Διαχείριση Δικτύων Βασισμένων στο Λογισμικό
2025 (DIT306)

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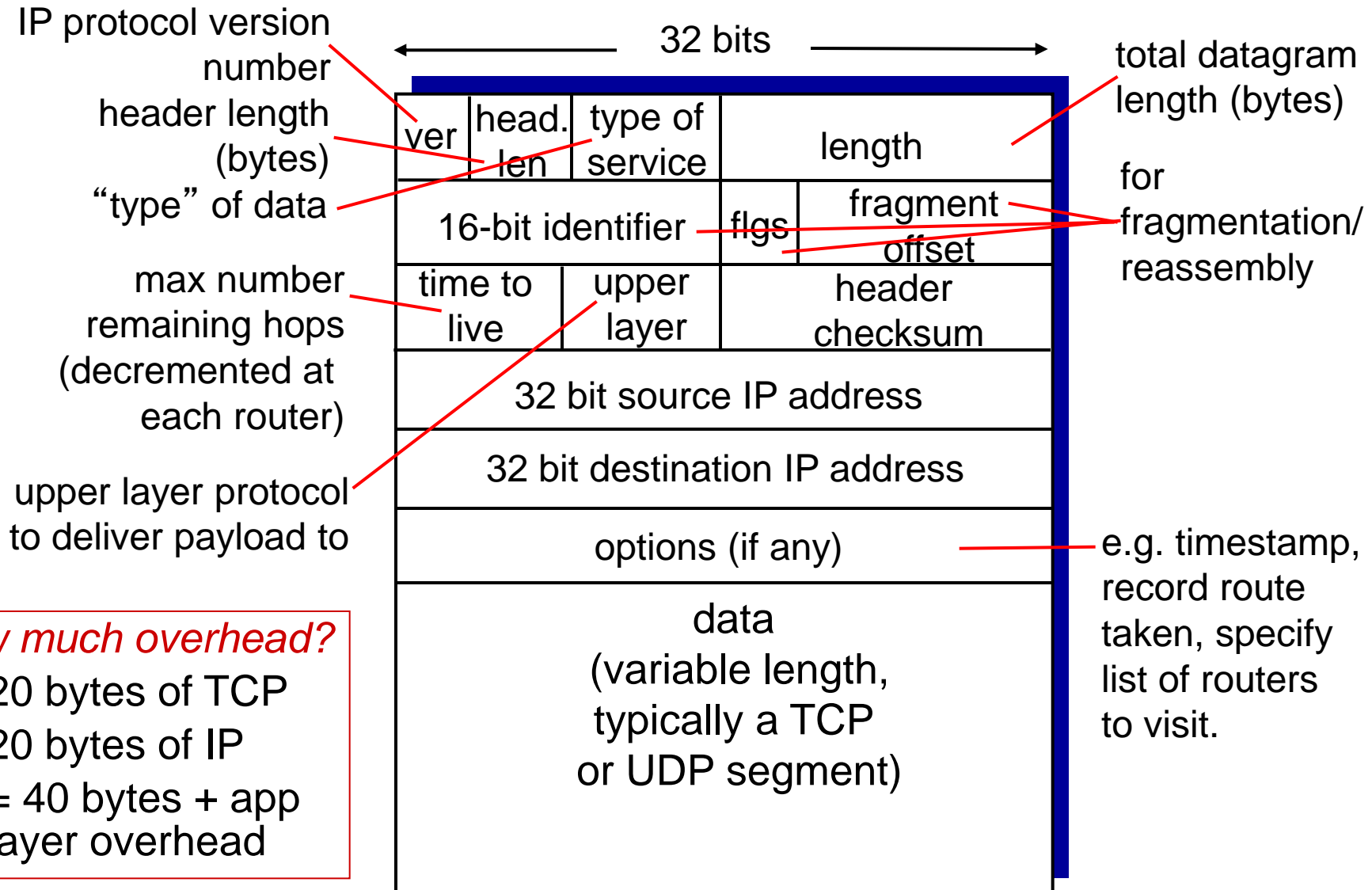
27/3/2025

