

# Computer Networks I

## Address Resolution Protocol (ARP)

Amitangshu Pal  
Computer Science and Engineering  
IIT Kanpur

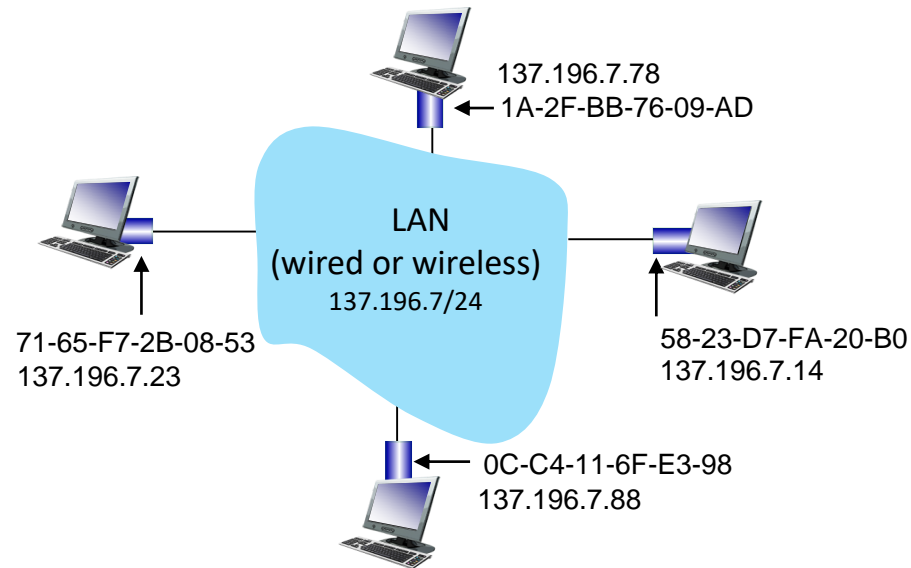
# MAC addresses

- 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)
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# MAC addresses

each interface on LAN

- has unique 48-bit **MAC** address
- has a locally unique 32-bit IP address

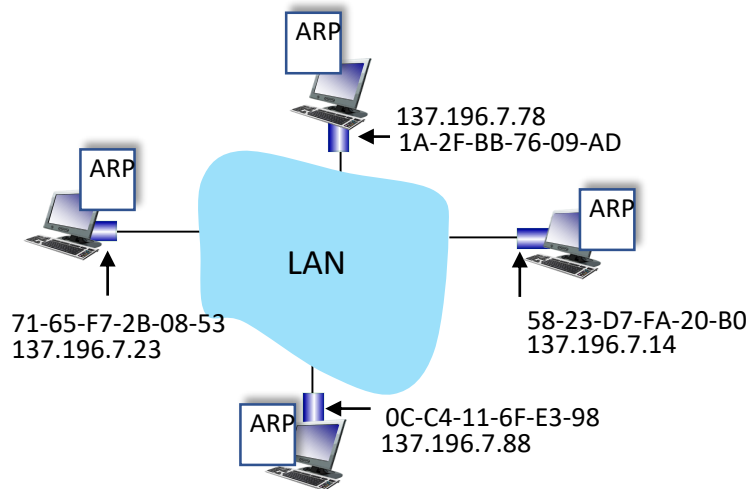


# MAC addresses

- MAC address allocation administered by IEEE
  - manufacturer buys portion of MAC address space (to assure uniqueness)
  - analogy:
    - MAC address: like Aadhar Card 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
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# 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

