



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.

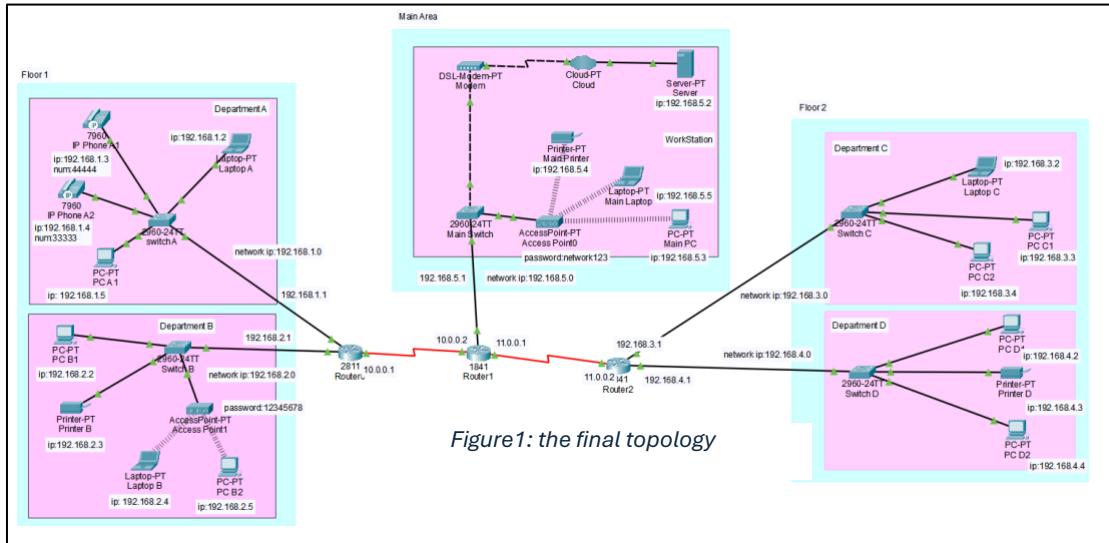
The network will include three Cisco routers (R1, R2, and R3) to manage external data flow, three Cisco switches (S1, S2, and S3) for efficient internal traffic management, and VoIP (IP Phones) for seamless communication across departments. This LAN is designed with future scalability in mind, enabling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



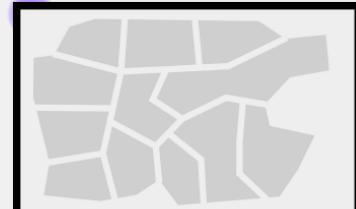
The logical topology of the university campus LAN consists of interconnected subnetworks, each designated for a specific department. The network employs a combination of star and partial ring topologies to optimize traffic flow and ensure redundancy. There are three routers—**2811 Router 1, 1841 Router 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.



University

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.

