

**DOKUZ EYLÜL UNIVERSITY  
ENGINEERING FACULTY  
DEPARTMENT OF COMPUTER ENGINEERING**

**CME 3204**

**Data Communication & Computer Networks**

**Metropolitan Area  
Network Simulation**

**By**

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**11/06/2021**

# Table of Contents

Table of Contents.....	1
1. Introduction .....	2-4
1.1 Project Definition and Problem Formulation .....	2
1.2 The Purpose and Motivation of the Project .....	2
1.3 Term Definitions.....	3-4
2. Method and Simulation.....	5-20
2.1 Simulation and Modeling Concepts .....	5
2.2 Simulation Environment/Tool .....	5
2.3 Network Design Requirements .....	6
2.4 Requirement Analysis.....	6-7
2.5 Definitions of the System/Model .....	7-13
2.6 Simulation Elements .....	14-20
3. Traffic Analysis and Simulation Results .....	21-52
4. Conclusion .....	53
5. References .....	54

# INTRODUCTION

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## 1.1 Project Definition and Problem Formulation

Metropolitan Area Network Simulation is a project to simulate and virtualize a Wide Area Network (WAN) system, which creates a network field for two branches of an office with 3 facilities each. Elaborately, the MAN project creates a network space to be able to make file transfer, e-mail operations, voice conferences, web usage etc. possible for these said branches. Essentially, MAN project connects local facilities internally in a wide range of area.

## 1.2 The Purpose and Motivation of the Project

An office with multiple branches will need a network system to be able to coordinate their workspace and stay updated with each facilities. In a world where communication is key, the need for a better way to create a network is a necessity. One of the main benefits of the project is to minimize the effort for technical operations. Also, with this project, it is possible to monitor the entire branch easily, as it is a local and isolated network within the office branches. There are currently no foreseen cons or negative outcomes of the project.

### 1.3 Term Definitions

**Network:** A data network is a system designed to transfer data from one network access point to one other or more network access points via data switching, transmission lines, and system controls. Data networks consist of communication systems such as circuit switches, leased lines, and packet switching networks.<sup>[1]</sup>

**Architecture:** Computer Network Architecture is defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data. Simply we can say that how computers are organized and how tasks are allocated to the computer.<sup>[2]</sup>

**Protocol:** Protocols define rules of communication between network devices.<sup>[3]</sup>

**Server:** A server is a computer or system that provides resources, data, services, or programs to other computers, known as clients, over a network. In theory, whenever computers share resources with client machines they are considered servers.<sup>[4]</sup>

**IP:** The Internet Protocol (IP) is the principal communications protocol in the Internet protocol suite for relaying datagrams across network boundaries. Its routing function enables internetworking, and essentially establishes the Internet.<sup>[5]</sup>

**DNS:** The domain name system (DNS) is a naming database in which internet domain names are located and translated into internet protocol (IP) addresses. The domain name system maps the name people use to locate a website to the IP address that a computer uses to locate a website.<sup>[6]</sup>

**Router:** A router is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. Data sent

through the internet, such as a web page or email, is in the form of data packets. A router is connected to two or more data lines from different IP networks.<sup>[7]</sup>

**Switch:** A switch is a device in a computer network that connects other devices together. Multiple data cables are plugged into a switch to enable communication between different networked devices.<sup>[8]</sup>

**Wireless:** Wireless data communication is a technology that uses the radio spectrum to transmit signals through the atmosphere. It may carry analog or digital signals and can be used on LANs or WANs in one- or two-way networks.<sup>[9]</sup>

**Ethernet:** Ethernet is primarily a standard communication protocol used to create local area networks. It transmits and receives data through cables. This facilitates network communication between two or more different types of network cables such as from copper to fiber optic and vice versa.<sup>[10]</sup>

**Node:** In telecommunications networks, a node is either a redistribution point or a communication endpoint. A physical network node is an electronic device that is attached to a network, and is capable of creating, receiving, or transmitting information over a communication channel.<sup>[11]</sup>

**Channel:** A channel is a communication medium, the path that data takes from source to destination. A channel can be comprised of so many different things: wires, free space, and entire networks. Signals can be routed from one type of network to another network with completely different characteristics.<sup>[12]</sup>

**Packet:** A packet is a bit of data that is packaged for transmission over a packet switched network. It is a small amount of data sent over a network, such as a LAN or the Internet.<sup>[13]</sup>

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## METHOD AND SIMULATION

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### 2.1 Simulation and Modeling Concepts

The intended simulation modeling is based on divide and conquer standard in which first the smaller components are designed and created and then the project is advanced hierarchially. i.e. First the nodes (endpoints) are selected and implemented to the simulation and then the connections are made via routers and switches. Finally, all endpoints are interconnected, therefore a wider range of network is created from a local range of devices. This method does not only provide a more convenient solution approach but it also prevents further error tracing and unit testing protocols.

A simulation also creates a solid surface for a possible real-life implementation, which can be tested real quick within the simulation. Also devices which will provide connection to the network are selected according to the most optimal cost-efficiency scale.

### 2.2 Simulation Environment/Tool

Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface. Packet Tracer makes use of a drag and drop user interface, allowing users to add and remove simulated network devices as they see fit.<sup>[14]</sup>

Using Packet Tracer made creating simulations, keeping track of the protocol flow, testing scenarios, previewing logical and phsyical design of the system possible throughout the project.

## 2.3 Network Design Requirements

The project is oriented on star topology from the smallest component to the largest structure. Using client/server architecture, the system consists of 3 routers, 2 wireless routers, 2 access point, 7 switches, a hub and a server farm that includes HTTP, FTP, WEB, DNS, MAIL (SMTP, POP3) and a DHCP server protocols. All of these components are used regarding the cost and the efficiency status. E.g. a hub is used to connect 5 workstations instead of a switch because it costs less and is enough to do the same connection.

## 2.4 Requirements Analysis

Servers require specific configurations for each. Each of them has unique IP addresses. Web servers must have HTTP service to be able to operate. DNS servers must store these web server IP addresses and domain names via DNS service to operate. This will allow web servers to operate and function correctly with the corresponding url.

Mail servers use SMTP and POP3 services to operate. The clients that will use e-mail functionality throughout the system must be registered within the mail server.

FTP servers use FTP and TFTP services to make data transfer possible and give access (rwdnl) to reach out to these files from clients.

DHCP server uses DHCP service with initial dynamic IP configurations.

All endpoints (mobile devices, workstations, wireless users) are configured and implemented into the system within the demanded constraints and expectations.

The VoIP voice conference system needs an additional router to connect phone signals and requests to be sent to the requested phone and redirect the response from them. These VoIP devices all share the same IP domain.

The connections are made using Gigabit Ethernet cables instead of Fast Ethernet cables for faster connections at the important junctions.

## 2.5 Definitions of the System/Model

<u>Topology</u>						
Star						
<u>Architecture</u>						
Server/Client		<u>1<sup>st</sup> Branch 1<sup>st</sup> Facility</u>	<u>1<sup>st</sup> Branch 2<sup>nd</sup> Facility</u>	<u>1<sup>st</sup> Branch 3<sup>rd</sup> Facility</u>	<u>2<sup>nd</sup> Branch 1<sup>st</sup> Facility</u>	<u>2<sup>nd</sup> Branch 2<sup>nd</sup> Facility</u>
IP Address	192.168.1.2-6 192.168.1.201-215	192.168.1.20-29 192.168.25.2-16		192.168.1.7-14	192.168.2.100-149	192.168.2.2-16
Devices	5 PC 5 Laptop 5 Smart Phone 1 Switch 1 Wireless Router 1 Hub	10 PC 1 Router 5 VoIP 5 VoIP 1 Switch	3 WEB 2 FTP 1 DHCP 1 MAIL 1 Switch	5 Wireless PC 5 Tablet 10 Laptop 1 MAIL 1 Switch	10 PC 5 Smart Phone 1 Switch 1 Wireless Router 1 Access Point	10 PC 5 Tablet 1 Switch 1 Access Point
Table 1: System Summary						

IP addresses of facilities and branches are monitored based on the top-most device's IP configuration. The main router of the first branch has the domain address of 192.168.1.1, thus endpoint devices that are connected to this router, has the IP address in the range of 192.168.1.x, with default gateway of 192.168.1.1. The other main router of the second branch has the domain address of 192.168.2.1, which enforces the conditional rule that

was applied in the first branch; the endpoints are configured with the address range of 192.168.2.x, and with a default gateway of 192.168.2.1.

These two routers that interconnects two branches are connected via a serial cable with a specified range of clock. These two routers have the configuration of allowed data flow dependencies on IP address domains, e.g. if there's a signal coming from the first branch towards the second branch, a configuration is made on the second main router to accept incoming data request.

The system is designed to work with minimum of 75 workstations, thus the connection speed is configured accordingly.

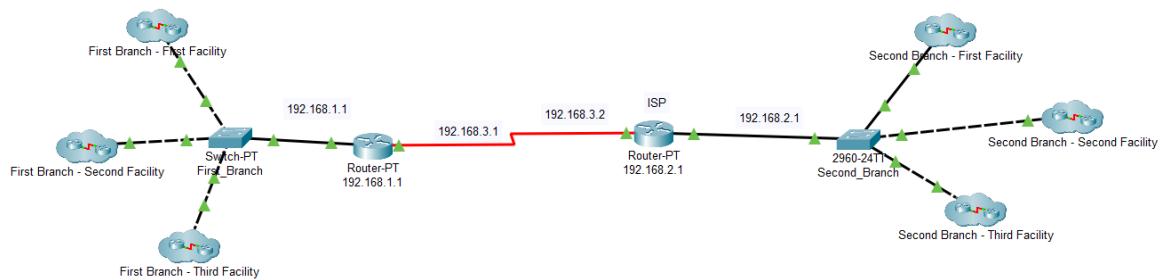


Figure A.1: Network.

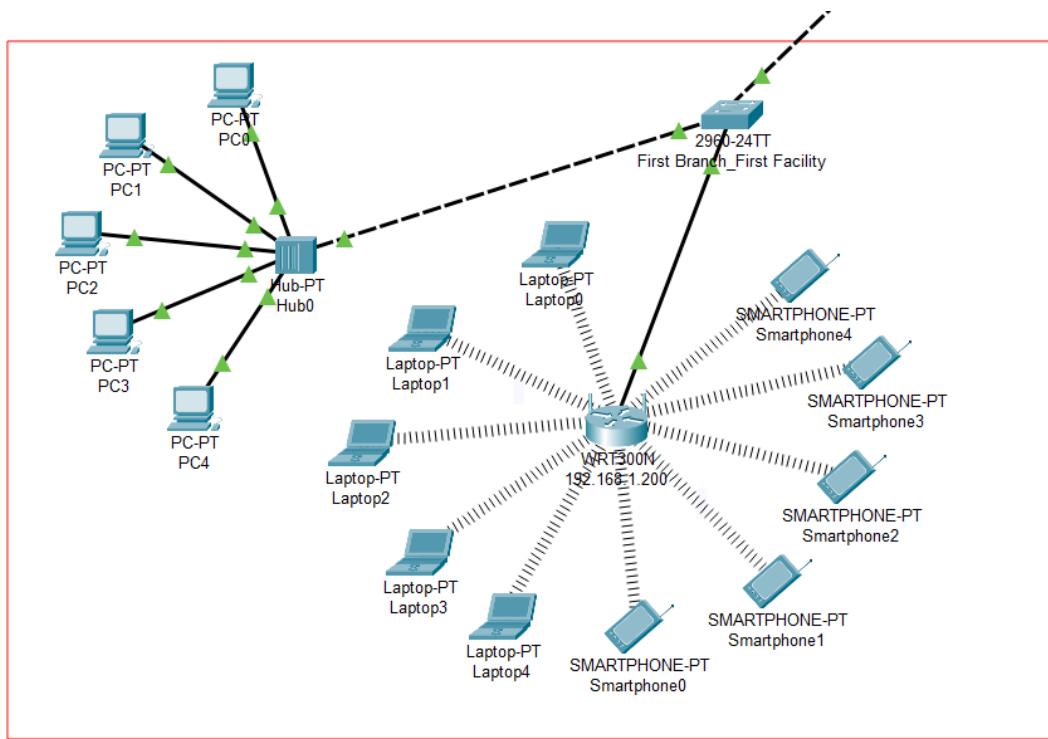


Figure A.2: First branch, first facility.

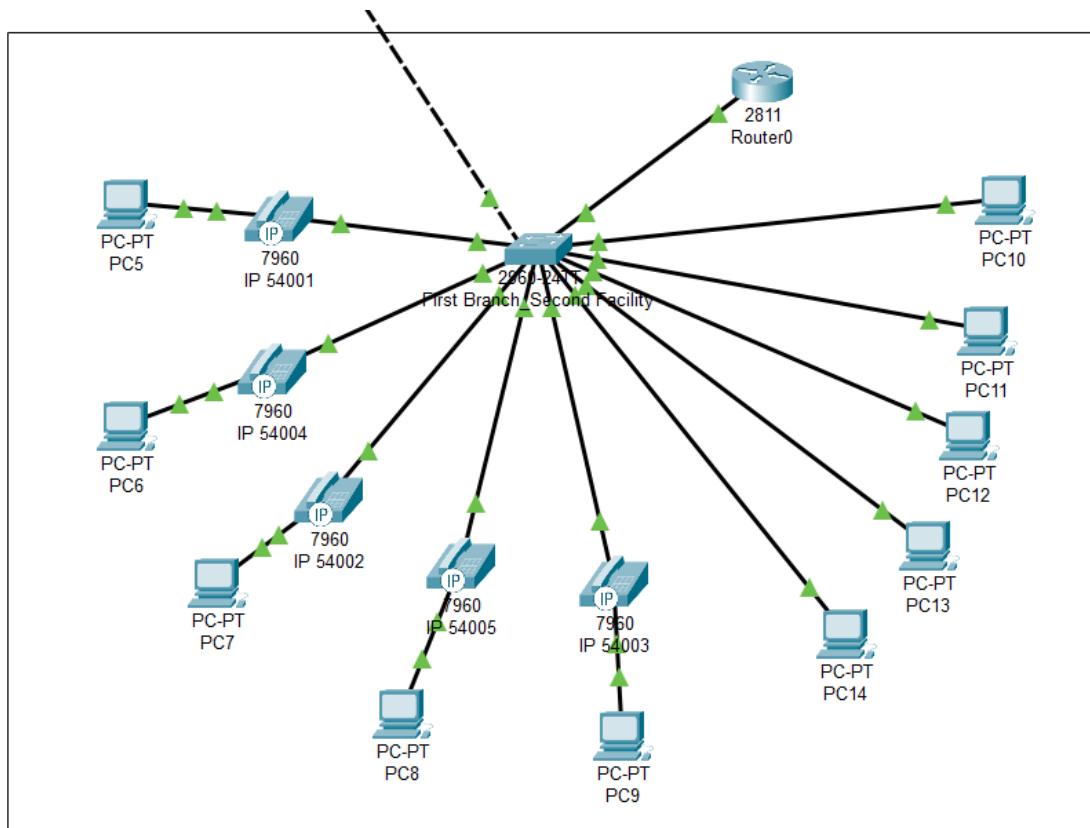


Figure A.3: First branch, second facility.

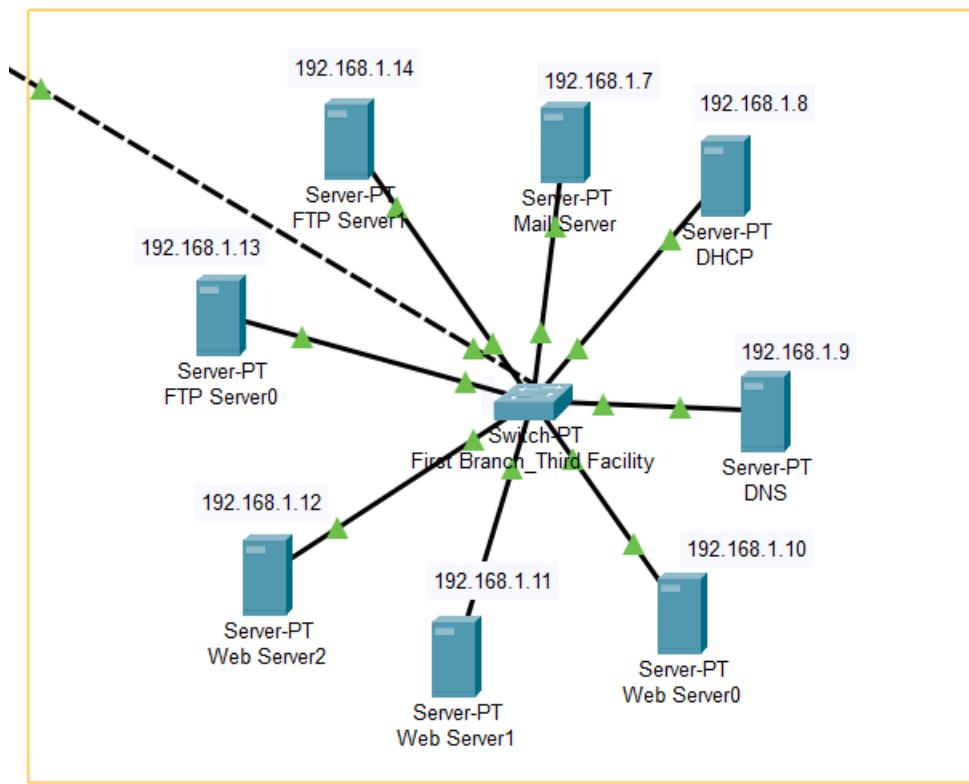


Figure A.4: First branch, third facility.

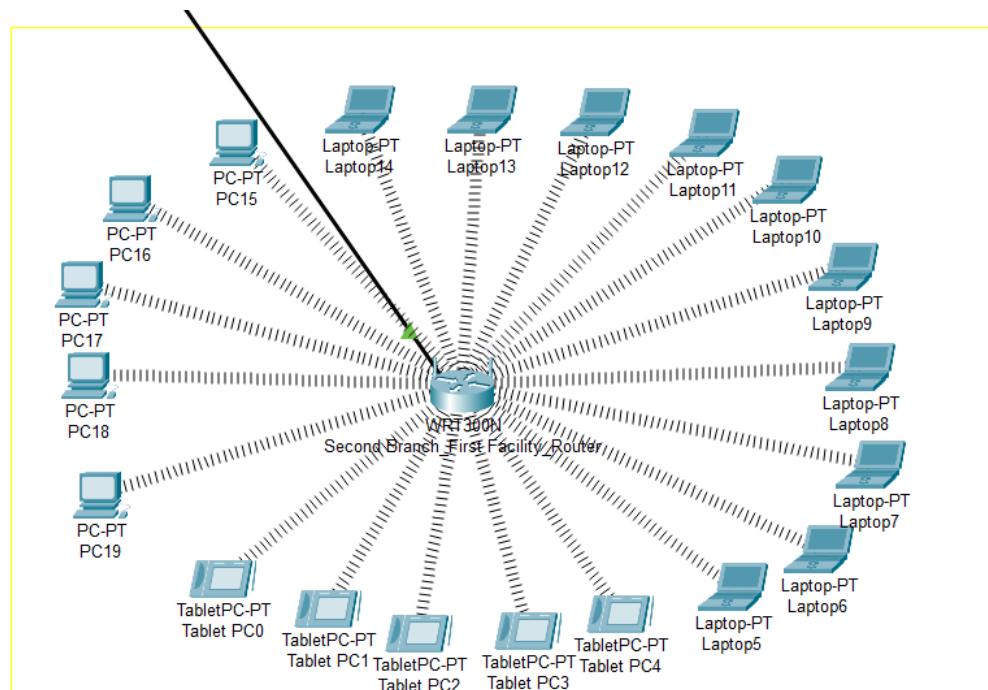


Figure A.5: Second branch, first facility.

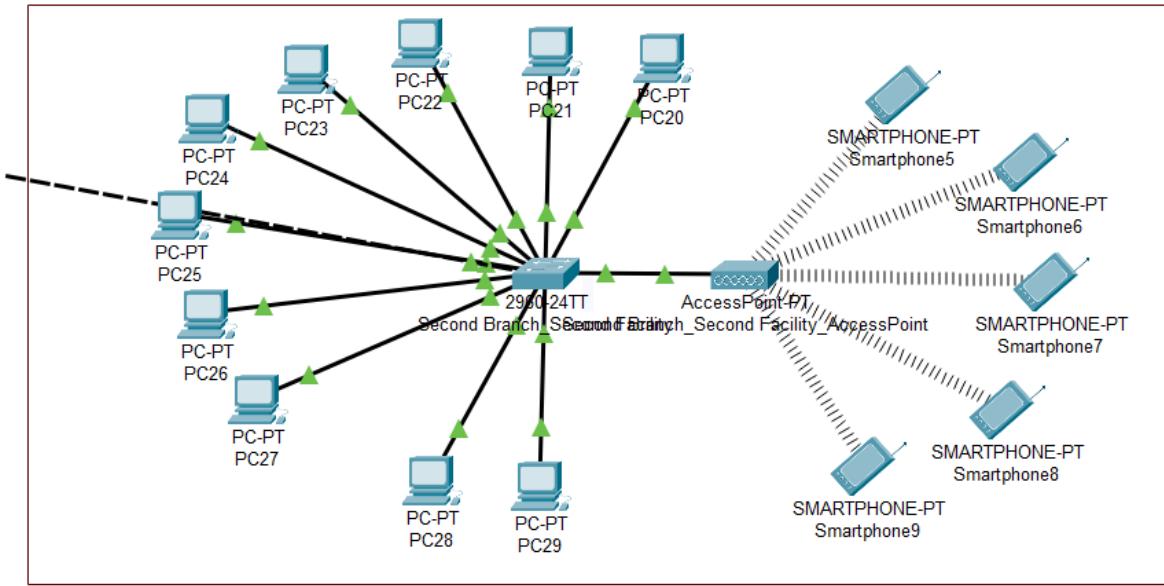


Figure A.6: Second branch, second facility.

