CSC4200/5200 – COMPUTER NETWORKING

Instructor: Susmit Shannigrahi

ARP AND DHCP

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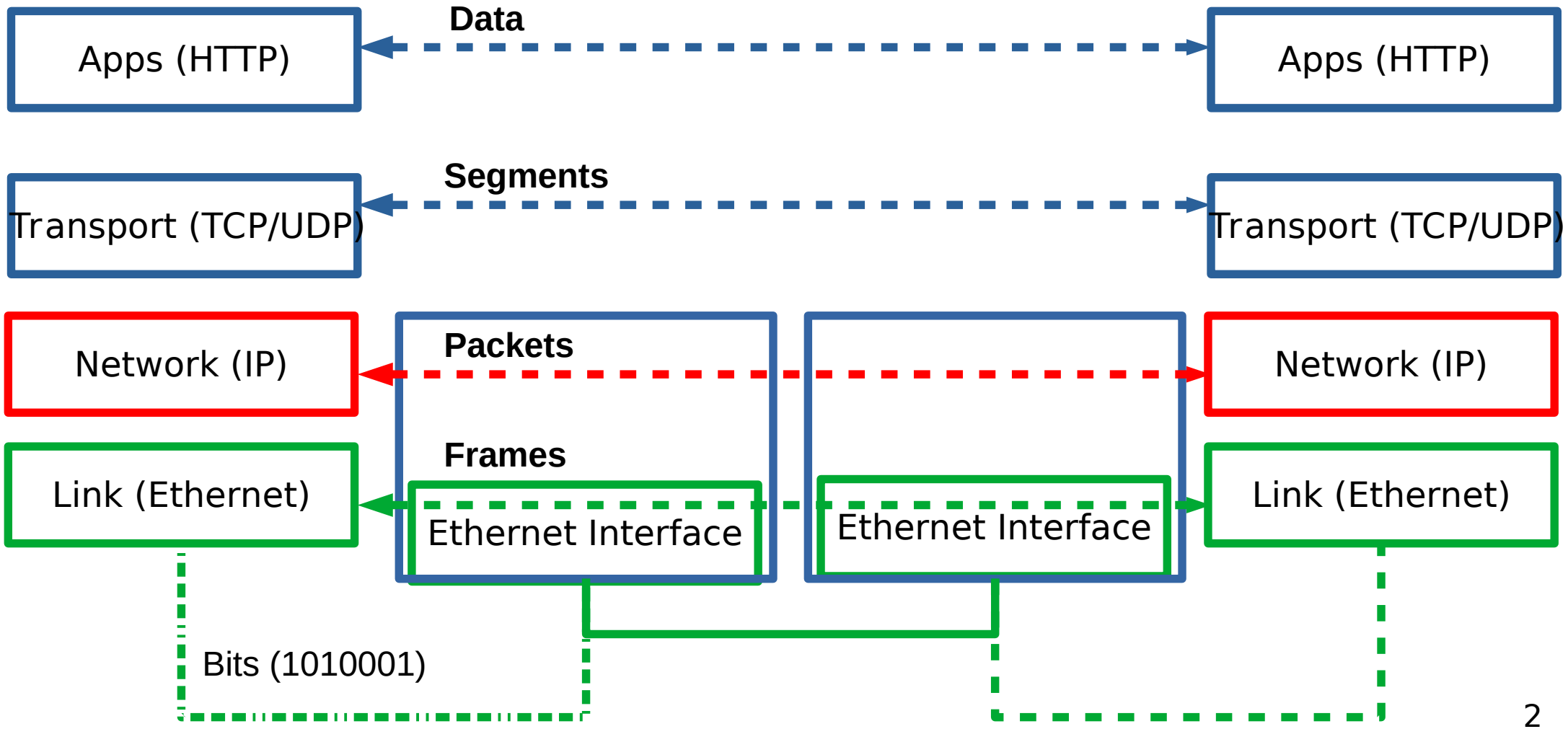
Tennessee TECH


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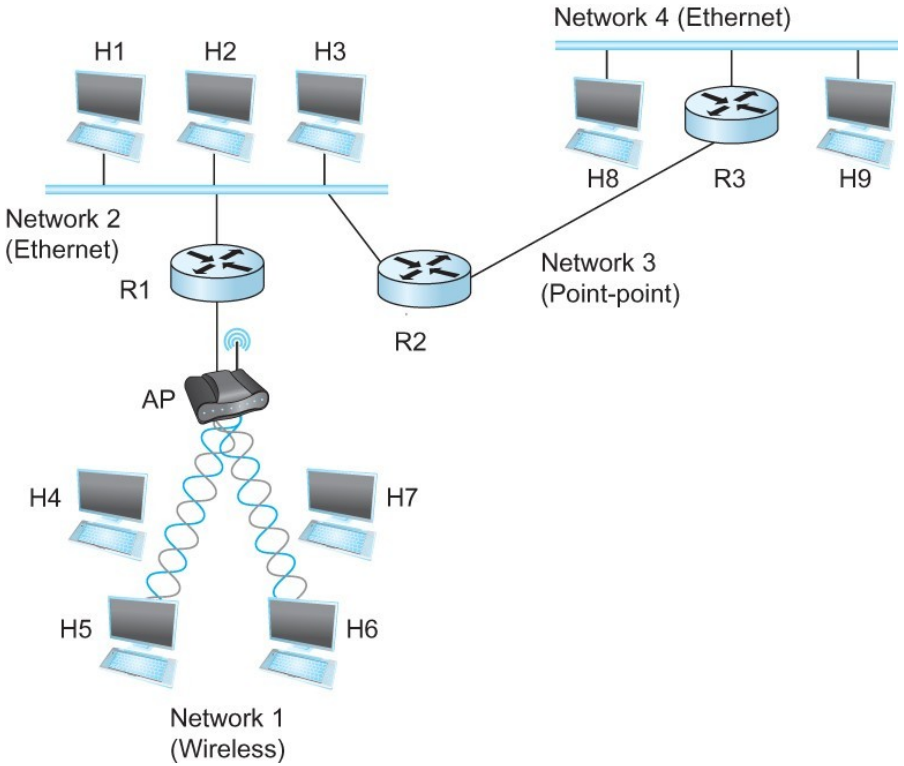
Transport (TCP/UDP)
Segments
Transport (TCP/UDP)
Network (IP)
Packets
Network (IP)
Link (Ethernet)
Frames
Ethernet Interface
Ethernet Interface
Link (Ethernet)
Bits (1010001)

So far...

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

Internetworking Protocol (IP)

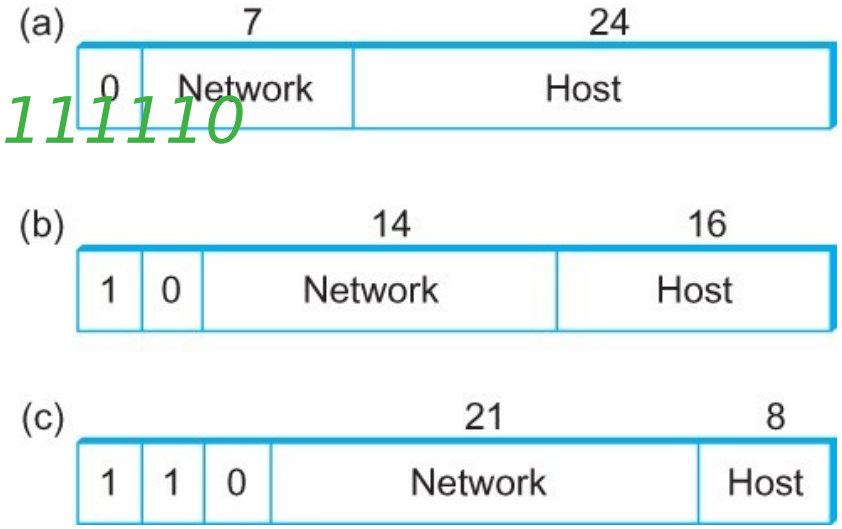
- What is an internetwork?
  - An arbitrary collection of networks
  - provide some sort of host-host to packet delivery service



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*

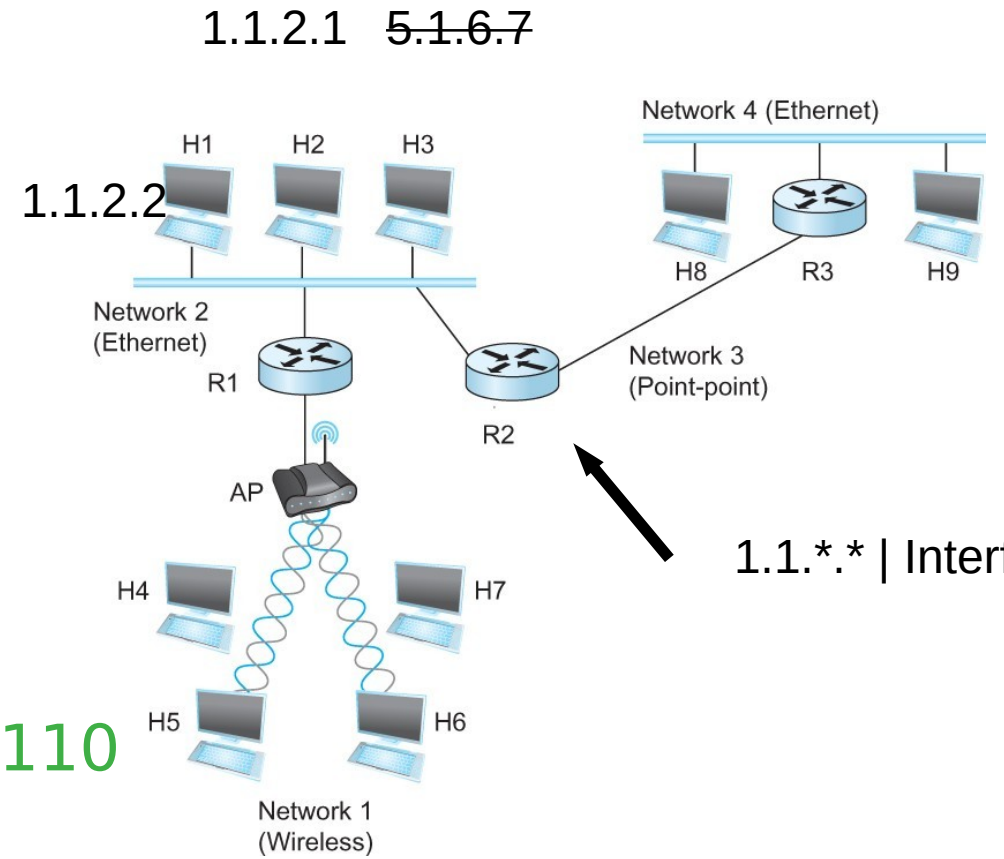
  10000001.01010010.10001010.11111110



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

11111111.11111111.11111111.111**00000** (LOGICAL AND)

