Data Communication and Network Lab

Project Report

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Project Title: University Campus Network Design and Implementation

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1. Introduction

The project involves designing and implementing a network infrastructure for a university consisting of two campuses. The network will support various protocols such as DHCP and RIP, and will incorporate subnetting, VLANs, and other network services.

2. Real World Application

A well-designed university network enhances communication and collaboration among students, faculty, and staff, supports academic and administrative functions, and provides secure and reliable access to resources and services.

3. Project Statement

This project aims to create a robust, scalable, and secure network infrastructure for the university's two campuses, facilitating efficient communication, resource sharing, and future expansion.

4. Objectives

- To create a robust and scalable network infrastructure for two university campuses.
- To ensure high availability and redundancy.
- To provide secure and fast communication channels.
- To implement network segmentation for better performance and security.
- To facilitate easy network management and troubleshooting.

5. Network Design

The network design includes the following key components:

- **Core Router:** Central device connecting the two campuses and providing a backbone for the network.
- **Distribution Layer:** Routers and multilayer switches distributing traffic within each campus.
- **Access Layer:** Switches and devices used by students, faculty, and staff.
- **DMZ (Demilitarized Zone):** Hosts servers accessible from the internet, such as web servers and email servers.
- **VPN Gateway:** Provides secure connection for remote access.
- **Firewall:** Security device to protect against external threats.

6. Network Topology

- **Core Layer:** A core router connects to multiple distribution routers, creating a backbone for the network between campuses.
- **Distribution Layer:** This layer includes routers and multilayer switches connecting different departments within each campus.
- **Access Layer:** End-user devices, such as PCs and printers, are connected to access switches.
- **DMZ:** Hosts servers accessible from the internet, such as web servers and email servers.
- **VPN Gateway:** Provides secure remote access to the internal network.
- **Firewall:** Protects the network by filtering incoming and outgoing traffic.

7. Protocols and Services

- **DHCP (Dynamic Host Configuration Protocol):** Automatically assigns IP addresses to devices on the network.
- **RIP (Routing Information Protocol):** Manages routing information within the network.
- **Subnetting:** Divides the network into smaller, manageable sub-networks.
- **VLANs (Virtual Local Area Networks):** Segregates network traffic for better performance and security.

8. Challenges

- **Network Security:** Ensuring the network is protected from cyber threats.
- **Scalability:** Designing the network to accommodate future growth.
- **Redundancy:** Implementing failover mechanisms to ensure network availability.
- **Performance:** Maintaining high network performance and low latency.
- **Management:** Simplifying network management and monitoring.

9. Solutions

- **Security Measures:** Implementing firewalls, VPNs, and intrusion detection/prevention systems.
- **Scalability:** Using multilayer switches and modular network devices that can be easily upgraded.
- **Redundancy:** Setting up redundant links and devices to prevent single points of failure.
- **Performance Optimization:** Using high-performance switches and routers, and implementing Quality of Service (QoS) policies.
- **Network Management Tools:** Utilizing network management and monitoring tools for efficient network administration.

