



BAHRIA UNIVERSITY ISLAMABAD

PROJECT REPORT

T Z E T Z O C

- 01 COVER PAGE.**
- 02 TABLE OF CONETENT.**
- 03 ABSTRACT.**
- 04 CH:1 INTRODUCTION.**
- 05 CH:2 REVIEW.**
- 06 CH:3 WORK DONE.**
- 07 CH:4 RESULTS.**
- 08 CH:5 CONCLUSION.**
- 09 CH:6 REFERENCES.**

Abstract

The aim of this project is to design the topology of the university network using the software Cisco Packet Tracer with the implementation of wireless networking systems. This university network consists of the following devices:

- 1) Router (1941)
- 2) Switches (2960-24TT)
- 3) Email server
- 4) DNS server
- 5) WEB server (HTTP)
- 6) Wireless Device (Access Point)
- 7) PCs
- 8) Laptops
- 9) Smartphones

The primary objective is to create a robust, scalable, and efficient network that meets the diverse needs of a university environment. The project details the configuration and integration of these devices to ensure seamless connectivity and communication across the campus. The implementation also addresses security considerations and optimal network performance, providing a comprehensive framework for a modern educational institution.

CHAPTER 1

Introduction

In this mini project, we defined a simulation of campus networks based on wireless networking. The network is divided into two sets: one for the campus area and the other for the hostel area.

The major aim of this project is to show the wireless connectivity that is used in universities to make the network efficient and mobile at the same time. Mobility is the major concentration of this project. To provide equal functionality to all the users (college staff and students), we have added DNS, Email, and HTTP servers for the maximum utilization of resources.

Hence the campus network provides different services such as connecting the user to the internet, data sharing among users (students, teachers, and different university members), accessing different web services for different functionalities, so it needs wireless networking for smooth processing.

CHAPTER 2

Review

What is a Packet Tracer? [1]

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. The software is mainly focused on Certified Cisco Network Associate Academy students as an educational tool for helping them learn fundamental CCNA concepts. Previously students enrolled in a CCNA Academy program could freely download and use the tool free of charge for educational use.

Router

A router is a device like a switch that routes data packets based on their IP addresses. The router is mainly a Network Layer device. Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets. Router divides broadcast domains of hosts connected through it.

Switch

A network switch (also called switching hub, bridging hub, officially MAC bridge is networking hardware that connects devices on a computer network by using packet switching to receive and forward data to the destination device. A network switch is a multiport network bridge that uses MAC addresses to forward data at the data link layer (layer 2) of the OSI model. Some switches can also forward data at the network layer (layer 3) by additionally incorporating routing

functionality. Such switches are commonly known as layer-3 switches or multilayer switches.

Network Packet

A network packet is a formatted unit of data carried by a packet-switched network. A packet consists of control information and user data, which is also known as the payload.

Server [2]

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. There are many types of servers, including web servers, mail servers, and virtual servers.

Many networks contain one or more of the common servers. The servers used in our project are as follows:

➤ DNS Server

DNS stands for Domain Name System servers which are application servers that provide a human-friendly naming method to the user computers to make IP addresses readable by users. The DNS system is a widely distributed database of names and other DNS servers, each of which can be used to request an otherwise unknown computer name. When a user needs the address of a system, it sends a DNS request with the name of the desired resource to a DNS server. The DNS server responds with the necessary IP address from its table of names.

➤ WEB Server

One of the widely used servers in today's market is a web server. A web server is a special kind of application server that hosts programs and data requested by users across the Internet or an intranet. Web servers respond to requests from browsers running on client computers for web pages, or other web-based services.

➤ EMAIL Server

An e-mail server is a server that handles and delivers e-mail over a network, using standard email protocols. For example, the SMTP protocol sends messages and handles outgoing mail requests. The POP3 protocol receives messages and is used to process incoming mail. When you log on to a mail server using a webmail interface or email client, these protocols handle all the connections behind the scenes.

● Wireless Network

A wireless network broadcasts an access signal to the workstations or PCs. This enables mobility among laptops, tablets, and PCs from room to room while maintaining a firm network connection continuously. A wireless network also presents additional security requirements.

● Ethernet

This is the backbone of our network. It consists of the cabling and is typically able to transfer data at a rate of 100mb/s. It is a system for connecting several computer systems to form a local area network, with protocols to control the passing of information and to avoid simultaneous transmission by two or more systems. Among the different types of ethernet, we have used Gigabit Ethernet, which is a type of Ethernet network capable of transferring data at a rate of 1000 Mbps and fast Ethernet is a type of Ethernet network that can transfer data at a rate of 100 Mbps.

● Computing Device

Computing devices are the electronic devices that take user inputs, process the inputs, and then provide us with the end results. These devices may be Smartphones, PC Desktops, Laptops, printer, and many more.

● Internet Protocol

Internet Protocol (IP) is one of the fundamental protocols that allow the internet to work. IP addresses are a unique set of numbers on each network, and they allow machines to address each other across a network. It is implemented on the internet layer in the IP/TCP model.

