Creating a Multi-Location Dial Plan Using
Avaya Communication Manager 2.0 - Issue 1.0

Abstract

This paper describes dial plan problems customers are likely to encounter when consolidating multiple independent office systems together into a single Avaya Communication Manager server with multiple media gateways, and points out how the latest Dial Plan enhancements included in Avaya Communication Manager 2.0 help make this consolidation easier.

1. Introduction

Customers almost always encounter dial plan problems when they consolidate multiple independent office systems together into a single Avaya Communication Manager (CM) server with multiple media gateways. This White Paper describes these problems, and shows how the latest Dial Plan enhancements included in CM 2.0 help make this consolidation easier. The intended audience includes Avaya Tier III and Tier IV technical support and design personnel, as well as customers developing a dial plan migration strategy for their corporate voice network.

A critical goal is that these notes be brief enough that the reader can find what he/she needs quickly, and that they contain just enough detail to explain things clearly without overwhelming the reader with non-essential information. In particular, *it is not the intent of these notes to explain feature administration and operation*, except for aspects that may be overlooked or misunderstood. This information can be found in customer documentation (see http://support.avaya.com).

2. Summary of Points

- Numbers are a more limited resource than many people realize.
- It may be impossible to collapse down to a single server without changing the extensions of one or more groups of users.
- To avoid numbering conflicts, the customer may need longer extensions than one might expect, based solely on the number of extensions the customer actually uses.
- Customers using DCS must migrate to QSIG if more than just name/number display are required.
- Migration of Voice Mail servers and other adjuncts such as CMS must be considered as well.

3. Challenges Faced

Many larger customers like the idea of consolidating dozens or even hundreds of existing office phone systems into a single media server such as the Avaya S8700, with media gateways replacing the many smaller systems. Management of the voice network can be done centrally by a few people. And when the customer enables or purchases a new system feature, all the company's users get the new feature at the same time, without the headache of upgrading many systems over a period of weeks or months.

Immediately, when a customer starts contemplating a consolidation like this, challenges pop up with respect to the dial plan. Those from a data-networking background may assume that reassigning extensions is as straightforward as reassigning IP addresses. But in fact, when a user has had an extension for a long time, and the external (DID) version of that extension is well known to his/her customers, changing that extension often causes even more turmoil than changing the same user's office number or street address. It is more analogous to changing a person's e-mail address.

Dial Plan conflicts fall into several categories, as covered in the following subsections.

3.1 Overlapping Extensions: Simple Case

Number conflicts are almost always present during a consolidation, especially when a large number of existing systems are involved. Let's take as an example a medium-sized customer with 8,000 employees of which 4,000 are at the headquarters, 2,000 are in a call center office, and the rest are dispersed among 30 branch offices. If we were starting from scratch, we could easily create a dial plan with 5-digit extensions and lots of room for growth, such as the following:

Pattern	Assignment	Available/Used
0	Operator / Attendant	1 available, 1 used
1xx	Trunk Access Codes	100 available, 83 used
2xxxx	Internal (non-DID) extensions	10,000 available, 1,000 used
30xxx – 37xxx	Extensions at Headquarters	8,000 available, 4,000 used
38xxx – 39xxx	Call Center	2,000 available, all used
4xxxx	Extensions in branches	10,000 available, 2,000 used
5xxxx 6xxxx 7xxxx	available for future growth	30,000 available, none used
8	AAR Feature Access Code (inter-office private-network calls)	1 available, 1 used
9	ARS Feature Access Code (public-network calls)	1 available, 1 used
*xx, #xx	other Feature Access Codes	n/a

Table 1: Sample Dial Plan for Medium-Sized Company

But in our scenario the customers is not starting from scratch. For example, what if Mary in Philadelphia already has the number **215-799-0958** and Jim in Minneapolis has **612-989-0958**? The last 5 digits of both numbers are the same. With independent systems, that is not a problem -- Mary and Jim use 3-digit dialing within their small branch offices (e.g., they can be reached by dialing **x958**), and to call each other, they simply dial ***9** followed by **1** and the 10-digit public number.

To collapse Jim's and Mary's systems into a single S8700, the customer cannot use the 5-digit dial plan shown in Table 1 (even though it has lots of room for growth) *if it is critical for Jim and Mary to keep dialing the way they were accustomed to*. The customer must instead create a 6-digit or 7-digit dial plan, even though that is really much longer than they need from the point of view of capacity.

