BAHRIA UNIVERSITY

(Karachi Campus)

Department of Software Engineering

Lab Project – FALL 2024

COMPLEX ENGINEERING PROBLEM

Course Title:	**Software Construction**	Course Code**: CEN 221**	
Class:	**BSE – 5(A/B/C)**	Shift: **Morning**	
Course Instructor:	**DR.HUSSAIN**	Date: **22nd December, 2024**	
Lab Instructor:	**ENGR. ASMA SHAHEEN**	Max. Marks:	**30 Marks**

Instructions:

1. **This is a Complex Engineering Problem Lab Project.**
2. **Demonstration of Project will be on the week before Theory Exam.**
3. **Report will be submitted on LMS in given Time Slot.**
4. **Report format is uploaded on LMS**
5. **If you submit your Report after the given deadline then 1 Marks will be deducted for the late submissions.**
6. **Group Members Should be 3 or 2.**
7. **Presentation must be of 5 min for project demonstration.**

Lab Project Task: **[CLO 3 ,15.0 marks]**

The Student should fulfill the following requirements in their lab project.

The application should implement networking features learned in the lab, such as message routing, data encryption, and secure communication. It should use appropriate protocols (like TCP/IP or HTTP), networking devices (like routers and servers), and tools like Packet Tracer or similar network simulation software for visualizing the network architecture.

Lab Project Report: **[CLO 5,5.0 marks]**

Lab Project Proposal: **[CLO 55.0 marks]**

Lab Project VIVA: **[CLO 6,5.0 marks]**

BAHRIA UNIVERSITY, Karachi Campus

Department of Software Engineering

REPORT

Course Title: COMPUTER COMMUNICATION NETWORKING **Course Code**: **CEN 221**
Course Instructor: **Dr Hussain** **Class**: BSE- (B)
Lab Instructor: Engr. Asma Shaheen **Name:** _____

PROJECT TITLE:

UNIVERSITY CAMPUS NETWORKING SYSTEM

GROUP MEMBERS LIST:

S.NO	Enrollment	Name
01	02-131222-101	ABDUL AHAD KHAN
02	02-131222-076	MUHAMMAD HARIS TAHIRI
03	02-131222-101	RAJA MUHAMMAD HAMMAD

SUBMISSION DATE: _____

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ABSTRACT

University network is an important part of campus life and network security is essential for a campus. Campus network faces challenges to address core issues of security which are governed by network architecture. Secured network protects an institution from security attacks associated with network.

Universities depend on the proper functioning and analysis of their networks for education, administration, communication, e-library, automation, etc. An efficient network is essential to facilitate the systematic & cost-efficient transfer of information in an organization in the form of messages, files, and resources. The project provides insights into various concepts such as topology design, IP address configuration, and how to send information in the form of packets to the wireless networks of different areas of a university.

Therefore, we have developed a secure campus network (SCN) for sending and receiving information among high-security end-users. We created a topology for a campus of multi networks and virtual local area networks (VLANs) using cisco packet tracer. We also introduced the most critical security configurations, the networking used in our architecture. We used many protocols to protect and accommodate the users of the SCN scheme. [1]

1. INTRODUCTION

1.1. Introduction

This project is totally dedicated to the Network Engineer for new and smart learning of the Network Structure. In this concept it is possible for the networker to check the Network Structure of a company spread in the big campus area. The incoming and the outgoing traffic can be maintained along with some security concepts as well. In this logic we use the multiple Routing Protocols in different areas of the university. The practical shows us the proper movement of the packet from one part of the university to the other part of the university campus. The project comprises of the different departments spread in different buildings of the university. Multiple Routing protocols have been used in different branches and all the departments can communicate with other different departments through the Redistribution among different Routing Protocols.

Most universities today use the network to provide online education by connecting widely dispersed students with their professors directly. or this reason, computer networks play a vital role in the education area by providing efficient communications for the university environment. However, the design of computer networks differs from one university to another. This is because of many factors which determine the differences. Such factors include adaptability, integration, resilience, security, and cost. Installing networks in a university relies on the universities budget, which differs by institution and from country to country. [1] [2]

1.2. Problem Statement

As organizations expand, the need for efficient, secure, and scalable network infrastructure becomes critical to ensure smooth communication and resource sharing among various departments. A campus with four distinct buildings, each housing different departments (Electrical and Computer Engineering, Mathematics, Admissions, and Computer Science), currently lacks a unified network that caters to their unique requirements. The absence of proper segmentation leads to inefficient traffic management, while a lack of dynamic IP allocation in Building A hinders device connectivity. Furthermore, there is no mechanism to ensure secure communication between internal networks and an external cloud-hosted email server.

