Campus Network

Submitted By

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LAB PROJECT REPORT

This Report Presented in Partial Fulfillment of the course CSE314(61_J1)**:**

Computer Networks Lab in the Computer Science and Engineering Department

DAFFODIL INTERNATIONAL UNIVERSITY

Dhaka, Bangladesh

December 13, 2024

DECLARATION

We hereby declare that this lab project has been done by us under the supervision of **Taslima Akter**, Lecturer, Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere as a lab project.

Submitted To:

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COURSE & PROGRAM OUTCOME

Table 1: Course Outcome Statements

CO's	Statements
CO1	**Define and Relate all the device and their interfaces, IP addresses, Subnet mask, default gateway**
CO2	**Apply Routing algorithm based on the floor/ VLAN design**
CO3	**Create an edge router and add a server. Make the server DHCP and Wireless network capable. Make the server reachable from any device of the topology.**
C04	**Develop a topology where everything is reachable one way or another.**

Table 2: Mapping of CO, PO, Blooms, KP and CEP

CO	PO	Blooms	KP	CEP
CO1	PO1	C1, C2	KP3	EP1, EP3
CO2	PO2	C2	KP3	EP1, EP3
CO3	PO3	C4, A1	KP3	EP1, EP2

The mapping justification of this table is provided in section **4.3.1**, **4.3.2** and **4.3.3**.

Table of Contents

Chapter 1

Introduction

1.1 Introduction

The Campus Network Project focuses on designing a scalable, secure, and efficient networking solution tailored to the needs of university campuses. It aims to provide high-speed connectivity and seamless communication for students, faculty, and staff. The network will address challenges such as bandwidth optimization, user management, and cybersecurity threats. By implementing a hierarchical architecture, VLANs, and wireless access points, the solution ensures scalability and reliability. It also integrates advanced monitoring tools for efficient management and real-time troubleshooting. This project will create a digitally empowered campus environment, fostering academic and operational excellence.

1.2 Motivation

The increasing reliance on digital tools and online platforms in education highlights the need for robust campus networks. Many universities face challenges such as insufficient bandwidth, poor scalability, and security vulnerabilities. This project is motivated by the desire to create a high-performing network that supports academic excellence and administrative efficiency.

1.3 Objectives

- Design a scalable network topology.
- Ensure robust security measures against cyber threats.
- Provide a reliable and high-speed connection.

1.4 Feasibility Study

The feasibility study of the Campus Network Project focuses on analyzing technical, economic, and operational aspects to ensure success. Technically, modern networking technologies like VLANs, firewalls, and wireless access points are viable and readily available. Economically, the project is cost-effective, with scalable options to align with budget constraints. Operationally, the design can be implemented using existing infrastructure with minimal disruptions. A comparison with similar projects reveals that this solution addresses common limitations, such as scalability and security, more effectively.

1.5 **Gap Analysis**

Existing campus networks often struggle with issues like insufficient bandwidth, poor scalability, and inadequate security measures. Many solutions fail to address the diverse needs of users, such as varying access privileges and seamless connectivity across large areas. This project bridges these gaps by implementing a scalable, secure, and efficient network architecture. It ensures high-speed access, robust cybersecurity, and flexible resource management tailored to the campus environment.

1.6 **Project Outcome**

The Campus Network Project will deliver a secure, scalable, and high-performance networking solution for university campuses. It ensures seamless connectivity, robust cybersecurity, and efficient resource management for students, faculty, and staff. The network will support diverse academic and administrative needs, including online learning, collaboration, and research. This outcome will transform the campus into a digitally empowered and future-ready environment.