3.2 Overlapping Extensions: More Complex Cases

The example in the previous subsection is relatively straightforward. Here are a few more complicated twists that can face a customer:

- One small office may have had 3-digit extensions starting with **4**; another larger office may have had 5-digit extensions starting with **4**.
- Two users may have had the exact same 7-digit number, with only the 3-digit area code being different (in the above example, Mary's number may instead have been **215-989-0958**).
- One office may have used **9** as the leading digit for an extension and ***9** as the ARS access code; another may have used **9** as the ARS access code.

Solutions to these issues can be found in Sections 4.1 through 4.4.

3.3 Overlapping Dial Access Codes

Large companies often have offices in several countries. If these offices migrate to a single media server, a number of questions arise. For example, what if users in one country expect to hear a different dial tone than those in another? Multinational questions such as these are outside the scope of this White Paper; they are covered in the White Paper *AVAYA Communication® Manager Application Notes: Configuring a Multinational Server (08/19/04)* [COMPAS 101178].[1]

The Multinational White Paper covers a scenario in which the system Dial Plan spans country boundaries. Specifically, Section 4.2.3 describes the case where users in North America are accustomed to dialing **9** to reach an outside line (that is, access ARS), while users in Europe generally dial **0** to do so. Similarly, users in North America typically dial **0** to reach an attendant, while in Europe they may dial **9** or **1**.[2]

Other Dial Access Codes (DACs) may conflict as well -- perhaps one office uses ***20** to activate Call Forwarding, while another uses the easy-to-remember code ***CF** (that is, ***23**). It is not possible to support two different DACs for Call Forwarding on the same server. But most DACs are less "culturally significant" than ARS and Attendant: that is, the "outside line" and "operator" DAC tend to be common across multiple companies and even in hotel rooms, creating more resistance to a change among users.

Finally, Trunk Access Codes (TACs) must be assigned uniquely for each trunk group in the consolidated system. Since users typically use ARS, AAR, or UDP to place outside calls, only the administrator needs to know the system TACs. However, the range of TACs used on one formerly independent system (e.g., **7xx**) may conflict with a range of extensions the customer wishes to assign in the consolidated system (e.g., **799-0958**). Does that mean all TACs and DACs must be "squeezed" into the range of 2000 numbers starting with * and # (that is ***000** - ***999** and **#000** - **#999**)?

Solutions to these issues can be found in Section 4.5.

3.4 Local Trunking: Pros and Cons

Before the consolidation, each office had its own local trunks: either public-network trunks, private-network trunks, or a combination of both. With a consolidated system, every office potentially has access to the trunk groups at every other office. That may not be desirable, if for example each office is responsible for paying for usage over its local trunks.

On the other hand, some customers may find it *desirable* for calls to route through their LAN/WAN and "hop off" the gateway nearest to the called party. For example, if Jim in Minneapolis calls a customer in suburban Philadelphia, the customer could save money by having the call route through the corporate WAN to Mary's office and then route "off-switch" using a local trunk to reach the called party.

Solutions to these issues can be found in Section 4.6.

3.5 UDP and DCS Feature Transparency

CM software has for many years included the Uniform Dial Plan (UDP) feature, which lets users on independent servers call each other using a 4-digit or 5-digit numbering plan, giving them the "feel" of being part of a single larger system. In addition, customers can get Calling Name and Number display (at the called party) if they use ISDN or H.323 trunks between servers.[3]

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1. This paper is available at http://support.avaya.com under Communication Systems -> Communication Manager 2.1.
2. Assigning multiple ARS or Attendant Access Codes requires the *Multiple Locations* feature. *Multinational Locations* and *Multiple Locations* are separate, but not independent, Optional Features. In general, a customer only needs *Multinational Locations* if their Media Gateways span international boundaries.
3. Calling Number is a standard feature provided by public-network ISDN trunks. Calling Name can be transported without DCS or QSIG over private-network ISDN and H.323 trunks using Supplementary Service Protocol A.

Avaya also offers a Feature Transparency protocol called DCS. This protocol goes one step beyond UDP, in that a selected number of high-runner features work across servers. The most popular of these features are as follows:

- Internal Ringing (at the called party)
- Called Name and Number display (at the calling party)
- Centralized Voice Mail
- Enhanced Call Coverage
- Path Optimization

If a server consolidation requires migration to a 6-digit or 7-digit dial plan, UDP will continue to work, but DCS will not. Therefore, migration to QSIG may be required. This is covered in Section 4.7.

