Computer Networks Laboratory Report

UIU InterLink: Department-Based Network Infrastructure

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Submitted By:

Md. Tanzamul Azad

Student ID: 0112230863

Email: mazad223863@bscse.uiu.ac.bd

Department of Computer Science and Engineering

United International University (UIU)

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Abstract

This project demonstrates the design and implementation of a department-based network infrastructure titled **UIU InterLink**. The network interconnects multiple departments — HR, IT, Admin, Research, and Public — using routers, switches, and workstations in Cisco Packet Tracer. Dynamic Host Configuration Protocol (DHCP) was implemented for automated IP assignment, while Open Shortest Path First (OSPF) routing ensured dynamic and scalable connectivity among routers. Network Address Translation (NAT) was configured on the public router to simulate external internet access. The project focuses on creating a practical, well-structured, and scalable enterprise-level topology.

(a) Network Description

The network was designed to represent a departmental structure similar to a university environment, where each department functions within its own subnet. The HR, IT, Admin, Research, and Public Server zones each have dedicated routers and switches, connected via a core backbone router. OSPF routing was implemented for inter-departmental communication, and DHCP was used for efficient IP allocation. The Public router also manages NAT to simulate external connectivity for testing internet-based communication.

Subnet Summary:

- HR Department: `192.168.10.0/26`
- IT Department: `192.168.20.0/26`
- Admin Department: `192.168.30.0/27`
- Research Department: `172.16.10.0/26`
- Public/Server Department: `198.51.100.0/24, 203.0.113.0/24`

Each router uses FastEthernet or Serial interfaces to interconnect departments using the `10.10.x.x/30` addressing scheme for point-to-point links.

(b) CLI Commands and Tools Used

The network was developed and configured using **Cisco Packet Tracer 8.x**. Both CLI-based configuration and visual topology design were utilized.

Router Configuration

General Setup:

```
enable
configure terminal
hostname <Router-Name>
ip cef
no ipv6 cef
```

DHCP Configuration Example:

```
ip dhcp excluded-address 192.168.10.1 192.168.10.10
ip dhcp pool HR
 network 192.168.10.0 255.255.255.192
 default-router 192.168.10.1
 dns-server 8.8.8.8
```

Interface Setup:

```
interface fa0/0
 ip address 192.168.10.1 255.255.255.192
 no shutdown
interface fa0/1
 ip address 10.10.0.1 255.255.255.252
 no shutdown
exit
```

OSPF Routing:

```
router ospf 1
 router-id 1.1.1.1
 network 192.168.10.0 0.0.0.63 area 0
 network 10.10.0.0 0.0.0.255 area 0
 passive-interface default
 no passive-interface fa0/1
end
```

NAT Configuration (Public Router):

```
access-list 10 permit 192.168.10.0 0.0.0.63
access-list 10 permit 192.168.20.0 0.0.0.63
access-list 10 permit 192.168.30.0 0.0.0.31
access-list 10 permit 172.16.10.0 0.0.0.63

interface fa5/0
```

```
 ip nat outside
interface fa0/0
 ip nat inside
ip nat inside source list 10 interface fa5/0 overload
```

Switch Configuration

```
enable
configure terminal
hostname SW-HR
interface vlan 1
 ip address 192.168.10.2 255.255.255.192
 no shutdown
spanning-tree mode pvst
end
write memory
```

Verification Commands

```
show ip interface brief
show ip route
show ip dhcp binding
ping 192.168.20.1
traceroute 203.0.113.1
```

These commands were used for network verification, connectivity testing, and routing diagnostics.

(c) Personal Contribution and Challenges

Personal Contribution

I was primarily responsible for ensuring that the overall **network operated smoothly and efficiently**. After my teammates completed the initial **router** and **DHCP configurations**, I focused on the **integration, testing, and troubleshooting** phases. My main tasks included:

- Verifying **connectivity across all departments** through systematic ping and traceroute testing.

- Correcting **addressing errors** and ensuring accurate subnet mask configurations.
- Configuring and validating **OSPF routing** across all routers to achieve full inter-network communication.
- Ensuring each **subnet received proper IP addresses via DHCP**.
- Testing and confirming proper **NAT functionality** for simulated internet access.
- Enabling disabled interfaces and confirming port status using `show ip interface brief`.

Through these tasks, I made the entire topology **functional, stable, and nearly complete**. My contribution directly resulted in achieving reliable communication between all routers, switches, and PCs.

Challenges Encountered

While working on this project, I faced and resolved several technical challenges:

- **Duplicate DHCP Pools:** Initially, multiple pools overlapped within the same subnet, causing address conflicts.
- **Incorrect Default Gateways:** Some routers had mismatched gateway addresses, leading to DHCP failures.
- **Routing Loops and OSPF Adjacency Issues:** OSPF failed initially due to missing network statements, which I corrected.
- **Inactive Interfaces:** Certain ports were administratively down; I used `no shutdown` to restore them.
- **Connectivity Gaps:** Final ping tests revealed inter-department communication gaps that I resolved through subnet and routing corrections.

Each issue improved my understanding of practical network troubleshooting and configuration logic.

Conclusion

The **UIU InterLink** project successfully demonstrates a realistic departmental network model using Cisco Packet Tracer. By integrating DHCP, OSPF, and NAT configurations, the network achieved automated addressing, dynamic routing, and simulated internet access. This project strengthened my practical understanding of IP subnetting, routing protocols, and enterprise-level topology design. The final setup achieved stable connectivity across all departments, representing a functional, scalable, and well-optimized academic network environment.

Final Network Topology

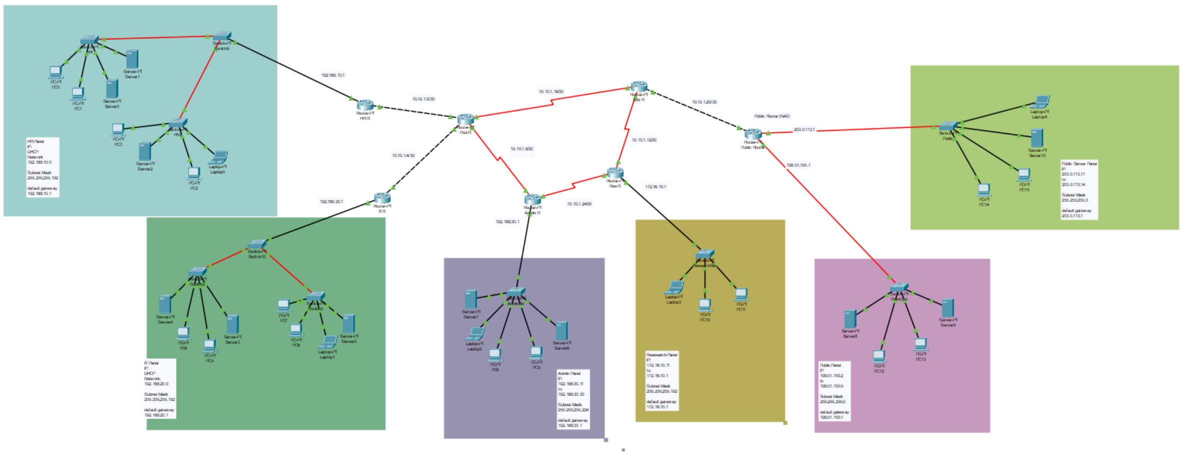

Figure: Final Project Topology of UIU InterLink in Cisco Packet Tracer