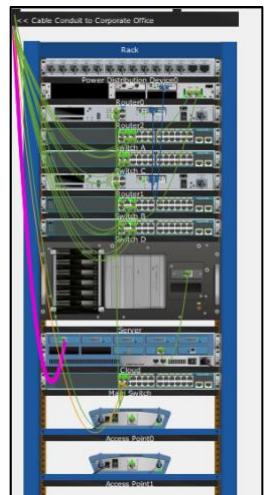


Figure 3: Cable conduit to corporate office

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

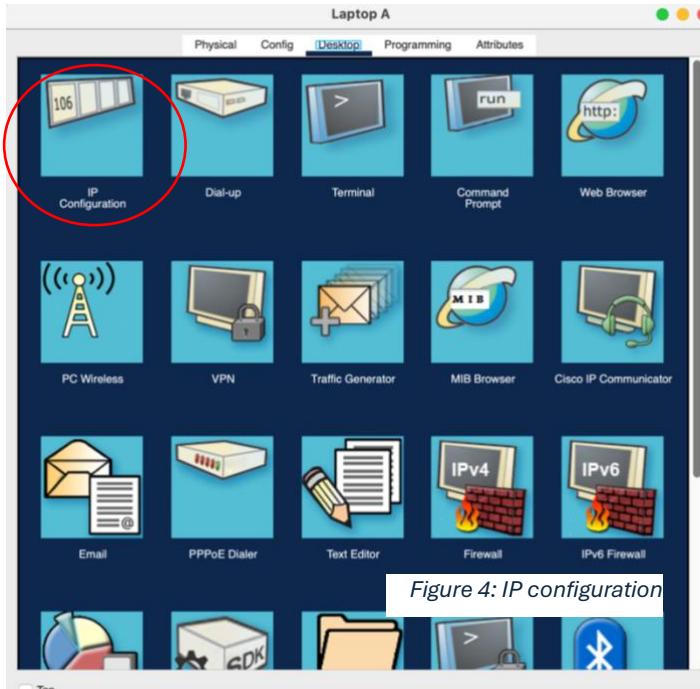


Figure 4: Desktop configuration

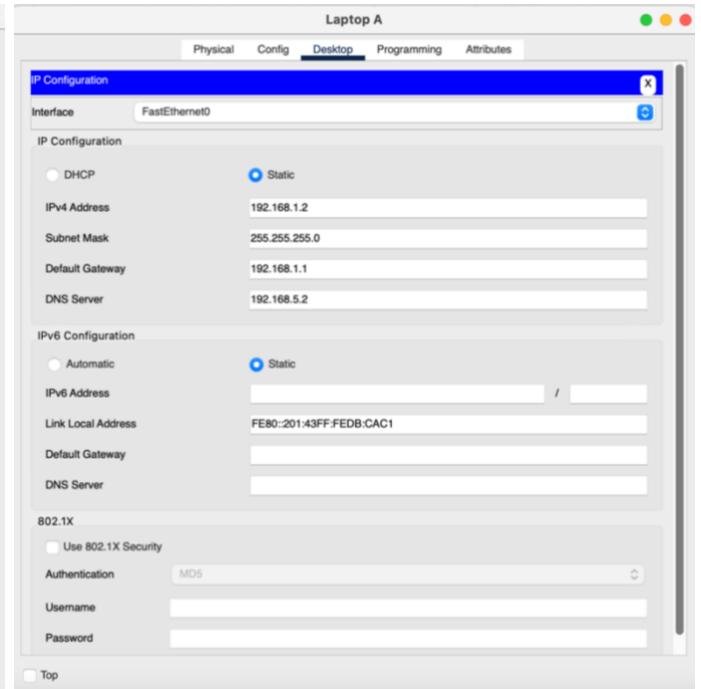


Figure 5: IP configuration

ie IP address and subnet mask:

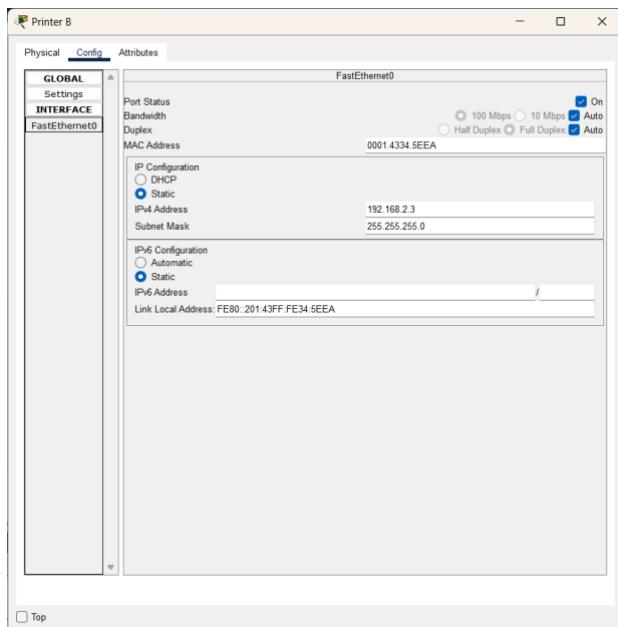
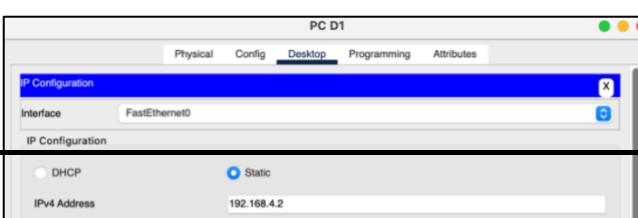


Figure 6: IP address and Subnet mask

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.

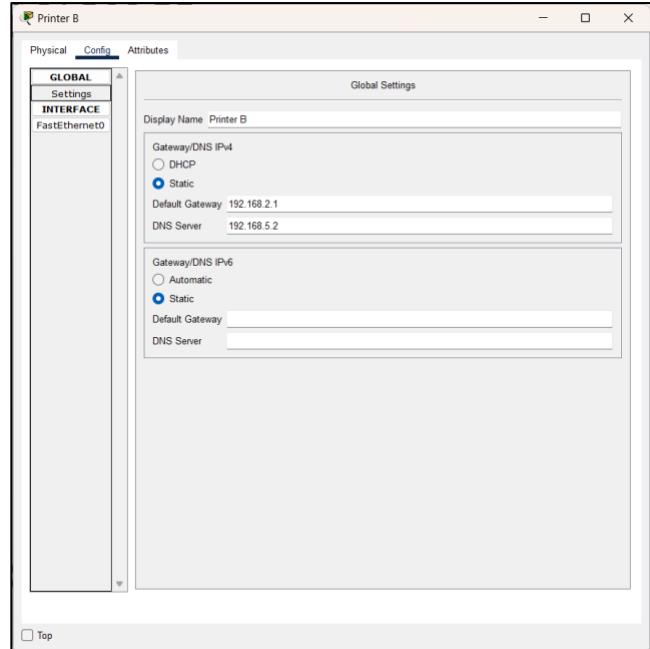


Figure 7: default gateway

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:

A screenshot of a terminal window titled "Router0". The window shows the configuration process for a Cisco router. It starts with a memory summary, followed by the "System Configuration Dialog" prompt. The user enters "yes" to start configuration. The terminal then displays the configuration commands entered, including setting IP addresses for FastEthernet0/0 and 0/1, and Serial0/2/0 interfaces, and defining static routes. The configuration ends with the "exit" command.

```
256K bytes of non-volatile configuration memory.
249856K bytes of ATA System CompactFlash 0 (Read/Write)

--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: yes
Press RETURN to get started!

Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface FastEthernet0/1
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/2/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#
Router(config-if)#
Router(config)#
Router(config)#ip route 192.168.5.0 255.255.255.0 10.0.0.2
Router(config)#ip route 192.168.3.0 255.255.255.0 10.0.0.2
Router(config)#ip route 192.168.4.0 255.255.255.0 10.0.0.2
```

Figure 8: Router 0 configuration

Router 1 configuration:

Router1

Physical Config CLI Attributes

IOS Command Line Interface

```
Technical Support: http://www.cisco.com/techsupport
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Compiled Wed Mar 14 21:07:52 2002 by pt_team

--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: i

Press RETURN to get started!

Router#enable
Router#config terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.5.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#i
!LINK-3-CHANGED: Interface FastEthernet0/0, changed state to up
!LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 10.0.0.2 255.0.0.0
Router(config-if)#ip address 10.0.0.2 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#i
!LINK-3-CHANGED: Interface Serial0/0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#i
!LINKPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up
ip address 11.0.0.1 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#i
!LINK-3-CHANGED: Interface Serial0/0/1, changed state to up

Router(config-if)#exit
Router(config)#i
!LINKPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up
ip route 192.168.1.0 255.255.255.0 10.0.0.1
ip route 192.168.1.0 255.255.255.0 11.0.0.1
Router(config)#ip route 192.168.3.0 255.255.255.0 11.0.0.2
Router(config)#ip route 192.168.3.0 255.255.255.0 11.0.0.2
Router(config)#exit
Router(config)#
!SYS-5-CONFIG_I: Configured from console by console

Router#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

Figure 9: Router 1 configuration

Router 2 configuration:

The screenshot shows the Router 2 configuration interface with the 'CLI' tab selected. The window title is 'Router2'. The main area displays the IOS Command Line Interface (CLI) output. The output includes system information like memory and processor details, followed by a configuration dialog prompt. The configuration part shows the setup of FastEthernet interfaces (FastEthernet0/0 and FastEthernet0/1) with IP addresses 192.168.4.1 and 192.168.3.1 respectively, and the serial interface Serial0/0 with IP address 11.0.0.2. The configuration ends with a shutdown command for the router.

```
Cisco 1841 (revision 5.0) with 114488K/14384K bytes of memory.  
Processor board ID 2D 000000000000  
M880 processor: part number 0, mask 49  
2 FastEthernet/IEEE 802.3 interface(s)  
1 V.35 synchronous/async network interface(s)  
181K bytes of SDRAM  
43488K bytes of ATA CompactFlash (Read/Write)  
Cisco IOS Software, 1841 Software (C1841-NV1PFSERVICEER3-M), Version 12.4(15)T1, RELEASE SOFTWARE (fc2)  
Processor Revision: 0x00000000  
Copyright: (c) 1984-2007 by Cisco Systems, Inc.  
Compiled Wed Mar 18 07:04:52 by pt_team  
  
--- System Configuration Dialog ---  
Would you like to enter the initial configuration dialog? [yes/no]:  
Press RETURN to get started!  
  
