Lecture 1: Routing Fundamentals

Practical Part

Task 1: Viewing and analyzing the IP Configuration

Activity: Subnetting Practice

Activity: Subnet a Given IP Range

Example of Subnetting a Class C Network into 8 Subnets

Given Network: 192.168.1.0/24

- **Default Subnet Mask: 255.255.255.0 (/24)**
- **Number of Required Subnets: 8**

Step 1: Determine the New Subnet Mask

To create 8 subnets, we need to borrow bits from the host portion.

Formula:

$$2^n >= \text{no. of subnets}$$

where n is the number of bits borrowed from the host part.

$$2^3=8$$

So, we borrow 3 bits from the host portion of the /24 network.

- **New subnet mask: /27 (24 + 3 = 27)**
- **Decimal format: 255.255.255.224**

Step 2: Calculate the Subnets

Each subnet will have:

- **Subnet Increment: 256 - 224 = 32**
- **Number of Hosts per Subnet: $2^{\text{remaining host bits}}-2=2^5-2=30$ hosts**
- **Subnet Table:**

Subnet #	Network Address	First Host	Last Host	Broadcast Address
1	192.168.1.0/27	192.168.1.1	192.168.1.30	192.168.1.31
2	192.168.1.32/27	192.168.1.33	192.168.1.62	192.168.1.63
3	192.168.1.64/27	192.168.1.65	192.168.1.94	192.168.1.95
4	192.168.1.96/27	192.168.1.97	192.168.1.126	192.168.1.127
5	192.168.1.128/27	192.168.1.129	192.168.1.158	192.168.1.159
6	192.168.1.160/27	192.168.1.161	192.168.1.190	192.168.1.191
7	192.168.1.192/27	192.168.1.193	192.168.1.222	192.168.1.223
8	192.168.1.224/27	192.168.1.225	192.168.1.254	192.168.1.255

. Network Simulation with Basic Routing

Activity: Simulate a Network in Cisco Packet Tracer

- **Scenario**: Create a small network with two PCs and a router.
- **Steps**:
    1. Configure IP addresses on the PCs (e.g., 192.168.1.10/24 and 192.168.1.20/24).
    2. Assign a default gateway to each PC (e.g., 192.168.1.1).
    3. Test connectivity using the **ping** command.
    4. Add a second network (e.g., 192.168.2.0/24) and configure routing on the router to allow communication between the two networks.

you can add additional Fast Ethernet (FE) interfaces to the router so that you don't need to use VLANs (Router-on-a-Stick). Instead, you can connect each subnet directly to a separate physical interface on the router. Here's how to do it in Packet Tracer:

1. Selecting a Router with Expandable Interfaces

By default, routers like Cisco 1941 or Cisco 2911 have only two FastEthernet or GigabitEthernet ports. To

support eight subnets, you need more interfaces.

Solution: Add an HWIC-4ESW Module
1. Select a router, such as Cisco 2911.
2. Click on the router and go to the Physical tab.
3. Turn off the router (power switch).
4. Add a HWIC-4ESW module (this adds 4 additional Fast Ethernet ports).
5. If needed, add two HWIC-4ESW modules to get 8 ports total.
6. Turn on the router.

2. Network Setup Without VLANs
• Each subnet will connect to a separate physical interface on the router.
• A Cisco 2960 or 3560 switch is not needed unless multiple hosts are in the same subnet.

Physical Connections

Router Interface Subnet Host IP Address Default Gateway
FastEthernet0/0 192.168.10.0/24 192.168.10.2 192.168.10.1
FastEthernet0/1 192.168.20.0/24 192.168.20.2 192.168.20.1
FastEthernet1/0 192.168.30.0/24 192.168.30.2 192.168.30.1
FastEthernet1/1 192.168.40.0/24 192.168.40.2 192.168.40.1
FastEthernet1/2 192.168.50.0/24 192.168.50.2 192.168.50.1
FastEthernet1/3 192.168.60.0/24 192.168.60.2 192.168.60.1
FastEthernet2/0 192.168.70.0/24 192.168.70.2 192.168.70.1
FastEthernet2/1 192.168.80.0/24 192.168.80.2 192.168.80.1

1. Check interfaces on the router:

show ip interface brief

2. Ping from one host to another (e.g., Host 10 → Host 20):

ping 192.168.20.2

If routing is working, the ping should be successful.

