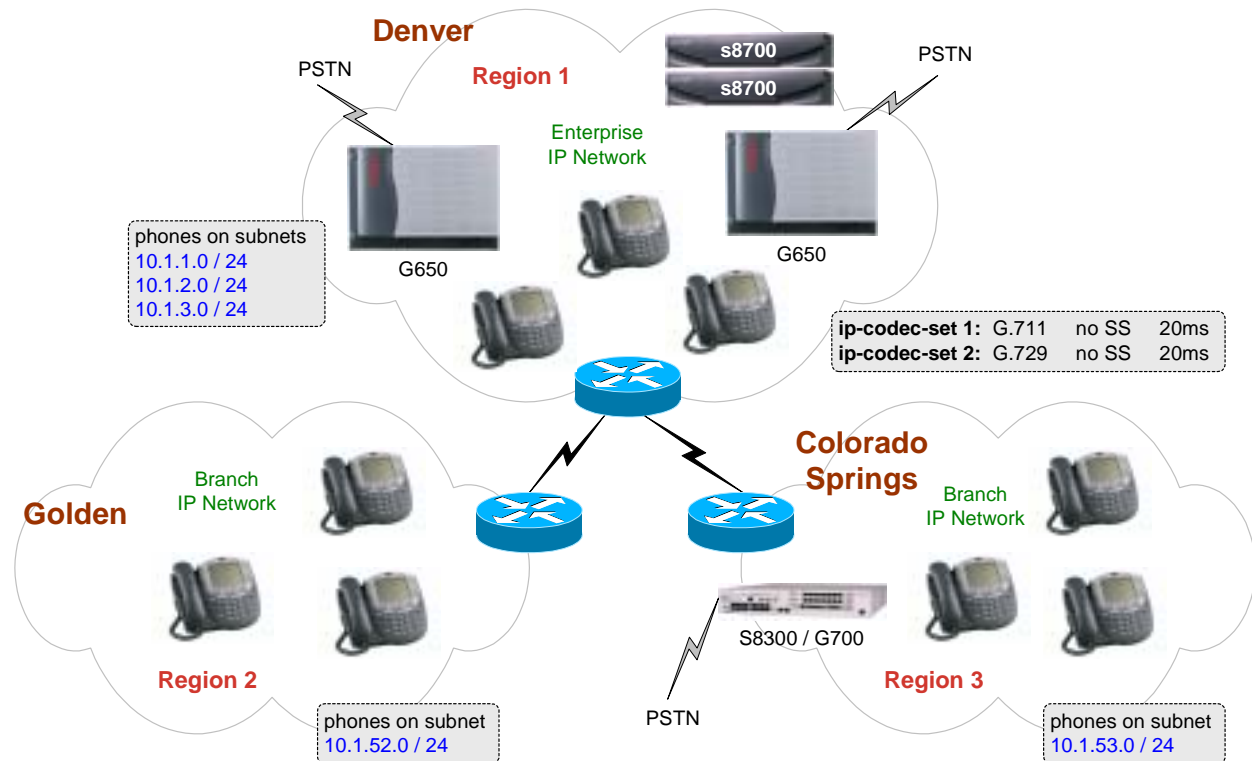
Suppose there is a CAC limit of 10 calls between Denver and Colorado Springs. Without IGAR the 11th call would be denied. With IGAR the 11th call can be permitted with the audio routed over the PSTN. The call is still an internal call, and all the Communication Manager features are preserved. The audio between the two sites is simply delivered via an alternate method.

Note that only the basic and fundamental points of IGAR are covered in this document. A much more thorough explanation of IGAR is covered in "Inter-Gateway Alternate Routing Overview – An IGAR White Paper," Avaya COMPAS ID 111863. The IGAR white paper is currently being processed for external posting.

Using the SAT administration already covered in section 3 as a starting point, the additional administration required for IGAR is covered here.