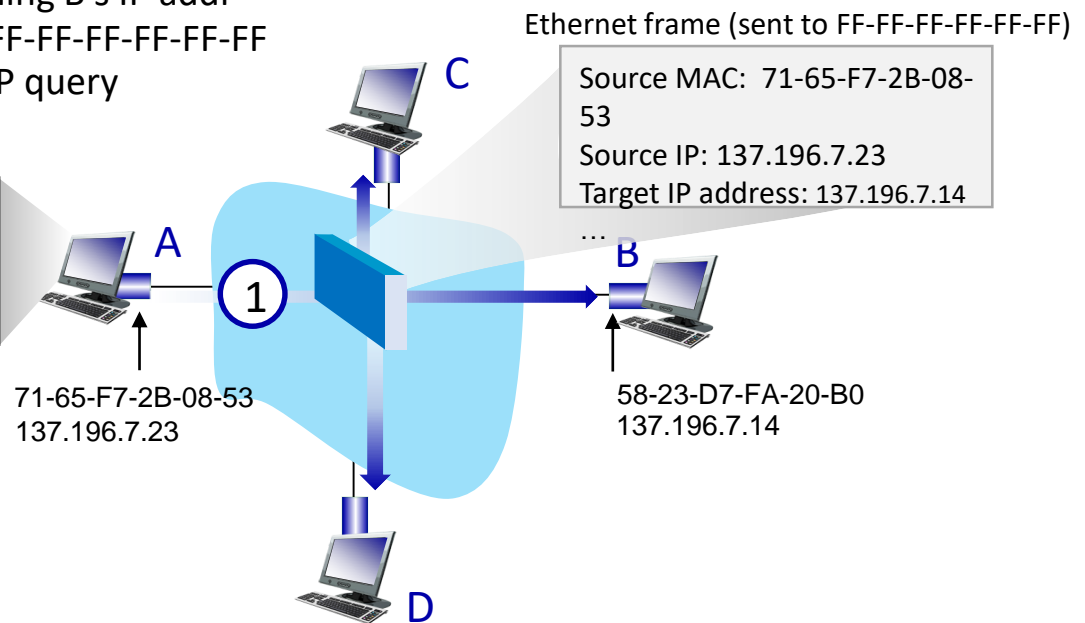
example: A wants to send datagram to B

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

- ① A broadcasts ARP query, containing B's IP addr
- destination MAC address = FF-FF-FF-FF-FF-FF
  - all nodes on LAN receive ARP query

