Lab 3: Simulation of Network Devices (Hub, Switch, Bridge, Router, Repeater) Using Cisco Packet Tracer

❖ Objective:

- To understand the working principles of basic network devices.
- To simulate hub, switch, bridge, router, and repeater using Cisco Packet Tracer.
- To observe data transmission and packet flow in different network devices.

❖ Theory:

Computer networking is the practice of connecting multiple computing devices to share data, resources, and services. Network devices are essential components that control how data is transmitted across a network.

A **hub** is a simple networking device that operates at the physical layer of the OSI model. It broadcasts incoming data packets to all connected devices, which can lead to network congestion and collisions.

Figure:

A **switch** operates at the data link layer and forwards data only to the intended recipient using MAC addresses. This improves network efficiency and reduces unnecessary traffic.

Figure:

A **bridge** is used to divide a network into smaller segments, reducing collisions and improving performance. It filters traffic based on MAC addresses and works similarly to a switch but with fewer ports.

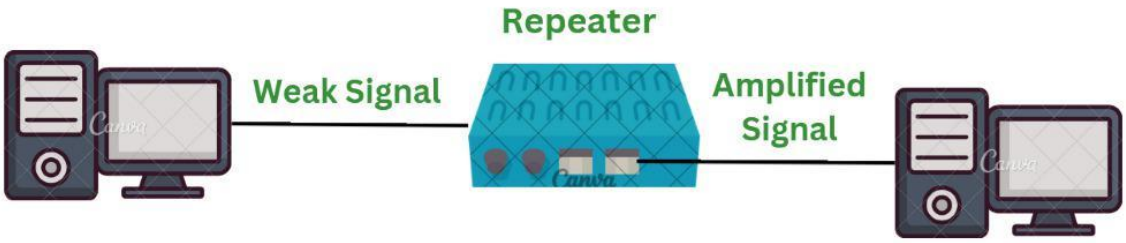
Figure:

A **router** operates at the network layer and connects multiple networks together. It uses IP addresses to determine the best path for data packets, enabling communication between different networks.

Figure:

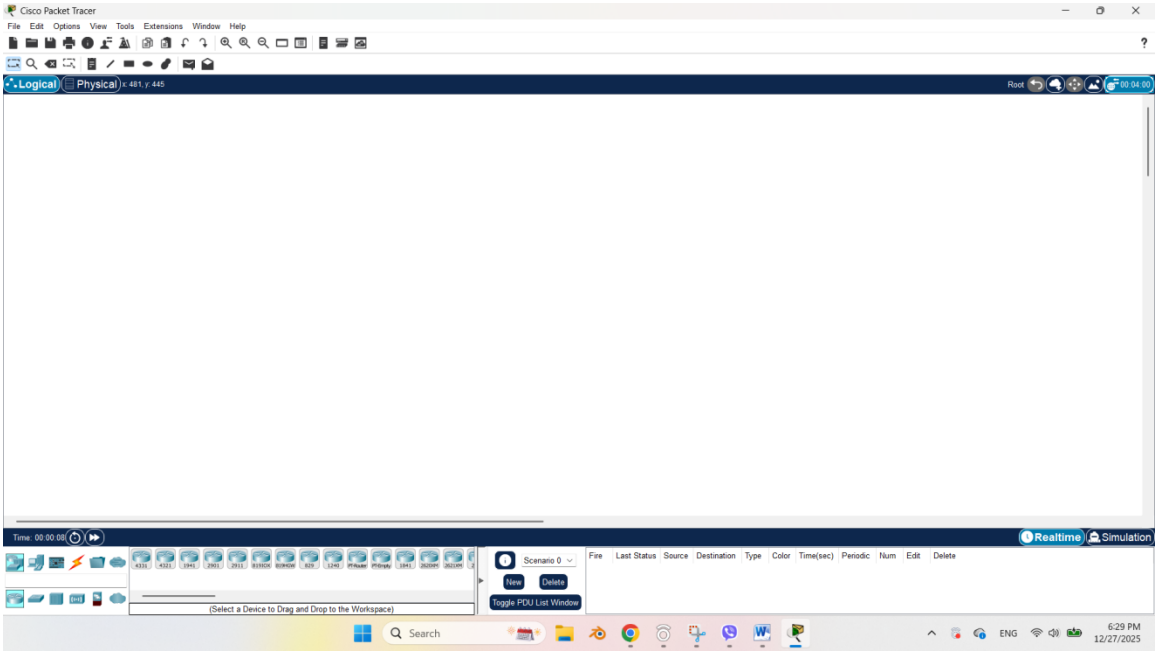
A **repeater** is a physical layer device that regenerates and amplifies signals to extend the distance of data transmission. It is commonly used in long network cables to prevent signal degradation.

Figure:



Cisco Packet Tracer is a network simulation tool developed by Cisco that allows users to design, configure, and test network topologies in a virtual environment. It helps students understand networking concepts without requiring physical hardware.

Figure:



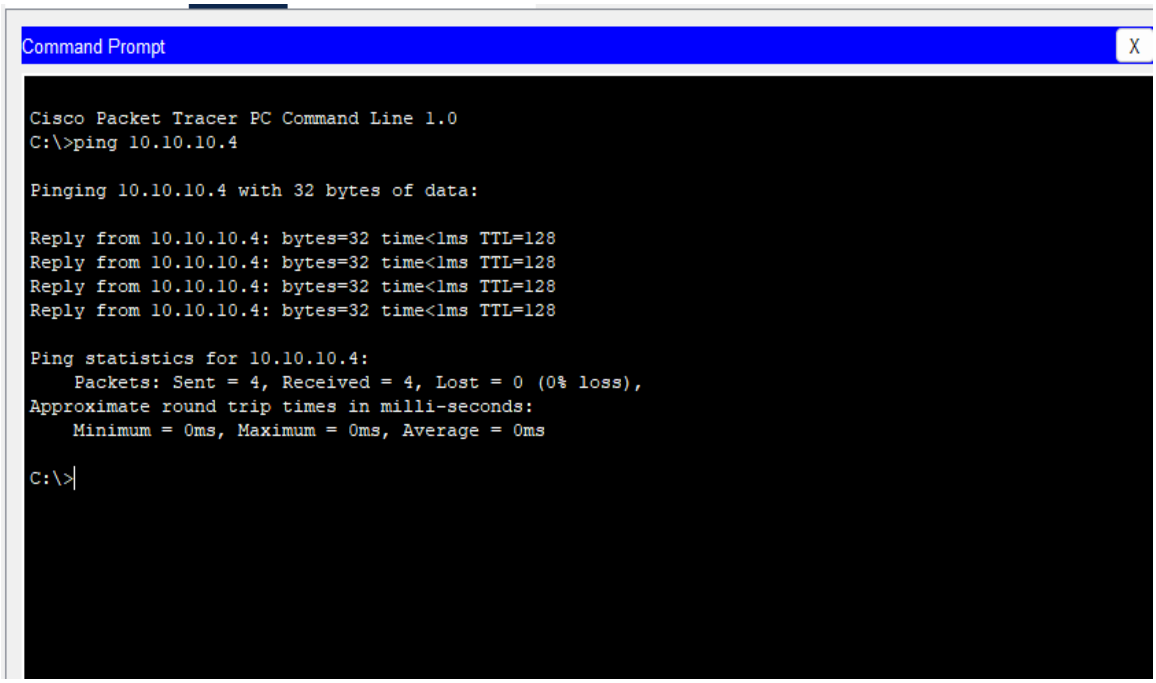
❖ Working method with output:

1. Hub

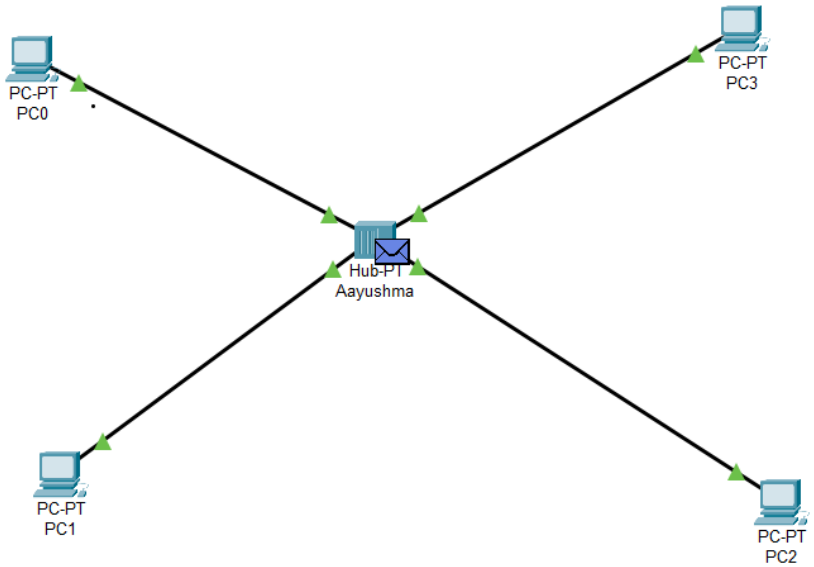
Working Method:

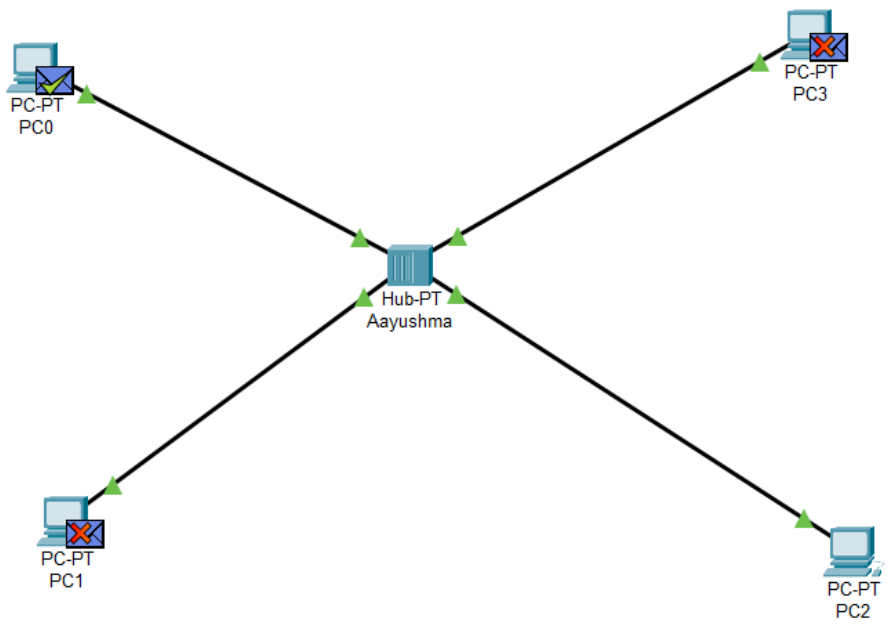
- First, we open **Cisco Packet Tracer** on the system.
- Then, we select **end devices (PCs)** and place them on the workspace.
- We add a **hub** and connect it to multiple PCs using **straight-through cables**.
- Next, we send data packets from one PC, and we observe that the **hub broadcasts the data to all connected devices**.
- This demonstrates that a hub **does not differentiate between devices** and sends data to every port, making it suitable for small networks but less efficient for larger ones.

