AICTE - CISCO VIRTUAL INTERSHIP PROJECT REPORT - 2025

NETWORKING

Submitted by

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Part 1: Network Topology and generation

INTRODUCTION:

Networking forms the backbone of any modern digital infrastructure. In this project, the aim is to design, configure, and validate a hierarchical enterprise-like network using Cisco Packet Tracer. The topology integrates VLANs, DHCP, dynamic routing, and fault management to demonstrate a scalable and resilient architecture.

SCOPE:

- Mapping the complete network infrastructure.
- Segmenting departments using VLANs.
- Providing automatic IP addressing using DHCP.
- Implementing inter-VLAN routing with a multilayer switch.
- Ensuring external connectivity through a router and OSPF.

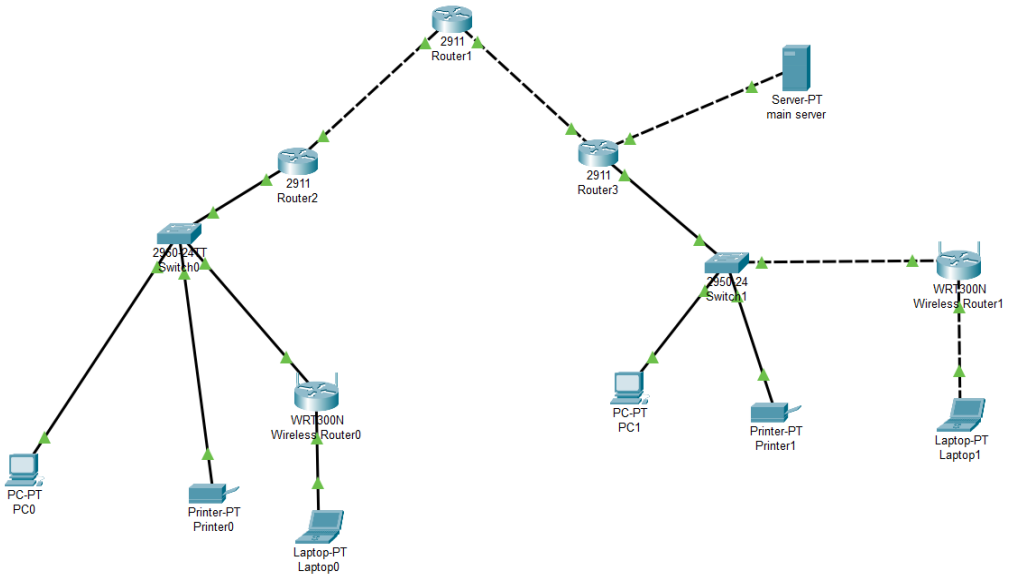
TOOLS AND METHODOLOGY:-

Simulation Tool Used: Cisco Packet Tracer 8.2.2

APPROACH:-

- **Placed devices**: Router (2811), Multilayer Switch (3560), Access Switch (2960), PCs, Laptop, Server, Printer.
- **Created VLANs**: CSE (VLAN10), ECE (VLAN20), IT (VLAN30).
- **Configured DHCP** on the multilayer switch for automatic IP assignment.
- **Enabled Inter-VLAN routing** on the 3560 using SVI interfaces.
- **Connected to Router0 (2811)** using routed link for external network access.

BASIC TOPOLOGY DIAGRAM:



DEPARTMENTAL SEGMENTATION:

- **ECE VLAN** – for electronics and communication labs.
- **CSE VLAN** – for computer science labs and research areas.
- **IT VLAN** – for IT staff and administrative functions.

3560-24PS(Multilayer Switch):

