



# CHAPTER 1

## Hosted UCS Call Routing and Dial Plans

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This chapter describes how call routing occurs and how dial plan models work within a Cisco Multi-tenant Hosted Unified Communications Services (UCS) 7.1(a) deployment. It also describes how to use the Vision OSS Unified Services Manager (USM) application to load dial plan models. This section includes the following sections:

- [Overview, page 1-1](#)
- [Call Routing Between Cisco PGW and Unified CM, page 1-3](#)
- [Gatekeeper Call Routing, page 1-8](#)
- [Using Dial Plan Models, page 1-8](#)

### Overview

This section describes how call routing occurs in a Hosted UCS system and includes the following topics:

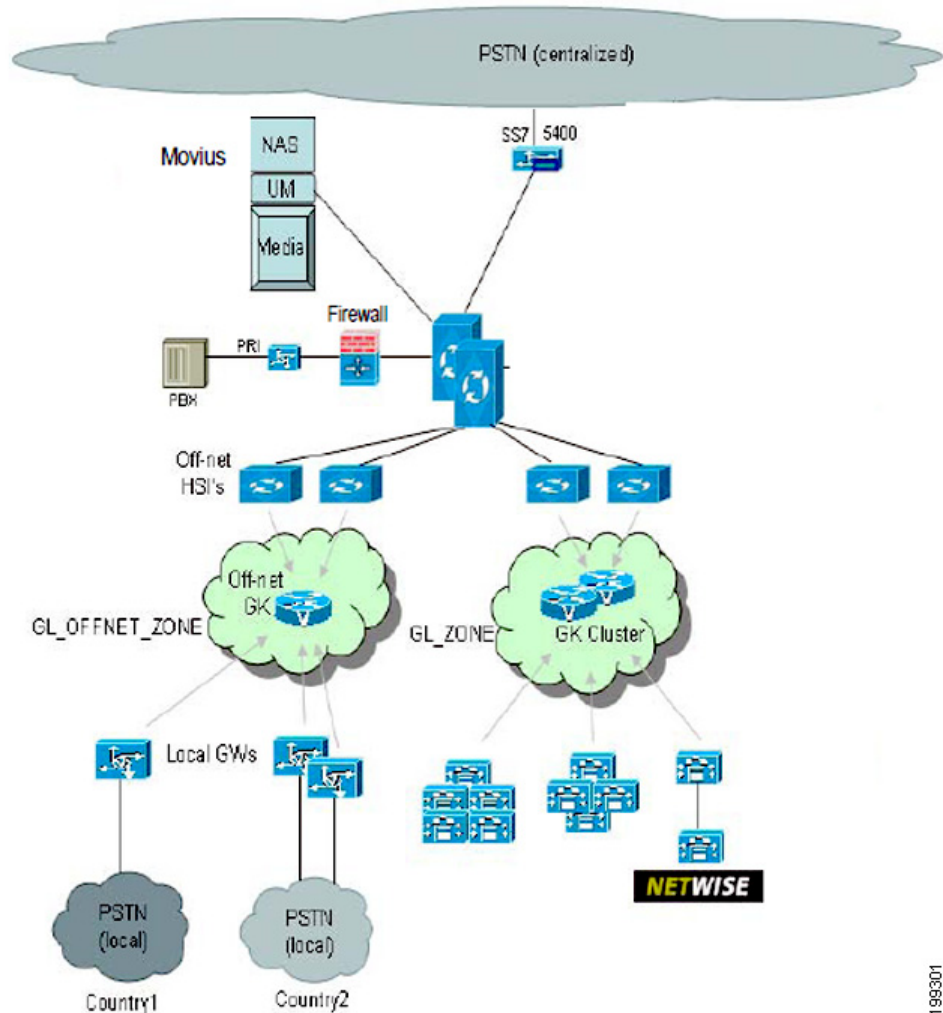
- [Hosted UCS System Overview, page 1-1](#)
- [Numbering, page 1-2](#)
- [Dialing Conventions, page 1-3](#)

### Hosted UCS System Overview

Hosted UCS is a distributed IP telephony system supporting one or more customers, at one or more locations for each customer. The telephony service is provided using primarily Cisco infrastructure, such as Cisco PGWs, Cisco Unified CMs and gatekeepers. The implementation may also include third-party products such as Movius (IP Unity) VoiceMail. USM is an integral part of the Hosted UCS system, provided by VisionOSS, a key Cisco partner involved in the development and deployment of Hosted UCS.

