EAST WEST UNIVERSITY
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Department of Computer Science & Engineering

Computer Networks - Mini Project Report

Course Title : Computer Networks

Course Code : CSE405

Section : 03

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Submitted To:

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1. Introduction

Apex University, like East West University, operates a multi-campus environment with a wide range of academic and administrative facilities. Its network infrastructure must support thousands of users across different campuses with reliable wired and wireless connectivity, centralized services, and scalability for future growth.

This project focuses on designing a complete network model using **Cisco Packet Tracer**, integrating **routing, DHCP, DNS, and web services** to achieve seamless connectivity across eight campuses.

2. Purpose of the Network

The primary goals of the network are:

A. Provide **wired and wireless access** in each campus.

B. Ensure centralized **DHCP service** for IP allocation.

C. Deploy a **single DNS server** for name resolution.

D. Host a **web server** accessible via http://www.apex.edu.bd.

E. Implement efficient **routing (OSPF)** for inter-campus connectivity.

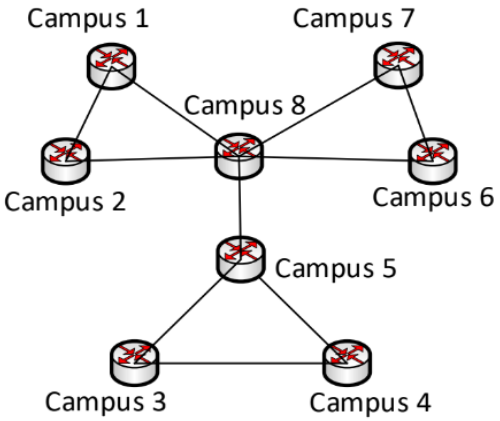
F. Support future expansion of subnets and services.

3. Physical Topology

The university network consists of **eight campuses** connected through routers in the topology shown below.

#Campus 1, 2, 3, 4, 6, 7 → Have LANs (wired + wireless).

#Campus 5, 8 → Serve as backbone/connection hubs; Campus 8 also hosts the servers.



Est. Router Connections Table (Topology)

Router	Ports	Connected To
R1 (Campus 1)	fa0/0, fa0/1, se2/0, se3/0	***Campus 8*** (se2/0), ***Campus 2*** (se3/0)
R2 (Campus 2)	fa0/0, fa0/1, se2/0, se3/0	***Campus 8*** (se2/0), ***Campus 1*** (se3/0)
R3 (Campus 3)	fa0/0, fa0/1, se2/0, se3/0	***Campus 5*** (se2/0), **Campus 4** (se3/0)
R4 (Campus 4)	fa0/0, fa0/1, se2/0, se3/0	**Campus 5** (se2/0), **Campus 3** (se3/0)
R5 (Campus 5)	fa0/0, fa0/1, se0/0/0, se0/0/1, se0/1/0	***Campus 8*** (se0/0/0), **Campus 3** (se0/0/1), **Campus 4** (se0/1/0)
R6 (Campus 6)	fa0/0, fa0/1, se2/0, se3/0	***Campus 8*** (se2/0), ***Campus 7*** (se3/0)

R7 (Campus 7)	fa0/0, fa0/1, se2/0, se3/0	***Campus 8*** (se2/0), ***Campus 6*** (se3/0)
R8 (Campus 8)	fa0/0, fa0/1, se0/0/0, se0/0/1, se0/1/0, se0/1/1, se0/2/0	***Campus 1*** (se0/0/0), ***Campus 2*** (se0/0/1), ***Campus 7*** (se0/1/0), ***Campus 6*** (se0/1/1), ***Campus 5*** (se0/2/0)

4. IP Addressing Scheme

We use a **Class B private network (172.16.0.0/16)**. Each campus receives a dedicated /24 subnets for easy management. Router-to-router serial links use /30 subnets.

4.1 LAN Subnets

Campus	Subnet	Gateway (Router Fa0/0)	Notes
Campus 1	172.16.1.0/24	172.16.1.1	Wired & wireless PCs
Campus 2	172.16.2.0/24	172.16.2.1	Wired & wireless PCs
Campus 3	172.16.3.0/24	172.16.3.1	Wired & wireless PCs
Campus 4	172.16.4.0/24	172.16.4.1	Wired & wireless PCs
Campus 5	172.16.5.0/24	172.16.5.1	Wired & wireless PCs
Campus 6	172.16.6.0/24	172.16.6.1	Wired & wireless PCs
Campus 7	172.16.7.0/24	172.16.7.1	Wired & wireless PCs
Campus 8	172.16.8.0/24	172.16.8.1	DHCP, DNS, Web, others

4.2 Server IPs

Campus 8 (Server LAN)

Server	IP Address	Purpose
DHCP Server	172.16.8.20	Assigns IP to all campuses
DNS Server	172.16.8.10	Resolves `www.apex.edu.bd`
Web Server	172.16.8.15	University website
Additional Servers (optional)	172.16.8.30+	Admissions, library, accounts, etc.

