Lab 3: Network Devices and Basic Configuration

Objectives:

- To be familiar with Network Simulation Tool: Packet Tracer
- To be familiar with network devices: Repeater, Hub, Bridge & Switch
- To be familiar with router, and its components
- To be familiar with commands for basic configuration of a router
- To be familiar with default gateway and its need in a network

Requirements:

- Network simulation tool: Packet Tracer

Procedure:

Procedure for Network Configuration and Testing

To create the network topology, IP addresses were assigned to all computers, with a subnet mask set to 255.255.255.0 for all devices. Connectivity was tested using the ping command, and results were recorded. In simulation mode, pings were initiated from PC0 to PC1, PC0 to PC2, and PC2 to PC0, with observations noted. The Repeater0 was then replaced by a bridge, and connectivity was re-tested using the ping command. Simulation mode pings were again observed and compared to previous results. Next, Hub0 and Hub1 were replaced with switches, and connectivity tests were repeated, noting any changes in packet travel. The IP addresses of PC2 and PC3 were updated, and connectivity was tested again, with any successful or unsuccessful connections analyzed.

Procedure for Network Modification with Router

The network was further modified to include a router. Connectivity was tested using the ping command from PC0 to PC1, PC2, and PC3, and from PC2 to PC0, PC1, and PC3. The router hostname was changed to ”samip”, console password to ”neupane”, enable password to ”samip”, and telnet password to ”samipneupane” An IP address of 200.10.8.1 with a subnet mask of 255.255.255.0 was configured on

the router's interface. Telnet was used from PC0 to connect to the router, and a second IP address of 200.10.9.1 was configured on another interface. Connectivity tests were conducted from PC0 and PC3 to all other PCs and both router IPs. The default gateways of PC0 and PC2 were set to 200.10.8.1 and 200.10.9.1, respectively, and connectivity tests were repeated. Finally, additional default gateways were set for PC1 and PC3, and connectivity from each PC to all others and the router was tested and documented.

Observation:

Answer for 3:

Connectivity between all PCs was established successfully, as demonstrated by the example terminal result shown in the figure below.

```
C:\>ping 200.10.8.43

Pinging 200.10.8.43 with 32 bytes of data:

Reply from 200.10.8.43: bytes=32 time<1ms TTL=128
Reply from 200.10.8.43: bytes=32 time=20ms TTL=128
Reply from 200.10.8.43: bytes=32 time=2ms TTL=128
Reply from 200.10.8.43: bytes=32 time<1ms TTL=128

Ping statistics for 200.10.8.43:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 20ms, Average = 5ms
```

Answer for 4:

Packets were transmitted through hubs and repeaters each time, reaching every device. This behavior is expected because hubs and repeaters operate at Layer 1 of the OSI model, functioning as simple signal regenerators without any filtering capability.

Answer for 6:

After replacing the repeater with a bridge, an initial "request timed out" message was displayed. However, connectivity was subsequently established, indicating that the bridge initially took time to learn the network's MAC addresses before successfully forwarding packets.

Answer for 7:

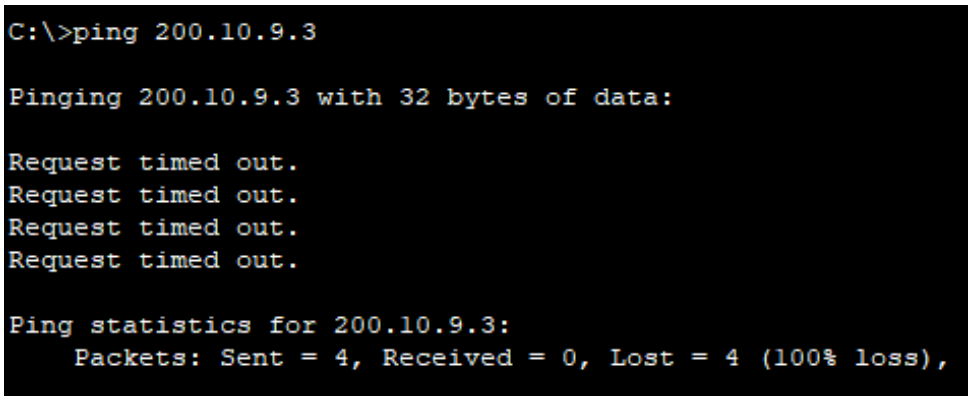
Packet travel to the opposite side of the bridge was restricted because PC0 and PC1 are on the same side of the bridge. Unlike repeaters, bridges operate at Layer 2 of the OSI model and are more intelligent, filtering traffic based on MAC addresses to reduce unnecessary network traffic.

