

LAN Addresses and ARP

32-bit IP address:

- *network-layer* address
- used to get datagram to destination network (recall IP network definition)

LAN (or MAC or physical) address:

- used to get datagram from one interface to another physically-connected interface (same network)
- 48 bit MAC address (for most LANs) burned in the adapter ROM

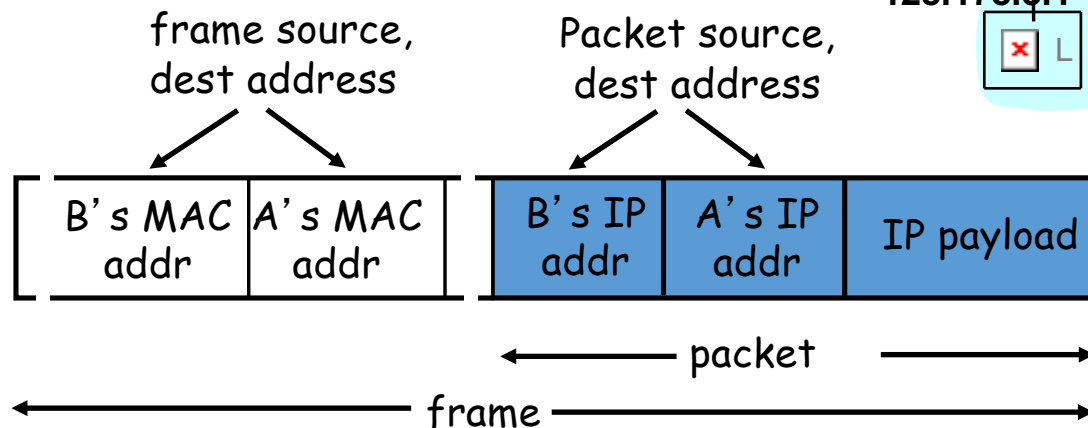
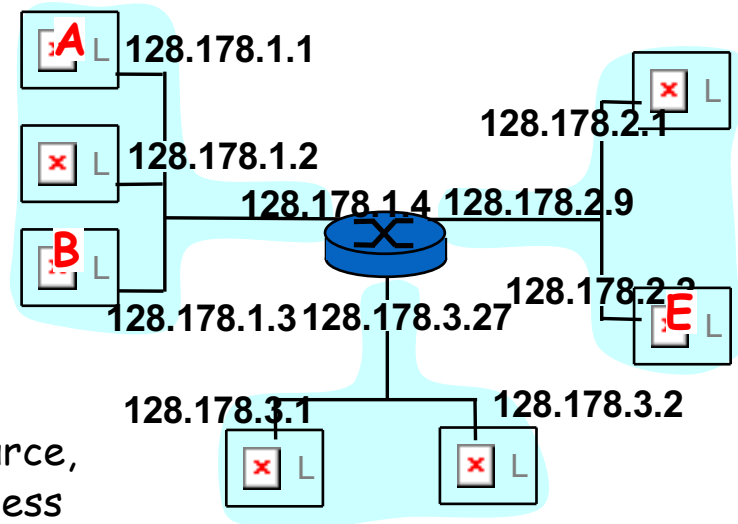
Why different addresses at IP and MAC?

- LANs not only for IP (LAN addresses are neutral)
- if IP addresses used, they should be stored in a RAM and reconfigured when host moves
- independency of layers