Chapter 4
# Network Layer:
The Data Plane

IP datagram format

IP protocol version number

header length (bytes)

"type" of data

max number remaining hops (decremented at each router)

upper layer protocol to deliver payload to

← 32 bits →

total datagram length (bytes)

for fragmentation/ reassembly

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)

e.g. timestamp, record route taken, specify list of routers to visit.

how much overhead?
- 20 bytes of TCP
- 20 bytes of IP
- = 40 bytes + app layer overhead

IP fragmentation, reassembly

- network links have MTU (max.transfer size) - largest possible link-level frame
  - different link types, different MTUs
- large IP datagram divided ("fragmented") within net
  - one datagram becomes several datagrams
  - "reassembled" only at final destination
  - IP header bits used to identify, order related fragments

fragmentation:
in: one large datagram
out: 3 smaller datagrams
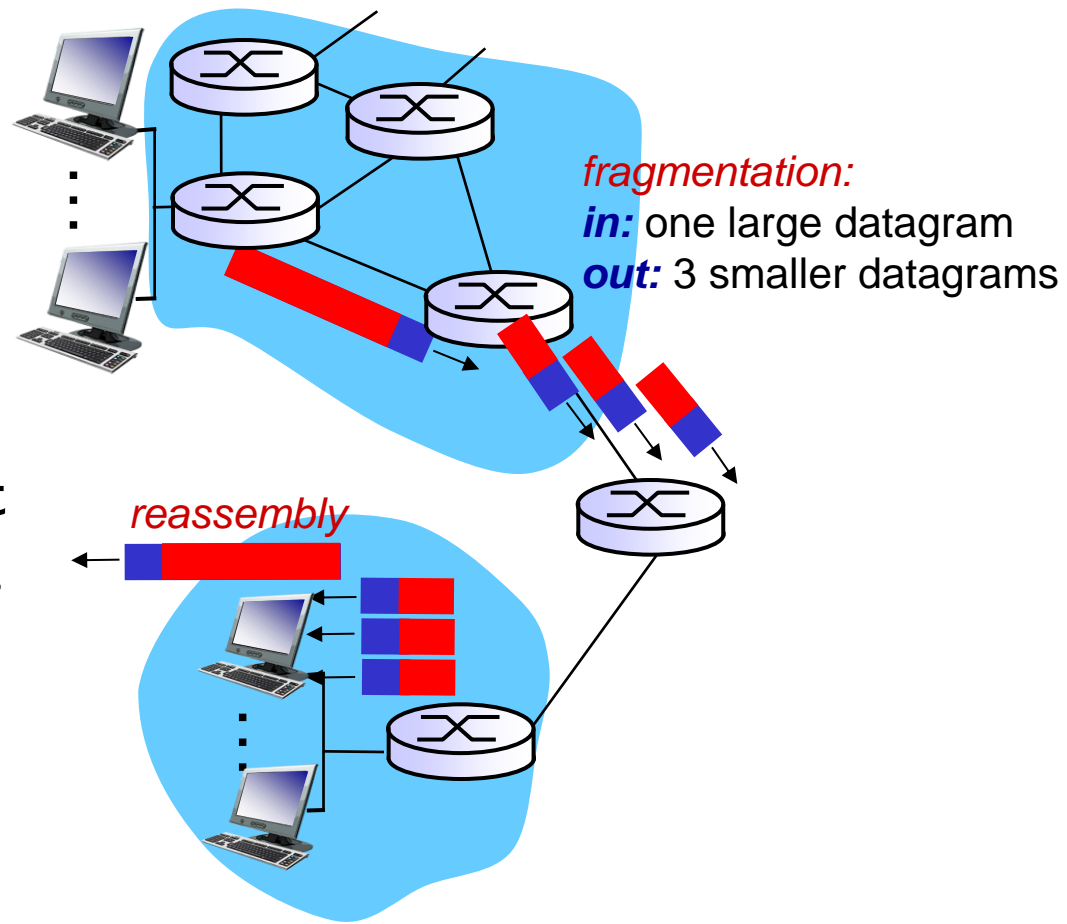
reassembly

