Introduction

I decided to create my own home lab environment to become proficient with the Call Manager product eight years ago. My IP Telephony home lab setup allowed me to test new versions of software and features, in addition to learning the core competencies of the call routing and IP phone administration. This white paper will give you the knowledge you need to select Cisco IP Phones, switches, and routers for your home lab. In addition, it will cover the configuration options of VMWare so you can load Cisco Call Manager and Cisco Unity virtual machines in a lab environment.

Consider whether you would like Cisco Unified Communications Manager (CUCM) and/or Cisco Unified Communications Manager Express (CUCME) in your lab. Either platform could act as the call processing device in your home Unified Communications (UC) deployment. CUCM and/or CUCME will act as the brains of the operation. If you aspire to the level of Cisco Voice CCIE certification, you will probably want to incorporate both components. This white paper will cover the configuration of a lab environment with one to two Cisco Unified Communications Managers. Either one of these CUCM servers could be CUCME if your focus will be on this offering.

I decided to buy the following hardware for my network.

- (2) Cisco 7960 IP Phones
- (1) Linksys Switch
- (1) Compaq DL320
- (1) Gateway router

I purchased used Cisco 7960 IP Phones on E-Bay. Although they were $300 each at the time, they came with AC power cords, so I did not need to buy a Power over Ethernet (PoE) switch. A PoE switch was over my budget, so I bought the cheapest Linksys data switch I could that gave me the ability to connect at least 6 Ethernet ports. The 3550-24T-PWR PoE switch is now a very affordable switch since it is approaching end of life (EoL) status. The end of sale (EoS) announcement was made on the 3550 inline power switch a long time ago. If you decide to buy this switch, you should be aware that it only supports Cisco inline power (PoE) with a maximum of 10 watts per port. Many of the newer Cisco IP Phones require more than 10 watts of power (7965 requires slightly over 12 watts). The 3550 will work well with both the 7960 and 7961 phones I recommend. The 3560 and 3750 switches have IEEE 802.3af inline power (PoE) support up to 15.4 watts per port, but these switches cost thousands of dollars.

If your budget is tight, buy a cheap Linksys switch and power bricks for your Cisco IP Phones. The 7960 is about eight years old at the time of this writing. I recommend buying a 7941 or 7961 phone because there are some
new CUCM 6.x and 7.x features that will not work on the older 7940, 7960, 7912, 7910, and 7905 IP Phones. The 79x1, 79x2, 79x5, 7970, and 7911 phones have more resources (DRAM and flash memory) to support new features.

The older phones are referred to in the CUCM SRND as Type A phones, while the newer phones are Type B phones. The flash and DRAM on the Type B phones allow them to support the full feature set, while Type A phones have been out of resources since Call Manager 4.2. A used 7960 phone should cost less than $100 per phone, while the 7961 will be less than $150 per phone. The 7961 is a better investment if you can spare the extra money. I recommend buying three Cisco IP Phones so you can simulate a real world dial plan on one of the phones. The real world dial plan will require two call processing agents in addition to three Cisco IP Phones.

Here are some examples of arrangements with two call processing agents.

1. Two CUCM clusters
2. One CUCM cluster and one CUCME platform
3. Two CUCME platforms

You can get started with one call processing agent, and then scale your home lab to two call processing agents if you want to take the environment to the next level. I put together my home lab over seven years ago when Call Manager 3.0 could not be run on a non-Cisco approved platform. If you are planning on running a version of Call Manager before version 5.0 on a non-approved platform, you will need to obtain a registry hack so the hardware looks like a Cisco approved platform to the Call Manager installation. The registry hack can easily be obtained by doing a Google search for “Call Manager Reg Hack” or asking your Cisco SE to share with you. The process for installing Call Manager on the server involves manually installing Windows 2000 server, SQL server 2000, and the required Microsoft service packs before applying the registry hack. I decided to buy my own Compaq DL320 at the time, but I highly recommend using VMWare nowadays.