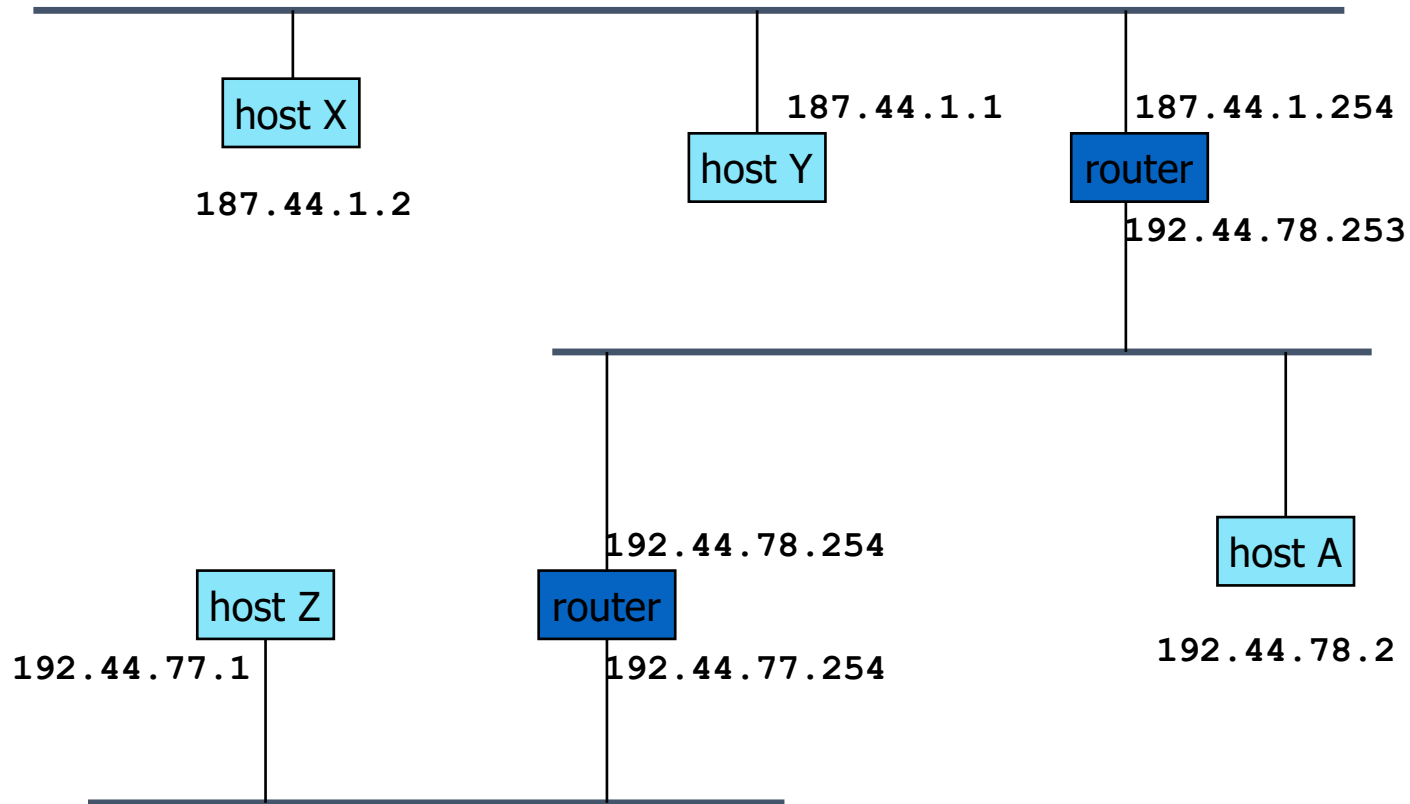
MAC Address resolution

Starting at A, given IP datagram addressed to B:

- look up net. address of B, find B on same net. as A
- link layer sends packet to B inside link-layer frame



Example



- Host A is on subnetwork 192.44.78

Packet delivery

Packet sent by 187.44.1.2 to 187.44.1.1

MAC-host-Y	MAC-host-X	187.44.1.1	187.44.1.2	payload
------------	------------	------------	------------	---------

Ethernet header

IP header

X needs to know MAC address of Y (ARP)

Packet sent by 187.44.1.2 to 192.44.78.2

MAC-router1	MAC-host-X	192.44.78.2	187.44.1.2	payload
-------------	------------	-------------	------------	---------

Ethernet header

IP header

MAC-host-A	MAC-router2	192.44.78.2	187.44.1.2	payload
------------	-------------	-------------	------------	---------

Ethernet header

IP header

X needs to know MAC address of router (X knows the IP address of router - configuration)

Router needs to know MAC address of A

ARP: Address Resolution Protocol

ARP is used to determine the MAC address of B given B's IP address

- Each IP node (Host, Router) on LAN implements **ARP** protocol and has ARP table
- ARP Table: IP/MAC address mappings for some LAN nodes
< IP address; MAC address >
< >
 - ARP table is a cache: after an interval (typically 20 min) the address mapping will be forgotten