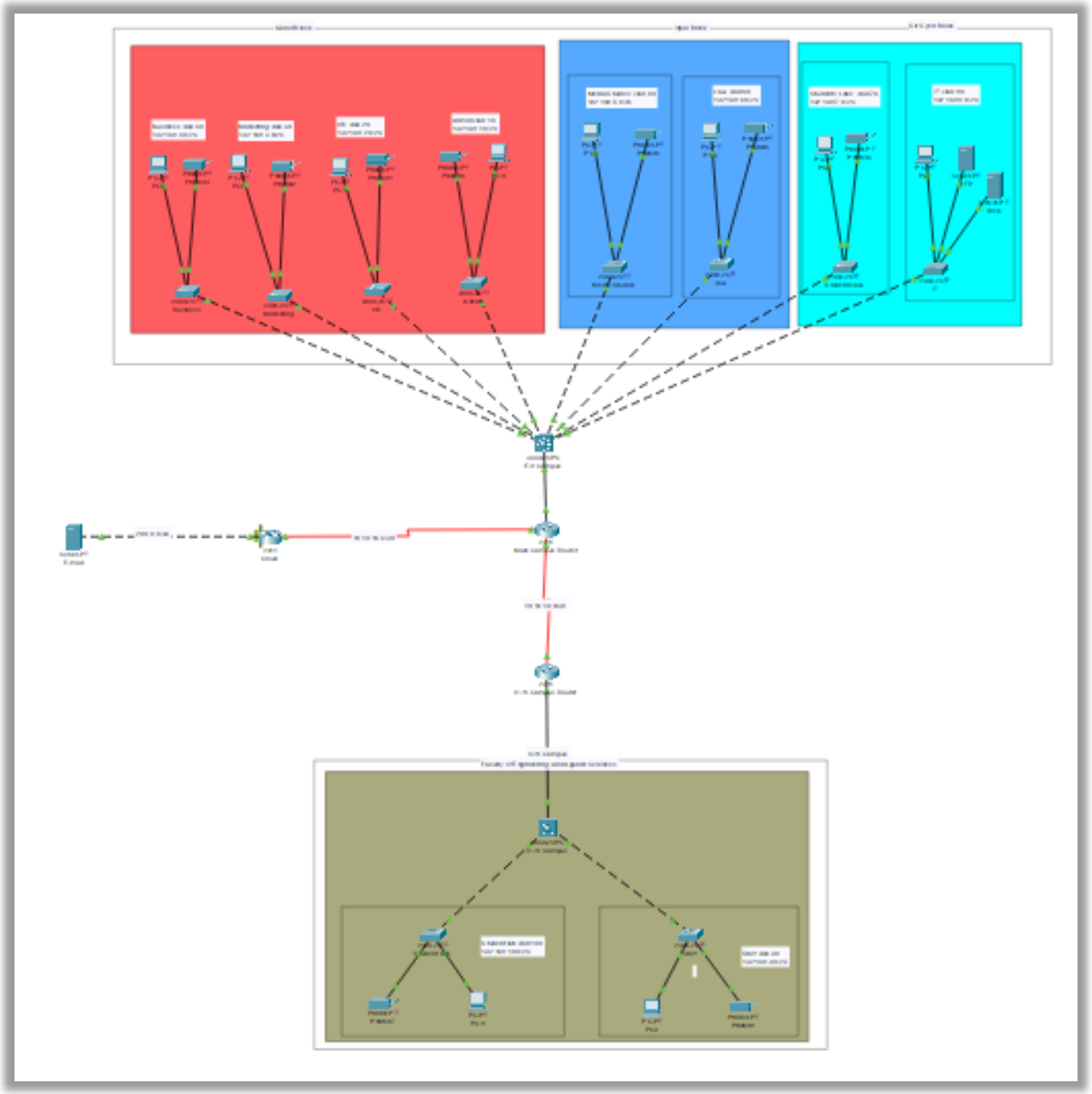
10. Process and Methodology

- **Scouting for Campus Network Features:** Detailed analysis of the campus requirements, including user needs, available resources, and existing infrastructure.
- **Planning and Design:** Detailed network requirements analysis and creating a comprehensive network design.
- **Procurement:** Acquiring necessary network devices and software.
- **Deployment:** Setting up core, distribution, and access layers, and configuring all network devices.
- **Testing:** Conducting extensive testing to ensure network reliability and performance.
- **Training:** Training IT staff on network management and troubleshooting.
- **Documentation:** Creating comprehensive network documentation for future reference.

11. Deliverables

- **Network Design Documentation:** Detailed diagrams and descriptions of the network architecture.
- **Hardware and Software Inventory:** List of all the hardware and software components used.
- **Configuration Files:** All configuration files for routers, switches, firewalls, and other network devices.
- **Testing Reports:** Documentation of all testing procedures and results.
- **User and Administrative Manuals:** Guides for network users and administrators.
- **Training Materials:** Training documents and schedules for IT staff.
- **Project Plan:** Detailed project timeline, milestones, and resource allocation.
- **Final Report:** Comprehensive report covering all aspects of the project from planning to implementation and testing.

12. Network Layout:



E8 Blocks:

- Quaid Block
- Iqbal Block
- Sir Syed Block

H11 Block:

- Main Block

13. Vlans Implemented:

Quaid Block:

- Admin : vlan 10 :192.168.1.0/24
- HR: vlan: 20192.168.2.0/24

- Marketing:vlan 30:192.168.3.0/24
- Buissness: vlan 40: 192.168.4.0/24

Iqbal Block:

- Media Studies: vlan 50:192.168.5.0/24
- Law : vlan 60 :192.168.6.0/24

Sir Syed Block

- Students Labs : vlan 70:192.168.7.0/24
- IT : vlan 80 : 192.168.8.0/24

H-11(Main Block)