Beginning with CUCM 5.0(4), Call Manager will install on any hardware platform. The installation will warn that Cisco will not support the non-Cisco approved platform, but installation will continue when you accept the warning. Unfortunately, Call Manager 5.x versions will require a license file to work. CUCM 6.0 has a built-in trial license that is more than adequate for a home lab, but it will not support clustering. At the time of this writing, I recommend using CUCM version 6.1 for your home lab. If you have the installation discs, you can go through the laborious process of installing CUCM from scratch. Hopefully, your Cisco SE or one of your co-workers has a VMWare image with CUCM already installed so you can hit the ground running. The CUCM and/or Unity virtual machines could easily exceed 6GB (gigabytes) each. You may want to buy an external hard drive to store and run your virtual machines.

Working with VMWare

VMWare virtual machines have become the de-facto standard way of running lab environments with CUCM. This can be uncomfortable for someone who has not dealt with virtual machines, but the learning curve is not very great. This white paper will serve as a tutorial to get you started using VMWare. I will be assuming that you will be getting started with a VMWare image that someone has created for you.
You do not need to buy VMWare workstation for your lab environments, but VMWare workstation has the ability to create snapshots of virtual machines (VM), while the other VMWare products do not. The snapshots will allow you to tryout upgrades, software options, and configuration options without harming your environment. If things don’t work well, you can revert to an earlier snapshot of your virtual machine. Each snapshot requires about 1GB of hard drive space. VMWare player and VMWare server can be downloaded for free. VMWare player will only allow you to run one virtual machine at a time, so I don’t recommend using it. I frequently run a Unity VM and a Call manager VM at the same time. Multiple virtual machines can be run using VMWare server. This white paper assumes that you are running either VMWare workstation or server.

I have found that each virtual machine and host operating system (OS) require at least 768MB each, but run better if you can allocate 1GB of DRAM to each. You will need a lot of DRAM installed on the machine you wish to run these virtual machines. My laptop has 4GB to allow me to comfortably run two virtual machines on top of Windows XP. 32-bit operating systems will only recognize the first 3.5GB of DRAM if you purchase 4GB of DRAM. A 64-bit host operating system will allow you to use the entire 4GB, but I have decided to stay with a 32-bit OS because of the lack of 64-bit drivers and applications. You will waste 512MB of DRAM, but DRAM is relatively cheap. I recommend a multi-core processor CPU as well. One virtual machine will run on a Pentium M processor, but you will need a dual core processor to effectively use multiple virtual machines.

Launch the VMWare console

You may be prompted with a dialog window in which you can attach to a VMWare server. If prompted, choose the local option to connect to your local VMWare service. If the VMWare console is launched very soon after booting into Windows, the local radio button will not show up because the VMWare services have not yet started. Close the VMWare console if this happens and wait five minutes. Open the VMWare console again and choose the local radio button. Choose File > Open from the Windows menu. Click Browse and navigate to the drive location of your virtual machine. The file type option will default to *.vmx or *.vmtm file, but there are more options available from the Files of Type drop down menu.

I have a few virtual machines on my local hard drive, but I frequently run virtual machines off of my USB 2.0 connected 250GB Western Digital hard drive. Virtual machines run very well from flash and external hard drives. Virtual machines have slightly better performance running on external devices because the external device uses a separate disk I/O controller from the host OS. Once your virtual machine is in VMWare, you will have all of the settings created by the last person who ran the virtual machine you’re playing with. The following paragraphs will discuss the tuning of these parameters.

In the VMWare virtual machine, you should see the Devices section on the right-hand side of the screen which includes the Memory, Hard Disc, CD-ROM, Ethernet, USB Controller, Sound Adapter, Display, and Processors. If you do not see these options, you can go into your virtual machine settings by choosing VM > Settings (or press Ctrl + D). If the virtual machine displays "State: Suspended" the last person running VMWare suspended the virtual machine. This is important because you cannot tune the settings of a suspended virtual machine without properly shutting down the virtual machine. If the virtual machine was created with a memory allocation of 2048MB and you only have 2GB of DRAM on your machine, starting the virtual machine will crash the PC you’re running it on. This is normally not an issue, but illustrates a potential issue you could run into. Analyze the virtual machine settings before starting a virtual machine you have never run before.
To properly shut down CUCM, the command “utils system shutdown” should be run from the CUCM Command Line Interface (CLI). CUCM virtual machines should not be abruptly stopped using the square stop button in the VMWare console. CUCM will display “Power down” after the virtual machine has completely shutdown. The virtual machine must be stopped to tune your hardware settings. Click the square stop button, or VM > Power > Shut Down Guest, or Ctrl + E.

