Computer Networks
COL 334/672

Data Plane

Slides adapted from KR

Sem 1, 2025-26

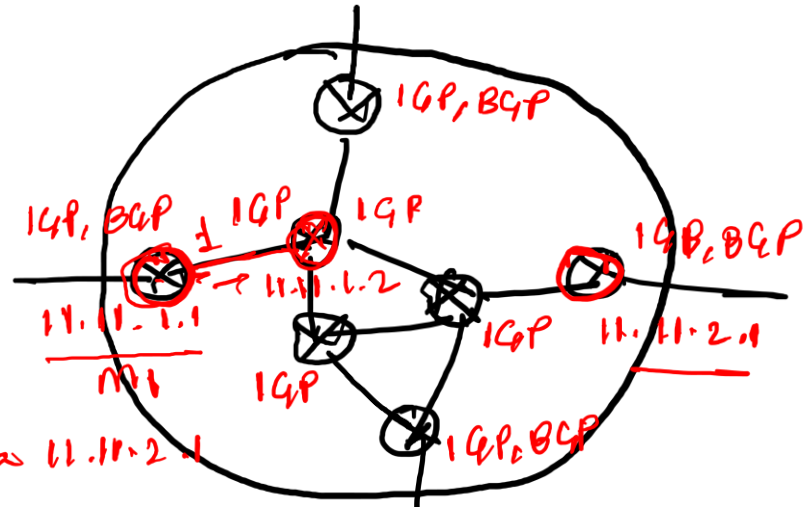
Quiz on Moodle (NOT Moodlenew)

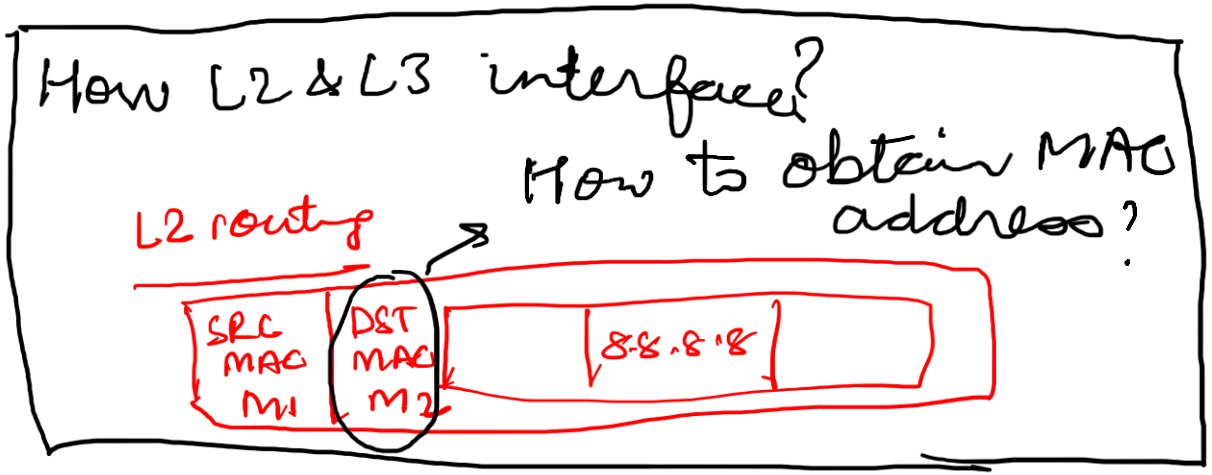
Password : bgp

Story so far ..

- Routing algorithms in the network layer
  - Intra-domain routing through an interior gateway protocol such as OSPF, RIP
  - Inter-domain routing through BGP