Assign all cabinets in Denver to location 1 and network region 1.

```
change cabinet 1
                                CABINET
 CABINET DESCRIPTION
               Cabinet: 1
         Cabinet Layout: rack-mount-stack
           Cabinet Type: expansion-portnetwork


             Location: 1        IP Network Region: 1
```

- The cabinet should already have the correct location assignment.
- Network region assignment to a cabinet is new to Communication Manager 3.0 and is meaningful only in the context of IGAR. It has no effect on network region assignments of boards or any other resources attached to the cabinet.
- All Center Stage- or ATM-connected port networks are automatically assigned to network region 1. IGAR is not required (not needed) among Center Stage- or ATM-connected port networks. However, IGAR can apply between one of these port networks and an IP-connected port network or gateway.

Colorado Springs media gateway already has correct location and network region assignment.

```
Display 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:
```

Add a CAC limit and enable IGAR for overflow between Colorado Springs and Denver.

```
Change 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   IGAR
 3   1    2      y          10:Calls                                    Y
 3   2    2      n                     1                                 n
 3   3    1
```

There is a CAC limit of 10 calls between Colorado Springs and Denver. Audio for the 11th call and thereafter is sent via the PSTN.

Add IGAR information to Denver network region 1.

```
change ip-network-region 1                                    Page   2 of  19
                          IP NETWORK REGION


INTER-GATEWAY ALTERNATE ROUTING
 Incoming LDN Extension: 1234567
 Conversion To Full Public Number - Delete: 0   Insert: 303
 Maximum Number of Trunks to Use: 20
```

- Incoming LDN Extension is the listed directory number to be dialed when making an IGAR call to this network region from other network regions.
- To convert the LDN to a Full Public Number, delete no (0) digits from the LDN and insert the area code 303. The dial plan, which is beyond the scope of this document, dictates what number is dialed. For example, assuming the digit 9 is required to access an external line…
  - Another network region in Denver (if there were one) making an IGAR call to this network region in Denver would dial 9-303-123-4567, because the PSTN in Denver requires 10-digit dialing.
  - Network region 3 in Colorado Springs making an IGAR call to this network region in Denver would dial 9-1-303-123-4567, because it is a long distance call.
- The Maximum Number of [local] Trunks in this network region that can be used to accept incoming IGAR calls is 20 in this example. This number must be carefully determined and figured into the overall capacity planning.

Add IGAR information to Colorado Springs network region 3.

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


INTER-GATEWAY ALTERNATE ROUTING
 Incoming LDN Extension: 7654321
 Conversion To Full Public Number - Delete: 0   Insert: 719
 Maximum Number of Trunks to Use: 20
```

- To convert the LDN to a Full Public Number, delete no (0) digits from the LDN and insert the area code 719. The dial plan, which is beyond the scope of this document, dictates what number is dialed. For example, assuming the digit 9 is required to access an external line…
  - Another network region in Colorado Springs (if there were one) making an IGAR call to this network region in Colorado Springs would dial 9-765-4321, because the PSTN in Colorado Springs uses 7-digit dialing.
  - Network region 1 in Denver making an IGAR call to this network region in Colorado Springs would dial 9-1-719-765-4321, because it is a long distance call.
- The Maximum Number of [local] Trunks in this network region that can be used to accept incoming IGAR calls is 20 in this example. This number must be carefully determined and figured into the overall capacity planning.

Permanent IGAR

Although IGAR is meant to be an overflow for CAC, it is possible to use IGAR permanently. However, permanent IGAR is only recommended between network regions with relatively few calls. The administration is as follows.

Select pstn as the inter-region codec set to enable permanent IGAR.

```
change 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    IGAR
 3   1    pstn
 3   2    2      n                        1                              n
 3   3    1
```

Audio for calls between network regions 3 and 1 is always routed over the PSTN.

(F)orce option is for testing IGAR, not permanent IGAR.

