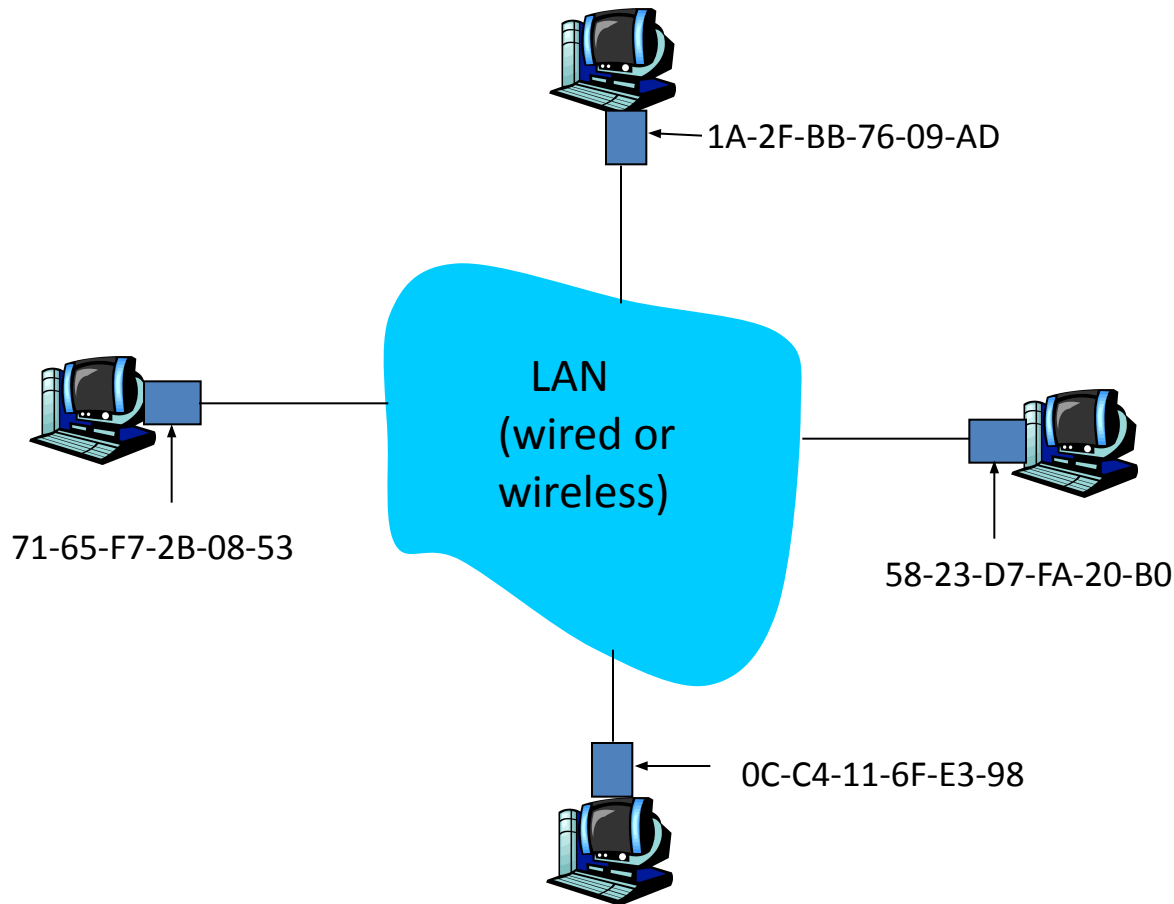


MAC Addresses and ARP

- 32-bit IP address:
 - *network-layer* address
 - used to get datagram to destination IP subnet
- MAC (or LAN or physical or Ethernet) address:
 - function: *get frame from one interface to another physically-connected interface (same network)*
 - 48 bit MAC address (for most LANs)
 - burned in NIC ROM, also sometimes software settable

LAN Addresses and ARP

Each adapter on LAN has unique LAN address



Broadcast address =
FF-FF-FF-FF-FF-FF

 = adapter

LAN Address (more)