Chapter 2

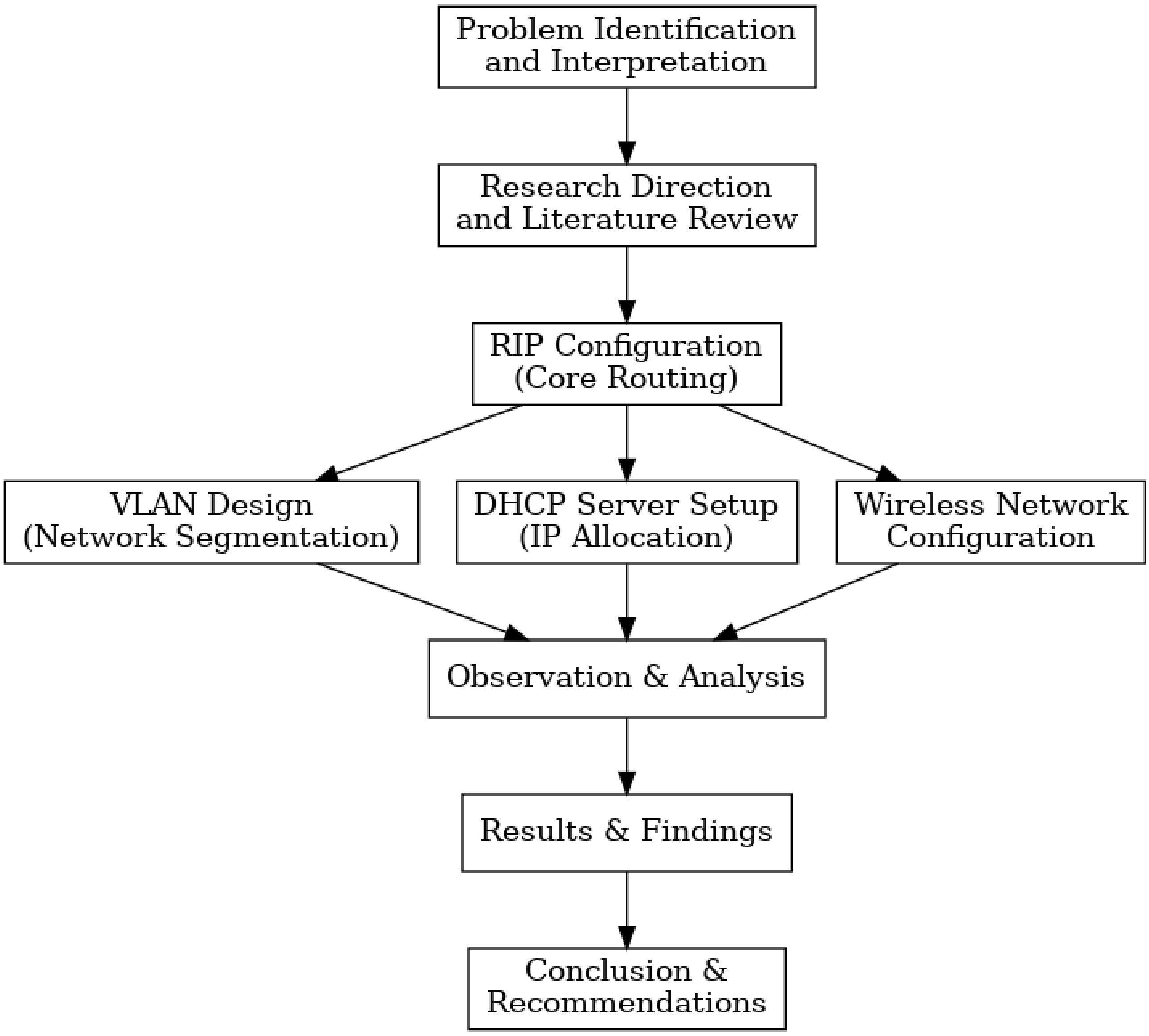
Proposed Methodology/Architecture

2.1 Requirement Analysis & Design Specification

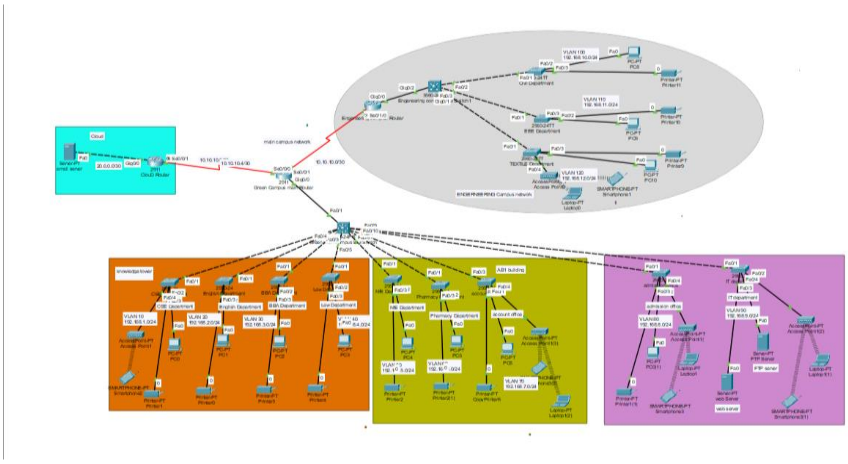
2.1.1 Overview

The Campus Network Project aims to design a modern, scalable, and secure networking infrastructure tailored for university campuses. It leverages advanced technologies like VLANs, hierarchical architecture, and wireless access points to ensure efficient connectivity and resource management

2.1.2 Proposed Methodology/ System Design



2.1.3 Our Project Design



2.1 Overall Project Plan

The project will be executed in four key phases: planning, design, implementation, and testing. Each phase includes specific milestones, such as requirement analysis, network simulation, hardware deployment, and performance evaluation. A timeline and resource allocation plan will ensure timely completion and smooth integration into the campus infrastructure.

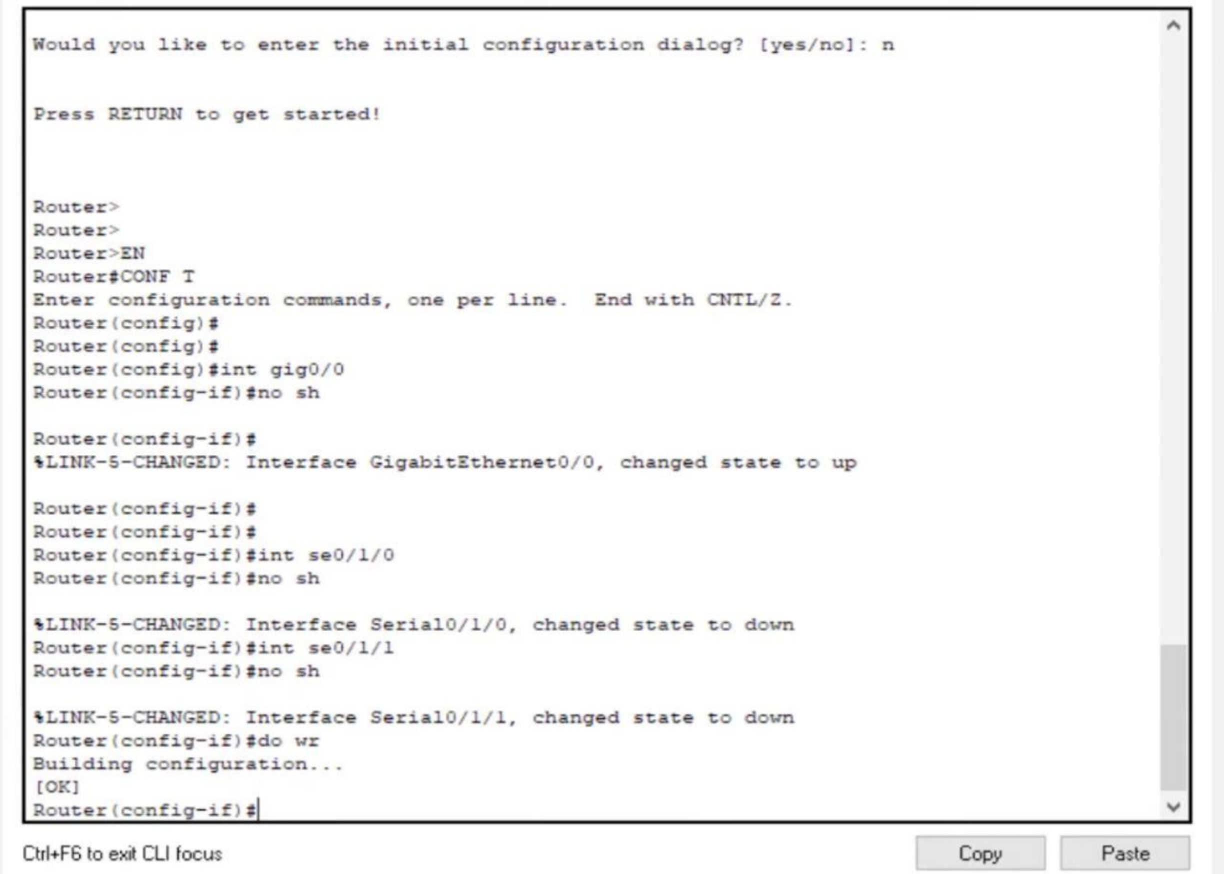
Chapter 3

Implementation and Results

3.1 Implementation

This section will describe the step-by-step process for the network setup, including router and switch configurations, VLAN implementation, DHCP configuration, and the activation of SSH for secure management,wireless network. Each phase of the implementation will be detailed, providing insights into the commands used and the configuration procedure for each device. Here’s a breakdown:

Green Campus Router

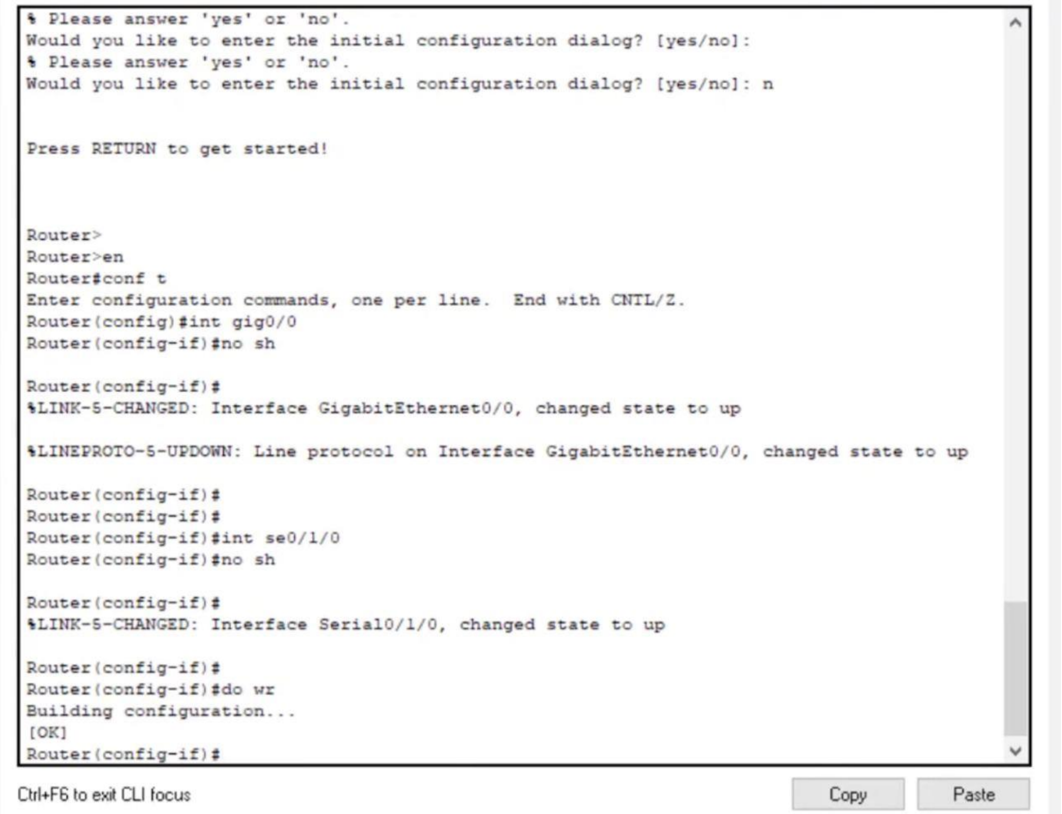


```
Would you like to enter the initial configuration dialog? [yes/no]: n


Press RETURN to get started!



Router>
Router>
Router>EN
Router#CONF T
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#
Router(config)#int gig0/0
Router(config-if)#no sh

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#
Router(config-if)#int se0/1/0
Router(config-if)#no sh

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
Router(config-if)#int se0/1/1
Router(config-if)#no sh

%LINK-5-CHANGED: Interface Serial0/1/1, changed state to down
Router(config-if)#do wr
Building configuration...
[OK]
Router(config-if)#
```

Ctrl+F6 to exit CLI focus

Copy Paste

Cloud Router



```
% Please answer 'yes' or 'no'.
Would you like to enter the initial configuration dialog? [yes/no]:
% Please answer 'yes' or 'no'.
Would you like to enter the initial configuration dialog? [yes/no]: n


Press RETURN to get started!



Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#no sh

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

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

Router(config-if)#
Router(config-if)#
Router(config-if)#int se0/1/0
Router(config-if)#no sh

Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

Router(config-if)#
Router(config-if)#do wr
Building configuration...
[OK]
Router(config-if)#
```

```
Router>
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#
Router(config)#
Router(config)#int se0/1/0
Router(config-if)#ip add
Router(config-if)#ip address  10.10.10.6 255.255.255.252
Router(config-if)#ex
Router(config)#
Router(config)#
Router(config)#int gig0/0
Router(config-if)#ip add
Router(config-if)#ip address 20.0.0.1 255.255.255.252
Router(config-if)#ex
Router(config)#
Router(config)#
Router(config)#do wr
Building configuration...
[OK]
Router(config)#
```

