COURSE TRAINING CENTER – NETWORK DESIGN DOCUMENT

1. INTRODUCTION

This document describes the complete Layer 2 and Layer 3 design of the Course Training Center network as implemented in Cisco Packet Tracer.

2. HIGH-LEVEL NETWORK TOPOLOGY

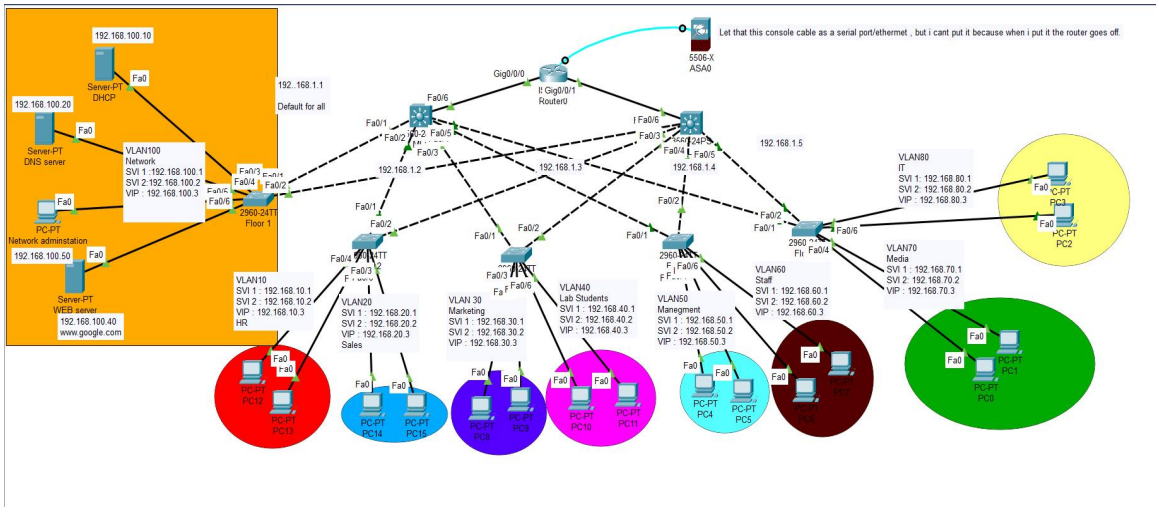
The topology is divided into:

• Campus LAN with departmental VLANs

• Server Farm

• Firewall representing Fortigate firewall filtering traffic from inside to outside and vice versa.

Logical topology :



3. Key Components

- **Router (R0):**
    - Routes upstream traffic toward ASA firewall.
    - Maintains gateway toward external networks.
    - Does *not* perform inter-VLAN routing inside the campus.
- **Primary Multi-Layer Switch (MLS-A – Left switch):**
    - Active SVI gateway for all VLANs (SVI state = up/up).
    - Provides inter-VLAN routing for internal LAN.
    - Connects to Server Farm and internal Access Layer switches.
- **Secondary Multi-Layer Switch (MLS-B – Right switch):**
    - Passive redundancy (STP alternate).
    - SVI interfaces exist but remain passive / shut down (standby).
    - Maintains Layer 2 failover and path redundancy.
- **Access Switches:**
    - Connect end-user devices.
    - VLANs assigned per department.
- **Server Farm:**
    - DHCP Server
    - DNS Server
    - Web Server
    - Admin PC
    - All servers configured with static IP addresses.
- **ASA 5506-X (Placeholder for FortiGate):**
    - Represents external perimeter firewall.
    - Interfaces with Router R0.
    - Used instead of “cloud” object for realism.

4. VLAN & IP ADDRESSING PLAN

VLAN	Department	Subnet	SVI (Active – MLS-A)	SVI (Passive – MLS-B)	VIP (HSRP Fallback, if needed)
10	HR	192.168.10.0/24	192.168.10.1	192.168.10.2	192.168.10.3
20	Sales	192.168.20.0/24	192.168.20.1	192.168.20.2	192.168.20.3
30	Marketing	192.168.30.0/24	192.168.30.1	192.168.30.2	192.168.30.3
40	Labs students	192.168.40.0/24	192.168.40.1	192.168.40.2	192.168.40.3
50	Management	192.168.50.0/24	192.168.50.1	192.168.50.2	192.168.50.3
60	Staff	192.168.60.0/24	192.168.60.1	192.168.60.2	192.168.60.3
70	Media	192.168.70.0/24	192.168.70.1	192.168.70.2	192.168.70.3
80	IT	192.168.80.0/24	192.168.80.1	192.168.80.2	192.168.80.3

