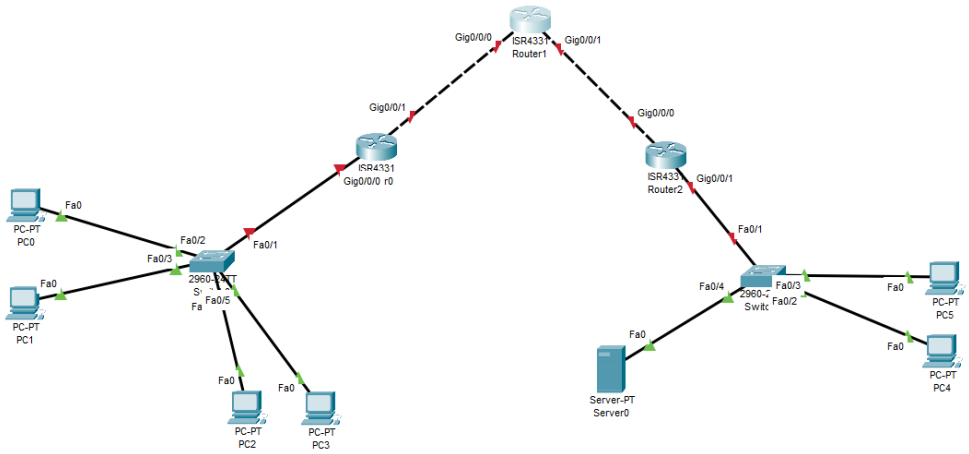
WIA1005 Lab Task 4 (Week 12 – 5%)

Opens: Friday, 6 June 2025, 12:00 AM
Due: Sunday, 22 June 2025, 12:00 AM

1 Objective

The primary objective of this laboratory exercise is to design, implement, and verify a moderately complex network infrastructure. This encompasses the configuration of a multi-router environment involving inter-VLAN routing, static route establishment for comprehensive network reachability, and the deployment of essential network services, specifically the Dynamic Host Configuration Protocol (DHCP) for automated IP address allocation and a dedicated Domain Name System (DNS) server for name resolution. Successful completion will demonstrate the ability to integrate these core networking technologies to create a functional, interconnected system with verifiable end-to-end connectivity across disparate network segments.

2 Instructions



VLANs on SW1:

a) VLAN 10: Student (e.g., for PC0, PC1) - Network: 192.168.10.0/24
b) VLAN 20: Staff (e.g., for PC2, PC3) - Network: 192.168.11.0/24
c) VLAN 99: Management_Native - Network: 192.168.99.0/24 (Also Native VLAN on trunk to R1)
d) LAN_External (on SW2): Network: 192.168.20.0/24

Connections:

a) PC0 and PC1 (VLAN 10) are connected to SW1 (e.g., Fa0/2, Fa0/3).

b) PC2 and PC3 (VLAN 20) are connected to SW1 (e.g., Fa0/4, Fa0/5).
c) SW1 Fa0/1 (trunk port, native VLAN 99) is connected to R1's Gig0/0/0 nterface (configured for router-on-a-stick).
d) R1's Gig0/0/1 interface is connected to R2's Gig0/0/1 interface.
e) R2's Gig0/0/0 interface is connected to R3's Gig0/0/0 interface.
f) R3's Gig0/0/1 interface is connected to SW2's Fa0/1 interface.
g) PC4, PC5, and Server0 are connected to SW2 (on LAN_External).

Configure the devices with the following IPv4 addresses and subnet masks:

Device	Interface	IP Address	Subnet Mask	Default Gateway	Notes
R1	Gig0/0/0.10	192.168.10.1	255.255.255.0	N/A	Gateway for VLAN10 (Student)
R1	Gig0/0/0.20	192.168.11.1	255.255.255.0	N/A	Gateway for VLAN20 (Staff)
R1	Gig0/0/0.99	192.168.99.1	255.255.255.0	N/A	Gateway for VLAN99 (Management), Native VLAN
R1	Gig0/0/1	10.0.1.1	255.255.255.252	N/A	Link to R2
R2	Gig0/0/1	10.0.1.2	255.255.255.252	N/A	Link to R1
R2	Gig0/0/0	10.0.2.2	255.255.255.252	N/A	Link to R3
R3	Gig0/0/0	10.0.2.1	255.255.255.252	N/A	Link to R2
R3	Gig0/0/1	192.168.20.1	255.255.255.0	N/A	Gateway for LAN_External (on SW2)
SW1	VLAN 99 (SVI)	192.168.99.254	255.255.255.0	192.168.99.1	Management IP for SW1
SW2	VLAN 1 (SVI)	192.168.20.254	255.255.255.0	192.168.20.1	Management IP for SW2
PC0, PC1	NIC	DHCP Client	DHCP Client	DHCP Client	Belong to VLAN10 (Student)
PC2, PC3	NIC	DHCP Client	DHCP Client	DHCP Client	Belong to VLAN20 (Staff)
PC4, PC5	NIC	DHCP Client	DHCP Client	DHCP Client	Belong to LAN_External (on SW2)
Server0	NIC	192.168.20.10	255.255.255.0	192.168.20.1	DNS Server (Static IP on LAN_External)