ARP table in A

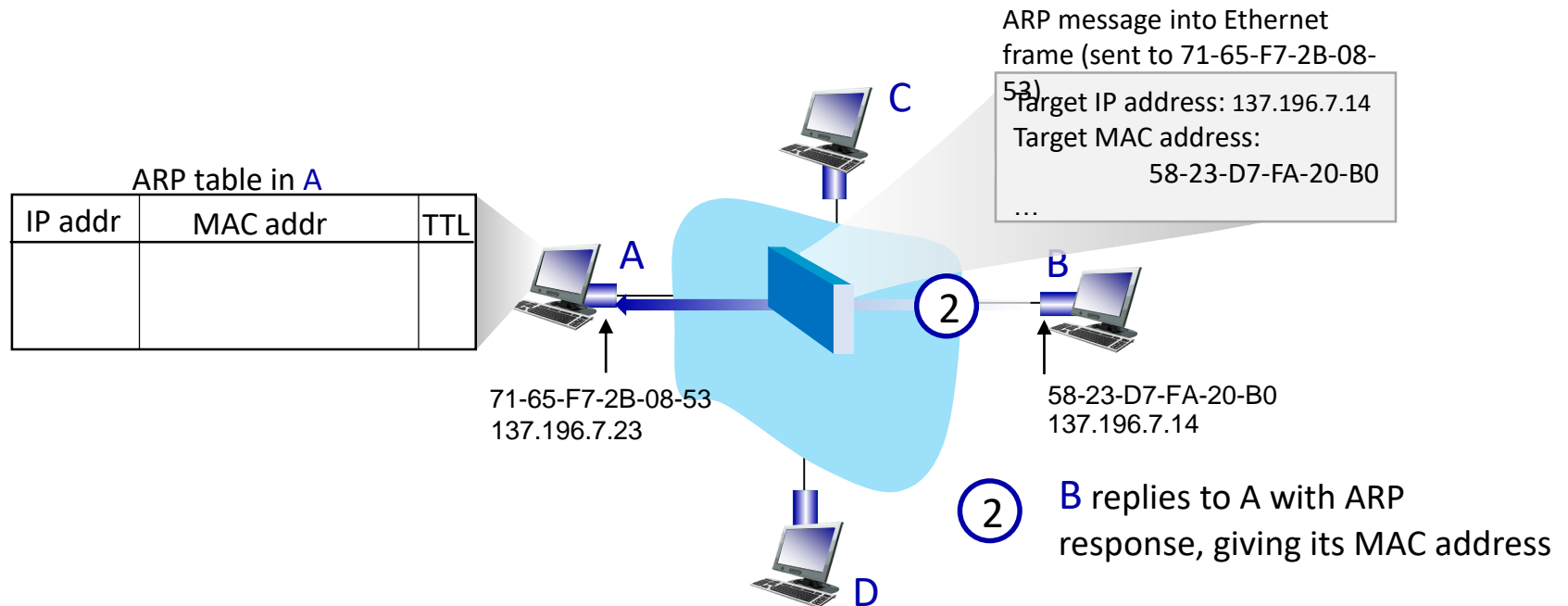
IP addr	MAC addr	TTL



# ARP protocol in action

example: A wants to send datagram to B

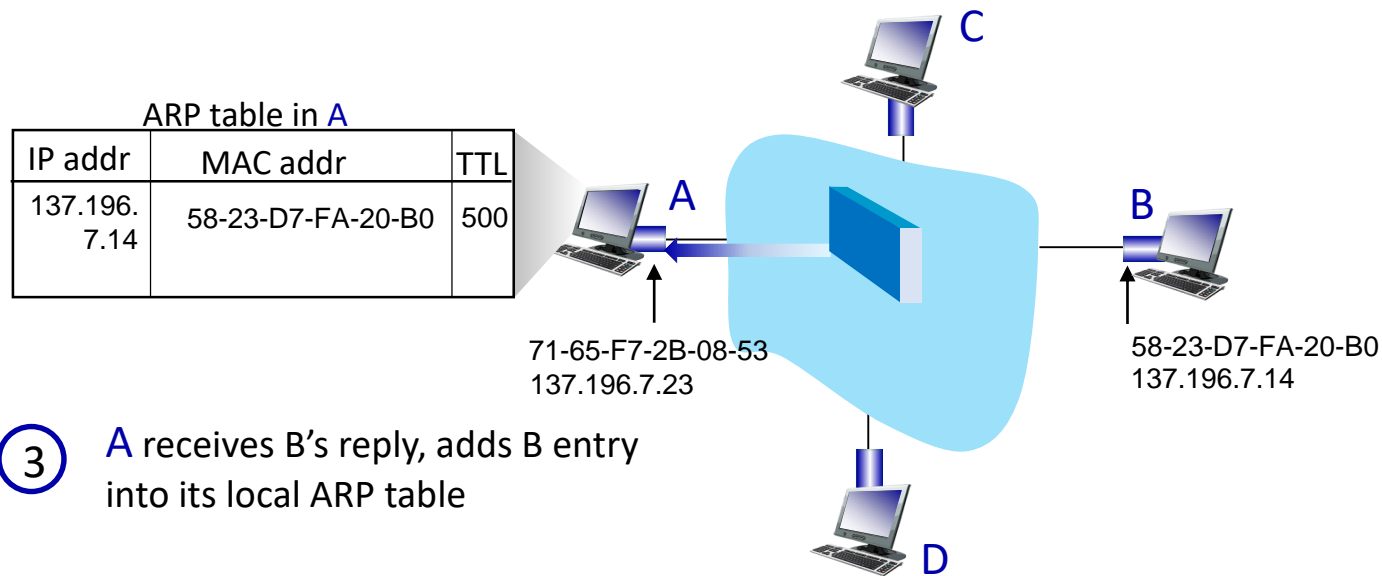
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# ARP protocol in action