Answer for 10 and 11:

In real-time, the ping command returned connectivity results with time in milliseconds. In simulation mode, the switch initially broadcasted packets in all directions as it lacked knowledge of the network topology. After learning the connection paths, the switch efficiently forwarded packets directly between PC0 and PC1, bypassing the bridge.

Answer for 14:

A "request timed out" message was displayed, as shown in the figure below. This occurred because IP addresses 200.10.8.2 and 200.10.9.3 belong to different subnets and cannot communicate directly without an intermediary device.



Answer for 15:

A router is necessary to facilitate communication between different subnets. Routers operate at Layer 3 of the OSI model, directing packets based on IP addresses and enabling communication between devices on different networks by routing traffic appropriately.

After Replacing Router:

Answer for 1:

Initially, the router configuration was not completed, resulting in "request timed out" messages. This occurred because the router had not been set up to forward packets between different subnets or devices, preventing any communication.

Answer for 10, 11, 12:

If the default gateway was not set for the PCs, the router would not be able to act as the intermediary for routing traffic between different subnets. Without a default gateway, the PCs would not know where to send packets destined for IP addresses outside their own subnet, leading to failed connectivity attempts.

Answer for 13, 14, 15, 16, 17:

After configuring the router and setting the default gateway for each PC, connectivity was established between different subnets. This success can be attributed to the router's ability to route traffic between subnets, allowing devices on separate networks to communicate. The router used its routing table to direct packets to the appropriate destinations, ensuring successful communication between the router and different PCs, between PCs and the router, and between PCs on different subnets. This setup enabled seamless network communication across the entire topology.

Conclusion:

In this lab, we set up and tested a network using different devices like hubs, repeaters, bridges, switches, and routers. Initially, we tested basic connectivity and then replaced some devices to see how it affected the network. After configuring the router and setting default gateways, we successfully connected devices across different subnets. This lab showed how important it is to configure devices correctly and how routers are essential for connecting different networks.

Exercises:

1. How do Repeater, Hub, Bridge and Switch work in a network? Explain on the basis of your observations.

Repeater: A repeater operates at Layer 1 of the OSI model. Its main function is to regenerate and amplify signals to extend the transmission distance between devices. In the lab, when we used a repeater, it simply retransmitted the incoming signals to all connected devices without any filtering, ensuring that the signal strength remained strong over longer distances.

Hub: Similar to a repeater, a hub also functions at Layer 1. It acts as a multi-port repeater, receiving signals from one port and broadcasting them to all other ports. During the lab activities, we observed that when packets were sent through a hub, they were received by all devices connected to it. This behavior is due to the hub's lack of intelligence, as it does not filter or direct traffic but instead sends it to every device in the network, leading to potential network congestion.

Bridge: A bridge operates at Layer 2 of the OSI model and is more intelligent than a hub or repeater. It connects two network segments and filters traffic by examining MAC addresses, forwarding packets only to the segment where the destination device resides. In the lab, after replacing a repeater with a bridge, we initially observed "request timed out" messages as the bridge learned the MAC addresses in the network. Once the bridge's MAC address table was populated, it efficiently forwarded packets only to the correct segment, reducing unnecessary traffic.

Switch: A switch also functions at Layer 2 but with greater efficiency and more ports compared to a bridge. It creates a dedicated path between the source and destination devices by learning and storing MAC addresses. During our lab, when we replaced hubs with switches, we noticed that initially, the switch broadcasted packets to all ports, similar to a hub. However, once it learned the network topology, it began forwarding packets directly to the appropriate destination. This significantly improved network performance by reducing collisions and ensuring that packets reached only their intended recipients.

2. What is a router? Explain its role in computer networks. Explain on the basis of your observations in this lab activity.

A router is a device that operates at Layer 3 (network layer) of the OSI model. It routes data packets between different networks using IP addresses, enabling communication between separate subnetworks or linking an internal network to the internet.

Role of a Router:

Interconnecting Networks: In the lab, configuring the router and setting default gateways allowed devices on different subnets to communicate. The router effectively connected different networks.
Routing Packets: The router directed packets based on IP addresses, using its routing table to find the best paths. This ensured efficient and accurate data transmission.
Default Gateway: Acting as the default gateway, the router enabled PCs to forward packets destined for outside their subnet, managing traffic between internal and external networks.
Traffic Management: The router balanced traffic loads and prevented congestion, facilitating smooth communication between different subnetworks.

Initially, without router configuration, "request timed out" messages were observed due to the lack of routing between subnets. After proper configuration, the router enabled connectivity between all devices, demonstrating its essential role in inter-network communication.