Internal VoIP

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Purpose

The motive behind performing the Internal *Voice over Internet Protocol (VoIP)* Lab was to operate the protocol with the utilization of a *Cisco Unified Communication (CUCM) Server* in our Internal network or the Local Area Network and make and receive a call from each *IP Phone* in the network. Once thoroughly completed, one can gain the ability to understand and correctly handle the performance of the Cisco IP Phones in his/her LAN. A person would also obtain a good experience of functioning the CUCM server in the LAN.

Background Information

Voice over Internet Protocol (VoIP) is a methodology and group of technologies for the delivery of voice communications sessions using the Internet Protocol. VoIP can turn a standard Internet connection into a way to place free phone calls. The practical upshot of this is that by using some of the free VoIP software that is available to make Internet phone calls, you're bypassing the phone company (and its charges) entirely. Although VoIP can be orchestrated on various instruments such as an *ATA* or a computer. For this lab, however, we would be using specialized phones known as *IP Phones*.

IP Phones appear like a normal telephone, which a handset, a cradle and a few buttons. Instead of having the standard RJ-11 phone connectors however, IP Phones utilize an RJ-45 ethernet connector, through which they can connect directly to a node or a host. During the whole lab, the phones would use a protocol known as the *SCCP.*

*The Skinny Client Control Protocol (SCCP)* is a proprietary network terminal control protocol originally developed by Selsius Systems, which was acquired by Cisco Systems in 1998.

SCCP is a lightweight IP-based protocol for session signaling with CUCM. The job of the protocol is to provide real time audio stream on the clients. The Cisco 7900 series of IP Phones is an example of an SCCP client.

Cisco Unified Communications Manager (CUCM) is an IP-based communications system integrating voice, video, data, and mobility products and applications. It enables more effective, secure communications and can transform the way in which one communicates. Today's challenging work environments increase the need for organizations to have a comprehensive, integrated collaboration solution that enables users to communicate from anywhere, using any device, on any network in a cost-effective, reliable, and secure manner. We would need to deploy the CUCM server on VMWare and make the entire topology function. For a detailed information on VMWare, kindly refer to the “RADIUS and TACACS+ Lab.”

Lab Summary

We commenced the lab with successfully installing the CUCM server on VMWare software, situated in our local hosts. Unlike the other encounters that we have had regarding the establishment of virtual machines on VMWare, we had to confirm that the virtual server installs with certain amount of RAM and space for it to function properly, which we learnt from our research that we completed prior to beginning the lab. During the installation, we performed a few commands on the router in order for the lab to progress further.

After installing the server on VMWare, we conducted the whole configuration on the router and the switch. After that was done, we used Google Chrome, and through the IP Address of the virtual server the we installed, we connected to the server to complete the configuration on the server, which included registering the pone in the server directory and providing the IP Phone a number, and after the whole process was finished, we were able to call each other using the IP Phones.

Topology and IP Addressing Scheme

A picture containing sky

Description generated with high confidence

Configurations

Step 1: -

A screenshot of a cell phone

Description generated with very high confidence

Assign IP addresses to the nodes and hosts according to the topology and execute the DHCP commands on the router. Open VMWare on the local host and create a new virtual machine on the software. Instead of automatically creating the virtual machine, select the custom option, which will further let us decide the specifications of the server. After clicking “next,” the user will be prompted to locate the image of the server.

A screenshot of a cell phone

Description generated with very high confidence

Step 2: -

A screenshot of a cell phone

Description generated with very high confidence

VMWare will not be able to recognize any operating system associated with the server’s image file. The user will have to choose a guest operating system, which the server will run on. In order for the successful completion of the lab, the user must utilize Linux as the guest operating system, and choose a Red Hat Enterprise Linux version from the dropdown.

Step 3: -

A screenshot of a cell phone

Description generated with very high confidence

Another condition that needs to be met for a successful installation is that the server must have 2 processors and should at least have one core per processor.

Step 4: -

A screenshot of a cell phone

Description generated with high confidence

The user must allocate at least 6GB of RAM to the server for it operate well.

