Enterprise Network Lab Documentation

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# Objective

To design and implement a simulated enterprise-grade network that incorporates industry best practices in hierarchical design, dynamic routing (OSPF), inter-VLAN routing, centralized DHCP services, and Layer 2 redundancy using Spanning Tree Protocol (STP).

# Topology Overview

Sites:  
- HQ (Headquarters)  
- Branch 1  
- Branch 2

Hierarchical Design:  
- Core Layer (L3 Switch): Handles VLAN gateways, OSPF, and inter-VLAN routing  
- Distribution/Aggregate Layer (L2 or L3): Connects access switches to the core  
- Access Layer (L2 Switches): Provides end-user connectivity

# Routing Configuration

Routing Protocol: OSPFv2  
Design: Single-area configuration (Area 0)  
Devices Running OSPF: HQ Router, Branch 1 Router, Branch 2 Router, Core L3 switch  
Planned Upgrade: Future conversion to multi-area OSPF (Area 0 backbone with Area 1 and Area 2 for branches)

# VLAN Design and Distribution

HQ VLANs: 10–80  
Branch 1 VLANs: 90–110  
Branch 2 VLANs: 120–140  
All Sites VLAN: 50 (DHCP/DNS)

Inter-VLAN Routing: Performed on the Core L3 switch  
SVIs Configured: On the core switch for each VLAN

# Spanning Tree Configuration

Mode: Rapid PVST+  
Root Bridge (per site): Set via 'spanning-tree vlan X priority 4096'’

Root Bridge Prioritization:

- Core Switches (HQ and Branches): spanning-tree vlan <range> priority 4096

- Distribution Switches: spanning-tree vlan <range> priority 8192

This setup ensures that core switches serve as the primary root bridges for their designated VLANs, while distribution switches act as secondary root bridges for redundancy.

Trunk Links: 'spanning-tree link-type point-to-point'  
Access Ports: 'spanning-tree portfast' and 'bpduguard enable'

# Centralized DHCP Services

DHCP Server: Located at HQ (VLAN 50)  
IP Address: 192.168.50.5  
DHCP Relay (IP Helper) Configured on SVIs:  
interface vlan 10  
 ip address 192.168.10.1 255.255.255.0  
 ip helper-address 192.168.50.5

# Security Best Practices Applied

PortFast + BPDU Guard: Enabled on access ports  
STP Root Bridge: Manually set  
VLAN Segmentation: Applied for logical isolation  
Central DHCP: Simplifies management and improves security

# Verification Checklist

✔️ VLANs reach their default gateway  
✔️ Inter-VLAN communication successful  
✔️ OSPF adjacencies form  
✔️ DHCP works across branches  
✔️ STP prevents loops  
✔️ Root bridge correctly elected

# Planned Future Enhancements

- Convert to multi-area OSPF  
- Add inter-branch OSPF redundancy  
- Implement ACLs  
- Add NAT, DHCP Snooping, DAI  
- Simulate failover, route summarization  
- Publish configs to GitHub

# Conclusion

This project simulates a secure, scalable, and modular enterprise network using real-world technologies. It lays the groundwork for advanced certifications such as CCNA, CCNP Enterprise, and Fortinet NSE 4+.