USM is a provisioning system that can be used to automate and standardize the configuration of the many network devices required for a large-scale, multi-tenant deployment of Cisco Unified CM.

Figure 1-1 Hosted UCS System



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The Hosted UCS solution supports automatic provisioning of customer locations in different countries, with appropriately configured PSTN dialing rules.

The diagram in [Figure 1-1](#) shows an overview of the solution components including IP Unity and Netwise. It also illustrates features including multiple PGWs, Legacy PBXes, local PSTN gateways and centralized gateways.

## Numbering

To support multiple tenants on a common infrastructure with overlapping number capability, it is necessary to use longer internal numbers within the system, which include the following four sub-components:

- CPID (Call Processing ID): A unique system-wide ID for a Unified CM, Cisco PGW or IP Unity system, which is dynamically allocated by USM
- RID (Routing ID): A value for a Location, unique per CPID, which is dynamically allocated by USM

- SLC (Site Location Code): An admin-entered ID (unique within customer only) for a customer location. The user dials this number (for example, 711) for inter-site calls
- Extension: The local extension of an IP Phone (for example, 001)

For multi-tenant deployments, directory numbers on IP Phones are a concatenation of these four sub-components in the following order:

CPID + RID + SLC + EXTENSION

## Dialing Conventions

Generally speaking, IP Phone users can make three types of calls:

- Intra-site calls: extensions at the same customer location by dialing just the EXTENSION they wish to reach
- Inter-site calls: extensions at other locations belonging to the same customers by dialing an inter-site prefix (typically 8) followed by SLC followed by EXTENSION
- PSTN calls: Destinations in the PSTN by dialing the PSTN breakout code (typically 9 or 0) followed by the E.164 number of the PSTN endpoint they wish to reach.

When the destination E.164 number corresponds to an IP Phone running within the Hosted UCS infrastructure, the system automatically routes the call to the identified endpoint. It presents the caller as an internal source if the caller belongs to the same customer as the called party. This type of call is known as a forced on-net call.

## Call Routing Between Cisco PGW and Unified CM

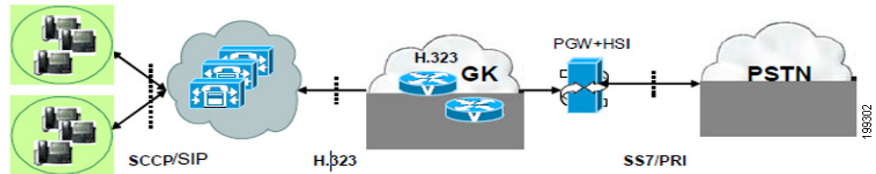
This section describes how call routing occurs between the Cisco PGW and a Unified CM cluster. It includes the following topics:

- [Cisco PGW to Unified CM Interface, page 1-3](#)
- [Unified CM to Cisco PGW Call Routing, page 1-4](#)
- [Cisco PGW to Unified CM Call Routing, page 1-5](#)
- [Example Calls, page 1-5](#)

### Cisco PGW to Unified CM Interface

The demarcation point between Unified CM and the Cisco PGW/HSI is an H.323 trunk, which is provisioned as an H.225 gatekeeper-controlled trunk on Unified CM. This trunk can be viewed as an internal interface in the system architecture (see [Figure 1-2](#)).

**Figure 1-2 H.323 Interface between the Cisco PGW and Unified CM**



Calls may traverse this interface in either direction:

- From Unified CM to Cisco PGW
- From Cisco PGW to Unified CM

In either case, the gatekeeper routes the call.

When the call is sent from the Cisco PGW towards Unified CM, the Cisco PGW must ensure that the called number begins with the CPID of the Unified CM Cluster on which the endpoint resides. Each Unified CM cluster registers with the gatekeeper using its CPID as tech-prefix, which ensures that the call reaches the correct cluster.

