EAST WEST UNIVERSITY

A full-fledged network for the University of Scholars with multiple subnets

Project Report

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1. Introduction

1.1. Abstract

This report presents the design and simulation of a comprehensive enterprise network for the University of Scholars, implemented using Cisco Packet Tracer. The network interconnects five campuses through OSPF dynamic routing protocol, supported by a centralized server infrastructure providing DHCP for automatic IP allocation, DNS for domain name resolution, and a web server hosting the university's official website. The design incorporates both wired and wireless connectivity to accommodate diverse user requirements and reflects real-world enterprise networking scenarios. The final implementation ensures complete inter-campus connectivity, efficient resource management, and scalability for future expansion.

1.2. Project Background

University of Scholars is an enterprise similar to East West University, managing a large number of computing devices within a complex network infrastructure. The university provides wired internet access to all classrooms, laboratories, employee workstations, library facilities, and administrative wings. Additionally, wireless internet access is available across all campuses to support mobile connectivity for students, faculty, and staff.

The university operates sophisticated networked systems to support critical business processes including student admissions, academic advising, examination results management, electronic tendering (eTender), library management systems, and financial accounting operations. This complex network infrastructure requires proper subnetting and implementation of switching and routing mechanisms to ensure efficient, secure, and scalable operations across all university facilities.

2. Design Specifications

2.1. Logical Design

The network architecture consists of five interconnected campuses arranged in a star topology, with Campus 5 serving as the central hub. Each campus is assigned a subnet from a Class A IP address pool (120.0.0.0/8 – 136.0.0.0/8), ensuring sufficient address space for current requirements and future expansion. A centralized server farm is maintained at Campus 5 for DNS, DHCP, and web services, providing unified service delivery across the entire university network.

Network Components:

- **DHCP Server (120.0.0.1):** Configured to automatically assign IP addresses to all hosts across the five campuses, with separate IP pools defined for each campus network
- **DNS Server (120.0.0.3):** Resolves the university's domain name (www.scholars.edu.bd) to the web server's IP address, enabling users to access the website using a memorable domain name instead of numerical IP addresses
- **Web Server (120.0.0.2):** Hosts the University of Scholars' official homepage containing institutional information, announcements, and resources
- **Five Routers (Router 1-5):** Connect all campus networks via serial WAN links, implementing OSPF routing for dynamic path selection and network convergence
- **Five Switches:** Connect multiple wired devices within each campus LAN, providing local network connectivity
- **Access Points:** Provide wireless connectivity alongside wired connections in each campus, supporting laptops and mobile devices
- **End Devices:** Combination of desktop PCs and laptops distributed across campuses to simulate actual university usage

2.2. Physical Design

The physical network architecture is organized as follows:

- **Server Room (Campus 5):** A dedicated LAN segment where DNS (120.0.0.3), DHCP (120.0.0.1), and Web (120.0.0.2) servers are deployed, connected via a switch to Router 5
- **Campus LANs:** Five distinct LANs (Campus 1-5), each with both wired host devices (desktop PCs) and wireless devices (laptops connected via access points)
- **WAN Backbone:** Five routers interconnected using serial DCE/DTE connections following the specified star topology:
    - Campus 1 ↔ Campus 4 (Serial link: 132.0.0.0/8)
    - Campus 1 ↔ Campus 5 (Serial link: 136.0.0.0/8)
    - Campus 2 ↔ Campus 5 (Serial link: 134.0.0.0/8)
    - Campus 2 ↔ Campus 3 (Serial link: 138.0.0.0/8)
    - Campus 3 ↔ Campus 4 (Serial link: 130.0.0.0/8)

- **End Devices:** Desktop computers and laptops distributed across campuses to represent faculty, staff, and student workstations

2.3. Required Devices

Hardware Components:

- **Routers:** 5 × Cisco 2811 Router with HWIC-2T modules (providing additional serial interfaces for WAN connectivity)
- **Switches:** 5 × Cisco 2960-24TT Switches (one per campus LAN for connecting wired devices)
- **Servers:** 3 × Generic Servers configured for different services:
    - DHCP Server (120.0.0.1) – Dynamic IP address allocation
    - DNS Server (120.0.0.3) – Domain name resolution
    - Web Server (120.0.0.2) – HTTP/HTTPS hosting of university website
- **End Devices:**
    - 20 × Generic PCs (wired hosts across five campuses)
    - 10 × Generic Laptops (wireless hosts across five campuses)
- **Wireless Devices:** 5 × Generic Access Point-PT (one per campus for wireless connectivity)
- **Cabling:**
    - Copper Straight-Through cables (for switch-to-device and switch-to-router FastEthernet connections)
    - Serial DCE/DTE cables (for router-to-router WAN connections)
- **Software:** Cisco Packet Tracer (Version 6.2 or later)

Current Host Distribution:

Campus	Wired PCs	Wireless Laptops	Server	Total Devices
Campus 1	5	2		7
Campus 2	4	2		6
Campus 3	4	2		6
Campus 4	3	2		5
Campus 5	4	2	3	9
Total	**20**	**10**	**3**	**33**

Table 1. Host distribution per campus

2.4. Network Diagram

The complete network topology is illustrated in the accompanying Packet Tracer file. The diagram shows:

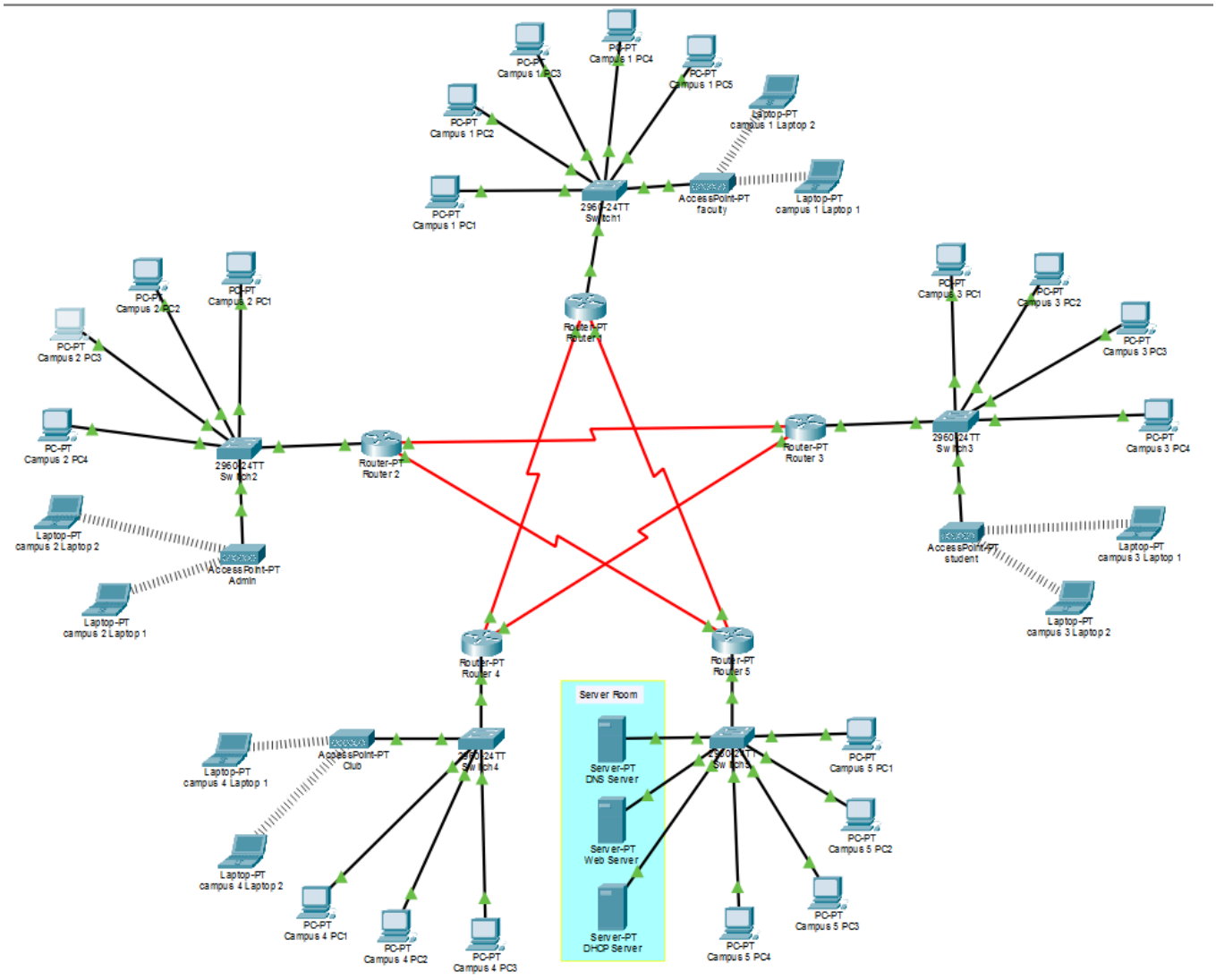

Figure 1. Full network diagram

3. Implementation

The network was systematically implemented in Cisco Packet Tracer according to the prescribed star topology. Five routers were deployed, each representing a campus, with Campus 5 functioning as the central hub connecting to all other campuses. Serial connections were established between routers to simulate WAN links, and OSPF was configured for dynamic routing.

3.1. IP Addressing and Subnetting

A Class A address block was utilized for the entire network, with separate Class A networks assigned to each campus LAN and inter-router serial connections. The use of Class A addresses (/8 subnet mask: 255.0.0.0) supports up to 16,777,214 hosts per network.

Campus LAN Addressing:

Campus	Network Address	Subnet Mask	Gateway IP	Maximum Hosts
Campus 1	124.0.0.0/8	255.0.0.0	124.255.255.254	16,777,214
Campus 2	126.0.0.0/8	255.0.0.0	126.255.255.254	16,777,214
Campus 3	122.0.0.0/8	255.0.0.0	122.255.255.254	16,777,214
Campus 4	128.0.0.0/8	255.0.0.0	128.255.255.254	16,777,214
Campus 5	120.0.0.0/8	255.0.0.0	120.255.255.254	16,777,214

Table 2. Network ip address of each campus

Serial Link Addressing:

Connection	Network Address	Router 1 Interface	Router 2 Interface
Campus 1 ↔ Campus 4	132.0.0.0/8	132.0.0.2 (se2/0)	132.0.0.1 (se2/0)
Campus 1 ↔ Campus 5	136.0.0.0/8	136.0.0.1 (se3/0)	136.0.0.2 (se3/0)
Campus 2 ↔ Campus 5	134.0.0.0/8	134.0.0.1 (se3/0)	134.0.0.2 (se2/0)
Campus 2 ↔ Campus 3	138.0.0.0/8	138.0.0.1 (se2/0)	138.0.0.2 (se2/0)
Campus 3 ↔ Campus 4	130.0.0.0/8	130.0.0.2 (se3/0)	130.0.0.1 (se3/0)

Table 3. Ip addresses of all serial connection

Server Addressing (Campus 5):

Server	IP Address	Subnet Mask	Default Gateway
DHCP Server	120.0.0.1	255.0.0.0	120.255.255.254
Web Server	120.0.0.2	255.0.0.0	120.255.255.254
DNS Server	120.0.0.3	255.0.0.0	120.255.255.254

Table 4. Ip addresses of servers

3.2. Router Configuration & OSPF Routing

Below are the complete CLI configuration commands for all five campus routers. These configurations include interface addressing, OSPF routing protocol, and DHCP relay settings.

Router 1 in Campus 1

```
interface fa0/0
ip address 124.255.255.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 132.0.0.2 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 136.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

router ospf 1
network 124.255.255.254 0.255.255.255 area 1
network 132.0.0.2 0.255.255.255 area 1
network 136.0.0.1 0.255.255.255 area 1
```

Figure 2. CLI command for router 1

Router 2 in Campus 2

```
interface fa0/0
ip address 126.255.255.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 138.0.0.1 255.0.0.0
no shut
do wr
exit

interface se3/0
ip address 134.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

router ospf 2
network 126.255.255.254 0.255.255.255 area 1
network 138.0.0.1 0.255.255.255 area 1
network 134.0.0.1 0.255.255.255 area 1
```

Figure 3. CLI command for router 2

Router 3 in Campus 3

```
interface fa0/0
ip address 122.255.255.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 138.0.0.2 255.0.0.0
clock rate 64000
no shut
do wr
exit

interface se3/0
ip address 130.0.0.2 255.0.0.0
no shut
do wr
exit

router ospf 3
network 122.255.255.254 0.255.255.255 area 1
network 138.0.0.2 0.255.255.255 area 1
network 130.0.0.2 0.255.255.255 area 1
```

Figure 4. CLI command for router 2

Router 4 in Campus 4

```
interface fa0/0
ip address 128.255.255.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 132.0.0.1 255.0.0.0
no shut
do wr
exit

interface se3/0
ip address 130.0.0.1 255.0.0.0
clock rate 64000
no shut
do wr
exit

router ospf 4
network 128.255.255.254 0.255.255.255 area 1
network 132.0.0.1 0.255.255.255 area 1
network 130.0.0.1 0.255.255.255 area 1
```

Figure 5. CLI command to for router 4

Router 5 in Campus 5

```
interface fa0/0
ip address 120.255.255.254 255.0.0.0
no shut
do wr
exit

interface se2/0
ip address 134.0.0.2 255.0.0.0
no shut
do wr
exit

interface se3/0
ip address 136.0.0.2 255.0.0.0
no shut
do wr
exit

router ospf 5
network 120.255.255.254 0.255.255.255 area 1
network 134.0.0.2 0.255.255.255 area 1
network 136.0.0.2 0.255.255.255 area 1
```

Figure 6. CLI command for router 5

3.3. DHCP Configuration

To enable automatic IP address assignment for all end devices across the university, a centralized DHCP server was deployed in the Campus 5 server room. This approach provides unified IP address management and simplifies network administration.

DHCP Server Static Configuration:

Before configuring DHCP pools, the server itself was assigned a static IP address:

- **IP Address:** 120.0.0.1
- **Subnet Mask:** 255.0.0.0
- **Default Gateway:** 120.255.255.254
- **DNS Server:** 120.0.0.3 (pointing to the DNS server on the same LAN)

DHCP Pool Configuration:

Five separate DHCP pools were configured, one for each campus network.Each pool default Gateway is The router's LAN interface IP for that campus

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
campus 1	124.255.255.254	120.0.0.3	124.0.0.1	255.0.0.0	100	0.0.0.0	0.0.0.0
campus 2	126.255.255.254	120.0.0.3	126.0.0.1	255.0.0.0	100	0.0.0.0	0.0.0.0
campus 3	122.255.255.254	120.0.0.3	122.0.0.1	255.0.0.0	100	0.0.0.0	0.0.0.0
campus 4	128.255.255.254	120.0.0.3	128.0.0.1	255.0.0.0	100	0.0.0.0	0.0.0.0
campus 5	120.255.255.254	120.0.0.3	120.0.0.4	255.0.0.0	100	0.0.0.0	0.0.0.0
serverPool	0.0.0.0	0.0.0.0	120.0.0.0	255.0.0.0	512	0.0.0.0	0.0.0.0

Figure 7. DHCP pool configuration

DHCP Relay Configuration:

Since the DHCP server resides in Campus 5, but clients exist in all five campuses, DHCP relay (IP helper-address) was configured on each router's LAN interface to forward DHCP broadcast requests to the central DHCP server:

```
Giving DHCP access to all Networks

enable
config
interface fa0/0
ip helper-address 120.0.0.1
```

Figure 8. DHCP relay configuration

3.4. Web Server Configuration

The Web Server hosts the official University of Scholars website, providing a centralized resource accessible from all campuses.

