COMP202-08B
Computer Communications

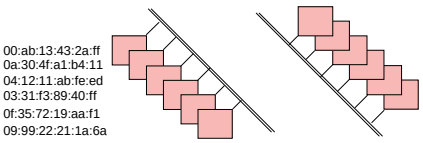
Lecture 8

Ethernet - ARP

So far

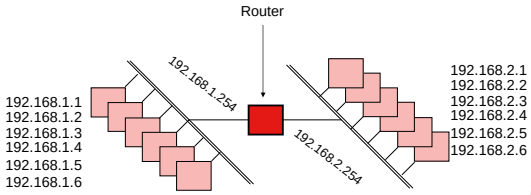
- Ethernet
  - 48 bit MAC address
  - Flat addressing scheme
  - Connect machines in small network
- Internet Protocol v4 (IPv4)
  - 32 bit IP addresses
  - Structured addressing scheme
  - Internet-wide addressing

Networks



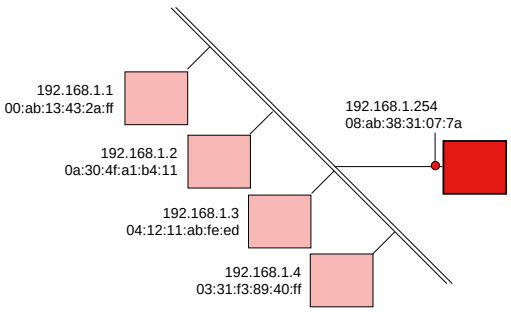
MAC addresses are wired in (flat)

Networks



MAC addresses are wired in (flat)
IP addresses are chosen (structured)

Networks



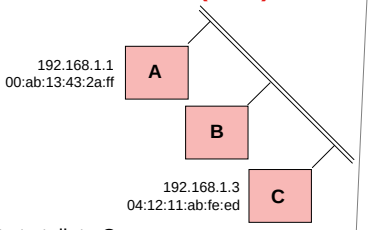
IP over Ethernet Communications

- From the software writer's perspective, the network protocols used are IP based.
  - Socket and ServerSocket open ports bound to IP addresses
- Application writers do not use Ethernet addresses
- The operating system handles communicating over Ethernet

IP over Ethernet

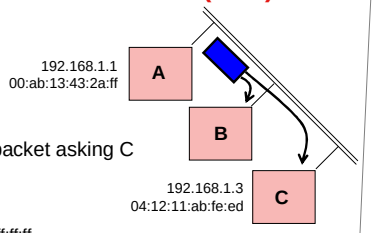
- The operating system needs to find out what destination Ethernet MAC address should be used when sending an IP packet
- Do this using the Address Resolution Protocol (ARP)

Address Resolution Protocol (ARP)



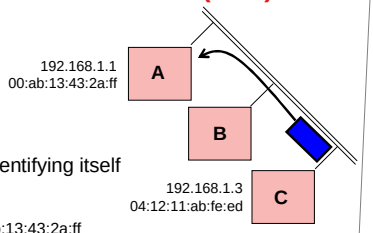
- Computer A wants to talk to C
- Link Layer is Ethernet
- Computer A needs to know how to fill out the Ethernet fields

Address Resolution Protocol (ARP)



- A broadcasts a packet asking C to identify itself
- Ethernet header:
  - To: ff:ff:ff:ff:ff:ff
  - From: 00:ab:13:43:2a:ff
- Ethernet Payload:
  - Who-has 192.168.1.3

Address Resolution Protocol (ARP)



- C replies to A, identifying itself
- Ethernet header:
  - To: 00:ab:13:43:2a:ff
  - From: 04:12:11:ab:fe:ed
- Ethernet Payload:
  - 192.168.1.3 is-at 04:12:11:ab:fe:ed

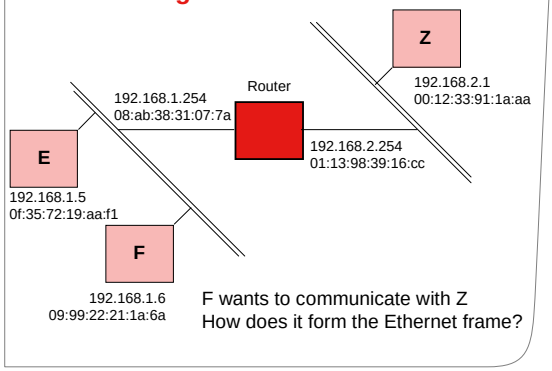
Address Resolution Protocol

- A computer does not do ARP every time it needs to send something
- Instead, it keeps a record of recent replies to arp requests
  - ARP cache
  - Periodically, entries are expired
- You can view the contents of the arp cache using
  - arp –a –n
  - /sbin/arp or /usr/sbin/arp depending on system

