Chapter 15: Address Resolution Protocol

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Overview

- Address resolution problem
- Address resolution techniques
- ARP protocol
- Proxy ARP, Reverse ARP, and Inverse ARP
Address Resolution Protocol (ARP)

- Problem: Given an IP address find the MAC address
- Solution 1. Table Lookup:
  Searching or indexing to get MAC addresses

<table>
<thead>
<tr>
<th>IP Address</th>
<th>MAC Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>197.15.3.1</td>
<td>0A:4B:00:00:07:08</td>
</tr>
<tr>
<td>197.15.3.2</td>
<td>0B:4B:00:00:07:00</td>
</tr>
<tr>
<td>197.15.3.3</td>
<td>0A:5B:00:01:01:03</td>
</tr>
<tr>
<td>197.15.3.4</td>
<td>04:06:07:08:09:10</td>
</tr>
<tr>
<td>197.15.3.5</td>
<td>06:07:09:08:03:01</td>
</tr>
</tbody>
</table>
ARP (Cont)

- 2. Closed-Form Computation: Using local IEEE 802 addresses, e.g., Hardware Address = (IP_address & 0xFF)!40:00:00:00:00:00

  - 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

<table>
<thead>
<tr>
<th>Issue</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address change does not affect other hosts</td>
<td>Message, Computation</td>
</tr>
<tr>
<td>Protocol address independent of h/w address</td>
<td>Table, Message</td>
</tr>
<tr>
<td>H/w address independent of protocol address</td>
<td>Table, Message</td>
</tr>
<tr>
<td>Uses broadcast</td>
<td>Message</td>
</tr>
<tr>
<td>Adds traffic to a network</td>
<td>Message</td>
</tr>
<tr>
<td>Resolves with min delay</td>
<td>Table, Computation</td>
</tr>
<tr>
<td>Easy to implement</td>
<td>Computation, Table, Message</td>
</tr>
</tbody>
</table>
### ARP Message Format

<table>
<thead>
<tr>
<th>0</th>
<th>8</th>
<th>16</th>
<th>24</th>
<th>32</th>
</tr>
</thead>
<tbody>
<tr>
<td>H/W Address Type</td>
<td>Protocol Address Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/W Adr Len</td>
<td>Prot Adr Len</td>
<td>Operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sender’s h/w address (6 bytes)</td>
<td>Sender’s Prot Address (4 bytes)</td>
<td>Target h/w address (6 bytes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Protocol Address (4 bytes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **H/W Address type:**
- **Protocol Address type:** 0x0800 = IP
- **Operation:** 1 = Request, 2 = Response
- **ARP messages are sent directly to MAC layer**
ARP Processing

- ARP responses are cached.
- Entry replaced when
  - Cache table fills up (oldest removed)
  - After some time, e.g., 20 minutes
- Sender’s address binding is stored in the cache of the target
- Proxy ARP: A router may act as a proxy for many IP addresses
Reverse ARP (RARP)

- What is the IP address of a given hardware address?
- Used by diskless systems to find their own IP address.
- Need RARP server to respond.
- Ref: RFC 903 and Comer’s “Internetworking with TCP/IP, Vol 1, 3rd Ed
Inverse ARP

- Used on point to point links
- Find IP address of the host on the other end
- Used in frame relay and ATM
- Ref: RFC 1293
ARP allows converting IP address to MAC addresses
Proxy ARP, RARP, Inverse ARP
Homework

- Read Chapter 15, RFC 826
- Submit answers to 15.6
References