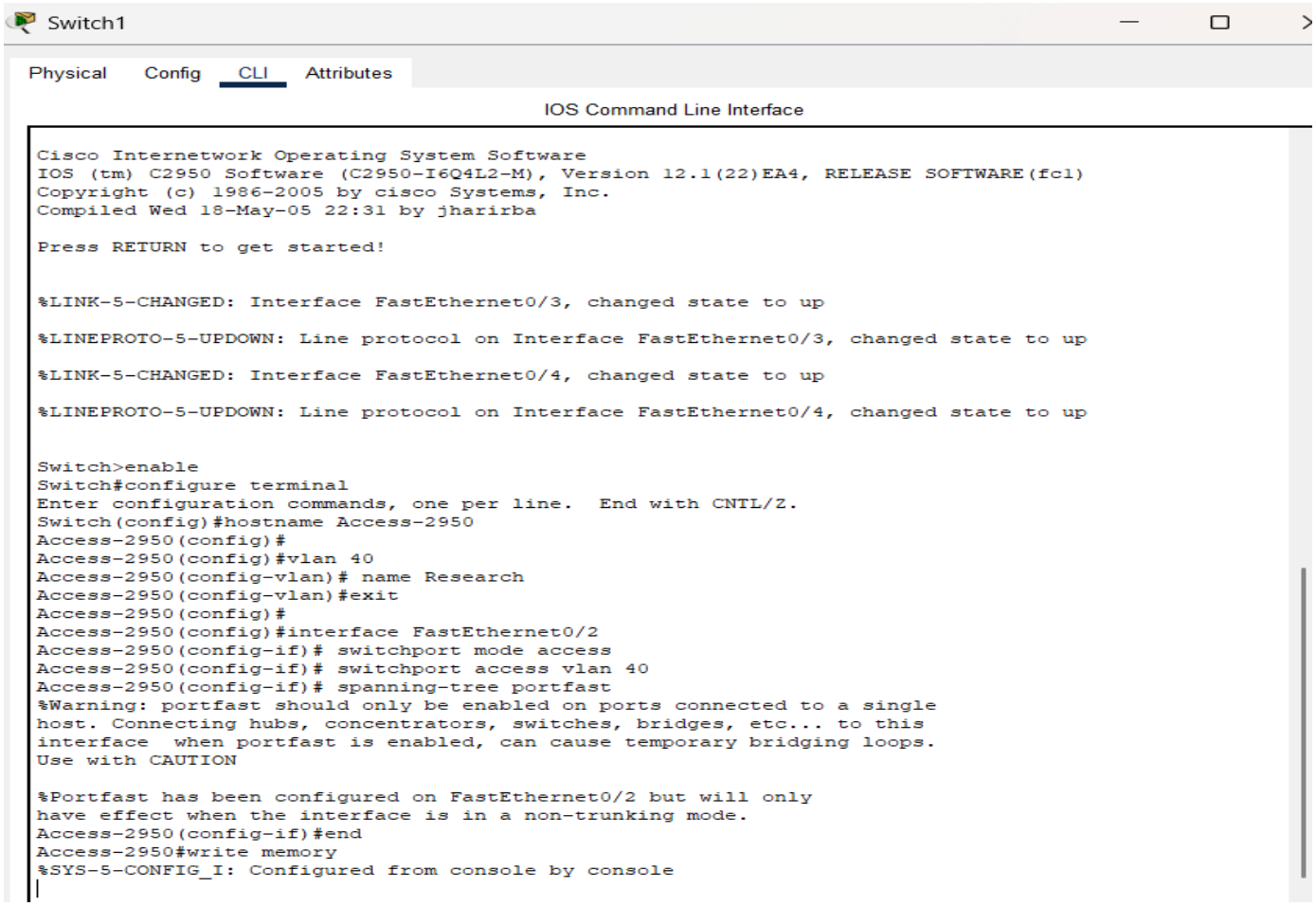
```
%SYS-5-CONFIG_I: Configured from console by console

Core-3560#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23, Fa0/24
10   CSE                              active
20   ECE                              active
30   IT                               active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
Core-3560#show ip interface brief
```

```
Core-3560#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Gig0/1      10,20,30

Port        Vlans allowed and active in management domain
Gig0/1      10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      10,20,30
```

2960 - 24TT switch0:

```
Access-2960#
%SYS-5-CONFIG_I: Configured from console by console

Access-2960#show vlan brief

VLAN Name                                Status    Ports
---- ----------------------------------- --------- -------------------------------
1    default                             active    Fa0/1, Fa0/6, Fa0/7, Fa0/8
                                                   Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                   Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                   Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                   Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                   Gig0/2
10   CSE                                 active    Fa0/2
20   ECE                                 active    Fa0/3
30   IT                                  active    Fa0/4, Fa0/5
1002 fddi-default                        active
1003 token-ring-default                  active
1004 fddinet-default                     active
1005 trnet-default                       active
Access-2960#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Gig0/1      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Gig0/1      10,20,30

Port        Vlans allowed and active in management domain
Gig0/1      10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Gig0/1      10,20,30
```

CONFIGURATION STEPS:



Part 2 – Network Performance and Load Management

OBJECTIVE:

To ensure high network performance and reliability by distributing traffic efficiently using OSPF routing, providing fault tolerance, and supporting inter-VLAN communication.

