# CSC4200/5200 – COMPUTER NETWORKING

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## ARP AND DHCP

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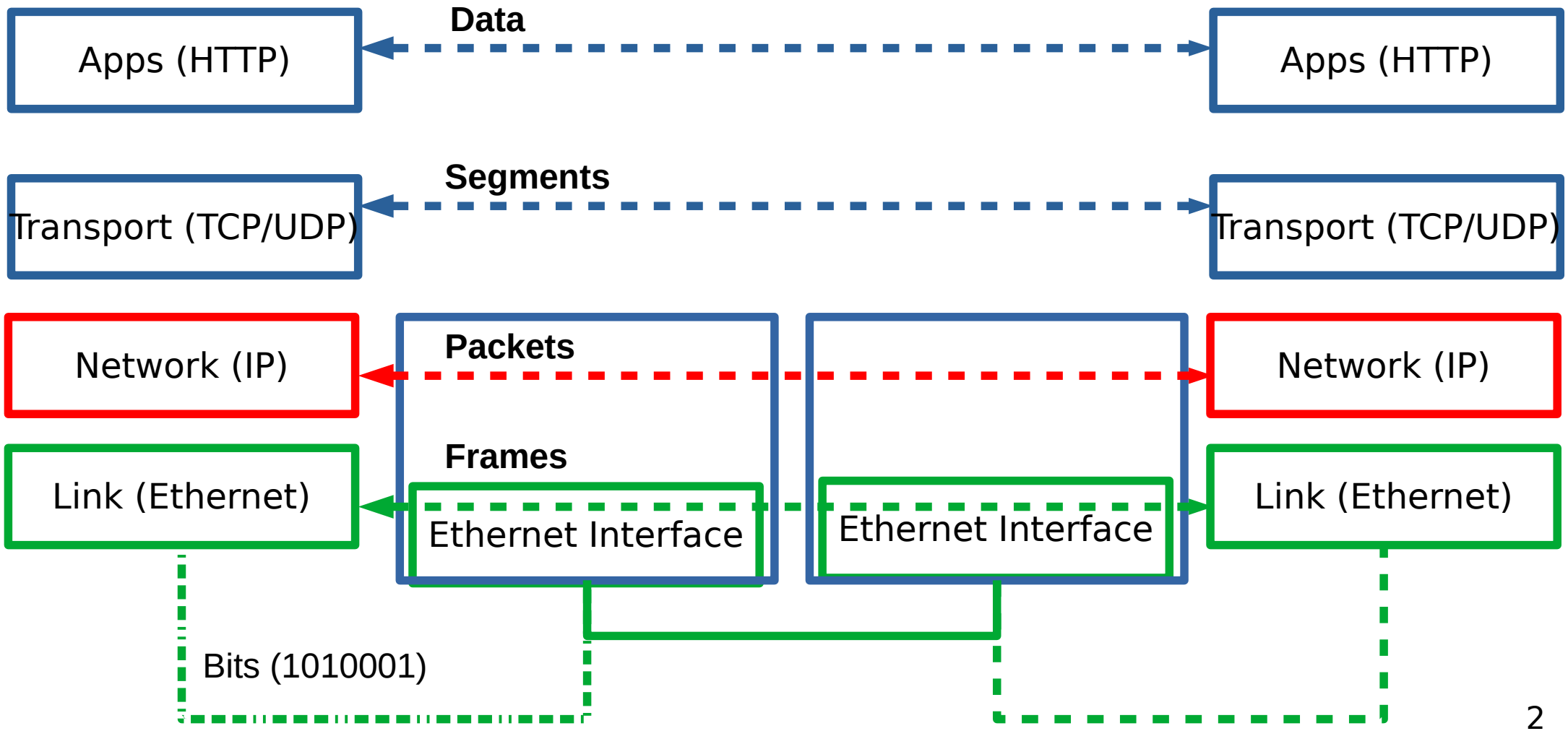
Tennessee TECH


Apps (HTTP)
Data
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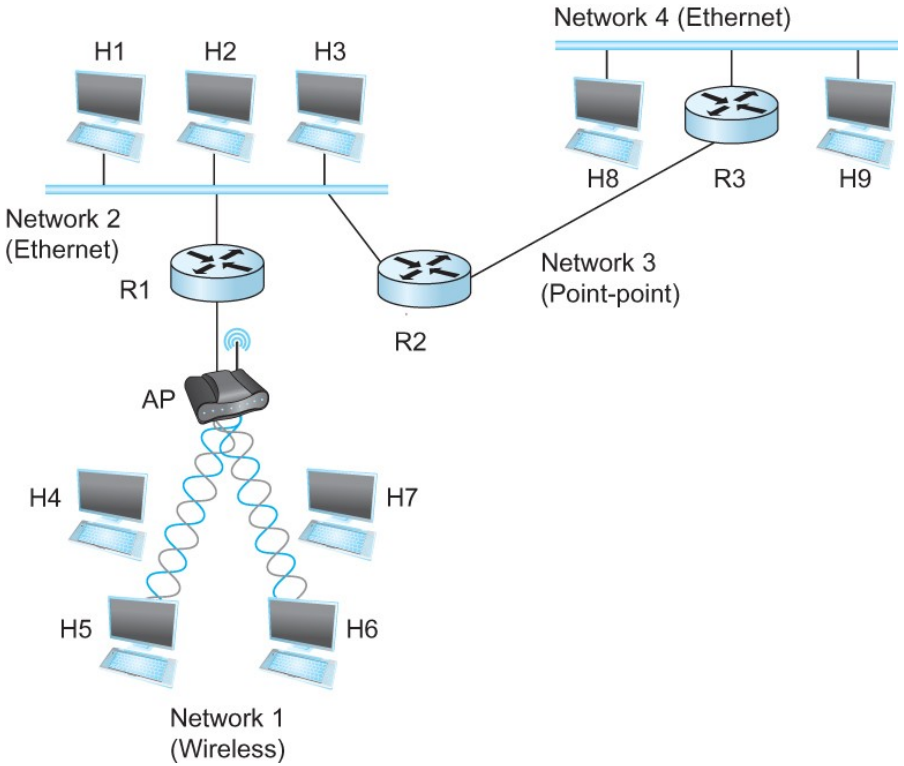
Transport (TCP/UDP)
Segments
Transport (TCP/UDP)
Network (IP)
Packets
Network (IP)
Link (Ethernet)
Frames
Ethernet Interface
Ethernet Interface
Link (Ethernet)
Bits (1010001)

# So far...

- We now know how to address hosts and networks!
- Subnetting for scale

# Internetworking Protocol (IP)

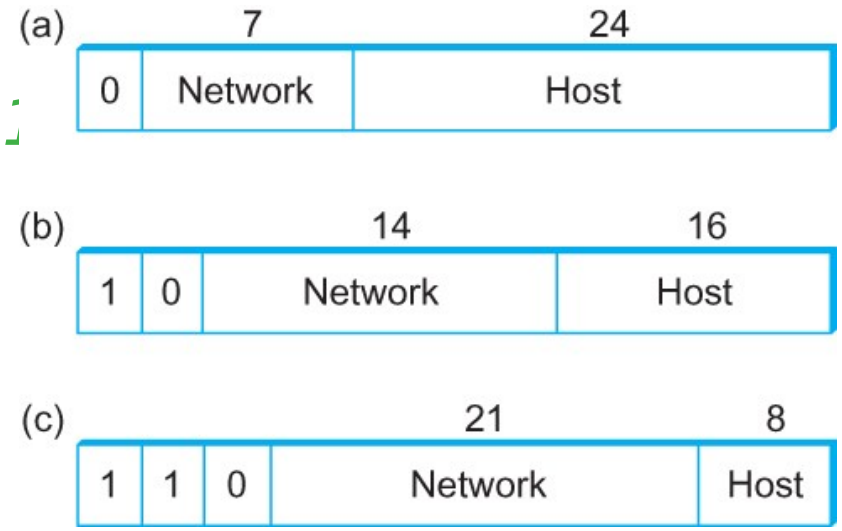
- What is an internetwork?
  - An arbitrary collection of networks
  - provide some sort of host-host to packet delivery service



# Global Address in IP – Each node has an unique address

- A 32 bit number in quad-dot notation
- Identifies an ***Interface***
  - ***A host might have several interfaces!!!***
- *129.82.138.254*

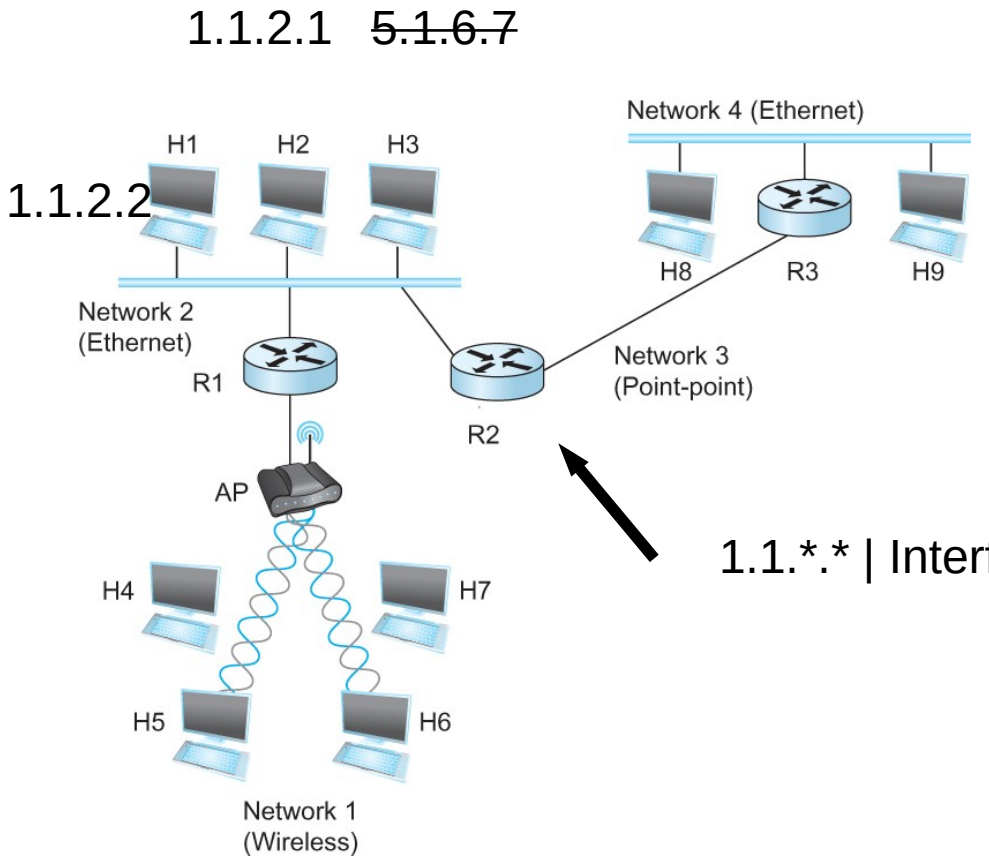
  *10000001.01010010.10001010.11*



# IP addresses are in Network + Host

- 1.1.2.1 →
  - 1.1 → Network part
  - 2.1 → host part
- Each octet can range from 1- 255