● SSH Protocol [3]

Secure Shell enables a user to access a remote device and manage it remotely. However, with SSH, all data transmitted over a network (including usernames and passwords) is encrypted and secure from eavesdropping.

SSH is a client-server protocol, with an SSH client and an SSH server. The client machine (such as a PC) establishes a connection to an SSH server running on a remote device (such as a router). Once the connection has been established, a network admin can execute commands on the remote device.

- **Benefits of wireless networking over wired networking [5]**

To better understand the wide usage of wireless networking in today's world, is to start with the benefits it has over traditional wired networking is crucial for our project implementation. Some major aspects have been stated below that show the various advantages of a wireless network over wired ones.

- 1. Mobility**

One of the major advantages of wireless is mobility. Users have the freedom to move within the area of the network with their computing devices staying connected to a network without being concerned about the cable connection.

- 2. Less Hassle**

The wireless network helps in the reduction of large amounts of cables or wires which becomes chaotic and difficult to maintain, it makes the connection hassle-free.

- 3. Accessibility**

Provide network access across your organization, even in areas that have been challenging to reach with the wired network, so your entire team can stay in touch.

- 4. Expandability**

The wireless network helps in the expansion of the network to a wide range by adding multiple new users and locations without additional need to run cables and wires.

5. Guest Access

Offer secure network access to guest users, including customers and business partners, while keeping your network resources protected.

With lots of advantages, there come disadvantages as well, like security issues which can be resolved using strict protection passwords. Also, the Speed of wireless networks is slow and having low bandwidth when compared to the direct cable connection networks.

● Simulation Environment

The simulations of our network topology can be easily achieved using cisco packet tracer. Using a simulation mode, you can see packets flowing from one node to another and can also click on a packet to see detailed information about the OSI layers of the networking. Packet Tracer offers a huge platform to combine realistic simulation and visualize them simultaneously. Cisco Packet Tracer makes learning and teaching significantly easier by supporting multi-user collaboration and by providing a realistic simulation environment for experimenting with projects.

CHAPTER 3

Work Done

To make our project understandable, we have divided the content into steps. They are as follows:

1. Software and hardware requirements

Before heading towards the implementation, we need to make sure of the following requirements.

- A proper workstation (any mid-high range laptop will suffice).
- Packet Tracer by Cisco
- 8 GB RAM.
- Any 10,000+ Average CPU Mark scored processor.
- 16 GB of dedicated hard disk space.
- USB 3.0+ port.

2. Brief knowledge about our approach

The proposed wireless network is implemented for a university campus. We have made a virtual visualization of the network using the Cisco Packet tracer which provides a huge platform for users to test their projects using simulation tools. A Wireless network in an educational campus makes it easier for teachers and students to access educational resources, by enabling an important platform to exchange information.

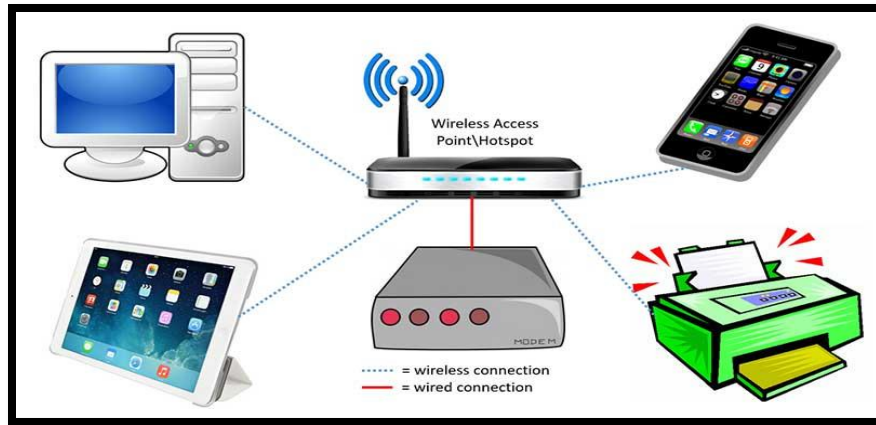


Figure 1: Shows the wireless connection access by various tool.

3. Network Requirements

Devices Used in The Network

Devices	Quantity
1) Router (1941)	3
2) Switches (2960-24TT)	3
3) EMAIL server	1
4) DNS server	1
5) WEB server (HTTP)	1
6) Wireless Device (Access Point)	7
7) PCs	12
8) Laptops	10
9) Smartphones	2