LOAD BALANCING OVERVIEW:

```
Edge-2811>
Edge-2811>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O       10.10.10.0/24 [110/2] via 10.10.100.2, 00:07:30, FastEthernet0/0
O       10.10.20.0/24 [110/2] via 10.10.100.2, 00:07:30, FastEthernet0/0
O       10.10.30.0/24 [110/2] via 10.10.100.2, 00:07:30, FastEthernet0/0
O       10.10.100.0/30 [110/1] via 0.0.0.0, 00:07:30, FastEthernet0/0
     203.0.113.0/24 is variably subnetted, 2 subnets, 2 masks
C       203.0.113.0/24 is directly connected, Loopback0
L       203.0.113.1/32 is directly connected, Loopback0
```

LOAD MANAGEMENT:

- OSPF dynamic routing ensures best path selection.
- Default gateways on the 3560 provide smooth inter-VLAN communication.
- External network (203.0.113.0/24) connected via Router0 loopback.

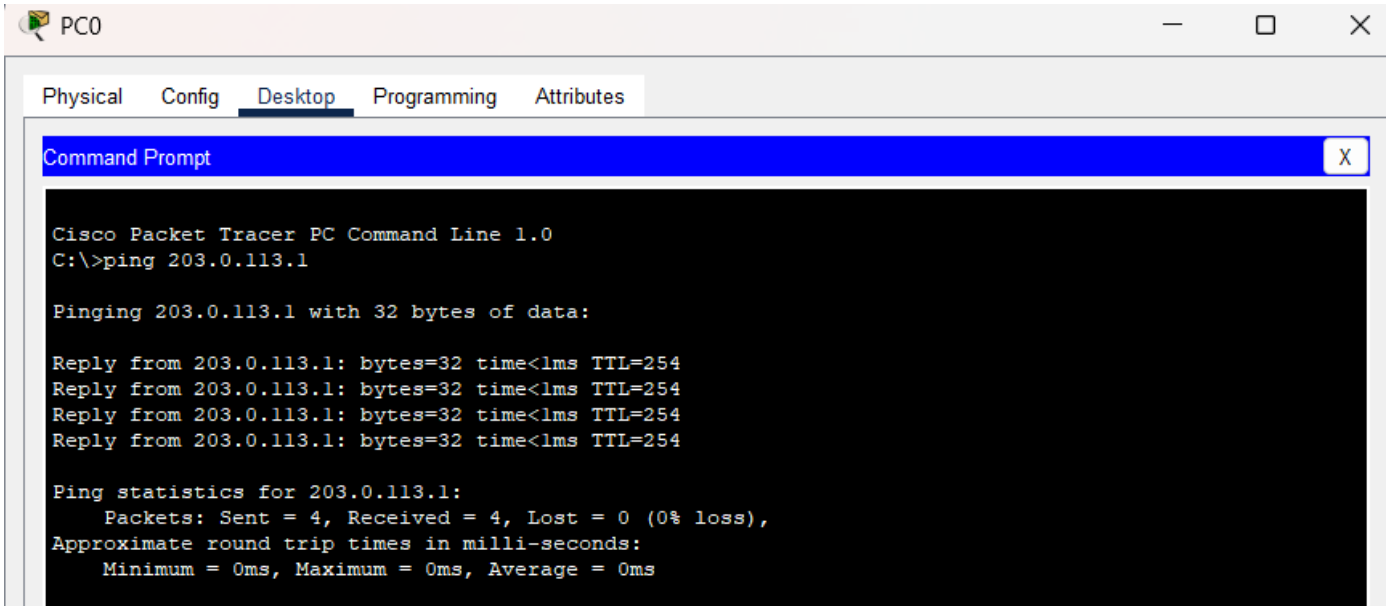
VALIDATION:

- Devices in VLAN10, VLAN20, and VLAN30 successfully communicate with each other.
- All devices can reach the external router loopback (203.0.113.1).