3.6 Voice Mail and Other Adjuncts

If extensions must be lengthened and in some cases changed, changes are required to voice mail and other adjuncts such as CMS that customers rely on each and every day. Questions like these are outside the scope of this White Paper; they are covered in the paper *Recommendations for Migration From DCS/DCS+ to QSIG In Preparation for 4/5 Digit Dial Plans to 6/7 Digit Dial Plans Conversions* [COMPAS 91858].[4]

4. Challenges Addressed

4.1 Managing Overlapping Extensions

Avaya Communication Manager 2.0 allows great flexibility in breaking the dial plan into components that do not conflict. Up to four digits can be entered in the Dialed String column, meaning that a number with the leading digits **8498** can have a different length and call type from a number starting with **8490** --- meaning that you can have extensions **84900** through **84909** as well as **849-8000** through **849-8999**. This is shown in Table 2 and was not possible prior to Release 2.0.

Dialed String	Total Length	Call Type
8490	5	ext
8498	7	ext

Table 2: Four-Digit Dialed String Example

The Dial Plan also now permits "exception" entries, similar to what has been permitted in the ARS and AAR forms for many years. Working from the previous example, Table 3 shows how you can specify that the leading three digits **849** indicate a seven-digit extension, *but* if the fourth digit is **0**, we have a five-digit number. In this case, we would have extensions **84900** through **84909** and **849-1000** through **849-9999**. This was also not possible prior to Release 2.0.

Dialed String	Total Length	Call Type
849	7	ext
8490	5	ext

Table 3: Exception Dialed String Example

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4. This paper is also available through Avaya sales teams.

Finally, it is still possible to create an "ambiguous" dial plan, in which the system cannot determine the length of a dialed number based on the leading digits. In such a case, the system uses the Short Interdigit Timer (which defaults to 3 seconds, but which can set to any value from 3 to 9 seconds). In Release 2.0 this must be administered using single-digit Dialed Strings, as shown in Table 4.

Dialed String	Total Length	Call Type
8	5	ext
8	7	ext

Table 4: Ambiguous Dialed String Example

4.2 A Simple Example

The capabilities described in Section 4.1 let users keep dialing extensions the way they did before their office system was replaced with a media gateway and their extensions were lengthened. Here is a simple example showing how it can work.

Assume three offices are consolidated into a single server. Local trunks deliver DID traffic inbound to each office. Users at each office dial four digits to reach others in the same office. After the consolidation, the dial plan is as follows:

Dialed String	Total Length	Call Type	DID Numbers	Comment
5243	7	ext	912-524-3xxx	Savannah branch 7-digit extensions
5246	7	ext	505-524-6xxx	Albuquerque branch 7-digit extensions
538	7	ext	303-538-xxxx	Denver main office 7-digit extensions
6	4	ext	n/a	local office 4-digit dialing (Albuquerque & Savannah only)

Table 5: Simple Example

Note that we preserve 4-digit dialing in the two branch offices by reserving the leading digit **6** for that purpose -- even in Savannah, where the last four digits of the DID number start with the digit **3**. The Appendix describes how this works -- how 4-digit "short" extensions can be mapped to 7-digit "real" extensions.

The customer can use ARS to control whether calls between offices travel over local PSTN trunks or the corporate WAN. If the WAN is the better route, then ARS Digit Conversion can change a dialed number such as **9-1-912-524-6246** to extension **524-6246** and treat the call as an "on-switch" call. Otherwise, ARS Analysis sends the dialed number to a Route Pattern and then over a local PSTN trunk group. Section 4.6 covers local trunking in detail.

4.3 Maintaining Dialing Patterns

In the example in Section 3.1, Jim and Mary were both accustomed to dialing **9xx** to reach another extension in their office. However, users in larger offices dialed **9** as their ARS access code, so if Table 1 were implemented unchanged, Jim and Mary would have to dial differently after the consolidation. The following subsections show different ways this can be handled.

It is important to note that there is no "free lunch". Some group of users must learn a new dialing pattern. The Dial Plan offers great flexibility, but when a direct "head to head" conflict exists, the system administrator must decide in favor of one or another group of users. In such a case, the impact on each group of

users to a dial plan change must be taken into consideration. As an example, groups such as Sales or Marketing may be highly resistant to getting a new extension (because of external customers that have their number on business cards), while other groups may grumble for a while, but over time will adapt to the new extensions and dialing patterns.

Solution 1: Jim and Mary Don't Have to Change

In this case, Jim and Mary (and their peers at small locations) can keep dialing **9xx** to reach others in their office, and the ARS access code for all users becomes ***9**. The details of how to make this work are covered in the Multinational White Paper cited earlier [COMPAS 101178] and will not be repeated here (for the reader's convenience, the relevant section is replicated in the Appendix of this White Paper); however, the Dial Plan entries *are* important to this discussion and are shown in Table 6. Some notes on the table:

- Jim's and Mary's extensions are actually administered using seven digits.
- A block of 3-digit numbers starting with the digit **9** is also reserved for local dialing in small offices.
- **989** <u>cannot</u> be used as a 3-digit local dialing extension, because it is reserved as the leading digits for 7-digit extensions in Minneapolis.