Router>enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/D.  
Router(config)#interface FastEthernet0/0  
Router(config-if)#ip address 192.168.4.1 255.255.255.0  
Router(config-if)#ip address 192.168.3.1 255.255.255.0  
Router(config-if)#no shutdown  
Router(config-if)#  
!LINEPROTO-5-CHANGED: Interface FastEthernet0/0, changed state to up  
!LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up  
Router(config-if)#exit  
Router(config)#interface FastEthernet0/1  
Router(config-if)#ip address 192.168.4.1 255.255.255.0  
Router(config-if)#ip address 192.168.3.1 255.255.255.0  
Router(config-if)#no shutdown  
Router(config-if)#  
!LINEPROTO-5-CHANGED: Interface FastEthernet0/1, changed state to up  
!LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up  
Router(config-if)#exit  
Router(config)#interface Serial0/0/1  
Router(config-if)#ip address 11.0.0.2 255.0.0.0  
Router(config-if)#ip address 11.0.0.2 255.0.0.0  
Router(config-if)#no shutdown  
Router(config-if)#  
Router#
```

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:

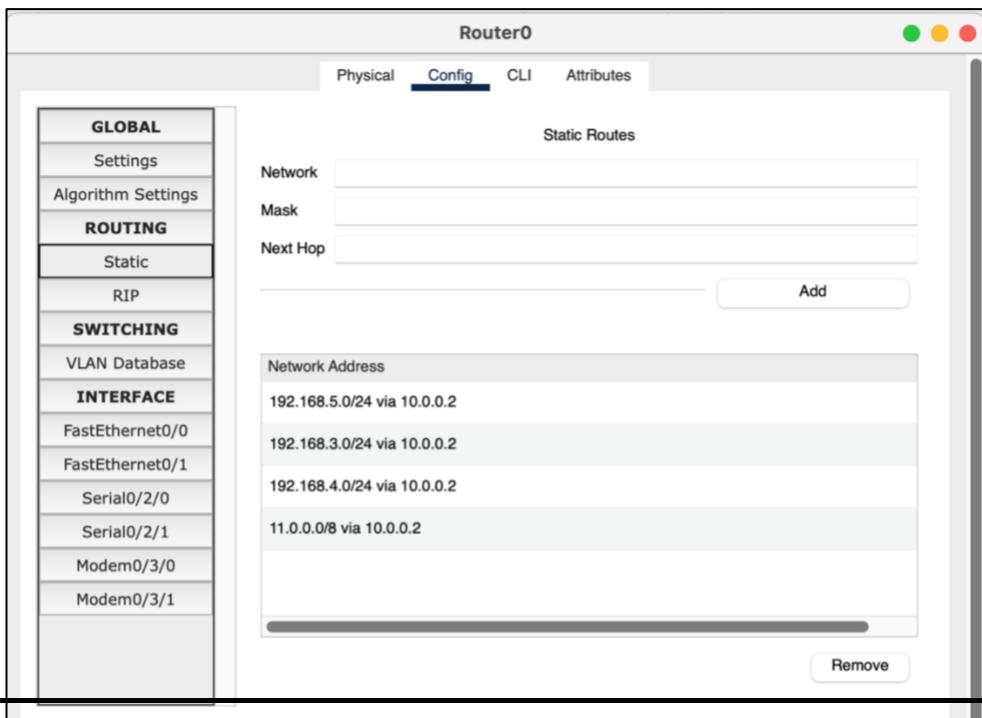


Figure 11: Router 0 routing table

Router 1:

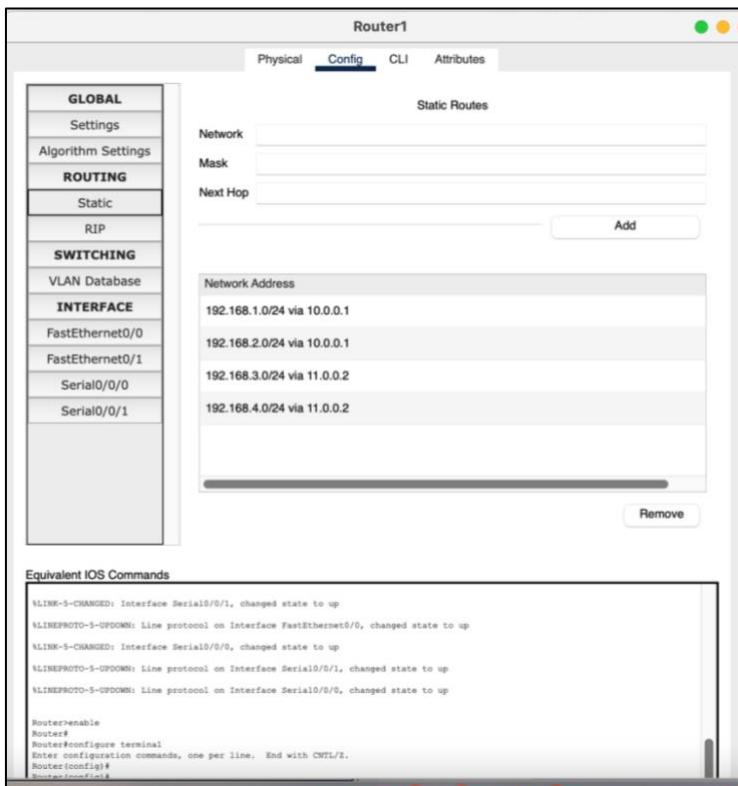
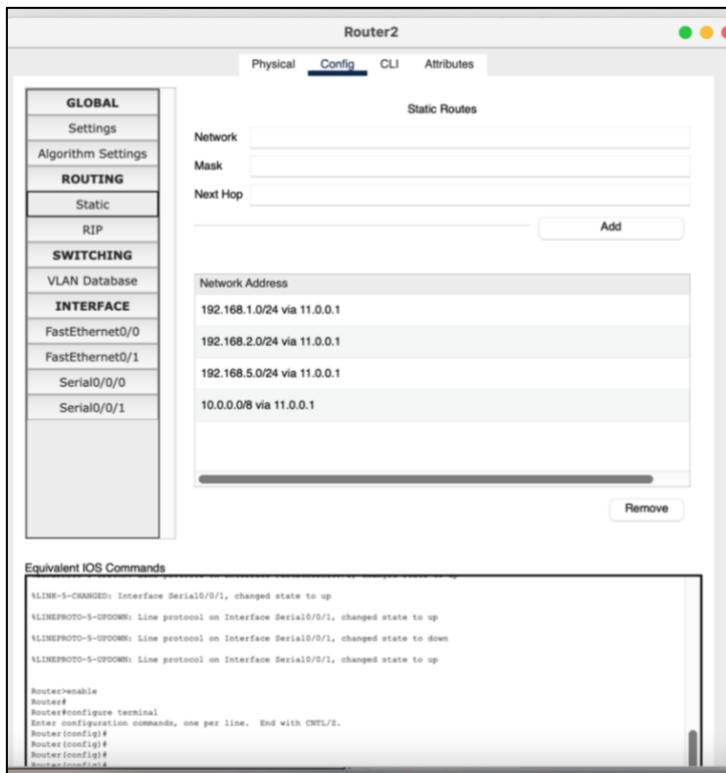


Figure 12: Router 1 routing table

Router 2:



Switch Configuration

Figure 13: Router 2 routing table

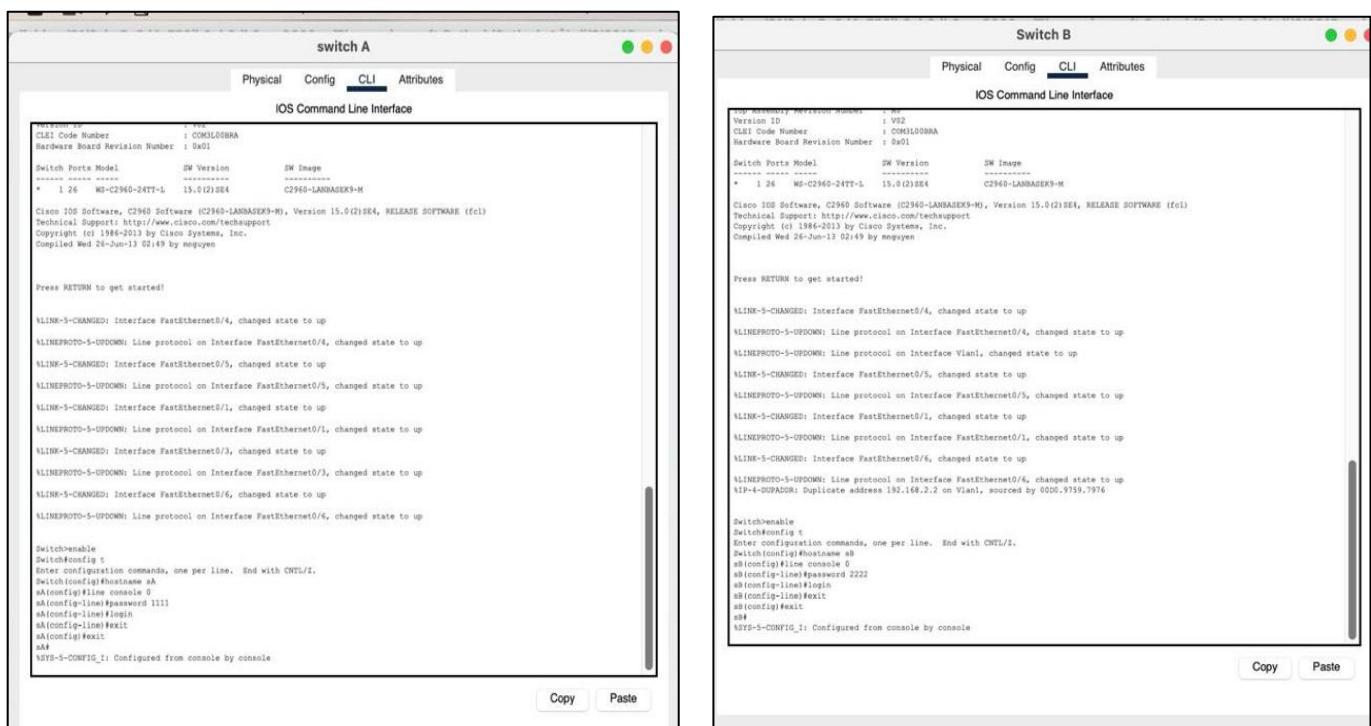


Figure 14:switch configuration A

Figure15:switch configuration B