Now, completing the picture





Routing Table

PREFIX	NXT HOP
8.8.8.0/24	11.11.2.1

+

IGP Routing Table

PREFIX	NXT HOP	PORT
11.11.2.0/24	11.11.1.2	1

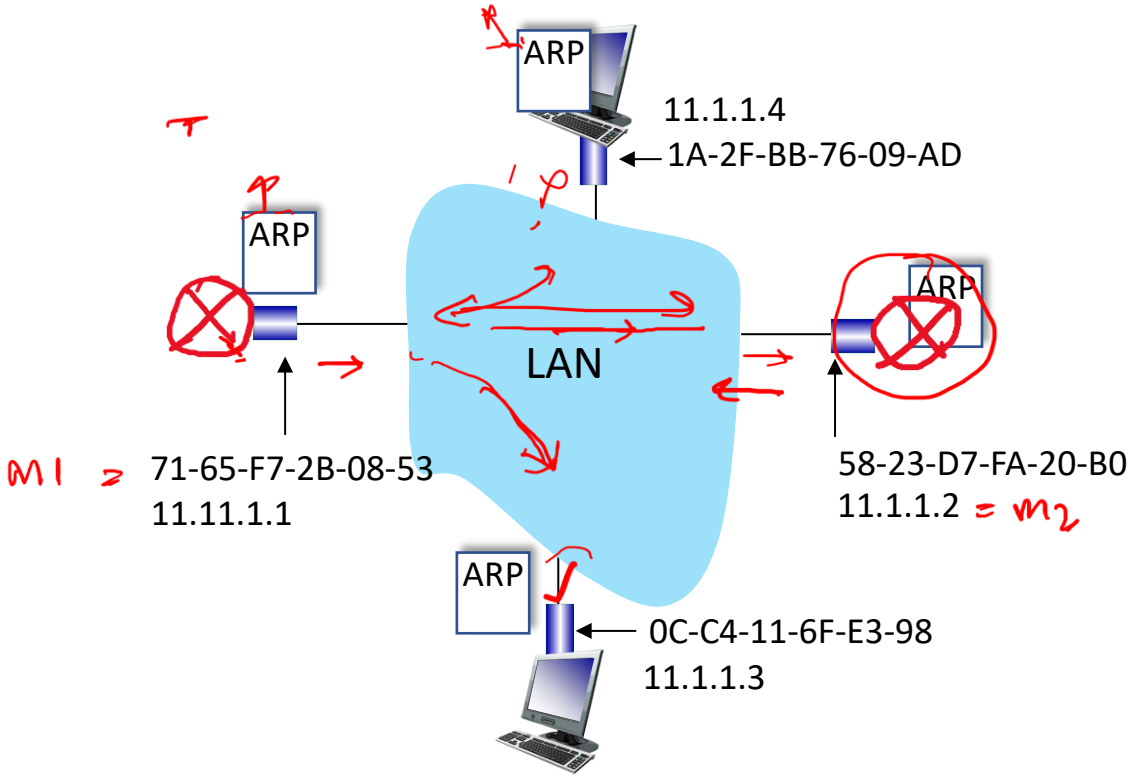
=

Forwarding Table

PREFIX	PORT	NXT HOP	MAC Address
8.8.8.0/24	1	11.11.1.2	

ARP: address resolution protocol

ARP: determines interface's MAC address, knowing its IP address



IP	MAC	TTL
11.11.1.2	m_2	900s

ARP REQ

ETHERNET PACKET

SRC MAC = m_1	DST MAC = ffffffff	Target IP = 11.1.1.2

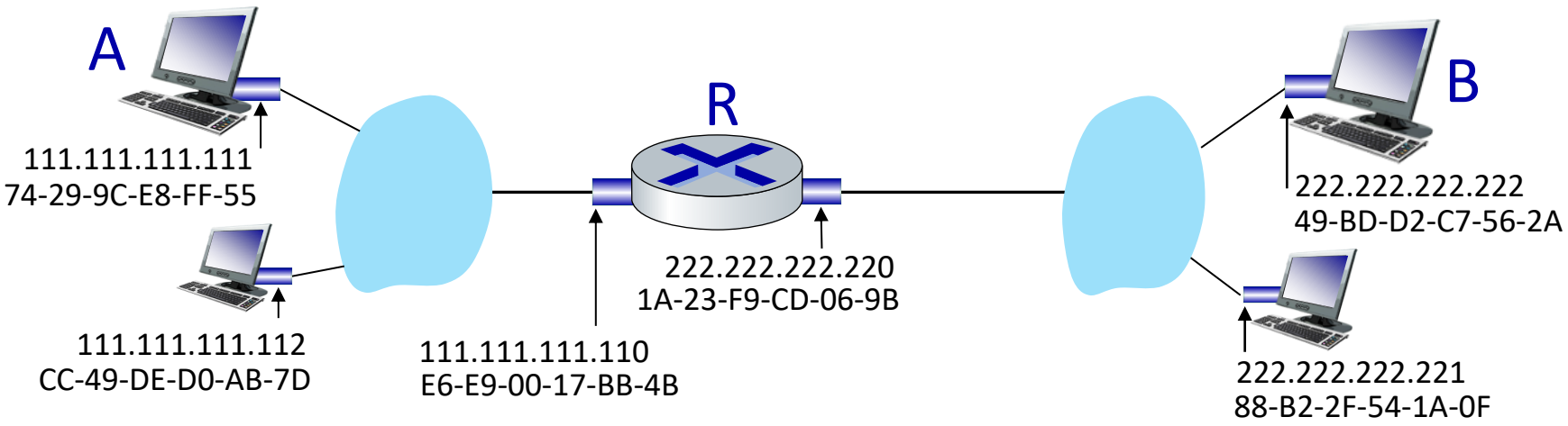
ARP REP

SRC MAC = m_2	DST MAC = m_1	TARGET IP: ... TTL = ...

