EAST WEST UNIVERSITY

Department of Computer Science & Engineering

REPORT on

A full-fledged network for an organization with multiple subnets

Course Title: Computer Networks

Course Code: CSE 405

Section No: 03

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1. Title:

A full-fledged network for an organization with multiple subnets.

2. Introduction:

Apex University, similar in scale to East West University, requires a robust & scalable computer network that can connect all of its eight campuses. The network must provide seamless wired & wireless internet access to students, faculty & staff across multiple academic & administrative wings.

In addition to basic internet access, the university depends on several critical systems such as admissions, advising, results, accounts, library management, & E-tender platforms. To ensure these services run efficiently, the network must support subnetting, routing, centralized IP allocation & DNS resolution for the university's official web domain: **http://www.apex.edu.bd**.

This report documents the design criteria, technical specifications & configurations used to implement the complete model of Apex University's network in Cisco Packet Tracer.

3. Purpose of the Network:

The purpose of this project is to design & implement a **full-fledged enterprise network** for Apex University, connecting multiple campuses with both wired & wireless hosts. It uses a centralized DHCP server for automatic IP assignment, a DNS server for website access & a routing protocol to ensure smooth inter-campus communication, with room for future expansion.

3.1. Requirements:

- The network must connect eight campuses using routers with serial connections.
- Each campus should have LANs with both wired & wireless hosts.
- A centralized DHCP server must assign IP addresses to all hosts automatically.
- A DNS server must resolve the university's domain: http://www.apex.edu.bd.
- A server room LAN will host DNS, DHCP & other university servers.
- Use a routing protocol (Static or, OSPF) to ensure full inter-campus connectivity.
- The subnetting scheme should allow future expansion of hosts & campuses.

Ultimately, this network is designed to mirror a real-world educational enterprise infrastructure, where connectivity, security & scalability are critical.

4. Design Details:

Some important components have been used to establish the network infrastructure. These includes:

- DHCP server
- DNS server
- Web server
- Switches (2960)
- Routers (For 2 ports generic model & for 3,5 ports 2811 model)
- Straight through cable (For different device connection)
- Cross over cable (For same device connection)
- Laptop (Host)
- PC (Host)
- Router Generic (For wireless connectivity)

4.1. DHCP server & services:

A DHCP server has been used in this project to automatically assign IP addresses to all hosts across the eight campuses, ensuring each device receives the correct IP address, subnet mask, default gateway & DNS settings. This eliminates manual configuration, reduces the risk of errors & makes network management more efficient. Additionally, centralizing DHCP allows the network to scale easily as new hosts or campuses are added in the future.

4.2. DNS server & services:

A DNS server has been used in this project to translate the university's domain name (www.apex.edu.bd) into its corresponding IP address, allowing users from any campus to access the web server easily. This ensures consistent & reliable access to the university's website without needing to remember IP addresses & it simplifies network management for administrators.

4.3. Routers:

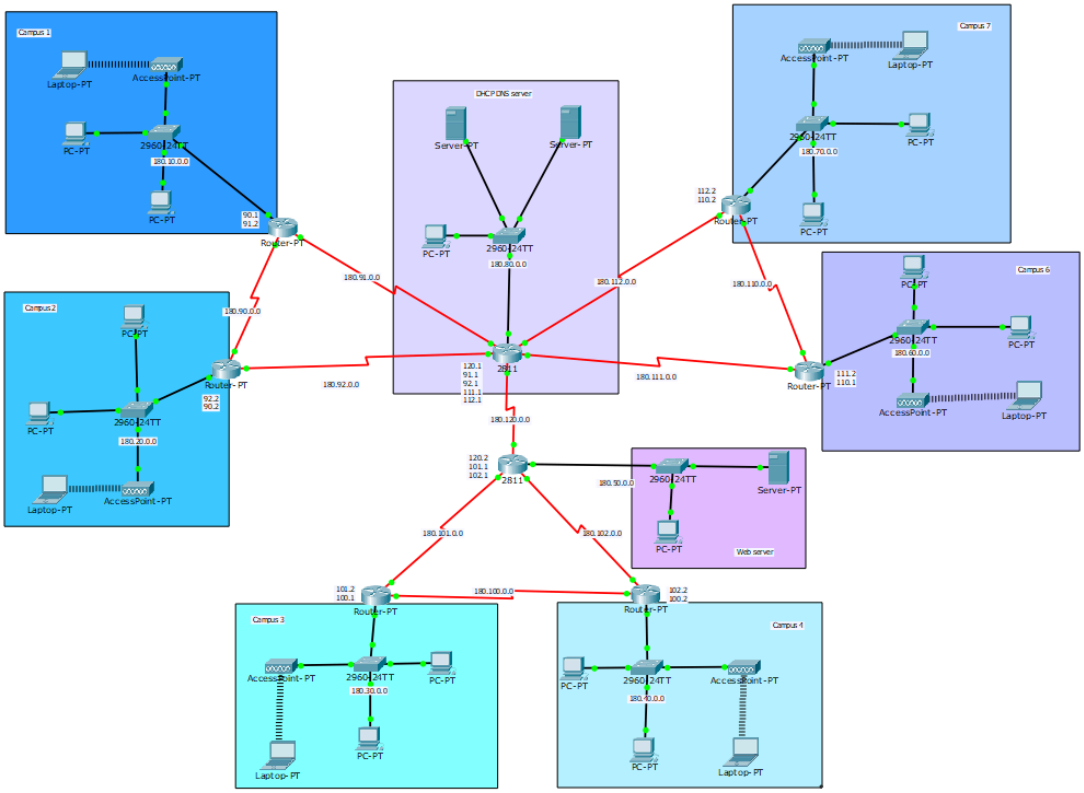
To get 5 ports for campus-8, router model 2811 has been implemented & same is used for 3 ports in campus-5. For 2 ports router model generic has been used in all other campuses. For implementing wireless connectivity router model Generic has been used.