4.3 Router Interconnections

4.3.1 Serial Point-to-Point Links

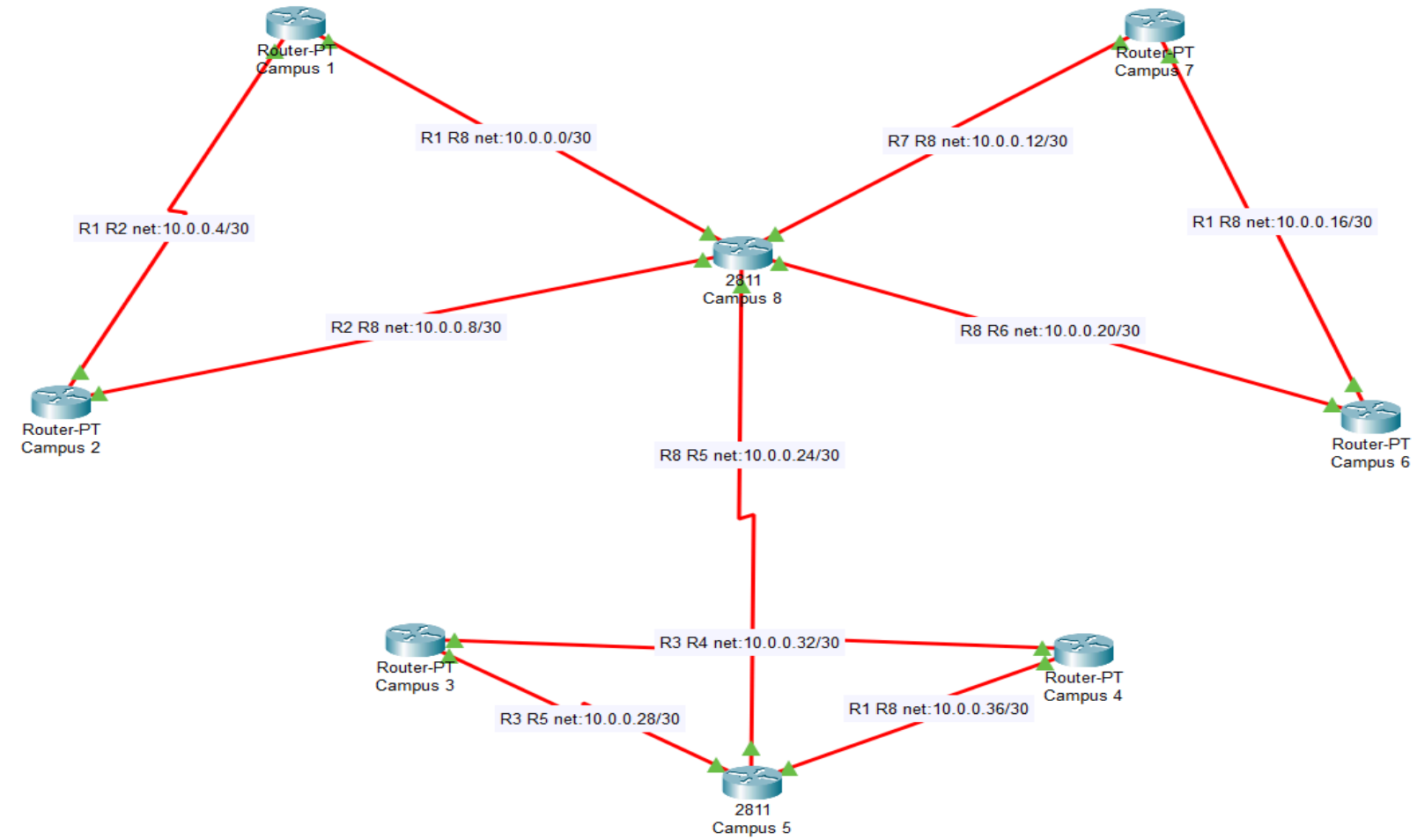
Link	Subnet (/30)	Router A (IP)	Router B (IP)
R1 ↔ R8	***10.0.0.0/30***	R1-Se2/0: 10.0.0.1	R8-Se0/0/0: 10.0.0.2
R1 ↔ R2	***10.0.0.4/30***	R1-Se3/0: 10.0.0.5	R2-Se2/0: 10.0.0.6
R2 ↔ R8	***10.0.0.8/30***	R2-Se3/0: 10.0.0.9	R8-Se0/0/1: 10.0.0.10
R8 ↔ R7	***10.0.0.12/30***	R8-Se0/1/0: 10.0.0.13	R7-Se2/0: 10.0.0.14
R7 ↔ R6	***10.0.0.16/30***	R7-Se3/0: 10.0.0.17	R6-Se2/0: 10.0.0.18
R6 ↔ R8	***10.0.0.20/30***	R6-Se3/0: 10.0.0.21	R8-Se0/1/1: 10.0.0.22
R5 ↔ R8	***10.0.0.24/30***	R5-Se0/0/0: 10.0.0.25	R8-Se0/2/0: 10.0.0.26
R5 ↔ R3	***10.0.0.28/30***	R5-Se0/0/1: 10.0.0.29	R3-Se2/0: 10.0.0.30
R3 ↔ R4	***10.0.0.32/30***	R3-Se3/0: 10.0.0.33	R4-Se2/0: 10.0.0.34
R4 ↔ R5	***10.0.0.36/30***	R4-Se3/0: 10.0.0.37	R5-Se0/1/0: 10.0.0.38

4.4 Routing Protocol

We use **OSPF (area 0)** for scalability and dynamic route updates. All routers advertise their LAN's and serial networks into OSPF. Since the network has **8 routers across multiple campuses**, OSPF (Open Shortest Path First) is chosen because:

1. It is a **dynamic routing protocol** (no need to manually update routes).
2. Works well with **large, hierarchical networks**.
3. Supports **VLSM (Variable Length Subnet Masking)**.
4. Converges faster than RIP.

