

Discussion 10:

A4 Help and L2/L3 questions

By Joey Buiteweg

Discussion Outline

By the end of this discussion we will:

- Know what assignment 4 entails
- Be able to reason about scenarios involving subnets and ARP

A4 Help

About Assignment 4

Due: Wednesday December 9th at 11:59 PM

Once implemented your static router will support:

- ICMP (Internet Control Message Protocol) messages, i.e *ping*
- *traceroute*
- Forwarding packets from application commands like, *wget*, *curl*, etc.

“static” means routing table doesn’t change while router is running

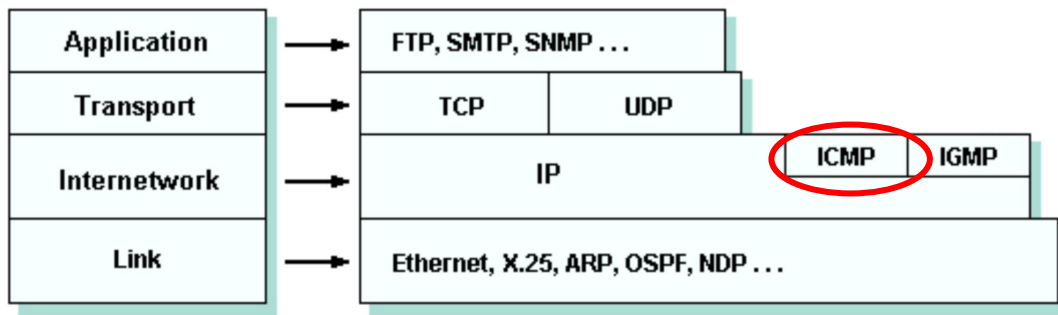
About Assignment 4

We will go through:

- Environment Setup
- Router execution flow chart

ICMP (Internet Control Message Protocol)

Network layer (L3) protocol, but delivered via IP packet payload



ICMP Header Format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Type								Code								Checksum															
4	32	Rest of Header																															

ICMP Messages

<u>Type</u>	<u>Code</u>	<u>Description</u>
0	0	echo reply (ping)
3	0	dest network unreachable
3	1	dest host unreachable
3	2	dest protocol unreachable
3	3	dest port unreachable
3	4	frag needed but DF set
3	6	dest network unknown
3	7	dest host unknown
8	0	echo request (ping)
9	0	route advertisement
10	0	router discovery
11	0	TTL expired
12	0	bad IP header

ICMP Common Usage

Echo Reply (type 0) and Echo Request (type 0) are a ping request and reply

Destination Unreachable (type 3)

Time Exceeded (type 11) has two uses:

- Send an error to the sending party when IP Time-to-Live (TTL) has been exceeded
- To notify a fragmented IPv4 packet isn't reassembled within a time limit

traceroute

Source sends a series of UDP (or ICMP, using -I flag on macOS) packets:

- First 3 packets have TTL set to 1
- Next 3 packets have TTL set to 2, and so on.