All these models of routers used to establish this full fledged network.

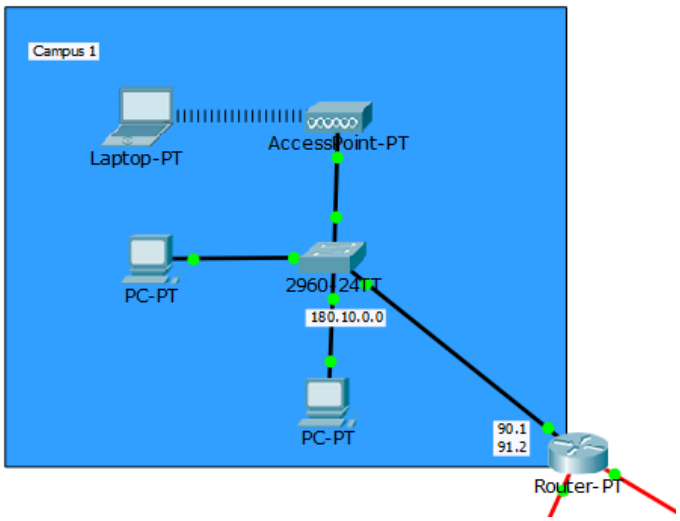
4.4. Network Topology & Connectivity Overview:

The entire university network has been designed in a mesh topology, allowing seamless communication between all campuses. The network supports both wired and wireless connectivity, enabling students and faculty to access resources from various locations across each campus. Switches are employed to segment the network into subnets for efficient traffic management, and the complete network design has been implemented using Cisco Packet Tracer simulation software.

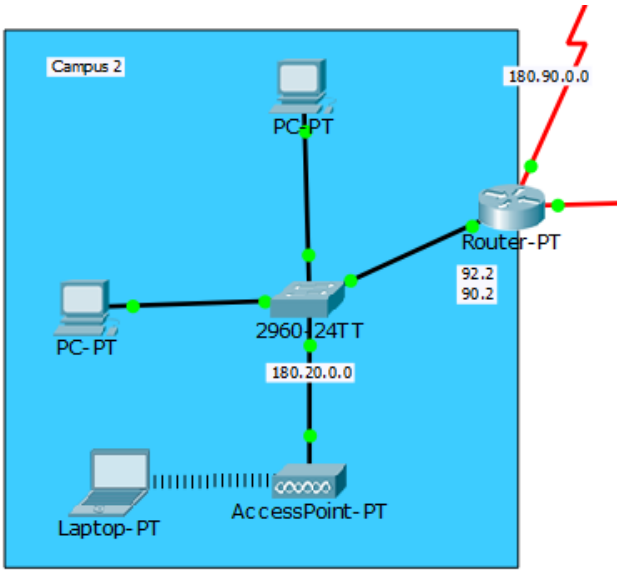
5. Physical Diagram:



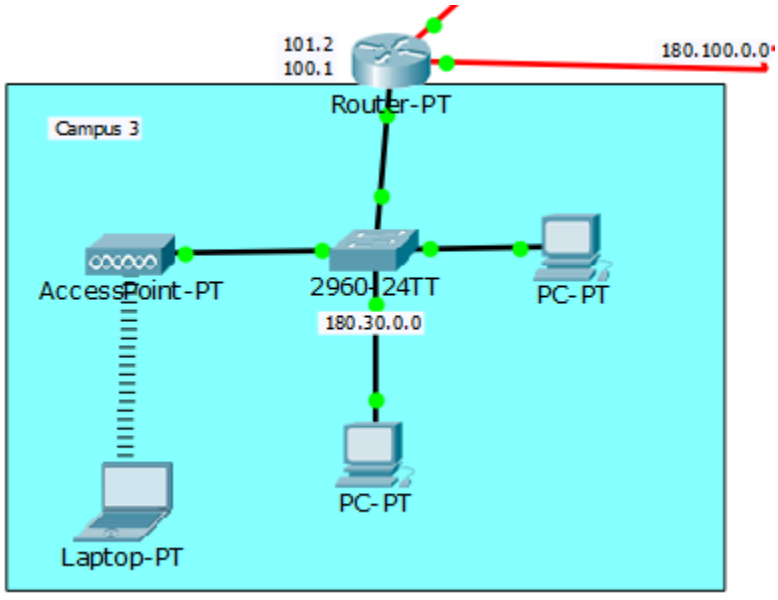
5.1. Campus 01:



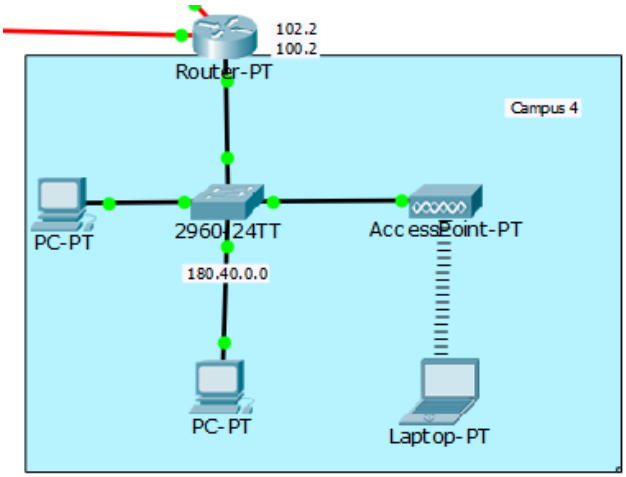
5.2. Campus 02:



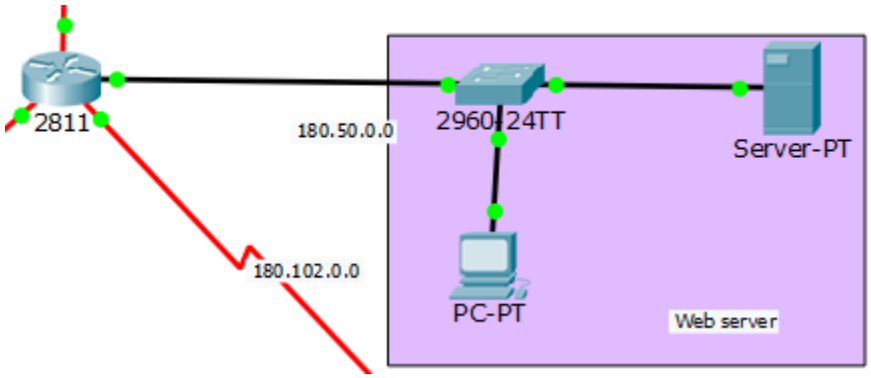
5.3. Campus 03:



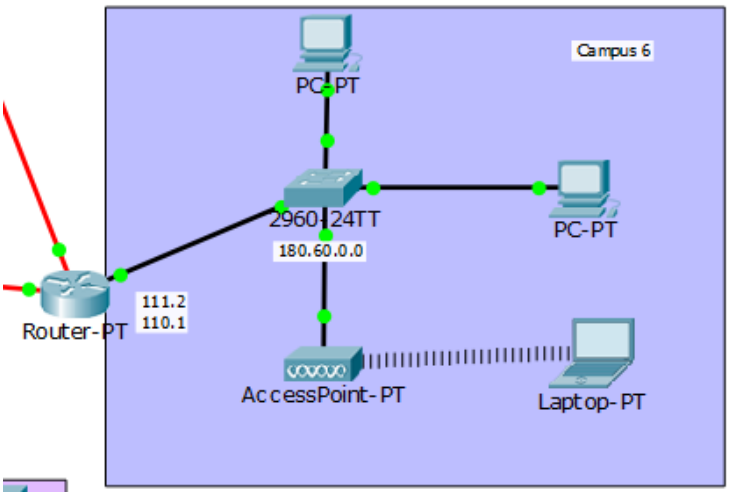
5.4. Campus 04:



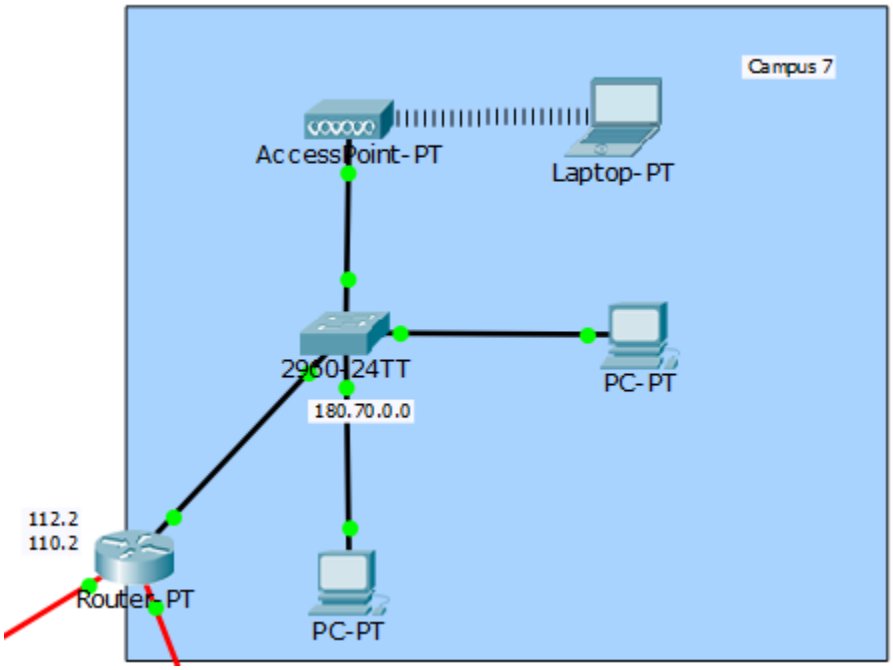
5.5. Campus 05 (Web Server room):