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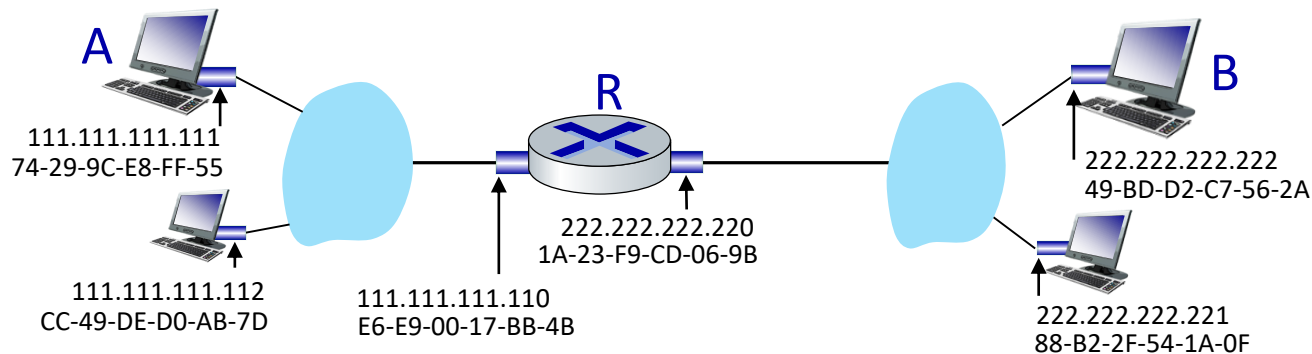




# Routing to another subnet: addressing

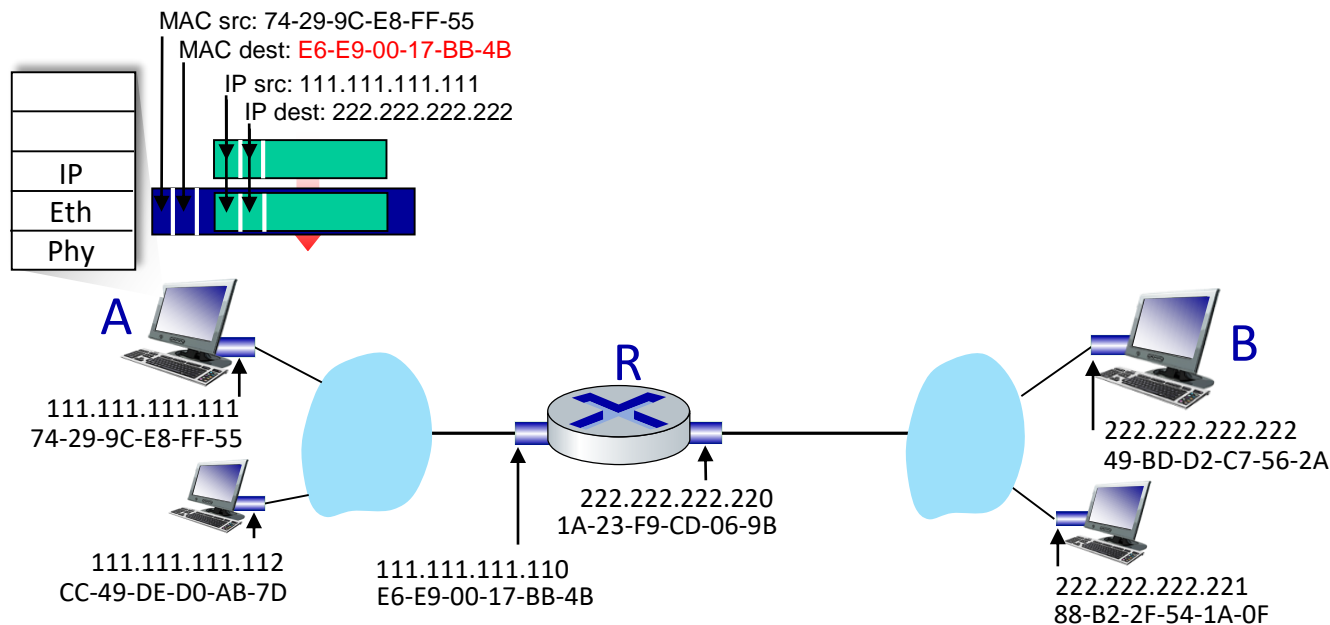
walkthrough: sending a datagram from *A* to *B* via *R*

- focus on addressing – at IP (datagram) and MAC layer (frame) levels
- assume that:
  - A knows B's IP address
  - A knows IP address of first hop router, R (how?)
  - A knows R's MAC address (how?)



