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

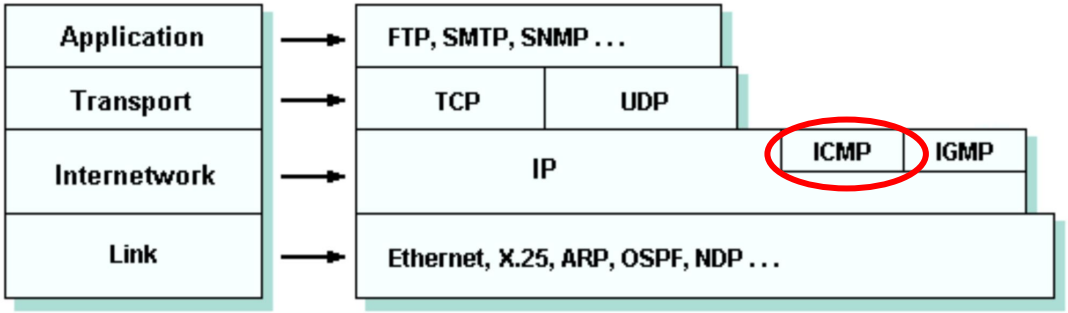
About Assignment 4

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

Type	Code	Description
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 8) 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.

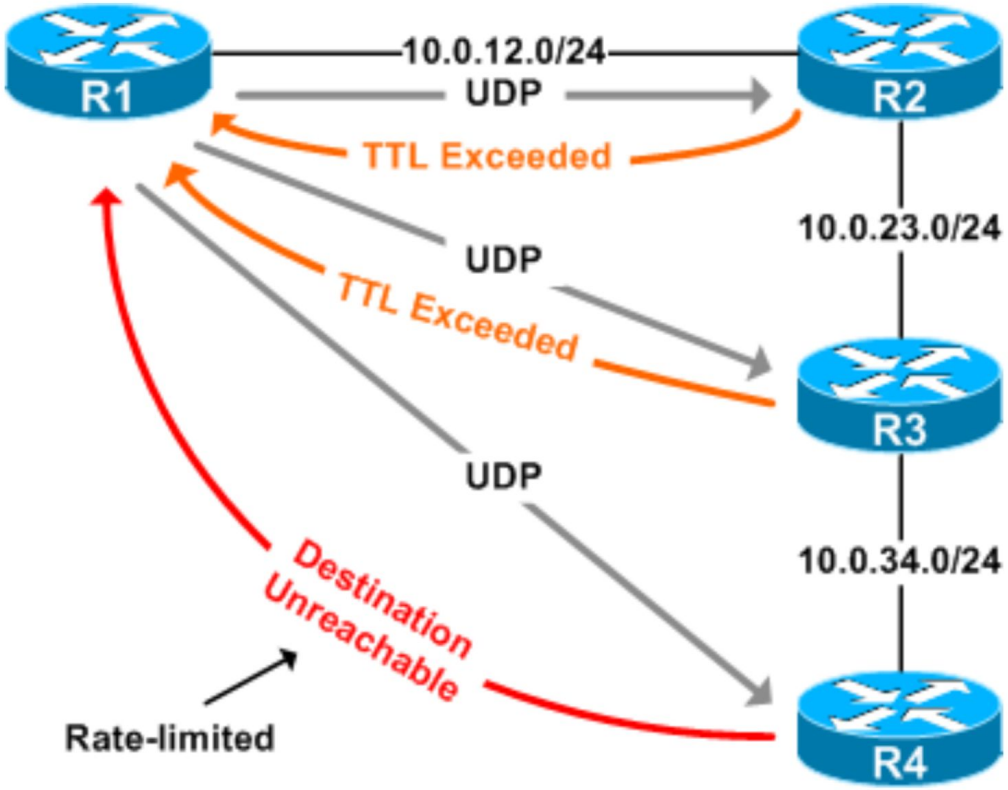
Packets all sent to an unused port number

Why send 3 packets?

