\<Metropolitan Area Network Simulation\>

CME 3204 Data Communication and Computer Networks
Term Project Report

2023-2024 SPRING

GROUP 13

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1. Introduction

1.1. Project Definition and Problem Formulation

The project aims to design and simulate a Metropolitan Area Network (MAN) using Cisco Packet Tracer software. The network comprises two branches in a city connected via routers over an Internet Service Provider (ISP). The project involves considering various connection technologies and meeting the diverse requirements of each branch.

1.2. The purpose and motivation of the project

The purpose of this project is to demonstrate proficiency in network planning and design, emphasizing the importance of balancing system requirements with cost-effectiveness. Motivations include gaining practical experience in MAN design, understanding network traffic characterization, and mastering simulation tools like Cisco Packet Tracer.

1.3. Term Definitions

- Within networking, a node acts as a pivotal connection point in a network, commonly representing devices like computers or routers in physical networks.
- In computer networks, packets function as containers transporting data across TCP/IP networks and internetworks, constituting the fundamental unit of transmitted data.
- Channels serve as communication mediums, delineating the path through which data travels from source to destination, which can include elements like wires, open space, or entire network infrastructures.
- Protocols, in networking, embody a set of rules governing data format and processing, serving as a shared language for interconnected computers.
- Network architecture encompasses the organizational structure of network devices and services, addressing the connectivity needs of client devices.
- Switches play a crucial role in networks, facilitating the interconnection of devices such as computers, wireless access points, printers, and servers within shared environments like buildings or campuses.
- Routers, as networking devices, direct data packets between computer networks, managing traffic and routing functions on the Internet.
- Data transmitted over the Internet, including web pages and emails, is typically in the form of data packets.
- Servers are computer systems designed to process requests and deliver data to other computers, either over the Internet or within local networks.
- Local Area Networks (LANs) consist of interconnected devices situated in a shared physical location like buildings, offices, or residential areas.

- Metropolitan Area Networks (MANs) link individuals to computer resources within a geographic area comparable in size to a metropolitan area, often integrating LANs within cities to establish an expanded network infrastructure.

1.4. Related Work

In our design phase, we employ Cisco Packet Tracer as our simulation tool. It offers a visual representation of network functionalities, aiding in comprehensive analysis and understanding of complex configurations.

2. Method and Simulation

You should present network requirements and constraints that you consider while modelling and simulating.

2.1. Simulation and Modeling Concepts

Cisco Packet Tracer comprises two primary components: the physical topology and the logical topology. The physical topology mirrors the actual physical connections within a network, encompassing cables, wires, and the arrangement of network components. Conversely, the logical topology illustrates data flow between devices independent of physical connections.

Physical topologies, while essential for network infrastructure, pose challenges in terms of flexibility and scalability. They are less adaptable to organizational changes and require extensive reconfiguration to accommodate new requirements. Additionally, physical networks necessitate robust security measures to safeguard against threats.

In contrast, logical topologies are defined by packet headers and can be easily adjusted to meet evolving needs. Cisco Packet Tracer offers two operating modes to visualize network behavior: real-time mode and simulation mode. Real-time mode replicates real device behavior, providing immediate responses to network activities, while simulation mode allows for deeper exploration of data transfer mechanisms and network operations, aiding in fundamental concept understanding.

2.3. Network Design Requirements

The project encompasses two branches connected via an Internet Service Provider (ISP), with each branch comprising three facilities housing various devices. In each facility, a router serves as the gateway to the main router connecting to the ISP.

Within the first branch, a server farm has been established, comprising one DHCP server, one DNS server, four FTP servers, and ten Web servers. IPs for these servers are statically assigned. End-devices in this branch obtain their IPs dynamically from the DHCP server. Additionally, an access point facilitates connectivity for laptops, smartphones, tablets, and PCs. Each facility is contains multiple devices connnect to a switch connects to a router.

In the second branch, several end-devices have been added, with their IPs assigned dynamically from the DHCP server located in the first branch. Each facility is contains multiple devices connnect to a switch connects to a router.

Various protocols were integrated into the network design, each serving specific communication and data transfer purposes:

- TCP/IP: Employed as the primary protocol suite for communication over the Internet, TCP/IP operates on a layered model. It follows the client-server model, where a client computer initiates requests, and servers respond to these requests.
- FTP (File Transfer Protocol): Widely used for transferring files over the Internet and private networks, FTP facilitates efficient file exchange between clients and servers.
- HTTP (Hypertext Transfer Protocol): HTTP is a protocol used for transmitting hypertext documents over the Internet. It enables the retrieval and display of linked resources, facilitating the browsing of web pages and the navigation of interconnected content..
- DNS (Domain Name System): Utilized to translate domain names into corresponding IP addresses, DNS plays a crucial role in facilitating user-friendly access to websites and online resources.

2.4. Requirement Analysis

The network must support various applications like VoIP for voice communication, web browsing for accessing online resources, file transfer for efficient data sharing, and email services for electronic communication. It should accommodate a specific number of users across both branches without causing congestion and provide adequate bandwidth for smooth operation. Additionally, ensuring low latency is crucial, especially for real-time applications like VoIP. However, budget limitations may restrict the choice of equipment and technologies, while physical space constraints within facilities may affect network deployment. Compliance with regulations and industry standards is essential, and security measures must be implemented to protect data and prevent unauthorized access. Lastly, the network should be scalable to accommodate future growth and expansion.

2.5. Definitions of the System/Model

The system comprises two branches, with each facility representing an office. Each office has three switches, each switch connects to a router. Each switch has several end-devices that has multiple features like sending mails, browsing web, Exchange files, and utilize VoIP technology for voice communication.

Web servers are deployed to facilitate web browsing activities. These servers, consisting of both hardware and software components, handle HTTP or HTTPS requests from user agents, such as web browsers or web crawlers, and respond by providing the requested web content or error messages.

For file operations, FTP servers are utilized to enable remote sharing of data between devices. These servers allow users to upload and download files using the FTP protocol, enhancing collaboration and data exchange within the network.

To automate the assignment of IP addresses, a DHCP server is employed. The Dynamic Host Configuration Protocol (DHCP) automates the process of providing IP addresses and other configuration parameters, such as subnet masks and default gateways, to IP hosts, simplifying network administration and management.

Mail servers manage email transactions within the system, facilitating the exchange of electronic messages between users. These servers handle the sending, receiving, and storage of emails, ensuring efficient communication within the network.

DNS serves a critical role in connecting users to the Internet using human-readable domain names. The Domain Name System translates domain names (e.g., 'google.com') into corresponding IP addresses, enabling computers and networks to locate and access websites seamlessly.

