INTRODUCTION

The purpose of this project is to design a comprehensive network solution for Albion University, a large institution with two campuses situated 20 miles apart. The university is divided into four main faculties and hosts a mix of administrative and academic departments. This network design project aims to establish a robust, scalable, and efficient architecture that meets Albion University's needs for connectivity, performance, and security.

In this report, we outline the network topology, IP addressing scheme, VLAN management, routing protocols, and security configurations. The project is implemented and tested in Cisco Packet Tracer, ensuring it meets all specified functional and security requirements.

PROJECT REQUIREMENTS AND OBJECTIVES

Albion University's network must support two campuses with the following main components:

- **Main Campus**: Comprising three buildings:
  - **Building A**: Houses the administrative departments (Admin, HR, and Finance) and the Faculty of Business. ○ **Building B**: Hosts the Faculty of Engineering and Computing and the Faculty of Art and Design. ○ **Building C**: Contains student labs and the IT department, which manages the university web server and other internal servers.
- **Smaller Campus**: Houses the Faculty of Health and Sciences, with staff and student labs situated on separate floors.

KEY REQUIREMENTS

- **Separate IP networks** for each building and brranch to facilitate network management and security.
- **VLAN configuration** to segment each department, isolating traffic and ensuring efficient data flow.
- **RIPv2** as the internal routing protocol to manage routes within the campus network.
- **OSPF** as the protocol for public IP addressing.
- **Static routing** for communication with an external email server hosted on the cloud.
- **DHCP services** for automatic IP assignment within certain areas.

DESIGN OVERVIEW AND NETWORK TOPOLOGY

The network topology is based on a hierarchical design with core, distribution, and access layers, each playing a critical role in scalability and ease of management.

Topology Components:

1. **Core Layer:** Main routers linking the two campuses with redundant connections for reliability.
2. **Distribution Layer:** VLAN-configured switches for departmental segmentation within each building.
3. **Access Layer:** Connecting PCs, servers, and printers to the network based on departmentspecific VLANs.

IP ADDRESSING REQUIREMENTS

Public and Private IP Addressing:
The network requires both private and public IP addressing to manage internal communication and enable access to external resources (e.g., email server). Private IP ranges are allocated to each department, while the university's email server, hosted externally on the cloud, uses a public IP.

IP Allocation Strategy:
Our IP addressing strategy involves allocating unique IP subnets for each building and department, ensuring efficient use of IP addresses and simplifying network management. Each subnet is large enough to accommodate the anticipated number of devices while allowing room for growth.

IP SUBNETTING AND VLAN MANAGEMENT

Subnetting Plan:

- A /26 subnet mask is applied for each VLAN to ensure adequate IP addresses within each subnet.
- The subnetting scheme is designed to avoid IP address overlap, optimize IP address usage, and allow easy addition of future devices or VLANs.

VLAN ID	Department/Area	Subnet Address	Subnet Mask
10	Admin	192.168.1.0/26	255.255.255.192
20	HR	192.168.1.64/26	255.255.255.192
30	FINANCE	192.168.1.128/26	255.255.255.192
40	BUSINESS	192.168.1.192/26	255.255.255.192
50	E&C	192.168.2.0/26	255.255.255.192
60	A&D	192.168.2.64/26	255.255.255.192
70	STD-LAB	192.168.3.0/26	255.255.255.192
80	IT-DEPT	192.168.3.64/26	255.255.255.192
90	STAFF	192.168.4.0/26	255.255.255.192
100	STD-LAB	192.168.4.64/26	255.255.255.192

VLAN Management Techniques

1. **Inter-VLAN Routing**:

- Implement **Router-on-a-Stick** for inter-VLAN communication, where a single router interfaces with multiple VLANs via subinterfaces. This allows devices in different VLANs to communicate while maintaining logical separation.
- Configure each VLAN's subinterface on the router with a unique IP address from the assigned subnet to enable routing.

2. **Switchport Security**:
   - Enable **port security** on each switch port to control device access. This configuration limits the number of MAC addresses on each port and can restrict access based on specific MAC addresses, preventing unauthorized access to the network.
3. **DHCP Configuration**:
   - Set up a **router-based DHCP server** in Building A to dynamically allocate IP addresses to devices in the Admin Department. This setup ensures consistent IP management and reduces manual configuration tasks.
4. **Network Segmentation**:
   - Each department or area is isolated within its own VLAN, which keeps broadcast traffic within each VLAN. This reduces network congestion and improves response times, enhancing the overall performance of the network.

