# Exercise Session 11: Link Layer

## COM-208: Computer Networks

## Reliable Internet

<u>Intermediate</u>

If all the physical links in the Internet provided reliable data delivery, would TCP be unnecessary? Why or why not?

# L2 forwarding

Consider an Ethernet IP subnet, where end-systems, labeled A through F, are star-connected to an Ethernet switch. Let's denote the link between A and the Switch as AS, between B and the Switch as BS, and so on. The switch's forwarding table is initially empty. Then:

1. B sends a packet to E.

2. E replies with a packet to B

3. A sends a packet to B.

4. B replies with a packet to A.

Show for each action, how the state of the switch's forwarding table change and identify the link(s) on which the transmitted frame will be forwarded (+ briefly explain why) .

## Address allocation and ARP

Consider three IP subnets interconnected by two routers (R1 and R2) as shown in Figure 1.
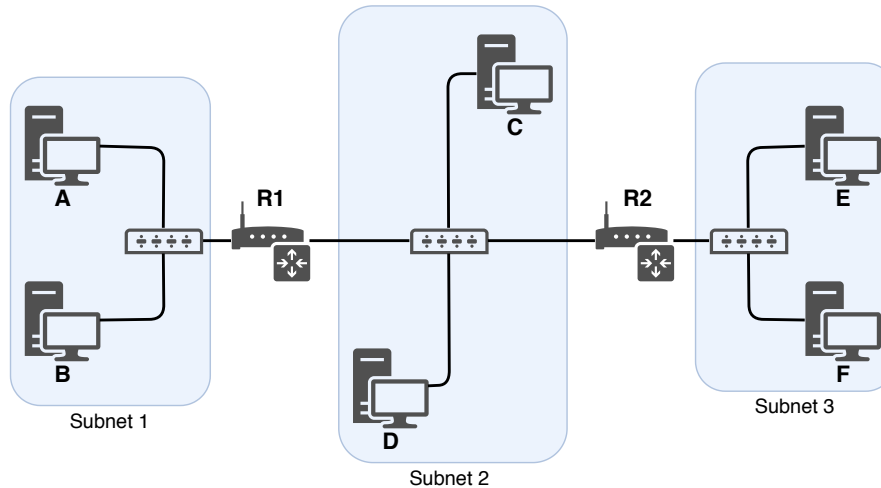


Figure 1: Three subnets, interconnected by routers

- Assign an IP address to each network interface of an end-system and router. Allocate addresses from IP prefix 192.168.1.0/24 for Subnet 1, 192.168.2.0/24 for Subnet 2, and 192.168.3.0/24 for Subnet 3.

- Assign a MAC address to each network interface.

- End-system E wants to send a packet to end-system B. List all the steps needed for the packet to be sent to B.
  Assume that the forwarding tables of all switches already have entries for all MAC addresses, and all end-systems and routers already know each other's MAC addresses.

- Now assume that end-systems and routers do NOT previously know each other's MAC addresses (but the forwarding tables of switches still have entries for all MAC addresses). What additional step(s) are needed for the packet to be sent to B?

Intermediate

Assume we changed the topology as shown in Figure 3. We replace the router between Subnets 1 and 2 with a switch S1, so now these subnets will become one subnet "subnet1-subnet2-merged". We also label the router between Subnets 2 and 3 as R1.
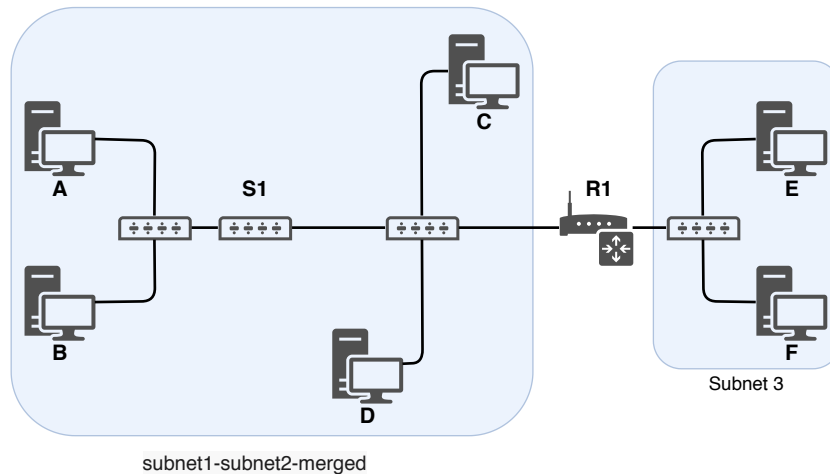
subnet1-subnet2-merged

Figure 3: the previous three subnets (now two), interconnected by switch or router

- End-system E wants to send a packet to end-system F. Is router R1 involved in forwarding the datagram? What are the source/destination MAC/IP addresses in the packet's Ethernet and IP headers?

- End-system E wants to send a packet to end-system B. E does not know B's MAC address. Will E send out an ARP request (before sending the actual packet) to learn B's MAC address? What are the source/destination MAC/IP addresses in the actual packet's Ethernet and IP headers?

- End-system A wants to send a packet to end-system B. Switch S1's forwarding table contains entries with B's and R1's MAC addresses only. Neither A nor B know each other's MAC address. Hence, A sends out an ARP request message before sending the actual packet.

  1. What will S1 do when it receives A's ARP request?

  2. Will router R1 also receive this ARP request? If so, will R1 forward the ARP request to Subnet 3?

  When end-system B receives this ARP request, it will send back an ARP response.

  3. Before sending this ARP response, does B need to send its own ARP request to learn A's MAC address?

  4. What will S1 do when it receives B's ARP response?

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## A wrap-up

You walk into a room, connect your laptop to an Ethernet outlet, and type in your web browser a URL of a web page. List all the messages/packets that you expect your laptop to send or receive until you download the web page. Assume that your laptop is configured with the IP address of a local DNS server, as well as the IP address of a default gateway (a router through which traffic from your laptop will exit the local IP subnet).