2.1 Device Configuration:

1. **Basic Settings (All Routers and Switches)**:
    - Device hostnames shall be configured as follows: matrix_R1, matrix_R2, matrix_R3, matrix_SW1, matrix_SW2.
    - Access credentials for console and Virtual Teletype (VTY) lines are to be established. The password "cisco" is designated for these access modalities, with mandatory enforcement of login authentication.
    - All clear-text passwords resident within the device configurations must be subjected to encryption.
    - A Message of the Day (MOTD) banner, conveying appropriate information, shall be instituted.
2. **Switch Configuration**:
    - On device **SW1**:
        - VLAN 10 is to be created and assigned the appellation 'Student'.
        - VLAN 20 is to be created and assigned the appellation 'Staff'.
        - VLAN 99 is to be created and assigned the appellation 'Management_Native'.
        - Switchports designated for connectivity to PC0 and PC1 are to be assigned to VLAN 10 and configured in access mode.
        - Switchports designated for connectivity to PC2 and PC3 are to be assigned to VLAN 20 and configured in access mode.
        - The interface (Fa0/1) connecting to router R1 must be configured as an IEEE 802.1Q trunk port, permitting the transit of traffic for VLANs 10, 20, and 99. Furthermore, VLAN 99 is to be specified as the native VLAN for this trunk.
        - A Switched Virtual Interface (SVI) for VLAN 99 shall be established and assigned the IP address 192.168.99.254 with a /24 network mask; its default gateway for management traffic is to be set to 192.168.99.1.
    - On device **SW2**:
        - It must be ensured that end devices (PC4, PC5, Server0) are allocated to the default VLAN (typically VLAN 1) or an alternative designated access VLAN.
        - An SVI for VLAN 1 (or an alternatively chosen management VLAN specific to SW2) shall be established and assigned the IP address 192.168.20.254 with a /24 network mask; its default gateway for management traffic is to be set to 192.168.20.1.
        - As a measure of prudent network administration, any switchports not currently in active use may optionally be assigned to a designated unused VLAN, configured in access mode, and administratively deactivated.
3. **Router Interface Configuration**:
    - On device **R1**:

        - The physical interface Gig0/0/0 must be confirmed to have no IP address directly assigned and is to be administratively activated.
        - Subinterface Gig0/0/0.10, corresponding to VLAN 10, is to be created. This subinterface must be configured with IEEE 802.1Q encapsulation for VLAN 10 and assigned the IP address 192.168.10.1 with a /24 network mask.
        - Subinterface Gig0/0/0.20, corresponding to VLAN 20, is to be created. This subinterface must be configured with IEEE 802.1Q encapsulation for VLAN 20 and assigned the IP address 192.168.11.1 with a /24 network mask.
        - Subinterface Gig0/0/0.99, corresponding to VLAN 99, is to be created. This subinterface must be configured with IEEE 802.1Q encapsulation specifically for VLAN 99 and designated as the native VLAN (encapsulation dot1Q 99 native). It is to be assigned the IP address 192.168.99.1 with a /24 network mask.
        - Interface Gig0/0/1 is to be configured with the IP address 10.0.1.1 with a /30 network mask and administratively activated.
    - On device **R2**:
        - Interface Gig0/0/1 is to be configured with the IP address 10.0.1.2 with a /30 network mask and administratively activated.
        - Interface Gig0/0/0 is to be configured with the IP address 10.0.2.2 with a /30 network mask and administratively activated.
    - On device **R3**:
        - Interface Gig0/0/0 is to be configured with the IP address 10.0.2.1 with a /30 network mask and administratively activated.
        - Interface Gig0/0/1, serving as the gateway for LAN_External, is to be configured with the IP address 192.168.20.1 with a /24 network mask and administratively activated.
    - All configured interfaces, both physical and subinterfaces, should be assigned descriptive labels.
4. **Static Routing Configuration**:
    - On device **R1**:
        - A static route is to be established for the LAN_External network segment (192.168.20.0/24), specifying the next-hop IP address as that of R2's interface on the interconnecting link (10.0.1.2).
        - A static route is to be established for the R2-R3 inter-router link network (10.0.2.0/30), specifying the next-hop IP address as that of R2's interface on the interconnecting link (10.0.1.2).

