Design a full-fledged network for an organization with multiple subnets.

CSE405: Computer Networks

Section – 01

Semester – Spring 2025

Mini Project Report

Submitted To:

Dr. Anisur Rahman (MAR)

Associate Professor,

Department of Computer Science and Engineering,

East West University

Submitted By:

Saifur Rahman

ID: 2021-3-60-033

Date of submission: 31 May, 2025

1. Overview

This documentation outlines the planning, design, and configuration of a distributed network architecture for Apex University. With five geographically dispersed campuses, this network ensures seamless communication, secure data flow, and centralized management for academic and administrative systems. The design features scalable addressing, dynamic routing via OSPF, and centralized service provisioning for DHCP, DNS, and web hosting.

Requirements:

Components Used:

1. Routers
2. Wireless Routers (Linksys-WRT300N)
3. DNS Server
4. Web Server
5. DHCP Server
6. Serial DCE Cable
7. Copper Cross-Over Cable
8. Copper Straight-Through Cable
9. Switches (Model 2960)
10. Wireless End Devices
11. PCs

Software Used:

Cisco Packet Tracer 6.2

2. Objective

To deploy a campus-wide network infrastructure for Apex University capable of supporting diverse services including:

- Online admissions and academic services
- Wireless and wired internet access across all campuses
- Centralized web, DNS, and DHCP services
- Interconnected routers supporting dynamic routing protocols

3. Network Infrastructure

Logical Structure:

- **Routers**: 5 (one per campus)
- **LAN Segments**: 5 total, each with wired and wireless nodes
- **Servers**: Hosted centrally in campus 4 LAN

Server IPs:

- DHCP Server: 196.168.30.2
- DNS Server: 196.168.30.3
- Web Server: 196.168.30.4 (hosts http://www.apex.edu.bd)

Router IP Assignments:

- Router-1: 150.15.255.254 (LAN), 20.0.0.1, 10.0.0.2 (Serial)
- Router-2: 160.25.255.254 (LAN), 30.0.0.1, 40.0.0.2 (Serial)
- Router-3: 170.35.255.254 (LAN), 50.0.0.1, 30.0.0.2 (Serial)
- Router-4: 180.45.255.254 (LAN), 196.168.30.254 (Server LAN), 10.0.0.1, 50.0.0.2 (Serial)
- Router-5: 190.55.255.254 (LAN), 40.0.0.1, 20.0.0.2 (Serial)

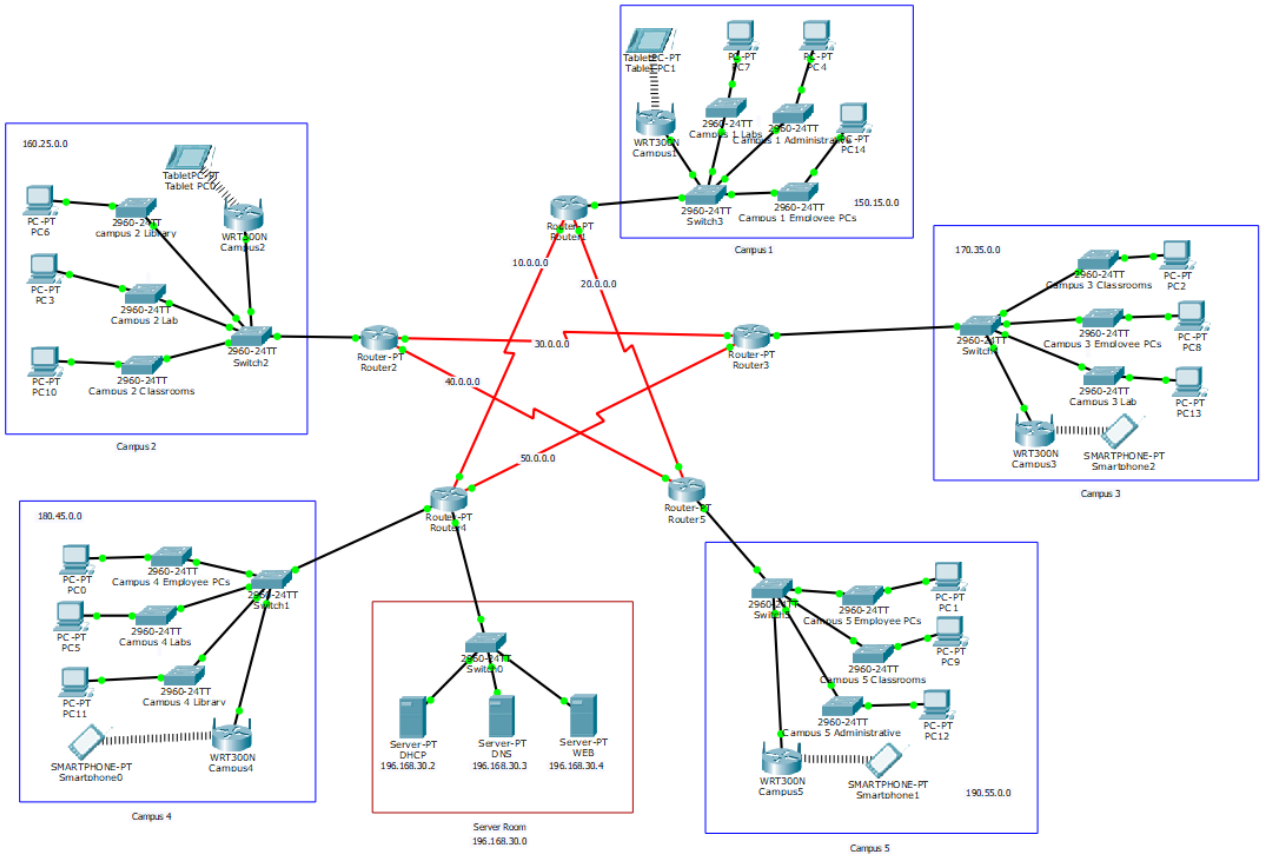
Total Subnets / Networks Used: 5 + 1 + 5 = 11 networks