10000001.01010010.10001010.11100000 → 129.82.138.224

Last host – host bits 1

10000001.01010010.10001010.11111110

11111111.11111111.11111111.111**11111** (LOGICAL AND)

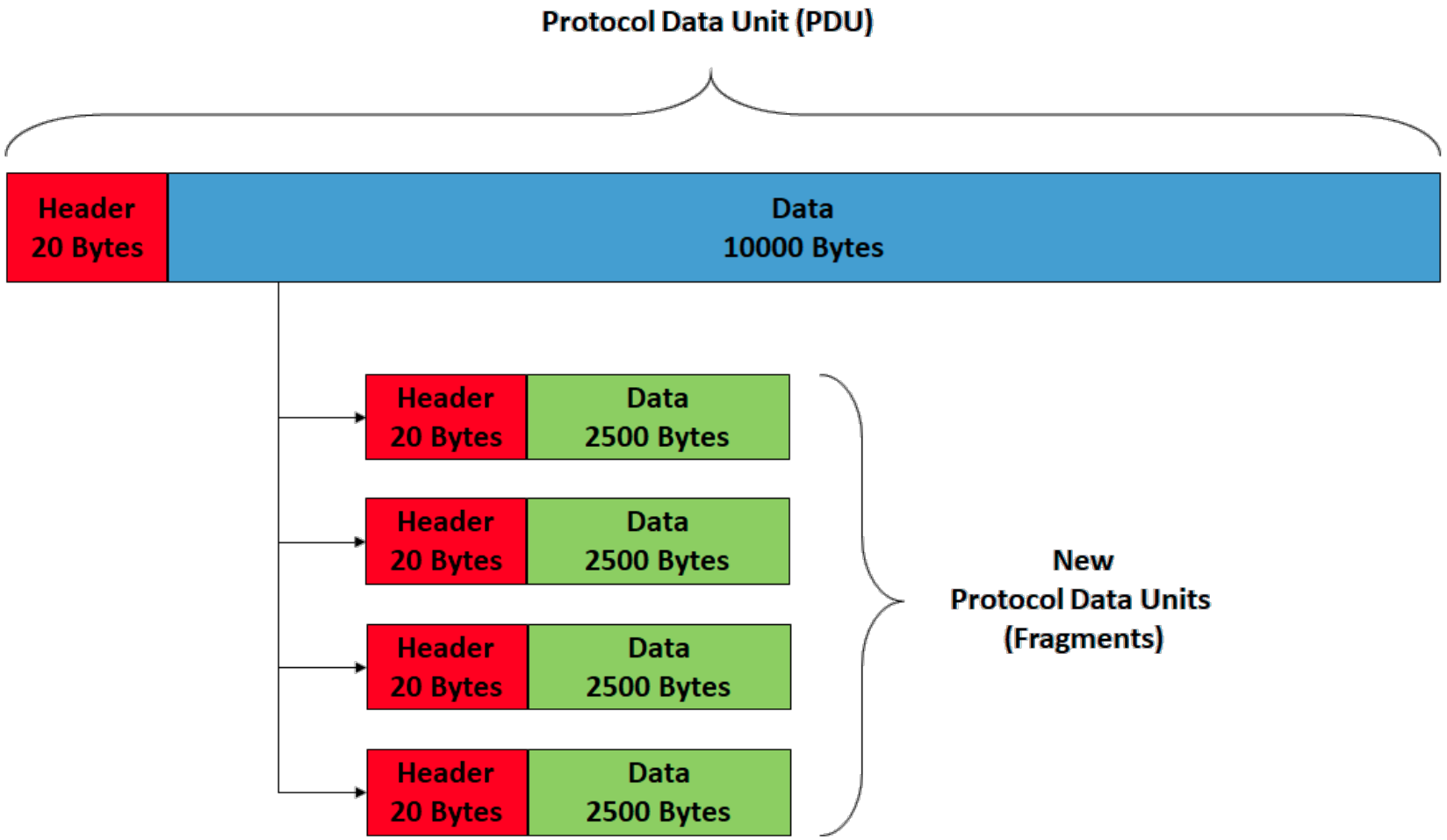
10000001.01010010.10001010.11111110 → 129.82.138.255

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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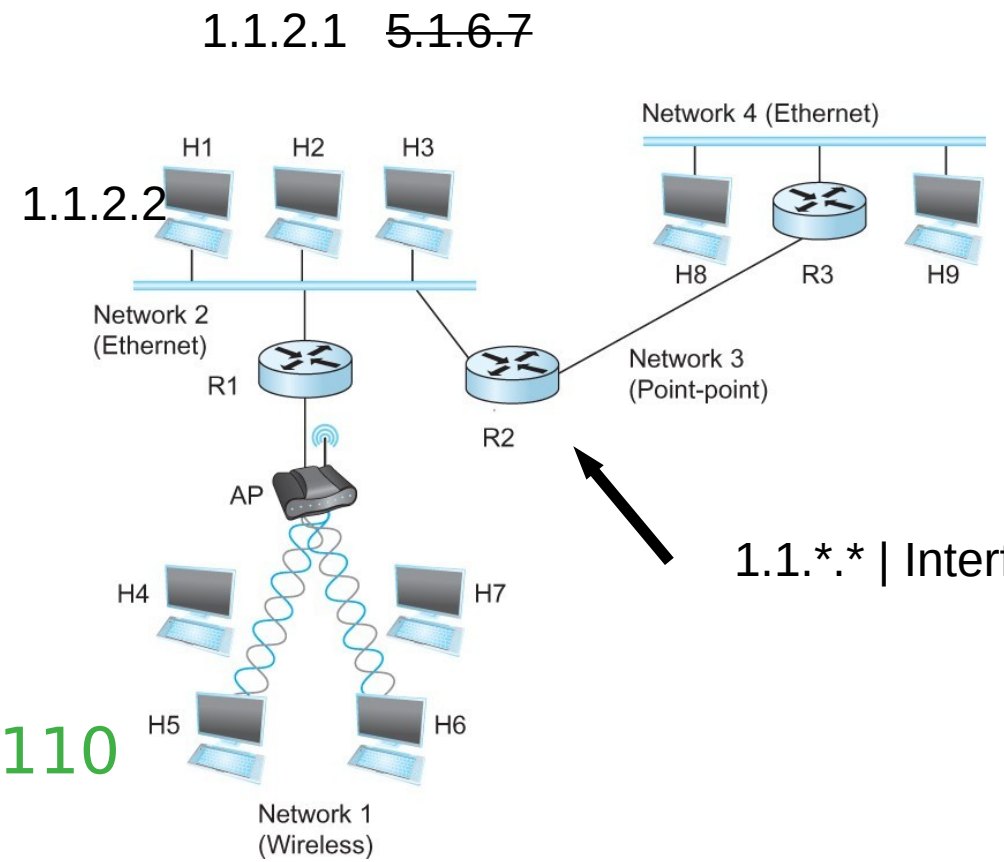

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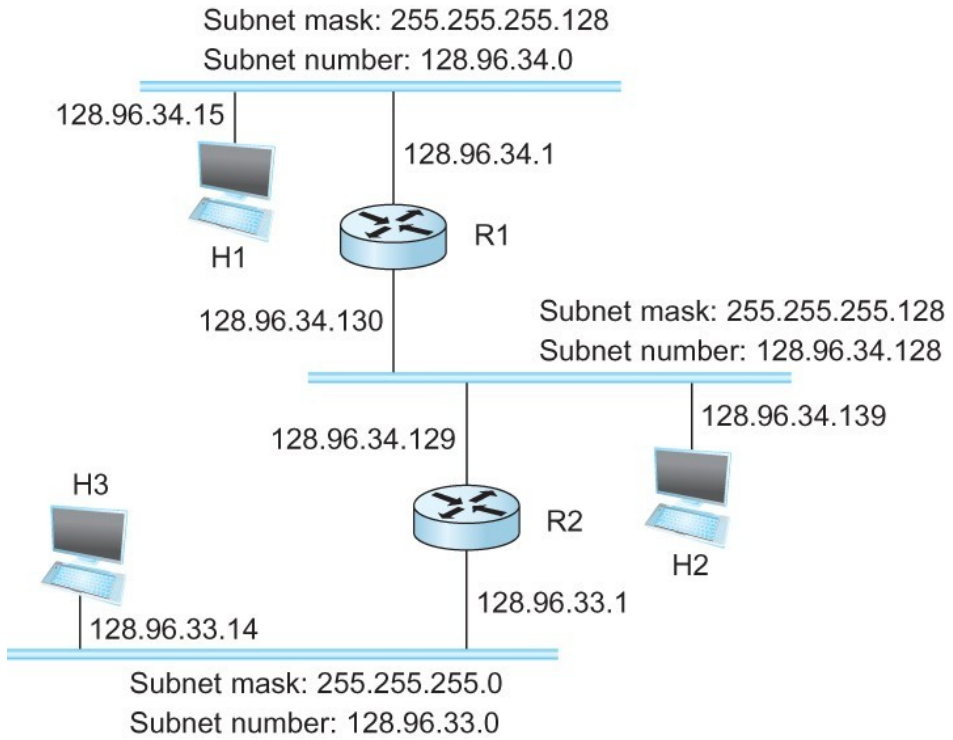
Subnetting