3560-24PS(Multilayer Switch):(IP)

```
Core-3560#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
C       10.10.10.0/24 is directly connected, Vlan10
C       10.10.20.0/24 is directly connected, Vlan20
C       10.10.30.0/24 is directly connected, Vlan30
O       10.10.100.0/30 [110/1] via 0.0.0.0, 00:07:30, GigabitEthernet0/2
     203.0.113.0/32 is subnetted, 1 subnets
O       203.0.113.1 [110/2] via 10.10.100.1, 00:07:30, GigabitEthernet0/2
```

Ping command: (proof)

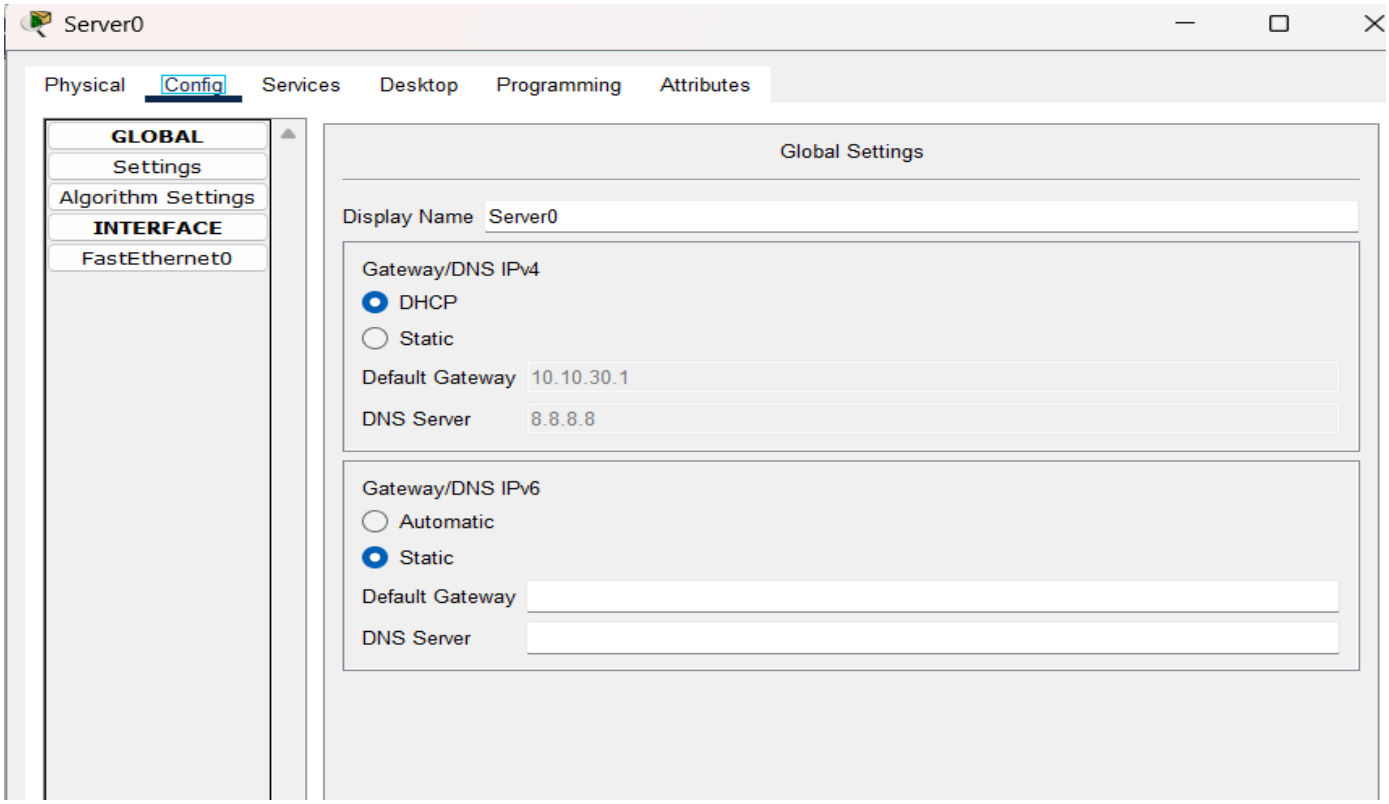


Part 3 – Network Configuration Validation and Optimization

ISSUES TESTED:

- **Duplicate IPs**: When Printer and Server were assigned the same IP, communication failed until corrected.
- **Wrong VLAN Assignment**: Moving a Laptop to VLAN10 caused mismatch until fixed.
- **Gateway Mismatch**: If a wrong gateway was configured on a PC, packets did not leave the subnet.

