LabCore Network Design Project

# Project Title

LabCore Network Design

# Objective / Problem Statement

The goal of this project was to design and configure a secure, segmented network for a small business using both Layer 2 and Layer 3 networking features. Within a simulated lab environment, I created VLANs to separate traffic, implemented inter-VLAN routing, configured DHCP to assign IP addresses dynamically, applied QoS to prioritize voice traffic, and added wireless access through a Wireless Access Point. I verified that all hosts had proper connectivity, phones could place internal and external calls, and devices could reach the internet.

# Project Scope

**Included:**

* Configuration of two switches
* Configuration of one router with Inter-VLAN routing and DHCP
* VLAN creation and assignment of access ports for data, voice, and management traffic
* QoS setup to prioritize VoIP traffic
* Wireless Access Point configuration and client connectivity
* Setup and verification of user devices and IP phones

**Not Included:**

* Configuration of the internet-facing router (ISP connection was preconfigured in the lab)
* External firewall implementation or advanced security hardening

# Tools & Technologies Used

* Cisco Packet Tracer
* Cisco Catalyst Switches and Router
* IP Phones and Wireless Access Point
* Basic PC endpoints and Tablet PC

# Step-by-Step Implementation

1. Configure Core Switch, LabCore-SW1
   1. Basic Configuration
      1. clock set hh:mm:ss DD MONTH YYYY
      2. hostname LabCore-SW1
      3. enable secret LabCorepass
      4. interface vlan 110
      5. ip address 192.168.110.251 255.255.255.0
      6. ip default-gateway 192.168.110.1
      7. username netadmin password LabC0re!Net
      8. service password-encryption
      9. line console 0
      10. login local
      11. ip access-list standard VTY
      12. permit 192.168.110.0 0.0.0.255
      13. line vty 0 15
      14. login local
      15. access-class VTY in
   2. Configure SSH and Disable Telnet
      1. ip domain-name labcore.local
      2. crypto key generate rsa
         1. *Modulus: 2048*
      3. ip ssh version 2
      4. line vty 0 15
      5. transport input ssh
      6. transport output ssh
   3. Configure Spanning-Tree Root Bridge
      1. spanning-tree vlan 1-1024 priority 0
   4. Create VLANs
      1. vlan 110
      2. name MGMT
      3. vlan 210
      4. name DATA
      5. vlan 160
      6. name VOICE
   5. Configure Access Ports
      1. interface fa0/1
      2. description NOC-PC
      3. switchport mode access
      4. switchport access vlan 110
      5. spanning-tree portfast
      6. *\*You can connect the NOC-PC to LABCORE-SW-1 port fa0/1 at this point for testing*
      7. interface range fa0/2-23
      8. description Access Port
      9. switchport mode access
      10. switchport access vlan 210
      11. switchport voice vlan 160
      12. spanning-tree portfast
      13. mls qos trust cos
      14. mls qos trust device cisco-phone
   6. Turn on mls qos
      1. mls qos
   7. Configure Trunk to Router
      1. interface fa0/24
      2. description Trunk to Router
      3. switchport mode trunk
   8. Configure Trunks to LabCore-SW2
      1. interface range g0/1 – 2
      2. description Trunks to LabCore-SW2
      3. switchport mode trunk
2. Configure Second Switch, LabCore-SW2
   1. Basic Configuration
      1. clock set hh:mm:ss DD MONTH YYYY
      2. hostname LabCore-SW2
      3. enable secret LabCorepass
      4. interface vlan 110
      5. ip address 192.168.110.252 255.255.255.0
      6. ip default-gateway 192.168.110.1
      7. username netadmin password LabC0re!Net
      8. service password-encryption
      9. line console 0
      10. login local
      11. ip access-list standard VTY
      12. permit 192.168.110.0 0.0.0.255
      13. line vty 0 15
      14. login local
      15. access-class VTY in
   2. Configure SSH and Disable Telnet
      1. ip domain-name labcore.local
      2. crypto key generate rsa
         1. Modulus: 2048
      3. ip ssh version 2
      4. line vty 0 15
      5. transport input ssh
      6. transport output ssh
   3. Create VLANs
      1. vlan 110
      2. name MGMT
      3. vlan 210
      4. name DATA
      5. vlan 160
      6. name VOICE
   4. Configure Access Ports
      1. interface range fa0/1 - 24
      2. description Access Port
      3. switchport mode access
      4. switchport access vlan 210
      5. switchport voice vlan 160
      6. spanning-tree portfast
      7. mls qos trust cos
      8. mls qos trust device cisco-phone
   5. Turn on mls qos
      1. mls qos
   6. Configure Trunks to LabCore-SW1
      1. interface range g0/1 - 2
      2. description Trunks to LabCore-SW1
      3. switchport mode trunk
   7. Save the configuration on both switches if you have not yet done so (LABCORE-SW1 & SW2)
      1. #copy running-config startup-config
      2. f. Using a crossover cable connect LABCORE-SW1 G0/1 and G0/2 to LABCORE-SW2 G0/1 and G0/2
3. Configure LabCore-RTR with Inter-VLAN routing, DHCP, & Internet Services
   1. Configure Interface G0/0 for Inter-VLAN routing for the Mgmt, Data, & Voice VLANs
      1. interface g0/0
      2. no shutdown
      3. description Trunk to LabCore-SW1
      4. interface g0/0.110
      5. description MGMT
      6. encapsulation dot1q 110
      7. ip address 192.168.110.1 255.255.255.0
      8. ip nat inside
