Network Layer

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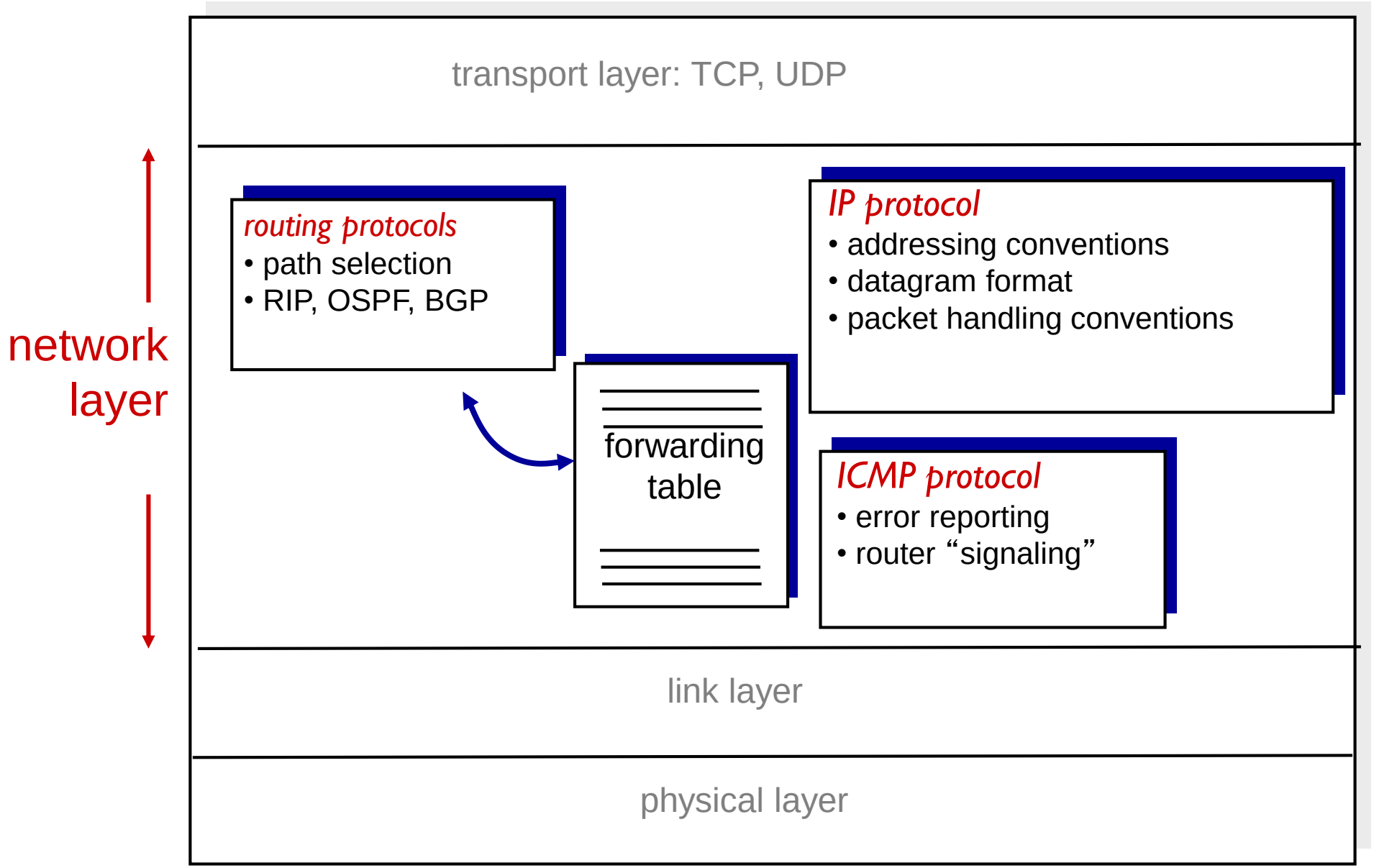