- Hierarchical address




**129.82.138**.254

10000001.01010010.10001010.11111110

Network part (24 bits). Host part(8 bits)

# Calculate the first and the last IP address of a subnet

**129.82.138.254/27**

First host - host bits 0

10000001.01010010.10001010.11111110

11111111.11111111.11111111.11100000 (LOGICAL AND)

---

10000001.01010010.10001010.11100000 → 129.82.138.224

Last host – host bits 1

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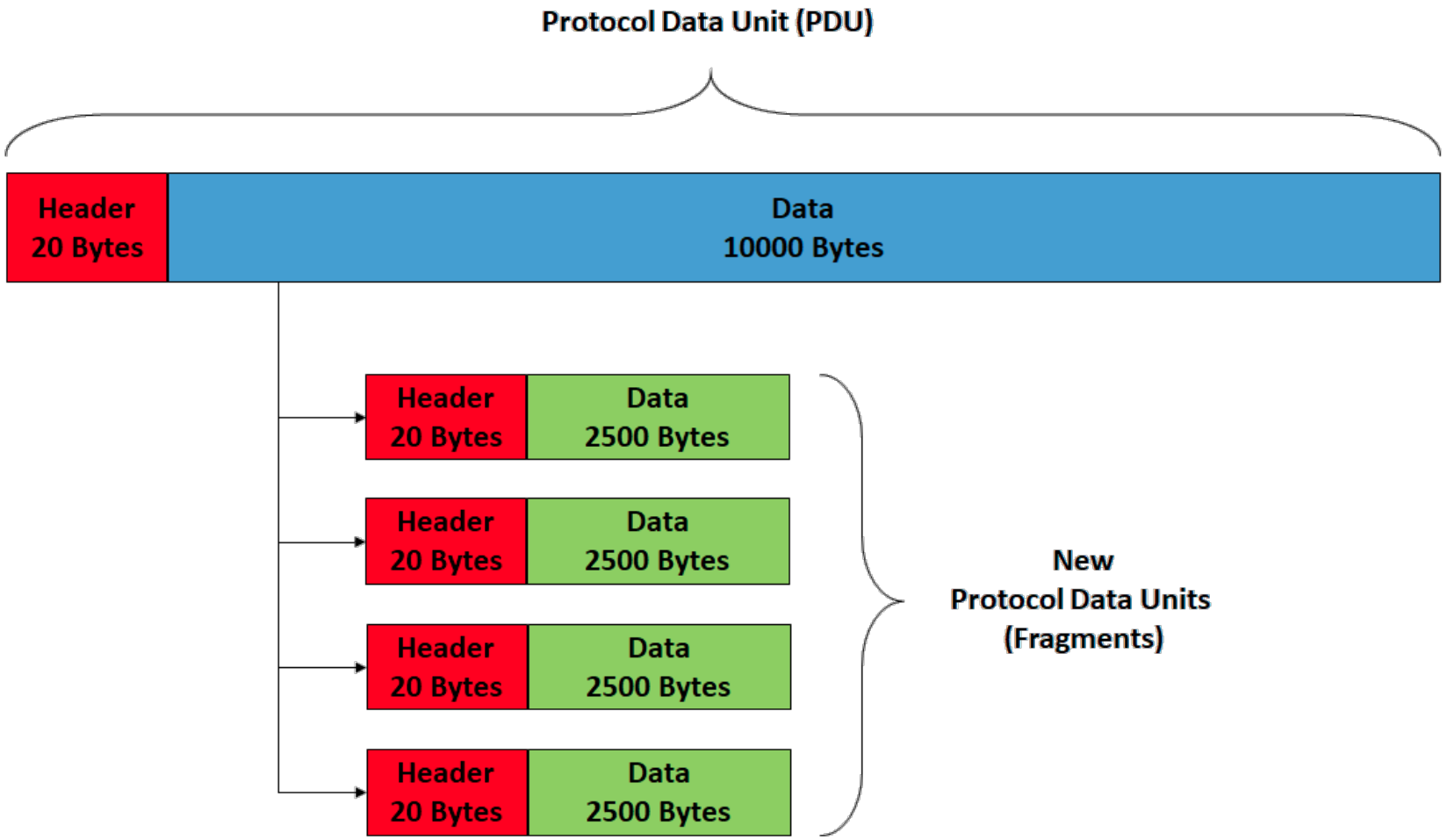
Perform logical AND to get the network part = 129.82.138.224

Available addresses – 129.82.138.225-129.82.138.254

Broadcast address – 129.82.138.255

# IP Fragmentation and Reassembly




wikipedia

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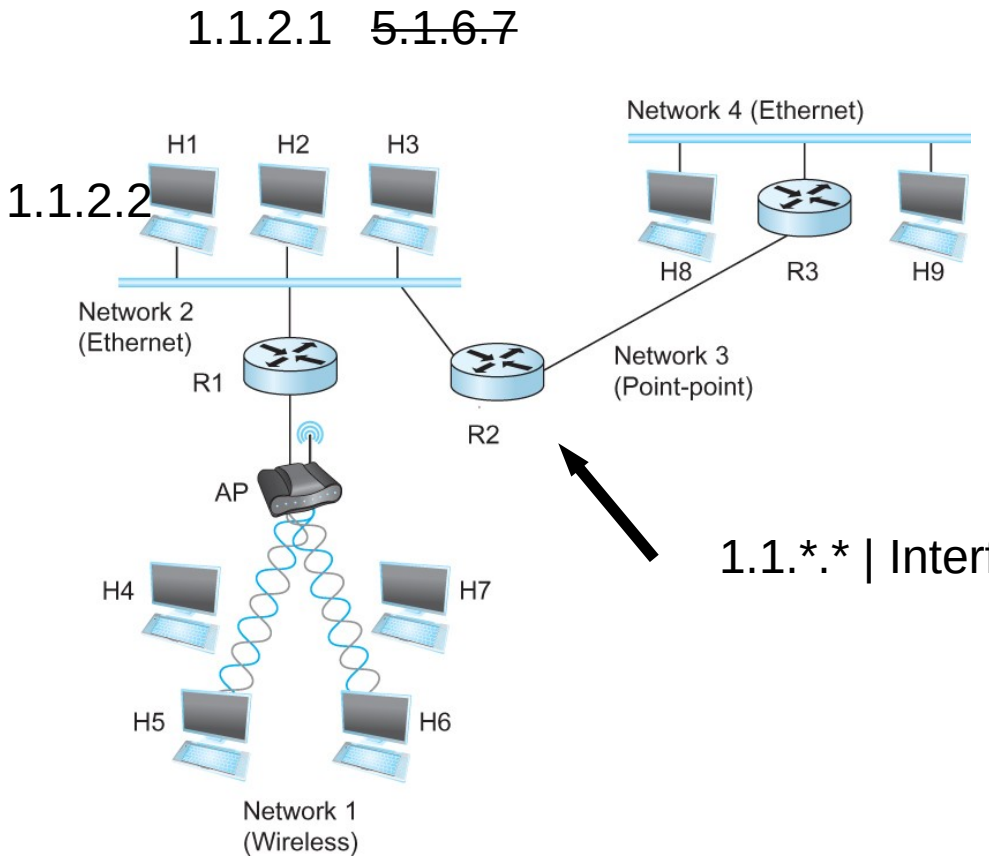


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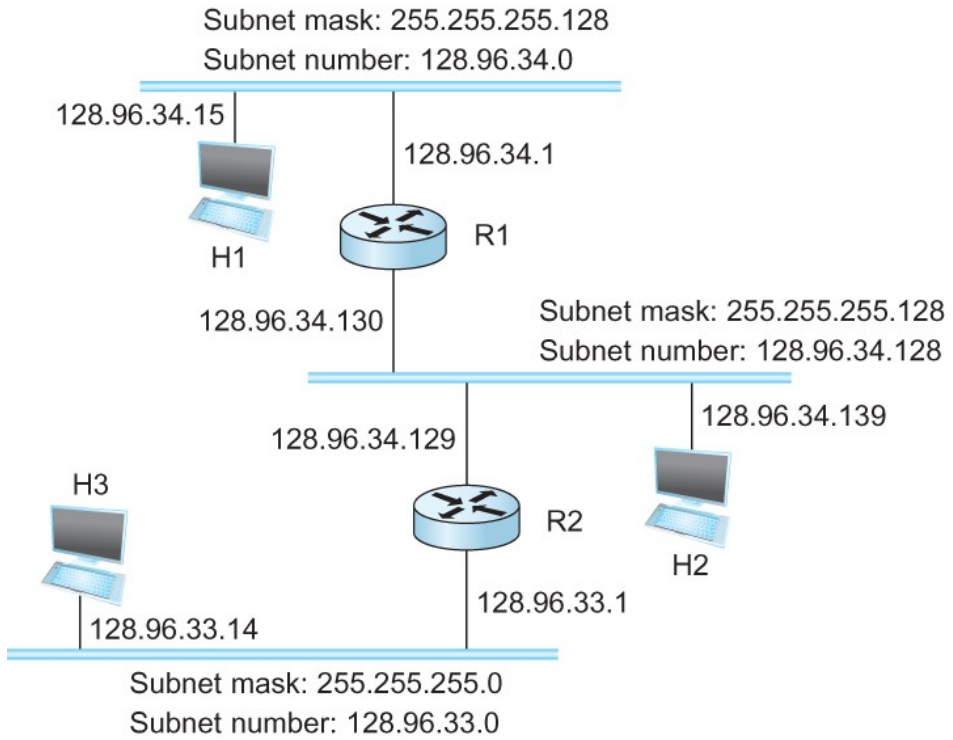
# Subnetting



