Project Title :

ARP Simulation in a Simple LAN using Cisco Packet Tracer

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Course :

L&T EduTech Industrial Internet of Things

Aim:

To construct a simple LAN using Cisco Packet Tracer and demonstrate the operation of Address Resolution Protocol (ARP) between connected PCs via an 8-port switch.

Problem Statement

Design and simulate a Local Area Network (LAN) with multiple PCs connected through an 8-port switch. Use ARP to resolve IP addresses to MAC addresses for communication between devices. Document the architecture, components, simulation, and demo as per submission guidelines.

Scope of the Solution

- Build a basic LAN topology in Cisco Packet Tracer using PCs and an 8-port switch.
- Assign unique IPv4 addresses to all PCs.
- Demonstrate ARP operation by initiating communication and observing ARP table updates.
- Document all steps, architecture, and simulation results.
- Provide screenshots and a demo video.

4. Understanding ARP (Address Resolution Protocol)

What is ARP?

- **ARP (Address Resolution Protocol)** is a network protocol used to map an IPv4 address (logical address) to a MAC address (physical address) on a local area network.
- It operates at the boundary between Layer 2 (Data Link) and Layer 3 (Network) of the OSI model.

How ARP Works

1. **When a device wants to communicate** with another device on the same LAN, it needs the destination device's MAC address.
2. **If the sender only knows the IP address**, it sends an ARP request as a broadcast message: "Who has this IP address? Tell me your MAC address."
3. **All devices on the LAN receive the ARP request**, but only the device with the matching IP address responds with an ARP reply, providing its MAC address.
4. **The sender stores this mapping** in its ARP table for future use, so it does not need to ask again.

Example ARP Table

IP Address	MAC Address	Type
192.168.1.3	00:1A:2B:3C:4D:5E	Dynamic
192.168.1.4	00:1A:2B:3C:4D:5F	Dynamic

- **Dynamic entries** are learned automatically and expire after some time.

- **Static entries** are manually set and remain until removed.

Why ARP is Important

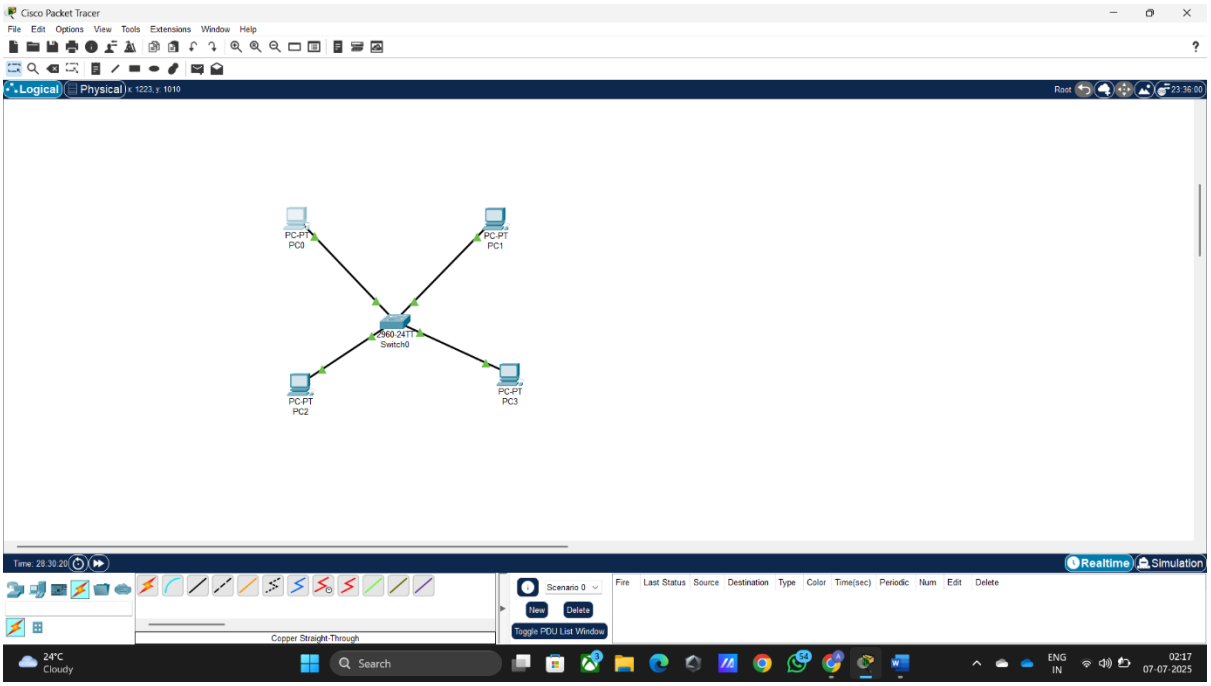
- Enables devices to communicate within the same network segment.
- Ensures accurate delivery of packets to the correct hardware address.
- Reduces unnecessary network traffic by caching address mappings.