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

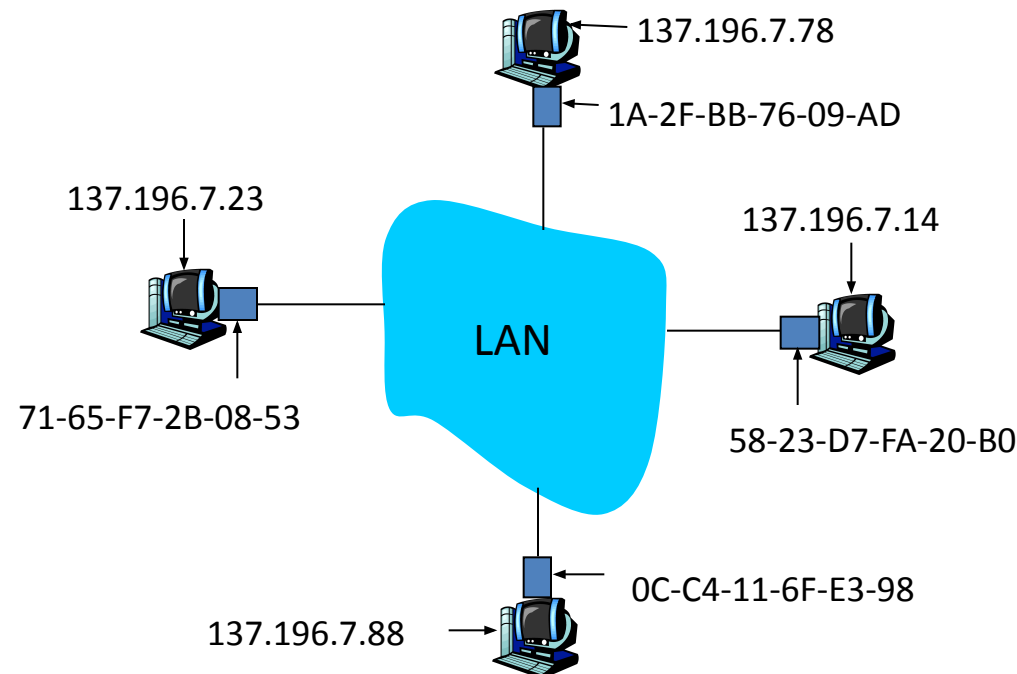
ARP: Address Resolution Protocol

Question: how to determine MAC address of B knowing B's IP address?

- Each IP node (host, router) on LAN has **ARP** table
- ARP 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)



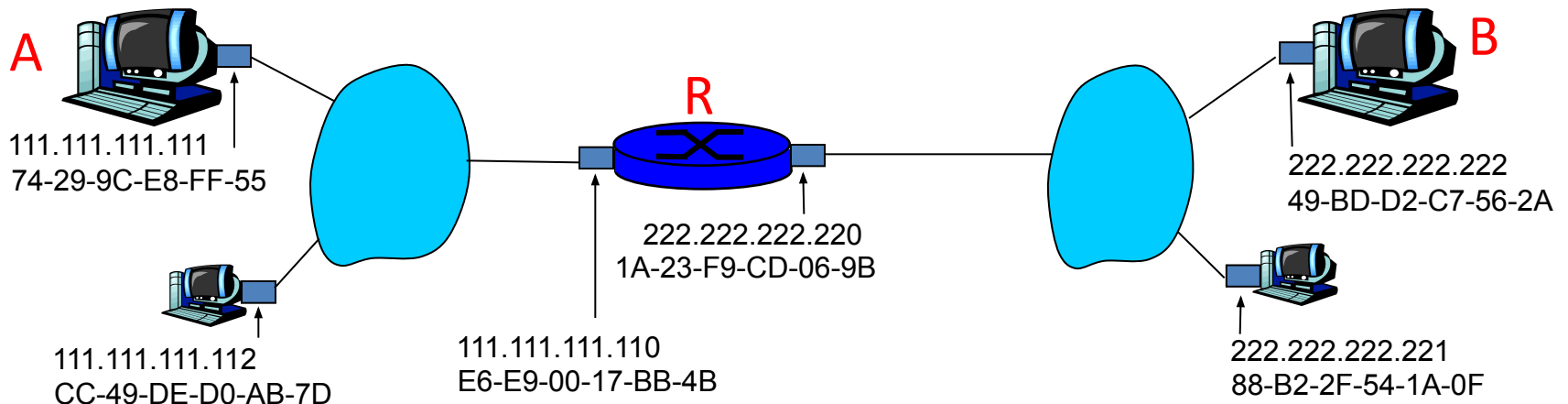
ARP protocol: Same LAN (network)