When the Unified CM initiates a call towards the Cisco PGW it sets the called number based on rules that ensure that called numbers begin with the appropriate digit (for example, 8 for internal calls or 9 for PSTN calls). No Unified CM Cluster should be registered to the gatekeeper with a CPID beginning with 8 or 9, so the gatekeeper can use its *default technology prefix* (configured to 999#) to route this call. The HSI registers with the gatekeepers using this default technology prefix to receive these calls and deliver them to the Cisco PGW.

## Unified CM to Cisco PGW Call Routing

Different types of calls are supported from Unified CM to Cisco PGW, and for each type, the Unified CM inserts a single Call Type (CT) digit into the calling number so that the Cisco PGW can detect the call type. The following call types may be sent from Unified CM to the Cisco PGW:

- Emergency calls (CT=4).
- Basic calls from an IP Phone at a customer location to another IP Phone at a location belonging to the same customer. (CT=8).
- Calls forwarded by an IP Phone at a customer location to another IP Phone at a location belonging to the same customer. (CT=6).
- Basic calls from IP Phones to the PSTN (CT=9)
- Calls forwarded by IP Phones to the PSTN (CT=5).
- Calls generated by certain applications (for example, Netwise) that need to reach endpoints that do not all belong to the same customer (CT=7).

For calls from Unified CM to the Cisco PGW, the Unified CM must always include the Call Type digit with the Calling Number in the following format:

Calling Number = CPID + RID + CT + SLC + EXTENSION.

If CT=9 or 5 (basic call to PSTN) then the Called Number must start with 9 followed by a normalized PSTN number beginning with either a 0 for a national PSTN call or 00 for an international call. For example, calls from a UK IP Phone to the PSTN would have the called number in the format 9+0+*nationalnumber* or 9+00+*internationalnumber*.

If CT=8 or 6 (inter-site calls) then the Called Number must equal 8 + SITECODE + EXTENSION. Unified CM normalizes the Inter-Site-Prefix to 8 as necessary for customers who have been provisioned to use another value when dialing between sites.

## Cisco PGW to Unified CM Call Routing

The following types of call are sent from the Cisco PGW to Unified CM

- Calls from the PSTN
- Calls from other internal endpoints (e.g. IP Phones or PBX extensions).
- Calls to Unified CM resources such a Message Waiting Indicator On or Off devices.

In all these cases, the Cisco PGW sets the called party number (B number) to the full internal number of the phone (or MWI device) that it wishes to reach. In the typical case where the called endpoint is an IP Phone, the calling number (A number) is set by the Cisco PGW to indicate the caller. This allows the destination IP phone user to automatically redial the caller, using a directory of received or missed calls. In the case of calls to the MWI On or Off devices, the calling number is set to the full internal number of the IP Phone whose message waiting light must be set or cleared.

## Example Calls

The following calls illustrate the format of calling and called numbers on call legs that cross the interface between Unified CM and the Cisco PGW.

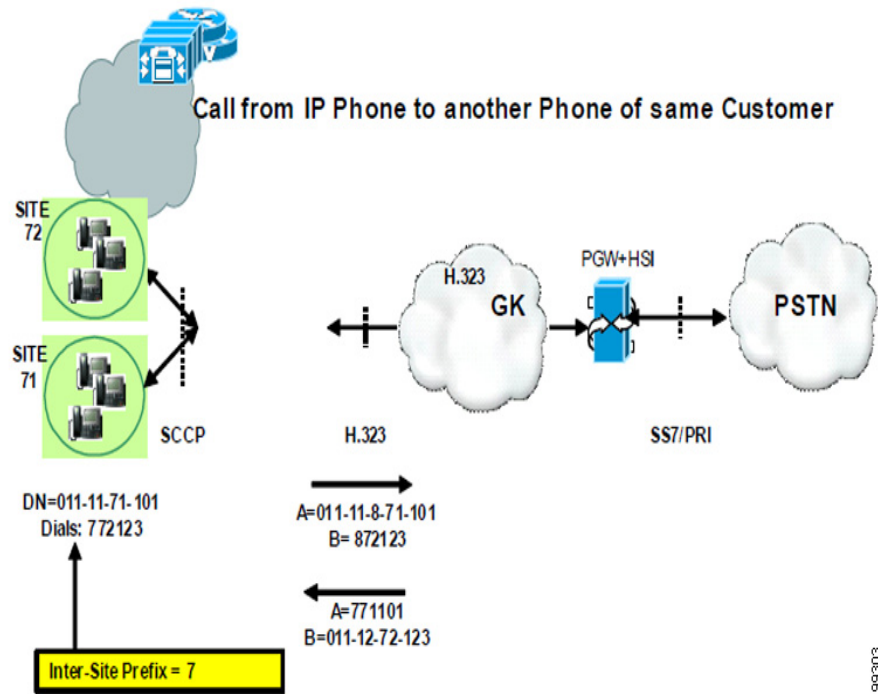
### Inter-site call (Call Type = 8)