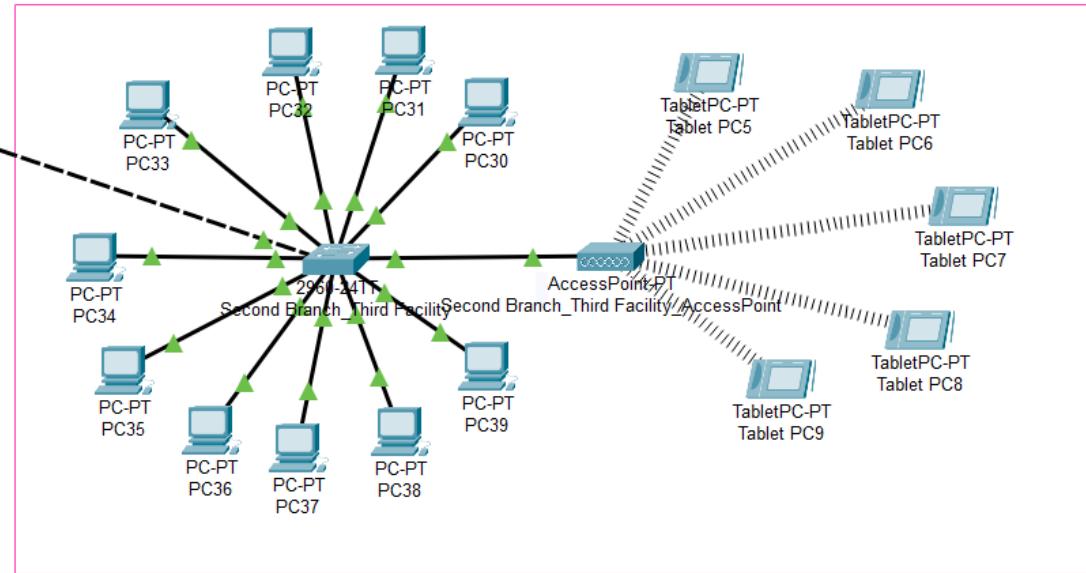


Figure A.7: Second branch, third facility.



Figure B.1: Physical branches preview.

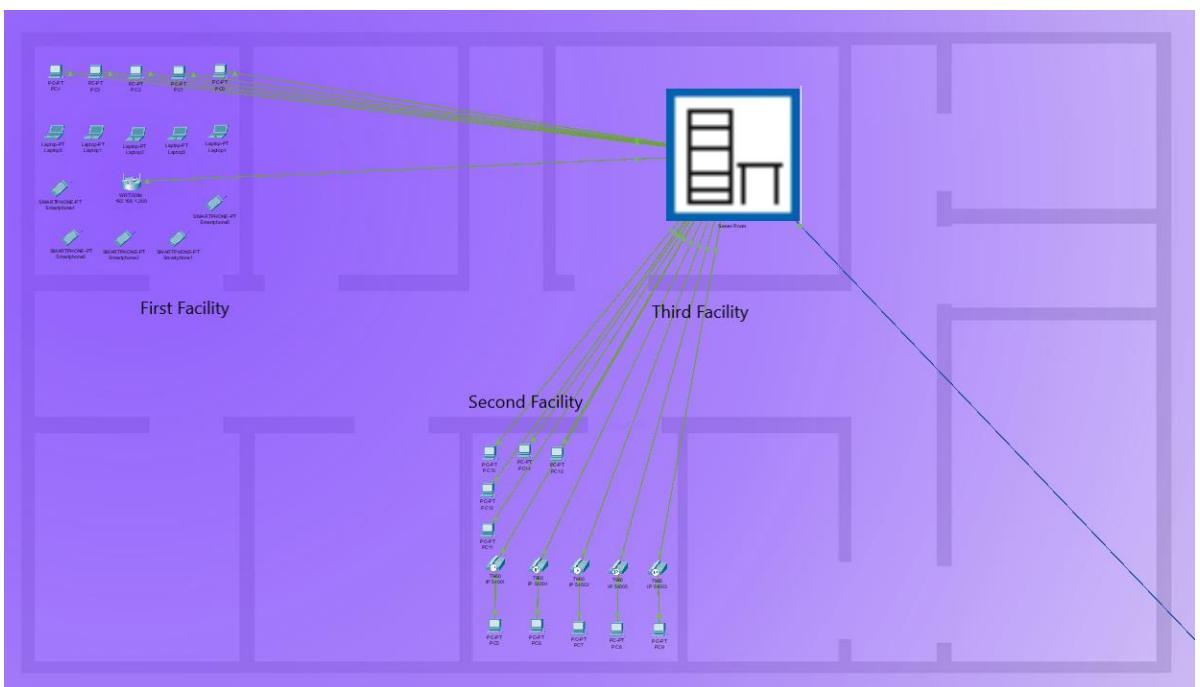


Figure B.2: First branch.

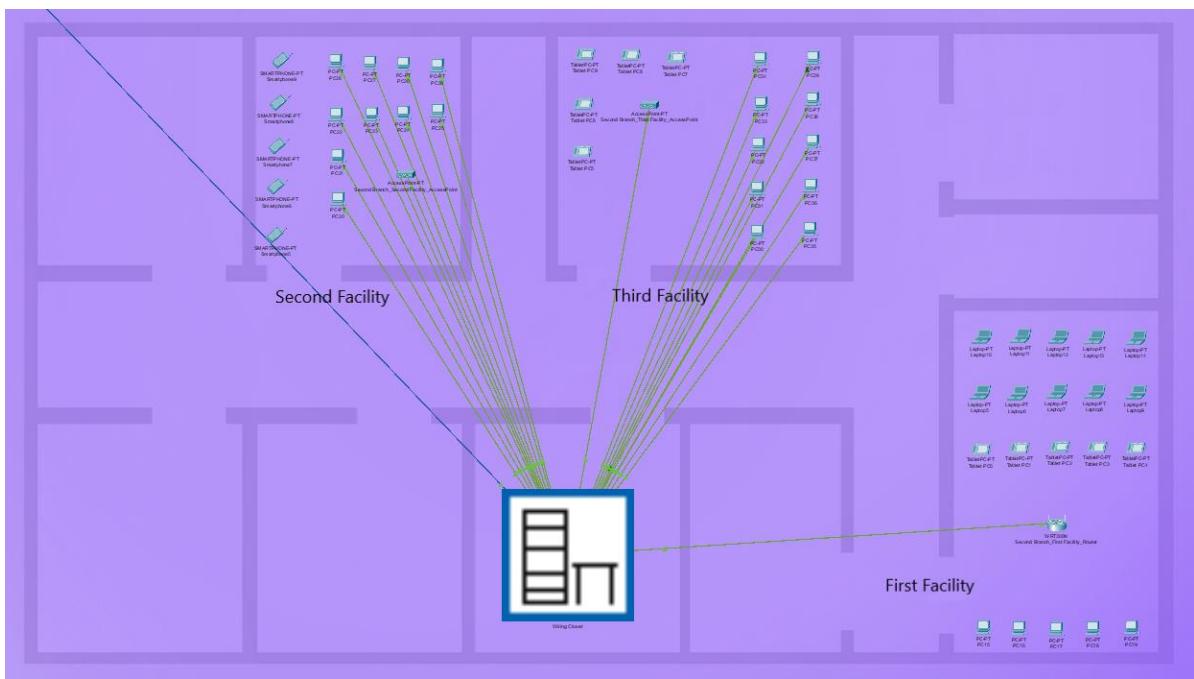


Figure B.3: Second branch.

## 2.6 Simulation Elements

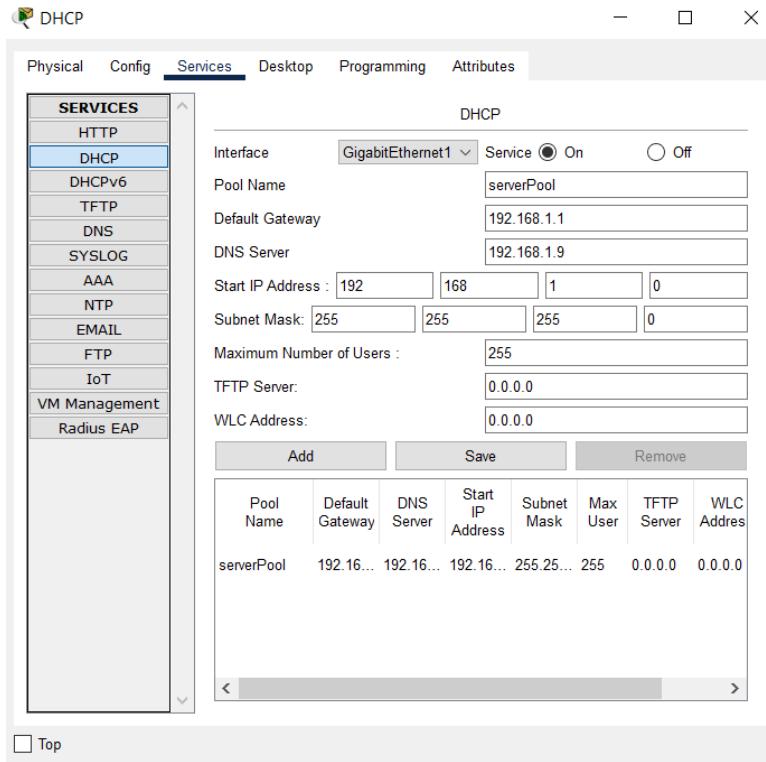


Figure C.1: DHCP server.

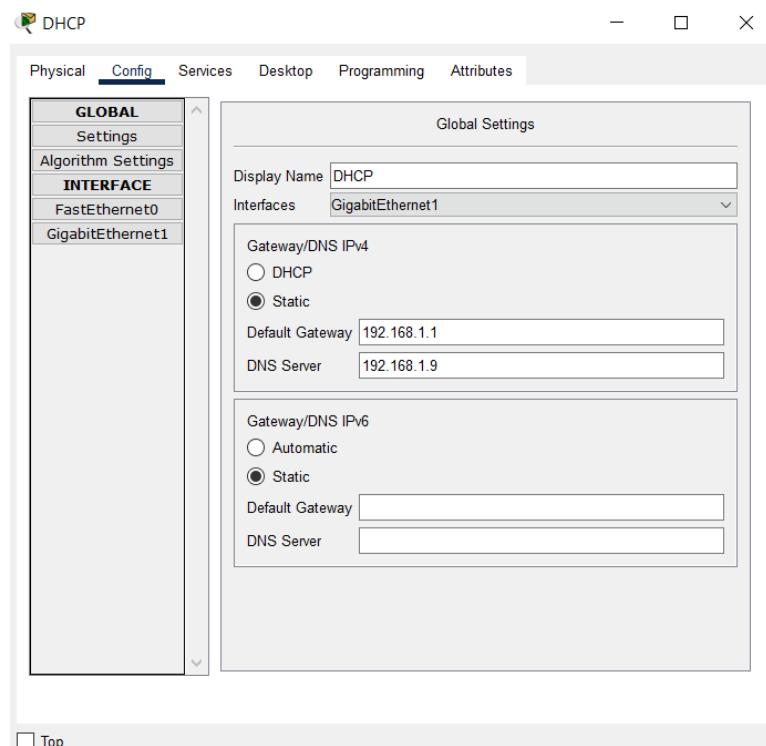


Figure C.2: DHCP Configuration.

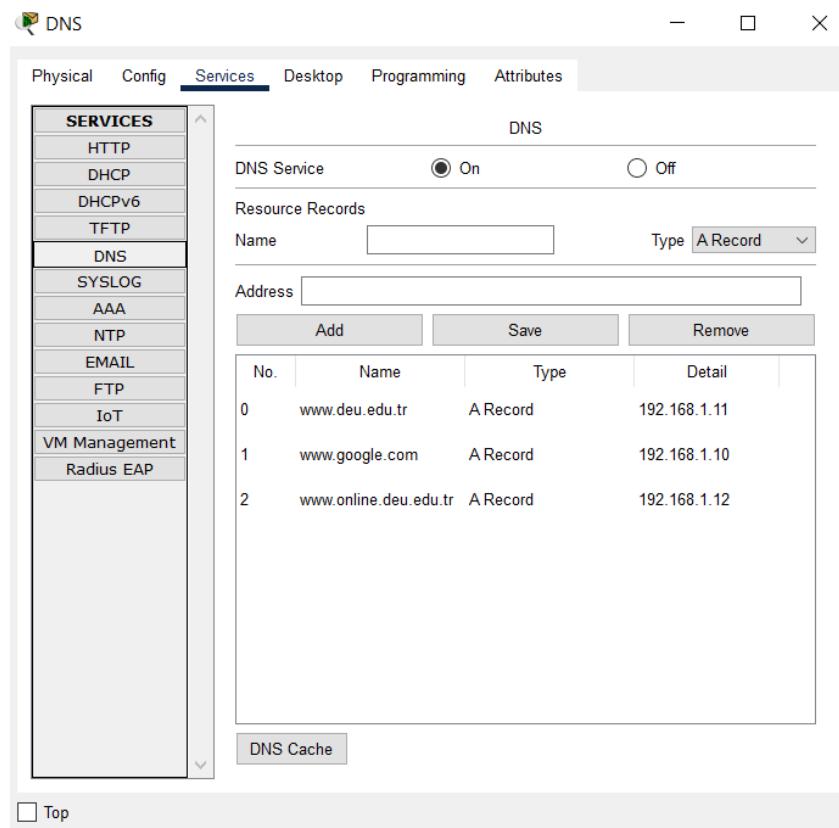


Figure C.3: DNS server.

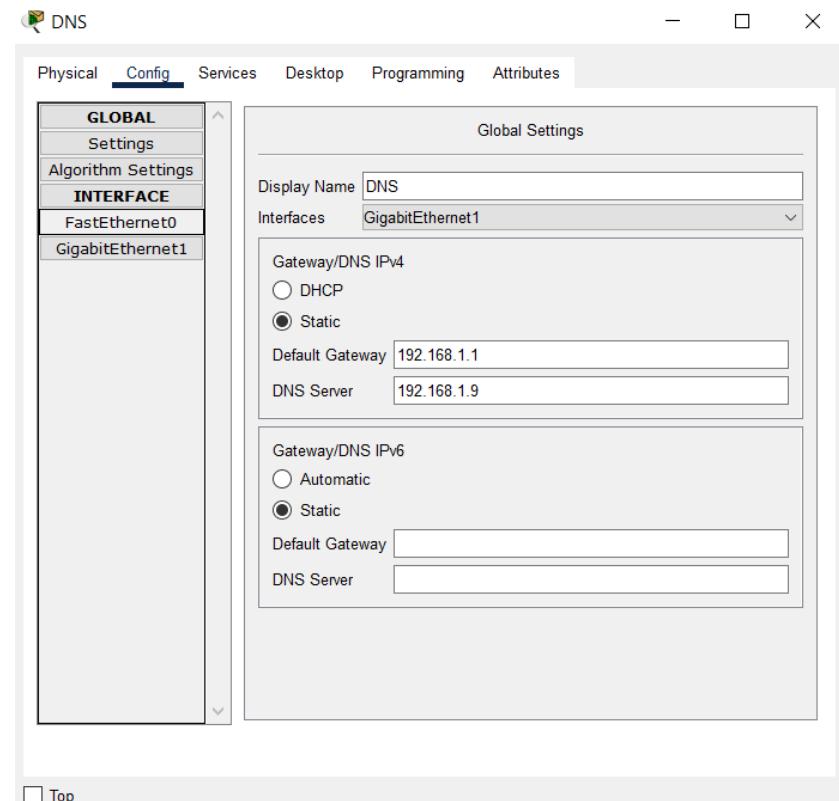


Figure C.4: DNS Configuration.

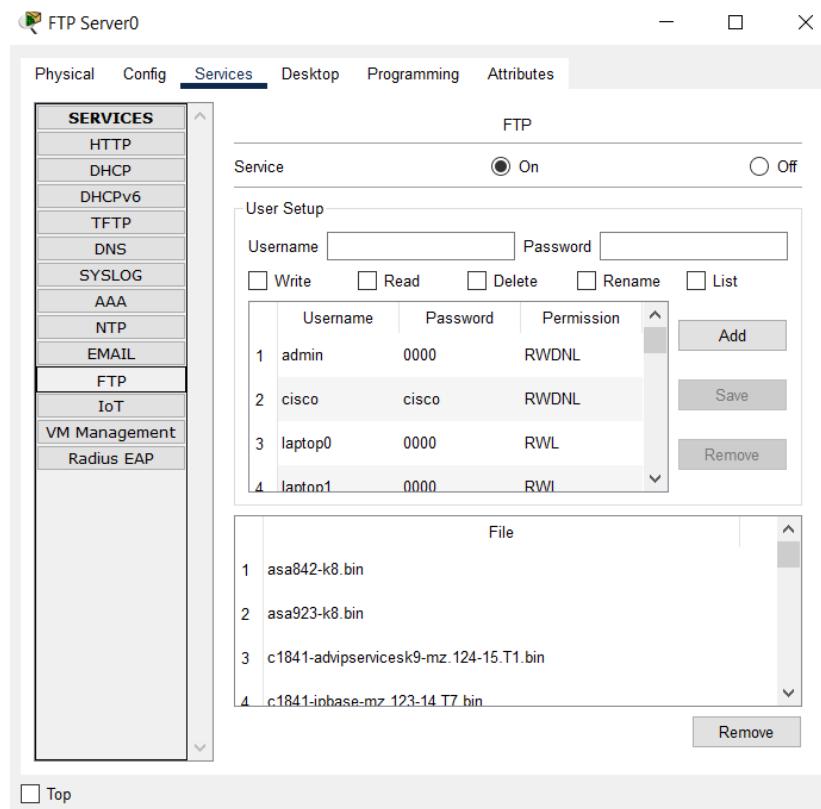


Figure C.5: FTP Server (FTP0).

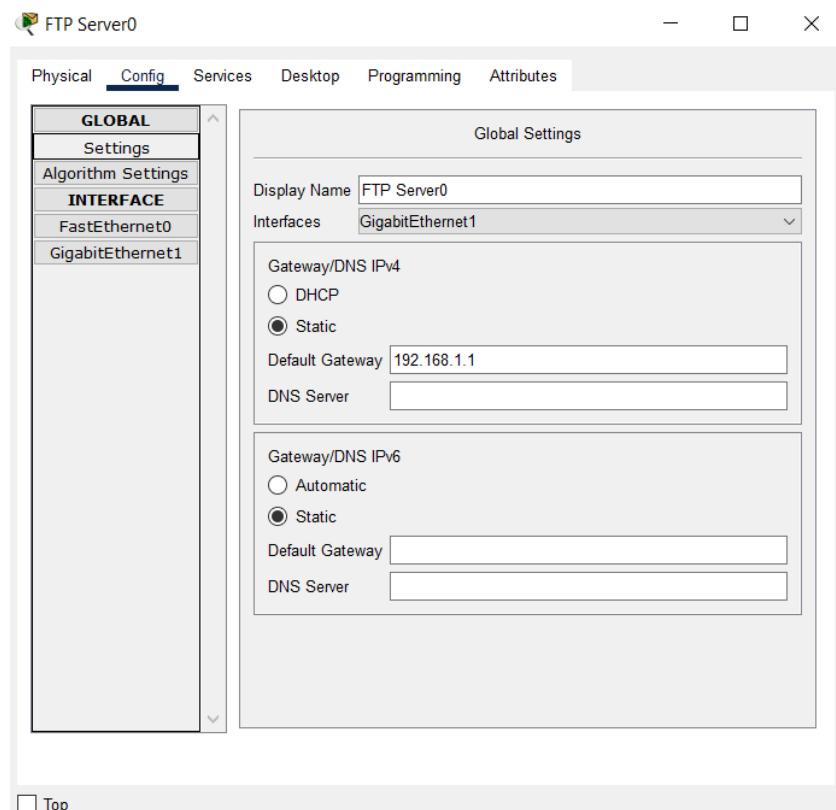


Figure C.6: FTP Configuration.

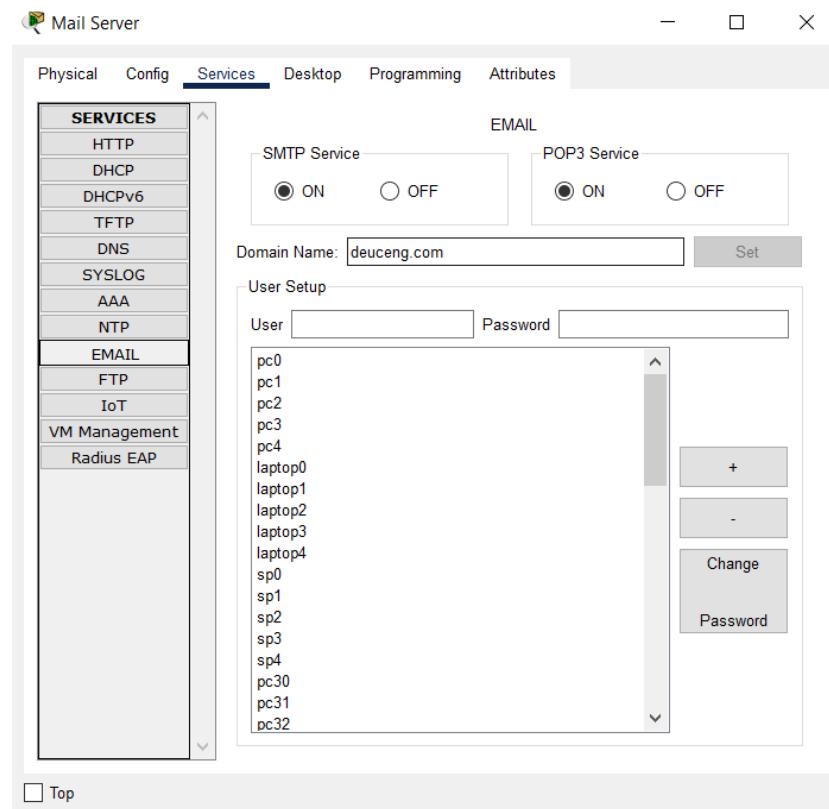


Figure C.7: Mail server.

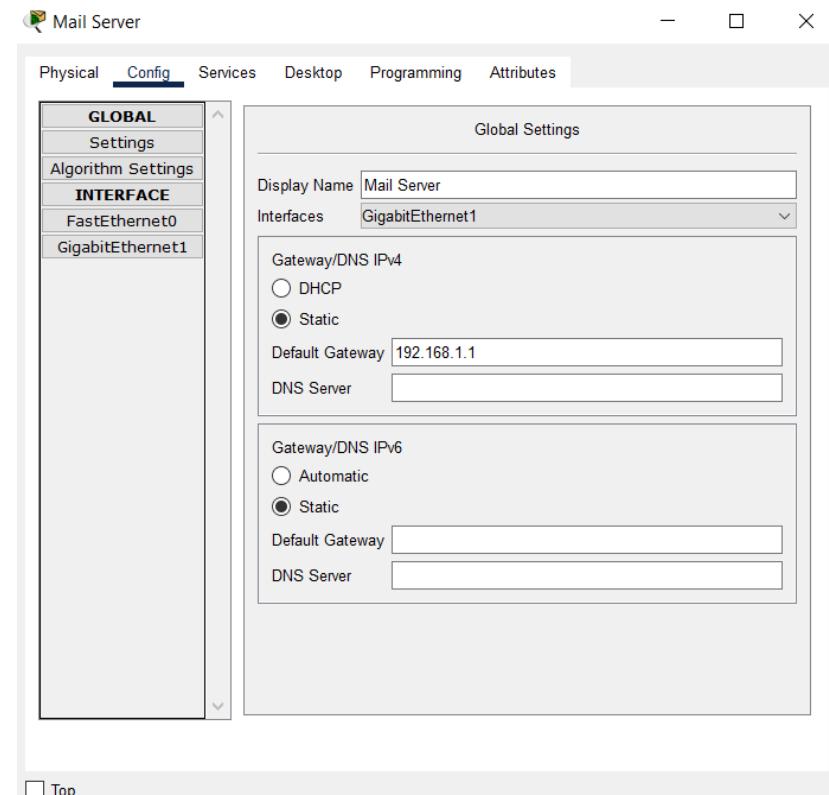


Figure C.8: Mail Configuration.