For redundancy in the case of drops / loss

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

traceroute


R1
10.0.12.0/24
UDP
R2
TTL Exceeded
10.0.23.0/24
UDP
TTL Exceeded
R3
UDP
10.0.34.0/24
Destination
Unreachable
Rate-limited
R4

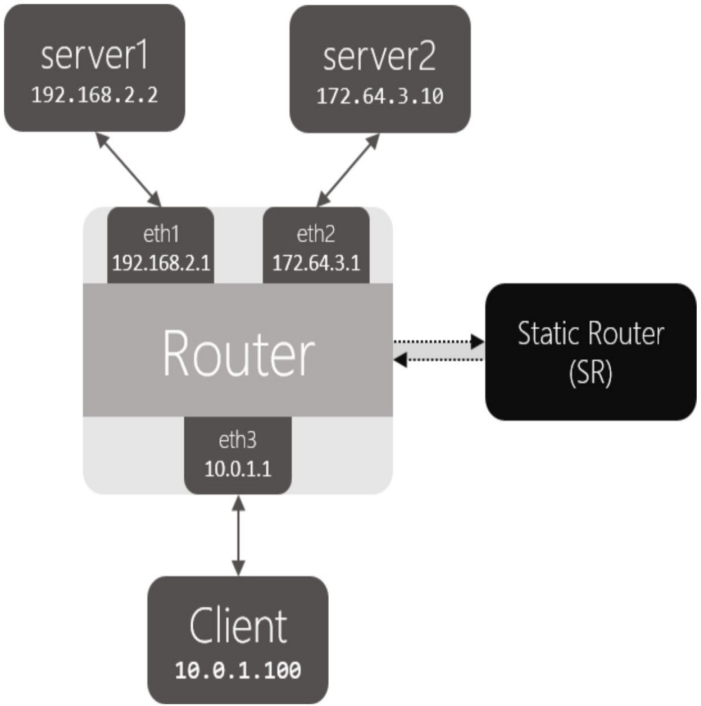
traceroute Demo

A4 Environment Setup

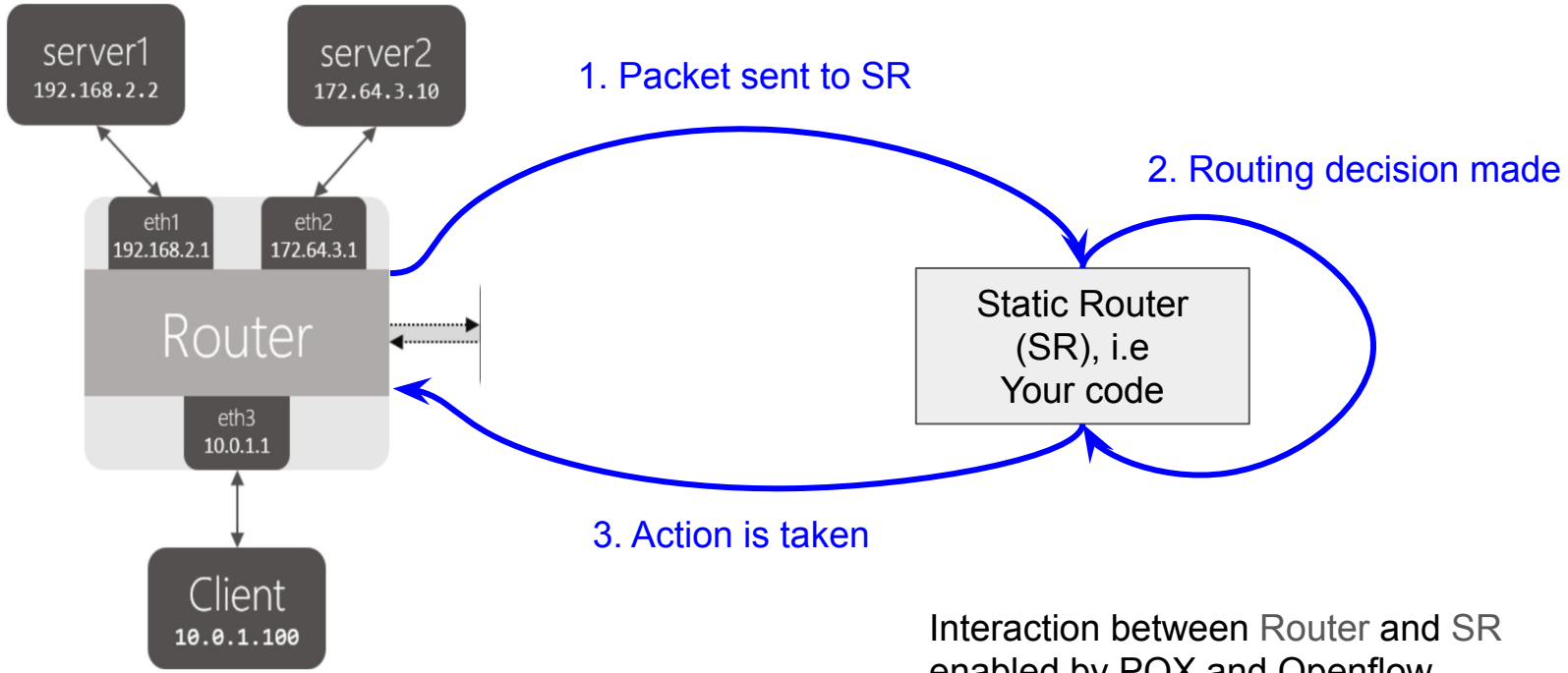
The Router is a software-defined switch/router

