VOICE OVER IP
PART 1

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CCNP PER. 1/2

Purpose

The purpose of this lab is to continue practicing our ability to set up networks in a Virtual Machine, and gain familiarity with the Cisco Unified Communications Manager. In addition, we were introduced to the basics of Voice over IP and applied our existing network configuration knowledge to IP phones.

Background Information

The concept of a telephone has existed for at least 200 years. Over time, technology has continued to develop new methods for communication, and communication via the telephone has evolved as well. Voice over IP (VoIP) is a method for telephony that does not use a physical phone network. Instead, as the name suggests, phone calls are sent over the IP network. On Cisco devices, this is a simple process. The main component is Dynamic Host Configuration Protocol (DHCP). In a network, every device has an IP address, that acts as an identifier, like a student ID number. All addresses in the network fall in the same specified range. If the IP addresses are like student ID numbers, then all students in the same grade have the same range of addresses, for example from 1000-1999. These addresses can be manually configured, or they can be dynamically assigned through DHCP. It would be incredibly inefficient for the school to manually assign each student an ID number, and the same is true in a network. Instead, the school can designate numbers 1000-1700 for students, leaving the other 300 numbers for staff. Similarly, when configured on the router, DHCP allows a router to designate a certain number of addresses to be assigned to the hosts. In the context of VoIP, the 2 phones must receive addresses from the DHCP server, which is the router, before they can be registered on the server.

Lab Summary

There were two main portions to the setup and configuration for this lab. First, I setup the Cisco Unified Communications Server through a virtual machine, setting R1 its default gateway. I configured the server with a static address of 192.168.10.6, and made sure to set an address within the network on my physical PC as well. During the install, I also setup my administrator account for accessing the server and the online GUI. Next, I entered the IP address of my server in my web browser to enter the Graphical User Interface (GUI) for Cisco Unified Communications Manager. On my router, I configured DHCP so that the 2 Cisco 7970 IP phones would lease addresses. I also issued a command in the DHCP configuration that indicated to the DHCP clients to get their phone configurations from my TFTP server on the VM. After checking that the phones had addresses from my router, I entered the Cisco Unified Communications Administration section of the GUI and registered the 2 phones with unique directory numbers. Then, setup was complete and I was able to call one phone from another using the set directory numbers.

Lab Commands

R1(config)#ip dhcp excluded-address [starting IP] [ending IP]
This command excludes a specified range of addresses from a DHCP pool. It must be configured before the pool is established so that the desired addresses are not assigned. The range of addresses usually includes the address of the router, and any other static end devices.

R1(dhcp-config)#ip dhcp pool [pool name]
To establish a DHCP pool, this command is issued. The pool is identified by the pool name. It also places you in the DHCP pool configuration mode.

R1(dhcp-config)#default-router [router IP]
This command is set within the DHCP pool and specifies the IP address of the default router for the DHCP clients.

R1(dhcp-config)#network [network address] [network mask]
The purpose of this command is to specify the subnet network number and mask of the DHCP pool.

R1(dhcp-config)#option [150/66] ip [server IP address]
This command defines the IP address of the TFTP server (CUCM) to download the phone configuration files. Option 66 indicates the IP address of a single TFTP server, while 150 provides IP addresses for a list of TFTP servers.

R1(config)#ntp master
This command sets the router as the authoritative NTP server, which was necessary in the configuration of the CUCM server.

Network Diagram
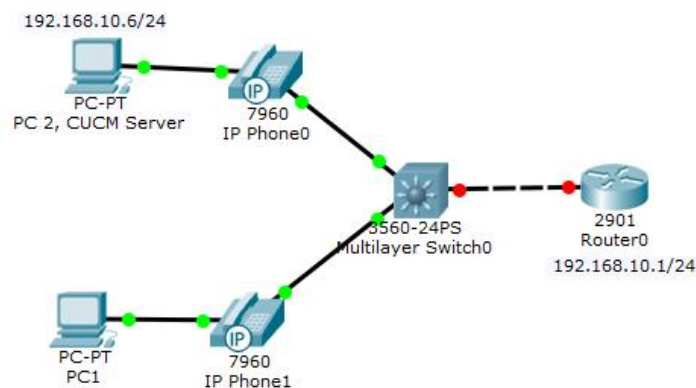
Configurations

```
R8(config-if)#do sh ip dhcp binding
Bindings from all pools not associated with VRF:
IP address          Client-ID/                Lease expiration        Type
                    Hardware address/
                    User name
192.168.10.11       0100.1e4a.5f0f.79         Jan 20 2017 06:59 PM    Automatic
192.168.10.12       0100.1e4a.5f0f.3a         Jan 20 2017 07:05 PM    Automatic
```

