Lab Report on Computer Networks Lab

Course Code: CSE314

Experiment No: 01

Topic: Exploring Different Network Topologies Using Basic Routing Commands.

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12/09/2024

Submitted on

Experiment Name:

Exploring Different Network Topologies Using Basic Routing Commands

3. Objectives

- To understand and configure different network topologies using Cisco devices.
- To explore how network topologies affect performance, redundancy, and fault tolerance.
- To implement multiple routing techniques (static and dynamic) across various topologies.
- To test the connectivity and communication between multiple networks within each topology.

4. Theory

Network topologies define the physical or logical arrangement of network devices such as routers, switches, and hosts. Each topology has its strengths and weaknesses in terms of fault tolerance, ease of management, and scalability. Cisco routers and switches can be used to implement different topologies in a real-world or simulated environment.

Topologies Overview:

1. **Bus Topology**:
    - A single central cable (bus) to which all network devices are connected.
    - Simple but has limited scalability and fault tolerance (failure in the bus breaks the entire network).
2. **Mesh Topology**:
    - Every device is connected to every other device.
    - Provides high redundancy and fault tolerance but is complex and costly to implement.
3. **Star Topology**:
    - Devices are connected to a central router or switch.
    - Easy to manage and scalable, but failure of the central device can bring down the entire network.
4. **Ring Topology**:
    - Devices are connected in a circular manner where each device has exactly two neighbors.
    - Data travels in one direction (unidirectional ring) or both directions (bidirectional ring).
5. **Hybrid Topology**:
    - A combination of two or more different topologies.
    - Offers flexibility and resilience by combining the strengths of different topologies.

5. Equipment Used

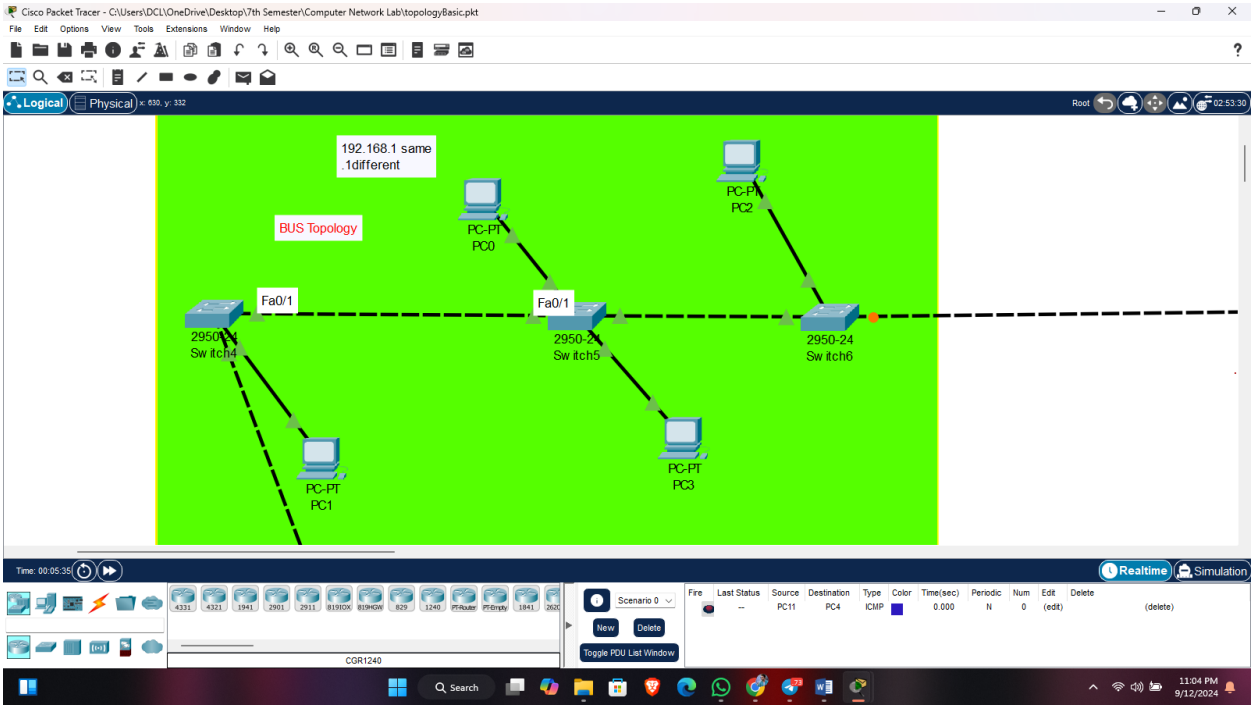
- **Cisco routers** (for routing between different networks)
- **Cisco switches** (for connecting multiple devices in star or hybrid topologies)
- **PCs or Virtual Machines** (to simulate hosts in each network)
- **Cisco Packet Tracer** (or a real-world lab for simulation)
- Ethernet cables (for physical connections)

6. Configuration Steps (Screenshots and Commands)

Configuration of Different Topologies:

A. Bus Topology

In a bus topology, all devices are connected to a single cable or backbone. For simplicity, in Cisco Packet Tracer, you can simulate this with a single router connecting multiple devices.