Ctrl+F6 to exit CLI focus   Copy   Paste

Engineering Complex Router

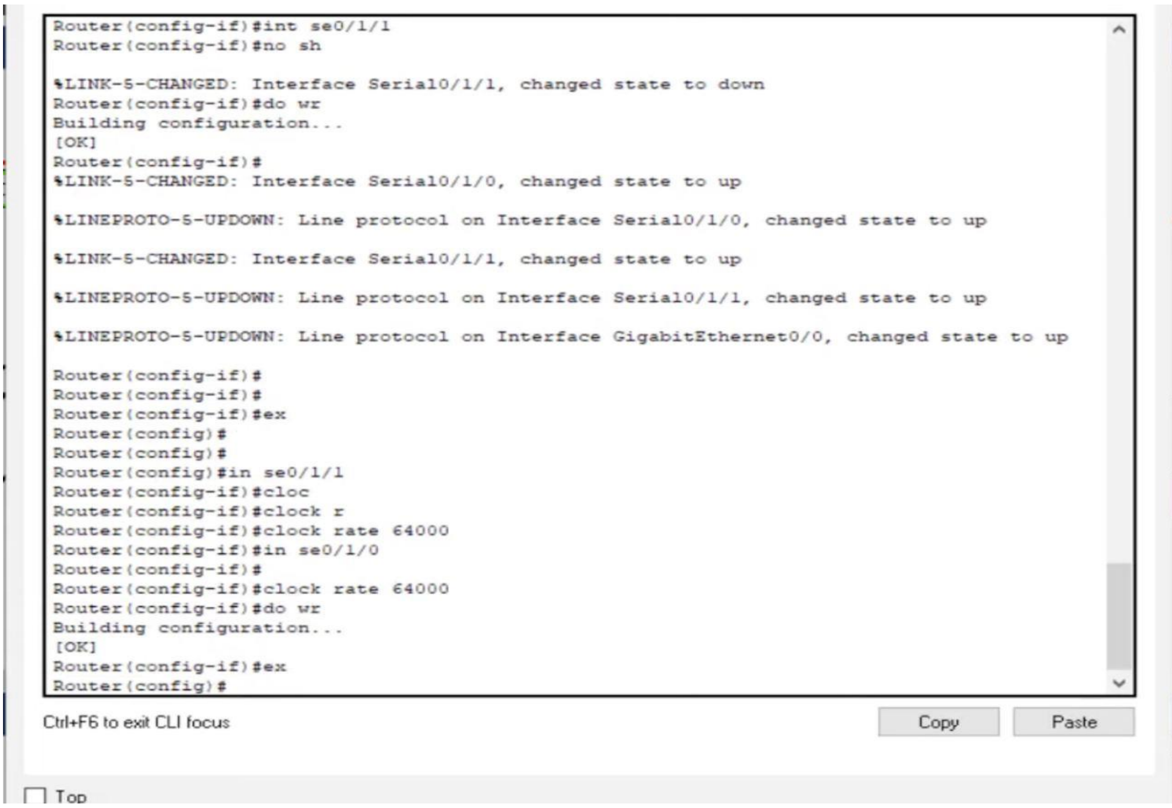
IOS Command Line Interface

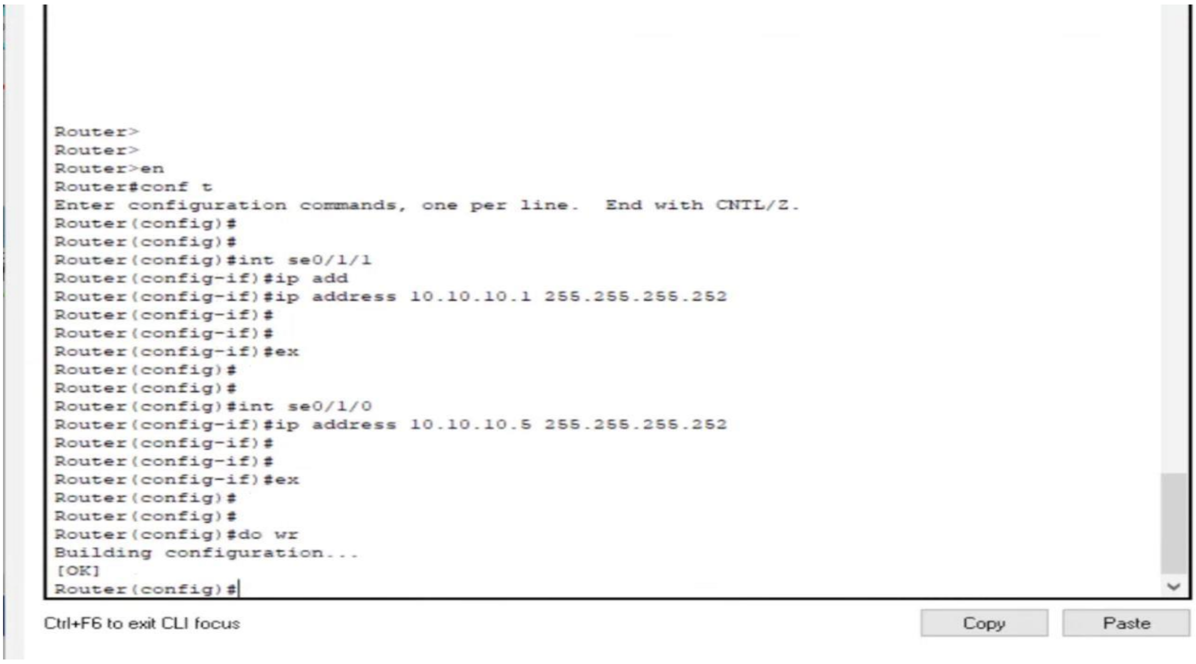
```
Router>
Router>conf t
            ^
% Invalid input detected at '^' marker.

Router>
Router>
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#
Router(config)#
Router(config)#int gig0/0
Router(config-if)#no sh

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#
Router(config-if)#
Router(config-if)#int se0/2/0
Router(config-if)#no sh

Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/2/0, changed state to up

Router(config-if)#
Router(config-if)#
Router(config-if)#do wr
Building configuration...
[OK]
```

```
Press RETURN to get started.









Router>
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
Router(config)#
Router(config)#int se0/2/0
Router(config-if)#ip add
Router(config-if)#ip address 10.10.10.2 255.255.255.252
Router(config-if)#ex
Router(config)#
Router(config)#
Router(config)#do wr
Building configuration...
[OK]
Router(config)#
```

Ctrl+F6 to exit CLI focus Copy Paste

Main campus router





Vlan configuration

```
Switch>
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#int range fa0/1-24
Switch(config-if-range)#switc
Switch(config-if-range)#switchport mo
Switch(config-if-range)#switchport mode acc
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switc
Switch(config-if-range)#switchport acc
Switch(config-if-range)#switchport access vlan 10
% Access VLAN does not exist. Creating vlan 10
Switch(config-if-range)#do wr
Building configuration...
[OK]
Switch(config-if-range)#
```

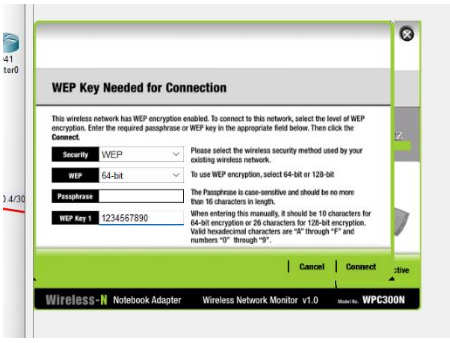
```
Switch(config)#
Switch(config)#do wr
Building configuration...
Compressed configuration from 7383 bytes to 3601 bytes[OK]
[OK]
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#int gig1/0/1
Switch(config-if)#switc
Switch(config-if)#switchport tr
Switch(config-if)#switchport trunk en
Switch(config-if)#switchport trunk encapsulation d
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#
Switch(config-if)#swit
Switch(config-if)#switchport m
Switch(config-if)#switchport mode tr
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to
down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/1, changed state to up

Switch(config-if)#
Switch(config-if)#
Switch(config-if)#ex
Switch(config)#
Switch(config)#
Switch(config)#do w
```

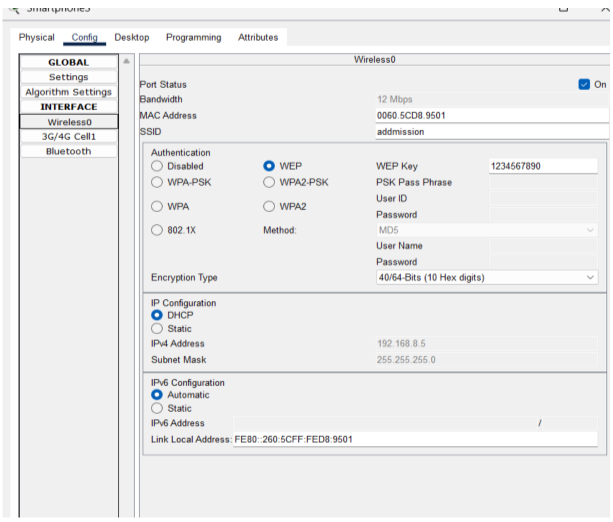
```
Switch(config)#
Switch(config)#int gig1/0/7
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 60
% Access VLAN does not exist. Creating vlan 60
Switch(config-if)#ex
Switch(config)#
Switch(config)#
Switch(config)#int gig1/0/8
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 70
% Access VLAN does not exist. Creating vlan 70
Switch(config-if)#ex
Switch(config)#int gig1/0/9
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 80
% Access VLAN does not exist. Creating vlan 80
Switch(config-if)#
Switch(config-if)#
Switch(config-if)#ex
Switch(config)#
Switch(config)#
Switch(config)#do wr
Building configuration...
Compressed configuration from 7383 bytes to 3601 bytes[OK]
[OK]
```