Step 5: -

A screenshot of a cell phone

Description generated with very high confidence

At this moment, the user should choose to use the recommended settings until they reach the part where they must set a disk capacity. The server requires at least 80 GB of space. After this moment, the server will successfully be set up on VMWare and we will forward on to configure and install the server on the software.

Step 6: -

A screenshot of a cell phone

Description generated with very high confidence

The first step in installing the server is testing the media. If the user wants to test the media, press okay, and if he/she intends to skip the process, they can opt out of it by selecting the “skip” option. If the user skips the process however, the server will not find any flaws in the image, which might lead to a termination of the installation of the server later.

Step 7: -

A screenshot of a cell phone

Description generated with very high confidence

Afterwards, the wizard asks the user to select the product suite that they want to install. They must choose to select “Cisco Unified Communication Manager” as that is what we will be working on to configure the IP Phones.

Step 8: -

A screenshot of a cell phone

Description generated with very high confidence

After the completion of the previous step, the wizard will notify the user of the version of the server found in the image. At that moment, the user must choose to proceed with the installation.

Step 9: -

A screenshot of a cell phone

Description generated with very high confidence

The wizard at this point will ask to proceed with the pre-installation tasks. The user must finish all the pre-installation tasks because selecting the “proceed” option will prompt the user to configure the server.

Step 10: -

A screenshot of a cell phone

Description generated with very high confidence

The wizard, in the next part of the installation procedure, will ask the user if he/she wants to upgrade the CUCM server version. The user can opt to apply the upgrade patch if connected to the internet, although he/she will have to disconnect from the internet at a later part of the lab.

Step 11: -

A screenshot of a cell phone

Description generated with very high confidence

The user will then be asked to enter their time zone. He/she must choose a time zone from the list time zones given and click ‘OK’ to progress to the next step.

Step 12: -

A screenshot of a cell phone

Description generated with very high confidence

At a later step, the wizard will ask the user if he/she wants to configure the IP addressing of the server using DHCP. Even though we are orchestrating DHCP on the routers, but it should not be used to provide addresses to the server as the DHCP configuration on the router is not enough to provide all the addresses that the server requires, and hence, those addresses will either have to be manually set up or denied being configured on the server.

Step 13: -

A screenshot of a cell phone

Description generated with very high confidence

Feed the IP address into the server that follows the topology and name the server.

Step 14: -

A screenshot of a cell phone

Description generated with very high confidence

The wizard will then ask the user if they want their server to become a DNS client. At this point, the user must answer by selecting the ‘No’ option because if the machine does not find a DNS server in the network, it will terminate the whole installation process.

Step 15: -

A screenshot of a cell phone

Description generated with very high confidence

The “Administer Login Stage” in the wizard will ask the username to feed a user into the server, which the user will later use to login to the CUCM server using their web browser.

Step 16: -

A screenshot of a cell phone

Description generated with very high confidence

The server requires the existence if an NTP Server in the network in order for the installation to successfully conclude. The user will issue the command: ntp master in the configuration terminal mode of the router to establish an NTP server in the router, and then feed the IP address into the wizard on the column that asks for the IP address of the NTP server.

Step 17: -

A screenshot of a cell phone

Description generated with very high confidence

The user should not make the server an SMTP host as we do not need any mailing service for the completion of the lab, an it would therefore, unnecessarily consume some valuable space on the server.

Step 18: -

A screenshot of a cell phone

Description generated with very high confidence

Enter a username that the user will be using to login to the application and press ‘OK.’ After this point, the wizard will install the server on VMWare and notify the user of any installation errors that take place. After the installation is complete, the user will be asked to enter the login information that they entered in the step before, and then the image below will appear on their screen.

A screenshot of a cell phone

Description generated with very high confidence

Step 19: -

Either during the installation or after the installation, the user must conclude their configuration on the nodes. To begin with, they can effectuate the command, telephony-service, in the configuration terminal mode on the router. This command sets up and switches to *telephony service* mode, through which, the user can establish phone directories, total number of phones, etc. In the telephony service mode, the user will need to specify the IP address of the CUCM server by entering the command, ip source-address 192.168.1.10 port 2000, where 192.168.1.10 is the IP address of the server. Another crucial command that the user must prosecute is the option 150 ip 192.168.1.10 under the DHCP router-config mode.