Figure 1-3 shows numbering on the Unified CM-to-Cisco PGW interface for the two call legs (from Unified CM to the Cisco PGW and back to Unified CM) associated with an inter-site call from a phone (Site 71) belonging to one customer and another phone at a different Site (Site 72) belonging to the same customer.

On the upward leg from Unified CM to the Cisco PGW, the calling number includes the CT=8 and the called number starts with an 8 regardless of the actual inter-site-prefix configured and dialed by the user.

On the downward call leg from the Cisco PGW to Unified CM, the called number is the Unified CM DN of the phone that will ring. The Unified CM DN is made up of the CPID + RID + SLC + EXTENSION and is known as the Full Internal Number (FINT). The calling number is formatted by the Cisco PGW into an internal number format that can be dialed by the called phone to reach the caller.

Figure 1-3 Numbering on H.323 Interface for Two Call Legs Associated with an Inter-site Call

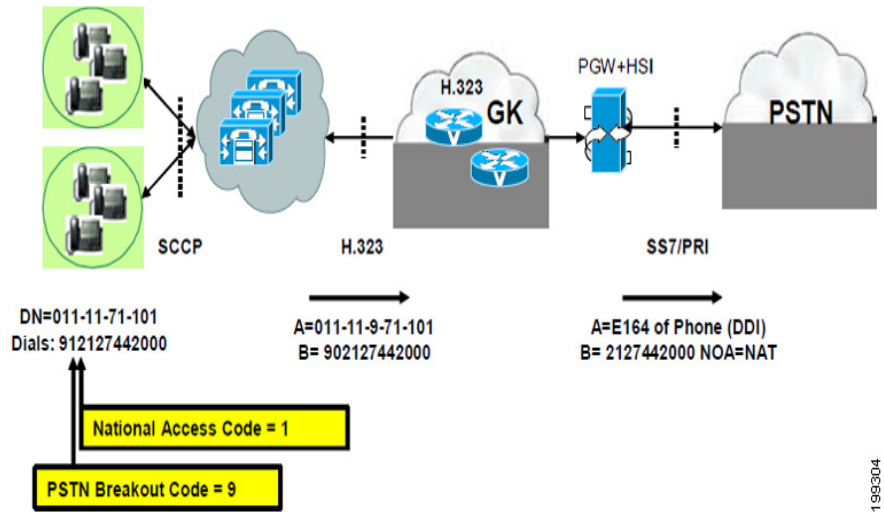


## Call from IP Phone to National PSTN (Call Type = 9)

If CT=9 or 5 (basic call to PSTN) then the Called Number must equal 9 followed by a normalized PSTN number beginning with either a 0 for a national PSTN call or 00 for an international call. For example, calls from a UK IP Phone to the PSTN would have the B-number in the format 9+0+nationalnumber or 9+00+internationalnumber.

Figure 1-4 shows the numbering of called and calling part number on the interface between Unified CM and the Cisco PGW for a call from IP Phone at a US location to the national PSTN. Note that the US long distance trunk selection code (1) has been replaced by a 0 to normalize this call for processing by the Cisco PGW.