When virtual machines are loaded on the VMWare console, there will tabs in VMWare with a brief name for each VM. The name of the VM can be changed by accessing the VMWare settings. The settings are available by right clicking the VM tab and choosing settings, VMWare menu (VM > settings), or Ctrl + D. In the VMWare settings, click the Options tab and change the Virtual Machine Name. Click the Hardware tab again so we can get back to tuning the virtual machine’s memory settings.

Select the tab for the virtual machine you want to modify. Double click the memory option and ensure your virtual machine has 1GB (1024MB) of DRAM allocated to it. The Cisco published minimum DRAM requirements for CUCM 5.x and 6.x is 2GB, but I have found that CUCM runs well with only 1GB in small lab environments. To verify how much DRAM your computer has, choose Start > Run from the Windows OS. Type in the command “winver” and click enter. At the bottom of the dialog box, notice the “Physical memory available to Windows” section. This is the amount of DRAM your PC has. 1GB is approximately one million kilobytes (1,000,000KB). Since my machine has 4GB installed, Windows reports that it has 3,667,864KB available. 32-bit Operating Systems can address less than 3.6GB of DRAM. I comfortably run both CUCM and Cisco Unity on my machine with 1GB of DRAM allocated to each virtual machine.

The Hard Disk maximum size is set when the virtual machine is first created. I’m not aware of a way to change the hard-disk size without deleting and recreating the virtual machine. It’s recommended to make the maximum hard-drive size much larger than anything you anticipate using when first creating it. By double-clicking the Hard Disk option, you can access the Utilities drop down menu which has a defragmentation utility. If the virtual machine is fragmented, VMWare will notify you when launching the virtual machine. It’s not a bad idea to defragment the virtual machine every once in a while.

The CD-Rom setting will default to Auto-Detect. This will allow your virtual machine to use a CD-Rom placed in the PC’s physical CD-Rom drive.

The Ethernet setting is where things can get confusing. During VMWare installation, a new network protocol “VMWare Bridge Protocol” is added to Windows and bound to the TCP/IP stack of every network connection. The bridge protocol will act like an OSI reference model (OSI-Rm) layer 2 bridge (switch) to allow multiple OSs running on the same machine to communicate with each other on the same layer 3 IP subnet. The bridge protocol requires a network card on the host PC to have a network link. If there is not a link on the physical network card, the virtual machine will not start the virtual network card. I set up my virtual machines to use bridge networking whenever I’m connected to a network (hard wired or wireless). I changed my virtual machine to use DHCP and the DHCP broadcast is forwarded to the physical network in which you’re connected. The MAC Address of your machine will be bound to multiple IP addresses from the perspective of the DHCP server if DHCP.

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The CUCM Linux platform model will allow the network card to be configured to use DHCP via the CLI or the GUI-based OS administration. Cisco Emergency Responder (CER), Cisco Unified Presence Server, and Cisco Unity Connection use the same Linux OS and IBM Informix database server (IDS) as CUCM. The CLI command is “set network dhcp eth0 enable” while the GUI-based OS administration menu is Settings > IP > Ethernet. Static IP addresses can be used on your virtual machines, but these IP addresses will need to be on the same subnet as the host OS if bridge networking is to be used. The bridge protocol allows the flexibility of running your machine on the Internet and also having connectivity to your virtual machines.

The installation of VMWare will also add two virtual network interface cards (NICs) to your Windows machine. These virtual NICs can be leveraged when your PC is not attached to a network. When I commute to NYC to teach classes for Global Knowledge, I spend nearly three hours on the train. Bridge networking does not allow me to connect to CUCM because I do not have any physical network connectivity. I hard-code an IP address on CUCM and one of my two VMWare network interface cards when commuting to NYC. The Custom Ethernet options allow you to choose one of the VMWare NICs that were installed with the VMWare software. The VMWare network connection you choose needs to be configured in the host OS within the same subnet as the CUCM virtual machine. I frequently use the 192.168.1.254 IP address for VMWare and the 192.168.1.253 IP address for CUCM when running CUCM away from a network connection.