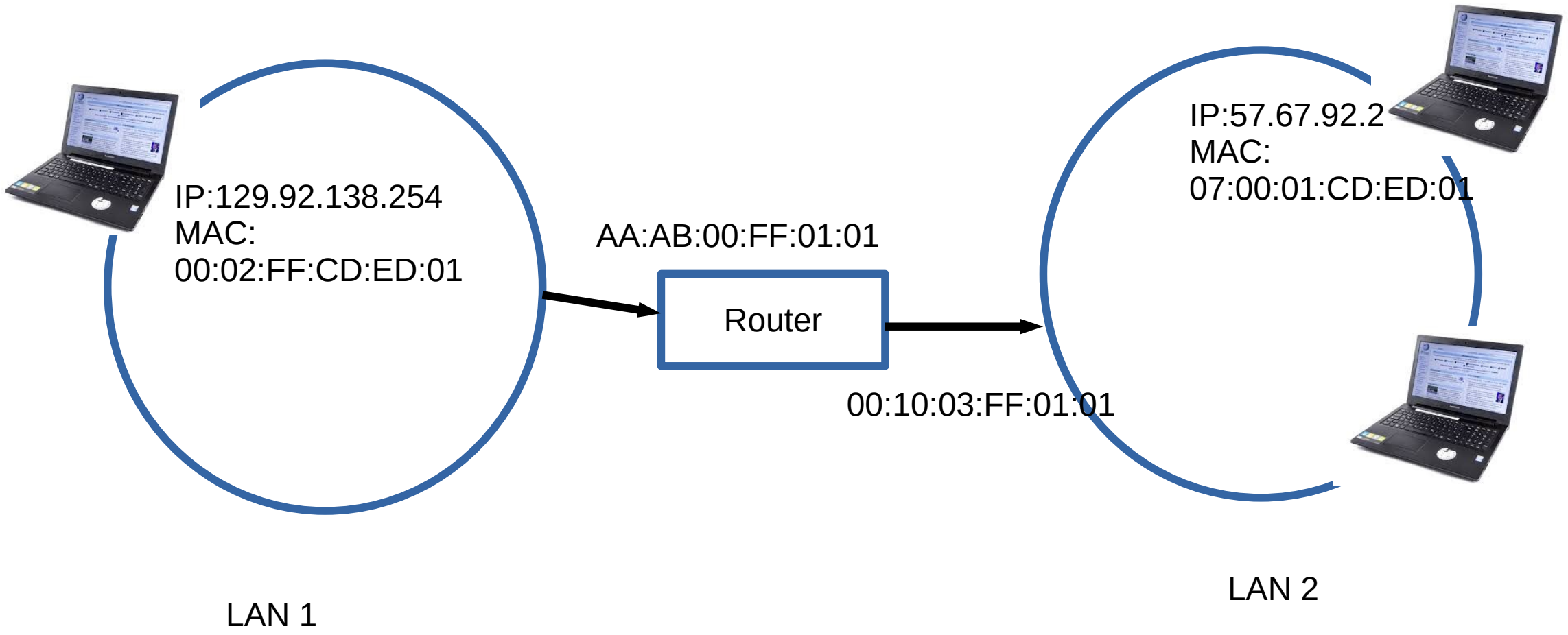

Forwarding Table at Router R1

| SubnetNumber | SubnetMask | NextHop |
|---|---|---|
| 128.96.34.0 | 255.255.255.128 | Interface 0 |
| 128.96.34.128 | 255.255.255.128 | Interface 1 |
| 128.96.33.0 | 255.255.255.0 | R2 |

# Now let’s map that to MAC address

- Adaptors only understand MAC addresses
- Source: 129.82.138.254, Destination: 129.82.138.5
- You machine does not know what that means:
  - Routers for getting you to the room
  - In the room, you still need to use the MAC address
- Put IP packet in a frame → **Encapsulation**

# IP ↔ MAC mapping: Address Resolution Protocol (ARP)



# IP ↔ MAC mapping: Address Resolution Protocol (ARP)

- Important concept → Broadcast
  - Shout in the room → Who here is Rachel?

# ARP table

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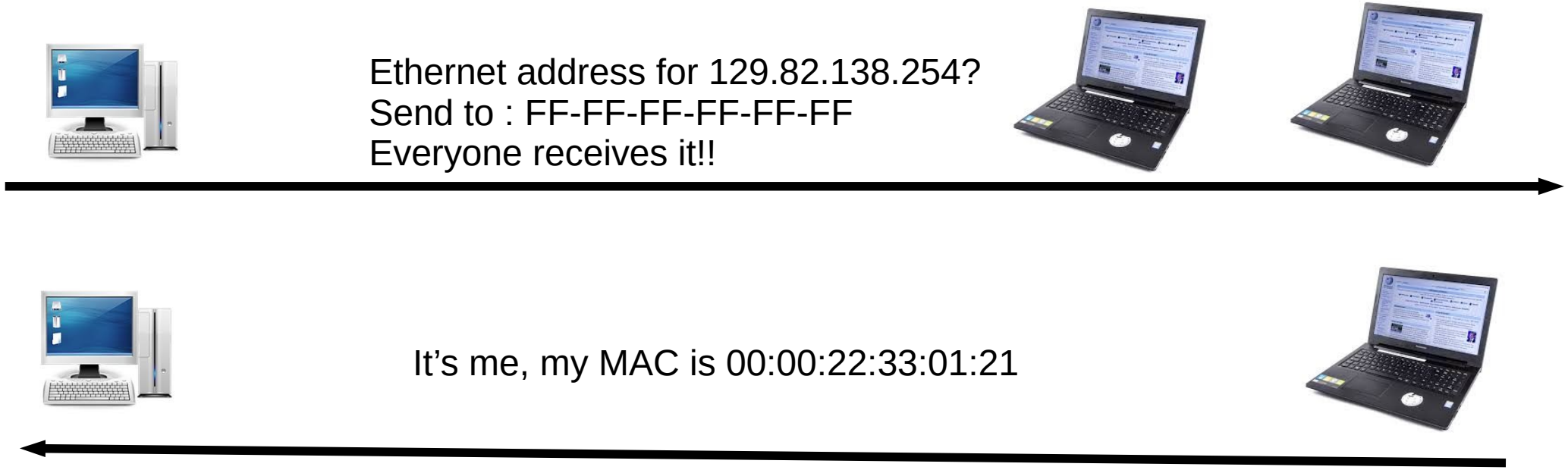
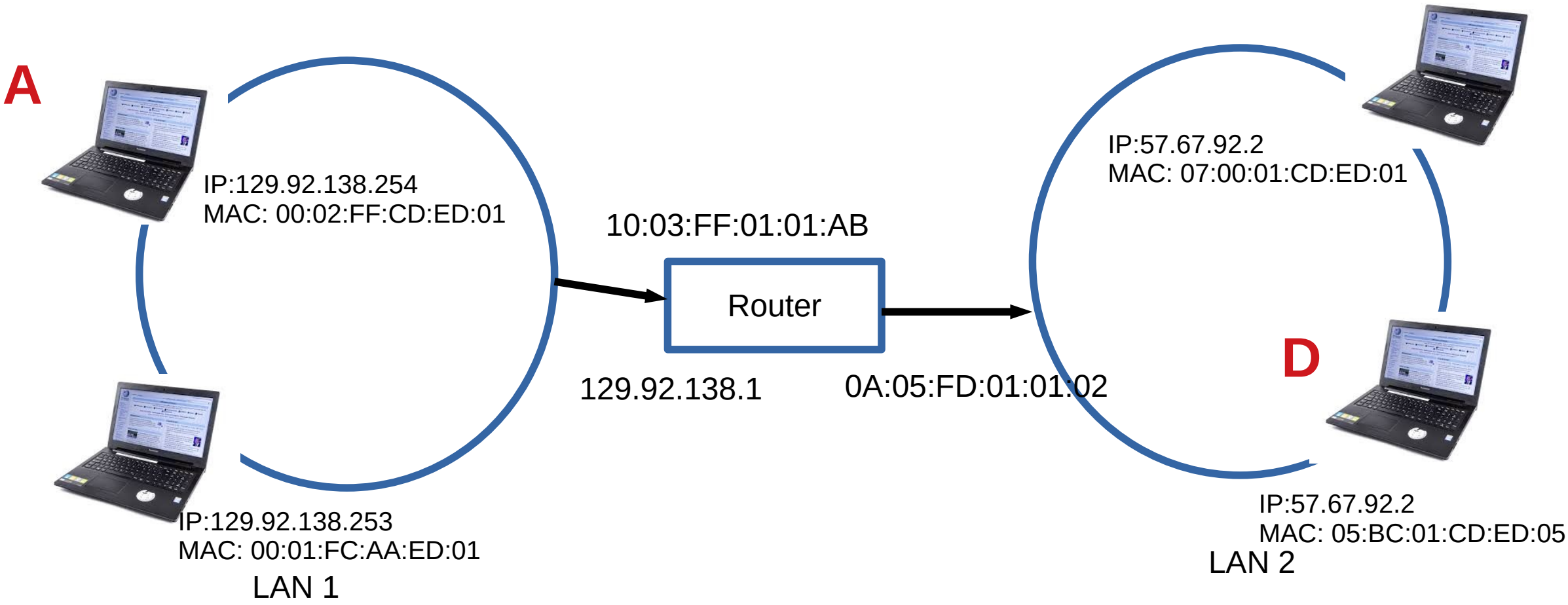
  - Shout in the room → Who here is Rachel?