Ping from PC2 to PC0:



Output:





2. Switch

Working Method:

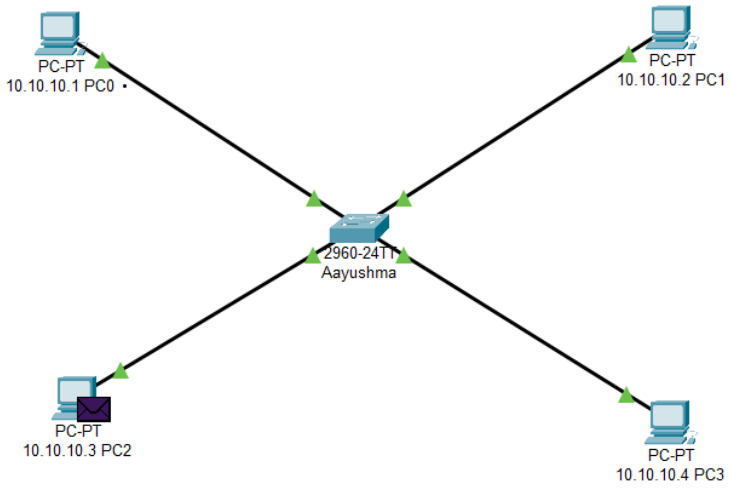
- After testing the hub, we **replace the hub with a switch** and reconnect the PCs using straight-through cables.
- We then send data packets from one PC and observe that the **switch forwards the data only to the intended destination device**.
- This happens because switches **maintain a MAC address table**, which allows them to **filter and direct traffic efficiently**.
- We also notice reduced network congestion compared to the hub, highlighting the **advantages of switches in larger networks**.

Ping from PC2 to PC0:

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 10.10.10.3

Pinging 10.10.10.3 with 32 bytes of data:

Reply from 10.10.10.3: bytes=32 time<1ms TTL=128
Reply from 10.10.10.3: bytes=32 time=1ms TTL=128
Reply from 10.10.10.3: bytes=32 time<1ms TTL=128
Reply from 10.10.10.3: bytes=32 time<1ms TTL=128

Ping statistics for 10.10.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

Output:



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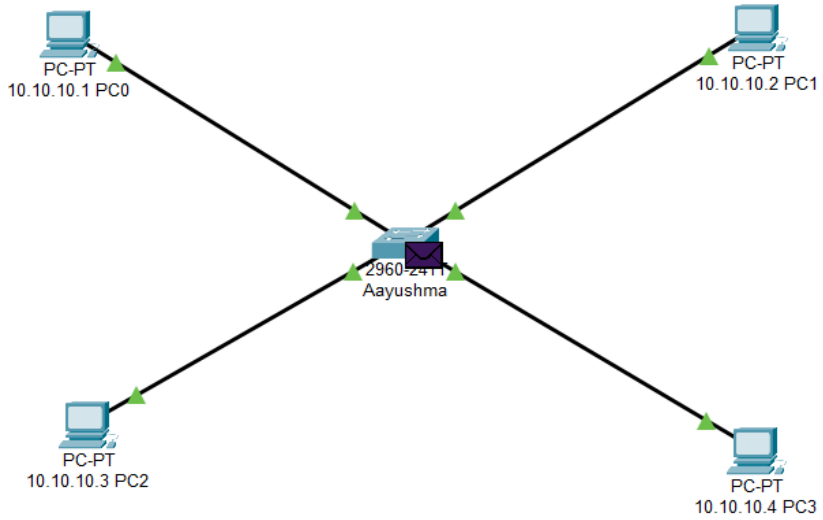
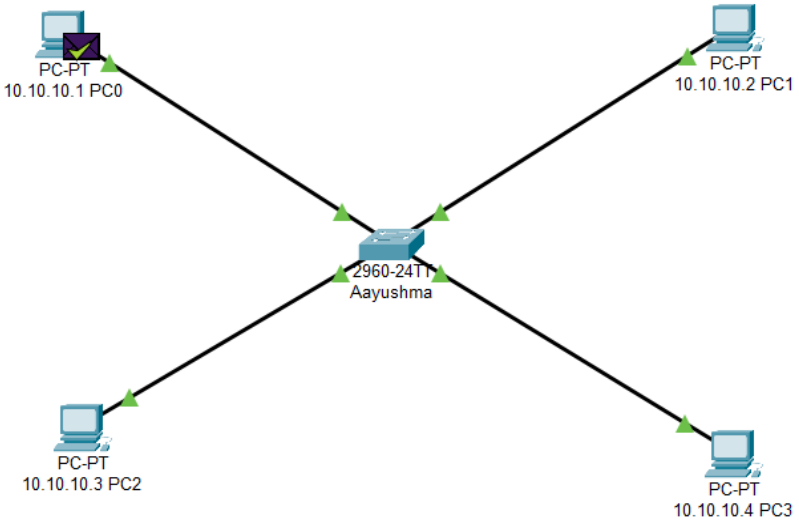




3. Bridge

<u>Working Method:</u>

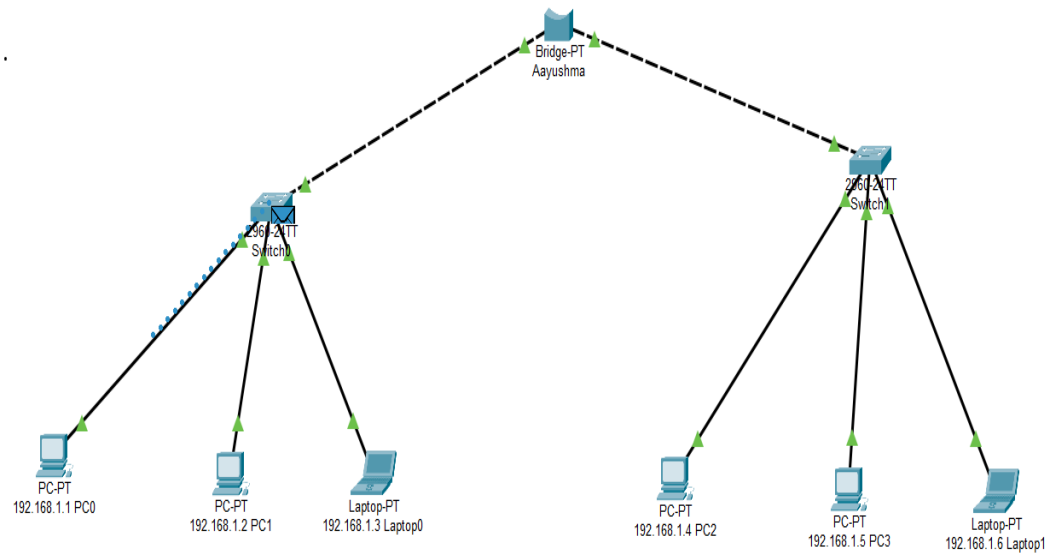
- We insert a **bridge between two network segments** in the workspace.
- PCs and Laptops from both segments are connected to the bridge using appropriate cables.