USB-connected devices will not be available to the virtual machine unless the virtual machine (VM) settings have the USB controller loaded. If the USB controller is not loaded in the VM settings, you can add the controller by clicking the Add button. Clicking the Add button will load the Add Hardware wizard in which you will notice device drivers that can be loaded for your virtual machine. The virtual machine will then automatically detect the insertion of a USB device and mount that device to the virtual machine OS. This can be problematic when you’re trying to copy files between the flash USB device and the host OS. The USB controller can be disconnected from the virtual machine so you will have access to the USB device from the host OS.

Most VM settings I come across only have one processor selected from the VM processor settings. If the hardware of your PC is an Intel Duo- or Duo 2-based processor, the physical processor has 2 CPU cores. I change this setting on my machine to 2 to ensure the virtual machine maximizes the use of the cores available to it. Click the OK button to commit your VM settings. It’s time to start your virtual machine. Click “Start this virtual machine” under the Commands section of VMWare. Alternatively, you can select the play icon from the tool bar.

If the virtual machine you are running is Windows-based, you may need to install the virtual machine tools after it has loaded. This will allow the virtual machine OS to detect the host OS hardware resources as devices available to the virtual machine. After installing the VMWare tools, the Network Interface Card (NIC) should become available in the virtual machine. If you have inherited a virtual machine from someone else, the VMWare tools may be loaded, but they may be outdated. A message to this effect will appear in the lower right hand portion of VMWare. At the time of this writing, I have not needed to use the virtual machine tools on any of the Linux-based versions of CUCM or Unity.

**Router Hardware**

This section will cover some of the router hardware you can purchase in your home lab for gateway and CUCME. If you plan to run CUCME, you will need to buy at least a 2610 XM router. The XM in the router model
stands for extendable memory. The 2600 XM series routers allow larger capacities of Flash and DRAM than the non-XM variants. The 2600 XM series routers are a bargain on E-bay, but the 2600 XM routers are not supported on the newer versions of CUCME. The 2600 XM router support CUCME versions 4.0 and earlier. If you’re on a tight budget, I recommend the 2600 or one of the 1700 or 1800 series routers that support voice interface cards (1751-V, 1760, etc.).

If money is not as tight, I recommend you purchase one of Cisco’s 2800 series Integrated Services Routers (ISR). The 2801 ISR router is the cheapest in the ISR family, but it should give you most of the flexibility you need for a smaller home-based lab. As of this writing, there are multiple E-bay listings for used 2801 routers at slightly over $1,000. While there are many router options to choose from, any router that is not in the ISR family will have limitations. I recommend that you start your lab off with an older 2600 or 1760 router and upgrade to a 2800 series router when you have the budget. All of the older routers will have some form of limitations that will make your learning that much more interesting.

If you want to test T-1 gateway functionality, you are going to need two routers with T-1 interfaces. Since this can be quite expensive, you may want to forego testing T-1 interfaces unless you have a more flexible budget. The 2801 router has two High-Density Voice WAN Interface Cards (HVWIC), while the 2811 supports four HVWIC slots. I’m assuming that everyone will want to test FXS (Foreign eXchange Station) and FXO (Foreign eXchange Office) interfaces. These interfaces will consume two HVWIC slots. The 2811 router will cost you an extra $200, but it well worth the extra money. The 2811 will give you some investment protection and the highest level of flexibility. This router is definitely my recommendation if you can afford it. Start out with a 2601 XM if you cannot afford this router right now.

Once you have a router, we will need some voice interfaces to test the gateway functionality of the router. A gateway converts VoIP RTP bearer (media) traffic into a time division multiplexing (TDM) format and vice-versa. The conversion functionality requires digital signal processors (DSPs). The DSP hardware can be quite expensive, so you will want to be very conscientious of price during the selection of your hardware. Cisco has a DSP calculator on their website at www.cisco.com/go/dspcalculator to help out with this, but the calculator requires you to logon with your CCO username/password.