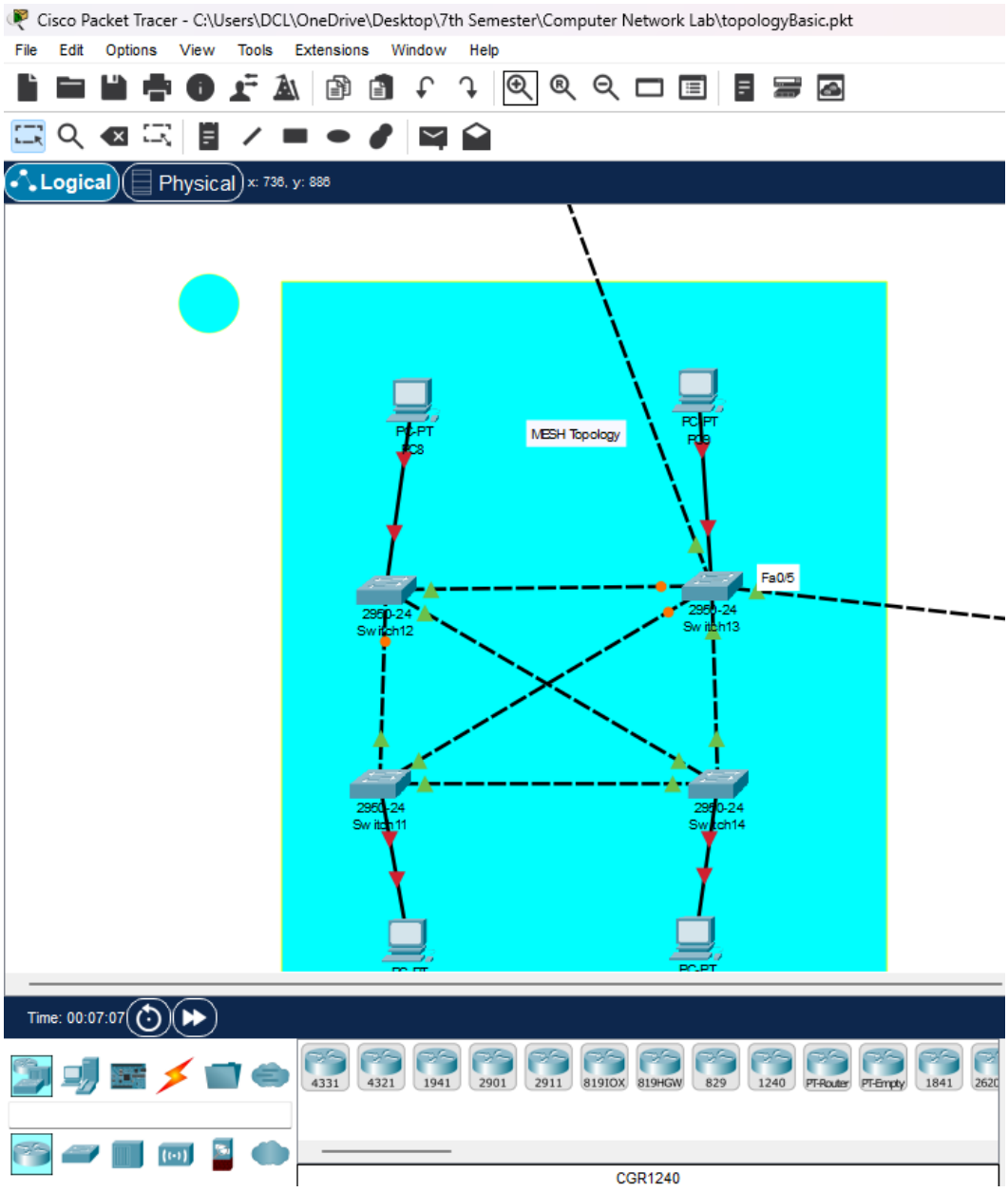
Configuration Steps:

1. **Design the Topology**:
    - Create a single central router and connect multiple PCs directly to the router via interfaces.

2. **Assign IP Addresses**:
    - Assign different IP addresses in the same subnet to all PCs.

B. Mesh Topology

In a mesh topology, each router is connected to every other router. This offers high redundancy.



