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**Network Design Project Report**

**Title:**

Enterprise Network Design and Simulation Using EIGRP, OSPF, and RIP Protocols

**Abstract:**

This project aims to design a multi-area network topology for an enterprise environment, integrating Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Routing Information Protocol (RIP) for efficient data management and communication. The network consists of multiple segmented areas, each configured with specific routing protocols to meet varying traffic and connectivity requirements. The design includes essential network services, such as DHCP, VLAN configurations, and server connectivity, facilitating streamlined network management and data exchange. This report provides a detailed analysis of the network design, configuration, and testing results, demonstrating the efficiency and scalability of the implemented topology.

**Introduction:**

In today’s enterprise networks, robust and efficient routing architectures are crucial to ensure reliable data transmission and seamless connectivity across diverse geographic or functional areas. Routing protocols like EIGRP, OSPF, and RIP offer different benefits, making them suitable for various segments of an enterprise network. This project develops a comprehensive network topology that employs these protocols in specific areas to optimize network performance, reliability, and ease of management. The topology design includes VLANs, DHCP servers, data servers, and end-user devices, demonstrating a realistic approach to enterprise networking.

**Background:**

Routing protocols play a critical role in managing network paths and ensuring data packets reach their intended destinations with minimal delay and maximum reliability. The protocols utilized in this network are:

EIGRP: A distance-vector routing protocol optimized for fast convergence and efficient routing within larger, more dynamic networks.

OSPF: A link-state protocol well-suited for hierarchical and segmented networks, providing fast convergence and optimal route selection.

RIP: A basic distance-vector protocol designed for smaller, less complex networks, providing straightforward routing capabilities but limited scalability.

This project’s network design combines these protocols to maximize the strengths of each in different network areas, creating an interconnected and efficient enterprise network.

**System Design:**

1. Network Topology Overview

The network topology consists of three primary routing areas, each designated with specific roles and routing protocols:

EIGRP Area: Contains several LANs and connects essential services like the DHCP and DATA servers. This area is designed for rapid internal communication and efficient data distribution across multiple LANs.

OSPF Area 1: Includes a larger hierarchical structure with multiple routers and switches, making it suitable for a more extensive network that benefits from OSPF’s link-state capabilities. It houses various laptops and a TFTP server for network file distribution.

RIP Area: A smaller segment configured with RIP, designed to handle routing for simpler subnets that don’t require advanced routing features.

2. Key Components

Routers (2811): These routers are configured to manage different routing protocols across the network and enable communication between separate areas.

Switches (2960-24TT): These layer-2 switches provide connectivity within each local network, connecting laptops and servers to the appropriate network segments.

Servers: Three main servers are used:

DHCP Server: Allocates IP addresses within the network dynamically to clients.

DATA Server: Hosts data accessible across the network for testing connectivity and data flow.

TFTP Server: Provides file transfer services for configuration updates and other network operations.

3. Routing Protocol Configuration

Each area uses a distinct routing protocol to best serve its specific requirements:

EIGRP Configuration: Configured with an Autonomous System (AS) number to manage routing within the EIGRP area. This segment supports rapid route convergence and is optimal for an enterprise’s internal communication needs.

OSPF Configuration: Configured with multiple areas (Area 1 and Area 0) to enable hierarchical network organization and efficient route calculation. Each router in this area is assigned to a specific OSPF area, allowing seamless inter-area communication.

RIP Configuration: Configured for a simpler network section that requires only basic routing capabilities. This protocol is applied to reduce the complexity of configuration in the designated area.

4. VLAN Configuration and DHCP Server

The VLANs are used to segment the network logically, enabling devices within the same VLAN to communicate efficiently while isolating traffic from other VLANs. The DHCP server is configured to allocate IP addresses dynamically within VLANs, simplifying network management and reducing manual configuration.

**Result and Discussion:**

1. Connectivity Testing

Ping and trace route tests were conducted across the network to verify connectivity between all devices. The results showed that:

* Devices within the same area were able to communicate without issues, confirming that the routing protocols were correctly configured.
* Cross-area communication was successful, indicating that the protocol redistribution between EIGRP and OSPF was properly managed.

2. Performance Analysis

The network was able to handle simulated traffic efficiently, with minimal latency observed during tests. The use of EIGRP in the core area allowed for fast convergence, while OSPF's hierarchical design managed traffic effectively in more extensive sections of the network. RIP, while simple, functioned well within its designated area without affecting overall network performance.

3. Challenges and Solutions

Some challenges encountered included:

Protocol Redistribution: Configuring protocol redistribution between EIGRP and OSPF required adjustments to prevent routing loops and ensure accurate route sharing.

VLAN Configuration: Ensuring VLANs operated correctly within their segments required careful configuration of the switches and DHCP server.

Solutions to these issues involved adjusting route summarization and carefully mapping VLAN IDs to corresponding switch ports and DHCP scopes.

**Conclusion:**

The multi-area network design project successfully demonstrates how multiple routing protocols can be used to build a scalable and efficient enterprise network. By segmenting the network into areas and using specific protocols, each part of the network was able to achieve optimal performance based on its requirements. Future improvements could include:

* Implementing additional redundancy through backup links.
* Adding security features such as Access Control Lists (ACLs) and firewalls to secure inter-area communication.
* Exploring advanced VLAN management and dynamic routing protocols for greater flexibility.
* This project provides a solid foundation for developing a complex and scalable enterprise network with multiple routing protocols.

**References:**

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