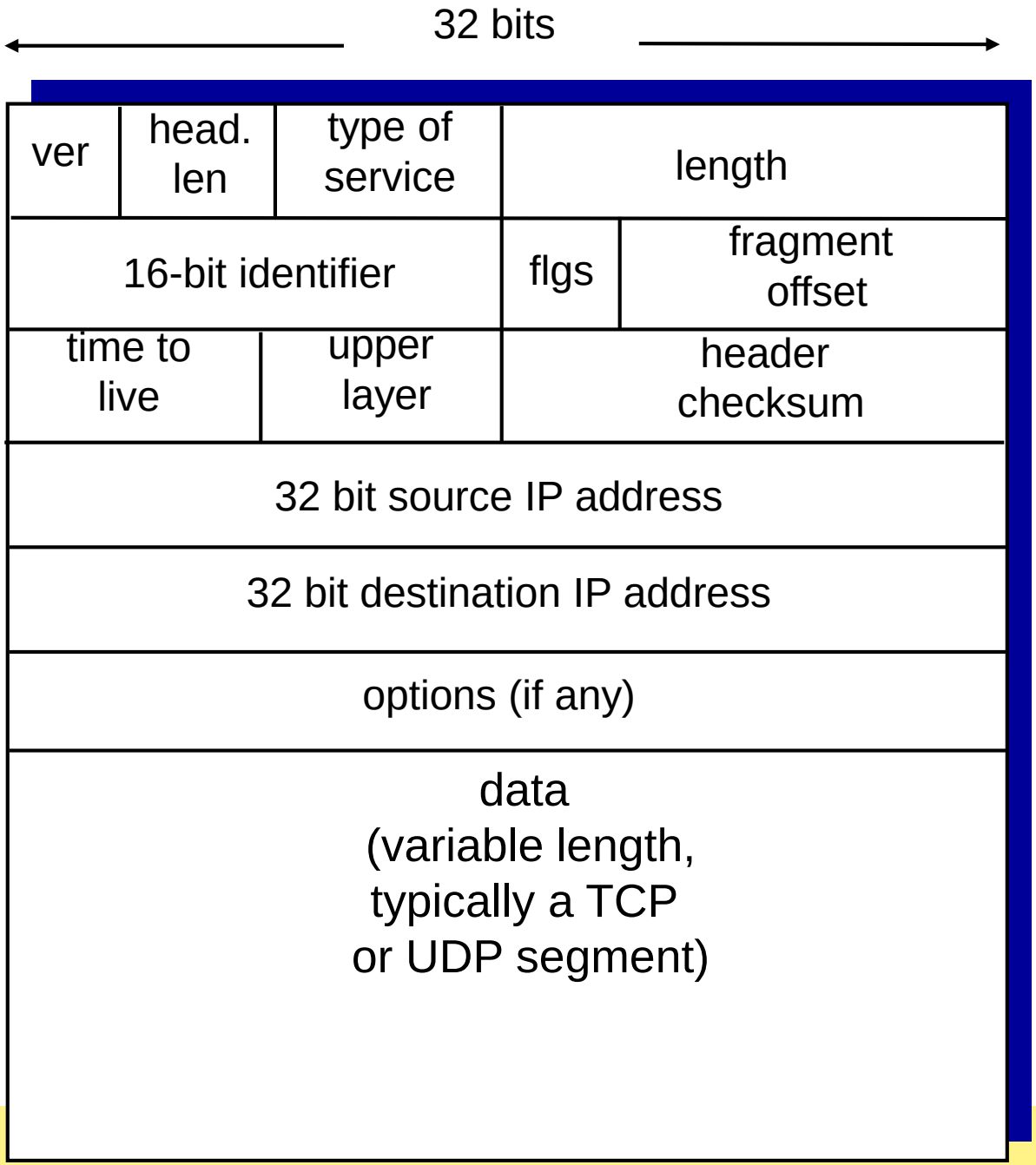
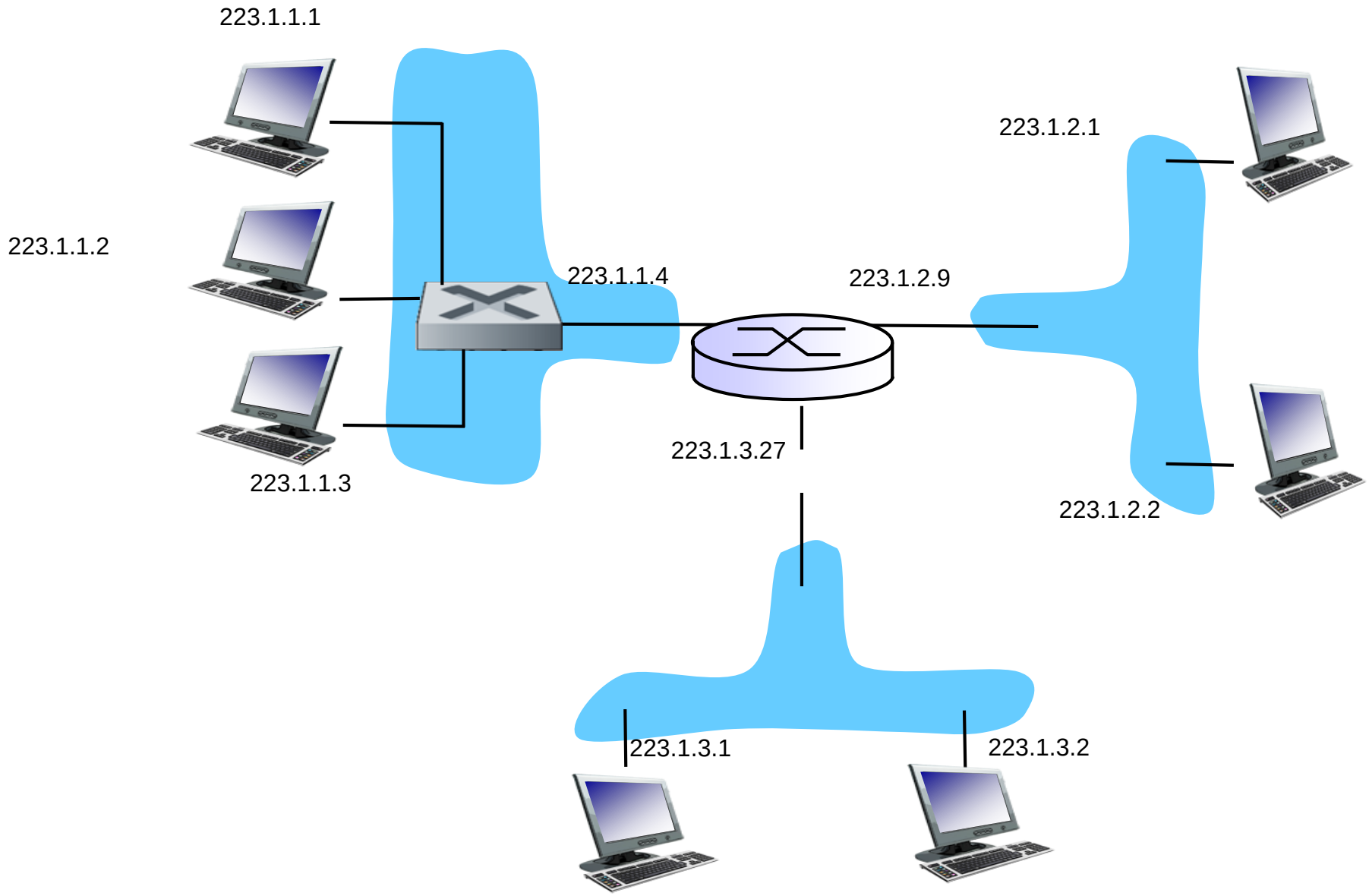