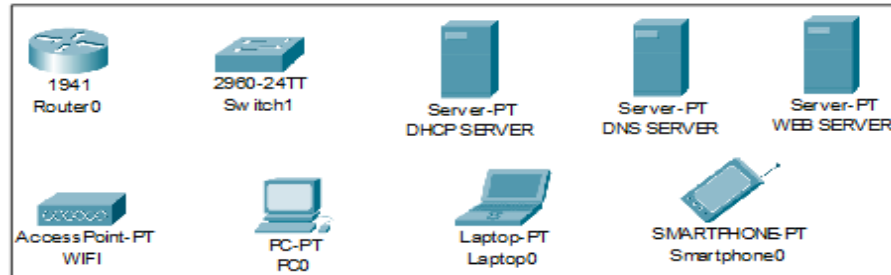


Figure 3: Devices used in the network

4. Implementation

- To design the wireless network of the university we initially started by placing the core devices into the frame as mentioned in the layout.
- Firstly, we placed the **main router** at the center of the university outline, which was further connected to the **server switch** using the gigabit ethernet port with copper straight-through cable and sub routers (**campus router** and **hostel router**) using the serial port with serial DCE cable at the hostel area and campus area respectively.
- The server switch was further connected to the **EMAIL, DNS, and WEB** servers respectively.
- Campus router was connected to the campus switch which was further connected with wireless access points of the academic block (**AB1 and AB2**), **dome building, library, and IT consulting**.
- The wireless access points were then connected to computing devices (PCs, laptops, and smartphones).
- Similarly, the hostel router was connected to the hostel switch which was further connected with the wireless access point of boy's block and girls block.

- The wireless access points were then connected to the computing devices (PCs, laptops, and smartphones), every area has a dedicated access point which can only be connected with the help of a password.
- All these connections are made through ethernet ports (gigabit ethernet and fast ethernet) using copper straight-through cables.

5. Configuring IP Addresses

We have attached the screenshots of all the IP configuration below:

- **Main Router configuration**

Global Settings	
Display Name	<input type="text" value="main_router"/>
Hostname	<input type="text" value="main_router"/>
NVRAM	<input type="button" value="Erase"/> <input type="button" value="Save"/>
Startup Config	<input type="button" value="Load..."/> <input type="button" value="Export..."/>
Running Config	<input type="button" value="Export..."/> <input type="button" value="Merge..."/>

GigabitEthernet0/1

IP Configuration	
IPv4 Address	<input type="text" value="192.168.2.1"/>
Subnet Mask	<input type="text" value="255.255.255.0"/>

Serial0/1/0

IP Configuration	
IPv4 Address	<input type="text" value="10.0.0.1"/>
Subnet Mask	<input type="text" value="255.0.0.0"/>

Serial0/1/1

IP Configuration	
IPv4 Address	11.0.0.1
Subnet Mask	255.0.0.0

RIP

Network Address
10.0.0.0
11.0.0.0
192.168.1.0
192.168.2.0

DNS Server

IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IP Address	192.168.2.3
Subnet Mask	255.255.255.0
Default Gateway	192.168.2.1
DNS Server	192.168.2.3

Global Settings	
Display Name	DNS
Gateway/DNS IPv4	
<input type="radio"/> DHCP	
<input checked="" type="radio"/> Static	
Gateway	192.168.2.1
DNS Server	192.168.2.3

WEB Server

IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IP Address	<input type="text" value="192.168.2.4"/>
Subnet Mask	<input type="text" value="255.255.255.0"/>
Default Gateway	<input type="text" value="192.168.2.1"/>
DNS Server	<input type="text" value="192.168.2.3"/>

Global Settings	
Display Name	<input type="text" value="WEB"/>
Gateway/DNS IPv4	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
Gateway	<input type="text" value="192.168.2.1"/>
DNS Server	<input type="text" value="192.168.2.3"/>

Email Server

IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IP Address	<input type="text" value="192.168.2.2"/>
Subnet Mask	<input type="text" value="255.255.255.0"/>
Default Gateway	<input type="text" value="192.168.2.1"/>
DNS Server	<input type="text" value="192.168.2.3"/>

Global Settings	
Display Name	<input type="text" value="EMAIL"/>
Gateway/DNS IPv4	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
Gateway	<input type="text" value="192.168.2.1"/>
DNS Server	<input type="text" value="192.168.2.3"/>

- **Campus Router**

Global Settings		Network Address
Display Name	College Router	11.0.0.0
Hostname	Router1	192.168.1.0

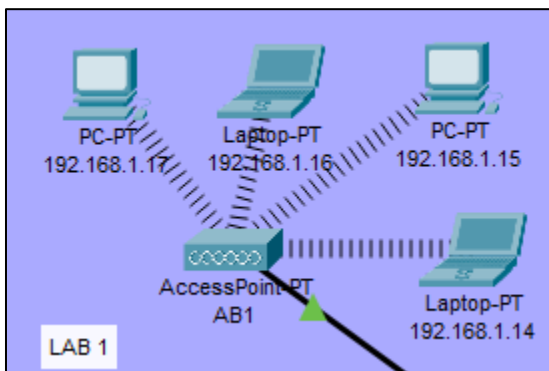
GigabitEthernet0/0

IP Configuration	
IP Address	192.168.1.1
Subnet Mask	255.255.255.0

Serial0/1/0

IP Configuration	
IP Address	11.0.0.2
Subnet Mask	255.0.0.0

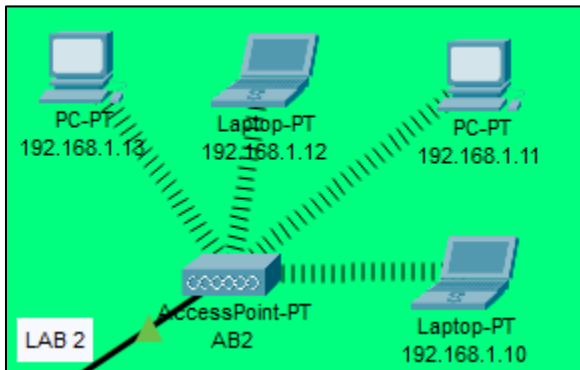
- **LAB 1**



IP Address are as follows.