Putting it all together: Routing to another subnet

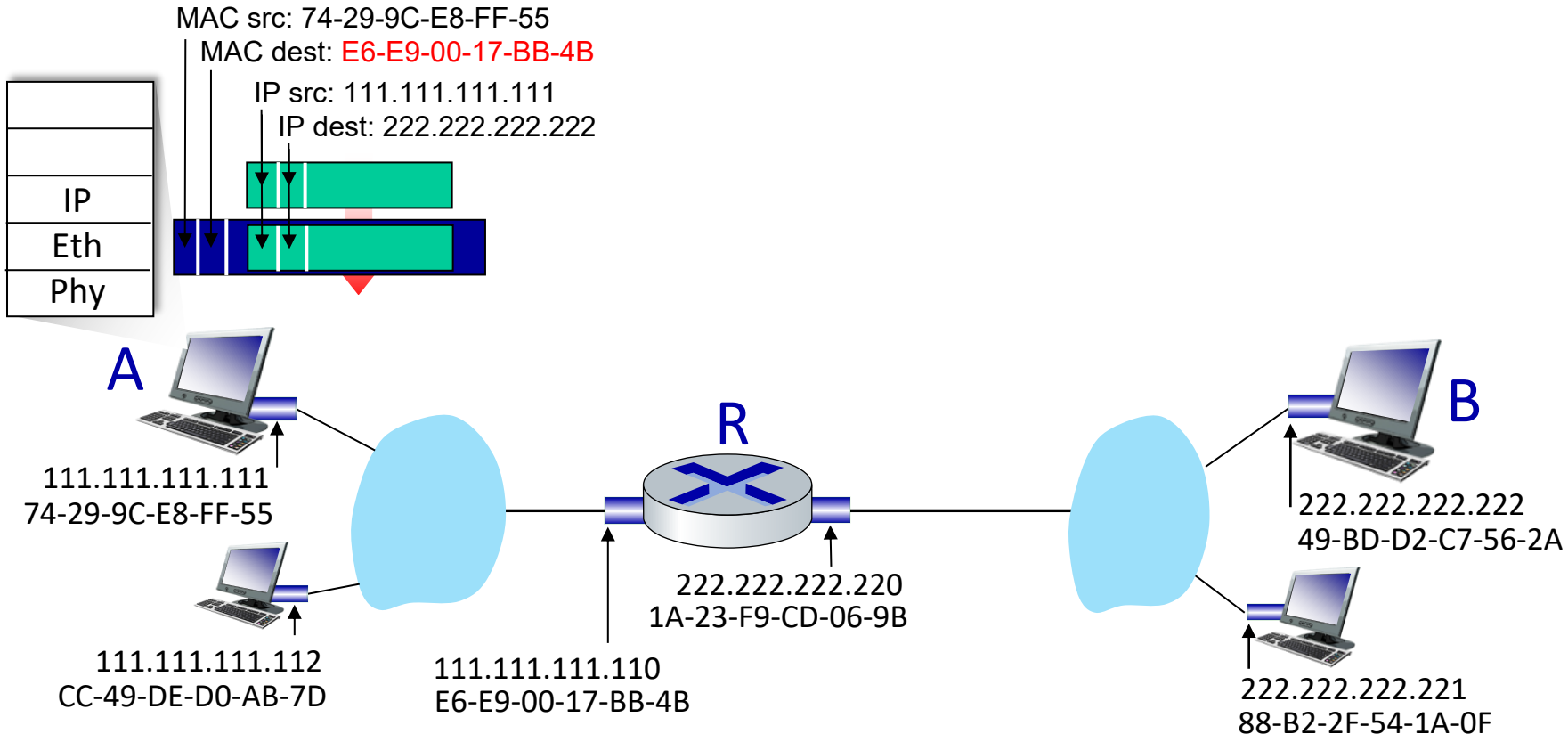
walkthrough: sending a datagram from *A* to *B* via *R*

- 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?)