Lecture 2: Routing Tables and Routing Protocols

Practical Part

Objectives:

By the end of this lab, students should be able to:

1. Understand the structure and function of routing tables.
2. View and analyze routing tables in Cisco Packet Tracer.
3. Configure static routing entries.
4. Observe routing decisions in Packet Tracer's simulation mode.

Task 1: Viewing and Analyzing a Routing Table

Check Routing Table on Windows

- Open **Command Prompt (cmd)** and run:
- route print
- Analyze the output:
    - Identify **Network Destination, Netmask, Gateway, Interface, and Metric**.
    - Find the **default route (0.0.0.0)** and explain its purpose.

Task 2: Basic Routing Configuration in Cisco Packet Tracer

2.1. Setting Up a Simple Network

- Create a topology with **three routers** and multiple PCs.
- Assign **IP addresses** to interfaces.

2.2. Configure Static Routing on Routers

- On Router 1 (R1):
- Router(config)# ip route 192.168.2.0 255.255.255.0 192.168.1.2
- On Router 2 (R2):
- Router(config)# ip route 192.168.1.0 255.255.255.0 192.168.2.1

- Test connectivity using ping.

2.3 Verify Static Routing Configuration

1. **Check routing tables:**
    - Open the **CLI tab** on each router and enter:

      show ip route
    - Verify that static routes.

Lecture 3: Distance-Vector Routing Protocols (RIP)

Practical Part

Objectives:

By the end of this lab, students should be able to:

1. Configure Routing Information Protocol (RIP) using Cisco Packet Tracer.
2. Verify RIP routing tables and packet exchanges.
3. Analyze RIP behavior using Packet Tracer's simulation mode.

Required Tools:

- Cisco Packet Tracer
- At least three routers and three PCs
- Ethernet cables (for connectivity)

Experiment 1: Basic RIP Configuration

Step 1: Network Topology Setup in Packet Tracer

1. Open **Cisco Packet Tracer**.
2. Drag and place **three routers (R1, R2, R3)**.
3. Add **three PCs (PC1, PC2, PC3)**.

4. Connect the devices using Ethernet cables:
    - **R1** connects to **R2** using a Serial or FastEthernet link.
    - **R2** connects to **R3** similarly.
    - Each router connects to a PC using an Ethernet connection.

Assign the following IP addresses:

- **R1:** 192.168.1.1/24 (to PC1), 10.0.0.1/30 (to R2)
- **R2:** 10.0.0.2/30 (to R1), 10.0.1.1/30 (to R3)
- **R3:** 10.0.1.2/30 (to R2), 192.168.2.1/24 (to PC3)

Step 2: Configure RIP in Packet Tracer Using Configuration Tabs

1. **Select R1**, go to the **Config tab**, and click **RIP** under **Routing**.
2. **Enable RIP** by toggling the switch.
3. **Add the following networks** under the RIP configuration:
    - 192.168.1.0
    - 10.0.0.0
    - 10.0.1.0
4. Repeat the same process for **R2 and R3**, adding their respective networks.
5. **Ensure RIP Version 2** is selected and **disable auto-summary**.

Step 3: Verify RIP Configuration in Packet Tracer

1. **Check RIP routing table:**
    - Go to the **CLI tab** on any router and enter:
2. show ip route rip

Expected Output: Routes learned via RIP should appear.

3. **Use Packet Tracer's Simulation Mode:**
    - Click **Simulation Mode** (bottom-right corner in Packet Tracer).
    - Choose **RIP packets** from the event list.
    - Observe RIP updates and how routes are shared among routers.
4. **Test network connectivity using PC terminals:**
    - Open **PC1 Command Prompt** and test ping to PC3:
5. ping 192.168.2.1

Experiment 2: Analyzing RIP Behavior in Packet Tracer

Step 1: Capture and Analyze RIP Updates

1. In **Simulation Mode**, filter for **RIP packets**.
2. Observe the **update intervals (every 30 seconds)** and routes exchanged.
3. Note how RIP manages hop counts (max = 15, indicating infinity).

Step 2: Simulate Link Failure in Packet Tracer

1. Select **R1-R2 link** and click the **Delete** tool to break the connection.
2. Observe how RIP reacts by checking **show ip route** on R3.
3. Restore the connection and monitor convergence time.

Discussion Questions:

1. What happens when a link fails in RIP? How does Packet Tracer show the update process?
2. How does RIP prevent routing loops?
3. What are the main drawbacks of RIP in larger networks?

Conclusion:

This lab demonstrated how to configure and analyze RIP in **Cisco Packet Tracer**. Students observed routing updates, network changes, and RIP's convergence behavior using simulation mode.