V 1.1 15ᵗʰ –May–2021

Universidad de León
Degree on Computer Engineering
Course on Computer Networks

Homework On LAN and IP Switching
Details about this homework submission are published in the agora

Exercises similar to those included in this homework assignment can be found in paloalto.unileon.es/cn under heading titled "Weekly Homework while on lockdown in year 2020 (For reference only))"

Exercise 1. The raw sockets that we have been using the past weeks provide access to the services offered by the datalink layer, in our case, Ethernet. In Linux, those sockets are created with the socket() syscall by passing it a protocol family of PF_PACKET; the type of socket can be selected from among SOCK_RAW and SOCK_DGRAM.

a. What's the technical name for the service interface that provides access to Internet Architecture layer 2, the IP layer? Is that *raw sockets,* also?

b. Type the C code that invokes the socket() syscall that will create a socket that accesses the IP layer interface.

c. Explain the meaning of the third actual parameter that you have passed to the socket call from the preceding question. Specifically, what's the relation of that 3rd parameter to the Internet Architecture? What kind of architectural element does this third parameter represent? That is, is it a layer? Is it a service? An interface, maybe? *What* is it?

Exercise 2.

a. Explain how you would program in C the sending of an Ethernet frame carrying a source MAC other than the transmitting NIC's.

b. Discuss the consequences of sending frames which source address is not that of the sending interface.

Exercise 3. Consider the extended LAN in fig. 1. Solve the following exercises:

a. Develop the evolution of the forwarding tables of all the switches as the following transmissions take place:

1. H_a sends a frame to H_g
2. H_a sends a new frame to H_g

3. H_c sends a frame to H_a
4. H_e sends a frame to the broadcast address
5. H_b sends a frame to the broadcast address
6. H_d sends a frame to H_e

b. Host H_b sends a frame which SRC MAC is that of H_g. Explain how H_b can do this assuming that it is running a Linux stack and have the forwarding tables updated after the said frame sending by H_b.

c. Now, H_a sends a frame to H_g. Update the forwarding tables and explain which hosts receive that frame.
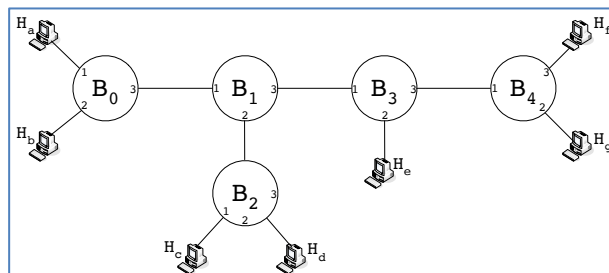

Figure 1. Extended LAN

Exercise 4. STP.

a. Obtain the *Spanning Tree* to the following Switched LAN comprised of STP Switches (B_i) and LANs (L_n).
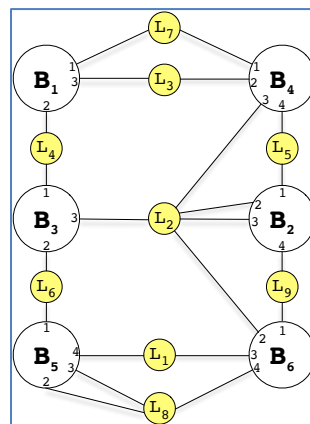

Figure 2. STP Switched LAN

b. Assume that the switches that comprise the extended LAN in fig. 2 don't implement STP. Devise a strategy for avoiding flooding storms in that Extended LAN altogether. Briefly, explain what changes to the LAN Switching algorithm should be necessary.

