LAB 3: Simulation Of Network Devices Using Cisco Packet Tracer

OBJECTIVES:

- To gain a fundamental understanding of computer networking concepts by using simulation software,
- To examine the internal working principles and operational logic of hardware like hubs, switches, and bridges,
- To study the roles of routers and repeaters in extending and directing network traffic.
- To analyze how data packets flow between different nodes to understand transmission patterns.
- To observe real-time communication processes to identify how various devices handle data delivery.

THEORY:

Cisco Packet Tracer is an interactive network simulation and visualization application used to design and analyze network topologies without relying on actual networking hardware. It is based on packet-level simulation principles, enabling users to create networks by placing virtual routers, switches, and end devices and studying how they communicate within a simulated environment. The tool offers two operating modes: Real-Time Mode, where configuration changes take effect instantly, and Simulation Mode, which allows users to pause network activity and closely examine the movement of individual packets across different OSI layers. By emulating the functionality of Cisco's IOS (Internetwork Operating System), Packet Tracer effectively connects networking theory with hands-on practice, making it an essential learning platform for understanding real-world network implementation.

Network Devices:

Hub

A Hub is a basic physical layer device that connects multiple computers in a network. It operates on a "broadcast" principle: when it receives a data packet on one port, it blindly copies and sends that data to every other port. Because all devices share the same bandwidth and receive every packet regardless of the intended recipient, hubs are inefficient, prone to data collisions, and offer minimal security.

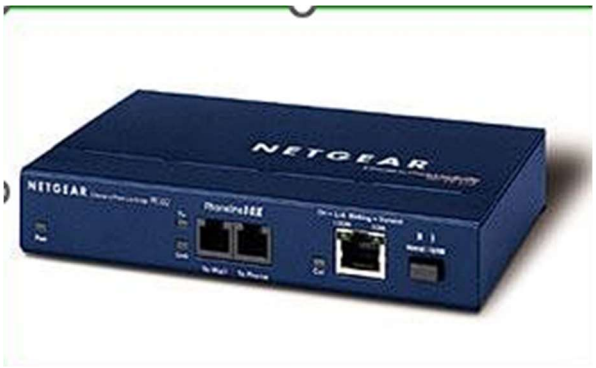
Switch

A switch is an intelligent network device that connects multiple devices within a local area network. It works at the data link layer (Layer 2) and forwards data only to the specific device for which it is intended by using MAC addresses. This selective forwarding reduces unnecessary traffic and minimizes collisions, making switches more efficient and secure than hubs.

Bridge

A Bridge is used to divide a large network into smaller, more manageable segments or to connect

two different network segments together. It monitors traffic and builds a table of MAC addresses to decide whether a packet needs to cross the bridge to the other side. By filtering traffic and keeping local data within its own segment, a bridge helps reduce unnecessary broadcast traffic across the entire network.



Router

A Router is a sophisticated network layer device responsible for routing data between different networks, such as connecting a home LAN to the Internet. It uses IP addresses and routing tables to determine the most efficient path for data packets to travel across interconnected networks.

Repeater

A repeater is a networking device used to extend the distance of a network by regenerating weak or distorted signals. Operating at the physical layer (Layer 1) of the OSI model, it receives

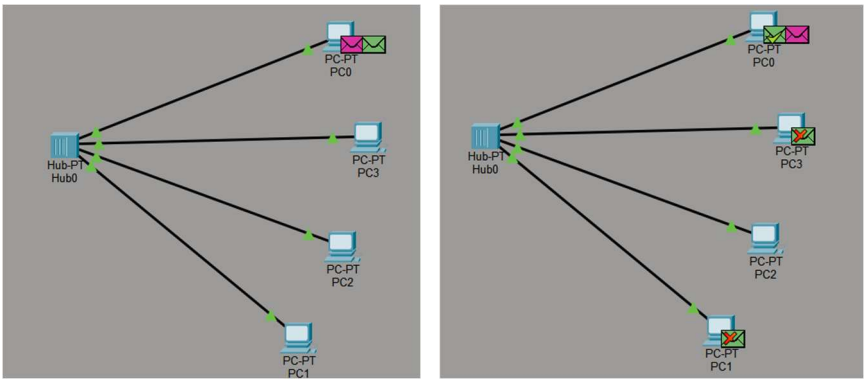
incoming signals, amplifies or reshapes them, and retransmits them to maintain signal strength over longer distances. Repeaters do not understand data or filter traffic; their sole purpose is signal regeneration.

