Understanding Network Regions: The Essentials
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Introduction
My Global Knowledge colleagues and I have received numerous requests for clarification of the purpose for network regions. I have, therefore, written this white paper to attempt to distill and clarify information about the subject. My primary resource for this white paper was the Avaya PDF Administering Network Connectivity on Avaya Aura Communication Manager, Release 6.2 555-233-504 Issue 16 July 2012. I have borrowed heavily from its pages in an effort to extract relevant information about network regions. I recommend that PDF for this topic and for its thorough presentation of the interworking of Communications Manager (CM) components. Another excellent document is the Avaya abstract Avaya Communication Manager Network Region Configuration Guide Application Note October 2005 COMPAS ID 103244. Although it was written for CM release 3.0 in October of 2005, it is still valid today. You will find a number of screen shots with helpful programming examples there.

Network Regions and Locations
Before I really get started on Network Regions, it might be helpful for you if I explain and contrast Network Regions with a somewhat related concept called Locations.

Within the CM environment Locations are used to organize a system (primarily for call routing purposes) into distinct geographic segments. Both Port Networks (on the cabinet form) and Media Gateways (on the media-gateway form) are assigned to a Location. When a digital or analog set is built on a card in the gateway (Port Network or H.248), it is automatically assigned to that location. This plays a critical role when assigning trunks for E911 calls placed by those devices (within the same sites’ gateways).

IP stations do not connect directly to a gateway. They are, therefore, assigned their location based on their Network Region. One of the ways this can be done is by mapping IP address ranges to regions in the form change ip-network-map. When IP phones that are assigned to a Network Region with this form register, they get the addresses of all of the gatekeepers (C-LAN and Procr) in their own region and in any direct WAN-connected regions. IP phones not assigned to a Network Region using this form only get the addresses of the gatekeepers in their own region and inherit the resources of that region.
Another programming area that you need to be aware of is `change node-names ip` where you need to build the table that references node names to their IP addresses. This serves as a sort of host table for port network components and `procr`.

Figure 1. change ip-network-map

Figure 2. change node-names ip form Screen
Note: Network Regions are programmed for C-LAN on form add IP-interfaces CCcscsss (Cabinet/Carrier/Slot) and procr on form add ip-interfaces procr.

Locations are determined by geography while Network Regions are determined by network topology. Since the two concepts do essentially the same thing (but for different devices), you may find it easier to program devices at the same site into the same number group (e.g., cabinet or media-gateway in group 7 and IP-network region 7).

You probably know this already, but there is a difference between a gateway and a gatekeeper. Gateways convert one type of communications protocol to another (e.g., analog, dcp, tdm), and provide digital signal processing (DSPs) so that audio can be transmitted over the LAN. Gateways include H.248 and port networks. Gatekeepers (C-LAN and Processor Ethernet) are the security guards that stand outside of the gateways. They register H323 IP phones with CM, and they handle signaling between CM and H323 IP sets. They usually reference alternate Gatekeepers. Before H323 IP sets and media gateways can operate with CM, they need to register with CM through a gate-keeper. Gatekeepers manage the signaling between CM and the devices.

Avaya describes the CM network as being able to “contain multiple interconnected servers and all of the equipment, including data networking devices, controlled by those servers.” This network could be installed within a large campus environment or in geographically dispersed environments.

From an organizational standpoint, it breaks down like this:

- A network can contain one or more systems.
- A system can contain one or more sites.
- A site can contain one or more network regions. Network Regions are numbered 1 to 250.
- A network region contains a logical grouping of endpoints, including stations, trunks, and gateways.

So (from smallest component to largest), a Network Region is part of a site, which is part of a system, which is part of a network.

One server can support multiple network regions. By default, Network Region 1 is assigned to all endpoints.