5. Overview / Architecture of the Solution

Network Topology

- Four PCs connected to a single 8-port switch using straight-through cables.
- Each PC is assigned a unique IPv4 address in the same subnet.

Topology Diagram



Description

- All PCs are connected to different ports on a single 8-port switch using straight-through cables.
- Each PC is assigned a unique IPv4 address in the same subnet (e.g., 192.168.1.2–192.168.1.5, subnet mask 255.255.255.0).

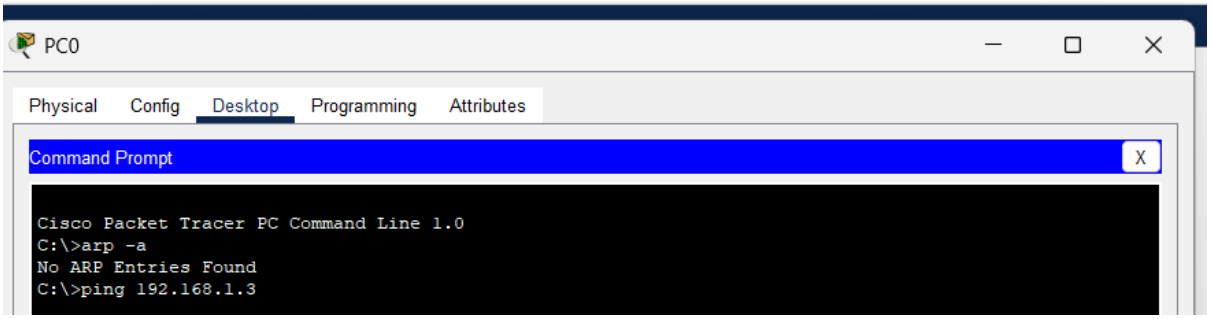
. Required Components

Component	Quantity	Purpose
Cisco Packet Tracer	1	Simulation software
PCs	4	End devices
8-port Switch	1	Central LAN device
Copper Straight Cables	4	PC-to-switch connections

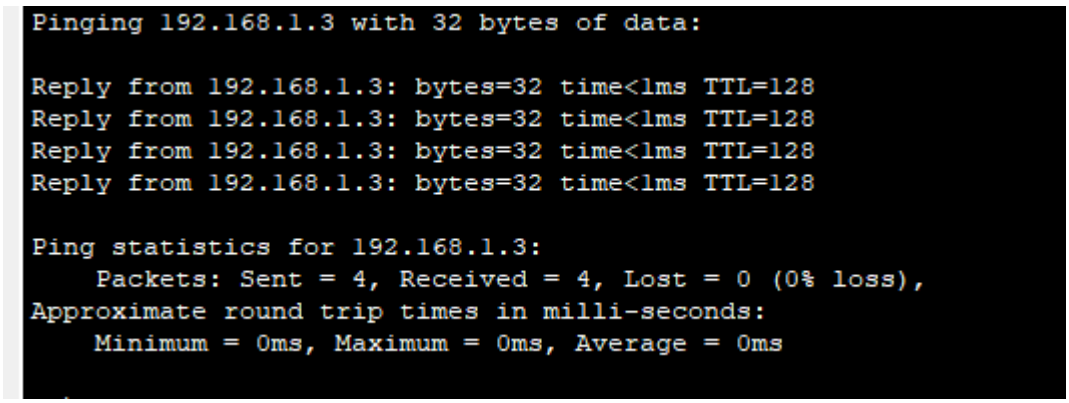
Simulation Screenshots :

ARP Table before ping :

Initiating Ping replies :



