Enterprise Network Design and Implementation

1. Project Description:

This project focuses on the design and implementation of a single-site enterprise network. The network consists of three routers, two distribution switches, four access switches, twenty PCs, and a server. The design utilizes a hierarchical network model with VLAN segmentation to enhance security and network performance. Key aspects include inter-VLAN routing, redundancy protocols, access control lists (ACLs), and network services such as DHCP and logging. The project emphasizes hands-on configuration of network devices using Cisco Packet Tracer and GNS3 network simulation tools.

2. Problem Statement:

Enterprises require robust, secure, and scalable networks to support their daily operations. This project addresses common networking challenges such as:

- **Network Congestion:** A flat network design can lead to congestion and performance bottlenecks as the number of devices increases. **Solution:** Implementing VLAN segmentation divides the network into smaller broadcast domains, reducing congestion and improving performance.
- **Security Risks:** Lack of access control can expose sensitive data to unauthorized users.
  Solution: Implementing ACLs restricts network access based on predefined rules, enhancing security.
- **Network Downtime:** Single points of failure can lead to complete network outages, disrupting business operations.
  Solution: Implementing redundancy protocols like HSRP ensures network availability even if a device fails.
- **IP Address Management:** Manually assigning IP addresses to a large number of devices is inefficient and error-prone.

Solution: Implementing DHCP automates IP address assignment, simplifying network administration.

- **Network Monitoring and Troubleshooting:** Identifying and resolving network issues in a large network can be challenging.
  Solution: Centralized logging enables efficient monitoring and troubleshooting by collecting logs from all network devices.

3. Terminology and Tools Used:

- **VLAN (Virtual Local Area Network):** A logical grouping of network devices that allows communication as if they were on the same physical network, even if they are connected to different switches.
- **Inter-VLAN Routing:** The process of enabling communication between different VLANs.
- **Access Control List (ACL):** A set of rules that permit or deny network traffic based on predefined criteria.
- **DHCP (Dynamic Host Configuration Protocol):** A protocol that automates the assignment of IP addresses to devices on a network.
- **HSRP (Hot Standby Routing Protocol):** A redundancy protocol that provides a backup router in case the primary router fails.
- **EtherChannel (Port Aggregation):** A technology that bundles multiple physical ports into a single logical link to increase bandwidth and provide redundancy.
- **Spanning Tree Protocol (STP):** A protocol that prevents loops in a network with redundant paths.
- **Cisco Packet Tracer:** A network simulation tool used to design, configure, and troubleshoot networks.
- **GNS3 (Graphical Network Simulator-3):** A network simulation tool that allows for the emulation of complex networks.