5. SERVER FARM (VLAN 100)

Device	Function	IP Address
DHCP Server	DHCP services for all VLANs	192.168.100.10
DNS Server	Internal DNS	192.168.100.20
Admin PC	Network admin host	192.168.100.50
Web Server	Internal training website	192.168.100.40
SVI1 – MLS-A	VLAN 100 gateway	192.168.100.1
SVI2 – MLS-B	Backup gateway	192.168.100.2
VIP (optional)	Gateway floating IP	192.168.100.3

6. Layer 3 Routing Design

6.1 Inter-VLAN Routing (Internal)

- All inter-VLAN routing is handled by **MLS-A** (Primary).
- ip routing enabled on MLS-A.
- MLS-B has SVI definitions but acts as *standby/passive*.

6.2 Upstream Routing

- MLS-A forwards all non-LAN traffic toward Router R0.
- R0 routes traffic to ASA 5506-X.
- ASA represents the external network boundary.

6.3 Default Gateway Flow

End Devices → Active SVI (MLS-A) → Router R0 → Firewall → Outside

7. LAYER 2 DESIGN & REDUNDANCY

Spanning Tree

- MLS-A is configured as **Root Bridge** for all VLANs.
- MLS-B is secondary root.
- Access switches forward toward MLS-A as primary path.

8. DHCP & DNS SERVICES

DHCP

- DHCP server resides in Server Farm VLAN 100.
- All scopes defined per VLAN.
- MLS-A performs DHCP relay using IP helper: ip helper-address 192.168.100.10

DNS

- DNS server resolves internal hostnames.
- External DNS (Google or ISP) simulated upstream.

9. Security & Firewall Integration

- ASA 5506-X is used as an external firewall placeholder for FortiGate.
- Basic functions:
    - Outside interface toward “Internet”
    - Inside interface toward Router R0
- Serial console cable is just representative of an ethernet connection

10. ACCESS LAYER DESIGN

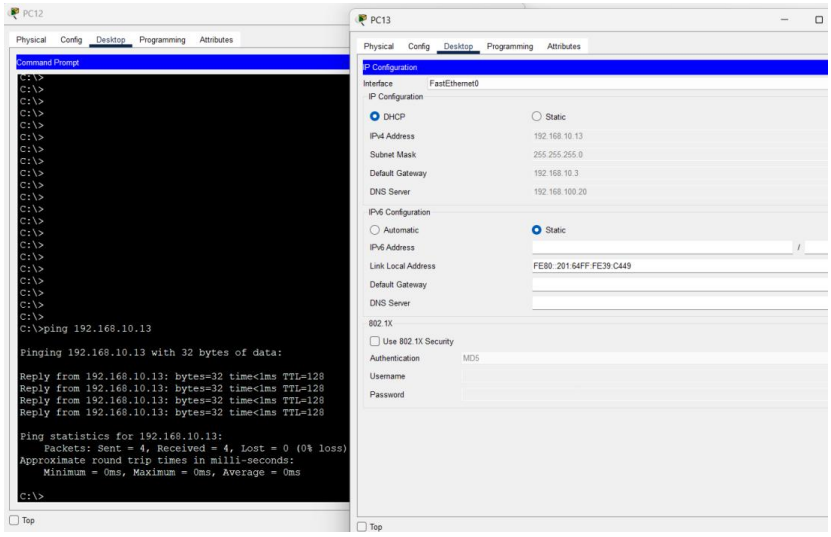
Each switch corresponds to a department VLAN.

