

Link layer, LANs: outline

5.1 introduction, services

5.2 error detection,
correction

5.3 multiple access
protocols

5.4 LANs

- addressing, ARP (Labs)
- Internetworking
Devices
- Ethernet
- WiFi

5.5 a day in the life of a
web request

MAC addresses and ARP

❖ 32-bit IP address:

- *network-layer* address for interface
- used for layer 3 (network layer) forwarding

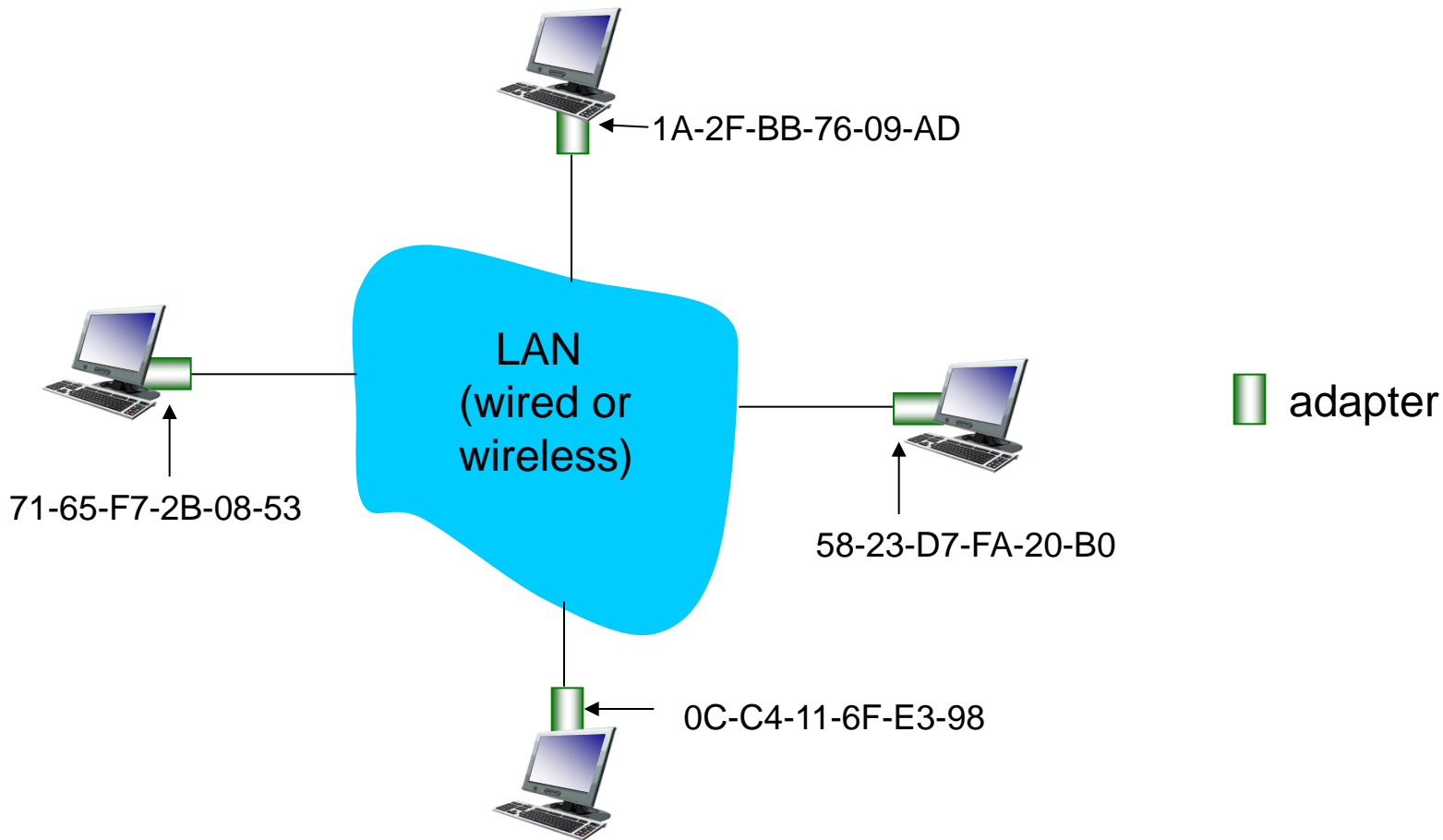
❖ MAC (or LAN or physical or Ethernet) address:

- function: *used ‘locally’ to get frame from one interface to another physically-connected interface (same network, 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 “number” represents 4 bits)

LAN addresses and ARP

each adapter on LAN has unique **LAN** address

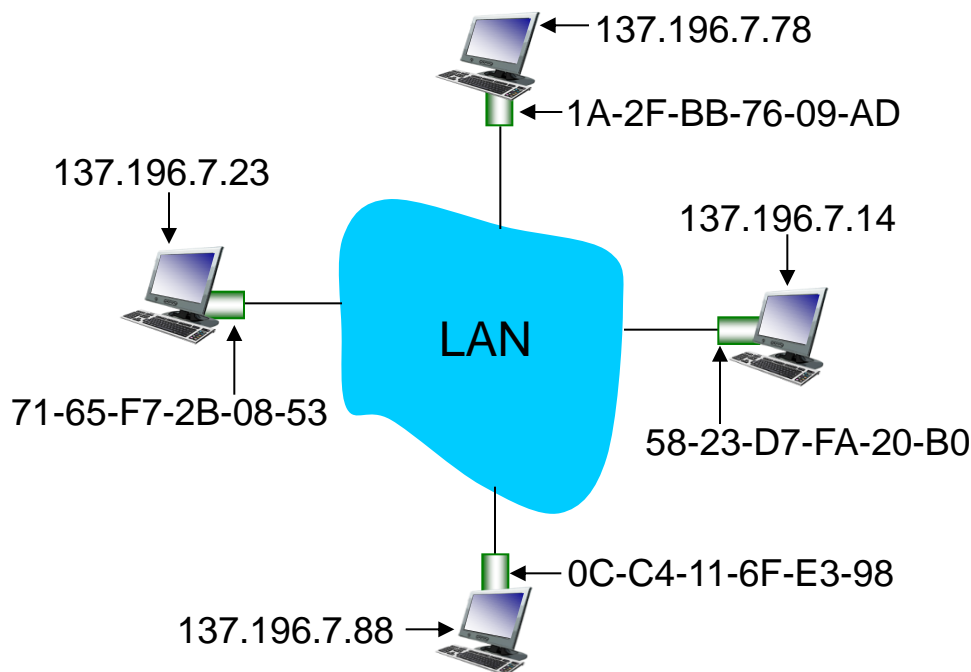


LAN addresses (more)

- ❖ 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 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 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)