```

Switch C
Physical Config CLI Attributes
IOS Command Line Interface

System serial number : FOC1018X164
Top Assembly Part Number : 800-27221-02
Top Assembly Revision Number : A0
Version ID : V02
CLME Code Number : C2960-000A
Hardware Board Revision Number : 9x01

Switch Ports Model SW Version SW Image
----- ----- -----
* 1 26 WS-C2960-24TT-L 15.0(2)SE4 C2960-LANBASEK9-H

Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
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Compiled Wed Jun 26 02:49 by nnguyen

Press RETURN to get started!

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up

Switch#enable
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname S
S(config)#line console 0
S(config-line)#password 3333
S(config-line)#end
S(config-line)#exit
S(config)#exit
S#S-5-CONFIG_I: Configured from console by console

Switch D
Physical Config CLI Attributes
IOS Command Line Interface

Switch Ports Model SW Version SW Image
----- ----- -----
* 1 26 WS-C2960-24TT-L 15.0(2)SE4 C2960-LANBASEK9-H

Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
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Press RETURN to get started!

%LINK-5-CHANGED: Interface FastEthernet0/4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/6, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/6, changed state to up

Switch#enable
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname S
S(config)#line console 0
S(config-line)#password 4444
S(config-line)#end
S(config-line)#exit
S(config-line)#exit
%
% Invalid input detected at '***' marker.
S(config-line)#exit
S(config)#exit
S#
SYS-5-CONFIG_I: Configured from console by console

```

Figure16:switch configuration C
Configure a voice Vlan on switch

Figure 17: switch configuration D

```

switch A
Physical Config CLI Attributes
IOS Command Line Interface

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/5, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/5, changed state to up
%LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
%LINK-3-UPDOWN: Interface FastEthernet0/3, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to down
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface range fa0/1-24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport voice vlan 1
Switch(config-if-range)#exit
Switch(config)#exit
Switch#
SYS-5-CONFIG_I: Configured from console by console

