

# COMPUTER NETWORKS LAB (CS315)

## Assignment-11

### Ethernet and ARP

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# MAC addresses

- 32-bit IP address:
  - *network-layer* address for interface
  - used for layer 3 (network layer) forwarding
  - e.g.: 128.119.40.136
- MAC (or LAN or physical or Ethernet) address:
  - function: used “locally” to get frame from one interface to another physically-connected interface (same subnet, in IP-addressing sense)
  - 48-bit MAC address (for most LANs) burned in NIC ROM, also sometimes software settable
  - e.g.: 1A-2F-BB-76-09-AD
    - hexadecimal (base 16) notation  
(each “numeral” represents 4 bits)

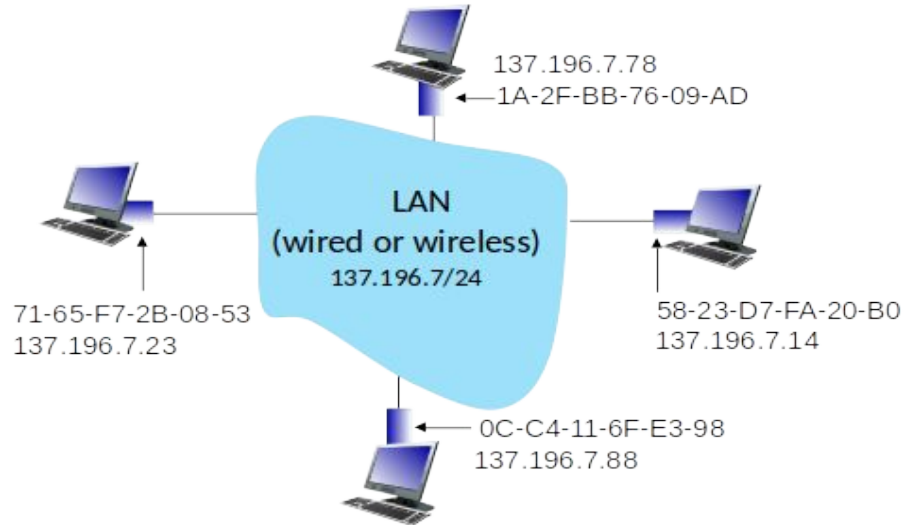
Link Layer: 6-<number>



# MAC addresses

each interface on LAN

- has **unique 48-bit MAC address**
- has a locally unique 32-bit IP address (as we've seen)



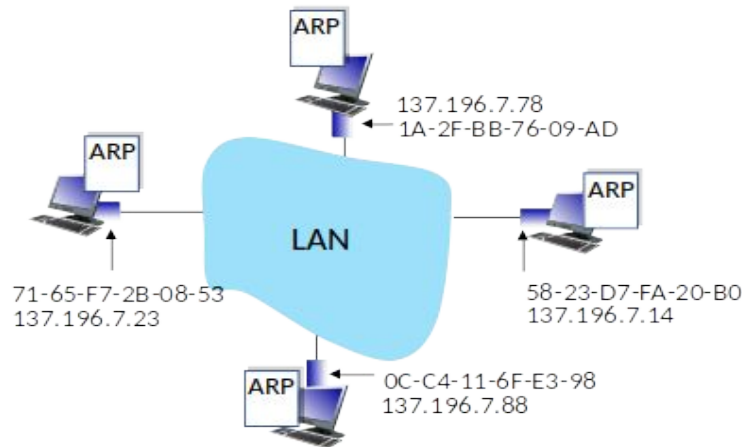
Link Layer: 6-<number>

# MAC addresses

- MAC address allocation administered by IEEE
- manufacturer buys portion of MAC address space (to assure uniqueness)
- analogy:
  - MAC address: like Social Security Number
  - IP address: like postal address
- MAC flat address: portability
  - can move interface from one LAN to another
  - recall IP address *not* portable: depends on IP subnet to which node is attached

# ARP: address resolution protocol

*Question:* how to determine interface's MAC address, knowing its IP address?