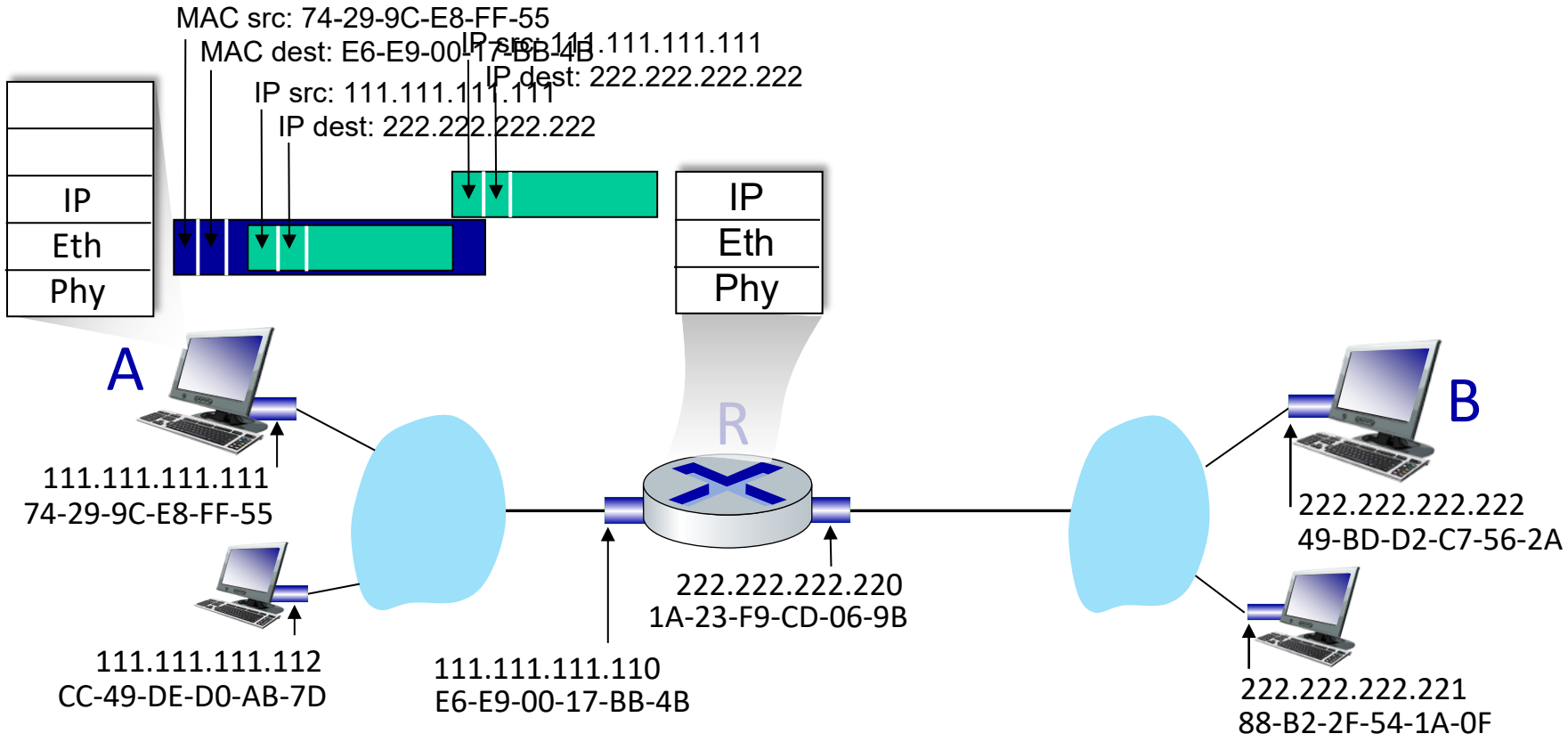
Routing to another subnet: addressing

- 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



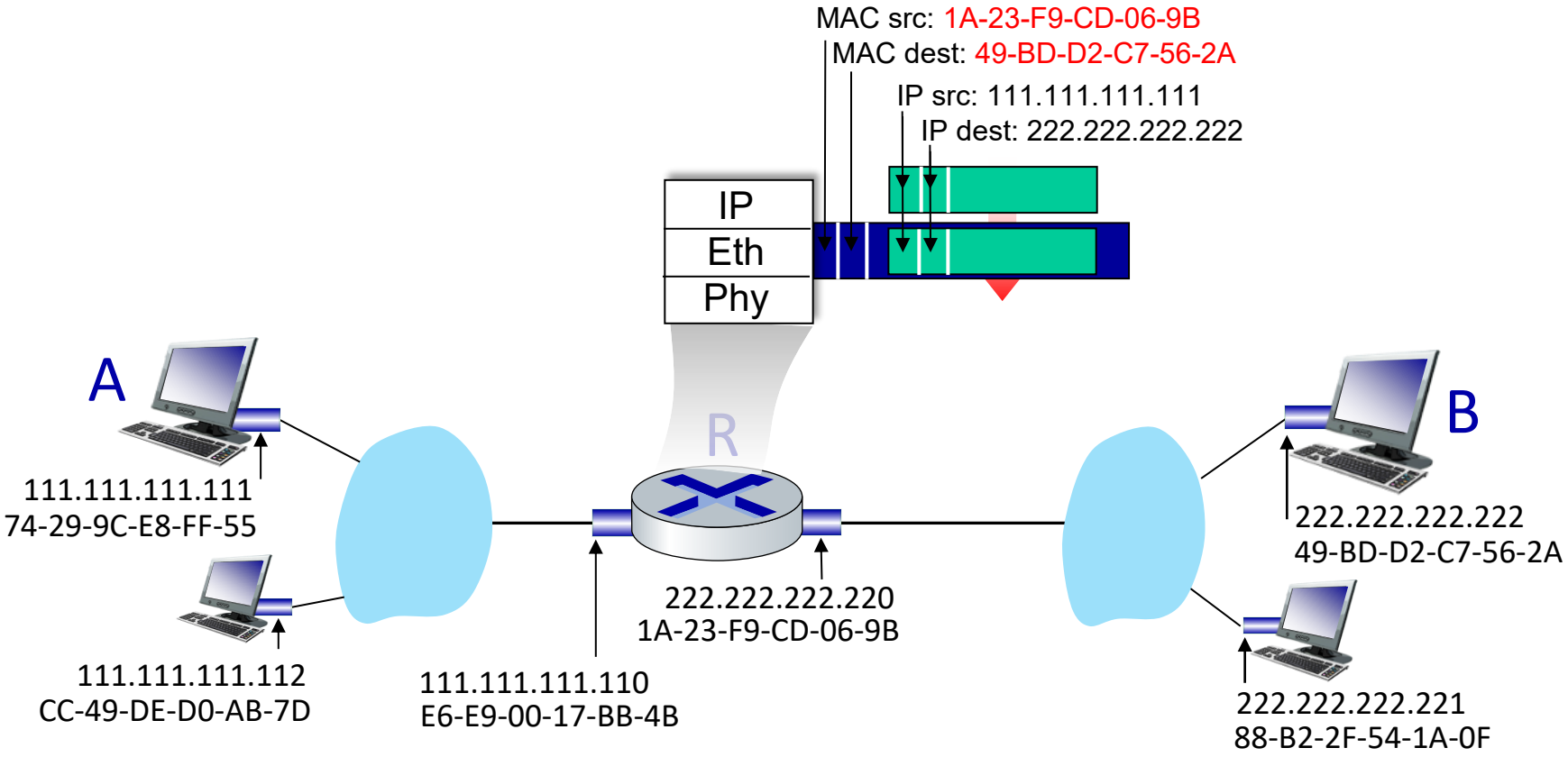
Routing to another subnet: addressing