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

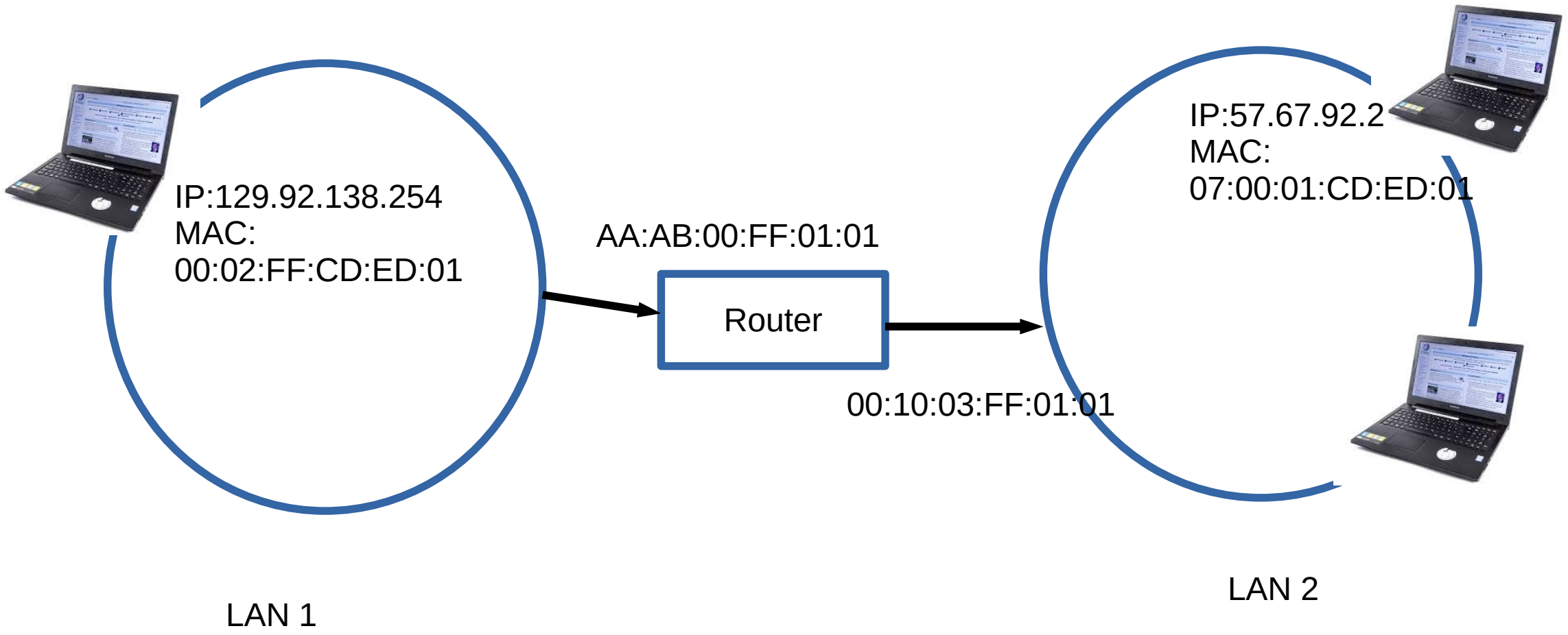
- Adaptors only understand MAC addresses

- 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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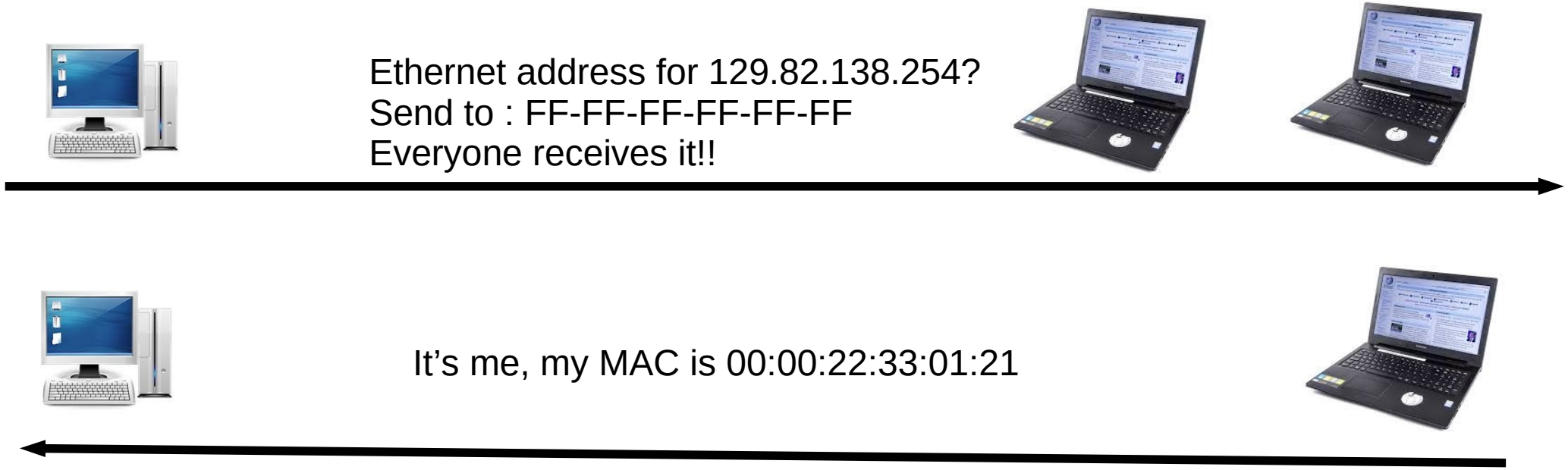
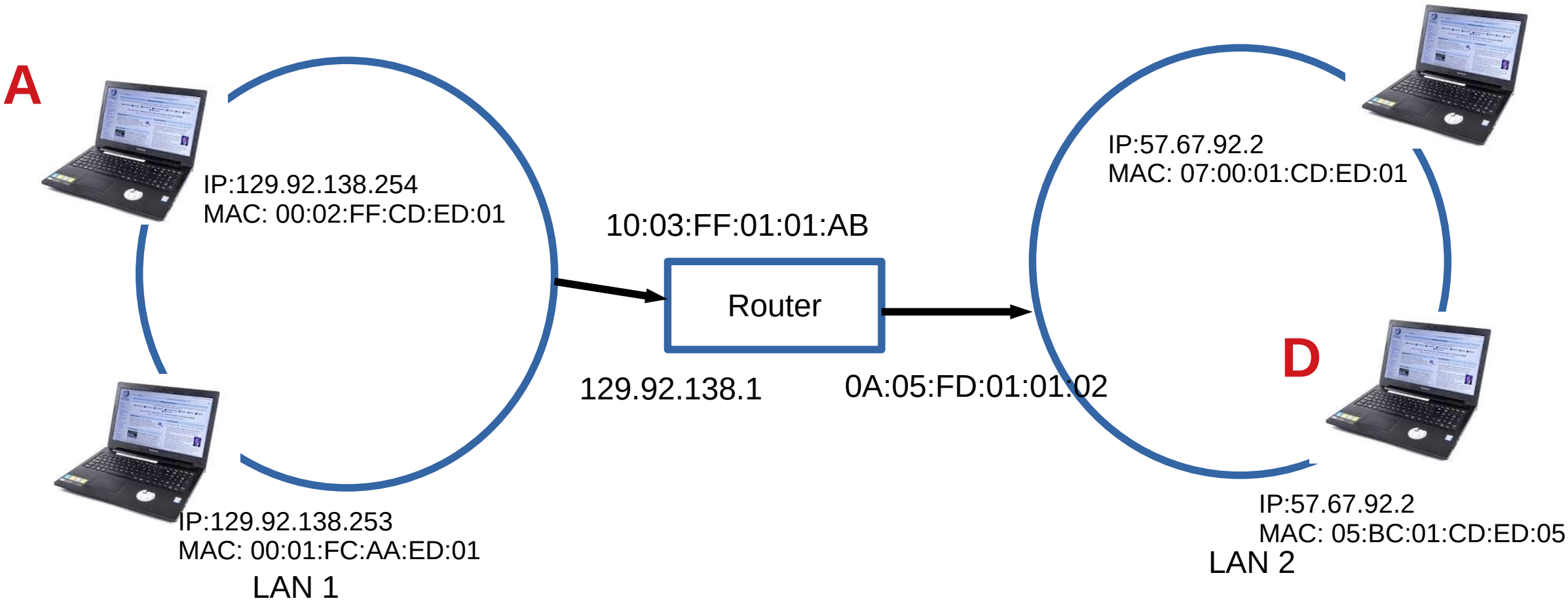
  - Shout in the room → Who here is Rachel?



