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وتقنية المعلومات

جامعة الإمام عبدالرحمن بن فيصل
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Communication & Network Fundamentals

CIS 315 – Project Form

Term 1 – 2024/2025

Group 12 – Team 2

Optimizing Internet Connectivity for University Campus

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Abstract

This project presents a comprehensive Local Area Network (LAN) design in order to address the connectivity challenges faced by a university campus with two floors and four departments. The proposed network integrates both logical and physical topologies, employing a combination of star and partial ring configurations to optimize performance, redundancy, and scalability. To enhance security and to ensure efficient traffic management, the network has three Cisco routers (R1, R2, and R3) and multiple Cisco switches. For seamless communication and wireless connectivity, wireless access points and VoIP configurations are incorporated

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Introduction

Background

Universities today rely on fast and reliable internet access to support their educational, research, and administrative operations. However, many institutions face challenges in maintaining consistent and strong connectivity, especially in high-traffic areas like lecture halls, research labs, and student centers. With the increasing number of devices connected to the network, there is significant pressure on bandwidth, leading to disruptions that affect the flow of learning, communication, and administrative tasks.

This project aims to build a robust Local Area Network (LAN) for a university campus consisting of two floors with two departments on each floor. The proposed network solution will improve internet connectivity by focusing on critical areas of weak coverage and optimizing the existing infrastructure. The design features a combination of star and ring topologies to provide redundancy, scalability, and high performance.

The network will include three Cisco routers (R1, R2, and R3) to manage external data flow, three Cisco switches (S1, S2, and S3) for efficient internal traffic management, and VoIP (IP Phones) for seamless communication across departments. This LAN is designed with future scalability in mind, enabling easy expansion to support additional users, devices, and emerging technologies.

Objectives

The objective is to configure, verify, and implement this network design using Cisco Packet Tracer to simulate real-world traffic conditions, ensuring reliable, uninterrupted internet access and smooth communication across the campus. Additionally, the network will be designed to accommodate future growth and technological advancements.

Network Design

Topology of Network

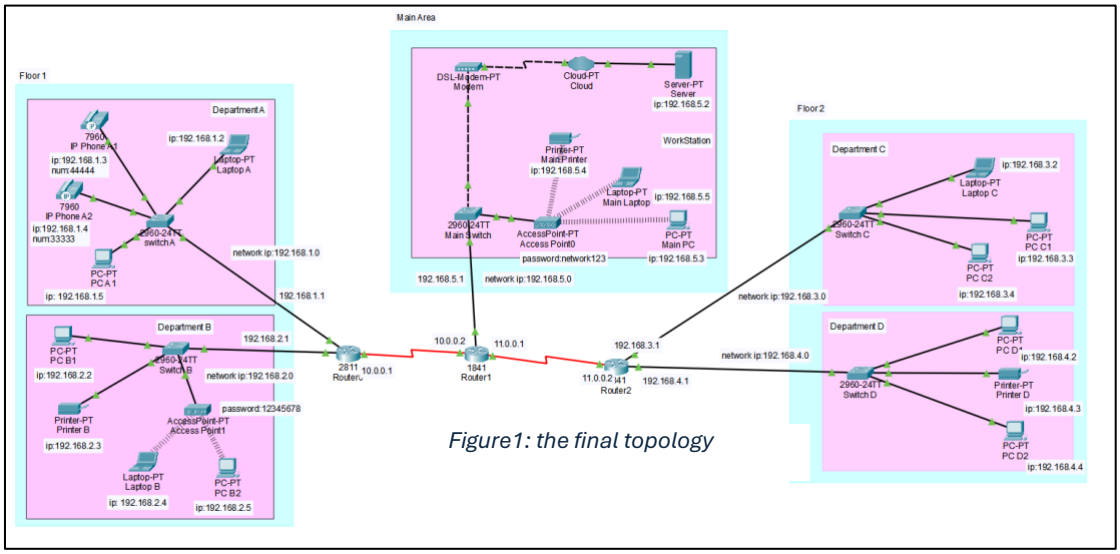


Figure1: the final topology

The logical topology of the university campus LAN consists of interconnected subnetworks, each designated for a specific department. The network employs a combination of star and partial ring topologies to optimize traffic flow and ensure redundancy. There are three routers—**2811 Router 1**, **1841 Router 2** to manage external and inter-departmental communication, with serial DCE connections between routers ensuring reliable, high-speed data flow.

The **2811 Router** (Router 0) on Floor 1 is ideal for handling the high traffic generated by Departments A and B due to its performance and multiple interface support. The **1841 Router** (Router 2) is used on Floor 2 to manage traffic for Departments C and D, offering cost-effectiveness and scalability for moderate data loads. Each router is connected to its respective switches, which link devices like PCs, printers, IP Phones, and access points to maintain efficient communication.

The central router in the main area serves as the network backbone, linking all departmental routers and managing high-traffic flows while routing connections to shared resources like the cloud, server, and internet.

Physical Topology

The physical topology of the university campus is designed for efficient connectivity and scalability across two floors, each with two departments. Using a star topology within departments, Cisco routers and switches connect devices such as PCs, laptops, printers, IP phones, and wireless access points.

Figure 2: Physical Topology

For reliable data flow, the routers are connected via serial links to a central switch that functions as the network backbone, connecting all departments to shared resources such as servers, cloud services, and the internet. The placement of wireless access points ensures strong coverage in high-traffic areas, assuring a reliable and robust network.

