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CME 3204
Data Communication & Computer Networks

Metropolitan Area
Network Simulation

By

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INTRODUCTION

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.^[1]

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.^[2]

Protocol: Protocols define rules of communication between network devices.^[3]

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.^[4]

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.^[5]

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.^[6]

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.^[7]

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.^[8]

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.^[9]

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.^[10]

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.^[11]

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.^[12]

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.^[13]

METHOD AND SIMULATION

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.^[14]

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>1st Branch 1st Facility</u>	<u>1st Branch 2nd Facility</u>	<u>1st Branch 3rd Facility</u>	<u>2nd Branch 1st Facility</u>	<u>2nd Branch 2nd Facility</u>	<u>2nd Branch 3rd Facility</u>
IP Address	192.168.1.2-6	192.168.1.20-29	192.168.1.7-14	192.168.2.100-149	192.168.2.2-16	192.168.2.17-31
	192.168.1.201-215	192.168.25.2-16				
Devices	5 PC		1 DNS			
	5 Laptop	10 PC	3 WEB	5 Wireless PC	10 PC	10 PC
	5 Smart Phone	1 Router	2 FTP	5 Tablet	5 Smart Phone	5 Tablet
	1 Switch	5 VoIP	1 DHCP	10 Laptop	1 Switch	1 Switch
	1 Wireless Router	1 Switch	1 MAIL	1 Wireless Router	1 Access Point	1 Access Point
	1 Hub		1 Switch			

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.

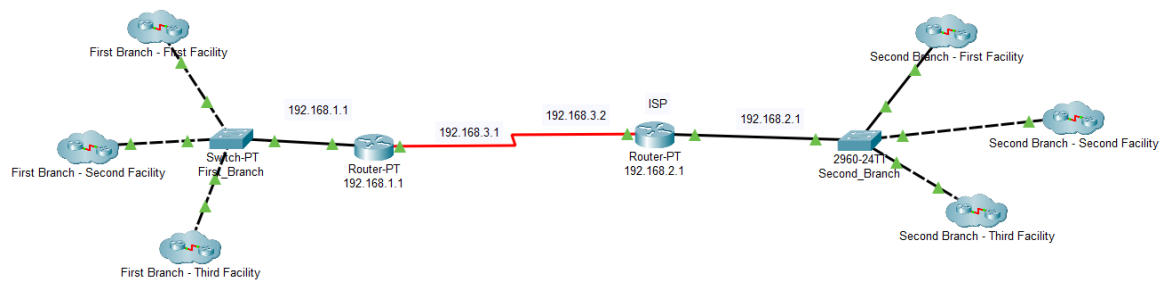


Figure A.1: Network.

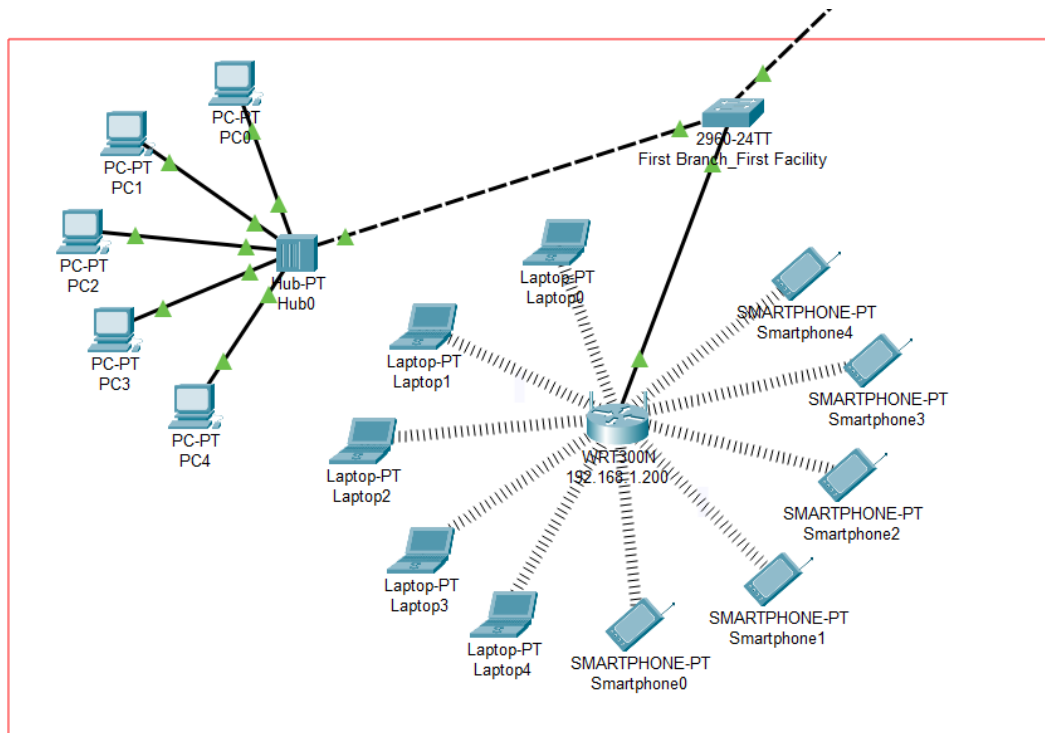


Figure A.2: First branch, first facility.

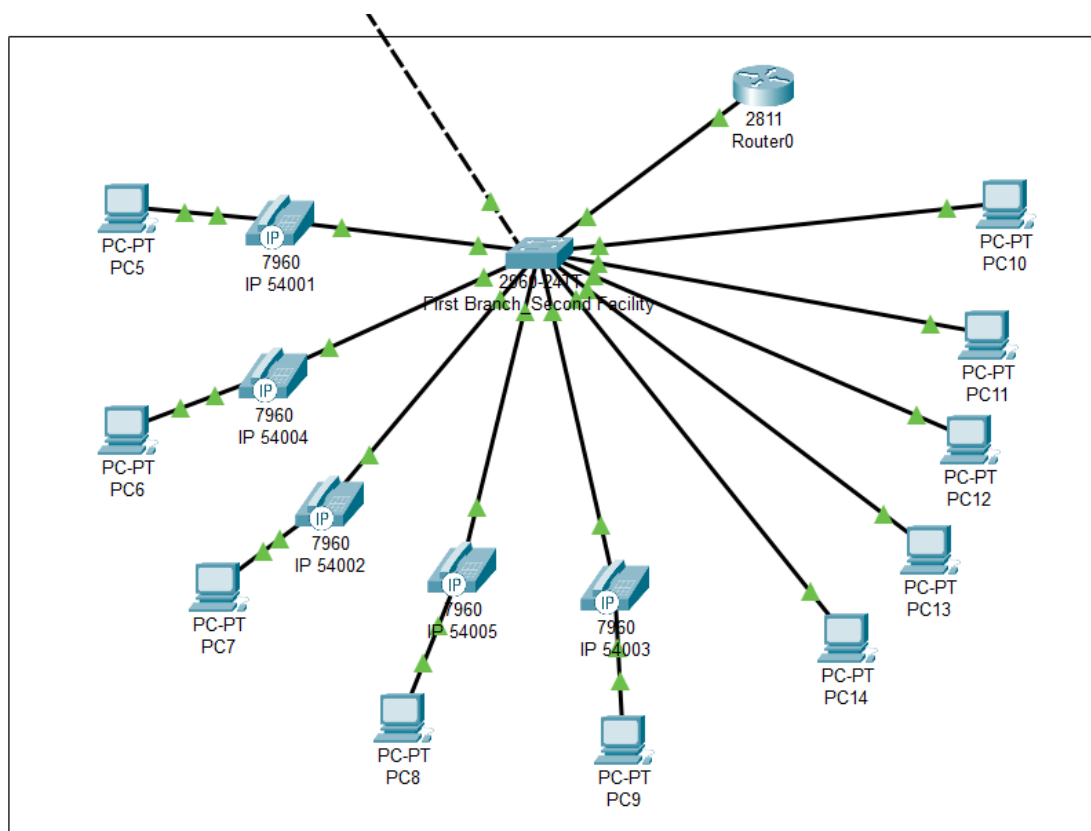


Figure A.3: First branch, second facility.

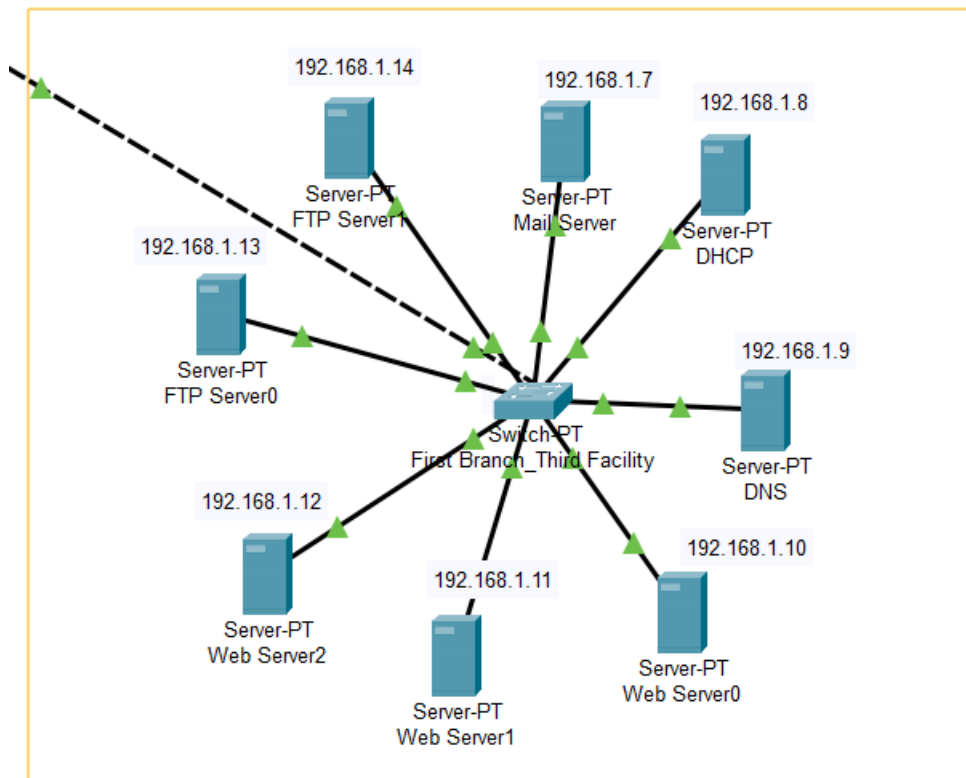


Figure A.4: First branch, third facility.

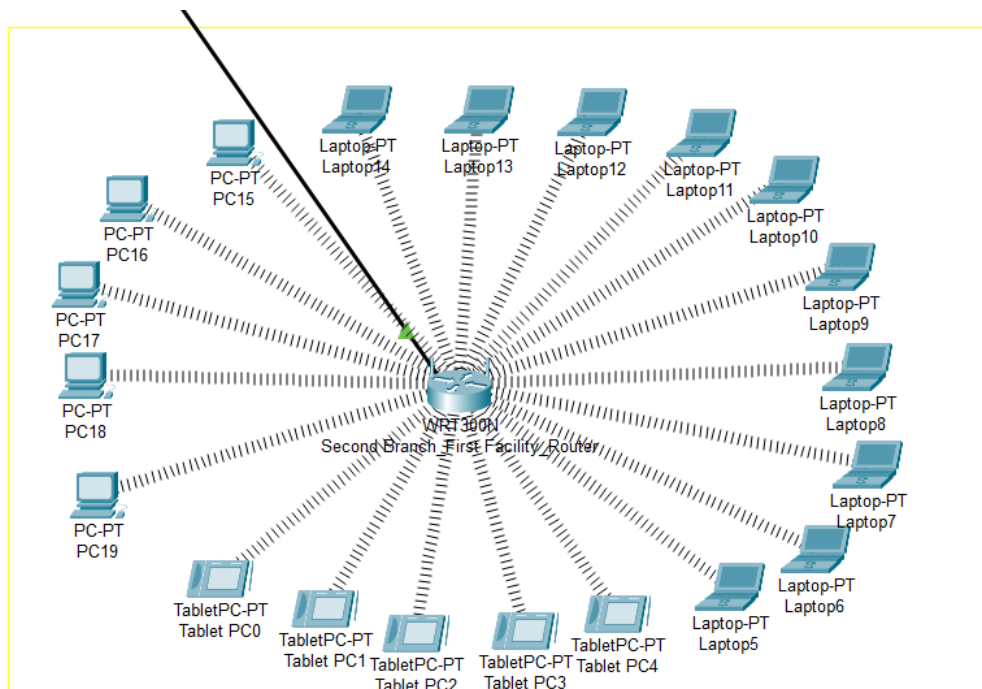


Figure A.5: Second branch, first facility.

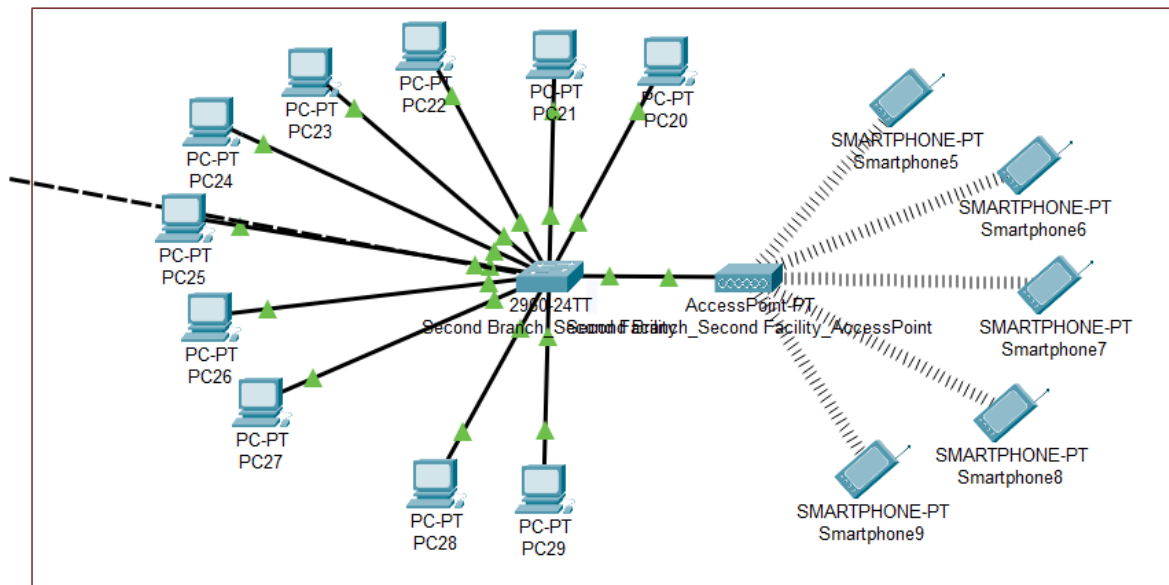


Figure A.6: Second branch, second facility.

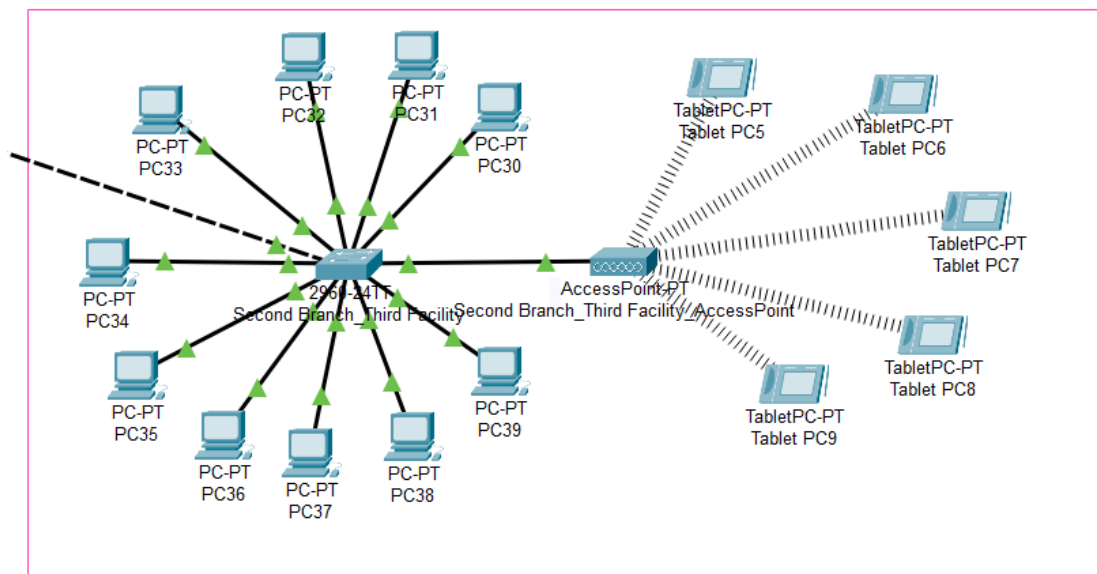


Figure A.7: Second branch, third facility.

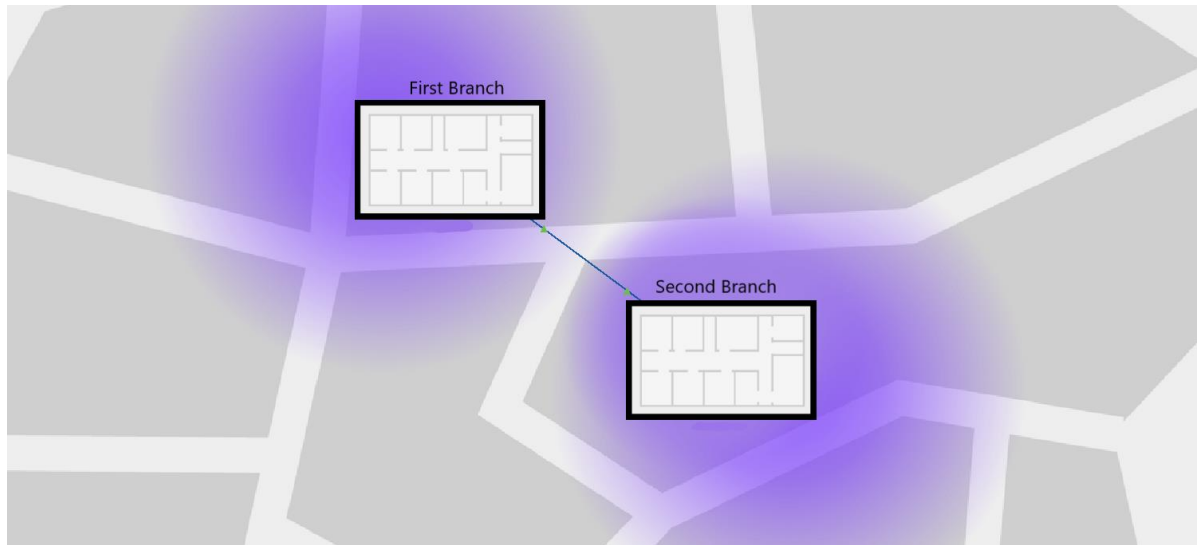


Figure B.1: Physical branches preview.