Router Orientation



5. Router Configurations

All routers are Cisco IOS based. The network uses **OSPF (area 0)** for routing and a **central DHCP server at Campus 8**.

Campus 1 Router

```
enable
configure terminal
hostname R1
!
interface FastEthernet0/0
 ip address 172.16.1.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial2/0
 ip address 10.0.0.1 255.255.255.252
 clock rate 64000
 no shutdown
!
interface Serial3/0
 ip address 10.0.0.5 255.255.255.252
 no shutdown
!
router ospf 1
 network 172.16.1.0 0.0.0.255 area 0
 network 10.0.0.0 0.0.0.3 area 0
 network 10.0.0.4 0.0.0.3 area 0
!
end
write memory
```

Campus 2 Router

```
enable
configure terminal
hostname R2
!
interface FastEthernet0/0
 ip address 172.16.2.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial2/0
 ip address 10.0.0.6 255.255.255.252
 no shutdown
!
interface Serial3/0
 ip address 10.0.0.9 255.255.255.252
 no shutdown
!
router ospf 1
 network 172.16.2.0 0.0.0.255 area 0
 network 10.0.0.4 0.0.0.3 area 0
 network 10.0.0.8 0.0.0.3 area 0
!
end
write memory
```

Campus 3 Router

```
enable
configure terminal
hostname R3
!
interface FastEthernet0/0
 ip address 172.16.3.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial2/0
 ip address 10.0.0.30 255.255.255.252
 no shutdown
!
interface Serial3/0
 ip address 10.0.0.33 255.255.255.252
 clock rate 64000
 no shutdown
!
router ospf 1
 network 172.16.3.0 0.0.0.255 area 0
 network 10.0.0.28 0.0.0.3 area 0
 network 10.0.0.32 0.0.0.3 area 0
!
end
write memory
```

Campus 4 Router

```
enable
configure terminal
hostname R4
!
interface FastEthernet0/0
 ip address 172.16.4.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial2/0
 ip address 10.0.0.34 255.255.255.252
 no shutdown
!
interface Serial3/0
 ip address 10.0.0.37 255.255.255.252
 clock rate 64000
 no shutdown
!
router ospf 1
 network 172.16.4.0 0.0.0.255 area 0
 network 10.0.0.32 0.0.0.3 area 0
 network 10.0.0.36 0.0.0.3 area 0
!
end
write memory
```

Campus 5 Router

```
enable
configure terminal
hostname R5
!
interface FastEthernet0/0
 ip address 172.16.5.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial0/0/0
 ip address 10.0.0.25 255.255.255.252
 no shutdown
!
interface Serial0/0/1
 ip address 10.0.0.29 255.255.255.252
 clock rate 64000
 no shutdown
!
interface Serial0/1/0
 ip address 10.0.0.38 255.255.255.252
 no shutdown
!
router ospf 1
 network 10.0.0.24 0.0.0.3 area 0
 network 10.0.0.28 0.0.0.3 area 0
 network 10.0.0.36 0.0.0.3 area 0
!
end
write memory
```

Campus 6 Router

```
enable
configure terminal
hostname R6
!
interface FastEthernet0/0
 ip address 172.16.6.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial2/0
 ip address 10.0.0.18 255.255.255.252
 clock rate 64000
 no shutdown
!
interface Serial3/0
 ip address 10.0.0.21 255.255.255.252
 no shutdown
!
router ospf 1
 network 172.16.6.0 0.0.0.255 area 0
 network 10.0.0.16 0.0.0.3 area 0
 network 10.0.0.20 0.0.0.3 area 0
!
end
write memory
```

Campus 7 Router

```
enable
configure terminal
hostname R7
!
interface FastEthernet0/0
 ip address 172.16.7.1 255.255.255.0
 ip helper-address 172.16.8.100
 no shutdown
!
interface Serial2/0
 ip address 10.0.0.14 255.255.255.252
 no shutdown
!
interface Serial3/0
 ip address 10.0.0.17 255.255.255.252
 no shutdown
!
router ospf 1
 network 172.16.7.0 0.0.0.255 area 0
 network 10.0.0.12 0.0.0.3 area 0
 network 10.0.0.16 0.0.0.3 area 0
!
end
write memory
```

Campus 8 Router (Core + Servers)

```
enable
configure terminal
hostname R8
!
interface FastEthernet0/0
 ip address 172.16.8.1 255.255.255.0
 no shutdown
!
interface Serial0/0/0
 ip address 10.0.0.2 255.255.255.252
 no shutdown
!
interface Serial0/0/1
 ip address 10.0.0.10 255.255.255.252
 clock rate 64000
 no shutdown
!
interface Serial0/1/0
 ip address 10.0.0.13 255.255.255.252
 clock rate 64000
 no shutdown
!
interface Serial0/1/1
 ip address 10.0.0.22 255.255.255.252
 no shutdown
!
interface Serial0/2/0
 ip address 10.0.0.26 255.255.255.252
 clock rate 64000
 no shutdown
!
router ospf 1
 network 172.16.8.0 0.0.0.255 area 0
 network 10.0.0.0 0.0.0.3 area 0
 network 10.0.0.8 0.0.0.3 area 0
 network 10.0.0.12 0.0.0.3 area 0
 network 10.0.0.20 0.0.0.3 area 0
 network 10.0.0.24 0.0.0.3 area 0
!
end
```