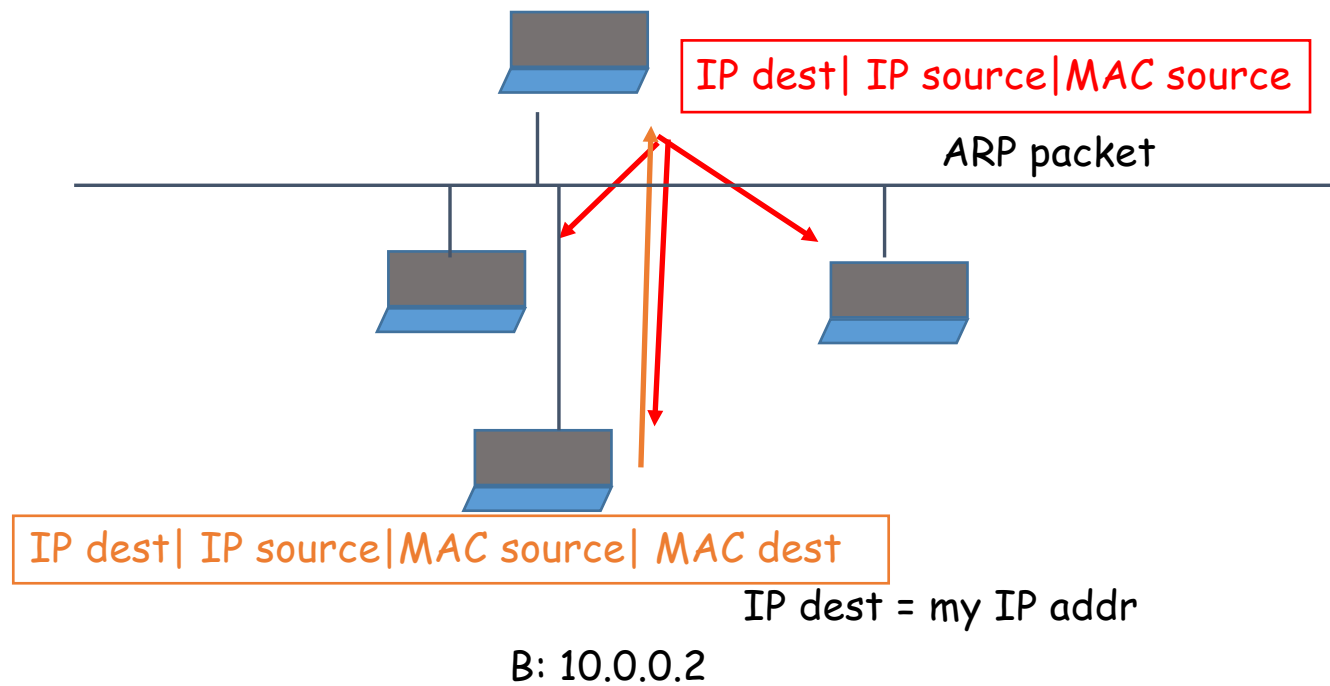
ARP protocol

- A knows B's IP address, wants to learn physical address of B
- A **broadcasts** ARP query pkt, containing B's IP address
 - all machines on LAN receive ARP query
- B receives ARP packet, replies to A with its (B's) physical layer address
- A caches (saves) IP-to-physical address pairs until information becomes old (times out)
 - soft state: information that times out (goes away) unless refreshed

ARP protocol

IP address	MAC address	TTL
10.0.0.2	49:BD:D2:07:56:2A	6:00:00

A: 10.0.0.1



ARP frames

- Request (**broadcast**)

- sender Ethernet address
- sender IP address
- target Ethernet address ???
- target IP address

- Reply (**unicast**)

- sender Ethernet address
- sender IP address
- target Ethernet address
- target IP address

The image shows a Wireshark network traffic capture. The top pane displays a list of captured packets. Two ARP frames are highlighted:

No.	Time	Source	Destination	src port	dst port	Protocol	Length	Info
366	65.91	Apple_9f:bb:42	Broadcast			ARP	42	Who has 129.88.55.254? Tell 129.88.55.155
367	65.9158:00:bb:59:a3:f0	Apple_9f:bb:42				ARP	60	129.88.55.254 is at 58:00:bb:59:a3:f0

The bottom pane shows the details of the selected ARP request frame (No. 366):

- Ethernet II, Src: Apple_9f:bb:42 (0c:4d:e9:9f:bb:42), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
- Address Resolution Protocol (request)
 - Hardware type: Ethernet (1)
 - Protocol type: IP (0x0800)
 - Hardware size: 6
 - Protocol size: 4
 - Opcode: request (1)
 - Sender MAC address: Apple_9f:bb:42 (0c:4d:e9:9f:bb:42)
 - Sender IP address: 129.88.55.155 (129.88.55.155)
 - Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
 - Target IP address: 129.88.55.254 (129.88.55.254)

The packet bytes pane shows the raw data of the ARP request:

```
0000 ff ff ff ff ff ff 0c 4d e9 9f bb 42 08 06 00 01 .....M ...B....
0010 08 00 06 04 00 01 0c 4d e9 9f bb 42 81 58 37 9b .....M ...B.X7.
0020 00 00 00 00 00 00 81 58 37 fe .....X 7.
```


Routing to another LAN

- Walkthrough: routing through a router