DOKUZ EYLUL UNIVERSITY

ENGINEERING FACULTY

DEPARTMENT OF COMPUTER ENGINEERING

METROPOLITAN AREA NETWORK SIMULATION PROJECT

by

Çağrı Anıl ERBEY 2014510028

Kemalcan ŞİMŞEK 2013510093

16.06.2021

İZMİR

CHAPTER ONE

INTRODUCTION

1.1. Project Definition and Problem Formulation

A metropolitan area network (MAN) is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN). The term is applied to the interconnection of networks in a city into a single larger network. It is also used to mean the interconnection of several local area networks by bridging them with backbone lines. The latter usage is also sometimes referred to as a campus network.

1.2. The Purpose and Motivation of the Project

MAN allows sending and receiving of local emails in a cheaper and more quicker manner. Due to its use of fiber optics, users can transfer databases and files quickly, as the speed of the network has the capacity of reaching 1000Mbps. This is why telephone companies across the world utilize the structure of MAN and use fiber optics to transfer data in an unprecedented speed. MAN has the feature of allowing network administrators to manage the entire network centrally leading to much more effective and efficient network management. Speaking of effective network management, it is always highly recommended to essential network training beforehand. A MAN is also considered a more secure network in comparison to a WAN[2].

1.3. Term Definitions

Network: This general term refers to all the components involved in getting computers and other types of hardware to talk to each other.

Server: Also called "file server" and "network server" this term refers to the "nerve center" of your network. It typically needs to be much more high-powered than a regular desktop workstation. The server is home to hardware that is networked (allows more than one person to use it simultaneously). All of your data will typically be stored on this machine.

Workstation: This refers to each person's computer. Your front and back office staff computers and the machines in the examination room will be workstations on the network.

Wireless: This refers to a type of network that broadcasts an access signal to the workstations. This allows for transporting laptops and tablet PCs from room to room while maintaining a network connection continuously. A wireless network also presents some additional security requirements.

Ethernet: This is the backbone of our network. It consists of the cabling and is typically able to transfer data at a rate of 100mb/s. What is not shown here are the hubs and switches that are used to connect computers and other devices together.

Router: This is your network's "air traffic controller." It routes all the data on your network to where it is supposed to go. It also assigns unique network addresses to all the computers (IP addresses). Routers can also hide the computer and devices that connect to it from the outside world. To people on the Internet, your entire network looks like one computer (one IP address). This adds another layer of protection to the computers on your network. A router may contain a VPN server and/or a firewall. Read more about hubs, switches and routers.

Architecture: Network architecture is the design of a computer network. It can also be defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data.

Switch: Switch is a high-speed device that receives incoming data packets and redirects them to their destination.

Server: Servers manage access to a centralized resource or service in a network.

Packet: Packet is a formatted unit of data carried by a packet-switched network.

Channel: Channel refers either to a physical transmission medium such as a wire or to a logical connection over a multiplexed medium such as a radio channel.

Protocol: Protocols define rules of communication between network devices.

DNS : DNS stands for domain name system. It is an application layer protocol used to provide a human-friendly naming mechanism for internet resources. It is what ties a domain name to an IP address and allows you to access sites by name in your browser.

IP : The IP protocol is one of the fundamental protocols that allow the internet to work. IP addresses are unique on each network and they allow machines to address each other across a network. It is implemented on the internet layer in the IP/TCP model[3].

CHAPTER TWO

METHOD AND SIMULATION

2.1. Simulation and Modelling Concepts

The network requirements, physical and logical needs were calculated. The alternate approach, known as bottom-up, is more commonly employed, but is far from optimal. They have a tendency to begin the design process at this level, leaving applications and services as an afterthought to be considered later. In most cases, taking a bottom-up approach tends to require a less thorough initial analysis, and is easier to implement as a quick fix.

The main approach to the modelling is building workstations (some facilities include the wireless workstation users and to provide a successful connection wireless router were used and their configurations were adjusted) as needed for facilities and connections between each of them. Furthermore, we could call it this method as divide and conquer. It makes the process much easier than the thought.

After building workstations, the IP`s are assigned for each workstation. In deeply, first campus is located on network. Network devices connections between workstations and network devices are analysed. In addition to analyse process, facilities have more than one network devices and they must be connected logically and physically to workstations. Network devices were configured.

In order to connect workstations to the each other to provide essential connection, the physical cable is chosen as automatically by the packet tracer simulation software. In this case, workstations are connected with straight copper cable to the switches.

A facilities which are located in the same campuses are connected each other with a main switch over a fast ethernet port. Router has been used for two different networks which are commonly used same network channel rules/bases. The other significant responsibility of the router is managing the packages; if one of the workstation wants to send something (message/mail or etc.) to another workstation at different network, router ensure the package goes to the other network with the help of static routing.(In packet tracer simulation, router has a option for redirecting the incoming network requests named as static routing configuration).

Finally, to achieve the main requested services; such as sending/receiving mail, browsing the web, sending/receiving files, VoIP Services (sending voice data over an IP between dedicated users/workstations) and lastly database management the servers are essential and needful. Servers are located in second campus, third facility. Servers were configured and connected to the main switch of server farm. This server farm switch is connected to the other switch of second facility.

To sum up, we did not want to mention the structure deeply. All network connections are ended and connected successfully to ensure the achievable accomplished network connection between two distinct campuses.

2.2. Simulation Environment

The simulations done in the project Cisco Packet Tracer was used. Packet Tracer offers a unique combination of realistic simulation and visualization experiences, complex assessment and activity authoring capabilities and opportunities for multi-user collaboration. Cisco Packet Tracer makes learning and teaching significantly easier by supporting multi-user collaboration and by providing a realistic simulation environment for exploration and experimentation.

2.3. Network Design Requirements

Server/client architecture was used as the architecture of the network. Seven switches, four access points, four routers and seven servers used for the design. MAIL, DNS, HTTP 3, HTTP 2, HTTP 1, FTP 1, FTP 2 and DHCP protocols were used for the communication between devices. LANs contained in the MAN use the star topology so in general our topology can be considered to be a hybrid topology. Logical and physical topology of the network is presented below with the configurations for the servers.

2.4. Requirement Analysis

All workstations in all facilities of the first branch and in the first, second and third facilities of the second branch have access to web servers located in the third facility of the first branch.

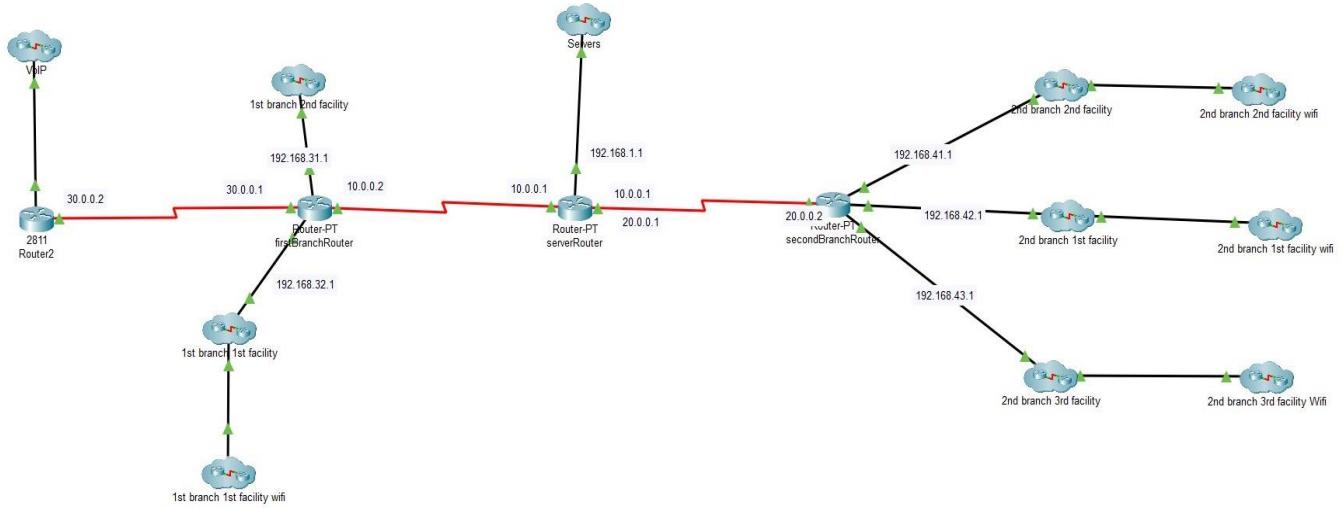
The mail server was authorized to send mail to all workstations in the first and second facilities of the first branch, to receive mail from workstations in the third facility of the first branch, and to use mail applications to the workstations in the first and third facilities of the second branch.

FTP servers were authorized to send files to workstations in the first and second facilities of the first branch, second facility of second branch, and access to the FTP server to workstations in the first facility.

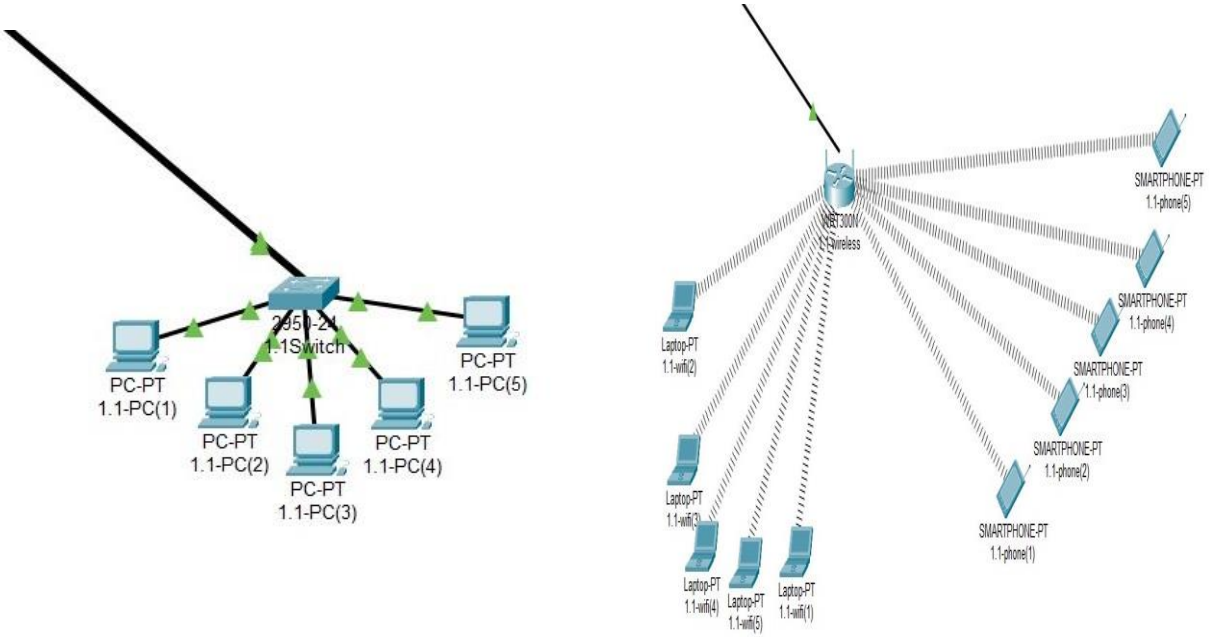
Workstations at the second facility of the first branch were given the authority to use the workstations at the second facility of the second campus were allowed to organize files and applications.

In addition, the access point was used for the wireless network feature of the workstations in the first facility of the second branch, and only 10 computers from the workstations in the second facility of the first branch were used in that facility for the VoIP protocol router2811 because other routers are not suitable for sending voice.