The challenge lies in designing a network that provides segmented IP networks for each building, VLAN-based traffic isolation, dynamic IP allocation for Building A, and seamless routing using RIPv2 and static configurations. The solution must also prioritize scalability, performance, and security to accommodate future growth and the diverse needs of the departments.

1.3. Proposed Solution

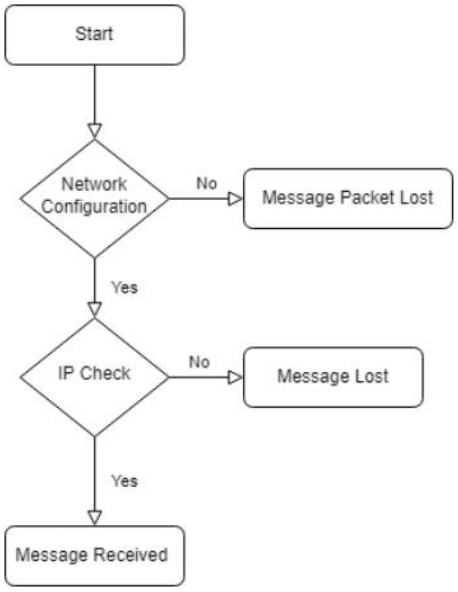
The proposed solution involves creating a robust and scalable network topology to meet the campus's requirements. The network will use VLANs to segment traffic based on departmental needs, ensuring secure and efficient communication. Dynamic IP address assignment will be provided through a router-based DHCP server for devices requiring it. Separate IP networks will be assigned to each department to isolate traffic and enhance manageability.

Switches will be configured with VLANs and appropriate security settings to enforce traffic isolation and prevent unauthorized access. RIPv2 will be implemented to enable dynamic routing between internal routers, ensuring seamless connectivity across the internal network. Additionally, static routing will be configured to connect the internal network to an external cloud-hosted email server.

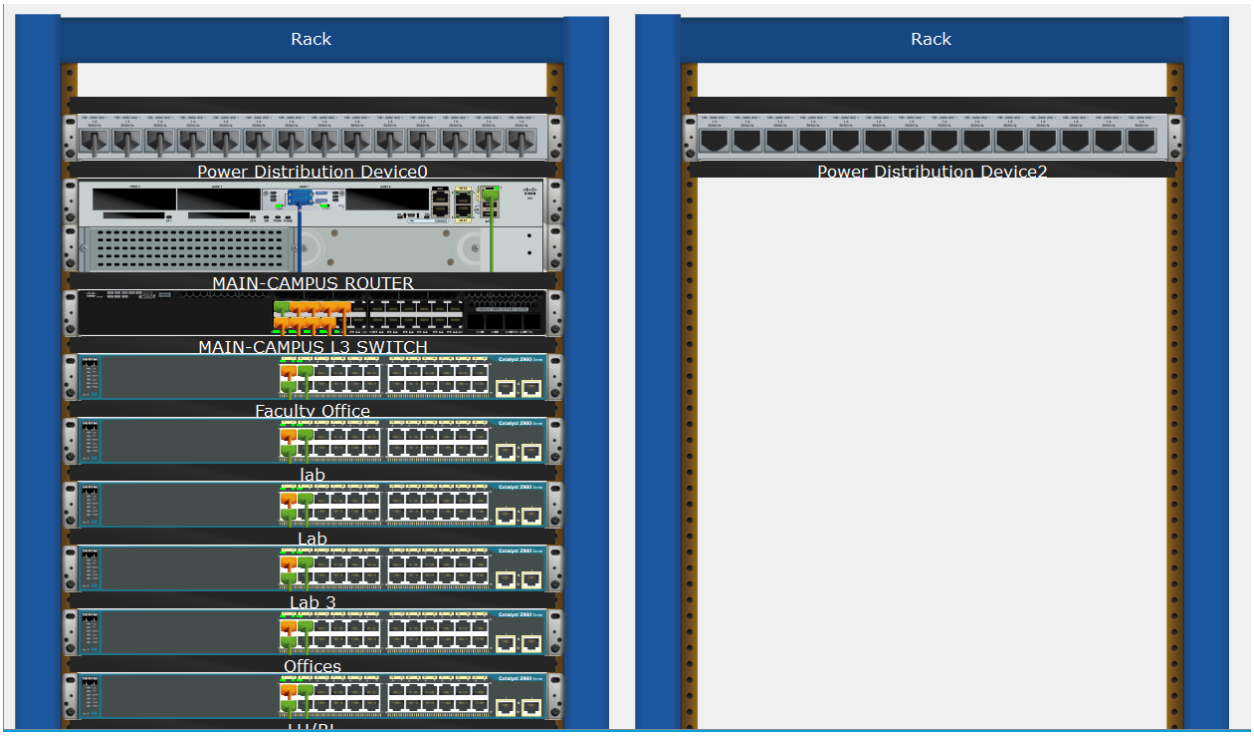
This design ensures end-to-end connectivity, scalability, and security while addressing the diverse needs of the departments, including efficient resource sharing, traffic management, and external server access.