Router 1 show run:

```
Current configuration: 1482 bytes
Last configuration change at 19:11:13 UTC Thu Jan 19 2017
version 15.1
hostname R1
no aaa new-model
ip cef
ip dhcp excluded-address 192.168.10.1 192.168.10.10
ip dhcp pool VOIP
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.1
 dns-server 192.168.10.1
 option 150 ip 192.168.10.6
no ip domain lookup
no ipv6 cef
license udi pid CISCO2811 sn FTX1233A58A
license accept end user agreement
interface FastEthernet0/0
 ip address 192.168.10.1 255.255.255.0
 duplex auto
 speed auto
ip forward-protocol nd
no ip http server
no ip http secure-server
line con 0
line aux 0
line vty 0 4
 login
 transport input all
scheduler allocate 20000 1000
ntp master
end
```

The second portion of this configuration involved installing Cisco Unified Communications Manager in the VM so that it could serve as the TFTP server for the IP phones. For our purposes, I chose to install the basic configuration, as most of the configuration would be done in the Graphical User Interface (GUI).
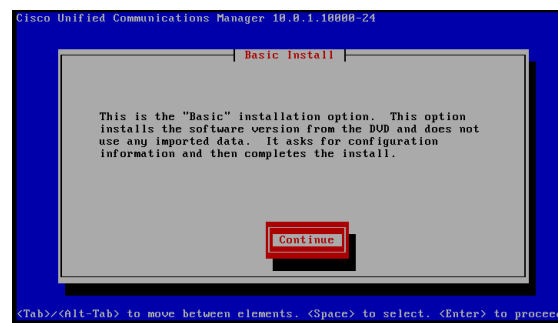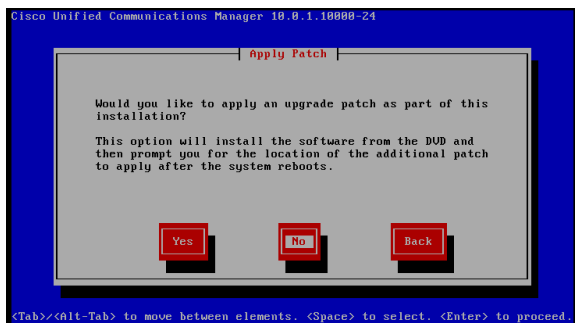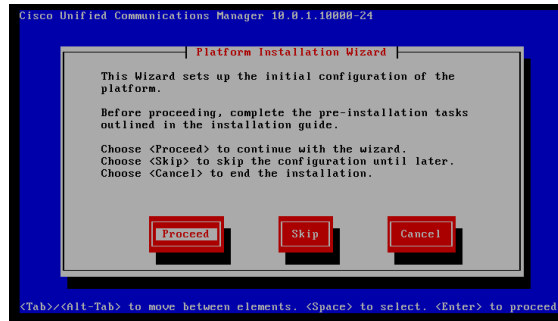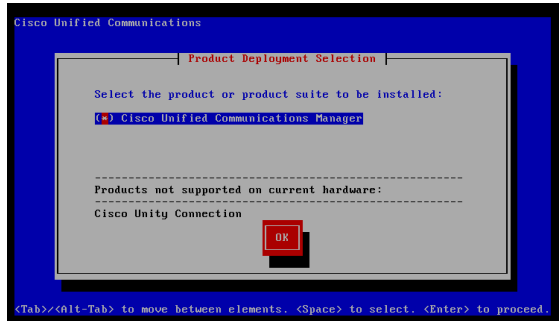