Green Main Campus TL3 switch

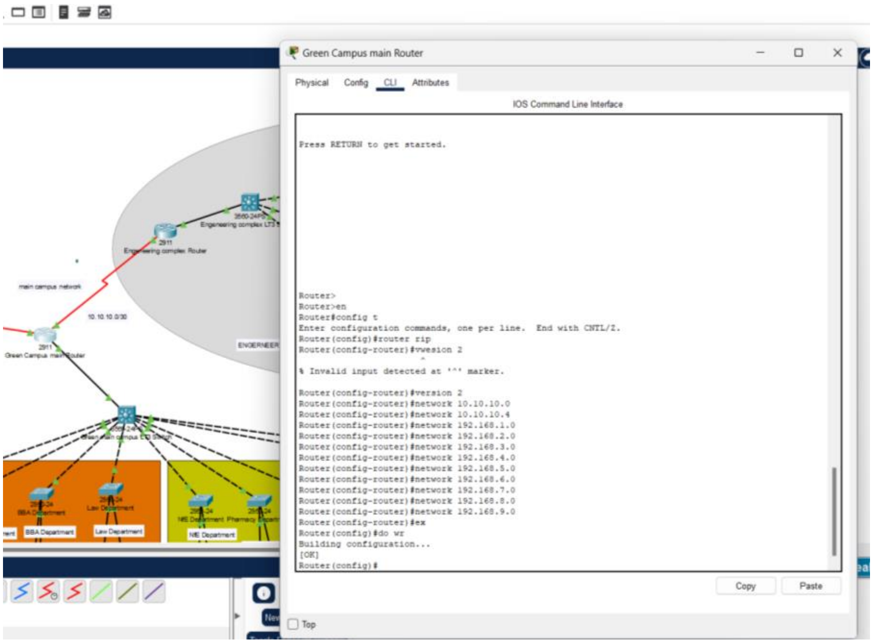
```
Switch>
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int range fa0/1-24
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
% Access VLAN does not exist. Creating vlan 20
Switch(config-if-range)#do wr
Building configuration...
[OK]
Switch(config-if-range)#
```

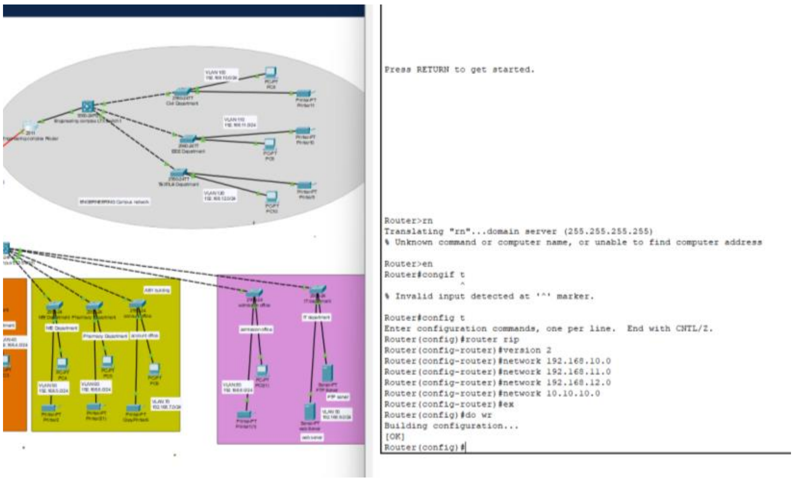
Wireless networks:



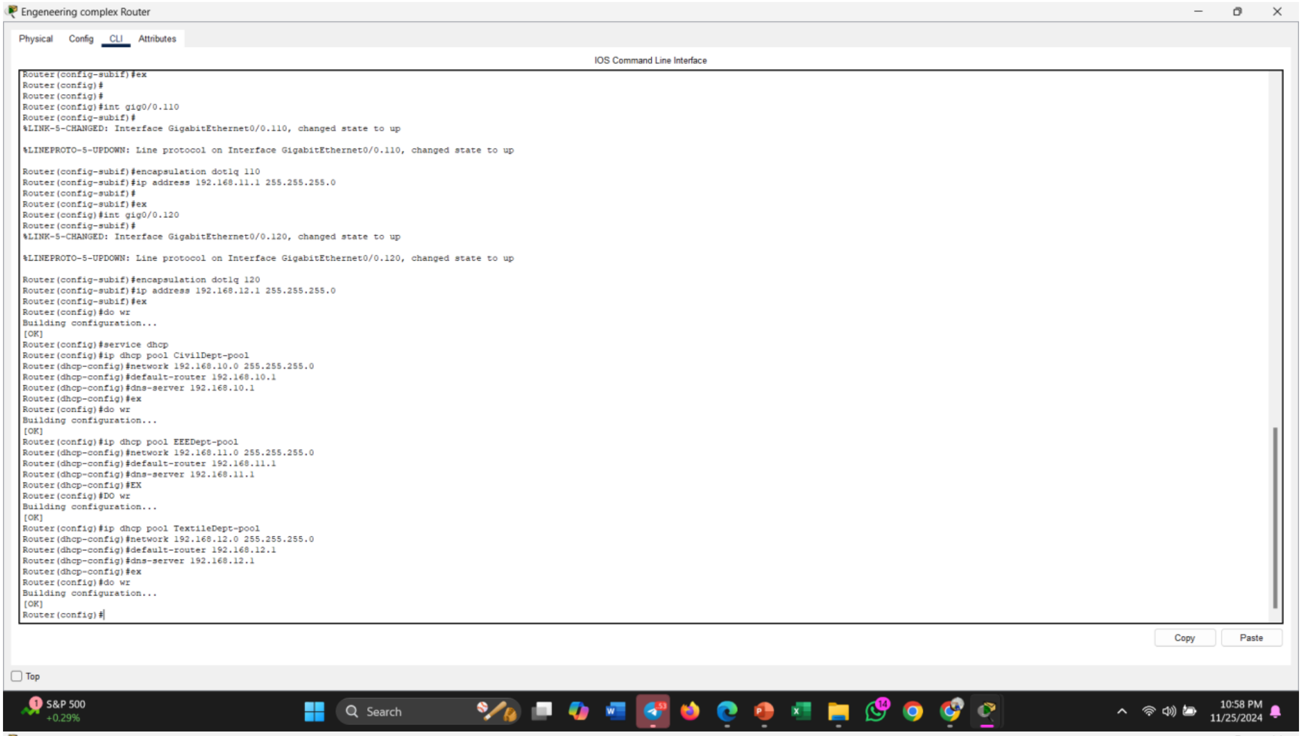


RIP:


Green Campus main Router
Physical
Config
CLI
Attributes
IOS Command Line Interface
Press RETURN to get started.
Router>
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#vwesion 2
^
% Invalid input detected at '^' marker.
Router(config-router)#version 2
Router(config-router)#network 10.10.10.0
Router(config-router)#network 10.10.10.4
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#network 192.168.3.0
Router(config-router)#network 192.168.4.0
Router(config-router)#network 192.168.5.0
Router(config-router)#network 192.168.6.0
Router(config-router)#network 192.168.7.0
Router(config-router)#network 192.168.8.0
Router(config-router)#network 192.168.9.0
Router(config-router)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#
Copy
Paste
Top


Press RETURN to get started.
Router>rn
Translating "rn"...domain server (255.255.255.255)
% Unknown command or computer name, or unable to find computer address
Router>en
Router#congif t
^
% Invalid input detected at '^' marker.
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 192.168.10.0
Router(config-router)#network 192.168.11.0
Router(config-router)#network 192.168.12.0
Router(config-router)#network 10.10.10.0
Router(config-router)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#

DHCP :



Engeneering complex Router
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router(config-subif)#ex
Router(config)#
Router(config)#
Router(config)#int gig0/0.110
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.110, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.110, changed state to up
Router(config-subif)#encapsulation dotlq 110
Router(config-subif)#ip address 192.168.11.1 255.255.255.0
Router(config-subif)#
Router(config-subif)#ex
Router(config)#int gig0/0.120
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.120, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.120, changed state to up
Router(config-subif)#encapsulation dotlq 120
Router(config-subif)#ip address 192.168.12.1 255.255.255.0
Router(config-subif)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#service dhcp
Router(config)#ip dhcp pool CivilDept-pool
Router(dhcp-config)#network 192.168.10.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.10.1
Router(dhcp-config)#dns-server 192.168.10.1
Router(dhcp-config)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#ip dhcp pool EEEDept-pool
Router(dhcp-config)#network 192.168.11.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.11.1
Router(dhcp-config)#dns-server 192.168.11.1
Router(dhcp-config)#EX
Router(config)#DO wr
Building configuration...
[OK]
Router(config)#ip dhcp pool TextileDept-pool
Router(dhcp-config)#network 192.168.12.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.12.1
Router(dhcp-config)#dns-server 192.168.12.1
Router(dhcp-config)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#
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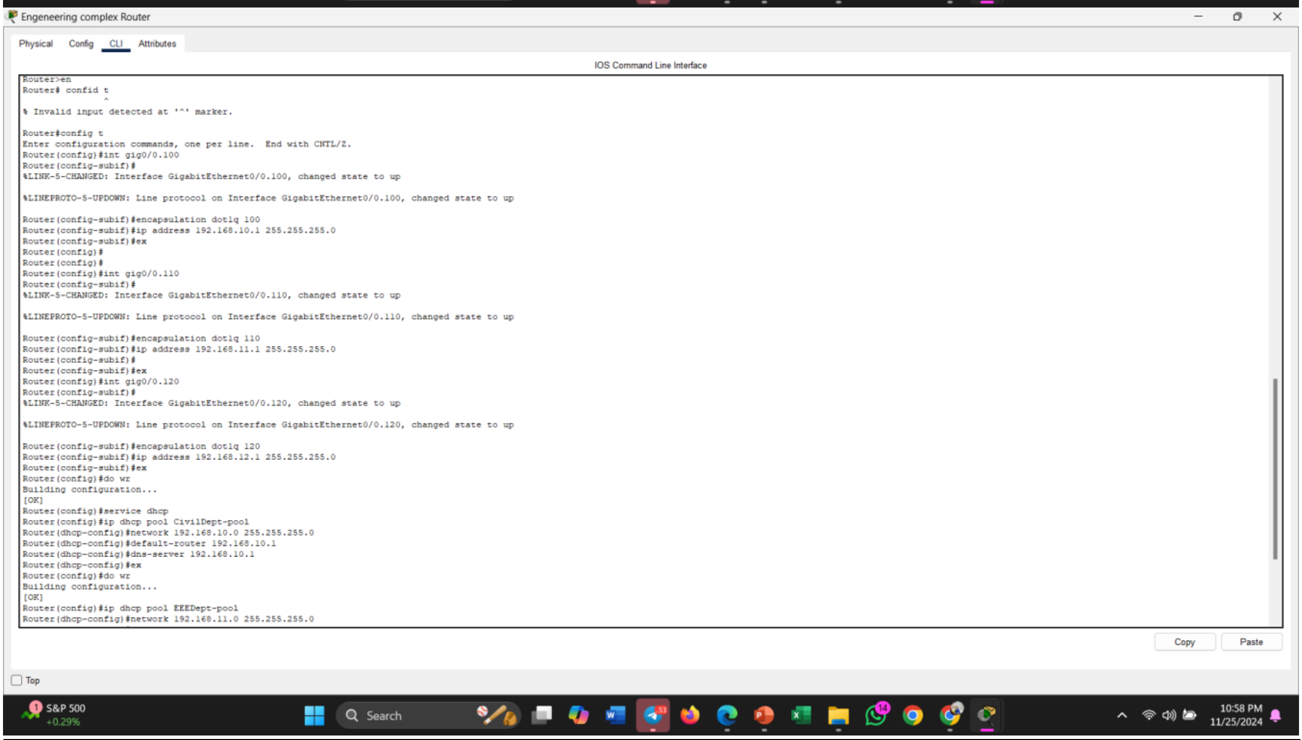
+0.29%
Search
10:58 PM
11/25/2024



Engeneering complex Router
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router>en
Router# confid t
^
% Invalid input detected at '^' marker.
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0.100
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.100, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.100, changed state to up
Router(config-subif)#encapsulation dotlq 100
Router(config-subif)#ip address 192.168.10.1 255.255.255.0
Router(config-subif)#ex
Router(config)#
Router(config)#
Router(config)#int gig0/0.110
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.110, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.110, changed state to up
Router(config-subif)#encapsulation dotlq 110
Router(config-subif)#ip address 192.168.11.1 255.255.255.0
Router(config-subif)#
Router(config-subif)#ex
Router(config)#int gig0/0.120
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.120, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.120, changed state to up
Router(config-subif)#encapsulation dotlq 120
Router(config-subif)#ip address 192.168.12.1 255.255.255.0
Router(config-subif)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#service dhcp
Router(config)#ip dhcp pool CivilDept-pool
Router(dhcp-config)#network 192.168.10.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.10.1
Router(dhcp-config)#dns-server 192.168.10.1
Router(dhcp-config)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#ip dhcp pool EEEDept-pool
Router(dhcp-config)#network 192.168.11.0 255.255.255.0
Copy
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Top
S&P 500
+0.29%
Search
10:58 PM
11/25/2024

Router Configuration: The routers need to be configured to support DHCP for dynamic routing. This will allow them to share routing tables across different floors and ensure efficient data communication.