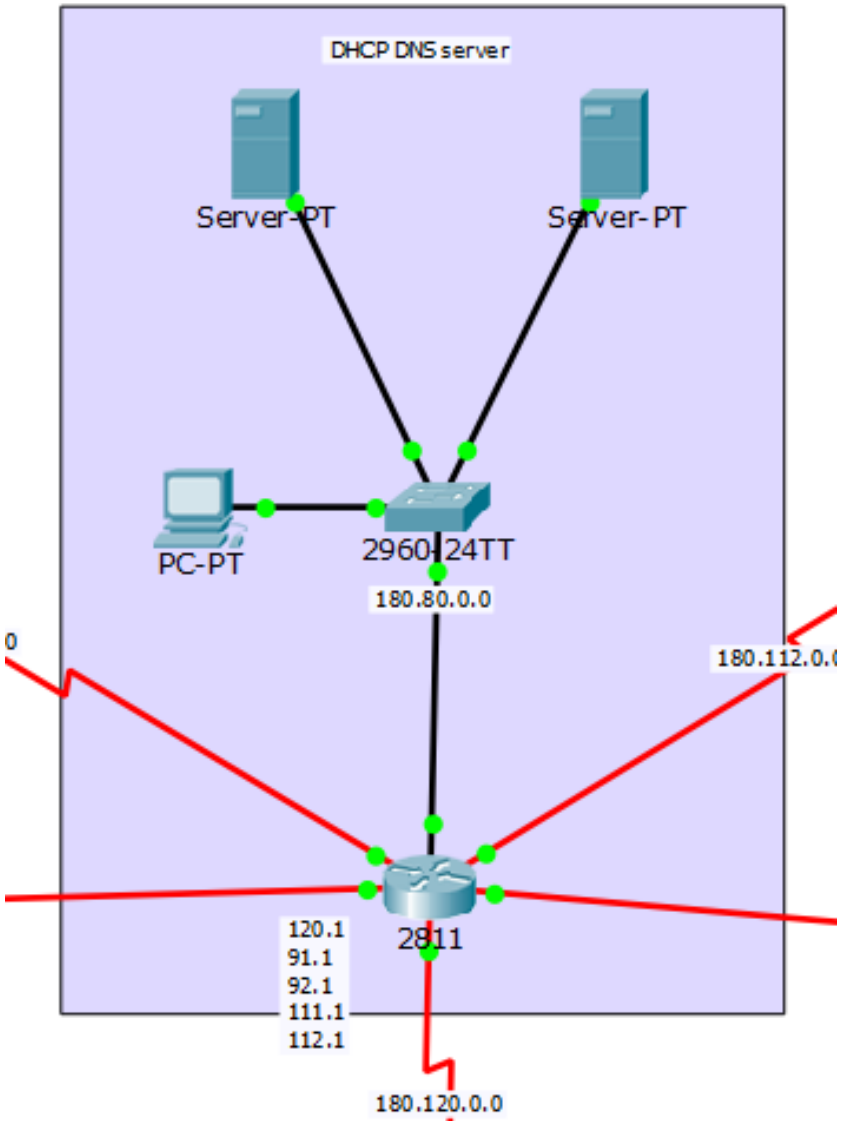
5.6. Campus 06:



5.7. Campus 07:



5.8. Campus 08 (Dedicated server room for DHCP & DNS Server):



6. Network Configuration:

➔ Servers:

A total of 3 servers with Static IP addresses have been implemented in the entire network.

Server	Server's IP
DHCP	180.80.0.50
DNS	180.80.0.100
WEB	180.50.0.50

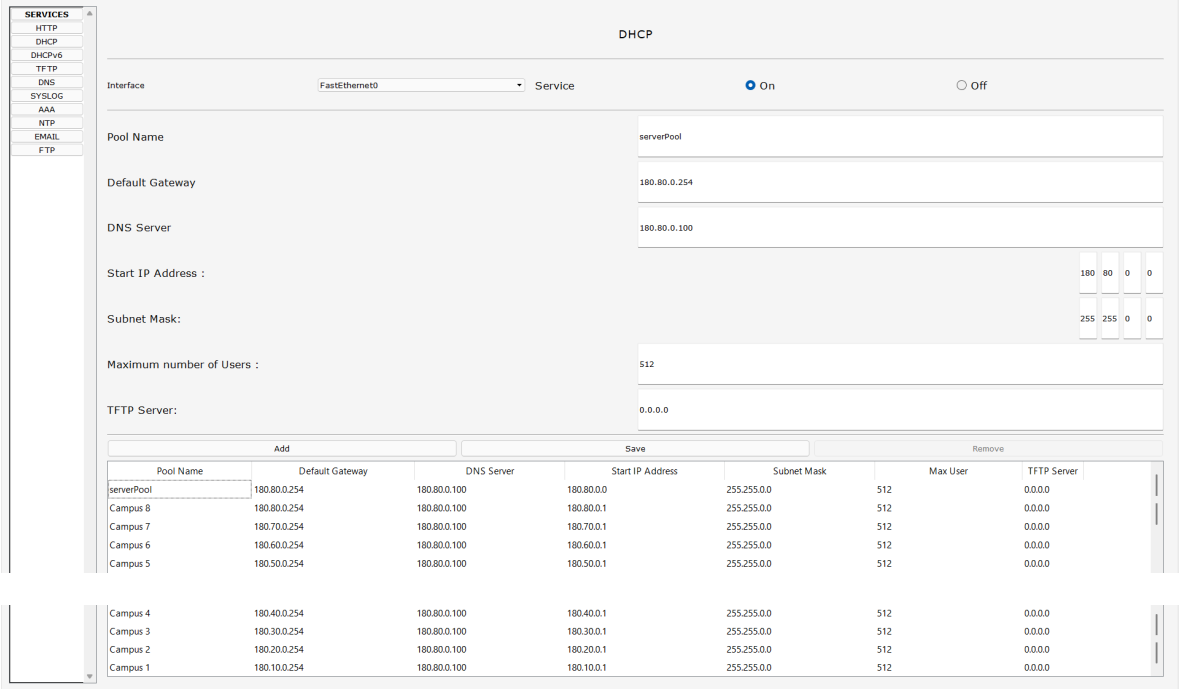
6.1. Server Configuration Analysis:

6.1.1. DHCP Server:

DHCP server is used to automatically assign unique IP addresses to devices across the university's network. Since there are 8 campus networks, the server provides IPs according to the specific campus each device belongs to. To make this process organized & efficient, 8 separate DHCP pools have been created—one for each campus—ensuring that every device receives the correct address without conflicts.

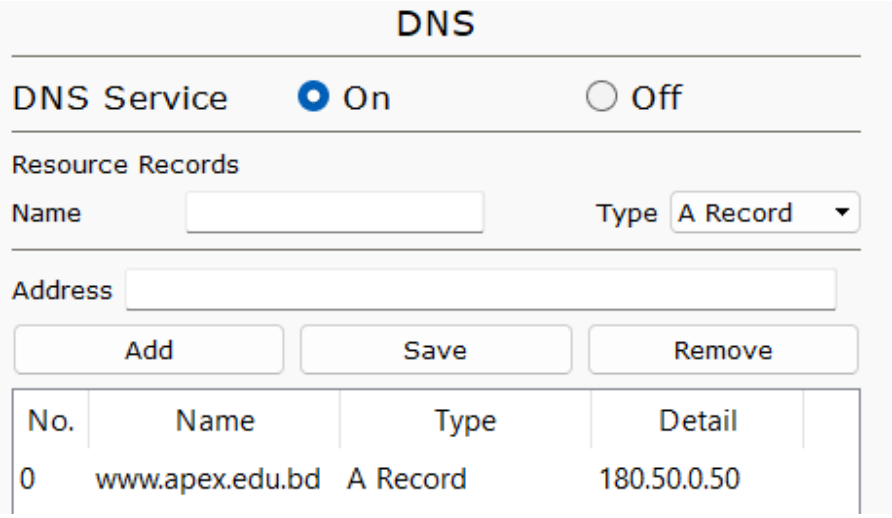
DHCP's IP is 180.80.0.50 & gateway is 180.80.0.254 in campus-08 network.

DHCP SERVER POOLS



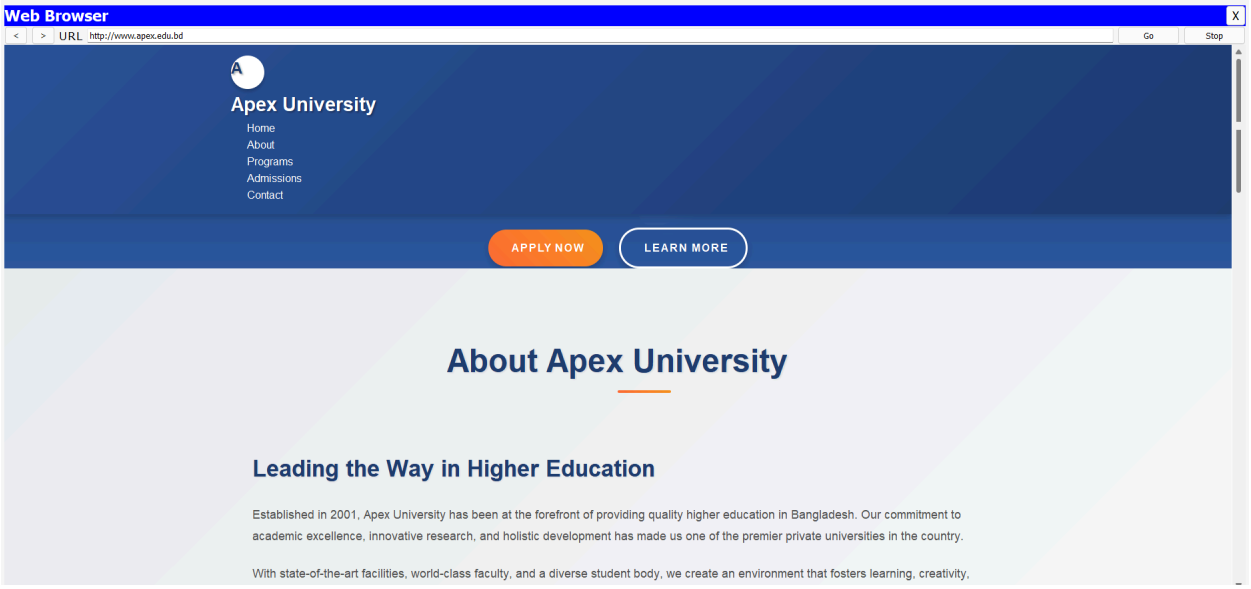
6.1.2. DNS Server:

With the DNS server we have provided an URL for the university's web server named as www.apex.edu.bd . IP for DNS server is 180.80.0.100 with gateway 180.80.0.254 in campus-08 network .