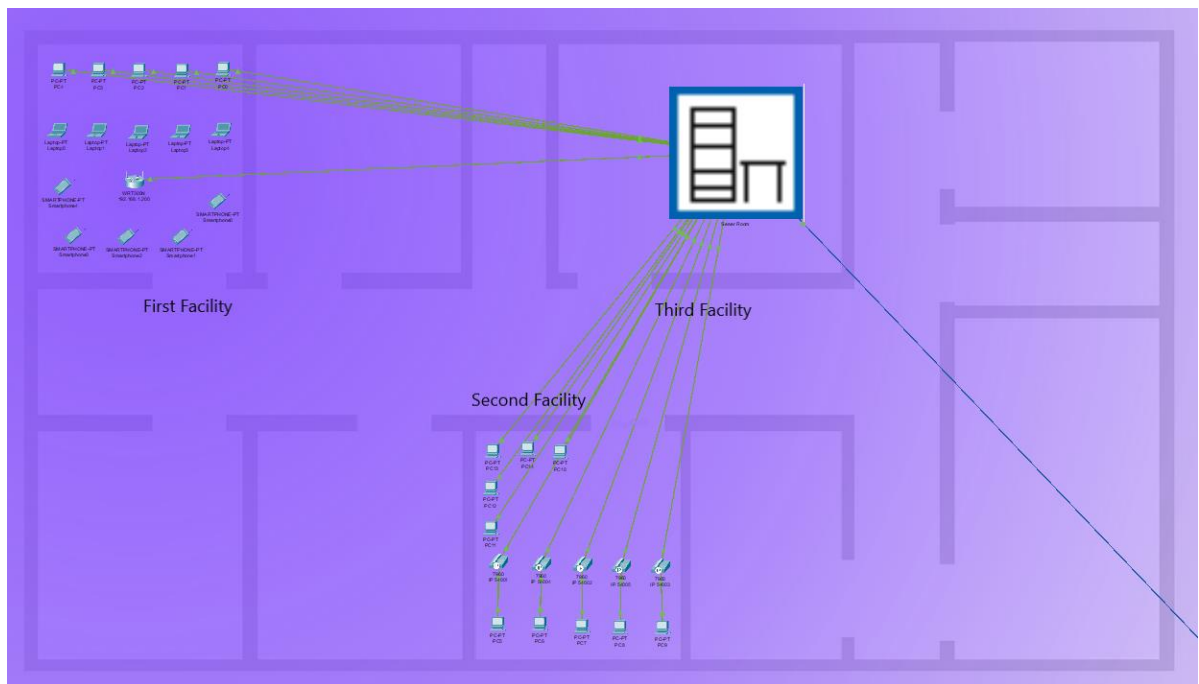


Figure B.2: First branch.

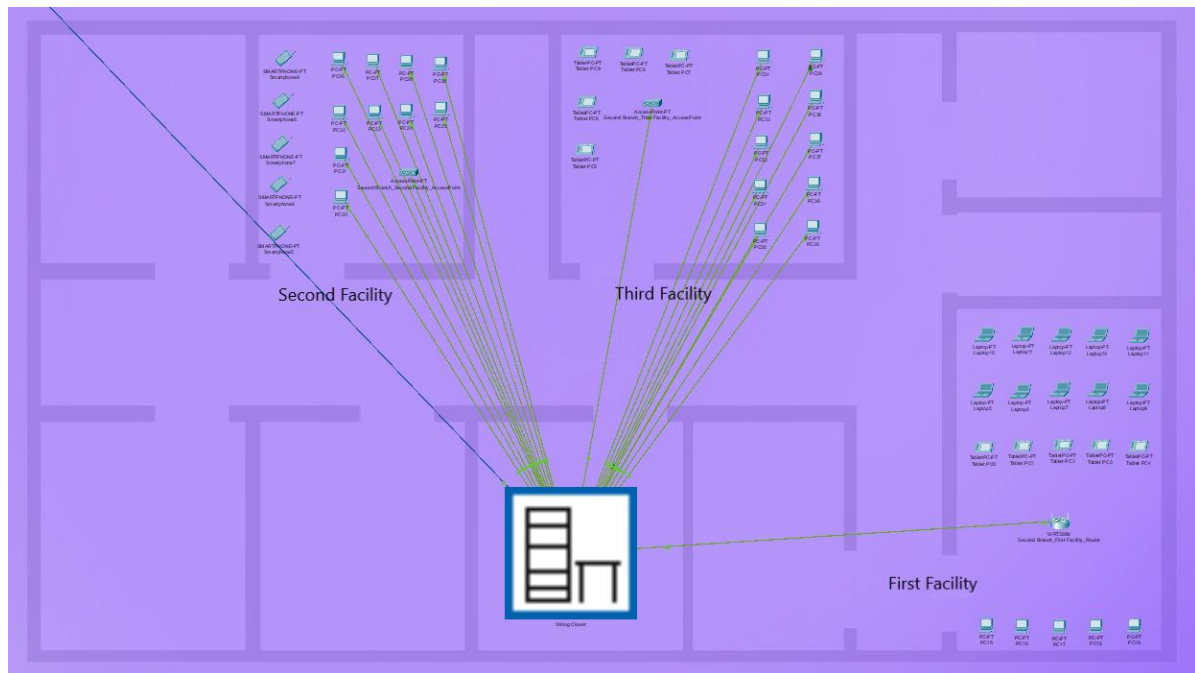
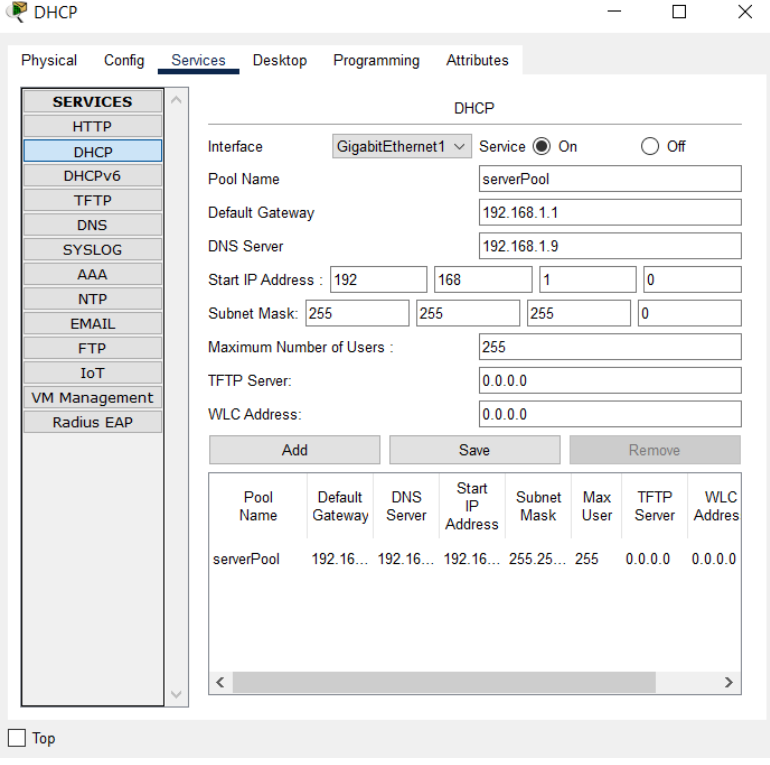


Figure B.3: Second branch.

2.6 Simulation Elements



The DHCP Services Configuration window shows the configuration for the DHCP service on the GigabitEthernet1 interface. The service is currently turned On. The configuration includes a pool named 'serverPool' with a default gateway of 192.168.1.1 and a DNS server of 192.168.1.9. The IP address range is 192.168.1.0 to 192.168.1.255 with a subnet mask of 255.255.255.0. The maximum number of users is set to 255. The TFTP and WLC addresses are both 0.0.0.0.

SERVICES

- HTTP
- DHCP**
- DHCPv6
- TFTP
- DNS
- SYSLOG
- AAA
- NTP
- EMAIL
- FTP
- IoT
- VM Management
- Radius EAP

DHCP

Interface: GigabitEthernet1 Service: ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 192.168.1.1

DNS Server: 192.168.1.9

Start IP Address: 192.168.1.0

Subnet Mask: 255.255.255.0

Maximum Number of Users: 255

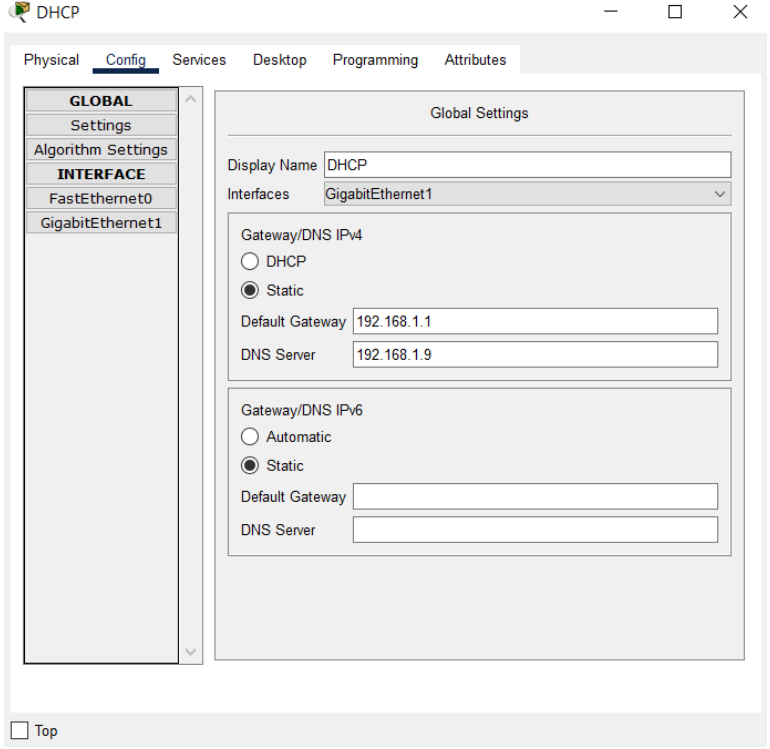
TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
serverPool	192.16...	192.16...	192.16...	255.25...	255	0.0.0.0	0.0.0.0

☐ Top

Figure C.1: DHCP server.



The DHCP Configuration window shows the global settings for the DHCP service. The display name is 'DHCP' and the interfaces are GigabitEthernet1. The Gateway/DNS IPv4 settings are configured with a default gateway of 192.168.1.1 and a DNS server of 192.168.1.9. The Gateway/DNS IPv6 settings are currently set to Automatic.

GLOBAL

- Settings**
- Algorithm Settings
- INTERFACE**
- FastEthernet0
- GigabitEthernet1

Global Settings

Display Name: DHCP

Interfaces: GigabitEthernet1

Gateway/DNS IPv4

☐ DHCP ☒ Static

Default Gateway: 192.168.1.1

DNS Server: 192.168.1.9

Gateway/DNS IPv6

☐ Automatic ☒ Static

Default Gateway:

DNS Server:

☐ Top

Figure C.2: DHCP Configuration.

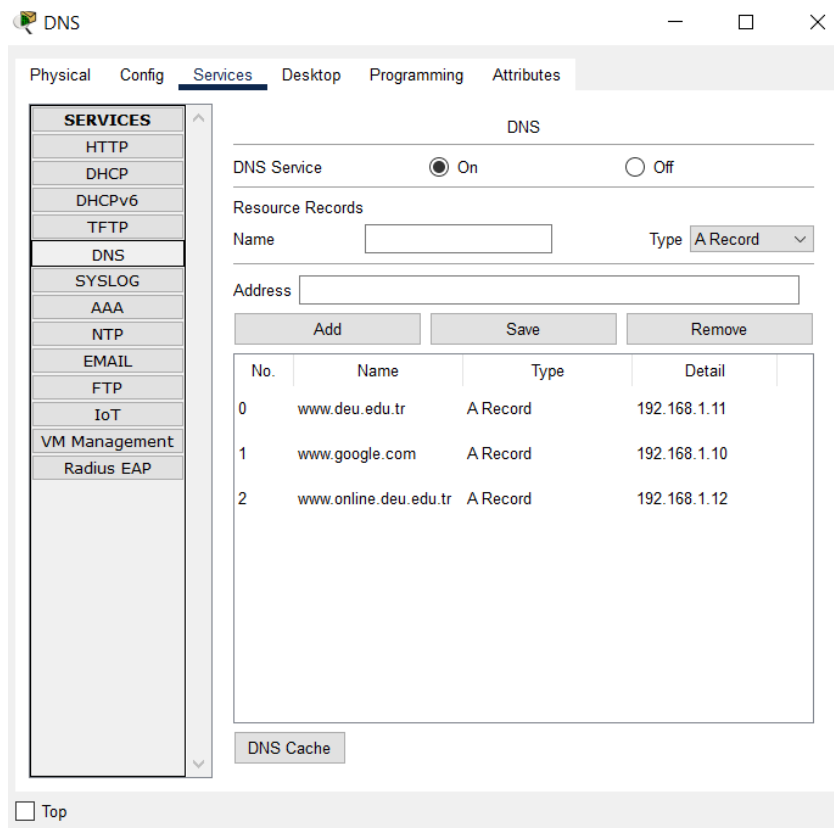


Figure C.3: DNS server.

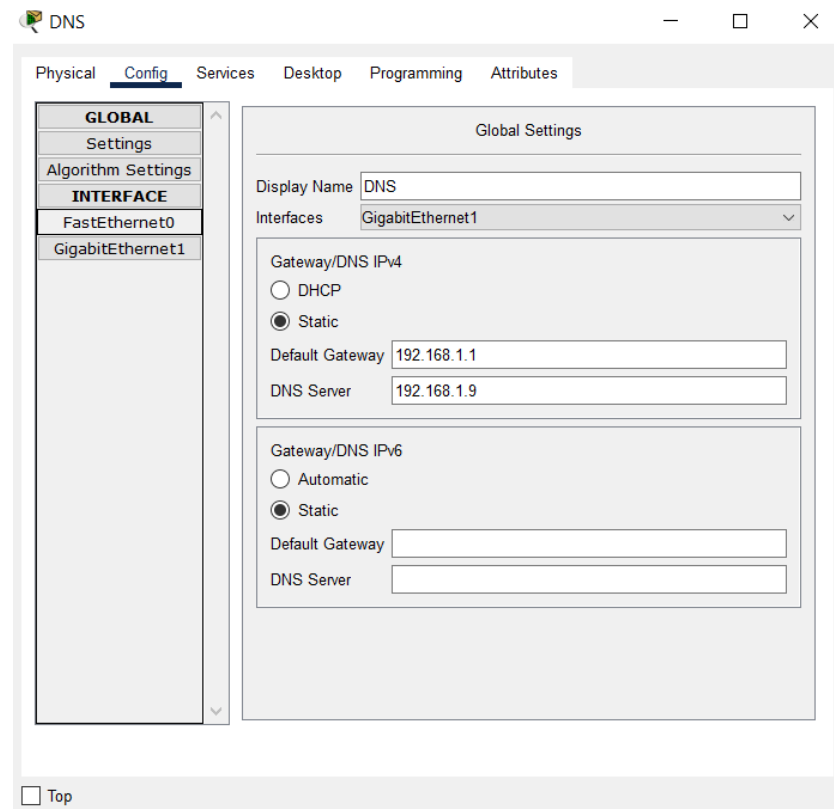


Figure C.4: DNS Configuration.

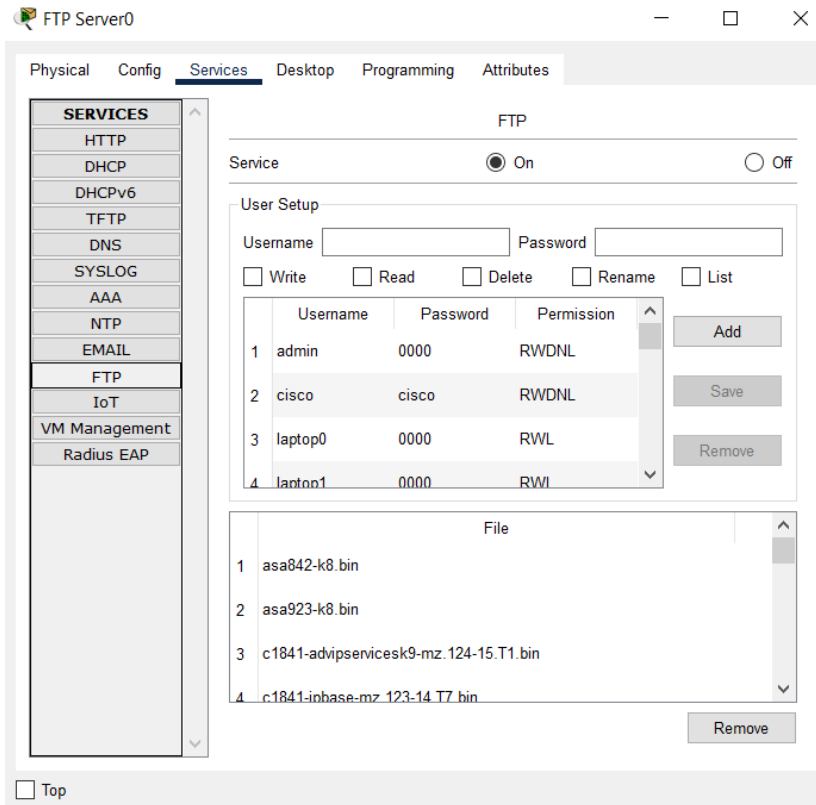


Figure C.5: FTP Server (FTP0).

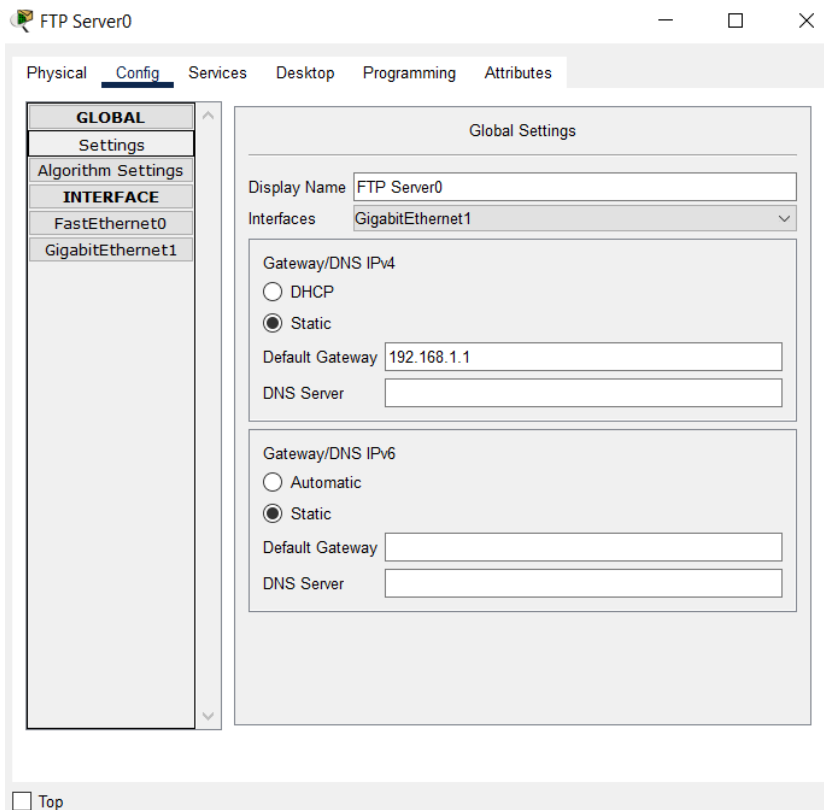


Figure C.6: FTP Configuration.