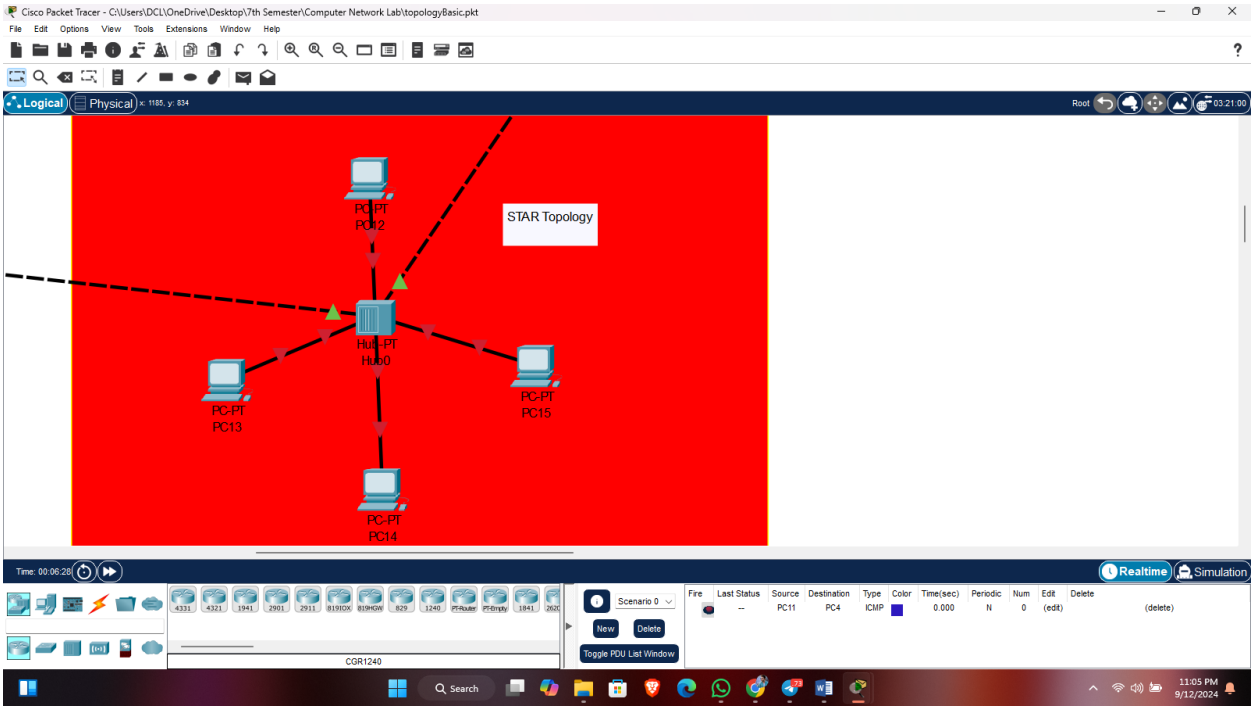
Configuration Steps:

1. **Design the Topology**:
    - Create three or more routers and connect each one to every other router.

2. **Assign IP Addresses**:
    - Assign IP addresses to each interface of the routers and PCs in different subnets.

C. Star Topology

In a star topology, all devices are connected to a central router or switch.

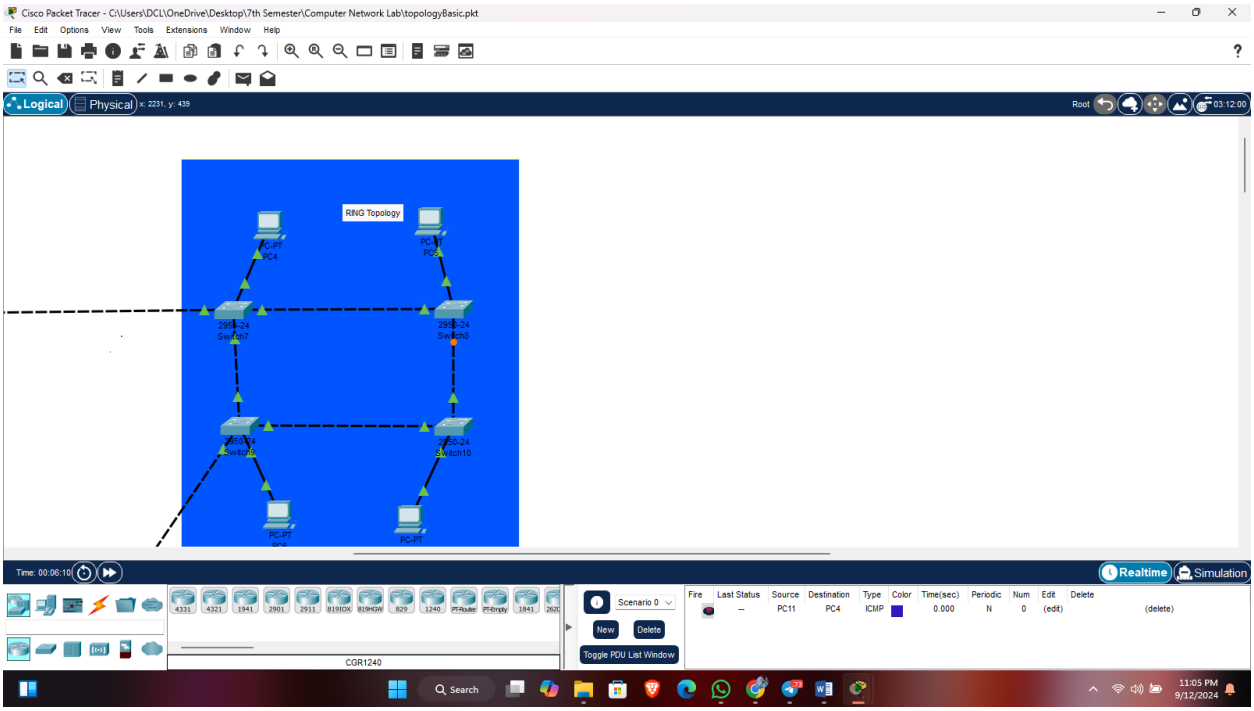


Configuration Steps:

1. **Design the Topology**:
    - Create a central router and connect multiple switches to it, then connect PCs to the switches.
2. **Assign IP Addresses**:
    - Assign IP addresses to each PC and interface of the router in different subnets.
3. **Configure Routing**:
    - Use static routing or RIP to configure routing between networks.
4. **Test Connectivity**:
    - Test connectivity using the ping command between PCs on different networks.