**Figure 1-4** Numbering on interface between Unified CM and the Cisco PGW for a National PSTN Call in US

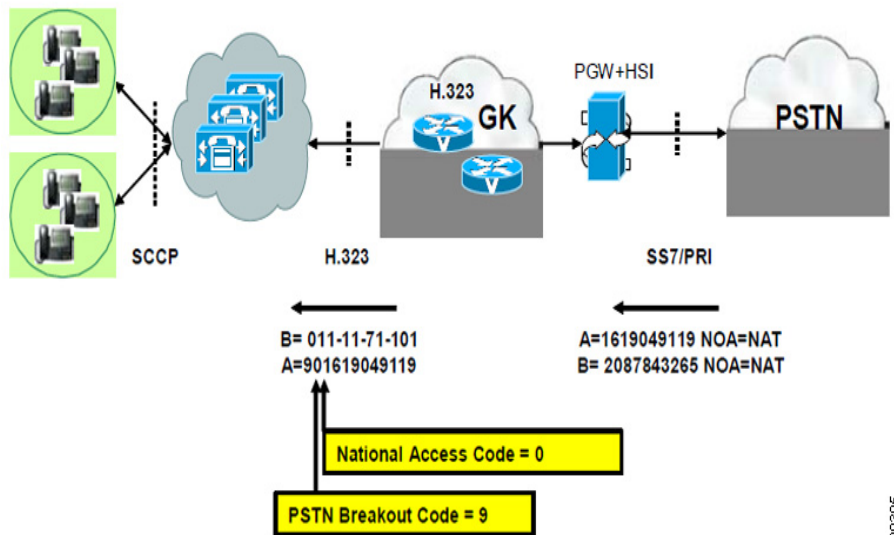


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### Call from PSTN to Unified CM

Figure 1-5 shows the numbering convention used on the interface between the Cisco PGW and Unified CM when sending calls toward an IP Phone. Note that no Call Type is used in the calling number in this direction. The called number corresponds directly to the Full Internal Number of the phone being called. The calling number has been formatted by the Cisco PGW so that the destination phone directory service can be used to redial the caller later. The calling number begins with the PSTN breakout code for the caller’s location (country) (for example, 9 in the UK, followed by the national or international trunk access prefix for that country).

**Figure 1-5** Inbound Call from PSTN to IP Phone



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# Gatekeeper Call Routing

This section describes how call routing occurs between a H.323 gatekeeper, a Cisco PGW, and the Unified CM cluster. It includes the following topics:

- [Cisco H.323 Gatekeepers, page 1-8](#)
- [Gatekeeper Routing between Cisco PGW and Cisco Unified CM, page 1-8](#)

## Cisco H.323 Gatekeepers

The Hosted UCS multi-tenant dialplan does not dynamically change the Cisco gatekeeper configuration. The gatekeeper configuration is manually setup at the start of deployment. The gatekeeper learns about H.323 devices, such as Unified CM trunks or IOS PSTN gateways, when USM provisions the systems to register with the gatekeepers. Gatekeepers route calls between:

- Cisco PGW and Cisco Unified CMs (mandatory)
- Cisco PGW and Local PSTN gateways (optional)

Cisco gatekeepers must be used because call routing uses the Cisco-proprietary *technology prefix* for routing calls. The Hosted UCS platform has been tested using gatekeeper clustering for high availability, using the GUP protocol.

Routing calls between the Cisco PGW and Unified CM and local PSTN gateways is logically distinct but gatekeeper device or cluster may provide both roles.

## Gatekeeper Routing between Cisco PGW and Cisco Unified CM

An H.323 zone `HUCS_ZONE` is used for routing calls between the Cisco PGW and Unified CM. A pool of Cisco HSI dedicated to Cisco PGW-to-Unified CM calls and the Unified CM clusters register within this zone. The Cisco PGW uses the *Unified CM* dialplan for handling calls received from these HSI and a dedicated route list (*rltist2hsi*) to send calls through the HSI to the Unified CM Clusters.

Call routing within this zone is based entirely on the technology prefix, which as explained earlier form the leading digits of the called number. There is no inter-zone call routing used in this solution.

The Cisco Unified CM clusters will be automatically configured by USM to register with the gatekeeper zone `HUCS_ZONE` using the CPID as the technology prefix. Because the Cisco PGW always sends calls to a Unified CM via the gatekeeper with a called number beginning with the CPID of a Unified CM cluster calls are routed to the correct cluster. The gatekeeper simply analyses the called number that matches its leading digits to the CPID of registered Unified CM clusters.