IP fragmentation, reassembly

example:

❖ 4000 byte datagram
❖ MTU = 1500 bytes

	length =4000	ID =x	fragflag =0	offset =0	

one large datagram becomes several smaller datagrams

1480 bytes in data field

offset = *1480/8*

	length =1500	ID =x	fragflag =1	offset =0	

	length =1500	ID =x	fragflag =1	offset =185	

	length =1040	ID =x	fragflag =0	offset =370	

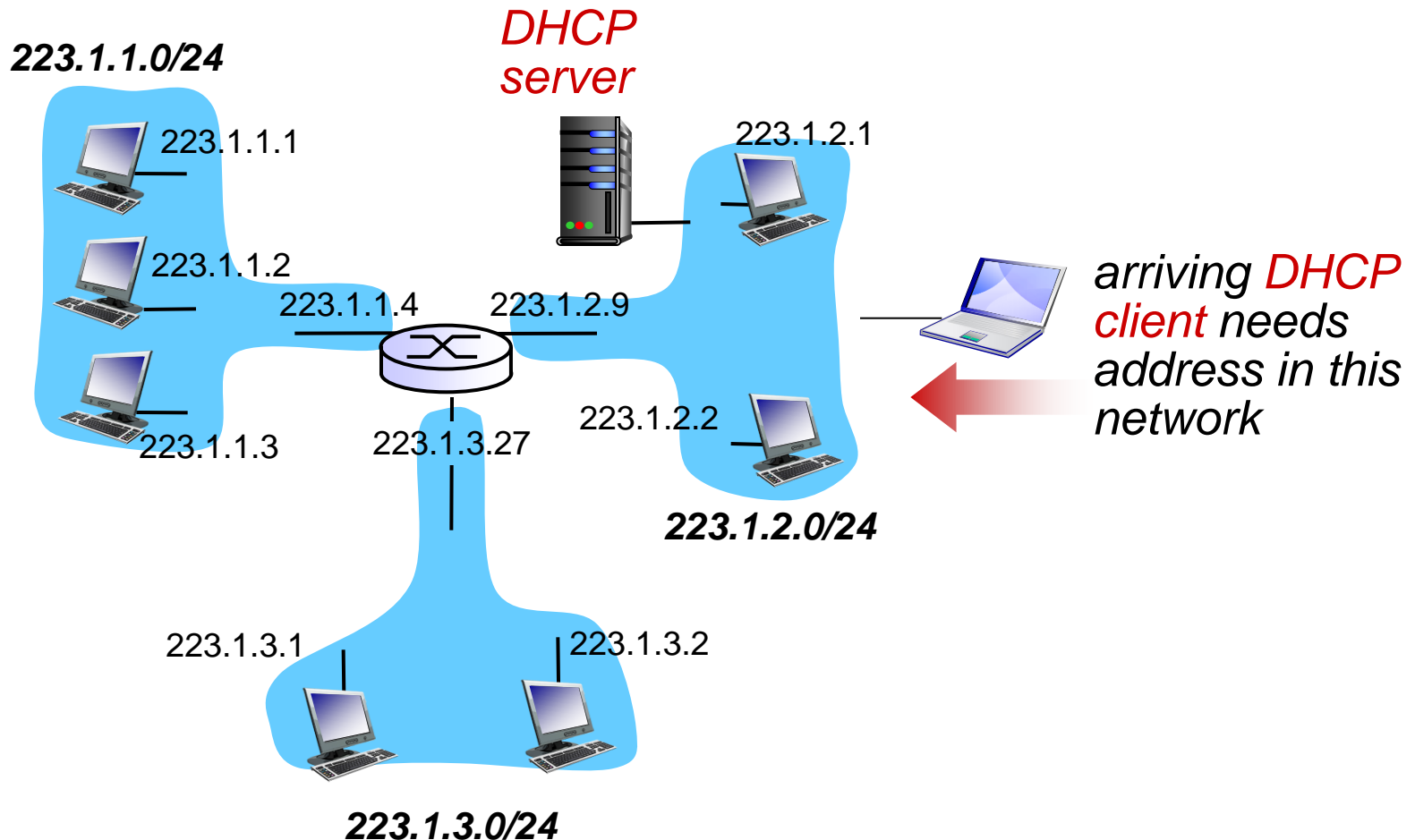# DHCP: Dynamic Host Configuration Protocol