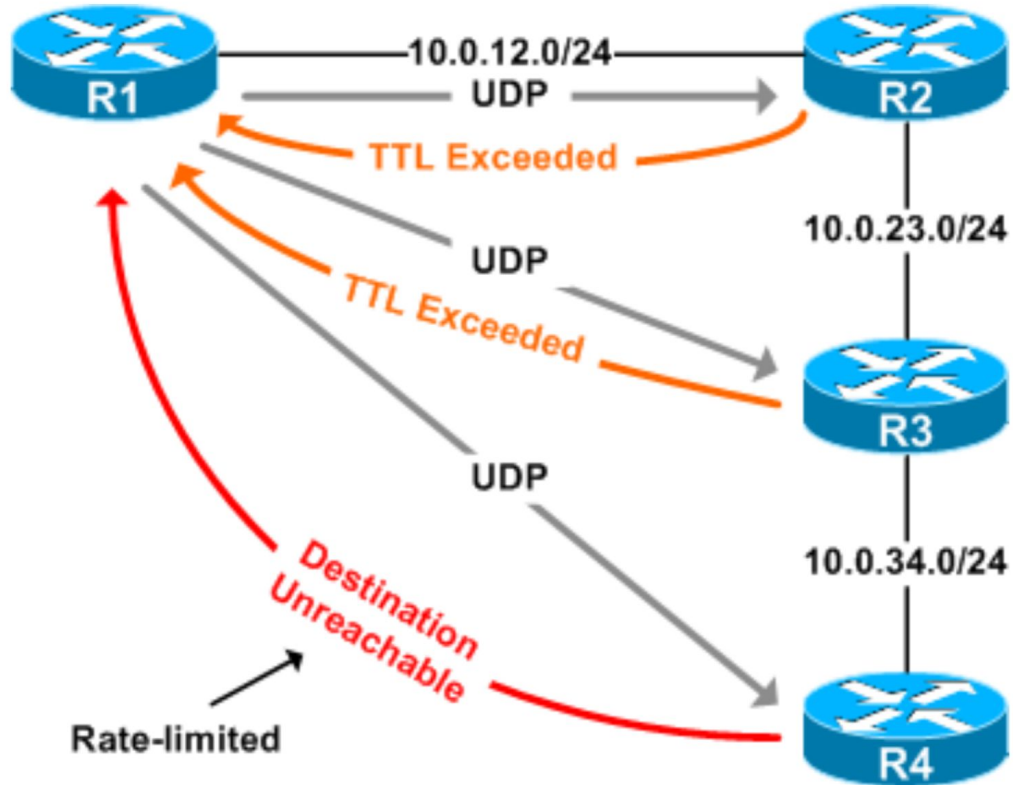
Packets all sent to an unused port number

Why send 3 packets?

For redundancy in the case of drops / loss

- Number of packets sent per TTL is configurable (-q flag)