Dialed String	Total Length	Call Type	Comment
799	7	ext	Philadelphia 7-digit extensions
9	3	ext	3-digit dialing within small offices
989	7	ext	Minneapolis 7-digit extensions
*	3	fac	default 3-digit feature access codes
*9	2	fac	2-digit FAC for ARS

Table 6: Jim and Mary Don't Have to Change

Solution 2: Jim and Mary Have to Dial a Prefix Digit

In this case, Jim and Mary can no longer dial three digits, but have to dial a leading digit **4** before the old 3-digit number to reach their local colleagues. The ARS access code is **9** -- this conflicts with the leading digit of the central office exchange in Minneapolis (989), so extensions in Minneapolis must instead be assigned using different leading digits such as **889-xxxx**, as shown in Table 7.

Dialed String	Total Length	Call Type	Comment
4	4	ext	dialing within a small office
799	7	ext	Philadelphia extensions
889	7	ext	Minneapolis extensions
9	1	fac	ARS FAC

Table 7: Jim and Mary Have to Change

4.4 Managing Different-Length Extensions

The previous example was simple, because we focused solely on small locations with 3-digit numbers before the consolidation. Let's take a more complicated example, where a medium-sized company has branch offices in Düsseldorf, Munich, Frankfurt, and Hamburg, Germany, as well as Vienna, Austria and Geneva, Switzerland. The offices in Munich and Frankfurt are bigger than the others, so they have 4-digit instead of 3-digit dialing. Assume in this case the company decides to migrate to 6-digit extensions, in

Author: CDB
Systems Engineering - Lincroft White Paper
page 7 of 18
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COMPAS 106860

order to keep the public-network number and the internal extensions as much the same as possible. Perhaps they would decide on a dial plan like that shown in Table 8.

Dialed String	Total Length	Call Type	Comment	Public DID Number
1	1	attd	attendant console	
2	3	ext	dialing within a small office	
2	4	ext	Munich 4-digit dialing	
2042	6	ext	Hamburg	8 digits: 27.20.42.xx
2963	6	ext	Geneva	7 digits: 829-63xx
3	3	ext	dialing within a small office	
377	6	ext	Frankfurt	8 digits: 54.37.7x.xx
4	3	ext	dialing within a small office	
5	3	ext	dialing within a small office	
532	6	ext	Vienna	9 digits: 24.55.32.xxx
5621	6	ext	Düsseldorf	7 digits: 85.62.1xx
6	3	ext	dialing within a small office	
7	4	ext	Frankfurt 4-digit dialing	
752	6	ext	Munich	8 digits: 21.75.2x.xx
8	3	ext	dialing within a small office	
9	3	ext	dialing within a small office	
0	1	fac	ARS access code	

Table 8: Sample Dial Plan with Mixed-Length Dialing

Some things about the above dial plan are worth emphasizing:

• Note the use of "exception" entries for the first digits **2**, **3**, **5**, and **7**. The 6-digit extension entries each "remove" one 3-digit entry from the local dialing block. In other words, it is not possible to administer extensions **204**, **296**, **377**, **532**, **562**, or **752**, as these leading digits are reserved for 6-digit extensions.

• Note also the use of "ambiguous numbering" for the first digit **2**. That is, when a caller in Düsseldorf dials the 3-digit extension **272**, the call takes an extra three seconds to route. This delay can be avoided in a number of ways:

   - Users can be trained to dial a trailing # after 3-digit numbers starting with **2**.

   - The two blocks of extensions can be made disjoint, so that the ambiguity is removed. However, this probably requires that some extensions be changed to eliminate the overlap. A simple solution is shown in Table 9, trading 30 three-digit extensions for 300 four-digit extensions.

Dialed String	Total Length	Call Type	Comment
2	3	ext	

Table 9: Resolving a Mixed Numbering Scenario (#1)

Author: CDB
Reviewed: various
Date: 1 October 2004

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page 8 of 18
MLDP-WhtPpr.mkr
COMPAS 106860

Dialed String	Total Length	Call Type	Comment
22	4	ext	Because of these entries, 22x, 23x, and 27x can no longer be used as 3-digit extensions.
23	4	ext	
27	4	ext	

Table 9: Resolving a Mixed Numbering Scenario (#1)

- Specific exceptions can be entered. This is, of course, more time-consuming, but the more specific the exception, the fewer extensions are lost from the default extension range, as shown in Table 10.