# IP ↔ MAC mapping: Address Resolution Protocol (ARP)

- Every node maintains an ARP table
  - <MAC, IP> mapping
- Consult this table when sending IP packets
- Encapsulate with the MAC address, send it the address
- If address is not known, broadcast!
- Cache the response for some time, and eventually forget
  - **Why not broadcast the IP packet?**

# How does A talk to D?



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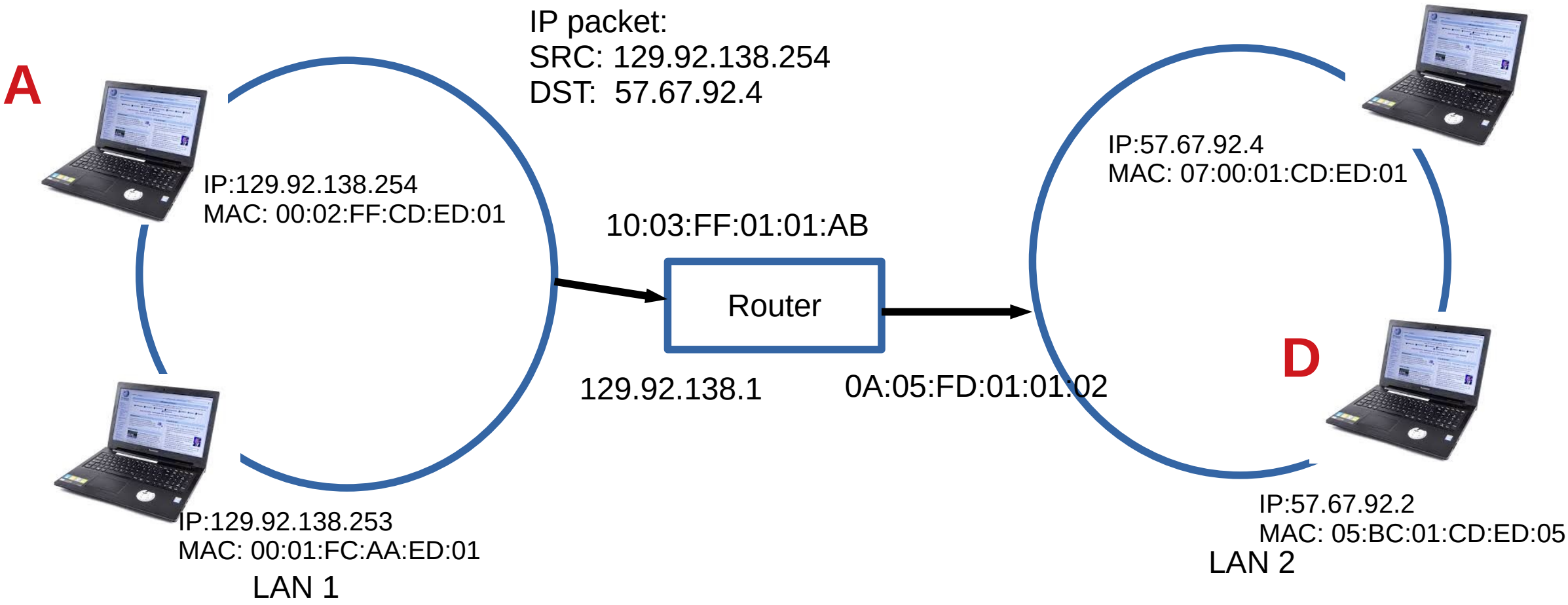

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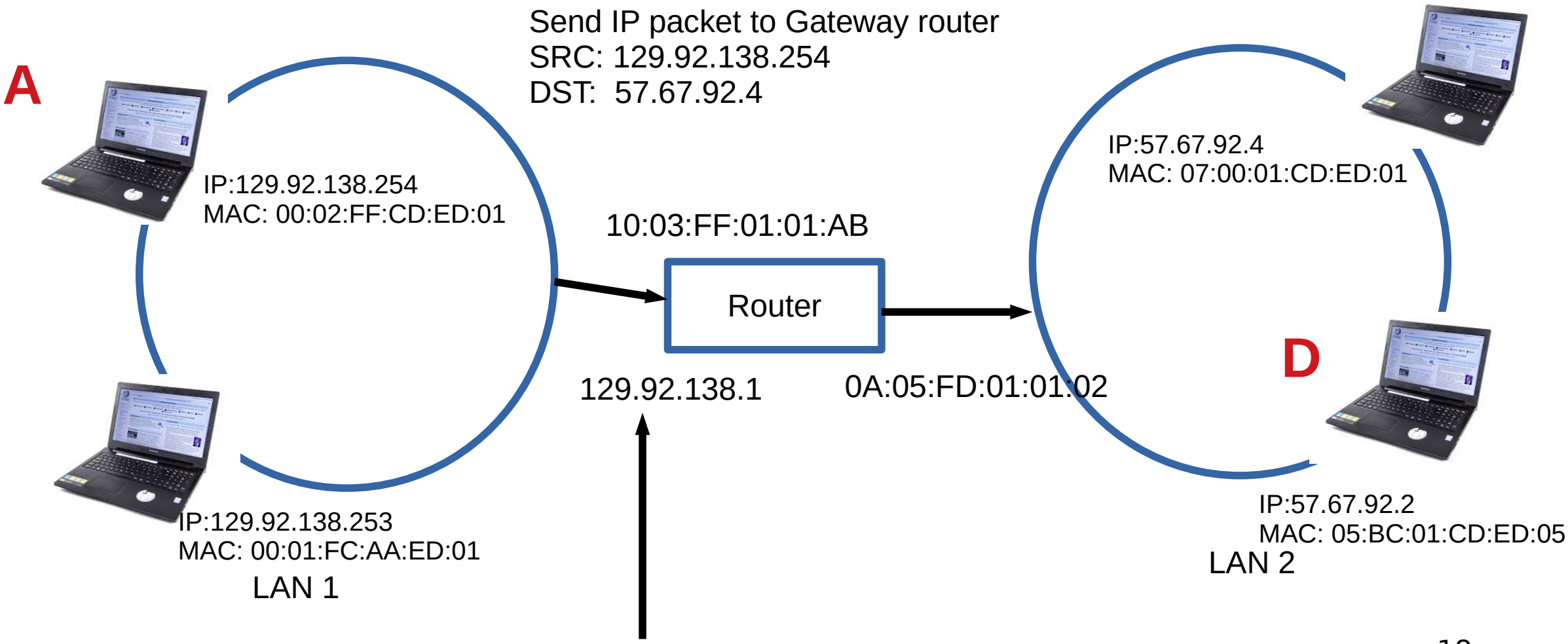

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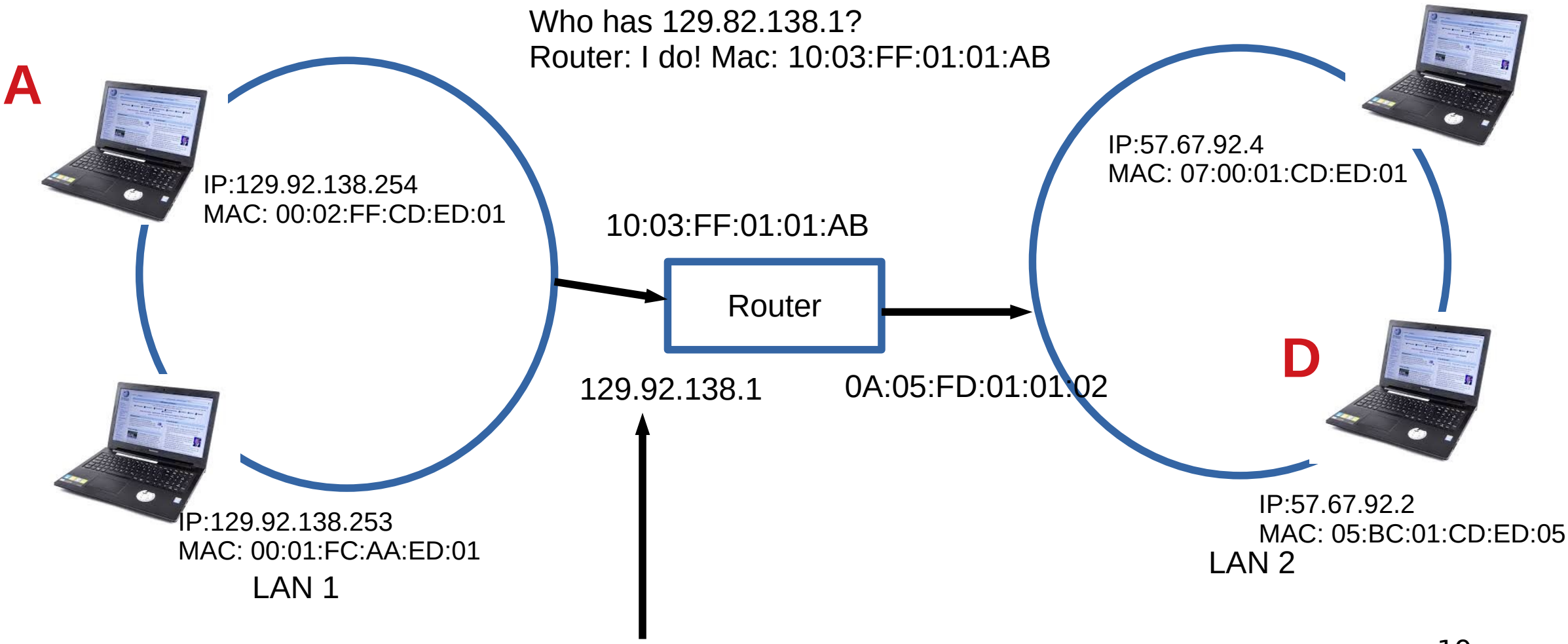