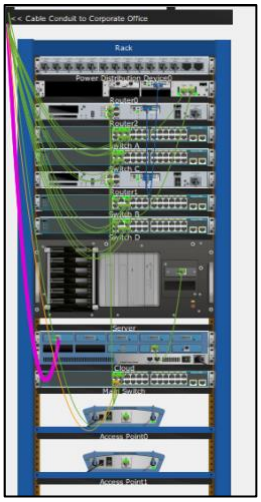


Figure 3: Cable conduit to corporate office

Addressing Table:

Device	Interface	IP Address	Subnet Mask	Default Gateway
PC A1	Ethernet	192.168.1.5	255.255.255.0	192.168.1.1
Laptop A	WiFi	192.168.1.2	255.255.255.0	192.168.1.1
Phone A1	Ethernet	192.168.1.3	255.255.255.0	192.168.1.1
Phone A2	Ethernet	192.168.1.4	255.255.255.0	192.168.1.1
Switch A	VLAN1	192.168.1.0 (-)	255.255.255.0 (-)	(-)
PC B1	Ethernet	192.168.2.2	255.255.255.0	192.168.2.1
Laptop B	WiFi	192.168.2.4	255.255.255.0	192.168.2.1
PC B2	Ethernet	192.168.2.5	255.255.255.0	192.168.2.1
Printer B	Ethernet	192.168.2.3	255.255.255.0	192.168.2.1

Switch B	VLAN1	192.168.2.0 (-)	255.255.255.0 (-)	(-)
Router 1	Fa0/0	192.168.1.1	255.255.255.0	(-)
Router 1	Fa0/1	192.168.2.1	255.255.255.0	(-)
Router 1	Serial 0/0/0	10.0.0.1	255.255.255.252	10.0.0.2
Router 2	Serial 0/0/0	10.0.0.2	255.255.255.252	10.0.0.1
Router 2	Fa0/0	192.168.3.1	255.255.255.0	(-)
Router 2	Fa0/1	192.168.4.1	255.255.255.0	(-)
PC C1	Ethernet	192.168.3.3	255.255.255.0	192.168.3.1
Laptop C	WiFi	192.168.3.2	255.255.255.0	192.168.3.1
PC C2	Ethernet	192.168.3.4	255.255.255.0	192.168.3.1
Switch C	VLAN1	192.168.3.0 (-)	255.255.255.0 (-)	(-)
PC D1	Ethernet	192.168.4.2	255.255.255.0	192.168.4.1
PC D2	Ethernet	192.168.4.4	255.255.255.0	192.168.4.1
Printer D	Ethernet	192.168.4.3	255.255.255.0	192.168.4.1
Switch D	VLAN1	192.168.4.0 (-)	255.255.255.0 (-)	(-)
Main Printer	Ethernet	192.168.5.4	255.255.255.0	192.168.5.1
Main Laptop	WiFi	192.168.5.5	255.255.255.0	192.168.5.1
Main PC	Ethernet	192.168.5.3	255.255.255.0	192.168.5.1
Main Switch	VLAN1	192.168.5.0 (-)	255.255.255.0 (-)	(-)
Cloud Server	Ethernet	192.168.5.2	255.255.255.0	192.168.5.1

PC and Laptop Configuration

To assign an Ip address:

1- From the desktop of PC or laptop.

2- Go to Ip configuration and enter the Ip address

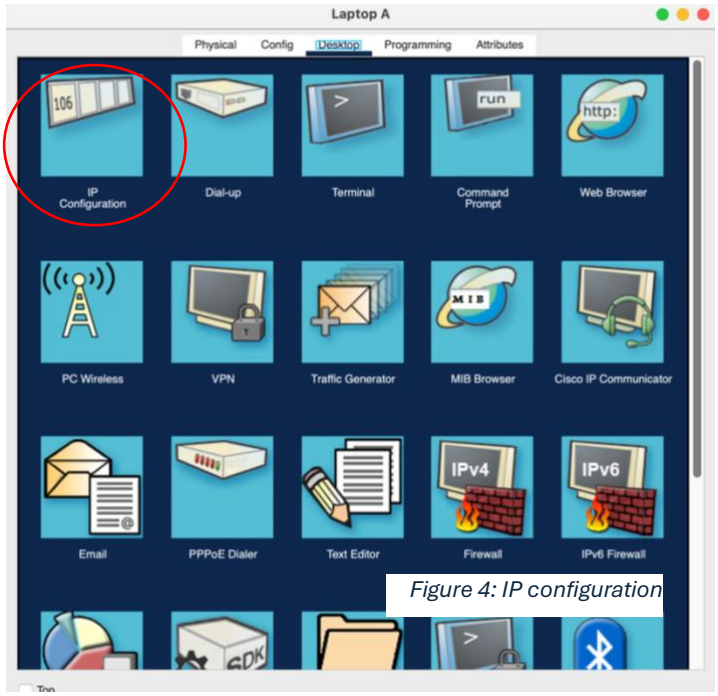


Figure 4: IP configuration

Figure 4: Desktop

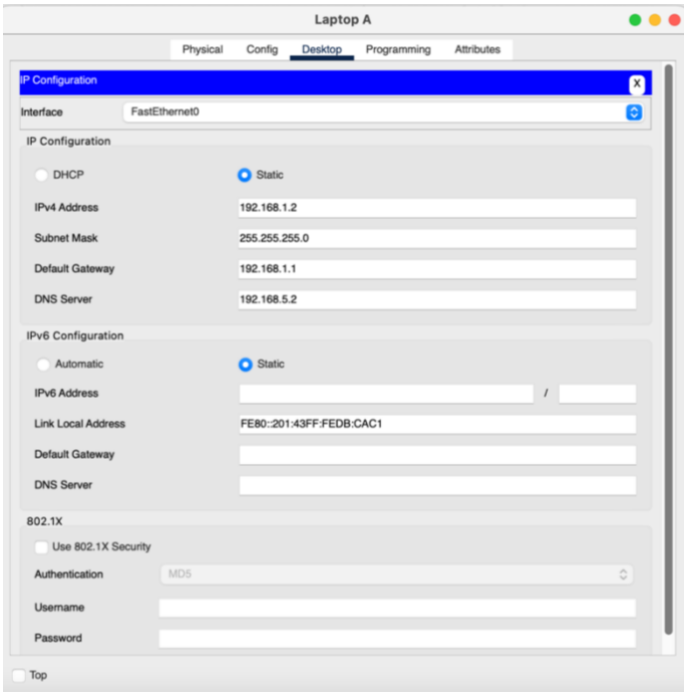


Figure 5: IP configuration

figuration

ıe IP address and subnet mask:

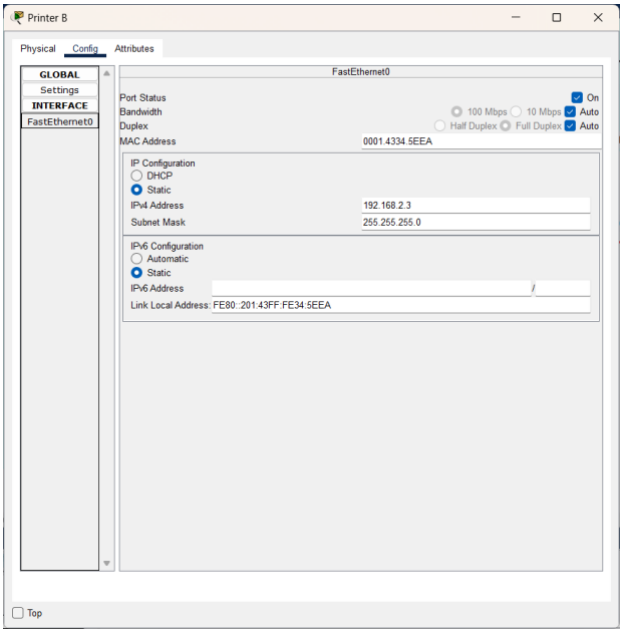
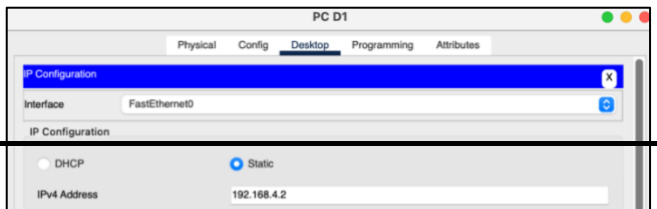


Figure 6: IP address and Subnet mask

In this step we have set the IP address for the printer which is 192.168.2.3 and the subnet mask was set automatically when we set the IP.

Step 2: assign the default gateway



Then we assign the default gateway in the printer.

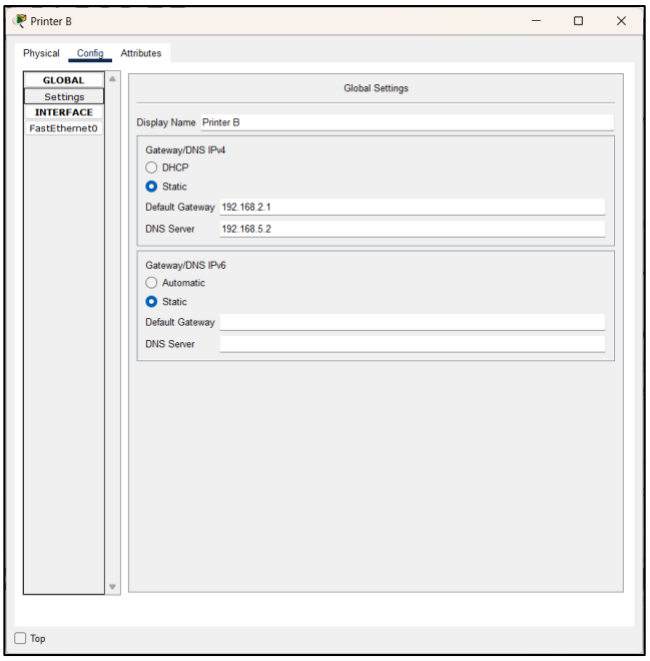


Figure 7: default gateway

Router Configuration

The role of router is to assign addresses, and configure the network, route data between networks.

1-Enter the CLI from the router

2-Enter the command to config the router

Router 0 configuration:

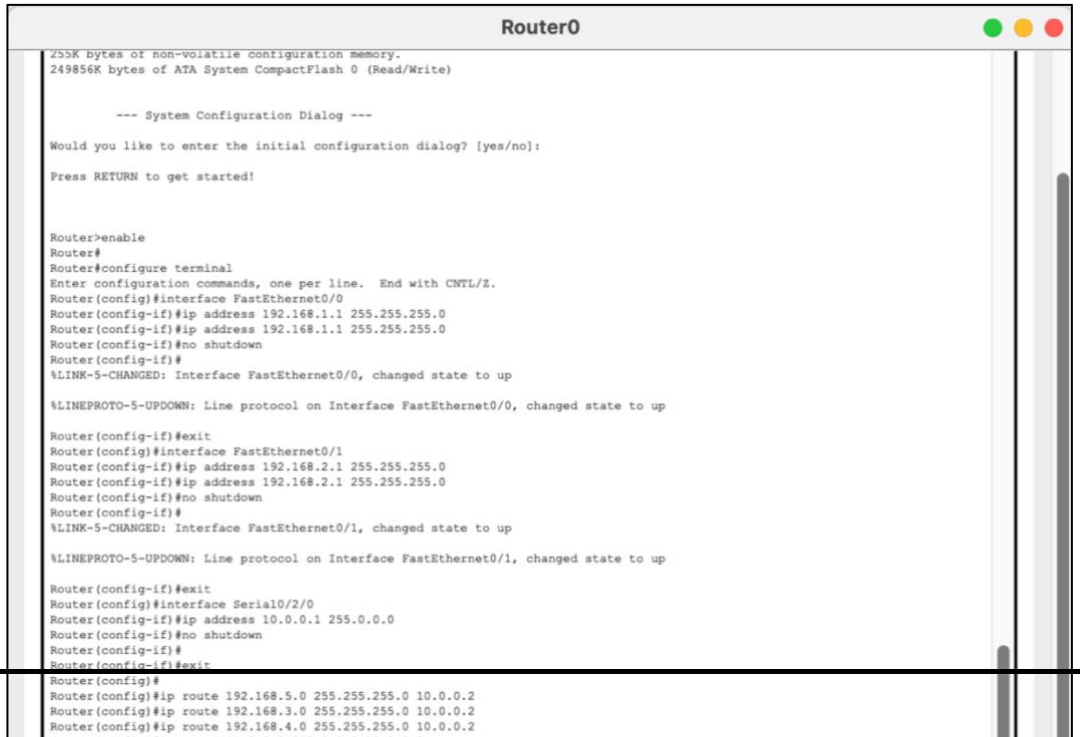


Figure 8: Router 0 configuration

Router 1 configuration:

Figure 9: Router 1 configuration

Router 2 configuration:

Figure 10: Router 2 configuration

Routing table

It is a table that contains the paths that routers use to route data to different destinations on the networks

Router 0:

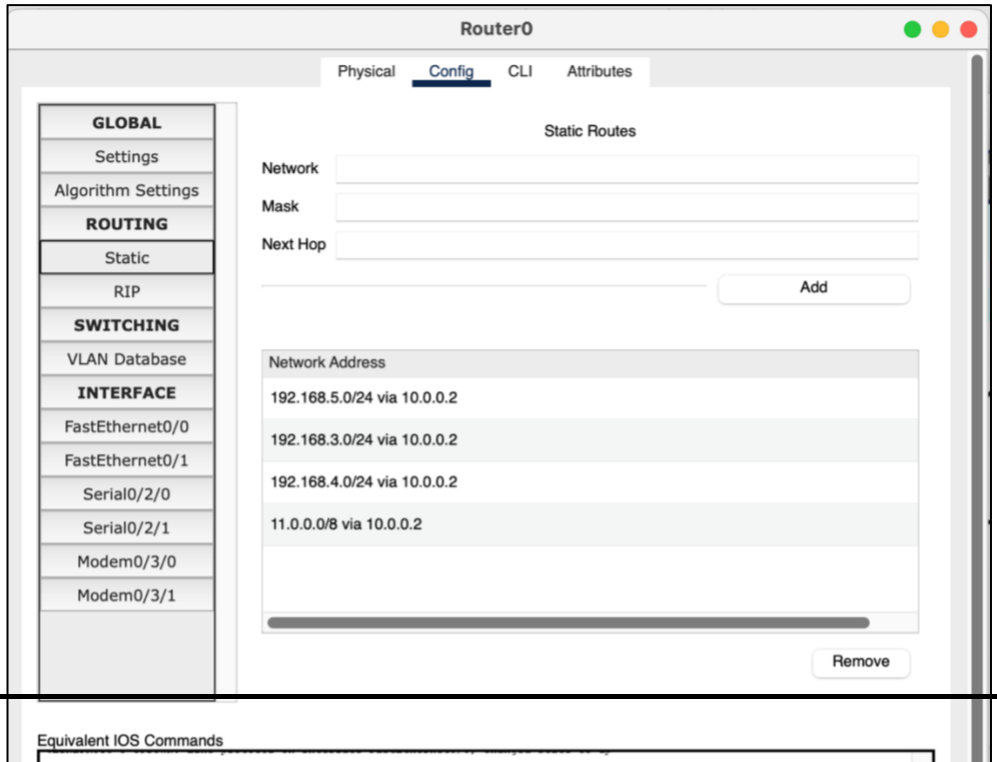


Figure 11: Router 0 routing table

Router 1:

Figure 12: Router 1 routing table

Router 2:

Figure 13: Router 2 routing table

Switch Configuration

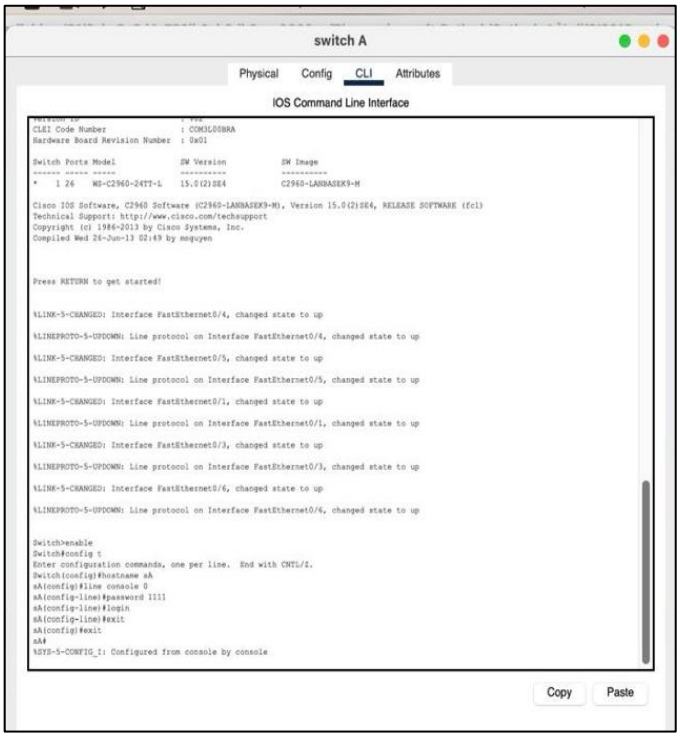


Figure 14:switch configuration A

Figure15:switch configuration B

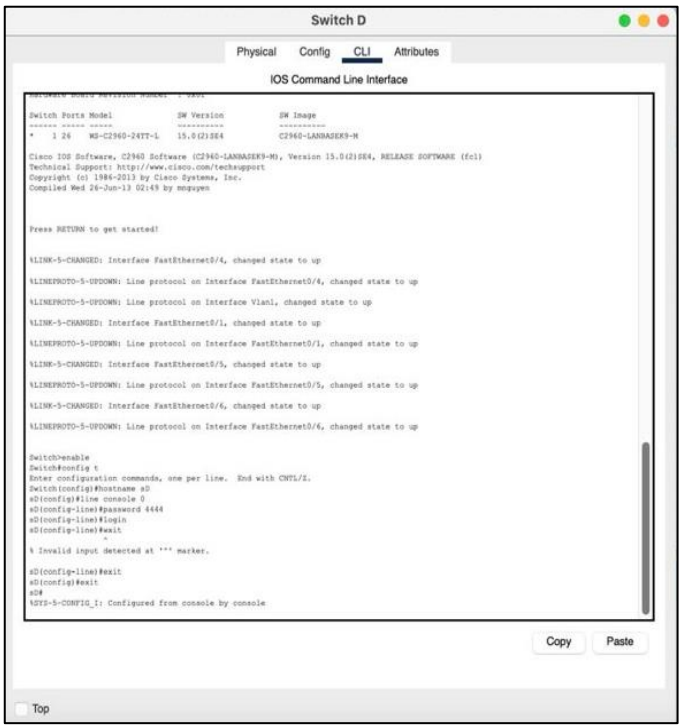


Figure16:switch configuration C

Figure 17: switch configuration D

Configure a voice Vlan on switch

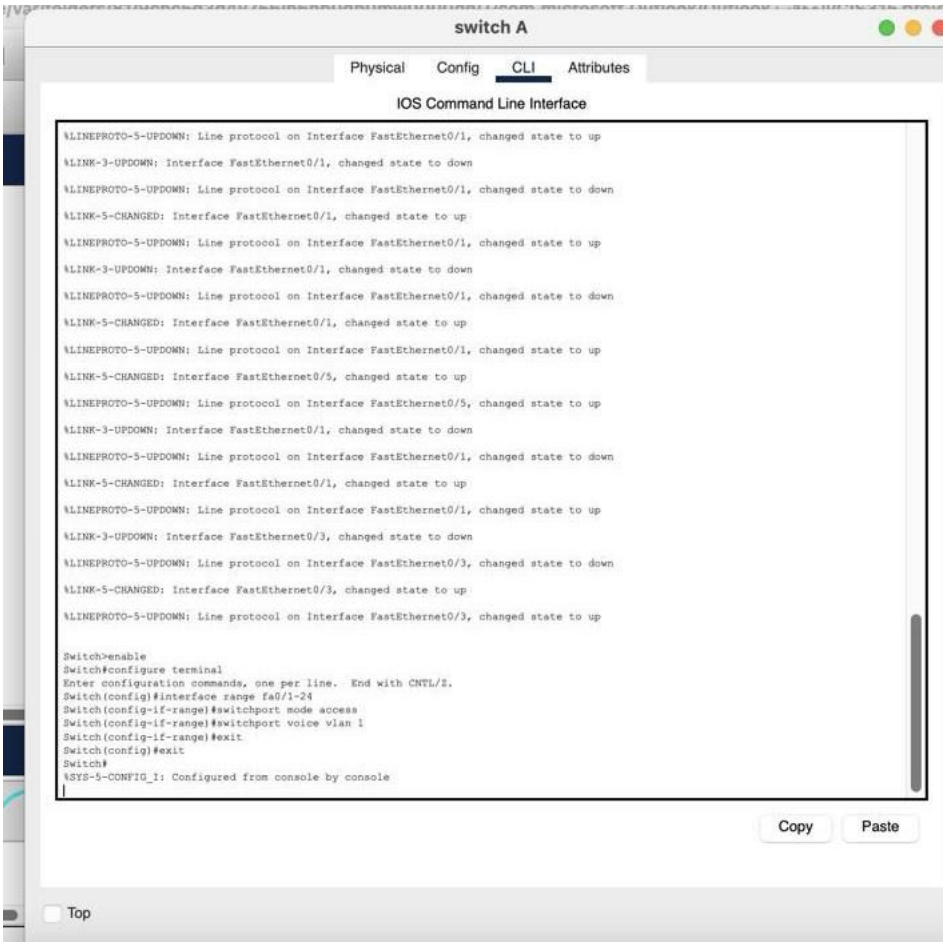


Figure 18: Vlan switch configuration

DSL Modem and Cloud Configuration

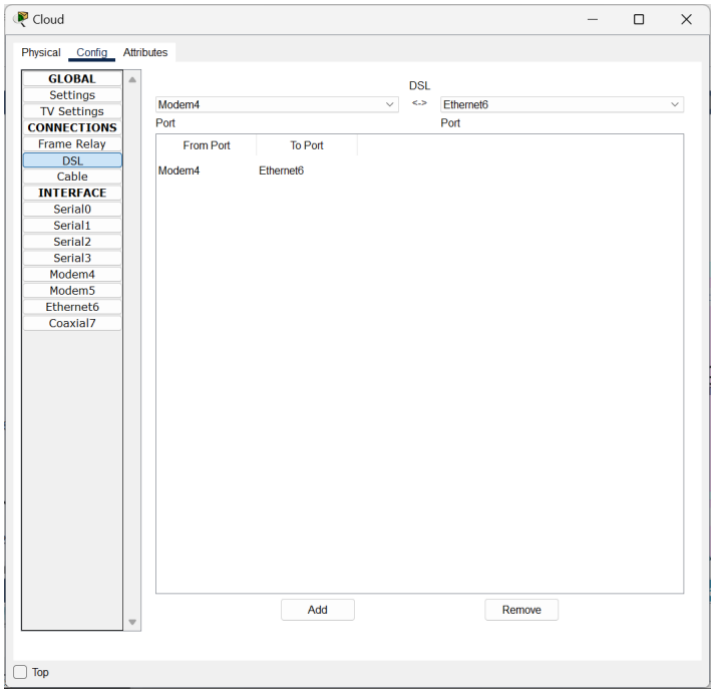


Figure 19: DSL Modem and Cloud configuration

1. Click on cloud and go to config
2. Select the DSL option
3. Click on add to enable the DSL settings

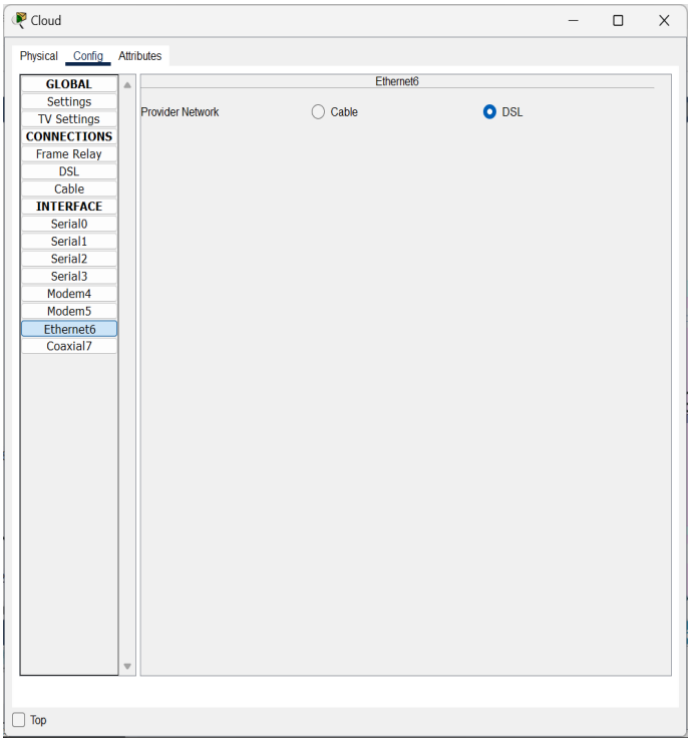


Figure 20: DSL Modem and Cloud configuration

4. Go to Ethernet6
5. Activate the DSL network provider

The modem is set

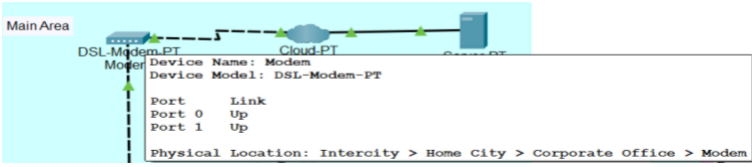