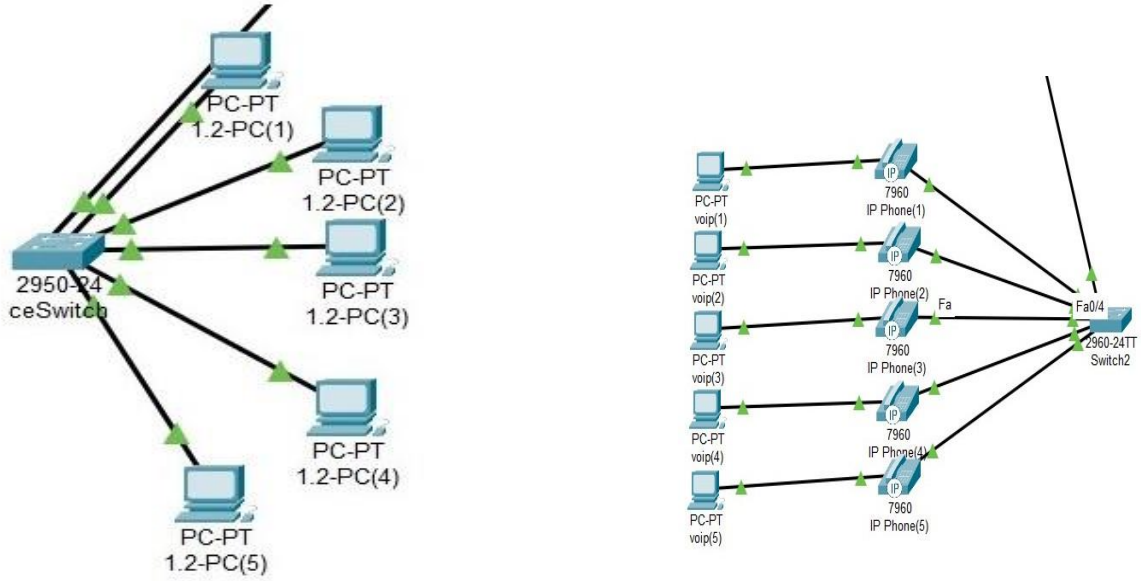
2.5. Definitions of the System/Model



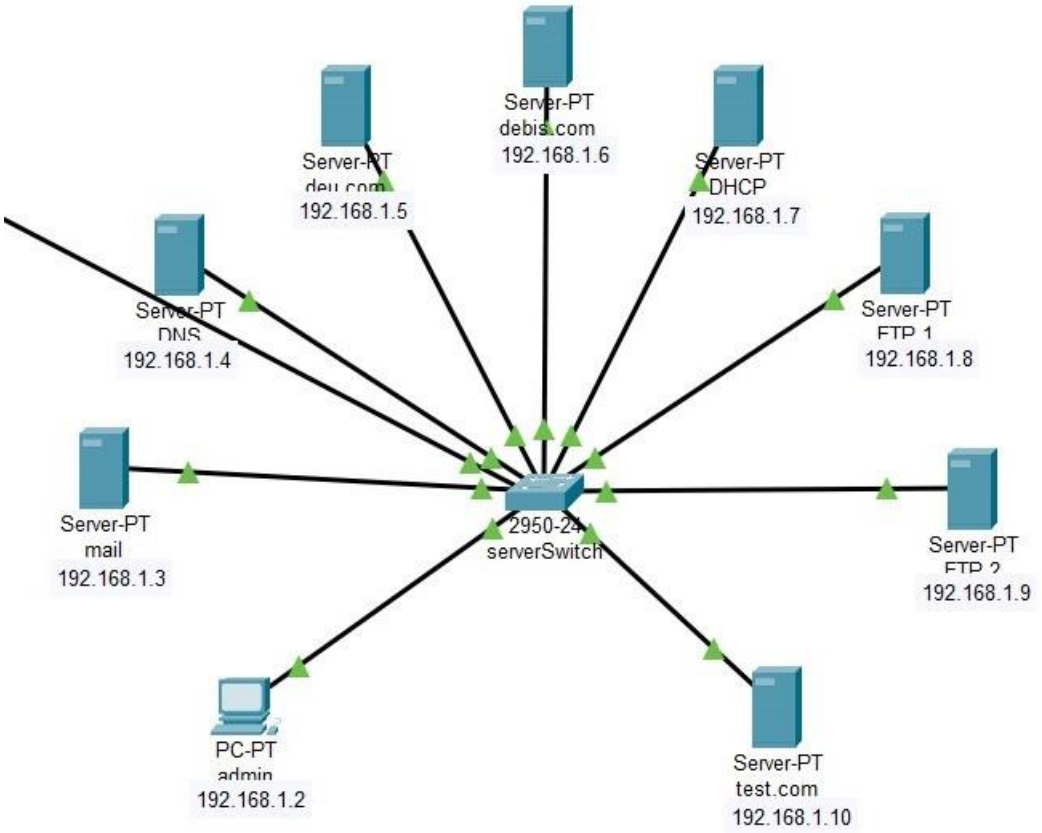
General Shape of The System



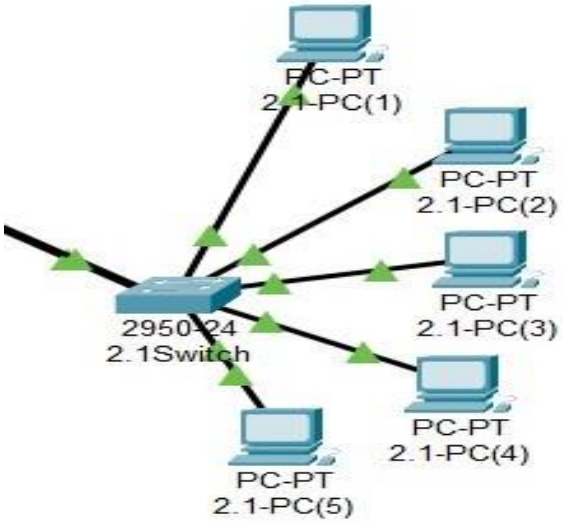
First Branch First Facility

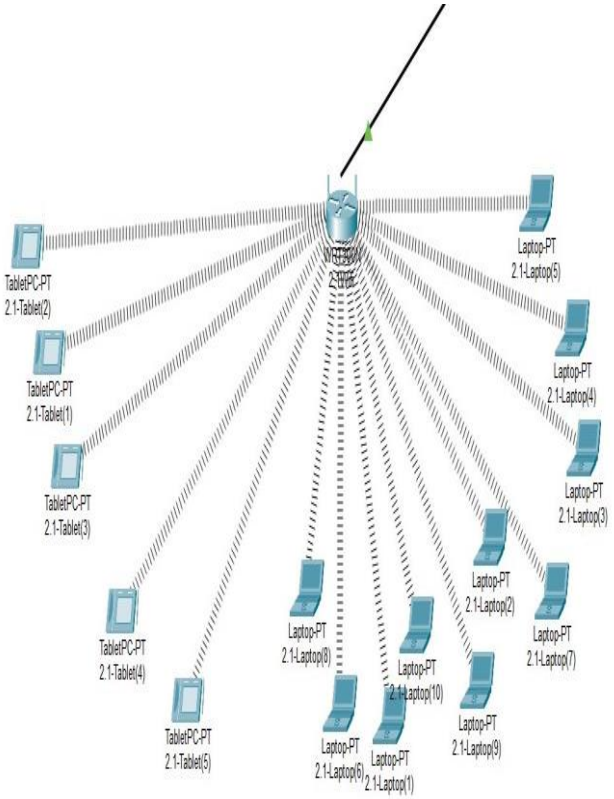


First Branch Second Facility

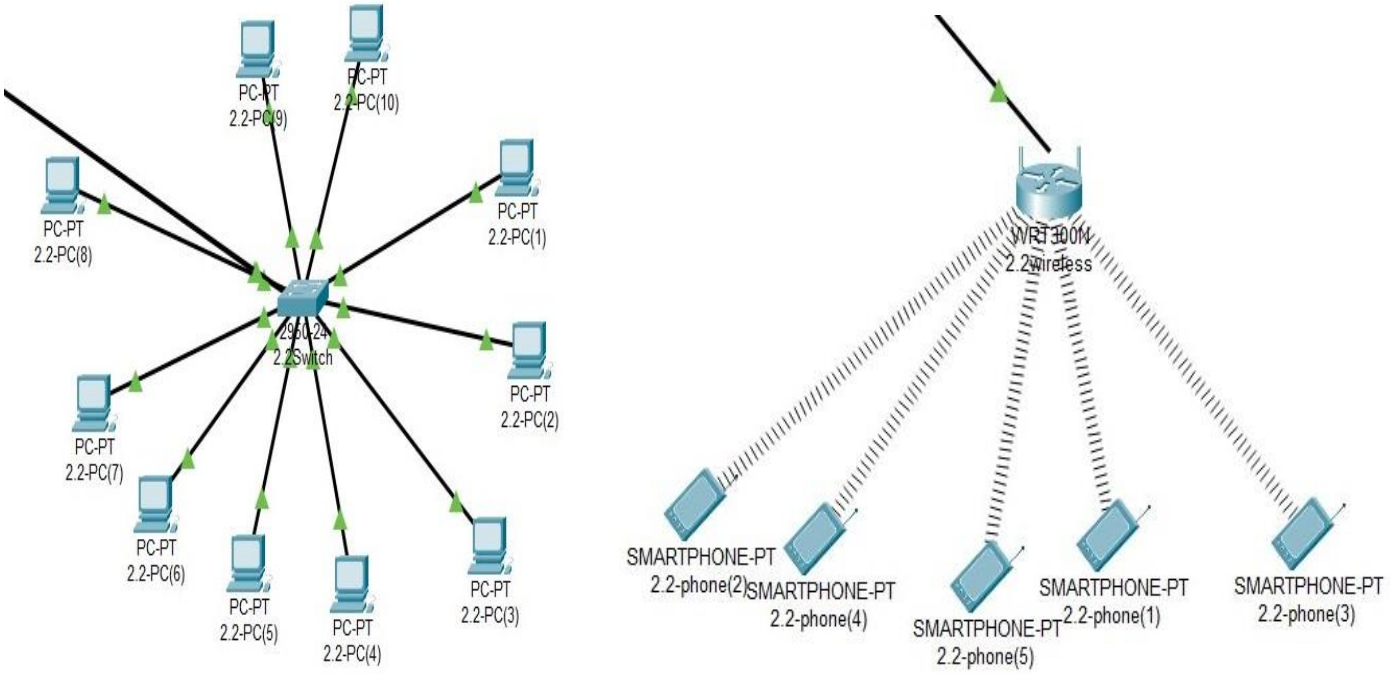


First Branch Third Facility

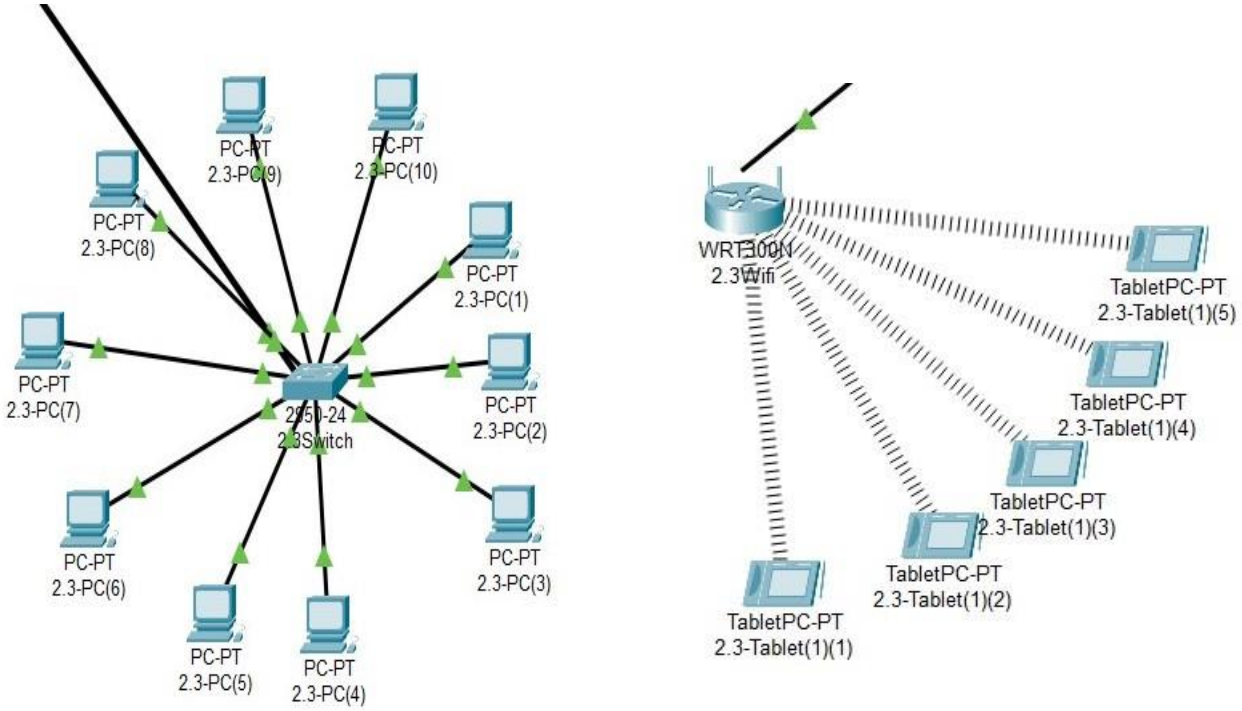




Second Branch First Facility

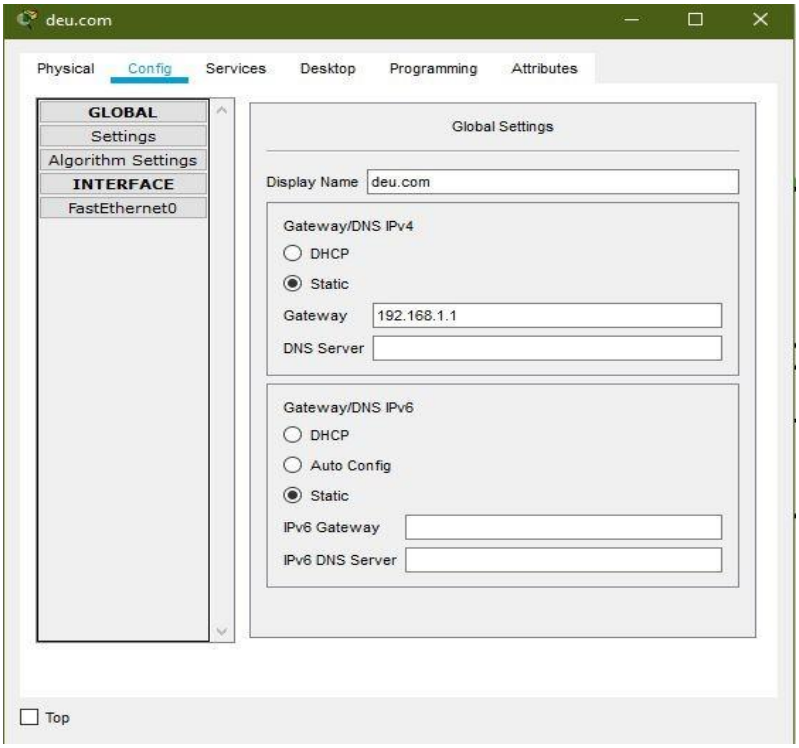


Second Branch Second Facility

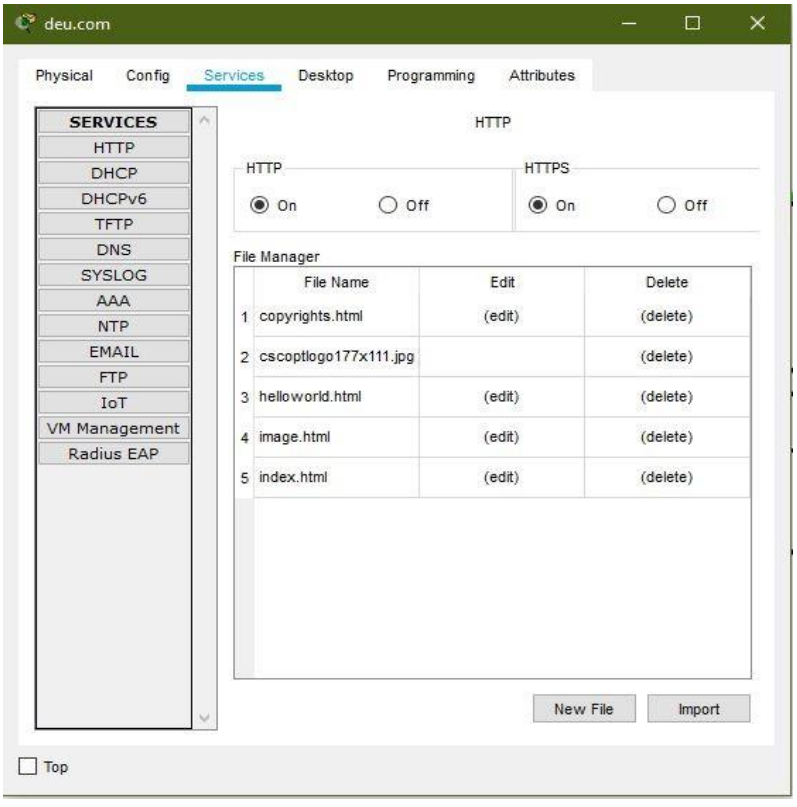


Second Branch Third Facility