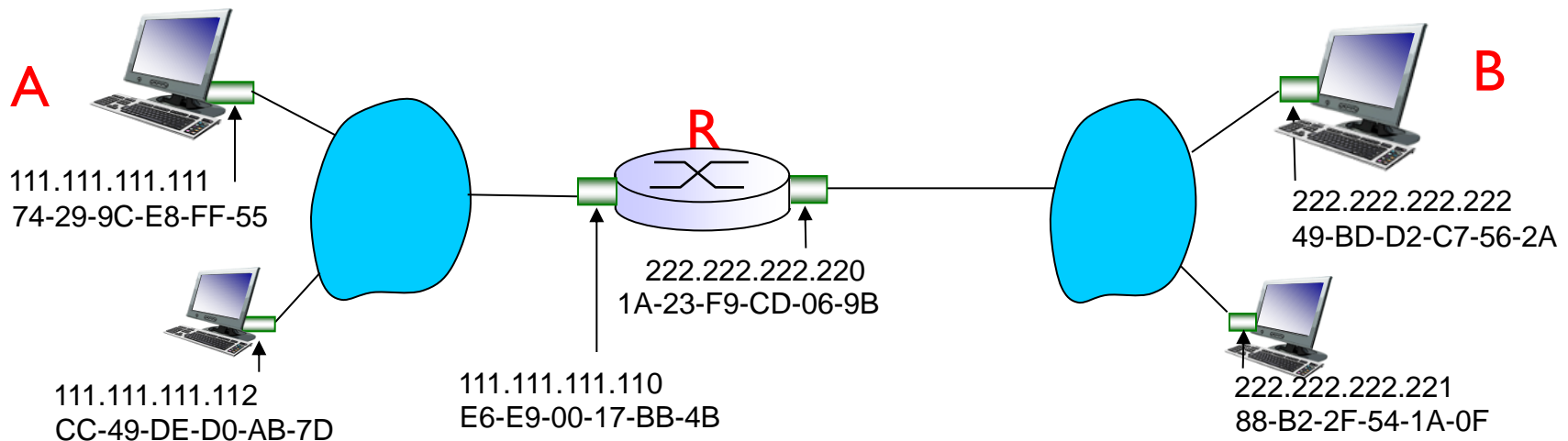
ARP protocol: same LAN

- ❖ A wants to send datagram to B
 - 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 nodes 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

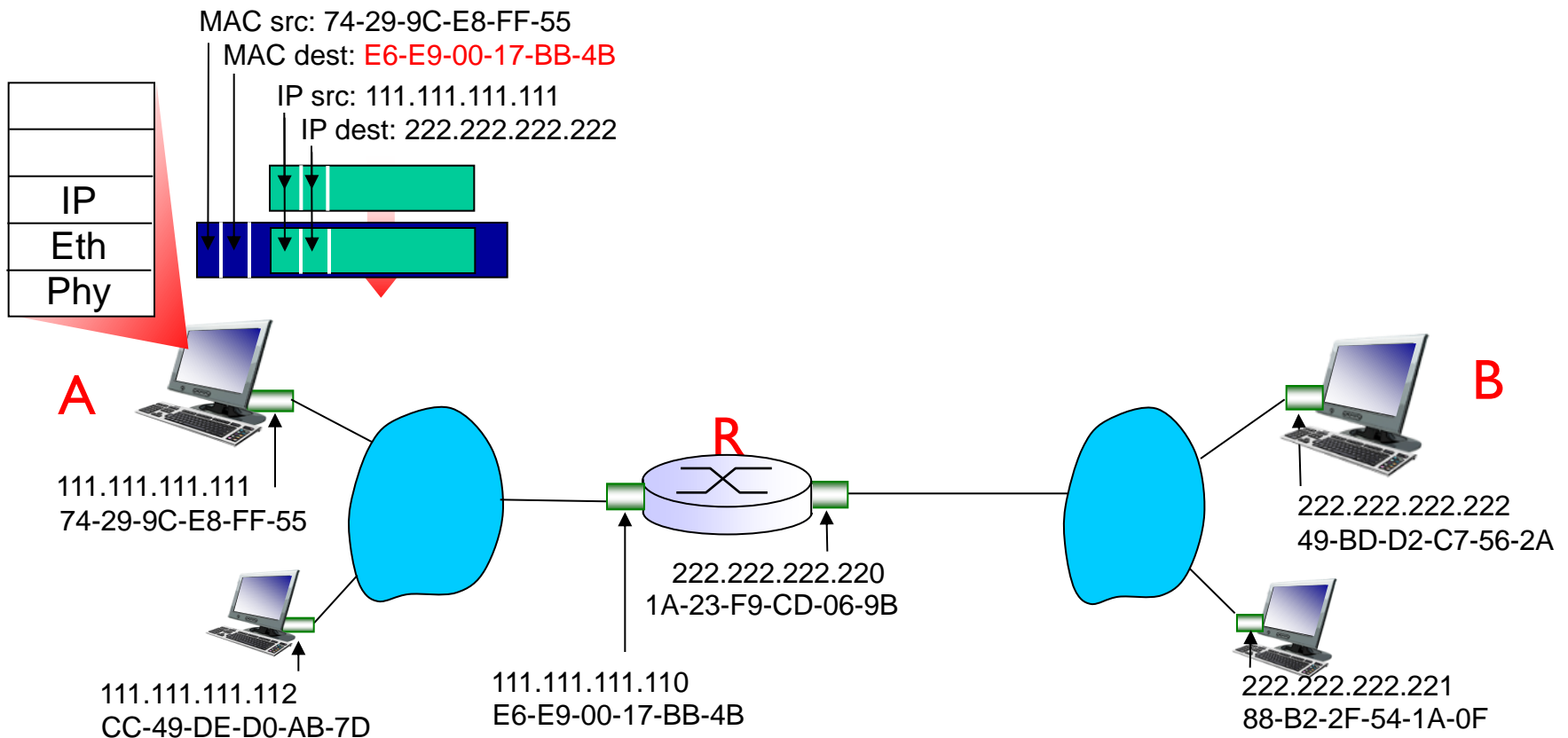
walkthrough: **send datagram from A to B via R**