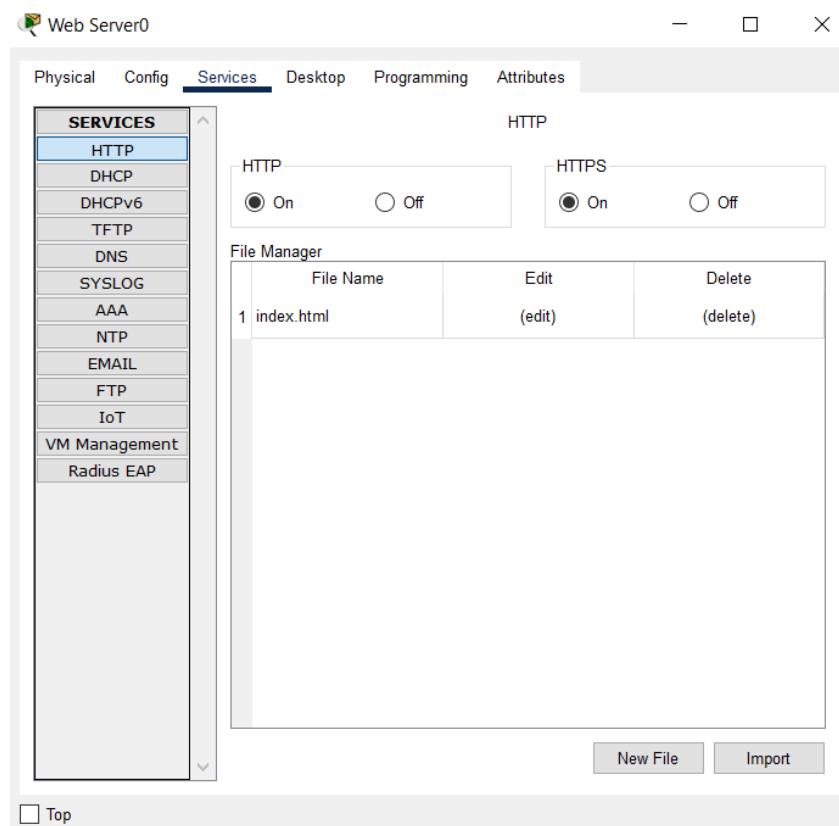


Figure C.9: Web server.

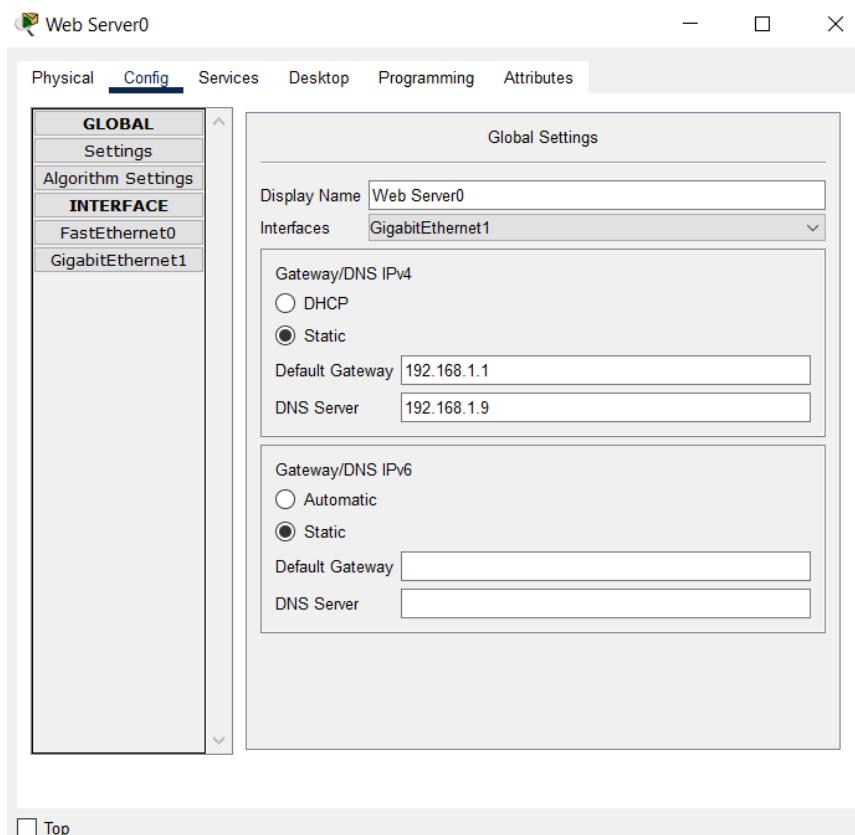


Figure C.10: Web Configuration.

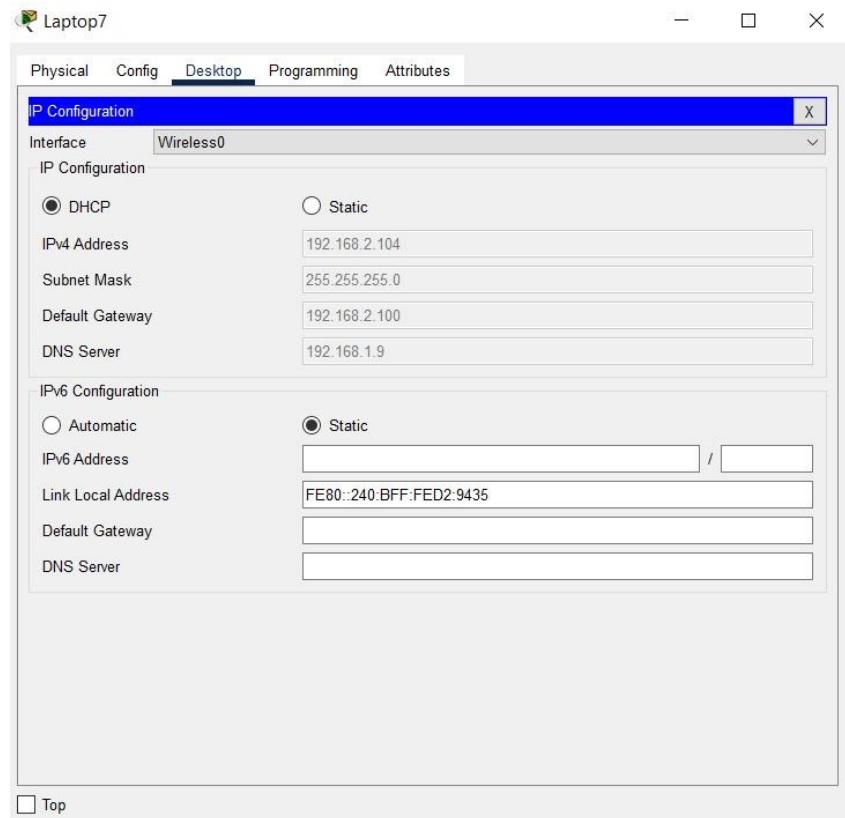


Figure C.11: Endpoint IP Configuration.

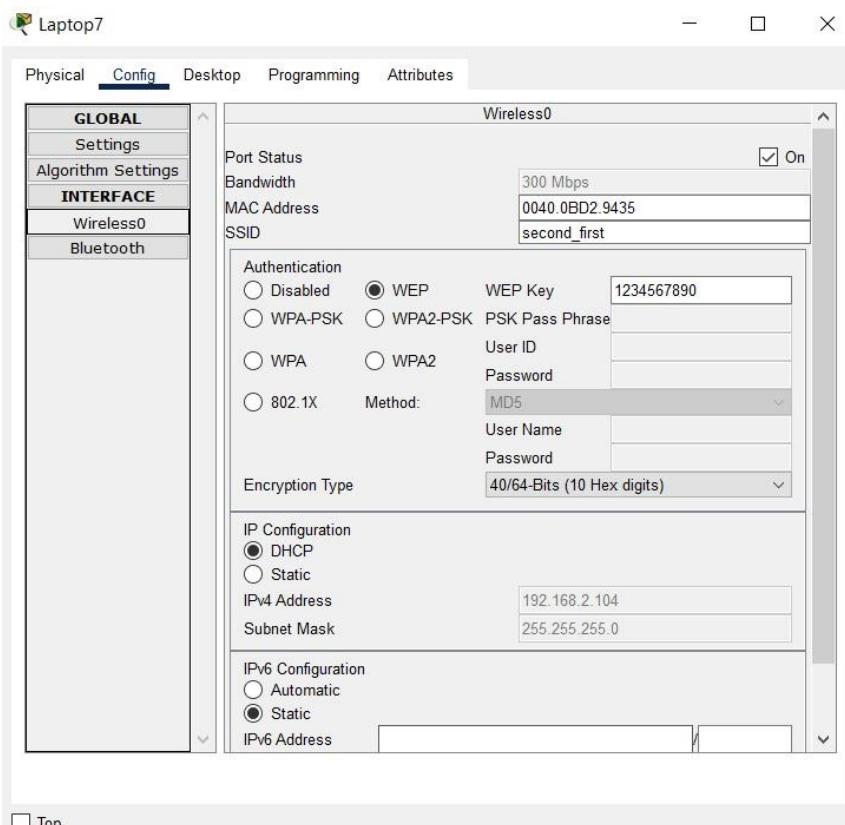


Figure C.12: Endpoint Wireless Configuration.

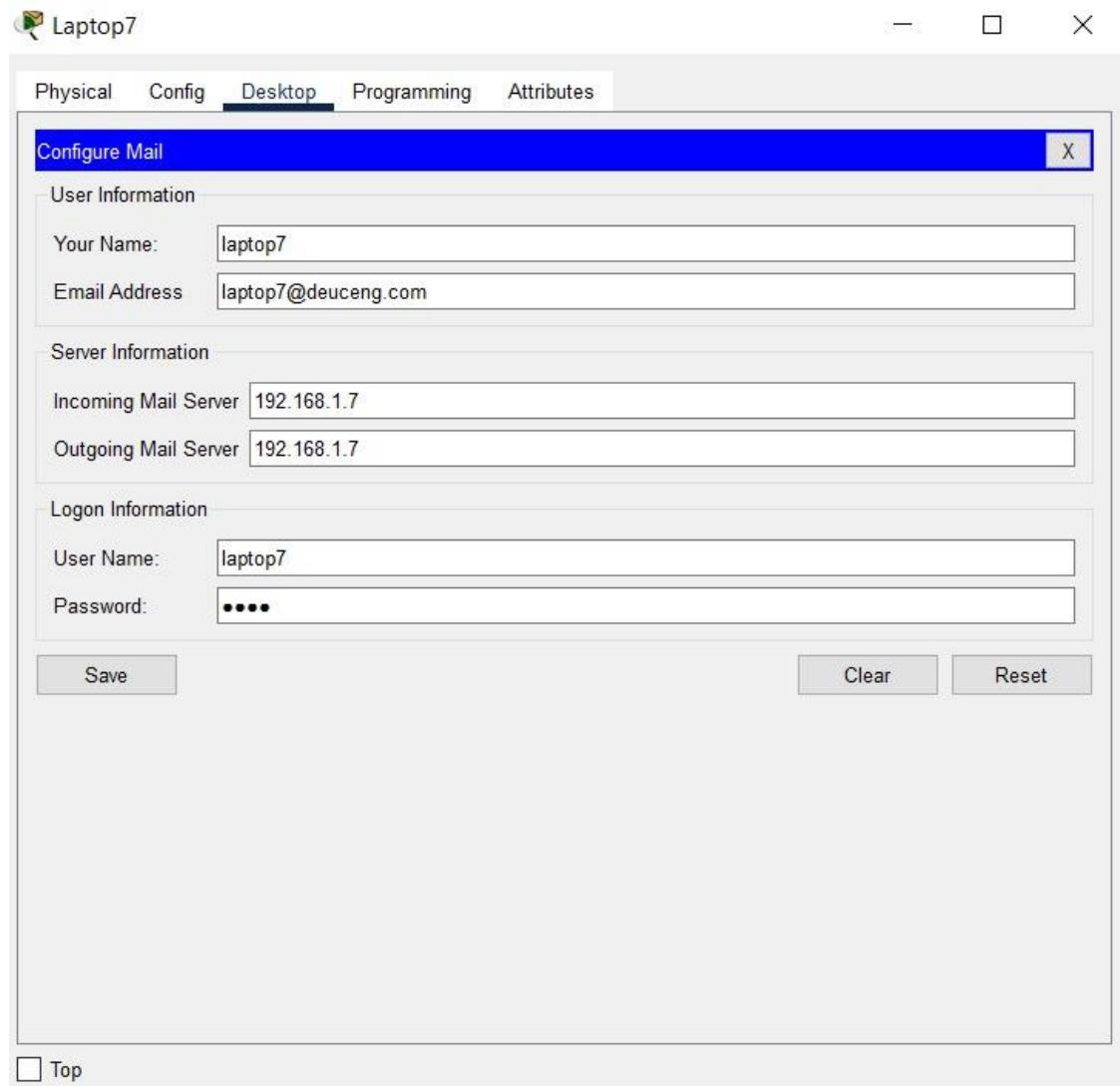


Figure C.13: Endpoint mail configuration.

# METHOD AND SIMULATION

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

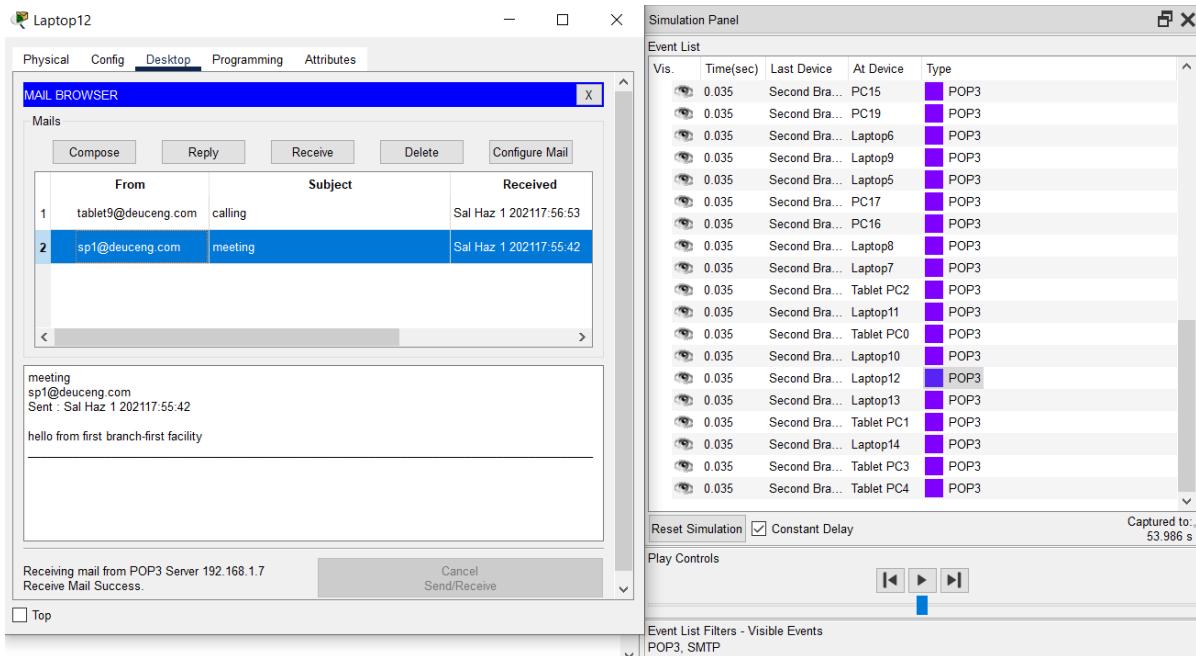


Figure 1.1.1: Read email event list.

PDU Information at Device: Laptop12

**OSI Model    Inbound PDU Details**

At Device: Laptop12 Source: Laptop12 Destination: POP3 CLIENT	
<b>In Layers</b>	<b>Out Layers</b>
Layer 7: POP3	Layer7
Layer6	Layer6
Layer5	Layer5
Layer 4: TCP Src Port: 110, Dst Port: 1026	Layer4
Layer 3: IP Header Src. IP: 192.168.1.7, Dest. IP: 192.168.2.107	Layer3
Layer 2: Wireless	Layer2
Layer 1: Port Wireless0	Layer1

1. The device receives a TCP PUSH+ACK segment on the connection to 192.168.1.7 on port 110.  
 2. Received segment information: the sequence number 1, the ACK number 233, and the data length 22.  
 3. The TCP segment has the expected peer sequence number.  
 4. The TCP segment has the expected ACK number. The device pops the last sent segment from the buffer.  
 5. TCP processes payload data.  
 6. TCP reassembles all data segments and passes to the upper layer.

**Challenge Me**    << Previous Layer    Next Layer >>

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Figure 1.1.2: Read email layers.

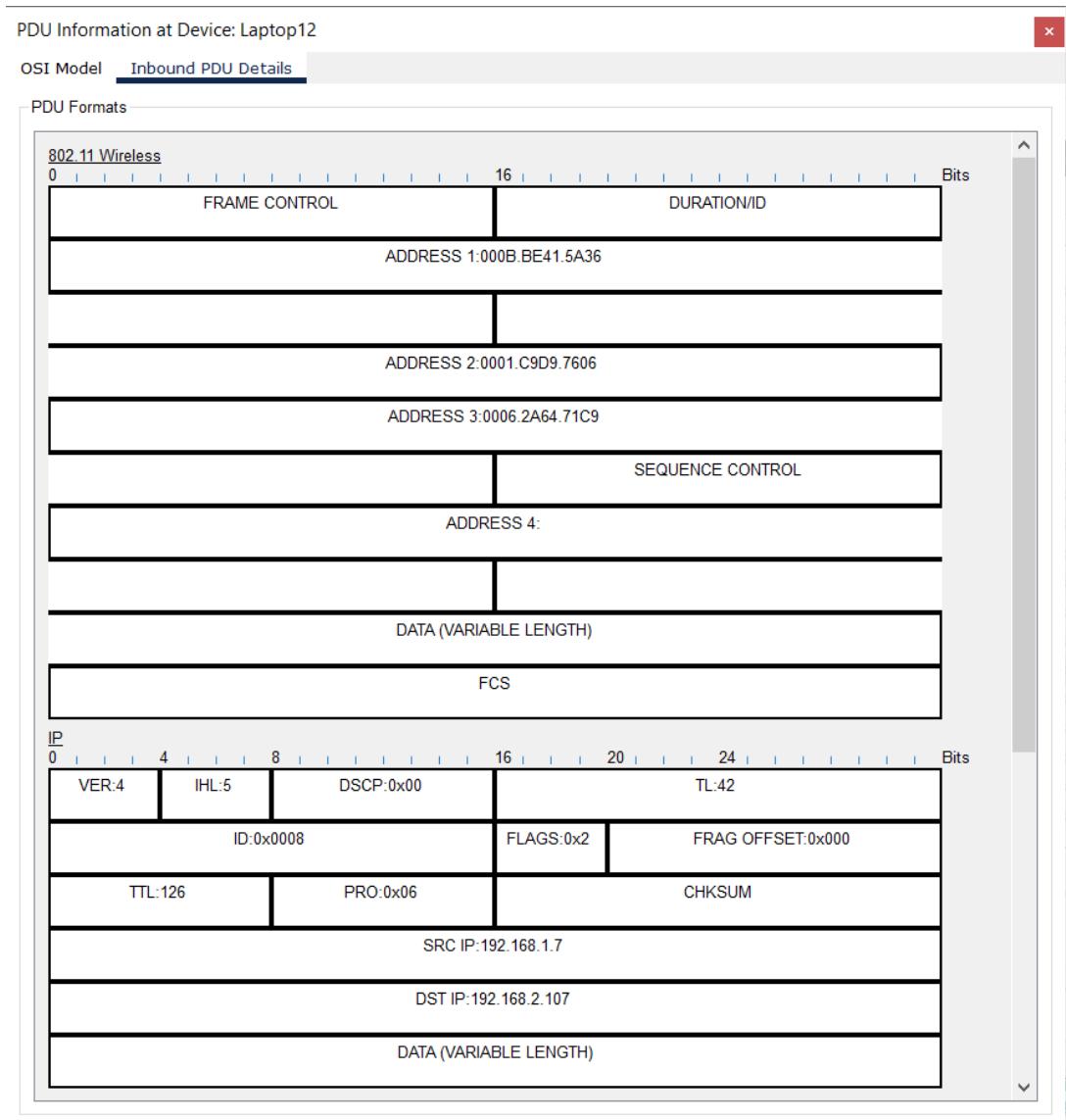


Figure 1.1.3: Read email PDU.