- Student lab : vlan 100 : 192.168.10.0/24
- Staff : vlan 90 : 192.168.9.0/24

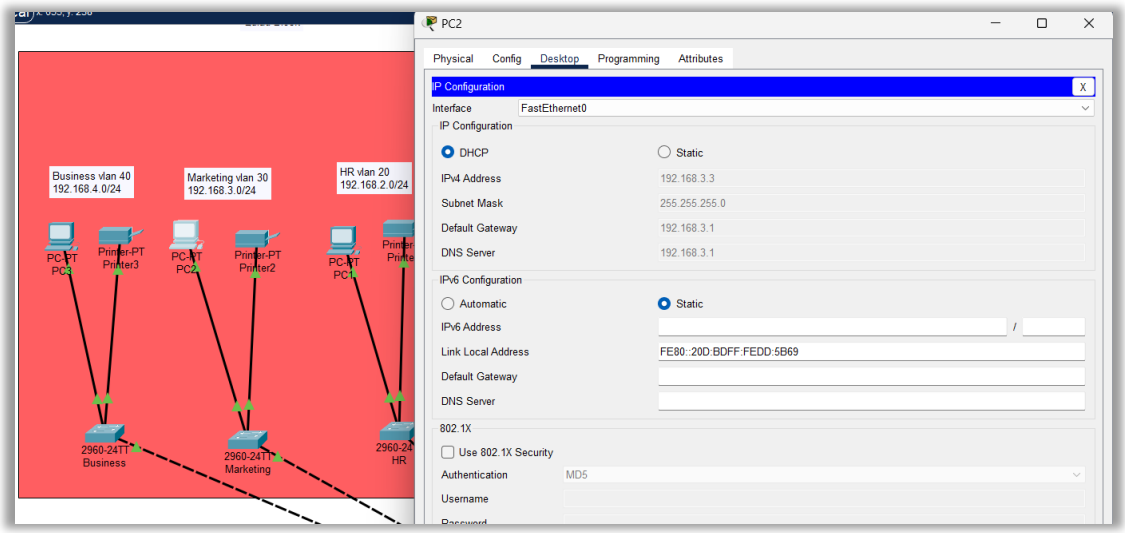
14. Protocols Used:

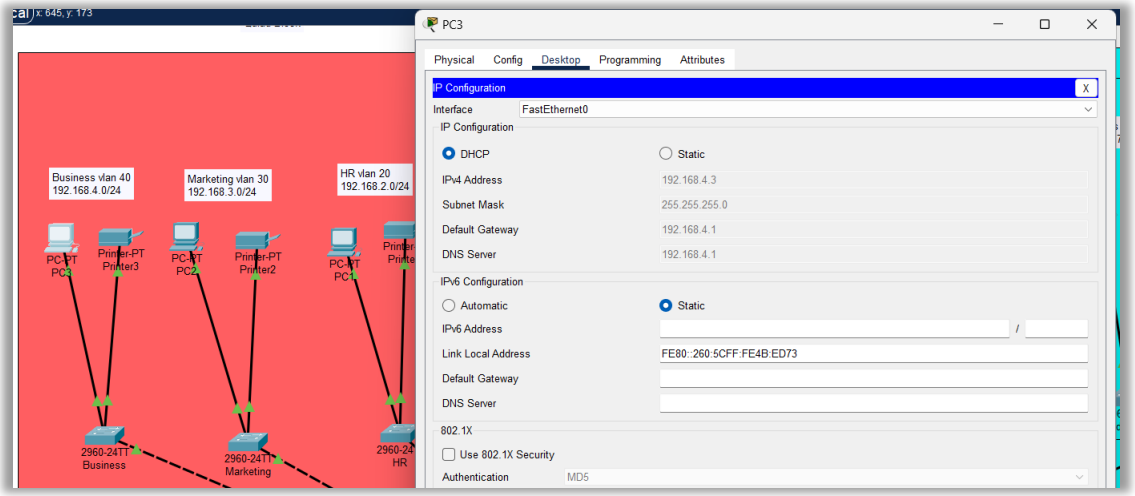
RIP:
RIP (Routing Information Protocol) is a dynamic routing protocol used in local and small-scale networks. It operates based on the distance vector algorithm, where routers exchange routing information periodically. RIP measures distance in hops and advertises routing updates every 30 seconds. However, its simplicity comes with limitations, such as slow convergence and a maximum hop count of 15, which makes it unsuitable for large networks. RIP is commonly used in small networks where simplicity outweighs scalability concerns.