Step 20: -

The switches must have 2 VLANs, obtaining the IP address from the router. Out of the two VLANs, one should be assigned to the ports connected to the IP phones and the other VLAN must be set up as a voice VLAN, by using the command, switchport voice vlan 20, where VLAN 20 is being used as the voice VLAN. The IP Phones communicate on the voice VLANs and due to that reason, they are necessary to be included in the network.

Step 21: -

A screenshot of a social media post

Description generated with very high confidence

After configuring the nodes and installing the server on VMWare, the user should be able to ping and configure the IP phones on the server. For the next step, the user must not be connected to the internet. They have to use a web browser (we recommend using Google Chrome) and type in the IP address of the CUCM server in the address bar to have this screen appear on their monitor. They would then have to click on the option that reads “Cisco Unified Communication Manager.”

Step 22: -

A picture containing screenshot

Description generated with very high confidence

The user must use the credentials that they used in the installation process to login to the server and begin configuring the IP phones.

Step 23: -

A picture containing screenshot

Description generated with very high confidence

There would be a drop-down menu at the top right corner of the screen, which the user has to click and select “Cisco Unified Serviceability” and press go. The user then have to activate all the services that have ben activated in the image below.

A screenshot of a cell phone

Description generated with very high confidence

The must use the same dropdown to select “Cisco Unified Communication Manager” to register the Ip Phones to the server and assigning them a number.



Step 24: -

A screenshot of a cell phone

Description generated with very high confidence

CUCM requires the user to add a user profile on the server to register the devices associated with it to register. To add a user to the server, the user must hover the cursor to the *User Management* option and select *end user*. The user will then be able to add a new user to the server application by selecting *add.* The image above is an example of the screen the user should be able to view once they complete this process.

Step 25: -

The next step involves manually registering of the IP phone. For that the user must go to *device>phone>add*. From thereon, the user can select the model of the IP phone from the dropdown and select *next.*

A screenshot of a cell phone

Description generated with very high confidence

Step 26: -

A screenshot of text

Description generated with very high confidence

A screen will appear on the monitor, with numerous options to choose, add and select. The user however, does not need to complete everything on the screen to register the phone. They will have to provide the MAC Address of the phone and make sure that the description is correct. The *device pool* should be made default unless it has been toyed with a little on the phones. The *Common Phone Profile* should be left *Standard {phone model} SCCP* as it is the protocol that we will be utilizing.

Step 27: -

Once the registering of the phone is completed, the user must add a line to it. After registering the phone, the application will show the user the configuration of the phone that was done in the last step. Next to it, there will be a few links, one of them will read: *Line [1] – Add a new DN*. In order to add a line and associate a number with the phone, the user must click on that link. It does not show up in the image above because at the time the screenshot was taken, the line was already added.

A screenshot of a cell phone

Description generated with very high confidence

Step 28: -

A screenshot of a cell phone

Description generated with very high confidence

Once this screen appears, the user has to provide a Directory Number that can be of the user’s liking, which will be used to call the phone that it is associated with.

Step 29: -

A screenshot of a cell phone

Description generated with very high confidence

Repeat the same steps for the other phone, and the user should be able to call the phones using each of the phone.