goal: allow host to *dynamically* obtain its IP address from network server when it joins network

- can renew its lease on address in use
- allows reuse of addresses (only hold address while connected/"on")
- support for mobile users who want to join network (more shortly)

DHCP overview:

- host broadcasts "DHCP discover" msg [optional]
- DHCP server responds with "DHCP offer" msg [optional]
- host requests IP address: "DHCP request" msg
- DHCP server sends address: "DHCP ack" msg

DHCP client-server scenario

223.1.1.0/24

223.1.1.1

223.1.1.2

223.1.1.4

223.1.1.3

DHCP server

223.1.2.1

223.1.2.9

223.1.3.27

223.1.2.2

223.1.2.0/24

arriving *DHCP client* needs address in this network

223.1.3.1

223.1.3.2

223.1.3.0/24

DHCP client-server scenario

DHCP server: 223.1.2.5

arriving client

DHCP discover

Broadcast: is there a DHCP server out there?

DHCP offer

Broadcast: I'm a DHCP server! Here's an IP address you can use

DHCP request

Broadcast: OK. I'll take that IP address!

DHCP ACK

Broadcast: OK. You've got that IP address!

DHCP client-server scenario

DHCP server: 223.1.2.5

arriving client

DHCP discover

src : 0.0.0.0, 68
dest.: 255.255.255.255,67
yiaddr: 0.0.0.0
transaction ID: 654

DHCP offer

src: 223.1.2.5, 67
dest: 255.255.255.255, 68
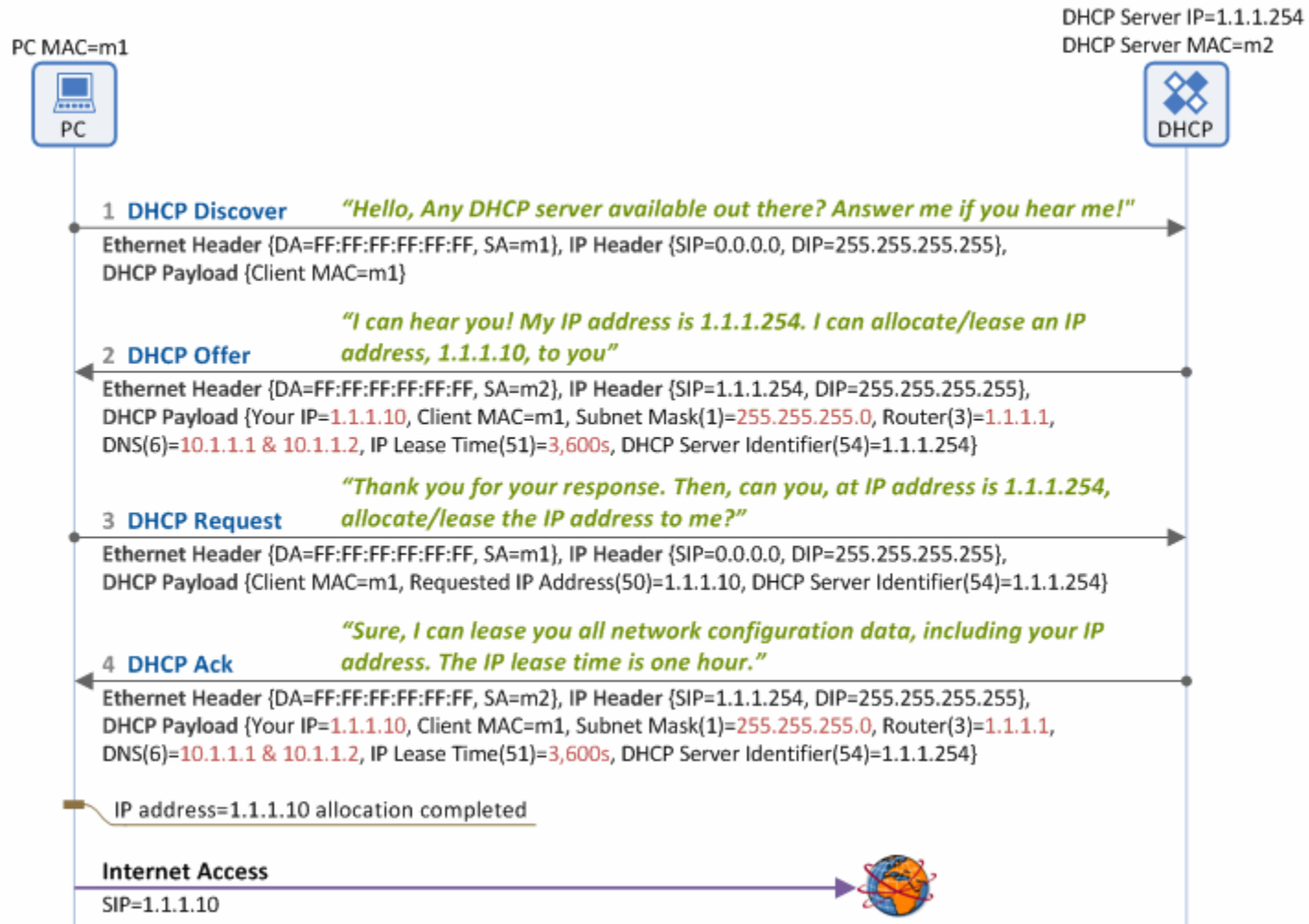yiaddrr: 223.1.2.4
transaction ID: 654
lifetime: 3600 secs