```
change 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    IGAR
 3   1    2      y          10:Calls                                     f
 3   2    2      n                        1                              n
 3   3    1
```

The IGAR column has a (f)orce option that some might use to enable permanent IGAR. However, the (f)orce option is meant for IGAR testing. So in this example, rather than make 10 calls and test IGAR on the 11th call, or change the CAC limit to 1 call temporarily, the IGAR column can be set to 'f' to invoke IGAR immediately, regardless of the CAC limit.

Appendix: Network Region Best Practices Checklist

1. See the "Avaya IP Telephony Implementation Guide," heading "C-LAN Capacity and Recommendations" for the recommended number of IP stations, media gateways, and signaling groups (IP trunks) per C-LAN.
2. Create a separate network region for adjuncts, such as CMS and CDR, and do not put users or other services in this network region. Also, do not connect this region to any other region. The C-LANs in this region are only for adjuncts.
3. If high predictability of IGC audio traffic flow is required, provision an IGC network region.
   ❐ Assuming port networks are not separated by WAN links, put a MedPro/MR320 board assigned to NR1 in every port network, and provision a G.711 codec for NR1. By design, IGC traffic traverses NR1 boards as first choice (refer to the IGC algorithm described in section 4). *Note: If port networks are separated by WAN links, in almost all cases the WAN-remote port network is in the same network region as the IP stations, just as a WAN-remote media gateway would be, and a compressed codec (G.729) is used to communicate to that port network.*
   ❐ Do not put users or adjuncts in NR1. Reserve NR1 as the IGC region.
   ❐ If segregation of IGC traffic is also required, such as placing IGC traffic on its own network segment isolated from the rest of the enterprise, then no other network regions may use the NR1 MedPro/MR320 boards.
       o Do not connect NR1 to any other region.
       o Every non-adjunct region must be able to connect to a MedPro/MR320 board in every port network. This is to prevent a double IGC, which is not allowed and results in call blockage. An example of a double IGC is a call that originates on a media gateway in NR5, connects to a NR5 MedPro in PN1 (first IGC), connects from PN1 to PN2 via NR1 MedPros (second IGC), and terminates on a station connected to PN2. This is not permitted, so there must be a MedPro/MR320 board in PN2 that is either in NR5 or is connected to NR5.
   ❐ If segregation of IGC traffic is not required, non-adjunct network regions may be connected to NR1 to share the NR1 MedPro/MR320 resources.
   ❐ In all cases, appropriate capacity engineering is required.
4. IP stations and media gateways in the same network region may share C-LANs. For example, there may be four C-LANs in NR5 that are sent via the Alternate Gatekeeper List to all the IP stations in NR5. There may also be media gateways in NR5 that have three of these C-LANs plus an LSP in the MGC list. The key is to distribute the IP stations evenly, and to distribute the media gateways evenly, across all four C-LANs.
5. Do not mix IP trunks and users (IP stations and media gateways) in the same network region, especially for heavily used IP trunks. Instead, put IP trunks in a separate network region. Several IP trunks may be placed in one region, or each IP trunk may be placed in its own region.
   ❐ If several IP trunks are placed in one region, make each far-end network region unique, so that each signaling group has a unique near-end/far-end network region pair. This better facilitates making changes to one signaling group without disturbing the others.
   ❐ If each IP trunk is designated its own network region, then the far-end region may be the same as the near-end region.
6. When network regions are large enough – have enough IP stations and/or media gateways – segregate the C-LAN resources. For example, rather than have 2,000 IP stations share 10 C-LAN boards (8 boards @ 250 IP stations each, plus 2 spare boards online)…
   ❐ Have groups of 1,000 share 5 C-LAN boards (4 boards @ 250 IP stations each, plus 1 spare board online).

- ❏ Or, have groups of 500 share 3 C-LAN boards (2 boards @ 250 IP stations each, plus 1 spare board online).
- ❏ This segregation of resources makes troubleshooting and maintenance easier, although it might require more C-LAN boards.
- ❏ Use physical boundaries such as different buildings or different floors of a building, or use logical boundaries like IP subnets.

7. When network regions are small, such as many small remote offices, put all the small offices or groups of small offices into a common, shared network region. But do not mix these small offices with a group large enough to be its own region. For example, the corporate HQ might have enough users to support two individual network regions – NR10 and NR11. There might be a few remote offices on the East Coast that would share NR20. There might also be a few remote offices on the West Coast that would share NR30. Do not mix in the small office to NR10 or NR11. This makes troubleshooting and maintenance much easier.

8. Carefully plan out a logical numbering scheme. For example, …
   - ❏ IGC is NR1.
   - ❏ Adjuncts are in NR2.
   - ❏ IP trunks are in single-digit network regions.
   - ❏ HQ users are in 1x (10-19) network regions.
   - ❏ East Coast offices are in 2x network regions.
   - ❏ West Coast offices are in 3x network regions.