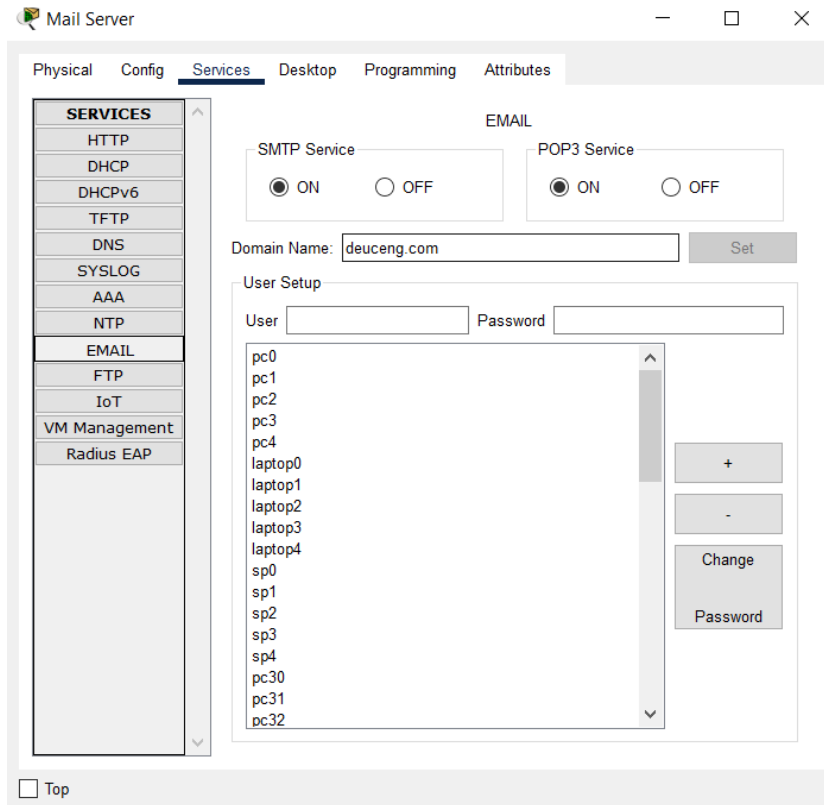


Figure C.7: Mail server.

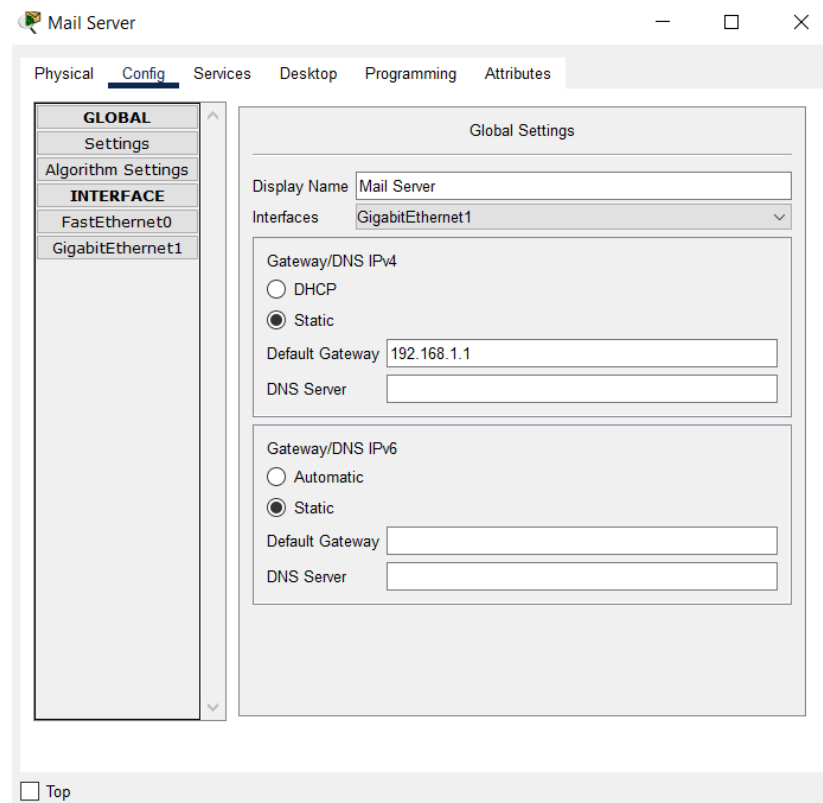


Figure C.8: Mail Configuration.

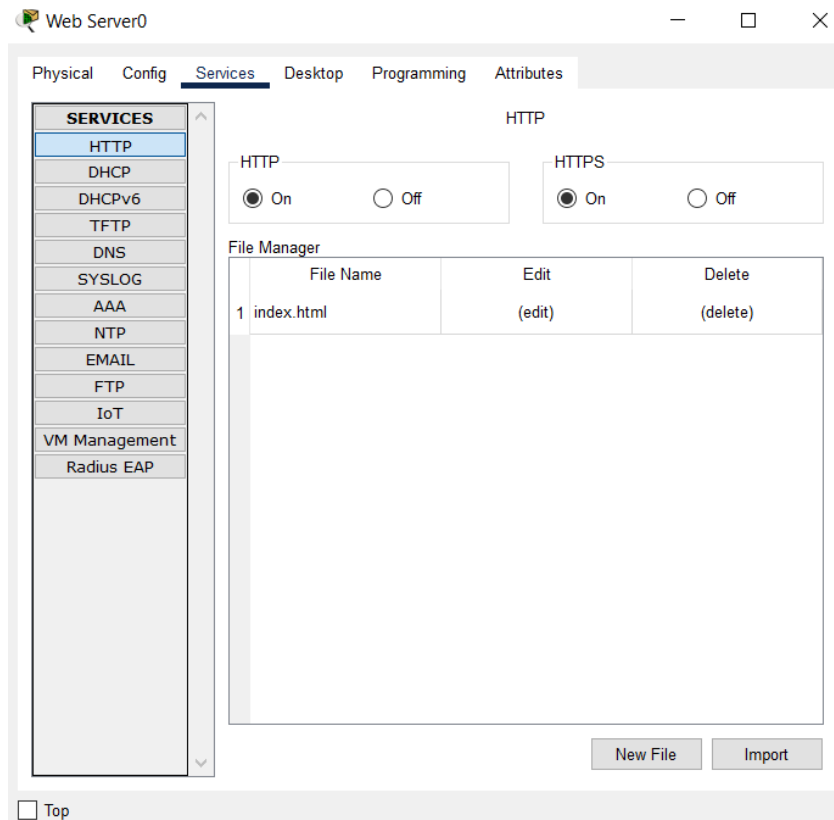


Figure C.9: Web server.

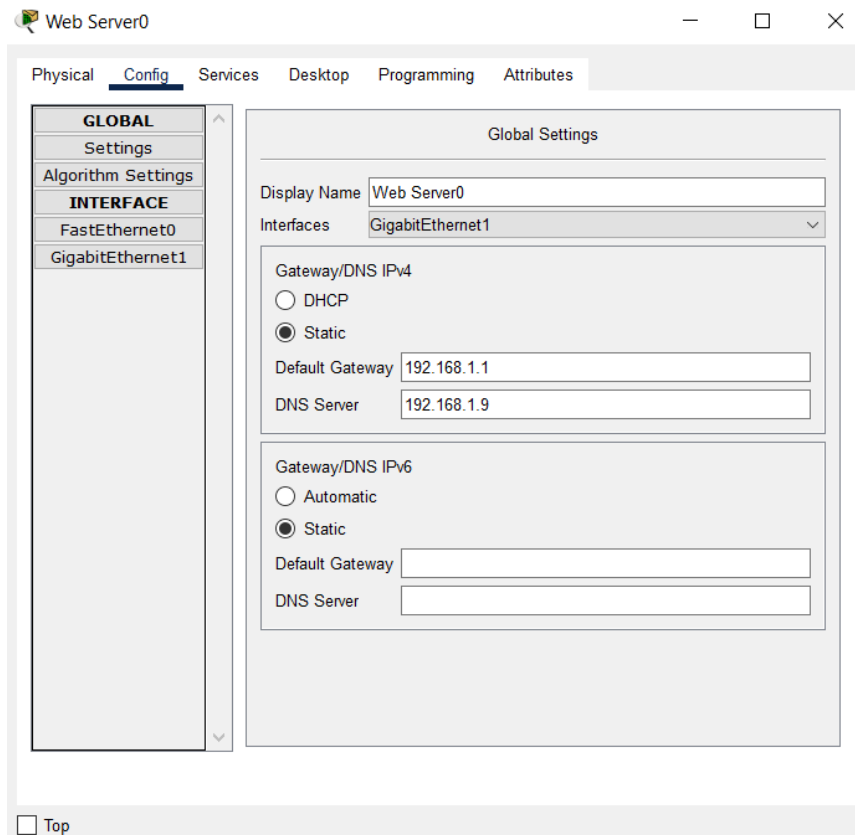


Figure C.10: Web Configuration.

Laptop7

Physical Config Desktop Programming Attributes

IP Configuration

Interface: Wireless0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address: 192.168.2.104

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.2.100

DNS Server: 192.168.1.9

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address: /

Link Local Address: FE80::240:BFF:FED2:9435

Default Gateway:

DNS Server:

Top

Figure C.11: Endpoint IP Configuration.

Laptop7

Physical Config Desktop Programming Attributes

GLOBAL

Settings

Algorithm Settings

INTERFACE

Wireless0

Bluetooth

Wireless0

Port Status: ☒ On

Bandwidth: 300 Mbps

MAC Address: 0040.0BD2.9435

SSID: second_first

Authentication

☐ Disabled ☒ WEP ☐ WPA-PSK ☐ WPA2-PSK ☐ WPA ☐ WPA2 ☐ 802.1X

WEP Key: 1234567890

PSK Pass Phrase:

User ID:

Password:

Method: MD5

User Name:

Password:

Encryption Type: 40/64-Bits (10 Hex digits)

IP Configuration

☒ DHCP ☐ Static

IPv4 Address: 192.168.2.104

Subnet Mask: 255.255.255.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address: /

Top

Figure C.12: Endpoint Wireless Configuration.

Laptop7

Physical Config **Desktop** Programming Attributes

Configure Mail X

User Information

Your Name:

Email Address:

Server Information

Incoming Mail Server:

Outgoing Mail Server:

Logon Information

User Name:

Password:

☐ Top

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.

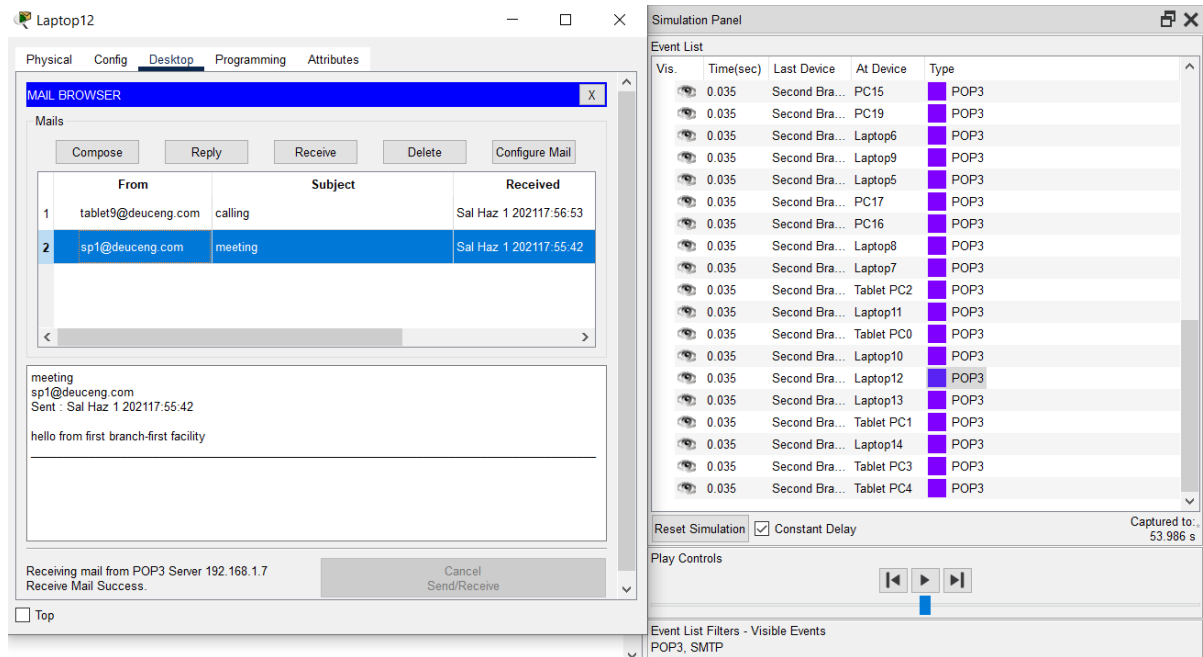


Figure 1.1.1: Read email event list.

PDU Information at Device: Laptop12



OSI Model Inbound PDU Details

At Device: Laptop12
Source: Laptop12
Destination: POP3 CLIENT

In Layers

Layer 7: POP3
Layer6
Layer5
Layer 4: TCP Src Port: 110, Dst Port: 1026
Layer 3: IP Header Src. IP: 192.168.1.7, Dest. IP: 192.168.2.107
Layer 2: Wireless
Layer 1: Port Wireless0

Out Layers

Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
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 >>

Figure 1.1.2: Read email layers.

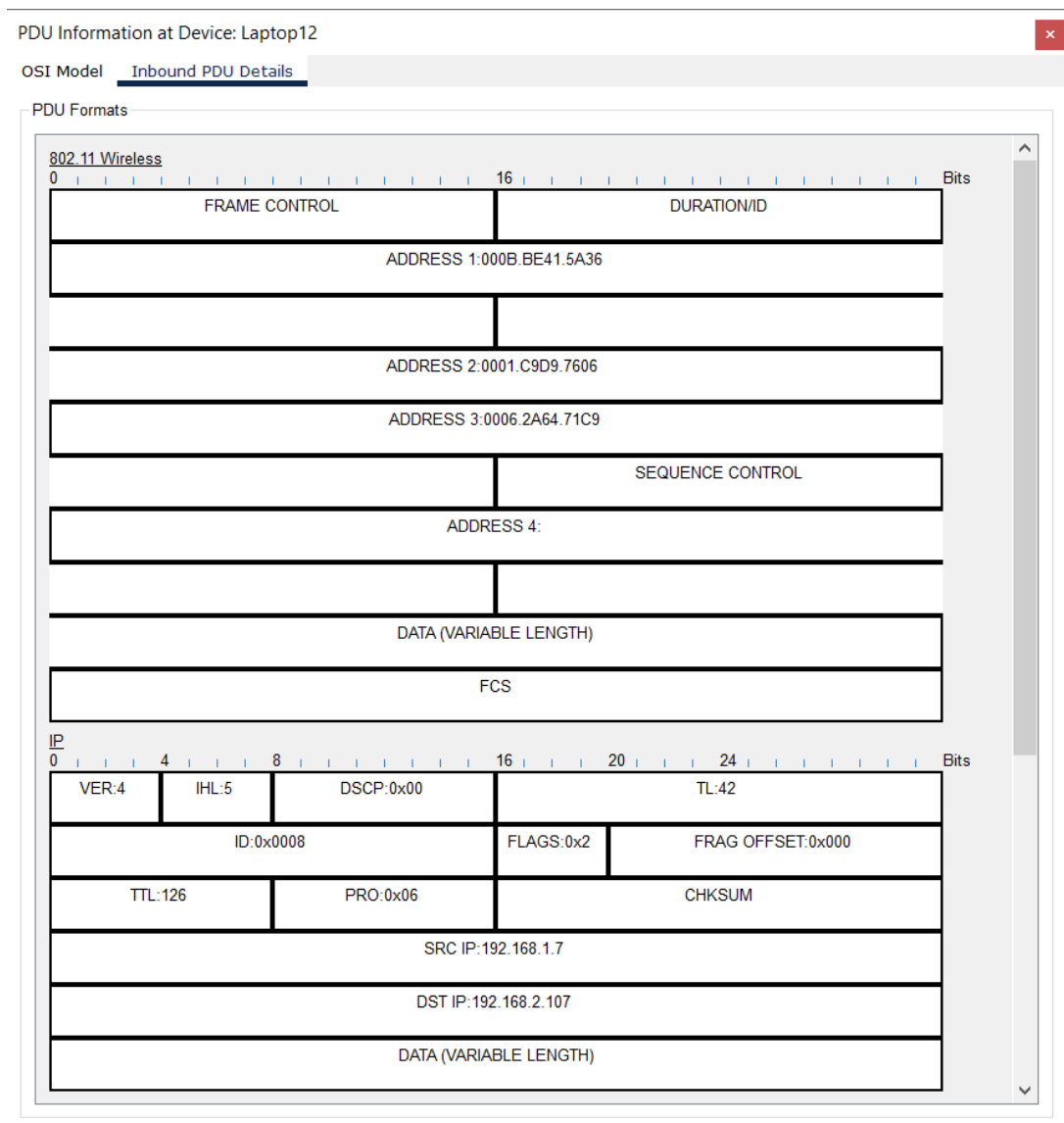


Figure 1.1.3: Read email PDU.

PDU Formats

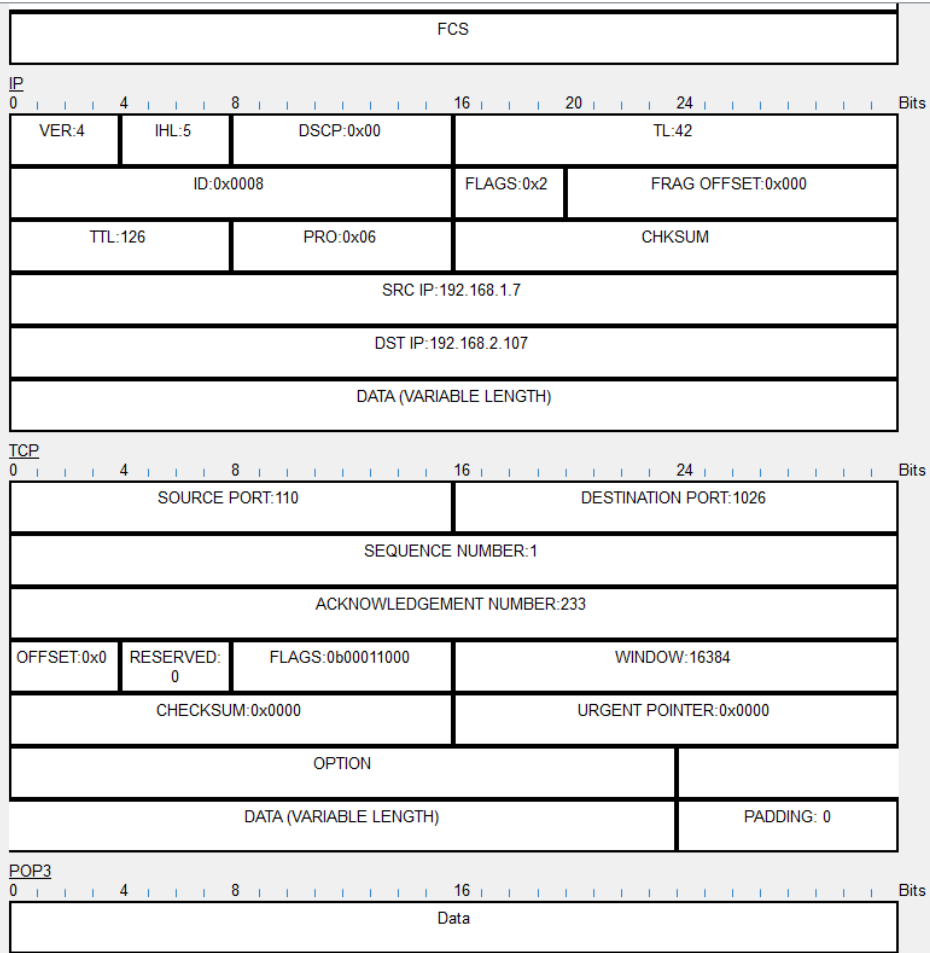


Figure 1.1.4: Read email PDU alt.

