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CCNP Collaboration Cloud and Edge Solutions

CLCEI 300-820

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well in this scenario because bandwidth will only be consumed at the locations involved with the call. This is true so long as the call is not a traversal call. With traversal calls, the media must always traverse through the Expressway. As mentioned in Chapter 6, “Registration on Cisco Expressway,” the Expressway supports four types of traversal calls: firewall traversal, SIP/H.323 interworking, IPv4/IPv6 interworking, and dual network traversal. The last type is only available on the Expressway Edge server. In the illustration of Figure 9-4, if an H.323 endpoint in Raleigh is trying to communicate with a SIP endpoint in Sydney, the media must travel through San Jose. Therefore, bandwidth at the San Jose site must be robust enough to support calls at all locations simultaneously, including San Jose itself. This could potentially create an issue with other calls connecting, even if they are not traversal calls. If the hosting site of San Jose runs out of bandwidth, signaling for call setup will not even get through this site. This is why this type of deployment model is not suitable for medium or large-sized organizations.

Complex Video Network with a Flat Dial Plan

As companies grow, the need for larger networks becomes inevitable. A simple means of scaling a network would be to add Expressways to each location. This creates a complex video network with a flat dial plan that would definitely overcome the limitations of the previously described deployment model.

This deployment model is complex for two main reasons. There are now more than one Expressway that need to be managed, and communication between the two or more Expressways needs to be established and maintained. However, the dial plan doesn’t change. You can continue to use the same flat dial plan used in the previous deployment model. Assume the same customer represented in Figure 9-4 simply adds an Expressway Core to each location, and then neighbors the Expressways together using Neighbor Zones. Because this model uses a flat dial plan, the Any Alias Search Rule could be used for each Neighbor Zone created. When an Expressway receives a call for an endpoint that is not registered locally, it sends out a **Location Request (LRQ)** to all the other Expressways it is neighbored to where there is a matching Search Rule. Figure 9-5 illustrates how this complex video network with a flat dial plan might look.

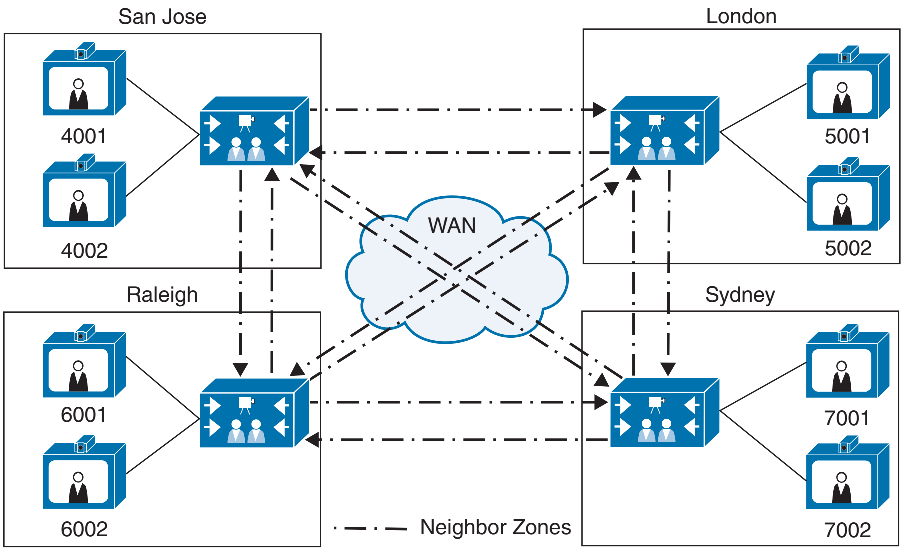

Figure 9-5 *Complex Video Network with a Flat Dial Plan*

There are several advantages to this type of deployment model. Even though it is called a complex video network, it is still a pretty simple concept to configure and maintain. So, the advantage of the simple video network holds true for this video network design as well. Additionally, the disadvantages of the simple video network become advantages within the complex video network model. Each Expressway is neighbored to all other Expressways in a full-mesh model. Therefore, there are three Neighbor Zones on each respective Expressway. Any calls between locations will consume bandwidth only within the involved locations regardless of the type of call, traversal or non-traversal. There is no longer a single point of failure either. If the Expressway in San Jose fails, calls are still possible between the other three locations.