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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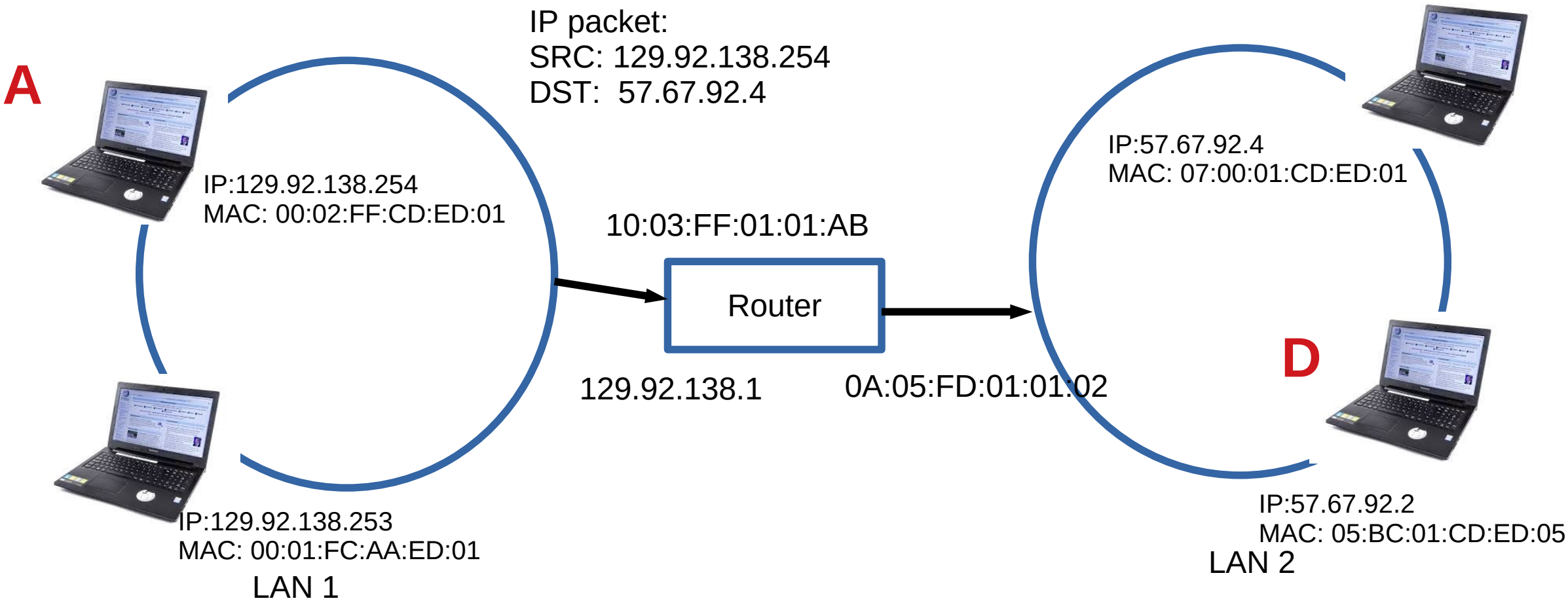

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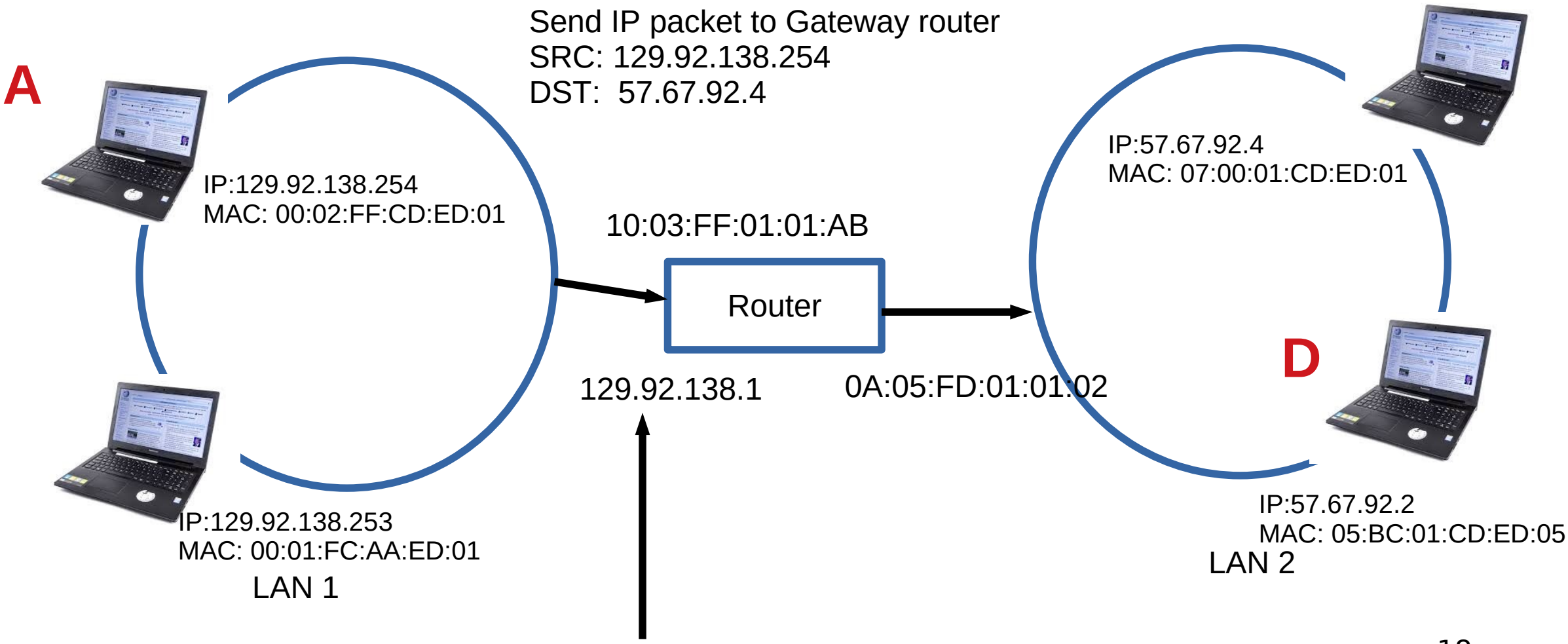

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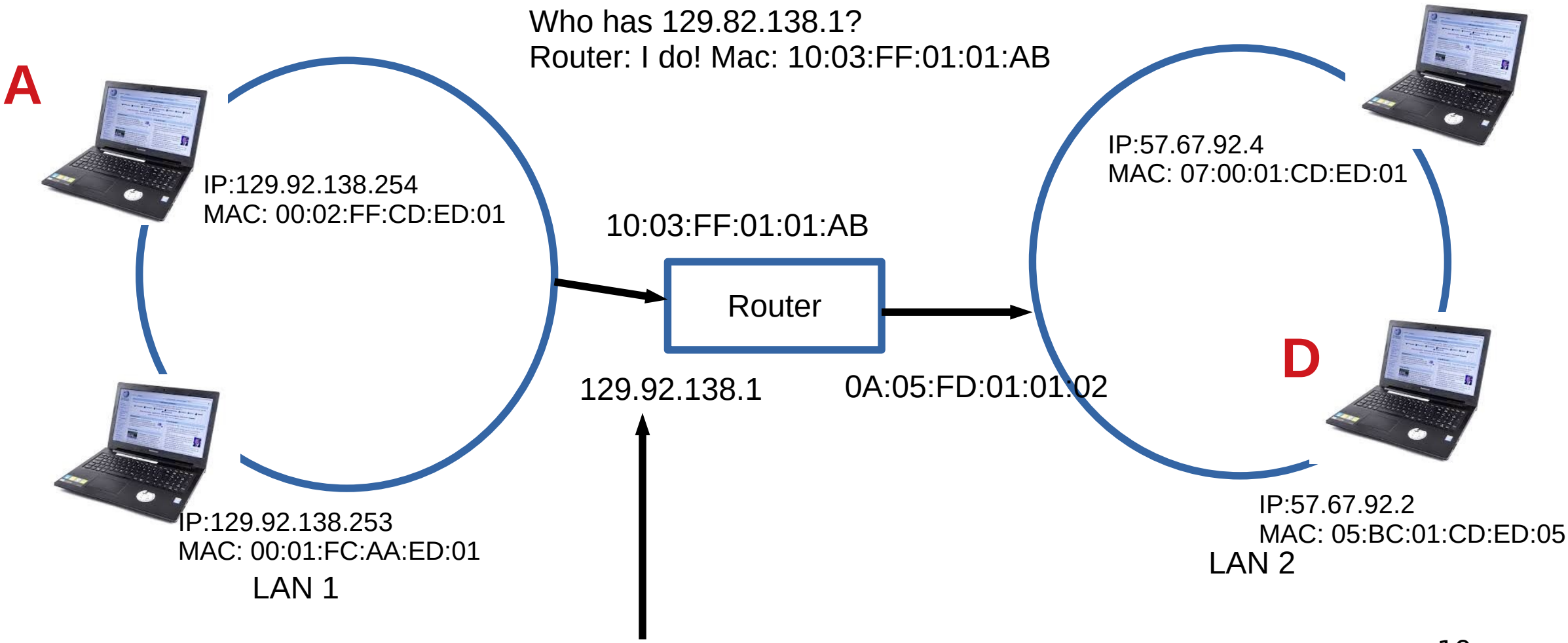