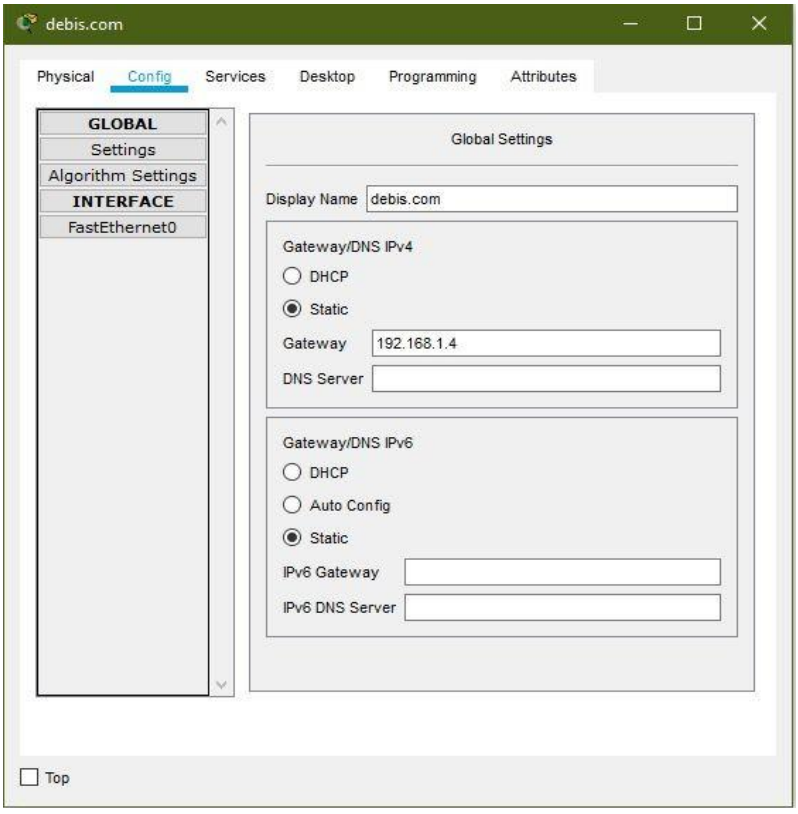
2.6. Simulation Elements



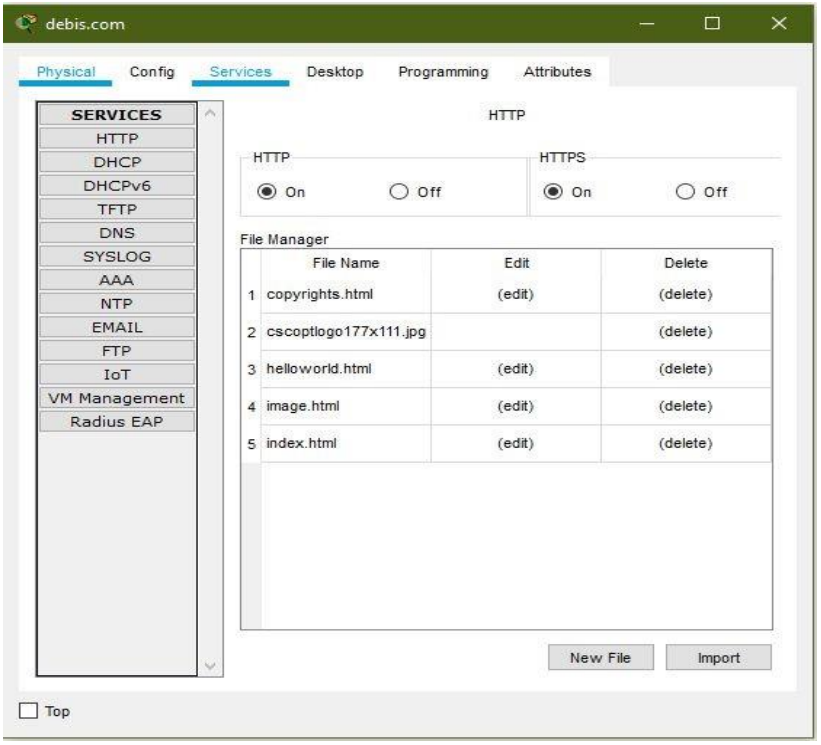
HTTP1 Server Config



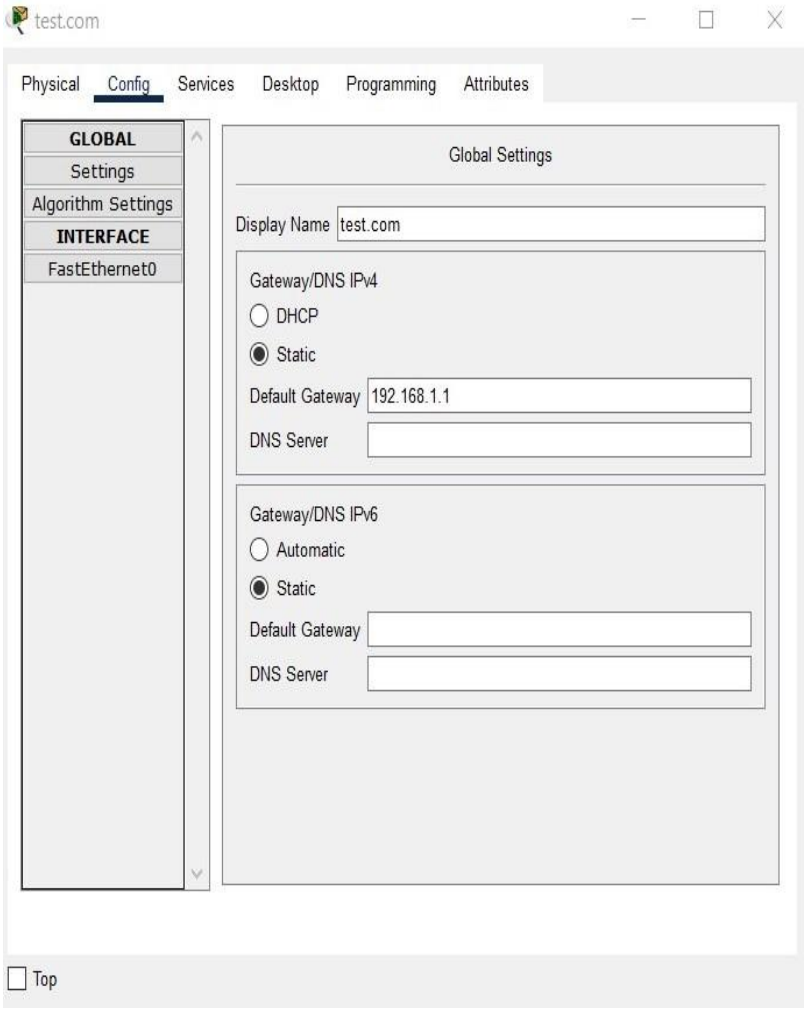
HTTP1 Server Services



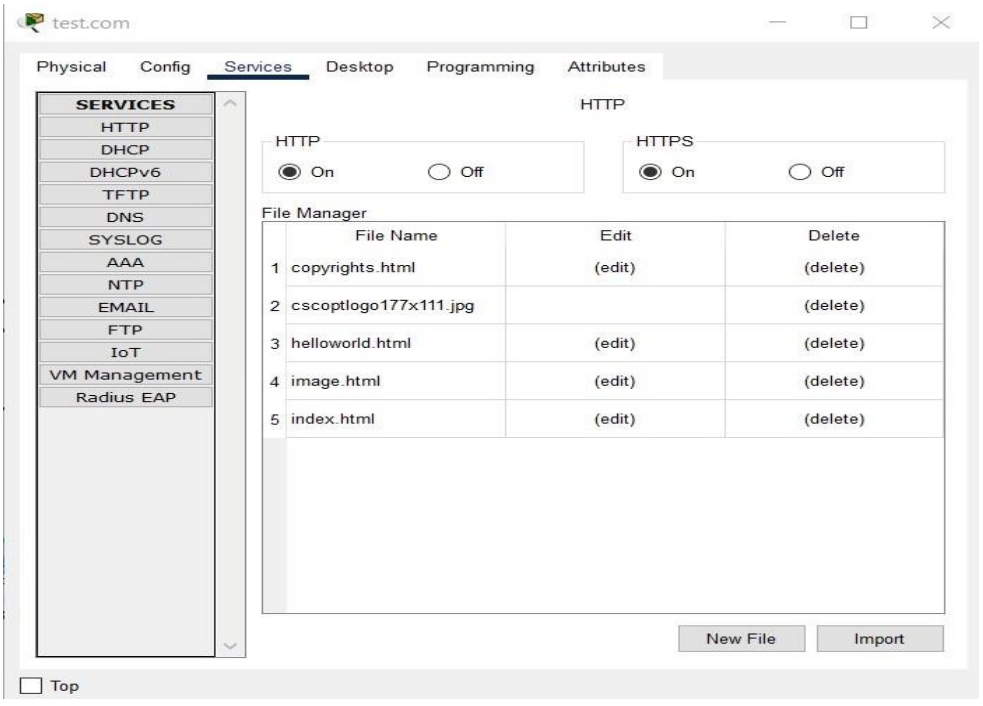
HTTP2 Server Config



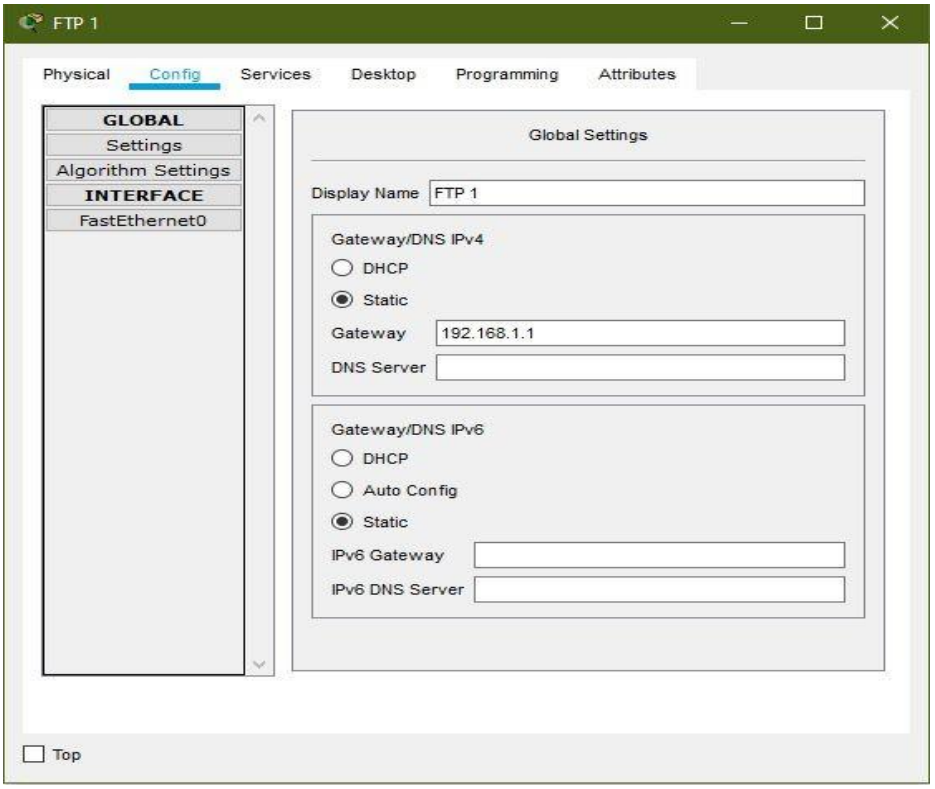
HTTP2 Server Services



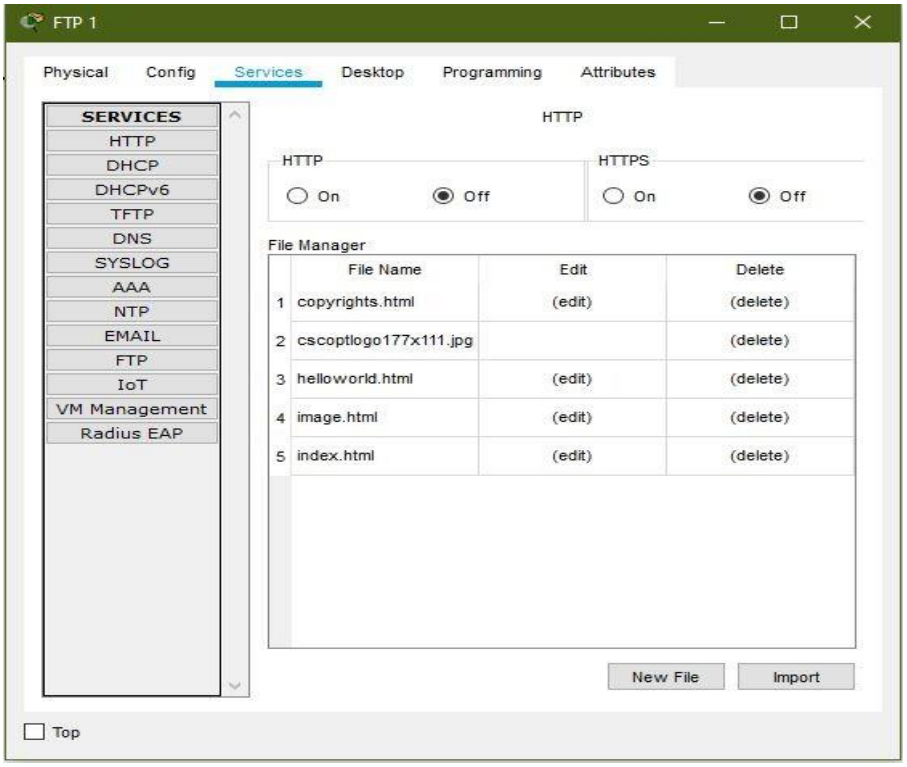
HTTP3 Server Config



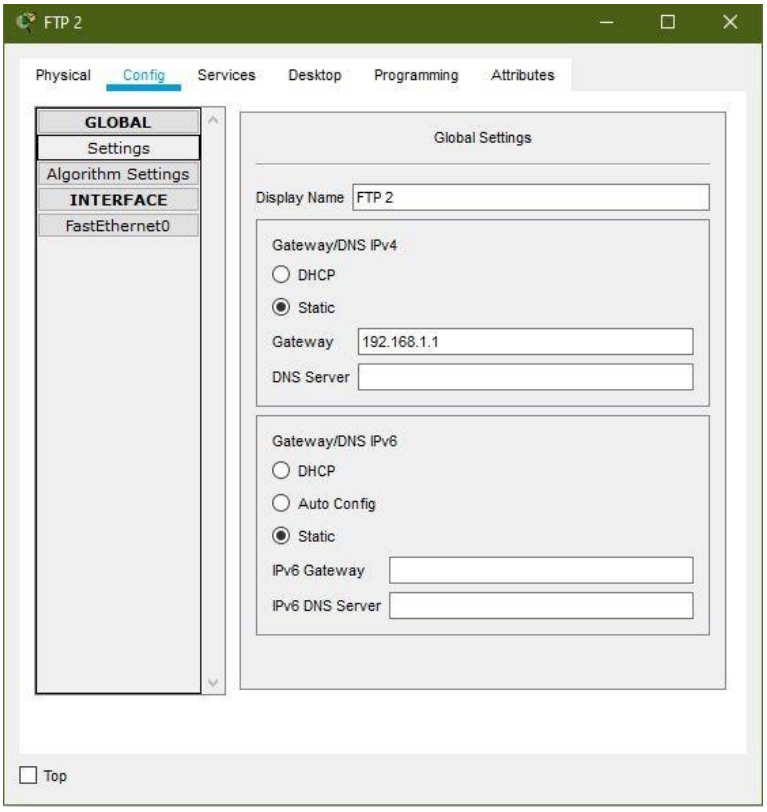
HTTP3 Server Services



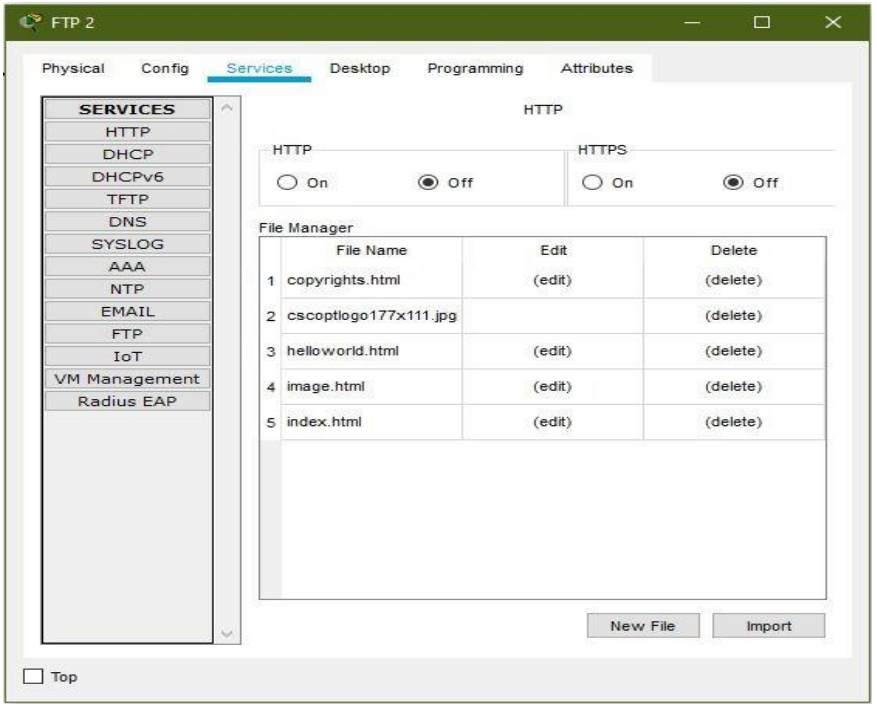
FTP1 Server Config



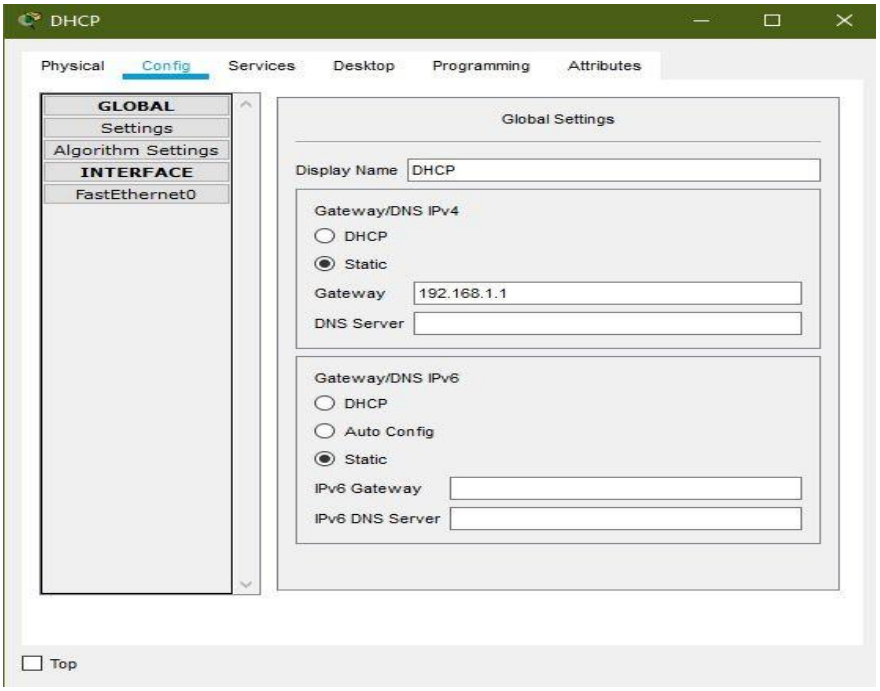
FTP1 Server Service