Figure 21

IP Phone Configuration (VoIP)

Step 1: Power the phone:

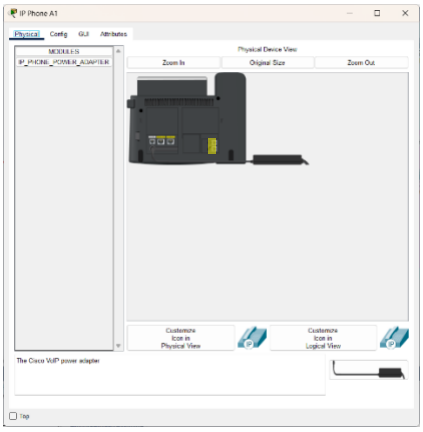


Figure22: power the phone

The phone was connected to the power to work

Step 2: Configuration on switch and router:

Figure 23: configuration on router

Figure 24: configuration on switch

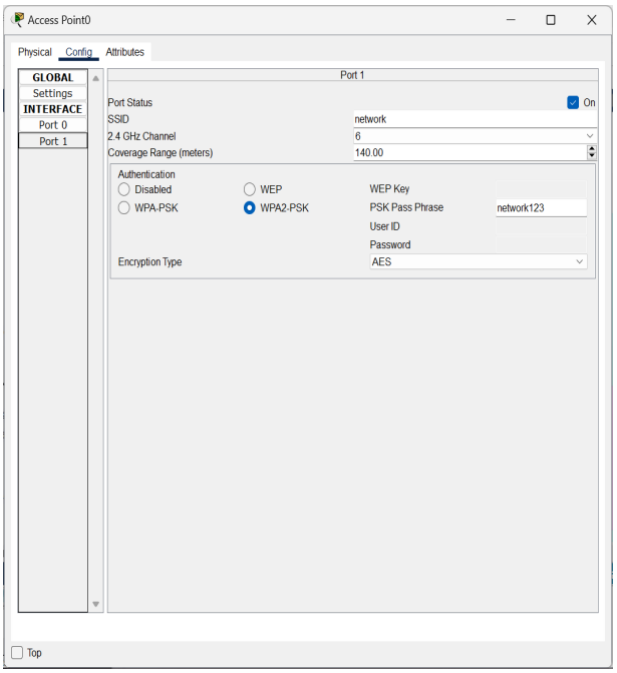
Step 3: make the connection between the two IP phones

Figure 25: connection between IP phones

A call was made between IP phone A1 and IP phone A2, where phone A1 called phone A2's number 44444

Access Point Configuration

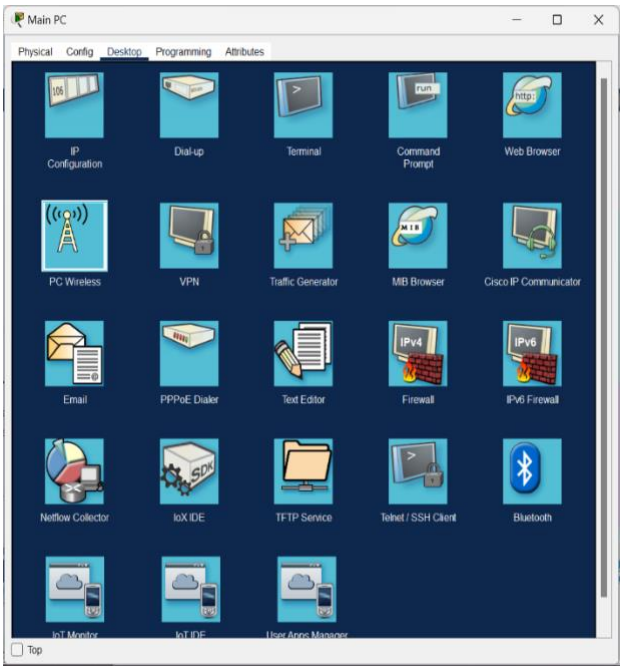
Step 1: Assign SSID and password



Go to config then port 1 and enter a unique SSID as the Wi-Fi network name and choose WPA2-PSK and set a password to secure the wireless network