Sample Configuration Brief:

Router 8 - Capmpus 8

```
R8#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        172.16.8.1      YES manual up                    up
FastEthernet0/1        unassigned      YES unset  administratively down down
Serial0/0/0            10.0.0.2        YES manual up                    up
Serial0/0/1            10.0.0.10       YES manual up                    up
Serial0/1/0            10.0.0.13       YES manual up                    up
Serial0/1/1            10.0.0.22       YES manual up                    up
Serial0/2/0            10.0.0.26       YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R8#
```

```
R8#show running-config | section router ospf
router ospf 1
 log-adjacency-changes
 network 172.16.8.0 0.0.0.255 area 0
 network 10.0.0.0 0.0.0.255 area 0
 network 10.0.0.0 0.0.0.3 area 0
 network 10.0.0.8 0.0.0.3 area 0
 network 10.0.0.12 0.0.0.3 area 0
 network 10.0.0.20 0.0.0.3 area 0
 network 10.0.0.24 0.0.0.3 area 0
R8#
```

Router 5 - Campus 5

```
R5#
R5#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        172.16.5.1      YES manual up                    down
FastEthernet0/1        unassigned      YES unset  administratively down down
Serial0/0/0            10.0.0.25       YES manual up                    up
Serial0/0/1            10.0.0.29       YES manual up                    up
Serial0/1/0            10.0.0.38       YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down down
R5#show running-config | section router ospf
router ospf 1
 log-adjacency-changes
 network 172.16.5.0 0.0.0.255 area 0
 network 10.0.0.0 0.0.0.255 area 0
 network 10.0.0.24 0.0.0.3 area 0
 network 10.0.0.28 0.0.0.3 area 0
 network 10.0.0.36 0.0.0.3 area 0
R5#
```

6. Server Configurations

6.1 DHCP Server

The DHCP server (IP: **172.16.10.11**) is configured to allocate IP addresses dynamically to clients from **all campus LAN subnets**. Each pool is defined with the default gateway (router interface), DNS server, and valid IP ranges.