Web Server Static Configuration:

- **IP Address:** 120.0.0.2
- **Subnet Mask:** 255.0.0.0
- **Default Gateway:** 120.255.255.254
- **DNS Server:** 120.0.0.3

HTTP Service Configuration:

The HTTP service was enabled on the web server, and the university's homepage was created by editing the **index.html** file.

The web server is accessible via: **http://120.0.0.2**

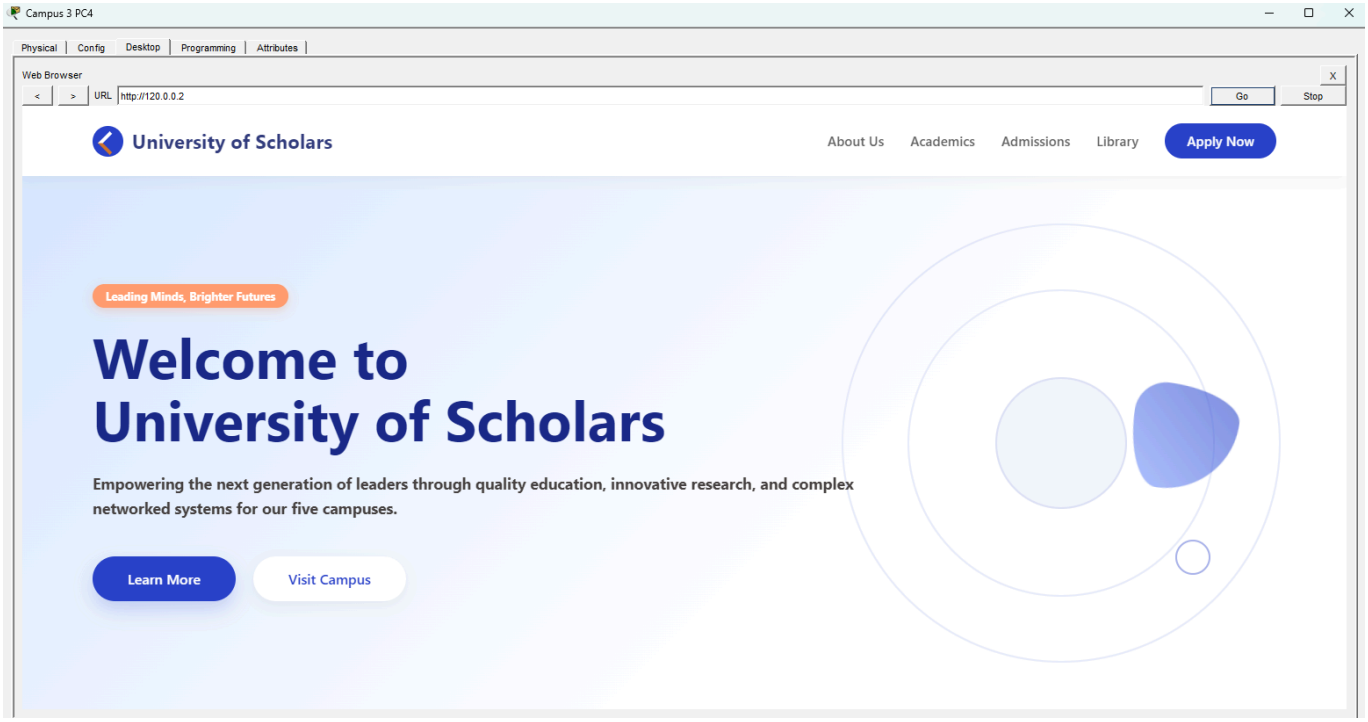

Figure 9. Web server access via web IP address

3.5. DNS Configuration

The DNS (Domain Name System) server provides name resolution services, translating the human-readable domain name (www.scholars.edu.bd) into the web server's IP address (120.0.0.2). This eliminates the need for users to remember numerical IP addresses.

DNS Server Static Configuration:

- **IP Address:** 120.0.0.3
- **Subnet Mask:** 255.0.0.0
- **Default Gateway:** 120.255.255.254

DNS Service Configuration:

The DNS service was enabled on the server, and an A (Address) record was created to map the university's domain name to the web server:

- **Domain Name:** www.scholars.edu.bd
- **Record Type:** A (Address Record)
- **Mapped IP Address:** 120.0.0.2