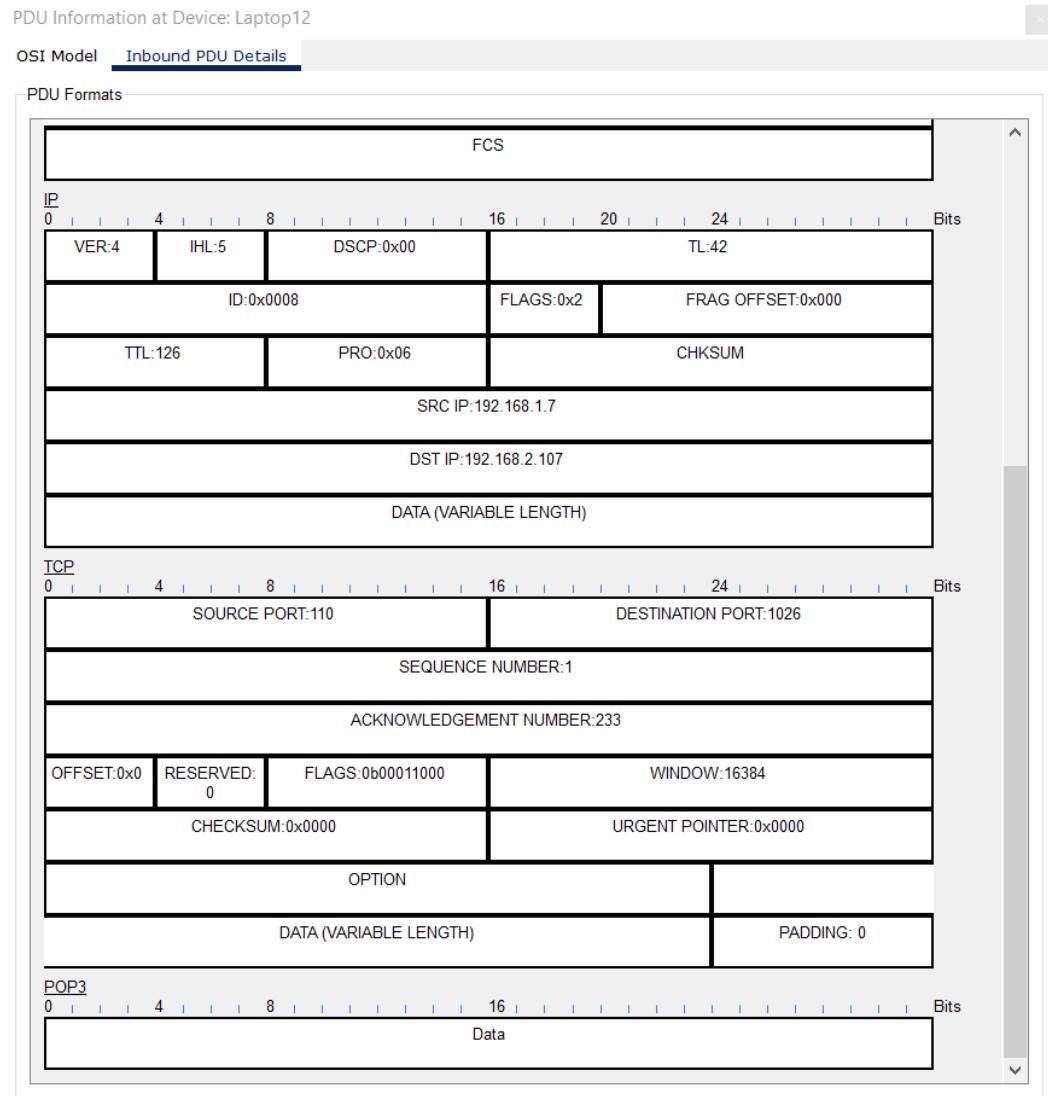


Figure 1.1.4: Read email PDU alt.

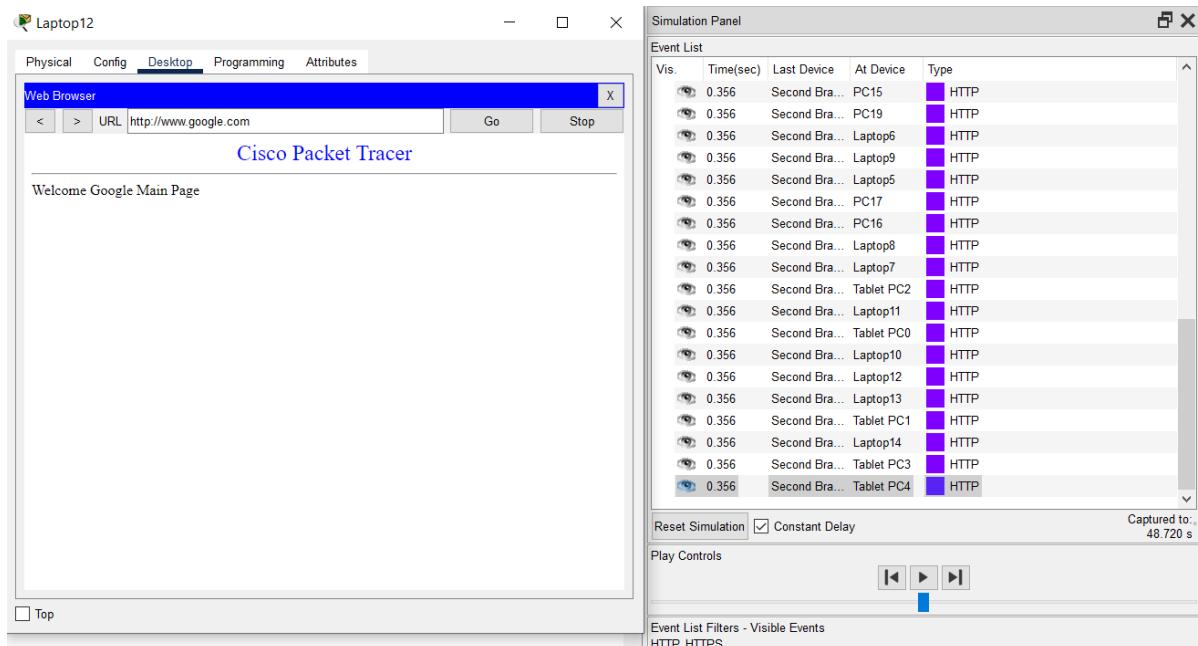


Figure 1.2.1: Browse Web event list.

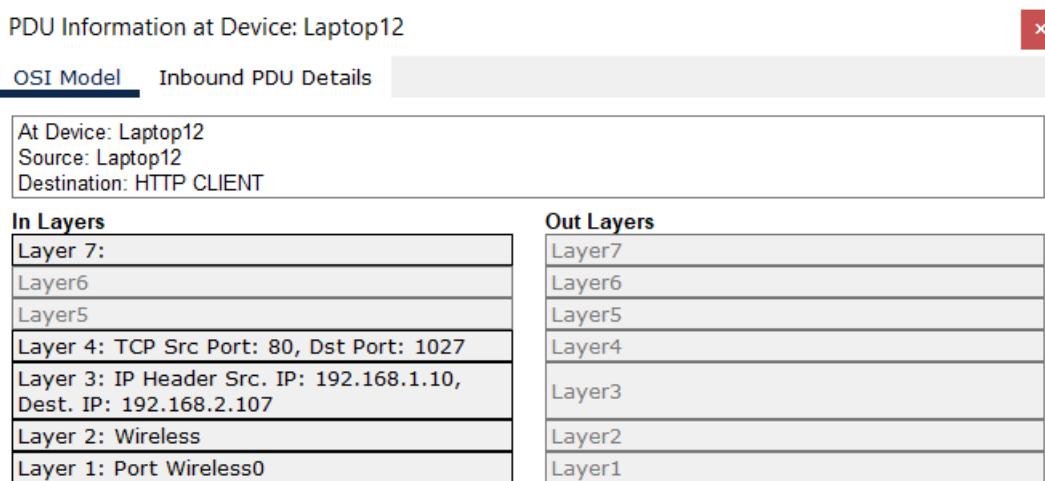


Figure 1.2.2: Browse Web layers.

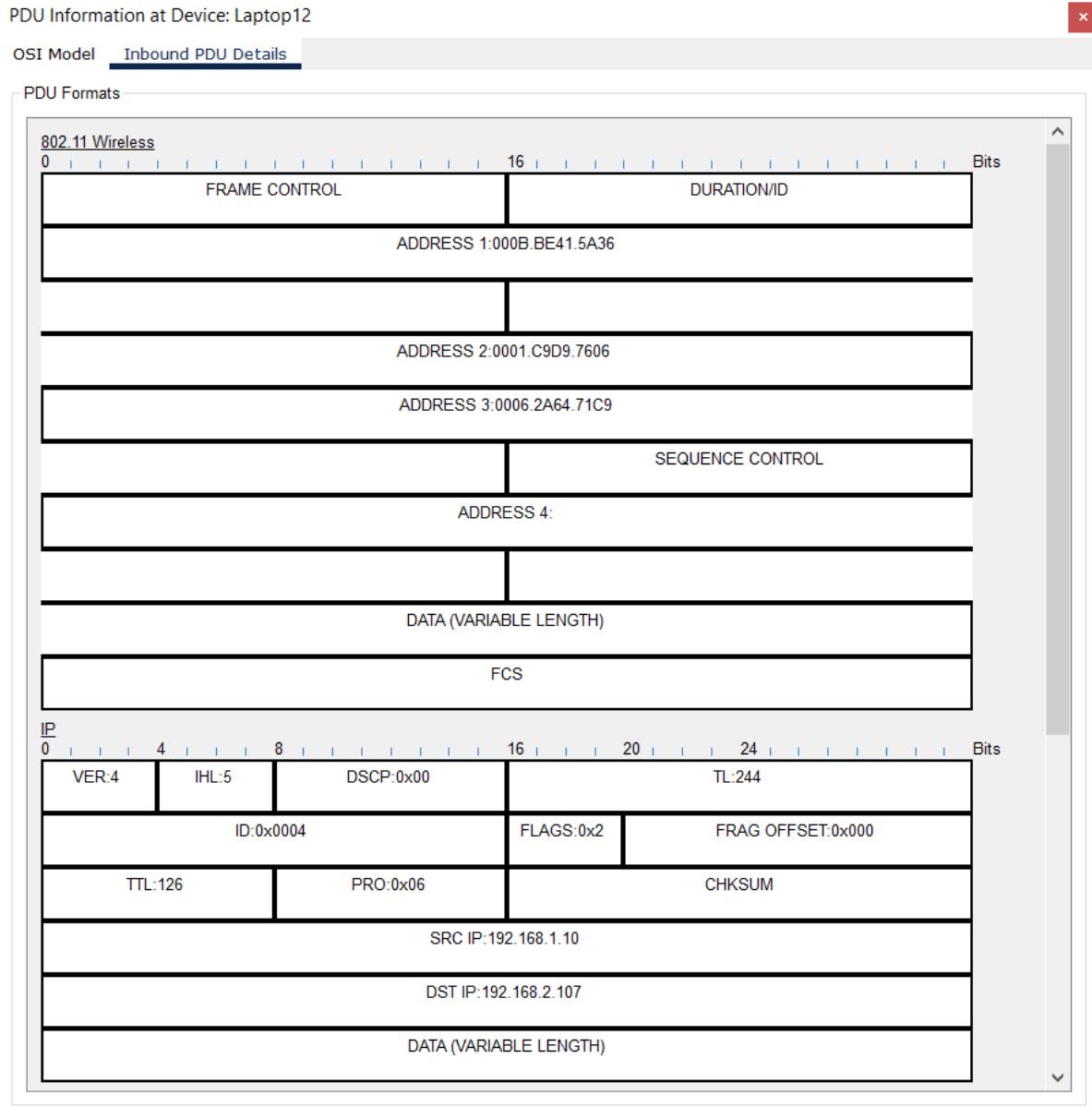


Figure 1.2.3: Browse Web PDU.

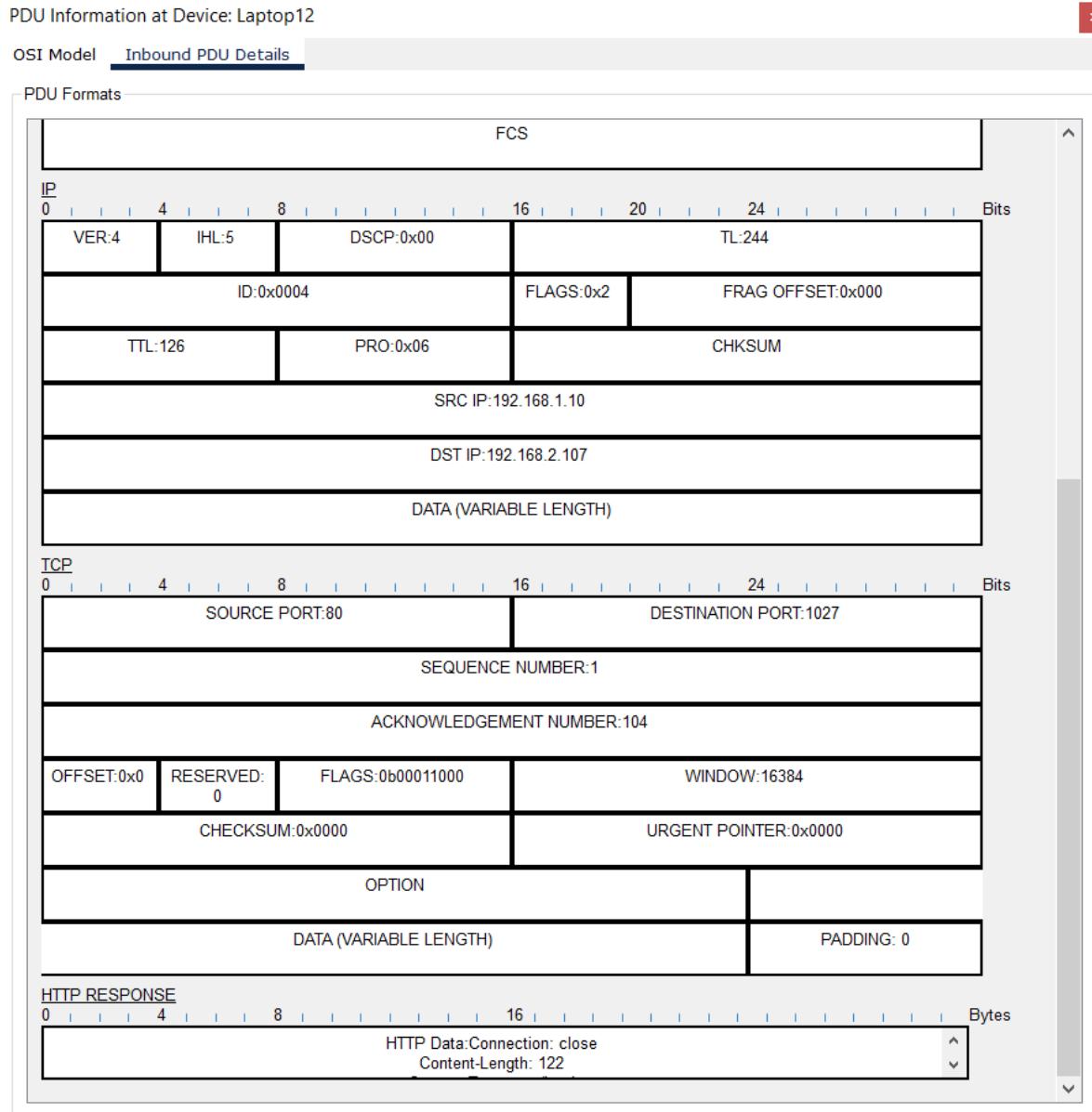


Figure 1.2.4: Browse Web PDU alt.

**Simulation 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.

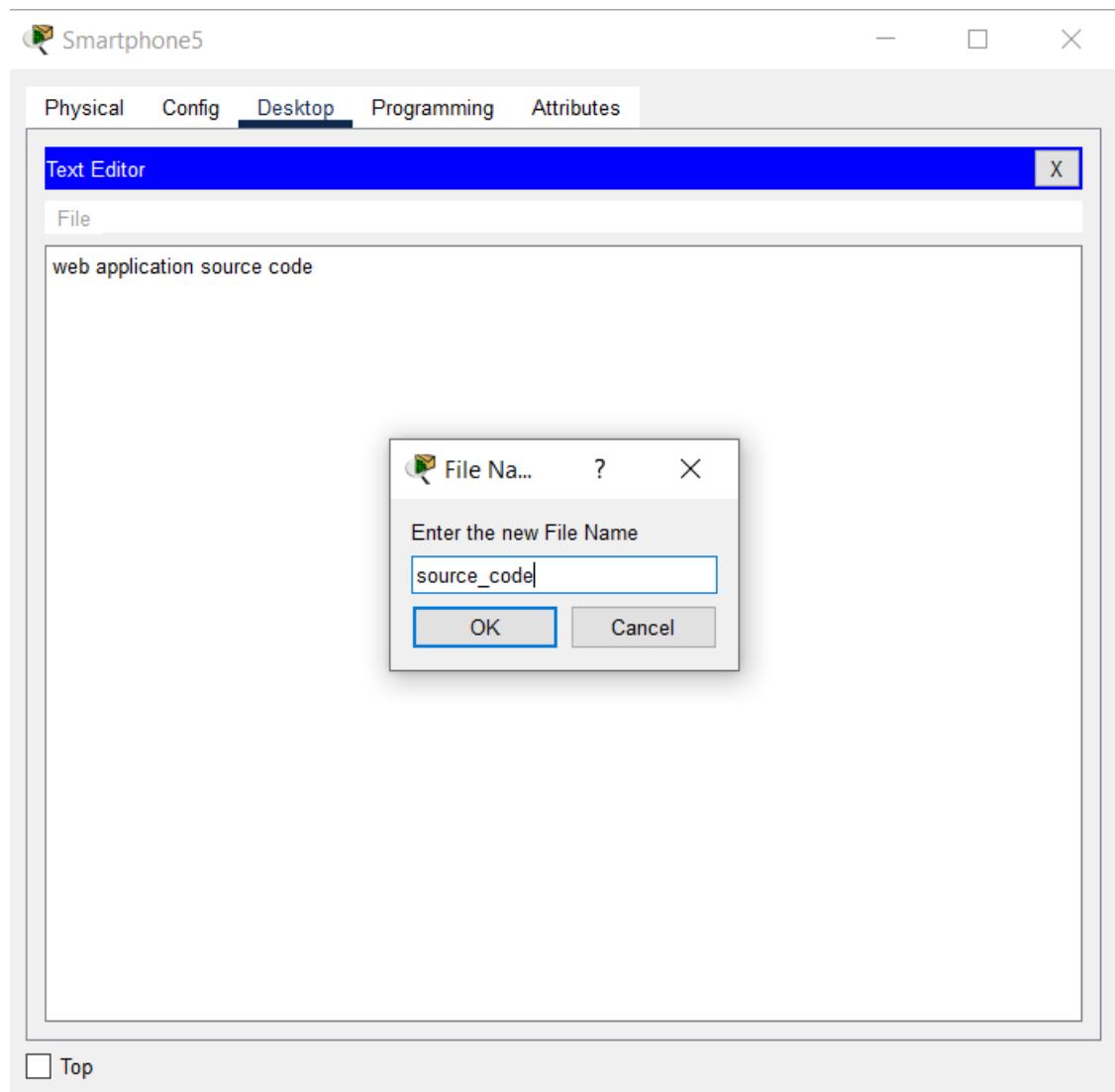


Figure 2.1: Create File on a workstation.

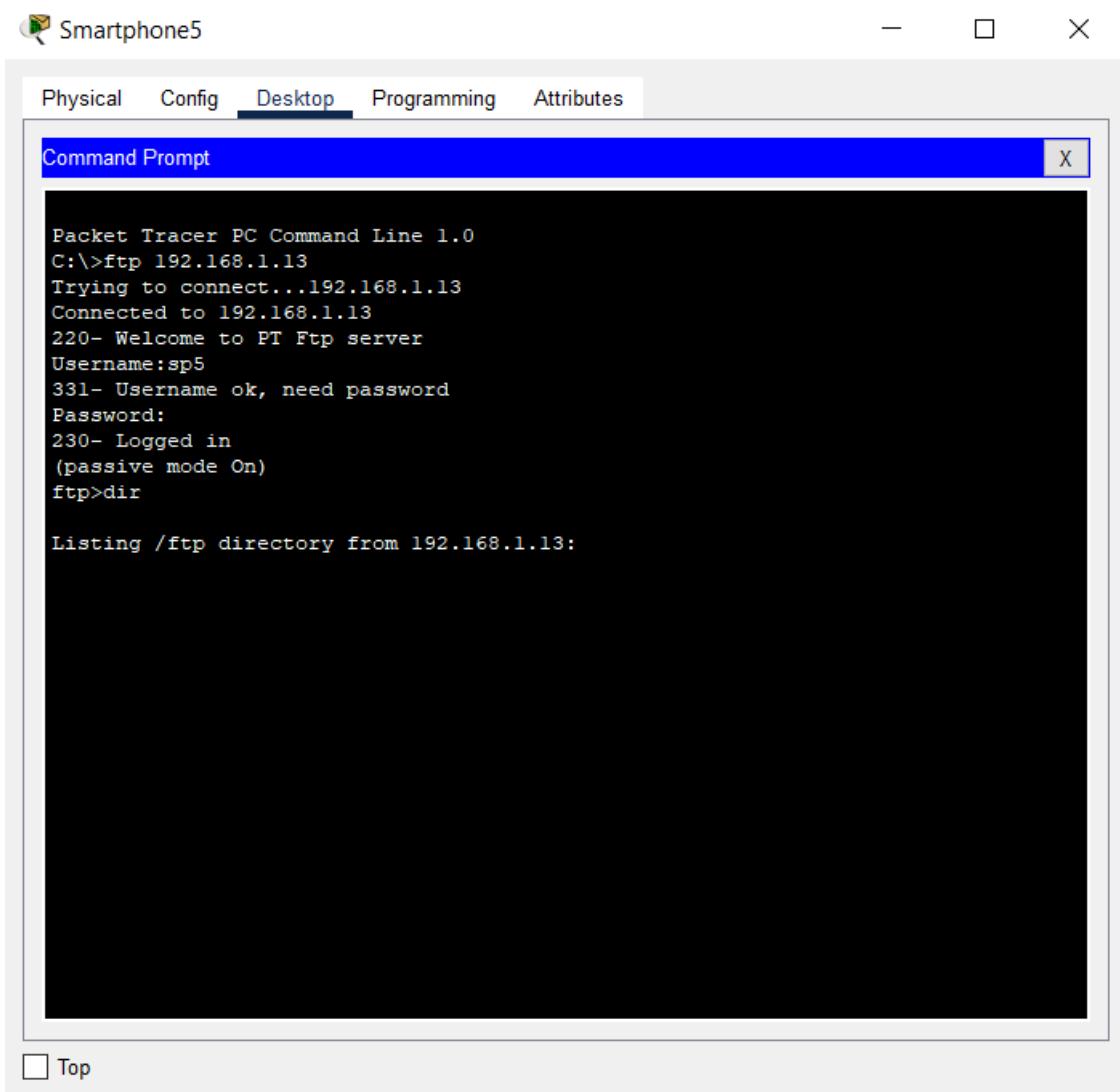


Figure 2.2: Connected to FTP server.