D. Ring Topology

In a ring topology, each router is connected in a circular fashion, forming a closed loop.

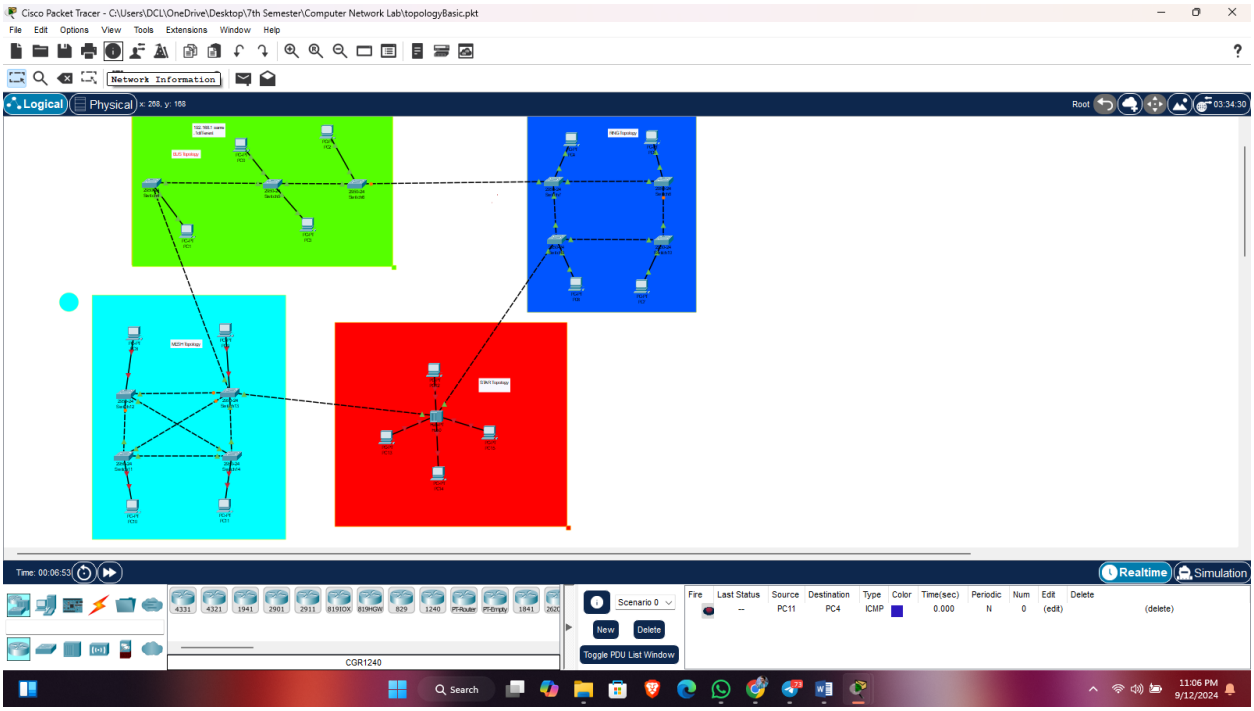


Configuration Steps:

1. **Design the Topology**:
    - Connect routers in a loop (each router has two neighbors).
2. **Assign IP Addresses**:
    - Assign unique IP addresses for each interface in different subnets.
3. **Configure Routing**:
    - Static routing or dynamic routing (e.g., OSPF or RIP) can be used.
4. **Test Connectivity**:
    - Ensure that all routers can communicate using ping.

E. Hybrid Topology

In a hybrid topology, combine different topologies (e.g., star and mesh, or ring and star).



Configuration Steps:

1. **Design the Topology**:
    - Connect one part of the network as a star topology, and another part as a mesh or ring.
2. **Assign IP Addresses**:
    - Assign IP addresses to all routers and PCs according to their subnets.
3. **Configure Routing**:
    - Use static or dynamic routing depending on the design.
4. **Test Connectivity**:
    - Test inter-network communication by pinging across different subnets.

7. Conclusion or Discussion

In this experiment, we successfully configured different network topologies using Cisco devices, including bus, mesh, star, ring, and hybrid. Each topology has its strengths and weaknesses:

- **Bus topology** is simple but lacks fault tolerance.
- **Mesh topology** provides the highest redundancy, but at the cost of complexity and scalability.
- **Star topology** is easy to manage and scalable but is reliant on the central device.
- **Ring topology** offers equal access to all devices but can suffer from delays if there are too many devices.

- **Hybrid topology** is the most flexible, combining the strengths of different topologies.

Lab Report on Computer Networks Lab

Course Code: CSE314

Experiment No: 02

Topic: Static Routing on Cisco Packet Tracer

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24/10/2024

Submitted on

1. Experiment No: 2

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2. Experiment Name:

Static Routing on Cisco Packet Tracer

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3. Objectives:

- To understand the concept of static routing in a network.
- To configure static routes in Cisco Packet Tracer for direct communication between multiple networks.
- To test the connectivity between devices after applying static routes in a multi-router network topology.

