

CS 372 Lecture #36

MAC addresses

Address Resolution Protocol (ARP)

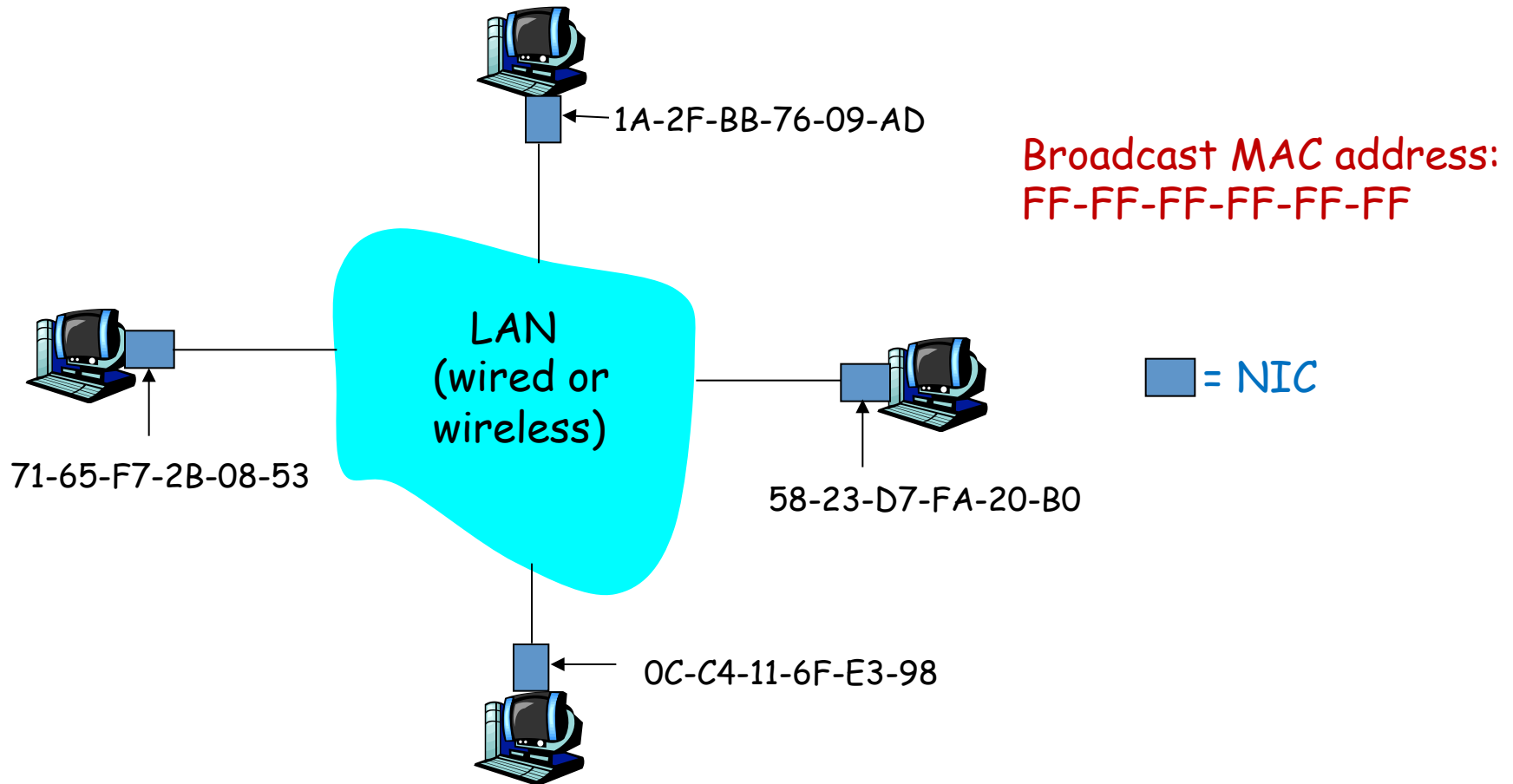
Note: Many of the lecture slides are based on presentations that accompany *Computer Networking: A Top Down Approach*, 6th edition, by Jim Kurose & Keith Ross, Addison-Wesley, 2013.