ARP table: each IP node (host, router) on LAN has table

- IP/MAC address mappings for some LAN nodes:

< IP address; MAC address; TTL >

- TTL (Time To Live): time after which address mapping will be forgotten (typically 20 min)

# ARP protocol in action

example: A wants to send datagram to B

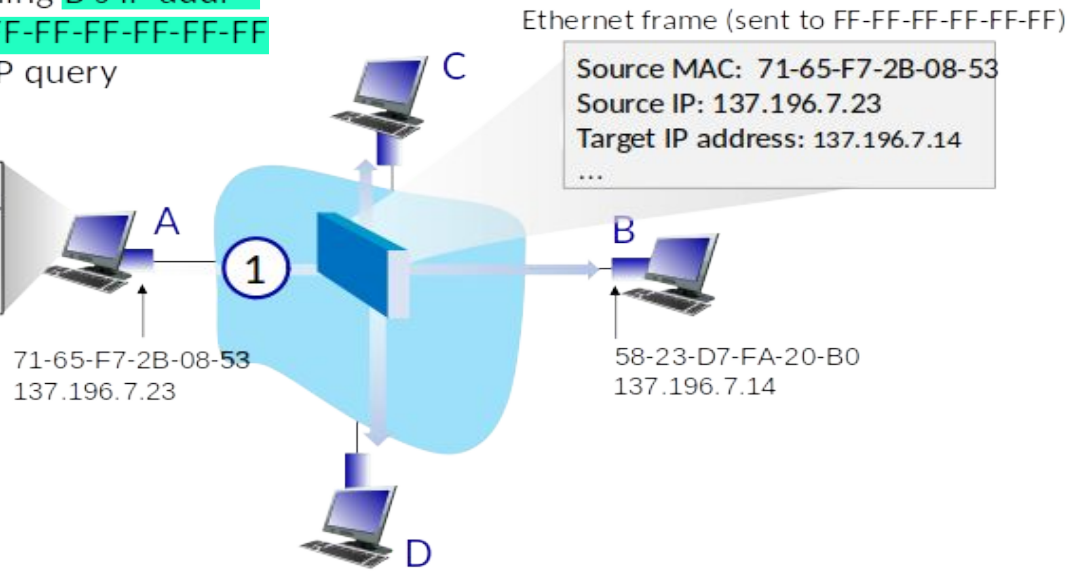
- B's MAC address not in A's ARP table, so A uses ARP to find B's MAC address

A broadcasts ARP query, containing B's IP addr

- 1 • destination MAC address = FF-FF-FF-FF-FF-FF  
• all nodes on LAN receive ARP query