No.	Name	Type	Detail
0	www.scholars.edu.bd	A Record	120.0.0.2

Figure 10. DNS pool configuration

Now, the web server is accessible via: **http://www.scholars.edu.bd**

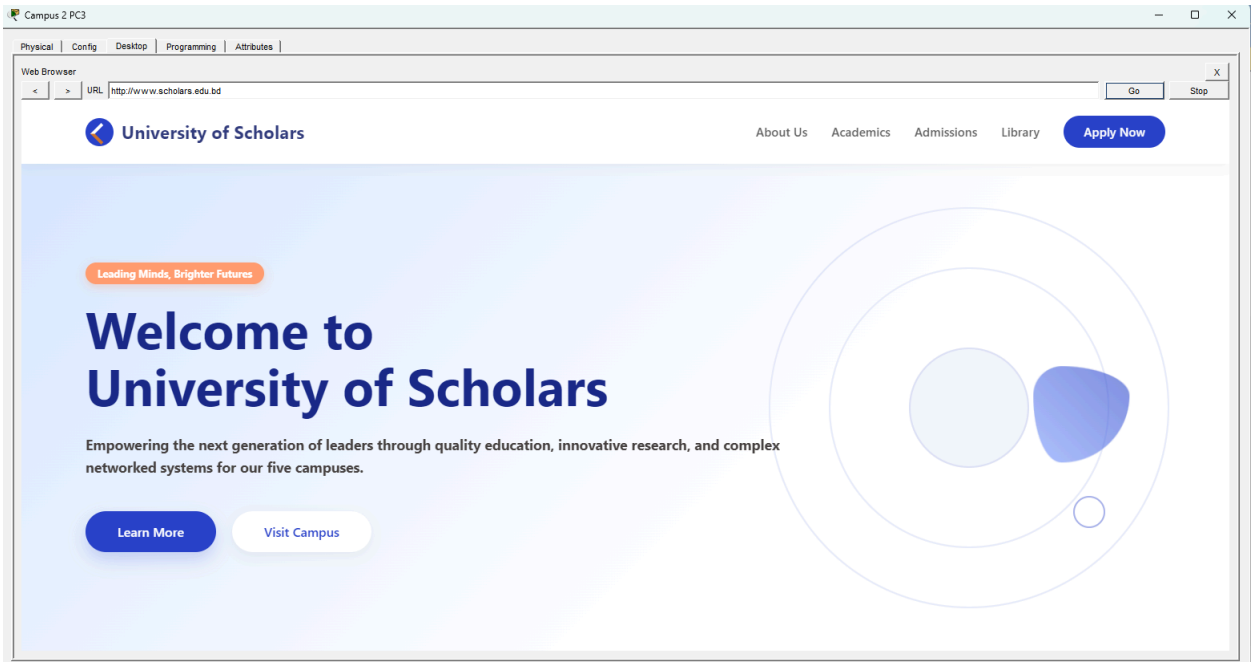

Figure 11. Web server access after DNS is set

4. *Network Testing*

4.1. DHCP Request

Test Objective: Verify that hosts in all campuses receive IP addresses automatically from the centralized DHCP server (120.0.0.1).

Test Procedure:

1. Configured all end devices (PCs and laptops) to obtain IP addresses via DHCP
2. Observed the DHCP request and response process
3. Verified that assigned IPs match the configured pool ranges
4. Confirmed that devices received correct default gateway and DNS server addresses

Test Results:

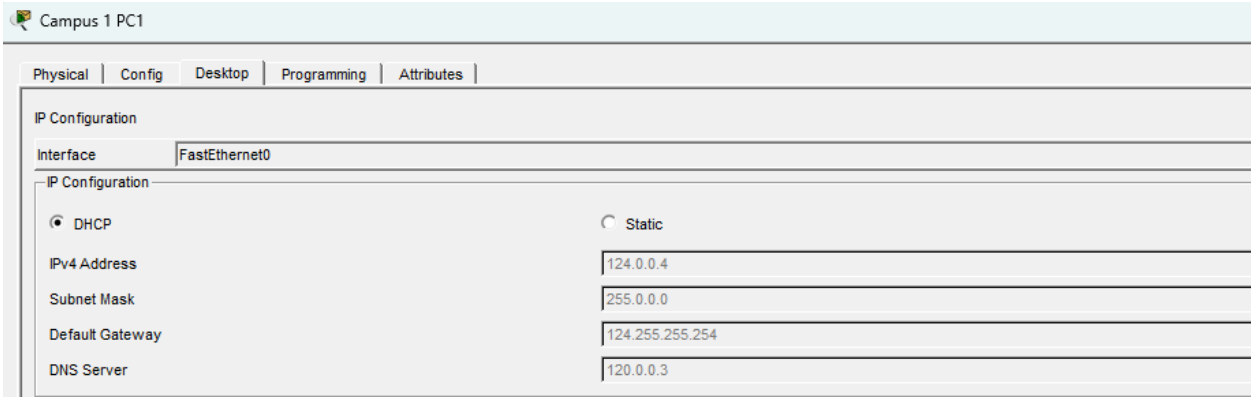

Figure 12. host IP address via DHCP of campus 1

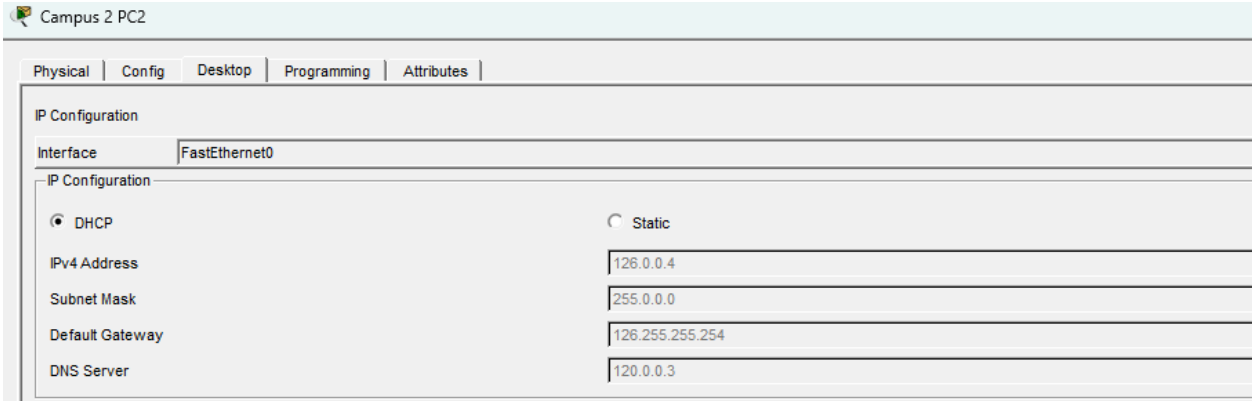

Figure 13. host IP address via DHCP of campus 2

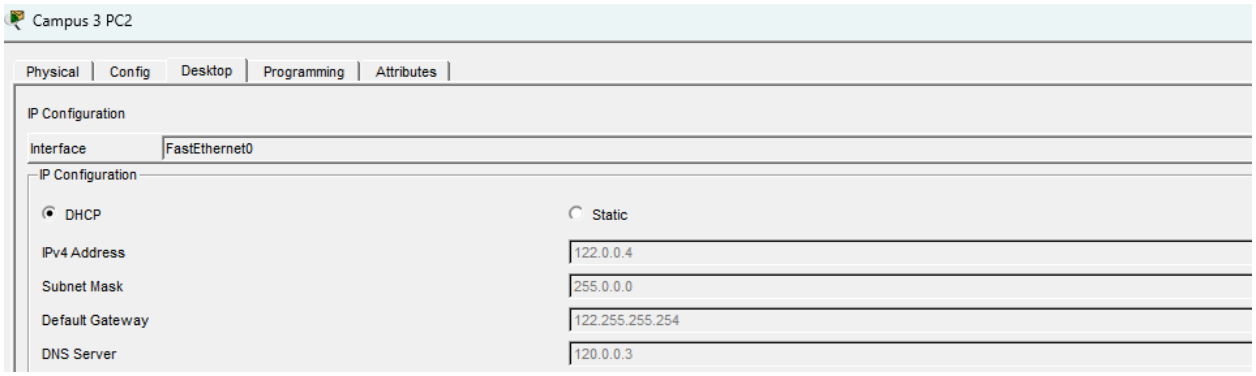

Figure 14. host IP address via DHCP of campus 3

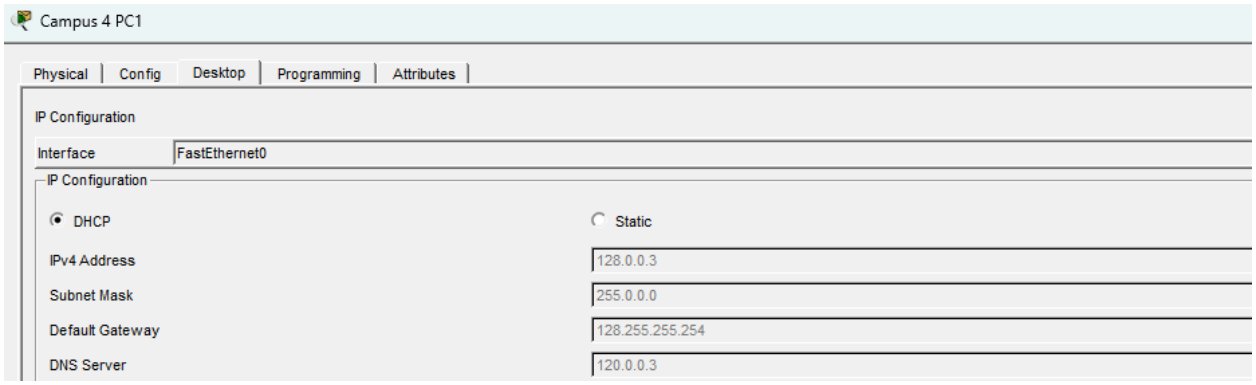

Figure 15. host IP address via DHCP of campus 4

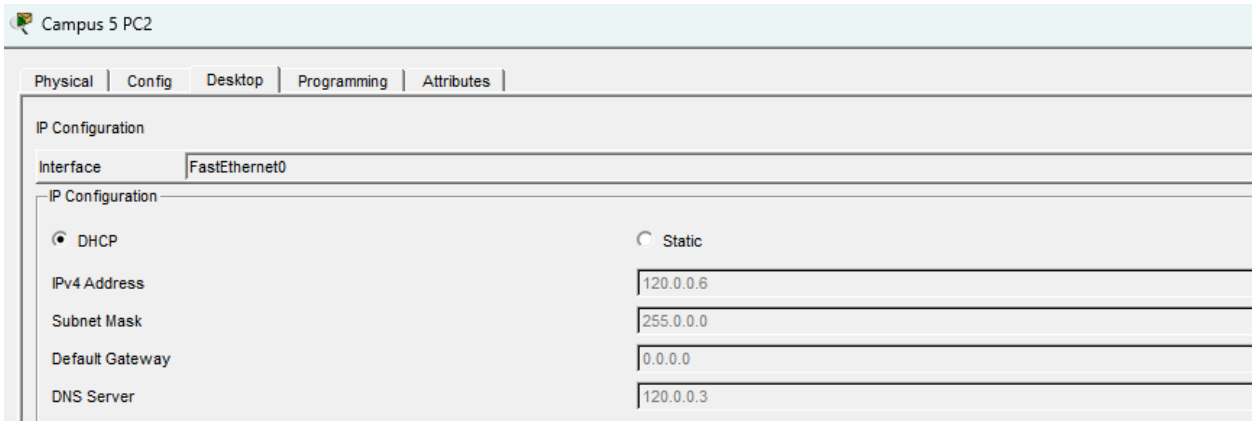

Figure 16. host IP address via DHCP of campus 5

4.2. ICMP Test

Test Objective: Verify complete Layer 3 connectivity between all hosts across different campuses using ping (ICMP echo request/reply).