- Controlled by an external SDN controller called POX

SR (static router) talks to POX to control Router

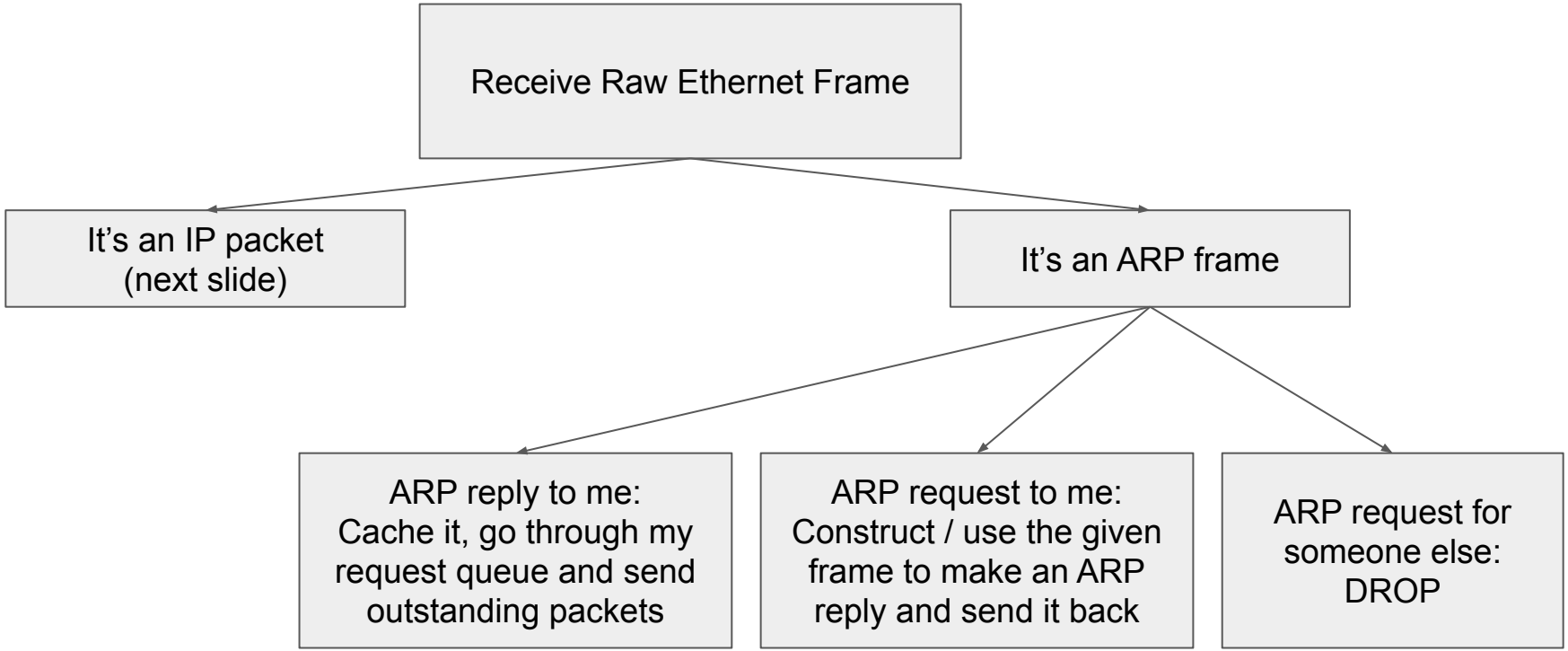


A4 Environment Setup

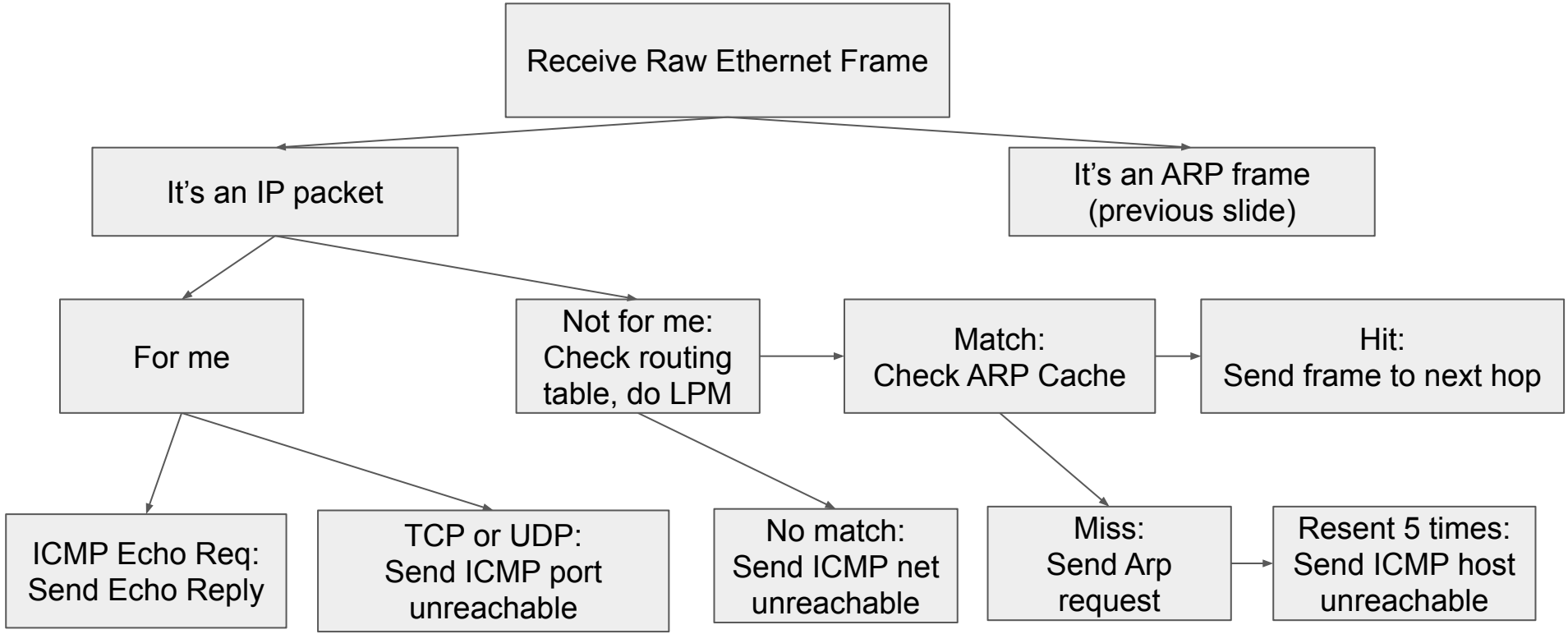