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



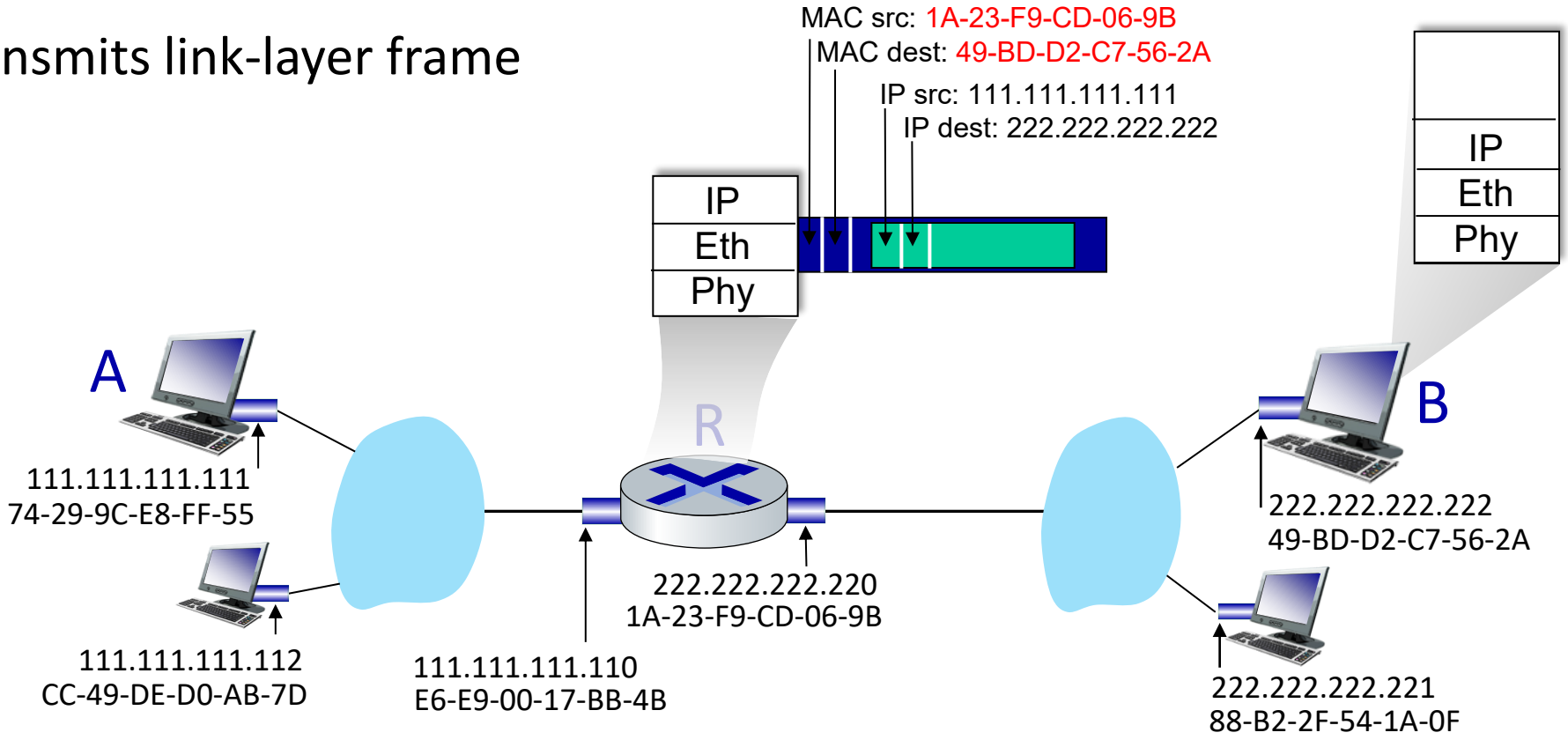
Routing to another subnet: addressing

- 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



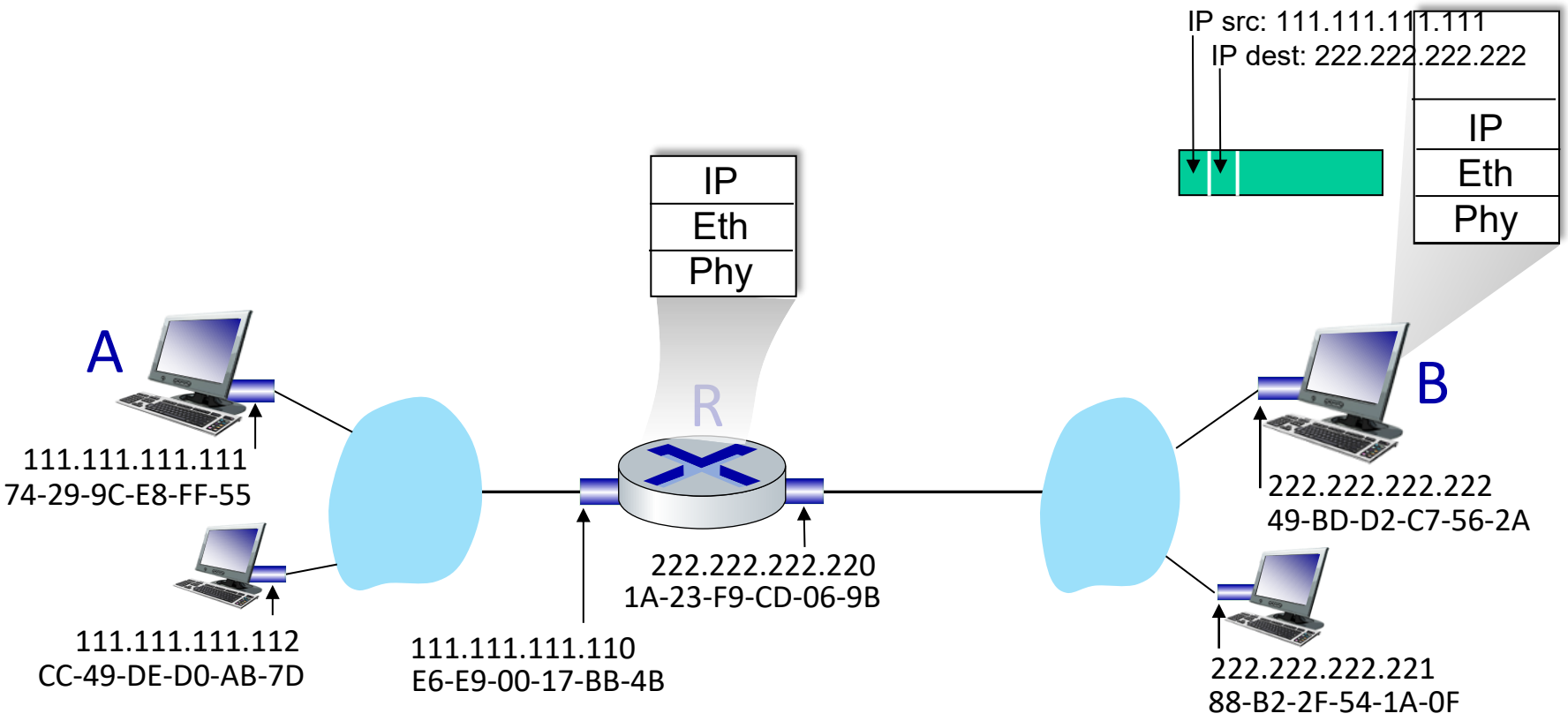