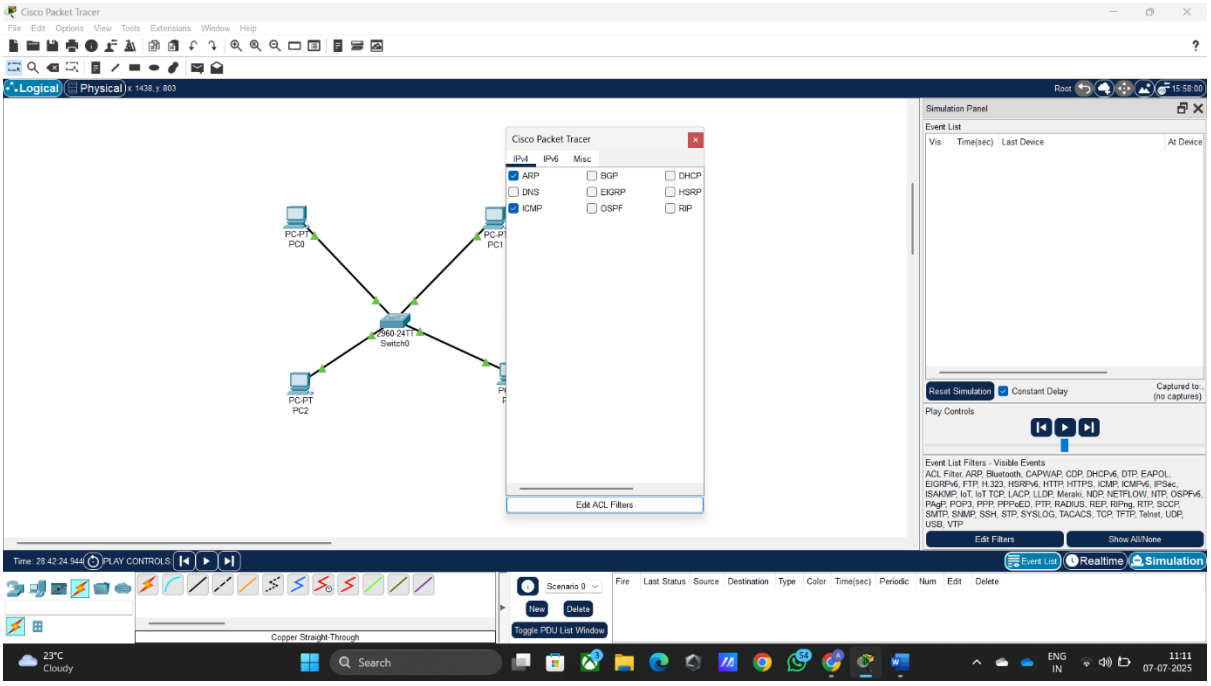
Ping Replies:



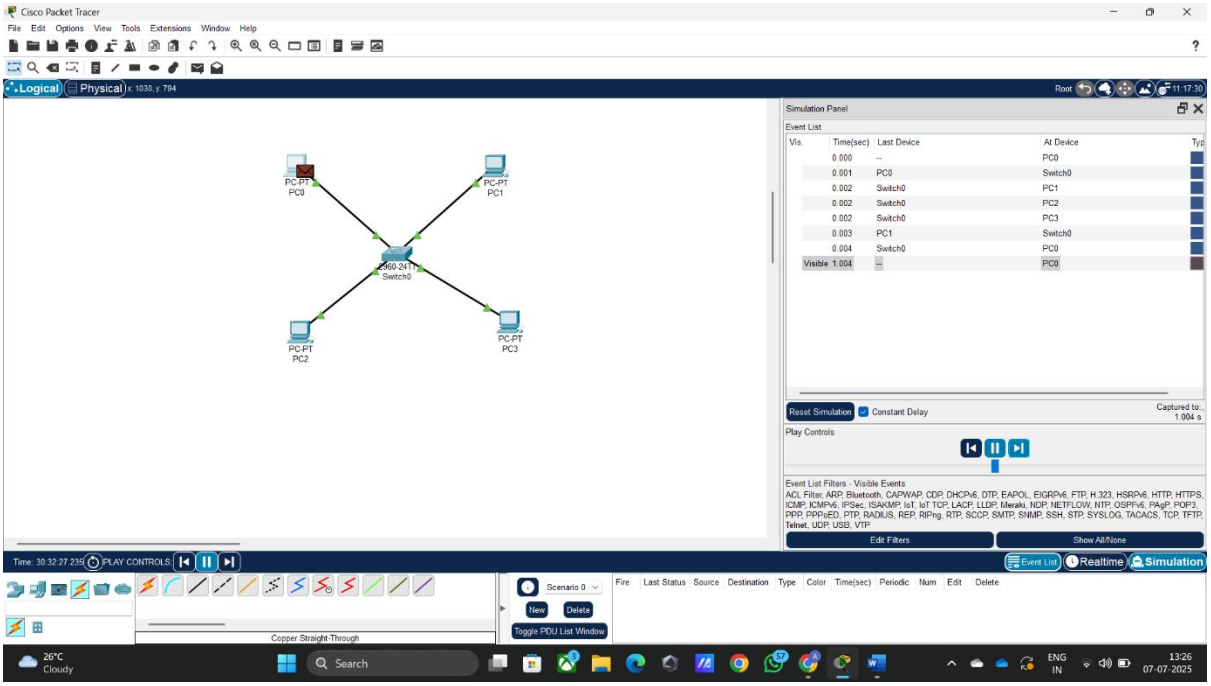
ARP table after ping:

```
C:\>arp  -a
  Internet Address      Physical Address      Type
  192.168.1.3           00d0.d3dc.5a88        dynamic
```