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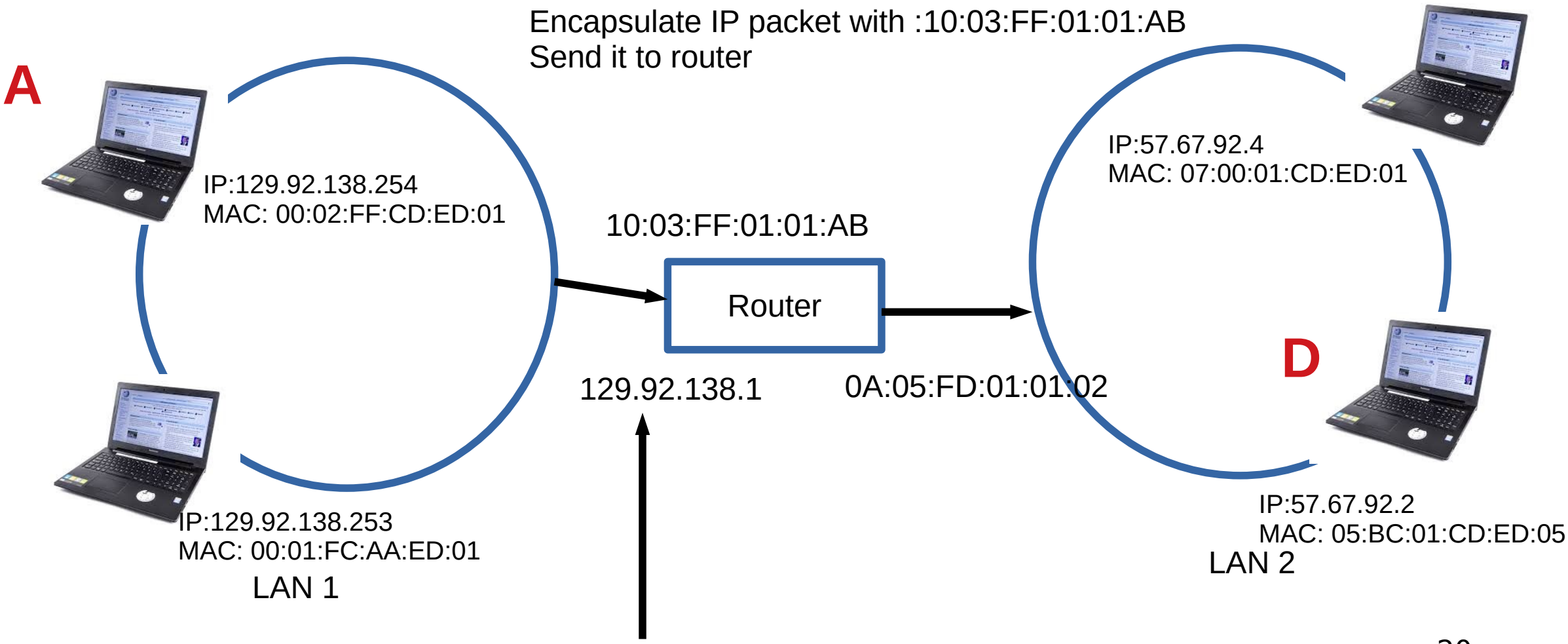

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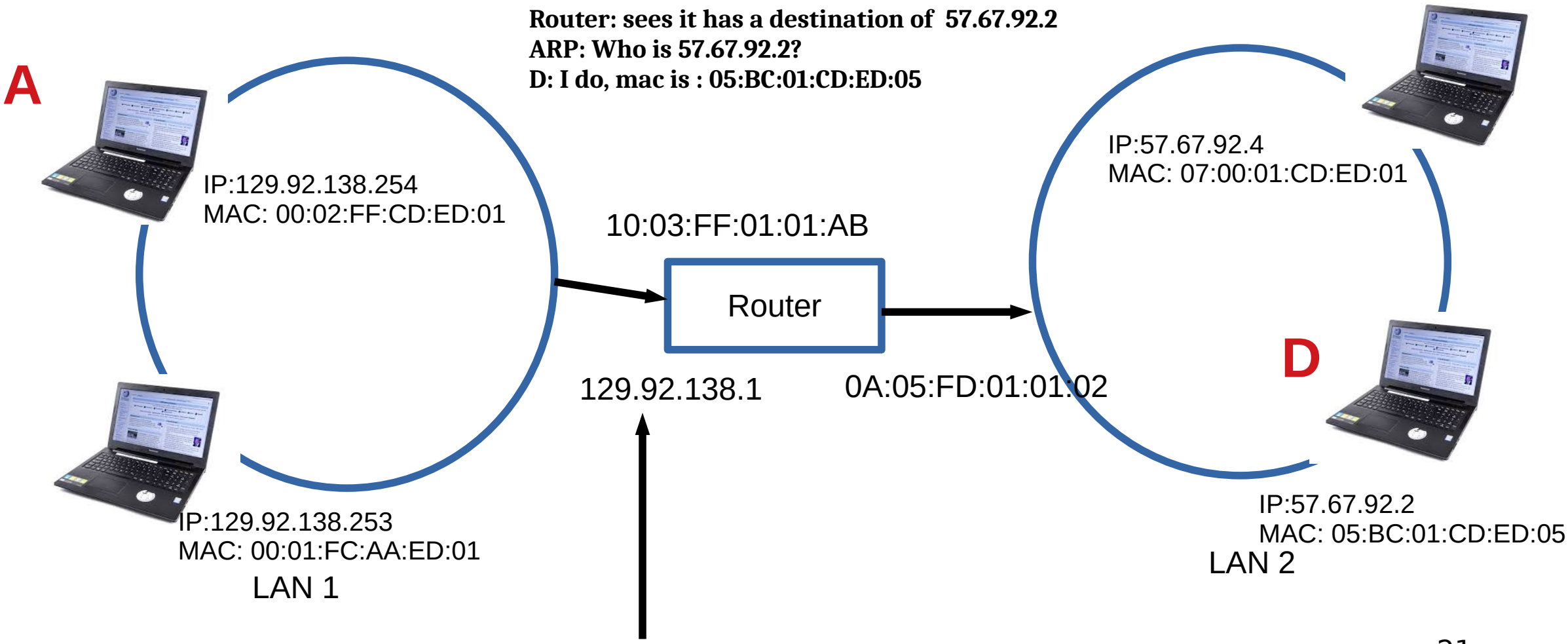

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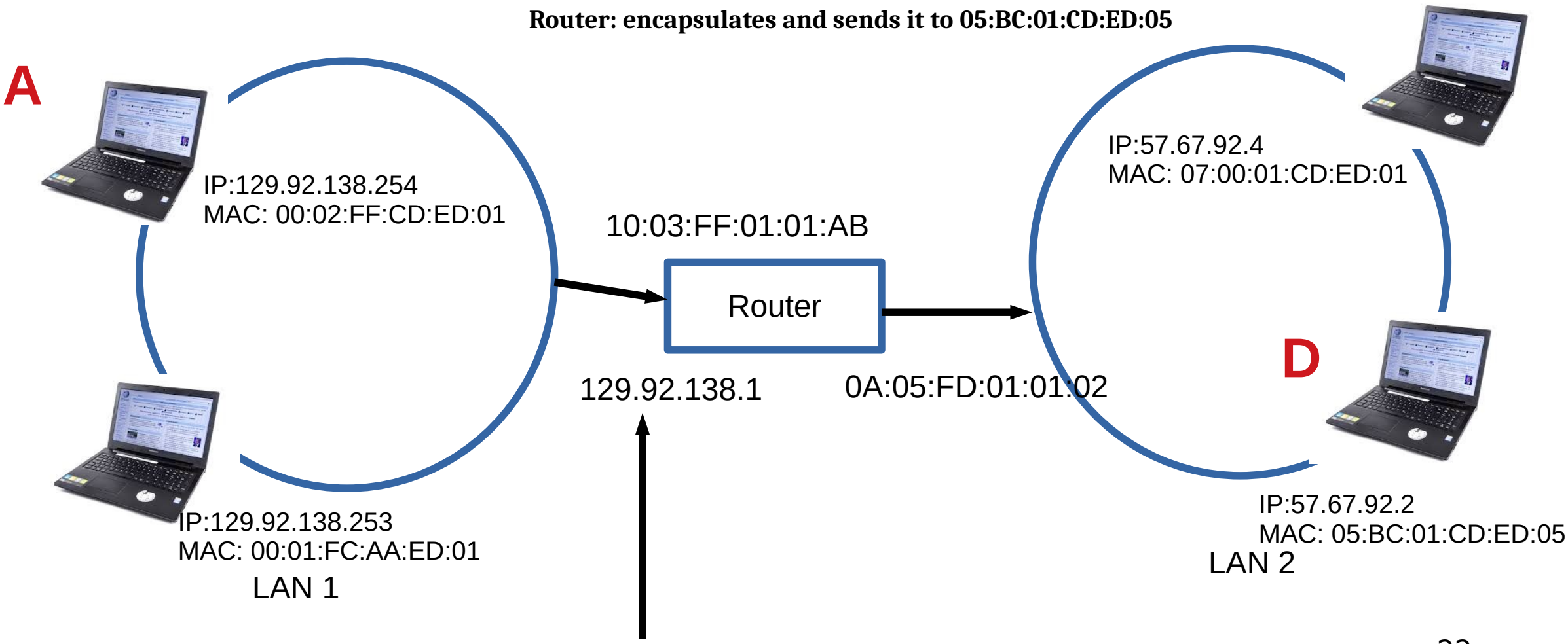
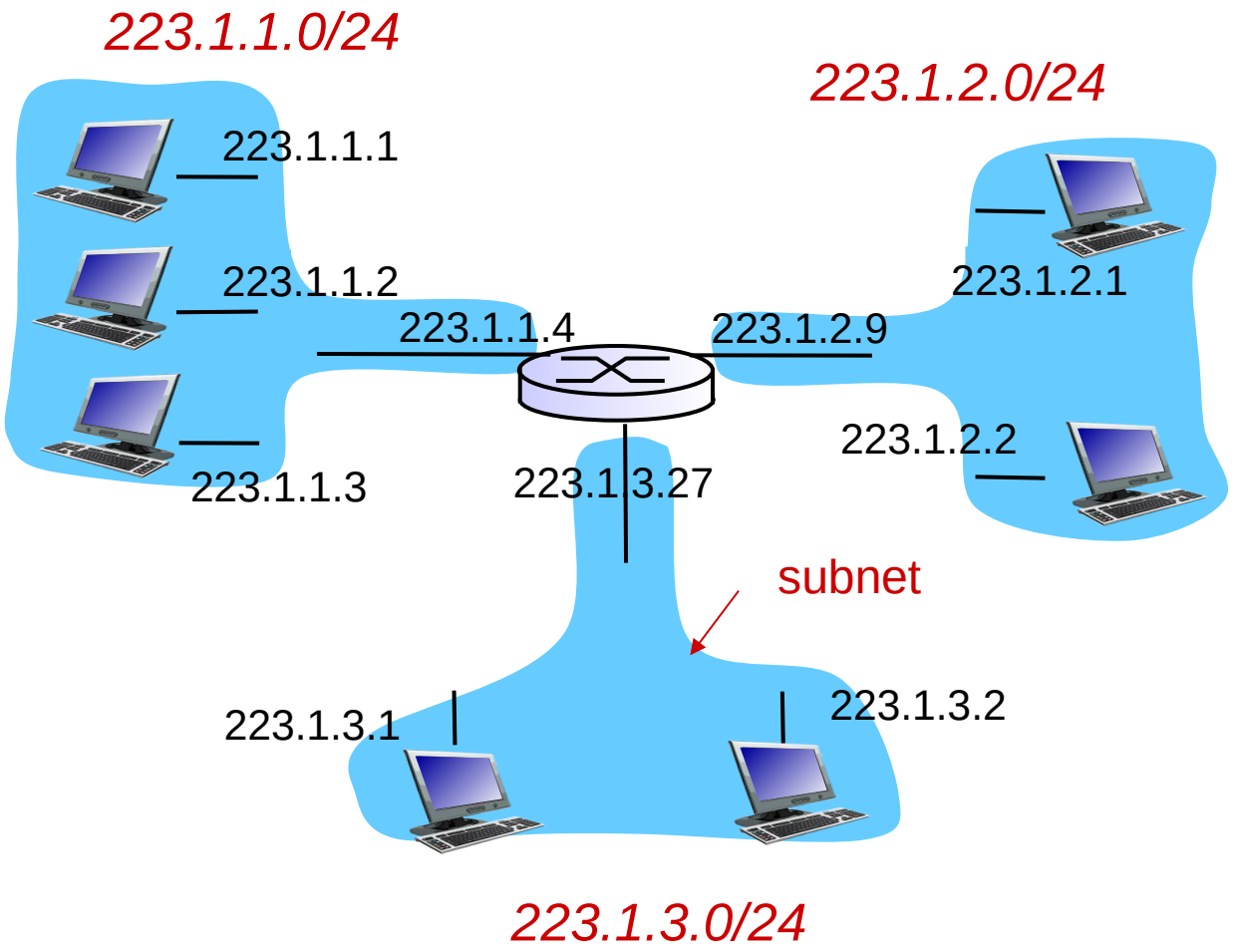