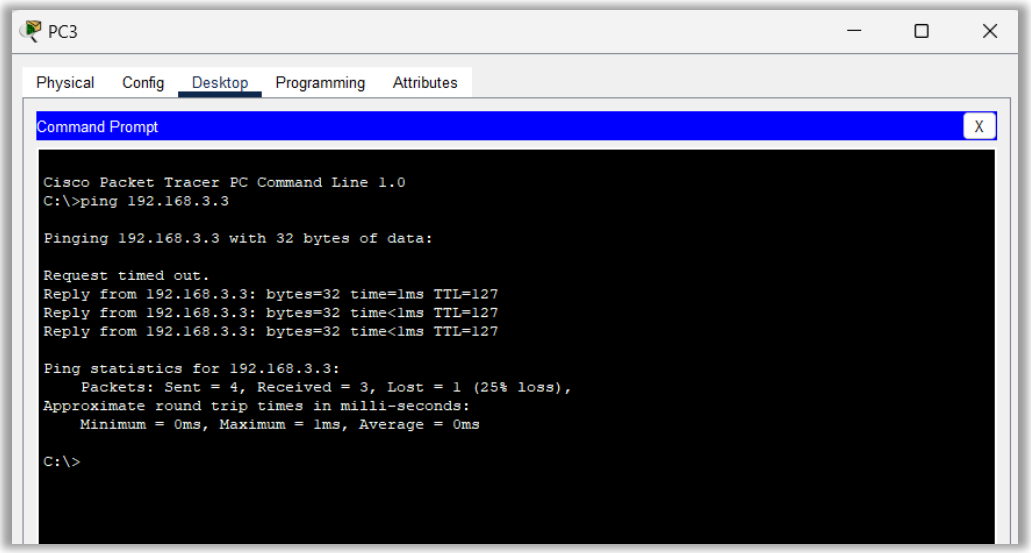
DHCP:
DHCP (Dynamic Host Configuration Protocol) is a network management protocol used to dynamically assign IP addresses and other network configuration parameters to devices on a network. DHCP operates based on a client-server model, where a DHCP server assigns IP addresses to clients from a predefined pool. It simplifies network administration by automating the process of IP address allocation, subnet mask assignment, default gateway configuration, and DNS server assignment. DHCP reduces the burden on network administrators and ensures efficient IP address management in dynamic network environments.

15. Test

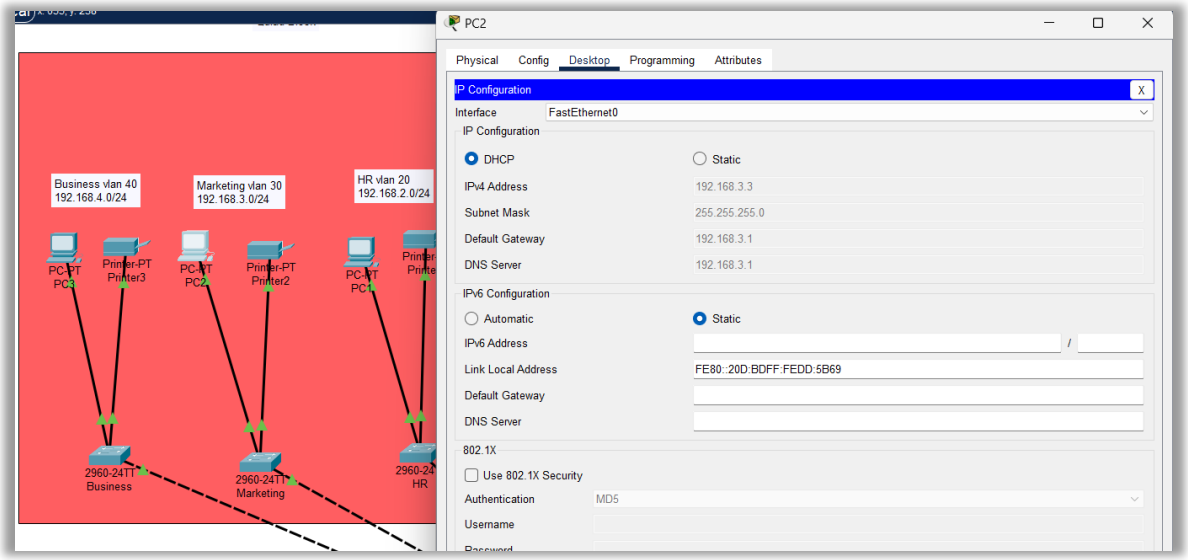
Ping Within Departments(Sir Syed Block):