ARP table in A

IP addr	MAC addr	TTL

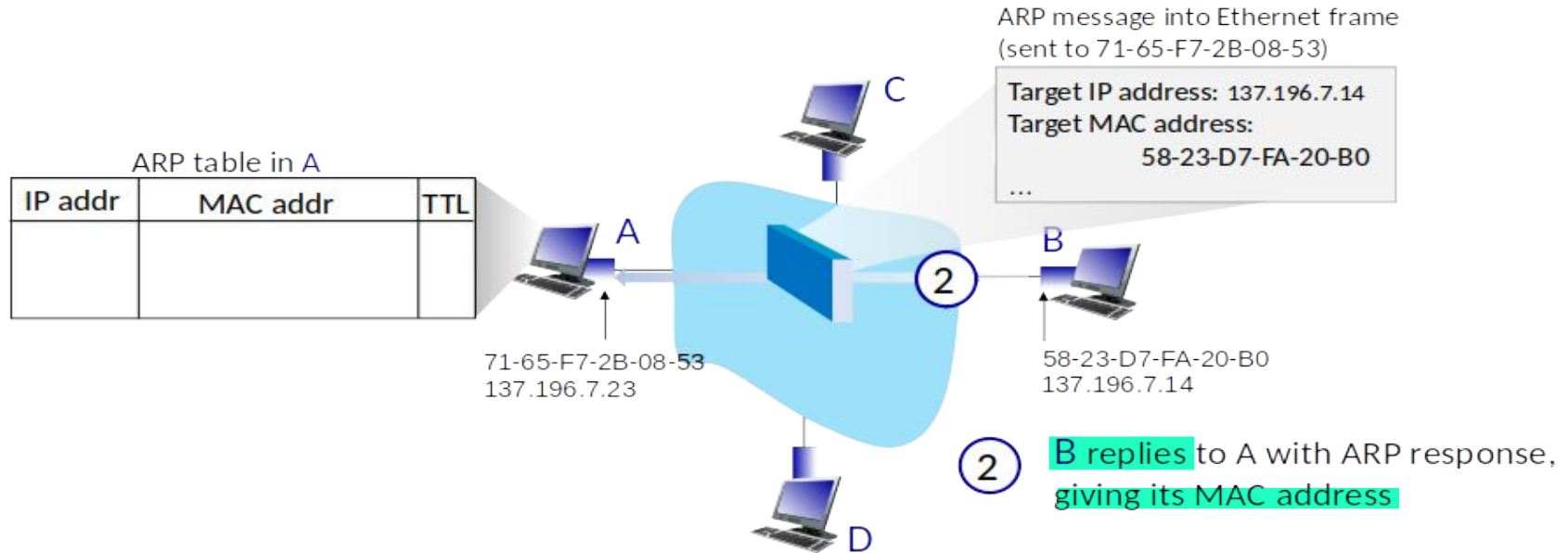


Link Layer: 6-<number>

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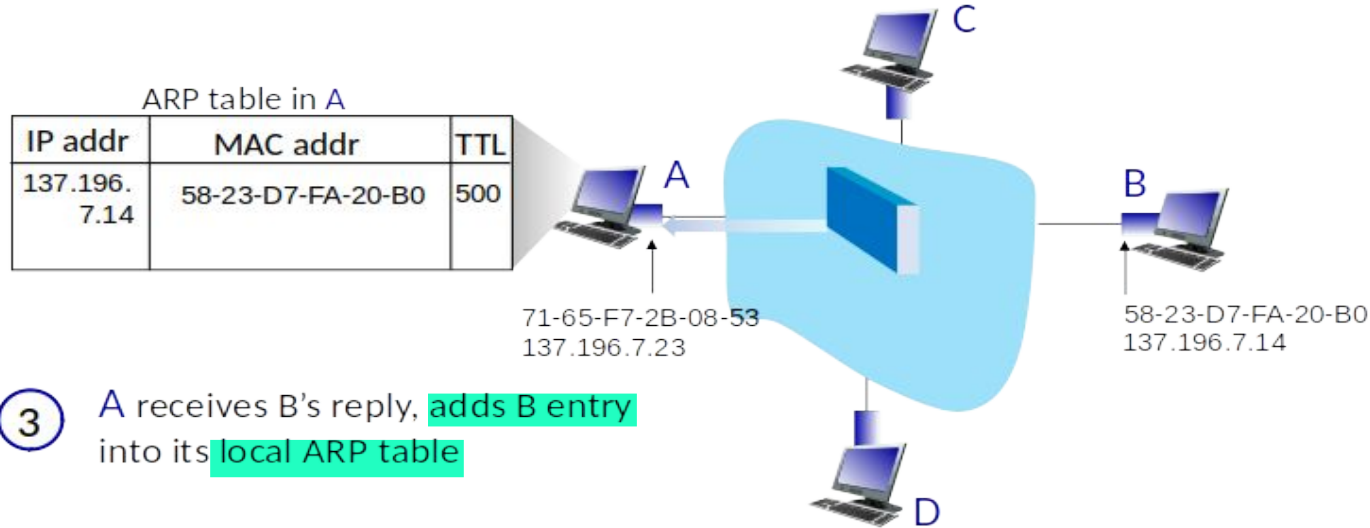


Link Layer: 6-<number>

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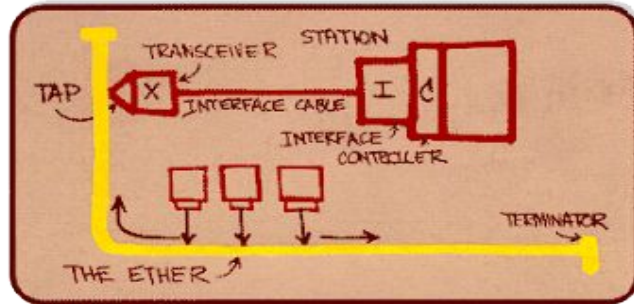
Link Layer: 6-<number>



# Ethernet

“dominant” wired LAN technology:

- first widely used LAN technology
- simpler, cheap
- kept up with speed race: 10 Mbps – 400 Gbps
- single chip, multiple speeds (e.g., Broadcom BCM5761)



*Metcalfe's Ethernet sketch*

<https://www.uspto.gov/learning-and-resources/journeys-innovation/audio-stories/defying-doubters>