- A wants to send datagram to B, and B's MAC address not in A's ARP table.
- A **broadcasts** ARP query packet, containing B's IP address
 - dest MAC address = FF-FF-FF-FF-FF-FF
 - all machines on LAN receive ARP query
- B receives ARP packet, replies to A with its (B's) MAC address
 - frame sent to A's MAC address (unicast)
- A caches (saves) IP-to-MAC address pair in its ARP table until information becomes old (times out)
 - soft state: information that times out (goes away) unless refreshed
- ARP is “plug-and-play”:
 - nodes create their ARP tables *without intervention from net administrator*

Addressing: routing to another LAN

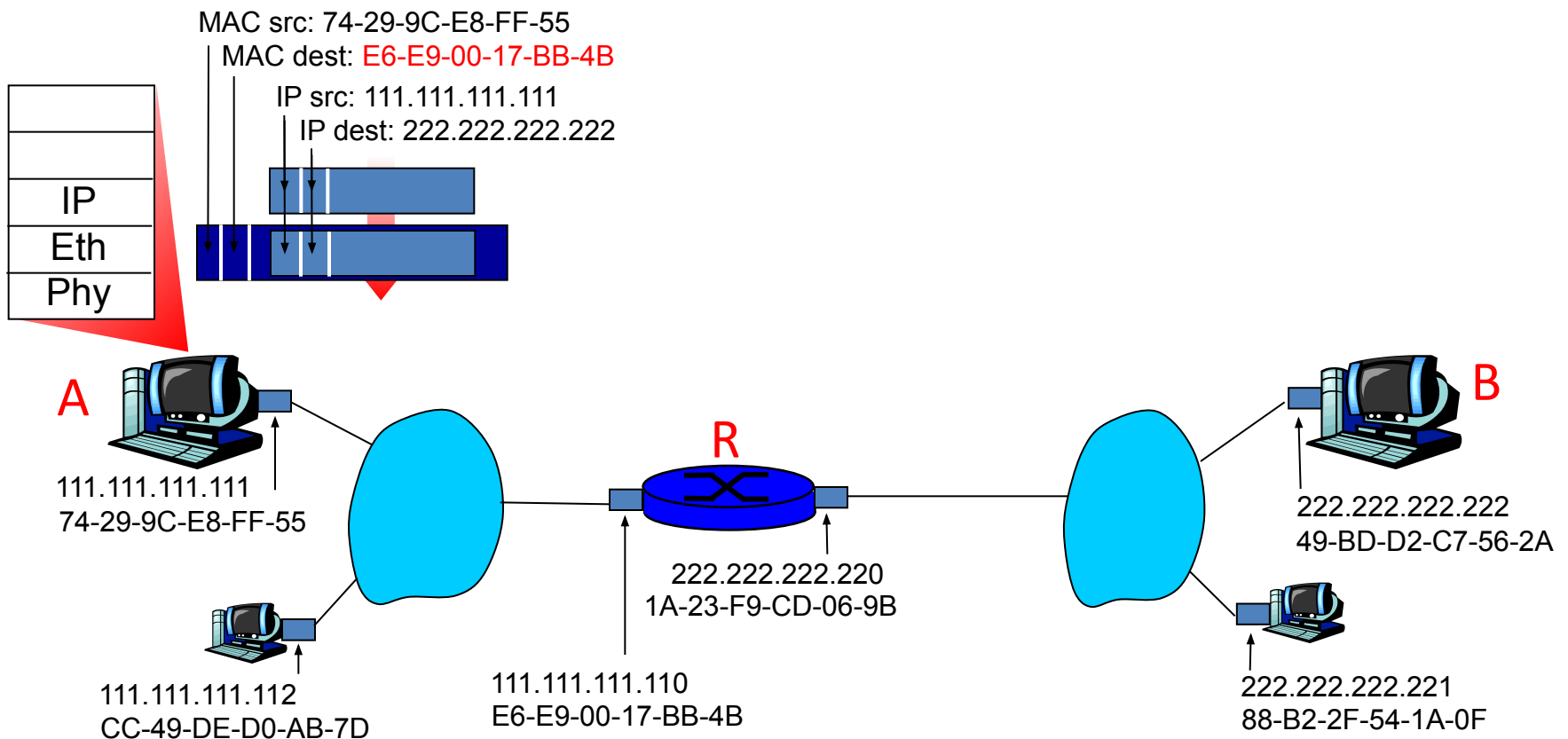
walkthrough: **send datagram from A to B via R.**