Smartphone5

Physical Config Desktop Programming Attributes

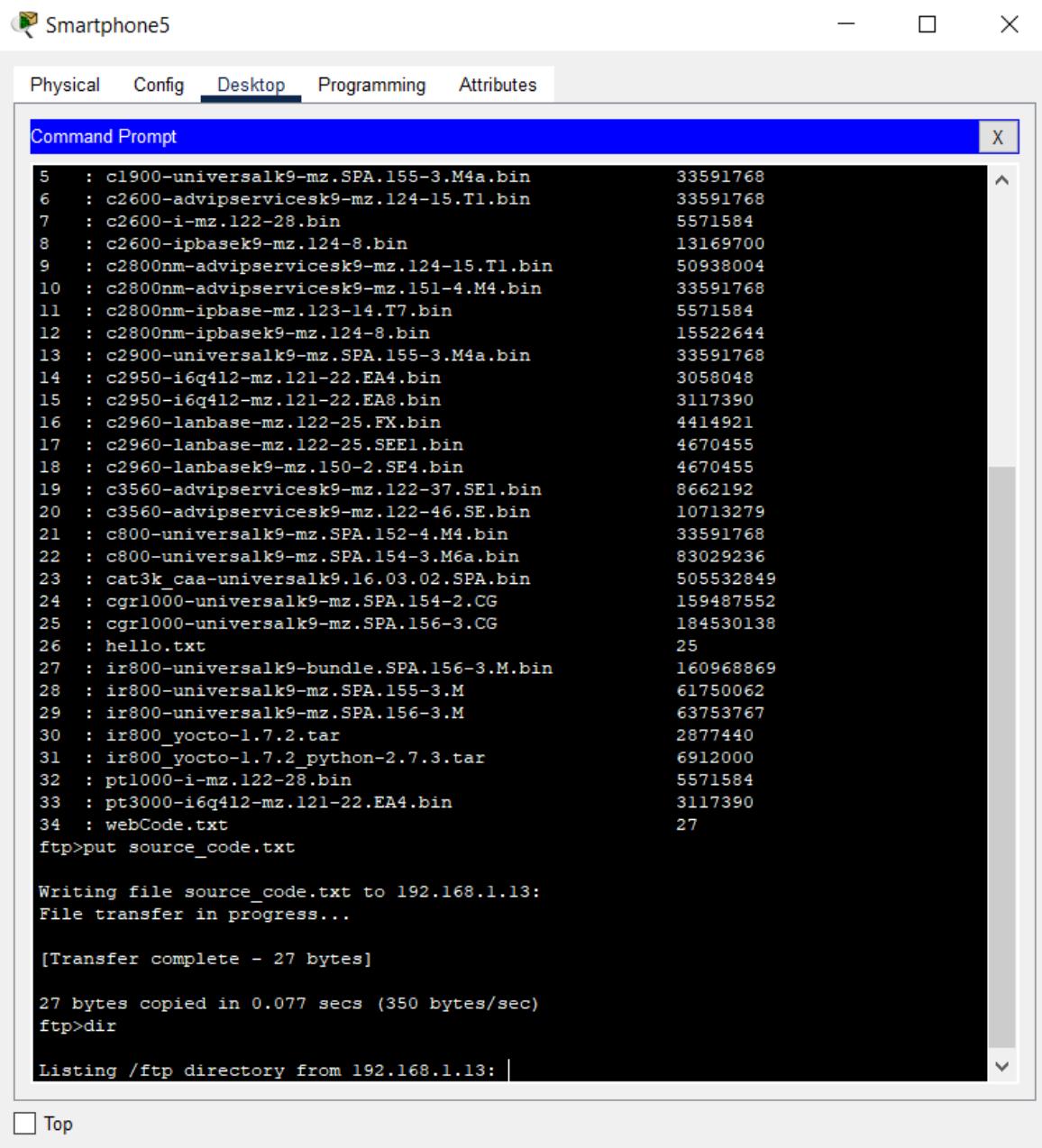
Command Prompt

```
230- Logged in
(passive mode On)
ftp>dir

Listing /ftp directory from 192.168.1.13:
0  : asa842-k8.bin          5571584
1  : asa923-k8.bin          30468096
2  : cl841-advipservicesk9-mz.124-15.T1.bin 33591768
3  : cl841-ipbase-mz.123-14.T7.bin   13832032
4  : cl841-ipbasek9-mz.124-12.bin  16599160
5  : cl900-universalk9-mz.SPA.155-3.M4a.bin 33591768
6  : c2600-advipservicesk9-mz.124-15.T1.bin 33591768
7  : c2600-i-mz.122-28.bin    5571584
8  : c2600-ipbasek9-mz.124-8.bin 13169700
9  : c2800nm-advipservicesk9-mz.124-15.T1.bin 50938004
10 : c2800nm-advipservicesk9-mz.151-4.M4.bin 33591768
11 : c2800nm-ipbase-mz.123-14.T7.bin   5571584
12 : c2800nm-ipbasek9-mz.124-8.bin  15522644
13 : c2900-universalk9-mz.SPA.155-3.M4a.bin 33591768
14 : c2950-i6q4l2-mz.121-22.EA4.bin  3058048
15 : c2950-i6q4l2-mz.121-22.EA8.bin 3117390
16 : c2960-lanbase-mz.122-25.FX.bin 4414921
17 : c2960-lanbase-mz.122-25.SE1.bin 4670455
18 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
19 : c3560-advipservicesk9-mz.122-37.SE1.bin 8662192
20 : c3560-advipservicesk9-mz.122-46.SE.bin 10713279
21 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
22 : c800-universalk9-mz.SPA.154-3.M6a.bin 83029236
23 : cat3k_caa-universalk9.16.03.02.SPA.bin 505532849
24 : cgr1000-universalk9-mz.SPA.154-2.CG 159487552
25 : cgr1000-universalk9-mz.SPA.156-3.CG 184530138
26 : hello.txt                25
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 : webCode.txt                  27
ftp>
```

Top

Figure 2.3: List files from FTP server.



The screenshot shows a Windows-style application window titled "Smartphone5". The window has a tab bar at the top with "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". Below the tabs is a title bar "Command Prompt" with a close button "X". The main area is a terminal window displaying the following text:

```
5 : c1900-universalk9-mz.SPA.155-3.M4a.bin 33591768
6 : c2600-advipservicesk9-mz.124-15.T1.bin 33591768
7 : c2600-i-mz.122-28.bin 5571584
8 : c2600-ipbasek9-mz.124-8.bin 13169700
9 : c2800nm-advipservicesk9-mz.124-15.T1.bin 50938004
10 : c2800nm-advipservicesk9-mz.151-4.M4.bin 33591768
11 : c2800nm-ipbase-mz.123-14.T7.bin 5571584
12 : c2800nm-ipbasek9-mz.124-8.bin 15522644
13 : c2900-universalk9-mz.SPA.155-3.M4a.bin 33591768
14 : c2950-i6q4l2-mz.121-22.EA4.bin 3058048
15 : c2950-i6q4l2-mz.121-22.EA8.bin 3117390
16 : c2960-lanbase-mz.122-25.FX.bin 4414921
17 : c2960-lanbase-mz.122-25.SEEl.bin 4670455
18 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
19 : c3560-advipservicesk9-mz.122-37.SE1.bin 8662192
20 : c3560-advipservicesk9-mz.122-46.SE.bin 10713279
21 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
22 : c800-universalk9-mz.SPA.154-3.M6a.bin 83029236
23 : cat3k_caa-universalk9.16.03.02.SPA.bin 505532849
24 : cgr1000-universalk9-mz.SPA.154-2.CG 159487552
25 : cgr1000-universalk9-mz.SPA.156-3.CG 184530138
26 : hello.txt 25
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 : webCode.txt 27

ftp>put source_code.txt

Writing file source_code.txt to 192.168.1.13:
File transfer in progress...

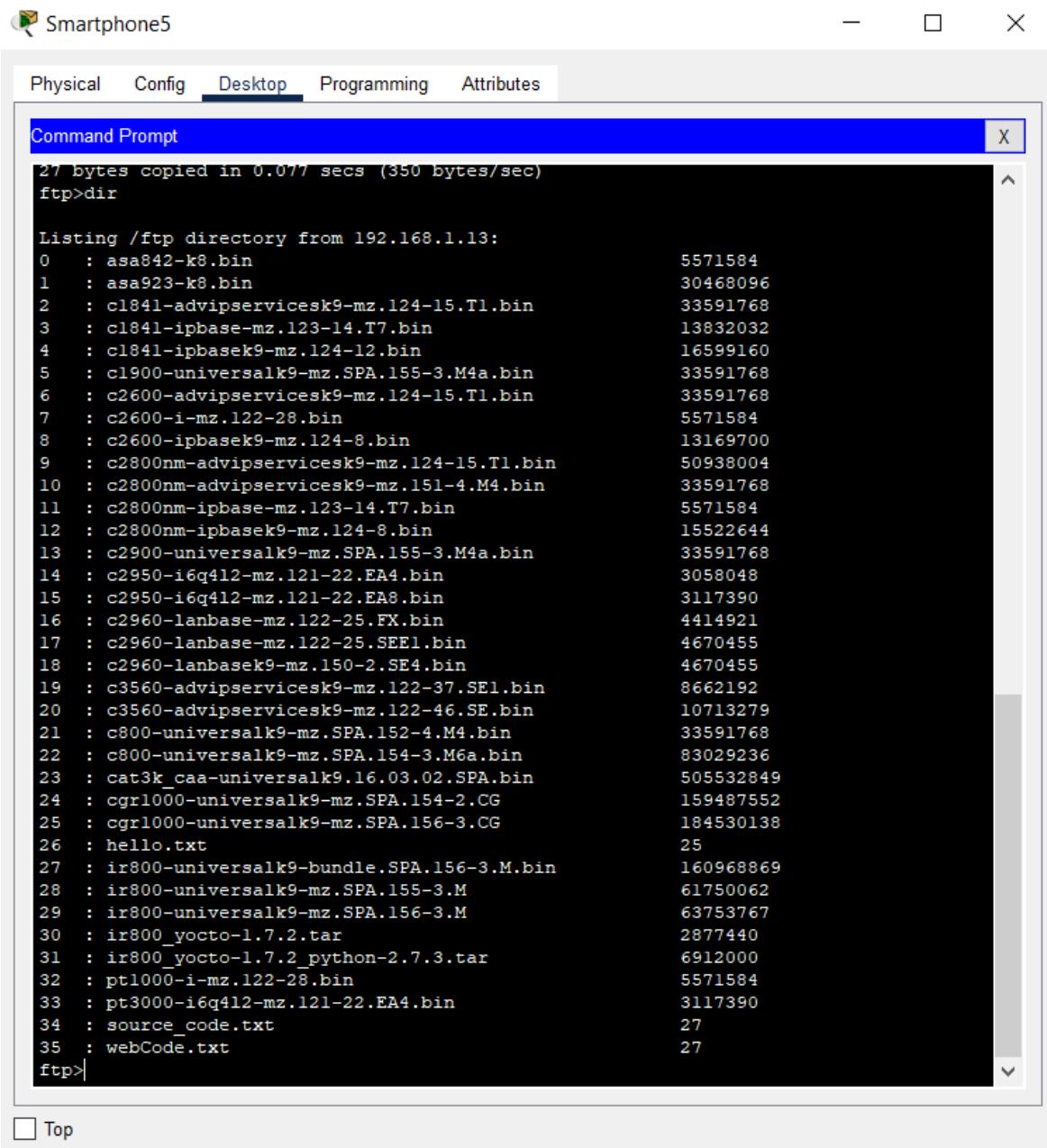
[Transfer complete - 27 bytes]

27 bytes copied in 0.077 secs (350 bytes/sec)
ftp>dir

Listing /ftp directory from 192.168.1.13: |
```

At the bottom left of the terminal window is a "Top" button.

Figure 2.3: Upload created file to FTP server.



The screenshot shows the 'Smartphone5' application window. At the top, there is a menu bar with tabs: Physical, Config, Desktop, Programming, and Attributes. The 'Desktop' tab is currently selected. Below the menu is a blue header bar with the text 'Command Prompt' and a close button ('X'). The main area is a terminal window displaying an FTP directory listing. The output shows the following:

```
27 bytes copied in 0.077 secs (350 bytes/sec)
ftp>dir

Listing /ftp directory from 192.168.1.13:
0   : asa842-k8.bin                               5571584
1   : asa923-k8.bin                               30468096
2   : cl841-advipservicesk9-mz.124-15.T1.bin    33591768
3   : cl841-ipbase-mz.123-14.T7.bin             13832032
4   : cl841-ipbasek9-mz.124-12.bin              16599160
5   : cl900-universalk9-mz.SPA.155-3.M4a.bin    33591768
6   : c2600-advipservicesk9-mz.124-15.T1.bin    33591768
7   : c2600-i-mz.122-28.bin                      5571584
8   : c2600-ipbasek9-mz.124-8.bin                13169700
9   : c2800nm-advipservicesk9-mz.124-15.T1.bin  50938004
10  : c2800nm-advipservicesk9-mz.151-4.M4.bin    33591768
11  : c2800nm-ipbase-mz.123-14.T7.bin          5571584
12  : c2800nm-ipbasek9-mz.124-8.bin            15522644
13  : c2900-universalk9-mz.SPA.155-3.M4a.bin    33591768
14  : c2950-i6q412-mz.121-22.EA4.bin           3058048
15  : c2950-i6q412-mz.121-22.EA8.bin           3117390
16  : c2960-lanbase-mz.122-25.FX.bin          4414921
17  : c2960-lanbase-mz.122-25.SEE1.bin         4670455
18  : c2960-lanbasek9-mz.150-2.SE4.bin         4670455
19  : c3560-advipservicesk9-mz.122-37.SE1.bin  8662192
20  : c3560-advipservicesk9-mz.122-46.SE.bin    10713279
21  : c800-universalk9-mz.SPA.152-4.M4.bin     33591768
22  : c800-universalk9-mz.SPA.154-3.M6a.bin    83029236
23  : cat3k_caa-universalk9.16.03.02.SPA.bin   505532849
24  : cgr1000-universalk9-mz.SPA.154-2.CG      159487552
25  : cgr1000-universalk9-mz.SPA.156-3.CG      184530138
26  : hello.txt                                25
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  : source_code.txt                           27
35  : webCode.txt                             27
ftp>|
```

Top

Figure 2.4: Uploaded file (source\_code.txt) is now in the FTP server.

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

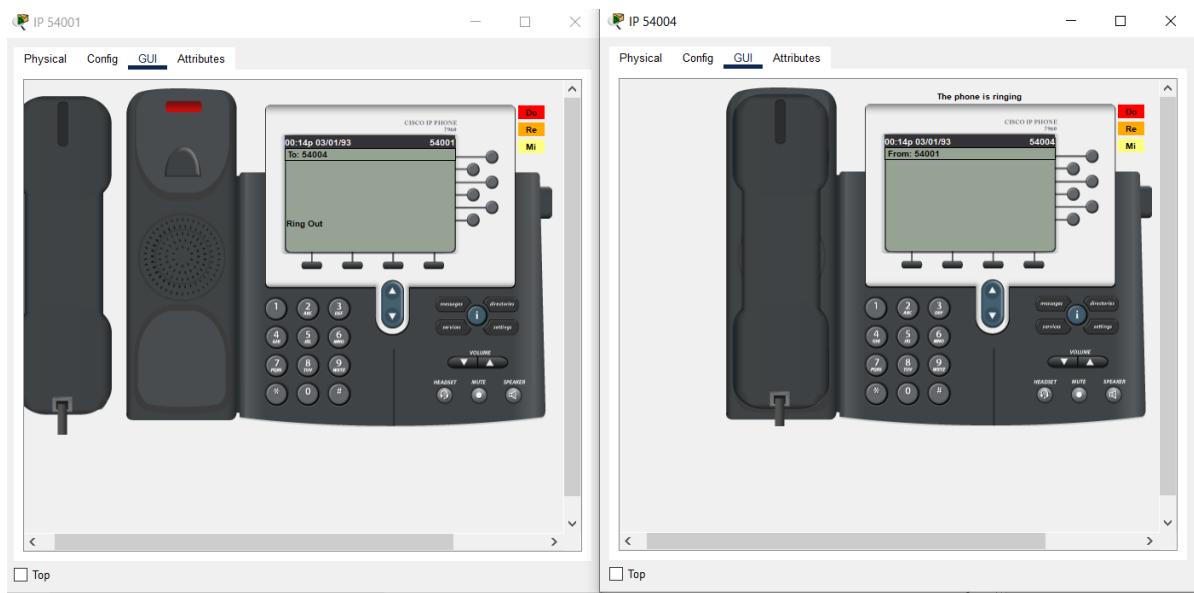


Figure 3.1: Making a call in GUI.

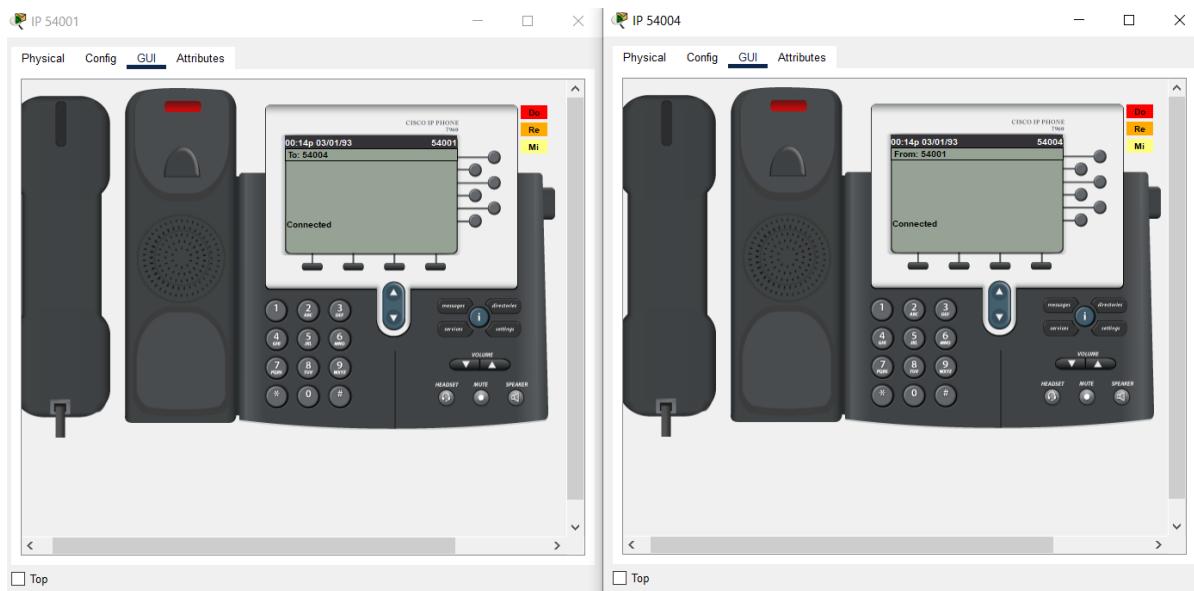


Figure 3.2: Voice conference is live, both devices are connected.

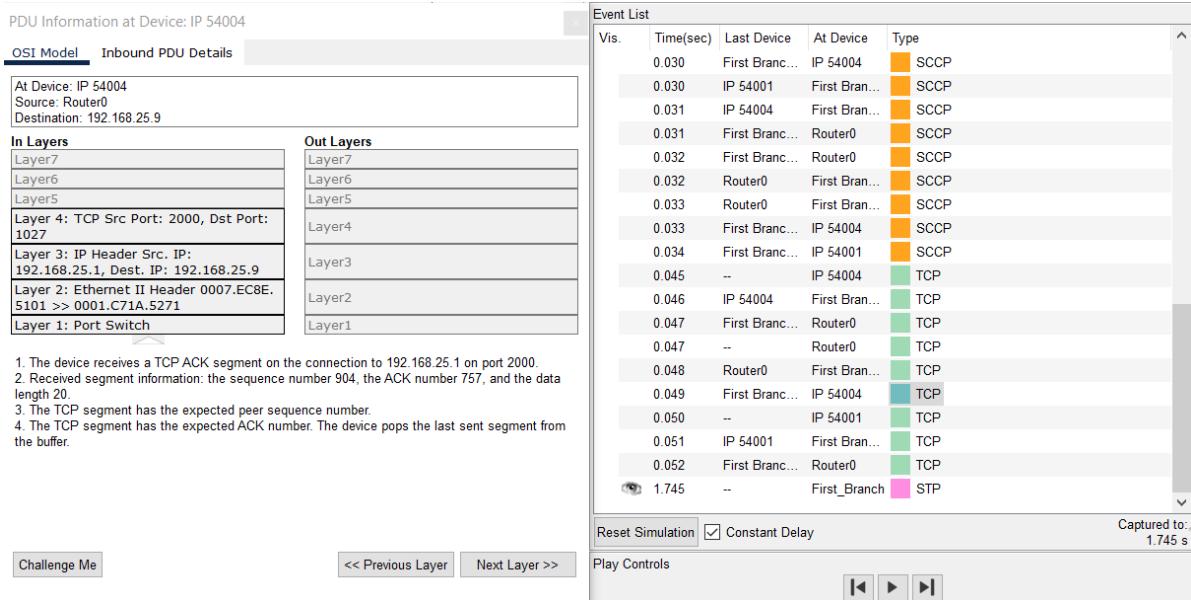


Figure 3.3: VoIP event list and layers.

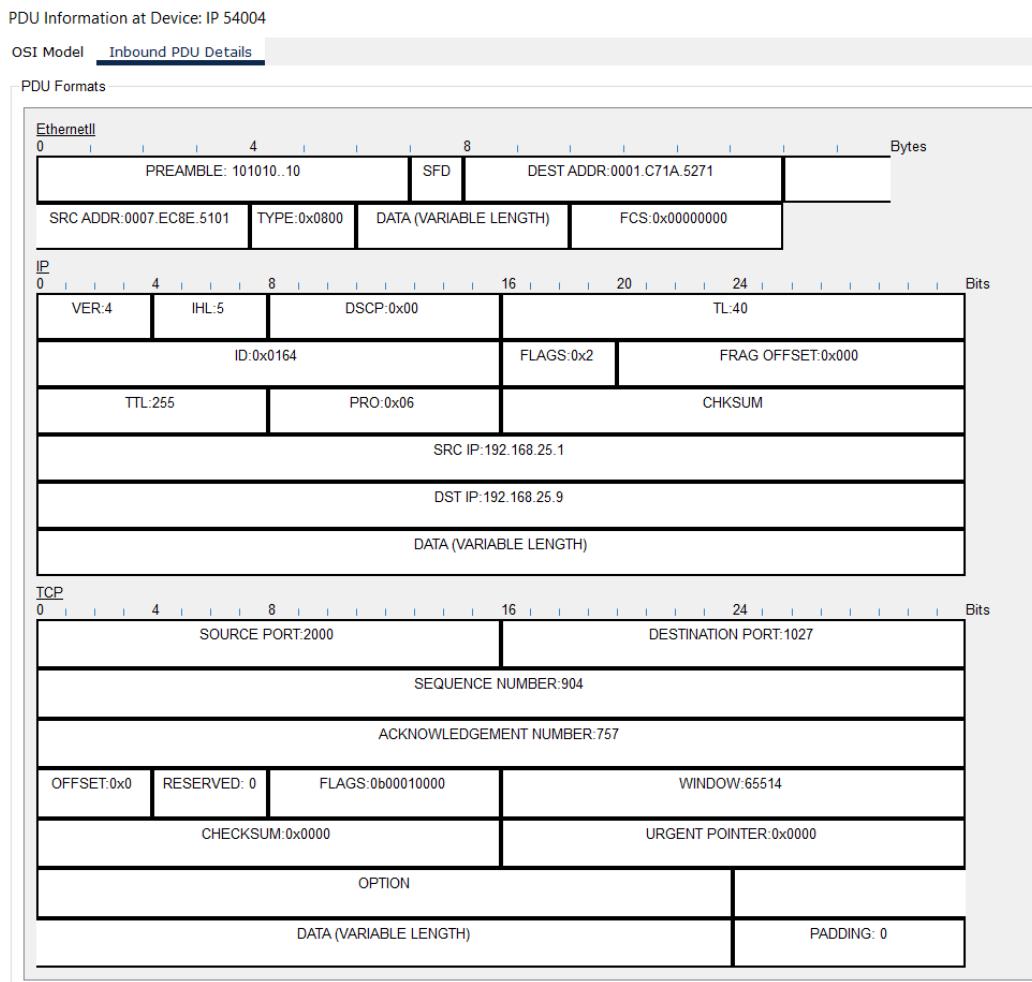


Figure 3.4: VoIP PDU.