192.168.1.14- Laptop
 192.168.1.15- PC
 192.168.1.16- Laptop
 192.168.1.17- PC
 Subnet Mask- 255.255.255.0
 Default Gateway- 192.168.1.1
 DNS Server- 192.168.2.3

- **LAB 2**



IP Address are as follows

192.168.1.10- Laptop

192.168.1.11- PC

192.168.1.12- Laptop

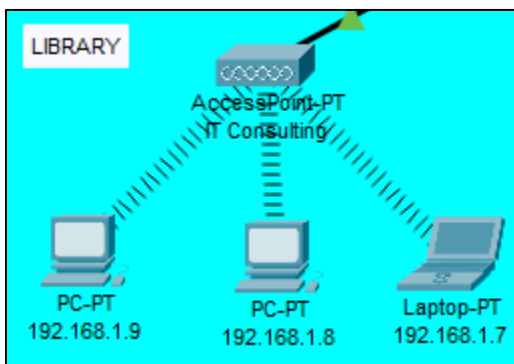
192.168.1.13- PC

Subnet Mask- 255.255.255.0

Default Gateway- 192.168.1.1

DNS Server- 192.168.2.3

- **LIBRARY**



IP Addresses are as follows

192.168.1.6- PC

192.168.1.8- PC

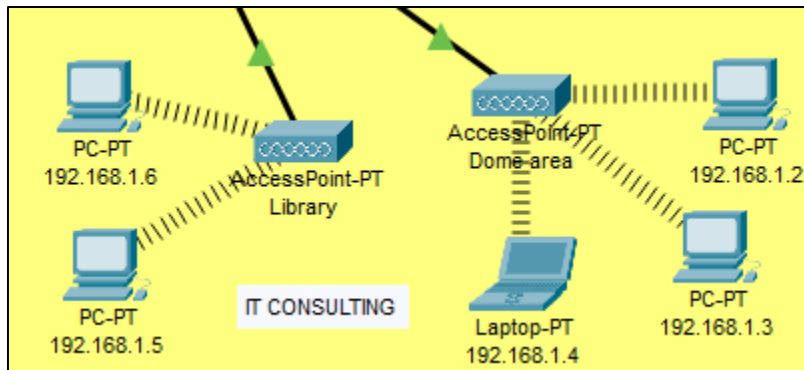
192.168.1.7- Laptop

Subnet Mask- 255.255.255.0

Default Gateway- 192.168.1.1

DNS Server- 192.168.2.3

- **IT Consulting**



IP Addresses are as follows

192.168.1.2- PC
192.168.1.3- PC
192.168.1.4- Laptop
192.168.1.5- PC
192.168.1.6- PC

Subnet Mask- 255.255.255.0
Default Gateway- 192.168.1.1
DNS Server- 192.168.2.3

- **HOSTEL ROUTER**

Global Settings		Network Address
Display Name	Hostel Router	10.0.0.0
Hostname	Router2	192.168.3.0

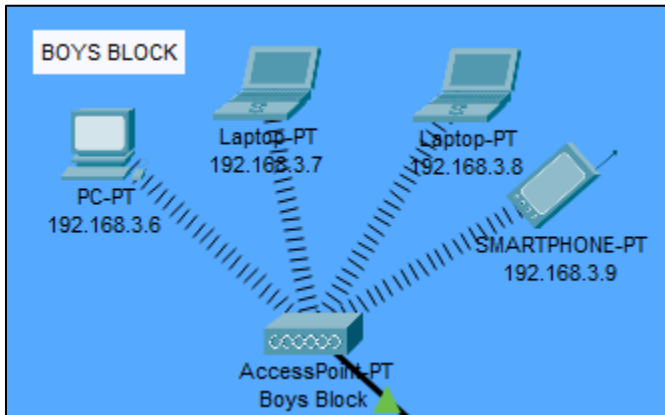
GigabitEthernet0/0

IP Configuration	
IP Address	192.168.3.1
Subnet Mask	255.255.255.0

Serial0/1/0

IP Configuration	
IP Address	10.0.0.2
Subnet Mask	255.0.0.0

- **Boys Block**



IP Addresses are as follows.