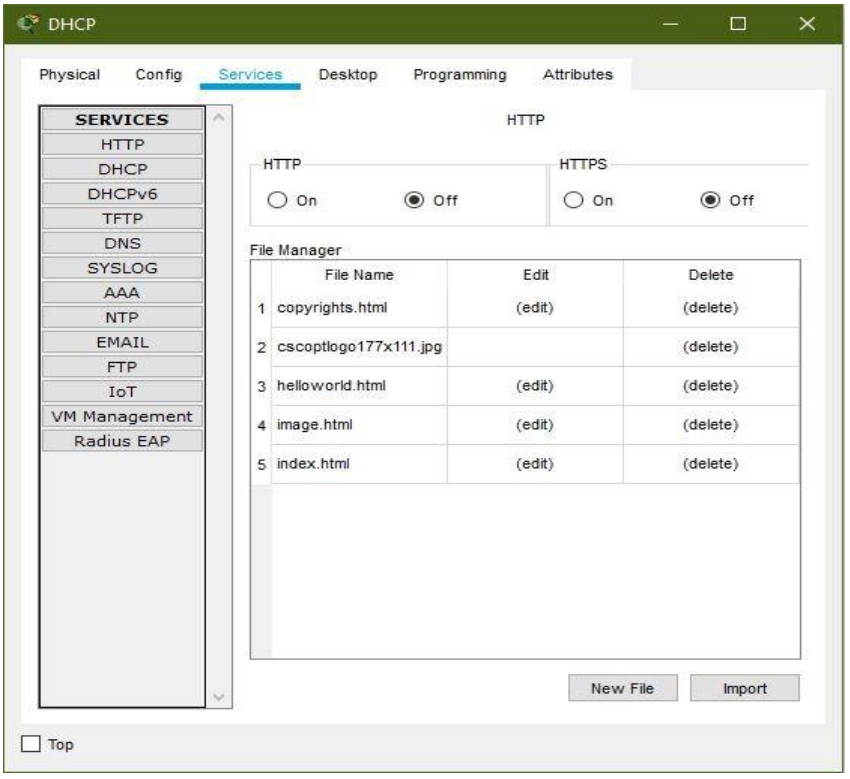
FTP2 Server Config



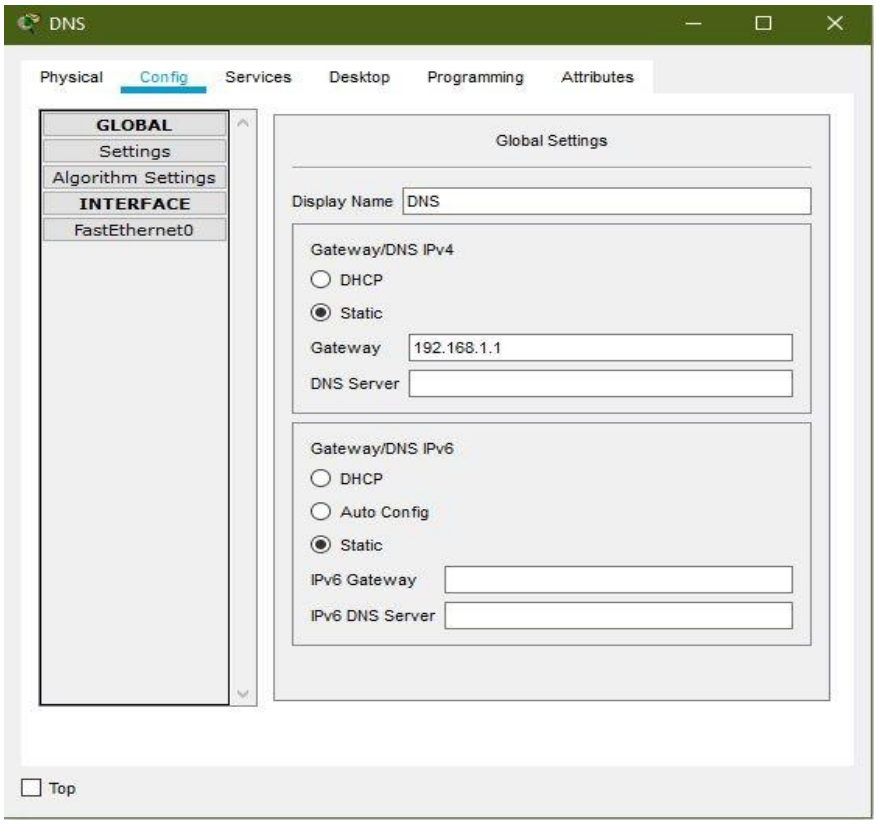
FTP2 Server Service



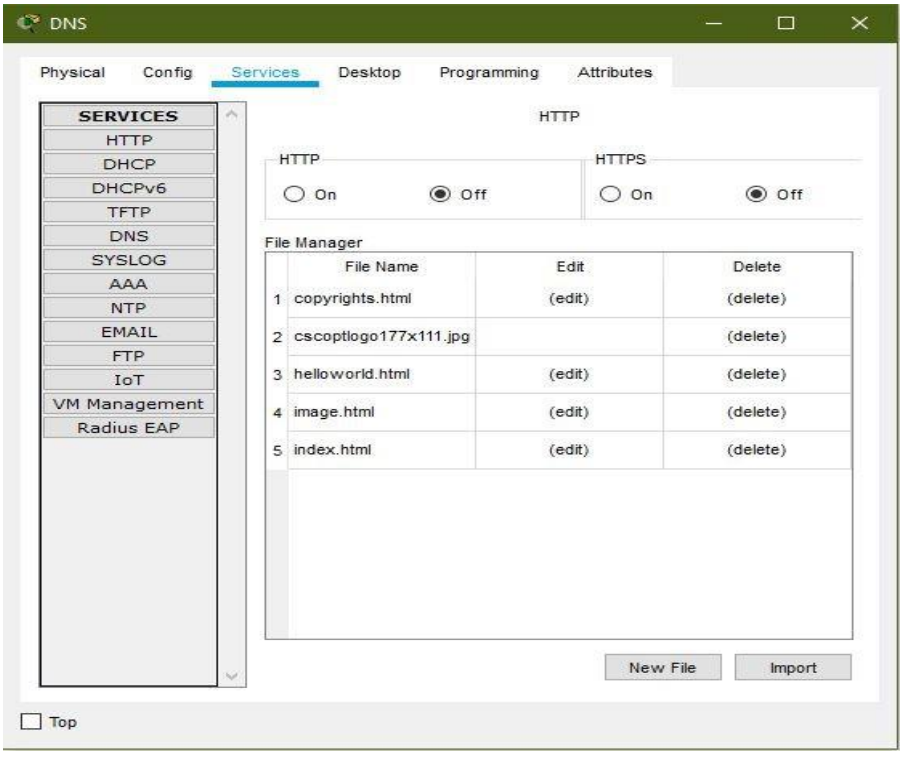
DHCP Server Config



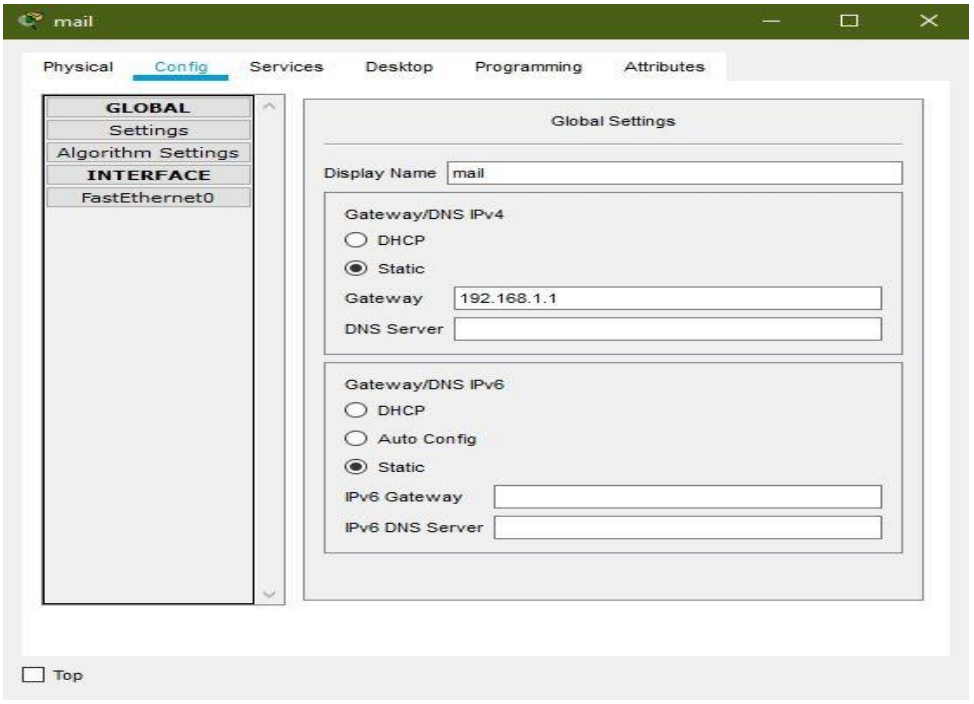
DHCP Server Service



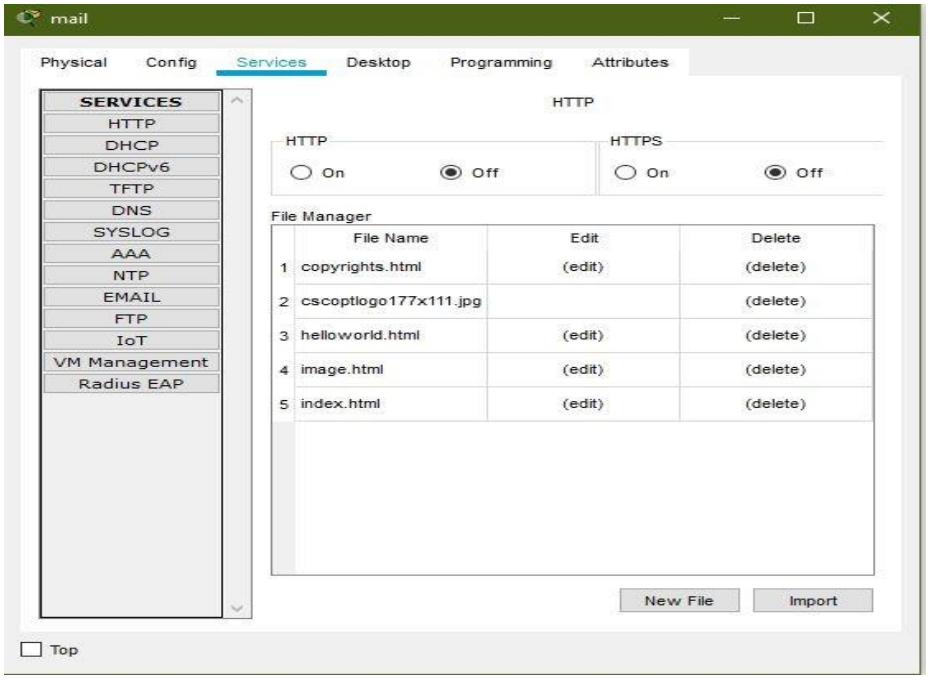
DNS Server Config



DNS Server Service



MAIL Server Config

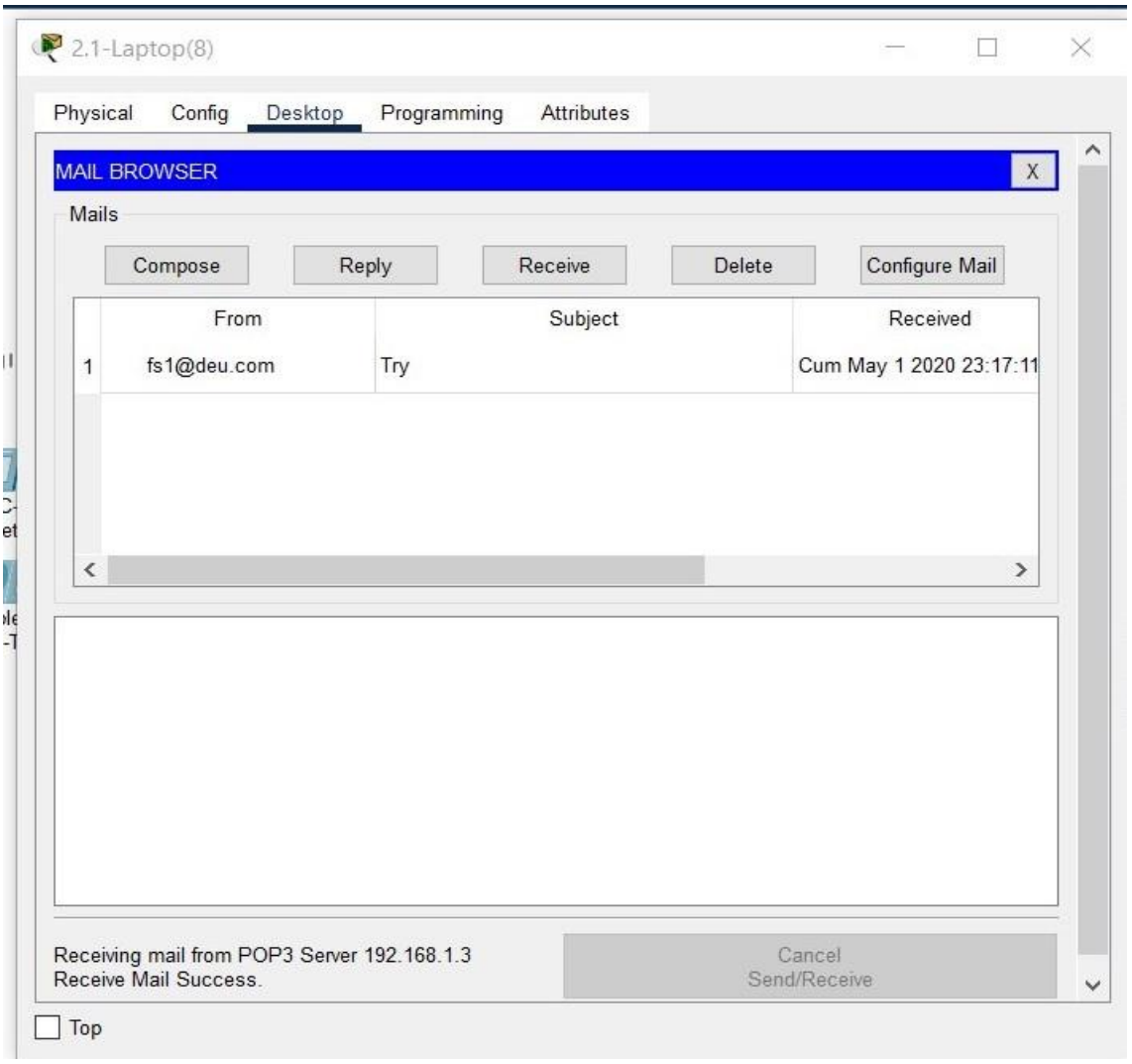


MAIL Server Service

CHAPTER THREE

TRAFFIC ANALYSIS & SIMULATION RESULTS

Scenario 1 : A wireless user from first facility of second branch wants to read emails and browse Web