ARP Cache

```
[mluckie@sorcerer mjl]$ /usr/sbin/arp -an
? (130.217.64.2) at 00:00:0c:07:ac:00 on rl0 [ethernet]
? (130.217.208.11) at 00:0b:db:94:be:e8 on rl0 [ethernet]
? (130.217.240.31) at 00:06:5b:19:8e:55 on rl0 [ethernet]
? (130.217.240.32) at 00:0f:1f:66:d4:26 on rl0 [ethernet]
? (130.217.241.36) at 00:13:21:ae:d3:76 on rl0 [ethernet]
? (130.217.244.90) at 00:e0:81:05:85:e8 on rl0 [ethernet]
? (130.217.247.31) at 00:06:5b:8d:20:46 on rl0 [ethernet]
? (130.217.250.10) at 00:19:b9:37:77:f1 on rl0 [ethernet]
? (130.217.250.13) at 00:50:45:bb:ae:02 on rl0 [ethernet]
? (130.217.250.15) at 00:07:e9:0c:52:b7 on rl0 [ethernet]
? (130.217.250.17) at 00:30:48:7f:55:44 on rl0 [ethernet]
```

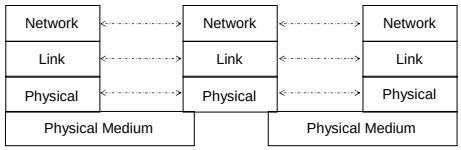
IP Networking



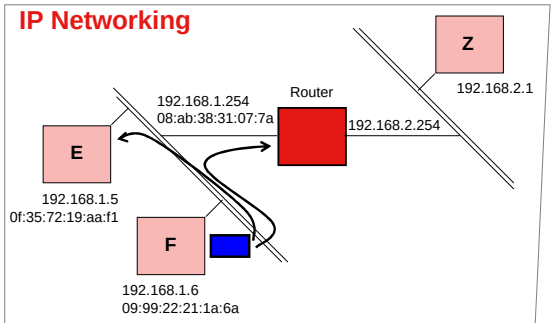
F wants to communicate with Z
How does it form the Ethernet frame?

OSI

- Physical, Link: Ethernet
- Network: IPv4

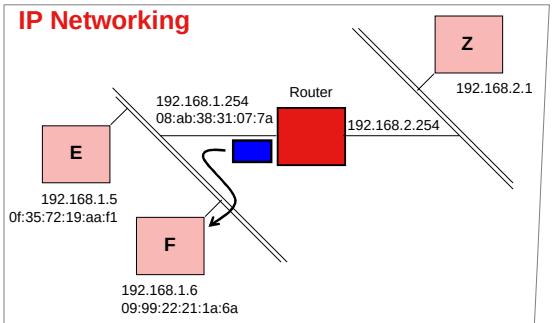


IP Networking



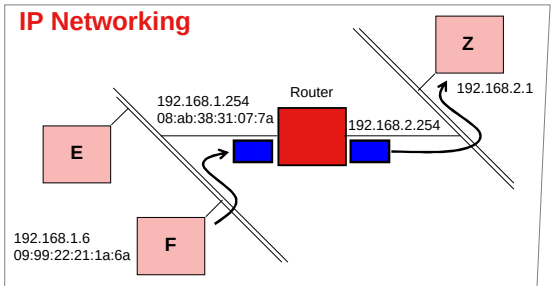
- F asks for the Router's Ethernet MAC address
- Ethernet Broadcast, who-has 192.168.1.254

IP Networking



- The router replies 192.168.1.254 is-at 08:ab:38:31:07:7a

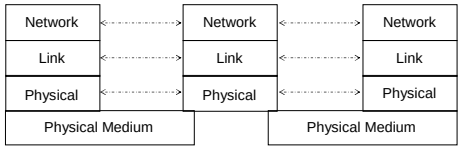
IP Networking



- F sends packet addressed to Z (192.168.2.1) via the router (08:ab:38:31:07:7a)
- The router will then arp for Z's Ethernet MAC address and then forward the packet

OSI

- Physical, Link: Ethernet
- Network: IPv4



Summary

- ARP maps IP addresses to Ethernet MAC addresses
- ARP tables are dynamically managed
- ARP tables are scoped to a single Ethernet bus