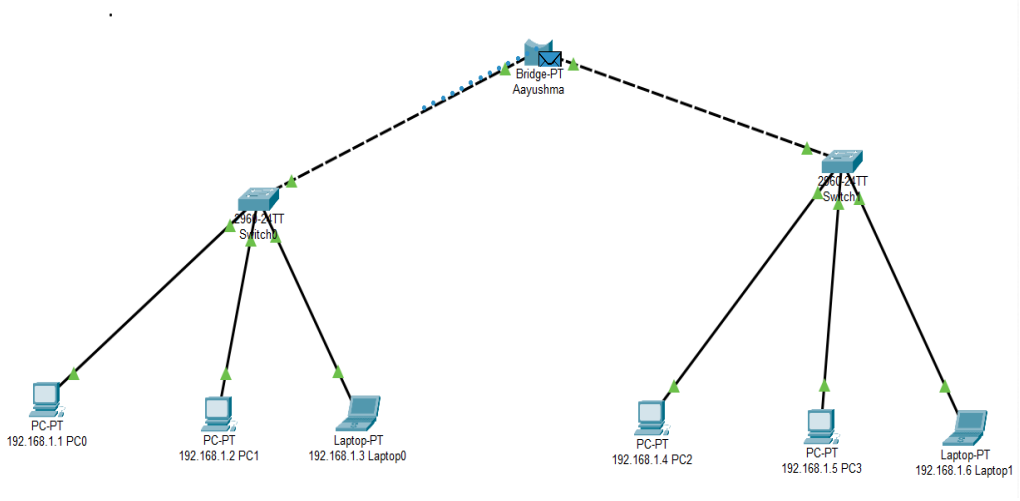
- Then, we send data packets between devices from different segments and observe that the **bridge filters and forwards data based on MAC addresses**.
- The bridge helps **segregate network traffic**, which reduces unnecessary load and **enhances network efficiency**.

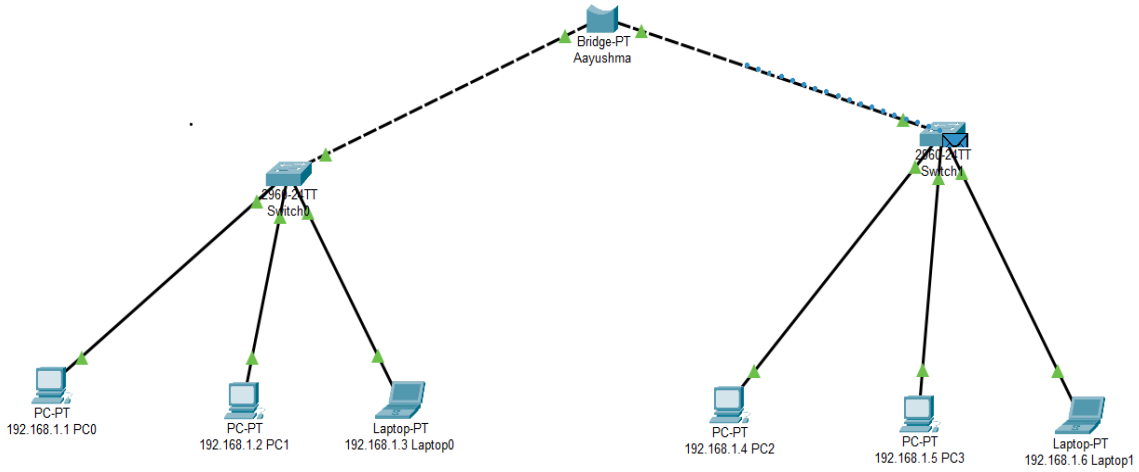
Ping from PC0to PC2:

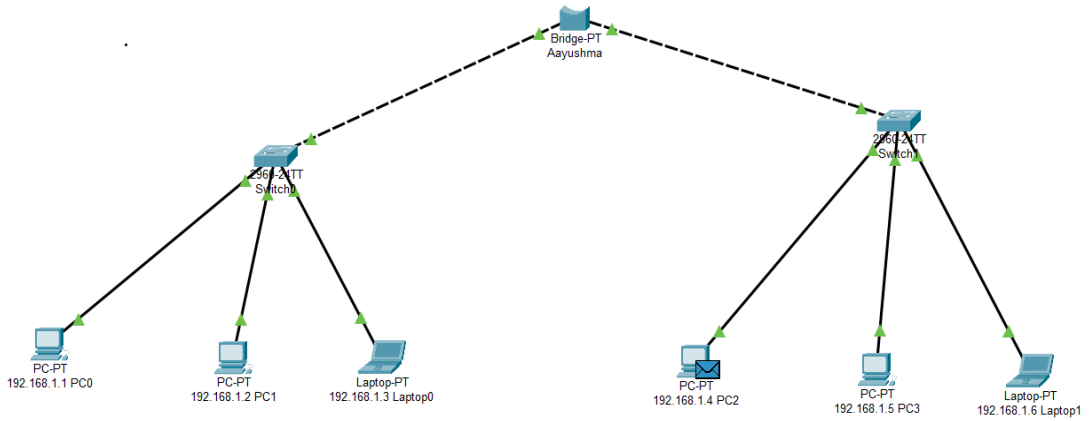
```
Command Prompt

Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.1.4

Pinging 192.168.1.4 with 32 bytes of data:

Reply from 192.168.1.4: bytes=32 time=1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=38ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 38ms, Average = 10ms

C:\>
```