PROTOCOL ID:0	V£ RSI0 N:0	MESSAGE TYPE:0

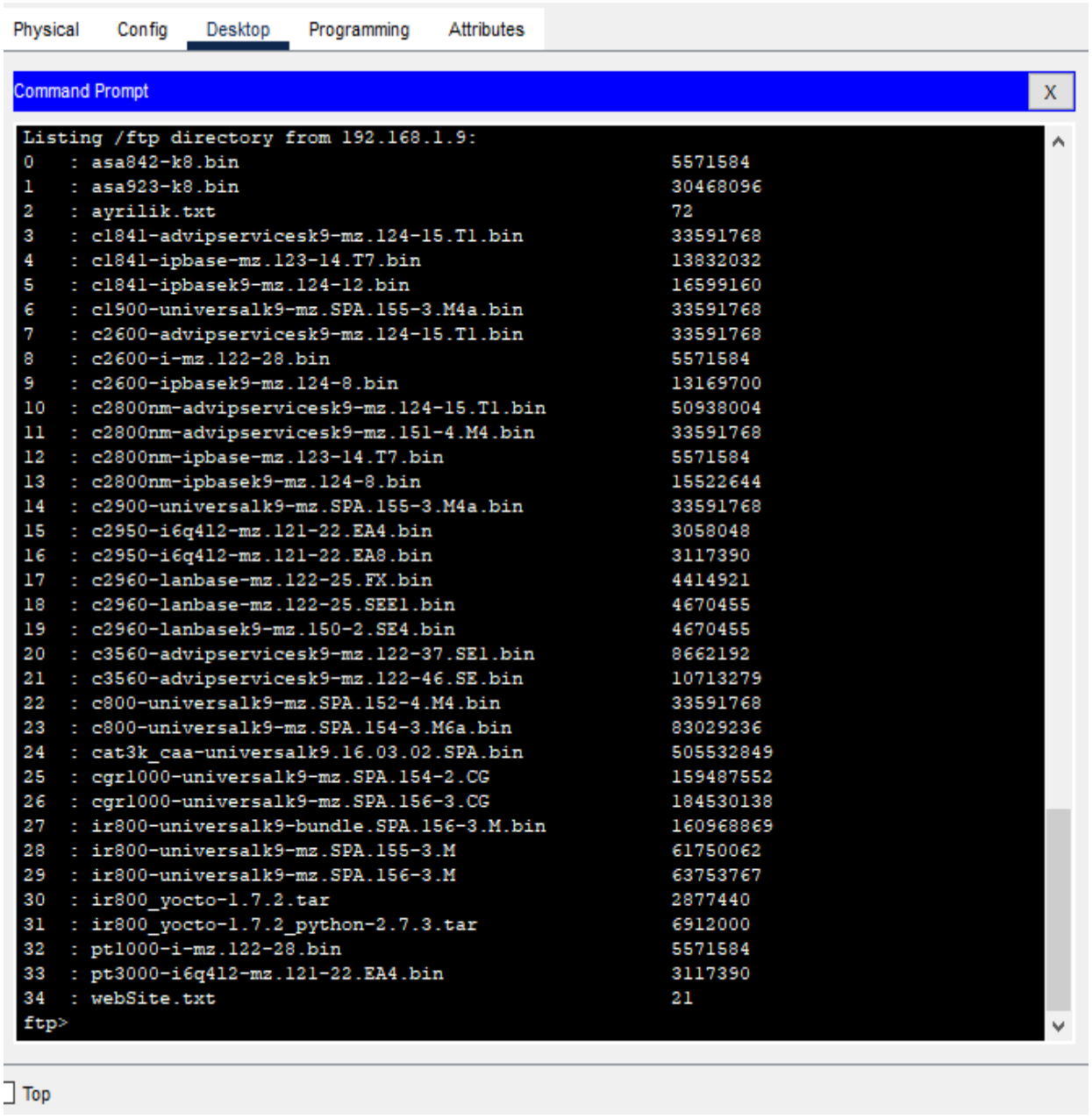
POR ^ TR0	

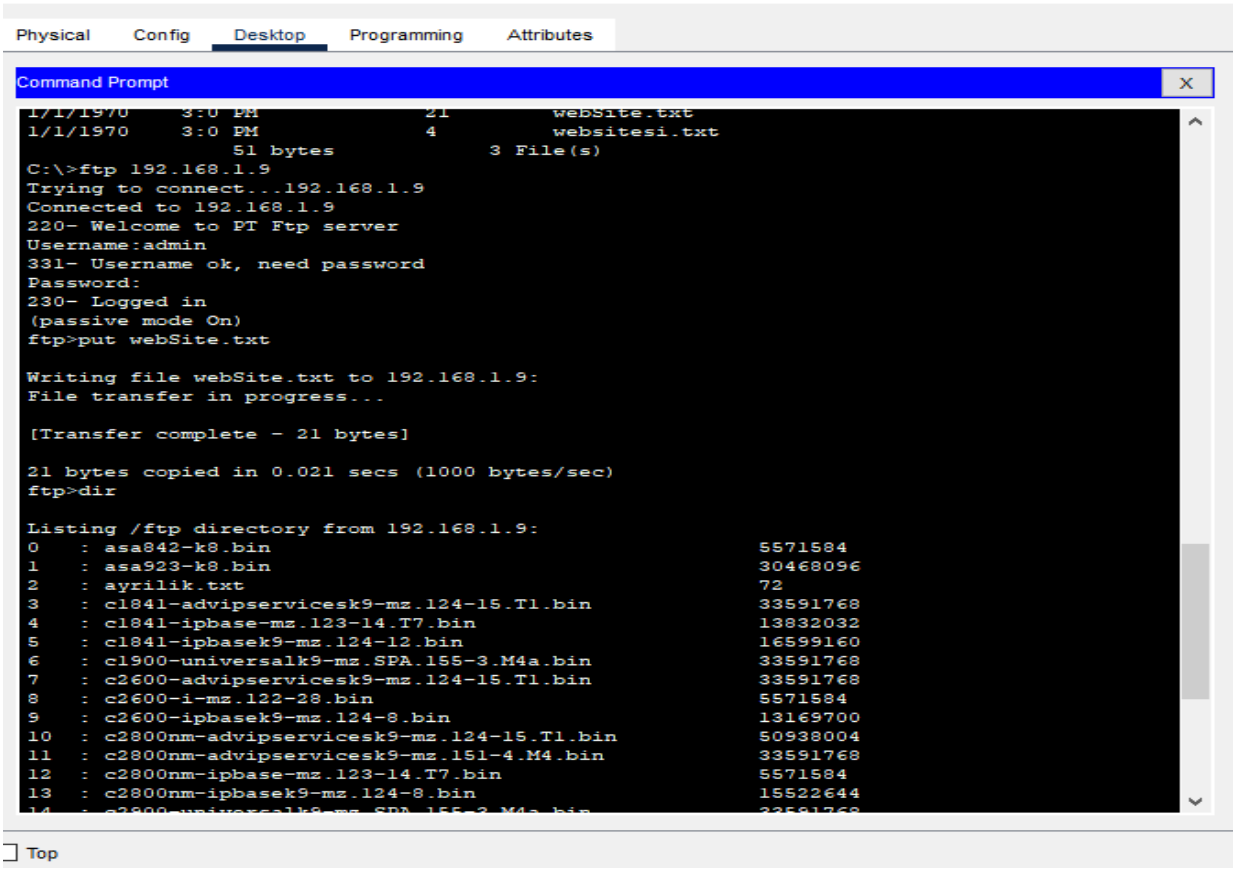
	ROOT PATH COST:0

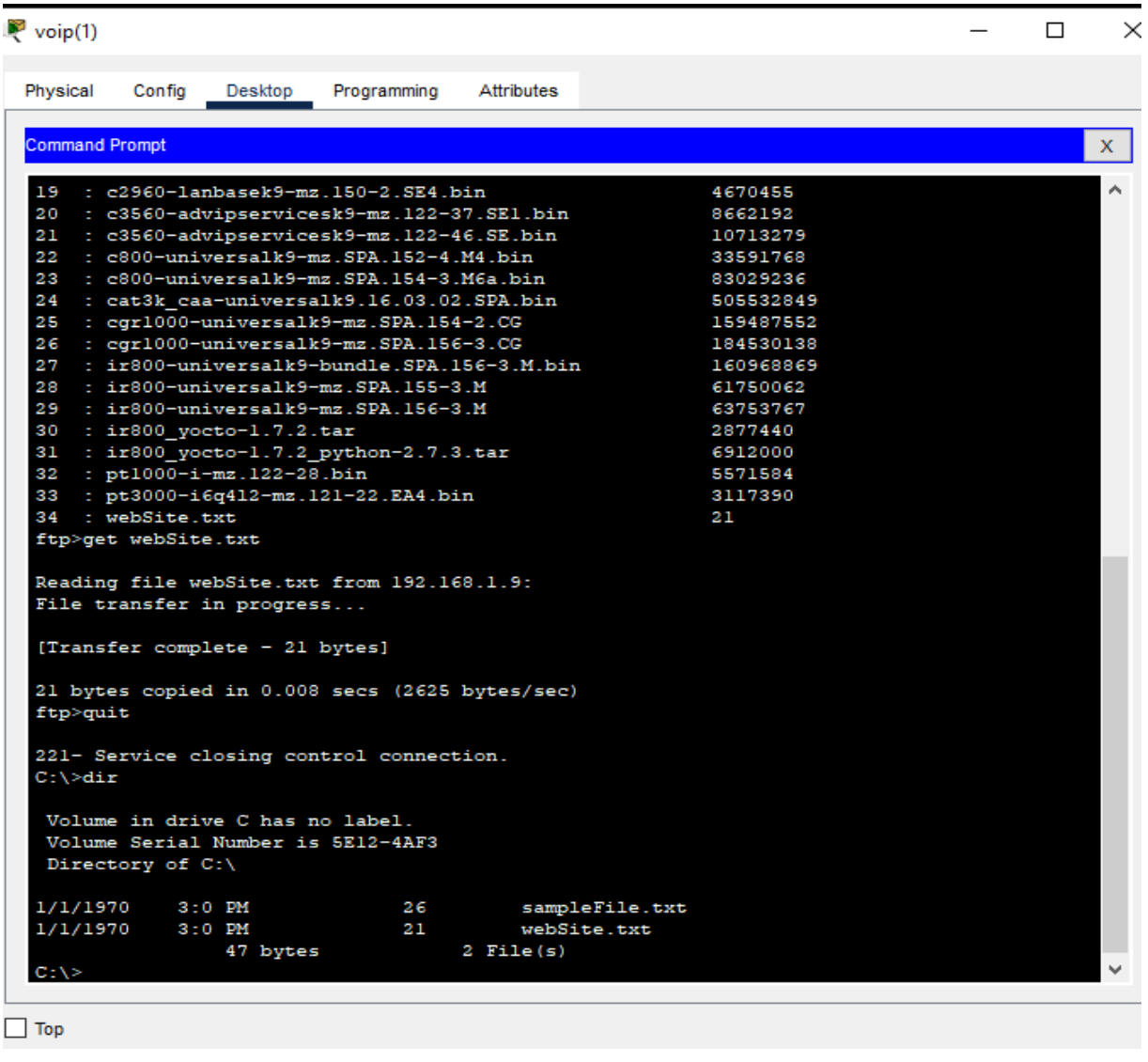
BRIDGE ID:32769 / 0001.43E3.65A9

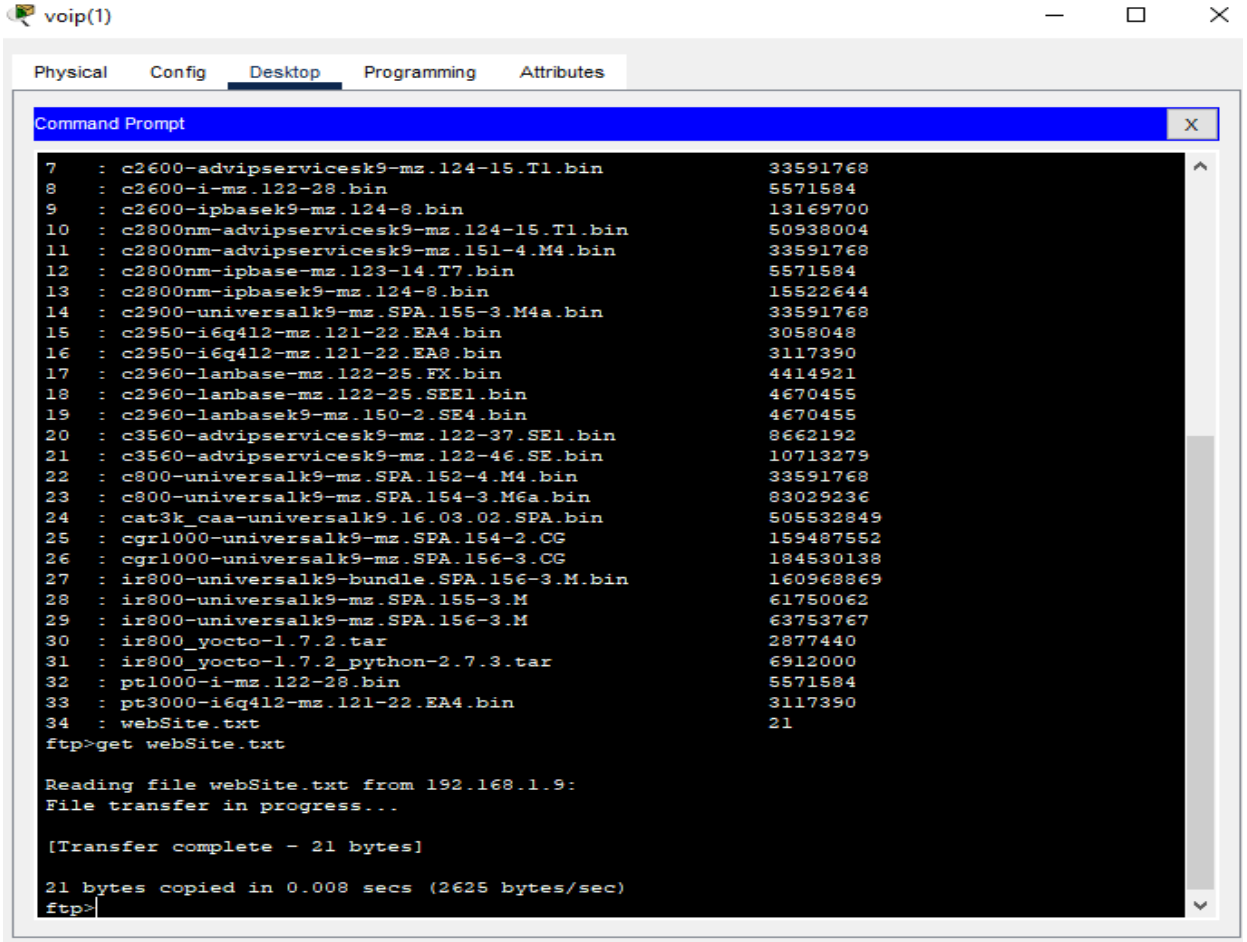
	PORT ID:32773	MESSAGE AGE:0
	MAX AGE:20	HELLO TIME:2
	FORWARD DELAY:15	

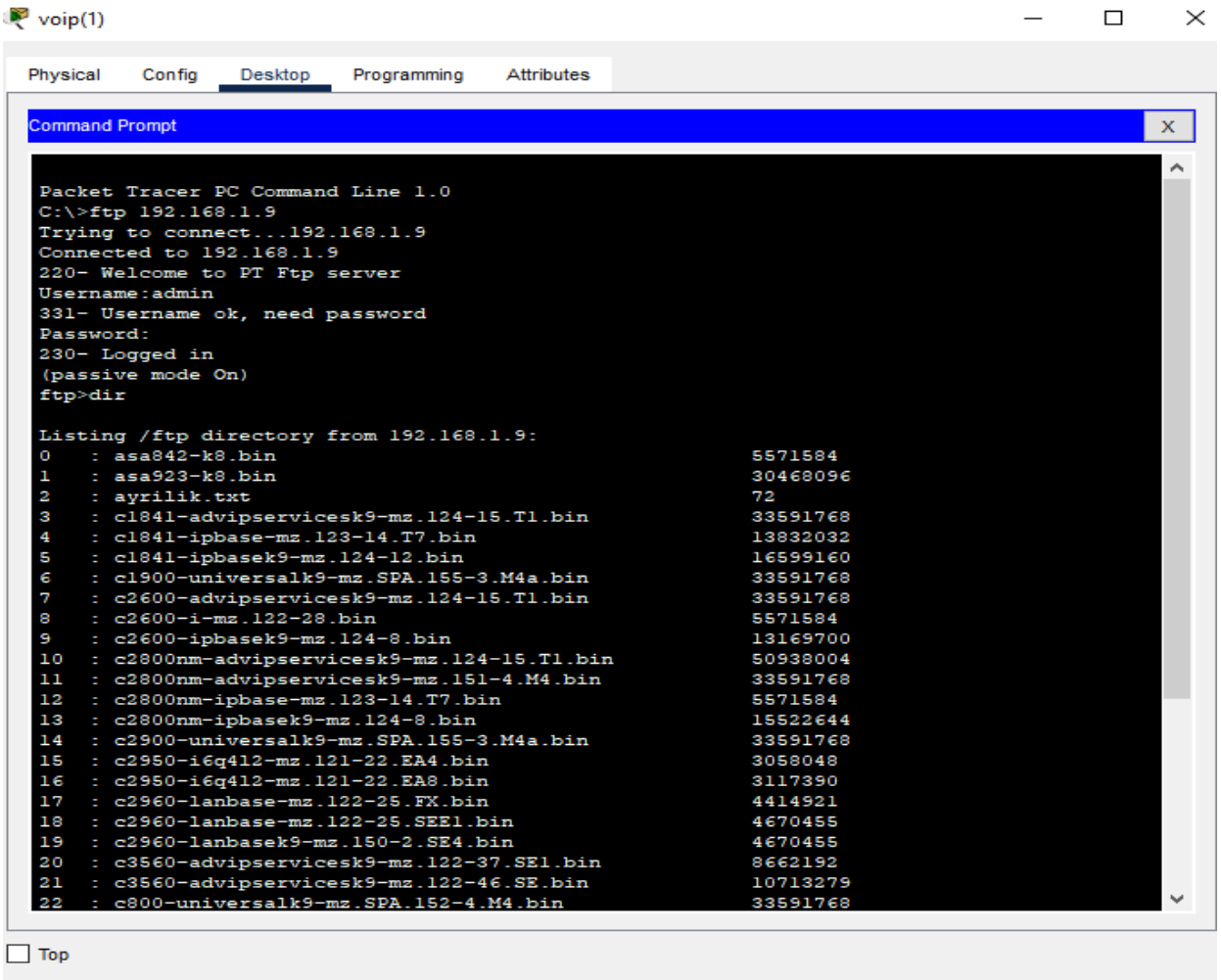
Scenario 2 : A computer engineer from second facility of second branch developed a web application and wants to send her code files to FTP server in the third facility of first branch.



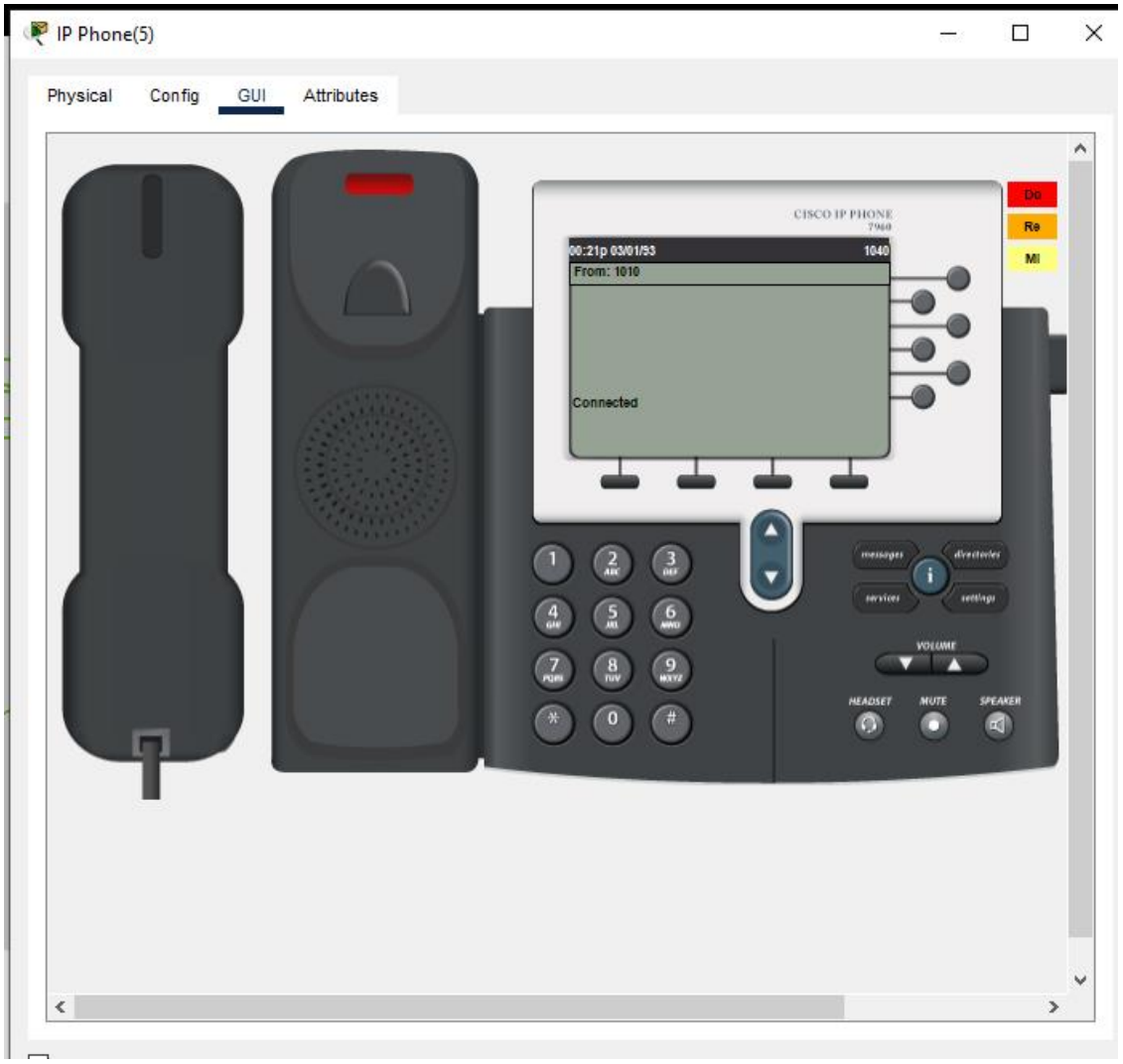

Physical
Config
Desktop
Programming
Attributes
Command Prompt
1/1/1970 3:0 PM 21 website.txt
1/1/1970 3:0 PM 4 websitesi.txt
51 bytes 3 File(s)
C:\>ftp 192.168.1.9
Trying to connect...192.168.1.9
Connected to 192.168.1.9
220- Welcome to PT Ftp server
Username:admin
331- Username ok, need password
Password:
230- Logged in
(passive mode On)
ftp>put webSite.txt
Writing file webSite.txt to 192.168.1.9:
File transfer in progress...
[Transfer complete - 21 bytes]
21 bytes copied in 0.021 secs (1000 bytes/sec)
ftp>dir
Listing /ftp directory from 192.168.1.9:
0 : asa842-k8.bin 5571584
1 : asa923-k8.bin 30468096
2 : ayrilik.txt 72
3 : c1841-advipservicesk9-mz.124-15.T1.bin 33591768
4 : c1841-ipbase-mz.123-14.T7.bin 13832032
5 : c1841-ipbasek9-mz.124-12.bin 16599160
6 : c1900-universalk9-mz.SPA.155-3.M4a.bin 33591768
7 : c2600-advipservicesk9-mz.124-15.T1.bin 33591768