OBSERVATION:

Hub:

For Hub: Hub-PT Hub0

PC Name	IP Address
PC-PT PC0	192.168.1.1
PC-PT PC1	192.168.1.2
PC-PT PC2	192.168.1.3
PC-PT PC3	192.168.1.4



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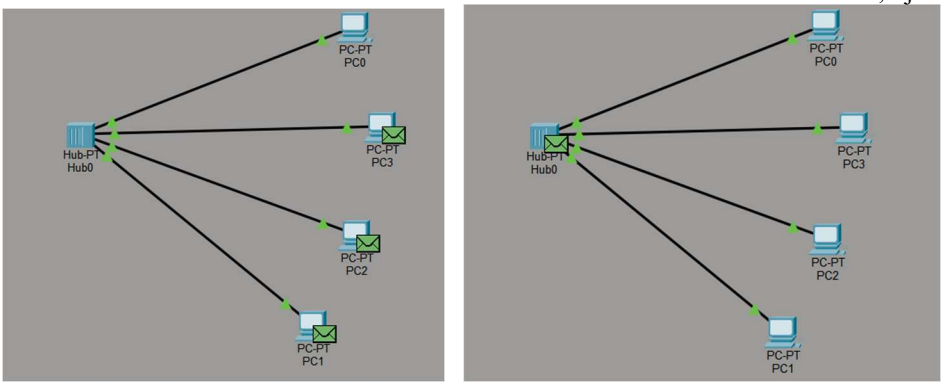


Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	In Progress	PC0	PC2	ICMP		0.000	N	0	(edit)	

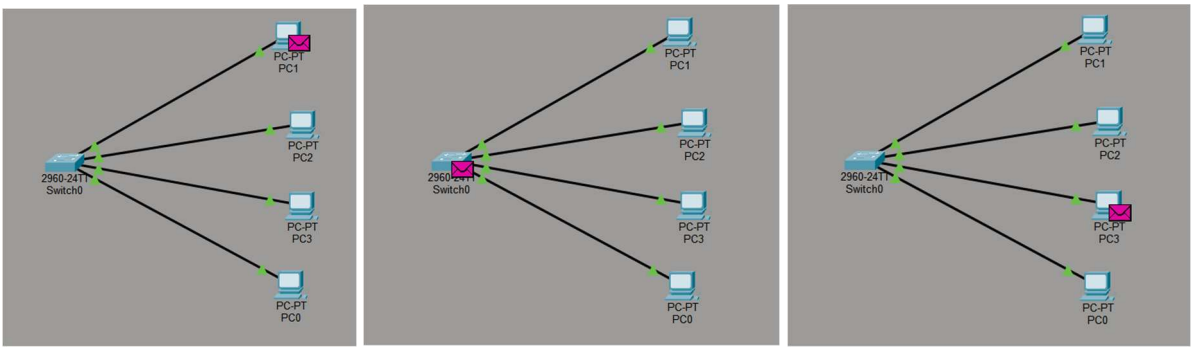
Vis.	Time(sec)	Last Device
	0.000	--
	0.000	--
	0.001	PC0
	0.002	Hub0
	0.002	Hub0
	0.002	Hub0
	0.003	PC2
	0.004	Hub0
	0.004	Hub0
	0.004	Hub0
	0.004	--

Here, the hub is served as the central connection point for multiple devices within a single network. It was observed that when a device sent data, the hub lacked the intelligence to identify the recipient and instead broadcasted the information to every connected port. This process created significant unnecessary traffic and increased the likelihood of data collisions, as multiple devices might attempt to use the shared path simultaneously. The simulation effectively demonstrated the inherent inefficiency of hubs, illustrating why they have been largely replaced by smarter devices in contemporary networking.