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



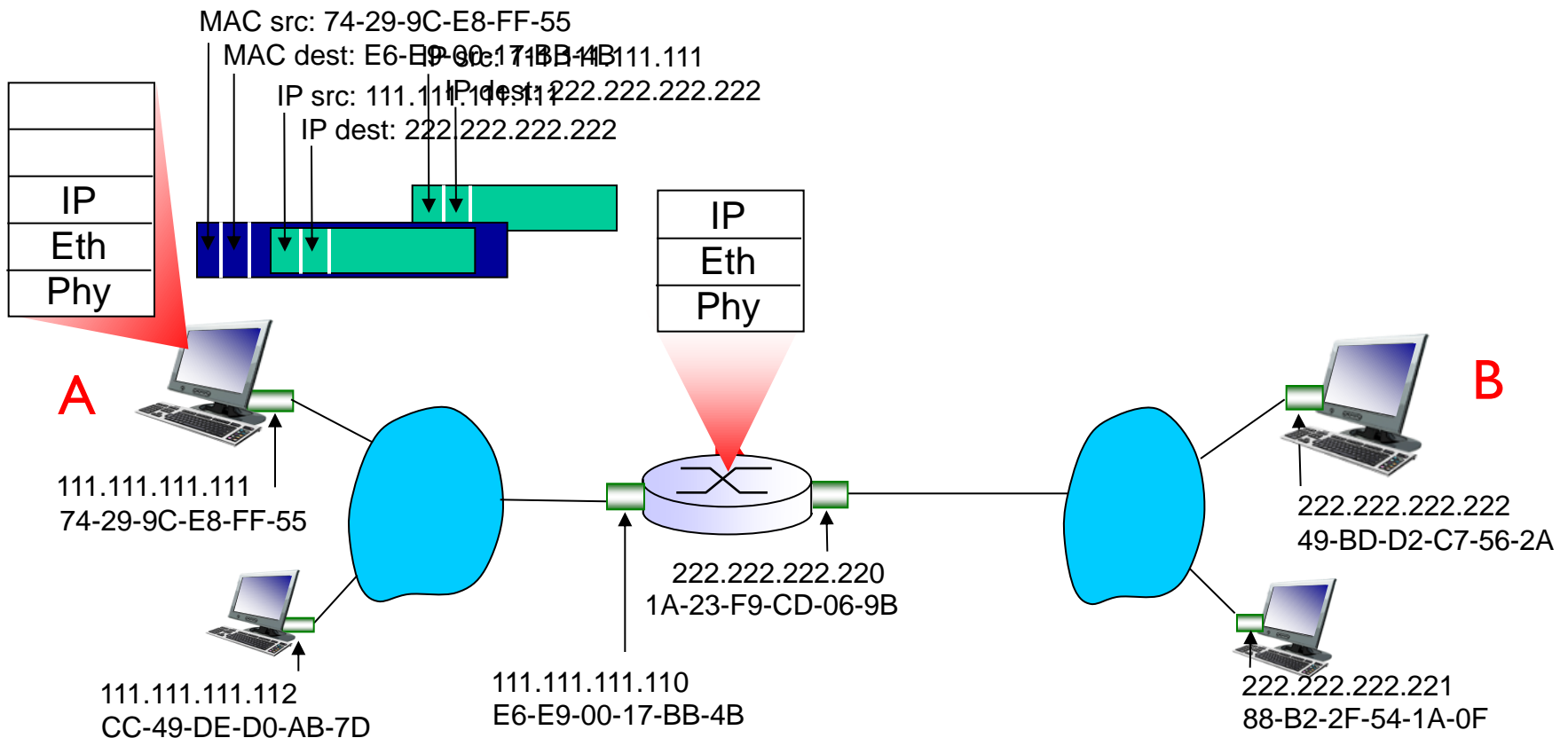
Addressing: routing to another LAN

- ❖ 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