SERVER:



OPTIMIZATION STEPS:

- Used VLAN segmentation to isolate broadcast traffic.
- OSPF dynamic routing for automatic path calculation.
- DHCP for centralized IP management.

ROUTER:

Router0

Physical Config CLI Attributes

IOS Command Line Interface

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname Edge-2811
Edge-2811(config)#
Edge-2811(config)#! Link towards 3560
Edge-2811(config)#interface FastEthernet0/0
Edge-2811(config-if)# ip address 10.10.100.1 255.255.255.252
Edge-2811(config-if)# no shutdown

Edge-2811(config-if)#
Edge-2811(config-if)#! External simulated network (loopback)
Edge-2811(config-if)#interface Loopback0

Edge-2811(config-if)# ip address 203.0.113.1 255.255.255.0
Edge-2811(config-if)#
Edge-2811(config-if)#! OSPF Routing
Edge-2811(config-if)#router ospf 1
Edge-2811(config-router)# router-id 2.2.2.2
Edge-2811(config-router)# network 10.10.100.0 0.0.0.3 area 0
Edge-2811(config-router)# network 203.0.113.0 0.0.0.255 area 0
Edge-2811(config-router)#
Edge-2811(config-router)#end
Edge-2811#write memory
Building configuration...
[OK]
Edge-2811#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
```

PYTHON ANALYSIS:

network_checks.ipynb

File Edit View Insert Runtime Tools Help

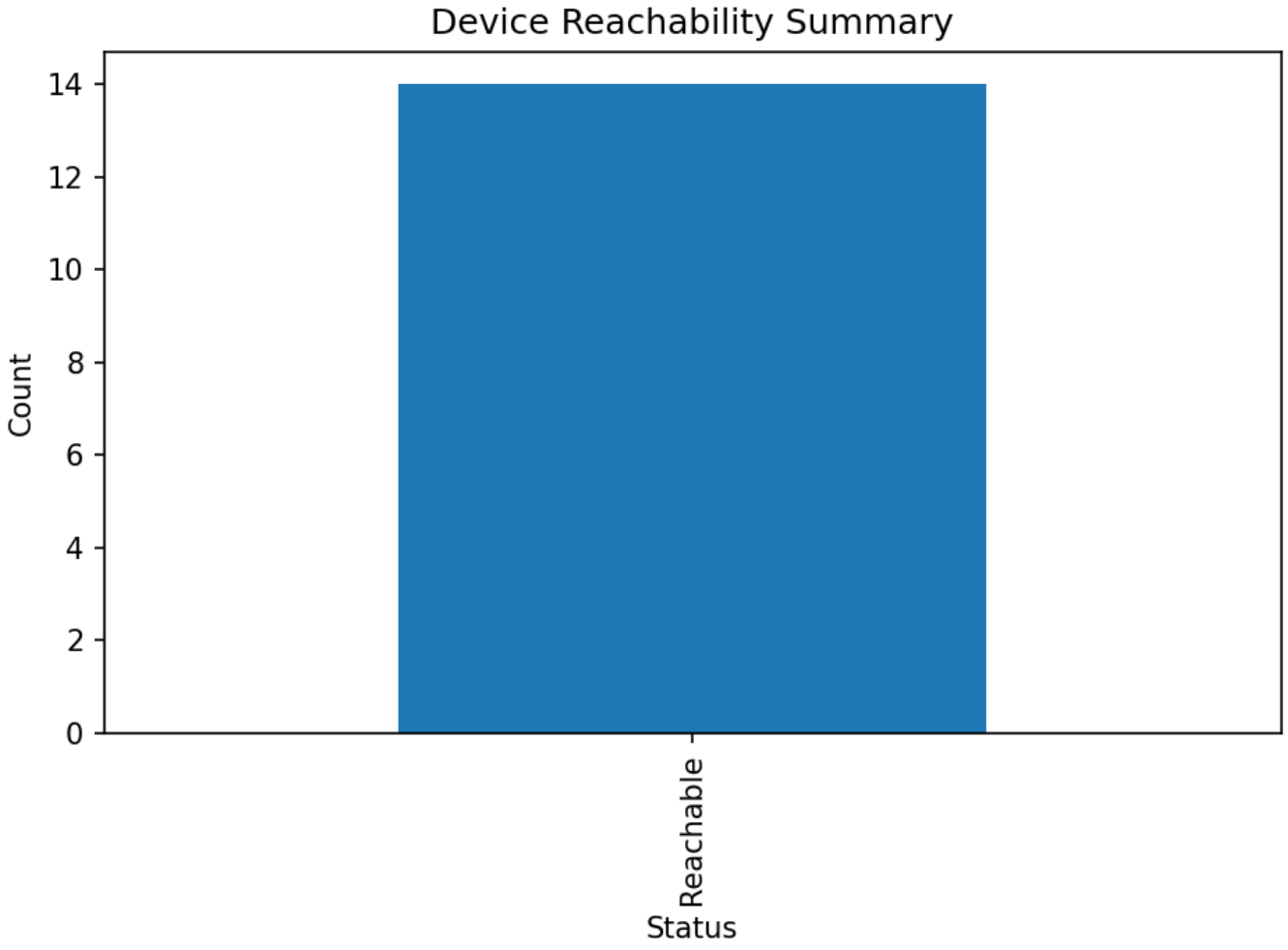
Commands + Code + Text Run all