The overall shape of the project is given below.
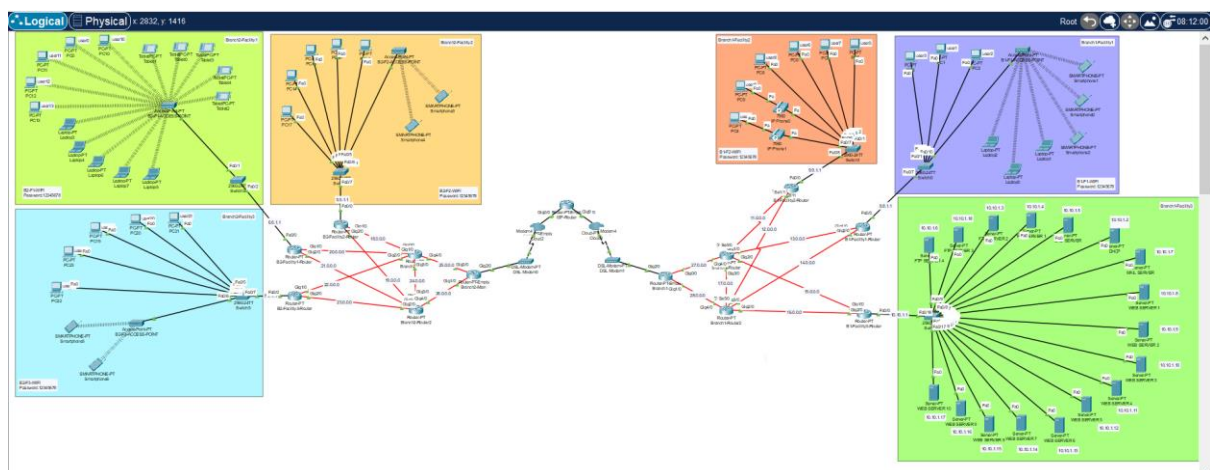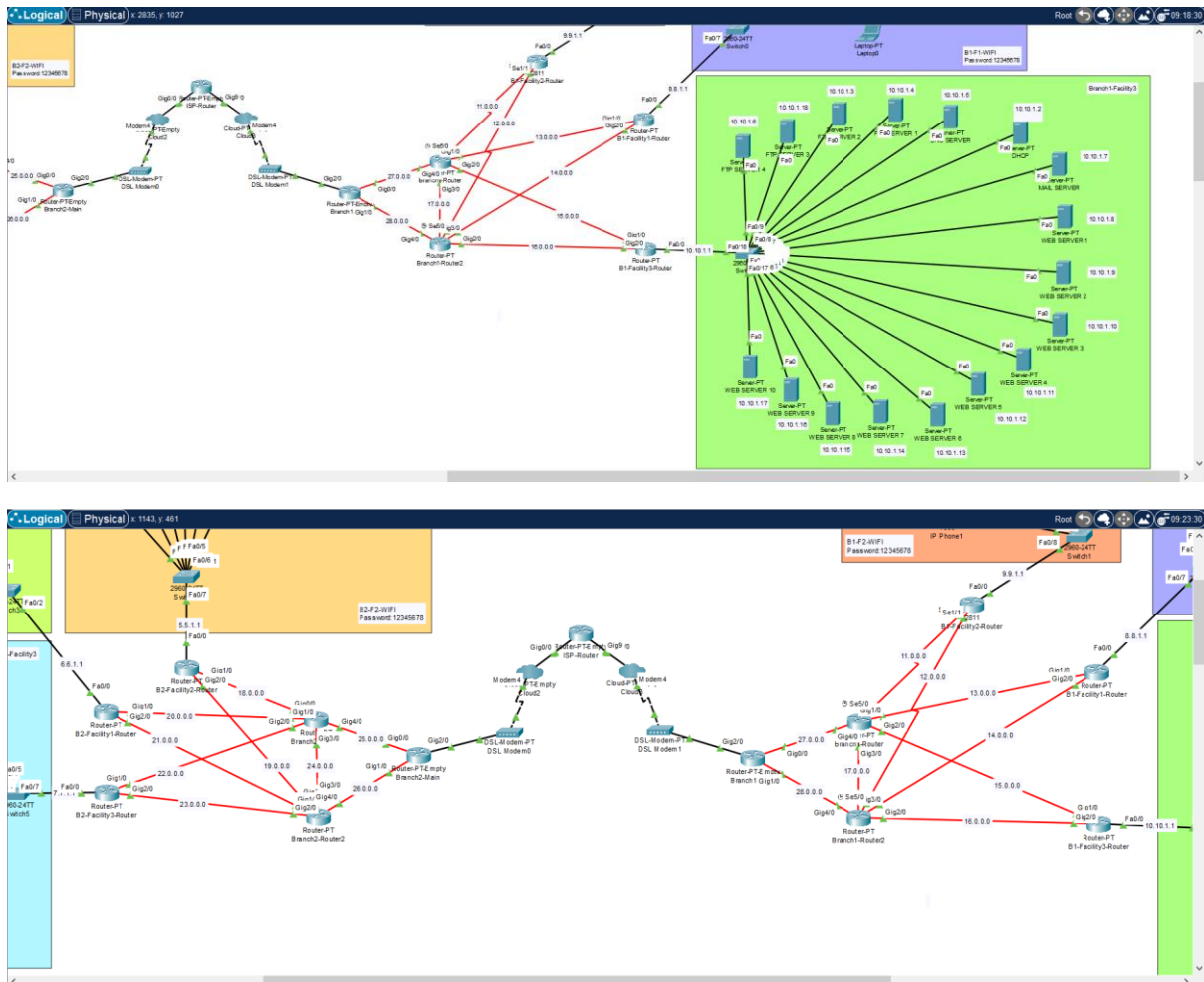
2.6. Simulation Elements

The Project includes these end-devices, 24 workstations (PC), 8 Laptops, 5 tablets, 7 smartphones, 10 Web servers, 4 FTP servers, 1 DHCP server, 1 mail server and 1 domain name server (DNS). Also, it includes internal devices, 4 access points, 6 switches, 13 routers, 2 DSL modems, 2 clouds, 2 IP phones.
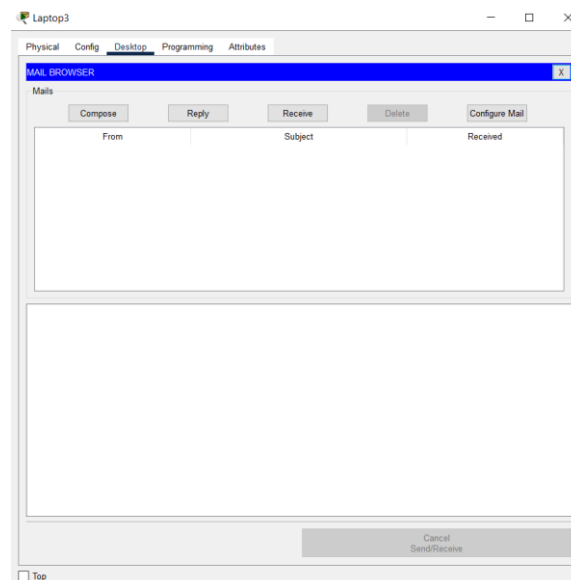
3. Traffic Analysis and Simulation Results

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

-Sending emails from Tablet4 to Laptop3. Laptop3 reads the email.
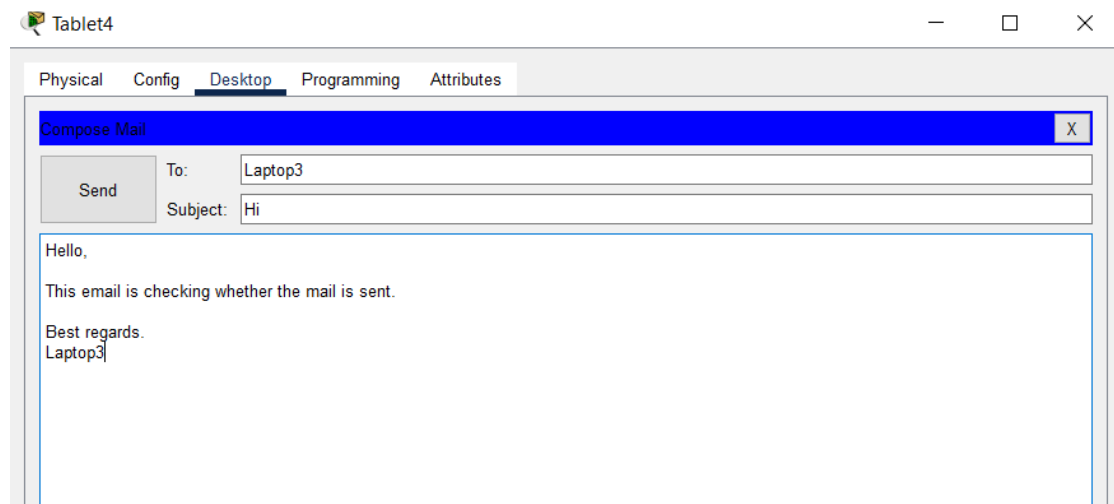
-Laptop3's screen before sending the email .