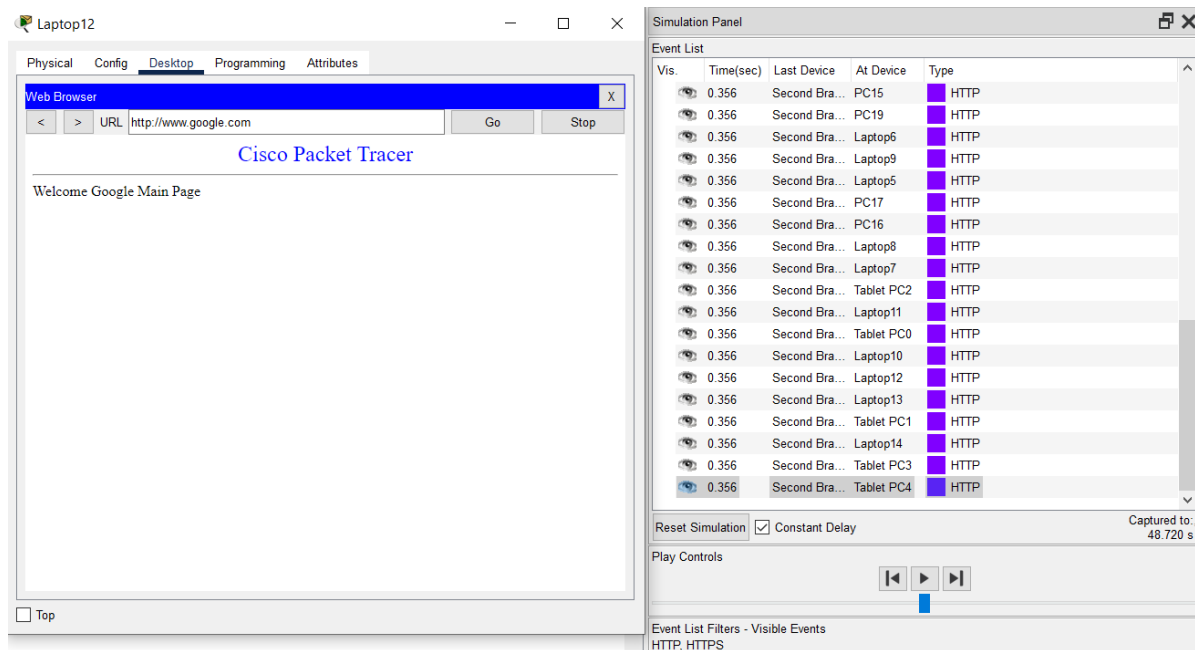


Figure 1.2.1: Browse Web event list.

PDU Information at Device: Laptop12

OSI Model

Inbound PDU Details

At Device: Laptop12
Source: Laptop12
Destination: HTTP CLIENT

In Layers

Layer 7:
Layer6
Layer5
Layer 4: TCP Src Port: 80, Dst Port: 1027
Layer 3: IP Header Src. IP: 192.168.1.10, Dest. IP: 192.168.2.107
Layer 2: Wireless
Layer 1: Port Wireless0

Out Layers

Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1

1. The HTTP client receives a HTTP reply from the server. It displays the page in the web browser.

Figure 1.2.2: Browse Web layers.

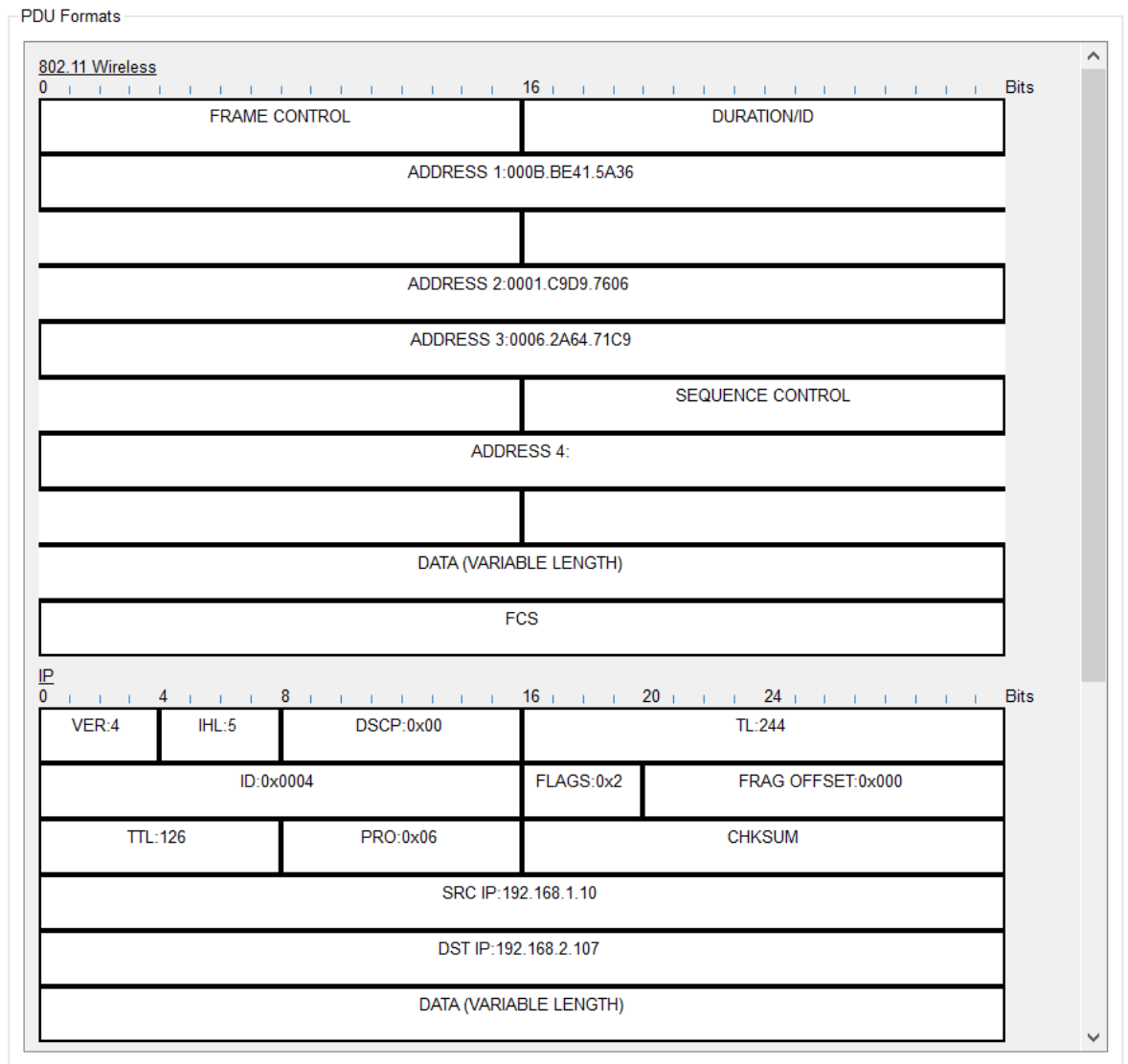


Figure 1.2.3: Browse Web PDU.

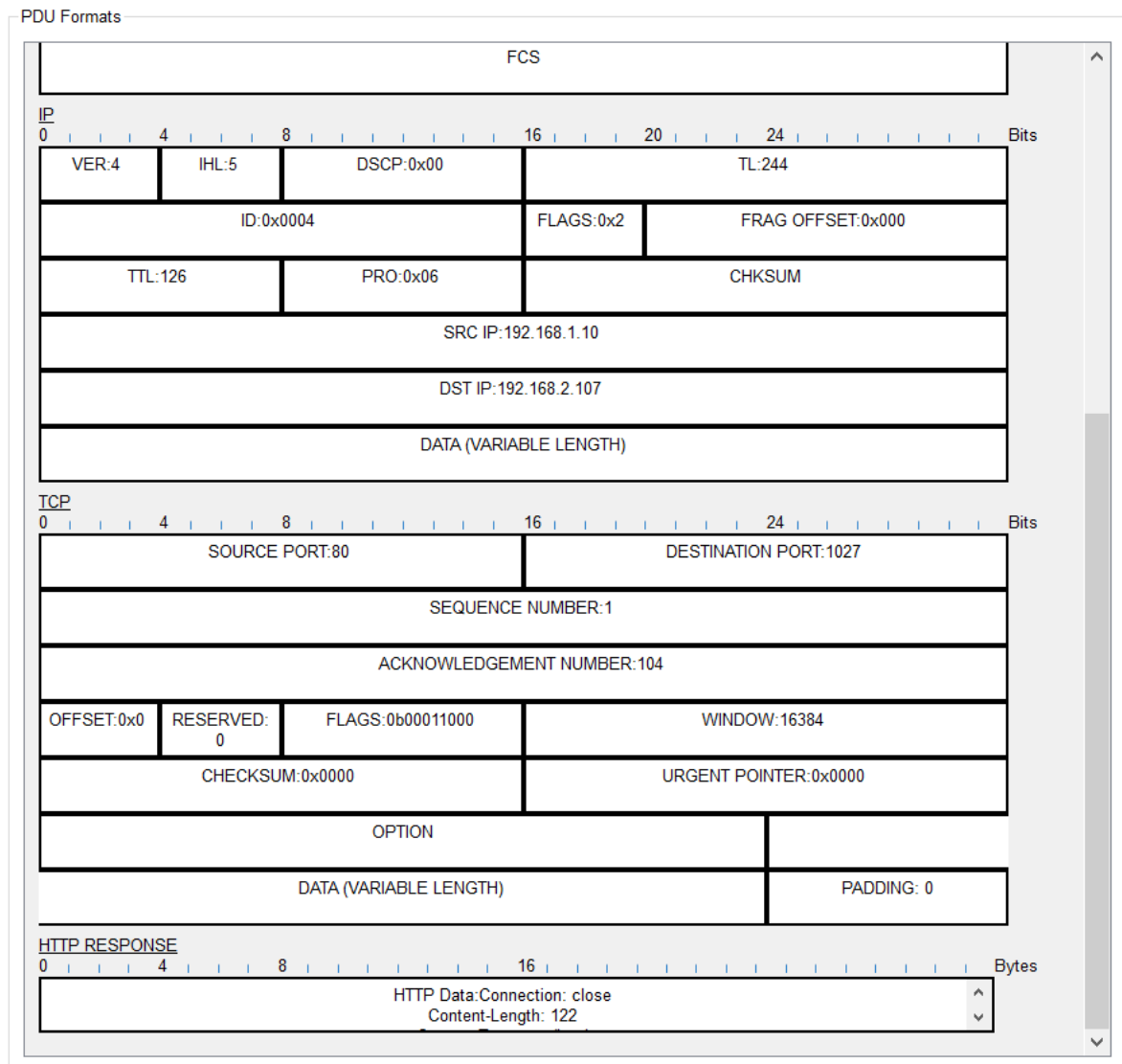


Figure 1.2.4: Browse Web PDU alt.

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.

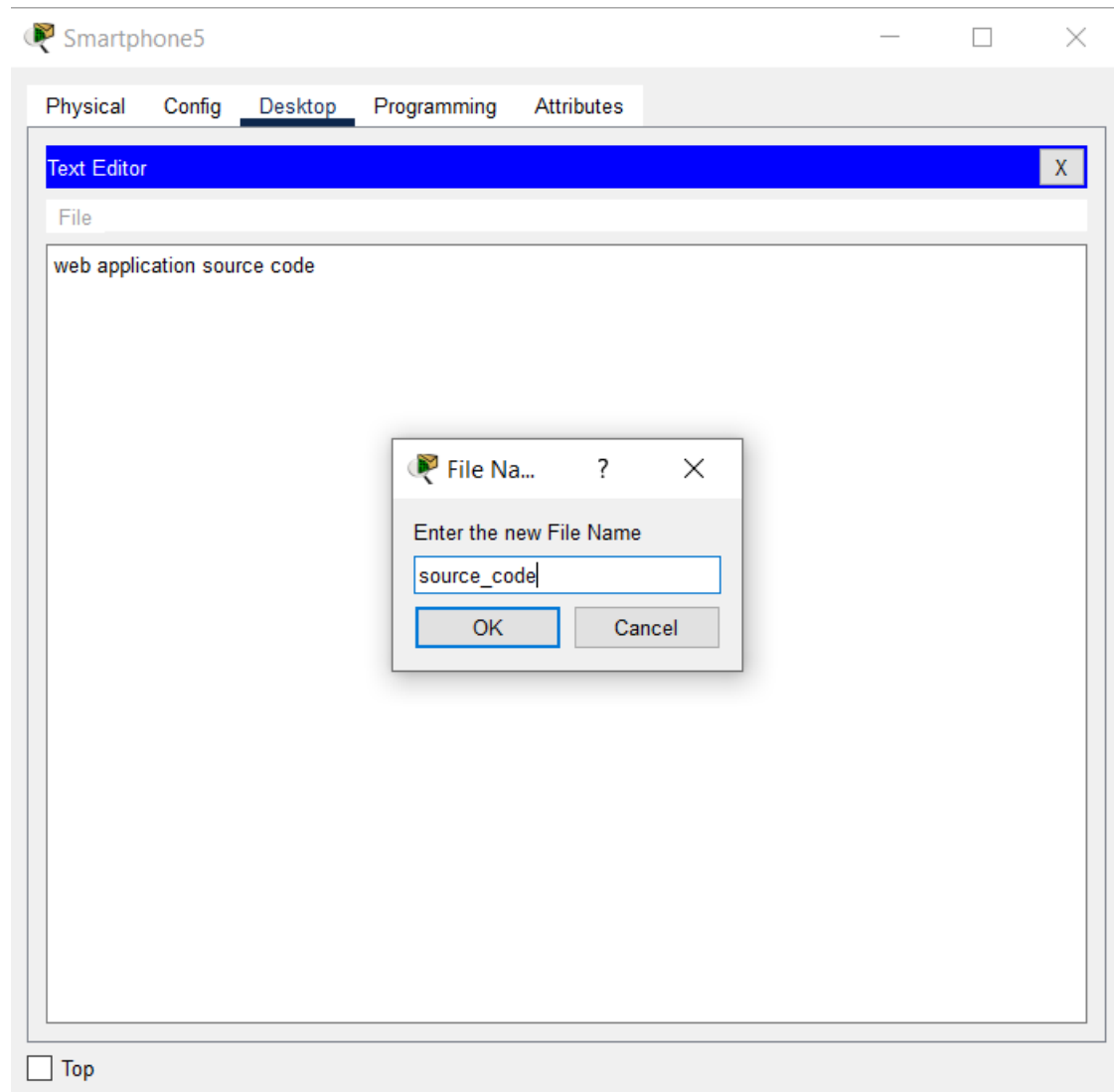


Figure 2.1: Create File on a workstation.

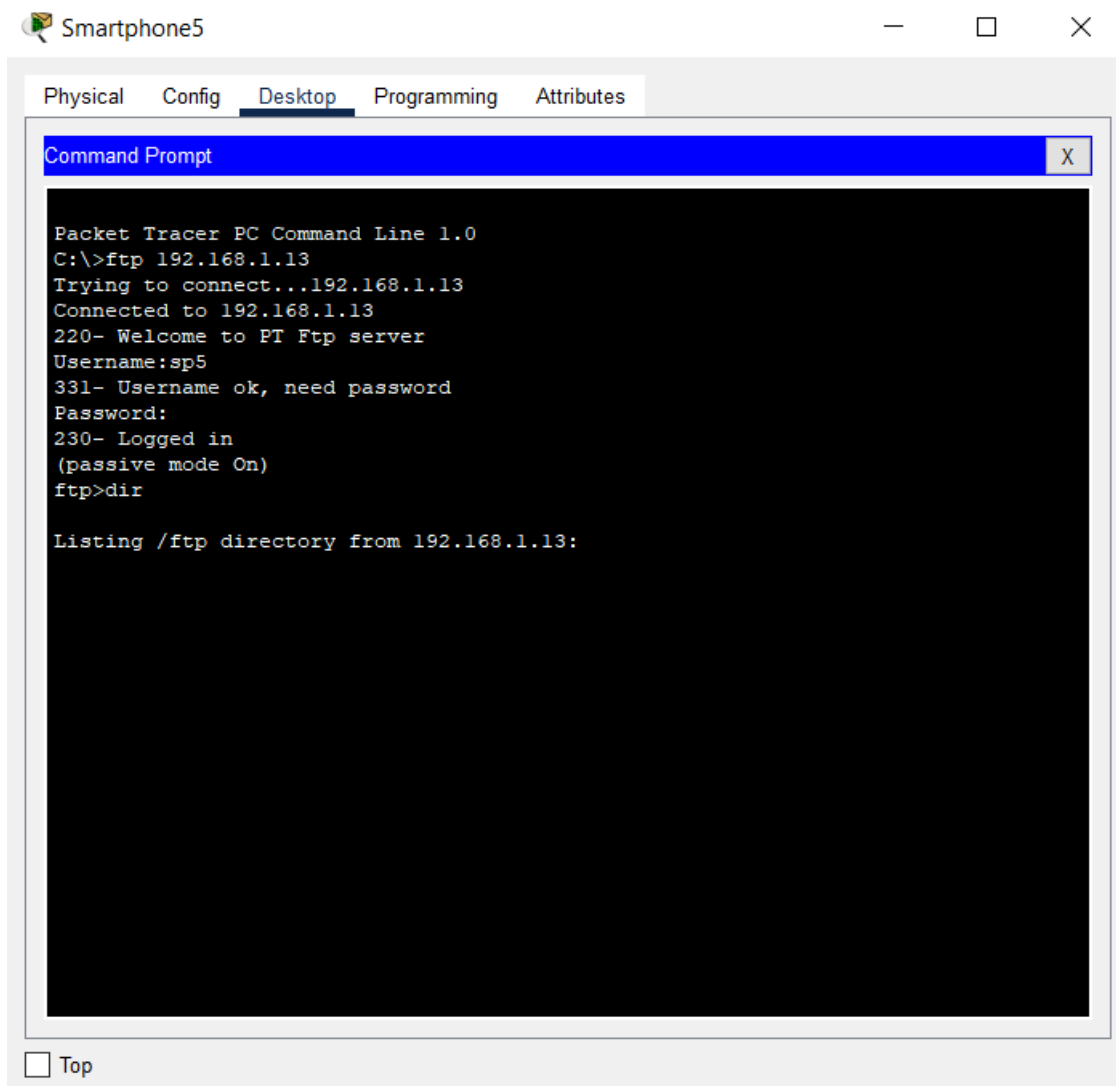


Figure 2.2: Connected to FTP server.