When a single server is able to support all of the endpoints in a customer network, decisions as to how the components communicate are generally LAN-related. When a single server isn’t capable of supporting all of the endpoints with one network, customers need to consider quite a range of connection issues, often expanding into WAN connectivity.
Figure 3. change ip network region 1 form Tab 1

Figure 4. change ip network region 1 form Tab 2
Figure 5. change ip network region 1 form Tab 3

Figure 6. change ip network region 1 form Tab 4
Administering IP Network Regions

You set up network regions so that you can group together IP endpoints (IP stations, IP trunks, Media Gateways and/or VoIP Signaling Resources [Media Processor and C-LAN circuit packs]) that share the same characteristics. Some of the characteristics that can be defined for these IP endpoints and resources are: Audio Parameters, Quality of Service Parameters, and WAN bandwidth limitations.

While the digital and analog endpoints that are common to many customer installations may not appear, on the surface, to be factors that need to be addressed in a network region because they directly connect on a separate wiring plant to cards in the system gateways, the gateways themselves are factors because they need to carry the call signaling data control messages from the phones to the server in the IP environment.

All IP endpoints must belong to a network region. By default, this is Network Region 1. As such, they share the same characteristics and resources of the region to which they are assigned. While assigning these endpoints to a single network region may be sufficient for some sites, there are several factors that argue for the creation of multiple network regions within a site. They include:

- When one group of endpoints requires a different CODEC than other groups. This would be especially true of video phones. CODEC conversion tasks can significantly impact Digital Signaling Processor (DSP) usage. Groups of endpoints could also need to be separated to satisfy bandwidth and encryption requirements.
- When calls between groups of endpoints require different codec sets than calls within individual groups do. This also involves considerations as to bandwidth and encryption.
- When specific C-LAN or MedPro or other resources must be accessible to only a specific group of endpoints
- When one group of endpoints requires a different UDP (User Datagram Protocol) port range or QOS (Quality of Service) parameters than another group.
- When one group of endpoints reports to a different VoIP Monitoring Manager server (an Avaya Integrated Management tool) than another group.

Although most customer LANs don’t suffer bandwidth constraints with normal data transfer, when you add voice, and even video, into the mix, the landscape changes. Decisions as to having CM run in its own dedicated network or integrated into the customer’s existing network (converged) directly impact bandwidth (among other things).

Drilling Down Deeper (Areas that Rely on Network Regions to Work)

Inter-Gateway Alternate Routing (IGAR)

In cases where a single server uses the WAN connection for carrying traffic between gateways, IGAR can provide a means of alternately using the PSTN when the IP-WAN is incapable of carrying the bearer connection. IGAR makes use of existing public and private-network facilities provisioned in a network region. Most trunks in use today can be used for IGAR (Public or Private ISDN PRI/BRI or R2MFC). One of the reasons that the network
A region/IGAR association could kick in is when a codec set is not specified between a network region pair or when forced redirection between a pair of network regions is configured.

Figure 7. change ip-codec set 1 form Tab 1

Figure 8. change ip-codec set 1 form Tab 2
Setting up Alternate Gatekeeper and C-LAN load balancing

As I pointed out earlier, when you map IP address ranges to regions in the form change ip-network-map, the IP phones that are assigned to a network region with this form register and get the addresses of all of the gatekeepers in their region and in connected regions. If registration with the original C-LAN circuit pack IP address is successful, the software sends back the IP addresses of all the C-LAN circuit packs in the same network region as the IP endpoint. That way, if the network connection to one C-LAN circuit pack fails, the IP endpoint re-registers with a different C-LAN. These addresses can also be used if the data network carrying the call signaling from the original C-LAN circuit pack fails.

This also allows for load-balancing (spread IP endpoint registration across more than one C-LAN circuit pack). This allows registrations within a network region to the C-LAN with the least number of sockets in use. The end result is an increase in system performance and reliability.

IP Telephones can be programmed to search for a gatekeeper independently of load-balancing through DHCP mapping.