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4. Theory:

Static routing is a method of manually configuring routes in a router's routing table. This contrasts with dynamic routing protocols, which learn routes automatically. Static routing is more secure and resource-efficient for small networks where paths are fixed, but it lacks flexibility in large, dynamic environments. It requires manual updates whenever network changes occur.

In this experiment, we use static routing to connect multiple networks across different routers in Cisco Packet Tracer. Each router is configured to forward packets to specific networks through predefined static routes, allowing communication between devices on separate subnets.

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5. Equipment Used:

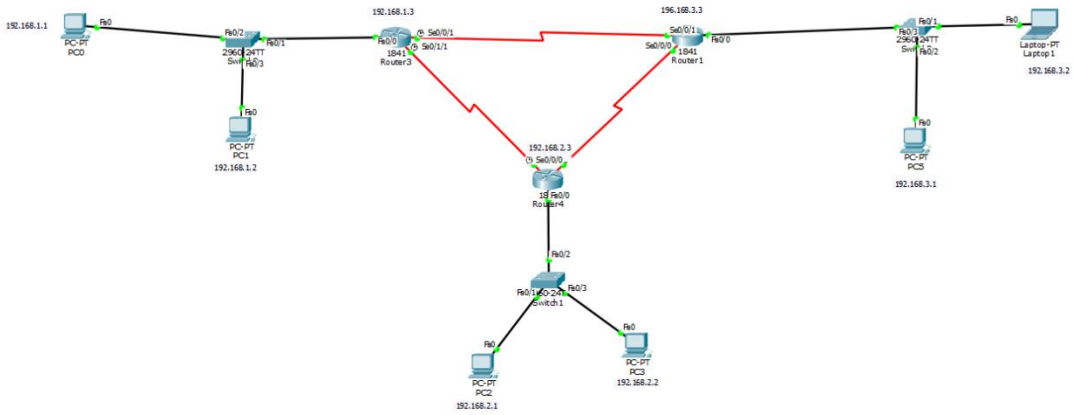
- Cisco Packet Tracer software
- **Routers**: Router1, Router3, Router4
- **Switches**: Switch0, Switch1
- **End Devices**: PCs and Laptops (e.g., PC0, PC1, PC2, PC3, PC5, Laptop0)
- **Connections**: Serial links between routers (Se0/0/0, Se0/0/1) and Ethernet cables for connecting switches and end devices
- IP addresses are assigned to devices from the following networks:
    - 192.168.1.0/24
    - 192.168.2.0/24
    - 192.168.3.0/24

6. Configuration Steps:

Step 1: Network Topology Setup

- The network consists of 3 routers (Router1, Router3, Router4), interconnected via serial connections (Se0/0/0, Se0/0/1).
- Each router is connected to a switch, which in turn connects to multiple end devices (PCs and laptops).
- The IP addresses used in the setup are:
    - **Router1 (Se0/0/0):** 196.168.3.1
    - **Router3 (Se0/0/1):** 192.168.1.3
    - **Router4 (Se0/0/0):** 192.168.2.3
    - **End Devices:** Assigned IP addresses within their respective subnets.

Screenshot:



Step 2: Assigning IP Addresses to Router Interfaces

- **Router1 Configuration:**

```
Router1> enable
Router1# configure terminal
Router1(config)# interface fastEthernet 0/0
Router1(config-if)# ip address 192.168.3.1 255.255.255.0
Router1(config-if)# no shutdown
Router1(config-if)# exit
```