The ISR (2800/3800) routers have Packet Voice DSP Modules (PVDM2) slots on the motherboard. The PVDM2 slots look like memory (Flash/DRAM) slots. The cheapest PVDM2 module is a PVDM2-8 which will fetch nearly $125 (US) on the used marketplace. The PVDM2-8 does not support hardware conference bridges though and will greatly limit the hardware media resource configurations (transcoders, MTP, and conference bridges) that will be able to register with CUCM. The PVDM2-16 module will cost nearly $200, but I highly recommend that you buy at least the PVDM2-16. The second-generation PVDM modules use the Texas Instrument (TI) 5510 DSPs and come in variants of -8, -16, -32, -48, and -64. Each ISR router class accommodates a different number of DSP slots on the motherboard. The older routers do not use DSP slots on the motherboard of the router. DSPs will be on the NM-1V and NM-2V network modules covered in upcoming paragraphs. Every router is a little different. I’m not very familiar with the 1700 and 1800 series router offerings.

Let’s delve into the myriad options that are available to terminate your voice channels in your home lab. The voice interfaces can be summarized as being first generation and second generation. First-generation voice interfaces will cost far less than second-generation voice interfaces, but most of them are not officially supported
for the 2811 ISR gateway router I have suggested. There are some first-generation hardware options that you only want to consider if you’re on a tight budget, and you have decided to use the 2600 XM series routers. The first-generation hardware includes the following network modules (NM) and voice interface cards (VICs).

- NM-1V (1 VIC slot)
- NM-2V (2 VIC slots)
- NM-HDV
- VIC-2FXO
- VIC-2FXS

The first-generation FXO modules have some limitations that you should be aware of if you plan on turning your home into an IP Telephony network like I did. I connected my router’s FXO port to the copper telephone wiring in my home by plugging the RJ-11 FXO interface into a wall jack. The router’s FXO port then picked up inbound calls to my house after one ring. I configured my gateway to dial a phone number that was shared between the analog phone plugged into my FXS port and two IP phones. I lost Caller-ID, Call Waiting, and Call Waiting with Caller-ID functionality using this configuration. All these features require battery reversal and the first-generation FXO card did not have it. Cisco’s VIC-2FXO M1 card would have provided these features, but it was 2002 and I had run out of discretionary income. I decided that VoIP was cool, but I didn’t want to lose my home phone features. I continued to run my home voice system from my provider unless I was playing in the home lab.

The first-generation T1 and E1 voice/WAN interface card (VWIC) are supported on the 2800 router because the second-generation VWICs (VWIC2) are expensive. VIC, WIC, and VWIC compatibility information is available at the following Tiny URL that redirects to Cisco’s website: http://tinyurl/2800list. When I put together my lab, I didn’t have the budget for two routers, two NM-HDV modules with a VWIC-1MFT-T1 for each. If you are on a budget, buy one router with FXS and FXO VICs. You can always buy another gateway and T1 interfaces later. If you decide to purchase a 2811 router, you will not need an NM-HDV or NM-HDV2 (second generation) to house the VWIC card. The VWIC card is inserted into one of the four built-in High-density Voice WAN Interface Card (HVWIC) slots.

You will most probably want to purchase a foreign exchange station (FXS) card to test gateway functionality from an analog phone and FXO to connect your PSTN analog connection into your lab test bed. FXS and FXO cards have RJ-11 connections, but they operate very differently. The FXS card generates dial tone for analog phones and fax machines that expect to receive dial tone when off-hook. An FXO port accepts dial tone from an FXS port. In a home environment with two routers, FXO to FXS connections can be used to test FXO functionality without analog phone connections from your PSTN provider. Two router lab environments would be well-served with (2) FXS VICs so analog phone to analog phone and fax machine to fax machine configurations over IP can be simulated. A simpler test environment will have one router with the FXO connected to the analog circuit at home provided by the PSTN provider. The local exchange carriers (LECs) and Voice over IP (VoIP) home services all provide RJ-11 connections in which an FXO connection could be connected. If the RJ-11 connection from the LEC or VoIP provider is connected to a wall jack in the house, the gateway’s FXO port can be connected to any phone jack in the home to terminate the call. I recommend the two port VIC2-FXO card for a home gateway, but the four-port VIC2-FXO can also be used in the ISR routers.
We will not be able to test T1 interfaces in a one router lab configuration. A two-router lab will want to add two VWIC-1MFT-T1 cards (one for each router). The T1 interface cards have 8-pin RJ-45 or RJ-48 connections. Standard Category 5 cabling can be used to connect the T1 interfaces, but they will need to be pinned out differently than standard straight through Category 5 cabling. Category 5 cabling is not a requirement. Any Unshielded Twisted Pair (UTP) category above category 3 will suffice for T1 connections. T1 voice interfaces use cable pins 1, 2, 4, and 5. Pins 1 and 2 are receive (RX) pins, while pins 4 and 5 are transmit (TX) pins. The T1 crossover cable should connect pins 1 and 2 to pins 4 and 5.