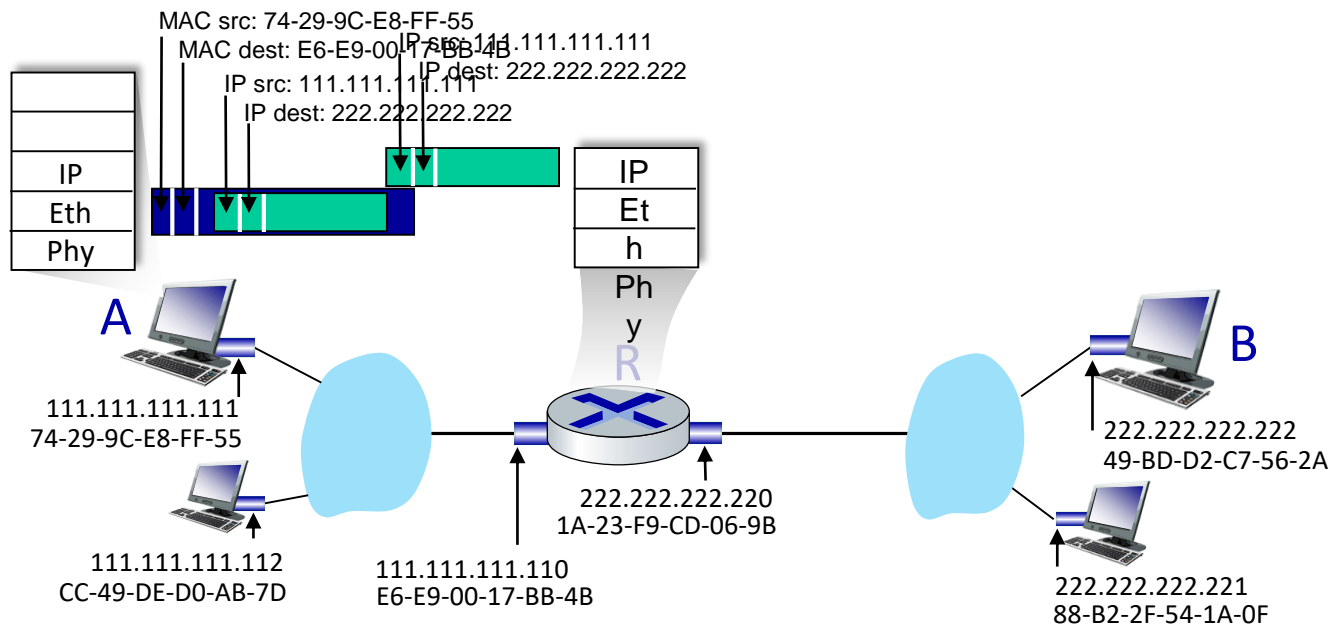
# Routing to another subnet: addressing

- A creates IP datagram with IP source A, destination B
- A creates link-layer frame containing A-to-B IP datagram
  - R's MAC address is frame's destination



