

**Department of Computer Science**

BAHRIA UNIVERSITY, ISLAMABAD

**Term Project**

**Bahria University Network**

**Data Communication and Networking**

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## Abstract

This project outlines the design and implementation of a comprehensive network infrastructure for a university, addressing its varied operational needs. The design incorporates IP addressing, subnetting, VLANs, and dynamic routing protocols to ensure a scalable, secure, and efficient network. The project emphasizes practical application of theoretical knowledge and simulates real-world network scenarios using tools like Packet Tracer.

## 1. Introduction

This project aims to design and implement a robust network for a university, focusing on efficient data handling, high availability, and robust security. The network infrastructure includes multiple VLANs, routing protocols, and IP addressing schemes. It also incorporates network security measures such as VTP security configurations to protect and manage the network effectively.

## 2. Network Design Overview

The network is segmented into several blocks, each representing different departments and labs within the university. The key components of the network include:

### 2.1. Cloud Server and Router

* **Cloud Server**: IP Address 20.0.0.0/30
* **Cloud Router**: Connected to the Cloud Server and the Main Router with IP addresses 20.0.0.1/30 and 10.10.10.4/30, respectively.

### 2.2. Main Router

Acts as the central point of connectivity between different blocks and the cloud network.

### 2.3. Campus Switches

Provide connectivity to various labs and departments.

### 2.4. VLANs

* VLAN 10 (192.168.1.0/24): Quaid Block
* VLAN 20 (192.168.2.0/24): Sir Syed Block
* VLAN 30 (192.168.3.0/24): Iqbal Block
* VLAN 40 (192.168.4.0/24): Ibn-e-Khaldun Block
* VLAN 50 (192.168.5.0/24): LT Halls and Library
* VLAN 60 (192.168.6.0/24): IT Department and Servers

## 3. Learning Outcomes

### 3.1. IP Addressing and Subnetting

* **Purpose**: IP addressing and subnetting are essential for network organization, efficient IP address allocation, and improving network security and performance. By dividing a network into subnets, we can control traffic and reduce congestion.
* **Application**: In this project, IP addressing and subnetting were applied to allocate unique IP ranges for different VLANs and segments, ensuring efficient utilization of IP addresses and segregation of network traffic.

### 3.2. RIP v2 Protocol

* **Purpose**: RIP v2 (Routing Information Protocol version 2) is a dynamic routing protocol used to facilitate the exchange of routing information between routers within an autonomous system. It helps in dynamically updating the routing table based on network topology changes.
* **Application**: RIP v2 was configured on routers to enable dynamic routing, allowing routers to exchange routing information and adapt to network changes without manual intervention.

### 3.3. VLANs (Virtual Local Area Networks)

* **Purpose**: VLANs are used to segment a physical network into multiple logical networks. This enhances network security, reduces broadcast domains, and improves network management.
* **Application**: VLANs were implemented to segment the network based on departments and labs, ensuring that each VLAN operates as an independent network. This segmentation enhances security and performance by limiting broadcast traffic within each VLAN.

## 4. Detailed Network Configuration

### 4.1. Basic Network Layout and IP Addressing

* Develop a basic network layout, including the choice of cable types and IP addressing scheme using IPv4 and IPv6.
* Allocate IP addresses for different VLANs and subnets.

### 4.2. Network Expansion and Device Configuration

* Set up a peer-to-peer network and expand it by adding switches and routers.
* Configure devices using CLI and connect multiple LANs.

### 4.3. Router and Switch Configuration

* Configure router settings, establish console sessions, and use HyperTerminal for managing configurations in DRAM and NVRAM.
* Implement backup solutions using TFTP servers.

### 4.4. VLAN and VTP Configuration

* Design and implement VLANs.
* Configure switches for VTP modes to manage VLAN distribution and ensure network security.

### 4.5. Routing Protocols

* Implement and configure RIP and OSPF routing protocols to ensure efficient inter-VLAN routing and network scalability.

### 4.6. DHCP and Packet Motion Simulation

* Simulate packet motion through a DHCP server in the network using Packet Tracer.
* Analyze data flow and troubleshoot potential issues.

### 4.7. Network Integration and Testing

* Integrate all components into a cohesive network.
* Ensure all parts operate harmoniously and meet the design specifications.

## 5. Evaluation and Analysis

* Simulate real-world network traffic and analyze the performance and security of the network.
* Test the implemented security measures to ensure the network's robustness.

## 6. Conclusion

The design and implementation of the university network involved a thorough understanding of IP addressing, subnetting, dynamic routing protocols, and VLANs. This project provided practical experience in configuring and managing network devices and highlighted the importance of network design in creating a scalable, secure, and efficient network infrastructure.

## 7. Real-World Applications

* **Industrial Applications**: This project serves as a prototype for industrial applications where maintaining a specific temperature range is crucial, such as in chemical processing plants or electronic manufacturing facilities.
* **Practical Experience**: Provides practical experience with industry-standard tools and techniques for electronic system design and troubleshooting.

## 8. Deliverables

* **Project Report**: A detailed report including network diagrams, IP addressing schemes, configurations, and security measures.
* **Simulated Network**: A fully simulated network using tools like Packet Tracer or GNS3 to demonstrate the working and security of the network.
* **Presentation/Video Demonstration**: A presentation or video showcasing the network design, features, and a walkthrough of the configuration.

## 9. Citations

1. Cisco Systems, "Understanding IP Addressing and Subnetting," Cisco Documentation.
2. Benard Otom: “[https://www.youtube.com/watch?v=e1cD2KImeE&t=1726s&ab\_channel=BenardOtom”](https://www.youtube.com/watch?v=e1cD2KImeE&t=1726s&ab_channel=BenardOtom%E2%80%9D)

By leveraging these concepts and technologies, the university network is designed to meet current needs and can be scaled to accommodate future growth and technological advancements.