Copy Paste

```

Top

Figure 18: Vlan switch configuration

DSL Modem and Cloud Configuration

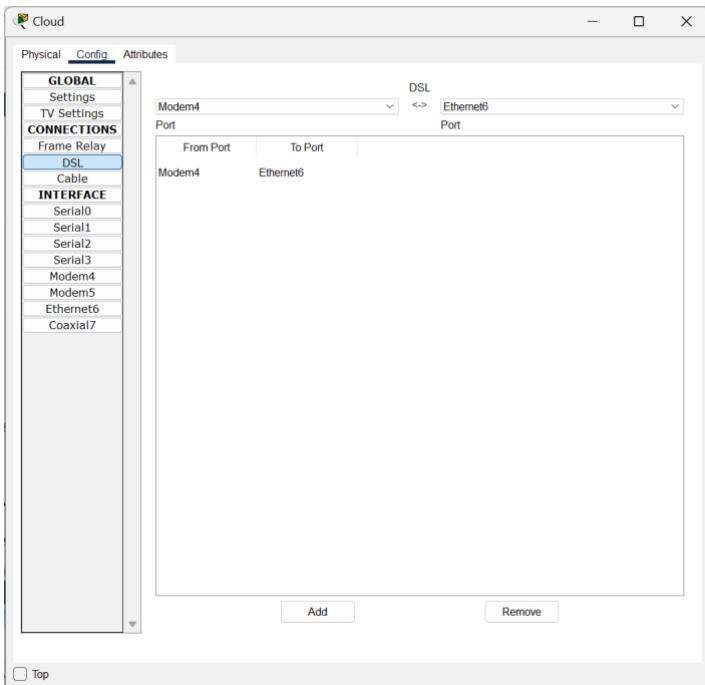


Figure 19: DSL Modem and Cloud configuration

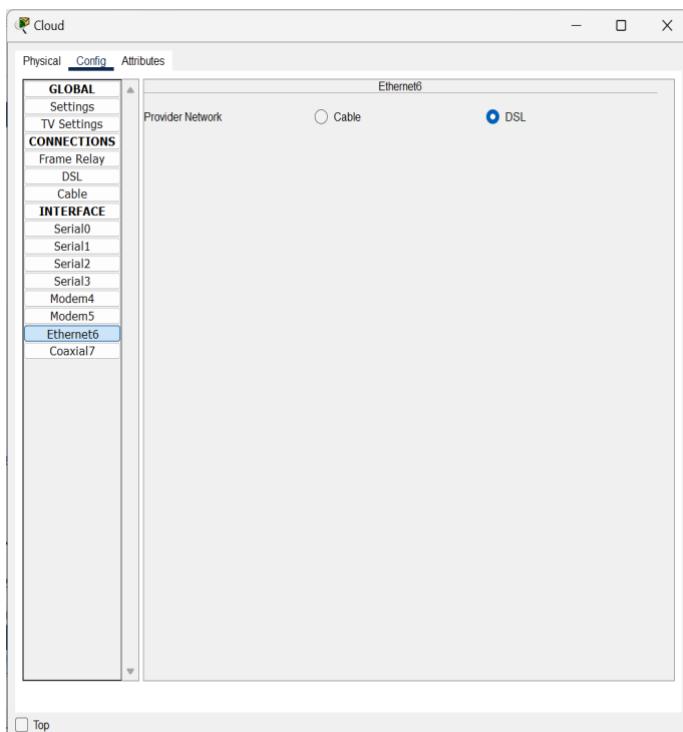


Figure 20: DSL Modem and Cloud configuration

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

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

The modem is set

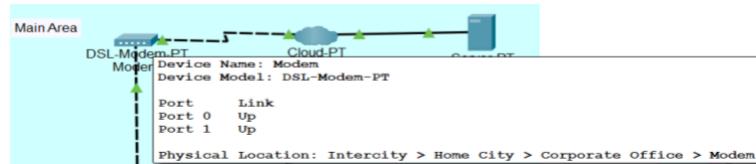


Figure 21

IP Phone Configuration (VoIP)

Step 1: Power the phone:

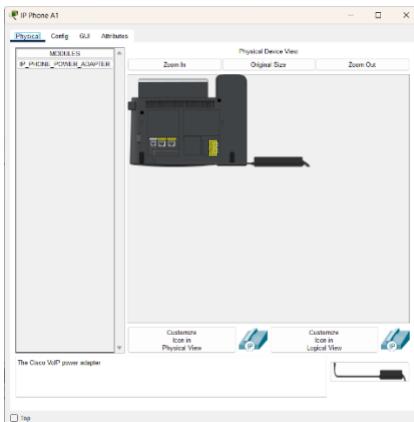


Figure22: power the phone