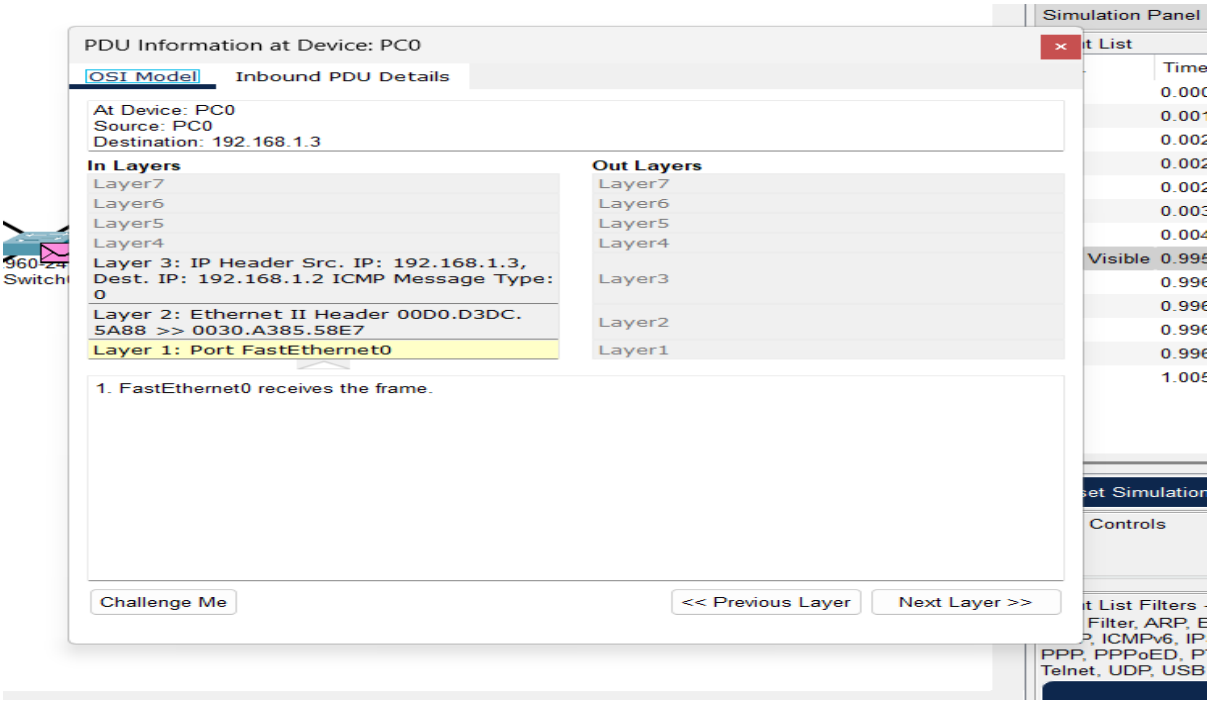
ARP and ICMP in the Event List Filters to focus on relevant packets:



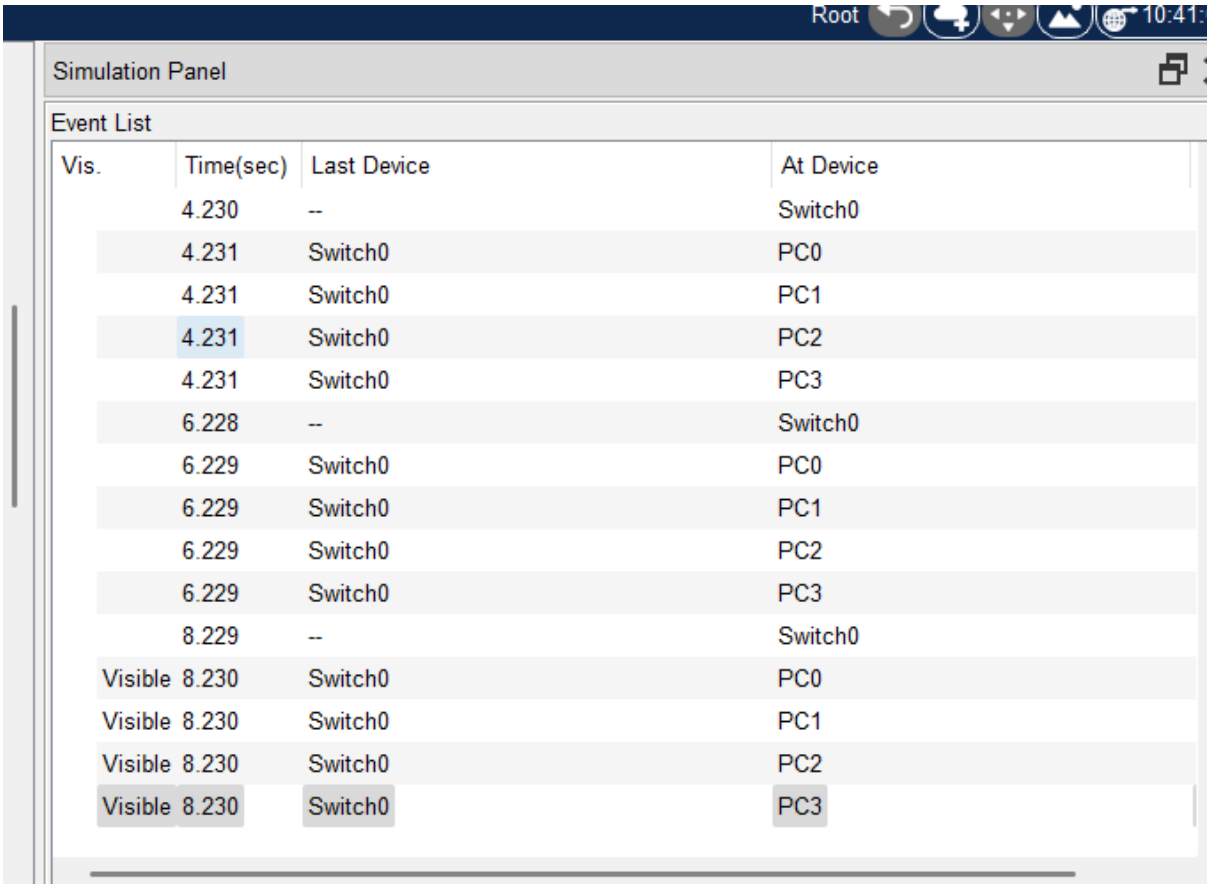
ARP request /reply:



Envelope details about the Source and destination:

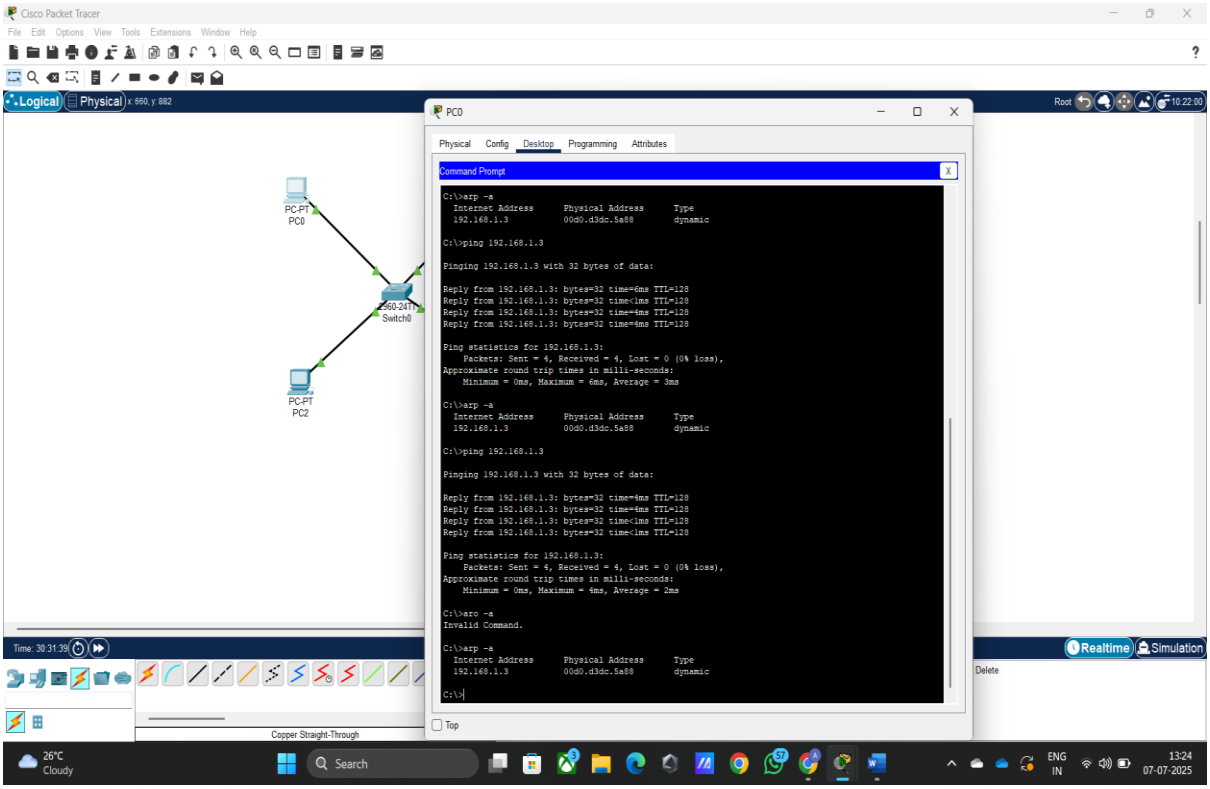


Event List :



Vis.	Time(sec)	Last Device	At Device
	4.230	--	Switch0
	4.231	Switch0	PC0
	4.231	Switch0	PC1
	4.231	Switch0	PC2
	4.231	Switch0	PC3
	6.228	--	Switch0
	6.229	Switch0	PC0
	6.229	Switch0	PC1
	6.229	Switch0	PC2
	6.229	Switch0	PC3
	8.229	--	Switch0
Visible	8.230	Switch0	PC0
Visible	8.230	Switch0	PC1
Visible	8.230	Switch0	PC2
Visible	8.230	Switch0	PC3

ARP table after Simulation



In the final execution phase, the LAN topology was constructed in Cisco Packet Tracer by connecting four PCs to a single 8-port switch using straight-through cables. Each PC was assigned a unique IPv4 address within the same subnet to ensure seamless communication. The ARP protocol was demonstrated by initiating a ping from one PC to another, which triggered the ARP process to resolve the destination MAC address. The ARP table was observed before and after the ping to confirm that the IP-to-MAC mapping was successfully established.

Simulation mode was utilized to visualize the step-by-step exchange of ARP Request and Reply packets, followed by the ICMP Echo Request and Reply (ping). This allowed for a clear understanding of how ARP enables devices to communicate on a local network by resolving hardware addresses. Screenshots of the topology, ARP tables, and packet flow were captured to document the process, and all files were organized and uploaded to the project repository for submission

Explanation of ARP

- ARP is used to map an IPv4 address to a MAC address within a LAN.
- When a device wants to communicate, it sends an ARP request as a broadcast.
- The device with the matching IP replies with its MAC address (ARP reply).
- The sender stores this mapping in its ARP cache for future use.

10. Conclusion

- Successfully constructed and simulated a LAN.
- Demonstrated ARP operation and observed how devices resolve MAC addresses from IP addresses.
- Understood the importance of ARP in local network communication.

11. Inference

Through this simulation, it is evident that ARP is a critical protocol for local area networking. Without ARP, devices would not be able to resolve IP addresses to MAC addresses, making direct communication on a LAN impossible. The simulation demonstrated how ARP dynamically builds a mapping table, enabling efficient and accurate data delivery within a subnet. This understanding is fundamental for troubleshooting and designing reliable computer networks.

12. References

Cisco, "Address Resolution Protocol (ARP) Overview," Cisco Documentation.
Available: https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/ipaddr_arp/configuration/xe-3s/arp-xe-3s-book/arp-config-arp.pdf

GeeksforGeeks, "Address Resolution Protocol (ARP)," GeeksforGeeks Networking Guide.
Available: https://www.geeksforgeeks.org/computer-networks/arp-reverse-arprarp-inverse-arp-inarp-proxy-arp-and-gratuitous-arp/

Cisco Networking Academy, "Getting Started with Cisco Packet Tracer."
Available: https://www.netacad.com/courses/getting-started-cisco-packet-tracer

13. Appendix

- **Drive link: Execution Video**
- **Github Link**

End of Report