MAC Addresses

- IP address is a virtual address:
 - *network-layer* address
 - gets datagram to destination IP subnet
- MAC (Media Access Control) address is a physical address:
 - function: get frame from one interface to another physically-connected interface (same network)
 - NOTE: **Every communication at the physical layer is sent to a MAC address!**
- MAC address allocation administered by IEEE
 - manufacturer buys portion of MAC address space
 - assures uniqueness
 - 48 bit MAC address (for most LANs)
 - burned in NIC ROM by manufacturer
- MAC addresses are portable
 - can move LAN card from one LAN to another
 - not true for IP address

MAC Addresses

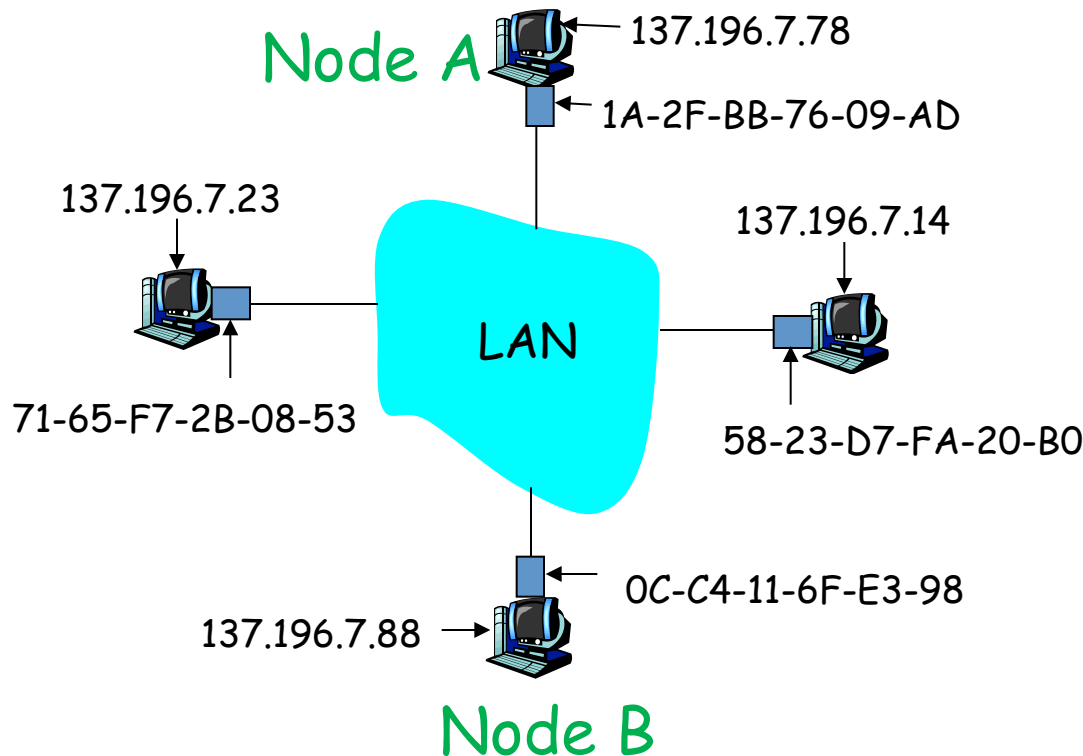
Each NIC (adapter) on LAN has unique MAC address



MAC Addresses

Given:

- **A** knows **B**'s MAC address
- **A** wants to send a frame to **B**



1. **A** encapsulates **B**'s MAC into the frame
2. **A** sends the frame into the medium
3. All nodes' NICs check the frame
 - Is this for me?
4. Only **B** accepts the frame
 - All other nodes discard the frame

ARP: Address Resolution Protocol

Given:

- **A** knows **B**'s IP address
- **A** does not know **B**'s MAC address
- **A** wants to send a frame to **B**