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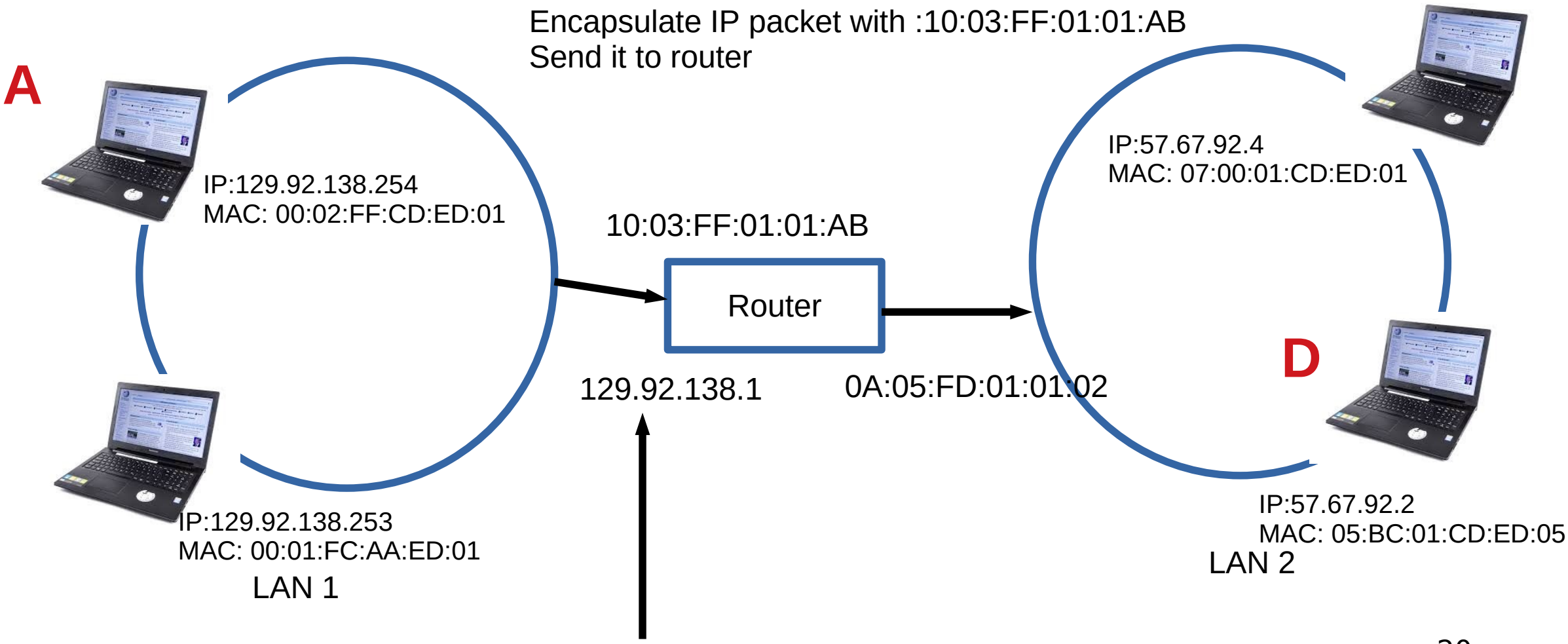

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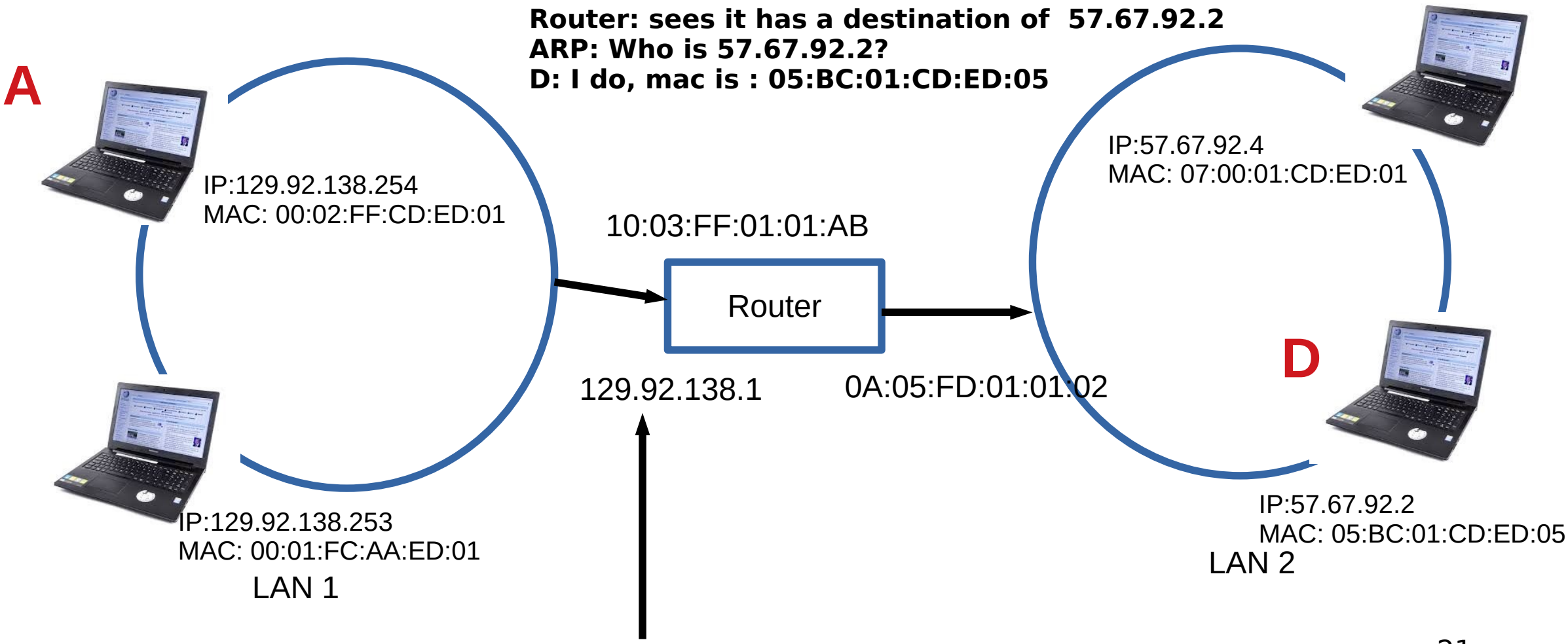

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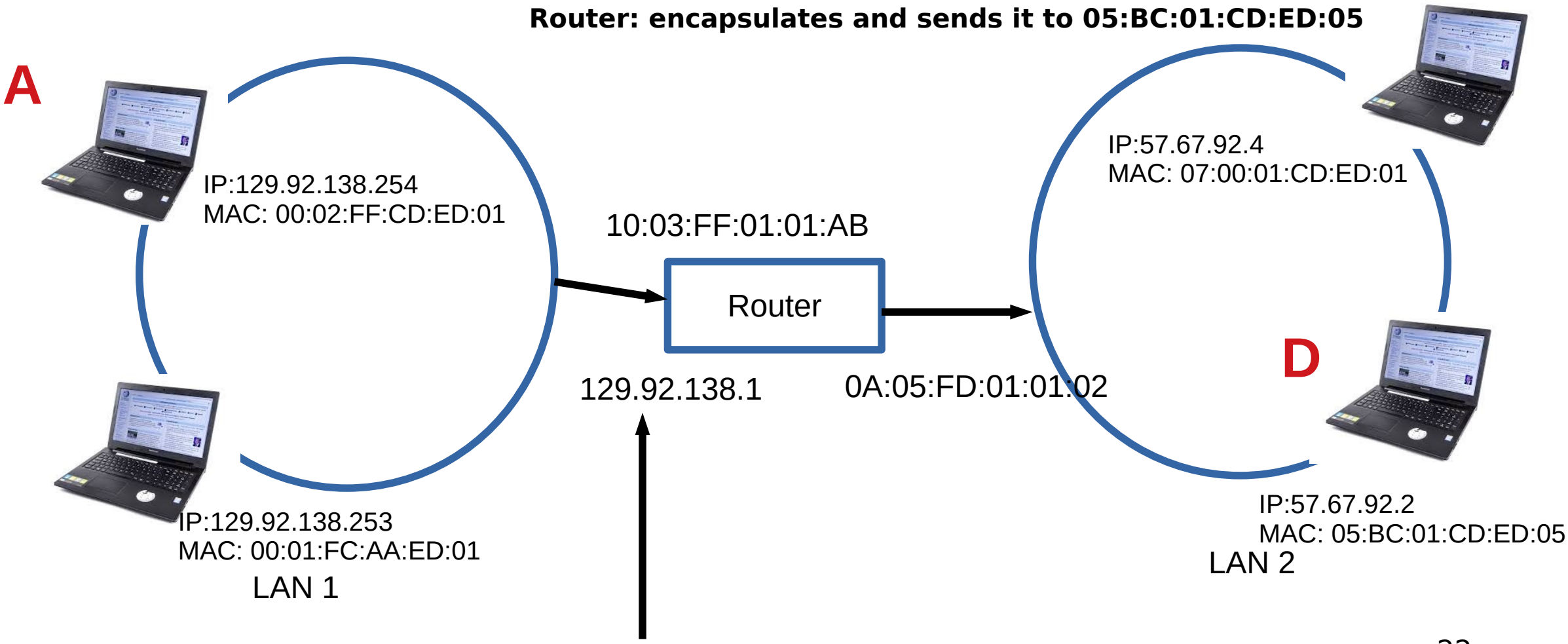
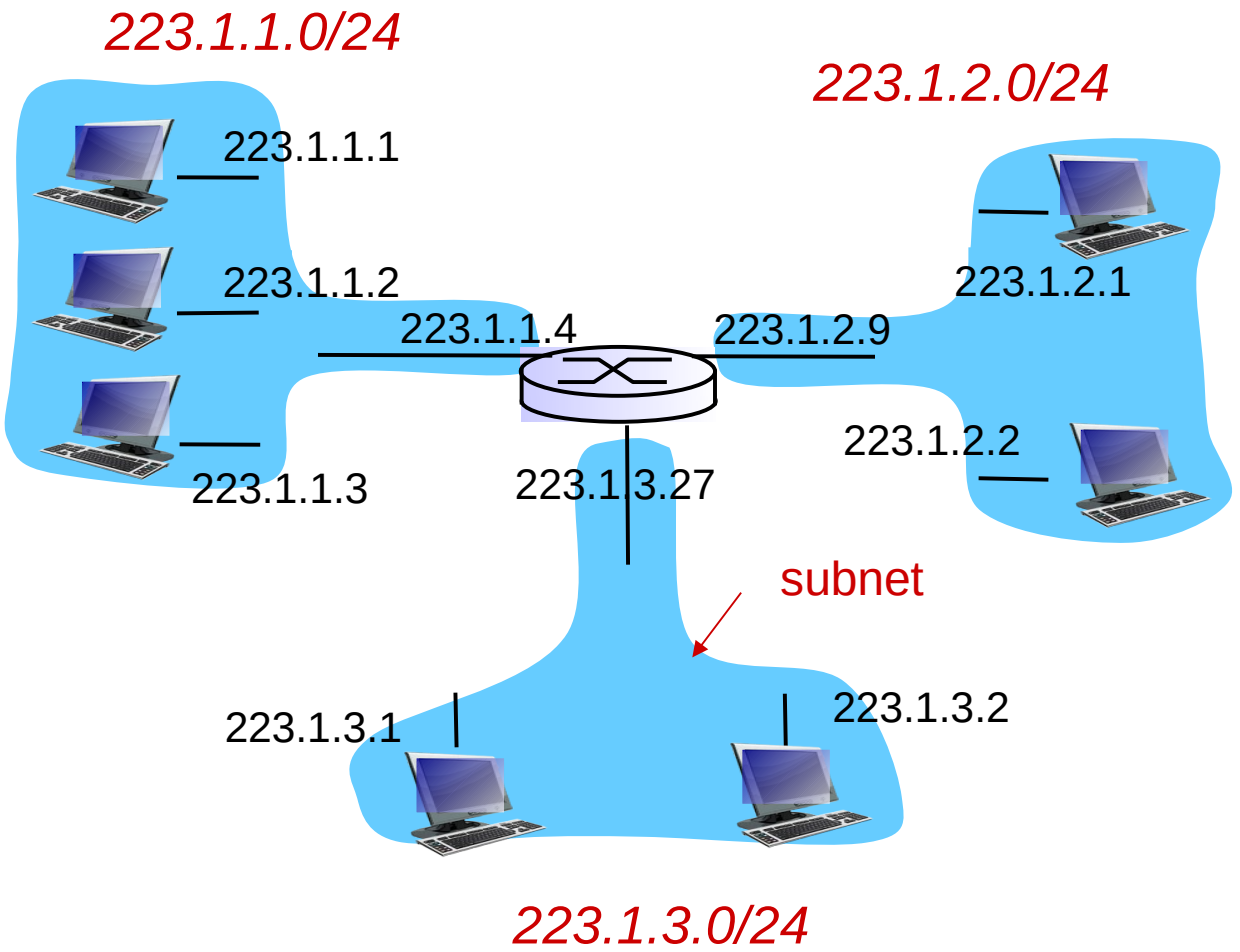