Test Categories:

a) Campus-to-Campus Router Connectivity:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	Router 2	Router 5	ICMP		0.000	N	0
	Successful	Router 4	Router 5	ICMP		0.000	N	1
	Successful	Router 4	Router 1	ICMP		0.000	N	2
	Successful	Router 2	Router 4	ICMP		0.000	N	3
	Successful	Router 1	Router 3	ICMP		0.000	N	4

Figure 17. Ping test between routers

b) Intra-Campus Connectivity:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	Campus 2 PC3	campus 2 Laptop 2	ICMP		0.000	N	0
	Successful	Campus 2 PC2	Campus 2 PC4	ICMP		0.000	N	1
	Successful	Campus 2 PC1	campus 2 Laptop 1	ICMP		0.000	N	2
	Successful	Campus 2 PC2	campus 2 Laptop 1	ICMP		0.000	N	3

Figure 18. Ping test between Intra campus hosts

c) Inter-Campus Host Connectivity:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	Campus 2 PC2	Campus 3 PC1	ICMP		0.000	N	0
	Successful	Campus 1 PC2	Campus 3 PC1	ICMP		0.000	N	1
	Successful	campus 2 Laptop 2	Campus 1 PC5	ICMP		0.000	N	2
	Successful	Campus 1 PC1	Campus 4 PC3	ICMP		0.000	N	3

Figure 19. Ping test between Inter campus hosts

d) Host-to-Server Connectivity:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	DHCP Server	Campus 5 PC1	ICMP		0.000	N	0
	Successful	Web Server	Campus 3 PC1	ICMP		0.000	N	1
	Successful	campus 1 Laptop 2	Web Server	ICMP		0.000	N	2
	Successful	Campus 2 PC4	DNS Server	ICMP		0.000	N	3

Figure 20. Ping test between servers and hosts

5. Routing Tables

The OSPF routing protocol automatically builds routing tables on each router. Below are sample routing tables showing learned routes for inter-campus connectivity.

Router 1 Routing Table (Campus 1)

Destination Network	Next Hop	Interface	Protocol
124.0.0.0/8	Directly Connected	Fa0/0	Connected
132.0.0.0/8	Directly Connected	Se2/0	Connected
136.0.0.0/8	Directly Connected	Se3/0	Connected
126.0.0.0/8	136.0.0.2	Se3/0	OSPF
122.0.0.0/8	132.0.0.1	Se2/0	OSPF
128.0.0.0/8	132.0.0.1	Se2/0	OSPF
120.0.0.0/8	136.0.0.2	Se3/0	OSPF
134.0.0.0/8	136.0.0.2	Se3/0	OSPF
138.0.0.0/8	136.0.0.2	Se3/0	OSPF
130.0.0.0/8	132.0.0.1	Se2/0	OSPF

Table 5. Routing table of router 1

Router 2 Routing Table (Campus 2)

Destination Network	Next Hop	Interface	Protocol
126.0.0.0/8	Directly Connected	Fa0/0	Connected
138.0.0.0/8	Directly Connected	Se2/0	Connected
134.0.0.0/8	Directly Connected	Se3/0	Connected
122.0.0.0/8	138.0.0.2	Se2/0	OSPF
120.0.0.0/8	134.0.0.2	Se3/0	OSPF
124.0.0.0/8	134.0.0.2	Se3/0	OSPF

128.0.0.0/8	138.0.0.2	Se2/0	OSPF
132.0.0.0/8	134.0.0.2	Se3/0	OSPF
136.0.0.0/8	134.0.0.2	Se3/0	OSPF
130.0.0.0/8	138.0.0.2	Se2/0	OSPF

Table 6. Routing table of router 2

Router 3 Routing Table (Campus 3)

Destination Network	Next Hop	Interface	Protocol
122.0.0.0/8	Directly Connected	Fa0/0	Connected
138.0.0.0/8	Directly Connected	Se2/0	Connected
130.0.0.0/8	Directly Connected	Se3/0	Connected
126.0.0.0/8	138.0.0.1	Se2/0	OSPF
128.0.0.0/8	130.0.0.1	Se3/0	OSPF
124.0.0.0/8	130.0.0.1	Se3/0	OSPF
120.0.0.0/8	138.0.0.1	Se2/0	OSPF
134.0.0.0/8	138.0.0.1	Se2/0	OSPF
136.0.0.0/8	130.0.0.1	Se3/0	OSPF
132.0.0.0/8	130.0.0.1	Se3/0	OSPF

Table 7. Routing table of router 3

Router 4 Routing Table (Campus 4)

Destination Network	Next Hop	Interface	Protocol
128.0.0.0/8	Directly Connected	Fa0/0	Connected
132.0.0.0/8	Directly Connected	Se2/0	Connected
130.0.0.0/8	Directly Connected	Se3/0	Connected