192.168.3.6- PC

192.168.3.7- Laptop

192.168.3.8- PC

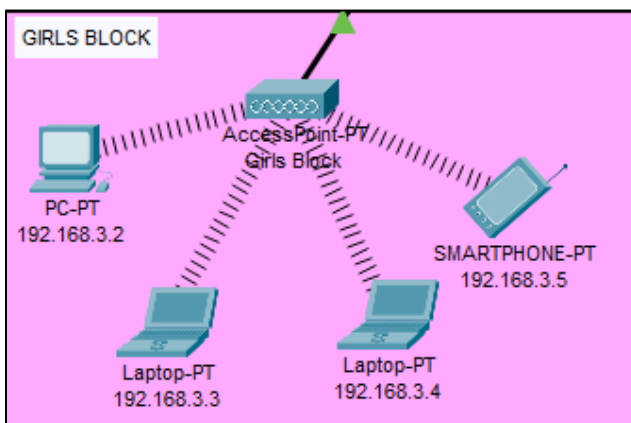
192.168.3.9- Smartphone

Subnet Mask- 255.255.255.0

Default Gateway- 192.168.3.1

DNS Server- 192.168.2.3

- **Girls Block**



IP Addresses are as follows
192.168.3.2- PC
192.168.3.3-Laptop
192.168.3.4- PC
192.168.3.5- Smartphone
Subnet Mask- 255.255.255.0
Default Gateway- 192.168.3.1
DNS Server- 192.168.2.3

- **WIRELESS ACCESS POINT**

SSID	Password
BUIC_LAB_1	1234567890
BUIC_LAB_2	1234567890
BUIC_LIBRARY	1234567890
BUIC_IT_CONSULTING	1234567890
BUIC_IT_CONSULTING_2	1234567890
BUIC_BOYS	1234567890
BUIC_GIRLS	1234567890

6.Securing the network

Passwords are used in accessing the router and all the wireless networks (mentioned in step 5 wireless access point) to make the access limited to university authorized users only.

Routers are also secured with ssh (Secure Shell). Routers and their assigned passwords are mentioned below:

Router Name	Passwords
1)main router	Console password: BUIC ssh password: admin
2)Campus Router	Console password: BUIC ssh password: admin
3)Hostel Router	Console password: BUIC ssh password: admin

```

Campus Router
Physical Config CLI Attributes
IOS Command Line Interface
If you require further assistance please contact us by sending email to
export@cisco.com.
Cisco CISCO1941/K9 (revision 1.0) with 491520K/32768K bytes of memory.
Processor board ID FTX152400KS
2 Gigabit Ethernet interfaces
2 Low-speed serial(sync/async) network interface(s)
DRAM configuration is 64 bits wide with parity disabled.
256K bytes of non-volatile configuration memory.
249856K bytes of ATA System CompactFlash 0 (Read/Write)

Press RETURN to get started!

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

User Access Verification
Password:

Router1>enable
Password:
Router1#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router1(config)#line console 0
Router1(config-line)#password BUIC
Router1(config-line)#end
Router1#
%SYS-5-CONFIG_I: Configured from console by console

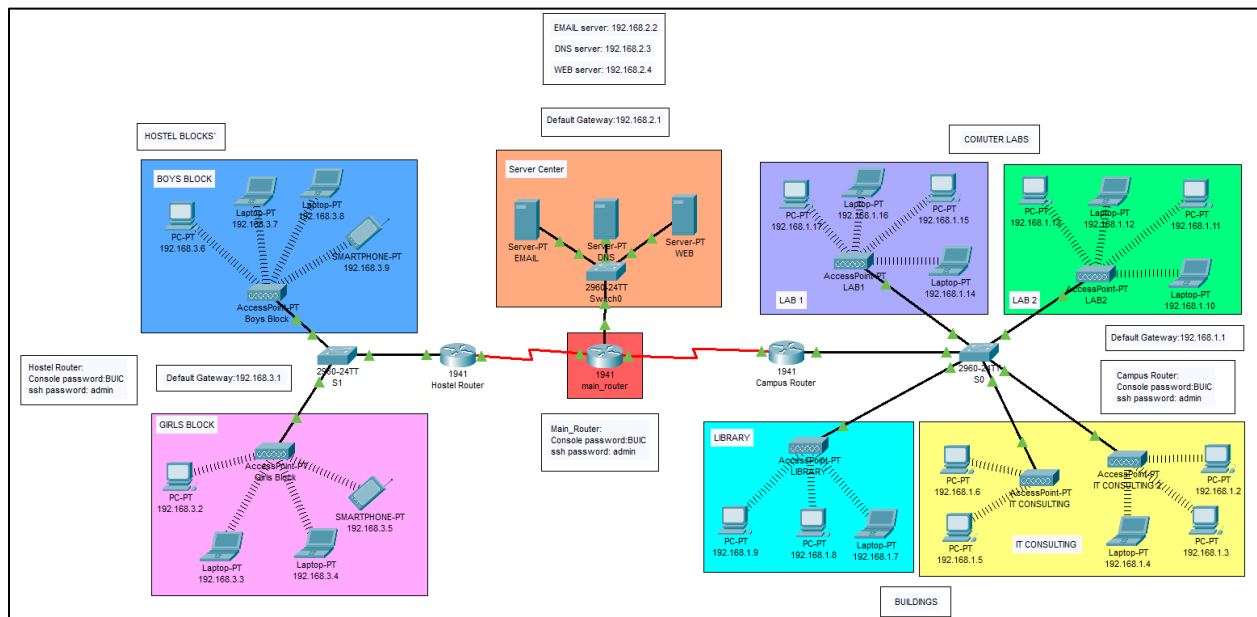
Ctrl+F6 to exit CLI focus
Copy Paste

```

CHAPTER 4

Result and discussion

Finally, we have combined all the steps as mentioned in chapter 3 (work done) and implemented the desired wireless network for university.