Unfortunately, this deployment model is not impervious to disadvantages. All Expressways must know about all other peers. This means that this is not a very scalable solution. Adding or removing an Expressway requires changing the configuration of every Expressway. Already, there are three Neighbor Zones on each Expressway. If the customer with the network shown in Figure 9-5 decided to add a location in Paris, it would have to create four Neighbor Zones on the Paris Expressway plus one additional Neighbor Zone on each of the existing Expressways. That's eight Neighbor Zones, plus corresponding Search Rules, that must be created just to add one location. Then for each location added after that, the number of Neighbor Zones grows exponentially. This is definitely not a very scalable deployment model.

Another disadvantage is that one call attempt can result in many LRQs being sent out. As mentioned previously, when calling an endpoint that is not registered on the same local Expressway, a LRQ will be sent to every Expressway with a matching Search Rule. Because this deployment model uses a flat dial plan, all the Search Rules use the Any Alias pattern match. This will result in an external LRQ going out to every neighbored Expressway. This can create a call routing error called **Loopback**, which results in the call failing. Figure 9-6 illustrates how loops can occur in a full-mesh topology between Expressways.

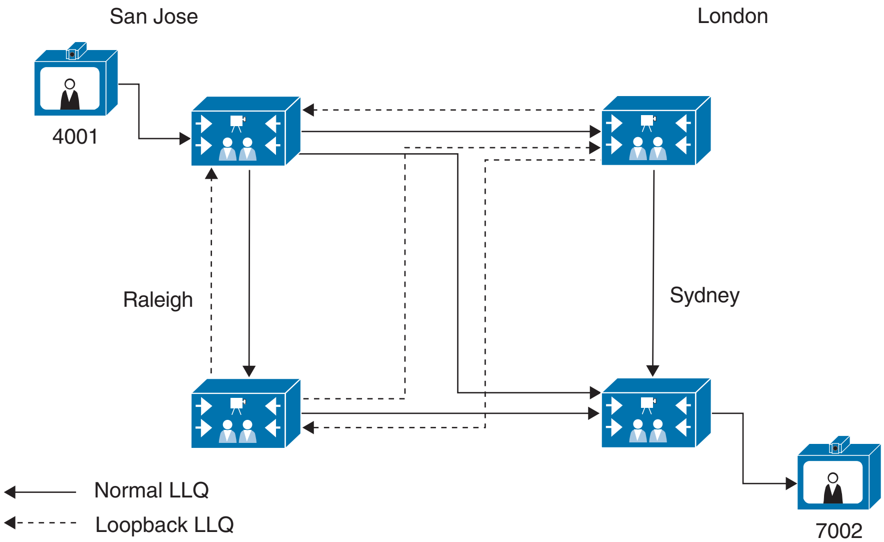

Figure 9-6 *Loopback Issues*

In Figure 9-6, endpoint 4001 in San Jose is attempting to call endpoint 7002 in Sydney. Because the alias 7002 is not registered to the San Jose Expressway, the Expressway sends out an LRQ to the London, Raleigh, and Sydney Expressways. Following the logical path, the Sydney Expressway identifies the endpoint registered locally and replies with a **Location Confirm (LCF)**. However, there are still two more searches out that must complete their cycle.