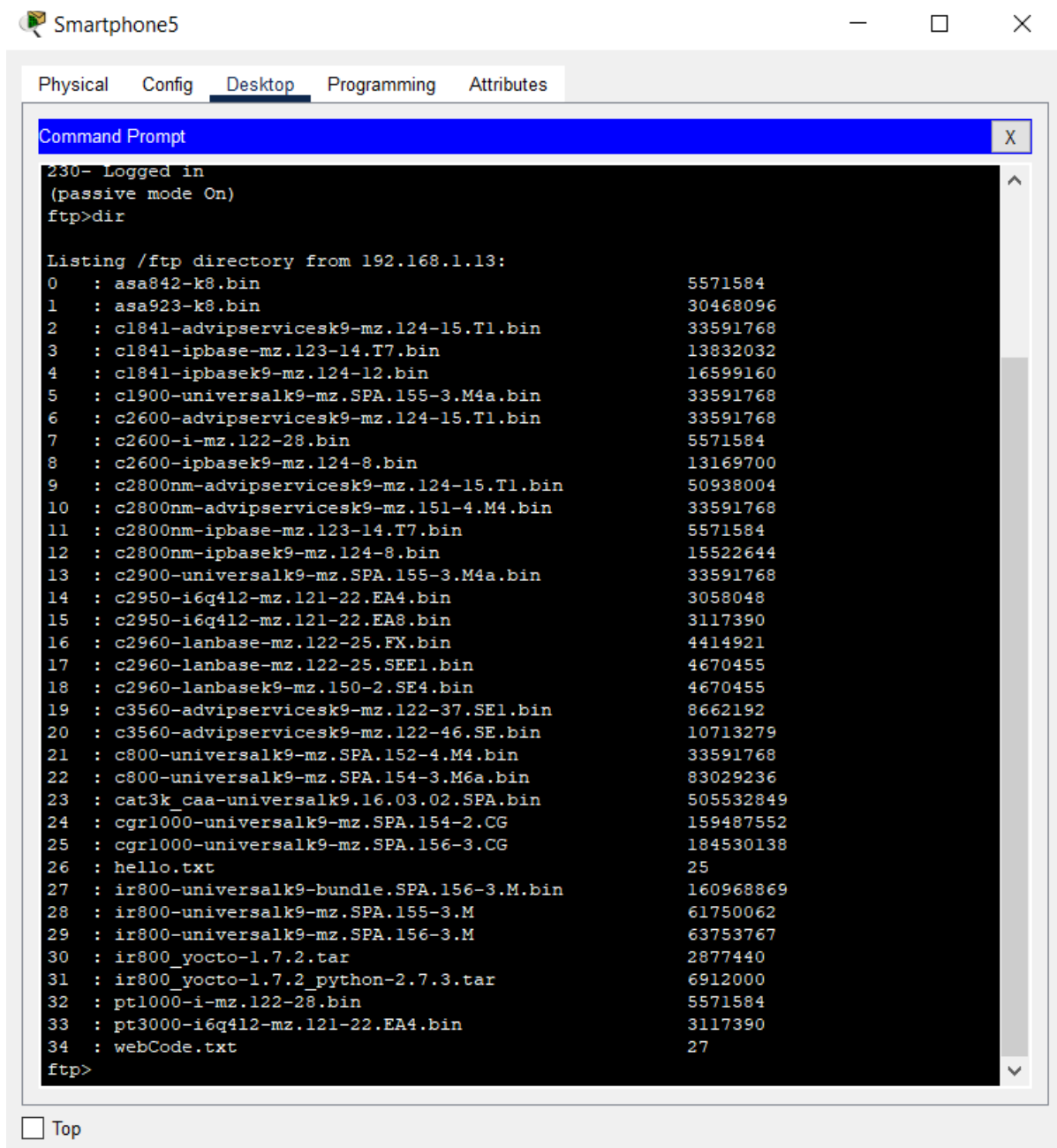


Figure 2.3: List files from FTP server.

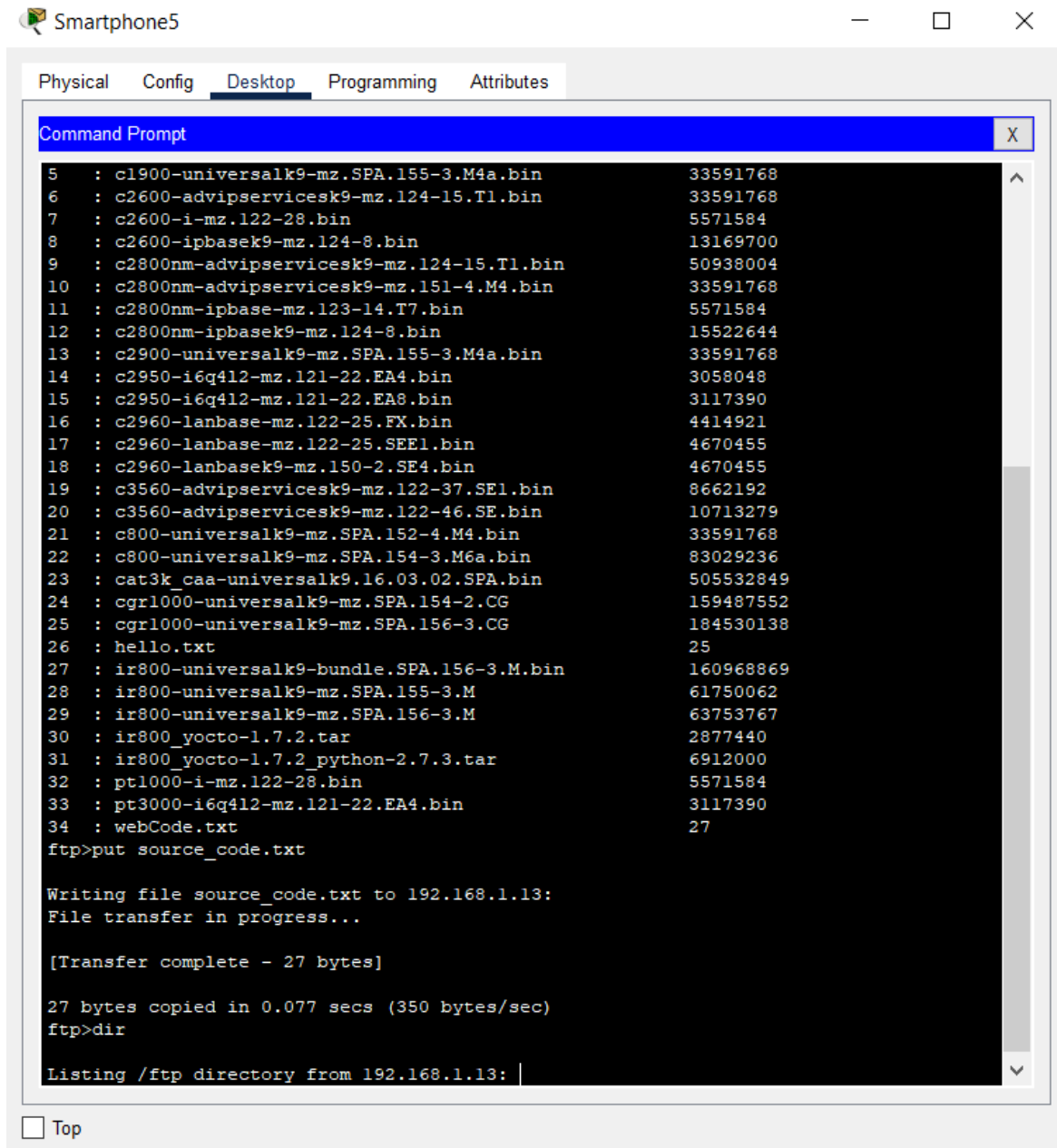


Figure 2.3: Upload created file to FTP server.

The screenshot shows a window titled 'Smartphone5' with a tabbed interface. The 'Desktop' tab is active, displaying a 'Command Prompt' window. The Command Prompt shows the output of an FTP 'dir' command, listing files and their sizes. The files include various .bin files (e.g., asa842-k8.bin, c1841-advipservicesk9-mz.l24-15.T1.bin) and .txt files (source_code.txt, webCode.txt). The 'source_code.txt' file is highlighted in the list.

```

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 : c1841-advipservicesk9-mz.l24-15.T1.bin  33591768
 3 : c1841-ipbase-mz.l23-14.T7.bin  13832032
 4 : c1841-ipbasek9-mz.l24-12.bin  16599160
 5 : c1900-universalk9-mz.SPA.155-3.M4a.bin  33591768
 6 : c2600-advipservicesk9-mz.l24-15.T1.bin  33591768
 7 : c2600-i-mz.l22-28.bin        5571584
 8 : c2600-ipbasek9-mz.l24-8.bin   13169700
 9 : c2800nm-advipservicesk9-mz.l24-15.T1.bin  50938004
10 : c2800nm-advipservicesk9-mz.l51-4.M4.bin  33591768
11 : c2800nm-ipbase-mz.l23-14.T7.bin  5571584
12 : c2800nm-ipbasek9-mz.l24-8.bin  15522644
13 : c2900-universalk9-mz.SPA.155-3.M4a.bin  33591768
14 : c2950-i6q4l2-mz.l21-22.EA4.bin  3058048
15 : c2950-i6q4l2-mz.l21-22.EA8.bin  3117390
16 : c2960-lanbase-mz.l22-25.FX.bin  4414921
17 : c2960-lanbase-mz.l22-25.SEE1.bin  4670455
18 : c2960-lanbasek9-mz.l50-2.SE4.bin  4670455
19 : c3560-advipservicesk9-mz.l22-37.SE1.bin  8662192
20 : c3560-advipservicesk9-mz.l22-46.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.l22-28.bin      5571584
33 : pt3000-i6q4l2-mz.l21-22.EA4.bin  3117390
34 : source_code.txt             27
35 : webCode.txt                 27
ftp>

```

Below the Command Prompt window, there is a 'Top' button with a square icon.

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.

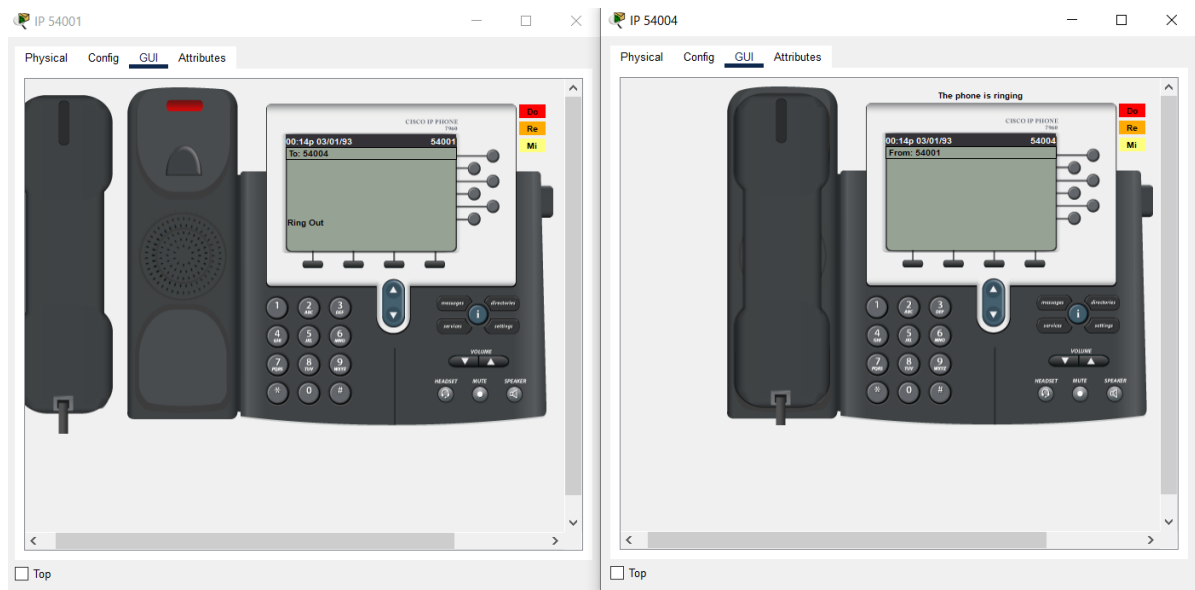


Figure 3.1: Making a call in GUI.

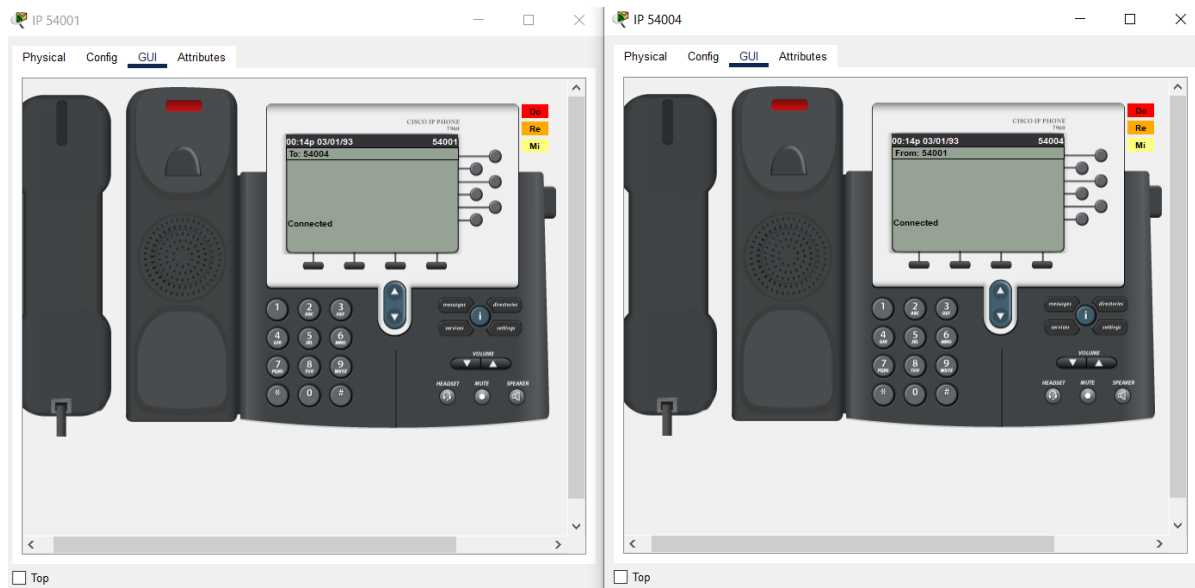


Figure 3.2: Voice conference is live, both devices are connected.

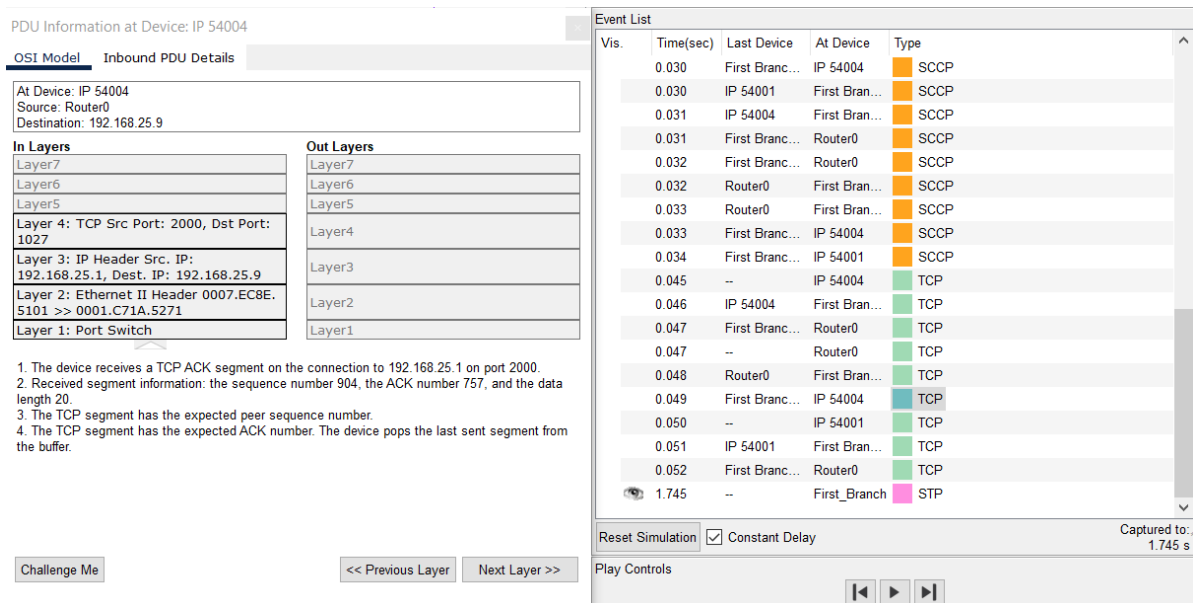


Figure 3.3: VoIP event list and layers.

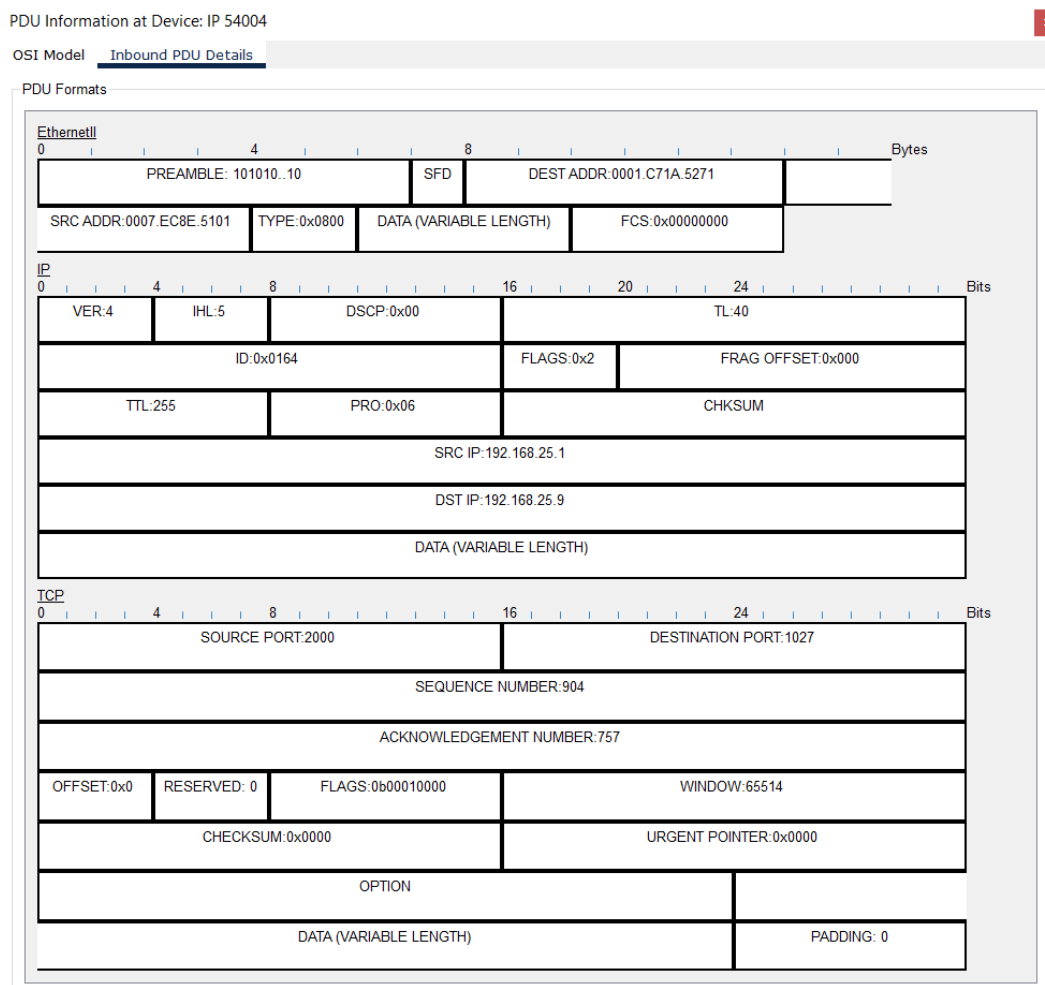


Figure 3.4: VoIP PDU.