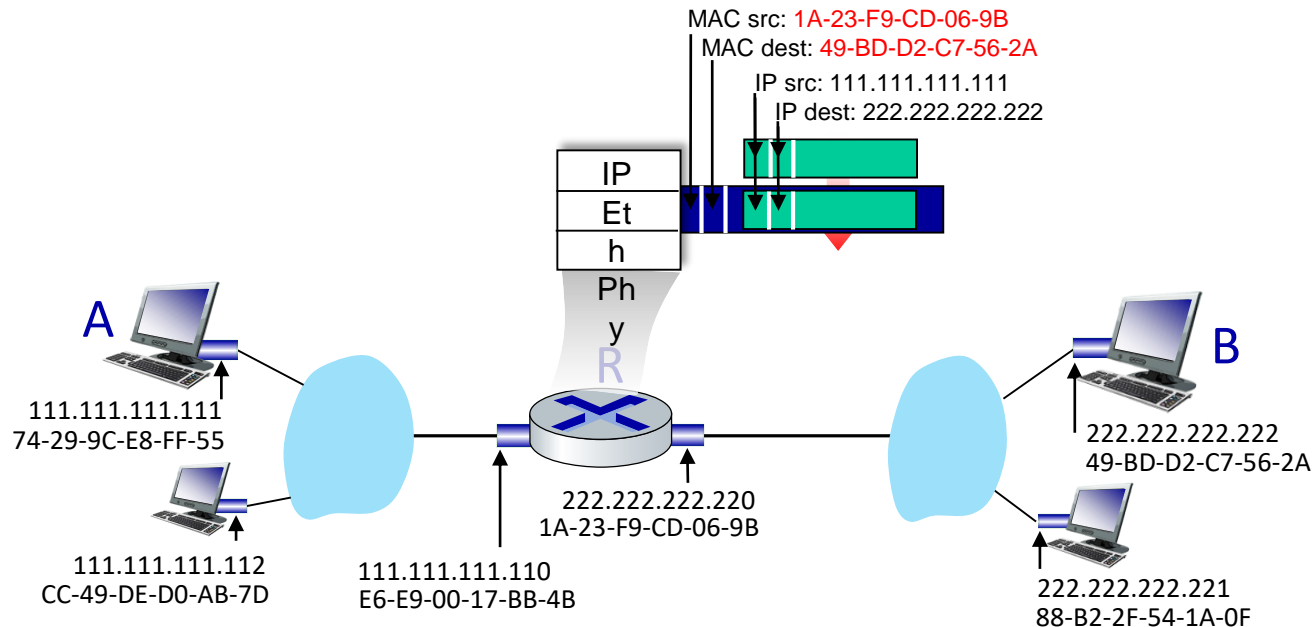
# Routing to another subnet: addressing

- frame sent from A to R
- frame received at R, datagram removed, passed up to IP