Router configs: -

hostname Router

boot-start-marker

boot-end-marker

no aaa new-model

memory-size iomem 25

ip cef

ip dhcp excluded-address 192.168.1.10

ip dhcp excluded-address 192.168.2.10

ip dhcp pool voice

network 192.168.1.0 255.255.255.0

default-router 192.168.1.1

dns-server 209.165.200.254

option 150 ip 192.168.1.10

ip dhcp pool data

network 192.168.2.0 255.255.255.0

default-router 192.168.2.1

dns-server 209.165.200.254

option 150 ip 192.168.1.10

ntp master

no ipv6 cef

multilink bundle-name authenticated

voice-card 0

license udi pid CISCO2901/K9 sn FTX180180M8

license accept end user agreement

license boot module c2900 technology-package securityk9

license boot module c2900 technology-package uck9

vtp domain CCNP

vtp mode transparent

redundancy

interface Embedded-Service-Engine0/0

no ip address

shutdown

interface GigabitEthernet0/0

no ip address

shutdown

duplex auto

speed auto

interface GigabitEthernet0/1

no ip address

duplex auto

speed auto

interface GigabitEthernet0/1.10

encapsulation dot1Q 10

ip address 192.168.1.1 255.255.255.0

interface GigabitEthernet0/1.20

encapsulation dot1Q 20

ip address 192.168.2.1 255.255.255.0

interface Serial0/0/0

no ip address

shutdown

clock rate 2000000

interface Serial0/0/1

no ip address

shutdown

clock rate 2000000

ip forward-protocol nd

no ip http server

no ip http secure-server

control-plane

mgcp profile default

gatekeeper

shutdown

telephony-service

max-ephones 5

max-dn 5

ip source-address 192.168.1.10 port 2000

max-conferences 8 gain -6

transfer-system full-consult

line con 0

line aux 0

line 2

no activation-character

no exec

transport preferred none

transport output lat pad telnet rlogin lapb-ta mop udptn v120 ssh

stopbits 1

line vty 0 4

login

transport input all

scheduler allocate 20000 1000

end

Switch configs: -

hostname Switch

boot-start-marker

boot-end-marker

no aaa new-model

system mtu routing 1500

vtp domain CCNP

vtp mode transparent

authentication mac-move permit

ip subnet-zero

spanning-tree mode pvst

spanning-tree etherchannel guard misconfig

spanning-tree extend system-id

vlan internal allocation policy ascending

vlan 2

name InSecure

vlan 3-5,7

vlan 10

name voice

vlan 12

vlan 20

name data

vlan 99

vlan 100

name Microsoft

vlan 192

name Guest

interface FastEthernet0/1

switchport access vlan 10

switchport mode access

switchport voice vlan 20

spanning-tree portfast

interface FastEthernet0/2

switchport trunk encapsulation dot1q

switchport trunk allowed vlan 10,20

switchport mode trunk

interface FastEthernet0/3

switchport access vlan 10

switchport mode access

switchport voice vlan 20

spanning-tree portfast

interface FastEthernet0/4

interface FastEthernet0/5

interface FastEthernet0/6

interface FastEthernet0/7

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11

interface FastEthernet0/12

interface FastEthernet0/13

interface FastEthernet0/14

interface FastEthernet0/15

interface FastEthernet0/16

interface FastEthernet0/17

interface FastEthernet0/18

interface FastEthernet0/19

interface FastEthernet0/20

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interface FastEthernet0/41

interface FastEthernet0/42

interface FastEthernet0/43

interface FastEthernet0/44

interface FastEthernet0/45

interface FastEthernet0/46

interface FastEthernet0/47

interface FastEthernet0/48

interface GigabitEthernet0/1

interface GigabitEthernet0/2

interface GigabitEthernet0/3

interface GigabitEthernet0/4

interface Vlan1

no ip address

shutdown

ip classless

ip http server

ip http secure-server

ip sla enable reaction-alerts

line con 0

line vty 5 15

end

Problems: -

We faced numerous problems during the course of this lab. Some of those lasted for days. For instance, the first problem that I faced was that the wizard could not establish a connection with the router, even though, I had bridged the connection to the PC, and the PC could ping the router. It was later, that I realized that VMWare, when installed on a machine, adds its own virtual interface on that machine, which was for a reason, absent on my PC. To fix this issue, I took a decision to wipe out everything on my SSD and start again from scratch. Once I got the server installed, I began configuring the IP phones on the Google chrome. I thought that I had completed every step on the browser to register the phone. I, however, forgot about activating the services on Cisco Unified Serviceability. After I completed the procedure, the phones were registered.

Conclusions: -

The lab was successfully completed and the motive of working on this lab was fulfilled. We learnt the proper functioning of IP phones and the protocols bound to it. IP telephony is important because this service can be used for transmission all kinds of multimedia content, which includes audio and video. The service can also be integrated with the current infrastructure. Another reason why businesses are adopting this service is because it is very cost efficient. Considering all aspects of the utilization of the technology involved in this lab, it proves to be a very crucial lab for students to participate and to learn.