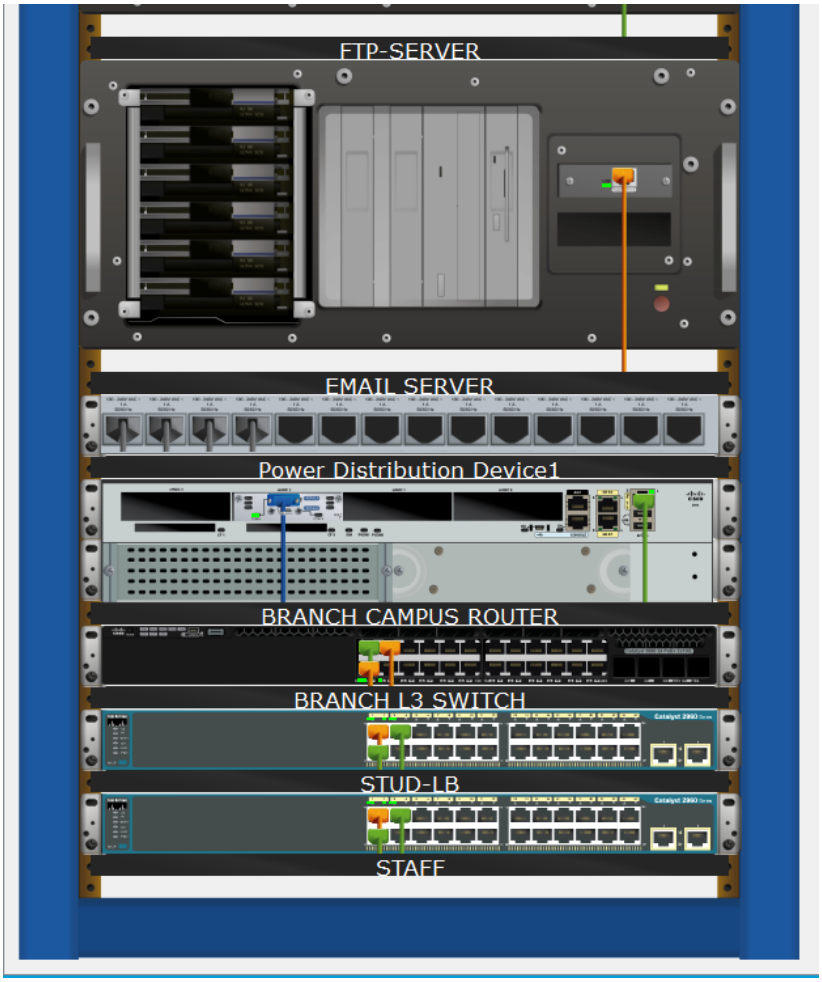
2. DESIGN

2.1. Workflow Diagram

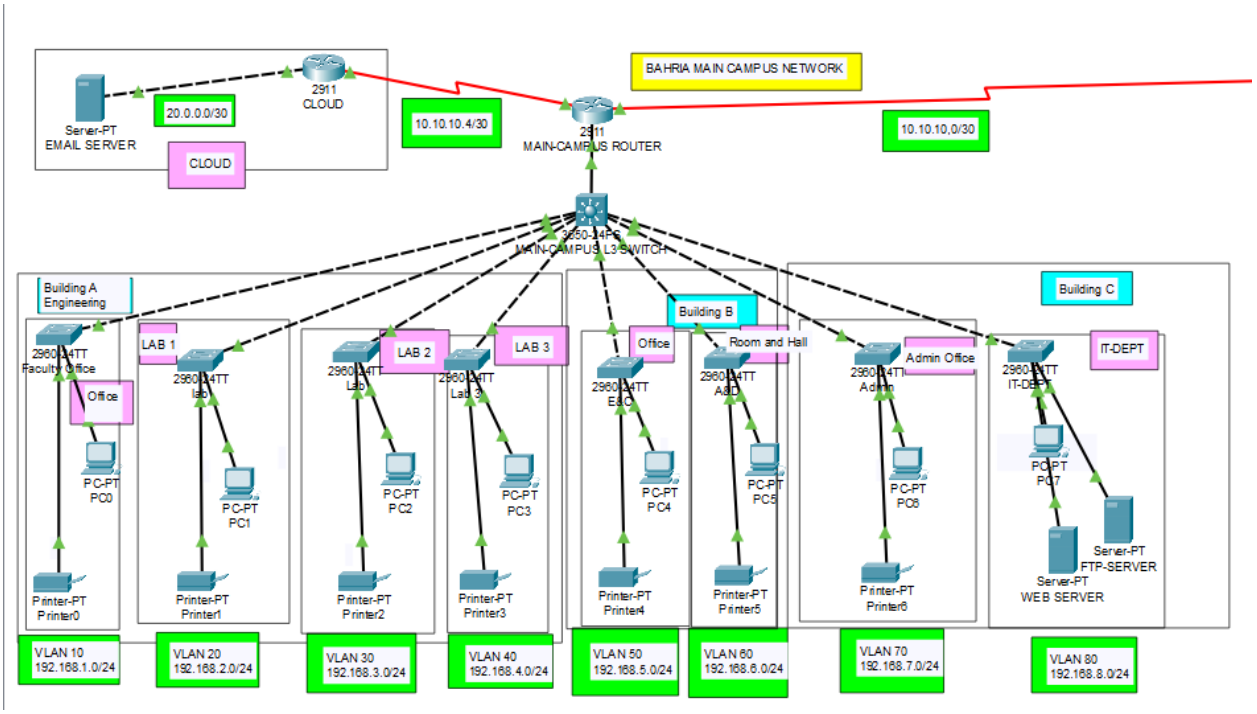


