# CAMPUS NETWORK DESIGN & IMPLEMENTATION PROJECT USING CISCO PACKET TRACER

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Last but not least, we'd want to thank all of our classmates who have made major contributions through criticism and counsel.

This project provided us with an excellent opportunity to learn new concepts and tackle problems that may arise during our project session. This will undoubtedly help us become better people in the future.

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# Introduction

In today's digital age, a robust and efficient campus network is essential for educational institutions to facilitate communication, collaboration, and the seamless flow of information. This concept paper outlines the Campus Network Design & Implementation Project, which aims to create an advanced network infrastructure for an educational campus using Cisco Packet Tracer. Cisco Packet Tracer is a powerful simulation tool that enables network engineers to design, configure, and troubleshoot network solutions in a virtual environment.

# Requirements:

Kathmandu University is a large university which has two campuses situated 20 miles apart. The university's students and staff are distributed in 4 faculties; these include the faculties of Health and Sciences; Business; Engineering/Computing and Art/Design. Each member of staff has a PC and students have access to PCS in the labs.

- Create a network topology with the main components to support the following:

**Main campus:**

**Building A:** Administrative staff in the departments of management, HR and

- Finance. The admin staff PCs are distributed in the building offices and it is
- Expected that they will share some networking equipment .The Faculty of

- Business is also situated in this building

**Building B:** Faculty of Engineering and Computing and Faculty of Art and Design

**Building C:** Students' labs and IT department. The IT department hosts the

- University Web server and other servers

There is also an email server hosted externally on the cloud.

**Smaller campus:**

- Faculty of Health and Sciences (staff and students' labs are situated on
- Separate floors)

# Project Objectives

The primary objectives of this project are as follows:

## 3.1. Design a Scalable Network Architecture

The project will start with a comprehensive analysis of the campus's networking requirements and existing infrastructure. The goal is to design a scalable and future-ready network architecture that can accommodate the current needs of the campus while allowing for growth and expansion in the future.

## 3.2. Implement Core and Distribution Layers

The core of the network will serve as the backbone, providing high-speed connectivity between different buildings and departments within the campus. The distribution layer will ensure efficient traffic routing and distribution throughout the campus network.

### 3.3. Secure the Network

Security is a paramount concern in any network infrastructure. This project will implement robust security measures, including firewalls, intrusion detection systems, and access controls, to protect sensitive data and ensure the integrity of the network.

### 3.4. Provide High Availability

To minimize downtime and ensure uninterrupted access to network resources, the project will incorporate redundancy and failover mechanisms, such as redundant links, load balancing, and backup power supplies.

### 3.5. Implement Quality of Service (QoS)

Quality of Service mechanisms will be employed to prioritize network traffic and ensure that critical applications, such as video conferencing and e-learning platforms, receive the necessary bandwidth and low latency.

## Methodology

The project will follow a structured methodology that includes the following phases:

## 4.1. Needs Assessment and Analysis

The project team will collaborate with campus stakeholders to understand their specific requirements, taking into account factors such as the number of users, types of devices, and expected network traffic.

## 4.2. Design and Simulation

Using Cisco Packet Tracer, the team will create a detailed network design, including the physical layout, IP addressing scheme, VLANs, and security policies. This design will be tested and optimized in a simulated environment.

## 4.3. Testing and Optimization

The network will undergo rigorous testing to identify and rectify any issues. Performance tuning and optimization will be carried out to ensure the network meets its objectives.

## 4.4. Documentation

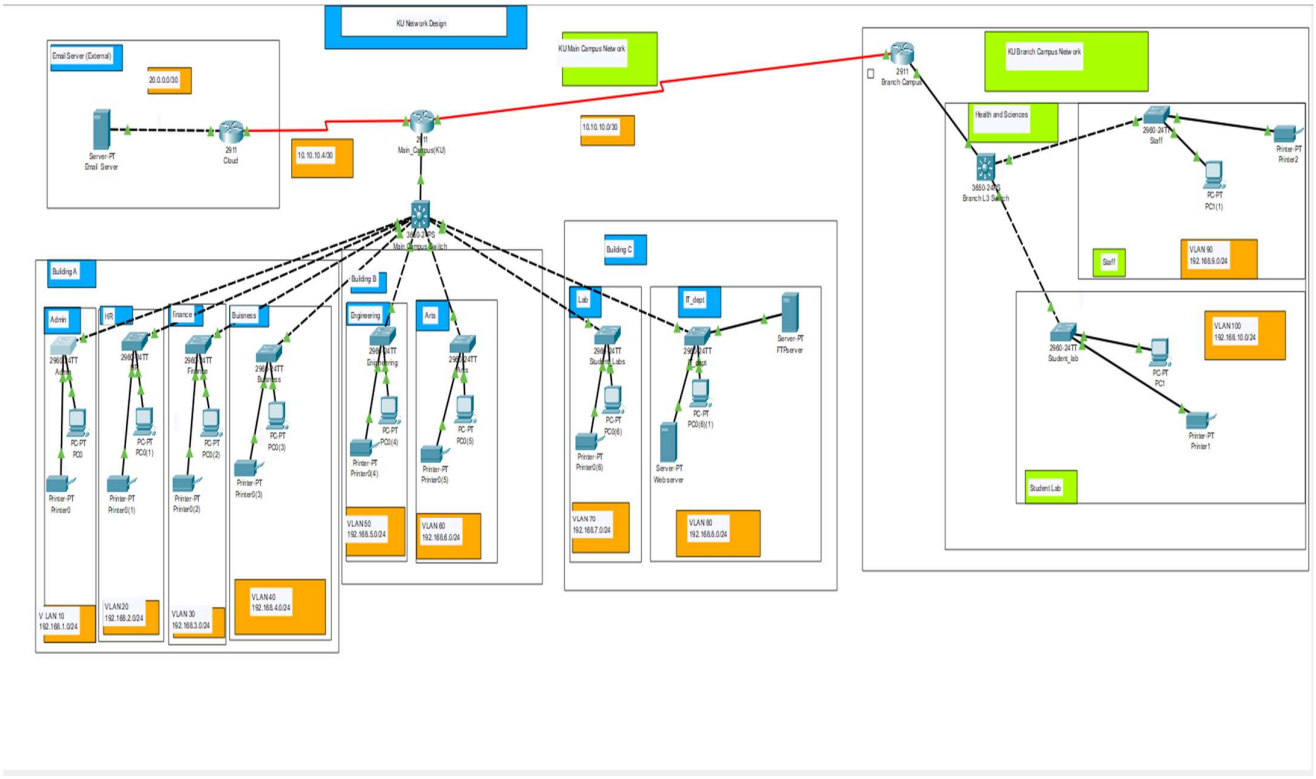
Comprehensive documentation will be created to facilitate future network management and troubleshooting.