Routing to another subnet: addressing

- 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

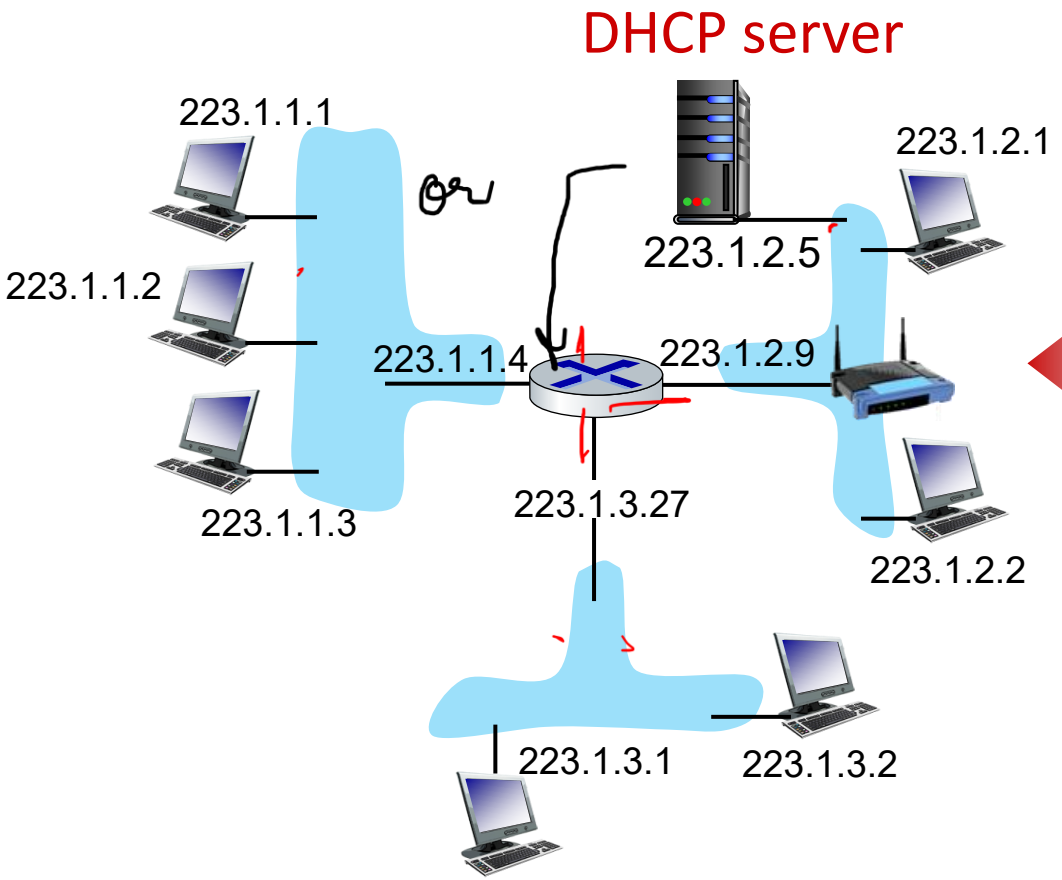


IP addresses: how to get one?

How does *host* get IP address?