6.1.3. Web Server:

This web page has been hosted using a static IP 180.50.0.50 in campus-05.



6.2. Ports Configuration:

6.2.1. Serial connection

From Campus 8

- ➔ se0/0/0 to se2/0 campus 1
- ➔ se0/0/1 to se2/0 campus 2
- ➔ se 0/2/0 to se2/0 campus 7
- ➔ se 0/2/1 to se 2/0 campus 6
- ➔ se 0/3/0 to se 0/2/0 campus 5

From Campus 5

- ➔ se 0/2/1 to se 2/0 campus 3
- ➔ se 0/3/0 to se 2/0 campus 4

From Campus 1

➔ se 3/0 to campus 2 se 3/0

From Campus 7

➔ se 3/0 to campus 6 se 3/0

From Campus 3

➔ se 3/0 to campus 4 se 3/0

6.2.2. Fa connection:

From switch's fa 0/1 to all router's fa 0/0

6.3. Router Configuration (CLI Commands):

Router 1 (campus 1):	**Router 5 (campus 5):**
Interface fa0/0 Ip address 180.10.0.254 255.255.0.0 ip helper-address 180.80.0.50 No shut Do wr Exit Interface se2/0 Ip address 180.91.0.2 255.255.0.0 No shut Do wr Exit Interface se3/0 Ip address 180.90.0.1 255.255.0.0 Clock rate 64000 No shut Do wr Exit	Interface fa0/0 Ip address 180.50.0.254 255.255.0.0 ip helper-address 180.80.0.50 No shut Do wr Exit Interface se0/2/0 Ip address 180.120.0.2 255.255.0.0 No shut Do wr Exit Interface se0/2/1 Ip address 180.101.0.1 255.255.0.0 Clock rate 64000 No shut Do wr Exit Interface se0/3/0

➔ **OSPF:**

```
Router ospf 1
Network 180.10.0.0 0.0.255.255 area 1
Network 180.90.0.0 0.0.255.255 area 1
Network 180.91.0.0 0.0.255.255 area 1
Exit
```

Router 2 (campus 2):

```
Interface fa0/0
Ip address 180.20.0.254 255.255.0.0
ip helper-address 180.80.0.50
No shut
Do wr
Exit

Interface se2/0
Ip address 180.92.0.2 255.255.0.0
No shut
Do wr
Exit

Interface se3/0
Ip address 180.90.0.2  255.255.0.0
No shut
Do wr
Exit
```

➔ **OSPF:**

```
Router ospf 2
Network 180.20.0.0 0.0.255.255 area 1
Network 180.90.0.0 0.0.255.255 area 1
Network 180.92.0.0 0.0.255.255 area 1
Exit
```

Router 3 (campus 3):

```
Interface fa0/0
Ip address 180.30.0.254 255.255.0.0
ip helper-address 180.80.0.50
No shut
Do wr
Ip address 180.102.0.1 255.255.0.0
Clock rate 64000
No shut
Do wr
Exit
```

➔ **OSPF:**

```
Router ospf 5
Network 180.50.0.0 0.0.255.255 area 1
Network 180.101.0.0 0.0.255.255 area 1
Network 180.102.0.0 0.0.255.255 area 1
Network 180.120.0.0 0.0.255.255 area 1
Exit
```

Router 6 (campus 6):

```
Interface fa0/0
Ip address 180.60.0.254 255.255.0.0
ip helper-address 180.80.0.50
No shut
Do wr
Exit

Interface se2/0
Ip address 180.111.0.2 255.255.0.0
No shut
Do wr
Exit

Interface se3/0
Ip address 180.110.0.1  255.255.0.0
No shut
Do wr
Exit
```

➔ **OSPF:**

```
Router ospf 6
Network 180.60.0.0 0.0.255.255 area 1
Network 180.110.0.0 0.0.255.255 area 1
Network 180.111.0.0 0.0.255.255 area 1
Exit
```

```
Exit

Interface se2/0
Ip address 180.101.0.2 255.255.0.0
No shut
Do wr
Exit

Interface se3/0
Ip address 180.100.0.1  255.255.0.0
Clock rate 64000
No shut
Do wr
Exit
```

➔ **OSPF:**

```
Router ospf 3
Network 180.30.0.0 0.0.255.255 area 1
Network 180.100.0.0 0.0.255.255 area 1
Network 180.101.0.0 0.0.255.255 area 1
Exit
```

Router 4 (campus 4):

```
Interface fa0/0
Ip address 180.40.0.254 255.255.0.0
ip helper-address 180.80.0.50
No shut
Do wr
Exit

Interface se2/0
Ip address 180.102.0.2 255.255.0.0
No shut
Do wr
Exit

Interface se3/0
Ip address 180.100.0.2  255.255.0.0
No shut
Do wr
Exit
```