DHCP request

src: 0.0.0.0, 68
dest:: 255.255.255.255, 67
yiaddrr: 223.1.2.4
transaction ID: 655
lifetime: 3600 secs

DHCP ACK

src: 223.1.2.5, 67
dest: 255.255.255.255, 68
yiaddrr: 223.1.2.4
transaction ID: 655
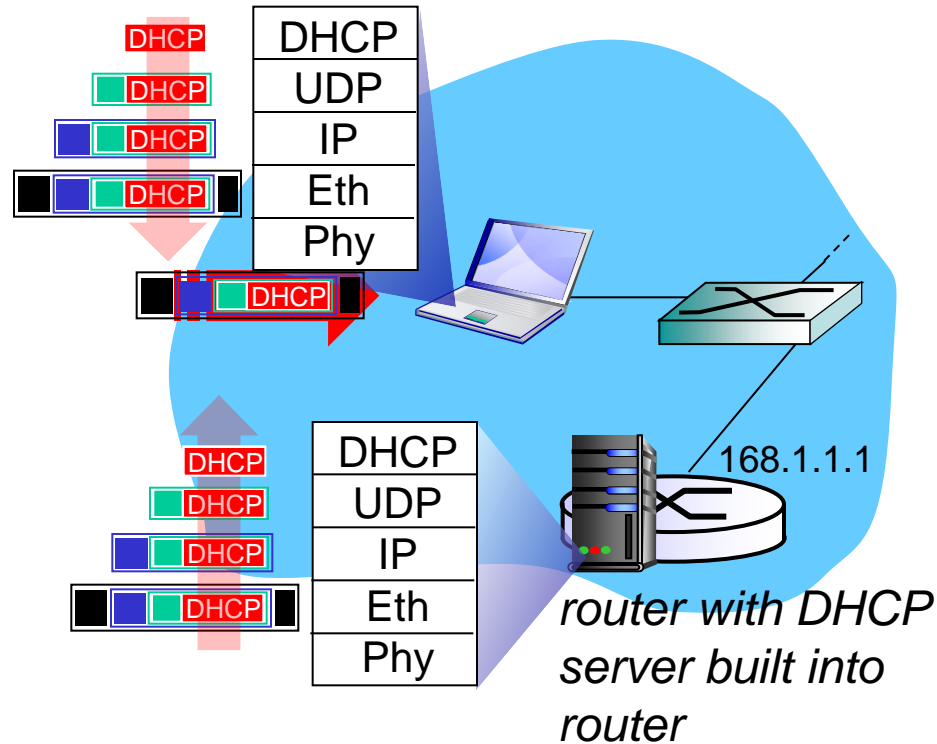lifetime: 3600 secs