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



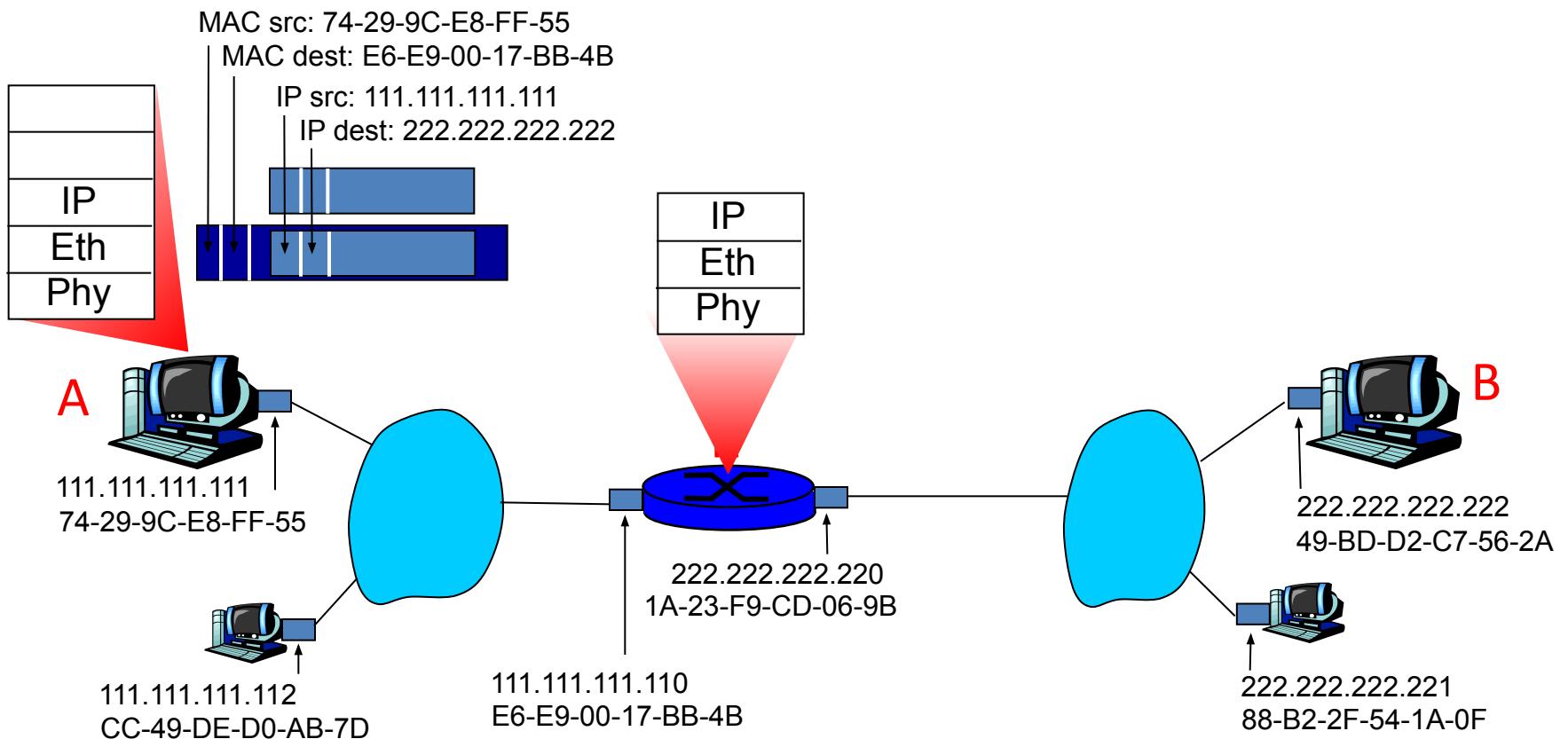
Addressing: routing to another LAN

- ❖ A creates IP datagram with IP source A, destination B
- ❖ A creates link-layer frame with R's MAC address as dest, frame contains A-to-B IP datagram