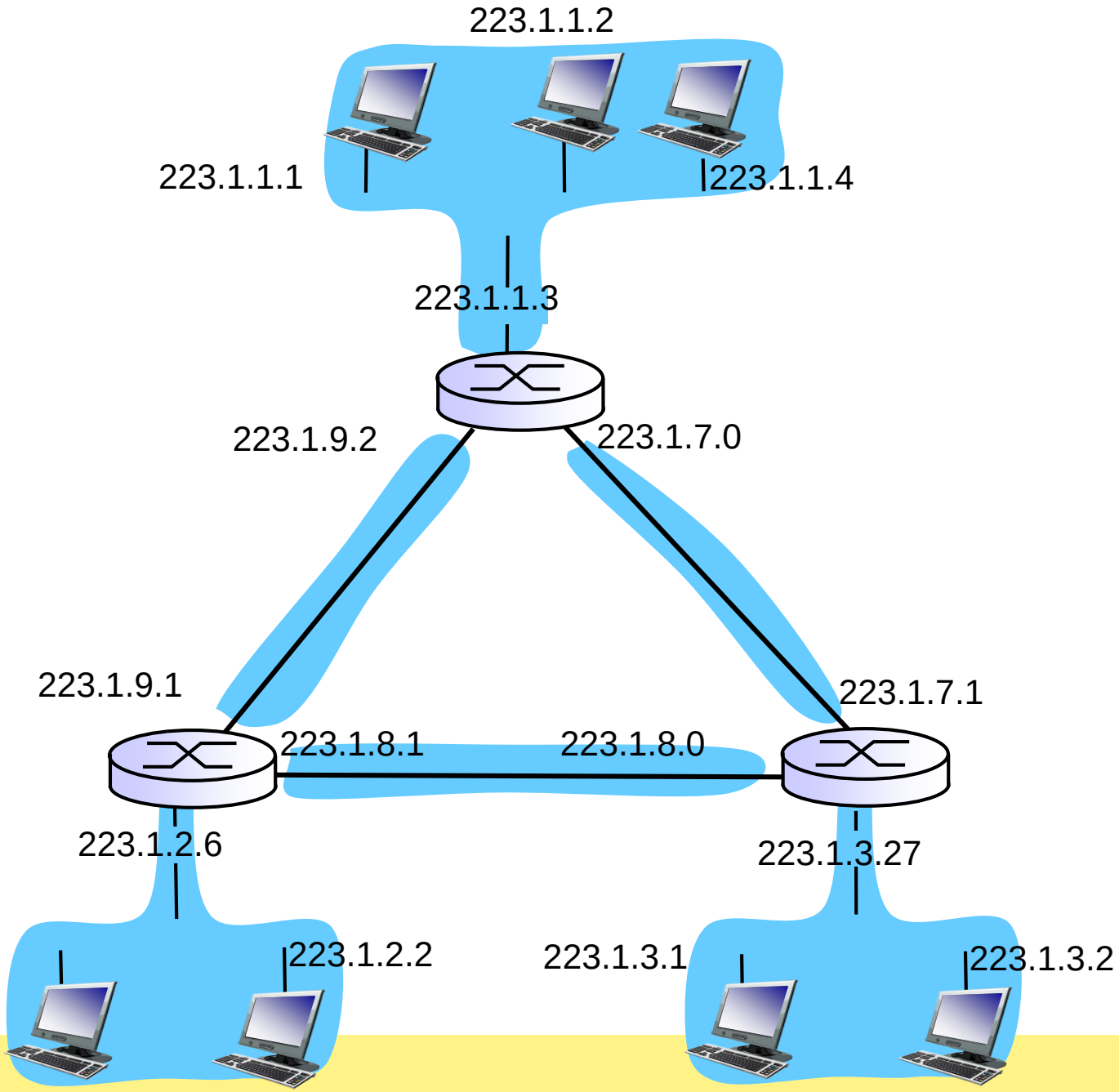