Next, I set the time zone, kept the default MTU size, and statically set an address for the server, with the router as the default gateway.
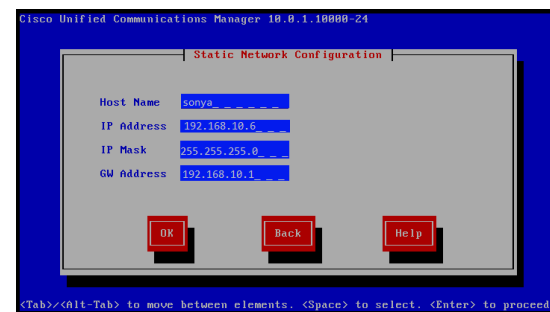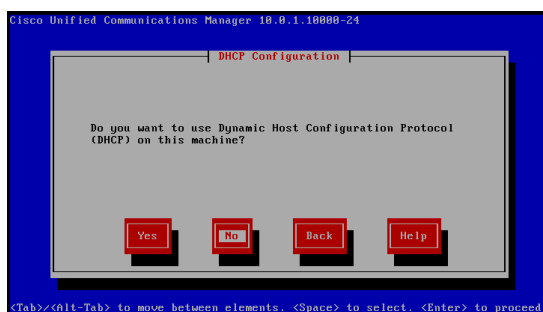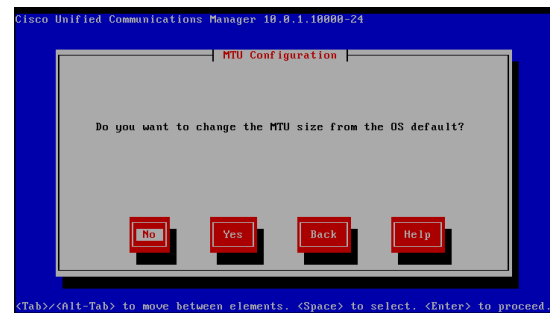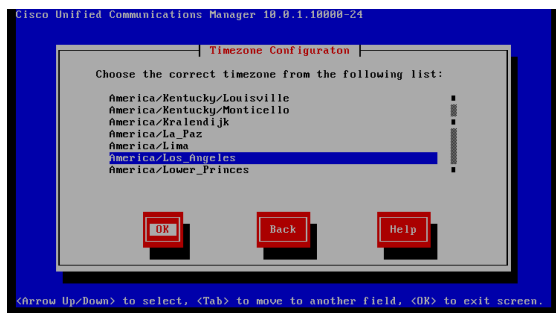
Next, I set the administrator ID and password, specified the organization, and pointed the CUCM to use the IP address of the router as its NTP server.
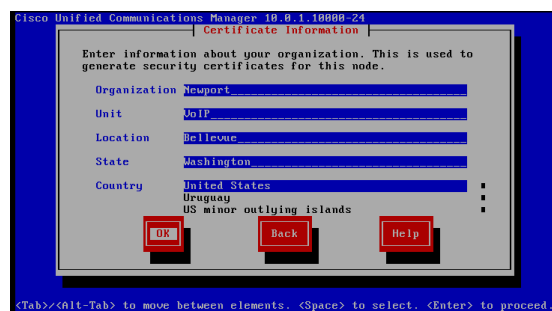