Interaction between Router and SR enabled by POX and Openflow

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

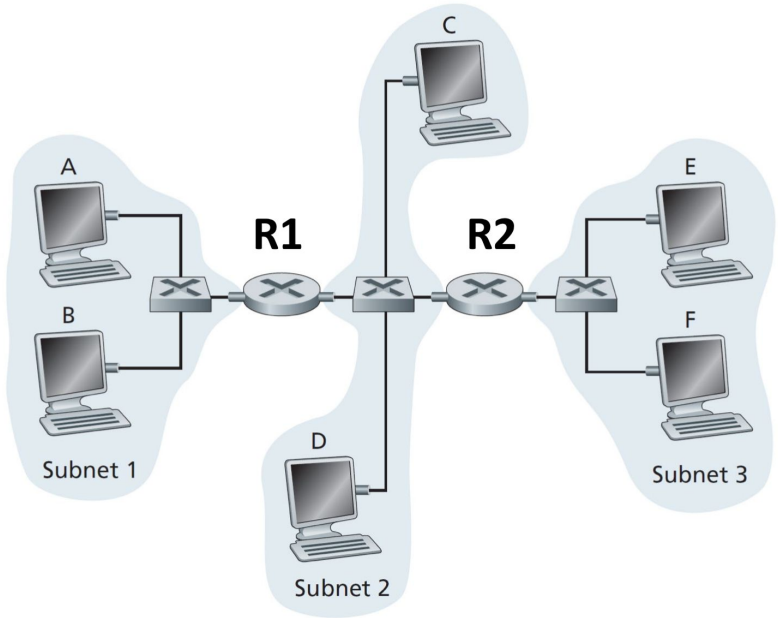
Lecture Based Questions

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.