Dialed String	Total Length	Call Type	3-digit Extension Eliminated
2	3	ext	
2100	4	ext	210
2125	4	ext	212
2159	4	ext	215
2359	4	ext	235
2368	4	ext	236
2386	4	ext	238
2555	4	ext	255
2765	4	ext	276

Table 10: Resolving a Mixed Numbering Scenario (#2)

4.5 Dial Access Codes

ARS and Attendant

ARS and Attendant access codes are typically a single digit. Thus, if two ARS single-digit access codes must be supported in a consolidated system, then two out of a possible ten first digits are unavailable to be assigned for other purposes. Similarly, if two Attendant access codes must be supported, one or two more first digits are consumed. This is because the ARS and Attendant access codes cannot also be the leading digit of another call type.

Note that in North America, 7-digit public numbers never begin with **0** or **1**. Since **0** is often used as the Attendant access code, that still leaves the first digit **1** as a reserved leading digit for special purposes when a customer migrates to a 7-digit dial plan. In Europe, it is also true that local public numbers do not begin with **0** or **1**, but **0** is generally reserved for the ARS access code. But again this leaves **1** as an open leading digits that can be reserved for special purposes, such as phantom extensions associated with features such as Security Violation Notifications or Separation of Bearer and Signaling.

These issues may drive a customer to choose longer extensions than they might otherwise have selected. And it may force the customer to assign new extensions to users that previously had an extension that conflicts with the ARS or Attendant code (typically **9** or **0** or **1**). Or even more likely, it may be a reason not to consolidate the North American and European media servers into a single server.

Features Other Than ARS and Attendant

If a particular DAC is different between two systems being consolidated, the users on one system must learn to use a different DAC. Alternatively, since most features can be accessed via a DAC or a button push, users can be assigned a softkey or feature button -- in that case, they do not need to learn the new DAC. Note that if all users that need a particular feature are given a button, *then no DAC is needed, and the DAC can be freed up for another purpose*. For example, if all users have a **call-park** button, then the **Call Park Access Code** on the Feature Access Codes form can be left blank.

Trunk Access Codes

The restriction described in the previous subsection also applies to *dialable* Trunk Access Codes (TACs) -- that is, those that belong to a trunk group for which *Dial Access* is enabled. Since users access most trunks via ARS or AAR or UDP, a customer can disable *Dial Access* for most or even all system TACs. These frees up the first digits used by those TACs. For example, if TACs have the format **7xx**, Table 11 shows how a customer can assign extensions starting with **7**, as long as the TACs are non-dialable and the extensions are four digits or longer.

Dialed String	Total Length	Call Type
7	3	dac
7	7	ext

Table 11: Non-Dialable TAC Example

It is tempting to use the exception technique for the extension entry, as shown in Table 12. This removes the requirement that the TACs be non-dialable, since the conflict between the two entries is gone (thanks to the rule that the longest matching Dialed String is the one selected). But remember that you cannot assign **799** as a block of 7-digit extensions if **799** is assigned as a DAC. Similarly, you cannot assign **79** as a block of 7-digit extensions if a DAC of the form **79x** is assigned.

Dialed String	Total Length	Call Type
7	3	dac
799	7	ext

Table 12: Dialable TACs with Extension Exception

4.6 Local Trunks for Public-Network Calling

As described earlier, some customers want calls from a media gateway to travel over their corporate WAN as much as possible before "hopping off" to the PSTN, while others want to restrict branch offices to using only the local trunks connected to the media gateway in their office, even after a consolidation makes it possible for that office to access the trunk groups at every other office.

Several solutions are possible, depending on the particular customer need.

Per-Location ARS

Several releases ago, CM software was enhanced to support multiple concurrent ARS tables. This feature is called *Multiple Locations*[5] on the Optional Features form, and was designed to let traditional port networks (PNs) be located at great distances from each other by means of ATM connectivity. Because of the great distances, the local public-network dial plan for one PN is likely to be different from another -- for

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5. Details of this feature are available in customer documentation.

example, a PN in Denver is required to dial ten digits for local calls, while one in Trenton can dial local calls using seven digits.

The intent of this feature is for all port networks or media gateways in the same geographic area to share the same ARS table; however, because each ARS table can assign its own route patterns to the various Dialed Strings, this mechanism can also be used to provide local trunking.