The complete diagram of the University Network

Final Simulation

In Simulation Mode, you can watch your network run at a slower pace, observing the paths that packets take and inspecting them in detail. The proposed architecture, when simulated on Cisco Packet Tracer, produced results which are demonstrated as follows:

The screenshot shows a network simulation software interface. The main workspace displays a network topology with several labs (LAB 1, LAB 2, LAB 3) and a central router. The simulation panel on the right shows an event list with columns for Vis., Time(sec), Last Device, At Device, and Type. The event list contains several entries for CDP (Cisco Discovery Protocol) events. The interface also includes a menu bar, a toolbar, and a simulation panel with various controls and filters.

Vis.	Time(sec)	Last Device	At Device	Type
0.950	--	Campus Router	Campus Router	CDP
0.950	--	Campus Router	Campus Router	CDP
0.951	--	Campus Router	S0	CDP
0.951	--	Campus Router	main_router	CDP
0.962	--	Switch0	Switch0	CDP
0.962	--	Switch0	Switch0	CDP
0.962	--	Switch0	Switch0	CDP
0.962	--	Switch0	Switch0	CDP

The screenshot shows a network simulation software interface. The main workspace displays a network topology with two main blocks (BOYS BLOCK and GIRLS BLOCK) and a central router. The simulation panel on the right shows an event list with columns for Vis., Time(sec), Last Device, At Device, and Type. The event list contains several entries for CDP (Cisco Discovery Protocol) events. The interface also includes a menu bar, a toolbar, and a simulation panel with various controls and filters.

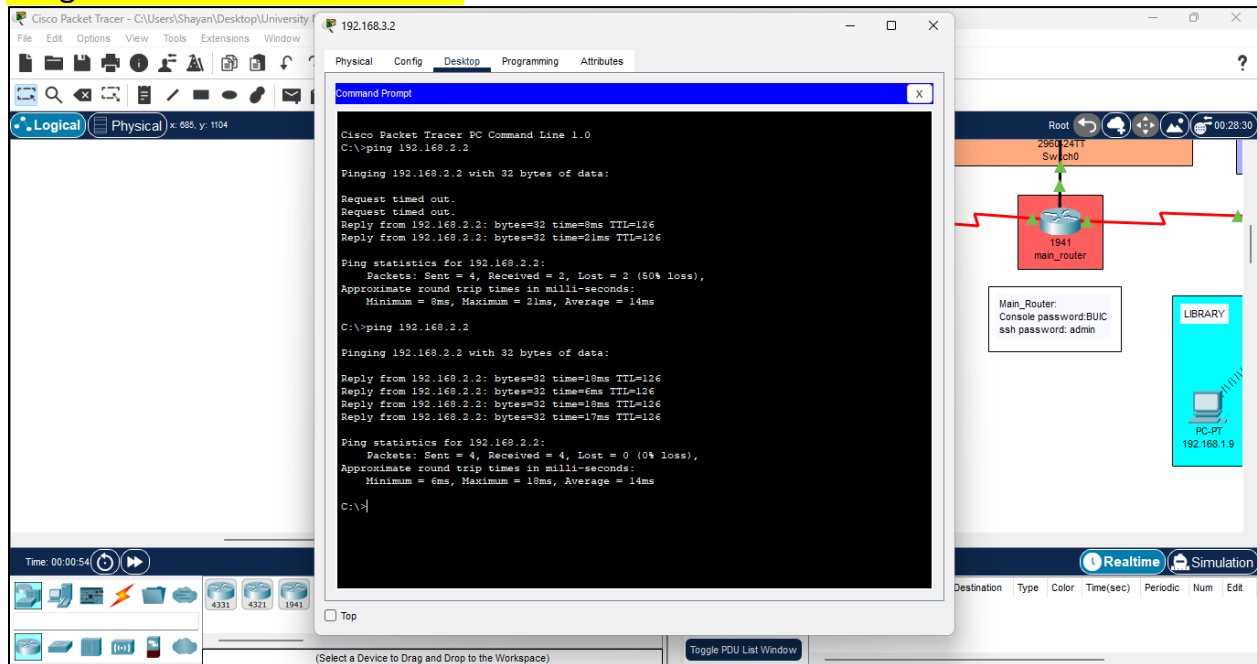
Vis.	Time(sec)	Last Device	At Device	Type
0.967	--	Boys Block	192.168.3.6	CDP
0.967	--	Boys Block	192.168.3.8	CDP
0.967	--	Boys Block	192.168.3.7	CDP
0.968	--	Girls Block	192.168.3.5	CDP
0.969	--	Girls Block	192.168.3.4	CDP
0.969	--	Girls Block	192.168.3.3	CDP
0.969	--	Girls Block	192.168.3.2	CDP