8 : c2600-i-mz.122-28.bin 5571584
9 : c2600-ipbasek9-mz.124-8.bin 13169700
10 : c2800nm-advipservicesk9-mz.124-15.T1.bin 50938004
11 : c2800nm-advipservicesk9-mz.151-4.M4.bin 33591768
12 : c2800nm-ipbase-mz.123-14.T7.bin 5571584
13 : c2800nm-ipbasek9-mz.124-8.bin 15522644
Top


voip(1)
Physical
Config
Desktop
Programming
Attributes
Command Prompt
19 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
20 : c3560-advipservicesk9-mz.122-37.SE1.bin 8662192
21 : c3560-advipservicesk9-mz.122-46.SE.bin 10713279
22 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
23 : c800-universalk9-mz.SPA.154-3.M6a.bin 83029236
24 : cat3k_caa-universalk9.16.03.02.SPA.bin 505532849
25 : cgr1000-universalk9-mz.SPA.154-2.CG 159487552
26 : cgr1000-universalk9-mz.SPA.156-3.CG 184530138
27 : ir800-universalk9-bundle.SPA.156-3.M.bin 160968869
28 : ir800-universalk9-mz.SPA.155-3.M 61750062
29 : ir800-universalk9-mz.SPA.156-3.M 63753767
30 : ir800_yocto-1.7.2.tar 2877440
31 : ir800_yocto-1.7.2_python-2.7.3.tar 6912000
32 : pt1000-i-mz.122-28.bin 5571584
33 : pt3000-i6q4l2-mz.121-22.EA4.bin 3117390
34 : webSite.txt 21
ftp>get webSite.txt
Reading file webSite.txt from 192.168.1.9:
File transfer in progress...
[Transfer complete - 21 bytes]
21 bytes copied in 0.008 secs (2625 bytes/sec)
ftp>quit
221- Service closing control connection.
C:\>dir
Volume in drive C has no label.
Volume Serial Number is 5E12-4AF3
Directory of C:\
1/1/1970 3:0 PM 26 sampleFile.txt
1/1/1970 3:0 PM 21 webSite.txt
47 bytes 2 File(s)
C:\>
Top