- hard-coded by sysadmin in config file (e.g., /etc/rc.config in UNIX)
- DHCP: Dynamic Host Configuration Protocol: dynamically get address from a server
  - "plug-and-play"
  - consists of a server running over UDP, responsible for assigning client IP address

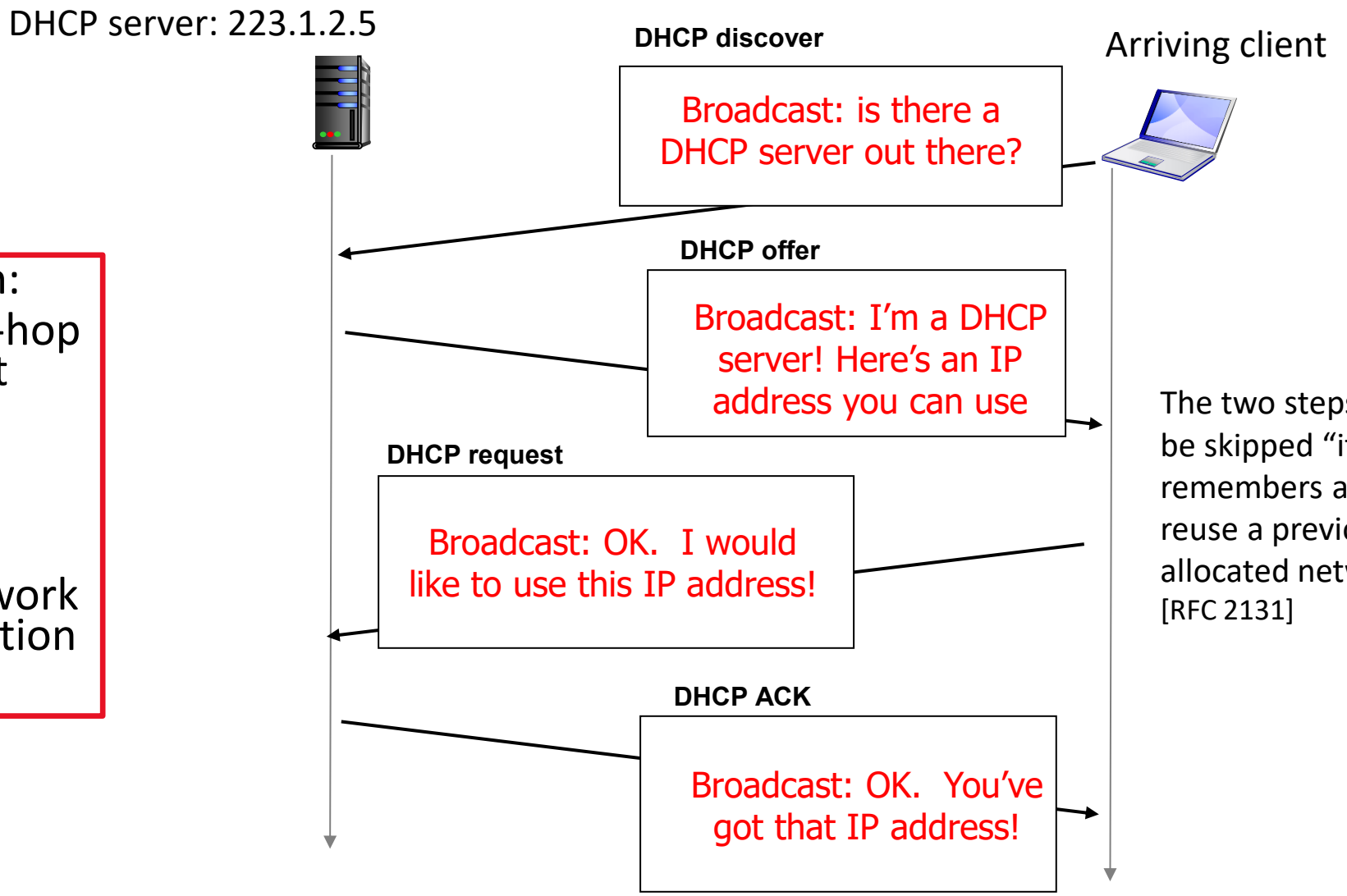
DHCP client-server scenario



Typically, DHCP server will be co-located in router, serving all subnets to which router is attached

arriving DHCP client needs address in this network

DHCP client-server scenario



Other information:

- address of first-hop router for client
- name and IP address of DNS sever
- network mask (indicating network versus host portion of address)

The two steps above can be skipped "if a client remembers and wishes to reuse a previously allocated network address" [RFC 2131]