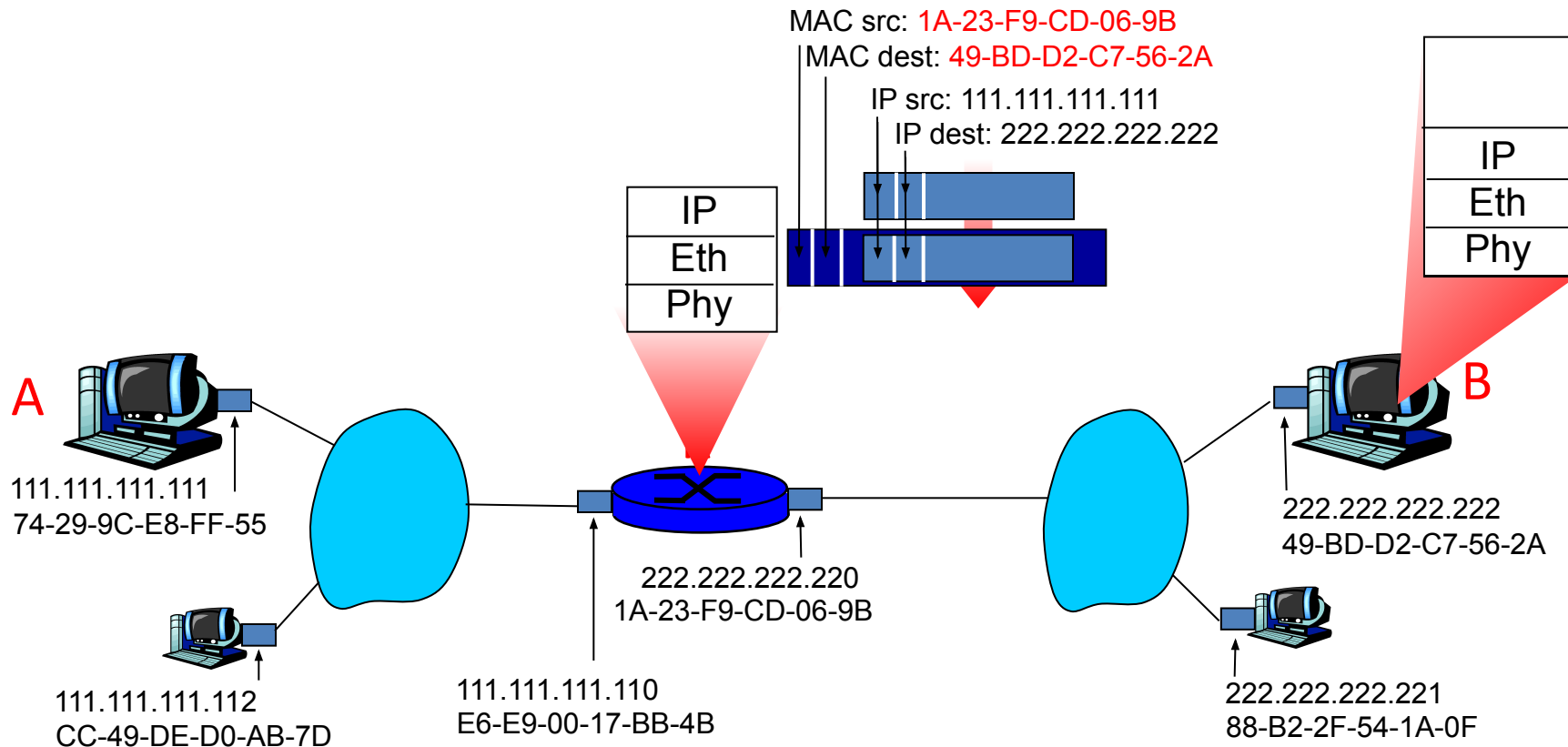
Addressing: routing to another LAN

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



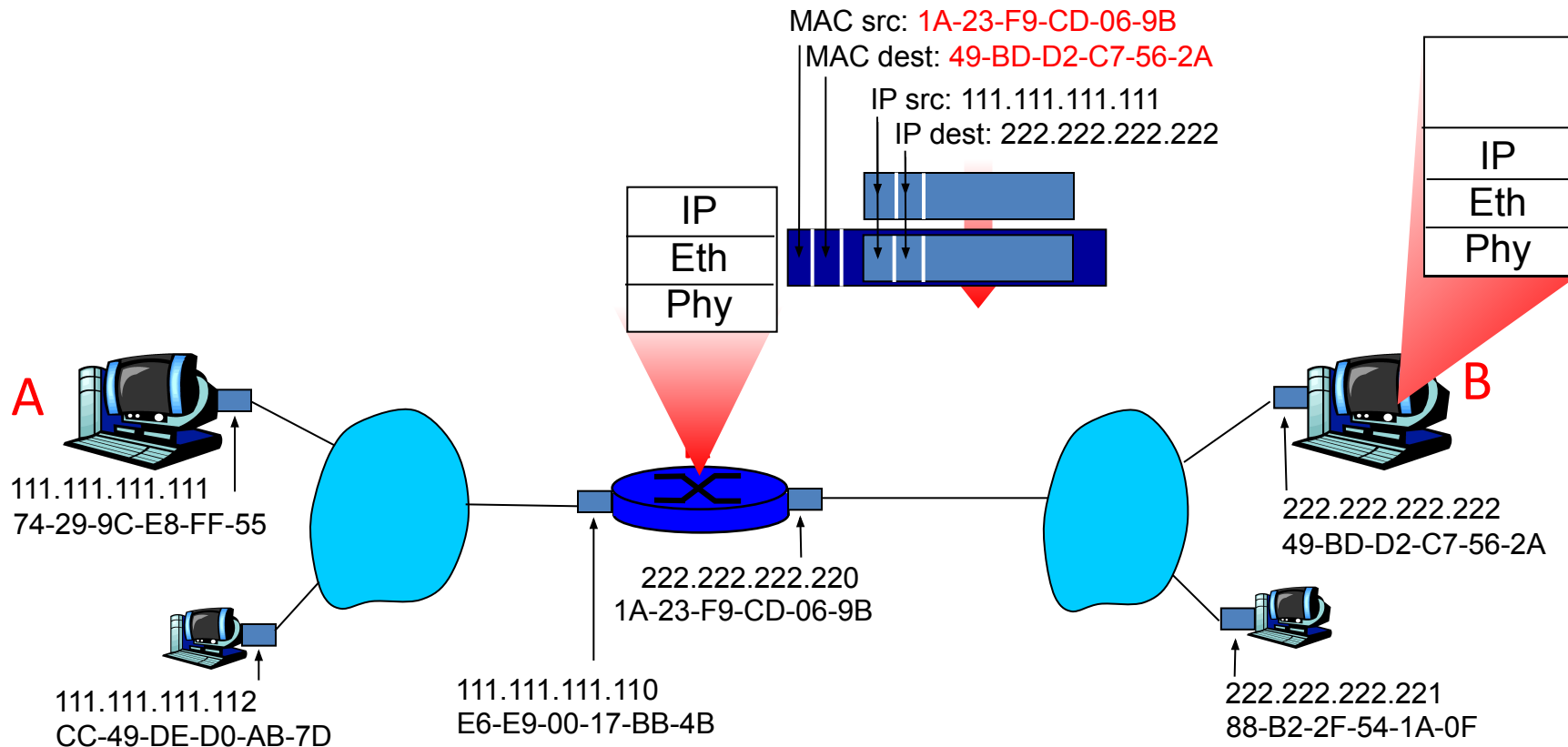
Addressing: routing to another LAN

- ❖ R forwards datagram with IP source A, destination B
- ❖ R creates link-layer frame with B's MAC address as dest, frame contains A-to-B IP datagram



Addressing: routing to another LAN

- ❖ R forwards datagram with IP source A, destination B
- ❖ R creates link-layer frame with B's MAC address as dest, frame contains A-to-B IP datagram



Addressing: routing to another LAN

- ❖ R forwards datagram with IP source A, destination B
- ❖ R creates link-layer frame with B's MAC address as dest, frame contains A-to-B IP datagram