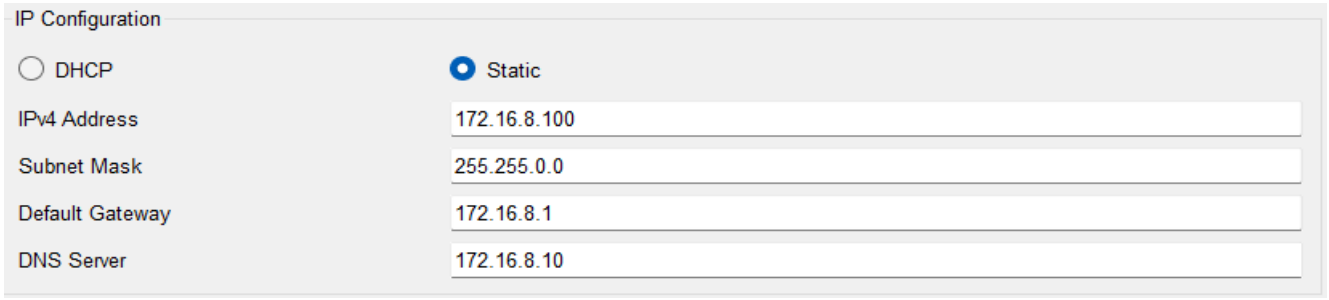
IP Address: `172.16.8.100`

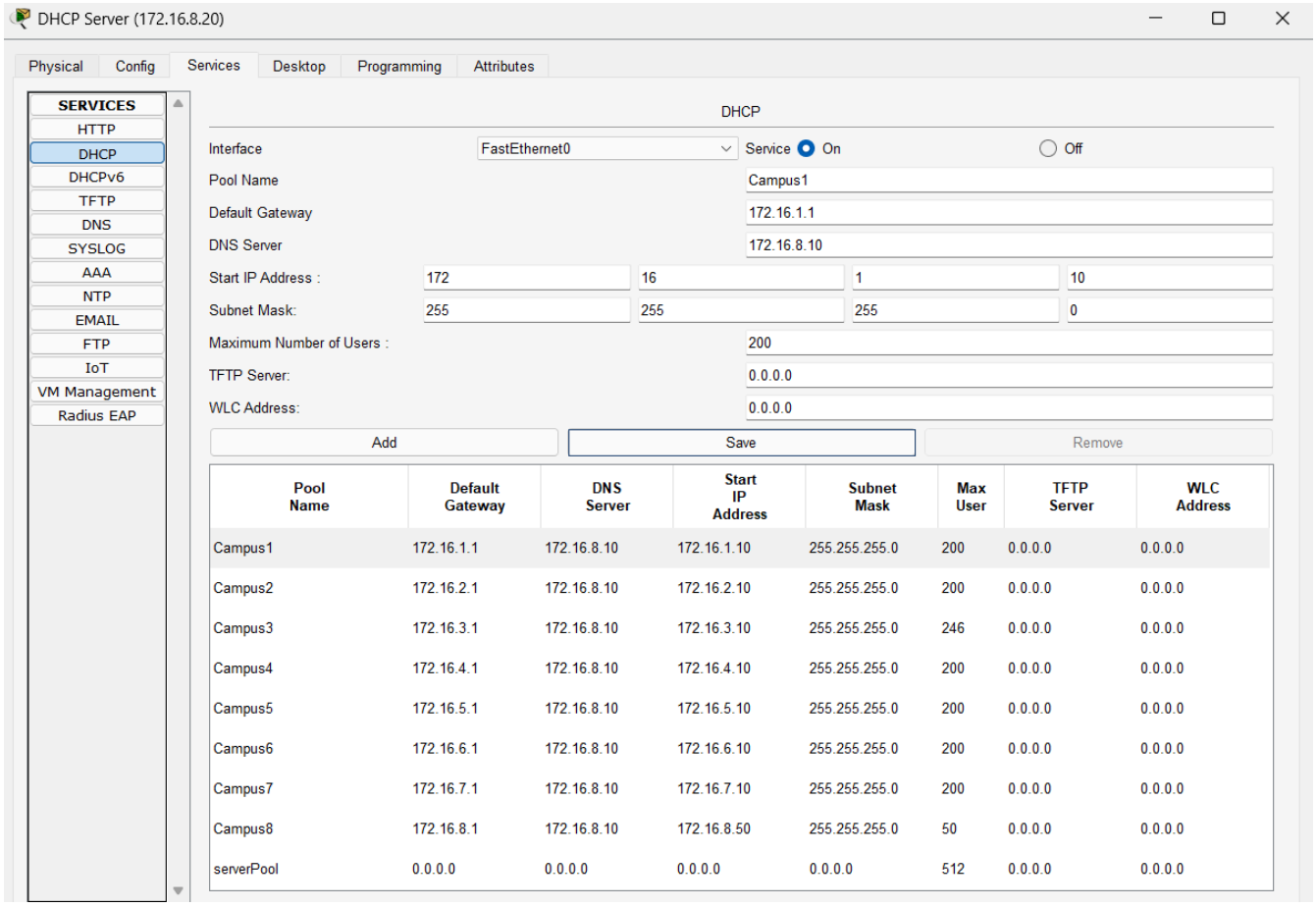
Subnet Mask: `255.255.255.0`

Gateway: `172.16.8.1` (first last host in Server LAN)

Pool Name	Default Gateway	Subnet	Start IP	End IP
Campus1	172.16.1.1	255.255.255.0	172.16.1.10	172.16.1.200
Campus2	172.16.2.1	255.255.255.0	172.16.2.10	172.16.2.200
Campus3	172.16.3.1	255.255.255.0	172.16.3.10	172.16.3.200
Campus4	172.16.4.1	255.255.255.0	172.16.4.10	172.16.4.200
Campus5	172.16.5.1	255.255.255.0	172.16.5.10	172.16.5.200
Campus6	172.16.6.1	255.255.255.0	172.16.6.10	172.16.6.200
Campus7	172.16.7.1	255.255.255.0	172.16.7.10	172.16.7.200
Campus8	172.16.8.1	255.255.255.0	172.16.8.50	172.16.8.100

Implantation





For All Routers (R1 - R7):

```
enable
configure terminal
interface fa0/0
ip helper-address 172.16.8.100
no shutdown
```