- On device **R2**:
  - A static route is to be established for the VLAN10 Student network segment (192.168.10.0/24), specifying the next-hop IP address as that of R1's interface on the interconnecting link (10.0.1.1).
  - A static route is to be established for the VLAN20 Staff network segment (192.168.11.0/24), specifying the next-hop IP address as that of R1's interface on the interconnecting link (10.0.1.1).
  - A static route is to be established for the VLAN99 Management_Native network segment (192.168.99.0/24), specifying the next-hop IP address as that of R1's interface on the interconnecting link (10.0.1.1).
  - A static route is to be established for the LAN_External network segment (192.168.20.0/24), specifying the next-hop IP address as that of R3's interface on the interconnecting link (10.0.2.1).
- On device **R3**:
  - A static route is to be established for the VLAN10 Student network segment (192.168.10.0/24), specifying the next-hop IP address as that of R2's interface on the interconnecting link (10.0.2.2).
  - A static route is to be established for the VLAN20 Staff network segment (192.168.11.0/24), specifying the next-hop IP address as that of R2's interface on the interconnecting link (10.0.2.2).
  - A static route is to be established for the VLAN99 Management_Native network segment (192.168.99.0/24), specifying the next-hop IP address as that of R2's interface on the interconnecting link (10.0.2.2).
  - A static route is to be established for the R1-R2 inter-router link network (10.0.1.0/30), specifying the next-hop IP address as that of R2's interface on the interconnecting link (10.0.2.2).

5. **DHCP Server Configuration**:
   - On device **R1**:
     - For VLAN10 (Student):
       - A DHCP address pool, designated LAN_STUDENT_POOL, is to be created.
       - The network address and subnet mask for this pool are to be defined as 192.168.10.0/24.
       - The default router address for clients within this pool shall be set to R1's subinterface IP address for VLAN10 (192.168.10.1).
       - The DNS server address for clients shall be set to Server0's IP address (192.168.20.10).

        - It must be ensured that R1's subinterface IP address for VLAN10 (192.168.10.1) is explicitly excluded from the assignable address range of this pool.
    - For VLAN20 (Staff):
        - A DHCP address pool, designated LAN_STAFF_POOL, is to be created.
        - The network address and subnet mask for this pool are to be defined as 192.168.11.0/24.
        - The default router address for clients within this pool shall be set to R1's subinterface IP address for VLAN20 (192.168.11.1).
        - The DNS server address for clients shall be set to Server0's IP address (192.168.20.10).
        - It must be ensured that R1's subinterface IP address for VLAN20 (192.168.11.1) is explicitly excluded from the assignable address range of this pool.
    - (It is noted that no DHCP pool is to be configured for VLAN 99, the Management_Native VLAN, as IP addresses within management segments are conventionally assigned statically.)
- On device **R3** (for LAN_External):
    - A DHCP address pool, designated LAN_EXTERNAL_POOL, is to be created.
    - The network address and subnet mask for this pool are to be defined as 192.168.20.0/24.
    - The default router address for clients within this pool shall be set to R3's LAN interface IP address (192.168.20.1).
    - The DNS server address for clients shall be set to Server0's IP address (192.168.20.10).
    - It must be ensured that R3's LAN interface IP address (192.168.20.1), SW2's management SVI IP address (192.168.20.254), and Server0's static IP address (192.168.20.10) are explicitly excluded from the assignable address range of this pool.

6. **PC/Server Configuration (All end devices)**:
    - Client devices PC0, PC1, PC2, PC3, PC4, and PC5 are to be configured to obtain their IP addressing parameters automatically via DHCP.
    - Server0 is to be configured with static IP addressing parameters: IP address 192.168.20.10, Subnet Mask 255.255.255.0, Default Gateway 192.168.20.1. The DNS server setting for Server0 itself may utilize its own IP address (192.168.20.10) or the loopback address (127.0.0.1).
    - Verification is required to confirm that all DHCP client devices have correctly received their IP address, subnet mask, default gateway address, and the DNS server address (192.168.20.10).