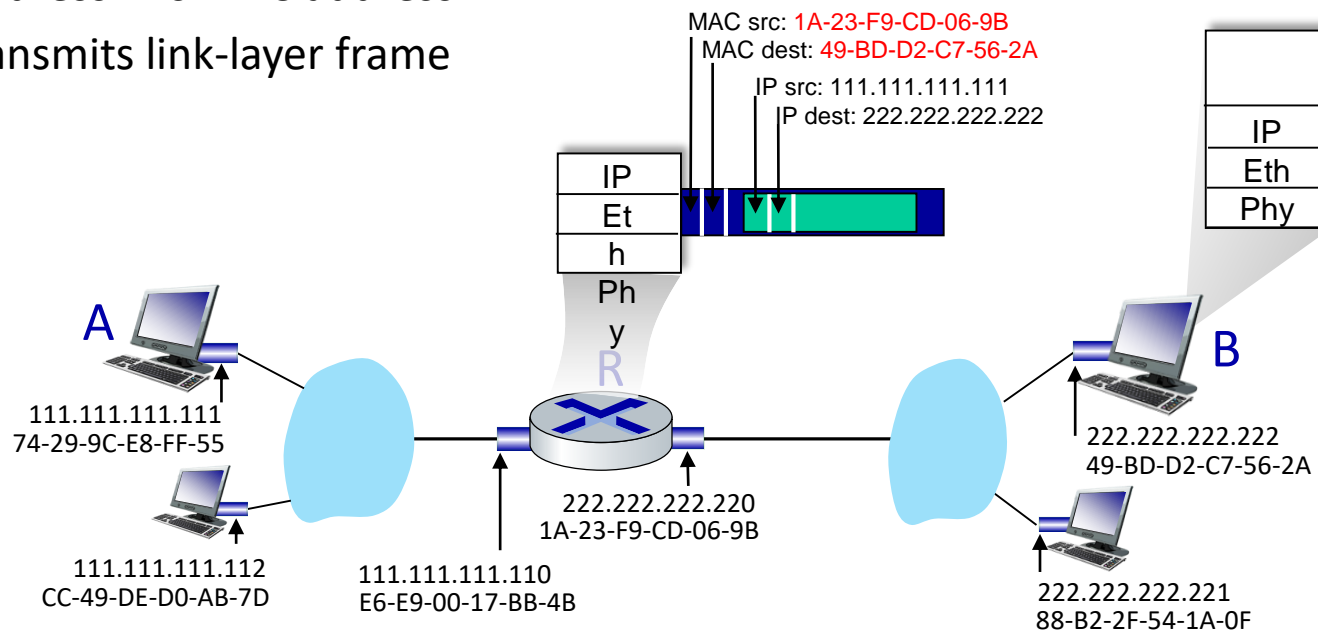
# Routing to another subnet: addressing

- R determines outgoing interface, passes datagram with IP source A, destination B to link layer
- R creates link-layer frame containing A-to-B IP datagram. Frame destination address: B's MAC address



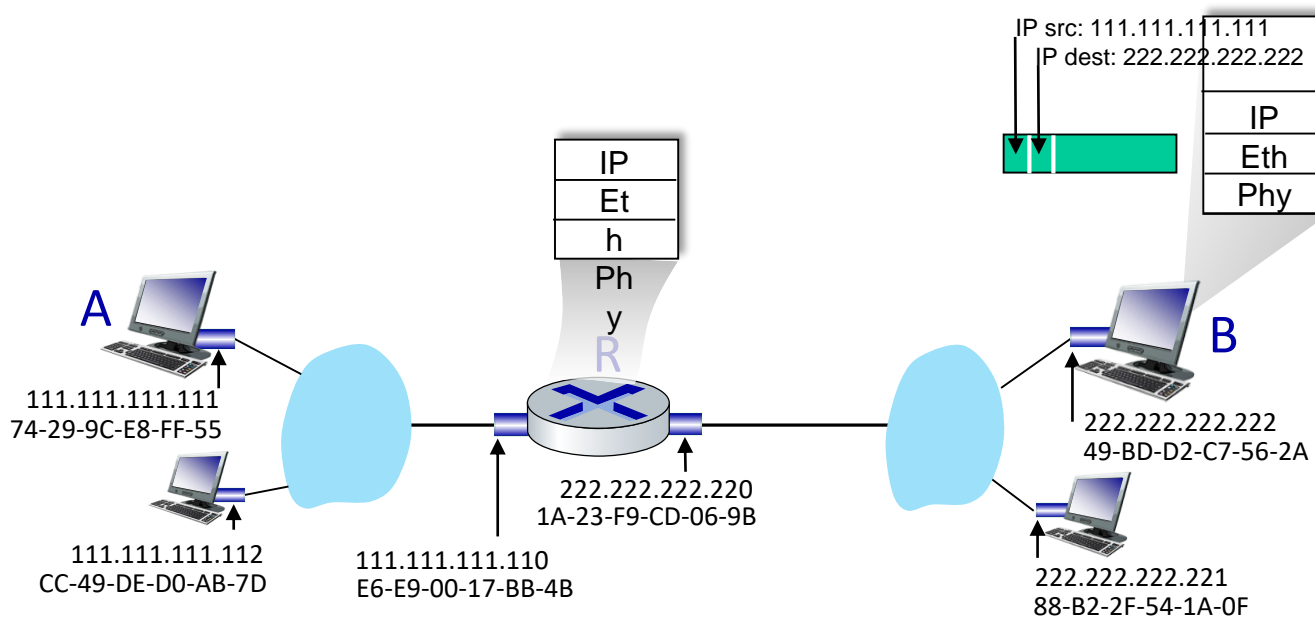
# Routing to another subnet: addressing

- R determines outgoing interface, passes datagram with IP source A, destination B to link layer
- R creates link-layer frame containing A-to-B IP datagram. Frame destination address: B's MAC address
- transmits link-layer frame



# Routing to another subnet: addressing

- B receives frame, extracts IP datagram destination B
- B passes datagram up protocol stack to IP



# THANK YOU

QUESTIONS???

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