The HSI must register with a technology prefix of `999#`, which must also be configured as the default technology prefix. This means that a call that does not start with a valid CPID is automatically sent to the HSI for handling by the Cisco PGW. Unified CM Clusters must never use a CPID of `999#`.

## Using Dial Plan Models

This section describes how dial plan models control call routing within the Hosted UCS system. It includes the following topics:

- [Accessing USM and Initial Setup, page 1-9](#)
- [Defining the Dial Plan Type, page 1-12](#)



- [Associating the Dial Plan with the Cisco PGW, page 1-13](#)
- [Edit Dial Plan and association, page 1-13](#)

The Hosted UCS dial plan is a set of rules for provisioning multiple products in a coordinated way to achieve a coherent and distributed call routing framework. The intent is to provide a multi-tenant architecture where the infrastructure is shared by one or more customers. It includes rules for provisioning four products:

- Cisco PGW
- Cisco Unified CM
- Cisco IOS gateways
- IP Unity

Only the first three components are used for call routing.

The purpose of using models (loaders) is to add configuration into the USM database. Models are created using Microsoft Excel files and USM loads the configuration by importing the Excel files. Importing these spreadsheets updates the USM database but does not actually provision the components. The data in the models is in the form of templates that are used by USM to provision the network components through a later operation.

There are currently five supported dial plan models, each in a separate Excel worksheet within a single Excel file. Sheets can be in different Excel files but it is common practice to keep all models in the same file. Each sheet is imported into USM using different USM bulk load tools.

Model data can be used multiple times by USM to provision network components. Variables within each (delimited by #) are substituted with specific values by USM for individual transactions.

## Accessing USM and Initial Setup

This section describes the steps required to access USM and perform the initial setup. It includes the following sections:

- [Accessing the USM GUI, page 1-9](#)
- [Creating an Internal System Superuser, page 1-10](#)
- [Defining Basic Setup Components, page 1-10](#)
- [Adding additional Phone Types \(optional\), page 1-11](#)

### Accessing the USM GUI

To access the USM GUI, perform the following steps:

#### Procedure

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- Step 1** Use the appropriate IP address to access the relevant USM server:
- Step 2** Log in as the superuser:
- Username—**bvsm**
  - Password—**password**

When logging in for the first time, you are prompted to change the password for USM.

- Step 3** Change the password of the superuser **bvsm** to an appropriate strong password, for example **ipcbuemea**.
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## Creating an Internal System Superuser

To create an internal system superuser, perform the following steps:

### Procedure

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- Step 1** Choose **General Administration > Users**.
- Step 2** Click **Add**.
- Step 3** Add the following:
- Username—*<username>*
  - Password—*<password>*
  - Role—**Internal System SuperUser**
  - First name—*<name>*
  - Last name—*<name>*
- Step 4** Click **Next >>**.
- Step 5** Choose the following:
- Web presentation theme—**Default GUI Branding**
  - Preferred country—*<country>*
  - Access profile—Default
- Step 6** Click **Add**.
- Step 7** Log out of USM and log in with the new username.
- When logging in for the first time, you are prompted to change the password.

## Defining Basic Setup Components

To prepare USM by loading the base system data (1-BaseData worksheet), perform the following steps:

### Procedure

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- Step 1** Choose **Setup Tools > Bulk load Samples**.
- Step 2** Click **01 - Base System Data**.
- Step 3** Click **Save** to save in your local machine.
- Step 4** Browse **General Tools > Bulk Load**.
- Step 5** Schedule a new job to upload **1-BaseData sheet**.
- Step 6** Click **Submit**.

This loads the information from the BaseData worksheet into the USM database, including the following:

- Default Cisco Unified CM phone button templates

- Valid Cisco Unified CM phone types and expansion module
- Service types, which are used in the Cisco Unified CM model for defining class of service (CoS) configuration. This is customer-specific.
- Dial plans and Hardware sets
- Associate Hardware sets with the dial plan
- Add countries

**Note**

Check for any errors or warnings at the completion of loading.