-After pressing 'Receive' button, the mail is received.

Laptop3 — □ ✕

Physical | Config | Desktop | Programming | Attributes

MAIL BROWSER [X]

Mails

Compose | Reply | Receive | Delete | Configure Mail

	From	Subject	Received
1	Tablet4@deu.edu.tr	Hi	Cum Nis 26 2024 00:32:03

Hi
Tablet4@deu.edu.tr
Sent : Cum Nis 26 2024 00:32:03

Hello,

This email is checking whether the mail is sent.

Best regards

Receiving mail from POP3 Server deu.edu.tr
DNS resolving. Resolving name: deu.edu.tr by querying to DNS Server: 10.10.1.5
DNS resolved ip address: 10.10.1.7
Receive Mail Success.

Cancel
Send/Receive

☐ Top

Simulation Panel (Panel 1)

Event List

Vis.	Time(sec)	Last Device
	8.406	--
	8.407	Tablet4
	8.407	Branch2-Main
	8.408	B2-F1-ACCESS-POİNT
	8.408	DSL Modem0
	8.408	--
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT

Simulation Panel (Panel 2)

Event List

Vis.	Time(sec)	Last Device
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	B2-F1-ACCESS-POİNT
	8.409	Switch3
	8.409	Cloud2
	8.410	B2-Facility1-Router
	8.410	ISP-Router
	8.411	Branch2-Router
	8.411	Cloud3
	8.412	Branch2-Main
	8.412	DSL Modem1
	8.413	DSL Modem0
	8.413	Branch1-Main

Simulation Panel (Panel 3)

Event List

Vis.	Time(sec)	Last Device
	8.415	ISP-Router
	8.415	B1-Facility3-Router
	8.416	Cloud3
	8.416	Switch2
	8.417	DSL Modem1
	8.418	Branch1-Main
	8.419	Branch1-Router2
	8.420	B1-Facility3-Router
	8.421	Switch2
	8.422	MAIL SERVER
	8.423	Switch2
	8.424	B1-Facility3-Router
	8.425	Branch1-Router

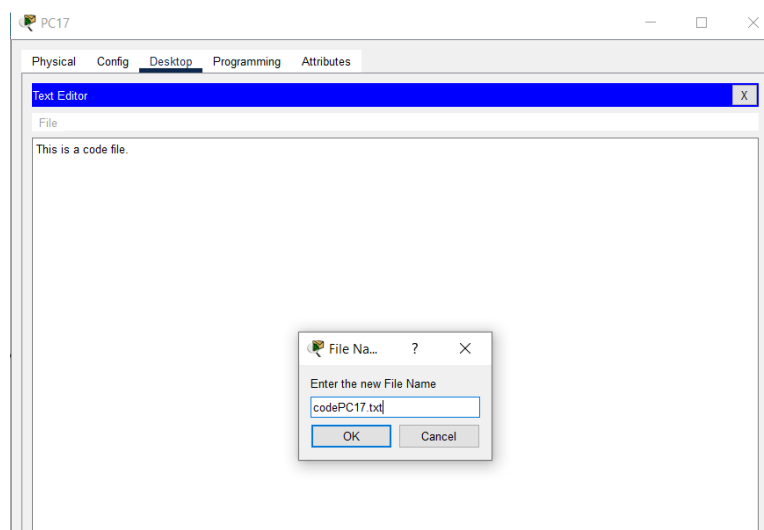-Browsing web from Laptop3, both with IP address and with the name.
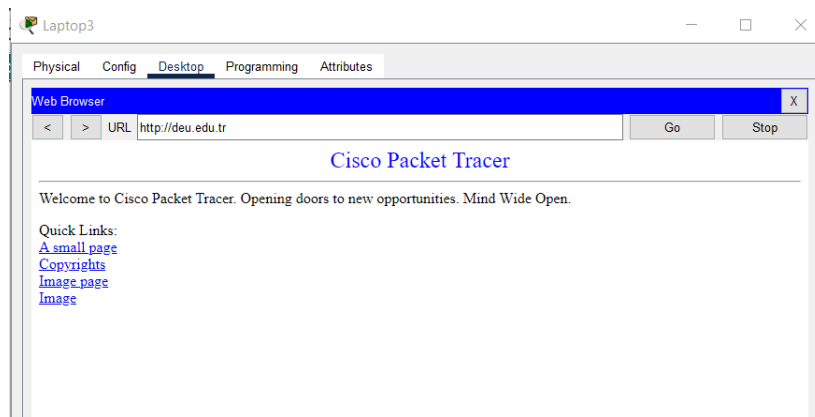

With domain name

With IP address

Scenario 2: A computer engineer from second facility of second branch developed a web application and wants to send his/her code files to FTP server in the third facility of first branch.
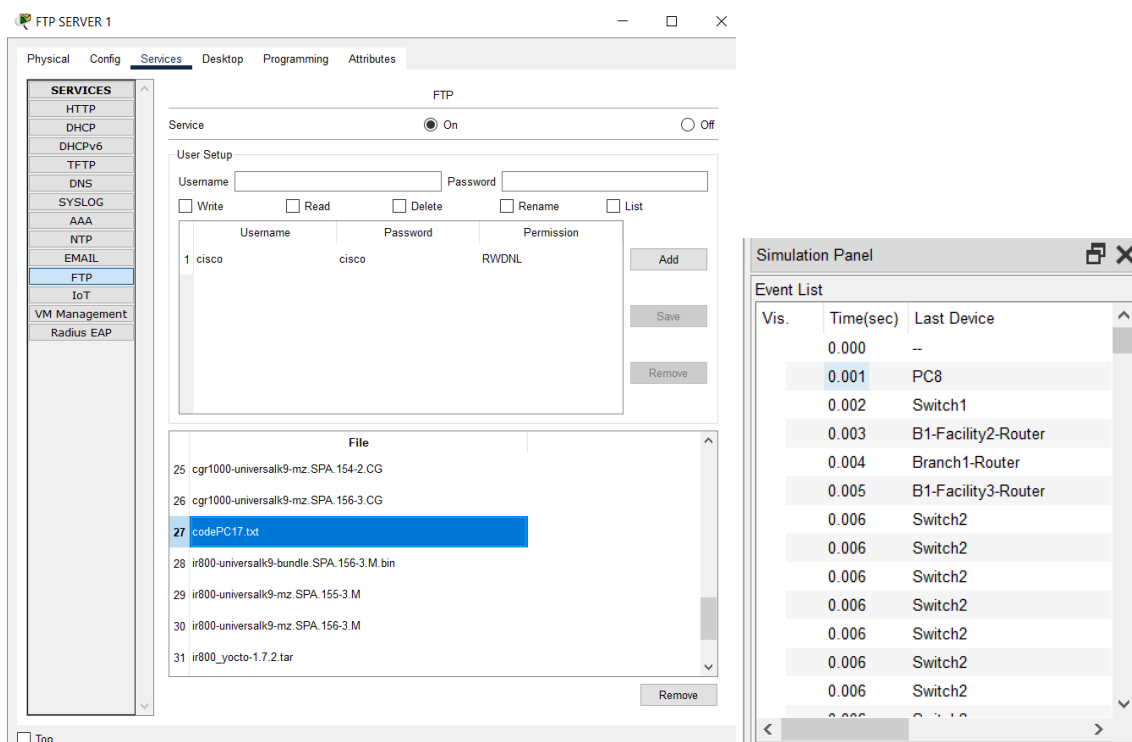
-Creating a text file in PC17 from 2nd facility of 2nd branch.