Output:




Bridge-PT
Aayushma
2960-24TT
Switch0
2960-24TT
Switch1
PC-PT
192.168.1.1 PC0
PC-PT
192.168.1.2 PC1
Laptop-PT
192.168.1.3 Laptop0
PC-PT
192.168.1.4 PC2
PC-PT
192.168.1.5 PC3
Laptop-PT
192.168.1.6 Laptop1


Bridge-PT
Aayushma
2960-24TT
Switch0
2960-24TT
Switch1
PC-PT
192.168.1.1 PC0
PC-PT
192.168.1.2 PC1
Laptop-PT
192.168.1.3 Laptop0
PC-PT
192.168.1.4 PC2
PC-PT
192.168.1.5 PC3
Laptop-PT
192.168.1.6 Laptop1

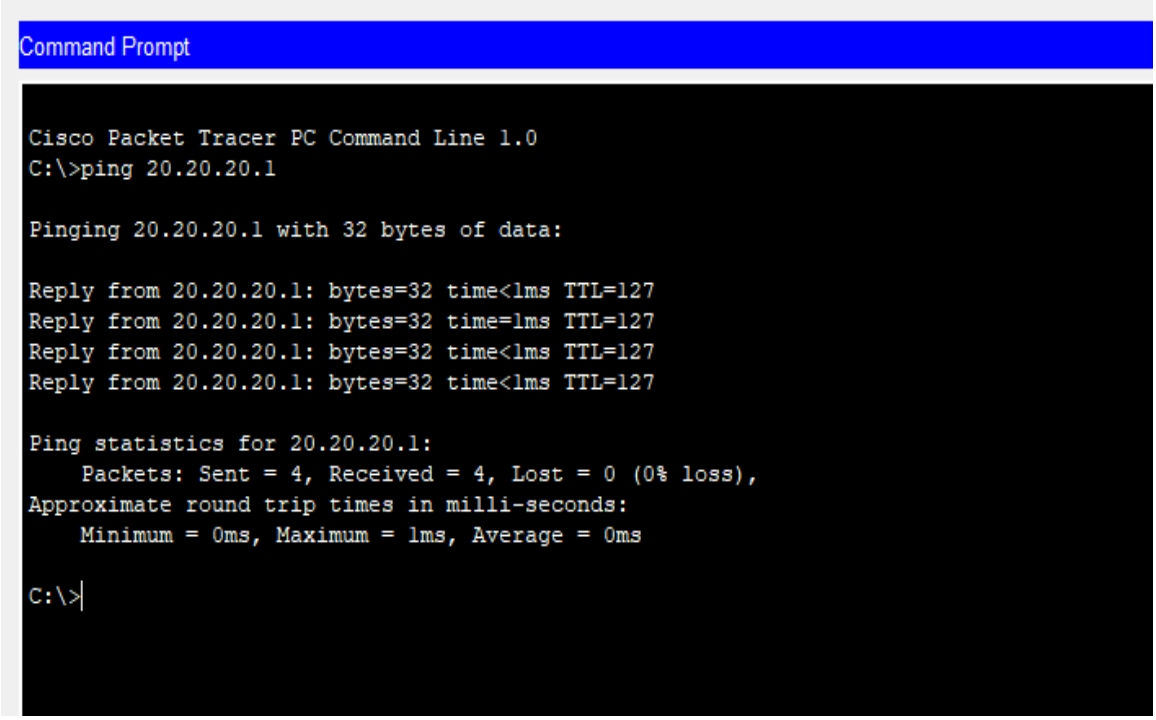

Bridge-PT
Aayushma
2960-24TT
Switch0
2960-24TT
Switch1
PC-PT
192.168.1.1 PC0
PC-PT
192.168.1.2 PC1
Laptop-PT
192.168.1.3 Laptop0
PC-PT
192.168.1.4 PC2
PC-PT
192.168.1.5 PC3
Laptop-PT
192.168.1.6 Laptop1

4. Router

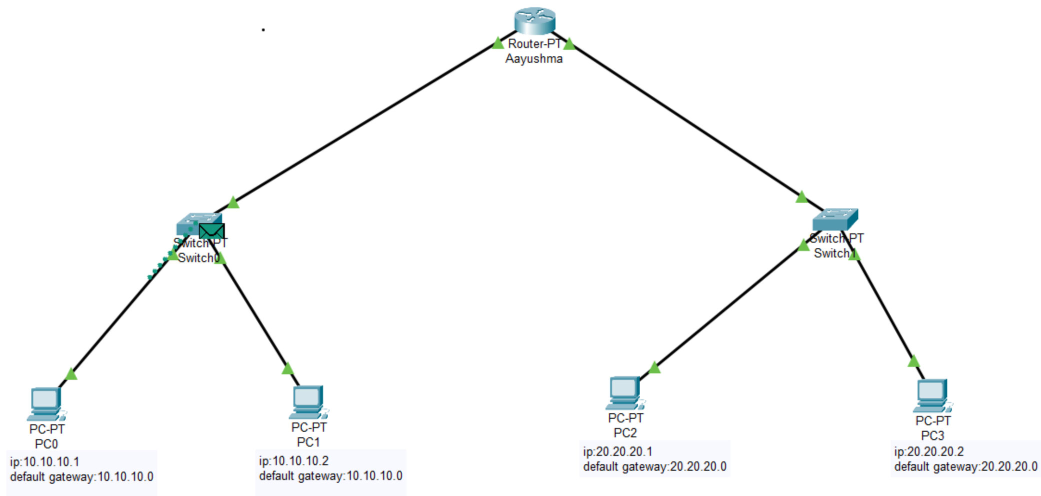
Working Method:

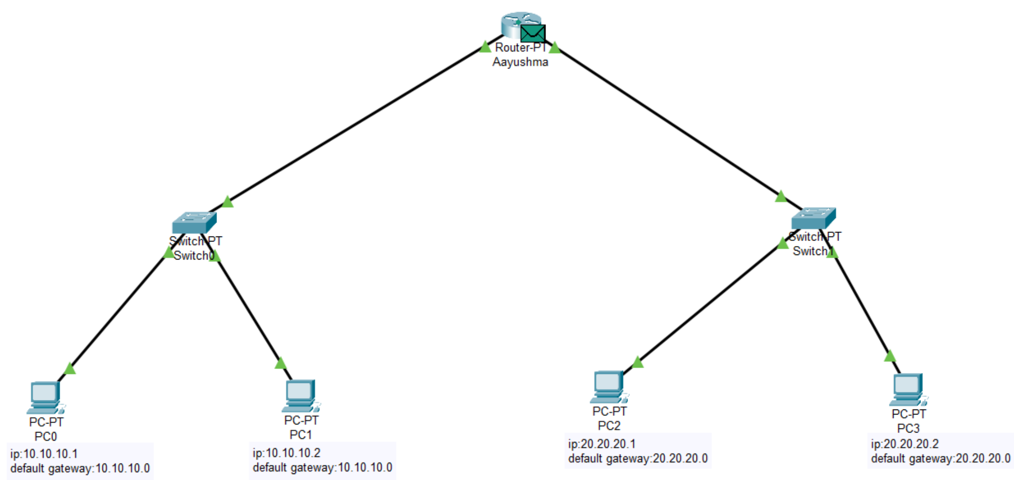
- Next, we add a **router** to the workspace and connect it to two different networks.
- We configure **IP addresses** for each interface of the router to ensure proper routing.
- We then test connectivity using the **ping command** between devices in different networks.
- The router **routes data packets based on IP addresses**, allowing **communication between separate networks**.
- We observe successful data transfer, demonstrating how routers **enable inter-network communication** and manage traffic intelligently.

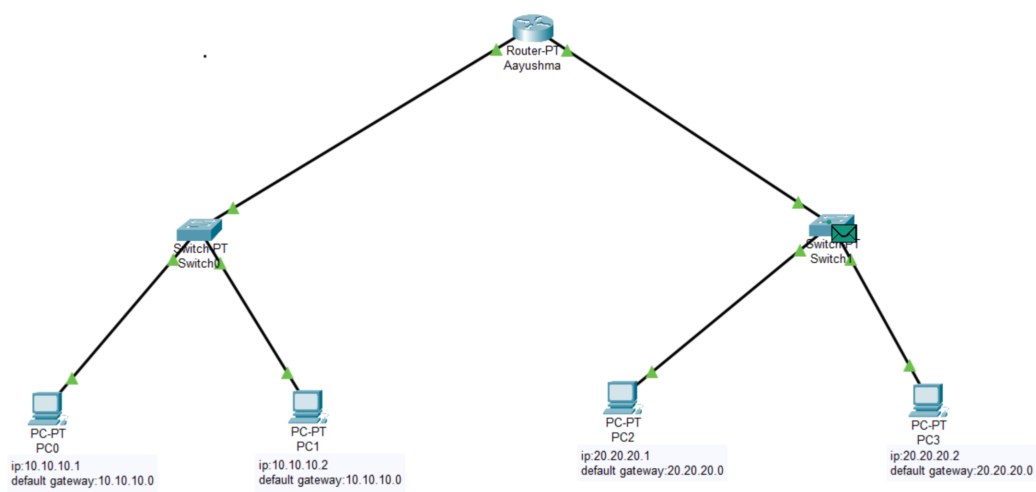
Ping from PC0to PC2:

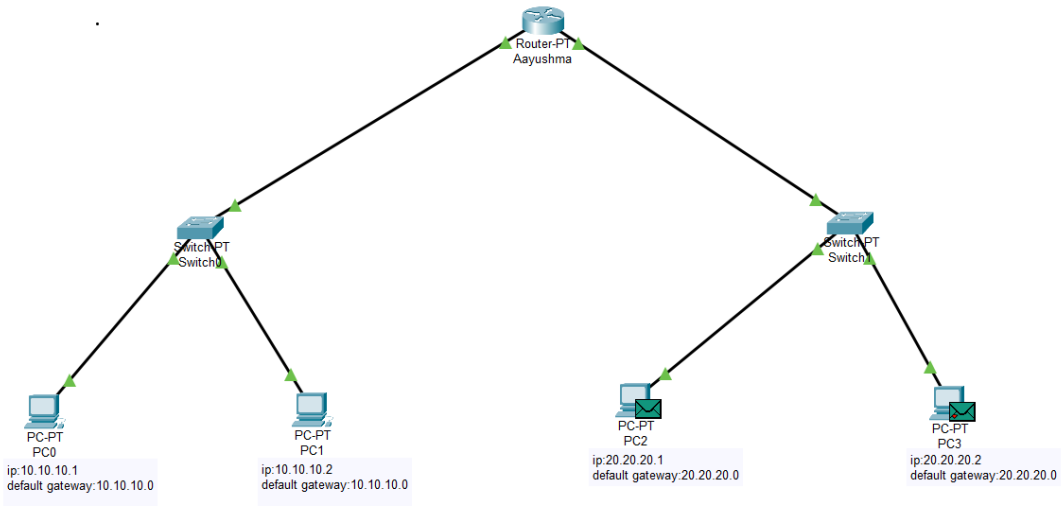


Output:


Router-PT
Aayushma
Switch-PT
Switch0
Switch-PT
Switch1
PC-PT
PC0
ip:10.10.10.1
default gateway:10.10.10.0
PC-PT
PC1
ip:10.10.10.2
default gateway:10.10.10.0
PC-PT
PC2
ip:20.20.20.1
default gateway:20.20.20.0
PC-PT
PC3
ip:20.20.20.2
default gateway:20.20.20.0