Switch:

For Switch: 2960-24TT Switch0

PC Name	IP Address
PC-PT PC0	192.168.1.1
PC-PT PC1	192.168.1.2
PC-PT PC2	192.168.1.3
PC-PT PC3	192.168.1.4



Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	PC1
	0.002	Switch0
	0.003	PC3
	0.004	Switch0

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num
	Successful	PC1	PC3	ICMP		0.000	N	0

Here, the switch was used to connect multiple devices in a Local Area Network (LAN). It was observed that unlike a hub, the switch used its internal MAC address table to direct data only to the specific port of the intended receiver. This resulted in a highly efficient data flow with no unnecessary traffic or collisions. The simulation clearly showed how switches provide a dedicated path for communication, which is why they are the standard choice for modern wired networks.

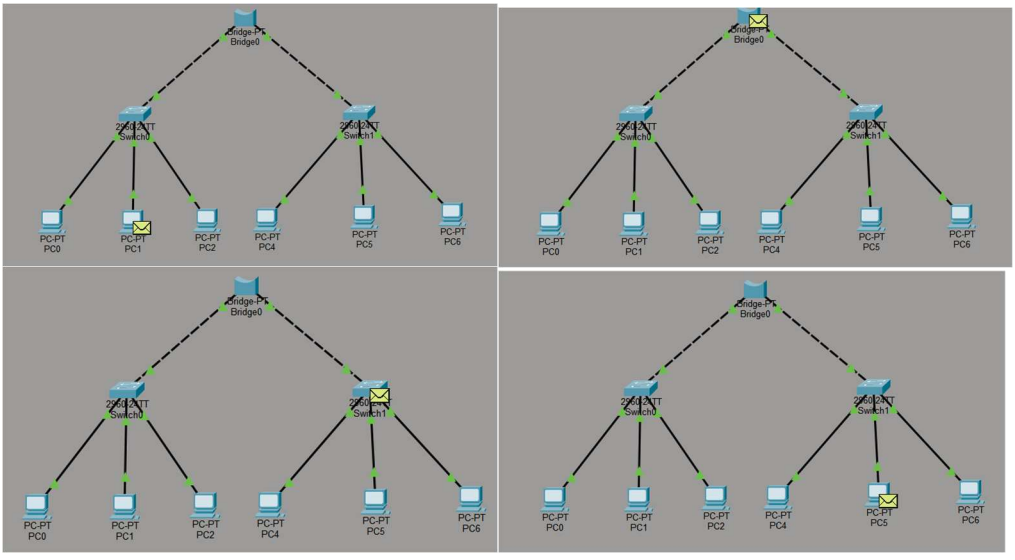
Bridge :

For Bridge: Bridge-PT Bridge0

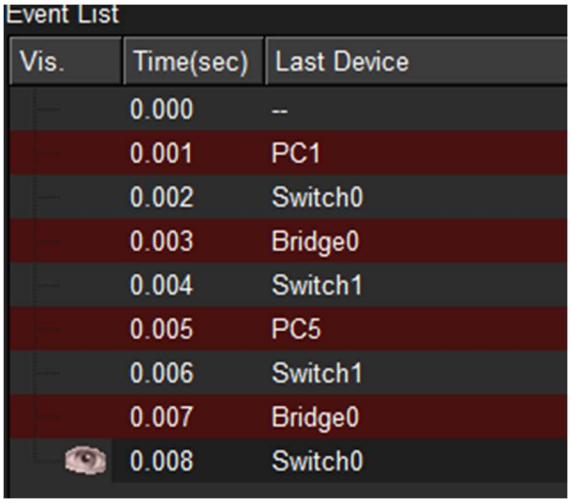
Switch: 2960-24TT Switch0

2960-24TT Switch1

PC Name	IP Address
PC-PT PC0	192.168.1.1
PC-PT PC1	192.168.1.2
PC-PT PC2	192.168.1.3
PC-PT PC4	192.168.1.4
PC-PT PC5	192.168.1.5
PC-PT PC6	192.168.1.6



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic
	Successful	PC1	PC5	ICMP		0.000	N



Here, the bridge was used to divide a large network into two distinct segments. It was observed that the bridge monitored traffic and only allowed data to pass through if the destination device was located

in the opposite segment. By filtering local traffic and preventing it from crossing over unnecessarily, the bridge reduced the overall congestion on the network. The simulation demonstrated its role in improving network performance by creating smaller collision domains.