-Open cmd on PC17, write the codes 'ftp (FTP server address)' and after connecting to the FTP server 1, enter username and password, then write code 'put (filename).txt
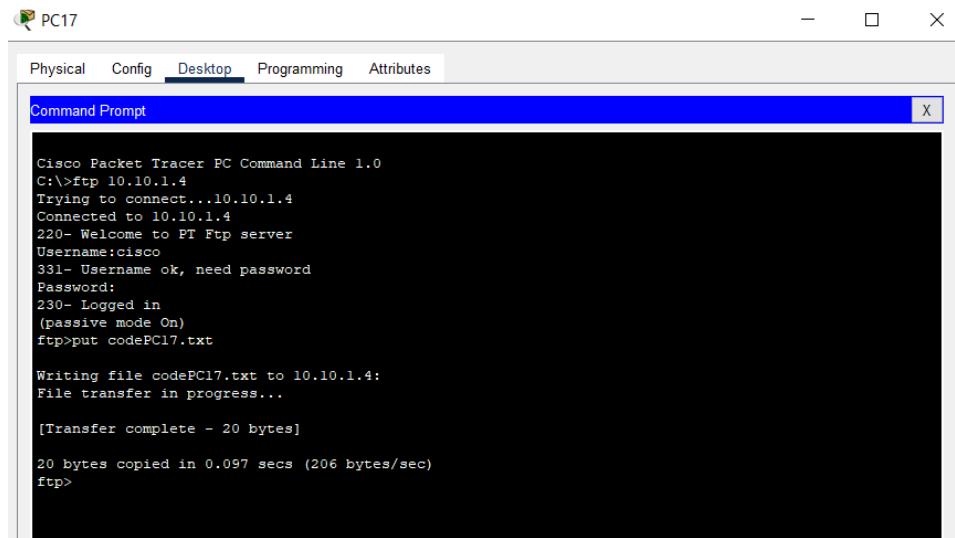
-The file is now on the FTP Server 1

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

-The number of the phone on the left is 112, the number of the other phone is 155. If it is entered 155 on the first phone it can be seen that the second phone is ringing.
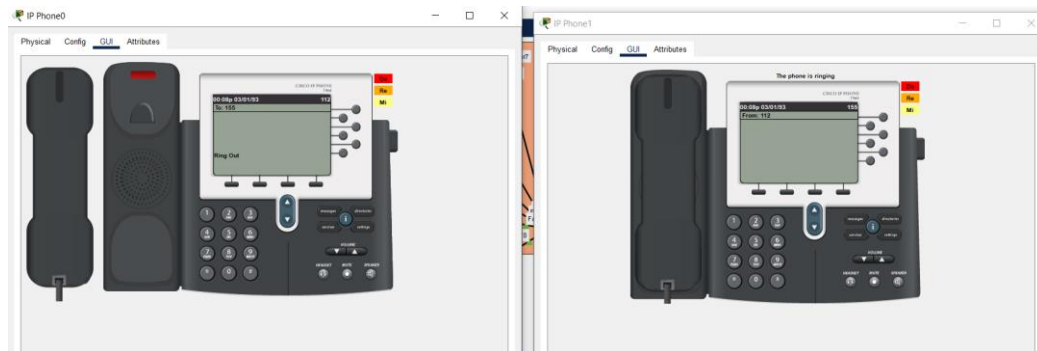
Scenario 4: A user in the second facility of first branch wants to send an email message to his friend in the second facility of second branch.

-It can be seen that the email is received.