# Expected Outcomes

Upon completion of the Campus Network Design & Implementation Project, the following outcomes are expected:

- A highly scalable and secure campus network infrastructure.
- Improved network performance and reliability.
- Enhanced support for online learning, research, and administrative tasks.
- Reduced downtime and efficient troubleshooting processes.
- Increased satisfaction among end users due to a seamless network experience.

# Design of the System



# Development of the System

## 7.0 Setup Phase

### 7.0.1 Main Campus:

First of all Main Campus 2911 Router is connected with the 3660-24 IPS Multilayer Switch with straight through cable.

#### 7.0.1.1 Main Campus Switch:

The multilayer switch is connected with switches of each depart (Admin to Art/Design) of the 3 buildings with Cross cable.

##### 7.0.1.1.1 Department Switches and Devices:

In each department there is 2960-24TT switch connected with the IPS multilayer switch through cross cable and the switch is also connected with individual end devices like computer and printer through straight through cable. Here in Main Campus there are 3 buildings. In building A there are 4 departments: Admin, HR, Finance, and Business

- In building B there are 2 departments: Engineering and Arts
- In building C there are also 2 departments: Student Lab and IT depart
- The IT department of building C hosts the University web server and other servers.

### 7.0.2 Branch Campus:

Just like in Main Campus, the branch campus also uses the 2911 router which is also connected with the 3660-24 IPS Multilayer Switch with straight through cable.

Also the branch campus router is connected with Main campus router through Serial DCE.

#### 7.0.2.1 Branch Campus Switch:

The multilayer switch is connected to the student lab and staff department of its single building with cross cable.

##### 7.0.2.1.1 Department Switches and Devices:

Just like in the Main campus, the branch campus also there are 2960-24TT switch again connected with IPS Multilayer switch through with straight through cable.

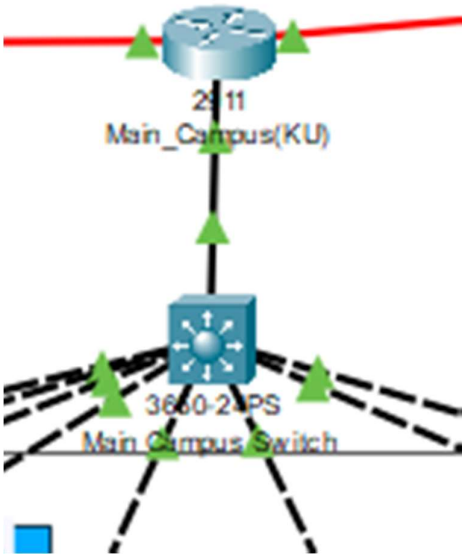
### 7.0.3 External Cloud Email Server:

In the external cloud email server, just like in Main campus and branch campus, 2911 router is used and connected with the Main Campus Router through Serial DCE. It is also connected with email server through cross cable, where it hosts external email for the Main Campus.

## 7.1 Configuration Phase:

### 7.1.1 Main Campus:

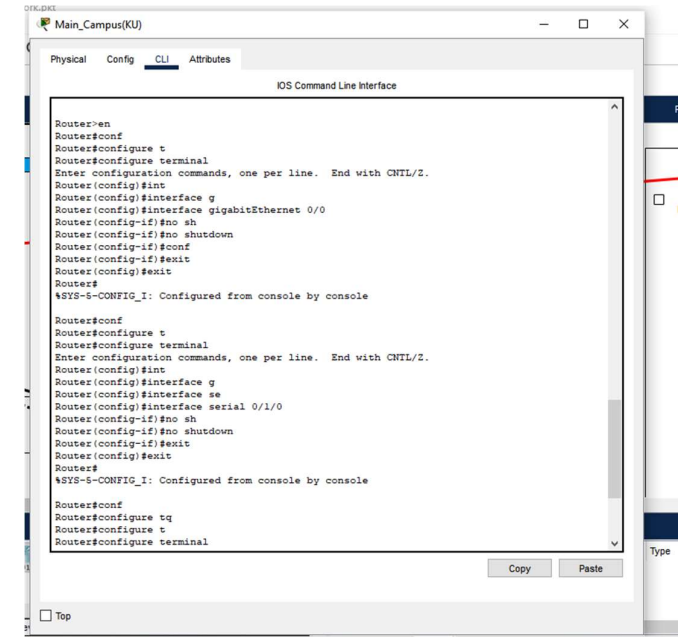
The Main Campus Router is connected with the Main campus switch through