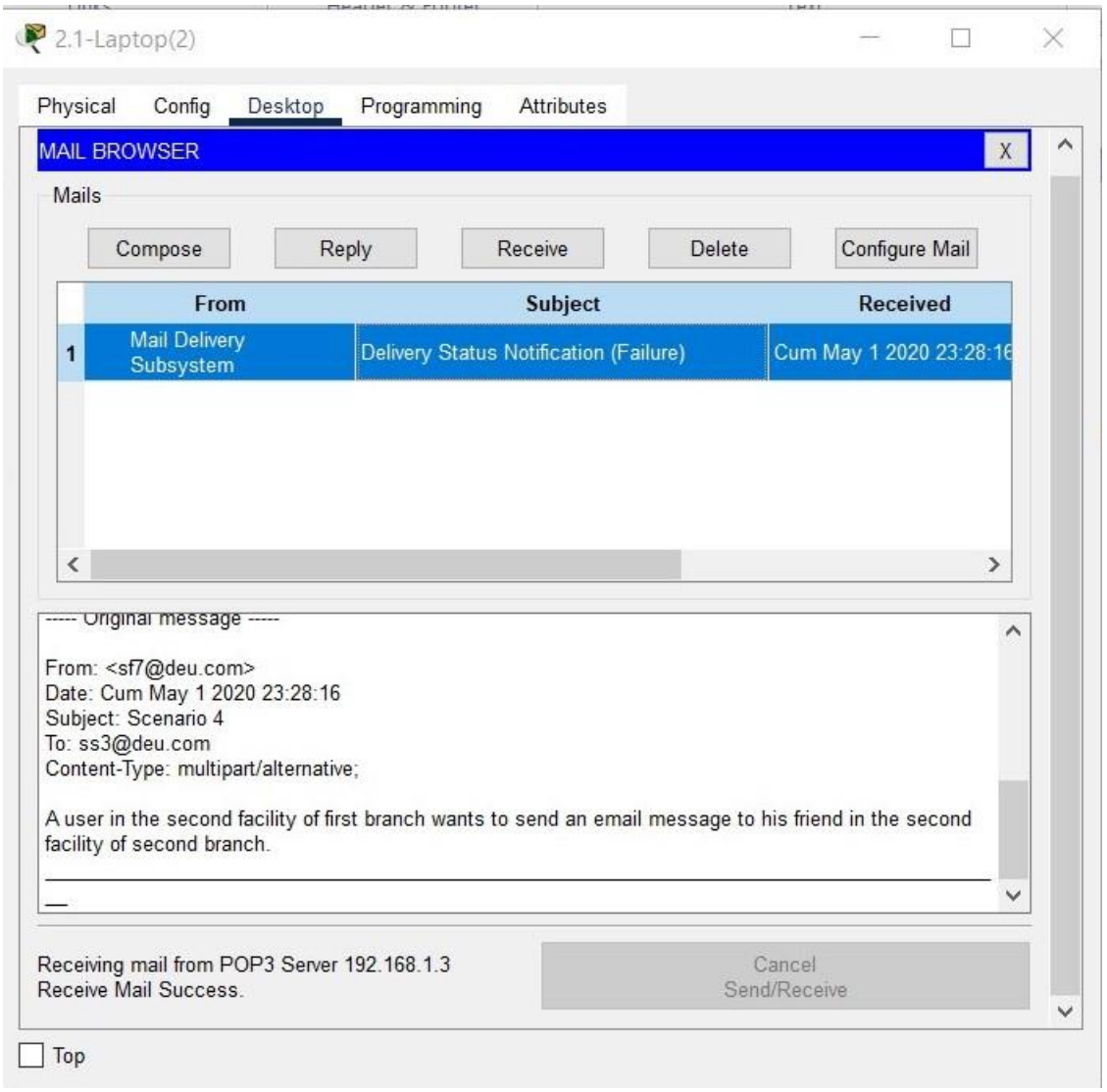

voip(1)
Physical
Config
Desktop
Programming
Attributes
Command Prompt
7 : c2600-advipservicesk9-mz.124-15.T1.bin 33591768
8 : c2600-i-mz.122-28.bin 5571584
9 : c2600-ipbasek9-mz.124-8.bin 13169700
10 : c2800nm-advipservicesk9-mz.124-15.T1.bin 50938004
11 : c2800nm-advipservicesk9-mz.151-4.M4.bin 33591768
12 : c2800nm-ipbase-mz.123-14.T7.bin 5571584
13 : c2800nm-ipbasek9-mz.124-8.bin 15522644
14 : c2900-universalk9-mz.SPA.155-3.M4a.bin 33591768
15 : c2950-i6q412-mz.121-22.EA4.bin 3058048
16 : c2950-i6q412-mz.121-22.EA8.bin 3117390
17 : c2960-lanbase-mz.122-25.FX.bin 4414921
18 : c2960-lanbase-mz.122-25.SEE1.bin 4670455
19 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
20 : c3560-advipservicesk9-mz.122-37.SE1.bin 8662192
21 : c3560-advipservicesk9-mz.122-46.SE.bin 10713279
22 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
23 : c800-universalk9-mz.SPA.154-3.M6a.bin 83029236
24 : cat3k_caa-universalk9.16.03.02.SPA.bin 505532849
25 : cgr1000-universalk9-mz.SPA.154-2.CG 159487552
26 : cgr1000-universalk9-mz.SPA.156-3.CG 184530138
27 : ir800-universalk9-bundle.SPA.156-3.M.bin 160968869
28 : ir800-universalk9-mz.SPA.155-3.M 61750062
29 : ir800-universalk9-mz.SPA.156-3.M 63753767
30 : ir800_yocto-1.7.2.tar 2877440
31 : ir800_yocto-1.7.2_python-2.7.3.tar 6912000
32 : pt1000-i-mz.122-28.bin 5571584
33 : pt3000-i6q412-mz.121-22.EA4.bin 3117390
34 : webSite.txt 21
ftp>get webSite.txt
Reading file webSite.txt from 192.168.1.9:
File transfer in progress...
[Transfer complete - 21 bytes]
21 bytes copied in 0.008 secs (2625 bytes/sec)
ftp>
Top


voip(1)
Physical
Config
Desktop
Programming
Attributes
Command Prompt
Packet Tracer PC Command Line 1.0
C:\>ftp 192.168.1.9
Trying to connect...192.168.1.9
Connected to 192.168.1.9
220- Welcome to PT Ftp server
Username:admin
331- Username ok, need password
Password:
230- Logged in
(passive mode On)
ftp>dir
Listing /ftp directory from 192.168.1.9:
0 : asa842-k8.bin 5571584
1 : asa923-k8.bin 30468096
2 : ayrilik.txt 72
3 : c1841-advipservicesk9-mz.124-15.T1.bin 33591768
4 : c1841-ipbase-mz.123-14.T7.bin 13832032
5 : c1841-ipbasek9-mz.124-12.bin 16599160
6 : c1900-universalk9-mz.SPA.155-3.M4a.bin 33591768
7 : c2600-advipservicesk9-mz.124-15.T1.bin 33591768
8 : c2600-i-mz.122-28.bin 5571584
9 : c2600-ipbasek9-mz.124-8.bin 13169700
10 : c2800nm-advipservicesk9-mz.124-15.T1.bin 50938004
11 : c2800nm-advipservicesk9-mz.151-4.M4.bin 33591768
12 : c2800nm-ipbase-mz.123-14.T7.bin 5571584
13 : c2800nm-ipbasek9-mz.124-8.bin 15522644
14 : c2900-universalk9-mz.SPA.155-3.M4a.bin 33591768
15 : c2950-i6q412-mz.121-22.EA4.bin 3058048
16 : c2950-i6q412-mz.121-22.EA8.bin 3117390
17 : c2960-lanbase-mz.122-25.FX.bin 4414921
18 : c2960-lanbase-mz.122-25.SEE1.bin 4670455
19 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
20 : c3560-advipservicesk9-mz.122-37.SE1.bin 8662192
21 : c3560-advipservicesk9-mz.122-46.SE.bin 10713279
22 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
Top

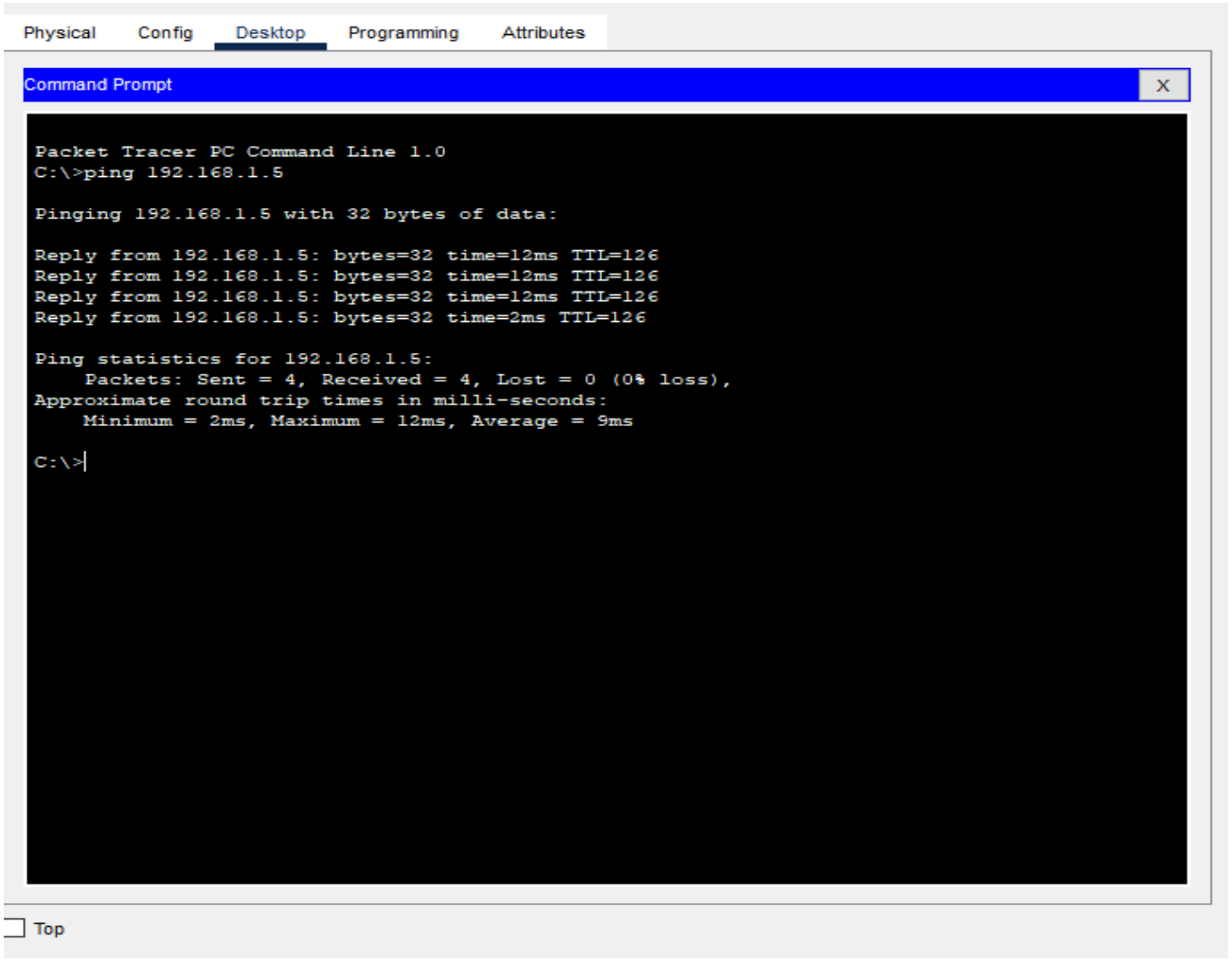
Scenario 3 : Two users from second facility of first branch want to talk via VoIP.



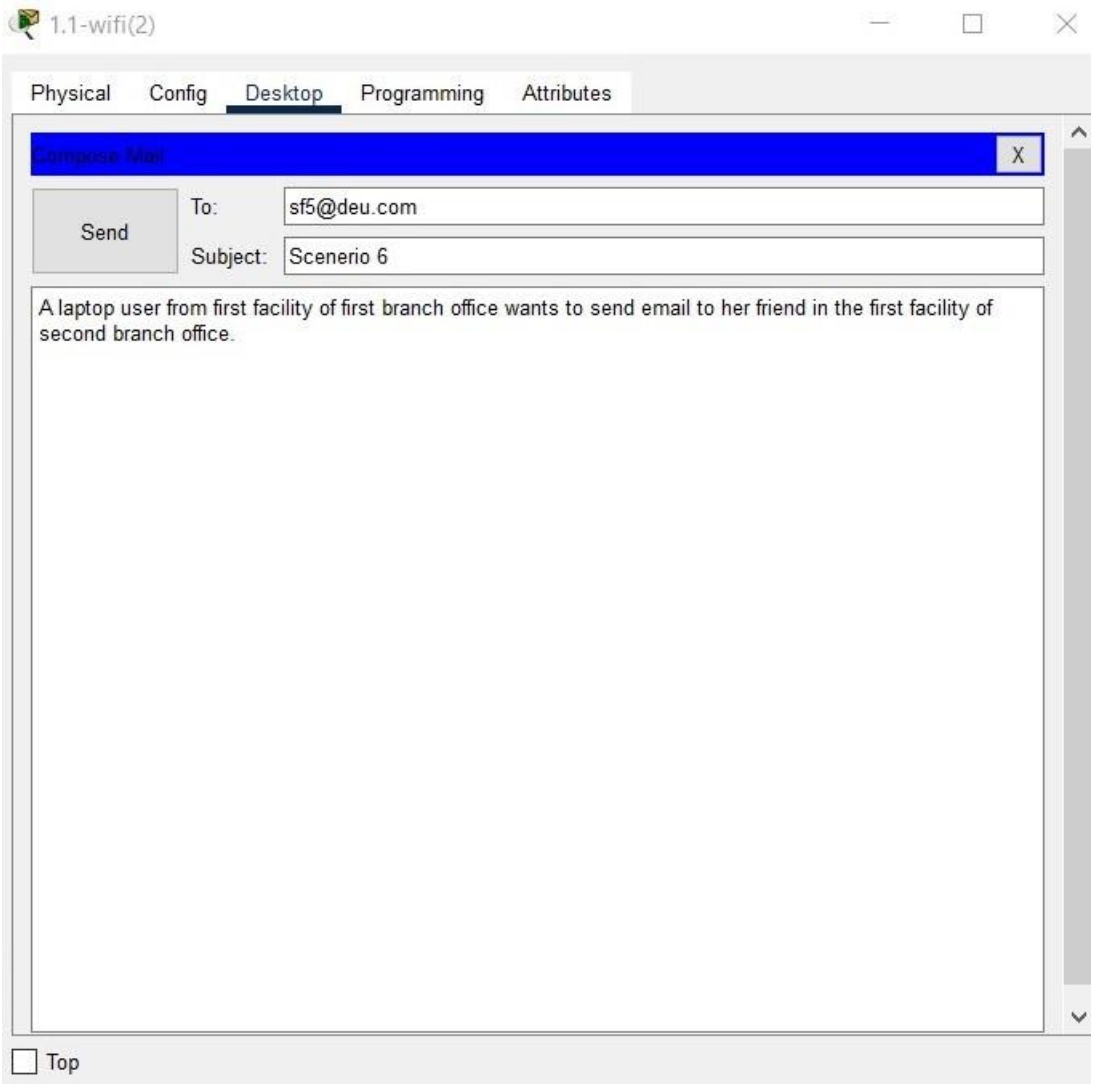
Scenario 4 : A user in the second facility of first branch wants to send an email message to his friend in the second facility of second branch.