6.2 DNS Server

➔ Record: `www.apex.edu.bd → 172.16.8.10`

`IP Address: 172.16.8.10`

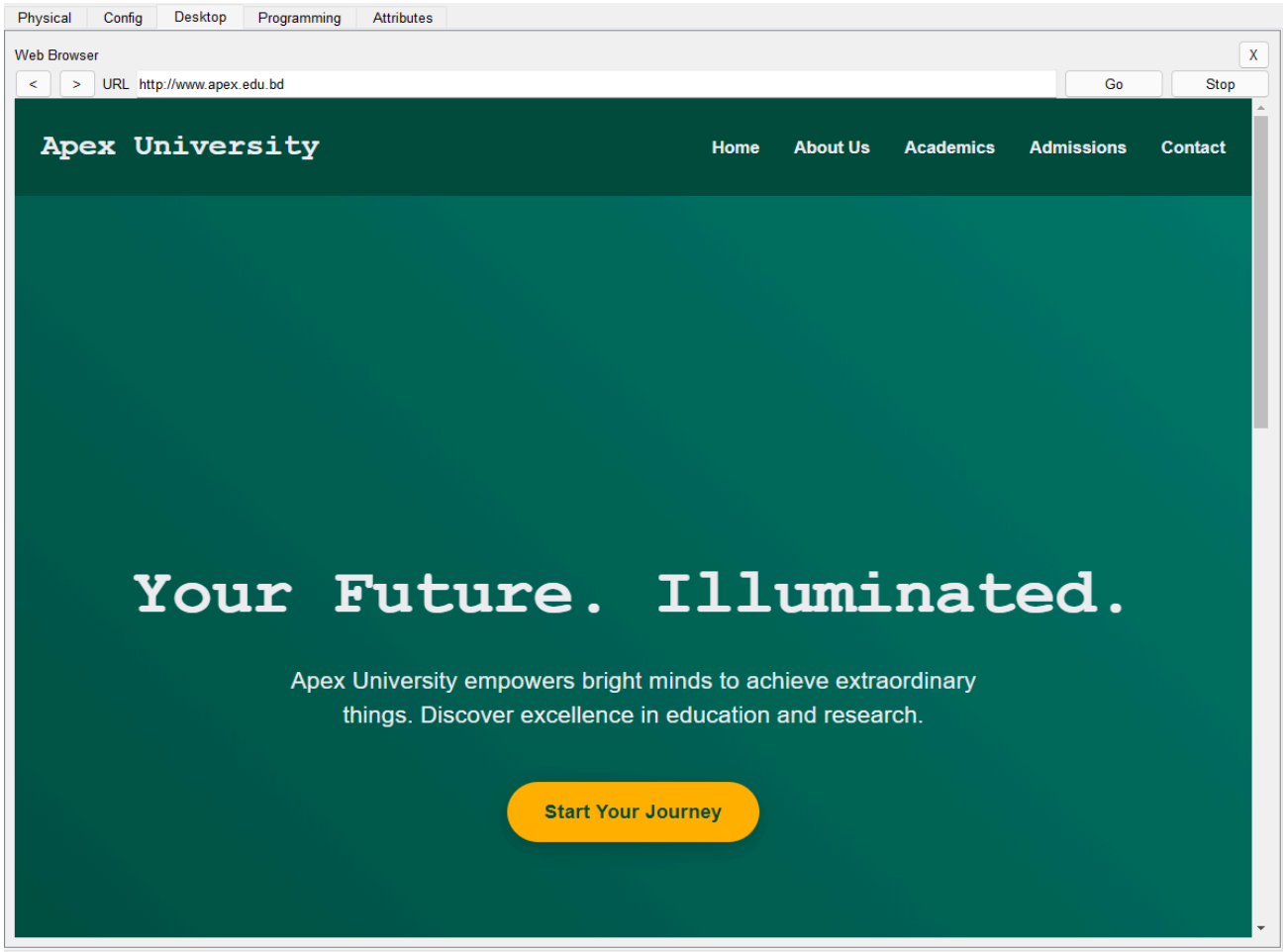
`Subnet Mask: 255.255.255.0`

`Gateway: 172.16.8.1`

Purpose

The DNS server allows students, faculty, and staff to access the university's official website using a domain name rather than an IP address.