MULTIPLE NETWORK INTEGRATION AND IP ROUTING

Multiple IP Networks for Routing:

- The campus network integrates multiple IP networks, one for each department, facilitating organized routing and management.
- Each subnet is isolated for security, ensuring that traffic from one department does not interfere with another.

Routing Protocols and Mechanisms:

- **RIPv2**: Used within the internal network for dynamic routing between routers in different campus buildings, allowing seamless data flow between the main and branch campuses.
- **Static Routing**: Configured for the email server hosted externally. This ensures a direct path for external communication without relying on dynamic routing.
- **OSPF**: as the protocol for public IP addressing.
- **NAT**: used to modify network address information in packet headers to enable multiple devices on a private network to share a single public IP address.

IMPLEMENTATION USING CISCO PACKET TRACER

Network Setup:

- The network is implemented in Cisco Packet Tracer following the hierarchical design principles, with core routers connecting main buildings and switches deployed in each building to manage VLANs and access points.

Configuration Documentation:

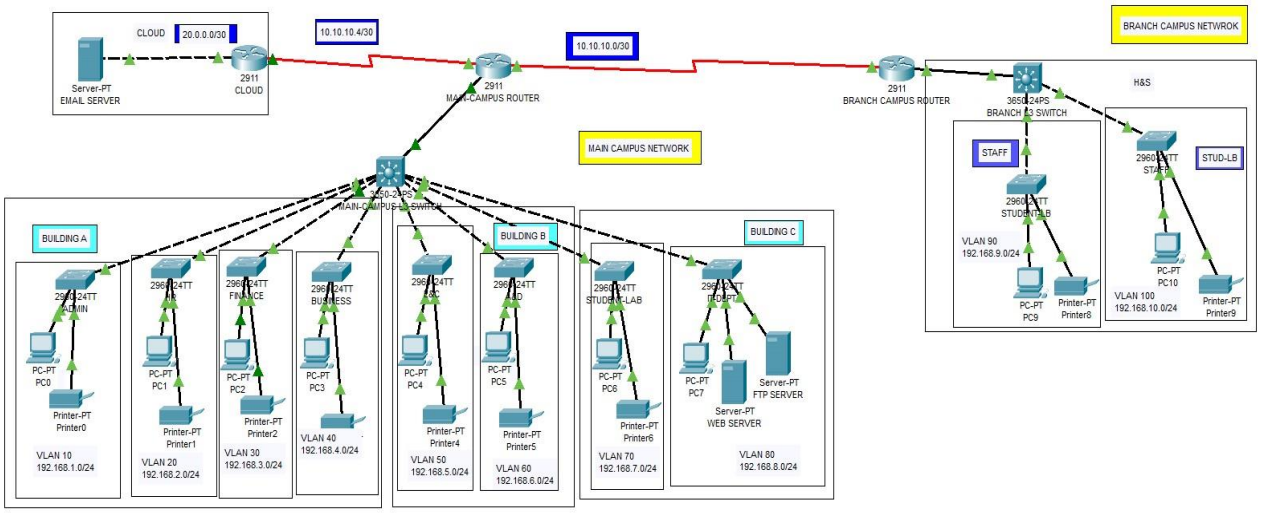
- **Device Configuration**: Each router and switch configuration is documented, including IP address assignments, routing protocols, and VLAN setup.

- **Testing and Verification**: The network configuration is tested for connectivity between VLANs, access to external servers, and routing functionality. Tools like ICMP ping and Packet Tracer's simulation mode are used to verify data flow and connectivity.

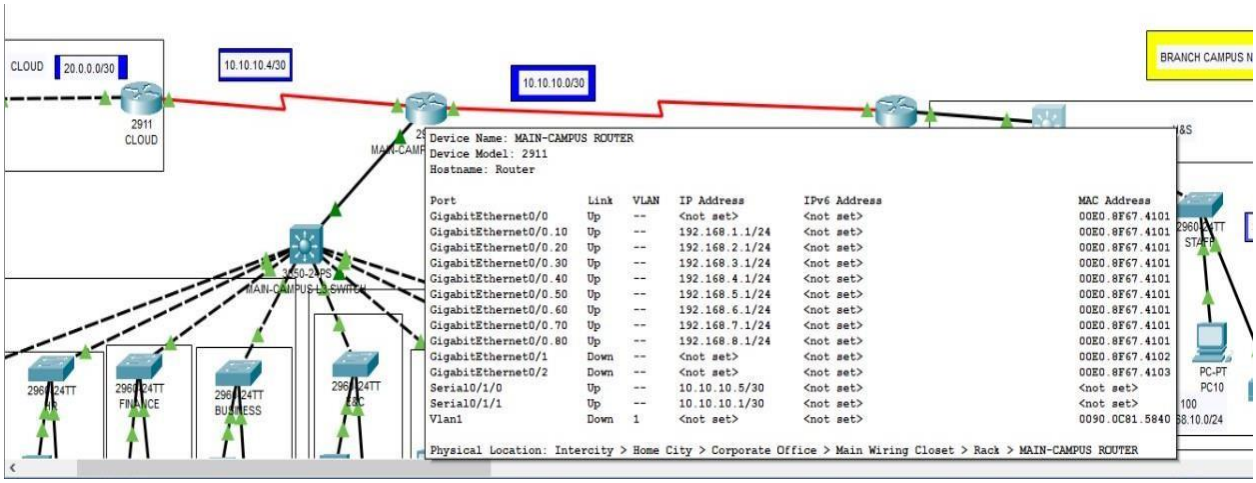
Network Diagram:

- A detailed network diagram is provided, highlighting the VLAN setup, IP address allocation, routing connections, and placement of servers, demonstrating the overall structure and ensuring a clear understanding of the network layout.

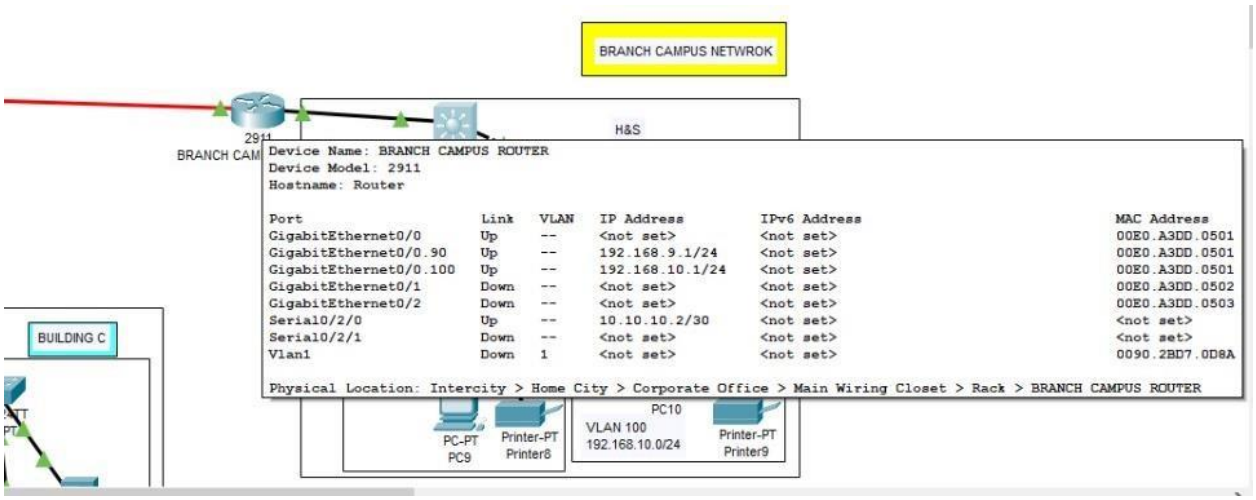
Network Topology:



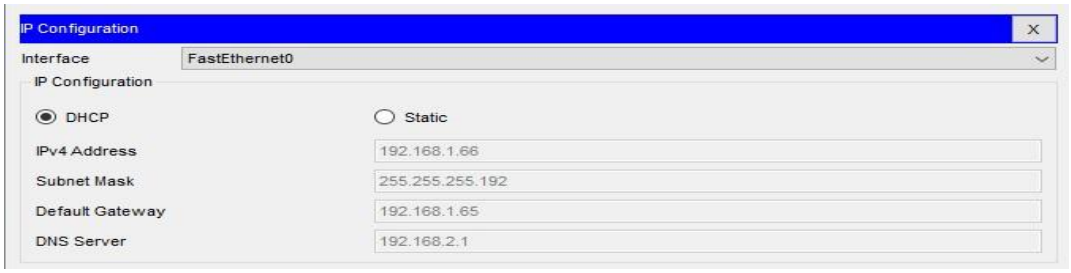
Main Campus Router Configuration:



Branch Campus Router:

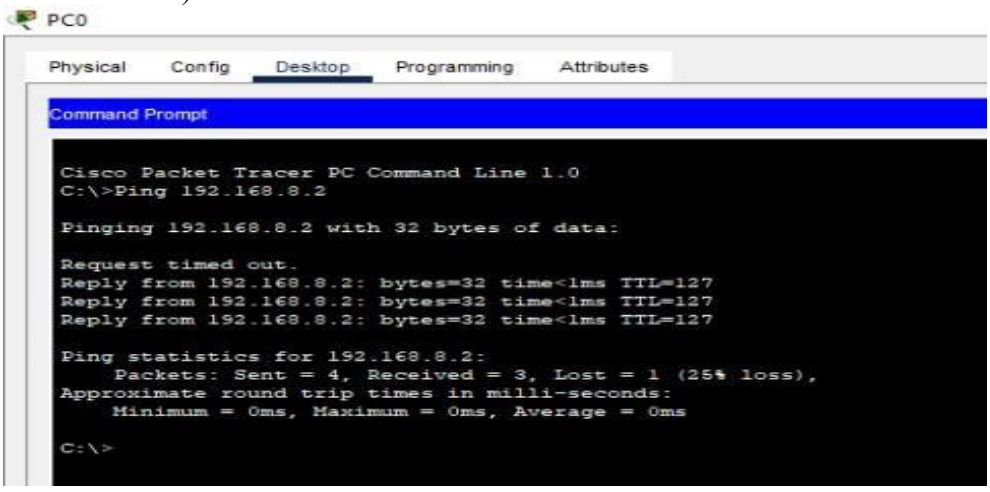


DHCP Configuration:

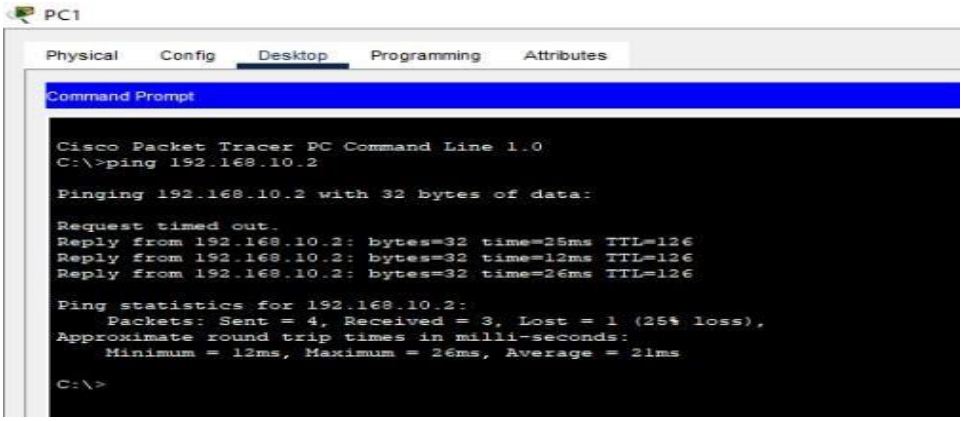


Connectivity Verification

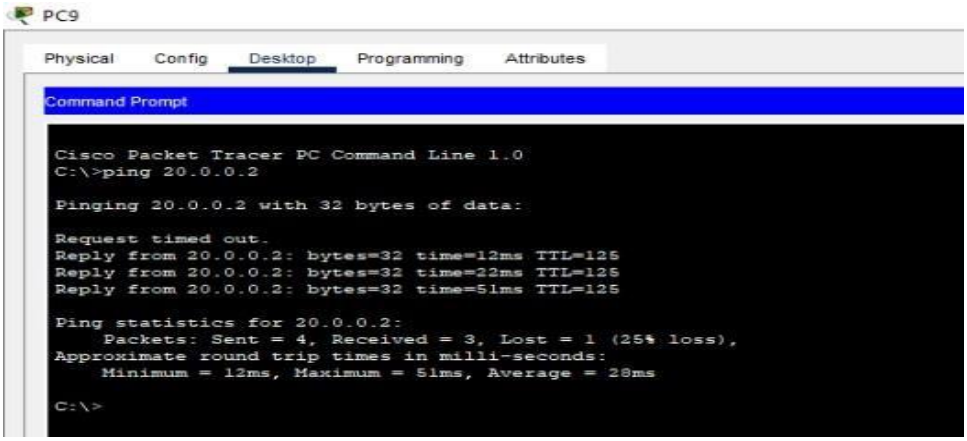
- **Figure 1:** Ping test results between VLANs (e.g., between the Admin VLAN and IT VLAN).



- **Figure 2:** Ping results from the main campus to the branch campus.



- **Figure 3:** Connectivity verification to the public IP of the email server.



CONCLUSION:

The proposed network design provides a reliable and scalable solution tailored to meet Albion University's needs for organized and efficient communication across different departments and campuses. By using VLANs to separate traffic for each department, RIPv2 for routing within the internal network, and static routing for the external connection to the email server, this design ensures secure, flexible, and well-structured network traffic.