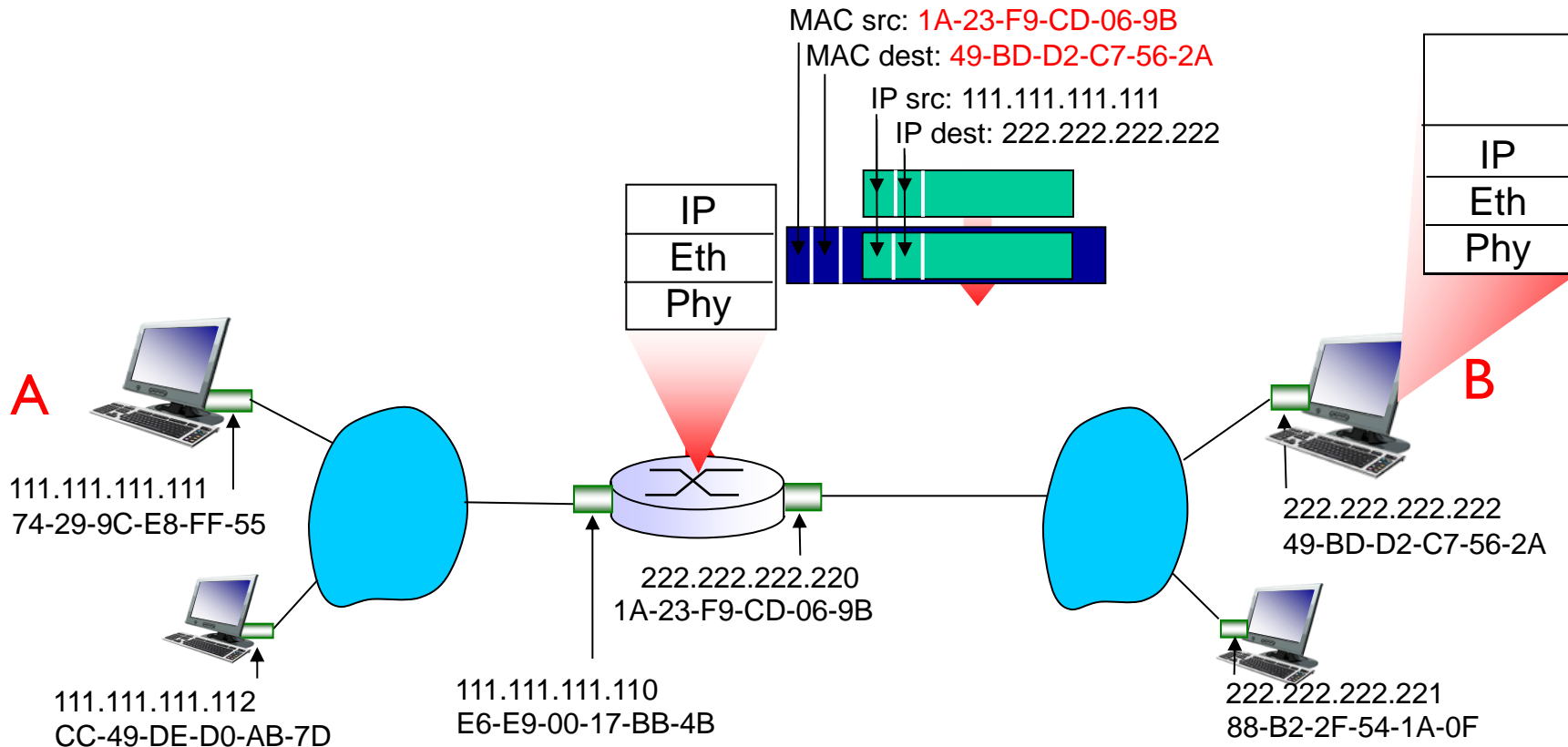
Addressing: routing to another LAN

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