124.0.0.0/8	132.0.0.2	Se2/0	OSPF
122.0.0.0/8	130.0.0.2	Se3/0	OSPF
126.0.0.0/8	130.0.0.2	Se3/0	OSPF
120.0.0.0/8	132.0.0.2	Se2/0	OSPF
136.0.0.0/8	132.0.0.2	Se2/0	OSPF
134.0.0.0/8	130.0.0.2	Se3/0	OSPF
138.0.0.0/8	130.0.0.2	Se3/0	OSPF

Table 8. Routing table of router 4

Router 5 Routing Table (Campus 5)

Destination Network	Next Hop	Interface	Protocol
120.0.0.0/8	Directly Connected	Fa0/0	Connected
134.0.0.0/8	Directly Connected	Se2/0	Connected
136.0.0.0/8	Directly Connected	Se3/0	Connected
126.0.0.0/8	134.0.0.1	Se2/0	OSPF
124.0.0.0/8	136.0.0.1	Se3/0	OSPF
122.0.0.0/8	134.0.0.1	Se2/0	OSPF
128.0.0.0/8	136.0.0.1	Se3/0	OSPF
138.0.0.0/8	134.0.0.1	Se2/0	OSPF
132.0.0.0/8	136.0.0.1	Se3/0	OSPF
130.0.0.0/8	134.0.0.1	Se2/0	OSPF

Table 9. Routing table of router 5

Key Observations:

- Each router has three directly connected networks (one LAN, two serial connections)
- All other networks are learned via OSPF
- OSPF automatically selects the best path based on cost metrics
- Changes in topology are automatically reflected in routing tables through OSPF updates

6. Limitations

Centralized DHCP Server:

- **Limitation:** Single point of failure—if the DHCP server fails, no new hosts can obtain IP addresses
- **Impact:** Existing hosts with leased IPs continue to function, but new devices or lease renewals may fail
- **Mitigation:** In production environments, DHCP redundancy (failover or hot-standby) would be implemented

Single OSPF Area:

- **Limitation:** All routers are in Area 1, which may impact scalability in very large networks
- **Impact:** Adequate for five routers, but networks with dozens of routers should use multi-area OSPF
- **Justification:** Simplified configuration and management appropriate for this scale

Inefficient Subnet Sizing:

- **Limitation:** Using /8 subnets for serial point-to-point links wastes millions of addresses
- **Impact:** No practical impact in a private network, but poor practice for real-world implementation
- **Best Practice:** Serial links should use /30 subnets (providing only 2 usable addresses)

Serial Connection Clock Rate:

- **Limitation:** 64 kbps clock rate simulates very slow WAN connections
- **Impact:** In real scenarios, slow links could create bottlenecks for data-intensive applications
- **Justification:** Adequate for simulation purposes and demonstrates WAN configuration principles

Cisco Packet Tracer Limitations:

- **Simulation Quirks:** Initial ping attempts may fail due to ARP resolution delays
- **Wireless-Wired Communication:** Occasional connectivity issues between wireless and wired hosts
- **Workaround:** Multiple ping attempts or IP configuration reset typically resolves issues
- **Hardware Constraints:** Limited protocol support compared to actual Cisco devices

7. Conclusion

This project successfully designed and implemented a comprehensive, fully functional network infrastructure for the University of Scholars, meeting all specified requirements and demonstrating practical application of advanced networking concepts.

Project Accomplishments:
All primary objectives were achieved:

- **Complete Inter-Campus Connectivity:** Five campuses are fully interconnected using serial WAN links arranged in a star topology, with Campus 5 serving as the central hub
- **Dynamic Routing Implementation:** OSPF routing protocol was successfully configured across all five routers, providing automatic route calculation, fast convergence, and simplified network management
- **Centralized Services:** A unified server farm was deployed in Campus 5, providing DHCP, DNS, and web services accessible from all campuses
- **Automatic IP Configuration:** A single DHCP server dynamically assigns IP addresses to all hosts across the five campuses, eliminating manual configuration and reducing administrative overhead
- **Domain Name Resolution:** The DNS server successfully resolves www.scholars.edu.bd to the web server, providing user-friendly access to university resources
- **Mixed Connectivity:** Both wired and wireless connectivity were implemented in each campus, accommodating diverse device types and user preferences
- **Scalable Design:** The network architecture supports substantial future growth in terms of both additional hosts per campus and expansion to new campuses

Real-World Relevance:
The designed network closely mirrors actual enterprise network architectures found in universities, corporate campuses, and multi-location organizations. The skills and knowledge demonstrated in this project are directly applicable to real-world network engineering positions.

Future-Ready Architecture:
The network's design prioritizes scalability and flexibility:

- Generous IP address space accommodates decades of growth
- Modular architecture allows easy addition of new campuses or services
- OSPF provides dynamic adaptation to topology changes
- Centralized service model simplifies management while supporting distributed access

Educational Value:
This project provided hands-on experience with:

- Network planning and design methodology
- Cisco router and switch configuration
- Troubleshooting network connectivity issues
- Understanding the interaction between network layers (Layer 2 switching, Layer 3 routing, Layer 7 application services)
- Documentation and professional reporting

In conclusion, the University of Scholars network project successfully demonstrates the design, implementation, and validation of a complex, multi-campus enterprise network. The infrastructure meets all current operational requirements while providing a solid foundation for future technological advancement and organizational growth. The project showcases both technical proficiency in network engineering and professional capability in documentation and presentation.