

Network basic: ARP (Address Resolution Protocol)

Introduction to ARP

ARP is a fundamental network protocol used in IPv4 networks. Its primary function is to map an IP address (Layer 3 in the OSI model) to a MAC address (Layer 2). This mapping is essential for local network communication.

How ARP Works

1. ARP Request:

When a device wants to communicate with another device on the same local network, it needs to know the recipient's MAC address. If it only knows the IP address, it sends out an ARP request. This request is a **broadcast** message sent to all devices on the local subnet. It essentially asks, "Who has this IP address? Please send me your MAC address."

2. ARP Reply:

The device with the matching IP address receives this broadcast and responds with an ARP reply. This reply is a **unicast** message sent directly back to the requester, providing its MAC address.

The ARP Process

1. Initiating Device:

The device (say, a computer) needs to send data to another device on the same LAN and knows the target device's IP address.

2. Checking the ARP Cache:

First, the initiating device checks its local ARP cache, a table where recent IP-to-MAC address mappings are stored. If the mapping is there, it proceeds to send the data. If not, it performs an ARP request.

3. Sending ARP Request:

The ARP request contains the sender's MAC and IP addresses and the target's IP address. The target's MAC address field is set to zeros, indicating it's unknown.

4. Broadcasting:

This ARP request is broadcasted to all devices on the local network. Each device on the network receives and processes this packet.

5. Receiving and Responding:

The device with the matching IP address responds with an ARP reply. This reply includes its MAC address. All other devices ignore the request since their IP addresses don't match.

6. Updating ARP Cache:

The initiating device receives the ARP reply and updates its local ARP cache with the new IP-to-MAC mapping. This cache update helps in future communications, reducing the need to broadcast ARP requests for the same IP address.

7. Data Transmission:

With the MAC address resolved, the initiating device can now format the data packet for the local network, including the target device's MAC address in the Ethernet frame. This allows the packet to be correctly delivered to the specific device on the LAN.

Key Points to Remember:

ARP is essential for local communication: It's crucial for IPv4 networks, as devices typically communicate based on MAC addresses at the data link layer.

Security aspect: ARP doesn't have a built-in authentication mechanism, making it susceptible to ARP spoofing attacks, where a malicious device sends false ARP messages to the network.

ARP Cache: Devices store ARP entries temporarily to reduce network overhead, but these entries can become stale and need to be updated or cleared periodically.

IPv6 Consideration: In IPv6, ARP's functionality is replaced by the Neighbor Discovery Protocol (NDP), which provides similar address resolution features with additional functionalities.