traceroute



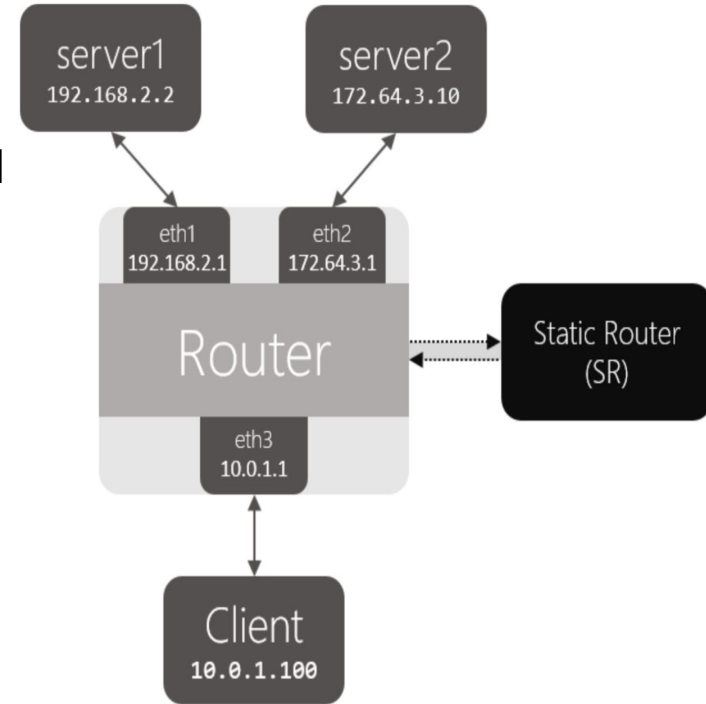
traceroute Demo

A4 Environment Setup

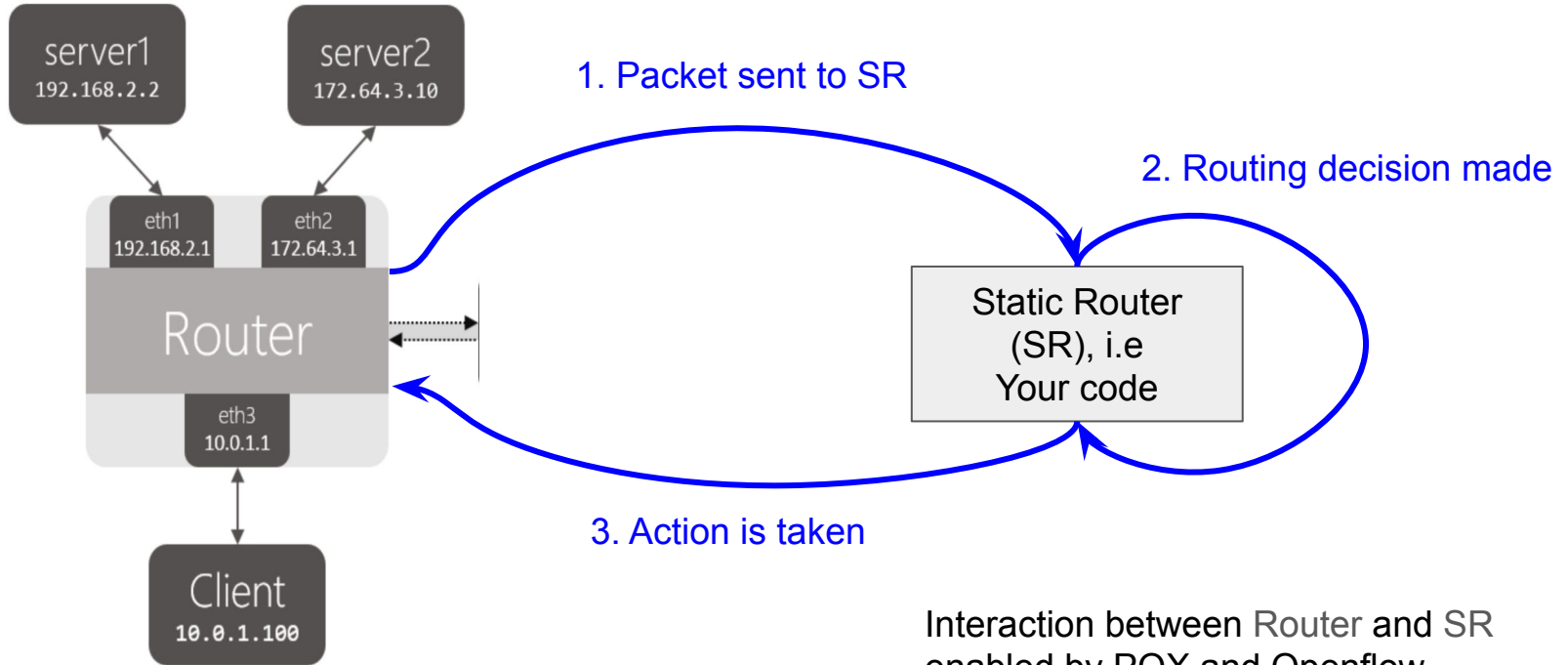
The Router is a software-defined switch/router