**Simulation 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.

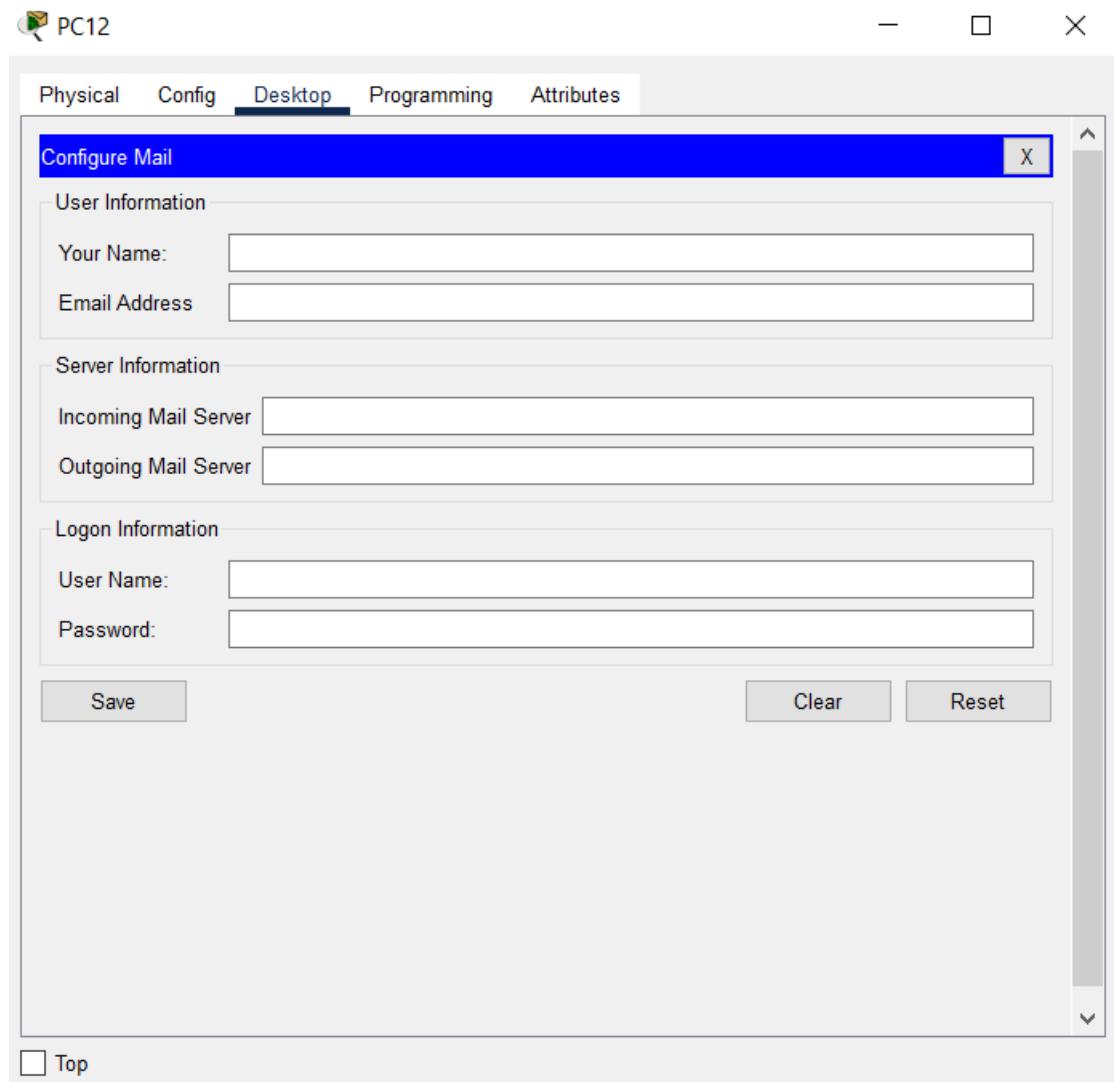


Figure 4.1: No email configuration due to lack of email service access.

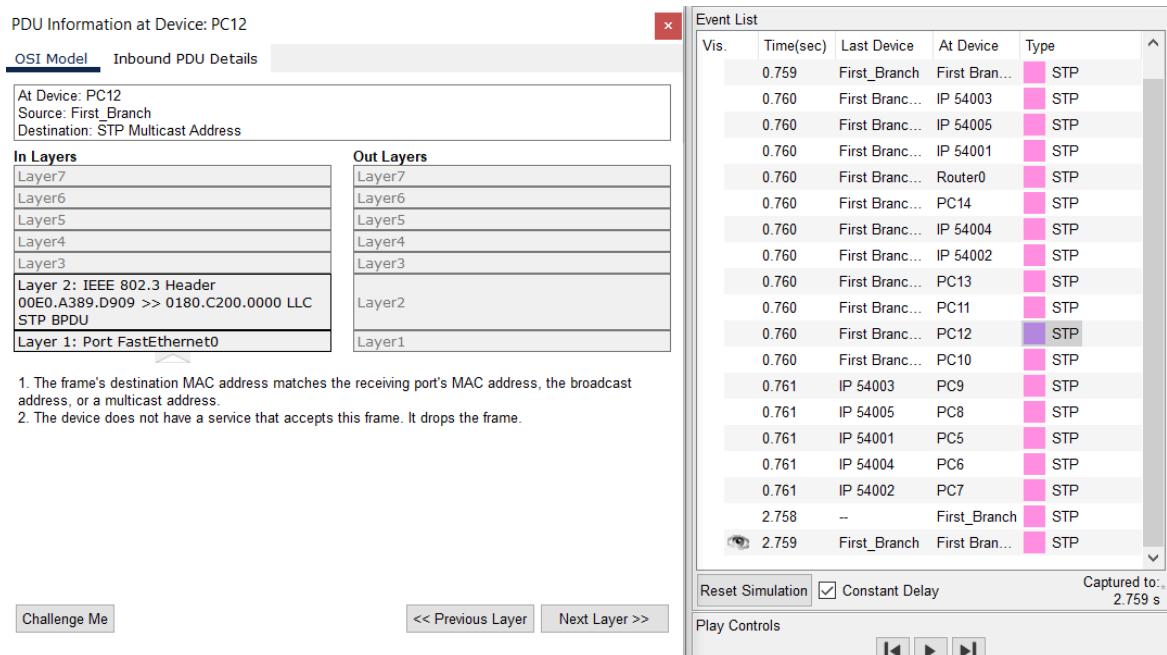


Figure 4.2: Event list and layers that display email will not function.

### PDU Information at Device: PC12

OSI Model    Inbound PDU Details x

PDU Formats

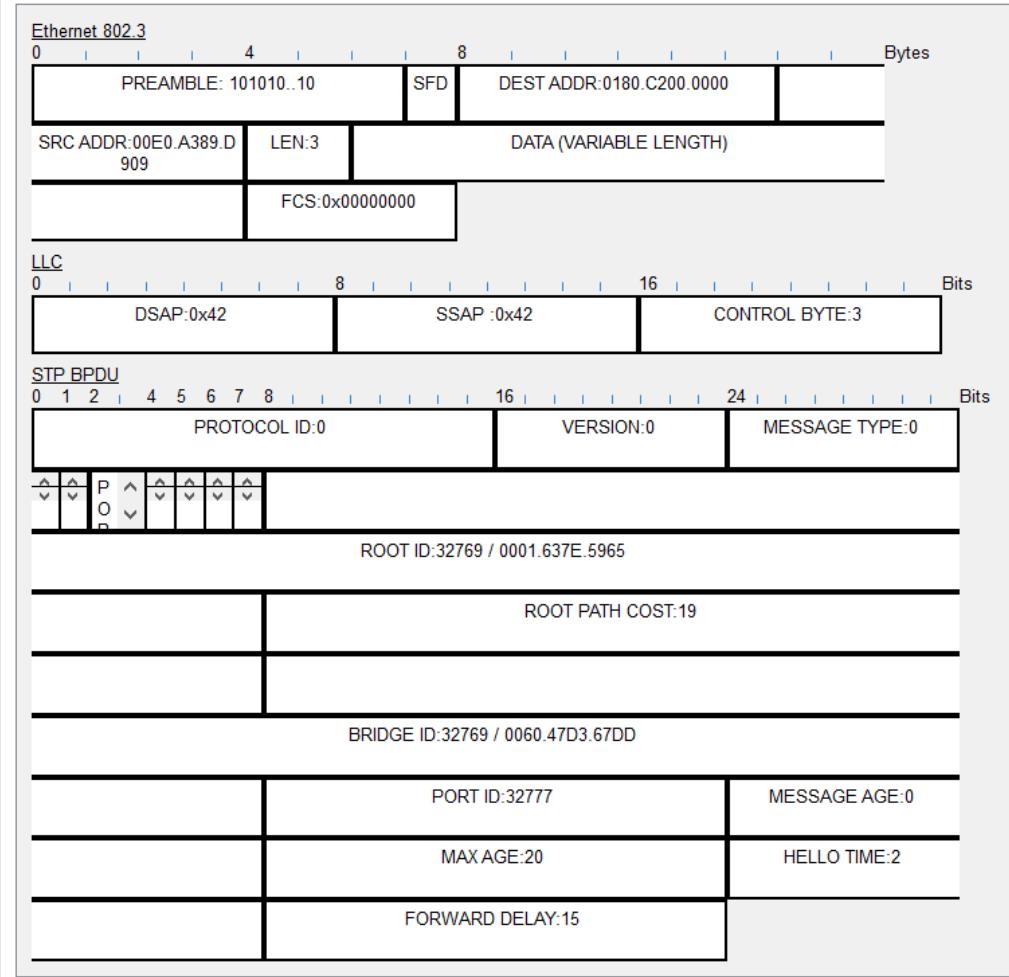


Figure 4.3: Simulation 4 PDU.

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

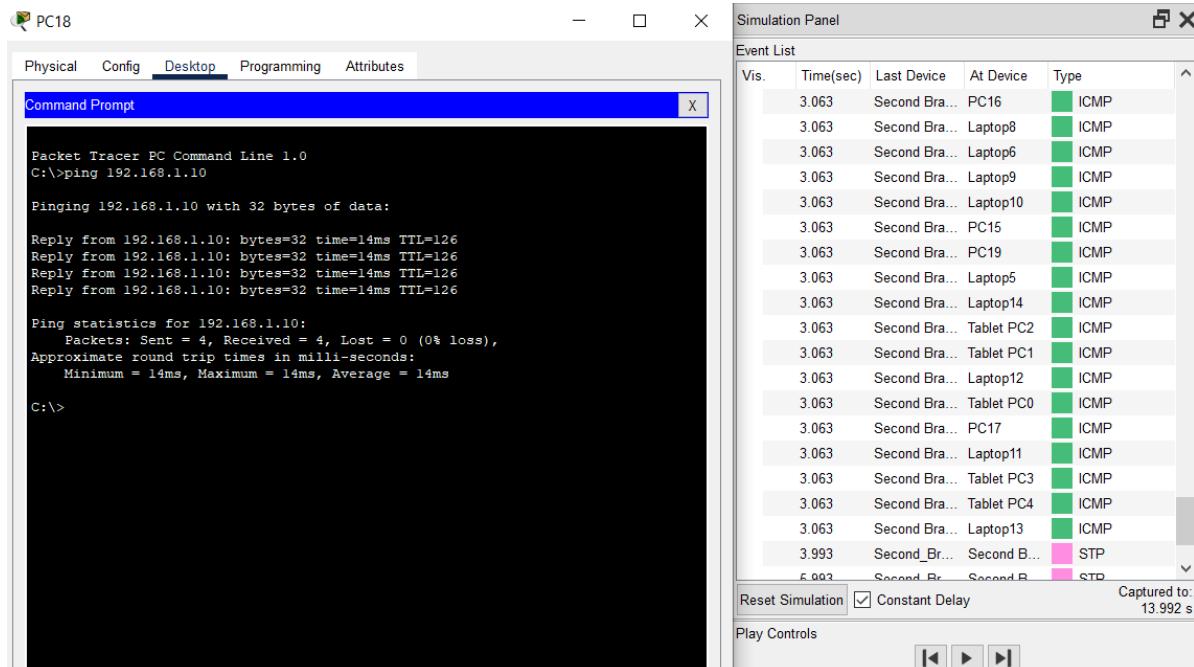
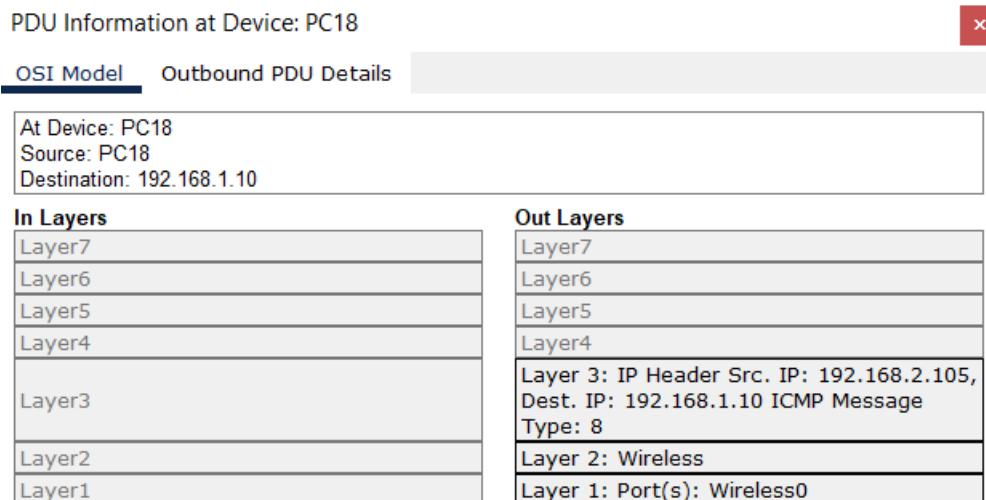


Figure 5.1: Ping Web server event list and command prompt.



1. The Ping process starts the next ping request.
2. The Ping process creates an ICMP Echo Request message and sends it to the lower process.
3. The source IP address is not specified. The device sets it to the port's IP address.
4. The destination IP address 192.168.1.10 is not in the same subnet and is not the broadcast address.
5. The default gateway is set. The device sets the next-hop to default gateway.

Figure 5.2: Ping Web server layers.

PDU Information at Device: PC18

OSI Model    Outbound PDU Details

PDU Formats

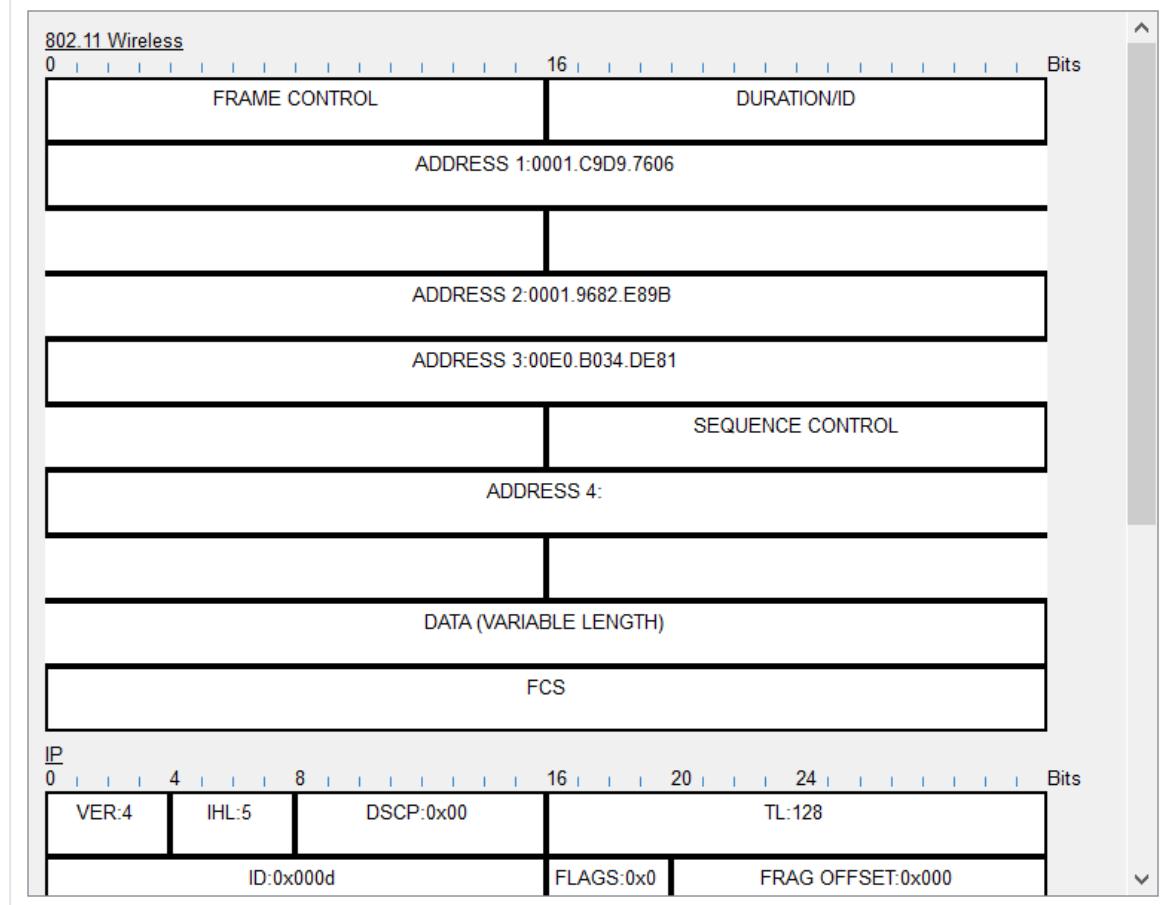


Figure 5.3: Ping Web server PDU.

PDU Information at Device: PC18

OSI Model Outbound PDU Details

PDU Formats

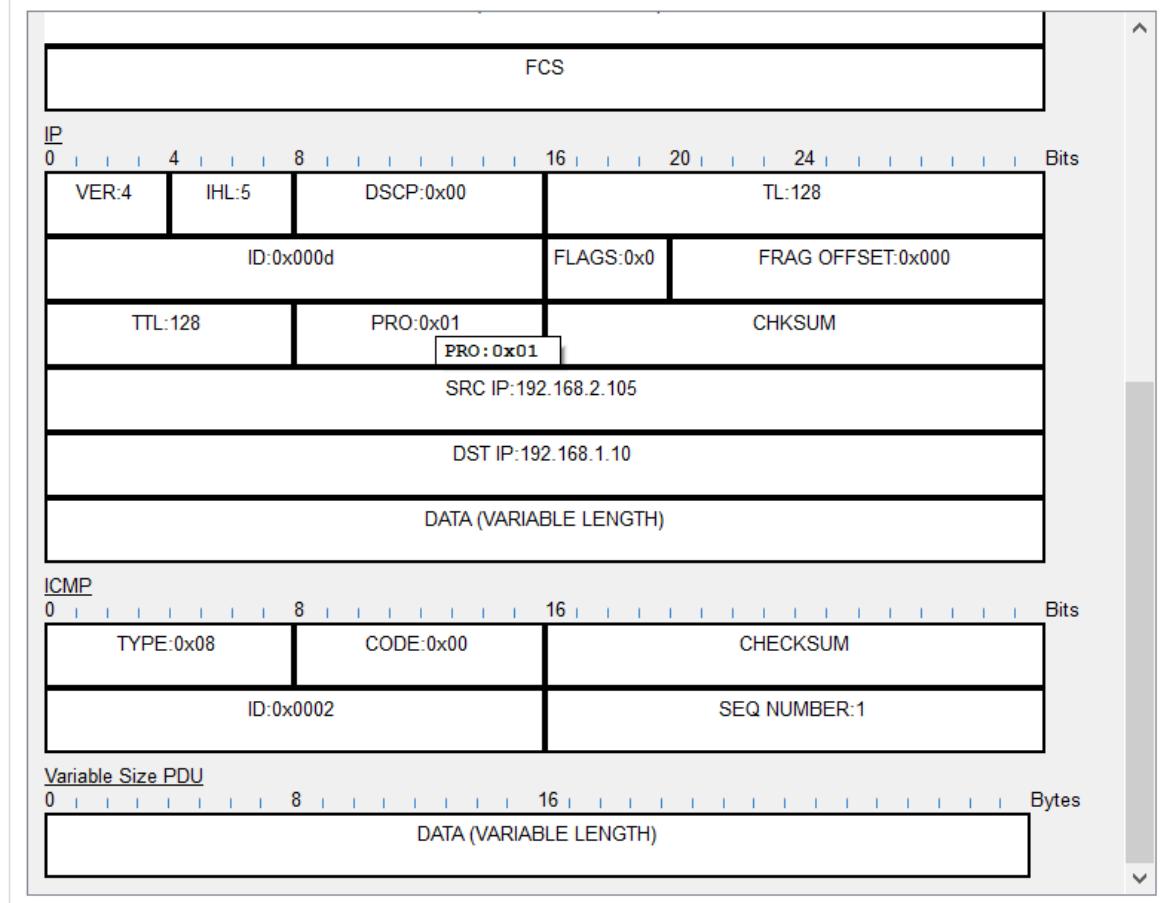


Figure 5.4: Ping Web server PDU alt.