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

user13 from the first facility of the second branch ping the WEBSERVER10 from the third facility of first branch. For this, opens the desktop of PC13, after that enters the Web Browser and enters the domain name of the web browser of 13.
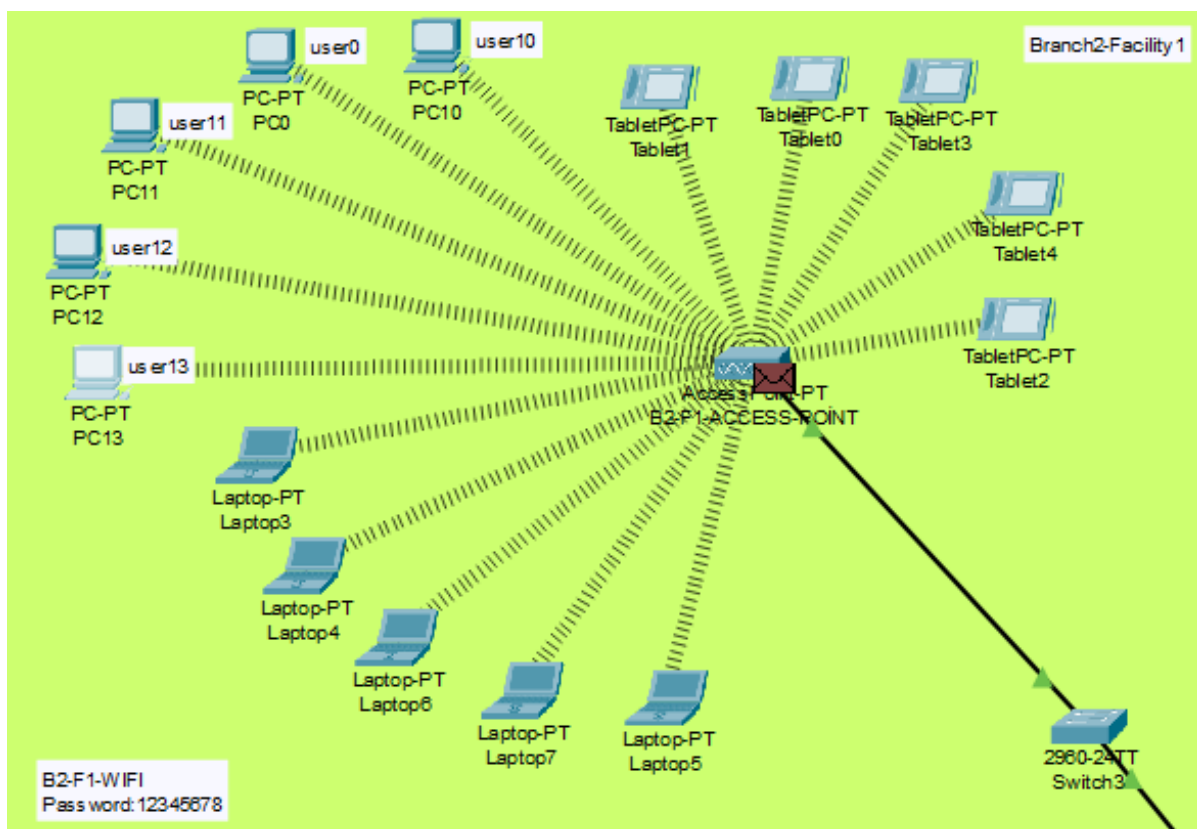
Letter reaches the Access Point.
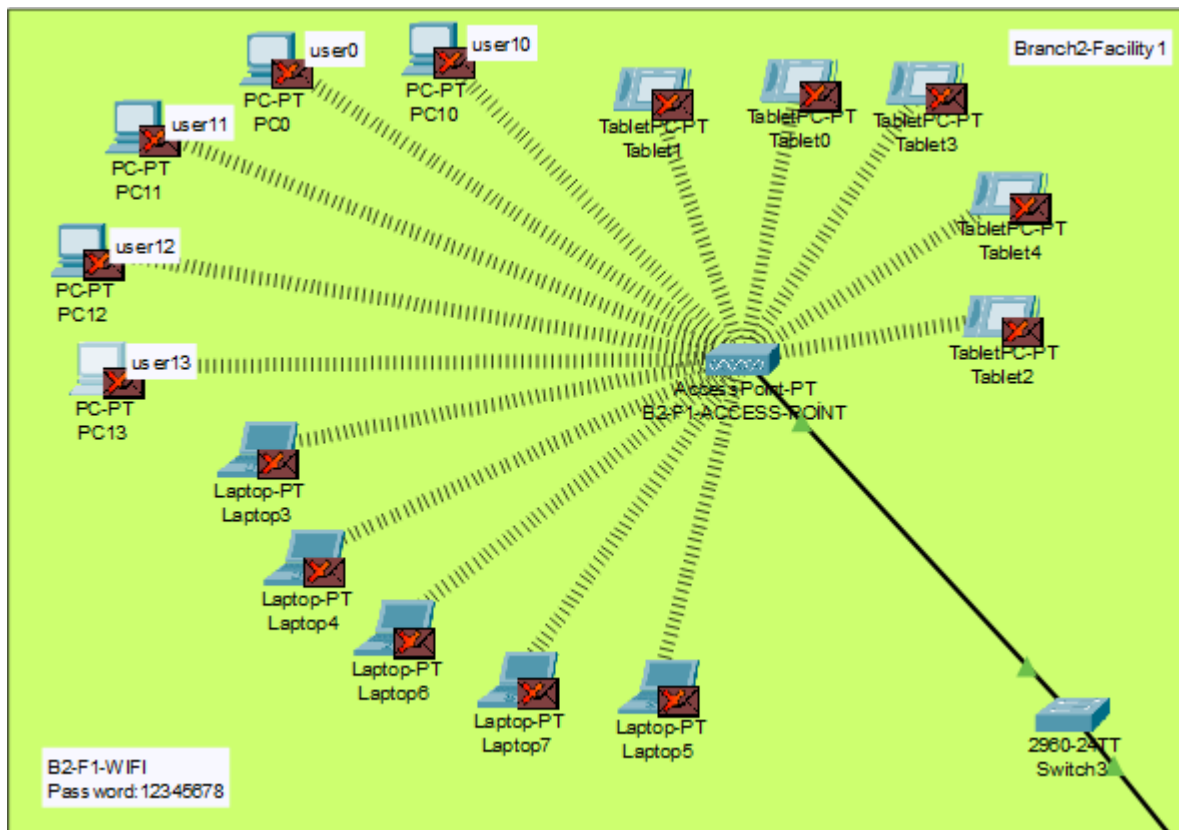
Access Point sends all devices that has connection with it. But they were not accept the message.
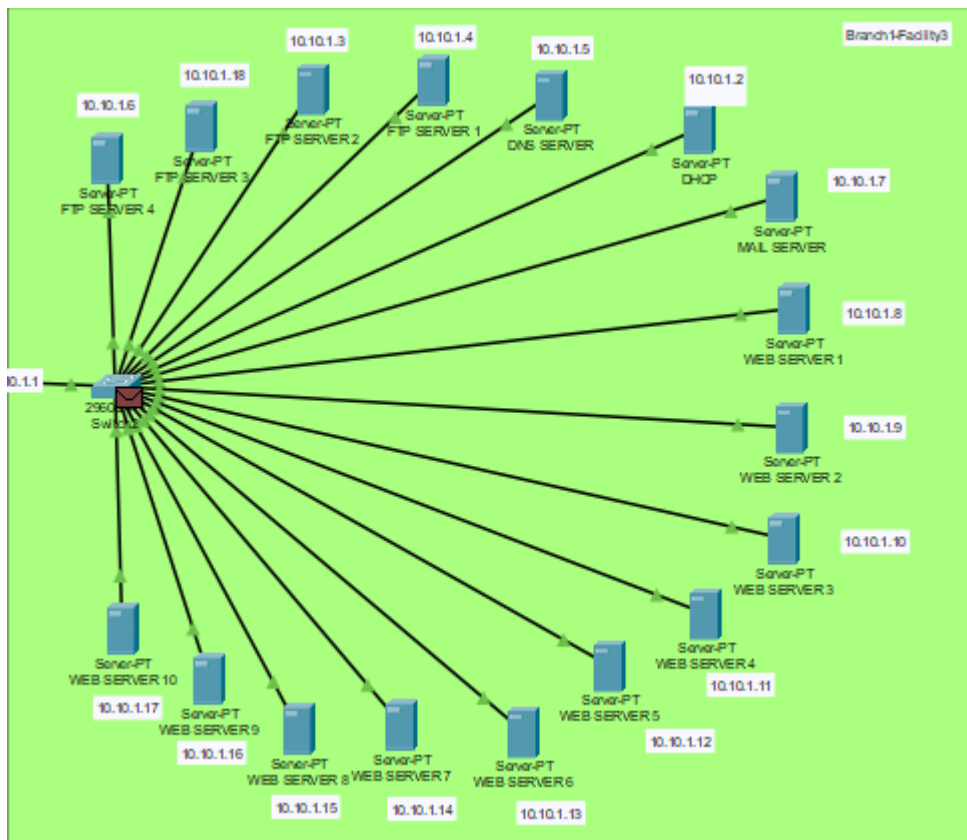
Finally letter reaches the final switch.
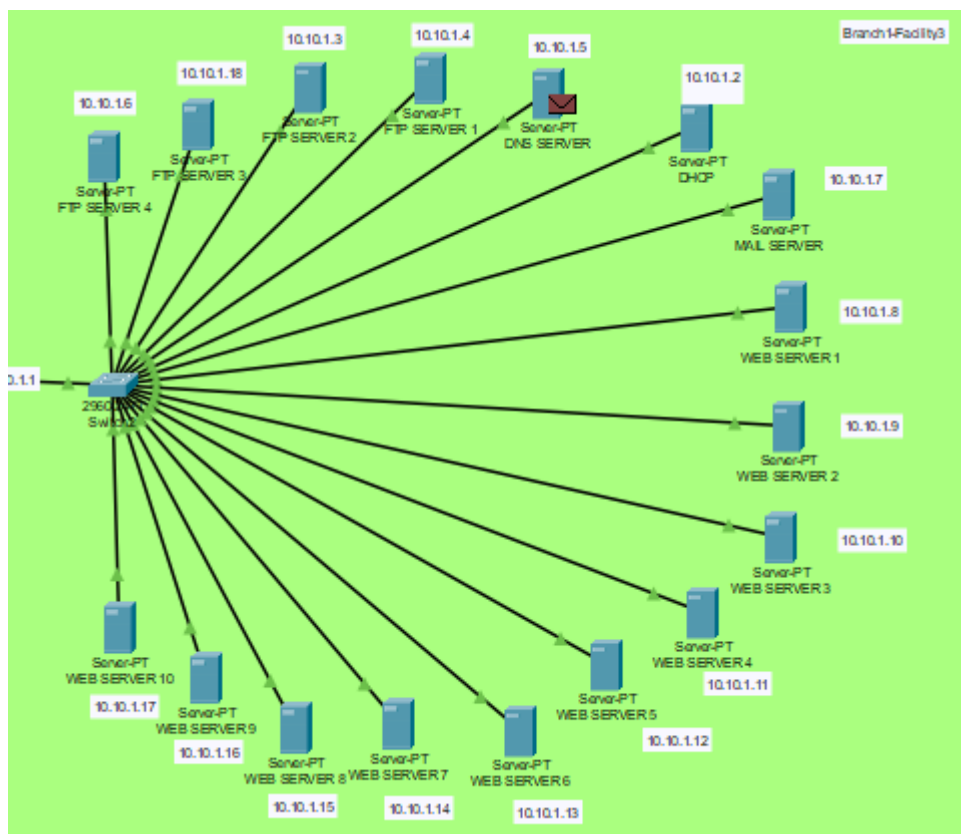
Switch sends the letter to DNS server. And IP address of related domain name received from the DNS.
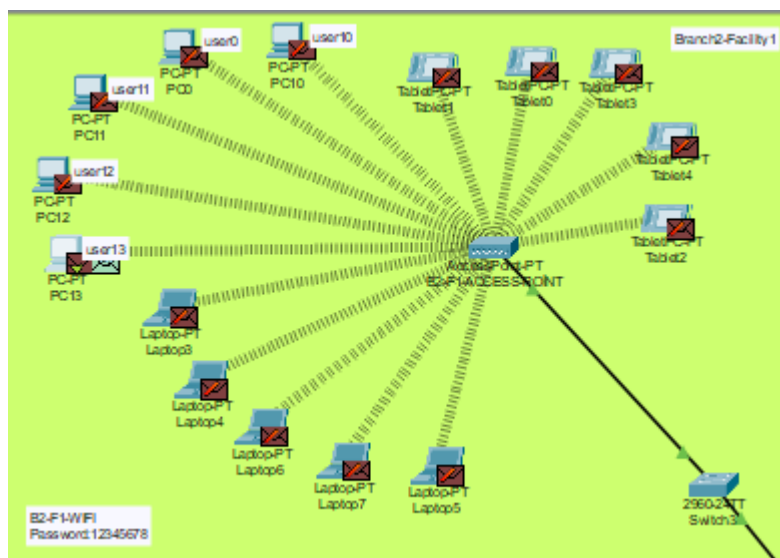
IP address reached the PC13.
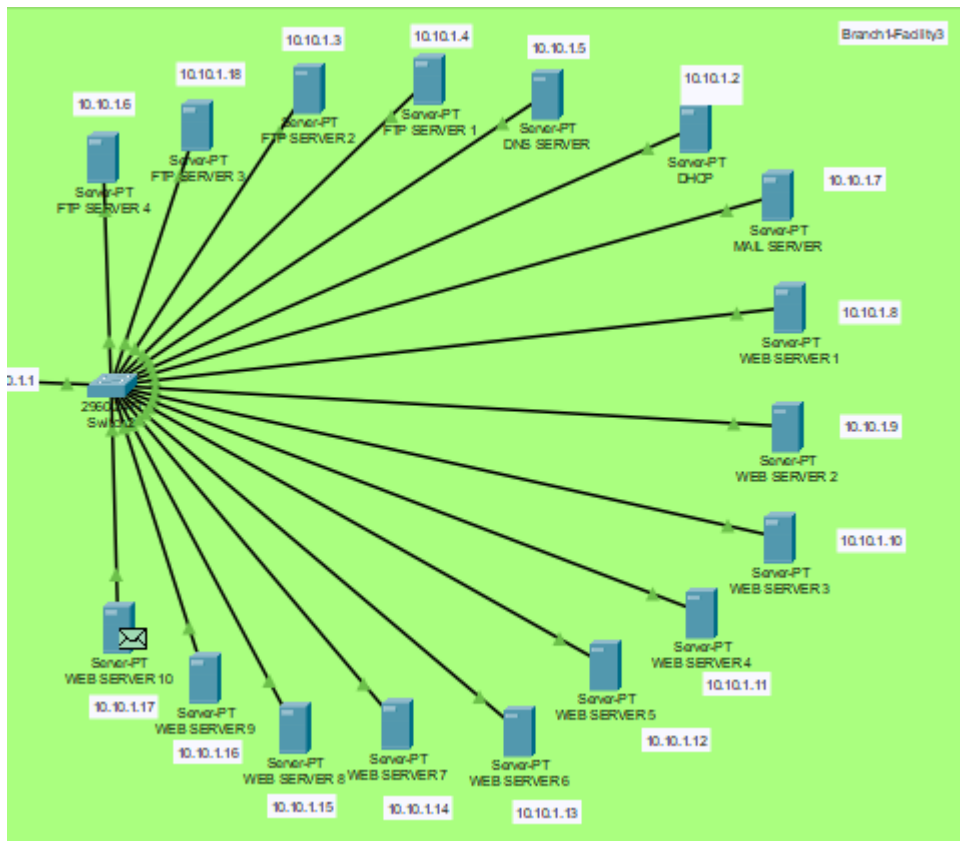
Finally the message goes to related web server.