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.

PC12

Physical Config **Desktop** Programming Attributes

Configure Mail X

User Information

Your Name:

Email Address:

Server Information

Incoming Mail Server:

Outgoing Mail Server:

Logon Information

User Name:

Password:

Save Clear Reset

☐ Top

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

PDU Information at Device: PC12

OSI Model

Inbound PDU Details

At Device: PC12

Source: First_Branch

Destination: STP Multicast Address

In Layers

Layer7

Layer6

Layer5

Layer4

Layer3

Layer 2: IEEE 802.3 Header
00E0.A389.D909 >> 0180.C200.0000 LLC
STP BPDU

Layer 1: Port FastEthernet0

Out Layers

Layer7

Layer6

Layer5

Layer4

Layer3

Layer2

Layer1

1. The frame's destination MAC address matches the receiving port's MAC address, the broadcast address, or a multicast address.

2. The device does not have a service that accepts this frame. It drops the frame.

Challenge Me

<< Previous Layer

Next Layer >>

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.759	First_Branch	First Bran...	STP
	0.760	First Branc...	IP 54003	STP
	0.760	First Branc...	IP 54005	STP
	0.760	First Branc...	IP 54001	STP
	0.760	First Branc...	Router0	STP
	0.760	First Branc...	PC14	STP
	0.760	First Branc...	IP 54004	STP
	0.760	First Branc...	IP 54002	STP
	0.760	First Branc...	PC13	STP
	0.760	First Branc...	PC11	STP
	0.760	First Branc...	PC12	STP
	0.760	First Branc...	PC10	STP
	0.761	IP 54003	PC9	STP
	0.761	IP 54005	PC8	STP
	0.761	IP 54001	PC5	STP
	0.761	IP 54004	PC6	STP
	0.761	IP 54002	PC7	STP
	2.758	--	First_Branch	STP
	2.759	First_Branch	First Bran...	STP

Reset Simulation

☒ Constant Delay

Captured to: 2.759 s

Play Controls

⏮

⏪

⏩

⏭

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

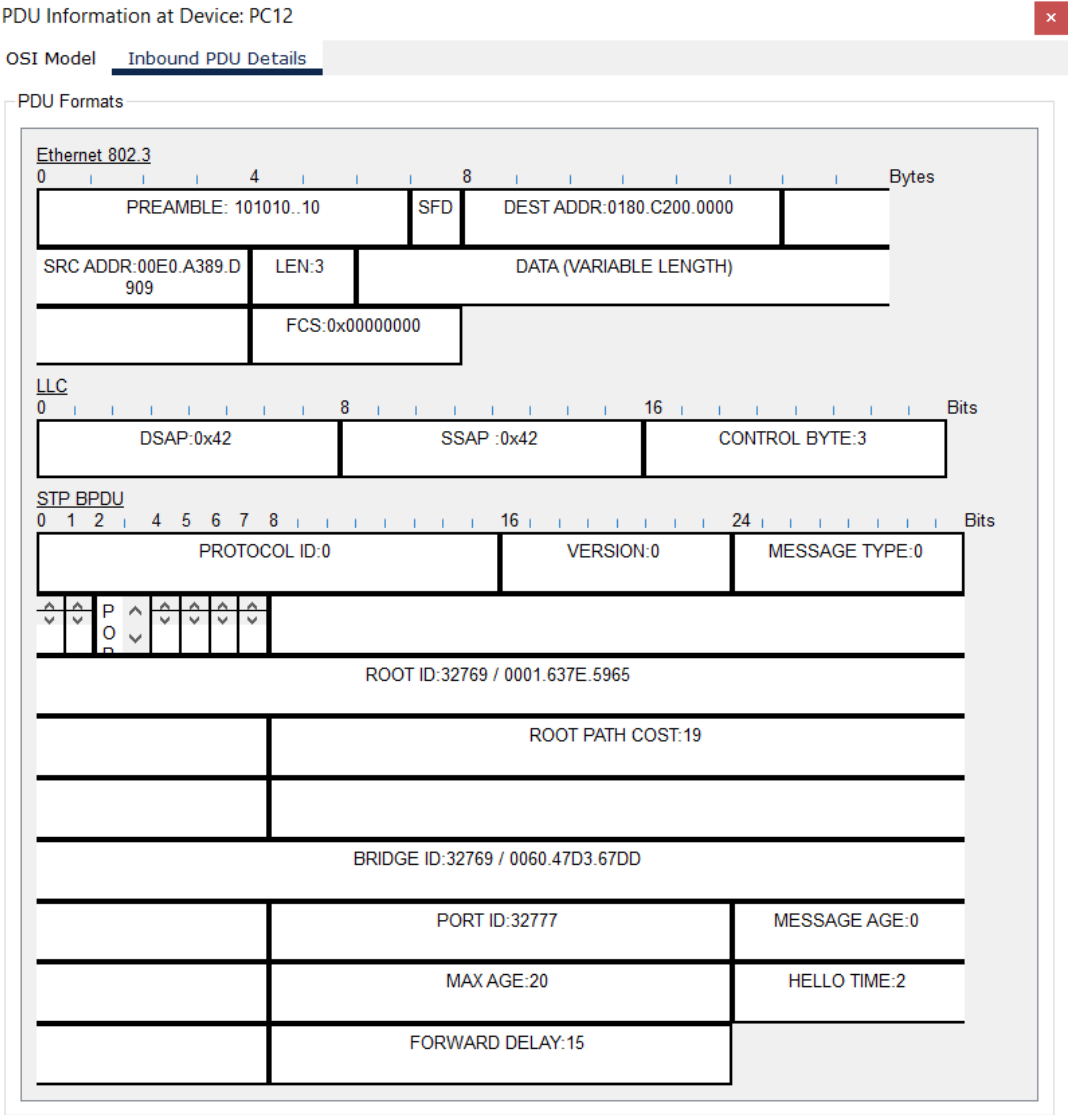


Figure 4.3: Simulation 4 PDU.

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

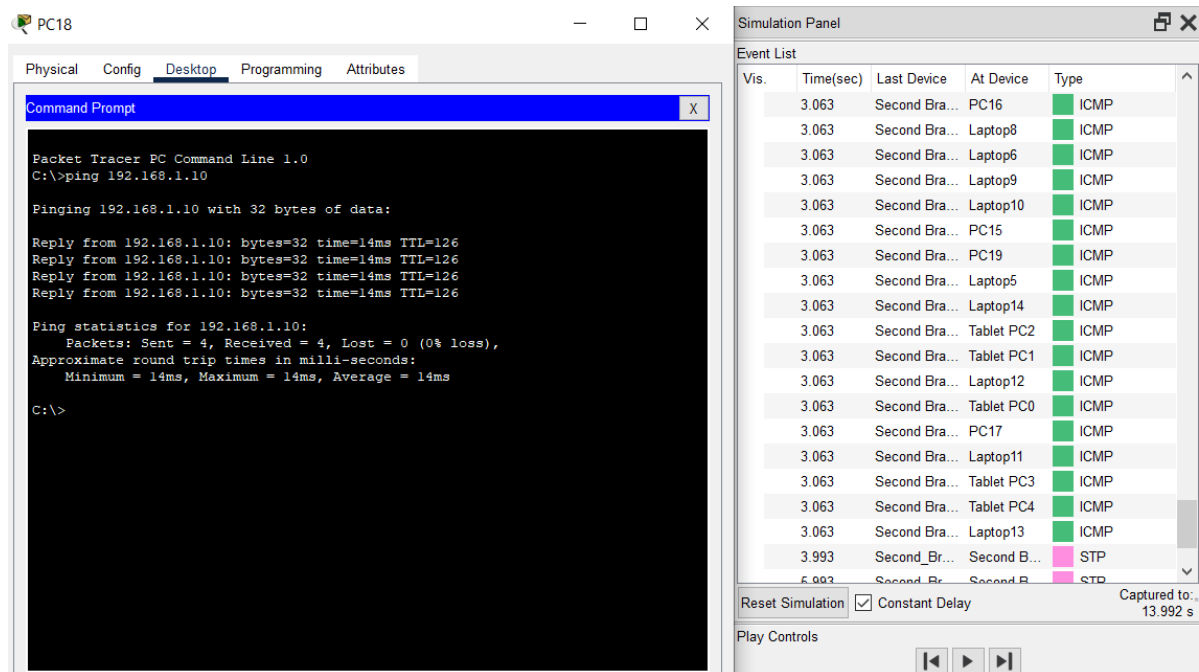


Figure 5.1: Ping Web server event list and command prompt.

PDU Information at Device: PC18

OSI Model Outbound PDU Details

At Device: PC18	
Source: PC18	
Destination: 192.168.1.10	

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer 3: IP Header Src. IP: 192.168.2.105, Dest. IP: 192.168.1.10 ICMP Message Type: 8
Layer2	Layer 2: Wireless
Layer1	Layer 1: Port(s): Wireless0

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.

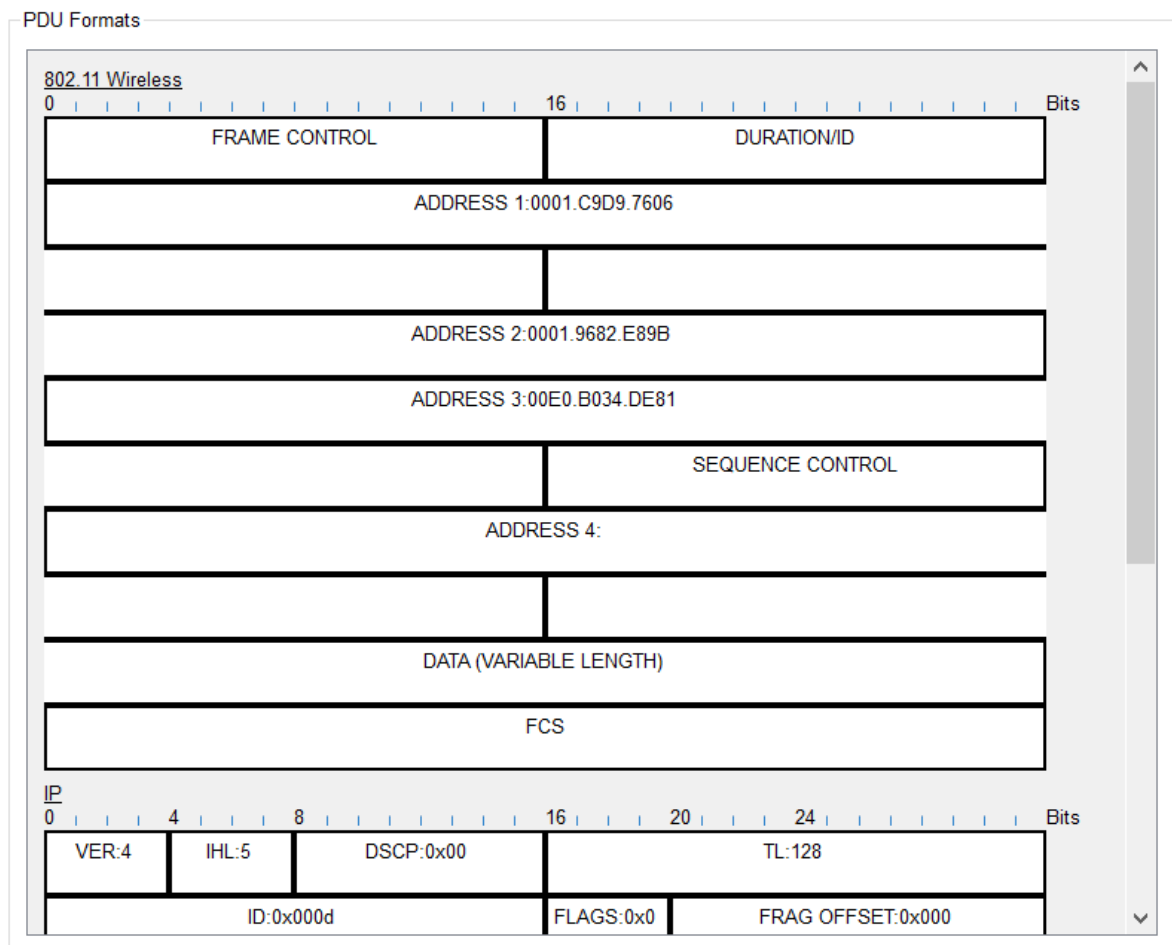


Figure 5.3: Ping Web server PDU.

PDU Formats

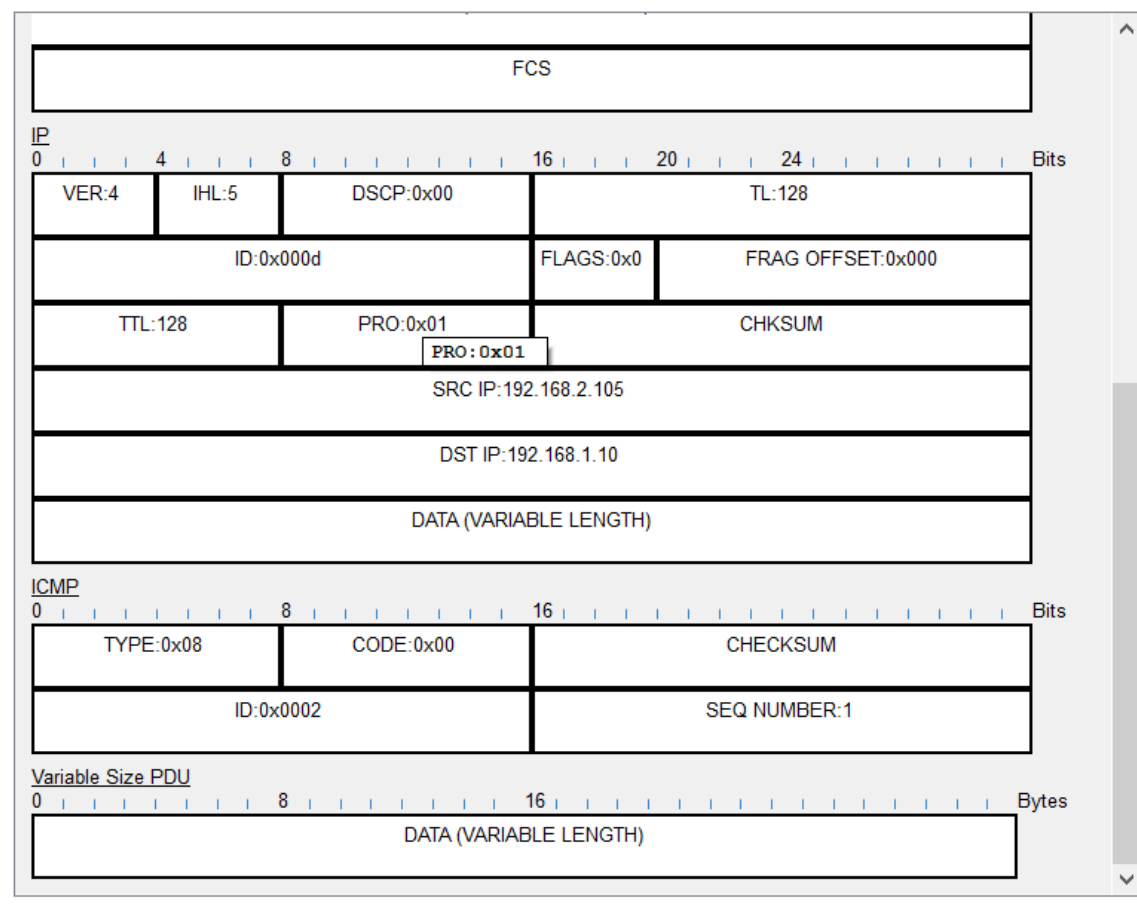


Figure 5.4: Ping Web server PDU alt.

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.

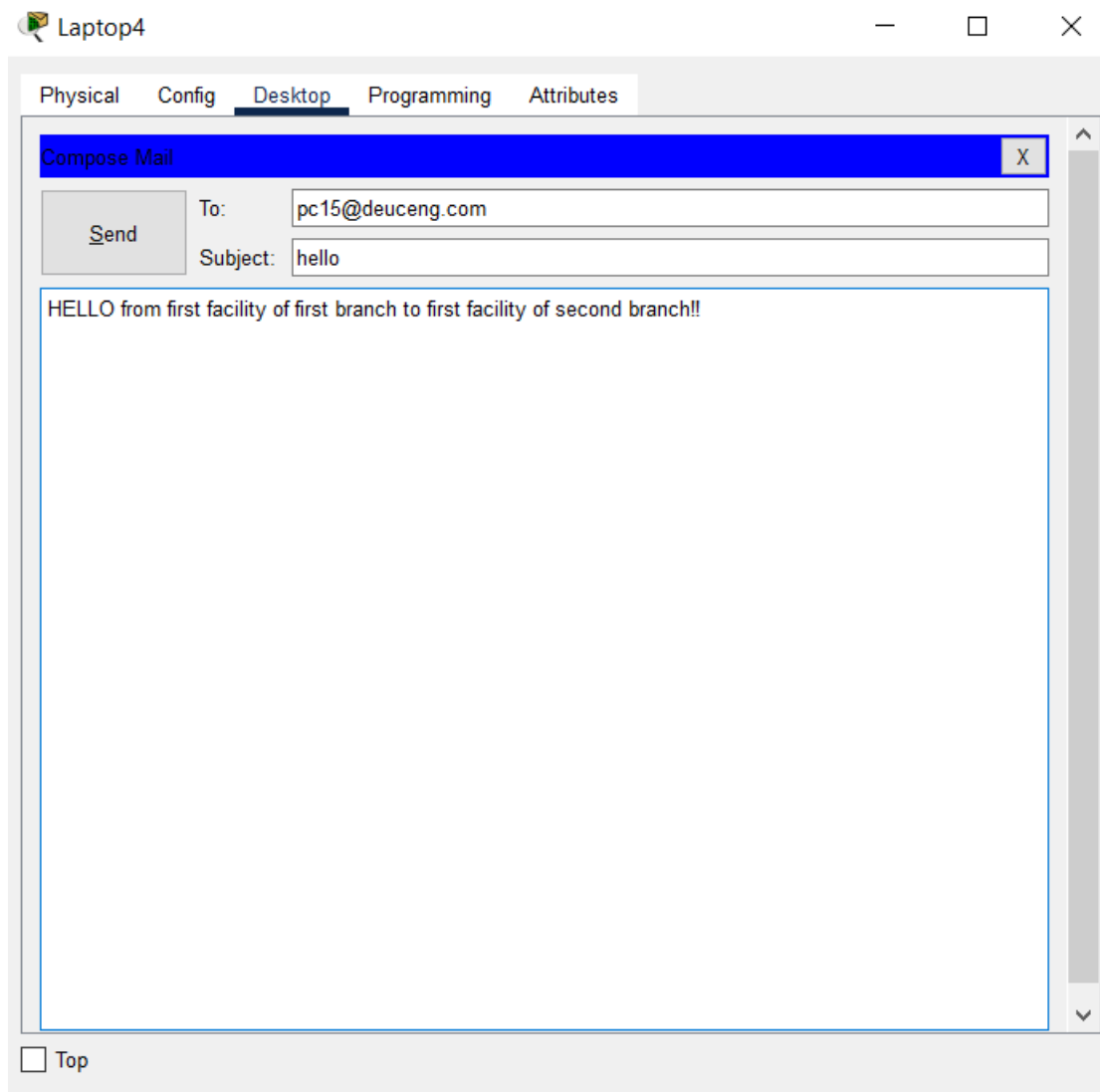


Figure 6.1: Create and send email.