Subnets Revisited

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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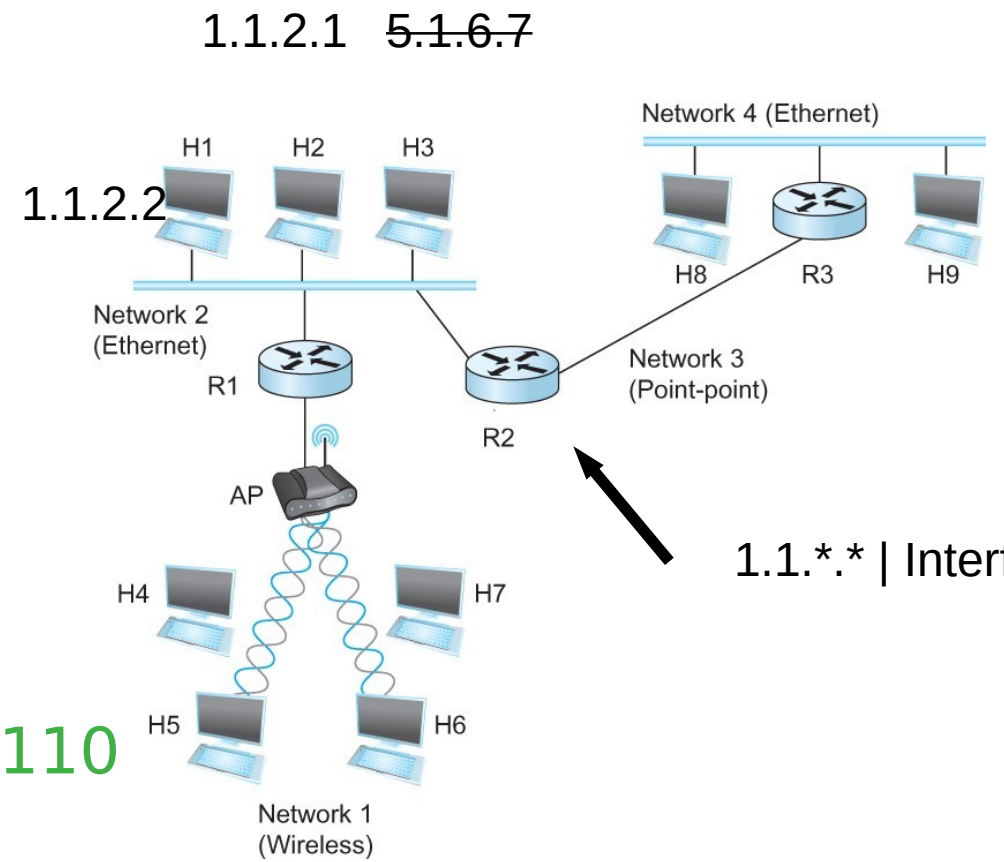

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Perform logical AND to get the network part = 129.82.138.224
Available addresses – 129.82.138.225-129.82.138.254
Broadcast address – 129.82.138.255

Problem

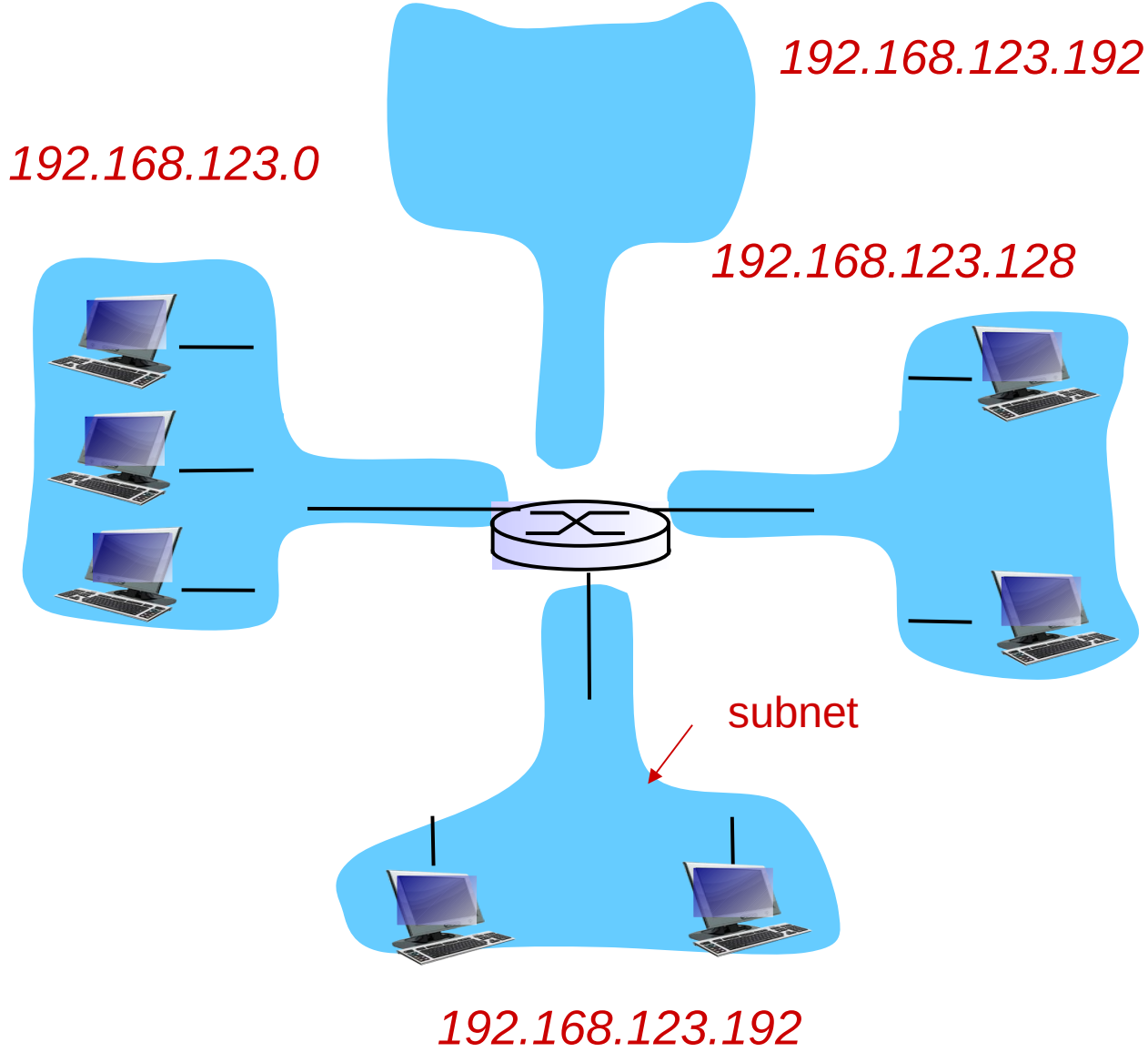
You have an address block:
192.168.123.0/24