After setting the Application administrative webpage login information and the system security password, the Platform configuration was complete. I set the same password across all administrative logins for the sake of uniformity.
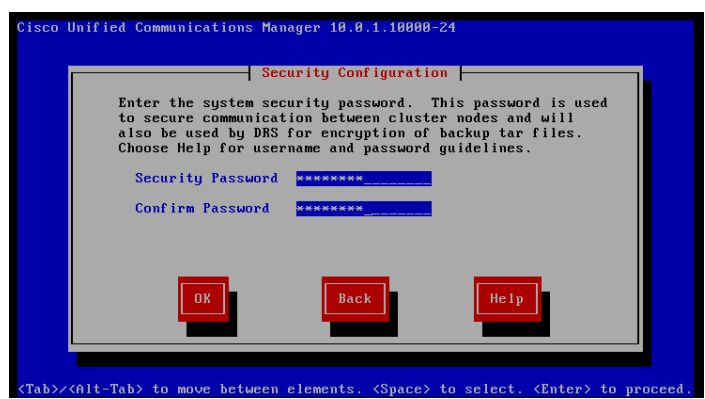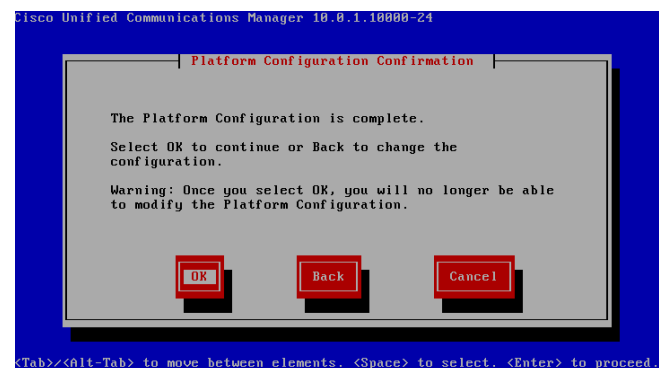
Once the installation on the VM was complete, I was able to open a web browser on my physical computer and enter in the IP address of the CUCM server.
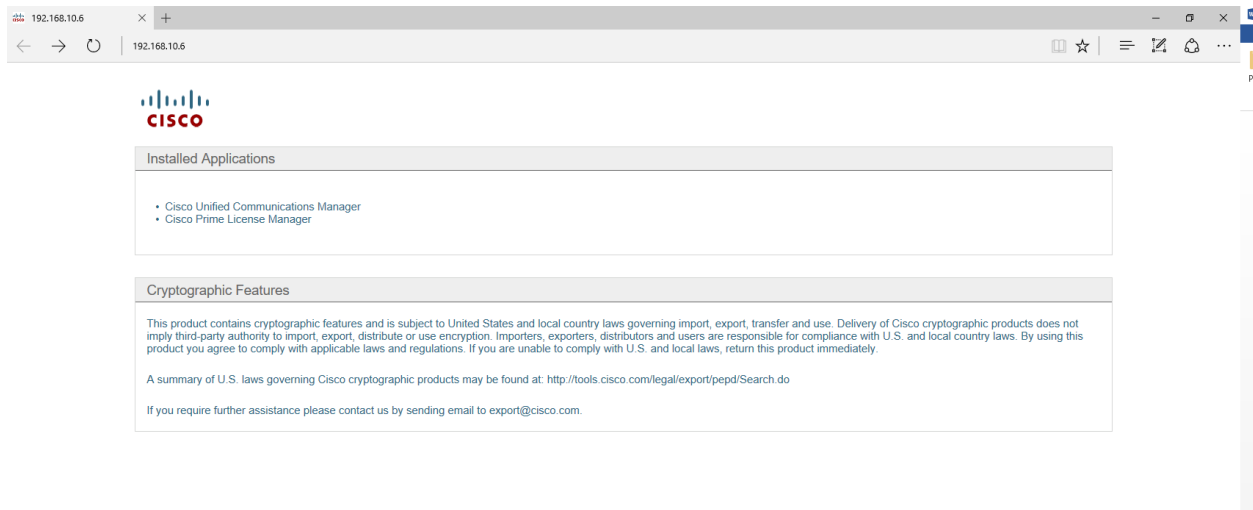
After logging in, I changed the Navigation to be on Cisco Unified Serviceability to activate all services. This is located on Tools > Service Activation. Without activating all services, we would not be able to register the IP phones to the network.
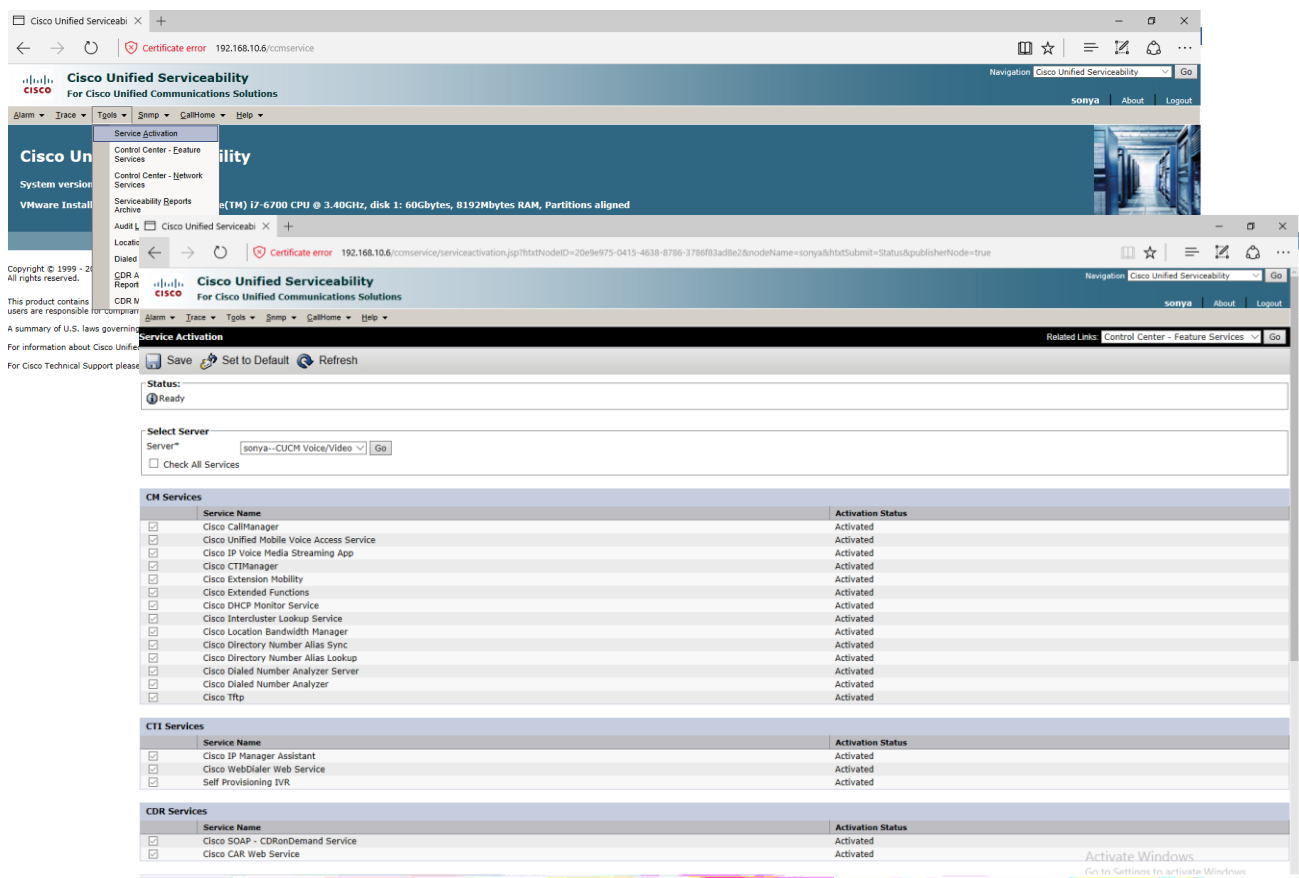
Next, I navigated to the Cisco Unified CM Administration page and added my 2 phones in Device > Phones based on their MAC addresses and Model number. I was working with the Cisco 7970 SCCP phones. Once they have been registered, they will appear below.