# Subnets Revisited

*recipe*

- to determine the subnets, detach each interface from its host or router, creating islands of isolated networks
- each isolated network is called a *subnet*




subnet mask: /24

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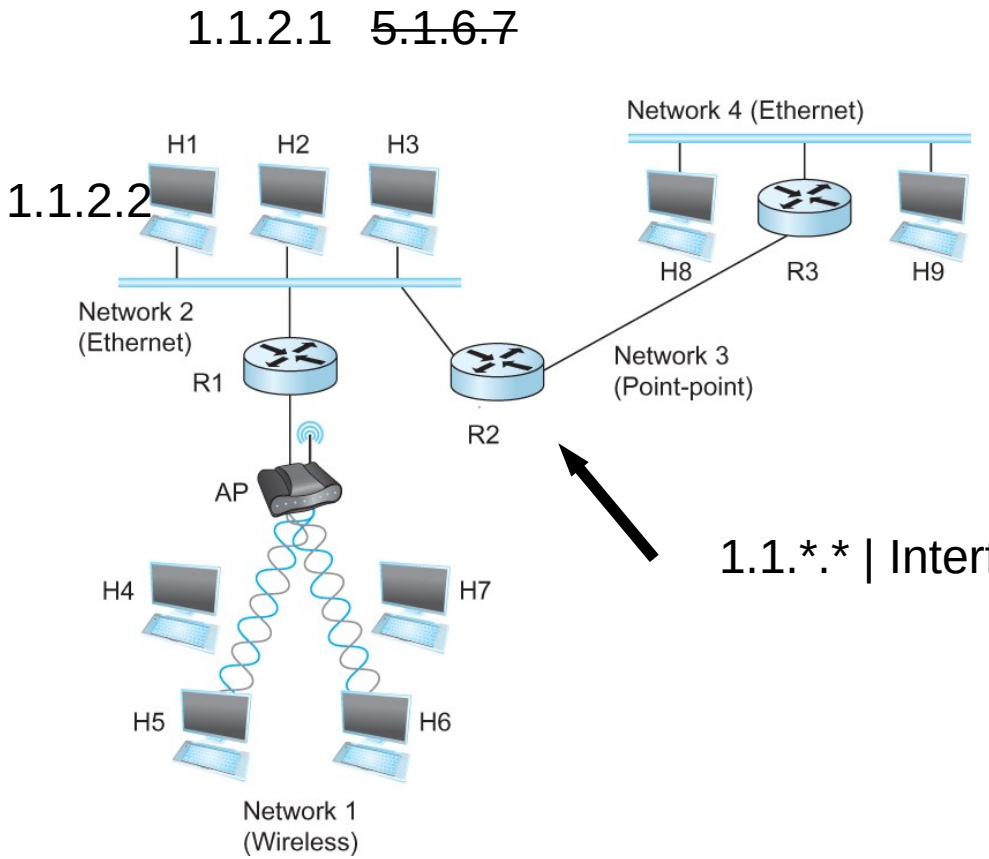


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Perform logical AND to get the network part = 129.82.138.224

Available addresses – 129.82.138.225-129.82.138.254

Broadcast address – 129.82.138.255

# Problem

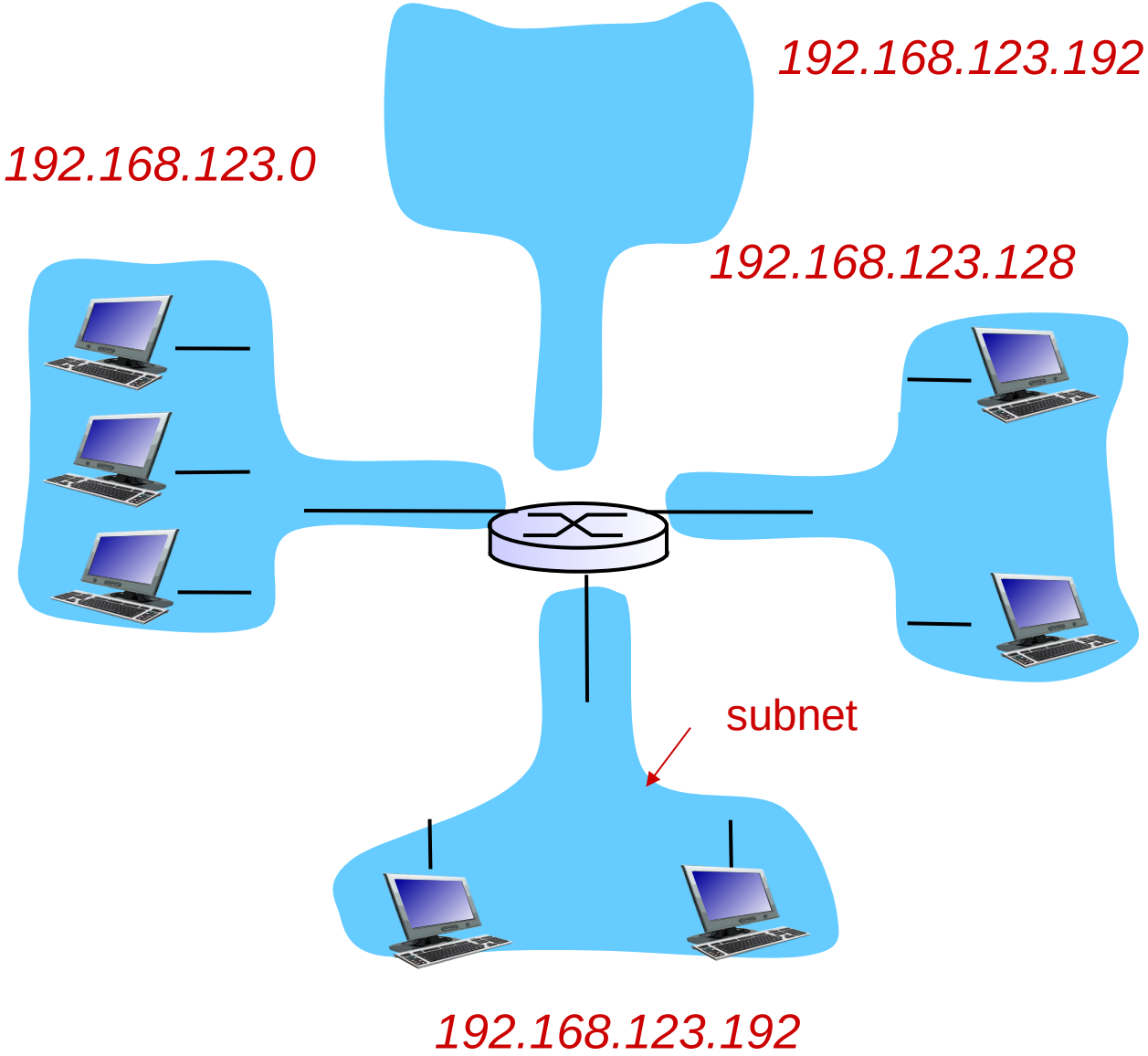
You have an address block:
192.168.123.0/24

- CSC needs 50 addresses
- Library needs 50
- Math needs 50
- ME needs 50

*They can not overlap!*
*Borrow some bits from the host part.*

*24 bits - 111111.11111111.111111.00000000*
*2 bits for network –*
*111111.11111111.111111.11000000*