1	www.apex.edu.bd	A Record	172.16.8.15



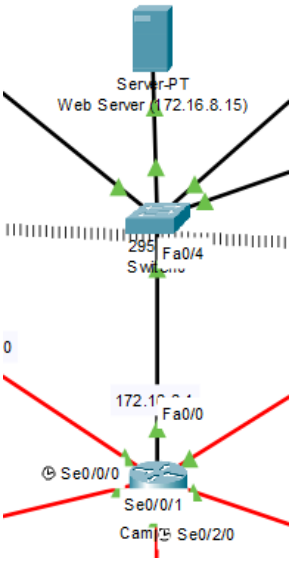
6.3 Web Server

- Hosted at 172.16.10.12 with university's webpage

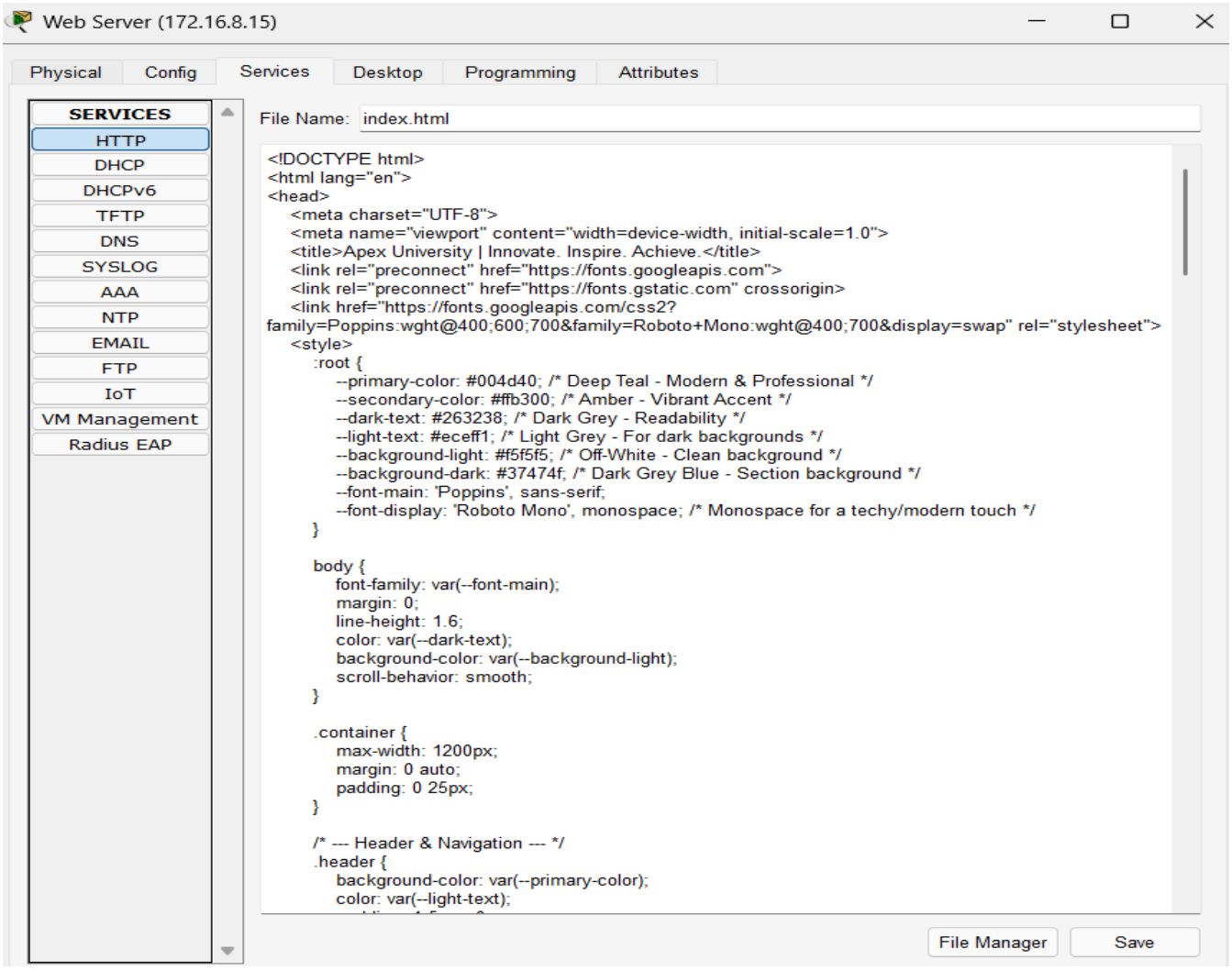
  IP Address: 172.16.8.15

  Subnet Mask: 255.255.255.0

  Gateway: 172.16.8.1 (router8)

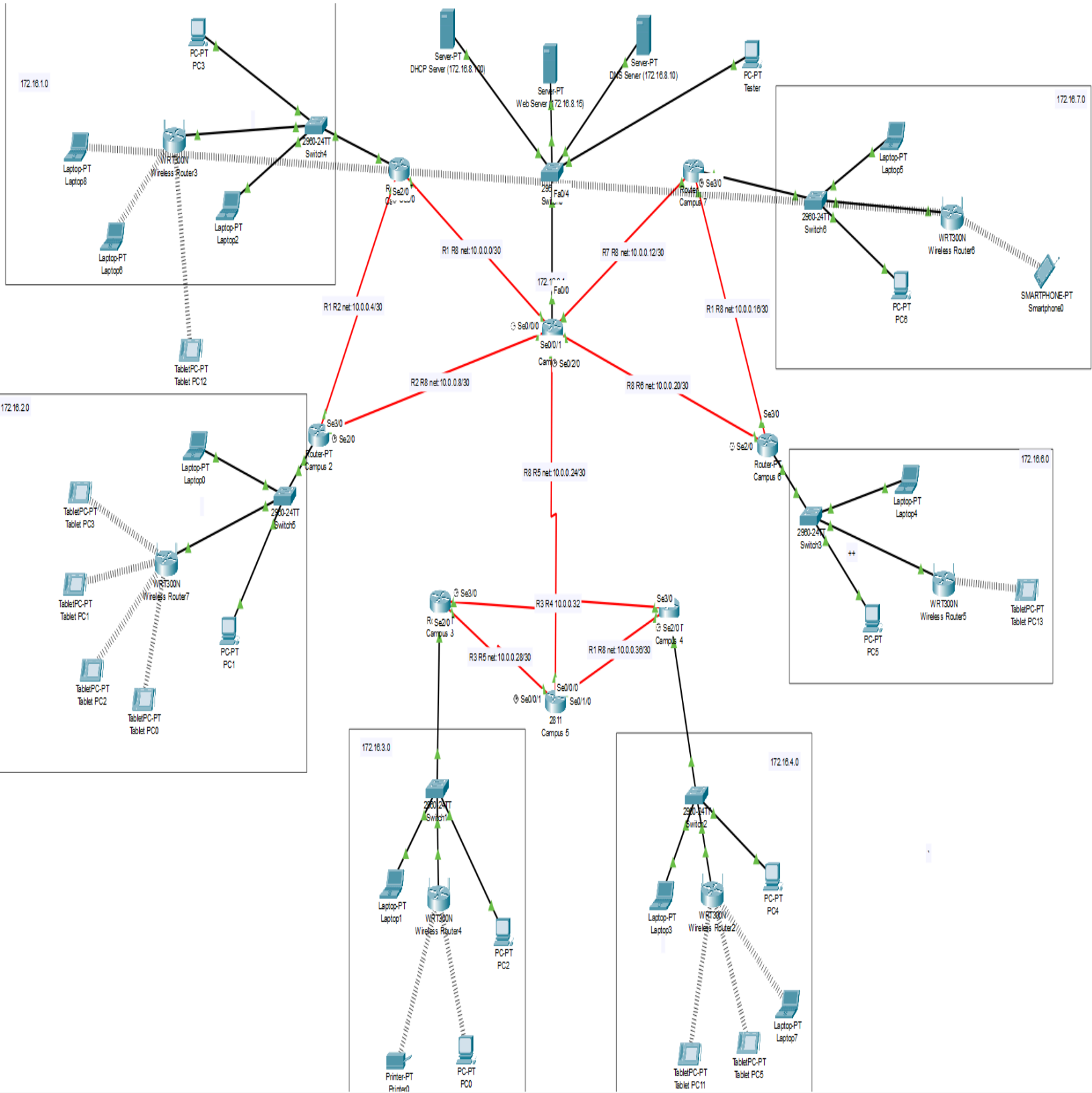



```
Device Name: DHCP Server (172.16.8.100)
Device Model: Server-PT

Port            Link   IP Address          IPv6 Address
FastEthernet0   Up     172.16.8.100/16     <not set>

Gateway: 172.16.8.1
DNS Server: 172.16.8.10
Line Number:  <not set>
```



8. Verification

- ➔ PCs in Campus 1–7 obtain IPs automatically via DHCP.
- ➔ All hosts can ping each other.
- ➔ Accessing `http://www.apex.edu.bd` resolves via DNS and opens the web server.
- ➔ Traceroute shows correct routing across campuses.