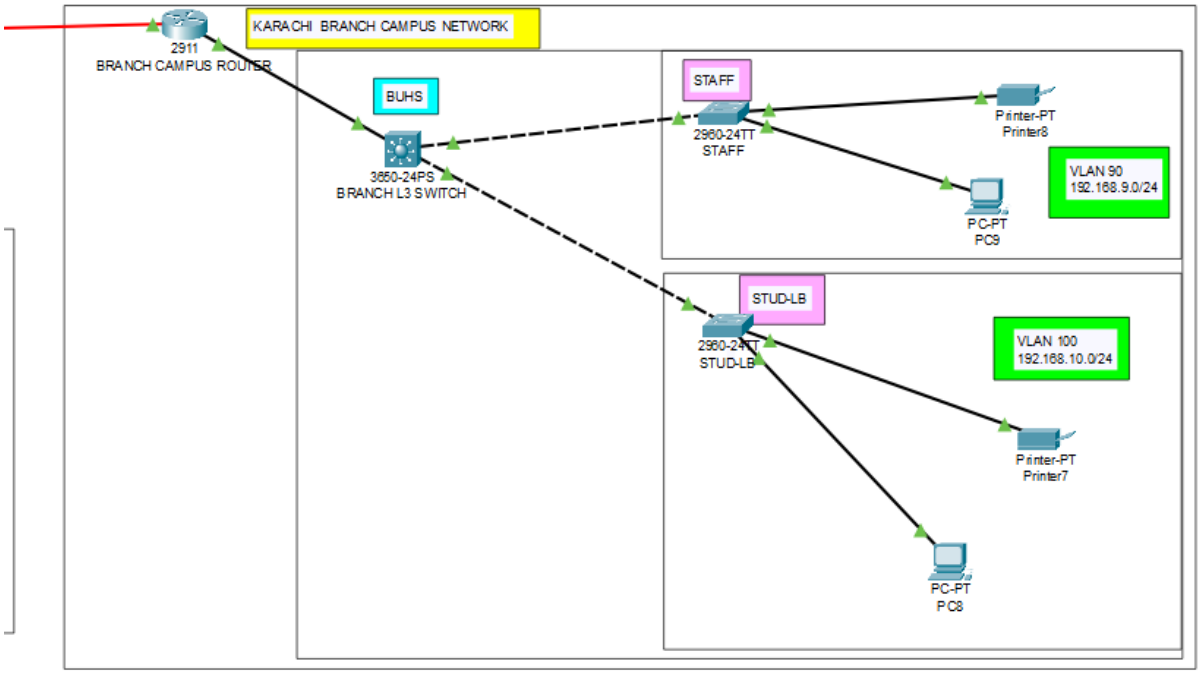
2.2. User Interfaces (Packet tracer, Physical View)