Final simulation for the network system to check all the connections

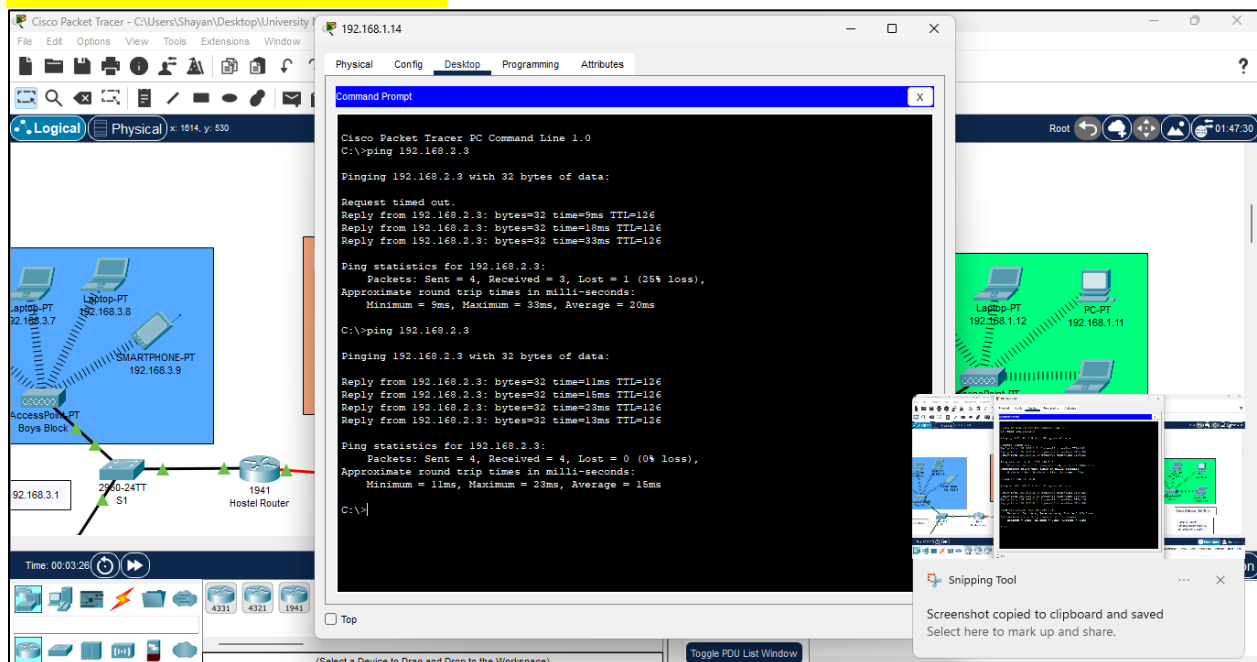
Ping Test

Network connectivity and communication can be tested using the ping command, followed by the domain name or the IP address of the device (equipment) whose connectivity one wishes to verify.

Ping Test for EMAIL server



PING TEST FOR DNS SERVER:



PING TEST FOR WEB SERVER

The screenshot displays the Cisco Packet Tracer interface. On the left, a network diagram shows a 'Boys Block' with three mobile devices (Laptop-PT 192.168.3.7, Laptop-PT 192.168.3.8, and Smartphone-PT 192.168.3.9) connected to an 'AccessPoint-PT' (192.168.3.1). This access point is connected to a '2500-24TT S1' switch, which is in turn connected to a '1941 Hostel Router'. The router is connected to a 'Campus Router'. The 'Campus Router' has a 'Default Gateway: 192.168.1.1' and a 'Console password: BUIC' and 'ssh password: admin'. The 'Campus Router' is connected to a 'Laptop-PT' (192.168.1.12) and a 'PC-PT' (192.168.1.11). The 'Campus Router' is also connected to a 'Laptop-PT' (192.168.1.10) and a 'PC-PT' (192.168.1.11). The 'Campus Router' is connected to a 'Laptop-PT' (192.168.1.12) and a 'PC-PT' (192.168.1.11).

In the center, a 'Command Prompt' window for the '192.168.1.10' device shows the following output:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.4

Pinging 192.168.2.4 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.4: bytes=32 time=13ms TTL=126
Reply from 192.168.2.4: bytes=32 time=18ms TTL=126
Reply from 192.168.2.4: bytes=32 time=7ms TTL=126

Ping statistics for 192.168.2.4:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 7ms, Maximum = 18ms, Average = 12ms

C:\>ping 192.168.2.4

Pinging 192.168.2.4 with 32 bytes of data:

Reply from 192.168.2.4: bytes=32 time=12ms TTL=126
Reply from 192.168.2.4: bytes=32 time=37ms TTL=126
Reply from 192.168.2.4: bytes=32 time=18ms TTL=126
Reply from 192.168.2.4: bytes=32 time=21ms TTL=126