**Simulation 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.

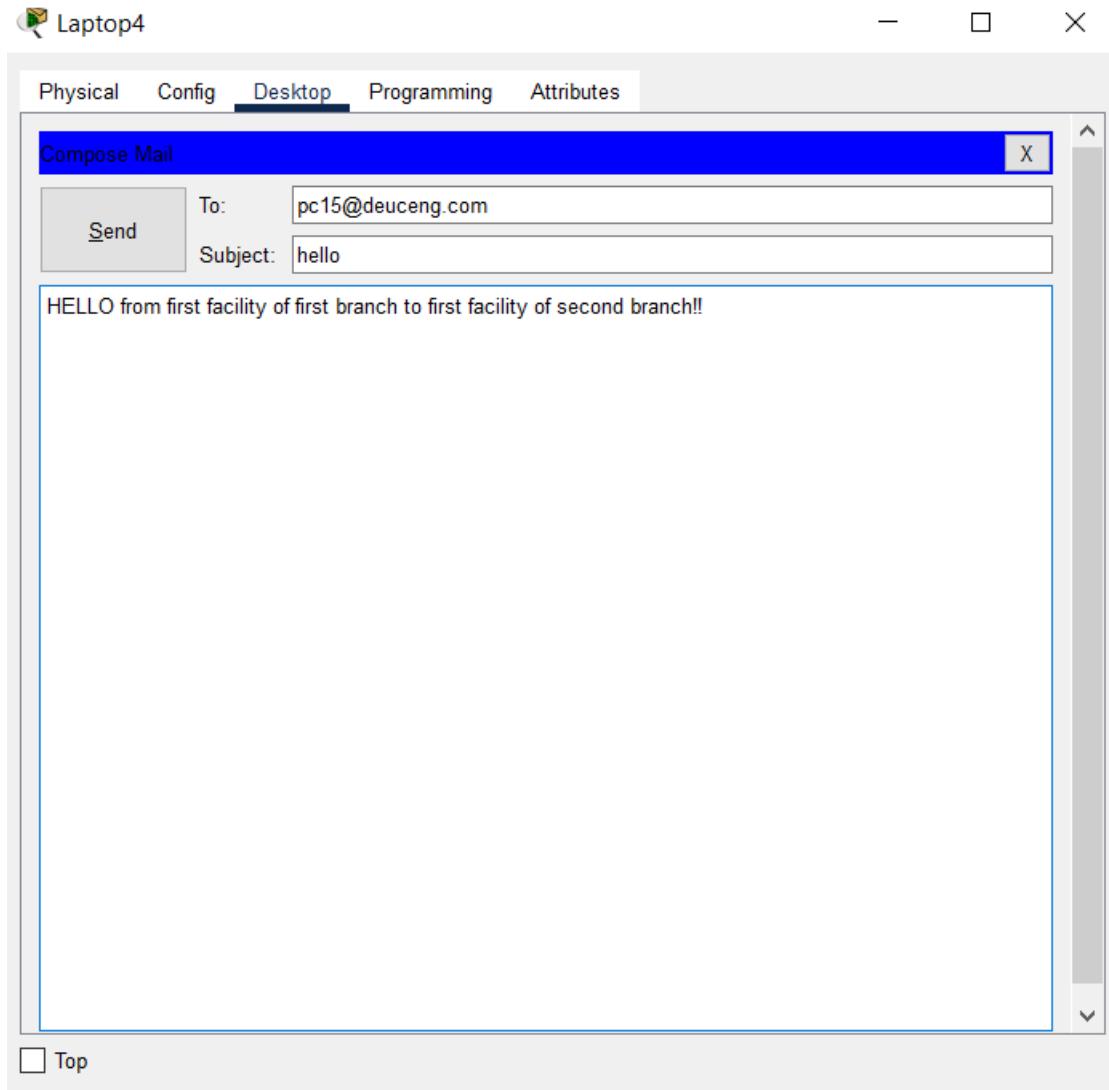


Figure 6.1: Create and send email.

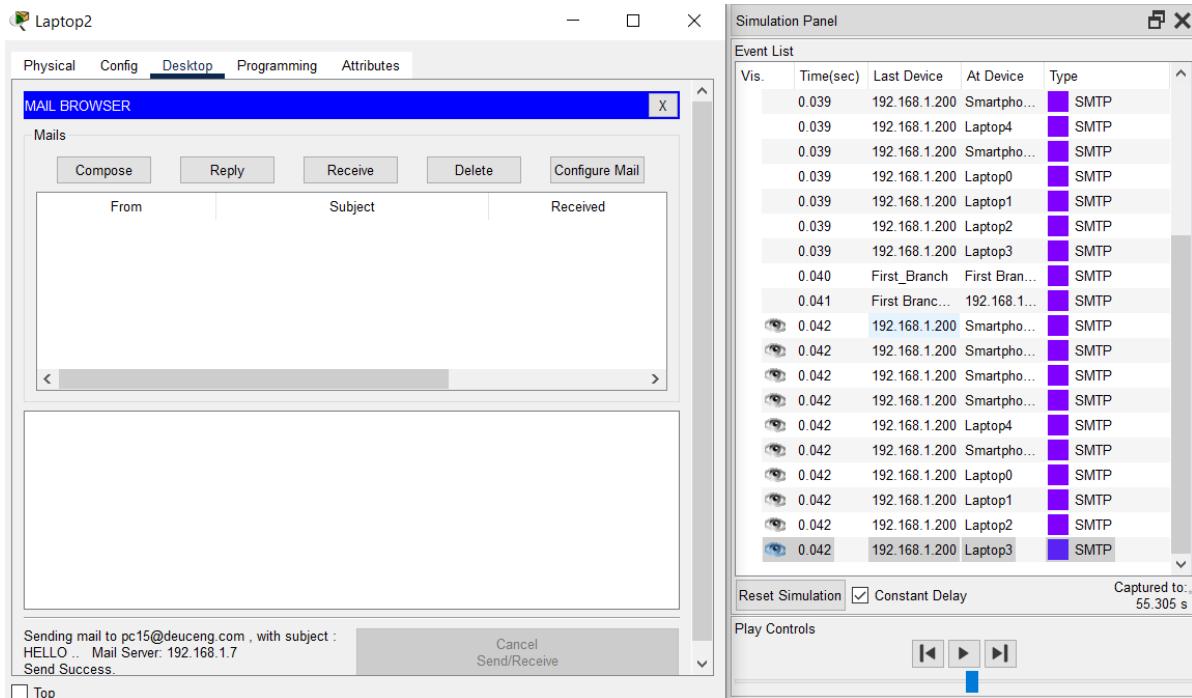
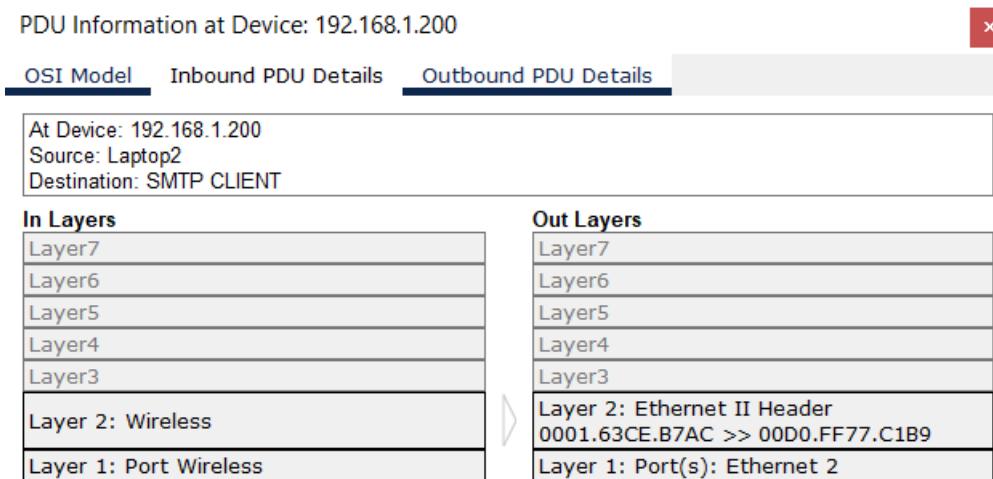


Figure 6.2: Send email success message and event list.



1. Wireless receives the frame.

Figure 6.3: Send email layers.

PDU Information at Device: 192.168.1.200

OSI Model    Inbound PDU Details    Outbound PDU Details

PDU Formats

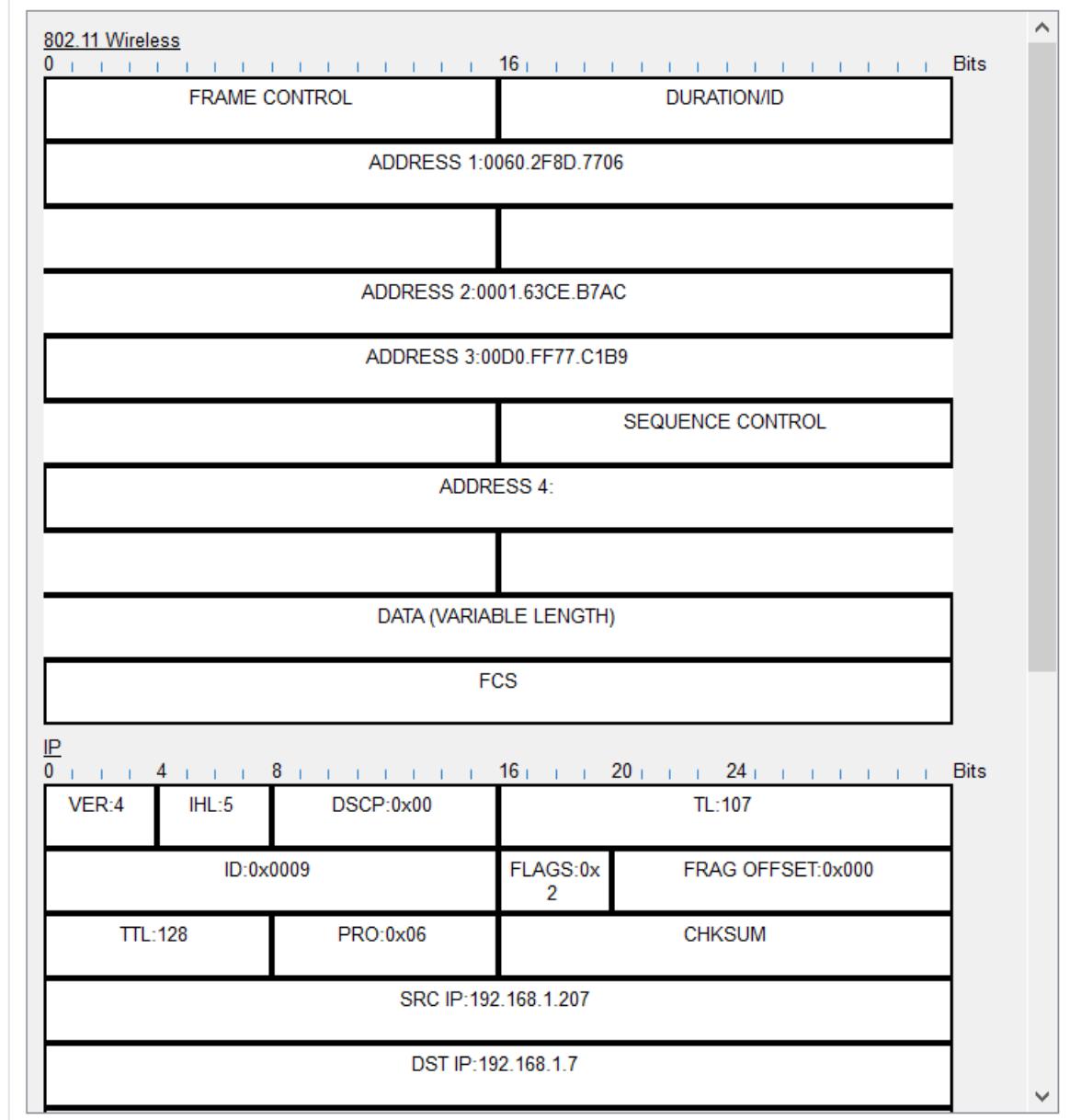


Figure 6.4: Send email inbound PDU.

PDU Information at Device: 192.168.1.200

OSI Model    Inbound PDU Details    Outbound PDU Details

PDU Formats

IP				Bits											
0	4	8	16	20	24	...									
VER:4	IHL:5	DSCP:0x00		TL:107											
ID:0x0009		FLAGS:0x2		FRAG OFFSET:0x000											
TTL:128	PRO:0x06		CHKSUM												
SRC IP:192.168.1.207															
DST IP:192.168.1.7															
DATA (VARIABLE LENGTH)															
TCP															
0	4	8	16	24	...	Bits									
SOURCE PORT:1025			DESTINATION PORT:25												
SEQUENCE NUMBER:1															
ACKNOWLEDGEMENT NUMBER:1															
OFFSET:0 x0	RESERVE D: 0	FLAGS:0b00011000	WINDOW:65535												
CHECKSUM:0x0000			URGENT POINTER:0x0000												
OPTION															
DATA (VARIABLE LENGTH)					PADDING: 0										
SMTP DATA															
0	4	8	16	...	Bits										
SMTP Data															

Figure 6.5: Send email inbound PDU alt.

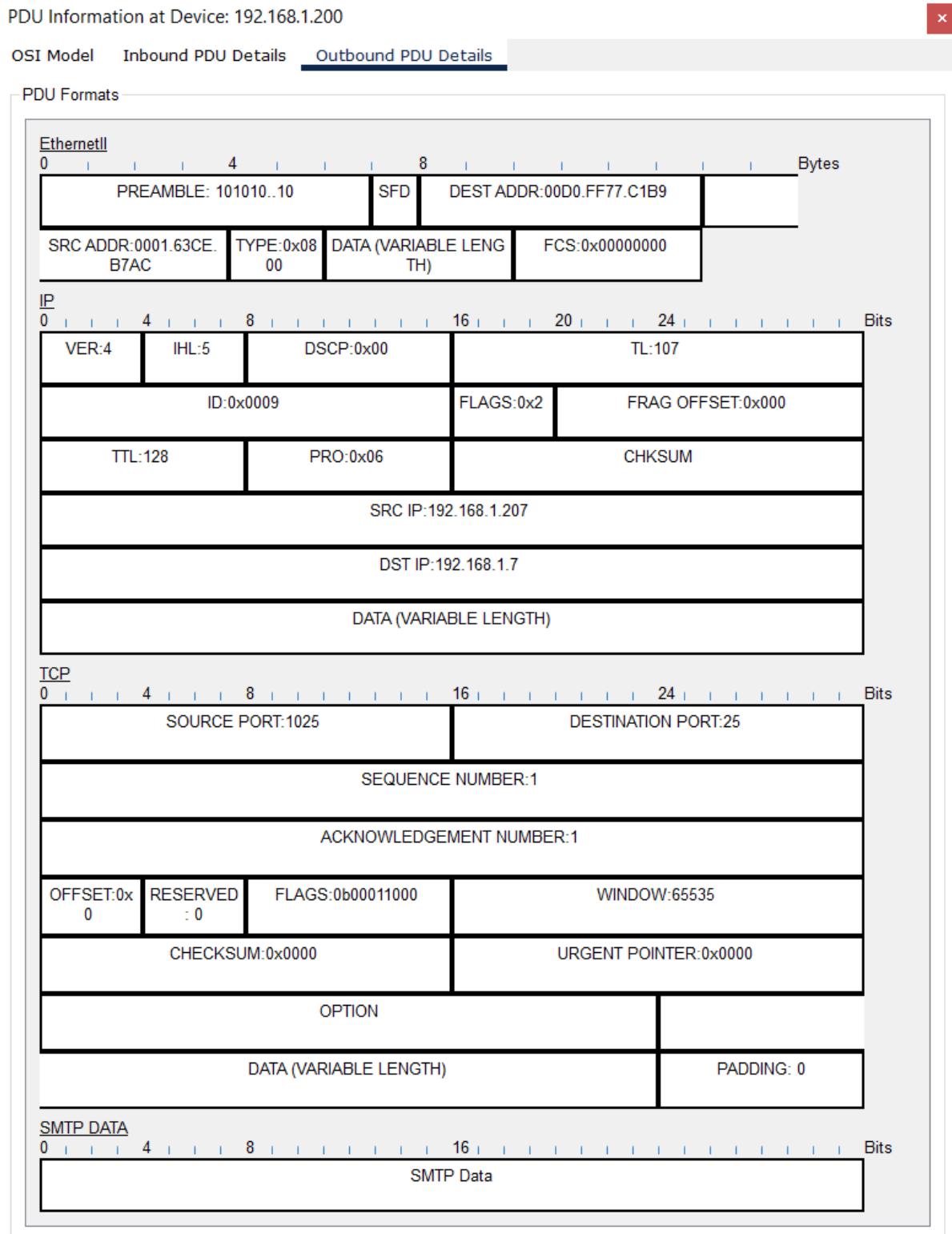
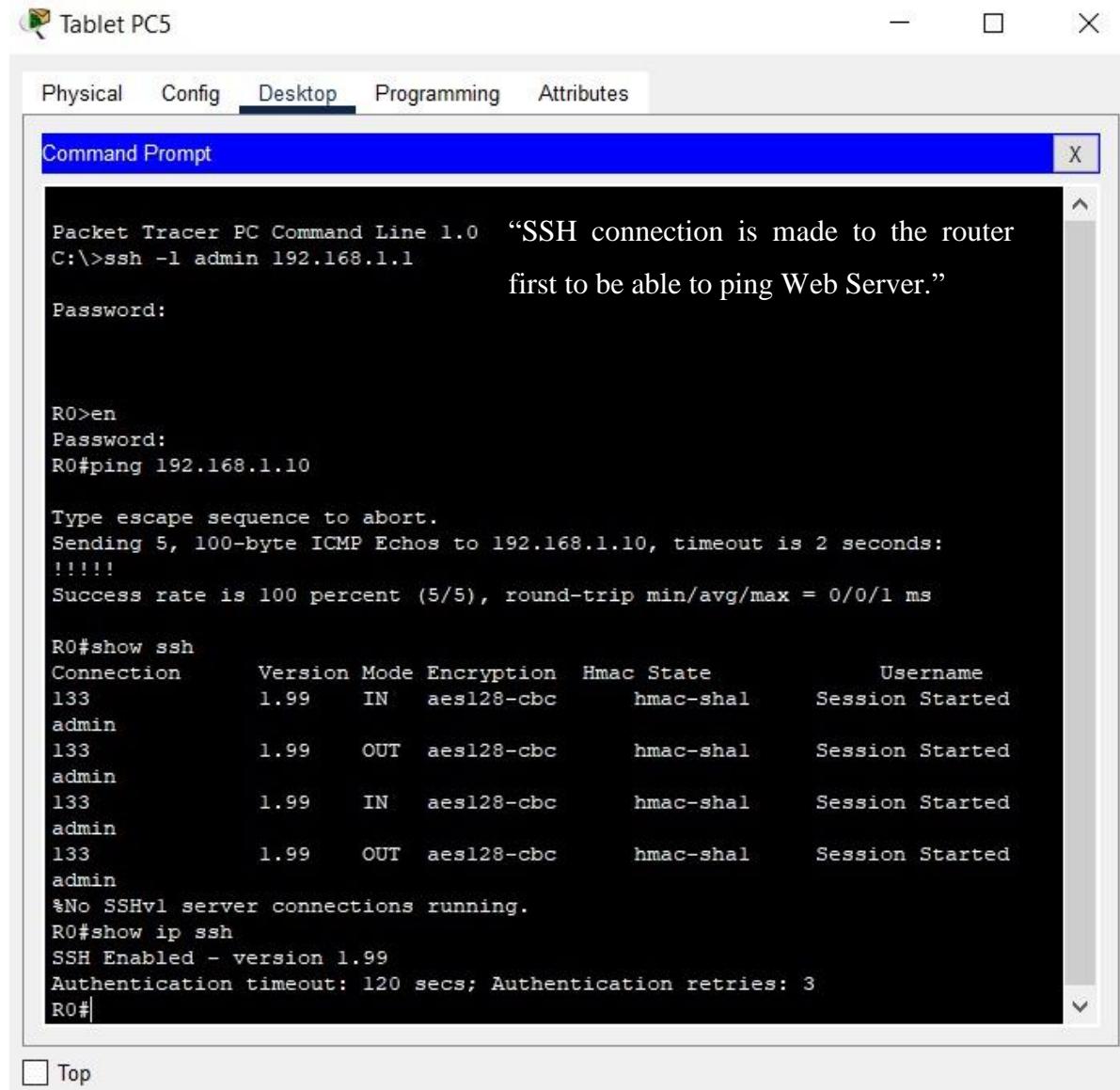


Figure 6.6: Send email outbound PDU.

**Simulation 7:** A smartphone user from third facility of second branch office wants to use ssh to connect to a Web server in the third facility of first branch office.



The screenshot shows a 'Command Prompt' window titled 'Command Prompt'. The window has a blue header bar with tabs: Physical, Config, Desktop, Programming, and Attributes. The 'Desktop' tab is selected. Below the header is a message: 'Packet Tracer PC Command Line 1.0 "SSH connection is made to the router C:\>ssh -l admin 192.168.1.1 first to be able to ping Web Server."'. The main area of the window displays the following terminal session:

```
Packet Tracer PC Command Line 1.0 "SSH connection is made to the router
C:\>ssh -l admin 192.168.1.1
first to be able to ping Web Server."
Password:

R0>en
Password:
R0#ping 192.168.1.10

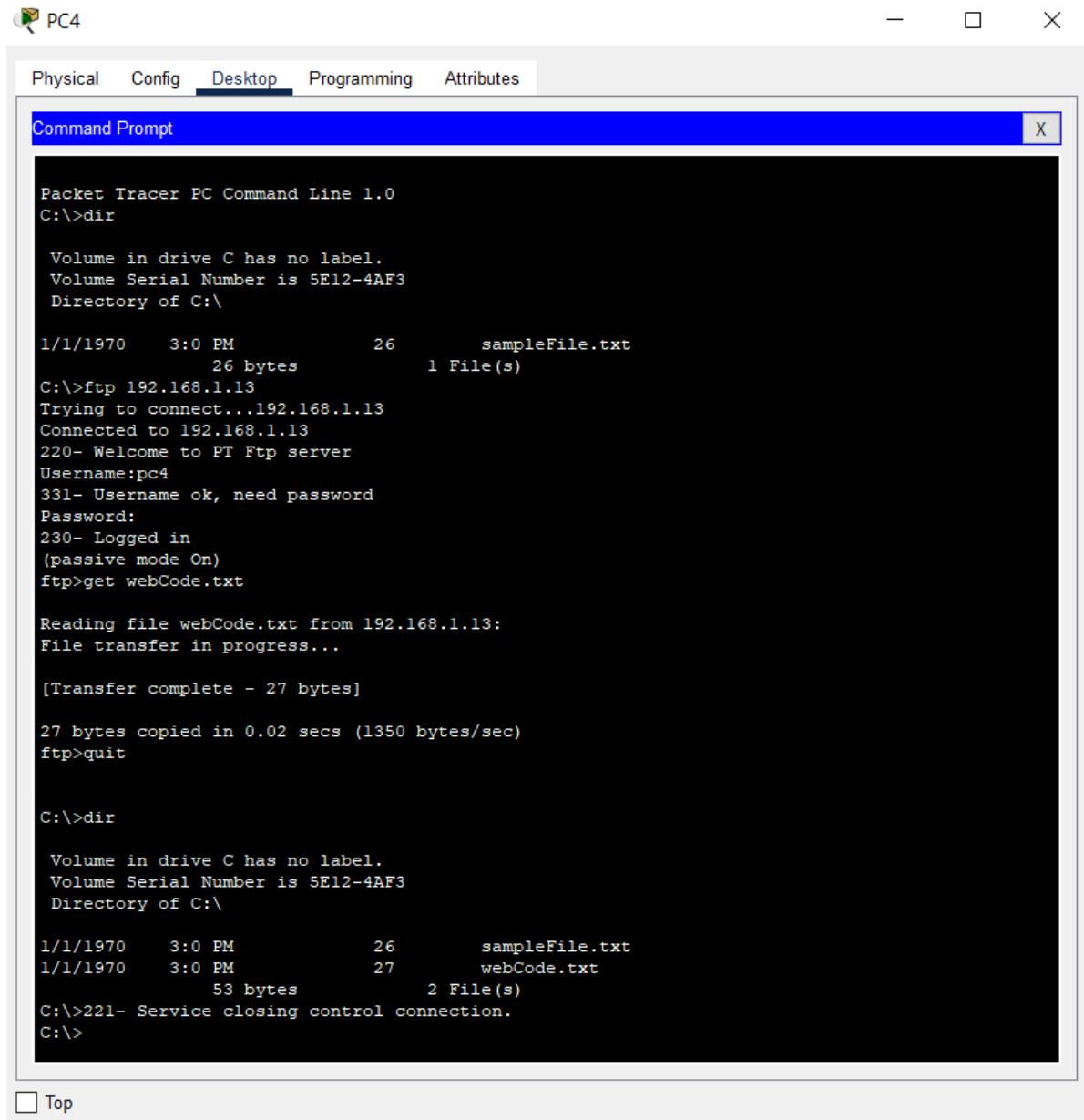
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms

R0#show ssh
Connection      Version Mode Encryption   Hmac State          Username
133             1.99   IN    aes128-cbc  hmac-shal    Session Started
admin
133             1.99   OUT   aes128-cbc  hmac-shal    Session Started
admin
133             1.99   IN    aes128-cbc  hmac-shal    Session Started
admin
133             1.99   OUT   aes128-cbc  hmac-shal    Session Started
admin
%No SSHv1 server connections running.
R0#show ip ssh
SSH Enabled - version 1.99
Authentication timeout: 120 secs; Authentication retries: 3
R0#
```

Top

Figure 7.1: SSH Connection demonstration.