- Controlled by an external SDN controller called POX

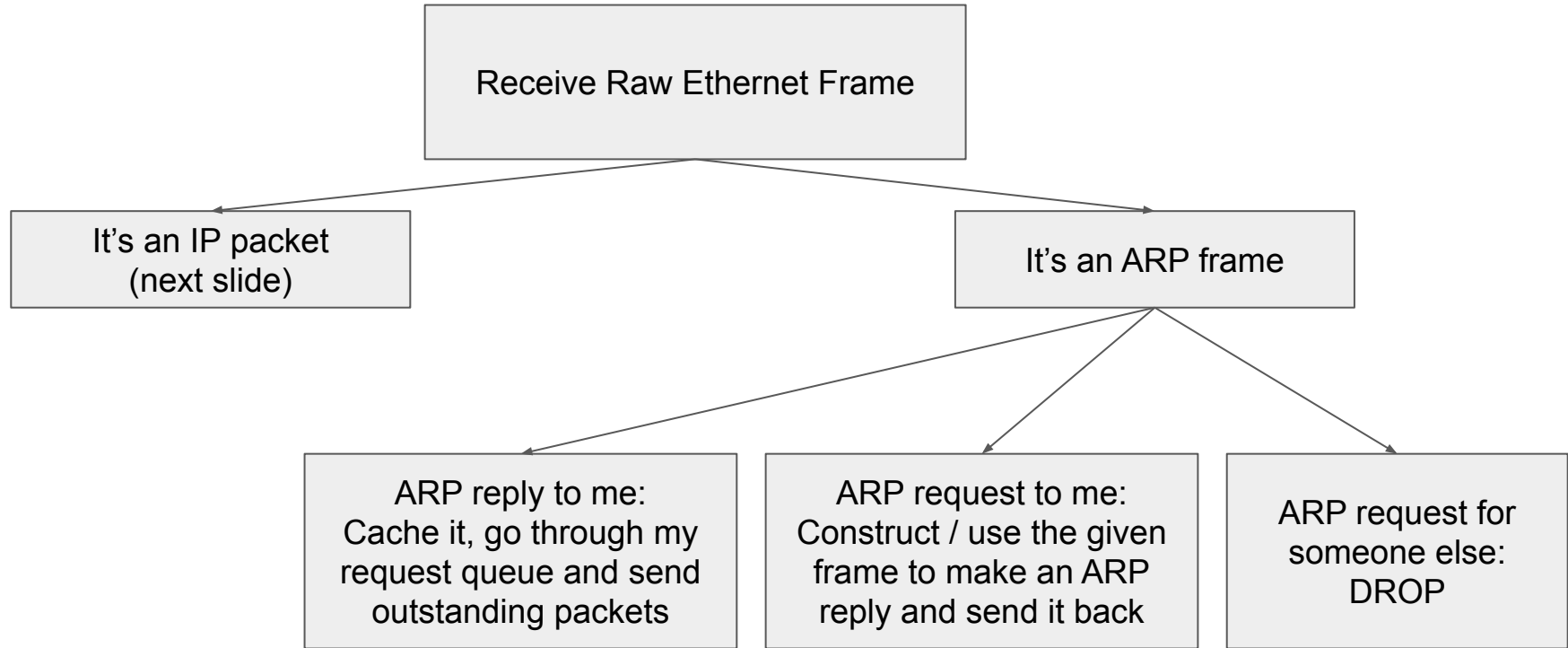
SR (static router) talks to POX to control Router