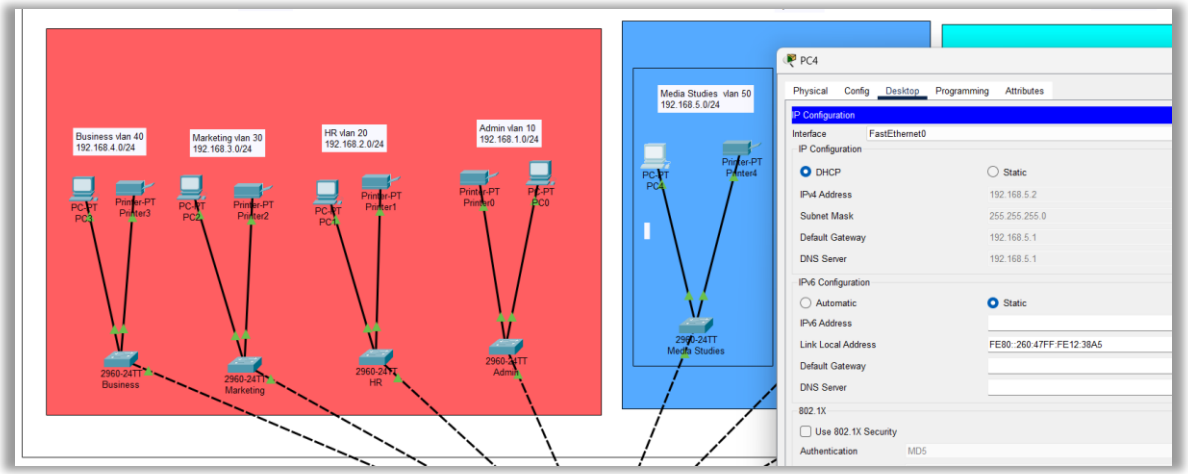


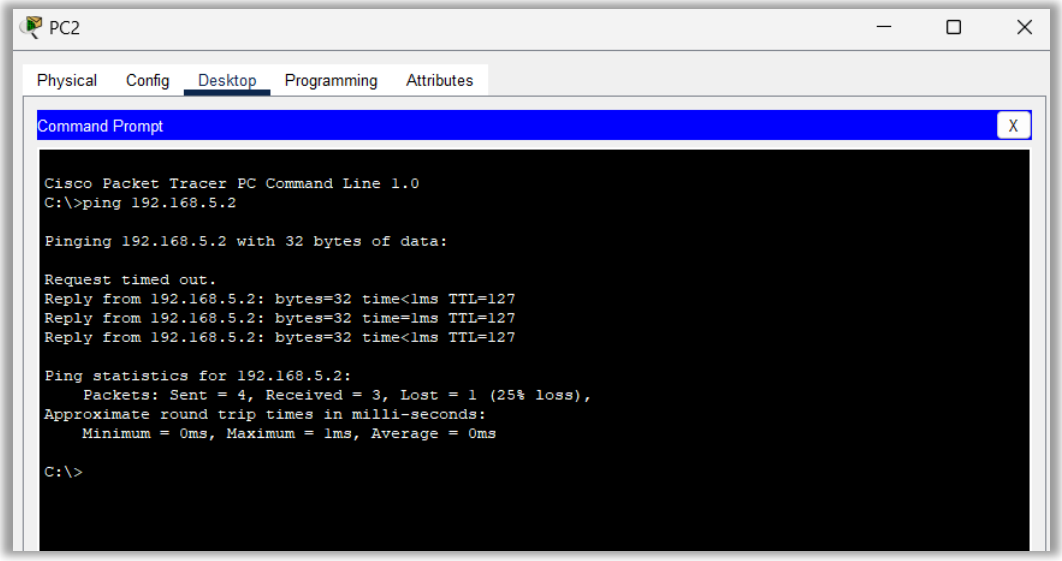




Ping Outside of Departments (Sir Syed to Iqbal Block)







16. Conclusion

The successful implementation of the designed network infrastructure will result in a robust, secure, and scalable network that meets the current and future needs of the university. By addressing the challenges and implementing appropriate solutions, the network will ensure high performance, security, and reliability.

17. Additional Links(Github + LinkedIn)

- GitHub
- LinkedIn

18. References

https://www.youtube.com/watch?v=nw7xNTM-MMM&t=326s&ab_channel=NetworkEngineerStuff
https://www.youtube.com/watch?v=krM9GprN6qA&ab_channel=NavinReddy
https://www.youtube.com/watch?v=kCf5sFnTB6U&t=675s&ab_channel=AllAboutComputers