## Adding additional Phone Types (optional)

**Note**

If the uploaded Base System Data does not have the required Phone type then you can manually add a phone type into USM for provisioning. Follow the steps below to add a phone type,

**Step 1** Navigate to **Setup Tools > Phone Types > Phone Type Management**.

**Step 2** Click Add to add a new phone type

**Step 3** Under **Details**, enter the following:-

- Name—<PhoneTypeName>, for example **7925 SCCP**
- Product—<ProductName>, for example **Cisco 7925**
- Product Model ID—<ProdModID>, for example **484**
- Protocol—<PhoneProtocol>, for example **SCCP**

**Step 4** Select other details according to phone model support

**Step 5** Click **Add**.

**Note**

Product Model ID value is a unique number for each phone model which should match with CUCM supported phone model IDs.

**Note**

If the phone type is added after provisioning dial plan, hardware sets and providers on USM, the associated dial plan with hardware set needs to be disconnected and connected back again so that the new phone type is available under the provider.

This section explains how to define the dial plan type in USM, associate the dial plan to the hardware set that defines which components can be used in the deployment and edit the dial plan and association.

This section includes the following topics:

- [Defining the Dial Plan Type, page 1-12](#)
- [Associating the Dial Plan with the Cisco PGW, page 1-13](#)

- [Edit Dial Plan and association, page 1-13](#)

## Defining the Dial Plan Type

When a dial plan is created, parameters are configured that define how the Hosted UCS environment is provisioned.

**Caution**

You should use the default dial plan models; Do not create a new dial plan or modify an existing dial plan without assistance from Cisco Advanced Services (AS) or VisionOSS.

To define the dial plan type, complete the following steps:

**Procedure**

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- Step 1** Choose **Dialplan Tools > Number Construction**.
  - Step 2** Click **Add**.
  - Step 3** From the Details menu, complete the following fields, as shown in this example:
    - Name—**HUCS**
    - Description—**Hosted UCS 7.1a Dial Plan**
  - Step 4** From the Codec Selection menu, complete the following fields:
    - Intra-region Codec—*<intra\_region\_codec>*
    - Inter-region Codec—*<inter\_region\_codec>*
  - Step 5** From the Single/Multi-Tenant Capable menu, click **Multi-Tenant Dial Plan**.
  - Step 6** From the Internal Number Format menu, do the following:
    - a. Click **Includes CPID**.
    - b. Enter CPID Digits—*<CPID>*; for example, **3**.
    - c. Click **Includes RID**.
    - d. Enter RID Digits—*<RID>*; for example, **4**.
    - e. Click **Includes Site Code**.
    - f. Enter Max. Site Code Digits—*<MaxSiteCodeDigitLength>*; for example, **3**.
    - g. Enter Site Code Rules—*<SiteCodeRules>*; for example, **3**.
    - h. Click **Variable Length Internal Number**.
  - Step 7** From the RID Type Selection menu, add the Routing Identifier (RID)—**Location RID**.
  - Step 8** From the Dial Prefixes menu, do the following:
    - Click **Inter-Site Prefix Required**.
    - Click **Inter-Site Prefix Configurable**.
    - Click **PSTN Access Prefix Required**.
    - Click **PSTN Access Prefix Configurable**.
  - Step 9** From the Format of External Phone Number Mask menu, do the following:

- Select the format of the External Phone Number Mask on Unified CM Device Line Configuration page.
- Step 10** Click **Add**.
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## Associating the Dial Plan with the Cisco PGW

After the dial plan is created, it must be connected with the Cisco PGW-CCM hardware set that identifies the network components associated with the dial plan.

To connect the dial plan, perform the following steps:

### Procedure

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- Step 1** Choose **Dialplan Tools > Hardware Sets**.
- Step 2** Click **Associated DialPlans** next to the PGW-CCM hardware set.
- Step 3** Click **Connect** to connect the desired dial plan.
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## Edit Dial Plan and association

This section describes required steps to edit the dial plan in USM. Following topics are included :

- [Edit Dial Plan, page 1-13](#)
- [Connect Dial Plan with Hosted Unified Communication Services Hardware Set, page 1-14](#)

## Edit Dial Plan

When a dial plan is created, a number of parameters are configured which defines how the Hosted UCS environment is provisioned. To edit an already created dial plan:

- 
- Step 1** Choose **Dialplan Tools > Number Construction**.
- Step 2** Click **HUCS Dial Plan**.
- Step 3** Under **Details**, use the following settings:
- Name—**HUCS**
  - Description—**HUCS Dial Plan**
- Step 4** Under **Codec Selection**, add the following:
- Intra-region Codec: <intra\_region\_codec> (for Hosted UCS 7.1(a) choose **G.711**)
  - Inter-region Codec: <inter\_region\_codec> (for Hosted UCS 7.1(a) choose **G.711**)
- Step 5** Under **Dial Plan Rules**, do the following:
- Check the **Multi-Tenant Dial Plan?** check box
  - Check the **Enforce HUCS Dial Plan?** check box

- Under **Internal Number Format**, ensure the following:
    - Check the **Includes CPID?** check box
    - CPID Digits—<CPID>, for example **2**
    - Check the **Includes RID?** check box
    - RID Digits—<RID>, for example **4**
    - Check the **Includes Site Code?** check box.
    - Max. Site Code Digits—<MaxSiteCodeDigitLenght>, for example **3**
    - Site Code Rules—<SiteCodeRules>, for example **3**
    - Check the **Variable Length Internal Number?** check box
    - Under **RID Type Selection**, enter the following:
      - Routing Identifier (RID)—**Location RID**
- Step 6** Under **Dial Prefixes**, do the following:
- Check the **Inter-Site Prefix Required?** check box.
  - Check the **Inter-Site Prefix Configurable?** check box
  - Check the **PSTN Access Prefix Required?** check box
  - Check the **PSTN Access Prefix Configurable?** check box
- Step 7** Under **Format of External Phone Number Mask** on Unified CM, do the following:
- Select the format of the External Phone Number Mask on Unified CM Device Line Configuration page. For Hosted UCS 7.1(a) testing select **Show National Code Prefix** and **Show National Code**.
- Step 8** Under **Format of IPPBX Configured Internal Number**, do the following:
- Uncheck the **Includes CPID** check box
  - Uncheck **Includes RID** check box
  - Ensure **Includes SiteCode** is selected
  - Ensure **Includes Extension** is selected
- Step 9** Click **Modify**.
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## Connect Dial Plan with Hosted Unified Communication Services Hardware Set



**Note** This step is to be done if the hardware set is not already associated with Hosted UCS dial plan

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To connect the dial plan, do the following:

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- Step 1** Choose **Dialplan Tools > Hardware Sets**.
- Step 2** Click **Associated DialPlans** corresponding to the HUCS hardware set.
- Step 3** Click **Connect** in order to connect the desired dial plan.
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## Loading the Dial Plan Models

This section describes the steps for loading the core Hosted UCS 7.1(a) models (Cisco PGW and Cisco Unified CM). The models define how USM should configure the Cisco PGW and Cisco Unified CM. This section includes the following topics:

- [Loading the Cisco Unified CM Model, page 1-15](#)
- [Loading the PGW MML Model, page 1-15](#)
- [Loading the PGW TimesTen Model, page 1-15](#)

### Loading the Cisco Unified CM Model

To prepare USM by loading the Cisco Unified CM model, perform the following steps:

#### Procedure

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**Step 1** Choose **Dialplan Tools > Configuration Models**.

**Step 2** Click **Schedule new job**.

**Step 3** Browse for the CCM model and click **Submit**.



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**Note** Check for any errors or warnings at the completion of loading.

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### Loading the PGW MML Model

To prepare USM by loading the PGW model, perform the following steps:

#### Procedure

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**Step 1** Choose **Dialplan Tools > Configuration Models**.

**Step 2** Click **Schedule new Job**.

**Step 3** Browse for the PGW MML model and click **Submit**.



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**Note** Check for any errors or warnings at the completion of loading.

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### Loading the PGW TimesTen Model

To prepare USM by loading the PGW TimesTen Model, perform the following steps:

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**Step 1** Choose **Dialplan Tools > Configuration Models**.

**Step 2** Click **Schedule New Job**.

**Step 3** Browse for the PGW-Times-Ten model and click **Submit**.



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**Note** Note: Check for any errors or warnings at the completion of loading.

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