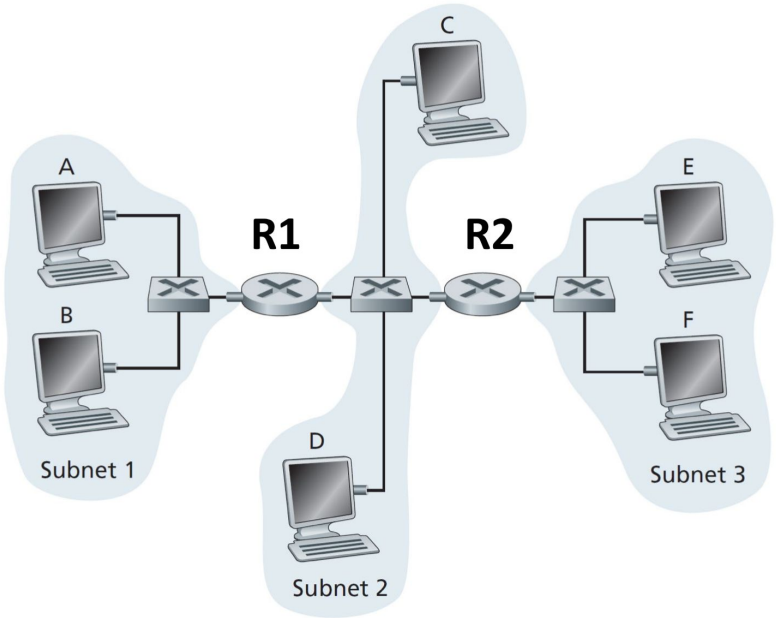
Q2 ARP

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)



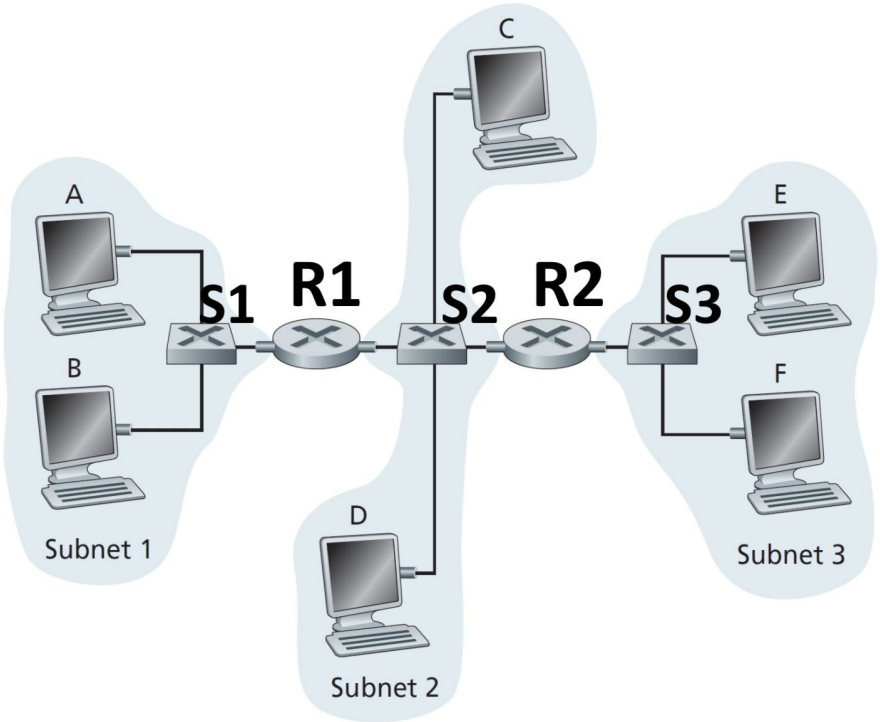
Q3 ARP and IP

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!