Administering SIP trunks

In the Avaya Aura environment, SIP serves as the glue that binds all of the pieces together. SIP trunking functionality is available on any of the CM Linux-based servers. While the servers themselves function as "plain old telephone service" (POTS) gateways, they also support name/number delivery between and among the various non-SIP endpoints supported by CM (analog, DCP, or H.323 stations and analog, digital, or IP trunks), and SIP-enabled endpoints. The SIP endpoints themselves are registered to Session Manager (ASM), while the SIP trunk serves as a communication link between CM and ASM.

Communication Manager assigns two types of numbering to an incoming SIP trunk call:

- **Private numbering**: if the domain of the P-Asserted Identity (PAI), Form, or Contact header in an incoming INVITE message matches the authoritative domain of the called-party network region, or

- **Public numbering**: if the domain of the PAI, From, or Contact header in an incoming INVITE does not match the authoritative domain of the called-party network region.

Hairpinning and Shuffling

**Hairpinning** re-routs the voice channel connecting two IP endpoints so that the voice channel goes through the IP Media Processor (MEDPRO) circuit pack in IP format instead of through the TDM bus. Communication Manager provides only shallow hairpinning.

**Shuffling** an audio connection between two IP endpoints means rerouting voice channel away from the usual TDM bus connection and creating a direct IP-to-IP connection.

Shuffling and hairpinning are similar because they preserve connection and conversion resources that might not be needed, depending on the compatibility of the endpoints that are attempting to interconnect.
To use either hairpinning or shuffling, the endpoints must be either in the same network region or in different, interconnected regions, and there must be at least one common codec between the endpoints involved and the Inter-network region Connection Management codec list.

**Quality of Service**

**Transcoding.** When IP endpoints are connected through more than one network region, it is important that each region use the same CODEC (literally Code DE-Code) Codecs are small, special purpose computers that convert audio signals into their digital equivalent and assign the companding properties. Packet delays occur when different CODECs are used within the same network region. In this case, the IP Media Processor acts as a gateway translating the different CODECs, and an IP-direct (shuffled) connection is not possible.

**In Conclusion**

You set up network regions so that you can group together IP endpoints that share the same characteristics. In this way you can have control over the allocation of these resources to sites within your Communications Manager system.

**References**

You can find specific programming instructions for programming IP Network Regions in the Avaya PDF *Administering Avaya Aura® Communication Manager 03-300509.*

There are sections on:
- Defining an IP network region
- Setting up Inter-Gateway Alternate Routing (IGAR)
- Setting up Dial Plan Transparency
- Network Region Wizard (NRW)
- Manually interconnecting the network regions
- Administering inter-network region connections
- Pair-wise administration of IGAR between network regions
- Reviewing the network region administration

**Additional Avaya Resources**

These documents can be found at the Avaya Support.

*Network Region Wizard - The Network Region Wizard (NRW)* is a job aid (worksheet) and is a standard IM support tool that can be used with every Linux-based Communication Manager system.

*Network Regions for Avaya MultiVantage™ Solutions - A Tutorial* (requires Adobe Reader)

For more information on configuring network regions in Communication Manager, see the application note *Avaya Aura® Communication Manager Network Region Configuration Guide* (requires Adobe Reader)
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About the Author
Jim Husted has been in the Telecom industry since 1977 in a variety of capacities. His career as an educator began when he worked as a substitute teacher in the Las Vegas school system. After three and a half years, he determined that his real niche was teaching adults, so in 1996 he began as a contractor for Nortel teaching Norstar. Two things happened in 2000; Global Knowledge bought the training division from Nortel, and the BCM was introduced. He began teaching BCM and soon began teaching some CS1K installation courses as well. Along came the IPO, and he added that system into his portfolio. He also teaches Communication Manager Administration. Since 2000, except for a two-year period between 2004 and 2006 (when he returned to contracting) he has been a full-time employee of Global Knowledge.