Figure 26: SSID and password

Step 3: Connect Main PC and Laptop and Printer to Access Point 1



Click on pc and go to desktop and choose pc wireless

Figure 27: Desktop page

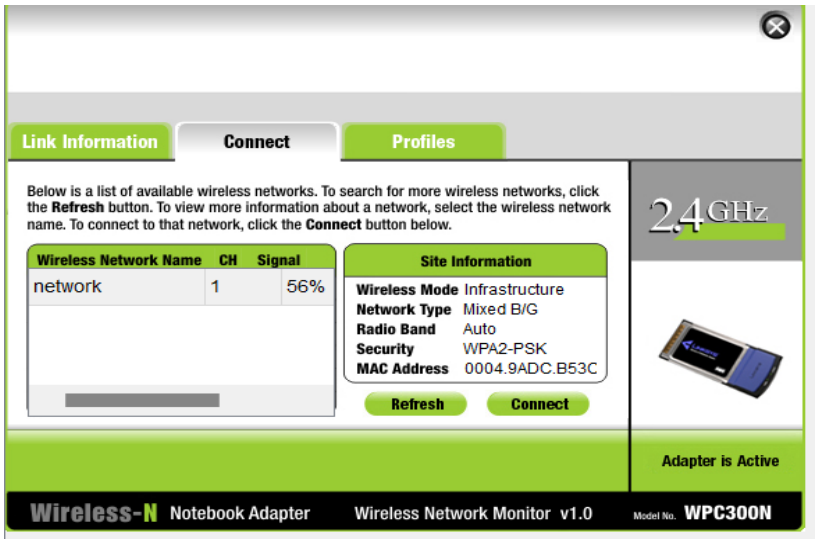


Figure 28

Click on refresh and choose the wireless network name and click on connect

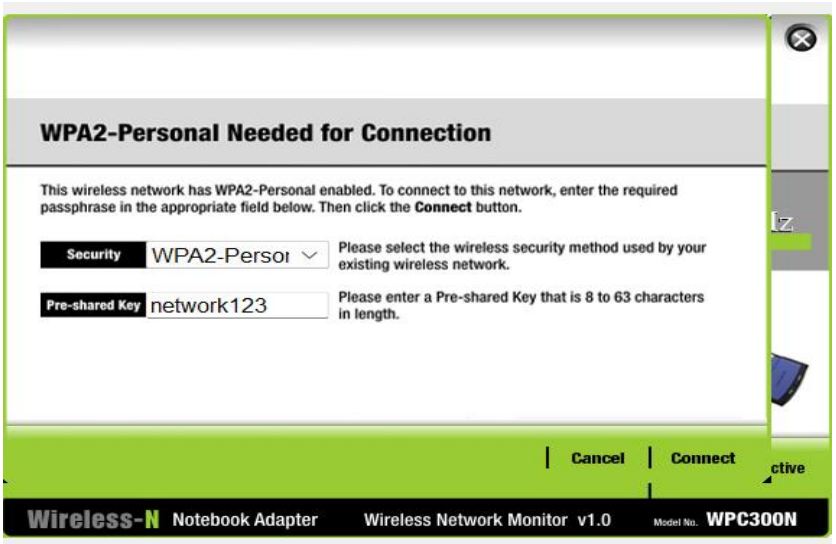


Figure 29

Enter the password and click on connect

Note: Same steps applied for configuring Access point 2

Server Configuration

Step 1: assign the IP address and subnet mask

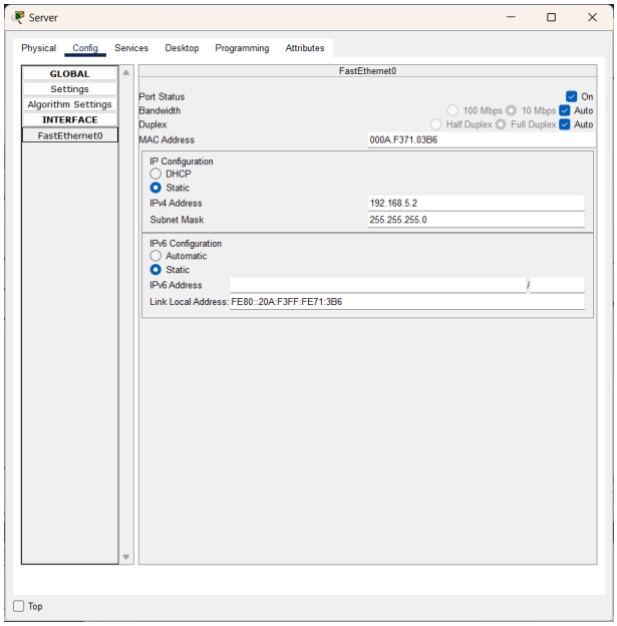
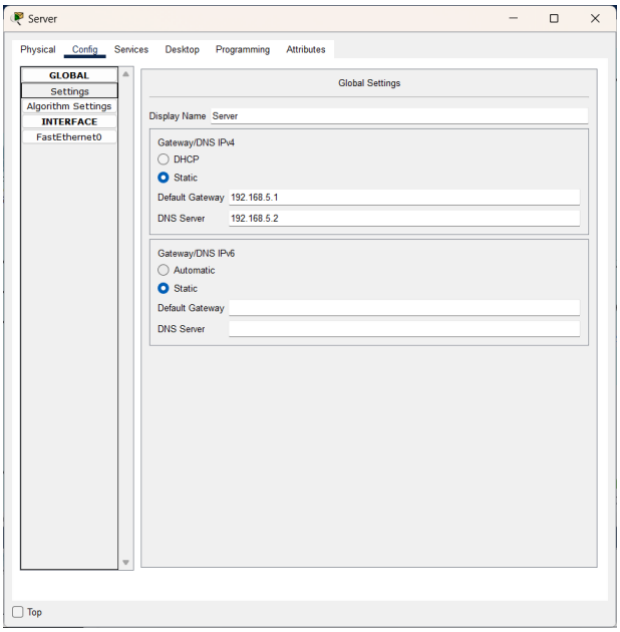


Figure 30: IP address and subnet mask for the server

Also, in this step we have set the IP address for the server which is 192.168.5.2 and the subnet mask was set automatically when we set the IP.