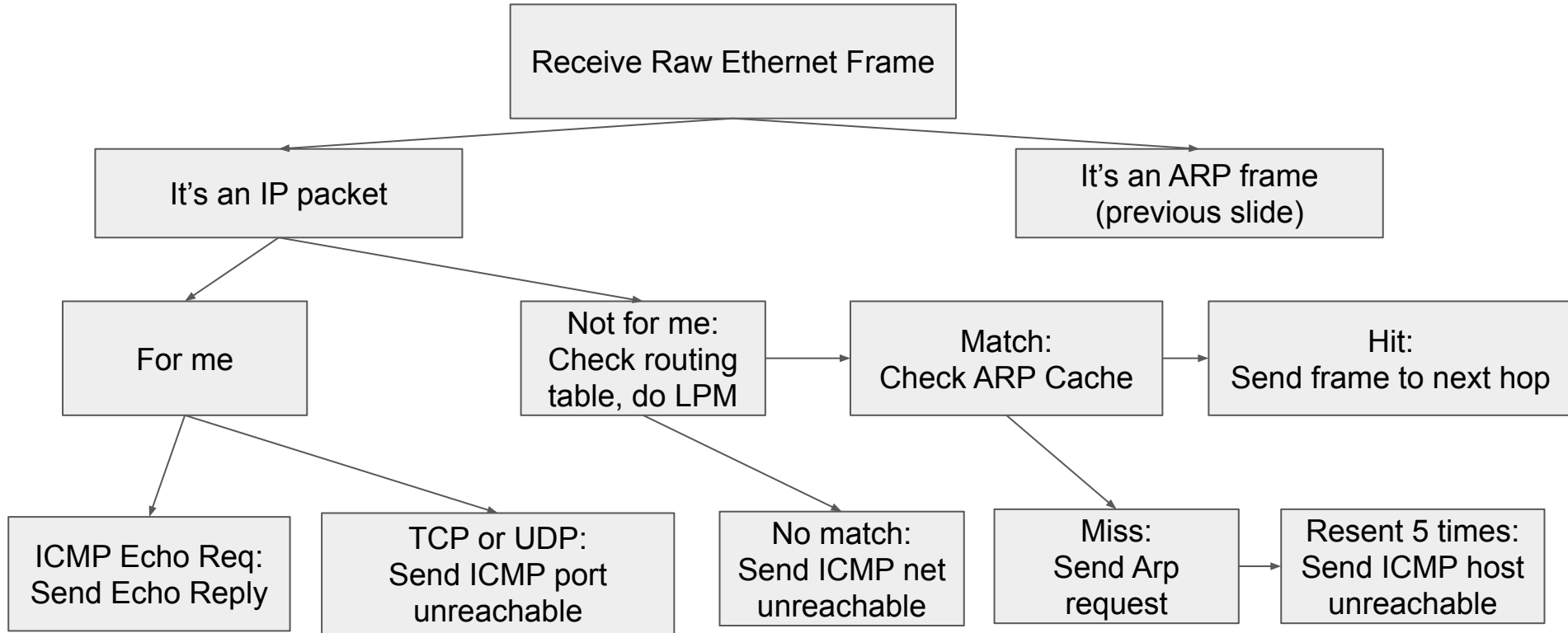
A4 Environment Setup



A4 Flow Chart - Handling ARP



A4 Flow Chart - Handling IP



A4 Tips

Debug using `./sr -l <pcap file>` , then open pcap file with wireshark

Compare wireshark output to `./sr_solution`'s output and pcap

Remember to use `htonl`, `htons`, `ntohs`, `ntohl`, where appropriate

Print debugging functions provided in `sr_utils.c`

- `print_hdrs()`, `print_add_ip_int()`, **etc.**

Test your `./sr` to make sure it works with `ping`, `curl`, `traceroute`, `wget`,
etc.

A4 Demo

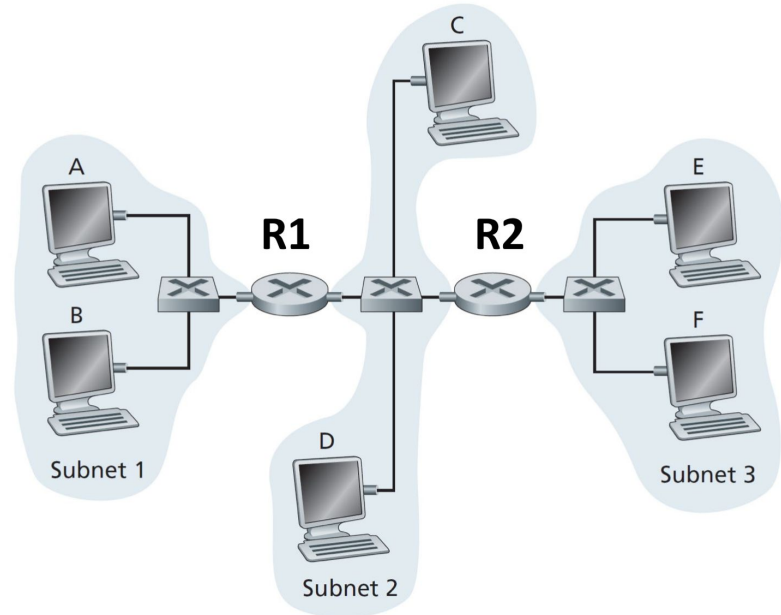
Lecture Based Questions

Q1 Forwarding

Consider sending an IP packet from Host E to Host F.

Will Host E ask router R2 to forward the packet? Why?

No. Host E and Host F are on the same subnet and are connected via switch.