When configuring back-to-back T1 interfaces between two routers, the timing configuration of one side of the connection will need to be modified. One T1 interface will need to be configured to provide clock in the T1 controller configuration (clock source internal), while the other will use the default line timing (clock source line). An H.323 T1 gateway providing timing will also need the isdn protocol-emulate network command in interface Serial 0/0/0:23 configuration mode (assuming the T1 card is in slot 0). An MGCP gateway providing the timing will need to have the MGCP T1 endpoint configured with a Protocol Side of Network in the CUCM configuration pages. All T1 controllers default to line timing to get their timing from the service provider. E1 interfaces could be used in addition to, or in place of, T1 interfaces. If a Voice CCIE is your final goal, plan on buying two T1 VICs and two E1 VICs eventually, unless you will be renting equipment online.

Two routers will also be required to simulate a wide area network (WAN). The WIC-1T card will give you one WAN interface with a DB-60 connector. Back-to-back serial cables with DB-60 connectors can be purchased on E-Bay. Searching for the term “back-to-back serial” on E-Bay will return lots of cabling results. Make sure the cables have DB-60 connectors. The WIC-2T card offers two WAN interfaces, but uses the Cisco Smart Serial connectors. The smart serial connectors allow higher port densities to be used on the WAN interface card (WIC) slots. Verify that you are ordering the proper cables to connect the WICs you have purchased. Smart Serial to DB-60 connected back-to-back cables are available for purchase online if one router has the WIC-1T and the other router has the WIC-2T.

Testing a PSTN Dial Plan

It’s time to build a lab environment in which we can test a Public Switched Telephone Network (PSTN) dial plan. In a one router solution with limited voice interfaces, I recommend connecting to your PSTN provider and routing calls to the PSTN. All calls would be routed to the FXO interface in the outside world. If your lab hardware involves two routers, there are lots of types of TDM calls that can be tested. We can test T1-CAS, PRI, FXO, and FXS connections in a two-router test lab environment with two T1 VICs. Two CUCM clusters will be required.

To properly test this dial plan, we will configure a software phone (IP Communicator) as a PSTN-connected device. This phone will accommodate up to eight phone numbers since IP Communicator is modeled after the 7970 phone which includes 8 buttons for lines, speed dials, service URLs, and programmable line keys (PLK). The IP Communicator configuration will include a 3-digit, 7-digit, 10-digit, 11-digit, and International pattern of your choosing. An example of this would be 411, 7381450, 9147381450, 19147381450, and 011338088. One IP Communicator will be used in each cluster for a total of two IP Communicators. Each IP Communicator will need unique phone numbers which will be attempted from the partner pod. Now that each lab has some PSTN phone
numbers that can be reached, we will be able to test calls in the future. An additional software or hardware phone will be required in each cluster to dial the PSTN pattern on the other CUCM cluster.

Assuming that the WAN between the routers has been configured with IP addresses and a routing protocol is running, we will create non-gatekeeper controlled inter-cluster trunks between the two CUCM clusters to route calls over the IP WAN. Provision the above-mentioned trunks from the Device > Trunk menu in Call Manager administration (ccmadmin). Name the trunk something descriptive to describe the trunk connection to the CUCM cluster you are pointing to. Point the trunk to the IP address of the remote CUCM server. Click Save and Reset the trunk. Create a Route Group from ccmadmin: Call Routing > Route/Hunt > Route Group and name the route group WAN_RG. The distribution algorithm does not matter at this time since there is only one device in the route group. Add the trunk to the WAN_RG. Click Save. Add a route list from ccmadmin: Call Routing > Route/Hunt > Route List. Name the route list WAN_RL and add the WAN_RG to the route list. Click Save and Reset. You will now provision route patterns to simulate a real-world PSTN dial plan. Each route pattern will point to the WAN_RL. The route patterns to simulate a PSTN dial plan will be as follows.