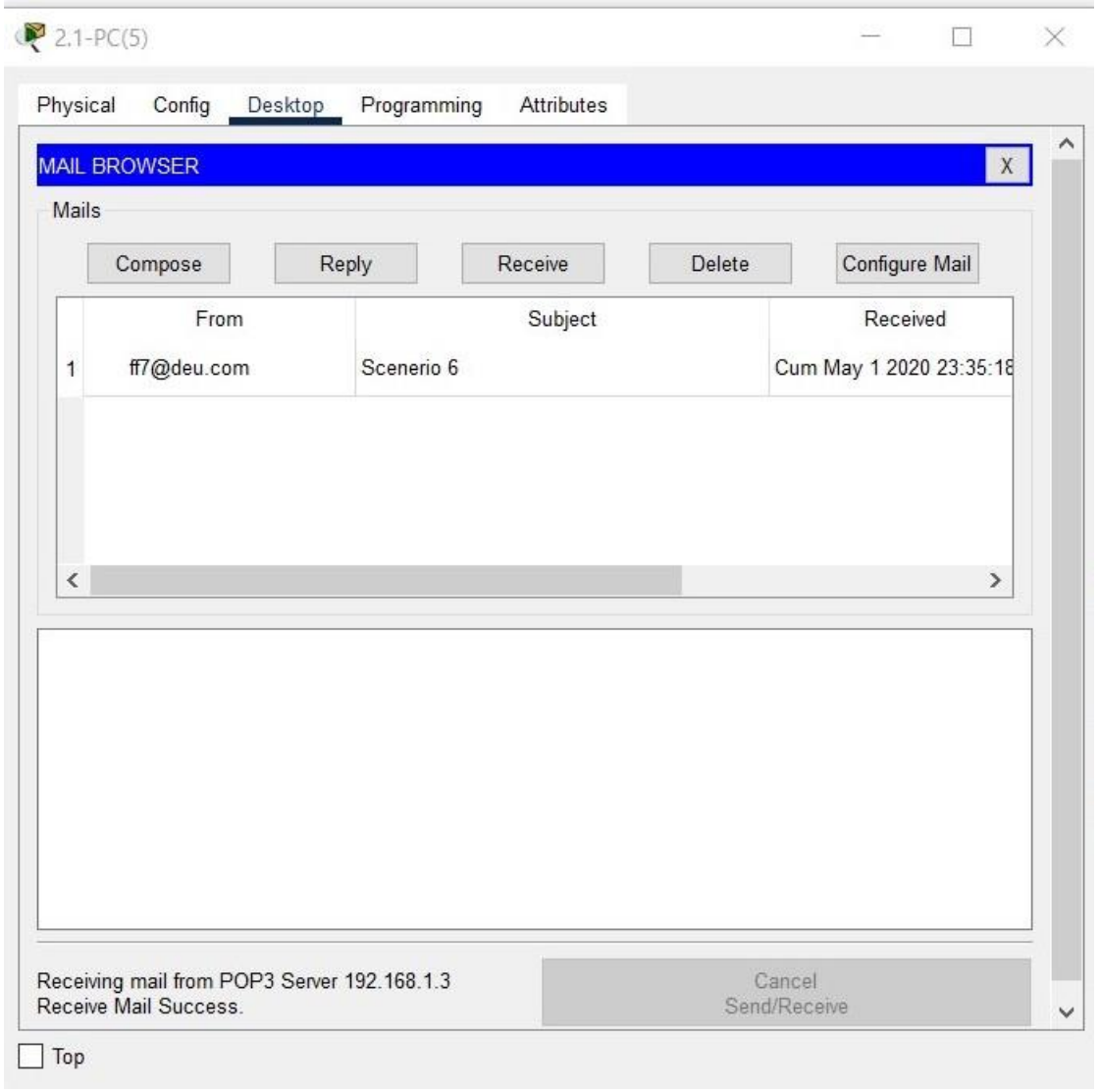


Scenario 5 : A user from first facility of second branch pings Web server of second facility of first branch.

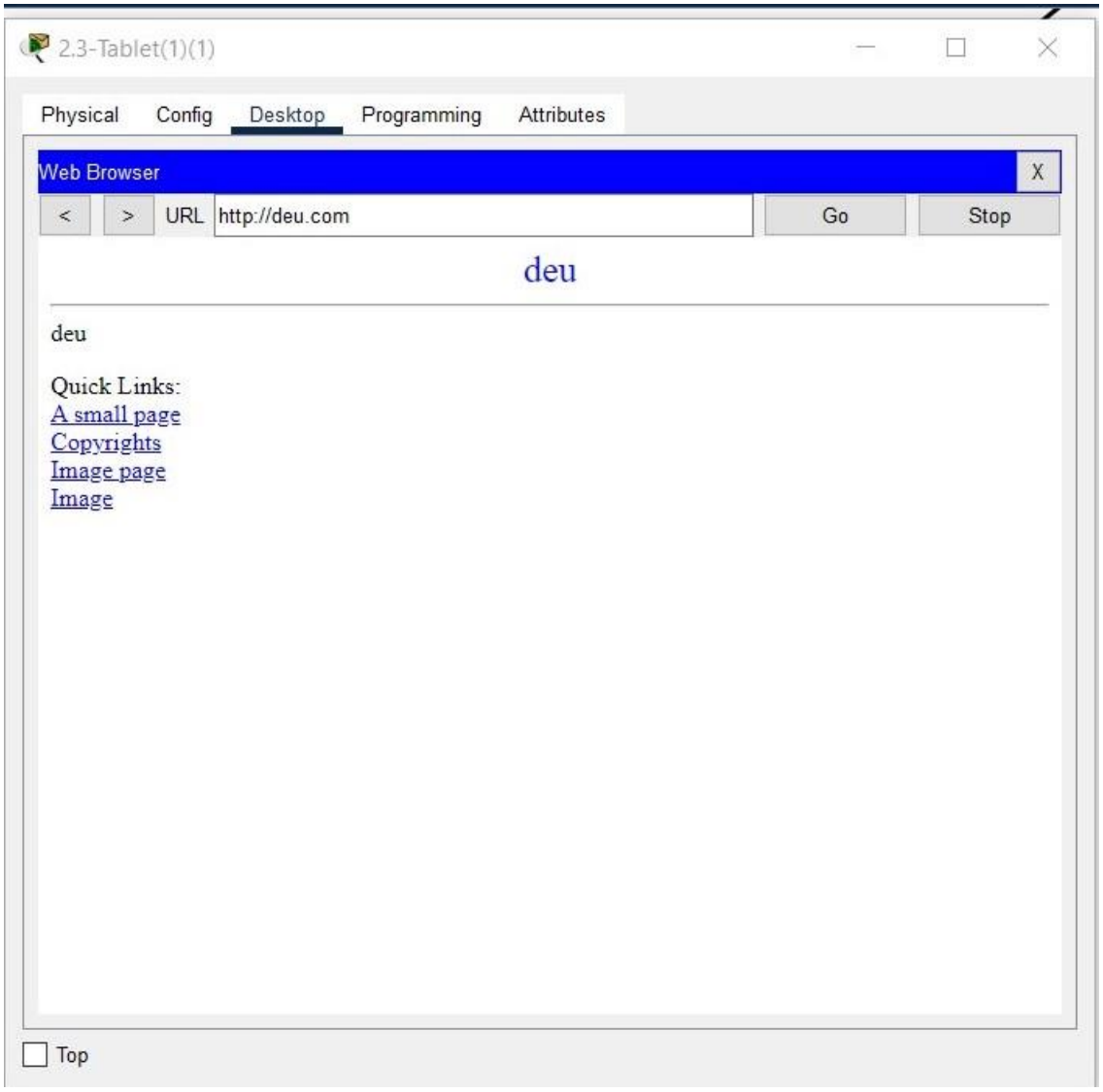


Scenario 6 : A laptop user from first facility of first branch office wants to send email to her friend in the first facility of second branch office.

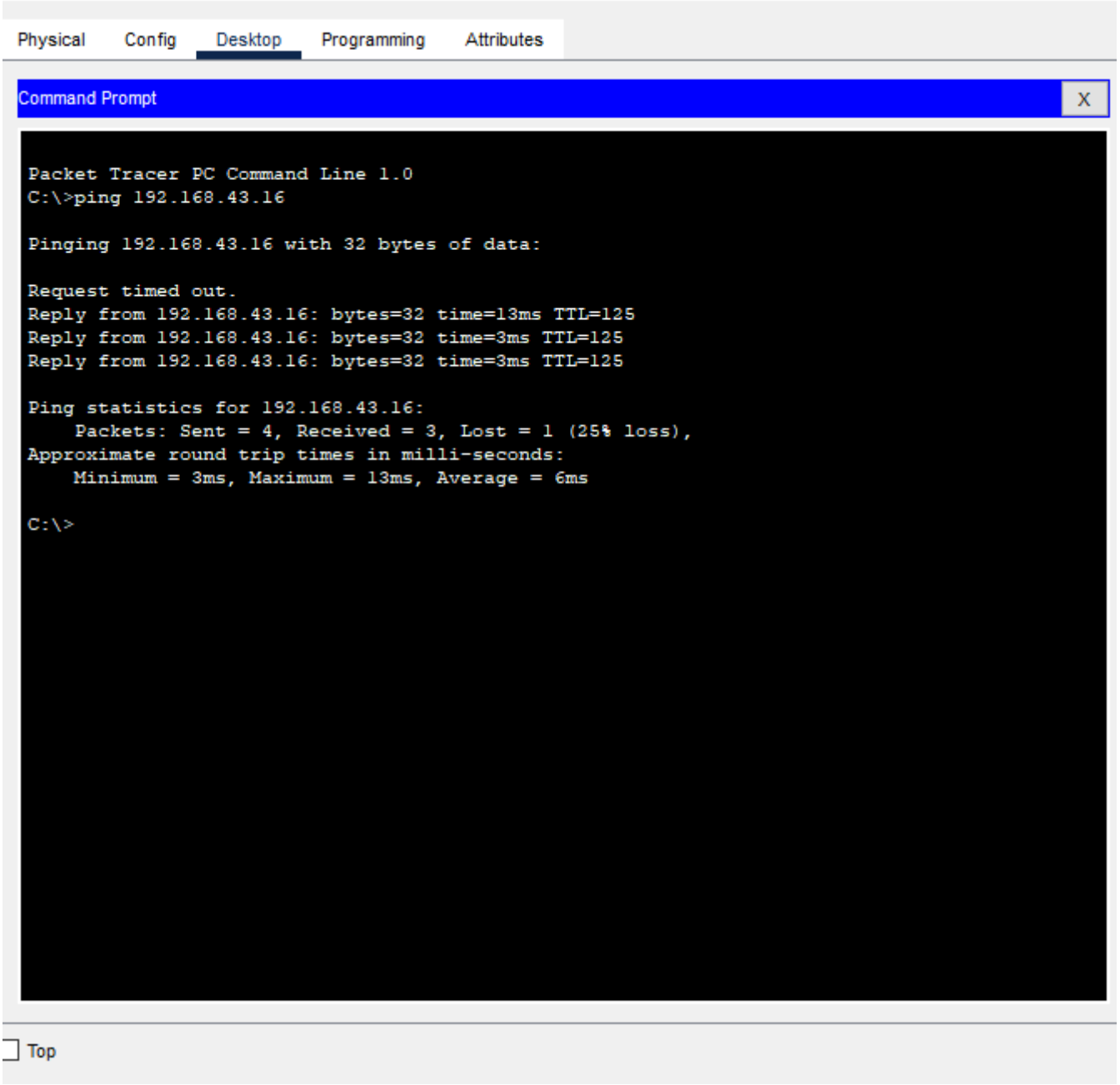



2.1-PC(5)
Physical
Config
Desktop
Programming
Attributes
MAIL BROWSER
X
Mails
Compose
Reply
Receive
Delete
Configure Mail
From
Subject
Received
1
ff7@deu.com
Scenerio 6
Cum May 1 2020 23:35:18
Receiving mail from POP3 Server 192.168.1.3
Receive Mail Success.
Cancel
Send/Receive
Top

Scenario 8 : A tablet user from third facility of second branch wants to read emails and browse Web.



Scenario 9: Pinging the pc that is in the second facility of first branch from a tablet which is in the third facility of second branch.



Scenario 10 : Connecting the 3rd device to the 2nd device's VoIP call

CHAPTER FOUR

CONCLUSION

Analysis and tests on simulation show that topology and architecture selection is done correctly according to requirements. Using the metropolitan area network instead of the wide area network provided the desired security and speed. The network was successful in providing the desired services using the protocols specified in the report. As a result, networks created between the two campuses of the university and within the campuses themselves were successful. The project team has gained insights into the network design and the challenges it brings.

CHAPTER FIVE

REFERENCES

[1] https://en.wikipedia.org/wiki/Metropolitan_area_network

[2] https://www.ibm.com/cloud/learn/networking-a-complete-guide

[3] https://www.digitalocean.com/community/tutorials/an-introduction-to-networking-terminology-interfaces-and-protocols