VLAN Setup on Routers: Assigning VLANs to specific interfaces will ensure traffic is segmented according to departments and floors, with appropriate routing between them using DHCP.

Serial DCE Cable Configuration: The routers are interconnected using serial DCE cables, requiring specific configuration for serial interfaces on each router to facilitate point-to-point communication.

Switch Configuration:

Each floor will have a dedicated switch that connects all devices within the VLAN. The switch will be configured with the appropriate VLAN assignments for each department to ensure proper traffic segmentation.

Trucking between Routers and Switches: To allow VLAN traffic to traverse between the routers and switches, trunk links are configured. These trunk links ensure that multiple VLANs can be transmitted across the same physical link.

DHCP Configuration:

Each router will act as a DHCP server for its respective VLANs. The DHCP pools will be configured to dynamically assign IP addresses to devices within each VLAN.

Device	Interface	IP Address	Subnet Mask	Default gateway
Cloud Router	Se0/0/1 GI0/0	30.30.30.6 10.10.10.1	255.0.0.0 255.255.255.252	
Green Campus Main Router	Se0/0/0 Se0/0/1	30.30.30.5 10.10.10.1	255.0.0.0 255.0.0.0	
Engineering Complex Router	Se0/1/0	10.10.10.2	255.0.0.0	
PC-0	Fa0	192.168.1.3	255.255.255.0	192.168.1.1
PC-1	Fa0	192.168.2.3	255.255.255.0	192.168.2.1
PC-2	Fa0	192.168.3.3	255.255.255.0	192.168.3.1
PC-3	Fa0	192.168.4.3	255.255.255.0	192.168.4.1
PC-4	Fa0	192.168.5.2	255.255.255.0	192.168.5.1
PC-5	Fa0	192.168.6.2	255.255.255.0	192.168.6.1
PC-6	Fa0	192.168.7.2	255.255.255.0	192.168.7.1
PC-0(1)	Fa0	192.168.8.2	255.255.255.0	192.168.8.1
PC-8	Fa0	192.168.9.3	255.255.255.0	192.168.9.1
PC-9	Fa0	192.168.11.2	255.255.255.0	192.168.10.1
PC-10	Fa0	192.168.11.3	255.255.255.0	192.168.11.1
Printer-1	0			192.168.1.1
Printer-10	0			192.168.11.1

Wireless Network Setup:

Access points (APs) are deployed to provide seamless wireless connectivity across the campus. Each AP is configured with unique SSIDs mapped to VLANs, ensuring traffic segmentation and security. We use phone,laptop,pc in our main campus and engeneering campus using accesspoint.WPA3 encryption is used to protect data, and DHCP dynamically assigns IPs to wireless devices. Seamless roaming between APs is enabled to maintain uninterrupted connections. Quality of Service (QoS) prioritizes essential traffic, and post-deployment testing optimizes signal strength and performance. This setup ensures efficient integration with the overall network infrastructure.

3.2 Performance Analysis

Implementation and Performance Metrics for Campus Network

1. Network Efficiency

- **Metric:** Bandwidth utilization, latency, packet loss
- **Testing:** Simulate VLAN traffic using tools like Cisco Packet Tracer; measure bandwidth with Wireshark/iPerf3; evaluate VLAN tagging during simultaneous operations (e.g., file transfers, video conferencing).
- **Load Scenarios:** Low (idle), medium (normal hours), high (events).
- **Expected Outcome:** Minimal latency and packet loss under medium loads; acceptable performance during peak times.

2. Speed

- **Metric:** Throughput (Mbps/Gbps)
- **Testing:** Measure transfer rates across VLANs, inter-floor speeds with DHCP routing, and Wi-Fi performance during concurrent device usage.
- **Tools:** Speedtest, LAN Speed Test, PingPlotter.
- **Expected Outcome:** Consistent throughput within VLANs and across floors, ensuring high-speed access for all users.

3. Security

- **Metric:** Resilience against unauthorized access
- **Testing:** Conduct penetration tests using tools like Kali Linux; validate firewalls and restrict inter-VLAN traffic; ensure encryption (e.g., HTTPS, VPNs).
- **Load Scenarios:** Normal and high traffic, including DDoS simulations.
- **Expected Outcome:** Blocks unauthorized access; ensures data integrity with robust encryption.

3.3 Results and Discussion

Communication Tests:

- **Intra-VLAN Communication**: Communication within each VLAN (such as Reception, Sales, HR, etc.) was efficient, with minimal latency and no significant packet loss. This ensured smooth operation for internal resources like printers and file servers.
- **Inter-VLAN Communication**: Inter-VLAN communication between departments worked

efficiently, with DHCP handling dynamic routing effectively. Some slight delays were observed when heavy traffic from guest devices competed with staff VLAN traffic.

Security Validations:

- **Penetration Testing**: The network passed penetration tests, with VLANs securely isolated, and no successful attacks detected against routers. The security measures effectively prevented common threats like VLAN hopping and ARP poisoning.
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Recommendations:

- **Security Improvements**: Ongoing security monitoring and regular updates will help mitigate evolving threats.
- **Scalability**: As the number of connected devices grows, scaling the network through technologies like Software-Defined Networking (SDN) could ensure continued performance and stability.

Overall, the network performed well in terms of communication and security but could benefit from further optimizations to address high traffic loads and future scalability needs.

Chapter 4

4. Engineering Standards and Mapping

4.1 Impact on Society, Environment, and Sustainability

4.1 Impact on Society, Environment, and Sustainability (Campus Network)
Impact on Society

1. **Enhanced Connectivity**: The campus network provides seamless and high-speed internet access, boosting communication between students, faculty, and staff, enhancing collaboration across departments.
2. **Improved Learning and Productivity**: Reliable network services support online learning platforms, research, and real-time communication tools, leading to improved academic performance and higher productivity.
3. **Data Security and Trust**: The network’s secure infrastructure ensures that sensitive academic and personal data is protected, fostering trust among students, staff, and faculty.
4. **Personalized Learning Experiences**: By integrating smart services, the

network enables personalized educational tools, enhancing the overall learning experience for students.

Impact on the Environment

1. **Energy Efficiency**: The use of energy-efficient networking equipment, such as low-power routers and switches, helps minimize electricity consumption across campus buildings.
2. **Smart Resource Management:** IoT integration allows the network to control energy usage, such as automatically adjusting lighting and heating systems based on occupancy, contributing to lower carbon emissions.
3. **Reduced Paper Usage:** Digital services, including e-learning and online document sharing, reduce reliance on paper and printing, promoting eco-friendly practices.
4. **Sustainability Practices:** The network facilitates environmental monitoring systems, allowing the campus to track energy usage and waste reduction efforts, supporting sustainability goals.