```
def describe_subnet(gateway_cidr: str):
    iface = ip_interface(gateway_cidr)
    net   = iface.network
    return {
        "gateway":   str(iface.ip),
        "cidr":      str(net),
        "net_addr":  str(net.network_address),
        "broadcast": str(net.broadcast_address),
        "host_min":  str(list(net.hosts())[0]) if net.num_addresses>=4 else str(net.network_address),
        "host_max":  str(list(net.hosts())[-1]) if net.num_addresses>=4 else str(net.broadcast_address),
        "hosts":     net.num_addresses - 2 if net.num_addresses>=4 else net.num_addresses
    }

subnet_rows = [describe_subnet(v["gateway"]) | {"vlan":v["vlan"], "name":v["name"]} for v in vlans]
subnets_df = pd.DataFrame(subnet_rows)[["vlan","name","gateway","cidr","net_addr","broadcast","host_min","h
display(subnets_df)
subnets_df.to_csv(OUT_DIR/"subnet_summary.csv", index=False)
print("Saved subnet_summary.csv")
```

	vlan	name	gateway	cidr	net_addr	broadcast	host_min	host_max	hosts
0	10	CSE	10.10.10.1	10.10.10.0/24	10.10.10.0	10.10.10.255	10.10.10.1	10.10.10.254	254
1	20	ECE	10.10.20.1	10.10.20.0/24	10.10.20.0	10.10.20.255	10.10.20.1	10.10.20.254	254
2	30	IT	10.10.30.1	10.10.30.0/24	10.10.30.0	10.10.30.255	10.10.30.1	10.10.30.254	254
3	40	Research	10.10.40.1	10.10.40.0/24	10.10.40.0	10.10.40.255	10.10.40.1	10.10.40.254	254