Event List screenshots are in below.

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	PC13
	0.002	B2-F1-ACCESS-POİNT
	0.003	Switch3
	0.003	--
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-F1-ACCESS-POİNT

Vis.	Time(sec)	Last Device
	0.004	B2-F1-ACCESS-POİNT
	0.004	B2-Facility1-Router
	0.005	Branch2-Router
	0.006	Branch2-Main
	0.007	DSL Modem0
	0.008	Cloud2
	0.009	ISP-Router
	0.010	Cloud3
	0.011	DSL Modem1
	0.012	Branch1-Main
	0.013	Branch1-Router2
	0.014	B1-Facility3-Router
	0.015	Switch2

0.016	DNS SERVER	
0.017	Switch2	
0.018	B1-Facility3-Router	
0.019	Branch1-Router2	
0.020	Branch1-Main	
0.021	DSL Modem1	
0.022	Cloud3	
0.023	ISP-Router	
0.024	Cloud2	
0.025	DSL Modem0	
0.026	Branch2-Main	
0.027	Branch2-Router	
0.028	B2-Facility1-Router	

Event List

Vis.	Time(sec)	Last Device
	0.030	B2-F1-ACCESS-POİNT
	0.030	B2-F1-ACCESS-POİNT
	0.030	--
	0.035	--
	0.036	PC13
	0.037	B2-F1-ACCESS-POİNT
	0.038	Switch3
	0.039	B2-Facility1-Router
	0.039	--
	0.040	B2-F1-ACCESS-POİNT
	0.040	B2-F1-ACCESS-POİNT
	0.040	B2-F1-ACCESS-POİNT
	0.040	B2-F1-ACCESS-POİNT

Event List

Vis.	Time(sec)	Last Device
	0.040	Branch2-Router2
	0.041	Branch2-Main
	0.042	DSL Modem0
	0.043	Cloud2
	0.044	ISP-Router
	0.045	Cloud3
	0.046	DSL Modem1
	0.047	Branch1-Main
	0.048	Branch1-Router
	0.049	B1-Facility3-Router
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2

Event List

Vis.	Time(sec)	Last Device
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
	0.050	Switch2
👁	0.051	WEB SERVER 10

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.

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.109	Switch2
	0.110	MAIL SERVER
	0.111	Switch2
	0.112	B1-Facility3-Router
	0.113	Branch1-Router
	0.114	Branch1-Main
	0.115	DSL Modem1
	0.116	Cloud3
	0.117	ISP-Router
	0.118	Cloud2
	0.119	DSL Modem0
	0.120	Branch2-Main
	0.121	Branch2-Router
	0.122	B2-Facility1-Router

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	B2-F1-ACCESS-POİNT
	0.124	--
	0.127	--
👁	0.128	PC13

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	Laptop2
	0.002	B1-F1-ACCESS-POİNT
	0.002	--
	0.003	B1-F1-ACCESS-POİNT
	0.003	B1-F1-ACCESS-POİNT
	0.003	B1-F1-ACCESS-POİNT
	0.003	B1-F1-ACCESS-POİNT
	0.003	B1-F1-ACCESS-POİNT
	0.003	B1-F1-ACCESS-POİNT
	0.003	Switch0
	0.004	B1-Facility1-Router
	0.005	Branch1-Router
	0.006	B1-Facility3-Router

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.010	B1-Facility3-Router
	0.011	Branch1-Router
	0.012	B1-Facility1-Router
	0.013	Switch0
	0.014	B1-F1-ACCESS-POİNT
	0.014	B1-F1-ACCESS-POİNT
	0.014	B1-F1-ACCESS-POİNT
	0.014	B1-F1-ACCESS-POİNT
	0.014	B1-F1-ACCESS-POİNT
	0.014	B1-F1-ACCESS-POİNT
	0.014	--
	0.016	--
	0.017	Laptop2
	0.018	B1-F1-ACCESS-POİNT