Impact on Sustainability

1. **Optimized Energy Use**: Real-time data analytics monitor energy consumption, helping identify inefficiencies and areas for improvement in energy usage.
2. **Sustainable Resource Allocation:** The network helps reduce waste and excess consumption through dynamic bandwidth and resource management.
3. **Green Technologies:** Integration of smart systems (e.g., automated lighting, HVAC control) reduces the campus' overall carbon footprint and promotes energy-saving practices.

4.1.1 **Impact on Life (Campus Network)**

The campus network positively impacts the daily lives of students, faculty, and staff by improving their digital experiences and operational efficiency.

For Students:

1. **Seamless Connectivity**: Students enjoy uninterrupted internet access, enabling them to study, attend online lectures, and stay connected with peers.
2. **Enhanced Learning**: The network supports e-learning tools, virtual classrooms, and research, providing a better learning environment.
3. **Convenience:** Personalized services like automated room bookings, resource scheduling, and campus navigation improve the student experience.

4.1.2 **Impact on Society & Environment (Campus Network)**

Impact on Society

1. **Digital Inclusion:** By providing high-speed internet access across the campus, the network supports equitable access to educational resources, reducing the digital divide.

2. **Enhanced Academic Experience**: Seamless connectivity enhances student engagement and faculty collaboration, driving positive academic outcomes.

Impact on Environment

1. Energy-Efficient Equipment: The network uses energy-efficient networking hardware that minimizes electricity consumption.
2. Resource Optimization: AI-driven network management helps balance resource

4.1.3 **Ethical Aspects (Campus Network)**

1. **Privacy and Security**: The network prioritizes data security with encrypted connections, secure access protocols, and compliance with data protection laws (e.g., GDPR), ensuring the ethical handling of sensitive student and staff information.
2. **Equal Access:** The network is designed to provide equitable internet access to all users, ensuring fair distribution of bandwidth and supporting digital inclusion.
3. **Transparency:** The network's policies are clear and accessible, informing users about data usage and privacy practices, fostering trust.
4. **Security Measures:** The network includes advanced cybersecurity features to prevent unauthorized access, ensuring the ethical responsibility of maintaining data integrity and security.
5. **Environmental Ethics:** The use of energy-efficient equipment, reduction of paper usage, and promotion of eco-friendly practices reflect the university's commitment to environmental sustainability.

4.1.4 **Sustainability Plan** (Campus Network)

1. **Energy-Efficient Infrastructure:** The network employs low-power routers, switches, and wireless access points to minimize electricity consumption.
2. AI-Driven Resource Management: Smart monitoring systems manage bandwidth and network traffic dynamically to reduce energy waste and optimize usage.
3. Paperless Operations: Digitizing administrative tasks, student services, and communication processes minimizes paper consumption, contributing to a greener campus.
4. Renewable Energy Integration: The campus plans to integrate renewable energy sources, like solar panels, to power networking equipment, further reducing.

4.2 **Project Management and Team Work (Campus Network)**

Team Collaboration and Roles

The project team included network engineers, IT security experts, sustainability advisors, and training leads to ensure successful network design, implementation, and operation.

- Project Manager: Oversaw budget, timeline, and stakeholder communication.
- Network Engineers: Designed and configured the network infrastructure.
- IT Security Experts: Ensured the network's security and compliance with data protection regulations.
- Training Leads: Provided staff training on network usage and security policies.

4.3 **Complex Engineering Problem (Campus Network)**

1. **Multidisciplinary Expertise:** Required knowledge in networking, cybersecurity, and sustainability. Key solutions included VLANs for traffic segregation and OSPF for routing.
2. **Conflicting Requirements**: The network had to balance performance (high-speed internet) with security (data protection).
3. **Depth of Analysis**: Extensive analysis to ensure optimal performance, security, and resource management.

4.3.1 **Mapping of Program Outcome**

PO's	Justification
PO1	Applied networking protocols and hardware configurations to address scalability, security, and performance.
PO2	Identified and solved issues around traffic management, security, and resource allocation by analyzing needs..
PO3	Designed the network considering security, performance, and sustainability, implementing VLANs and DHCP and Wireless network.

4.1.1 Complex Problem Solving

EP1 Dept of Knowledge	EP2 Range of Conflicting Require-ments	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of Applicable Codes	EP6 Extent of Stake-holder Involve-ment	EP7 Inter-dependence
√	√	√	√	√	√	√

4.1.1 Engineering Activities

EP1 Dept of Knowledge	EP2 Range of Conflicting Require-ments	EP3 Depth of Analysis	EP4 Familiarity of Issues	EP5 Extent of Applicable Codes	EP6 Extent of Stake-holder Involve-ment	EP7 Inter-dependence
√	√	√	√	√	√	√

Chapter 5

5.1 Summary

The Campus Network Project provides a secure, scalable, and high-performance networking solution designed to support the academic and administrative needs of a university campus. The network infrastructure utilizes modern technologies such as VLANs, OSPF routing, and advanced security protocols to ensure reliable, high-speed internet access, seamless communication, and enhanced security for all users. The project also focuses on sustainability by integrating energy-efficient equipment and smart resource management systems, reducing operational costs, and minimizing the environmental footprint. Overall, the project aims to improve the learning experience, enhance staff productivity, and promote eco-friendly practices across the campus.

5.2 Limitations

1. **Dependency on Infrastructure**: The network's performance heavily relies on the existing infrastructure, meaning that any limitations in the physical building setup (e.g., cabling or outdated hardware) may hinder the network's efficiency.
2. **Initial Setup Costs**: Despite the long-term savings, the initial setup of the network, including hardware and software licensing, requires significant investment.
3. **Scalability Challenges**: While the network is designed to scale, future expansions may require additional hardware or system upgrades, especially if user numbers or bandwidth demands increase beyond expected levels.
4. **Security Risks:** As with any network, the potential for cyberattacks exists. While security measures are implemented, evolving threats and vulnerabilities may require ongoing updates and monitoring.

5.3 Future Work

1. **Integration with IoT Devices:** Future enhancements could include integrating more IoT devices for smart campus features, such as automated lighting, heating, and real-time location tracking for students and staff.
2. **Upgrading to 5G or Wi-Fi 6:** As demand for faster speeds increases, transitioning to 5G or Wi-Fi 6 could improve network performance and reduce latency for users.
3. **Cloud-Based Solutions:** Moving more network functions to the cloud (e.g., virtualized network services or cloud storage) could enhance scalability, reduce hardware costs, and streamline network management.

References

- Project Documentation
- Online Tutorials and Documentation