R&D Documentation

1. Basics of MAC Addressing

1. MAC (Media Access Control) Addressing is a fundamental concept in computer networking, particularly at the Data Link Layer (Layer 2) of the OSI model.
2. A MAC address is a unique hardware identifier assigned to a network interface card (NIC) by the manufacturer. It allows devices on a local network to communicate with each other.
3. Format: Typically represented in hexadecimal and separated by colons or hyphens, such as: 00:1A:2B:3C:4D:5E (or) 00-1A-2B-3C-4D-5E

Types of MAC Addresses

1. Unicast: Identifies a single unique device on the network.
2. Multicast: Represents a group of devices (used in streaming, for instance).
3. Broadcast: FF:FF:FF:FF:FF:FF – sent to all devices on the local network.

Why is a MAC Address Used?

A MAC address is used to identify your device on a local network, like home Wi-Fi or office network. When your computer wants to send data (like a message or a file) to another device on the same network, it needs to know exactly where to send it.

MAC Address Diagram

MAC Address

00:14:2B:3C:CF:7A

00:23:45:67:89-AB

00:1A:2B:3C:4D:5E

00:F2:34:C5:D6 E7

00:99:88:77:66-55
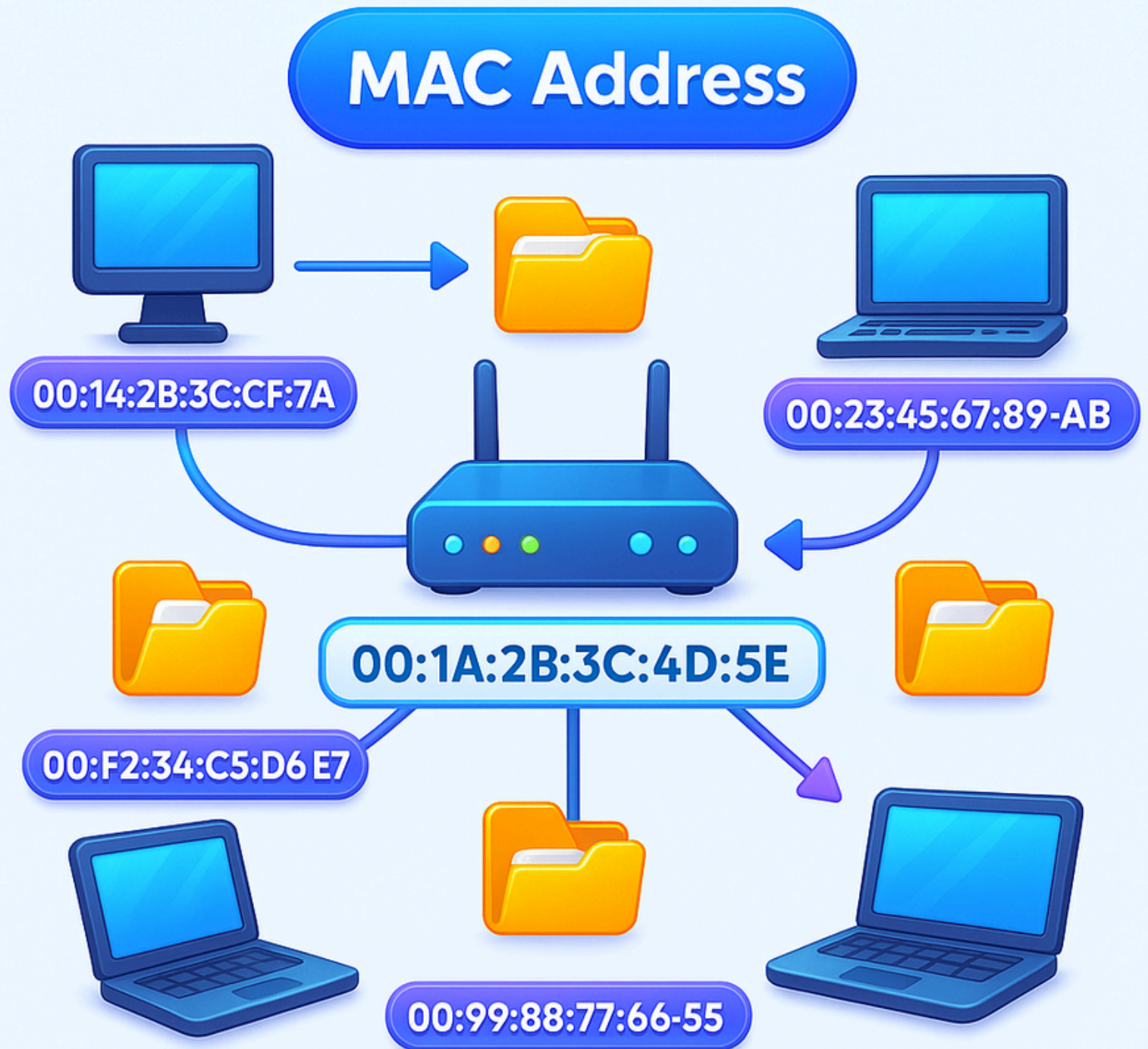
2. Functionality of ARP

1. ARP (Address Resolution Protocol) is used to map an IP address to a MAC address in a local network.

   - When a device wants to communicate with another device on the local network, it sends an ARP request.