Because the destination endpoint is not found in Raleigh, that Expressway sends out its own set of LRQs to try and locate the endpoint. The request originated from San Jose, so the Raleigh Expressway does not send an LRQ back to the San Jose Expressway. However, it does send an LRQ to the London and Sydney Expressways. Likewise, the London Expressway continues the search from the San Jose LRQ by sending its own LRQ to Raleigh and Sydney. This is where the issue begins to propagate. Neither Raleigh nor London sent an LRQ back to San Jose from the original LRQ sent to these locations. However, Raleigh does send the LRQ from London to San Jose and Sydney. Likewise, London sends the LRQ from Raleigh to San Jose and Sydney. Even though the endpoint was located in Sydney, the call fails because the San Jose Expressway received a loopback LRQ on the original request it sent out.

Key Topic

The **Call Loop Detection Mode** setting on the Expressway prevents search loops from occurring. Each search has a call serial number and a call tag. The serial number is unique to the search, but the call tag information is passed with an LRQ. The Expressway uses the tag to identify a call that has already been received and hence ignored, preventing loopback errors. This is not a foolproof method for preventing loopbacks. However, customers for whom using a complex video network with a flat dial plan makes sense can still be protected from being crippled from this loopback issue. Figure 9-7 shows the Call Loop Detection Mode setting on the Cisco Expressway and the menu path to access it.

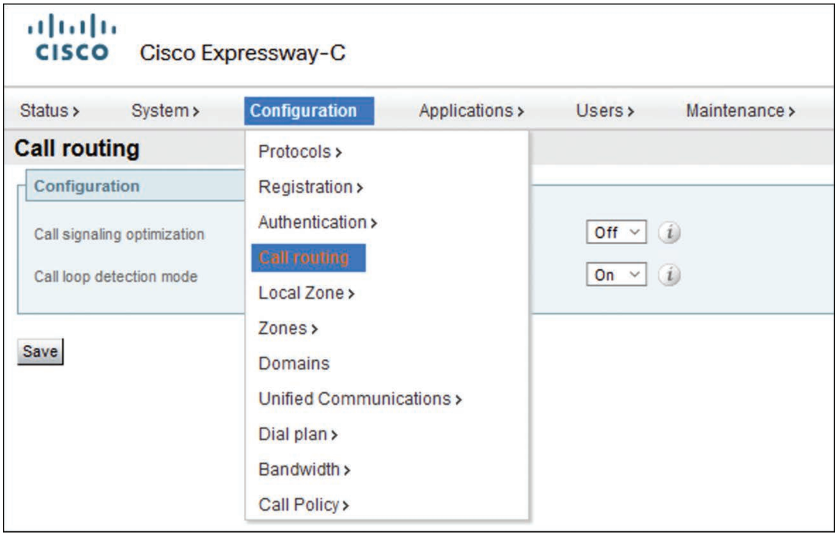

Figure 9-7 *Cisco Expressway Call Loop Detection Mode Setting*

Complex Video Network with a Structured Dial Plan

Because the Call Loop Detection Mode setting does not always work to prevent loopbacks, there is another deployment model that can be used as a foolproof method for preventing loopbacks. The complex video network with a structured dial plan introduces a more complex and structured dial plan that allows Search Rules to target specific locations based on the alias patterns that are matched. Figure 9-8 illustrates how a complex video network with a structured dial plan can be configured.