      9. interface g0/0.210
      10. description DATA
      11. encapsulation dot1q 210
      12. ip address 192.168.210.1 255.255.255.0
      13. ip nat inside
      14. interface g0/0.160
      15. description VOICE
      16. encapsulation dot1q 160
      17. ip address 192.168.160.1 255.255.255.0
      18. ip nat inside
   2. b. Using a straight-through cable connect LABCORE-SW1 Fa0/24 to LABCORE-RTR G0/0
   3. \*All currently connected devices should now have Layer 3 connectivity to all VLANs
4. Configure DHCP Services for the Data VLAN
   1. ip dhcp pool DATA
   2. network 192.168.210.0 255.255.255.0
   3. default-router 192.168.210.1
   4. dns-server 8.8.8.8
   5. ip dhcp excluded-address 192.168.210.1 192.168.210.50
5. Add a Default Route for Internet Access
   1. ip route 0.0.0.0 0.0.0.0 205.10.49.33
6. Connect User A & User B to the Network
   1. Using a straight-through cable connect User A to LABCORE-SW1
   2. Verify the User A is configured as a DHCP client
   3. From the desktop of User A access the command prompt utility and perform the following
      1. ipconfig /all (to verify ip address obtained from DHCP server)
      2. ping 192.168.210.1 (to verify IP connectivity to Data gateway IP on LABCORE-RTR)
      3. ping 8.8.8.8 (to verify IP connectivity to the internet)
   4. Using a straight-through cable connect User B to LABCORE-SW2
   5. Verify the User B is configured as a DHCP client
   6. From the desktop of User B access the command prompt utility and perform the following
      1. ipconfig /all (to verify ip address obtained from DHCP server)
      2. ping 192.168.210.1 (to verify IP connectivity to Data gateway IP on LABCORE-RTR)
      3. ping 8.8.8.8 (to verify IP connectivity to the internet)
   7. \*User A and User B are now connected to the LAN and should be able to ping all network nodes and browse the internet to www.google.com using the web browser on the host desktops
7. Connect & Configure VoIP Phones
   1. Using a straight-through cable connect Phone A to LABCORE-SW1
   2. show running-config (on LABCORE-RTR, to verify ephone 1 is automatically added)
   3. Using a straight-through cable connect Phone B to LabCore-SW2
   4. show running-config (on LABCORE-RTR, to verify ephone 2 is automatically added)
8. Add Directory Numbers to the ephones on LabCore-RTR
   1. ephone-dn 1
   2. number 1101
   3. ephone-dn 2
   4. number 1102
   5. ephone 1
   6. button 1:1
   7. ephone 2
   8. button 1:2
   9. \*Phones A and B should now properly register and be able to make internal and external calls
9. Save your configuration
   1. copy running-config startup-config
10. Connect & Configure Wireless Access
    1. Using a straight-through cable connect the LabCore-WAP to port Fa0/23 on LabCore-SW1
    2. Add a description to the switchport on LabCore-SW1 to note the WAP is connected there and also clean up the interface configuration by removing the voice configurations.
11. Configure the Wireless SSID & WPA2 PSK on LabCore-WAP
    1. LabCore-WAP->Config->Port 1
    2. SSID: Core-Lab
    3. Authentication: WPA2 PSK: LabCore1
12. Configure the Tablet PC for wireless access
    1. Tablet-PC-> Config -> Wireless0
    2. SSID: Core-Lab
    3. WPA2 PSK: corelab1
    4. \*The Wireless Tablet PC should now be connected to the network, pull an address via DHCP, and have network and internet connectivity.
13. Lab Show Commands
    1. Switch:
       1. show vlan
       2. show mac address-table
       3. show interfaces trunk
       4. show spanning-tree
       5. show mls qos interface <interface>
    2. Router:
       1. show ip route
       2. show ip dhcp binding
       3. show ip nat translations
       4. show ephone
       5. show policy-map interface <interface>
    3. Both:
       1. show running-config
       2. show running-config | begin <word>
       3. show running-config | include <word>
       4. show startup-config
       5. show ip interface brief
       6. show interface <interface>
       7. show clock
       8. show ssh
       9. show access-list

# Challenges and Solutions

* **IP Phones not registering:**
  + Manually configured MAC addresses for the phones
  + Verified switchport settings for voice VLAN and QoS configurations
  + Confirmed ephones were registered correctly on the router
* **VLANs not routing:**
  + Checked and corrected encapsulation settings on router sub-interfaces

# Project Outcomes / Results

The project met all initial objectives. VLANs successfully segmented traffic by type, and inter-VLAN routing allowed communication across VLANs. DHCP functioned correctly, dynamically assigning addresses within the appropriate subnet. VoIP phones were able to register and place calls, and the wireless client was able to connect, receive a DHCP address, and browse the internet. Overall, the simulated environment mirrored real-world setups effectively.

# Screenshots / Diagrams

Add relevant images, diagrams, or screenshots that show your setup or results.

# Conclusion / Lessons Learned

This project gave me hands-on experience with core networking tasks in a simulated environment that closely resembles real-world scenarios. It strengthened my understanding of how to build secure and scalable LANs, and helped me troubleshoot key services like DHCP, QoS, and inter-VLAN routing.

# GitHub or Project Link

If you have uploaded this project online, include the link here.