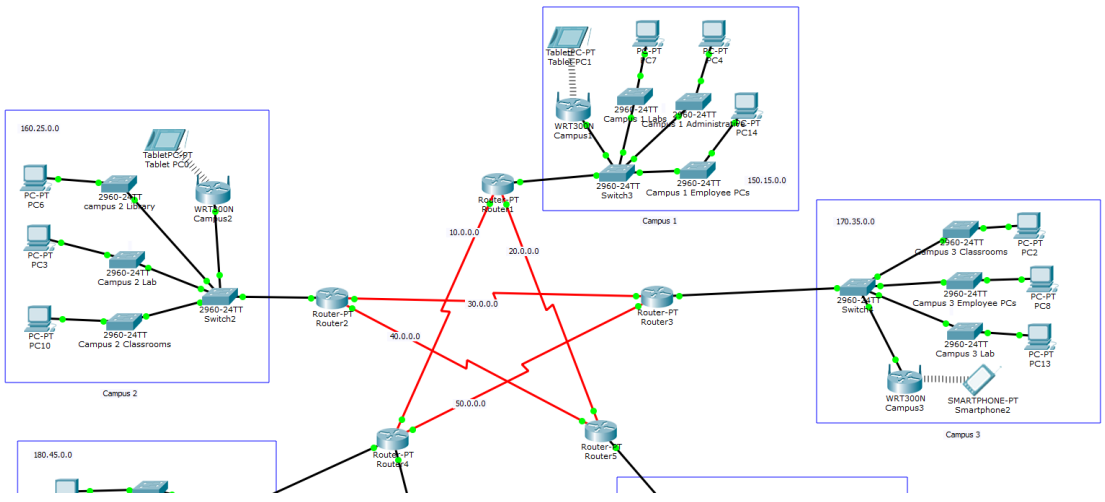
Total wired hosts: 26

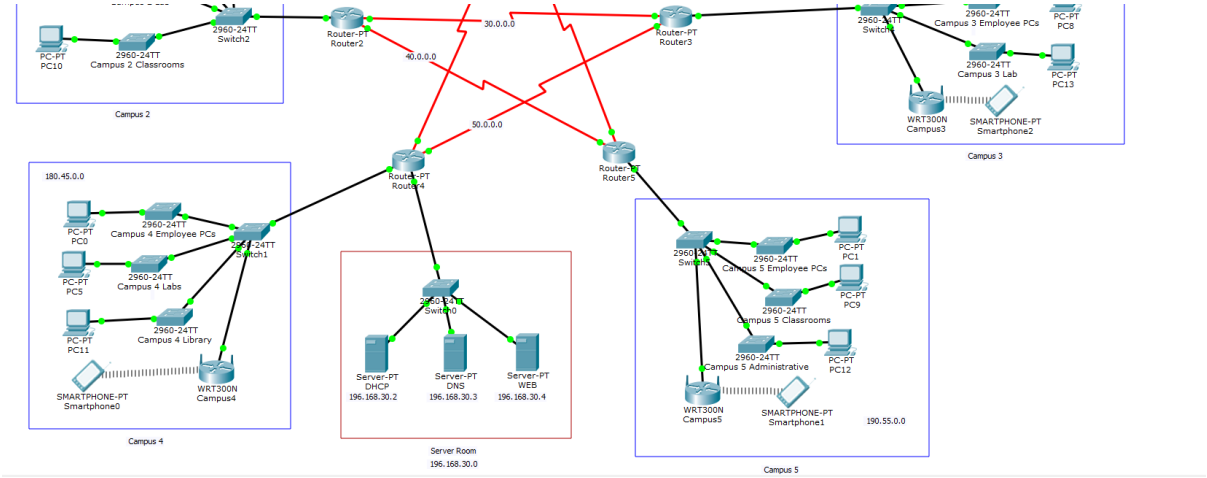