transport layer: TCP, UDP
network layer
routing protocols
• path selection
• RIP, OSPF, BGP
forwarding table
IP protocol
• addressing conventions
• datagram format
• packet handling conventions
ICMP protocol
• error reporting
• router "signaling"
link layer
physical layer

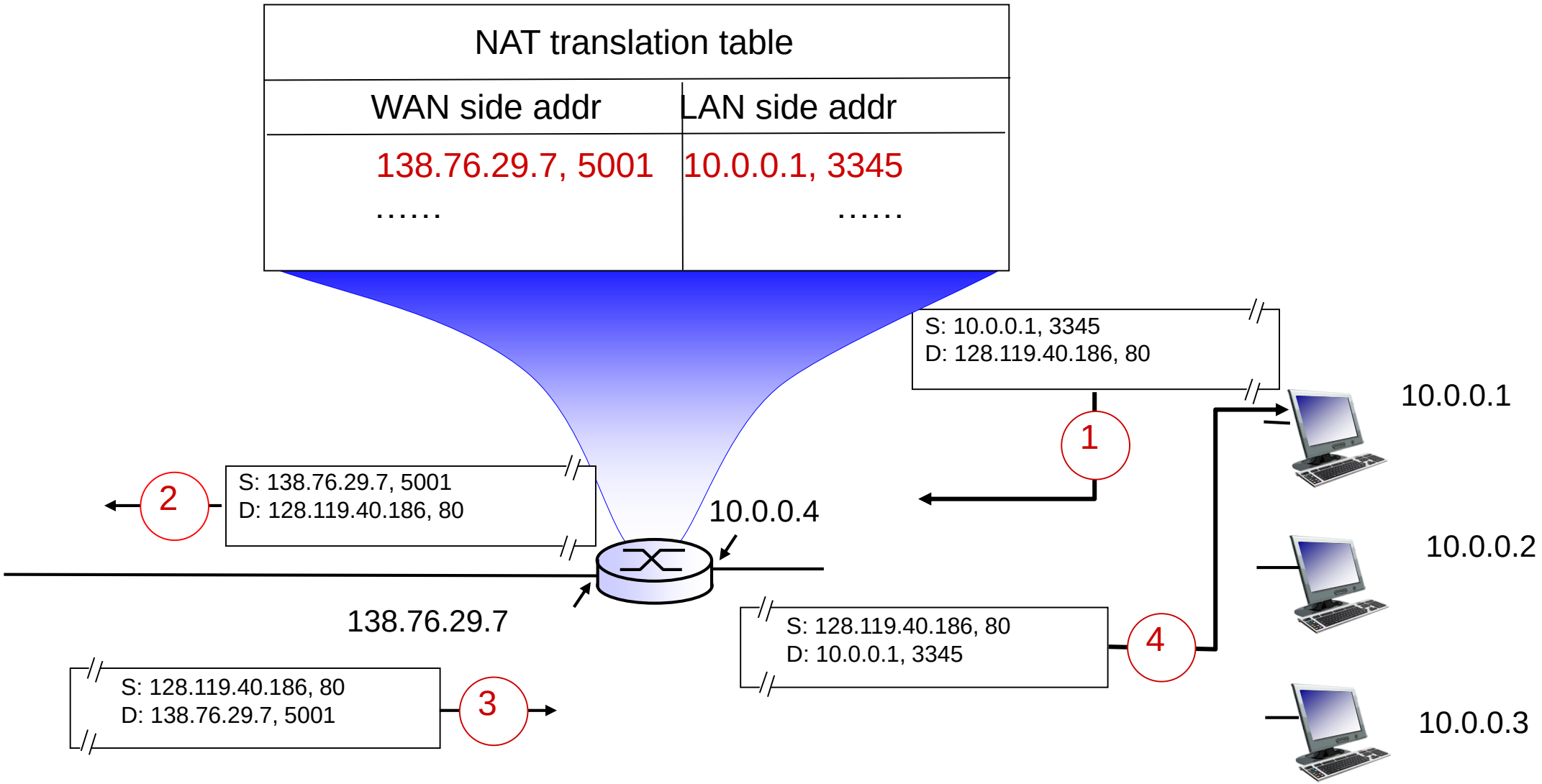
IP Header


32 bits
ver
head. len
type of service
length
16-bit identifier
flgs
fragment offset
time to live
upper layer
header checksum
32 bit source IP address
32 bit destination IP address
options (if any)
data
(variable length,
typically a TCP
or UDP segment)