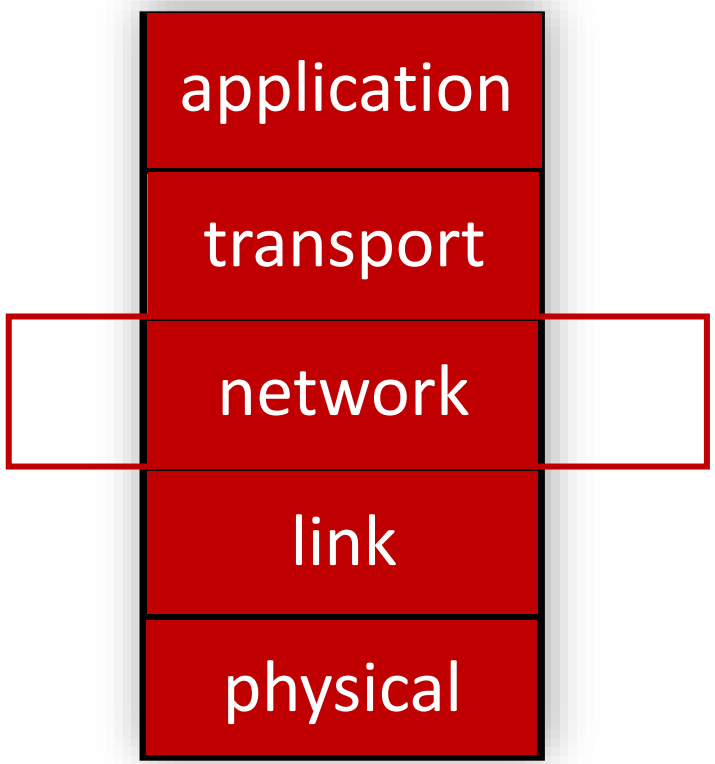
Recap

Network-layer functions:

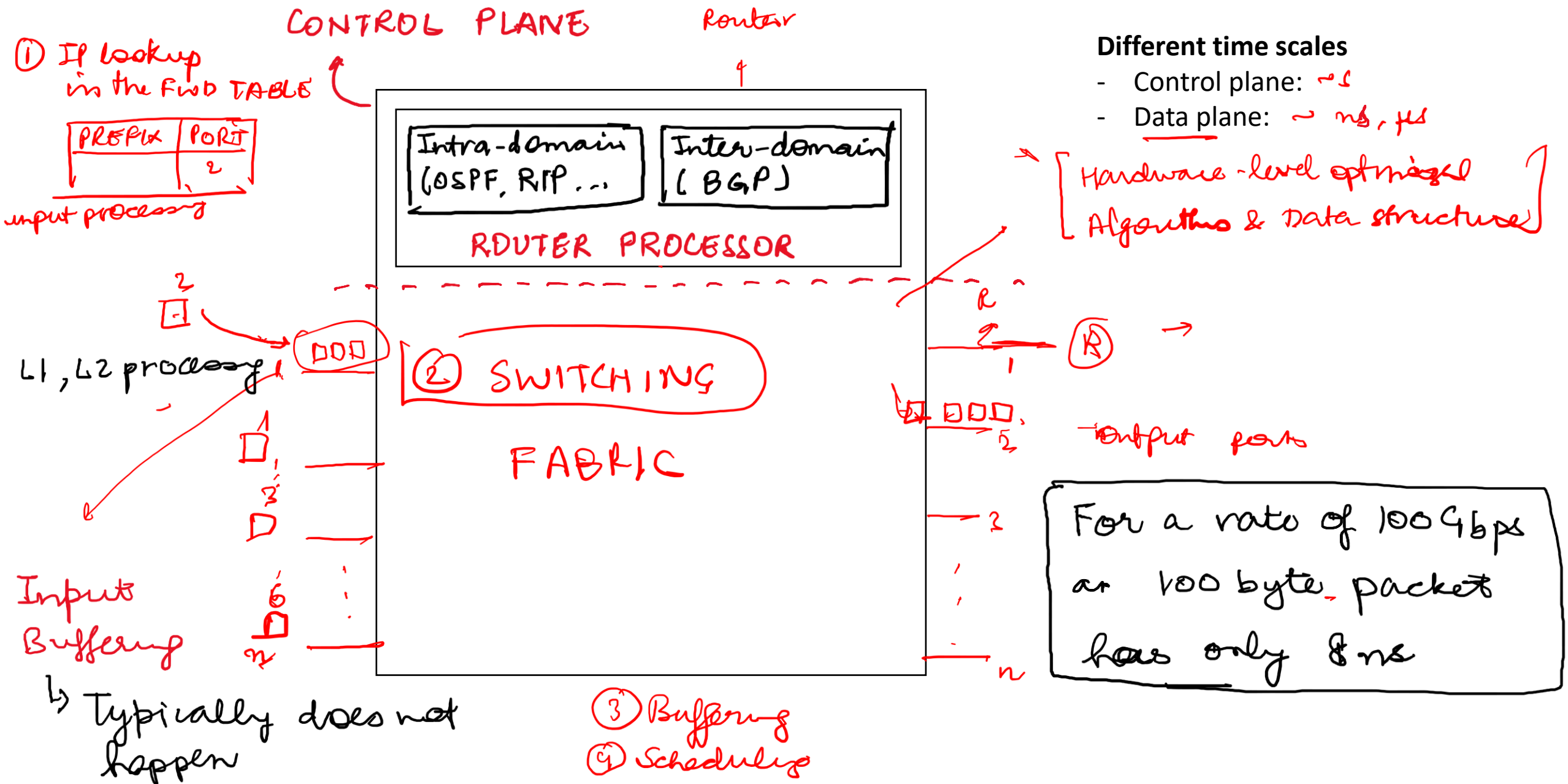
- *routing:* determine route taken by packets from source to destination
  - *routing algorithms*

Chapter 4

- *forwarding:* move packets from a router's input link to appropriate router output link



Router Architecture



Different time scales

- Control plane: ~ s
- Data plane: ~ ns, µs

Next Class: Data Plane Functions

- IP lookup
- Switching
- Queuing
- Scheduling