- *How many networks?*
- *How many hosts in each of these networks?*

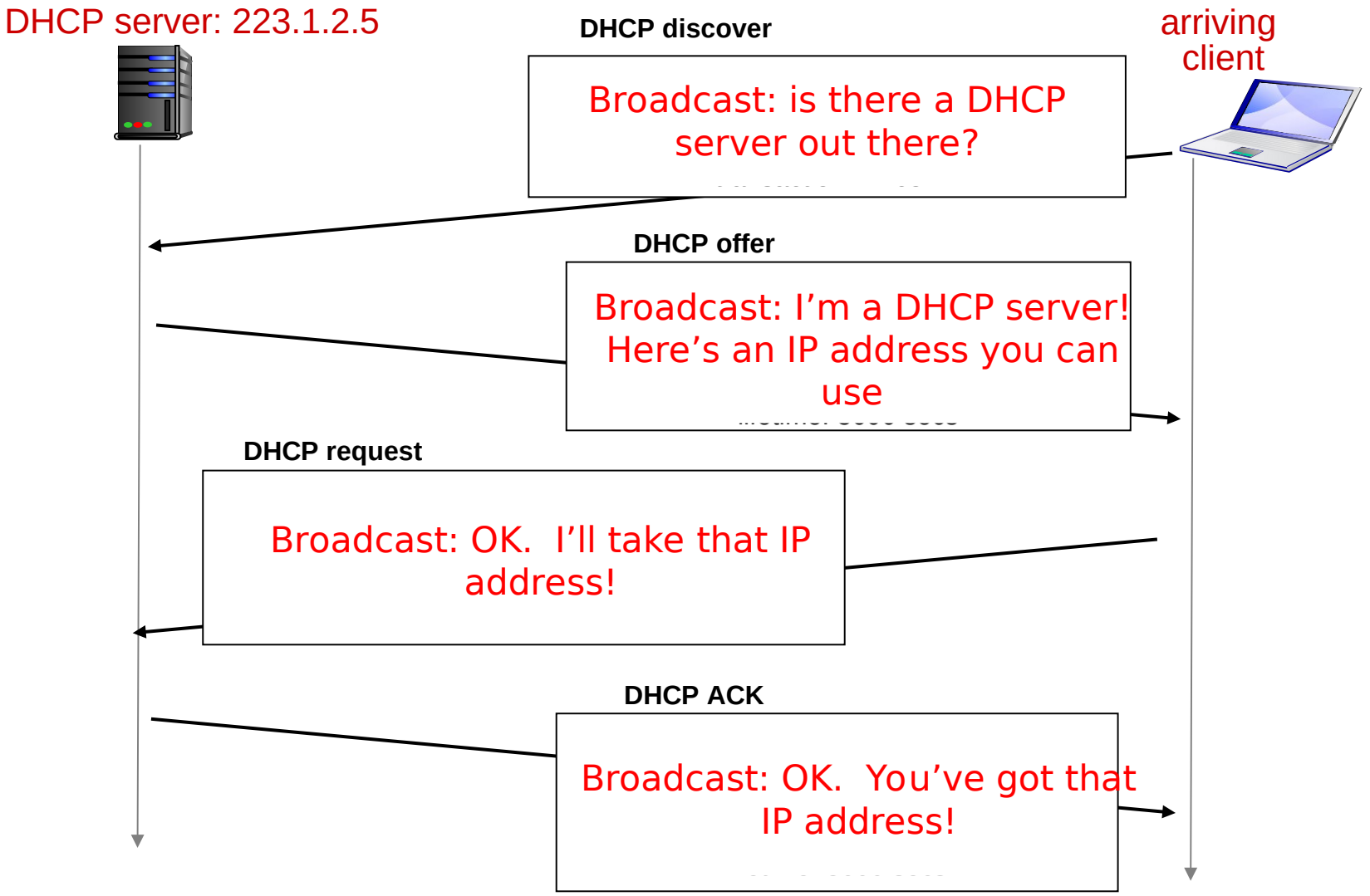



subnet mask: /26

# DHCP

- **New laptop joins a network**
  - Does not have source address
  - Does not know who to ask
  - Does not know other network parameters like DNS or Gateway router information

# DHCP client-server scenario




kurose/ross

# DHCP Server

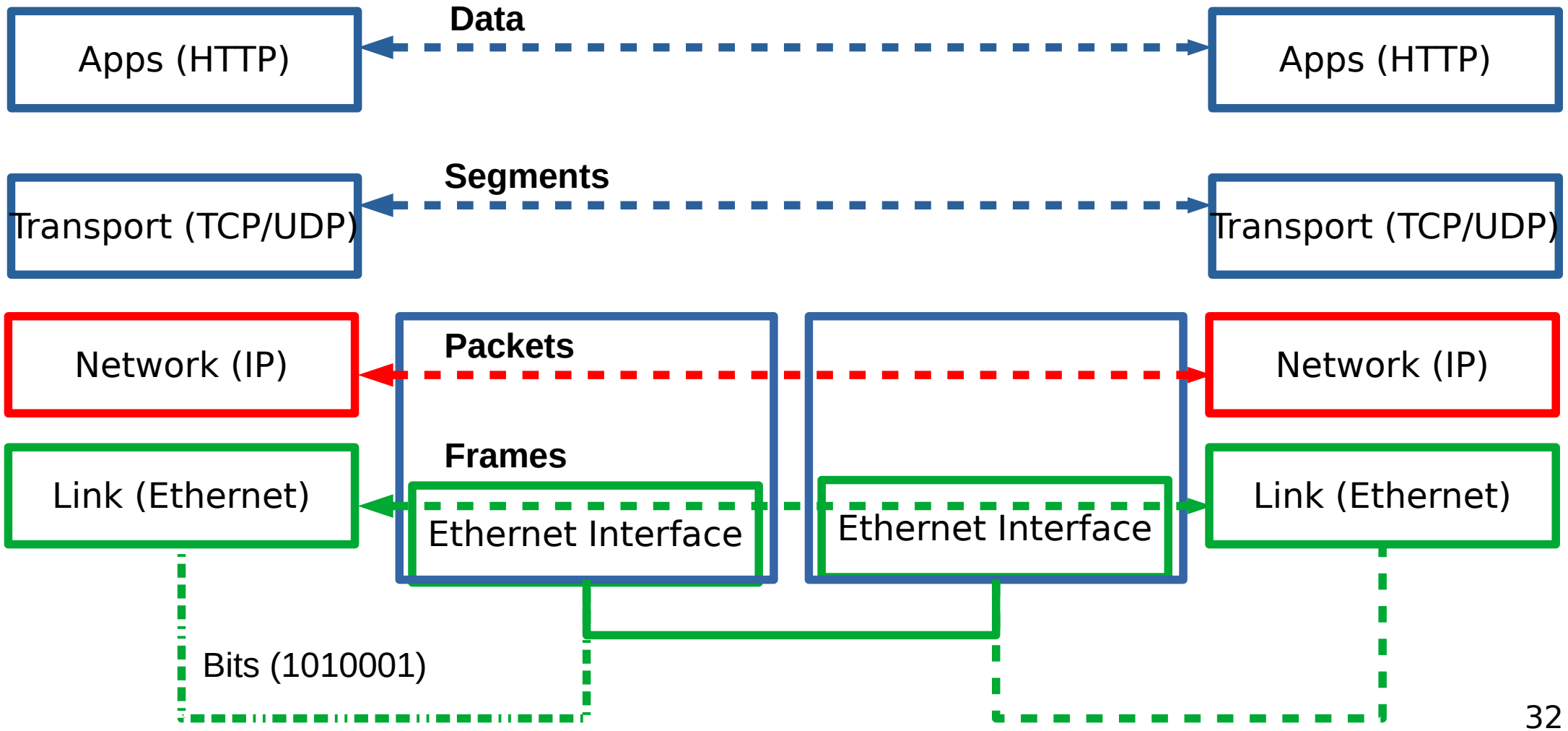
- A local central database with a list of IP addresses
  - 10.0.0.1/8
- Offers an available IP to a client for a period of time
  - Lease time – 24 hours, 1 hour, configurable ← ***Soft State***
- Multiple servers might coexist and offer IP to the same request
  - Broadcast medium
  - Client decides which one to accept

# DHCP Client – Keep refreshing!

- IP address provided expires after time ***t***
- Client can release DHCP lease
  - Shutdown the laptop
- If you walk away from the building
  - Crash
- Performance trade off
  - Short time – too many broadcasts, quick recovery of addresses
  - Long time – less network traffic, longer recovery of addresses

# Reading Assignment

- ARP
  - https://book.systemsapproach.org/internetworking/basic-ip.html#address-translation-arp
  - About 10 minutes
- DHCP
  - https://book.systemsapproach.org/internetworking/basic-ip.html#host-configuration-dhcp
  - About 10 minutes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Ethernet Interface
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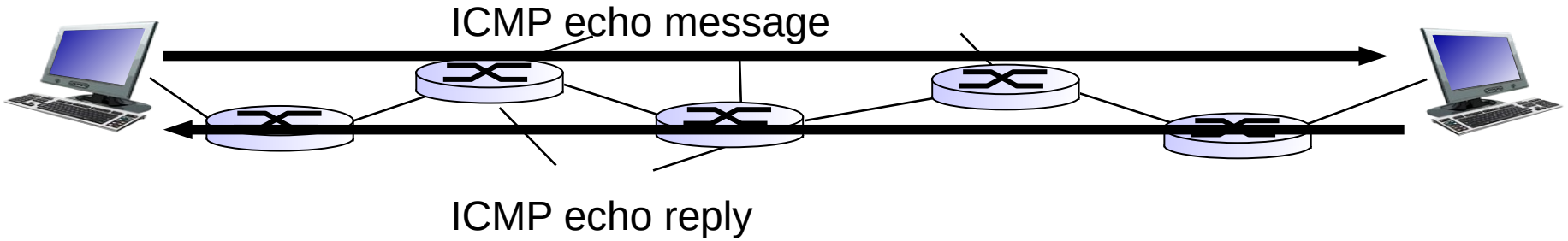
Bits (1010001)