Department	Access Switch	VLAN
HR	SW-Floor2	VLAN 10
Sales	SW-Floor2	VLAN 20
Marketing	SW-Floor3	VLAN 30
Lab Students	SW-Floor3	VLAN 40
Management	SW-Floor4	VLAN 50
Staff	SW-Floor4	VLAN 60
Media	SW-Floor5	VLAN 70
IT	SW-Floor5	VLAN 80
Network (Server Farm)	SW-Floor1	VLAN 100

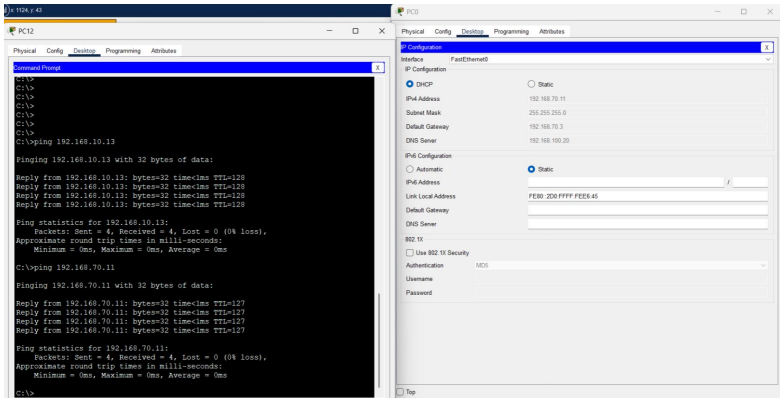
11. CONNECTIVITY & TESTING PLAN

Test	Result
1-PC within same VLAN ping	Successful
2-PC between different VLANs ping	Successful (inter-VLAN routing)
3-PC → Server Farm	Successful
4-DHCP addressing	Correct scopes per VLAN

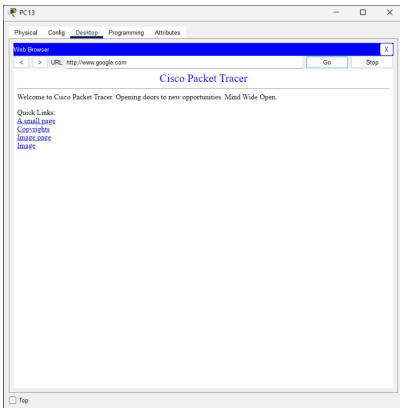
1-PC within same VLAN ping



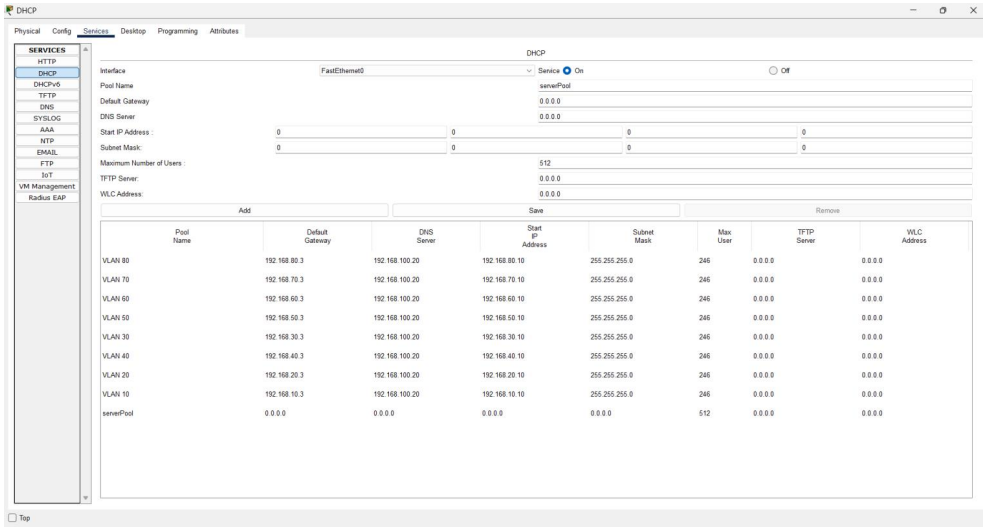
2- PC between different VLANs ping



3- PC → Server Farm (PC can access google.com through DNS server in server farm)



4- DHCP addressing



Conclusion:

This network design provides a structured, scalable, and resilient infrastructure suitable for a training center environment, ensuring reliable inter-VLAN communication, centralized services, and controlled external connectivity.

Limitations:

Due to limited resources a topology of this scale couldn’t be inside a GNS3 topology due to intensive resource consumption , so we put it into cisco packet tracer , this also causes us to replace the fortigate firewall with a firewall placeholder which makes our topology have no fortigate firewall features.