In order for the phones to call one another, they must have directory numbers. These can be set on the left-hand side of the screen in the Line 1 link. Once the directory numbers have been set and the phones have reset, I was able to send a call from one phone to another.

Problems

When I initially began setting up the network, I was unable to use my IP phones because they did not have power. Even though the phones were connected to the Layer 3 Power over Ethernet switch, they were not receiving power from the switch. I tried changing the cables that attached the phones to the switch, but nothing changed. I also tried reloading the switch, thinking that there was a past configuration that was preventing power from being granted. However, I realized that the real issue was with the ports on the switch. Once I entered the interfaces of the ports connected to the phones and issued the `no shutdown` command, then the ports and phones turned on.

In addition, when I initially installed CUCM in my VM, everything went smoothly. But when I attempted to login to the CUCM Administrative webpage, there was a "Database Communication Error". I researched for answers online, and some people suggested entering a set of commands in the VM CUCM command line to reset the system, but it made no difference for me. Unable to find a solution, I tried using my second PC, where I had also installed CUCM into the VM in exactly the same manner. I was able to login to the CUCM Administrative webpages on my second PC, so I decided to use that installation instead, so that I could move forward.

Conclusion

Understanding how to build and deploy a Voice over IP network is extremely valuable knowledge. It reminds me of how far technology has advanced since the 1800s when the telephone was first invented. Technology is increasingly incorporating itself in all areas of life and VoIP networks are certainly no exception. I think it is important to understand the technology that we use in everyday life, and discovering how to setup a VoIP network helped me gain appreciation for the telephone, something that I've taken for granted.