Total wireless hosts: 7

Grand Total Hosts: 33 devices

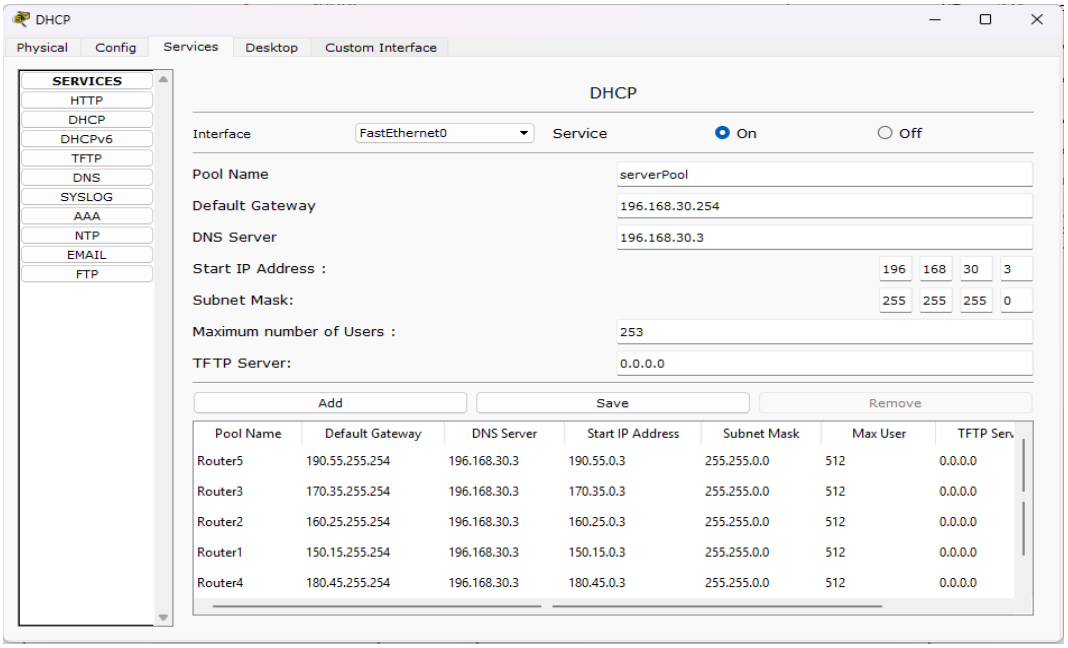
Physical Topology:





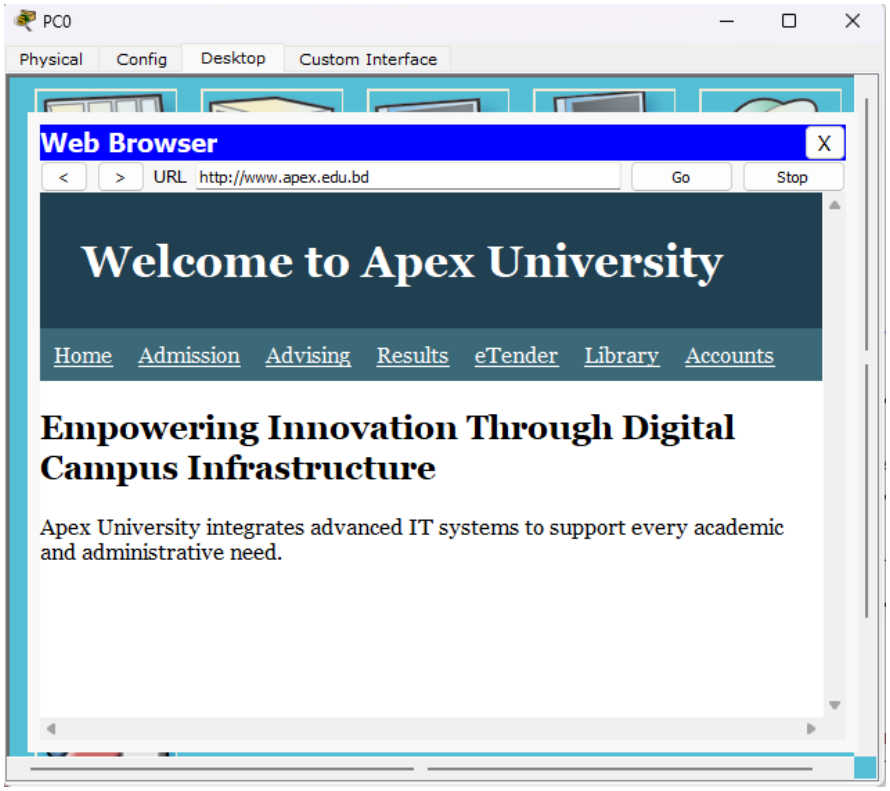


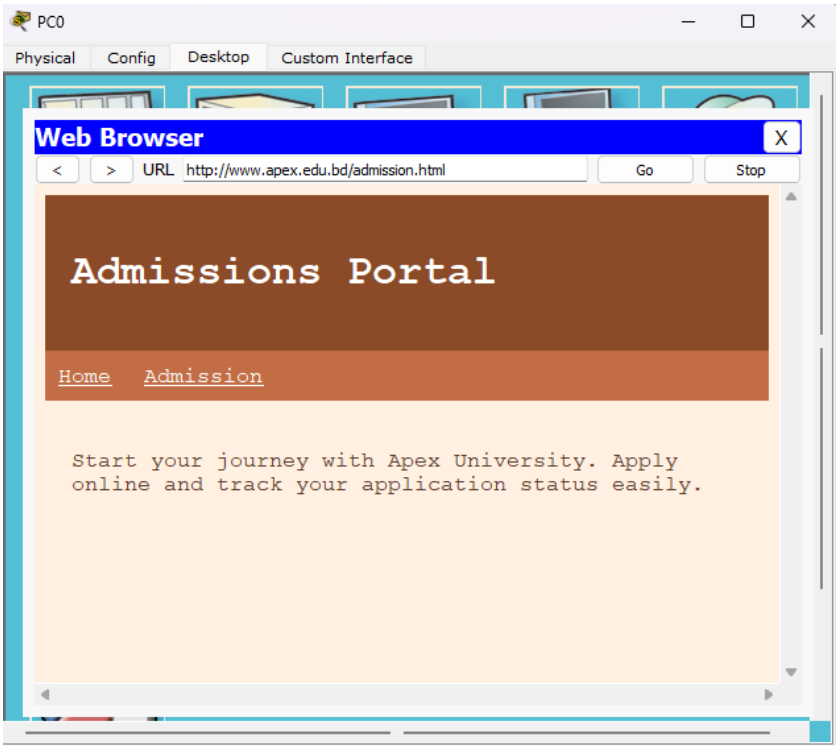
DHCP Server Setup:



\

Apex Web Site Visit:





4. Technical Specifications

Addressing Scheme:

- Mix of Class A, B, and C networks for diversity and simulation of real-world IP allocation.
- Sufficient addressing blocks for campus-wide scalability.