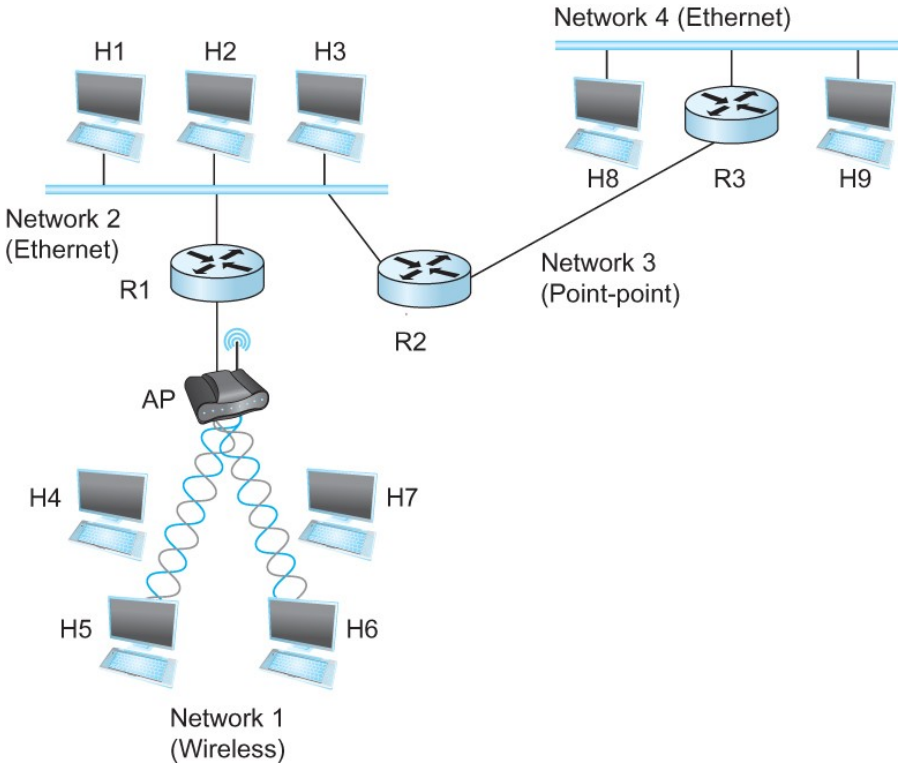
# Ping and ICMP

- source sends an ICMP echo message
- Destination sends an ICMP echo reply

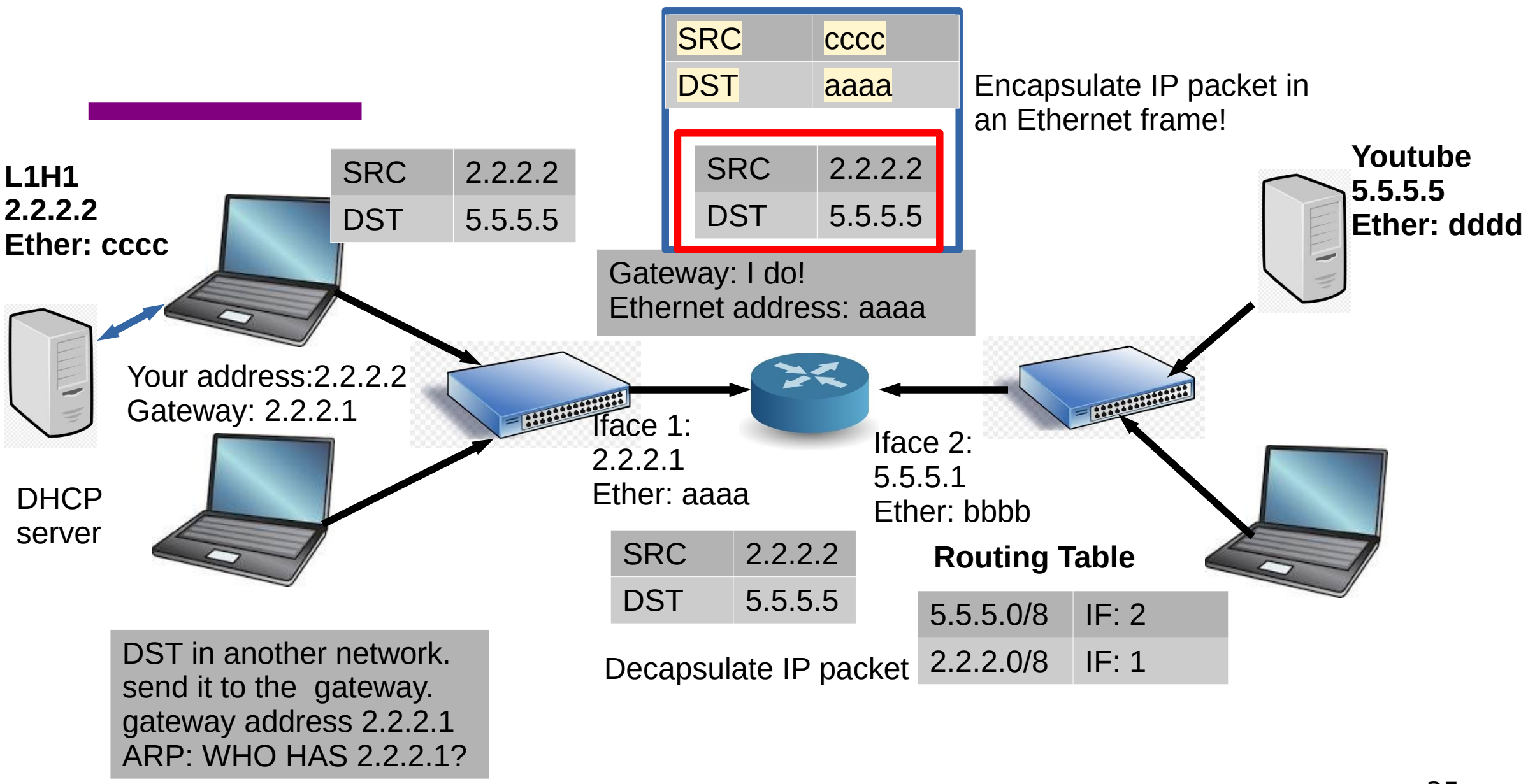


# Tying it all together in the network layer

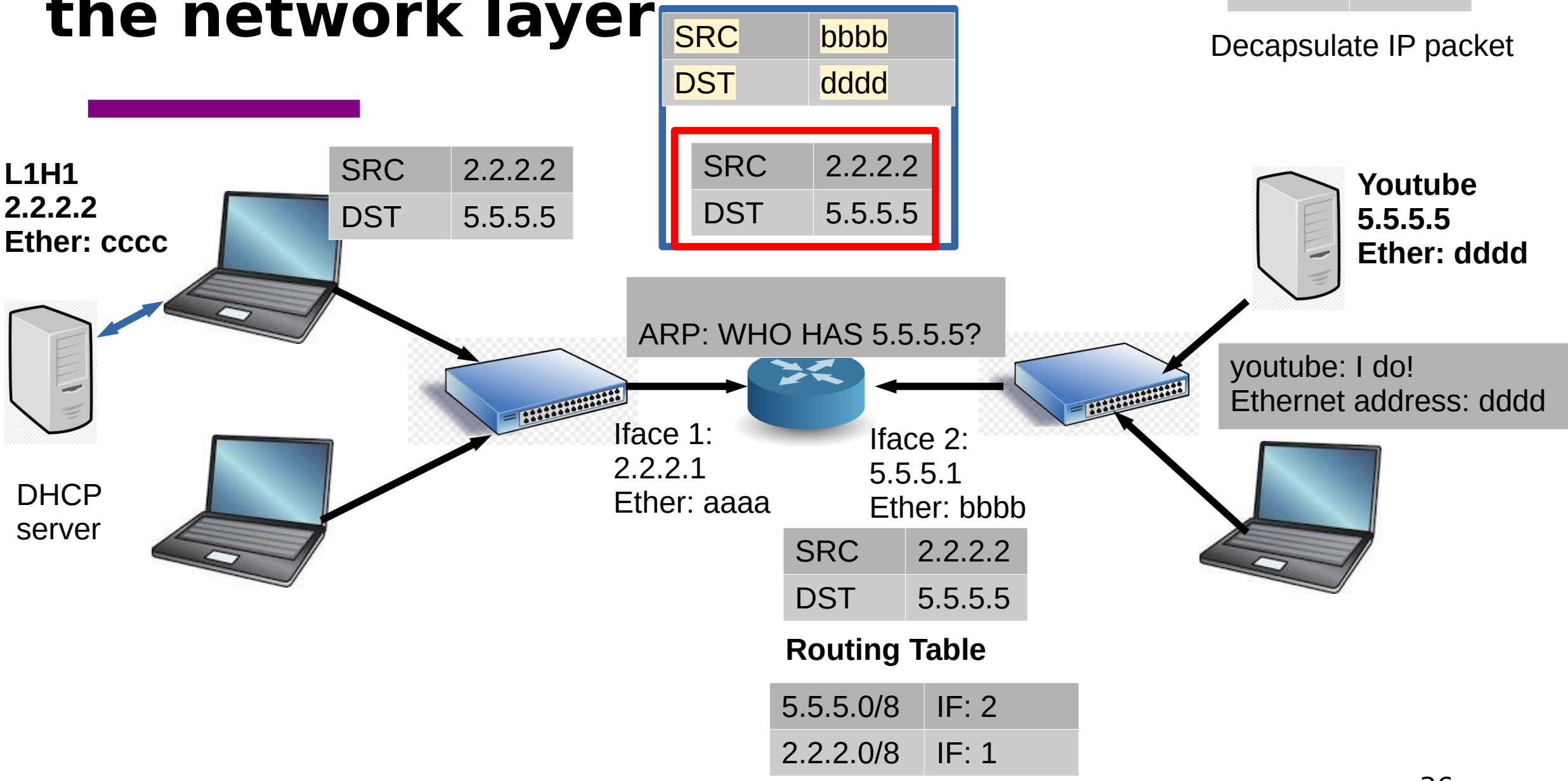
## Internetworking Protocol (IP)



# layer


SRC cccc
DST aaaa
SRC 2.2.2.2
DST 5.5.5.5
Encapsulate IP packet in an Ethernet frame!
L1H1
2.2.2.2
Ether: cccc
SRC 2.2.2.2
DST 5.5.5.5
Youtube
5.5.5.5
Ether: dddd
Gateway: I do!
Ethernet address: aaaa
Your address:2.2.2.2
Gateway: 2.2.2.1
Iface 1:
2.2.2.1
Ether: aaaa
Iface 2:
5.5.5.1
Ether: bbbb
DHCP server
SRC 2.2.2.2
DST 5.5.5.5
Routing Table
5.5.5.0/8 IF: 2
2.2.2.0/8 IF: 1
Decapsulate IP packet
DST in another network.
send it to the gateway.
gateway address 2.2.2.1
ARP: WHO HAS 2.2.2.1?

# Tying it all together in the network layer



# Next Steps

Wait - how are the routing tables populated?
Read through chapter 3.2.

Very useful video: https://www.youtube.com/watch?v=rYodcvhh7b8