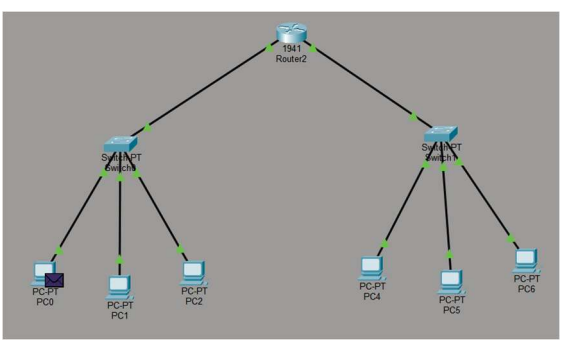
Router:

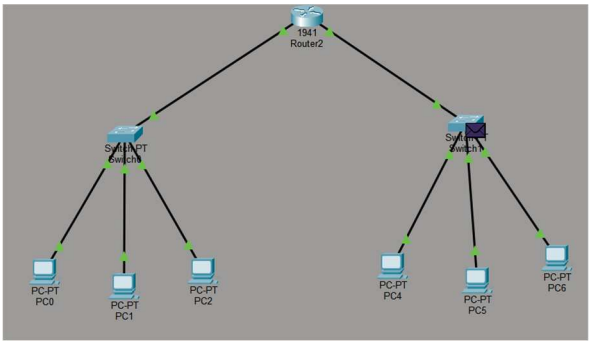
For Switch: 2960-24TT Switch0

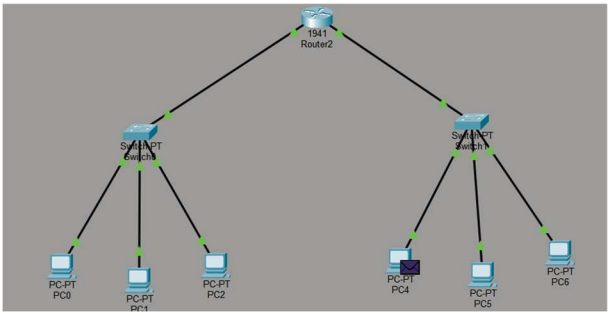
2960-24TT Switch1

Router: 1941 Router2	IP Address
GigabitEthernet0/0	192.168.1.4
GigabitEthernet0/1	10.10.10.4

PC Name	IP Address
PC-PT PC0	192.168.1.1
PC-PT PC1	192.168.1.2
PC-PT PC2	192.168.1.3
PC-PT PC4	10.10.10.1
PC-PT PC5	10.10.10.2
PC-PT PC6	10.10.10.3







Event List

Vis.	Time(sec)	Last Device
	0.000	--
	0.001	PC0
	0.002	Switch0
	0.002	Switch0
	0.002	Switch0
	0.003	Router2
	0.004	Switch1
	0.005	PC4
	0.006	Switch1
	0.007	Router2
	0.008	Switch0

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic
	Successful	PC0	PC4	ICMP		0.000	N

Here, the router was used to facilitate communication between two entirely different networks with different IP address ranges. It was observed that the router examined the IP address of each packet and used its routing table to determine the best path to the destination. Unlike switches that handle local traffic, the router acted as a gateway, blocking broadcast traffic and managing inter-network communication. The simulation highlighted its role in connecting LAN to Internet.

Repeater :