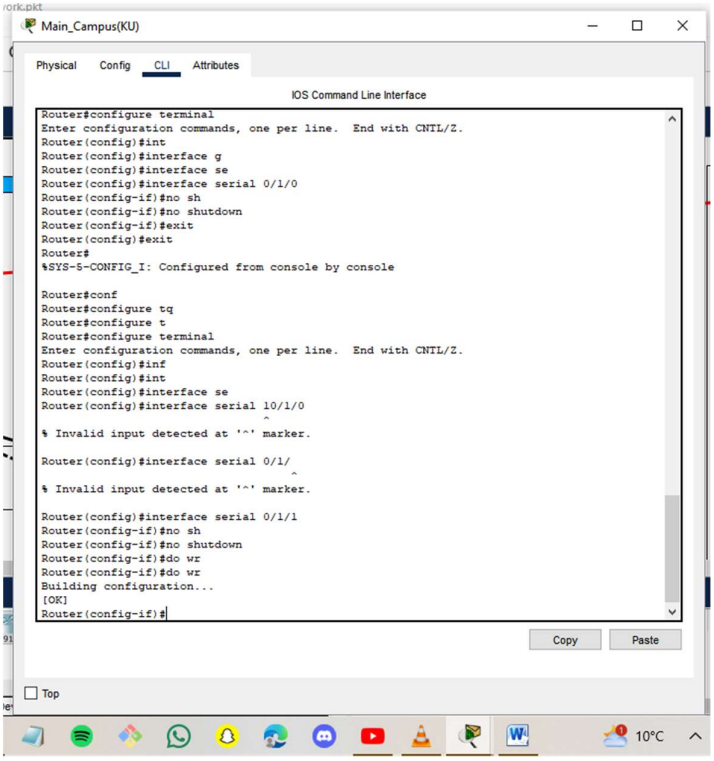



Straight through cable with interfaces Gigabit Ethernet 0/0 in the Router and 1/0/1 in the Switch.

### 7.1.1.1 Main Campus Switch:

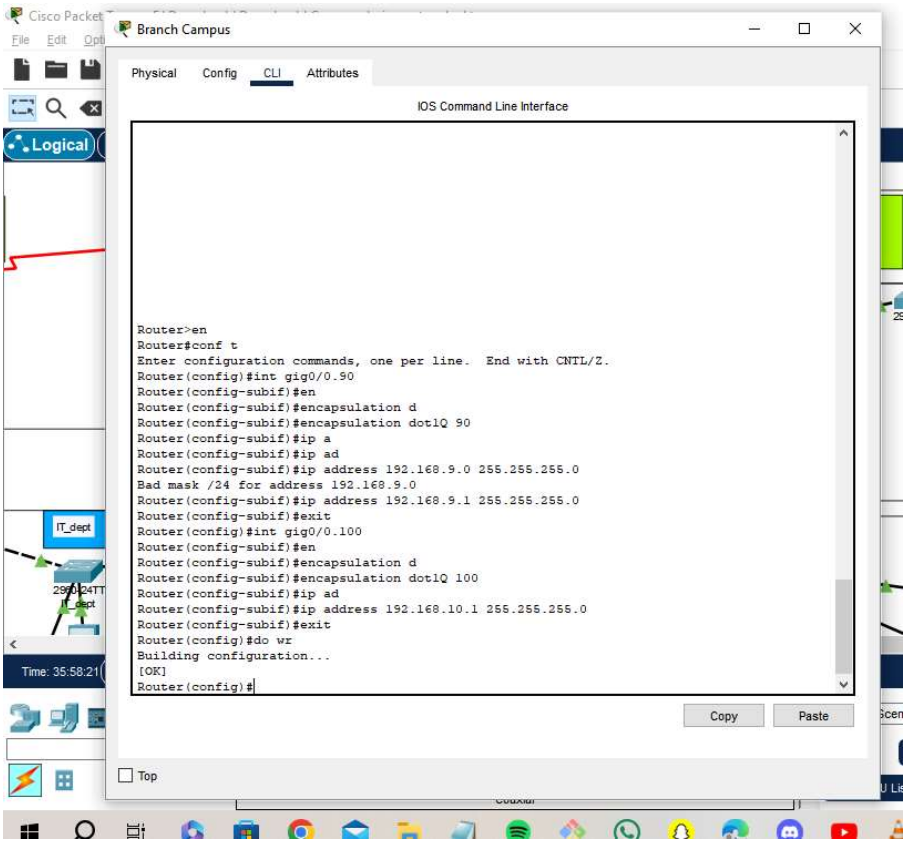
The Main Campus Switch is connected with the Main Campus router and also with all the buildings and their respective departments with the interface gig1/0/2 to 1/0/9 to the respective Vlans 10 to 80 with IP addresses 192.168.1.0/24 to 192.168.8.0/24 and the Vlans are configured in the Main Campus Switches afterwards.



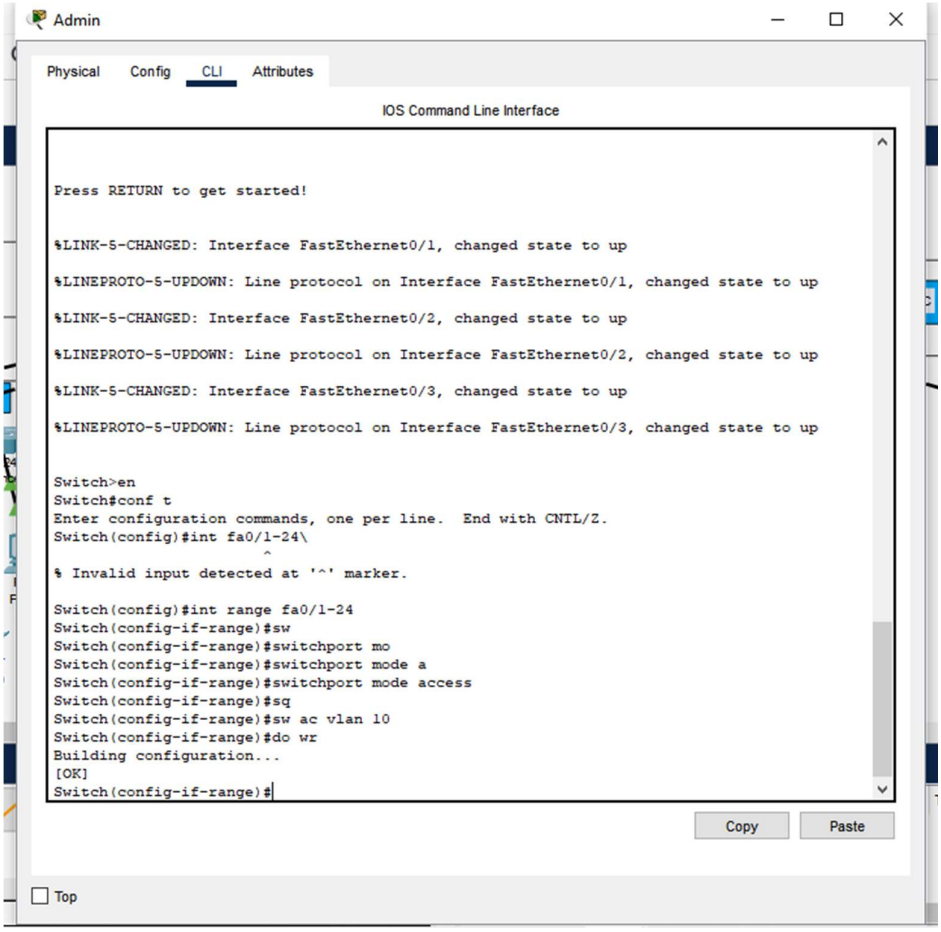



Taking example of setting up Admin department:

- Here we setup the admin department's switch with the multilayer switch by opening configuration terminal in the admin switch and setting up the interface fast Ethernet 0/1 to 0/24 using interface range command. And changing the switch port mode to access port. After setting up the interface we also configure the Vlan 10 in admin department with IP address 192.168.1.0/24.
- We will repeat this process to setup all the departments in the buildings of Main Campus.



Here, is the code snippet of configuring the sub interfaces gig 0/0.10 to 0.80 in the Main Campus and we will similarly configure in Branch Campus Router too.




## 7.1.1.2 DHCP server:

The router is configured with DHCP to all the VLANS

**#Service dhcp admin-pool**

**#network 192.168.1.0 255.255.255.0**

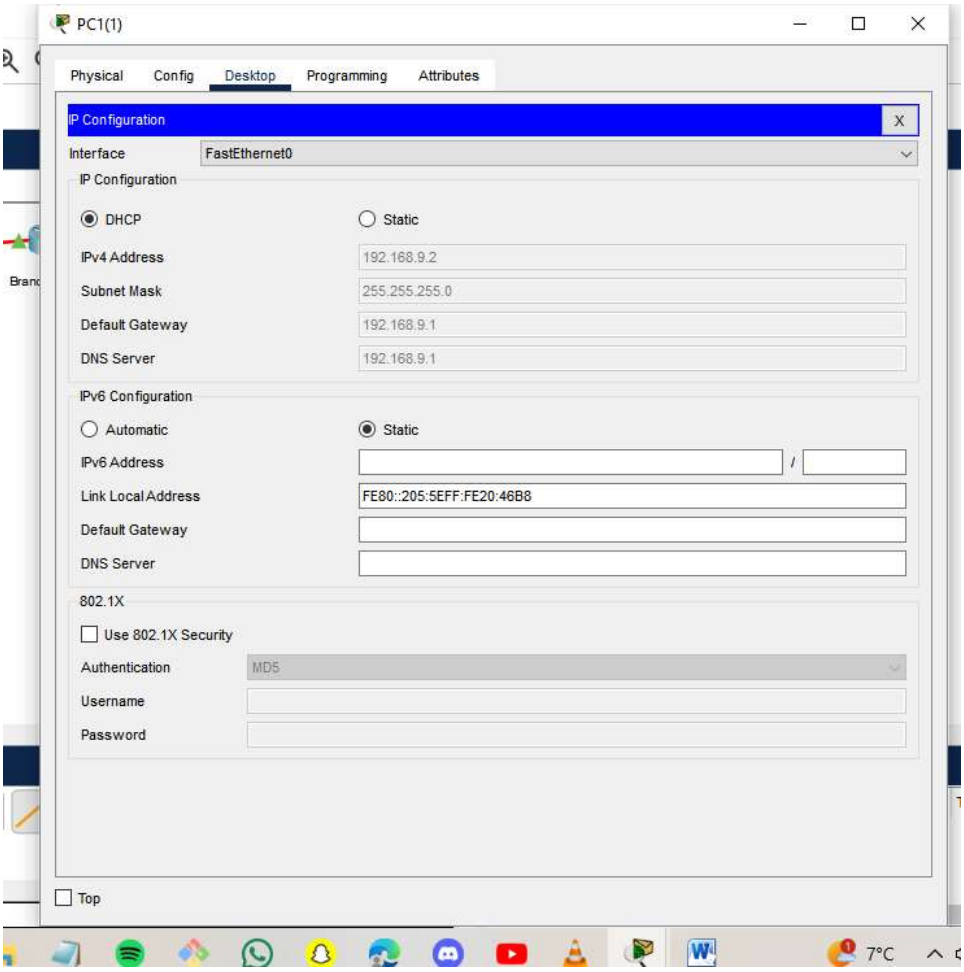
**#default-router 192.168.1.1**

**#dns 192.168.1.1**

- Above is the code snippet of configuring the DHCP server for admin department with the main campus switch

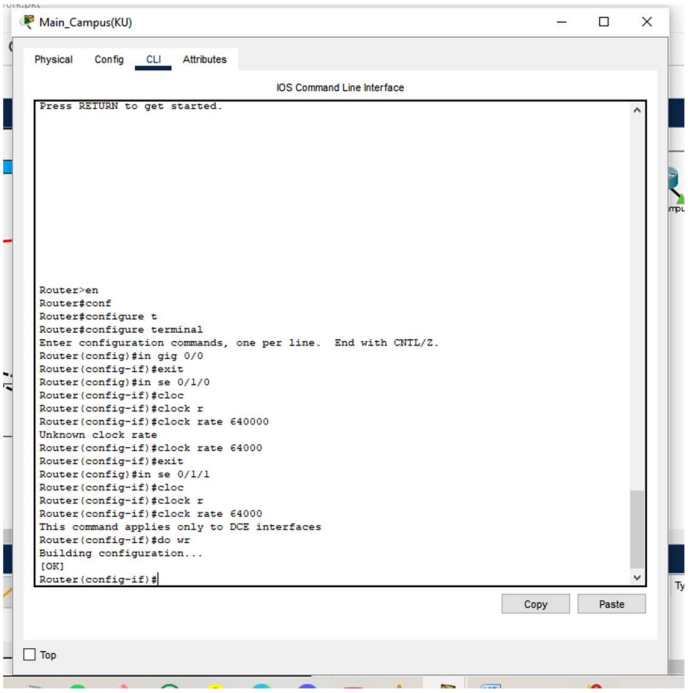
- We will configure all the departments in similar way.