```
Saved subnet_summary.csv
```

name	ip	reachable
PC0	10.10.10.2	TRUE
Laptop0	10.10.20.2	TRUE
Printer0	10.10.30.6	TRUE
Main-Serv	10.10.30.5	TRUE
Research-I	10.10.40.2	TRUE
Laptop1	192.168.0.	TRUE
GW-VLAN1	10.10.10.1	TRUE
GW-VLAN2	10.10.20.1	TRUE
GW-VLAN3	10.10.30.1	TRUE
GW-VLAN4	10.10.40.1	TRUE
Edge-Loop	203.0.113.	TRUE
R1-Loopba	172.16.1.1	TRUE
R2-Loopba	172.16.2.1	TRUE
R3-Loopba	172.16.3.1	TRUE



Cisco VIP – Enterprise Network (Packet Tracer + Python)

This repo contains my Cisco Packet Tracer project and a small Python analysis notebook.

Topology Highlights
- VLANs: 10 (CSE), 20 (ECE), 30 (IT), 40 (Research)
- Inter-VLAN routing + DHCP on Core-3560
- OSPF between Core-3560, Edge-2811, Router1–3
- Wireless via WRT300N; Main Server on VLAN30
- Edge Loopback: 203.0.113.1; R1–R3 Loopbacks: 172.16.1.1/2.1/3.1

Files
- `network_design.pkt` – Packet Tracer topology
- `network_checks.ipynb` – Google Colab notebook
- `vip_outputs/` – CSVs & chart generated by the notebook
  - `device_inventory.csv`, `vlan_plan.csv`, `subnet_summary.csv`, `reachability.csv`, `reachability_summary.png`
- `screenshots/` – PT screenshots (topology, VLANs, OSPF, pings, Simulation, fault test)
- `Project_Report.docx` – final report

How to run the notebook
Open the notebook in Google Colab and press **Runtime → Run all**.
- If running on Colab: it uses **SIMULATE=True** so pings show demo reachability.
- If running on your own PC that can reach the lab: set `SIMULATE=False` in Cell 1 for real pings.