Let's look at the Denver gateway first. It could be designated Location 58 (a randomly selected number) with the following ARS entries:

Dialed Number	Min/Max	Route Pattern	Comment
1	11	581	national calls
1719, 1970	11	582	calls within Colorado
303, 720	10	583	Denver-area calls

Table 13: ARS Table for Denver Location

The Trenton gateway could be Location 19 (another randomly selected number) with these ARS entries:

Dialed Number	Min/Max	Route Pattern	Comment
1	11	191	national calls
1201, 1732, 1856, 1908, 1973	11	192	calls within New Jersey
2, 3, 4, 5, 6, 7, 8, 9	7	193	609-area calls

Table 14: ARS Table for Trenton Location

Now let's add a new location in Atlantic City. Atlantic City is also in the 609 area code, but we want Atlantic City to use its own trunks. We could add Atlantic City as Location 62 with these entries:

Dialed Number	Min/Max	Route Pattern	Comment
1	11	621	national calls
1201, 1732, 1856, 1908, 1973	11	622	calls within New Jersey
2, 3, 4, 5, 6, 7, 8, 9	7	623	609-area calls

Table 15: ARS Table for Atlantic City Location

Tenant Partitioning

Another way to provide local trunking is with Tenant Partitioning.[6] This feature partitions not only trunks, but a host of other system features such as attendants. The S8700 server supports 100 tenant partitions.

To provide local trunking using Tenant Partitioning, each gateway (or group of gateways) must be designated as a separate tenant. The trunks local to that office are assigned the same tenant number as that

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6. Details of this feature are available in customer documentation.

office. CM routing algorithms automatically skip any trunk group in a route pattern that the calling party is not allowed to access (based on the calling permissions administered for each tenant).

So, using the example in the previous section, Trenton becomes Tenant 19 and Atlantic City is Tenant 62. They share the same ARS table (since they reside in the same area code) and Route Patterns, but Tenant Partitioning forces users from Trenton to route exclusively over Trenton trunks. In other words, the ARS table for Trenton and Atlantic City would look like Table 14 or 15. Denver still needs its own ARS table to support 10-digit local dialing.

One limitation of this solution is that each Route Pattern on an S8700 server supports only 16 preferences. To support more than 16 different local trunk groups for gateways in the same area code, the customer must combine Tenant Partitioning with one of the other solutions presented in this section.

Another limitation is that this solution assumes users are not mobile. If a Trenton user drives to Atlantic City and logs in with an IP Softphone, the Multiple Locations feature adjusts accordingly and assigns the user an Atlantic City trunk when the user makes an outgoing call. Tenant Partitioning, on the other hand, requires administrator intervention to assign local trunks to a user logged in via an IP Softphone.

One advantage of this solution is that it also handles private-network calls dialed using AAR, whereas per-location ARS does not.

ARS Partition Groups

Local trunking can also be provided on a small scale using ARS partition groups. Each ARS entry can be associated either with an "array" of up to eight Route Patterns. Similar to the Tenant Partitioning solution, each office can be assigned to a separate partition group. When a user in a given office dials a number, the Communication Manager routing algorithm selects the appropriate route pattern and local trunk group associated with that office.

So, using our example, Trenton is assigned Partition Group 2 and Atlantic City is Group 3. They share the same ARS table, but instead of being routed to a single Route Pattern, they are routed to an intermediate Partition Route Table. Calls within New Jersey (see Table 14) can be assigned to *p29*. Partition Route Table entry 29 can then route calls from Partition Group 2 (Trenton) to Route Pattern 622, and calls from Partition Group 3 (Atlantic City) to Route Pattern 355. As before, Denver still needs its own ARS table to support 10-digit local dialing.

Like Tenant Partitioning, this solution also handles private-network AAR calls. On the down side, it also assumes users are not mobile.

Forcing Calls to Use Trunks (not the WAN)

Customers may request an *automatic* way to force calls between geographically distant offices to travel over the same public-network trunks they used before. They may be aware of the Call Admission Control (CAC) feature, and wonder if that can be used to do so. It can help, but it cannot do the complete job.

Release 2.0 supports two ways of forcing calls to travel over trunks between offices:

1. Use the CAC feature to block users from calling another office by dialing the extension directly. This forces them to places inter-office calls using AAR or ARS, as they did before the consolidation.

2. Set up the Uniform Dial Plan as the first place the system looks when routing an internal call. The UDP table can then map the extension to an ARS or AAR number. When the call arrives over a trunk at the distant office, use location-based ARS to convert the number to a local extension.

The second case works as follows, assuming the customer uses 7-digit extensions.

- **Dial Plan Parameters form**: Set *UDP Extension Search Order* to *udp-table-first*.

- **UDP form**: Map extensions to PSTN numbers. For the Jim & Mary example from Section 4.3, when Mary dials Jim's extension **989-0958**, the UDP form maps it to the ARS number **1-612-989-0958**.
- **Location-based ARS**: At Mary's location, the ARS digits **1612** route to a local trunk group. The digits **989-0958** arrive over the incoming trunk group at Jim's location. UDP converts those digits back to **1-612-989-0958**, but Jim's ARS Digit Conversion table deletes the leading area code and disables further conversion because the *Conv?* column is *n*. Jim's phone rings, and the call is complete.