Below is the example IP address obtained from DHCP

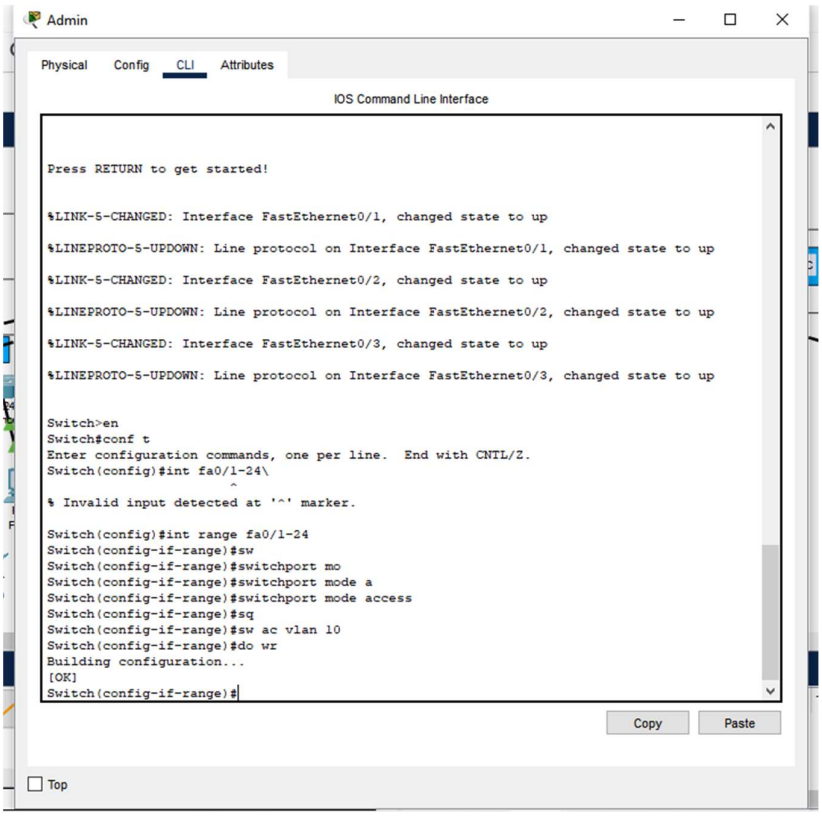


### 7.1.2 Branch Campus:

The Branch Campus Router has Serial DCE connection to Main Campus router, so we must set a clock rate in the branch campus router so below is the code snippet of setting the clock rate.

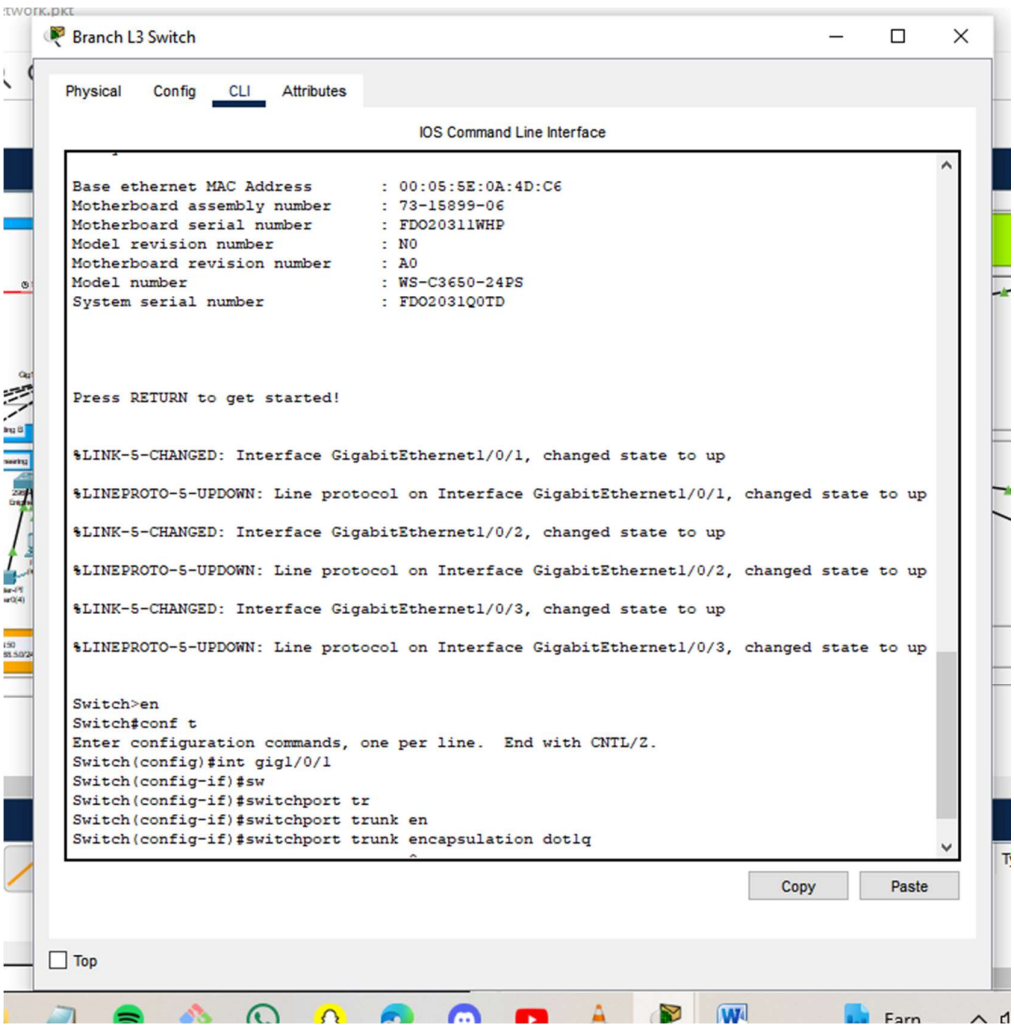



Also, all the fast Ethernet interfaces are setup in each department just like in the Main campus, and below is the code snippet of the range interface to Vlans.