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.016	--
	0.017	Laptop2
	0.018	B1-F1-ACCESS-POİNT
	0.018	--
	0.019	B1-F1-ACCESS-POİNT
	0.019	B1-F1-ACCESS-POİNT
	0.019	B1-F1-ACCESS-POİNT
	0.019	B1-F1-ACCESS-POİNT
	0.019	B1-F1-ACCESS-POİNT
	0.019	B1-F1-ACCESS-POİNT
	0.019	Switch0
	0.020	B1-Facility1-Router
	0.021	Branch1-Router2
	0.022	B1-Facility3-Router

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.100	DSL Modem1
	0.101	DSL Modem0
	0.101	Branch1-Main
	0.102	Cloud2
	0.102	Branch1-Router2
	0.103	ISP-Router
	0.103	B1-Facility3-Router
	0.104	Cloud3
	0.104	Switch2
	0.105	DSL Modem1
	0.106	Branch1-Main
	0.107	Branch1-Router
	0.108	B1-Facility3-Router
	0.109	Switch2

PDU Information at Device: B2-F1-ACCESS-POİNT

OSI Model   Inbound PDU Details   Outbound PDU Details

At Device: B2-F1-ACCESS-POİNT
Source: PC13
Destination: 10.10.1.7

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer2	Layer2
Layer 1: Port Port 1	Layer 1: Port(s): Port 0

1. Port 1 receives the frame.

Challenge Me   << Previous Layer   Next Layer >>

-Sending an email.
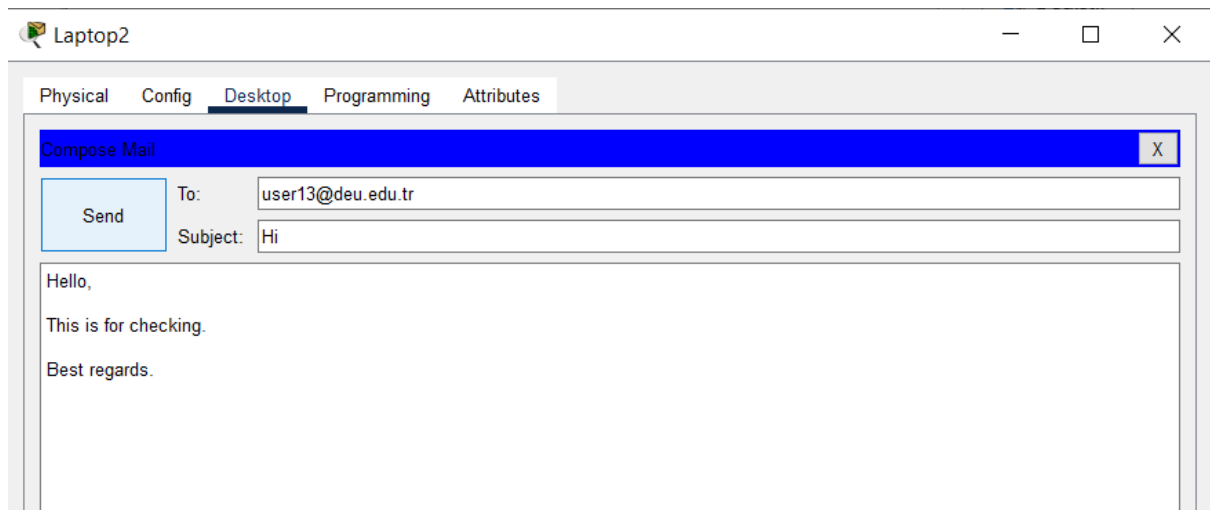
-The email is received after pressing 'Receive' button.
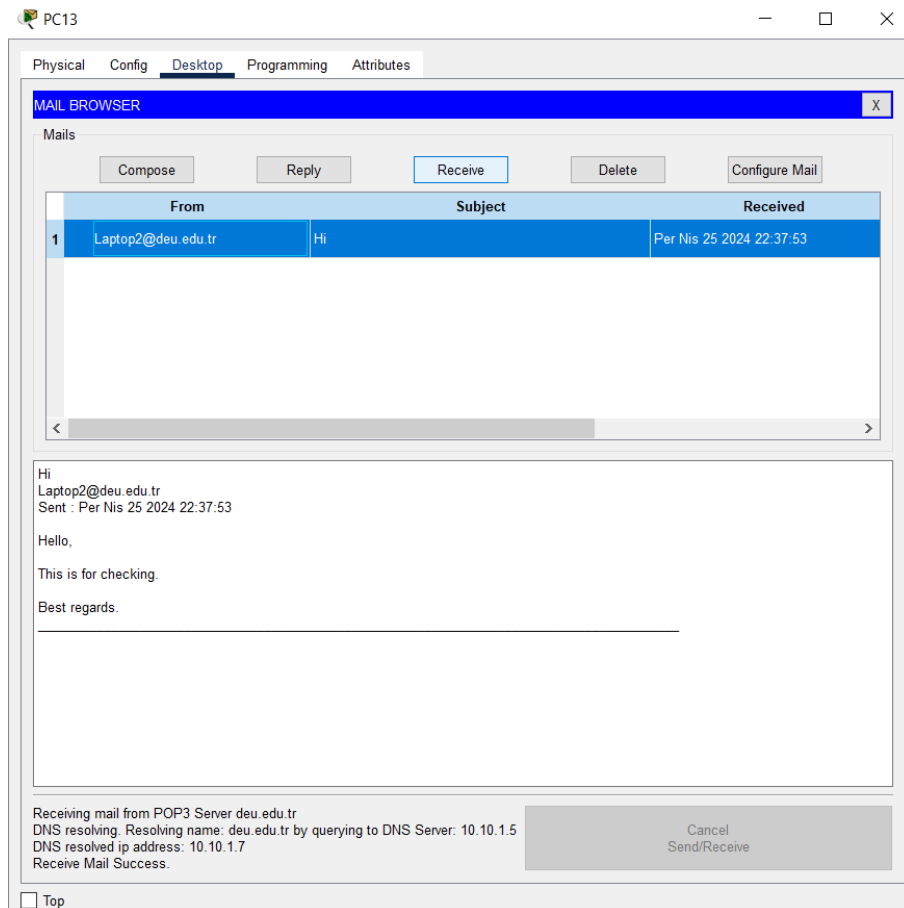
Scenario 7: A smartphone user from third facility of second branch office wants to use ssh to connect to a Web server in the third facility of first branch office.