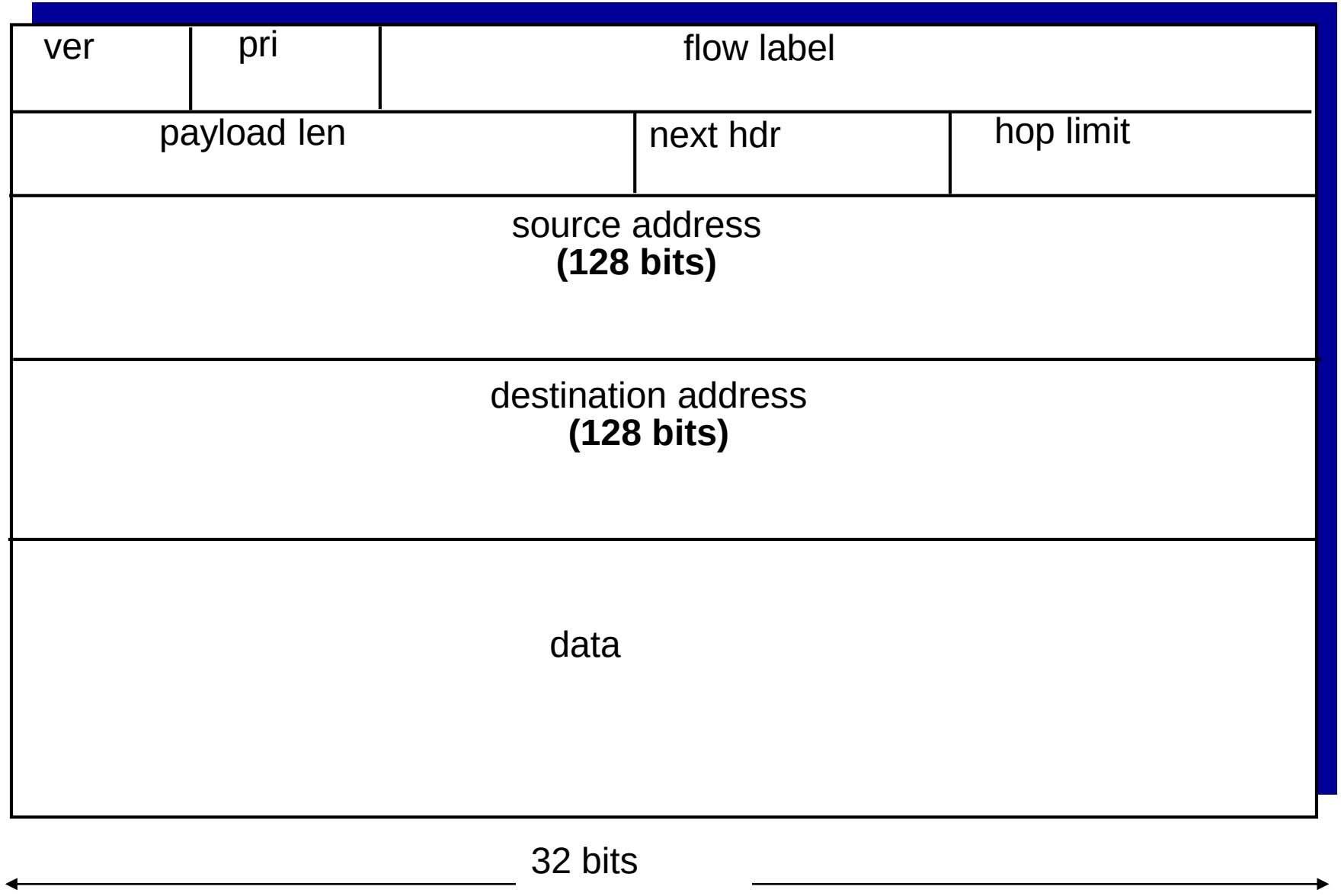

223.1.1.1
223.1.1.2
223.1.1.3
223.1.1.4
223.1.2.9
223.1.2.1
223.1.2.2
223.1.3.27
223.1.3.1
223.1.3.2

IP Subnet


223.1.1.2
223.1.1.1
223.1.1.4
223.1.1.3
223.1.9.2
223.1.7.0
223.1.9.1
223.1.7.1
223.1.8.1
223.1.8.0
223.1.2.6
223.1.3.27
223.1.2.2
223.1.3.1
223.1.3.2


NAT translation table
WAN side addr
LAN side addr
138.76.29.7, 5001
10.0.0.1, 3345
……
……
S: 10.0.0.1, 3345
D: 128.119.40.186, 80
1
10.0.0.1
2
S: 138.76.29.7, 5001
D: 128.119.40.186, 80
10.0.0.4
10.0.0.2
138.76.29.7
S: 128.119.40.186, 80
D: 10.0.0.1, 3345
4
S: 128.119.40.186, 80
D: 138.76.29.7, 5001
3
10.0.0.3