4.7 QSIG and QSIG-VALU

QSIG is an international standard by which CM software can support certain features not only among Avaya servers, but also between Avaya and non-Avaya servers such as Nortel and Siemens. CM software also supports QSIG-VALU, which goes beyond QSIG to provide an even higher level of feature transparency in an all-Avaya network, in many cases beyond what was supported by DCS.

As noted earlier, when a customer migrates to a 6-digit or 7-digit dial plan because of a server consolidation, they must also consider migrating from DCS to QSIG. The details of how to do this are beyond the scope of this document; instead, they are covered by other White Papers such as the DCS-QSIG Migration Paper cited earlier [COMPAS 91858].

The main point to be made here is that customers often consider DCS and UDP to be the same feature. However, if the DCS features listed in Section 3.5 are not critical to certain user groups, then it may not be necessary to migrate them to QSIG. Instead, it may be sufficient to give them UDP dialing to other offices. When used in conjunction with a network feature such as the AT&T Software Defined Network or MCI VNET, available in the United States, the users will see the Calling and Connected Name and Number on their display, and that may be sufficient.

4.8 Voice Mail Servers and Adjuncts

An independent network of Communication Manager servers can have a separate voice mail system at each site. When the servers are consolidated, the customer must keep in mind that a single CM server can support only a handful of Voice Mail servers:

- no more than eight Intuity® Audix systems
- no more than ten servers such as Modular Messaging (designated as QSIG-MWI hunt groups).

This means consolidation of Voice Mail servers must be an integral step whenever CM servers are consolidated. One option would be to consolidate the VM servers first, since that can be done right away, without making any changes to the dial plan.

Likewise, if the extensions of call center agents are changed due to a consolidation, adjuncts such as CMS must likewise be updated. See the DCS-QSIG Migration Paper cited earlier [COMPAS 91858] for details.

5. Challenges Not Addressed

Despite the new dial plan flexibility discussed in Section 4, some challenges remain when consolidating the dial plans of formerly independent offices.

5.1 Survivability

When a gateway becomes completely disconnected from the main server, it goes into "survivability" mode. If inter-office calls were routed through the corporate WAN, and a survivability condition persists, the customer may need to intervene to reroute calls over the PSTN, and they may need to notify users that many features have become temporarily unavailable. For example, calling/called party displays will differ, and call setup times will be longer. The details of survivability mode are outside the scope of this paper.

5.2 Displays

Avaya Communication Manager (CM) 2.0 lets users in small offices dial "short" extensions to reach other users in the same office, provided the leading digits of the extensions of each user matches. For example, in the Philadelphia/Minneapolis solution shown in Table 6, Jim and Mary can dial **9xx** to reach their local colleagues. However, the display on the calling and called terminal is the full, "long" extension -- for Jim, that would be **989-09xx**. The display on call appearance buttons on stations with downloadable button labels will likewise be the "long" extension.

Furthermore, CM software provides only a single display format for all 6-digit and all 7-digit extensions. It may happen in a mixed-length scenario (for example, Section 4.4) that a single display format does not work for all users. For some, the format **xxx-xxxx** may be best, while for others, **xxxx-xxx** may be the most logical. This could happen if one large group of users is at headquarters, where the normal North American format is most intuitive, while the other group is at retail stores, where the leading four digits are the store number, and the trailing three digits are the internal extension. The only way to resolve this conflict is to use two independent servers for the different user communities, each of which uses its own display format.

5.3 IP Agents and Expert Agent Selection

Many call centers use the feature Expert Agent Selection. With this feature, a call center agent logs into a logical extension when he/she begins work each day. The agent may log into this extension from any physical station in the call center office. Thus, a call center agent consumes two extensions -- one for the physical station, and another for the logical extension.

With the IP Agents, customers may ask if they can conserve extensions, because the IP Agent is able to log in from a PC without sitting at a physical station. Unfortunately, this is not possible. The system needs both extensions to support the existing range of call center features.

5.4 Common Shared Extensions

Some retail store customers use the Common Shared Extensions (CSEs) associated with the attendant group to park incoming calls for retrieval by store employees after they are paged. They would like to use the same range of CSEs at every store after the stores are consolidated, to maintain the same functionality they had before they migrated to an S8700 with a gateway in each store.