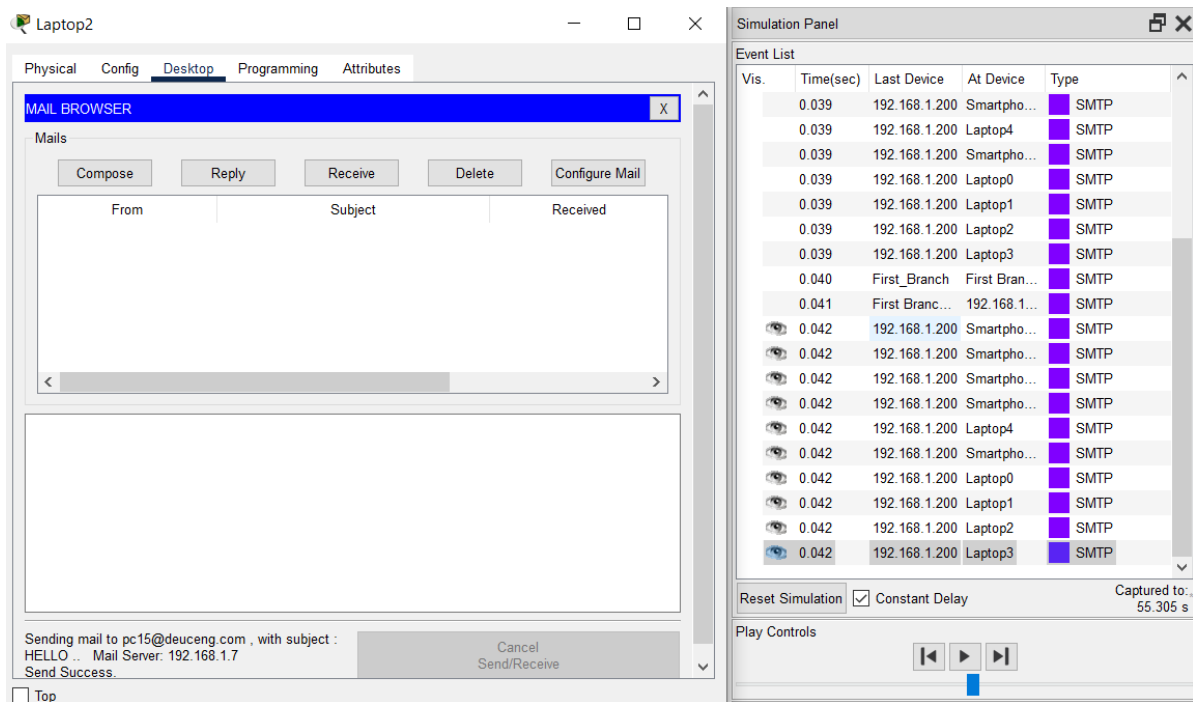


Figure 6.2: Send email success message and event list.

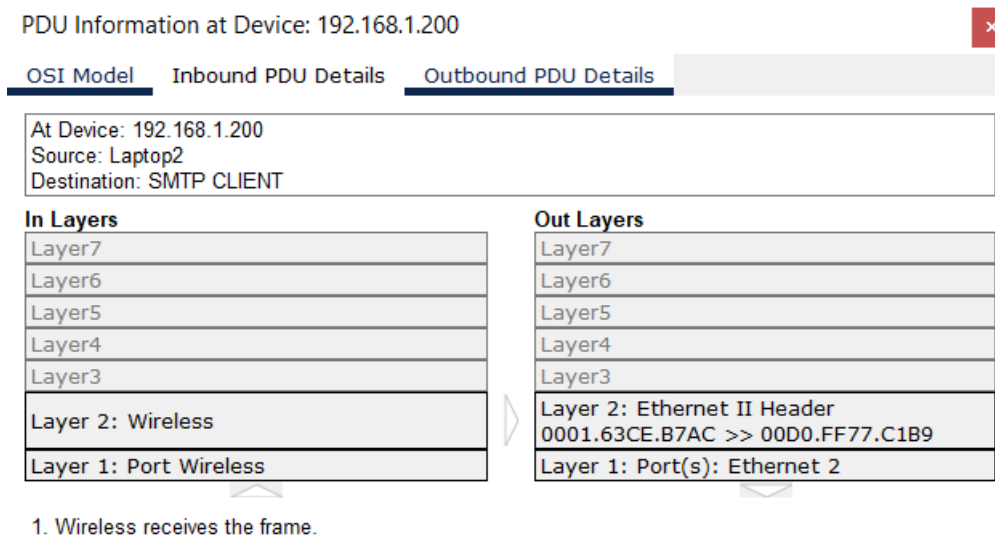


Figure 6.3: Send email layers.

PDU Information at Device: 192.168.1.200



OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

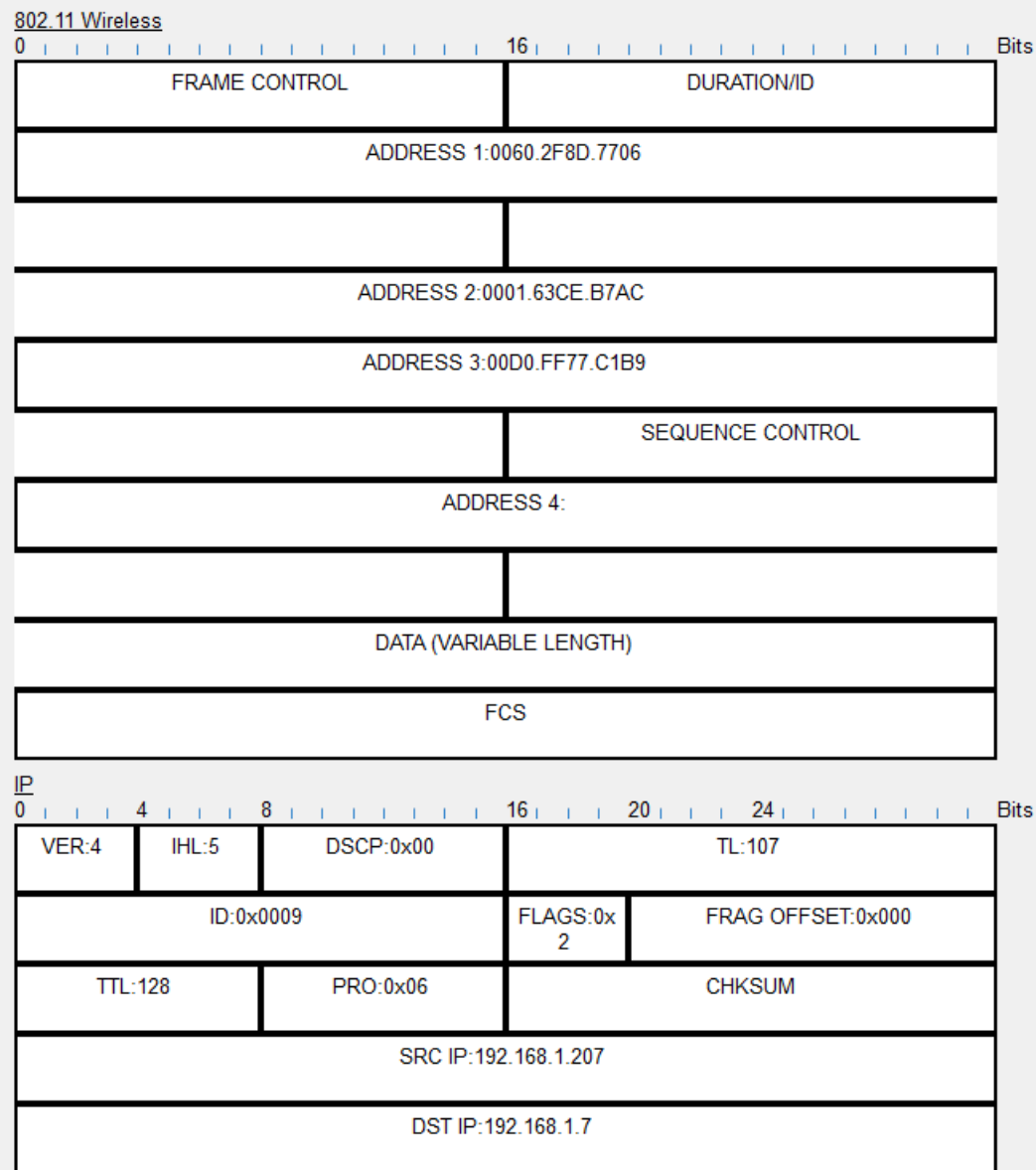


Figure 6.4: Send email inbound PDU.

PDU Information at Device: 192.168.1.200

OSI Model Inbound PDU Details Outbound PDU Details

PDU Formats

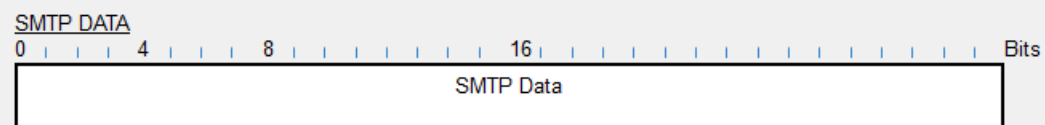
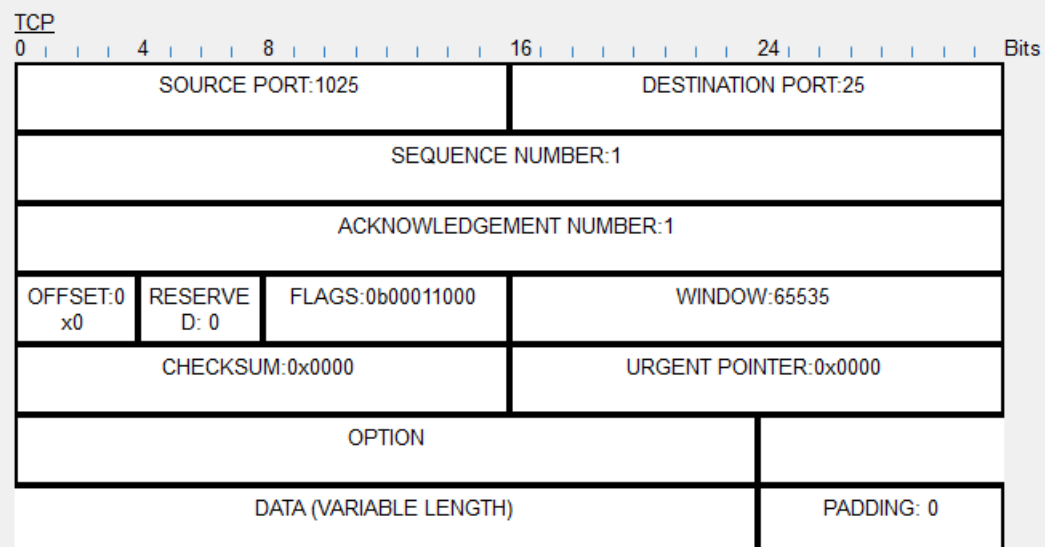
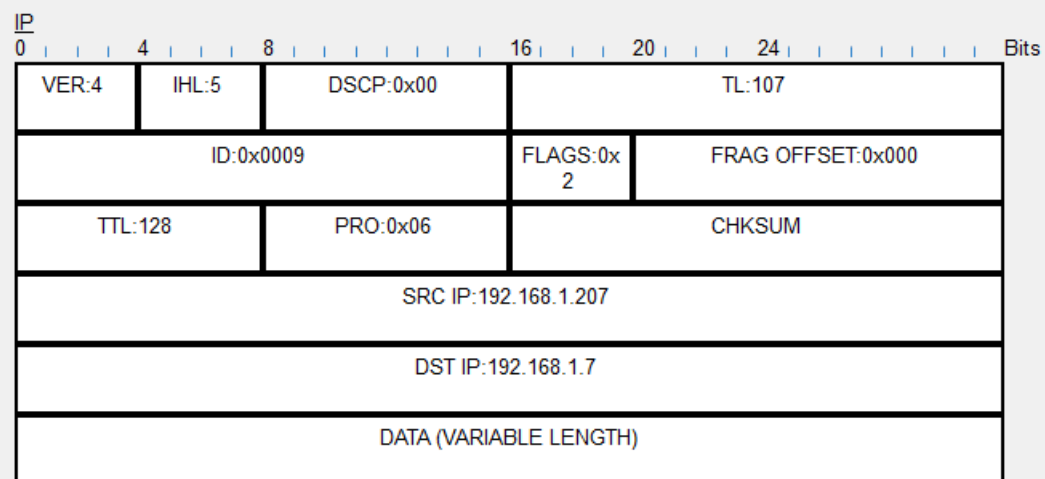


Figure 6.5: Send email inbound PDU alt.

PDU Formats

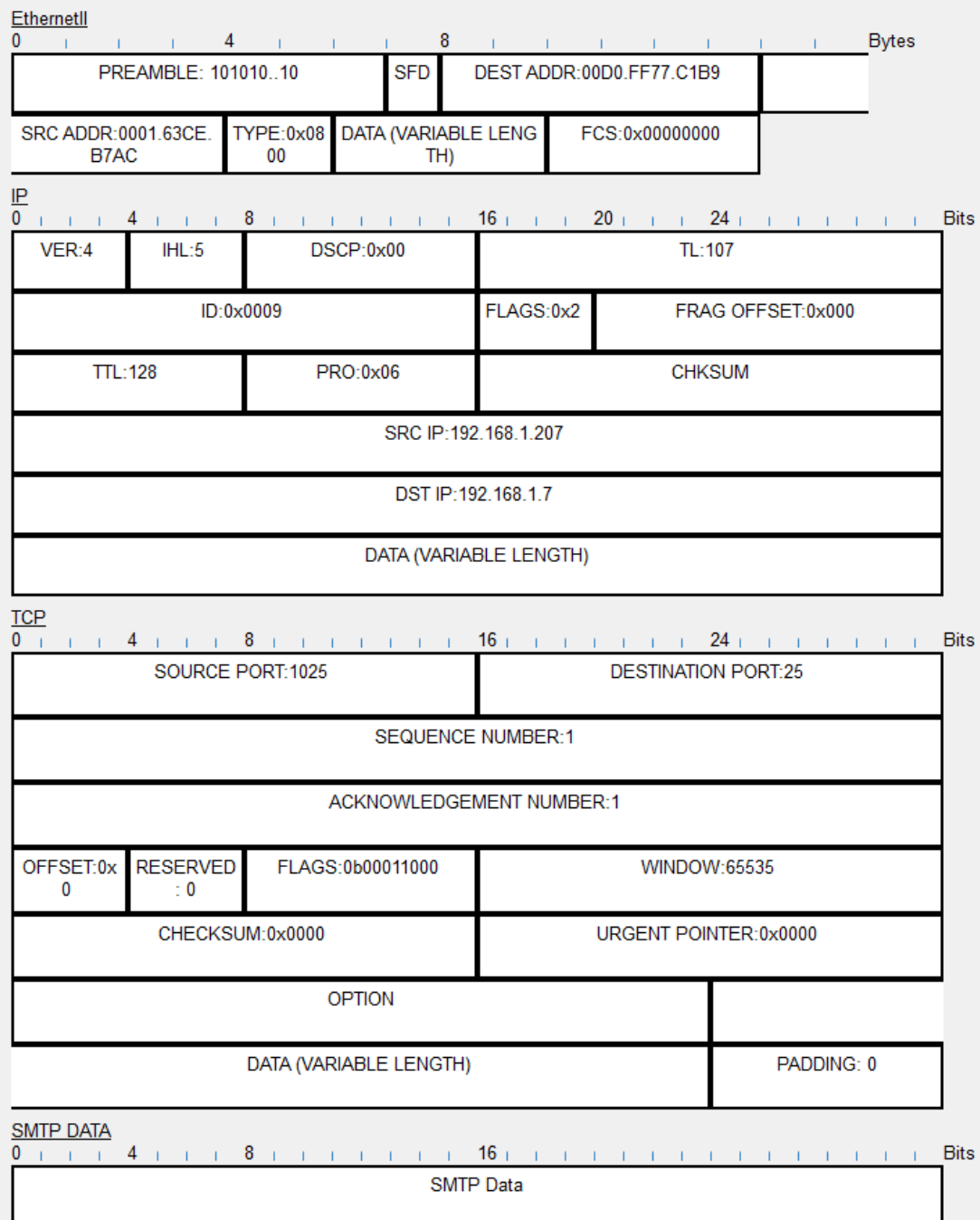


Figure 6.6: Send email outbound PDU.

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.