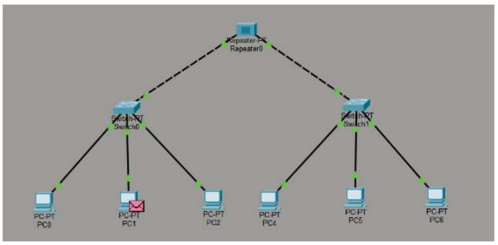
For Repeater: Repeater-PT

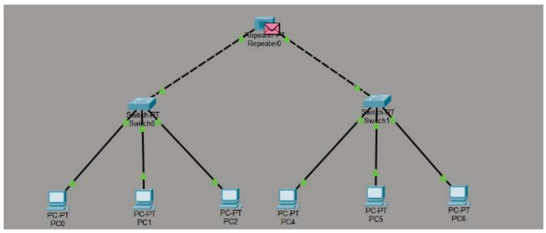
Repeater0 Switch: 2960-24TT

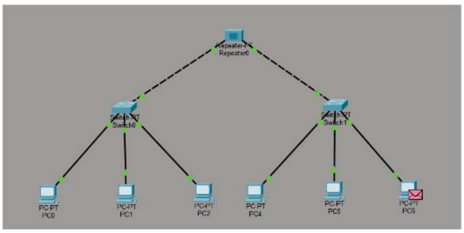
Switch0

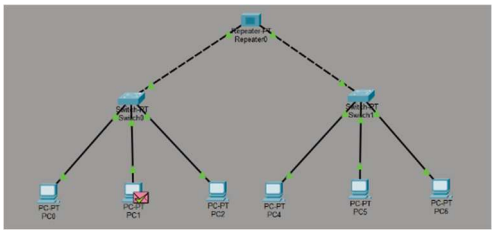
2960-24TT Switch1

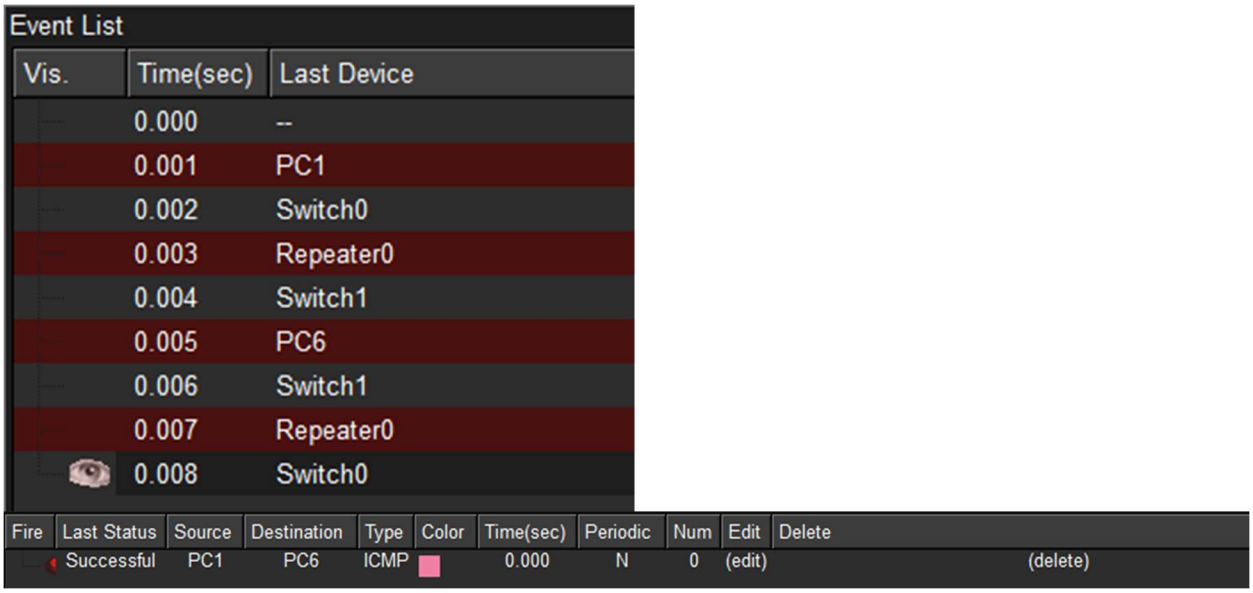
PC Name	IP Address
PC-PT PC0	192.168.1.1
PC-PT PC1	192.168.1.2
PC-PT PC2	192.168.1.3
PC-PT PC4	192.168.1.4
PC-PT PC5	192.168.1.5
PC-PT PC6	192.168.1.6











Here, a repeater was placed between two nodes that were separated by a long physical distance. It was observed that as the signal began to weaken due to the length of the cable, the repeater captured the fading signal, regenerated it to its original strength, and retransmitted it. This allowed the data to reach the destination without corruption or loss. The simulation helped in understanding how repeaters overcome the physical limitations of transmission media to extend network reach.

CONCLUSION

In conclusion, this experiment successfully simulated the fundamental operations of key network hardware using Cisco Packet Tracer. We observed the comparison of these devices reveals a clear evolution in network intelligence. While hubs and repeaters operate at the Physical Layer (Layer 1) and lack the ability to process addresses, switches and bridges operate at the Data Link Layer (Layer 2) using MAC addresses for smarter delivery. The router sits at the top of this hierarchy at the Network Layer (Layer 3), using IP addresses to manage global connectivity.