Address Resolution Protocol (ARP) - Simplified Explanation

Now that you understand **MAC addresses (Data Link Layer)** and **IP addresses (Network Layer)**, let's see **how they work together** using **Address Resolution Protocol (ARP).**

What is ARP?

ARP is a protocol that helps a device **find the MAC address** of another device **when only the IP address is known**.

When a device **wants to send data** over a network, it needs:

- **The receiver's IP address** (to identify the device).
- **The receiver's MAC address** (to deliver data on the local network).

Since an **Ethernet frame** requires a **MAC address**, ARP helps map an IP address **to a MAC address**.

How Does ARP Work?

1 Step 1: Check the ARP Table

Every network device **maintains an ARP table**, which is a **list of IP addresses and their corresponding MAC addresses**.

- If the destination IP's **MAC address is already in the ARP table**, the device **uses it immediately**.
- If not, it proceeds to Step 2.

---

2 Step 2: Send an ARP Request (Broadcast)

If the **MAC address is unknown**, the sender **broadcasts an ARP request** to all devices on the network.

- **This request asks:** "Who has IP `10.20.30.40`? Tell me your MAC address."
- **The request is sent to:** `FF:FF:FF:FF:FF:FF` (MAC broadcast address).
- **Every device** on the local network receives this request.

---

3 Step 3: ARP Reply (Unicast)

The device with the **matching IP (`10.20.30.40`) responds directly** with its **MAC address**.

- **Reply message:** "I have IP `10.20.30.40`, and my MAC address is `AA:BB:CC:DD:EE:FF`."
- The sender **stores this MAC address in its ARP table** for future use.

4️⃣ Step 4: Send the Data

Now that the **MAC address is known**, the sender can **encapsulate the IP packet inside an Ethernet frame** and send it over the network.

Why Does ARP Table Expire?

ARP table entries **don't last forever** because:

1. Devices might **change their IP addresses**.
2. New devices may join the network, replacing old ones.
3. **Old entries are removed** so that the network stays updated.

Most ARP table entries **expire within a few minutes**.

Key Takeaways

☑ **ARP maps IP addresses to MAC addresses** so devices can communicate.
☑ **ARP requests** are **broadcasted** (sent to all devices).
☑ **ARP replies** are **unicast** (sent only to the requester).
☑ **ARP tables store mappings temporarily** to reduce repeated ARP requests.