   - The request is broadcasted to all devices in the network segment.
   - The device with the matching IP responds with its MAC address.
   - The sender stores this information in its ARP table for future use.

Why Do We Need ARP?

When one device (like your computer) wants to send data to another device on the same network, it knows the IP address of the other device — but to actually send the data, it needs the MAC address. That's where ARP comes in.

Example

Let's say your computer wants to send a file to a printer:

   - It knows the printer's IP: 192.168.1.50

   - It sends an ARP request: "Who has 192.168.1.50?"

   - The printer replies: "I do! My MAC is 00:1A:2B:3C:4D:5E."

   - Your computer saves this info and sends the file directly to that MAC address.
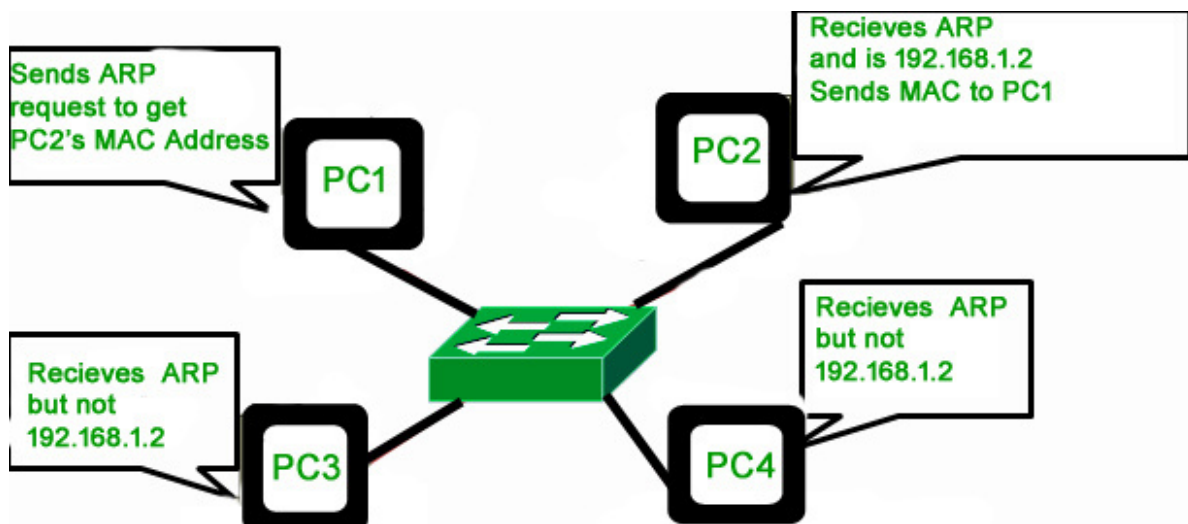
3. Functionality of RARP

1. RARP (Reverse Address Resolution Protocol) does the opposite of ARP. Instead of finding a MAC address from an IP address, it finds an IP address from a MAC address.

   - The device sends a RARP request:
      "Here's my MAC address, can someone tell me what my IP address is?"
   - The request is broadcasted to all devices in the network segment.A RARP server on the network checks its list of MAC addresses and their matching IPs.
   - The server replies with the correct IP address.
   - The device receives its IP and can now communicate on the network.

Why Do We Need RARP?

RARP was mainly used in the past by diskless computers or workstations — devices that didn't have their own storage to remember settings like IP addresses.
When these devices started up, they only knew their MAC address (since it's built into the hardware), but they needed an IP address to join the network. So they used RARP to ask for one.

Example

   - A diskless computer boots up and sends a RARP request:

      "My MAC is 00:1A:2B:3C:4D:5E. What's my IP?"

   - The RARP server responds:

      "Your IP address is 192.168.1.10."

   - Now the computer can start working on the network.

Device
Broadcasts MAC. Needs to know its IP

RARP server
Receives MAC and tells IP of the 'Device'

Conclusion

Understanding MAC addressing, ARP, and RARP is essential for anyone studying computer networks or working with networked systems.
TCP establishes a reliable connection using a three-way handshake, ensures ordered data transfer with acknowledgments, and terminates via a structured four-step process.

MAC addresses serve as unique identifiers for devices at the hardware level, enabling reliable data delivery within local networks.

ARP helps devices translate IP addresses into MAC addresses, ensuring successful communication over LANs.

RARP, though now largely obsolete, historically provided a way for devices to discover their IP addresses when they only had a MAC.

These protocols, while operating quietly in the background, are crucial building blocks that keep network communication smooth, efficient, and reliable.

References

https://en.wikipedia.org/wiki/MAC_address

https://en.wikipedia.org/wiki/Address_Resolution_Protocol

https://en.wikipedia.org/wiki/Reverse_Address_Resolution_Protocol