Testing

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	2.180	Switch2	Laptop3	STP
	2.180	Switch2	Wireless Router2	STP
	2.180	Switch2	PC4	STP
	2.180	Switch2	Campus 4	STP
	2.341	--	Switch3	STP
	2.342	Switch3	Campus 6	STP
	2.342	Switch3	Wireless Router5	STP
	2.342	Switch3	Laptop4	STP
	2.342	Switch3	PC5	STP
	2.507	--	Wireless Router7	STP
	2.508	Wireless Router7	Switch5	STP
	2.509	Switch5	Laptop0	STP
	2.509	Switch5	PC1	STP
	2.509	Switch5	Campus 2	STP
	2.785	--	Switch0	STP
	2.786	--	Switch0	STP
	2.786	--	Switch0	STP
	2.786	--	Switch0	STP
	2.786	--	Switch0	STP
	2.786	Switch0	DHCP Server (172.16.8.100)	STP
	2.786	Switch0	Web Server (172.16.8.15)	STP
	2.786	Switch0	DNS Server (172.16.8.10)	STP
	2.786	Switch0	Campus 8	STP
	2.786	Switch0	Tester	STP
	2.786	--	Switch0	STP
	2.787	Switch0	DHCP Server (172.16.8.100)	STP
	2.787	Switch0	Web Server (172.16.8.15)	STP
	2.787	Switch0	DNS Server (172.16.8.10)	STP
	2.787	Switch0	Campus 8	STP
	2.787	Switch0	Tester	STP
	3.878	--	Switch6	STP
	3.879	Switch6	Campus 7	STP
	3.879	Switch6	Laptop5	STP
	3.879	Switch6	PC6	STP
	3.879	Switch6	Wireless Router6	STP

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	5.987	Switch4	Campus 1	STP
	5.987	Switch4	Laptop2	STP
	5.987	Switch4	PC3	STP
	5.987	Switch4	Wireless Router3	STP
	6.142	--	Campus 6	CDP
	6.142	--	Campus 6	CDP
	6.142	--	Campus 6	CDP
	6.143	Campus 6	Switch3	CDP
	6.143	Campus 6	Campus 8	CDP
	6.143	Campus 6	Campus 7	CDP
	6.143	--	Campus 1	ICMP
	6.144	Campus 1	Campus 8	ICMP
	6.145	Campus 8	Campus 1	ICMP
	6.156	--	Campus 4	CDP
	6.156	--	Campus 4	CDP
	6.156	--	Campus 4	CDP
	6.157	Campus 4	Switch2	CDP
	6.157	Campus 4	Campus 5	CDP
	6.157	Campus 4	Campus 3	CDP
	6.180	--	Switch2	STP
	6.181	Switch2	Laptop3	STP
	6.181	Switch2	Wireless Router2	STP
	6.181	Switch2	PC4	STP
	6.181	Switch2	Campus 4	STP
	6.337	--	Switch3	STP
	6.338	Switch3	Campus 6	STP
	6.338	Switch3	Wireless Router5	STP
	6.338	Switch3	Laptop4	STP
	6.338	Switch3	PC5	STP
	6.506	--	Wireless Router7	STP
	6.507	Wireless Router7	Switch5	STP
	6.508	Switch5	Laptop0	STP
	6.508	Switch5	PC1	STP
	6.508	Switch5	Campus 2	STP

5.987	Switch4	Campus 1	STP
5.987	Switch4	Laptop2	STP
5.987	Switch4	PC3	STP
5.987	Switch4	Wireless Router3	STP
6.142	--	Campus 6	CDP
6.142	--	Campus 6	CDP
6.142	--	Campus 6	CDP
6.143	Campus 6	Switch3	CDP
6.143	Campus 6	Campus 8	CDP
6.143	Campus 6	Campus 7	CDP
6.143	--	Campus 1	ICMP
6.144	Campus 1	Campus 8	ICMP
6.145	Campus 8	Campus 1	ICMP
6.156	--	Campus 4	CDP
6.156	--	Campus 4	CDP
6.156	--	Campus 4	CDP
6.157	Campus 4	Switch2	CDP
6.157	Campus 4	Campus 5	CDP
6.157	Campus 4	Campus 3	CDP
6.180	--	Switch2	STP
6.181	Switch2	Laptop3	STP
6.181	Switch2	Wireless Router2	STP
6.181	Switch2	PC4	STP

9. Limitations

1. Single point of failure at Campus 8 (central servers).
2. Physical serial links assumed; real-world implementation may use fiber or VPNs.
3. Only one DNS server—redundancy not covered.

10. Future Scope

➔ Add redundancy with **HSRP or VRRP**.

➔ Deploy **load-balanced DNS & DHCP**.

➔ Implement **firewalls and ACLs** for security.

➔ Integrate **VoIP, Video conferencing** services.

11. Conclusion

The designed network provides a scalable, centralized, and fully functional model for Apex University. Using OSPF, DHCP, and DNS ensures efficient management, seamless connectivity, and support for academic and administrative processes across eight campuses.