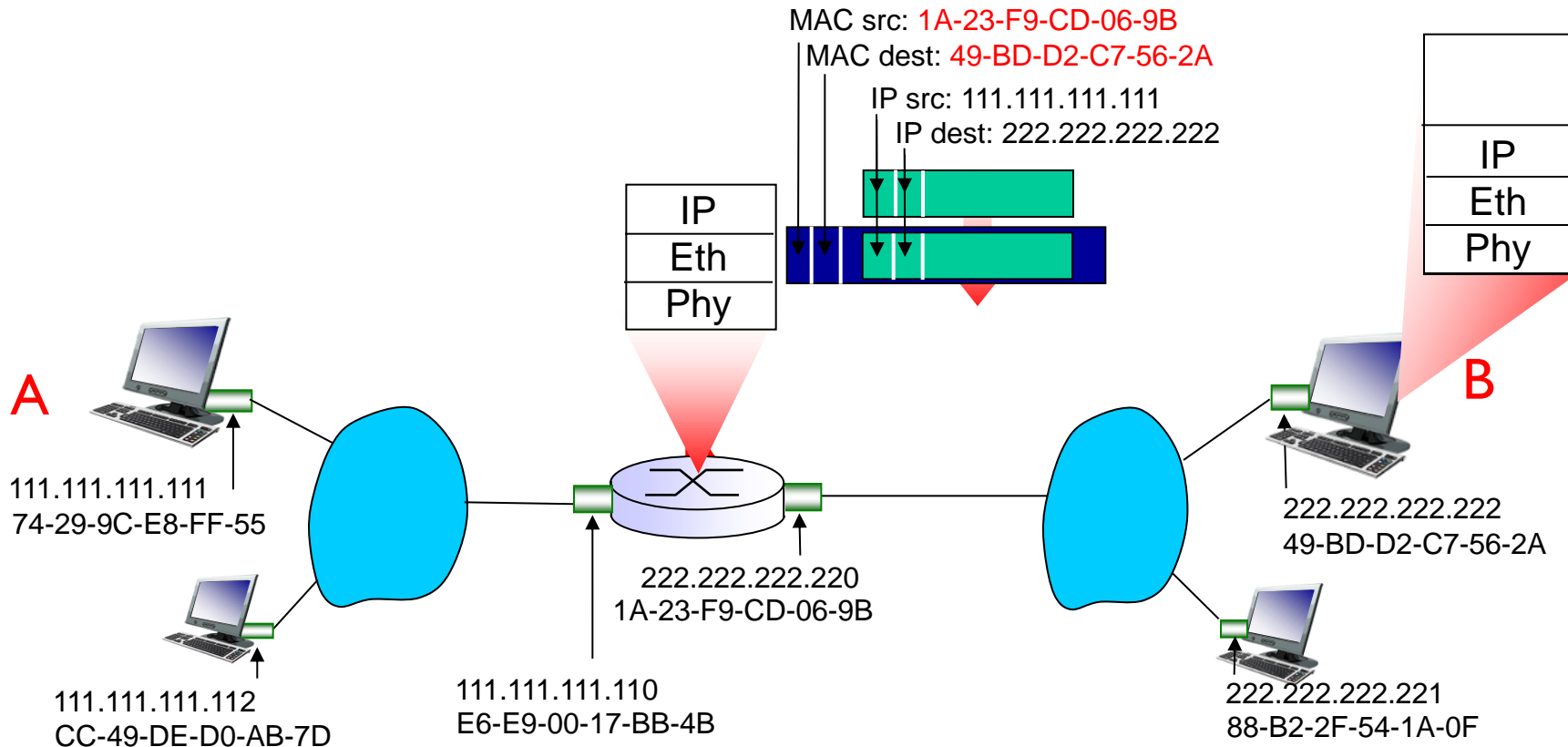
Addressing: routing to another LAN

- ❖ 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
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