Dynamic Routing (OSPF Configuration): Routers are configured with area 1 OSPF across all serial and LAN interfaces.

DHCP Configuration:

- A centralized DHCP server with IP 196.168.30.2.
- Routers forward DHCP requests using the ip helper-address command on their respective LAN interfaces.

DNS Configuration:

- One DNS server at 196.168.30.3 resolves www.apex.edu.bd domain for clients across all campuses.

Web Hosting:

- Web services for university info are hosted at 196.168.30.4, accessible through the internal DNS name.

5. Router Configuration

Router-1 (Campus 1):

```
enable
config
interface fa0/0
ip address 150.15.255.254 255.255.0.0
no shut
do wr
exit

interface se2/0
ip address 20.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 10.0.0.2 255.0.0.0
no shut
do wr
exit
```

Router-2 (Campus 2):

```
enable
config
interface fa0/0
ip address 160.25.255.254 255.255.0.0
no shut
do wr
exit

interface se2/0
ip address 30.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 40.0.0.2 255.0.0.0
no shut
do wr
exit
```

Router-3 (Campus 3):

```
enable
config
interface fa0/0
ip address 170.35.255.254 255.255.0.0
no shut
do wr
exit

interface se2/0
ip address 50.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 30.0.0.2 255.0.0.0
no shut
do wr
exit
```

Router-4 (Campus 4):

```
enable
config
interface fa0/0
```

ip address 180.45.255.254 255.255.0.0
no shut
do wr
exit

interface fa1/0
ip address 196.168.30.254 255.255.255.0
no shut
do wr
exit

interface se2/0
ip address 10.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 50.0.0.2 255.0.0.0
no shut
do wr
exit

Router-5 (Campus 5):
enable
config
interface fa0/0
ip address 190.55.255.254 255.255.0.0
no shut
do wr
exit

interface se2/0
ip address 40.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 20.0.0.2 255.0.0.0
no shut
do wr
exit

Syntax of Routing Table:

Router-1 (Campus 1):
enable
config

router OSPF 1
network 150.15.0.0 0.0.255.255 area 1
network 10.0.0.0 0.255.255.255 area 1
network 20.0.0.0 0.255.255.255 area 1
exit

Router-2 (Campus 2):
enable
config
router OSPF 2
network 160.25.0.0 0.0.255.255 area 1
network 30.0.0.0 0.255.255.255 area 1
network 40.0.0.0 0.255.255.255 area 1
exit

Router-3 (Campus 3):
enable
config
router OSPF 3
network 170.35.0.0 0.0.255.255 area 1
network 30.0.0.0 0.255.255.255 area 1
network 50.0.0.0 0.255.255.255 area 1
exit

Router-4 (Campus 4):
enable
config
router OSPF 4
network 180.45.0.0 0.0.255.255 area 1
network 10.0.0.0 0.255.255.255 area 1
network 50.0.0.0 0.255.255.255 area 1
network 196.168.30.0 0.0.0.255 area 1
exit

Router-5 (Campus 5):
enable
config
router OSPF 5
network 190.55.0.0 0.0.255.255 area 1
network 50.0.0.0 0.255.255.255 area 1
network 40.0.0.0 0.255.255.255 area 1
exit

Codes for single DHCP setup

For all Routers:
enable
config
interface fa0/0
ip helper-address 196.168.30.2
exit

OSPF Area Designation: All routers operate under a unified OSPF area 1, optimizing route sharing and reducing administrative overhead.

6. Design Considerations

- **Scalability**: Reserved address ranges within each subnet for future host addition.
- **Centralization**: Server LAN connected directly to Router-4 for efficient access to critical services.
- **Performance**: Serial connections ensure reliable inter-campus routing.
- **Security**: Segmentation of networks per campus minimizes broadcast domains and isolates faults.

7. Limitations and Future Enhancements

- **Redundancy**: Future improvements may include backup DHCP/DNS servers and additional routing redundancy.
- **Bandwidth**: Serial interfaces are limited; replacing them with gigabit links could improve performance.
- **Monitoring**: Integration of SNMP and network monitoring tools could enhance fault diagnosis.

8. Conclusion

This version of the Apex University network infrastructure provides a solid foundation for connected academic operations. Centralized services, dynamic routing, and a flexible subnetting scheme ensure the network is robust and prepared for growth.