# Address Resolution (ARP, RARP)

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- **Address resolution problem**
- **Address resolution techniques**
- **ARP protocol**
- **Proxy ARP, Reverse ARP (RARP), and Inverse ARP**

**Ref: RFC 826, 903; Chap 4,5**



## Resolution Problems

- **Indirection through addressing/naming => requires resolution**
- **Problem usually is to map destination layer N address to its layer N-1 address to allow packet transmission in layer N-1.**

## ARP techniques

- 1. Direct mapping: **Make the physical addresses equal to the host ID part.**
  - **Mapping is easy.**
  - **Only possible if admin has power to choose both IP and physical address.**
  - **Ethernet addresses come preassigned (so do part of IP addresses!).**
  - **Ethernet addresses are 48 bits vs IP addresses which are 32-bits.**



## ARP techniques (contd)


- **2: Table Lookup:**
  **Searching or indexing to get MAC addresses**
  - **Similar to lookup in /etc/hosts for names**
  - **Problem: change Ethernet card => change table**

| IP Address | MAC Address |
|---|---|
| 197.15.3.1 | 0A:4B:00:00:07:08 |
| 197.15.3.2 | 0B:4B:00:00:07:00 |
| 197.15.3.3 | 0A:5B:00:01:01:03 |



## ARP techniques (Cont)

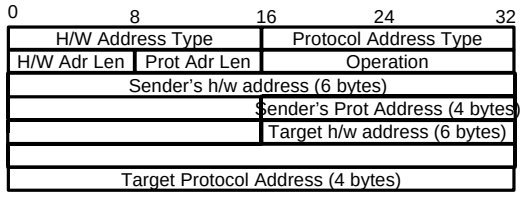
- **3. Dynamic Binding: ARP**
  - **The host *broadcasts* a request: "What is the MAC address of 127.123.115.08?"**
  - **The host whose IP address is 127.123.115.08 replies back: "The MAC address for 127.123.115.08 is 8A-5F-3C-23-45-56$_{16}$"**
- **All three methods are allowed in TCP/IP networks.**

## Comparison of ARP Techniques

| Issue | Method |
|---|---|
| 1. Address change does not affect other hosts | Message, direct |
| 2. IP address independent of h/w address | Table , Message |
| 3. Uses broadcast | Message |
| 4. Resolves with min delay | Table, direct |
| 5. Easy to implement | All three |



## ARP Message Format




- **Type: ARP handles many layer 3 and layer 2s**
- **Protocol Address type: 0x0800 = IP**
- **Operation: 1= Request, 2=Response**
- **ARP messages are sent directly to MAC layer**

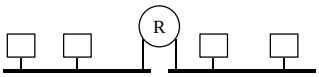


## ARP Processing

- **See ARP dynamics in figs 4.2, 4.4, 4.5**
- **ARP responses are cached. Replacement:**
  - **Cache table fills up => LRU policy used**
  - **Timeout: e.g., 20 minutes**
  - **Others may snoop on ARP, IP packets for address bindings**
- **Note:**
  - **A point-to-point link like SLIP does not require ARP.**
  - **Telephony does not require ARP.**

## Proxy ARP

- Hack for better address space utilization
- Hosts on multiple subnets use same subnet address {“virtual subnet”} => assume direct connectivity thru’ LAN
- A router acts as proxy for IP addresses on either side and replies to ARP requests on behalf of hosts on the other side.






## Proxy ARP (contd)

- Problem:both router interface and hidden hosts will have same LAN address in the ARP cache
  - Considered security hazard
- Also called “promiscous ARP” or “ARP hack”
- Original use: hide old TCP/IP version hosts (eg: which could not handle subnetting etc) on a separate cable
- Superceded by subnet addressing.



## Gratuitous ARP

- ARP message for its own IP address
- Used during bootstrap time to check if no other host is configured with the same IP address.

## Reverse ARP (RARP)

- H/w address -> IP address
- Used by diskless systems
  - RARP server responds.
  - Once IP address is obtained, use “tftp” to get a boot image. Extra transaction!
- RARP design complex:
  - RARP request broadcast, not unicast!
  - RARP server is a user process and maintains table for multiple hosts (/etc/ethers). Contrast: no ARP server



## RARP (contd)

- RARP cannot use IP
  - Needs to set unique Ethernet frame type (0x8035)
  - Works through a filter like BPF or nit_if/nit_pf streams modules (fig: A.1, A.2)
- Multiple RARP servers needed for reliability
  - RARP servers cannot be consolidated since RARP requests are broadcasts => router cannot forward
- BOOTP, DHCP replaces RARP



## Summary & Informal exercises

- ARP, Proxy ARP, RARP
- Read the man page for the “arp” command
- Approximate the tcpdump experiments given in the text using your rcs and networks lab accounts.
- ARP requires a broadcast enabled LAN. What would happen on a non-broadcast medium access (NBMA) LAN ? Guess first and then see RFC 1735.

## References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