911
9.911
9.[2-8]11
9.[2-9]xxxxxx
9.0111!
9.0111!#

After each of the router patterns has been added, the calls to the phone numbers that are configured on the IP Communicator of the destination cluster can be attempted from a phone on the cluster. The IP Communicator phone registered to the destination cluster should ring if everything has been properly configured.

T1-CAS (Channel Associated Signaling) and T1 PRI (ISDN Primary Rate Interface) can be tested, but an MGCP T1-CAS circuit cannot be configured to provide clocking. The network side of the T1-CAS simulation will always have to be configured in the Cisco router IOS (H.323). If you’re fortunate enough to have the two port T1 VIC on each router, configure one port as a PRI and the other as T1-CAS. If you only have the one port T1 VIC cards, you’ll be able to test each functionality, but not at the same time.

MGCP T1 configuration. To add an MGCP gateway in CUCM, choose the Device menu and select gateway (Device > gateway). Click the Add New Gateway hyperlink and select the router model you’re using from the drop-down menu. Select MGCP as the Device Protocol and click the Next button. A fully qualified domain name (FQDN) can be configured, but the FQDN must match what is configured on the router. DNS resolution is not required; the hostname or FQDN is used as an authentication identifier in the MGCP protocol. The following router configuration example will be used.

```
Router#configure terminal
Router(config)#hostname SANESTER
Router(config)#ip domain-name TMB.COM
```
Based on the above router configuration, the MGCP gateway will need to be configured as SANESTER.TMB.COM. The show ccm-manager router IOS command can be used to verify the FQDN. Select a Call Manager Group of Default after the FQDN is configured in CUCM and click the Save button. You will now need to configure the hardware modules that are in the router. If you’re using a 2811 ISR, you will select the NM-4VWIC-MBRD to select one of the four built in HWIC slots. Click the Save button. You will now need to select the VIC cards that are populated in the router. After selecting the appropriate hardware types from the drop-down menus (Subunit 0 through Subunit 4 for the ISR), click Save. Click the Endpoint Identifiers hyperlinks next to your T1 card selection to enter the T1 configuration. The Device Protocol drop down menu now appears. Select T1-CAS or T1-PRI from the drop down menu. Ensure that the other side of the T1 connection matches the Device Protocol configuration. Use default for the Device Pool unless another device pool has been configured. All other configuration items are optional. If you have configured class of service (CoS) restrictions, you will need to configure a Calling Search Space for inbound calls. One side of the connection will need to be configured with a Protocol Side of Network. When done, click Save and Reset the gateway. The save button in CUCM 5.0 and later replaced the Insert and Update buttons used in Call Manager versions before 5.0.

The following router configuration will be required for the MGCP gateway to pull its configuration from the CUCM TFTP server component.

```
Router(config)#ccm-manager config
Router(config)#ccm-manager config server 192.168.100.1
```

Replace the IP Address used in the configuration example above to the IP Address of your CUCM server running the TFTP service. A configuration will be dynamically loaded into the router based on the CUCM gateway configurations performed in CUCM.

Put the T1 gateway into a new route group called PSTN_RG and create a new route list called RemoteSite_RL. Add the WAN_RG and then the PSTN_RG to the PSTN_RL. Remember to reset the route list when configured and any time any changes are made to the route group details (digit manipulation) in the route list. While you have an active call over the T1 link, use the Show Voice Port Summary IOS command to verify that one of the voice port channels are in use.

**Summary**

I hope this white paper has given you a head start to creating your own Cisco Unified Communications Manager home lab. Many additional components can be added to the base components mentioned here. I recommend integrating Unity voicemail using an additional virtual machine on the PC you have chosen for your home lab. Once you have taken a Cisco Unified Communications course, I recommend trying to re-create as many of the labs as possible. It’s easier trying to re-create labs you’ve already done than starting from scratch. The more times you can do the same labs, the more potential challenges you may come across. Play with the environment and try new features from the Cisco Features and Services Guide. The link to the CUCM 6.1 Features and Services Guide has been provided for your reference below.
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About the Author

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