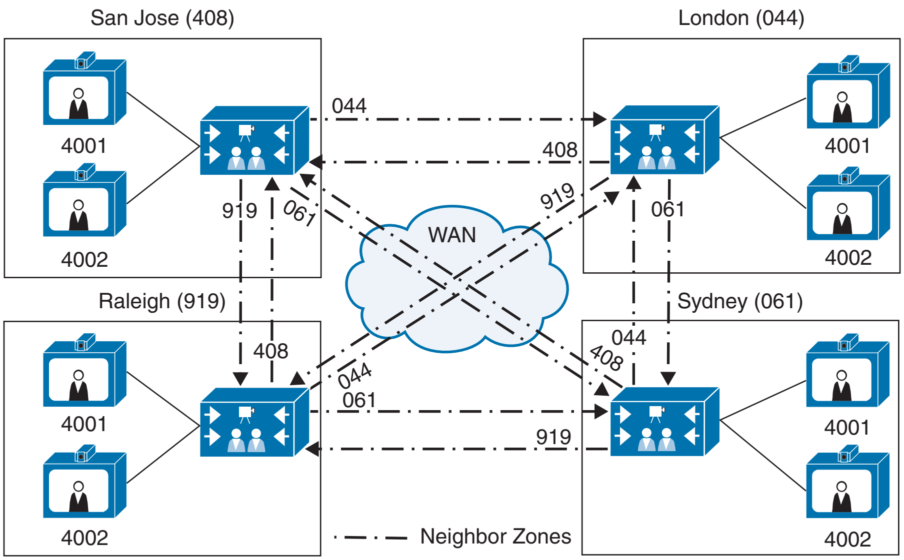

Figure 9-8 *Complex Video Network with a Structured Dial Plan*

In Figure 9-8, notice first that all the endpoints use the same four-digit numbers as their local extensions regardless of their location. In a production environment, it would not be necessary to use the same numbers on all endpoints. It is done in this example only to illustrate that the structure of this dial plan allows for this type of overlap in extensions. This in turn allows for up to 10,000 phones to be supported within each location while still using four-digit extensions. Using the flat dial plan exemplified in previous figures, only 1000 phones could be supported per location using a four-digit extension.

The real key to this structured dial plan is the use of a site code of sorts. These are not "site codes" like you would configure on the Unified CM. The Search Rules that would coincide with Figure 9-8 would actually use a prefix pattern match. A suffix could also be used for domain routing, if SIP URIs are being used as the alias type without a numeric host portion of the URI. In the case of Figure 9-8, a site code, or prefix, is assigned to each location. San Jose is 408, London is 044, Raleigh is 919, and Sydney is 061. These prefixes are not configured on the Expressways for the site they are assigned to. Rather, the Search Rules on the other three Expressways are configured with the prefix of the fourth Expressway. For example, a Search Rule on the London Expressway will be configured with the 408 prefix and applied to the San Jose Neighbor Zone. The default Any Alias rule for the Local Zone could be changed to use a regular expression that allows local dialing to include the London prefix or not. That regular expression would look something like this:

9

```
(044)?\d{4}
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The **(044)?** indicates that the dialed number can start with 044, or not. The **\d{4}** indicates there must be four numbers at least in this pattern match. If any endpoint in London dials 4084002, the call will be routed only to San Jose. It will not search the Local Zone, nor will it send an LRQ to Raleigh or Sidney. In this manner, the structure of this dial plan will prevent loopback errors from occurring. This is the greatest advantage of the complex video network with a structured dial plan.

Because this is still a complex video network, however, this solution still possesses most of the disadvantages of the complex video network with a flat dial plan. The greatest disadvantage is the lack of scalability. The complexity of this solution grows exponentially as each additional location with an Expressway is added.

Hierarchical Video Network with a Structured Dial Plan

The scalability issue of the previous two deployment models is resolved in the hierarchical video network with a structured dial plan. There is no need to neighbor all the Expressways with each other in a full-mesh pattern. One Expressway is nominated as the **directory Expressway** for the hierarchical deployment. The "directory" designation is in name only based on the network positioning and function this Expressway will serve. No actual settings or licensing determines if an Expressway is the directory Expressway or not. Each additional Expressway is neighbored to that directory Expressway, and the structured dial plan on the directory Expressway determines how calls are routed. Different directory Expressways can also serve as sub-directory Expressways by using a global directory Expressway between them. Figure 9-9 illustrates a hierarchical video network with a structured dial plan that uses a global directory Expressway with regional sub-directory Expressways.

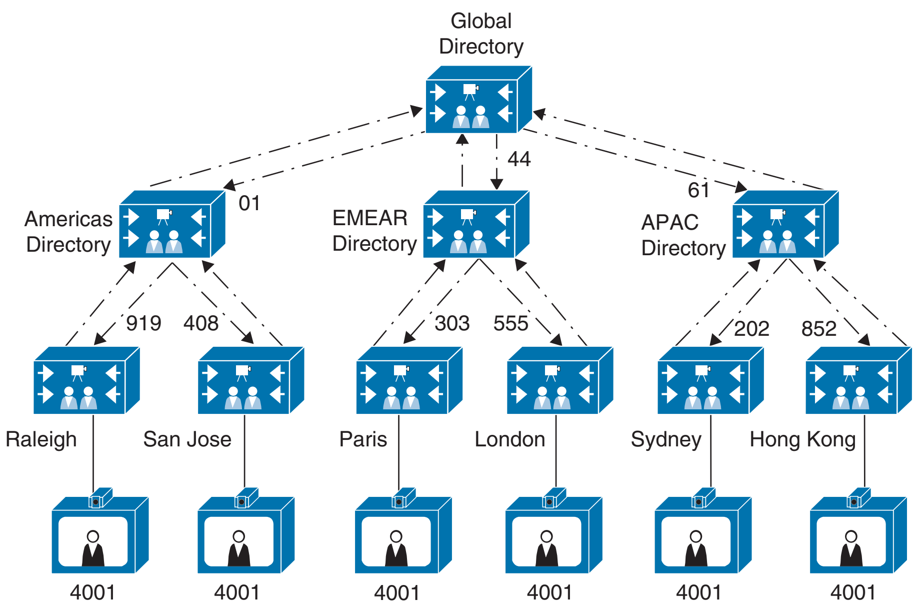

Figure 9-9 *Hierarchical Video Network with a Structured Dial Plan*

Obviously, this type of video network design would be best suited for a large enterprise corporation with a wide footprint that spans multiple locations. Each location possesses its own Expressway that can support the local registration of endpoints. In the example provided in Figure 9-9, there are three geographical regions, each represented with an Expressway acting as the directory for that region. The local Expressway for each location is neighbored to the regional directory Expressway and vice versa. Each regional directory Expressway is also neighbored to a global directory Expressway, and vice versa, so that communication can be shared globally. A structured dial plan accompanies this design so that loopbacks can be avoided, and calls can be routed quickly and easily between endpoints located in different locations.

As with each of the deployment models discussed previously, there are certain advantages and disadvantages to this model. We mentioned the first of these advantages at the beginning of this section. The hierarchical video network with a structured dial plan resolves the scalability issue of the complex video network designs. Adding a location only requires building two Neighbor Zones with corresponding Search Rules. Using the example in Figure 9-9, if the company wanted to add a location in Los Angeles, it would need to build a Neighbor Zone between the LA Expressway and the Americas Directory Expressway and vice versa. Now any endpoint from any location can call to an endpoint in LA and an LA endpoint can call to any endpoint at any other location. The company can add a location in Berlin, Germany, and only need to create two Neighbor Zones and corresponding Search Rules. It can add a location in Tokyo, Japan, and only need to create two Neighbor Zones and corresponding Search Rules. This deployment model is very scalable, only requiring the same minimum effort to add an unlimited number of locations each time.

Another series of advantages to the hierarchical video network with a structured dial plan is closely related to the scalability advantage:

Key Topic

- No fully connected mesh of Expressways is required. All local Expressways do not need to know all other Expressways. Each Expressway only needs to know how to reach its own directory Expressway.
- A minimized number of LRQs need to be issued when a call is attempted.
- Calls consume bandwidth only within the local Expressway locations.

The reason these advantages exist and are all so closely related has to do with a function of the Cisco Expressways called **optimal call routing**, which should be used anytime more than one Expressway is used. Figure 9-10 illustrates how optimal call routing operates.