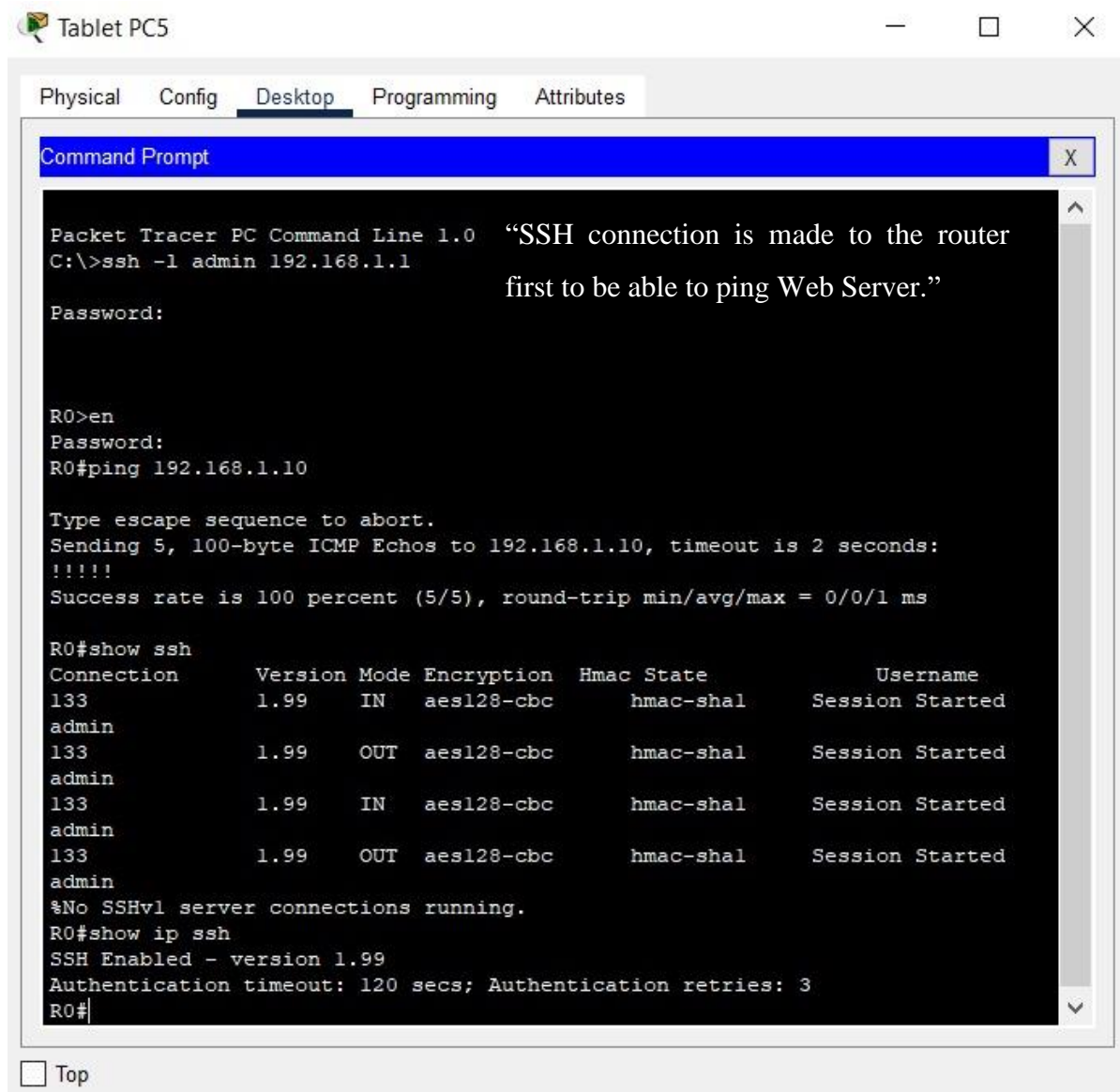
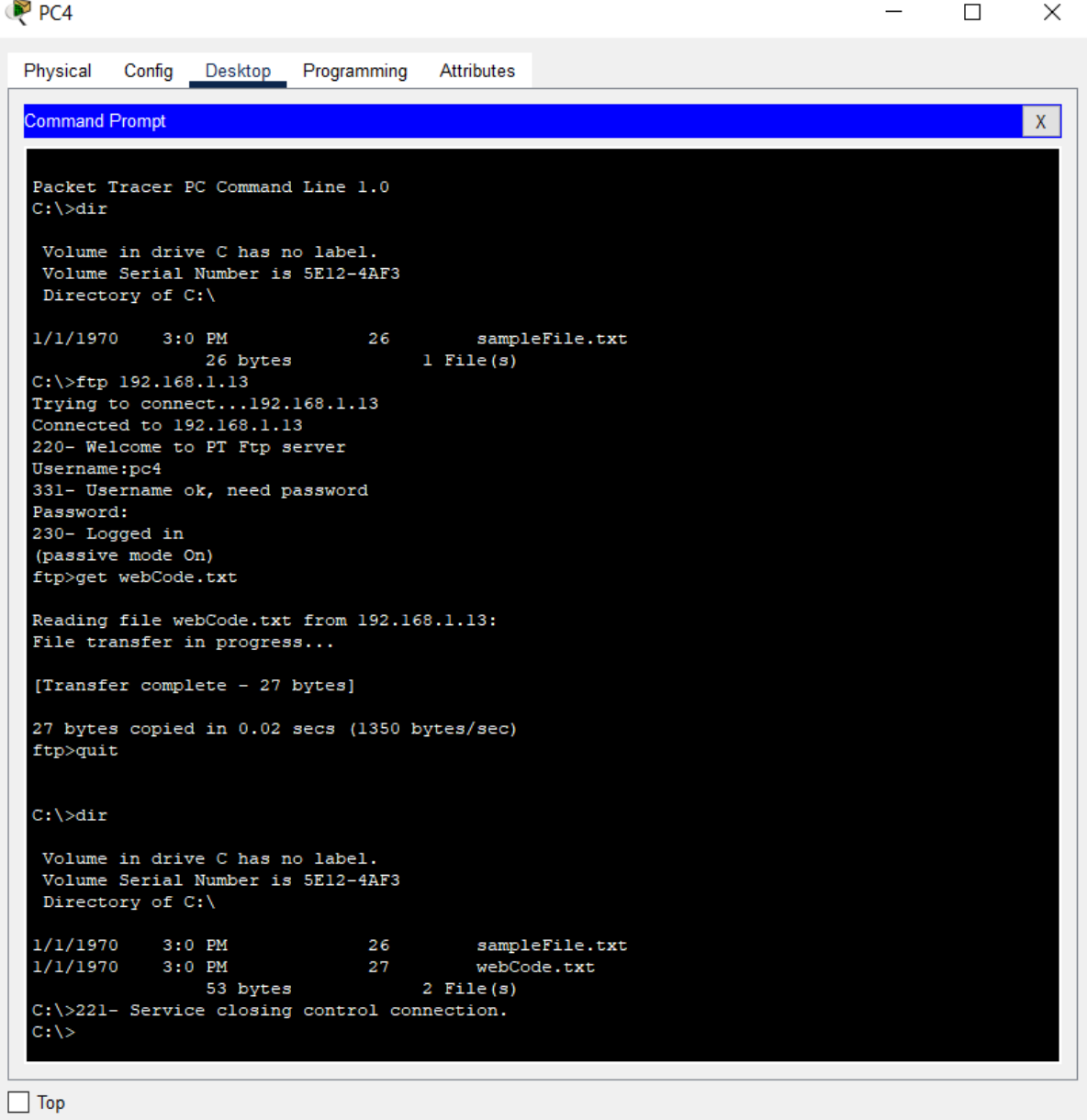


Figure 7.1: SSH Connection demonstration.

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



The screenshot shows a Packet Tracer PC Command Line window for a device named 'PC4'. The window has tabs for 'Physical', 'Config', 'Desktop' (selected), 'Programming', and 'Attributes'. The 'Command Prompt' window is open, displaying the following text:

```
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
(passive 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:\>
```

At the bottom of the window, there is a 'Top' button.

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

Layer 7: FTP
Layer6
Layer5
Layer 4: TCP Src Port: 21, Dst Port: 1025
Layer 3: IP Header Src. IP: 192.168.1.13, Dest. IP: 192.168.1.6
Layer 2: Ethernet II Header 000A.4110.A82E >> 000A.4107.913E
Layer 1: Port FastEthernet0

Out Layers

Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1

1. FastEthernet0 receives the frame.

Figure 8.2: Download from FTP - layers.

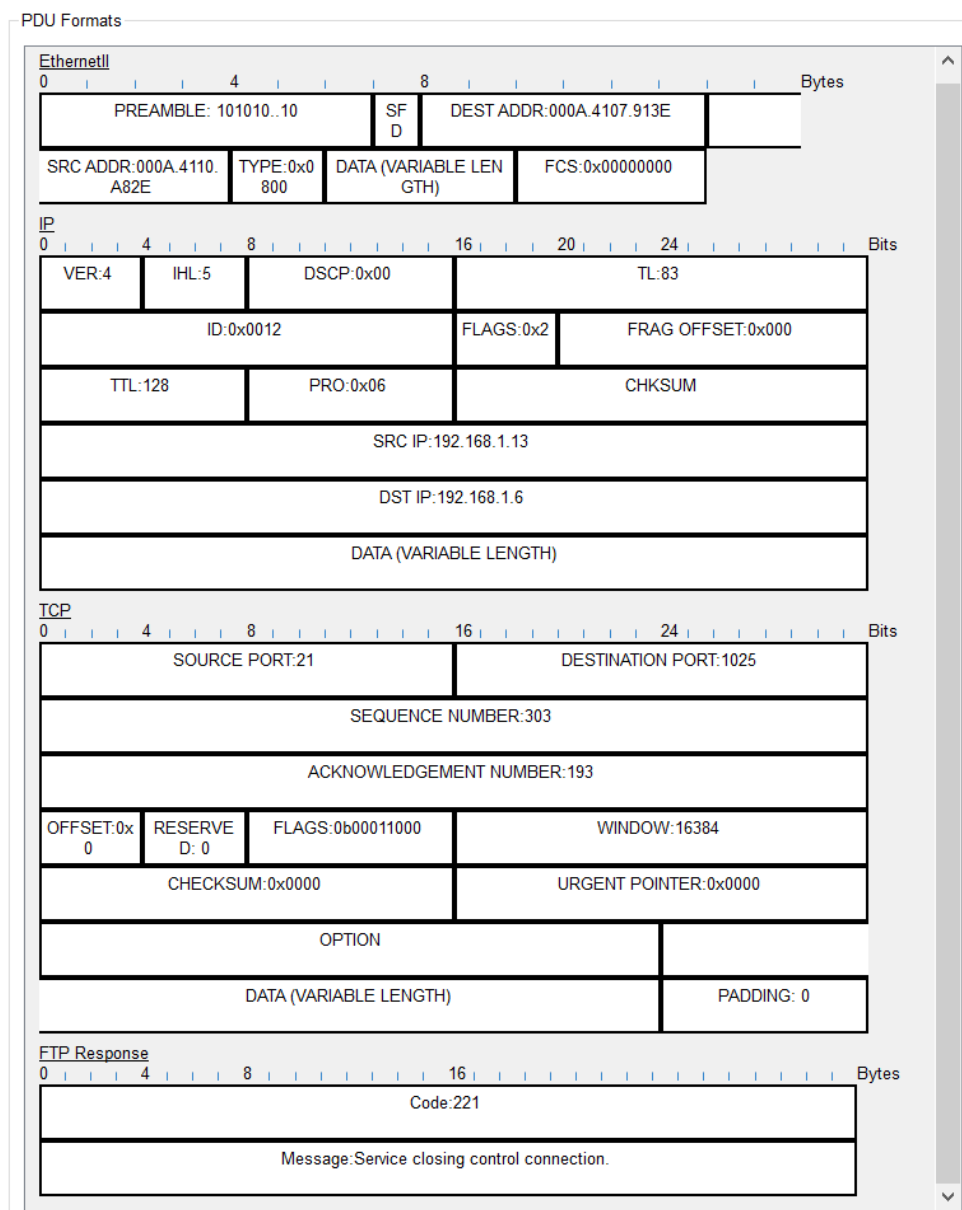
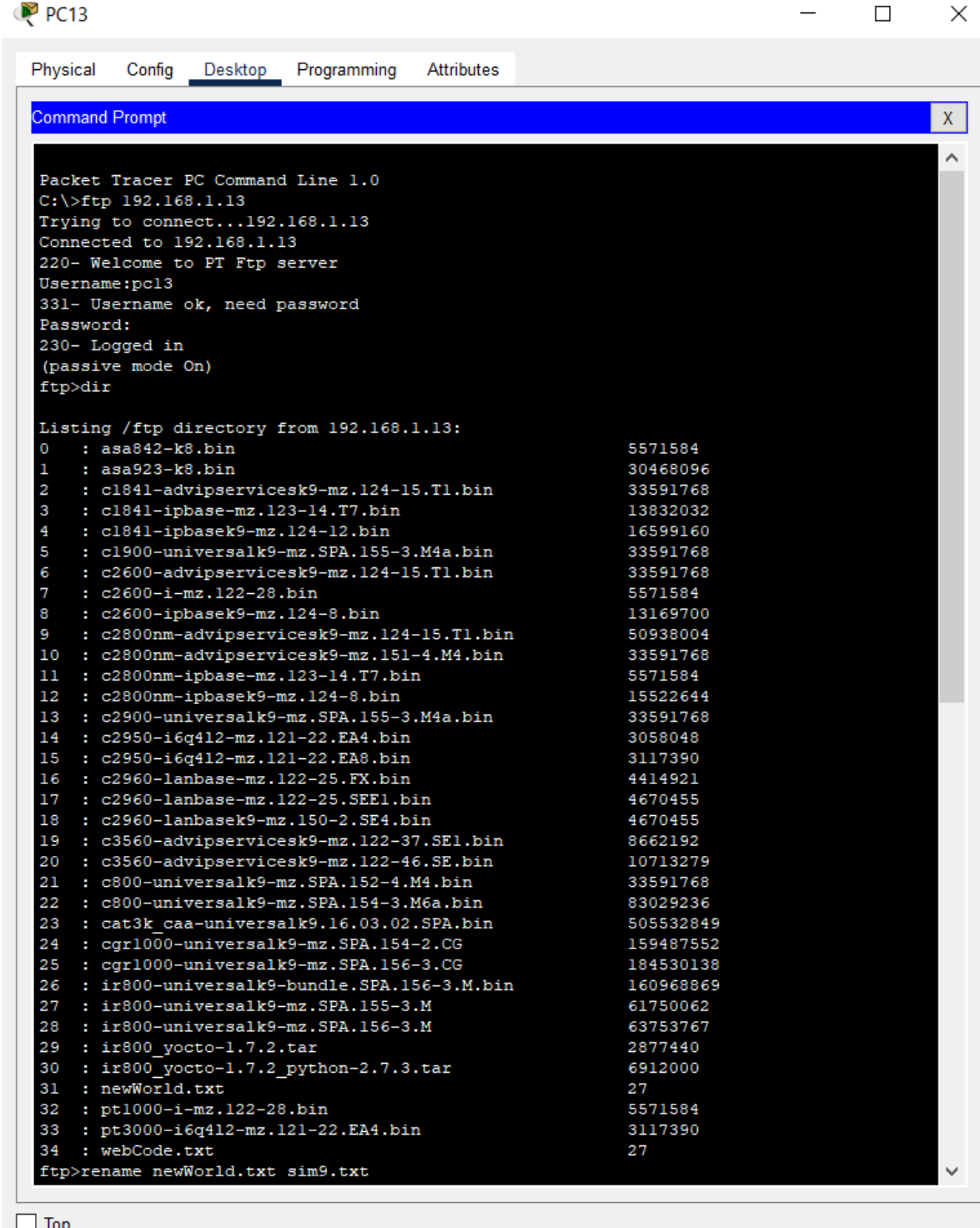


Figure 8.3: Download from FTP – PDU.

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



PC13

Physical Config **Desktop** Programming Attributes

Command Prompt

```
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 FT 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  : 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.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  : 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-i6q4l2-mz.121-22.EA4.bin            3117390
34  : webCode.txt                             27
ftp>rename newWorld.txt sim9.txt
```

☐ Top

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

```

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-i6q412-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

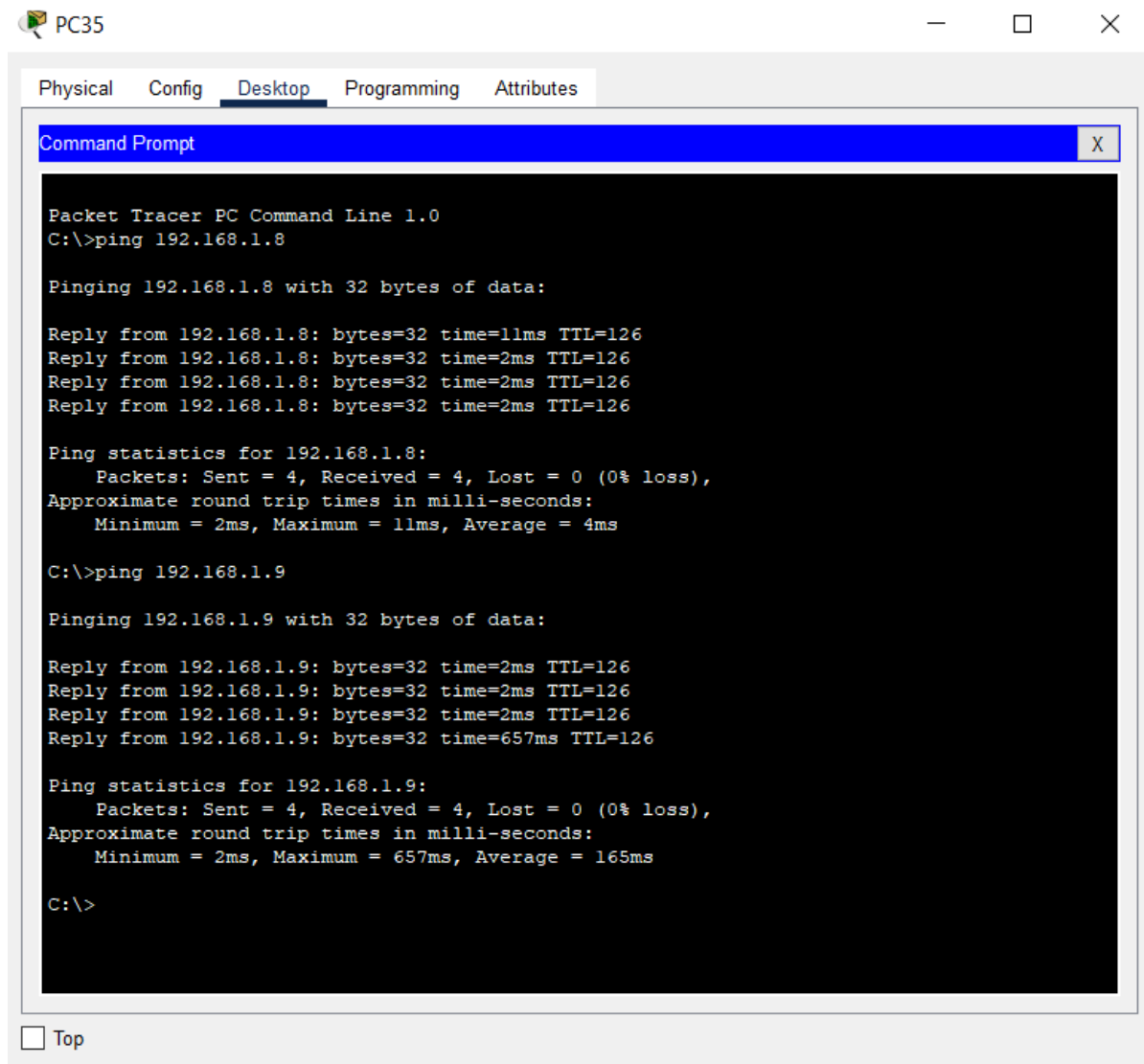
Listing /ftp directory from 192.168.1.13:
 0 : asa842-k8.bin                        5571584
 1 : asa923-k8.bin                       30468096
 2 : c1841-advipservicesk9-mz.124-15.T1.bin 33591768
 3 : c1841-ipbase-mz.123-14.T7.bin         13832032
 4 : c1841-ipbasek9-mz.124-12.bin          16599160
 5 : 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.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 : 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-i6q412-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.



The screenshot shows a Packet Tracer PC Command Line window for PC35. The window has tabs for Physical, Config, Desktop, Programming, and Attributes, with Desktop selected. The Command Prompt shows the following output:

```
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:\>
```

At the bottom of the window, there is a checkbox labeled "Top" which is currently unchecked.

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 flow 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.

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