IP Version6


ver
pri
flow label
payload len
next hdr
hop limit
source address
(128 bits)
destination address
(128 bits)
data
32 bits

Datalink Layer

Purpose

- understand principles behind link layer services:
  - error detection, correction
  - sharing a broadcast channel: multiple access
  - link layer addressing (IEEE 802.xx)
  - Framing (Header)
  - local area networks: Ethernet, VLANs

- instantiation, implementation of various link layer technologies (Ethernet, fast-Ethernet, Wifi, ppp)

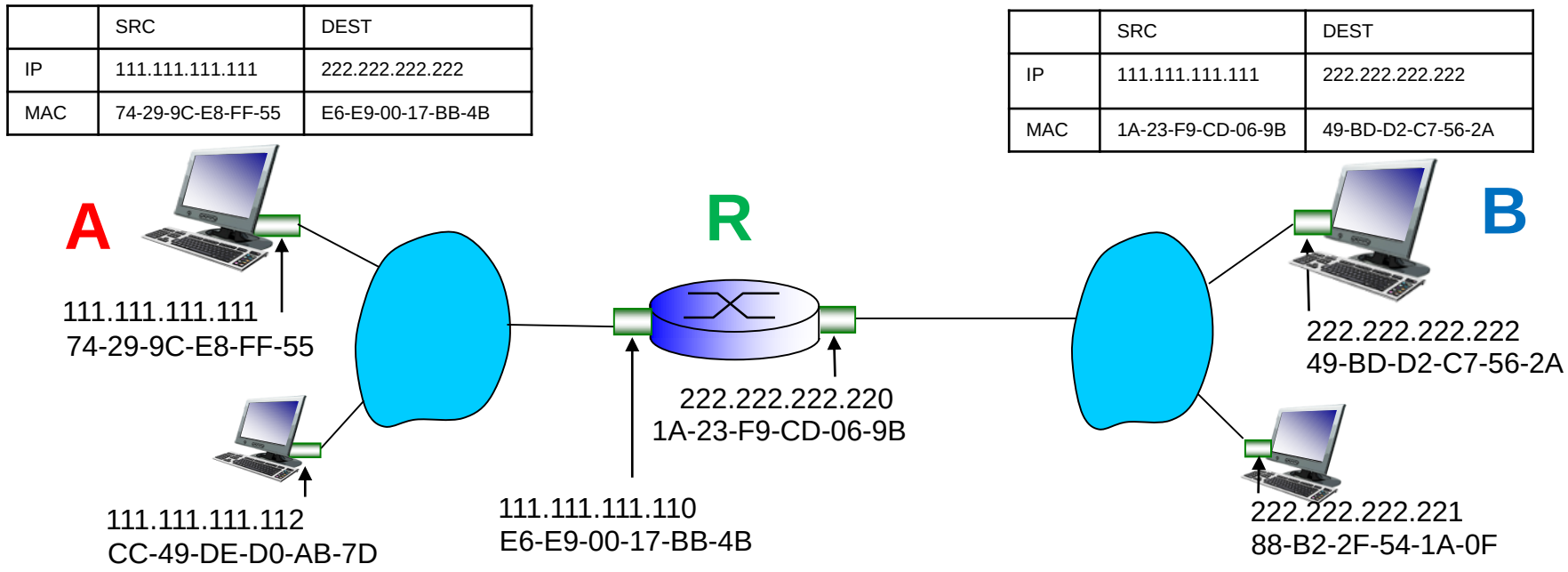
Addressing

- **Most protocols => IEEE 802.x standards**

  - Media Access Control (MAC) 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

Address Resolution Protocol (ARP)



A : arp-broadcast ‘Who have 111.111.111.110 ?
Only R: reply ‘I have 111.111.111.110’ – which mean on MAC E6-E9-00-17-BB-4B
A: make frame with IP dest 222.222.222.222 and MAC dest E6-E9-00-17-BB-4B

R: arp-broadcast ‘Who have 222.222.222.222 ?
Only B: reply ‘I have 222.222.222.222’ – which mean on MAC 49-BD-D2-C7-56-2A
R: make frame with IP dest 222.222.222.222 and mac dest 49-BD-D2-C7-56-2A