-Configurated the routers as below. But could not succeed.
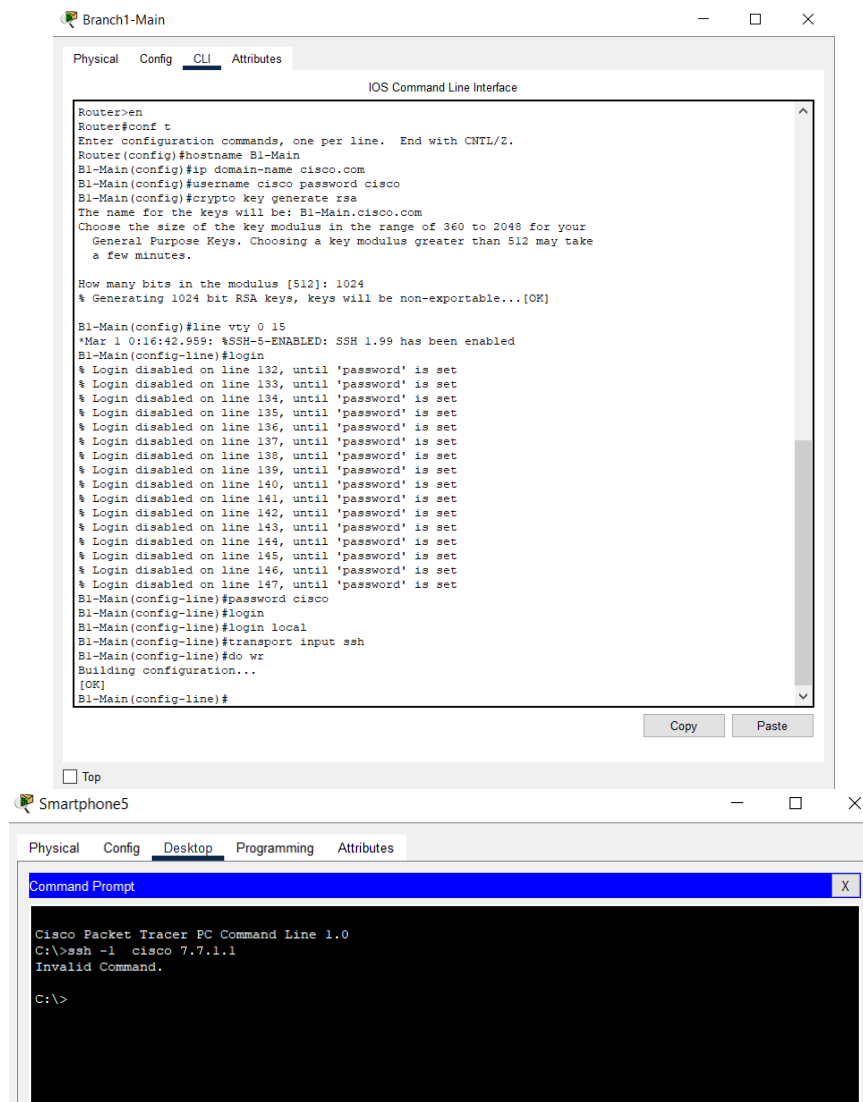
Additional Scenario 1: A PC user in second facility of second branch office wants to see the files in the FTP server.

-If the commands below are written on the cmd of the user, the files in the FTP server can be seen.

1. 'ftp (ip address of the ftp server)',
2. entering the username and the password
3. 'dir'

PC16 — □ X

Physical   Config   **Desktop**   Programming   Attributes

Command Prompt   X

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ftp 10.10.1.3
Trying to connect...10.10.1.3
Connected to 10.10.1.3
220- Welcome to PT Ftp server
Username:cisco
331- Username ok, need password
Password:
230- Logged in
(passive mode On)
ftp>dir

Listing /ftp directory from 10.10.1.3:
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-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   : pt1000-i-mz.122-28.bin                     5571584
32   : pt3000-i6q4l2-mz.121-22.EA4.bin            3117390
ftp>
```

☐ Top

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.004	--
	0.005	PC15
	0.006	Switch4
	0.007	B2-Facility2-Router
	0.008	Branch2-Router
	0.009	Branch2-Main
	0.010	DSL Modem0
	0.011	Cloud2
	0.012	ISP-Router
	0.013	Cloud3
	0.014	DSL Modem1
	0.015	Branch1-Main
	0.016	Branch1-Router
	0.017	B1-Facility3-Router
	0.018	Switch2

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.016	Branch1-Router
	0.017	B1-Facility3-Router
	0.018	Switch2
	0.019	FTP SERVER 2
	0.020	Switch2
	0.021	B1-Facility3-Router
	0.022	Branch1-Router2
	0.023	Branch1-Main
	0.024	DSL Modem1
	0.025	Cloud3
	0.026	ISP-Router
	0.027	Cloud2
	0.028	DSL Modem0
	0.029	Branch2-Main

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.021	B1-Facility3-Router
	0.022	Branch1-Router2
	0.023	Branch1-Main
	0.024	DSL Modem1
	0.025	Cloud3
	0.026	ISP-Router
	0.027	Cloud2
	0.028	DSL Modem0
	0.029	Branch2-Main
	0.030	Branch2-Router2
	0.031	B2-Facility2-Router
	0.032	Switch4
	0.033	PC15
	0.034	Switch4

Additional Scenario 2: A smartphone user from the third facility of the second branch wants to access a specific webpage hosted on one of the web servers in the third facility of the first branch.

Smartphone5

Physical   Config   Desktop   Programming   Attributes

Web Browser

< > URL http://10.10.1.13   Go   Stop

Web Server 6

Smartphone5

Physical   Config   Desktop   Programming   Attributes

Web Browser

< > URL http://web6.com   Go   Stop

Web Server 6

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	Smartphone5
	0.002	B2-F3-ACCESS-POİNT
	0.003	Switch5
	0.004	B2-Facility3-Router
	0.004	--
	0.005	B2-F3-ACCESS-POİNT
	0.005	B2-F3-ACCESS-POİNT
	0.005	Branch2-Router
	0.006	Branch2-Main
	0.007	DSL Modem0
	0.008	Cloud2
	0.009	ISP-Router
	0.010	Cl..2

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.010	Cloud3
	0.011	DSL Modem1
	0.012	Branch1-Main
	0.013	Branch1-Router2
	0.014	B1-Facility3-Router
	0.015	Switch2
	0.016	DNS SERVER
	0.017	Switch2
	0.018	B1-Facility3-Router
	0.019	Branch1-Router
	0.020	Branch1-Main
	0.021	DSL Modem1
	0.022	Cloud3

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.018	B1-Facility3-Router
	0.019	Branch1-Router
	0.020	Branch1-Main
	0.021	DSL Modem1
	0.022	Cloud3
	0.023	ISP-Router
	0.024	Cloud2
	0.025	DSL Modem0
	0.026	Branch2-Main
	0.027	Branch2-Router
	0.028	B2-Facility3-Router
	0.029	Switch5
	0.030	B2-F3-ACCESS-POİNT

Simulation Panel

Event List

Vis.	Time(sec)	Last Device
	0.023	ISP-Router
	0.024	Cloud2
	0.025	DSL Modem0
	0.026	Branch2-Main
	0.027	Branch2-Router
	0.028	B2-Facility3-Router
	0.029	Switch5
	0.030	B2-F3-ACCESS-POİNT
	0.030	B2-F3-ACCESS-POİNT
	0.030	--
	0.034	--
	0.035	Smartphone5
👁	0.036	B2-F3-ACCESS-POİNT

PDU Information at Device: PC21 ✖

OSI Model   Inbound PDU Details

At Device: PC21
Source: Switch5
Destination: STP Multicast Address

In Layers

| Layer7 |
| Layer6 |
| Layer5 |
| Layer4 |
| Layer3 |
| Layer 2: IEEE 802.3 Header 0090.0C41.1C05 >> 0180.C200.0000 LLC STP BPDU |
| Layer 1: Port FastEthernet0 |

Out Layers

| Layer7 |
| Layer6 |
| Layer5 |
| Layer4 |
| Layer3 |
| Layer2 |
| Layer1 |

1. FastEthernet0 receives the frame.

Challenge Me   << Previous Layer   Next Layer >>

4. Conclusion

In summary, the Metropolitan Area Network (MAN) simulation project using Cisco Packet Tracer software has been a valuable learning experience. It aimed to enhance our understanding of network planning and design while demonstrating the importance of cost-effectiveness and meeting system requirements. The project motivated us to gain practical skills in MAN design, traffic analysis, and simulation tools. Benefits included improved proficiency in network protocols, configuration, and troubleshooting, while challenges involved complexity in topology design and potential errors. Despite challenges, the project provided valuable insights and skills for future endeavors in data communications and computer networks.

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