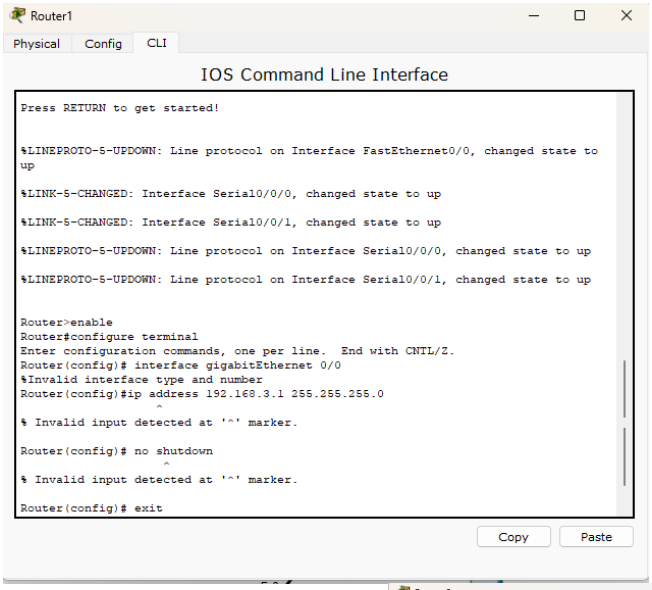
- **Router3 Configuration:**

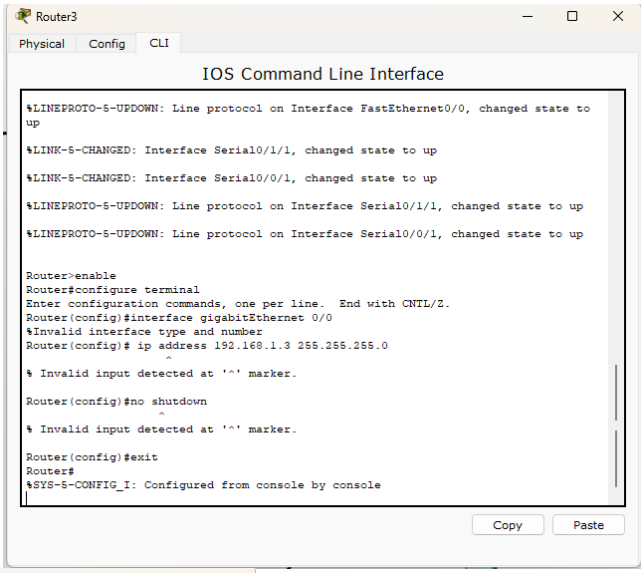
```
Router3> enable
Router3# configure terminal
Router3(config)# interface fastEthernet 0/0
Router3(config-if)# ip address 192.168.1.3 255.255.255.0
Router3(config-if)# no shutdown
Router3(config-if)# exit
```

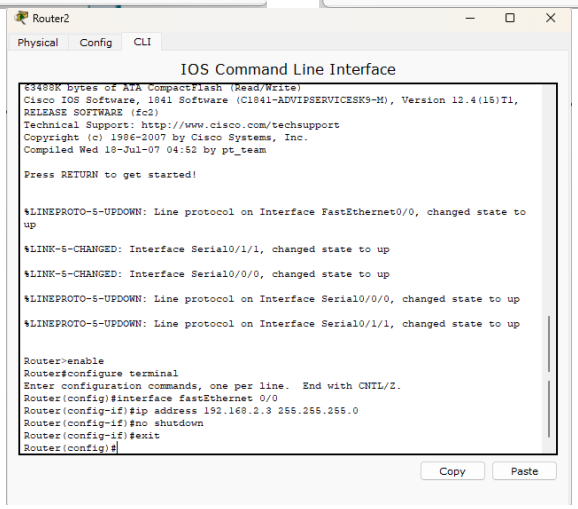
- **Router4 Configuration:**

```
Router4> enable
Router4# configure terminal
Router4(config)# interface fastEthernet 0/0
Router4(config-if)# ip address 192.168.2.3 255.255.255.0
Router4(config-if)# no shutdown
Router4(config-if)# exit
```

Screenshot:







Step 3: Configuring Static Routes

- After assigning IP addresses, configure static routes so that each router knows how to reach the networks connected to the other routers.
- **Router1:**

```
Router1(config)# ip route 192.168.1.0 255.255.255.0 192.168.3.2
Router1(config)# ip route 192.168.2.0 255.255.255.0 192.168.3.2
```

- **Router3:**

```
Router3(config)# ip route 192.168.3.0 255.255.255.0 192.168.1.1
Router3(config)# ip route 192.168.2.0 255.255.255.0 192.168.1.1
```

- **Router4:**

```
Router4(config)# ip route 192.168.1.0 255.255.255.0 192.168.2.2
Router4(config)# ip route 192.168.3.0 255.255.255.0 192.168.2.2
```

Step 4: Verifying the Configuration

- Use the `ping` command to verify connectivity between devices across different networks.
- For example, from **PC0** (192.168.1.1) ping **PC3** (192.168.3.2) to check if static routing is configured correctly.

```
PC0> ping 192.168.3.2
```

- Verify routing tables using the `show ip route` command:

```
Router# show ip route
```

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7. Conclusion or Discussion:

In this lab, we successfully implemented static routing in a multi-router network setup using Cisco Packet Tracer. The configured static routes enabled communication between devices across different networks. Static routing is beneficial for smaller networks with fixed paths as it offers greater control and security. However, in larger and more dynamic networks, maintaining static routes manually can become cumbersome and less efficient.

By verifying network connectivity with ping commands and examining the routing tables, we ensured that the static routes were functioning as intended. This experiment provided valuable experience in configuring and troubleshooting static routes in real-world scenarios.

Lab Report on Computer Networks Lab

Course Code: CSE314

Experiment No: 03

Topic: RIP(v1 &v2),OSPF, Static and dynamic NAT

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28/11/2024

Submitted on

1. Experiment No: 3

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2. Experiment Name:

RIP (v1 & v2), OSPF, Static NAT, and Dynamic NAT Configuration

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3. Objectives:

- To configure and understand RIP (v1 & v2) and OSPF routing protocols.
- To learn the differences between static and dynamic NAT.
- To implement and verify routing protocols and NAT in Cisco Packet Tracer for seamless communication across different networks.

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4. Theory:

Routing Protocols:

- **RIP (Routing Information Protocol):** A distance-vector protocol that uses hop count as the metric.
    - **RIP v1:** Supports classful routing, doesn't include subnet masks.
    - **RIP v2:** Supports classless routing, includes subnet masks, and allows variable-length subnet masks (VLSM).
- **OSPF (Open Shortest Path First):** A link-state routing protocol that calculates the shortest path using Dijkstra's algorithm. OSPF is more efficient than RIP for large networks, as it has faster convergence and supports hierarchical routing.