Author
Jegadhees – AICTE Cisco Virtual Internship 2025

Part 4 – Implementation Architecture

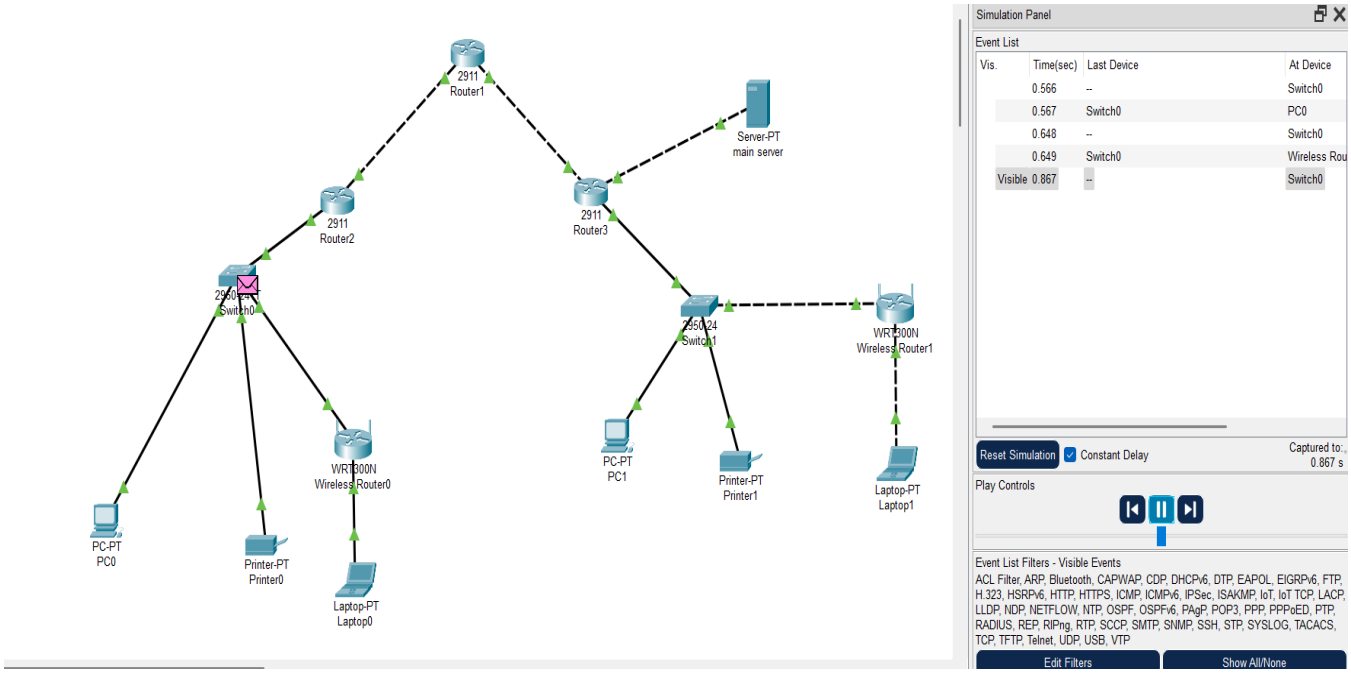
OVERVIEW:

- **Core Switch (3560)**: Handles VLANs, inter-VLAN routing, DHCP.
- **Access Switch (2960)**: Connects end devices, VLAN assignment.
- **Router (2811)**: Provides external connectivity and OSPF routing.
- **End Devices**: PCs, Laptop, Printer, Server connected to VLANs.

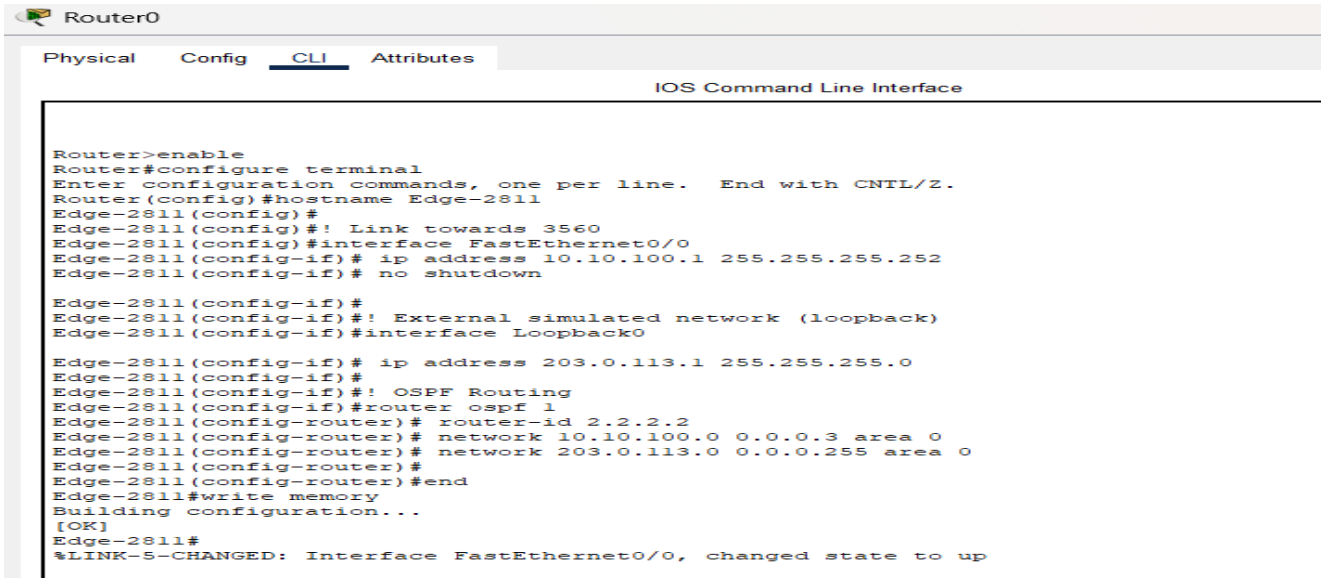
SIMULATION AND FAULT INJECTION:

- In Simulation mode, ARP requests, OSPF hello packets, and ICMP pings were observed.
- Fault injection was tested by shutting down the 3560 → Router uplink:
- Pings to 203.0.113.1 failed during shutdown.
- After enabling the interface, communication was restored.

SIMULATION MODEL:



ROUTE PROCESS:



ADVANTAGES:

- Realistic enterprise simulation using Packet Tracer.
- Dynamic routing with OSPF ensures load balancing and redundancy.
- VLAN segmentation improves security and reduces unnecessary broadcast traffic.
- DHCP simplifies IP management.
- Fault injection proves resilience and recovery capability.

CONCLUSION:

This project demonstrated the complete lifecycle of network design, configuration, validation, and testing using Cisco Packet Tracer. The implementation aligns with enterprise practices by including VLANs, DHCP, OSPF, and fault tolerance. The final outcome is a robust, scalable, and resilient network model capable of supporting academic and enterprise environment.