Now, in access mode in Branch Campus, to communicate with other devices on different router, multiple vlans can't communicate so we must setup trunk encapsulation.

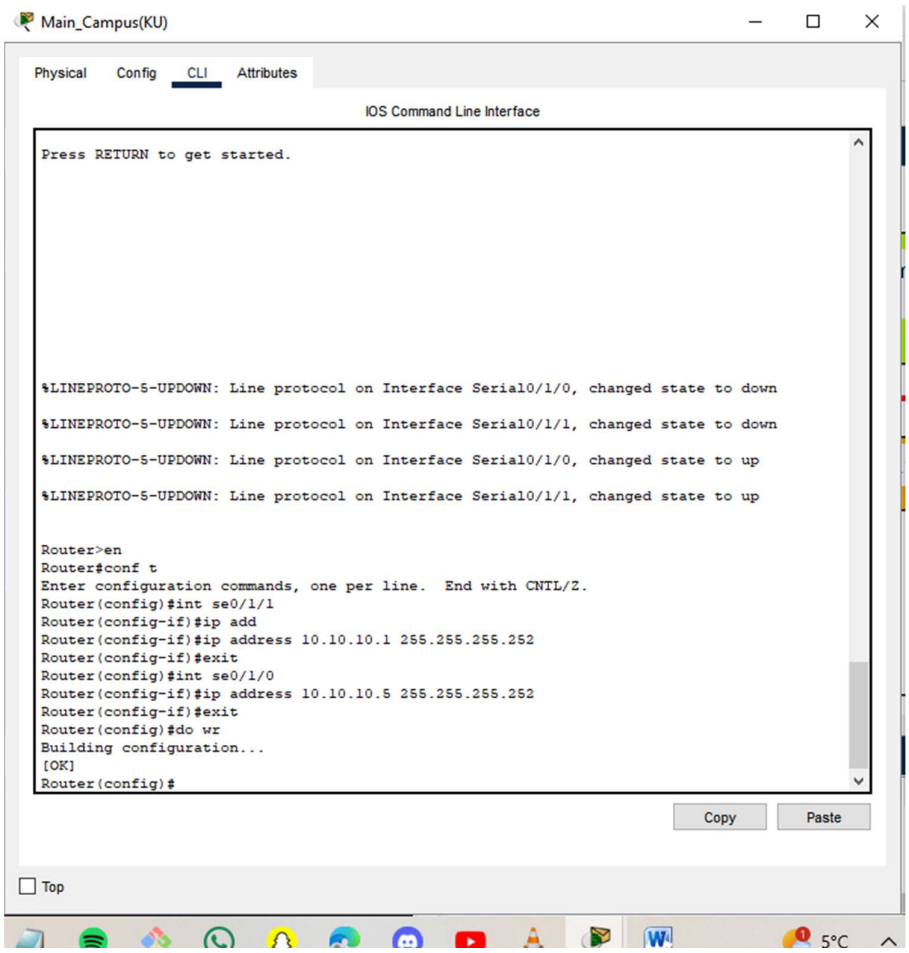
Below is the code snippet of the trunk encapsulation in the Branch Campus. We also have to setup the trunk in Main Campus Switch too.



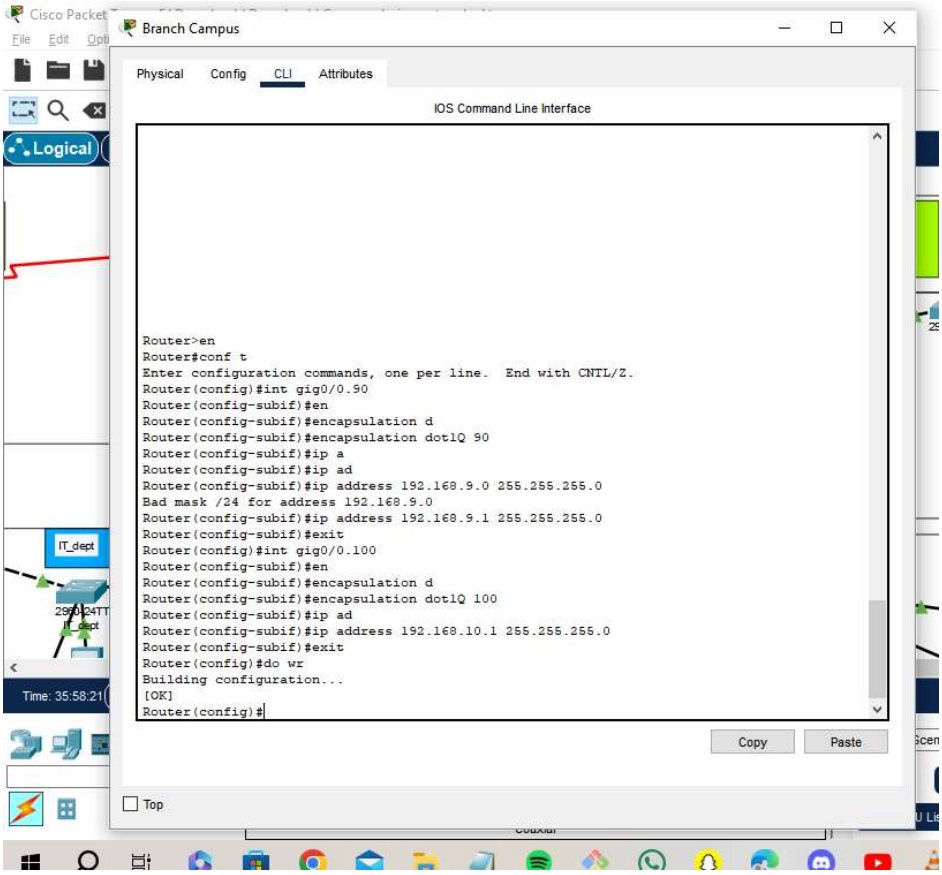

Now configuring the IP address of Main Campus Router to Branch Campus Router and External Email server respectively.