**Simulation 8:** First facility of first branch downloads a file from the FTP server to the workstation.



The screenshot shows a window titled "PC4" with a tab bar containing "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". Below the tabs is a "Command Prompt" window with a blue header bar. The command prompt output is as follows:

```
Packet Tracer PC Command Line 1.0
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
              26 bytes          1 File(s)

C:\>ftp 192.168.1.13
Trying to connect...192.168.1.13
Connected to 192.168.1.13
220- Welcome to PT Ftp server
Username:pc4
331- Username ok, need password
Password:
230- Logged in
(pассив mode On)
ftp>get webCode.txt

Reading file webCode.txt from 192.168.1.13:
File transfer in progress...

[Transfer complete - 27 bytes]

27 bytes copied in 0.02 secs (1350 bytes/sec)
ftp>quit

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           27      webCode.txt
              53 bytes          2 File(s)
C:\>221- Service closing control connection.
C:\>
```

Figure 8.1: Connect to FTP server and download file.

### PDU Information at Device: PC4

OSI Model	Inbound PDU Details
At Device: PC4	
Source:	FTP Server0
Destination:	192.168.1.13
In Layers	Out Layers
Layer 7: FTP	Layer7
Layer6	Layer6
Layer5	Layer5
Layer 4: TCP Src Port: 21, Dst Port: 1025	Layer4
Layer 3: IP Header Src. IP: 192.168.1.13, Dest. IP: 192.168.1.6	Layer3
Layer 2: Ethernet II Header 000A. 4110.A82E >> 000A.4107.913E	Layer2
Layer 1: Port FastEthernet0	Layer1

1. FastEthernet0 receives the frame.

Figure 8.2: Download from FTP - layers.

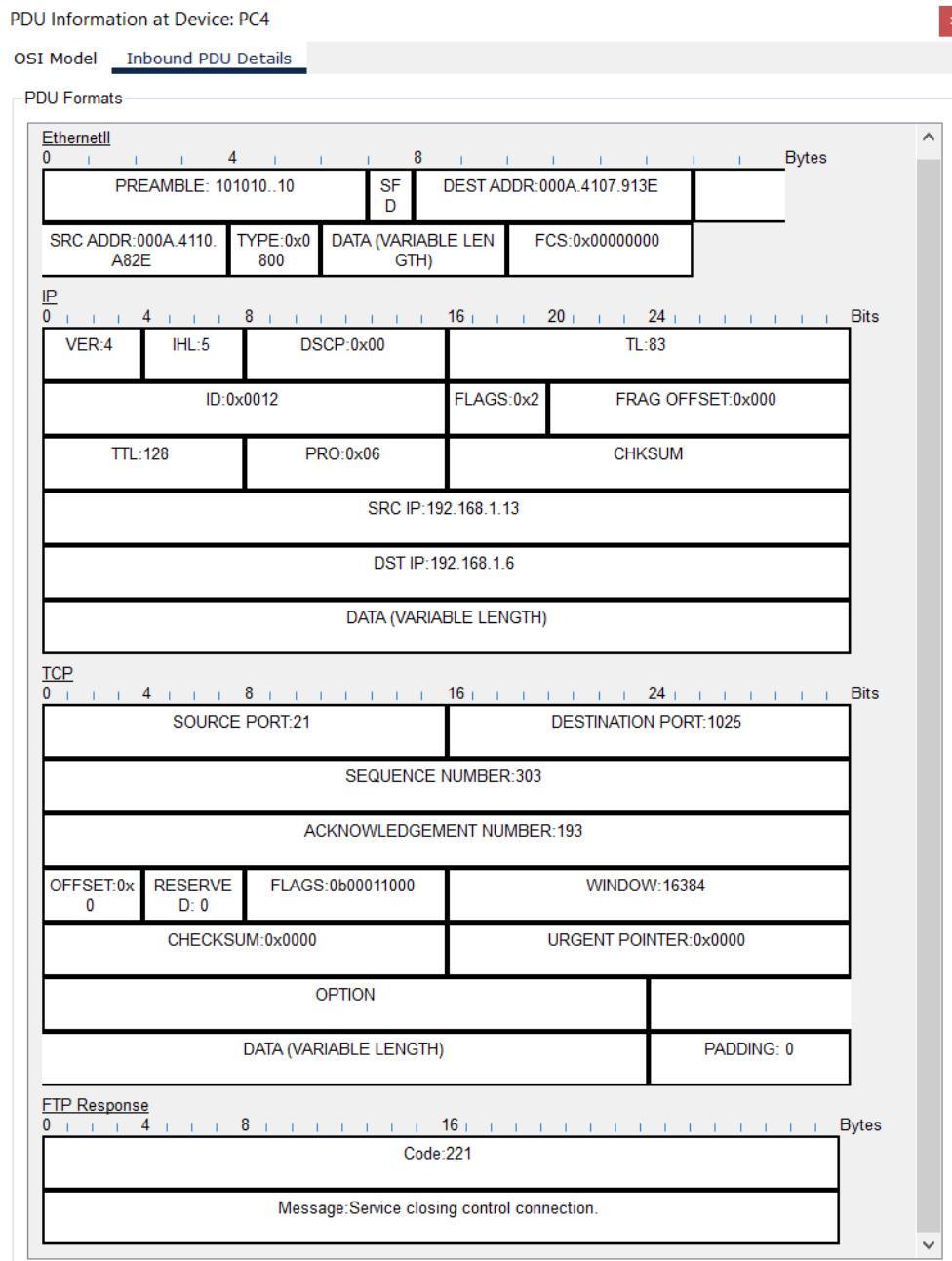
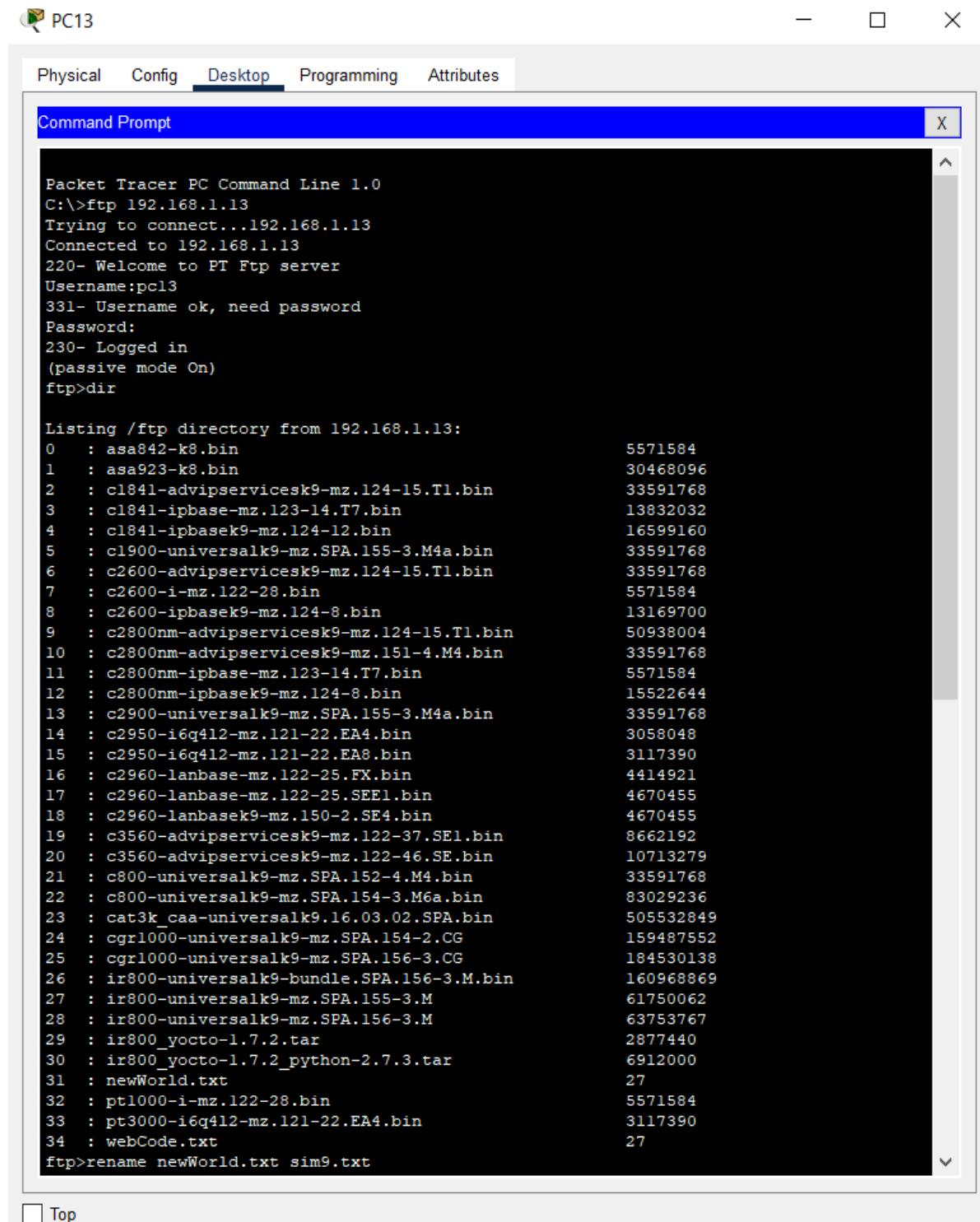


Figure 8.3: Download from FTP – PDU.

Simulation 9: Second facility of first branch changes the file name in FTP server.



The screenshot shows a window titled "PC13" with tabs for Physical, Config, Desktop (selected), Programming, and Attributes. A "Command Prompt" window is open, displaying the following text:

```
Packet Tracer PC Command Line 1.0
C:\>ftp 192.168.1.13
Trying to connect...192.168.1.13
Connected to 192.168.1.13
220- Welcome to PT Ftp server
Username:pc13
331- Username ok, need password
Password:
230- Logged in
(passive mode On)
ftp>dir

Listing /ftp directory from 192.168.1.13:
0 : asa842-k8.bin 5571584
1 : asa923-k8.bin 30468096
2 : c1841-advipservicesk9-mz.124-15.T1.bin 33591768
3 : c1841-ipbase-mz.123-14.T7.bin 13832032
4 : c1841-ipbasek9-mz.124-12.bin 16599160
5 : c1900-universalk9-mz.SPA.155-3.M4a.bin 33591768
6 : c2600-advipservicesk9-mz.124-15.T1.bin 33591768
7 : c2600-i-mz.122-28.bin 5571584
8 : c2600-ipbasek9-mz.124-8.bin 13169700
9 : c2800nm-advipservicesk9-mz.124-15.T1.bin 50938004
10 : c2800nm-advipservicesk9-mz.151-4.M4.bin 33591768
11 : c2800nm-ipbase-mz.123-14.T7.bin 5571584
12 : c2800nm-ipbasek9-mz.124-8.bin 15522644
13 : c2900-universalk9-mz.SPA.155-3.M4a.bin 33591768
14 : c2950-i6q412-mz.121-22.EA4.bin 3058048
15 : c2950-i6q412-mz.121-22.EA8.bin 3117390
16 : c2960-lanbase-mz.122-25.FX.bin 4414921
17 : c2960-lanbase-mz.122-25.SE1.bin 4670455
18 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
19 : c3560-advipservicesk9-mz.122-37.SE1.bin 8662192
20 : c3560-advipservicesk9-mz.122-46.SE.bin 10713279
21 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
22 : c800-universalk9-mz.SPA.154-3.M6a.bin 83029236
23 : cat3k_caa-universalk9.16.03.02.SPA.bin 505532849
24 : cgr1000-universalk9-mz.SPA.154-2.CG 159487552
25 : cgr1000-universalk9-mz.SPA.156-3.CG 184530138
26 : ir800-universalk9-bundle.SPA.156-3.M.bin 160968869
27 : ir800-universalk9-mz.SPA.155-3.M 61750062
28 : ir800-universalk9-mz.SPA.156-3.M 63753767
29 : ir800_yocto-1.7.2.tar 2877440
30 : ir800_yocto-1.7.2_python-2.7.3.tar 6912000
31 : newWorld.txt 27
32 : pt1000-i-mz.122-28.bin 5571584
33 : pt3000-i6q412-mz.121-22.EA4.bin 3117390
34 : webCode.txt 27

ftp>rename newWorld.txt sim9.txt
```

Figure 9.1: Connect to FTP server and change the name of the file "newWorld.txt".

PC13

Physical Config Desktop Programming Attributes

**Command Prompt**

```

29 : ir800_yocto-1.7.2.tar          2877440
30 : ir800_yocto-1.7.2_python-2.7.3.tar 6912000
31 : newWorld.txt                  27
32 : pt1000-i-mz.122-28.bin       5571584
33 : pt3000-i6q4l2-mz.121-22.EA4.bin 3117390
34 : webCode.txt                  27

ftp>rename newWorld.txt sim9.txt

Renaming newWorld.txt
ftp>
[OK Renamed file successfully from newWorld.txt to sim9.txt]
ftp>dir

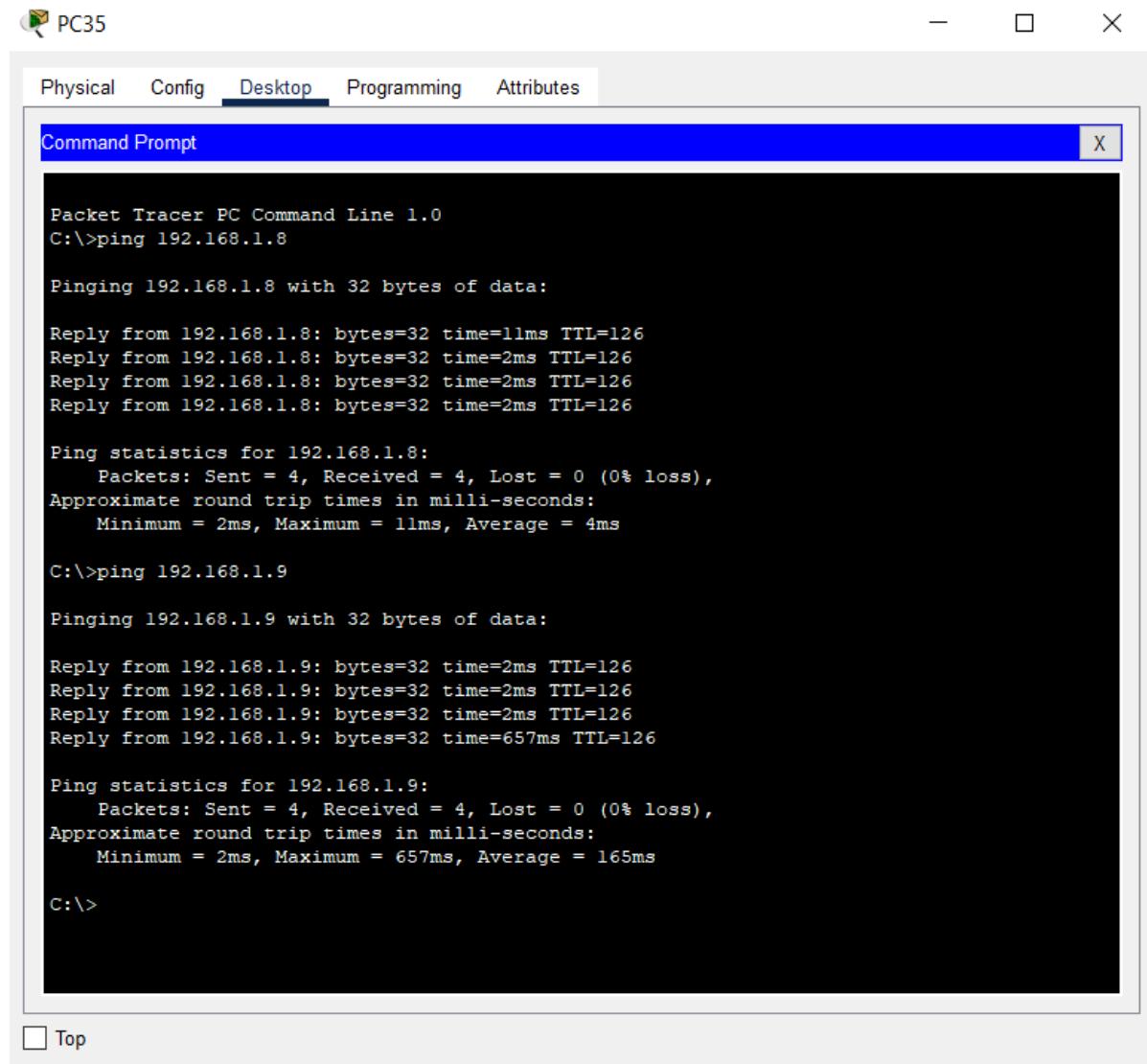
Listing /ftp directory from 192.168.1.13:
0 : asa842-k8.bin          5571584
1 : asa923-k8.bin          30468096
2 : c1841-advipsericesk9-mz.124-15.T1.bin 33591768
3 : c1841-ipbase-mz.123-14.T7.bin       13832032
4 : c1841-ipbasek9-mz.124-12.bin      16599160
5 : c1900-universalk9-mz.SPA.155-3.M4a.bin 33591768
6 : c2600-advipsericesk9-mz.124-15.T1.bin 33591768
7 : c2600-i-mz.122-28.bin        5571584
8 : c2600-ipbasek9-mz.124-8.bin    13169700
9 : c2800nm-advipsericesk9-mz.124-15.T1.bin 50938004
10 : c2800nm-advipsericesk9-mz.151-4.M4.bin 33591768
11 : c2800nm-ipbase-mz.123-14.T7.bin    5571584
12 : c2800nm-ipbasek9-mz.124-8.bin    15522644
13 : c2900-universalk9-mz.SPA.155-3.M4a.bin 33591768
14 : c2950-i6q4l2-mz.121-22.EA4.bin   3058048
15 : c2950-i6q4l2-mz.121-22.EA8.bin   3117390
16 : c2960-lanbase-mz.122-25.FX.bin  4414921
17 : c2960-lanbase-mz.122-25.SEE1.bin 4670455
18 : c2960-lanbasek9-mz.150-2.SE4.bin 4670455
19 : c3560-advipsericesk9-mz.122-37.SE1.bin 8662192
20 : c3560-advipsericesk9-mz.122-46.SE.bin 10713279
21 : c800-universalk9-mz.SPA.152-4.M4.bin 33591768
22 : c800-universalk9-mz.SPA.154-3.M6a.bin 83029236
23 : cat3k_caa-universalk9.16.03.02.SPA.bin 505532849
24 : cgr1000-universalk9-mz.SPA.154-2.CG 159487552
25 : cgr1000-universalk9-mz.SPA.156-3.CG 184530138
26 : ir800-universalk9-bundle.SPA.156-3.M.bin 160968869
27 : ir800-universalk9-mz.SPA.155-3.M 61750062
28 : ir800-universalk9-mz.SPA.156-3.M 63753767
29 : ir800_yocto-1.7.2.tar          2877440
30 : ir800_yocto-1.7.2_python-2.7.3.tar 6912000
31 : pt1000-i-mz.122-28.bin       5571584
32 : pt3000-i6q4l2-mz.121-22.EA4.bin 3117390
33 : sim9.txt                     27
34 : webCode.txt                  27

ftp>|
```

Top

Figure 9.2: Display the FTP server with the new file name "sim9.txt".

Simulation 10: Third facility of second branch pings DHCP and DNS servers.



PC35

Physical Config Desktop Programming Attributes

Command Prompt X

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.8

Pinging 192.168.1.8 with 32 bytes of data:

Reply from 192.168.1.8: bytes=32 time=11ms TTL=126
Reply from 192.168.1.8: bytes=32 time=2ms TTL=126
Reply from 192.168.1.8: bytes=32 time=2ms TTL=126
Reply from 192.168.1.8: bytes=32 time=2ms TTL=126

Ping statistics for 192.168.1.8:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 11ms, Average = 4ms

C:\>ping 192.168.1.9

Pinging 192.168.1.9 with 32 bytes of data:

Reply from 192.168.1.9: bytes=32 time=2ms TTL=126
Reply from 192.168.1.9: bytes=32 time=2ms TTL=126
Reply from 192.168.1.9: bytes=32 time=2ms TTL=126
Reply from 192.168.1.9: bytes=32 time=657ms TTL=126

Ping statistics for 192.168.1.9:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 657ms, Average = 165ms

C:\>
```

Top

Figure 10.1: Ping DHCP and DNS servers.

## CONCLUSION

---

The simulation of the Metropolitan Area Network System is completed with every demanded checkpoints. With the project, network systems and connection flaw is comprehended quite well, and the importance of simulation in terms of implementing a project to real life is processed. Main impediments that were encountered; router connections and interrelations, IP address distribution, and selecting the correct device models to operate correctly. Although all components and systems work completely fine, some simulations have not yielded a PDU list due to a full buffer error, even if the event list is empty. This error does not interrupt the operation in any manner, but only fails to present a PDU list as mentioned. Those simulation results that do not include a PDU list is affected by this error.

## REFERENCES

---

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