- 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 - 1111111.11111111.1111111.00000000
2 bits for network –
1111111.11111111.1111111.11000000

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

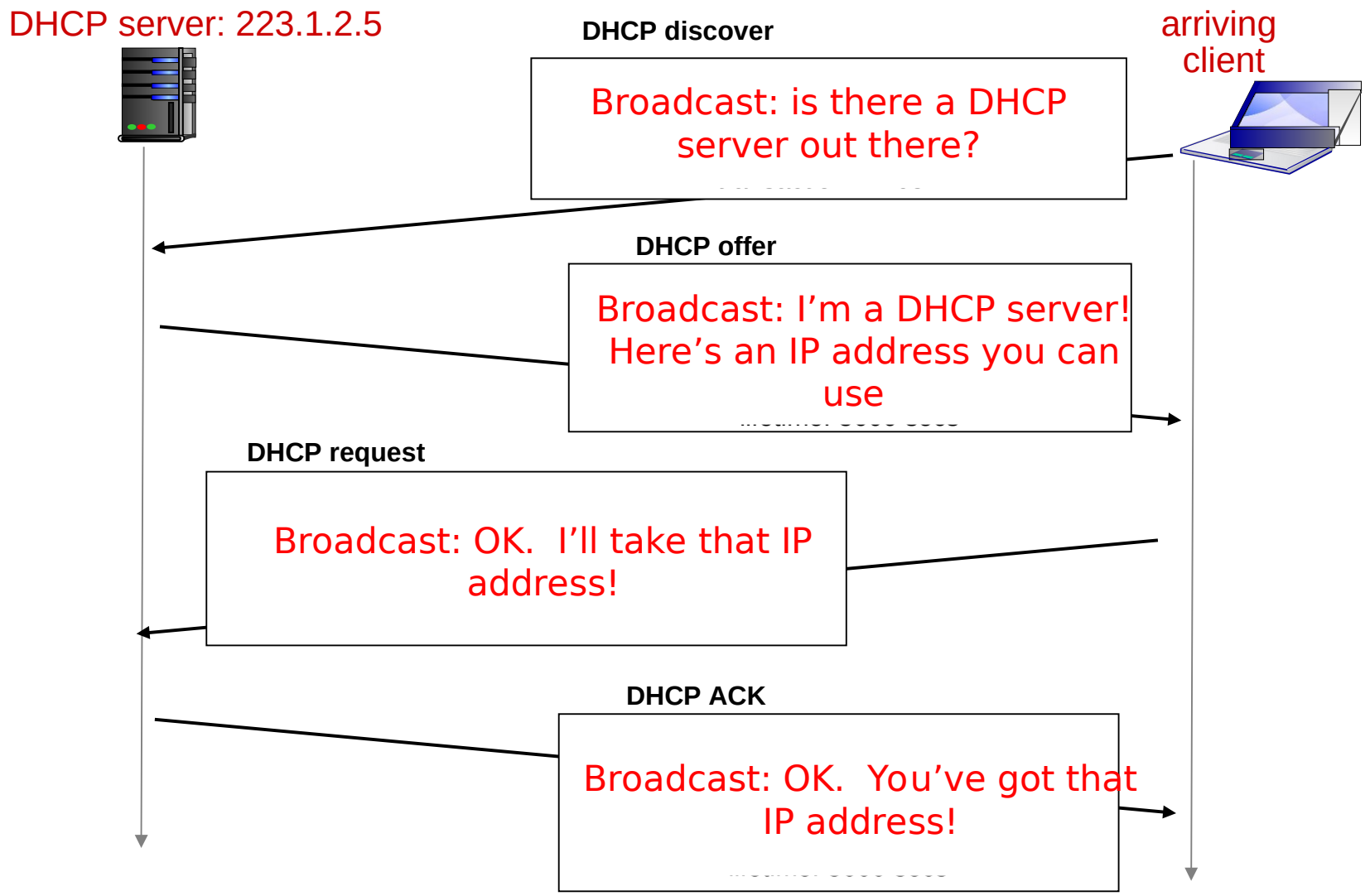


subnet mask: /26

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

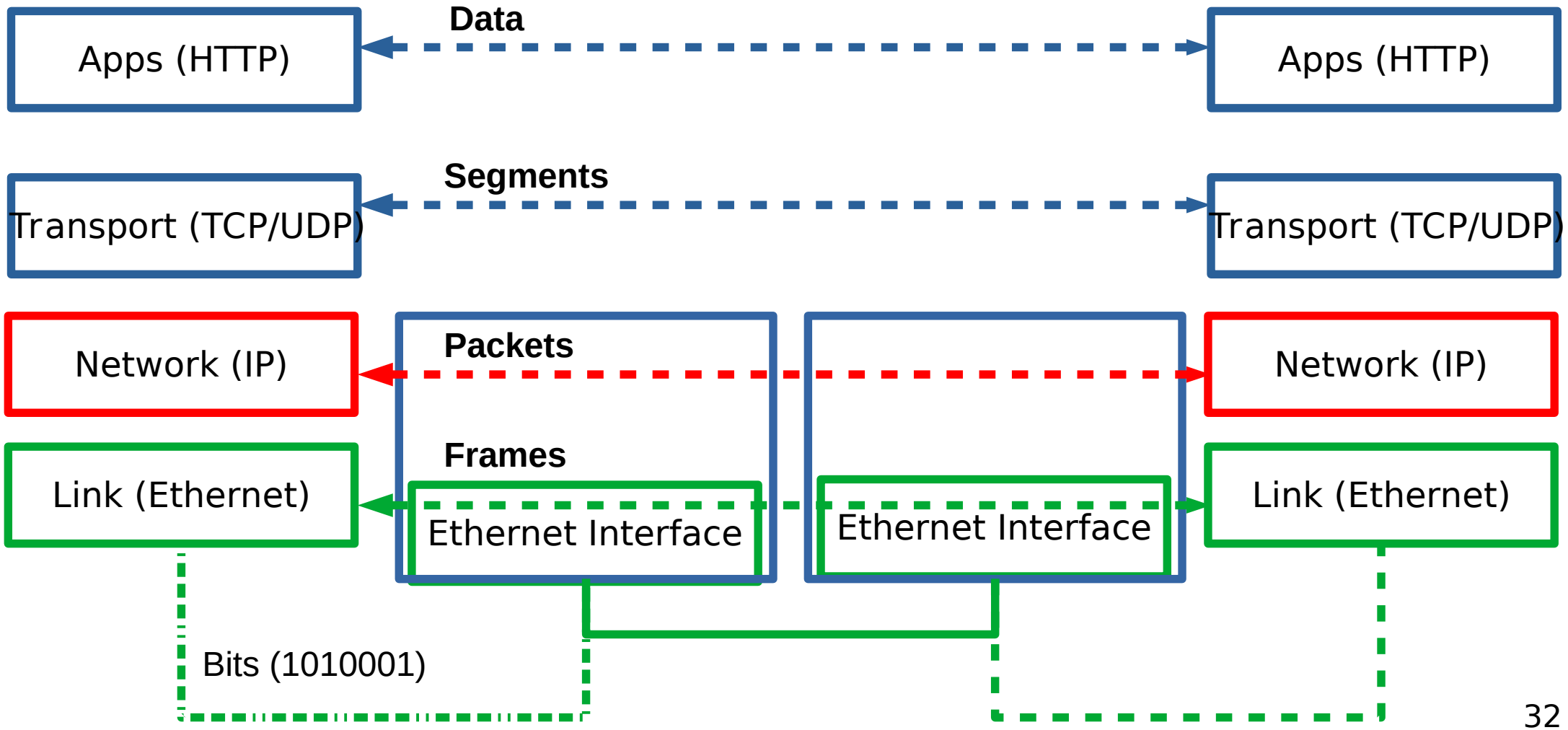
- A local central database with a list of IP addresses
  - 10.0.0.1/8
- Offers an available IP to a client for a period of time
  - Lease time – 24 hours, 1 hour, configurable ← ***Soft State***
- Multiple servers might coexist and offer IP to the same request
  - Broadcast medium
  - Client decides 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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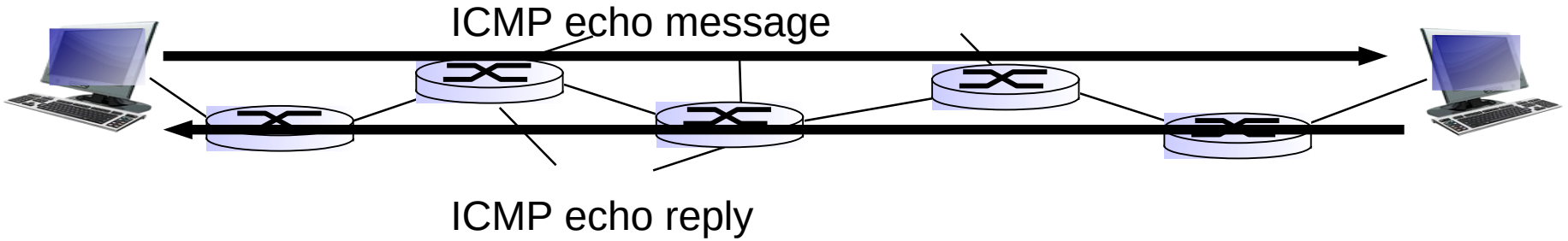
Ethernet Interface
Ethernet Interface
Link (Ethernet)
Bits (1010001)