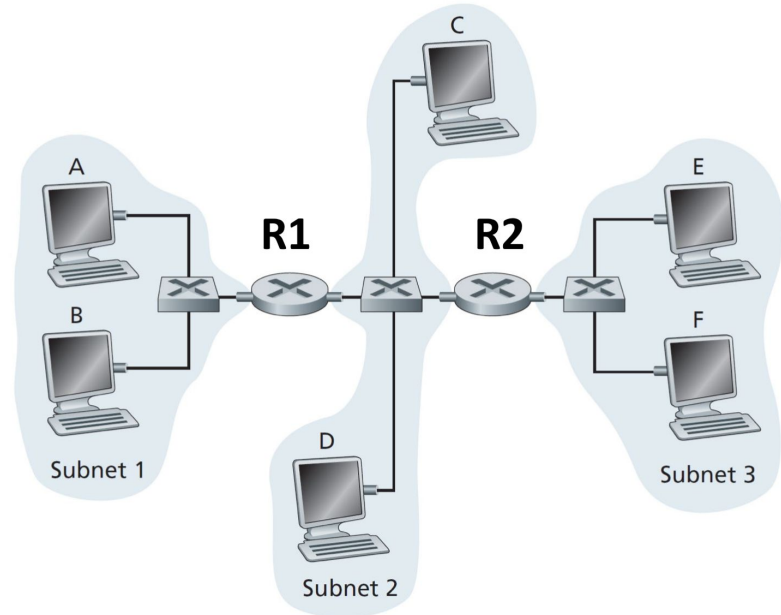
Q2 ARP

Consider E sending an IP packet to B.
Assume E's ARP cache is empty.

Will E make an ARP request to
find B's MAC address?

**No. Host B and
Host E are on the
different subnets.**

Who will E make an ARP
request to? **R2 (next hop to B)**



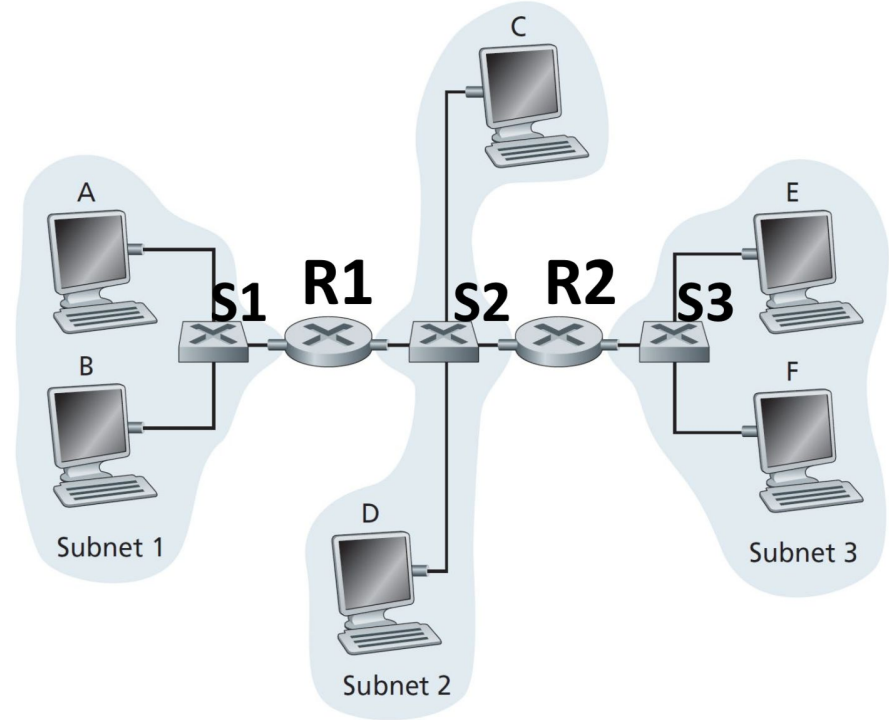
Q3 ARP and IP

Consider E sending an IP packet to B.

In the Ethernet frame of the IP packet going to B that is delivered to **router R1**, what are the source and destination IP and MAC addresses?

srcIP: IP-E, dstIP: IP-B

srcMAC: MAC-R2, dstMAC: MAC-R1



Thank you!

This is my last discussion for the semester! Thanks for being flexible.

I appreciate you all participating and staying engaged.

Have a wonderful break, and good luck with the assignment!