DHCP client-server scenario

DHCP: more than IP addresses

DHCP can return more than just allocated IP address on subnet:

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

DHCP: example

router with DHCP server built into router

- connecting laptop needs its IP address, addr of first-hop router, addr of DNS server: use DHCP

- DHCP request encapsulated in UDP, encapsulated in IP, encapsulated in 802.1 Ethernet

- Ethernet frame broadcast (dest: FFFFFFFFFFFF) on LAN, received at router running DHCP server

- Ethernet demuxed to IP demuxed UDP demuxed to DHCP

DHCP: example

router with DHCP
server built into
router
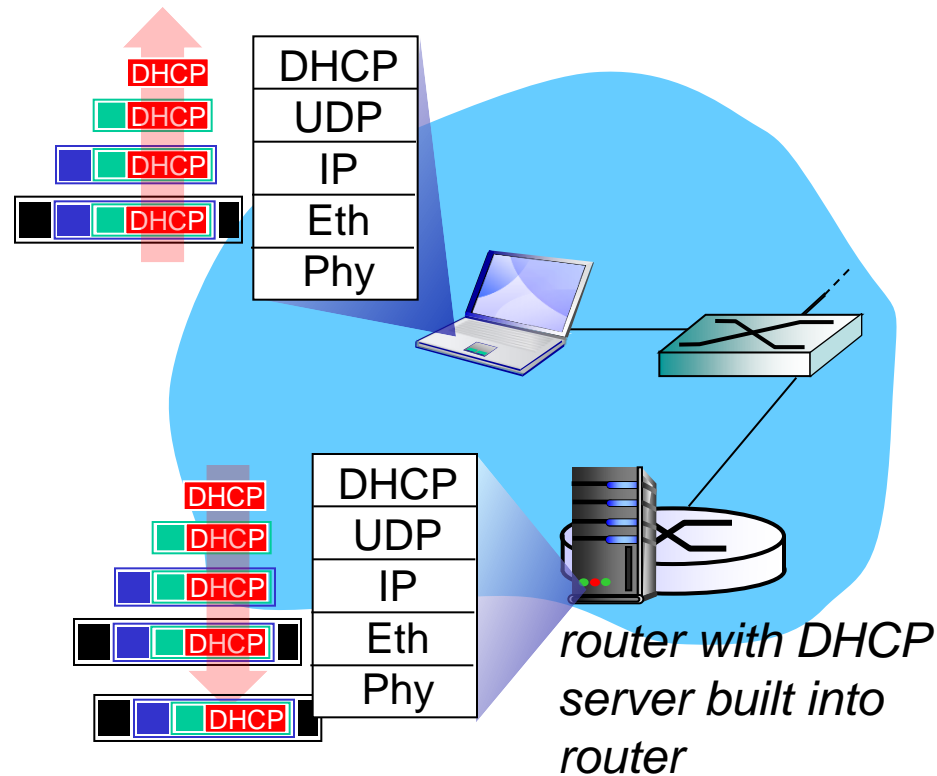
- DHCP server formulates DHCP ACK containing client's IP address, IP address of first-hop router for client, name & IP address of DNS server

- encapsulation of DHCP server, frame forwarded to client, demuxing up to DHCP at client

- client now knows its IP address, name and IP address of DNS server, IP address of its first-hop router