Since CSEs are not assignable per location, a workaround is needed. In a nutshell, customers must create the necessary CSEs by hand. The following explains how the workaround solves the problem:

- **Before Consolidation**: Each store had an identical dial plan with the same block of CSEs assigned. As an example for a 3-digit dial plan, assume extensions **500-519** were CSEs.
- **After Consolidation**: With a 6-digit dial plan and 100 stores, the customer must create phantom extensions of this format: **<3-digit store number>-<3-digit CSE>**. These phantom extensions can be X-ported analog stations, for example. They must add a total of 2000 X-ported analog stations with 6-digit extensions. The dial plan must still have **5xx** as a valid extension range, and CM software automatically inserts the 3-digit location code and thus maps **5xx** to **xxx-5xx** when a call is parked.

Thus, this workaround lets the attendant park incoming calls using same range of extensions as before (**500-519**), and attendants at several stores can park calls at the same extension at the same time. And of course, an employee in the store can retrieve the call by dialing the "unpark" access code followed by the same range of extensions (**500-519**).

6. The Future

Customers may ask whether the challenges of consolidating Dial Plans are worthwhile, given that some time soon we may be calling each other using e-mail addresses (using SIP) or by "pointing and clicking"

using an LDAP on-line directory. While the telecommunications industry is headed in this direction, it is doubtful that it will happen quickly enough to make the issues covered in this document irrelevant.

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Appendix: Short UDP Extension Numbers
(Section 4.2.2 of the Multinational White Paper)

Communication Manager software allows users in several countries to dial the same digit string and reach a destination in their own country. Although it is not technically an extension number, a digit string that is mapped to different extensions depending on the location of the caller is commonly called a "short extension number". For example, suppose you want each user to dial 3 digits to reach extensions in their own country, and to dial 4 digits to reach an extension in another country. Suppose that you always want the three digit string **555** to reach a security office in the same country as the person who dialed the call.

The Uniform Dial Plan (UDP) form has a column "Insert Digits". You can put into that column the key words **L1**, **L2**, **L3**, **L4**, or **L5**. The corresponding number of Location specific digits will be taken from the Prefix field on the Locations form and prepended to the front of the dialed string.

Continuing the example, suppose you administer forms as follows:

```
display uniform-dialplan 1                                      Page 1 of  2
                      UNIFORM DIAL PLAN TABLE
                                                          Percent Full: 0
  Matching           Insert           Node   Matching          Insert           Node
  Pattern   Len Del  Digits Net Conv Num     Pattern  Len Del Digits Net Conv Num
  5          3   0    L1    ext   y
  8          3   0    L1    ext   y




display locations                                               Page 1 of 16
                             LOCATIONS

          ARS Prefix 1 Required For 10-Digit NANP Calls? y

  Loc. Name         Timezone Rule  NPA  ARS    Attd Loc.   Pre-  Proxy Sel.
  No.               Offset              FAC    FAC  Parms. fix   Rte.  Pat.
  1:  London        + 00:00   0            0    9            1
  2:  New York      - 05:00   0            9    0            2
  3:  Tokyo         + 07:00   0                 0            3
  4:  Paris         + 01:00   0            0                 4
  5:  Berlin        + 01:00   0            0                 5
```

Suppose further that numbers for the country's security offices are extension **1555** in London, extension **2555** in New York, and extension **3555** in Tokyo. Suppose a user in London dials the three digits **555**. Those dialed digits match the first pattern on the uniform-dialplan form. The corresponding Insert Digits field is set to **L1**. Communication Manager software looks up one digit to insert from the Prefix column of the locations form. Since the caller is in location 1, the associated Prefix is **1**. Inserting one digit from that prefix into the beginning of the dialed number converts the dialed number into **1555**. The security office in London will answer the call.

In this example, the digit string **555** is the "short extension", and the corresponding location based long extensions, i.e. real extension numbers, are **1555**, **2555**, **3555** and so on.

In addition to end users dialing extension numbers, several fields in Communication Manager administration accept extension numbers. You might think that if you put a short extension number into one of those

fields, then the equivalent long extension number corresponding to the country of the end user invoking the administered feature would be used. Whether that is true or not may vary from feature to feature, and some features may require some extra administration.

- Some administration fields internally store extension numbers as digits. Those fields can take short extension numbers. For example, call forwarding and abbreviated dialing can take short extensions. If someone dials a short extension that has been forwarded, Communication Manager software uses the country of the party that set up the forwarding, not the country of the caller, to interpret the short extension.

- Some administration fields internally store extension numbers as software pointers to a specific station. Those fields will not accept short extensions. However, there is a way around that.
  - If the field can take a Vector Directory Number (VDN), that VDN's vector in turn can consist only of a "route to" step. Vector route-to fields can take a short extension.
  - If the field can not take a VDN, then enter into the field a real extension. Call forward all calls from that real extension to a VDN. After setting up call forwarding, save translations. Call forwarding instructions survive system resets if translations have been saved. Then use the method described in the previous bullet to route the VDN to a short extension.