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

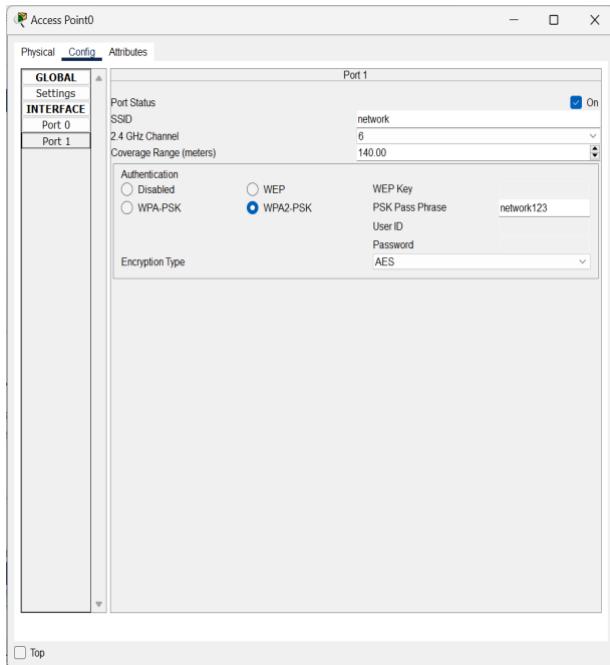
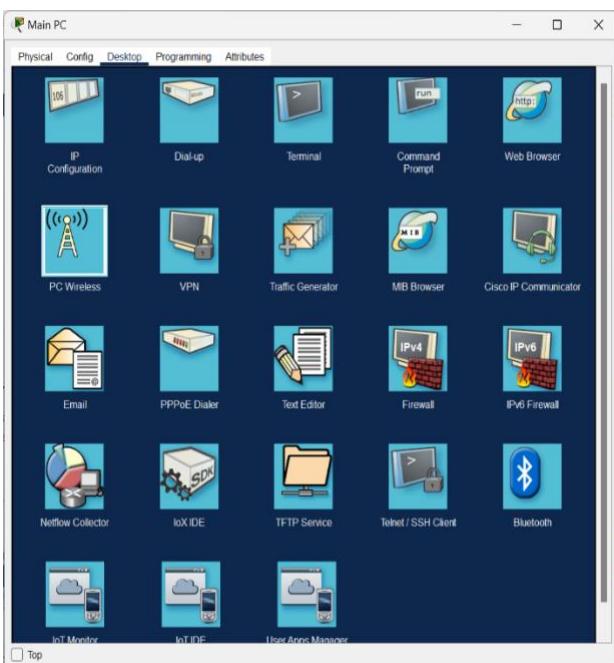


Figure 26: SSID and password

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

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

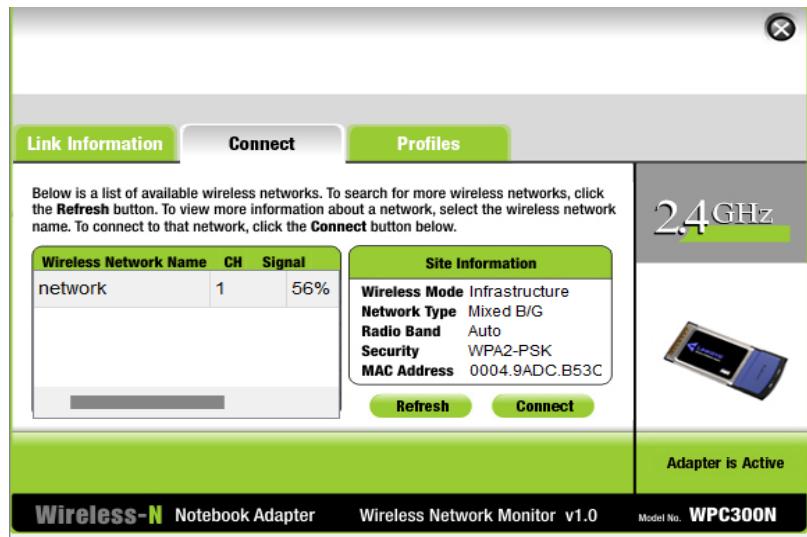


Figure 28

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

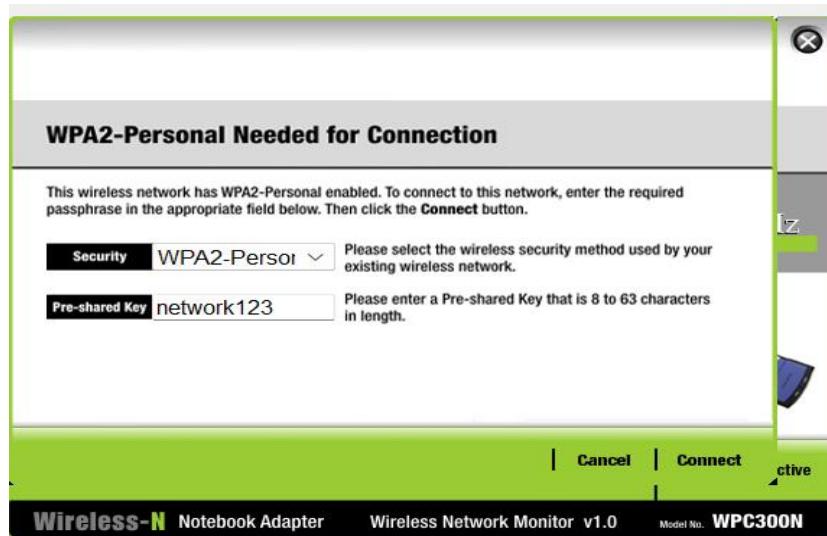


Figure 29

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

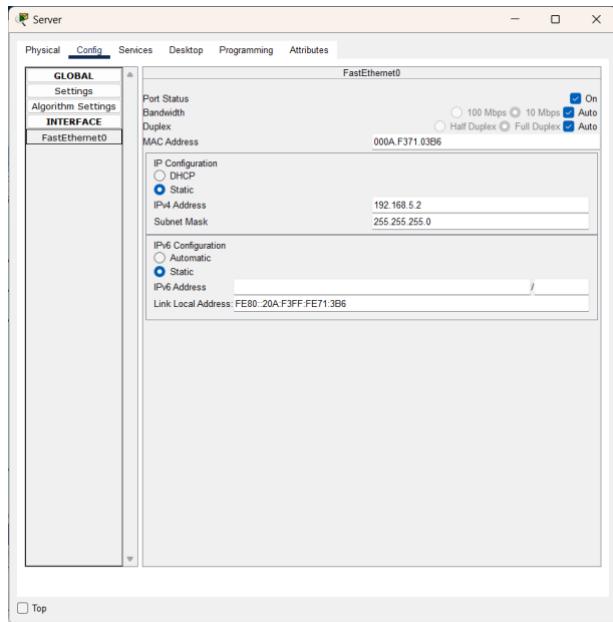
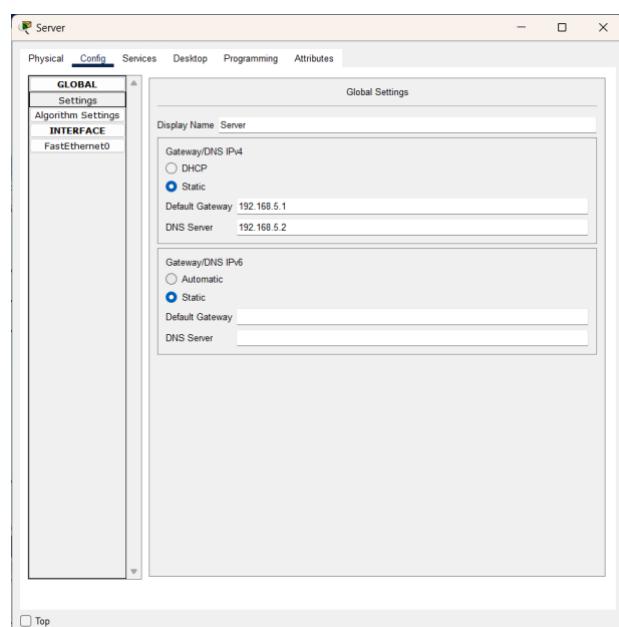


Figure 30: IP address and subnet mask for the server