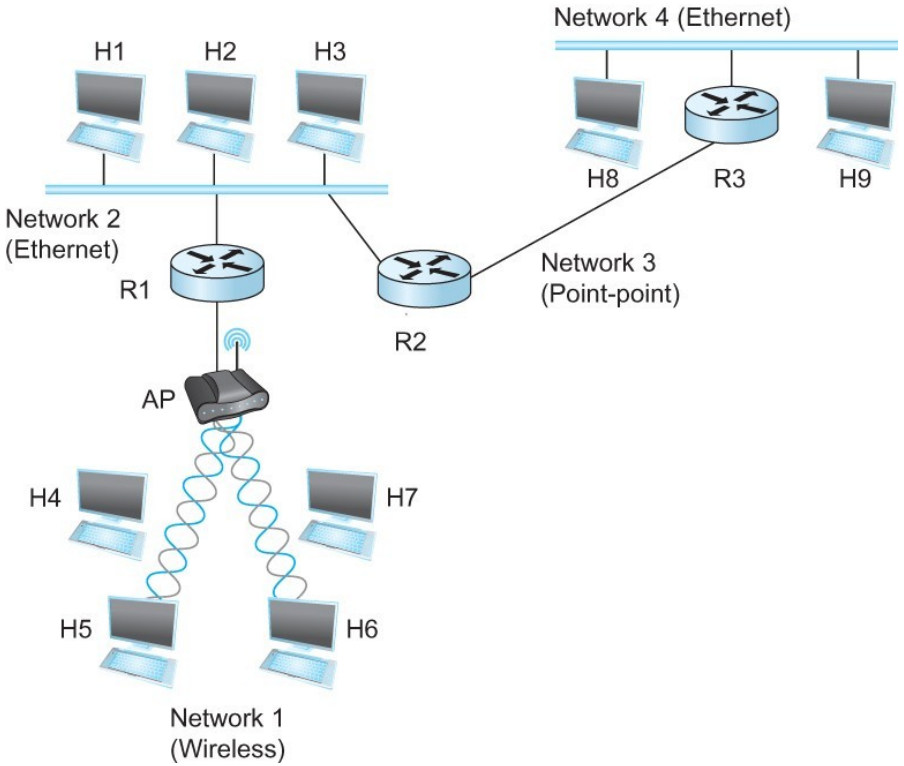
Ping and ICMP

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

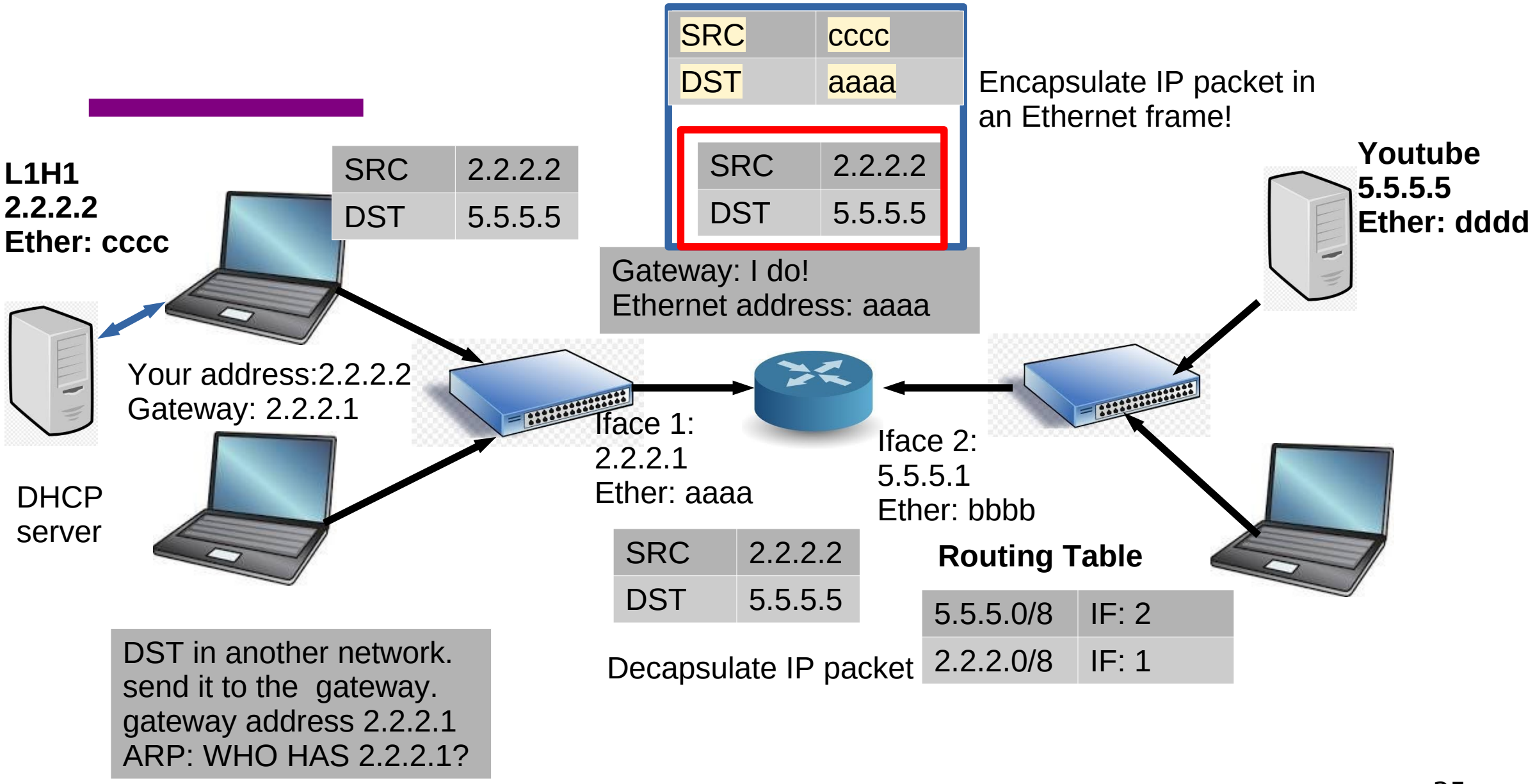


Tying it all together in the network layer

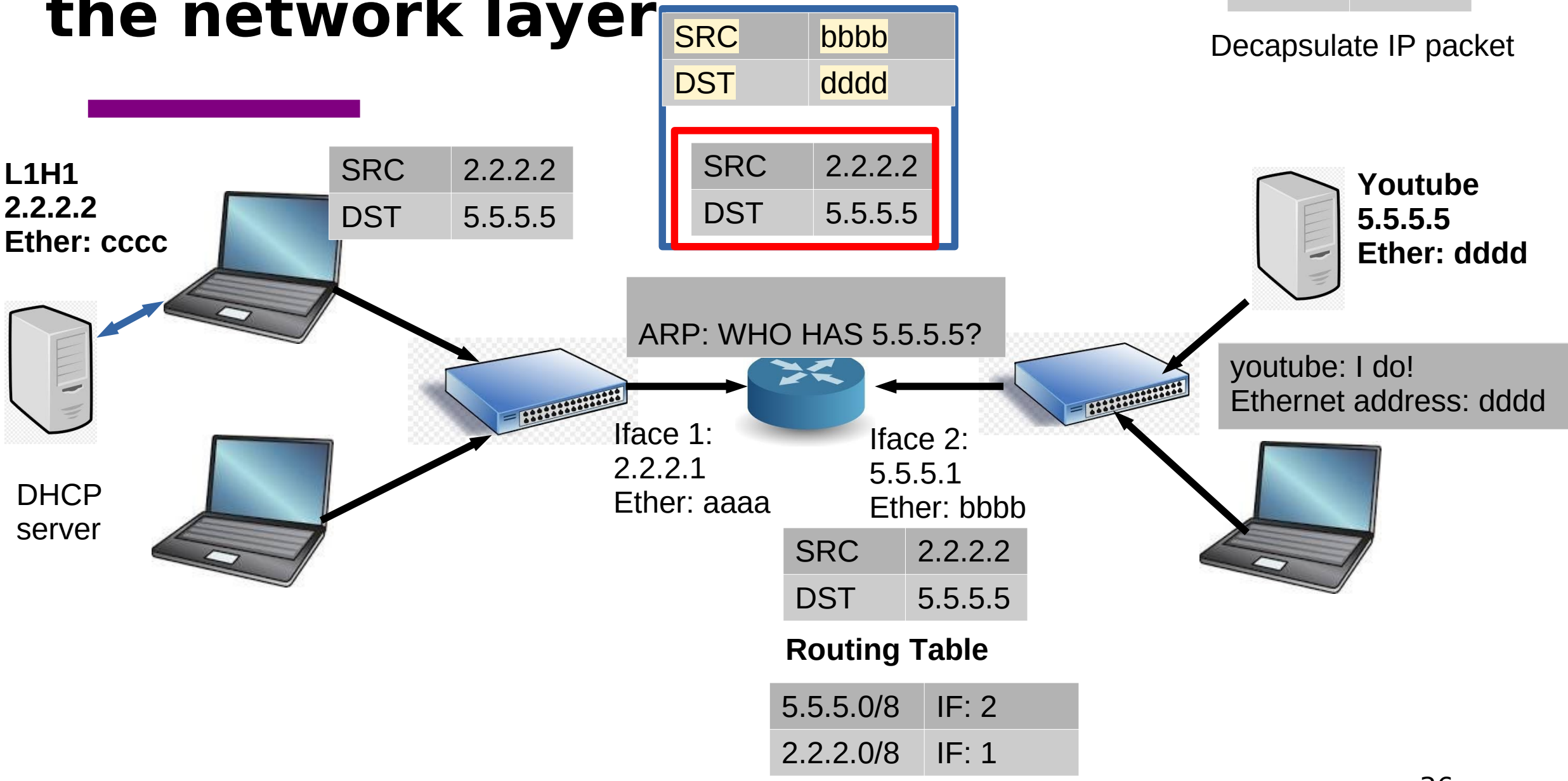
Internetworking Protocol (IP)



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