Research & Development Document

Topic: Basics of MAC Addressing and Functionality of ARP & RARP
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1. Introduction

Both data link (MAC) and IP addressing are involved in communication on the network. MAC addresses function at the data link layer, and ARP (Address Resolution Protocol) and RARP (Reverse ARP) use translation protocols between IP addresses and MAC addresses. This document discusses MAC addressing and the way ARP/RARP protocols work over a network.

2. Prerequisites

- Knowledge of the OSI Model is required (especially Layer 2 and Layer 3)
- Basic knowledge of networking and IP communication
- Familiarity with Ethernet communication

3. Requirements

- Network-enabled device with a NIC (Network Interface Card)
- IP addressing configured
- Layer 2 switches or routers for ARP functionality

4. MAC Addressing Basics

- **Definition:** A MAC address is the 48-bit physical address assigned to the Network Interface Card of a device. It is 6 pairs of hexadecimal digits (e.g., 00:1A:2B:3C:4D:5E)
- **Types:**
    - Unicast MAC: Represents a single receiver
    - Broadcast MAC: FF:FF:FF:FF:FF:FF
    - Multicast MAC: Used to send data to a group

Structure of MAC Address:

- First 3 bytes: Organizationally Unique Identifier (OUI)
- Last 3 bytes: NIC-specific address

5. ARP (Address Resolution Protocol)?

- **Goal:** It maps the known IP address to its corresponding MAC address
- **Works in:** IPv4 networks
- **Protocol Type:** Request/Reply-based
- **Functionality:**
    1. Host checks ARP cache.
    2. If not found, sends ARP Request.
    3. Target replies with ARP Reply.
    4. MAC- The IP mapping is stored in the ARP table (i.e cache).

6. RARP (Reverse Address Resolution Protocol)?

- **Goal:** It maps a known MAC address to the IP address
- **Used by:** Diskless or booting devices to get IP from server
- **Functionality:**
    - Client broadcasts RARP request
    - RARP gives response with IP address assigned to that MAC

7. Additional Information

- ARP is only for IPv4. IPv6 uses **Neighbor Discovery Protocol (NDP)**.
- MAC addresses are crucial for LAN switching, while IP is for routing.
- ARP spoofing is a common network attack; mitigation involves dynamic ARP inspection.

8. Real-World Applications

- ARP used by routers to forward packets within LAN
- MAC addresses used in network access control
- ARP tables used by switches and firewalls for traffic forwarding

9. Related Information

- **RFC 826:** ARP Specification

- **RFC 903:** RARP Specification
- **IEEE 802.3:** Ethernet and MAC Address Standards
- Tools: Wireshark, ARPwatch, IP scanner

10. Conclusion

Knowing MAC addressing and ARP/RARP protocols is key to successful network communications. MAC addresses allow for proper delivery of frames to the data connection layer, and ARP and RARP act as translators of logical and physical addresses. Understanding these concepts for network engineers makes it easier to build, design and security of local networks.