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'

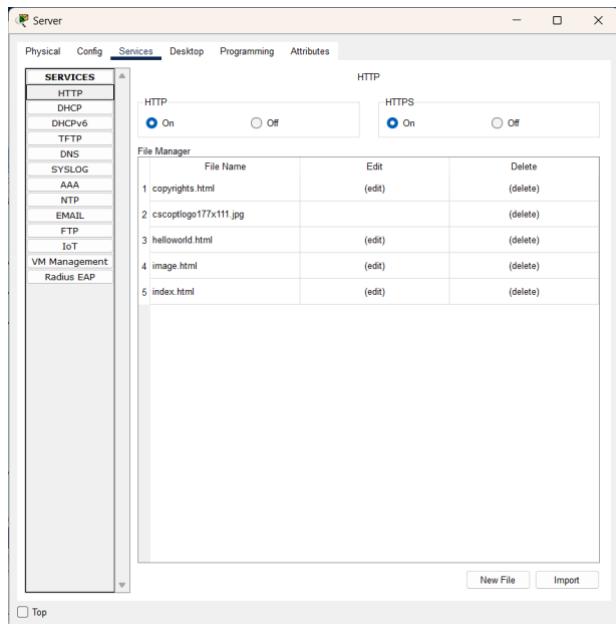


Figure 32: http on

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

Step 4: Make the DNS work 'on'

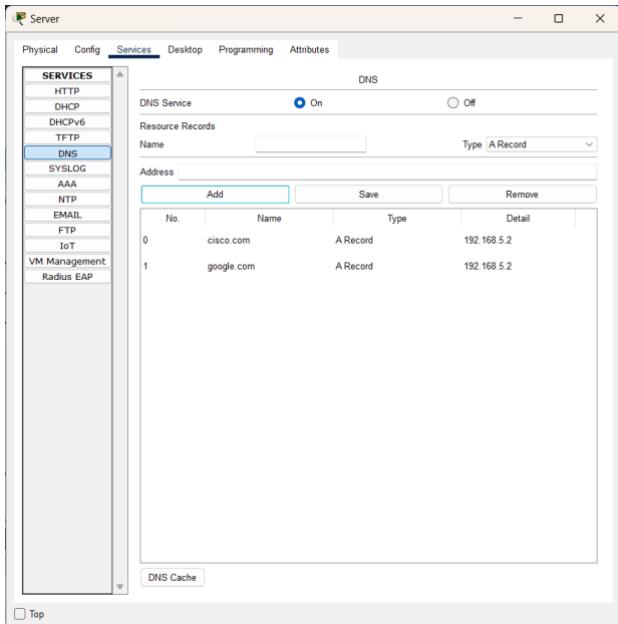


Figure 33: DNS on

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

Step 5: Browse the web through PCs or Laptops

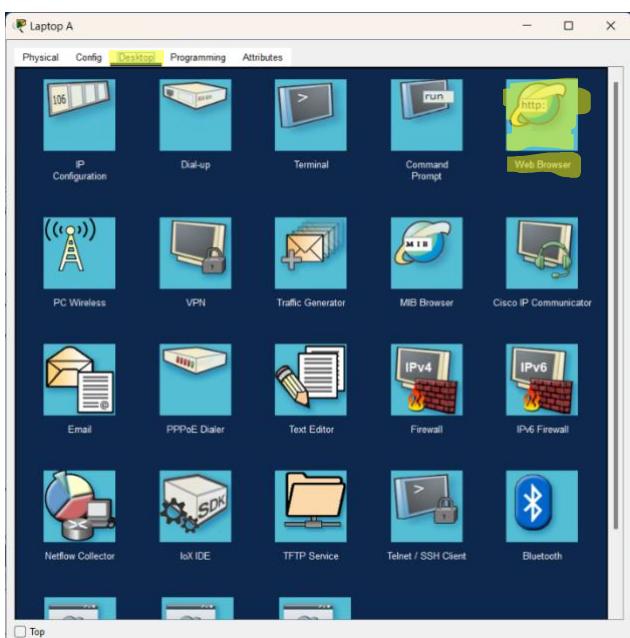


Figure 34: Desktop page

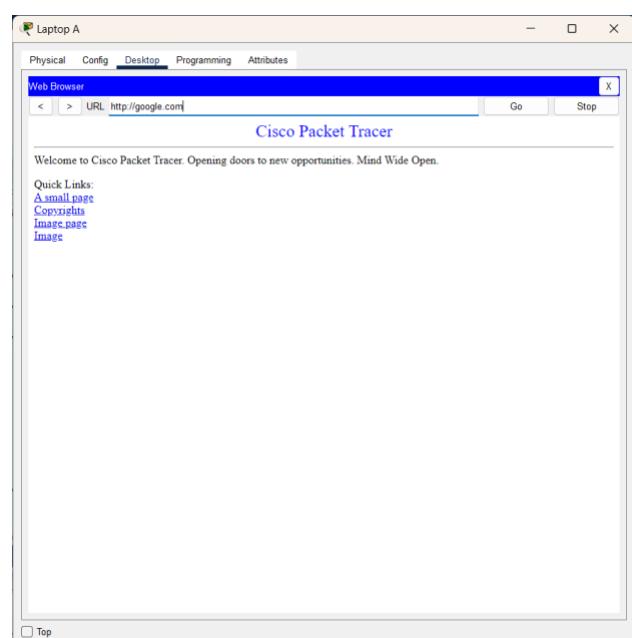


Figure 35: web Browser

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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