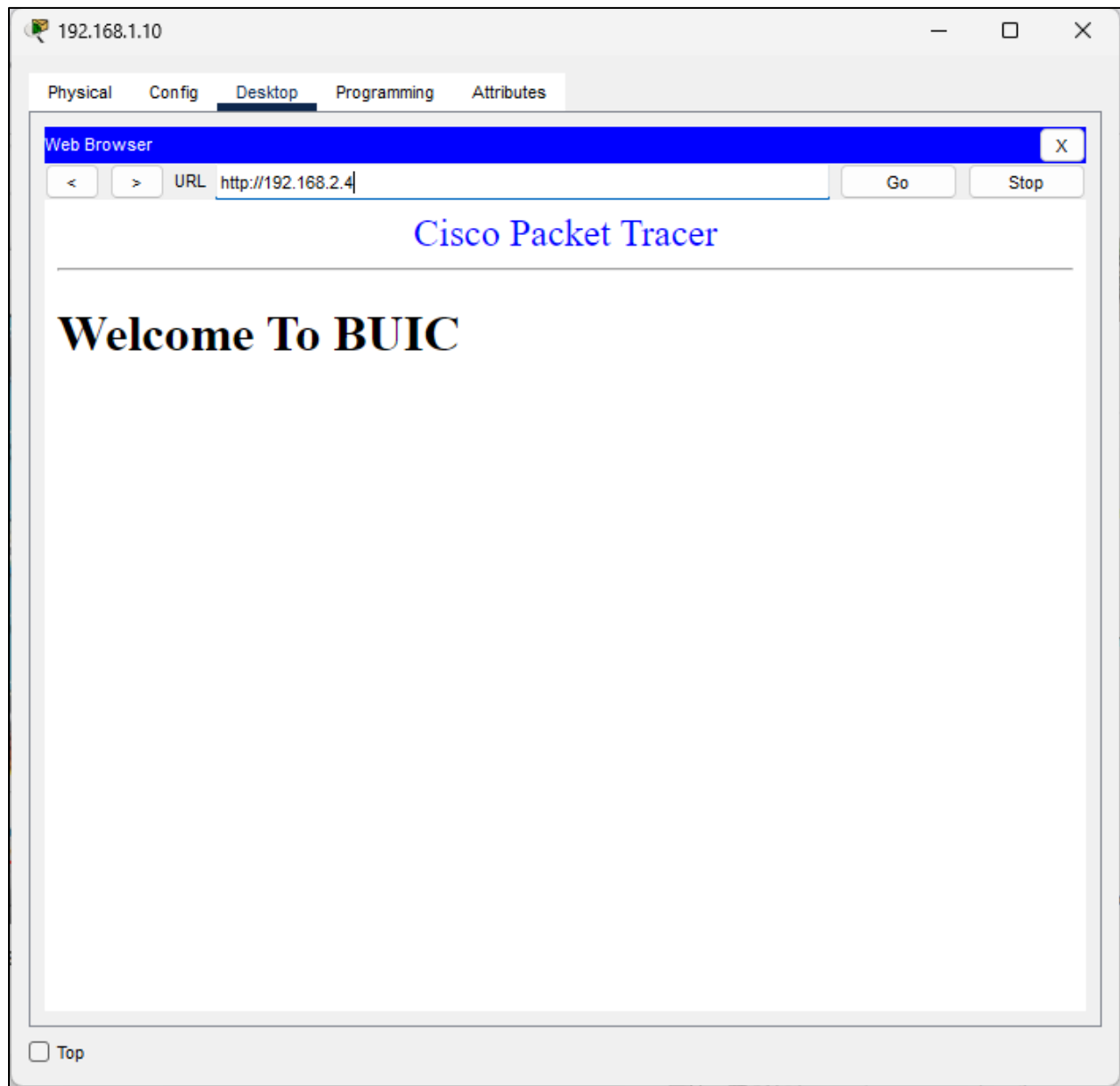
Ping statistics for 192.168.2.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 12ms, Maximum = 27ms, Average = 18ms

C:\>
```

On the right, a 'Realtime' simulation window shows the network topology with a table for packet statistics:

Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
--------	-------------	------	-------	-----------	----------	-----	------

Website accessed through Web Browser in Packet Tracer



CHAPTER 5

Conclusion

We started our discussion with the word “digitalization” and in order to achieve it, we aimed to start with an educational institute, and finally, we designed a network for a university, which is wireless. As we mentioned, mobility and efficiency are the key aspects of wireless networks, which were our main goal, and hence, we decided to shift to a wireless network instead of a wired one, making our network clean and less chaotic.

In this project, we designed a University Network using Cisco Packet Tracer that uses a networking topology implemented using servers, routers, switches, and end devices in a multiple area networks. We have covered all the necessary features that are required for a network to function properly. We have included a DNS server and a web server for establishing a smooth communication system between different areas of our network and specifically for the communication between students and teachers. We have included an email server to facilitate intra university communication through emails within the domain. We have used console passwords and ssh protocol to ensure a safe and secure transfer of data.

CHAPTER 6

References

- [1]https://en.wikipedia.org/wiki/Packet_Tracer
- [2]<https://www.paessler.com/it-explained/server>
- [3]<https://computernetworking747640215.wordpress.com/2018/07/05/secure-shell-ssh-configuration-on-a-switch-and-router-in-packet-tracer/>
- [4]<http://router.over-blog.com/article-how-to-configure-cisco-router-password-106850439.html>
- [5]<https://www.cognoscape.com/benefits-going-wireless/>