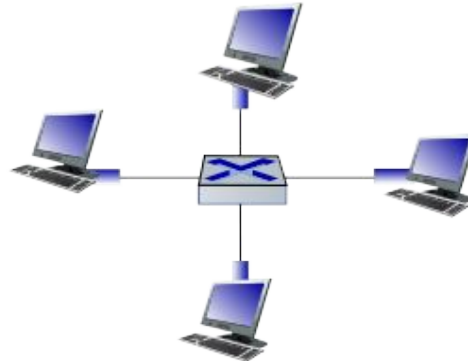
Link Layer: 6-<number>



# Ethernet: physical topology

- **bus:** popular through mid 90s
  - all nodes in same collision domain (can collide with each other)
- **switched:** prevails today
  - active **link-layer 2 switch** in center
  - each “spoke” runs a (separate) Ethernet protocol (nodes do not collide with each other)

bus: coaxial cable



switched

Link Layer: 6-<number>

# Ethernet frame structure

sending interface encapsulates IP datagram (or other network layer protocol packet) in **Ethernet frame**



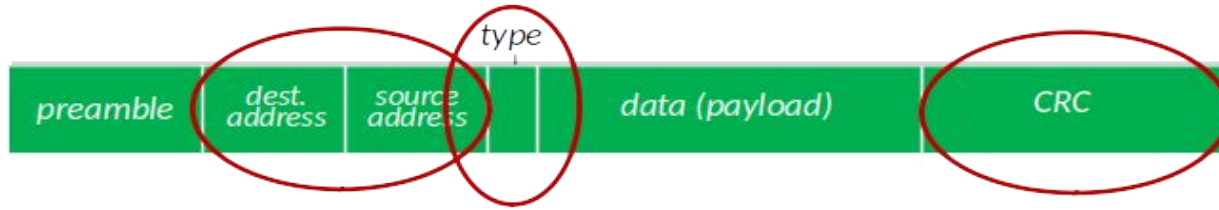
*preamble:*

- used to synchronize receiver, sender clock rates
- 7 bytes of 10101010 followed by one byte of 10101011

Link Layer: 6-<number>



# Ethernet frame structure (more)



- **addresses:** 6 byte source, destination MAC addresses
  - if adapter receives frame with matching destination address, or with broadcast address (e.g., ARP packet), it passes data in frame to network layer protocol
  - otherwise, adapter discards frame
- **type:** indicates higher layer protocol
  - mostly IP but others possible, e.g., Novell IPX, AppleTalk
  - used to demultiplex up at receiver
- **CRC:** cyclic redundancy check at receiver
  - error detected: frame is dropped

Link Layer: 6-<number>

# Ethernet: unreliable, connectionless

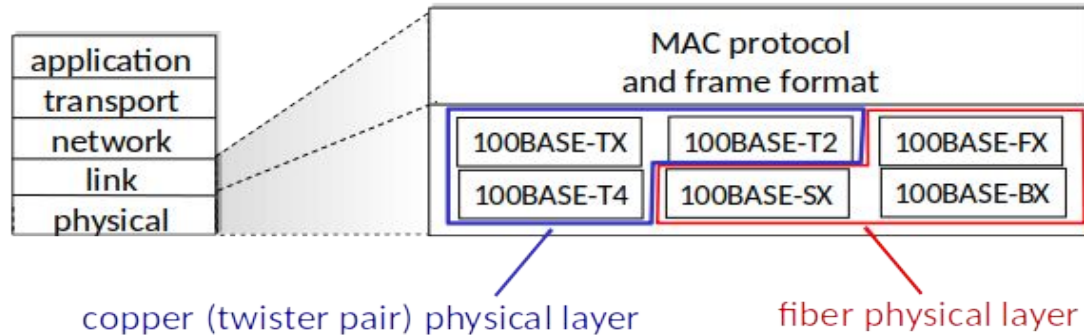
- **connectionless**: no handshaking between sending and receiving NICs
- **unreliable**: receiving NIC doesn't send ACKs or NAKs to sending NIC
  - data in dropped frames recovered only if initial sender uses higher layer rdt (e.g., TCP), otherwise dropped data lost
- Ethernet's MAC protocol: unslotted CSMA/CD with binary backoff

Link Layer: 6-<number>



## 802.3 Ethernet standards: link & physical layers

- *many* different Ethernet standards
  - common MAC protocol and frame format
  - different speeds: 2 Mbps, 10 Mbps, 100 Mbps, 1Gbps, 10 Gbps, 40 Gbps
  - different physical layer media: fiber, cable



Link Layer: 6-<number>

# Thank you