- In interface se0/1/1 (Branch Campus) the IP is 10.10.10.1 255.255.255.252 so that it can only hold two IPs one for Main campus and other for branch
- Similarly in interface se0/1/0 (External Email Server) it is from 5-6 in same way.

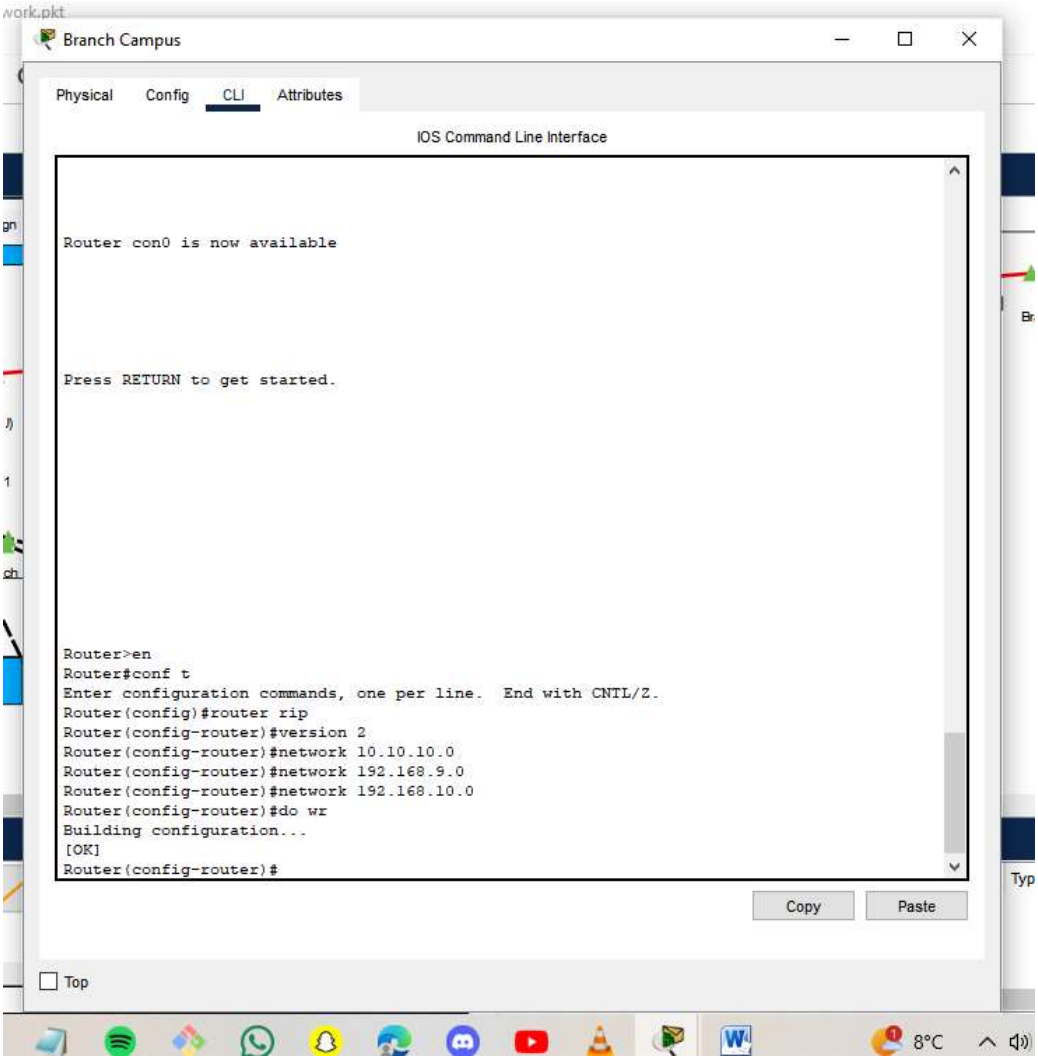
Also in the Branch Campus router setting IP 10.10.10.2 255.255.255.252 in se0/1/1 which is connected to serial 0/1/1 to Main campus and in the external email server router setting IP 10.10.10.6 in se 0/1/0 which is connected to main campus router.




Now, below is the code snippet of configuring the sub interfaces in the branch campus.



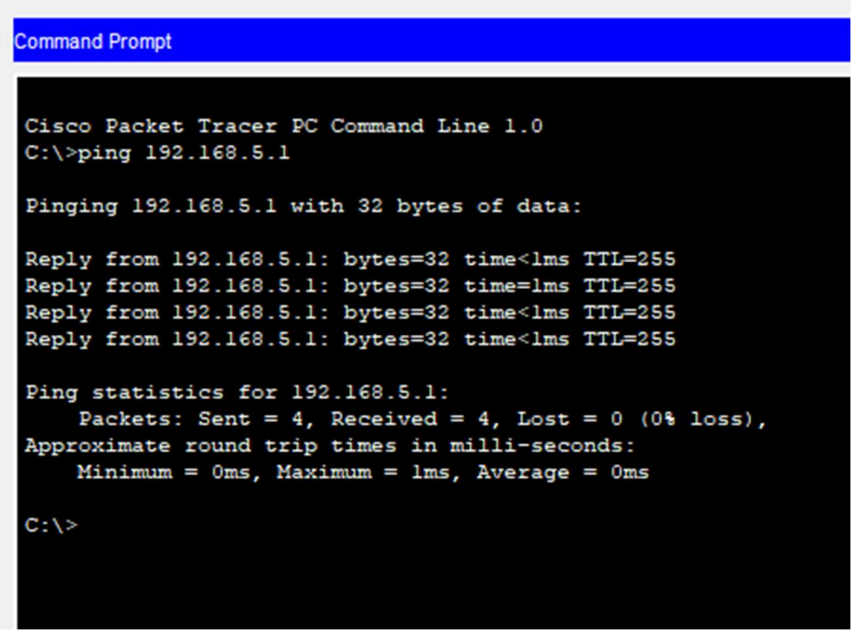

Now we need to configure all three routers (main,branch and external) using RIP (Router Information Protocol) version 2 to allow all the devices to communicate with all other devices under all the routers




The RIP needs to be configured on each network present under the router either from router to switch or from switch to individual switches and Vlans.