➔ **OSPF:**

```
Router ospf 4
```

Router 7 (campus 7):

```
Interface fa0/0
Ip address 180.70.0.254 255.255.0.0
ip helper-address 180.80.0.50
No shut
Do wr
Exit

Interface se2/0
Ip address 180.112.0.2 255.255.0.0
No shut
Do wr
Exit

Interface se3/0
Ip address 180.110.0.2 255.255.0.0
Clock rate 64000
No shut
Do wr
Exit
```

➔ **OSPF:**

```
Router ospf 7
Network 180.70.0.0 0.0.255.255 area 1
Network 180.110.0.0 0.0.255.255 area 1
Network 180.112.0.0 0.0.255.255 area 1
Exit
```

Router 8 (campus 8):

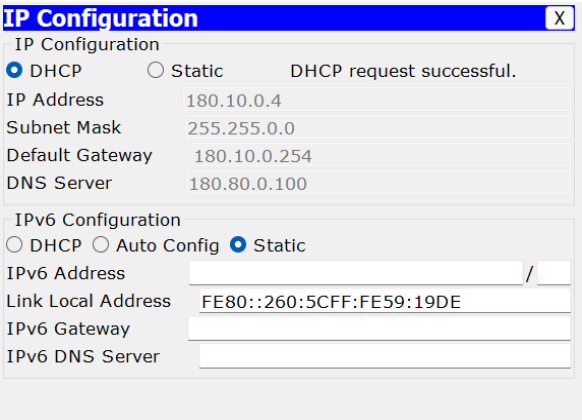
```
Interface fa0/0
Ip address 180.80.0.254 255.255.0.0
ip helper-address 180.80.0.50
No shut
Do wr
Exit

Interface se0/0/0
Ip address 180.91.0.1 255.255.0.0
Clock rate 64000
No shut
Do wr
Exit
```

Network 180.40.0.0 0.0.255.255 area 1 Network 180.100.0.0 0.0.255.255 area 1 Network 180.102.0.0 0.0.255.255 area 1 Exit	Interface se0/0/1 Ip address 180.92.0.1 255.255.0.0 Clock rate 64000 No shut Do wr Exit Interface se0/3/0 Ip address 180.120.0.1 255.255.0.0 Clock rate 64000 No shut Do wr Exit Interface se0/2/1 Ip address 180.111.0.1 255.255.0.0 Clock rate 64000 No shut Do wr Exit Interface se0/2/0 Ip address 180.112.0.1 255.255.0.0 Clock rate 64000 No shut Do wr Exit ➔ **OSPF:** Router ospf 8 Network 180.80.0.0 0.0.255.255 area 1 Network 180.91.0.0 0.0.255.255 area 1 Network 180.92.0.0 0.0.255.255 area 1 Network 180.120.0.0 0.0.255.255 area 1 Network 180.111.0.0 0.0.255.255 area 1 Network 180.112.0.0 0.0.255.255 area 1 Exit

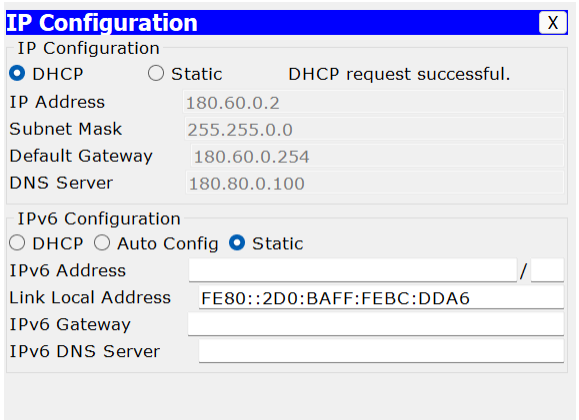
7. Network Testing:

A web server was configured & integrated with DNS to allow access using domain names instead of IP addresses. The following screenshots demonstrate successful name resolution & web page accessibility.

➔ Providing IP addresses to all network's devices:

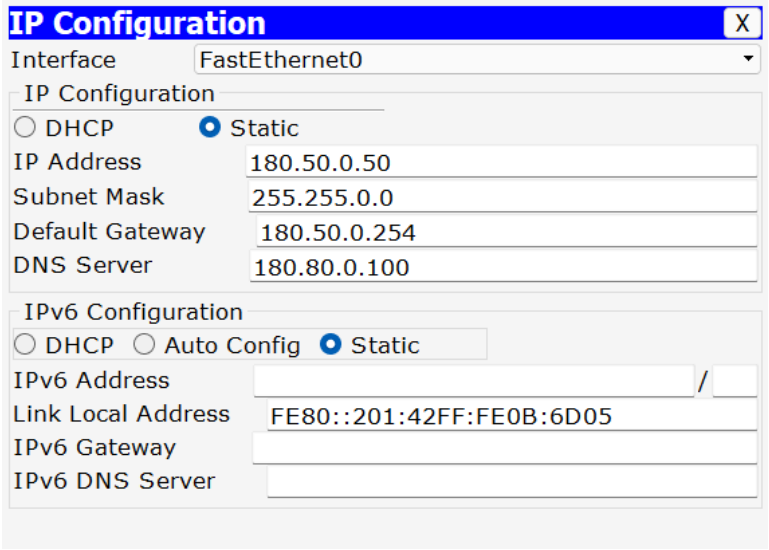


Campus-01

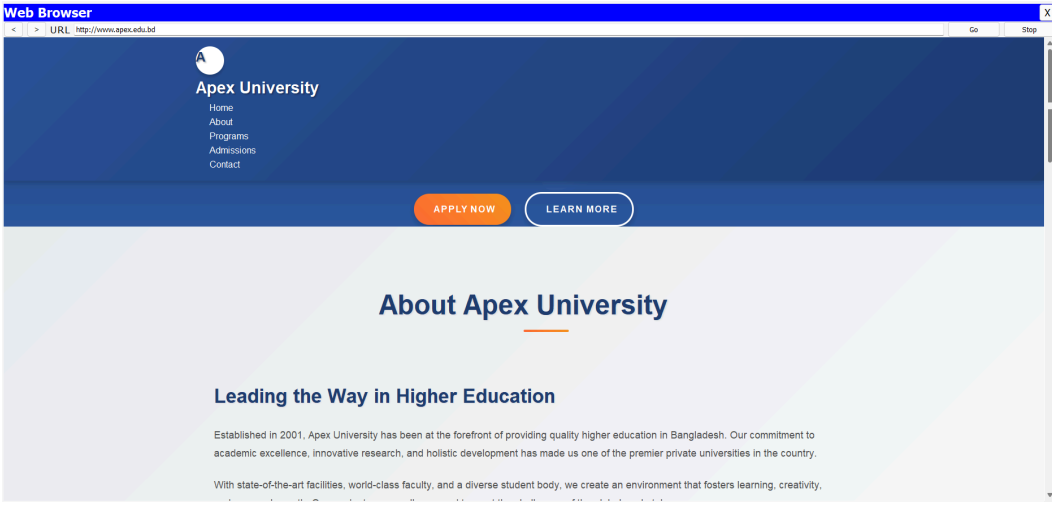


Campus-06

➔ Web server's IP configuration:



➔ Pinging to the DNS server from other campuses:



Pinging to web server from campus-01 using DNS server's URL

➔ Pinging between all 8 campuses (Including wired & wireless hosts) :

Fire	Last Status	Source	Destination	Type	Color	Time(se	Periodic	Num	Edit	Delete
	Successful	Campus 1	Campus 8	ICMP		0.000	N	0	(edit)	
	Successful	Campus 2	Campus 5	ICMP		0.000	N	1	(edit)	
	Successful	Campus 8	Campus 5	ICMP		0.000	N	2	(edit)	
	Successful	Campus 3	Campus 6	ICMP		0.000	N	3	(edit)	
	Successful	Campus 7	Campus 4	ICMP		0.000	N	4	(edit)	
	Successful	PC0	PC3	ICMP		0.000	N	0	(edit)	
	Successful	PC0	PC12	ICMP		0.000	N	1	(edit)	
	Successful	PC0	PC9	ICMP		0.000	N	2	(edit)	
	Successful	Laptop4	PC3	ICMP		0.000	N	3	(edit)	
	Successful	PC7	PC4	ICMP		0.000	N	4	(edit)	
	Successful	PC7	PC13	ICMP		0.000	N	5	(edit)	
	Successful	Laptop5	PC3	ICMP		0.000	N	0	(edit)	
	Successful	Laptop1	Laptop0	ICMP		0.000	N	1	(edit)	
	Successful	Laptop4	PC9	ICMP		0.000	N	2	(edit)	
	Successful	Laptop3	PC10	ICMP		0.000	N	3	(edit)	
	Successful	Laptop1	Laptop2	ICMP		0.000	N	4	(edit)	
	Successful	Laptop2	PC7	ICMP		0.000	N	5	(edit)	

8. Design Issues:

While planning the Apex University network, key considerations were made to guarantee performance, flexibility & dependable operation. The main design considerations are outlined below:

8.1. Number of Hosts:

Campus	Network Address	Broadcast Address	Total Hosts
1	180.10.0.0	180.10.255.255	65,534
2	180.20.0.0	180.20.255.255	65,534
3	180.30.0.0	180.30.255.255	65,534
4	180.40.0.0	180.40.255.255	65,534
5	180.50.0.0	180.50.255.255	65,534
6	180.60.0.0	180.60.255.255	65,534
7	180.70.0.0	180.70.255.255	65,534
8	180.80.0.0	180.80.255.255	65,534

9. Limitations:

When transferring data between devices in Cisco Packet Tracer, the first attempt may show FAILED, but subsequent attempts are SUCCESSFUL. This happens because the network connections take a short time to initialize when the file is first opened.

10. Future Expansion:

Some ports on the routers & switches have been kept free to allow for future network expansion.

11. Conclusion:

Despite the challenges encountered during the project, I was able to successfully implement the planned design in accordance with the project requirements. The configuration of DNS, DHCP & dynamic routing was completed using Cisco Packet Tracer, ensuring the network met the specified objectives. The difficulties faced during implementation have been documented in the Limitations section & potential enhancements are outlined under Future Improvements for further development.