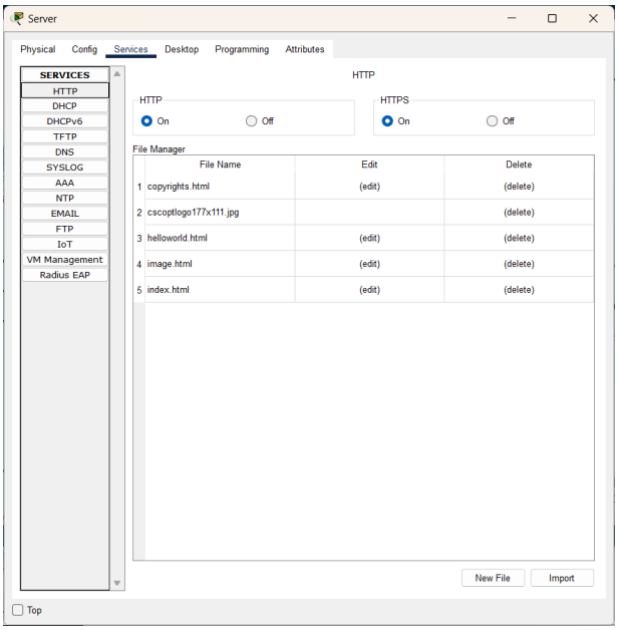
Step 2: assign the default gateway:



Then we assign the default gateway in the server.

Figure 31: default gateway

Step 3: Make the http work 'on'



In this step, we make sure that the HTTP is turned on.

Figure 32: http on

Step 4: Make the DNS work 'on'

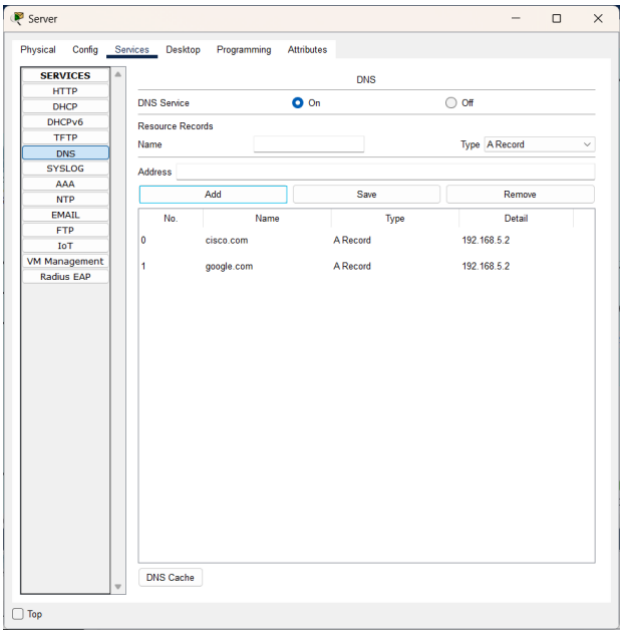


Figure 33: DNS on

We made this move to make web search using google.com, cisco.com available

Step 5: Browse the web through PCs or Laptops

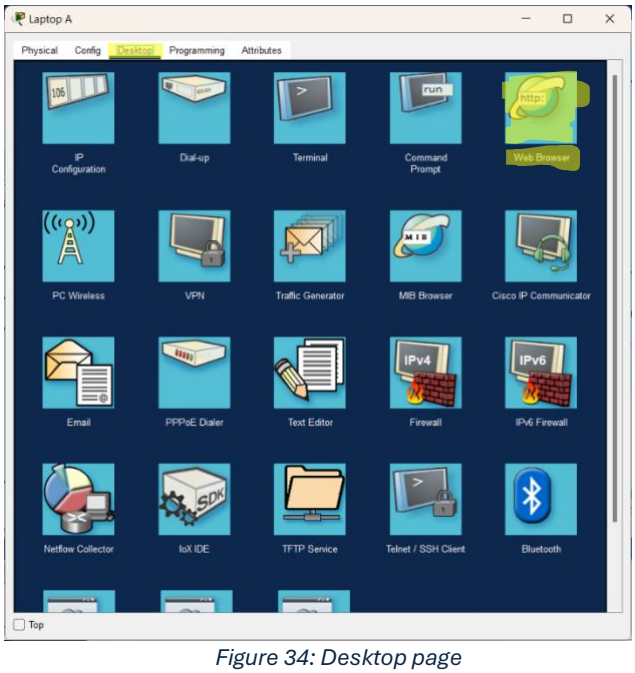


Figure 34: Desktop page

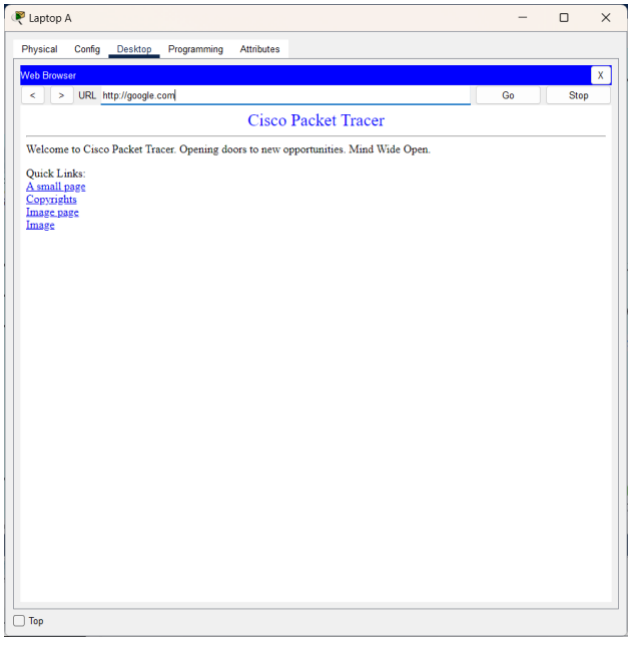


Figure 35: web Browser

In this step, all devices can browse the web, regardless of which floor or building they are on

Conclusion

To sum up, the implementation of the LAN enhances connectivity across the university campus. By integrating Cisco routers, switches, and VoIP, we enable seamless communication between departments. The network is reliable and ready for real-world demands, ensuring that our objectives are met and providing a solid foundation for future growth. A strong network is essential for a thriving educational environment.

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