NAT (Network Address Translation):

- **Static NAT:** Maps a single private IP address to a public IP address. Ideal for servers needing a fixed public IP.
- **Dynamic NAT:** Maps a pool of private IP addresses to a pool of public IPs. Useful for conserving public IP addresses by dynamically assigning them as needed.

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5. Equipment Used:

- Cisco Packet Tracer software
- **Routers**: Various models (e.g., 1841, 2911)
- **Switches**: 2960-24TT

- **End Devices**: PCs and laptops
- **Connections**: Serial and Ethernet cables
- IP Address Pools for NAT
- Routing Protocols Configuration

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6. Configuration Steps:

A. RIP Configuration:

Step 1: Enable RIP on Routers

- **RIP v1:**

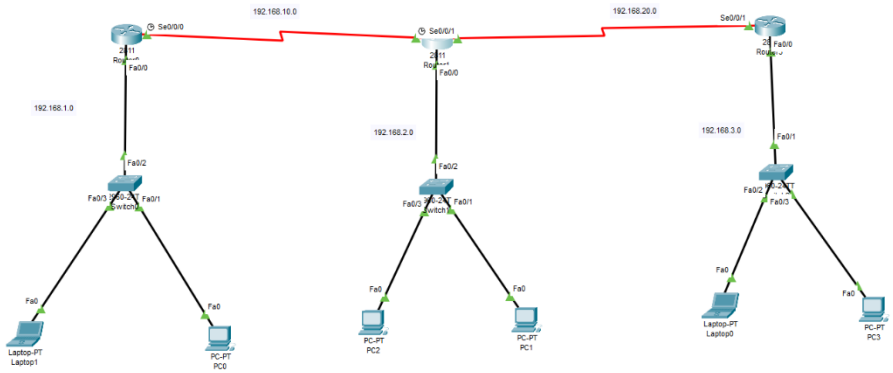
```
Router(config)# router rip
Router(config-router)# version 1
Router(config-router)# network 192.168.1.0
Router(config-router)# network 192.168.2.0
```

- **RIP v2:**

```
Router(config)# router rip
Router(config-router)# version 2
Router(config-router)# no auto-summary
Router(config-router)# network 192.168.1.0
Router(config-router)# network 192.168.2.0
```

Step 2: Verify RIP Configuration
Use `show ip route` and `show ip protocols` commands.

Screenshot:



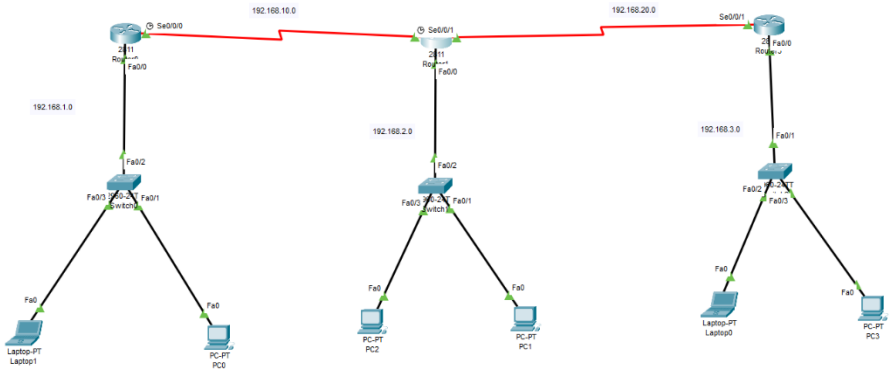
B. OSPF Configuration:

Step 1: Enable OSPF

```
Router(config)# router ospf 1
Router(config-router)# network 192.168.1.0 0.0.0.255 area 0
Router(config-router)# network 192.168.2.0 0.0.0.255 area 0
```

Step 2: Verify OSPF
Use `show ip ospf neighbor` and `show ip route`.

Screenshot:



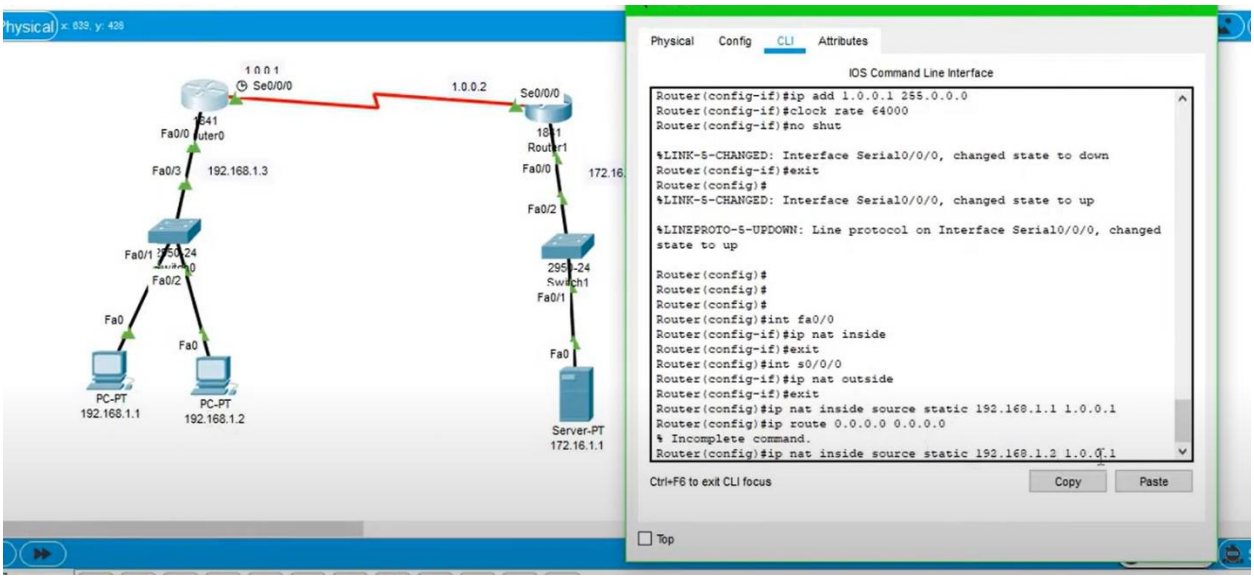
C. Static NAT Configuration:

Step 1: Configure Static NAT

```
Router(config)# ip nat inside source static 192.168.1.2 203.0.113.2
Router(config)# interface gigabitEthernet 0/0
Router(config-if)# ip nat inside
Router(config-if)# exit
Router(config)# interface serial 0/0/0
Router(config-if)# ip nat outside
```

Step 2: Verify Static NAT
Use the command `show ip nat translations`.

Screenshot:



D. Dynamic NAT Configuration:

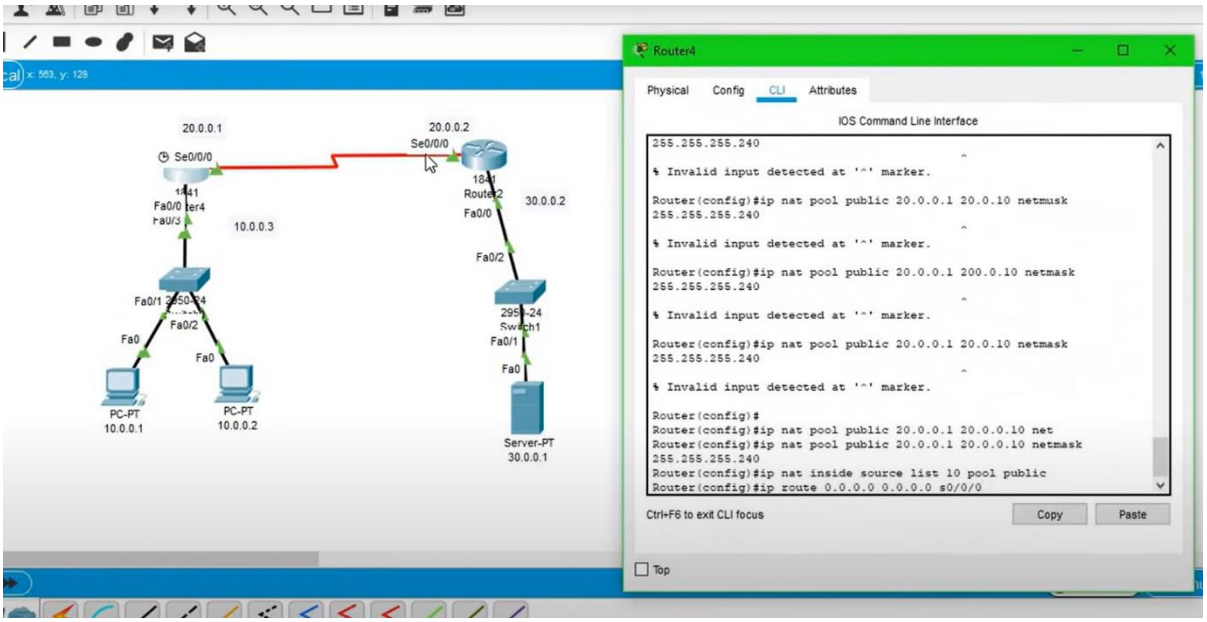
Step 1: Configure Dynamic NAT with Pool

```
Router(config)# ip nat pool public 203.0.113.2 203.0.113.10 netmask
255.255.255.0

Router(config)# access-list 1 permit 192.168.1.0 0.0.0.255
Router(config)# ip nat inside source list 1 pool public
Router(config)# interface gigabitEthernet 0/0
Router(config-if)# ip nat inside
Router(config-if)# exit
Router(config)# interface serial 0/0/0
Router(config-if)# ip nat outside
```

Step 2: Verify Dynamic NAT
Use `show ip nat statistics` and `show ip nat translations`.

Screenshot:



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7. Conclusion or Discussion:

This lab experiment demonstrated the configuration of RIP (v1 & v2), OSPF, and NAT (Static and Dynamic) in Cisco Packet Tracer. RIP is simpler but slower in convergence compared to OSPF, which is faster and more efficient for large-scale networks. NAT was effectively used to translate private IP addresses to public addresses, allowing seamless communication between internal and external networks. This exercise provided hands-on experience in setting up complex routing and NAT configurations, crucial for real-world networking scenarios.