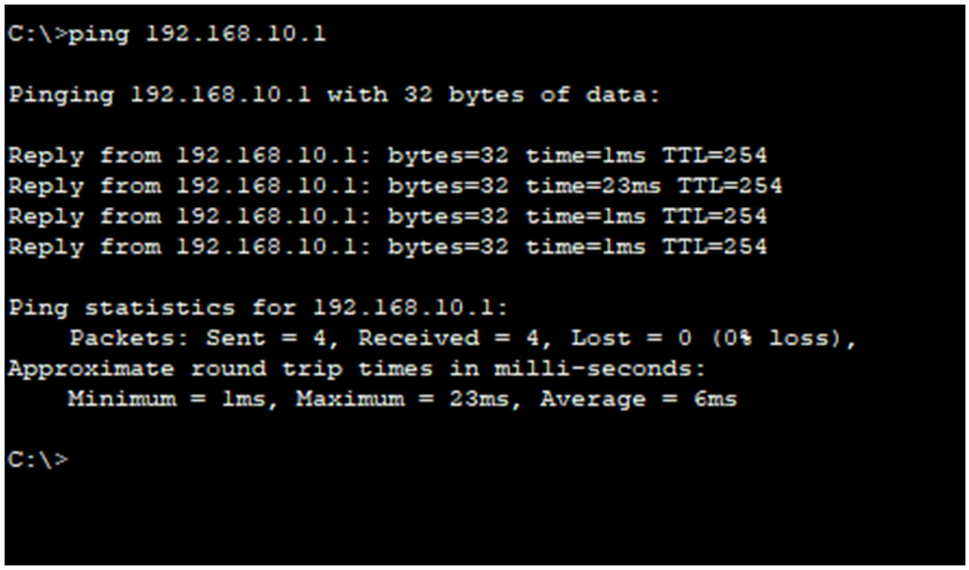
## 7.2 Test Phase

### 7.2.1 Pinging device on another building but within main campus



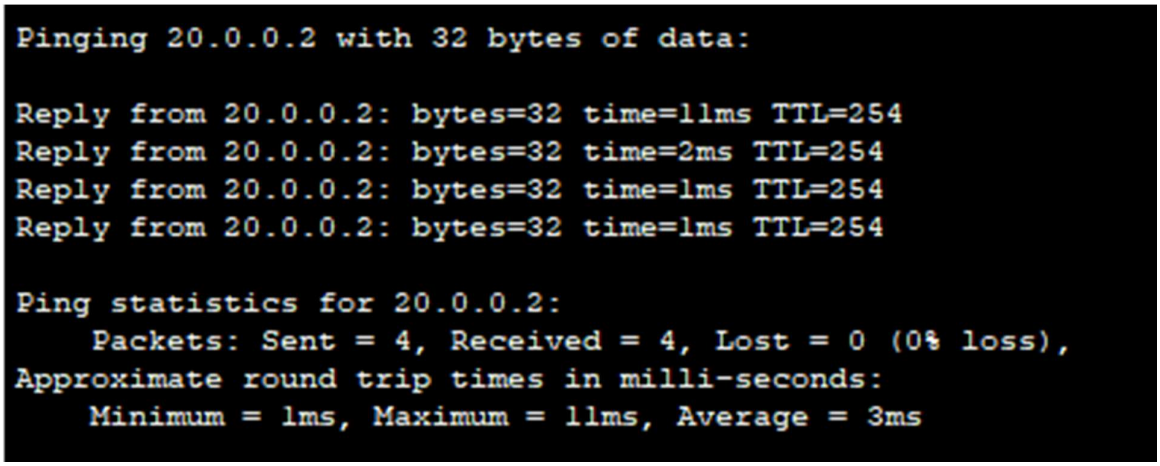

Here, we have pinged device from admin block with IP 192.168.1.1 to device in engineering block with IP 192.168.5.1,both in different building but connected with same main campus router. The result of pinging show that the establishment of connection between two devices was successful where four packet were sent and four packet were received with loss of 0%.

### 7.2.2 Pinging device between main campus and branch campus




Here, we have pinged device from admin block with IP 192.168.1.1 to device in health and science block of branch campus with IP 192.168.10.1, both in different building and connected with different main routers, where router of branch campus is connected to router of main campus. The result of pinging show that the establishment of connection between two devices was successful where four packet were sent and four packet were received with loss of 0%.

### 7.2.3 Pinging to the external Email Cloud server



Here, we have pinged device from admin block with IP 192.168.1.1 to the server of external Email cloud with IP 20.0.0.2, both in different building and connected to main routers using RIPv2. The result of pinging show that the establishment of connection between two devices was successful where four packet were sent and four packet were received with loss of 0%.

# Conclusion

In conclusion, the network setup we created for Kathmandu University using Cisco Packet Tracer is like a carefully crafted puzzle that fits all the pieces of the university's needs. We wanted to make sure everyone—students, staff, and administrators—has a smooth and secure experience. Imagine the main campus as a small town with three main areas: Building A for administrative stuff and the Business Faculty, Building B for the Engineering and Computing Faculty, and Building C for student labs and the IT department. To keep things organized, we used Cisco switches and routers, kind of like traffic cops, to make sure everyone can talk to each other without any hiccups.

We also added something called VLANs to keep things private and safe. It's like having different rooms in a house for different people. This helps protect important info and keeps everything running smoothly. Think of it as having a secret code to enter certain rooms. We didn't stop there! We even connected the university to a cloud-based email server outside. It's like having an extra mailbox that's super reliable and can handle lots of messages. We tested everything to make sure it works like a charm—checking if everyone can connect, making sure servers do what they're supposed to, and even putting some extra pressure on the system to see how tough it is. So, in a nutshell, the network we set up for Kathmandu University using Cisco Packet Tracer is not just about meeting requirements. It's like building a strong and flexible foundation for the university's daily operations, studies, and tech needs. It's like giving the university a powerful tool to manage everything smoothly and keep everyone connected in this modern age of education.