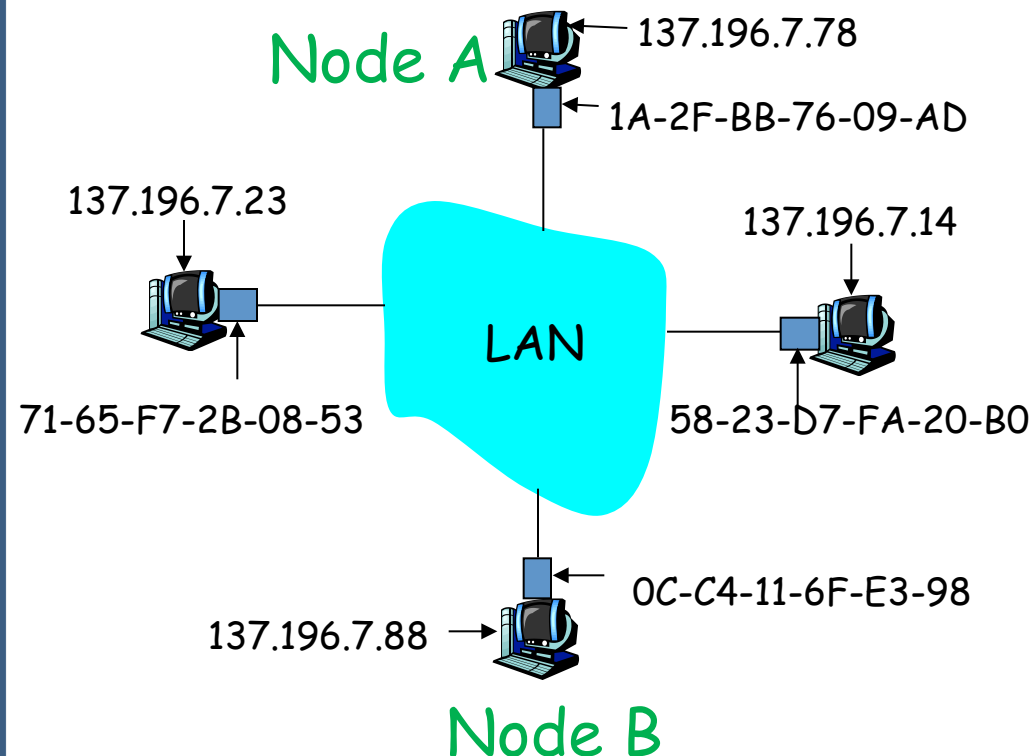
ARP

- Each IP node (host, router) on LAN has **ARP** table
- **ARP** table: maps IP, MAC address for some LAN nodes

< IP address; MAC address; TTL >

- remove mapping after TTL (typically 20 min)

1. **A** looks up **B**'s MAC address in its ARP table
2. **A** encapsulates **B**'s MAC into the frame
3. **A** sends the frame into the medium
4. Only **B** accepts the frame



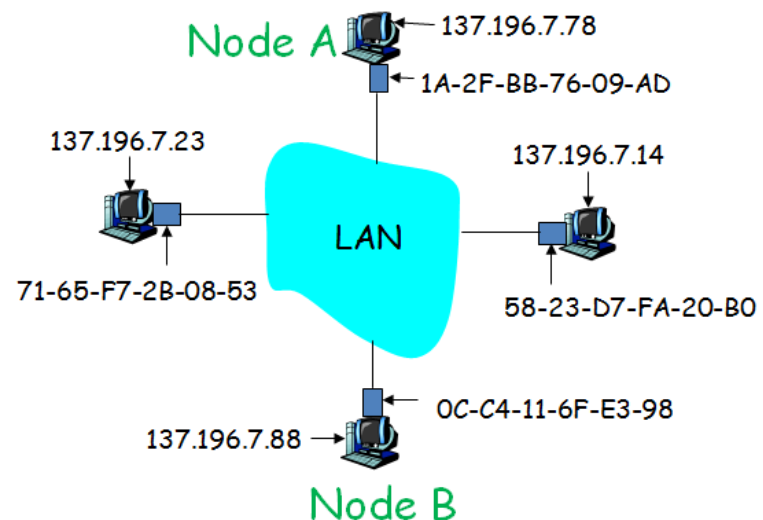
ARP: Case 1—Same LAN

Given:

- **A** knows **B**'s IP address
- **B**'s MAC address is not in **A**'s ARP table
- **A** wants to send a frame to **B**

1. **A** broadcasts ARP query packet, containing **B**'s IP address
 - broadcast MAC address is **FF-FF-FF-FF-FF-FF**
 - all machines on LAN receive ARP query
2. **B** receives ARP packet, replies to **A** with **B**'s MAC address
3. **A** sends frame to **B** since it now knows its MAC address

- **A** **cached** IP-to-MAC address pair in its ARP table until information times out (TTL)
- **ARP** is plug-and-play
 - nodes create their ARP tables without intervention from network administrator

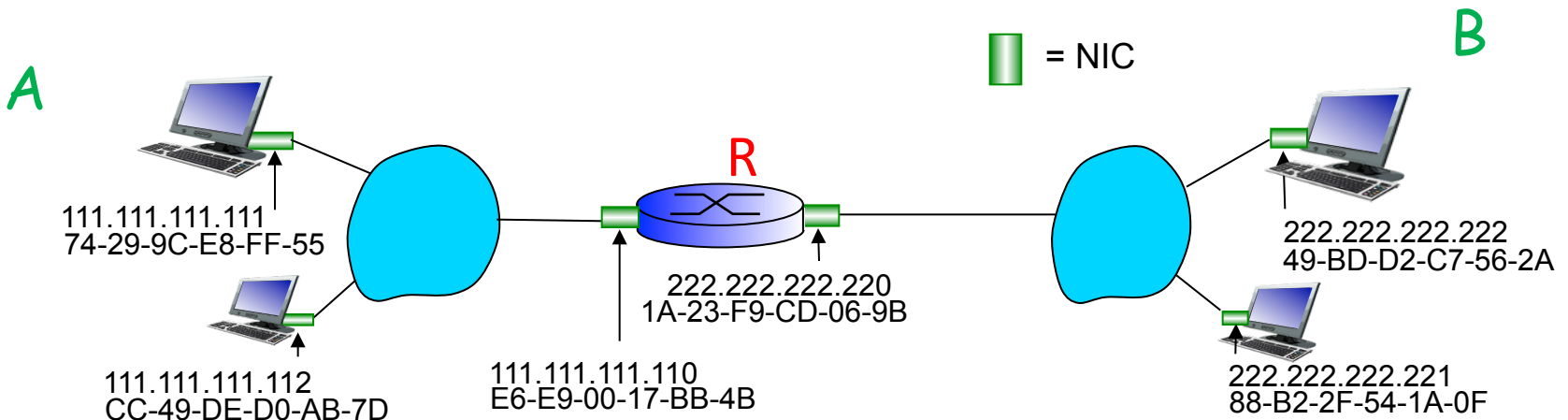


ARP: Case 2—routing to another LAN

Given:

- **A** knows **B**'s IP address
- **B** is in a separate LAN, so MAC address is not in **A**'s ARP table
- **A** wants to send a frame to **B**

- **A** knows that **B** belongs to a different subnet by checking **B**'s IP address (222.222.222.222)
- **A** also knows IP address of router **R** (111.111.111.110)
- 1. If necessary, **A** uses ARP to get **R**'s MAC address (E6-E9-00-17-BB-4B)
- 2. **A** creates frame with **R**'s MAC address as destination
 - frame contains **A**-to-**B** IP datagram
- 3. **A**'s NIC sends frame and **R**'s NIC receives it
- 4. **R** removes IP datagram from Ethernet frame, sees its destination is **B**
- 5. **R** uses ARP to get **B**'s MAC address (49-BD-D2-C7-56-2A)
- 6. **R** creates frame containing **A**-to-**B** IP datagram and sends it to **B**



- MAC addresses
 - MAC broadcast
- Address Resolution Protocol (ARP)
- ARP scenarios
 - creating/using ARP internal LAN tables
 - routing to external IP address

Discussion question: Why can't we just use IP addresses?