Router-PT
Aayushma
Switch-PT
Switch0
Switch-PT
Switch1
PC-PT
PC0
ip:10.10.10.1
default gateway:10.10.10.0
PC-PT
PC1
ip:10.10.10.2
default gateway:10.10.10.0
PC-PT
PC2
ip:20.20.20.1
default gateway:20.20.20.0
PC-PT
PC3
ip:20.20.20.2
default gateway:20.20.20.0


Router-PT
Aayushma
Switch-PT
Switch0
Switch-PT
Switch1
PC-PT
PC0
ip:10.10.10.1
default gateway:10.10.10.0
PC-PT
PC1
ip:10.10.10.2
default gateway:10.10.10.0
PC-PT
PC2
ip:20.20.20.1
default gateway:20.20.20.0
PC-PT
PC3
ip:20.20.20.2
default gateway:20.20.20.0

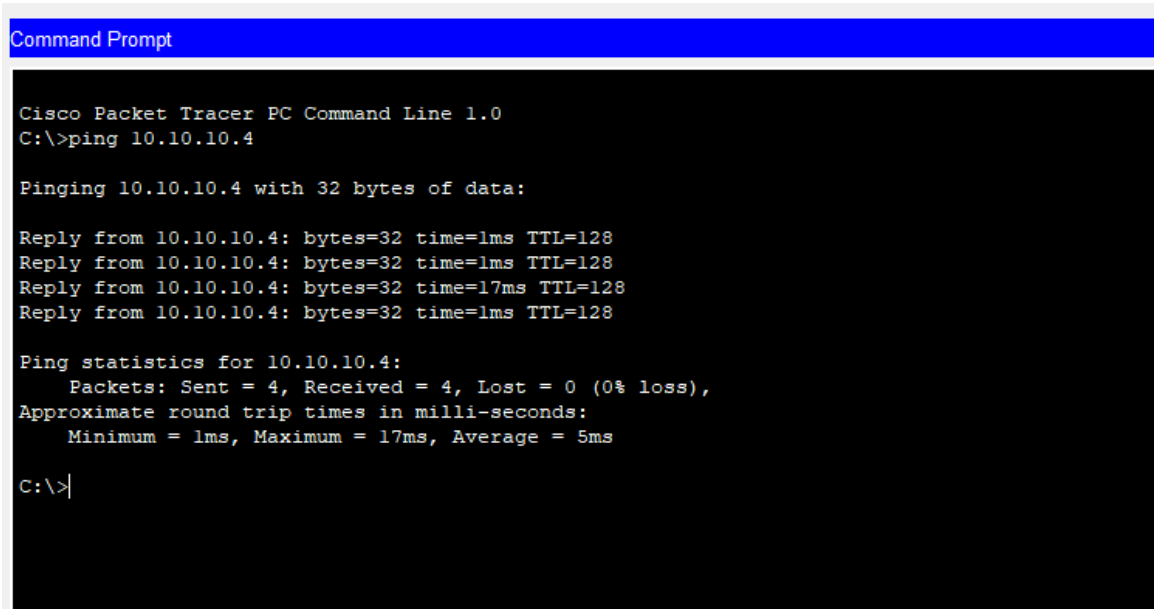


5. Repeater

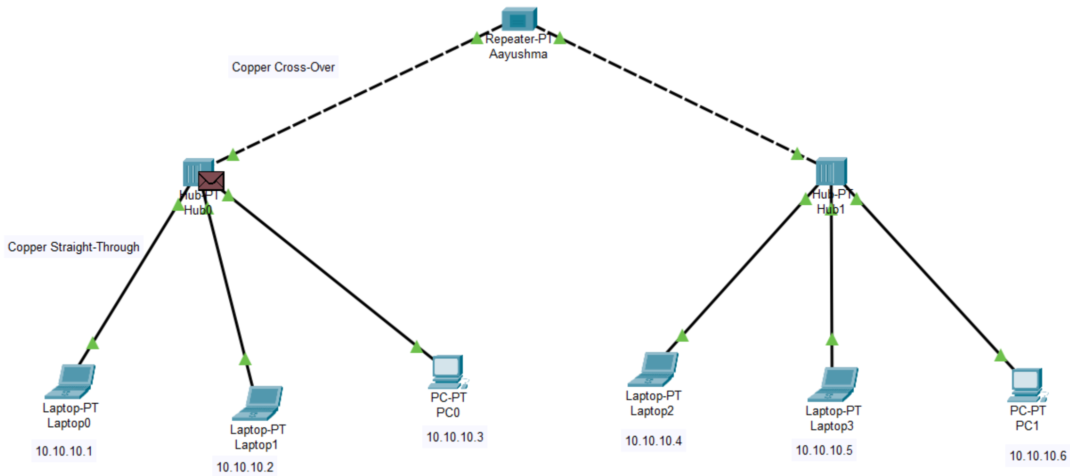
Working Method:

- Finally, we place a **repeater** between distant devices in the network.
- We connect devices on either side using straight-through cables.
- We then send data packets and observe that the repeater **regenerates and amplifies the signal**, extending the network range.
- This ensures that **long-distance communication is maintained** without data loss, showing the repeater's importance in larger network setups.

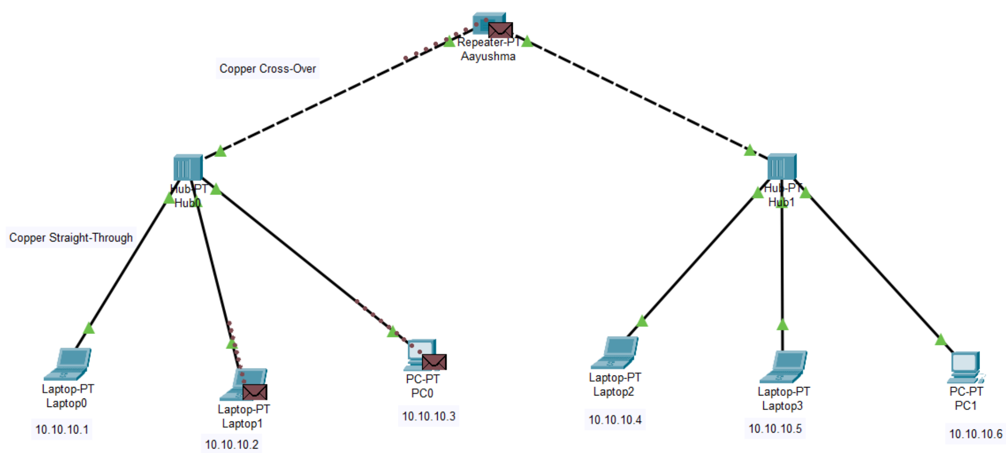
Ping from Laptop0 to Laptop2:



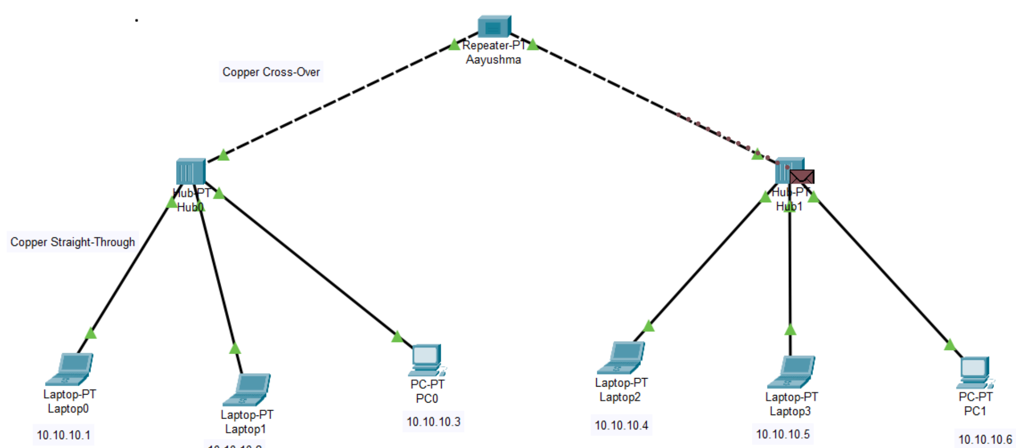
Output:



Repeater-PT
Aayushma
Copper Cross-Over
Hub-PT
Hub0
Hub-PT
Hub1
Copper Straight-Through
Laptop-PT
Laptop0
10.10.10.1
Laptop-PT
Laptop1
10.10.10.2
PC-PT
PC0
10.10.10.3
Laptop-PT
Laptop2
10.10.10.4
Laptop-PT
Laptop3
10.10.10.5
PC-PT
PC1
10.10.10.6



Repeater-PT
Aayushma
Copper Cross-Over
Hub-PT
Hub0
Hub-PT
Hub1
Copper Straight-Through
Laptop-PT
Laptop0
10.10.10.1
Laptop-PT
Laptop1
10.10.10.2
PC-PT
PC0
10.10.10.3
Laptop-PT
Laptop2
10.10.10.4
Laptop-PT
Laptop3
10.10.10.5
PC-PT
PC1
10.10.10.6



Repeater-PT
Aayushma
Copper Cross-Over
Hub-PT
Hub0
Hub-PT
Hub1
Copper Straight-Through
Laptop-PT
Laptop0
10.10.10.1
Laptop-PT
Laptop1
10.10.10.2
PC-PT
PC0
10.10.10.3
Laptop-PT
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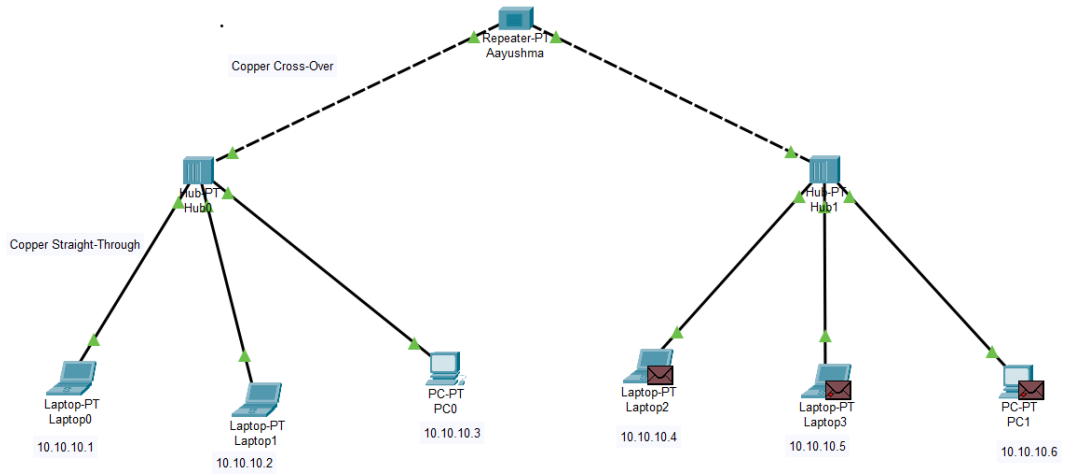
PC-PT
PC1
10.10.10.6



❖ Discussion and Conclusion:

In this lab, we observed that each network device serves a distinct purpose in managing network traffic within a network. Firstly**,** hubs operate in a very basic manner by broadcasting data packets to all connected devices, which often leads to unnecessary traffic and collisions. In contrast**,** switches function more intelligently by forwarding data only to the intended destination device using MAC addresses, thereby improving network efficiency. Similarly**,** bridges play an important role by dividing a network into smaller segments, which helps in reducing congestion and minimizing collision domains. Furthermore**,** routers are essential for enabling communication between different networks, as they use IP addresses to determine the best path for data transmission. In addition**,** repeaters are used to regenerate and amplify signals, allowing data to travel longer distances without degradation. Therefore**,** we realized that selecting the appropriate network device based on network requirements significantly enhances overall performance. Finally**,** we clearly observed these functional differences through simulation in Cisco Packet Tracer, which made the theoretical concepts easier to understand and apply in practical scenarios.