Research and Development Document on MAC Addressing and Functionality of ARP and RARP

Tushar Bhosale

Last Updated: June 2025

Contents

1   Introduction

This document provides a detailed study of MAC addressing and the working functionality of ARP (Address Resolution Protocol) and RARP (Reverse Address Resolution Protocol). These components are vital to communication within a local network and play an essential role in ensuring that data reaches the correct physical machine.

2   MAC Addressing

A MAC (Media Access Control) address is a unique hardware identifier assigned to a network interface card (NIC) by the manufacturer. It is used at the Data Link Layer (Layer 2) of the OSI model to ensure physical addressing within a network segment.

Key Features

- MAC addresses are 48-bit hexadecimal numbers, usually represented in the format: `00:1A:2B:3C:4D:5E`

- They are unique to each device, assigned by the IEEE.

- MAC addresses are used only within the local broadcast domain.

Types of MAC Addressing

- **Unicast:** Identifies a single receiver.

- **Broadcast:** Targets all devices in a network.

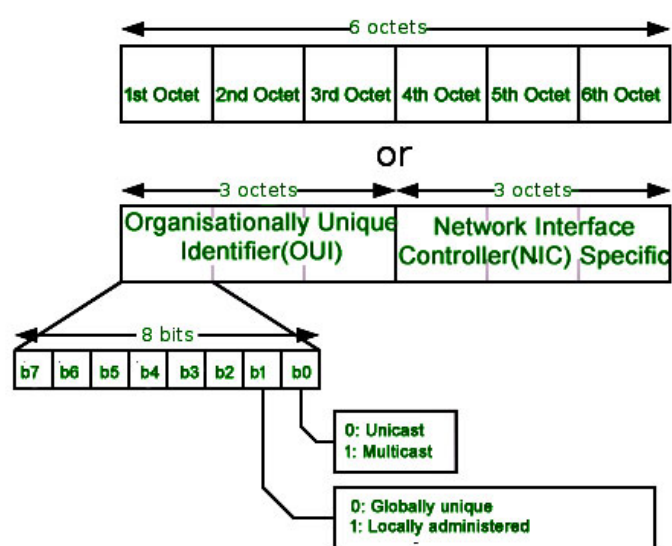- **Multicast:** Targets a specific group of devices.

Figure 1: Structure of a MAC Address

3   Address Resolution Protocol (ARP)

ARP is a network protocol used to find the MAC address associated with a given IP address. It operates between the Network Layer and Data Link Layer.

Working of ARP

When a device wants to communicate with another device in the same local network, it must know the recipient's MAC address. If it only has the IP address, it uses ARP to resolve this:

1. The sender broadcasts an ARP request on the local network.

2. The device with the matching IP responds with its MAC address.

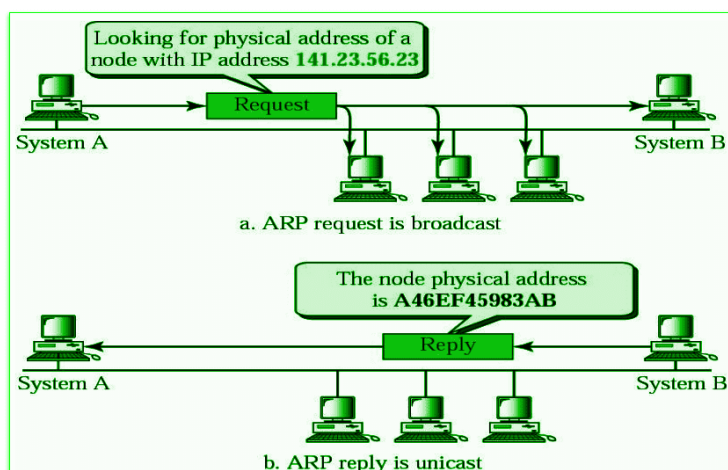3. The sender stores this in its ARP cache for future use.

Figure 2: Working of ARP Protocol

4   Reverse Address Resolution Protocol (RARP)

RARP performs the reverse function of ARP. It is used by a device to request its IP address from a gateway server, given its MAC address. This protocol is mostly obsolete and has been replaced by BOOTP and DHCP.

Use Cases

- Used by diskless workstations that do not know their IP address at boot.

- The server maintains a table of MAC-to-IP address mappings.

3

Working of RARP

1. The client sends a RARP request containing its MAC address.

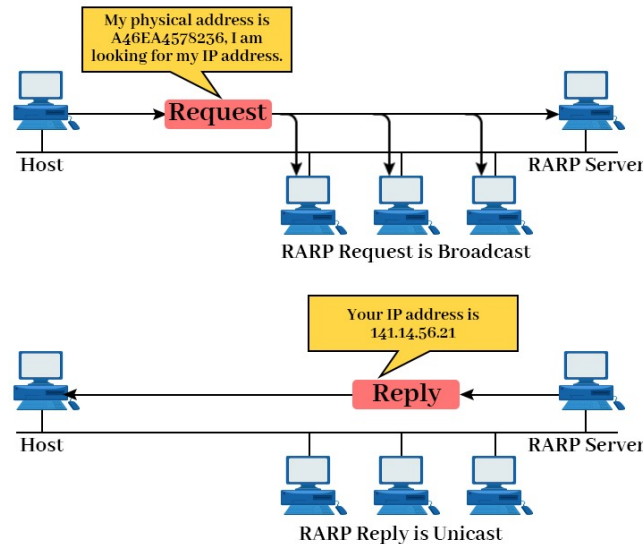2. A RARP server responds with the corresponding IP address.

Figure 3: Functionality of RARP

5   Conclusion

MAC addressing, ARP, and RARP form the foundational components of addressing and communication within a LAN. MAC addresses provide unique device identification, ARP resolves IP to MAC, and RARP (now deprecated) resolved MAC to IP. While RARP has been replaced in modern networks, understanding its role helps grasp how early networking operated.