7. **Connectivity Verification**:
    - From device **PC0** (resident in VLAN10):
        - Validate connectivity to its default gateway (R1: 192.168.10.1).
        - Validate connectivity to **PC2** (resident in VLAN20; IP address obtained via DHCP).
        - Validate connectivity to **PC4** (resident in LAN_External; IP address obtained via DHCP).
        - Validate connectivity to Server0 (192.168.20.10).
        - Validate connectivity to R1's Management IP address (192.168.99.1).
        - Validate connectivity to SW1's Management IP address (192.168.99.254).
    - From device **PC2** (resident in VLAN20):
        - Validate connectivity to its default gateway (R1: 192.168.11.1).
        - Validate connectivity to **PC0** (resident in VLAN10; IP address obtained via DHCP).
        - Validate connectivity to Server0 (192.168.20.10).
        - Validate connectivity to R1's Management IP address (192.168.99.1).
    - From device **PC4** (resident in LAN_External):
        - Validate connectivity to its default gateway (R3: 192.168.20.1).
        - Validate connectivity to SW2's management IP address (192.168.20.254).
        - Validate connectivity to **PC0** (resident in VLAN10; IP address obtained via DHCP).
        - Validate connectivity to **PC2** (resident in VLAN20; IP address obtained via DHCP).
        - Validate connectivity to Server0 (192.168.20.10).
        - Validate connectivity to R1's Management IP address (192.168.99.1).
    - Use show commands for diagnostic and verification purposes:
        - show ip interface brief (to be executed on all routers and on switches possessing configured SVIs).
        - show vlan brief (to be executed on SW1).
        - show interfaces trunk (to be executed on SW1, with particular attention to interface Fa0/1 to confirm native VLAN status).
        - show ip route (to be executed on all routers).
        - show ip dhcp binding (to be executed on R1 and R3).
        - show ip dhcp pool [pool_name] (to be executed on R1 and R3).

8. **Save Configurations**:
    - The running configuration on all routers and switches must be committed to the startup configuration to ensure persistence across device reinitialization.
    - The command to effect this is copy running-config startup-config.

2.2 Submission Instructions:

The underlisted files and corroborative documentation are required for submission:

1. matrix_number_task4_final.pkt – The Packet Tracer simulation file.
2. matrix_number_R1.txt – The running configuration output from R1 (show running-config).
3. matrix_number_R2.txt – The running configuration output from R2 (show running-config).
4. matrix_number_R3.txt – The running configuration output from R3 (show running-config).
5. matrix_number_SW1.txt – The running configuration output from SW1 (show running-config).
6. matrix_number_SW2.txt – The running configuration output from SW2 (show running-config).
7. Matrix_number_screenshots.docx.
   Screenshots providing evidentiary support for the following (All images in one document file):
    - Successful acquisition by PC0 (VLAN10) of DHCP-assigned IP parameters, inclusive of Server0's IP as the designated DNS server, from R1.
    - Successful acquisition by PC2 (VLAN20) of DHCP-assigned IP parameters, inclusive of Server0's IP as the designated DNS server, from R1.
    - Successful acquisition by PC4 (LAN_External) of DHCP-assigned IP parameters, inclusive of Server0's IP as the designated DNS server, from R3.
    - The static IP configuration parameters assigned to Server0.
    - Successful ICMP echo request (ping) from PC0 (VLAN10) to PC2 (VLAN20).
    - Successful ICMP echo request (ping) from PC0 (VLAN10) to PC4 (LAN_External).
    - Successful ICMP echo request (ping) from PC0 (VLAN10) to Server0 (192.168.20.10).
    - Successful ICMP echo request (ping) from PC0 (VLAN10) to R1's Management IP (192.168.99.1).
    - Successful ICMP echo request (ping) from PC0 (VLAN10) to SW1's Management IP (192.168.99.254).

- Successful ICMP echo request (ping) from PC4 (LAN_External) to SW2's management IP.
- The output of the show ip route command on routers R1, R2, and R3, confirming the presence of routes to the 192.168.99.0/24 network.
- The output of the show ip dhcp binding command on R1 (demonstrating leases for both Student and Staff VLANs) and R3.
- The output of the show ip dhcp pool command on R1 and R3, displaying the configured DNS server.
- The output of the show vlan brief and show interfaces trunk commands on SW1, confirming the status of VLANs and the native VLAN 99 configuration.
- The output of the show ip interface brief command on R1 (displaying subinterface .99 status), SW1, and SW2 (displaying SVI status).

Ver 1.0