FTP-SERVER
EMAIL SERVER
Power Distribution Device1
BRANCH CAMPUS ROUTER
BRANCH L3 SWITCH
STUD-LB
STAFF

2.3. Network Diagram (Packet tracer, Logical View)





3. METHODOLOGY

3.1 Technologies Use

Category	Technologies/Devices Used	Description
3.1.1. Networking Devices:	Routers, Switches, PCs, Servers	Core components for routing, switching, end-device communication, and external server connectivity.
3.1.2. Protocols	RIPv2, VLANs, Static Routing, DHCP	Ensures dynamic and static routing, traffic segmentation, and automated IP address allocation.
3.1.3. Configuration Tools	Cisco Packet Tracer, CLI	Tools for designing, configuring, and testing network devices and their connectivity.
3.1.4. Additional Concepts	IP Subnetting, Network Segmentation, Security (Access Control Lists, VLAN Security)	Key concepts used to implement efficient and secure network communication.

3.2. Network Communication Methodology

In the proposed network topology, communication is structured to ensure efficiency, security, and isolation where needed:

1. **Intra-department Communication**: Devices within the same VLAN can communicate freely. VLANs are used to isolate traffic for different departments.
2. **Inter-department Communication**: Communication between VLANs is enabled through routers using RIP to ensure dynamic and efficient routing.

3. **External Communication**: Internal devices requiring access to the external cloud-hosted email server communicate via static routes, configured on the core routers to ensure reliable and secure connections.
4. **DHCP Functionality**: Devices dynamically acquire IP addresses in specific networks, such as in departments where frequent device changes occur.
5. **Access Control**: VLANs and Access Control Lists (ACLs) ensure only authorized traffic flows between networks, protecting sensitive data and enhancing overall security.

This methodology ensures that all departments can access shared resources, collaborate efficiently, and connect securely to external services as needed.

3.3. Commands

Below are the key commands used to configure the network, with explanations:

1. **VLAN Configuration on Switches**:

```
en
config t
vlan 10
name Faculty
vlan 20
name Labs
exit
int range f0/1 - 12
switchport mode access
switchport access vlan 10
exit
```

***Explanation*:**
VLAN 10 and VLAN 20 are created for faculty and labs. Interfaces are assigned to their respective VLANs.

2. **Routing with RIPv2 on Routers**:

```
router rip
network 192.168.1.0
network 192.168.2.0
no auto-summary
exit
```

***Explanation*:**
RIP is configured to route traffic between subnets 192.168.1.0 and 192.168.2.0. and we can perform it through router GUI function.

3. **Static Routing for External Server**:

```
ip route 0.0.0.0 0.0.0.0 203.0.113.1
```

***Explanation*:**
A default route is added to send all external traffic to the gateway at 203.0.113.1.

4. **DHCP Configuration on Router**:

```
en
config t
ip dhcp pool FacultyPool
network 192.168.10.0 255.255.255.0
default-router 192.168.10.1
dns-server 8.8.8.8
exit
```

***Explanation*:**
A DHCP pool is created for the faculty VLAN to dynamically assign IP addresses.

4. CONCLUSIONS AND FURTHER WORK

The project successfully implemented a secure, scalable network topology addressing the communication and operational needs of a campus with multiple departments. Each department is isolated through VLANs, ensuring traffic segmentation and security, while RIP dynamically manages routing within the internal network. Static routing was used effectively for external server access. DHCP ensured seamless IP address allocation for devices.

Further work could include enhancing the network with redundant links for improved reliability, integrating advanced protocols like OSPF for better scalability, and implementing network monitoring tools for real-time performance analysis. Additionally, testing and incorporating IPv6 can future-proof the network against evolving technological demands.

5. REFERENCES

[1] M. Alam, UNIVERSITY NETWORK A Cisco Packet Tracer Showcase, https://www.researchgate.net/publication/376513199_UNIVERSITY_NETWORK_A_Cisco_Packet_Tracer_Showcase, 2023.

[2] R. S. S. AlSarhan, “Computer network design for universities in developing countries", 2016.

Projects’ GitHub Link

https://github.com/RajaMuhammadHammad/UNIVERSITY-CAMPUSNETWORKING-SYSTEM.git