Exercise 5. EuroNet Associates needs to partition prefix P_a= 192.168.0.0/19 into 8 equal sized IP blocks for numbering their internal subnetworks.

    a. What's the size of P_a?
    b. Obtain the IP block parameters of P_a= 192.168.0.0/19. You may wish to use the Linux ipcalc utility.
    c. Divide size(P_a)/8. The resulting size is the size of each of the 8 resulting subnets. What's the CIDR prefix of each resulting subnet?
    d. What are the parameters of the first resulting IP block? (The initial IP address in prefix 192.168.0.0/19 is inherited by the first IP block resulting after the breakdown)
    e. Calculate the parameters of all the remaining IP Blocks (#0 - #7)

Exercise 6. Can IP blocks 192.168.211.0/24 and 192.168.212.0/24 be joined into a single IP block that encompasses both without adding additional space? Discuss why and do the joining if possible.

Exercise 7. Complete the forwarding table of Router R1 so that it can *efficiently* forward traffic to all networks included in the internetwork diagram in Figure 3.
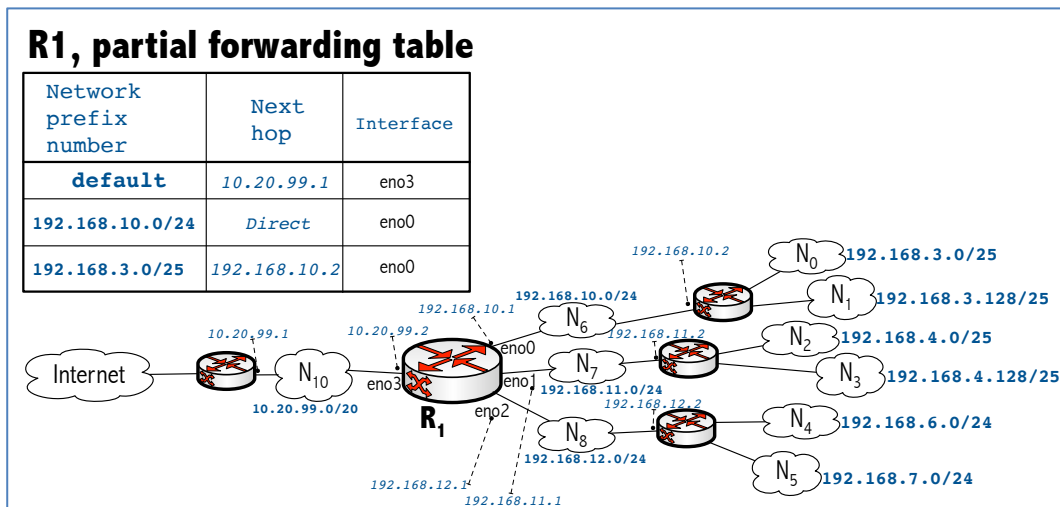

Figure 3. Internetwork

Exercise 8. Explain the trip of an IP packet that is transmitted from host 10.20.99.10 to host 192.168.12.12. Give meaningful symbolic names to the relevant MAC addresses, which are missing on the diagram, for example the MAC used by the transmitting host can be represented as MAC_{H1}.

Exercise 9. An IP router has built the following forwarding table and at some instant it receives an IP packet P which destination IP is 10.20.76.100. Simulate the execution of the *Longest Prefix Matching* algorithm when the router is switching P. Clearly indicate the router interface selected for the retransmission of P. Assume no ordering whatsoever in the forwarding table entries.

Dest Network Prefix	Next hop	Interface
192.168.1.0/24	Direct	enp1s0
192.168.2.0/24	Direct	enp2s0
192.168.3.0/24	Direct	enp3s0
10.20.77.0/24	192.168.2.1	enp2s0
10.20.76.0/25	192.168.1.1	enp1s0
10.20.76.128/25	192.168.1.1	enp1s0
10.20.76.128/25	192.168.3.1	enp2s0
10.20.76.0/24	192.168.1.1	enp1s0
10.20.76.0/23	192.168.1.1	enp1s0

Table 1. Forwarding table

Exercise 10. Given the following Internet autonomous system based on the OSPF protocol, calculate the SPT (Shortest Path Tree) of router A by applying the Dijkstra's algorithm.
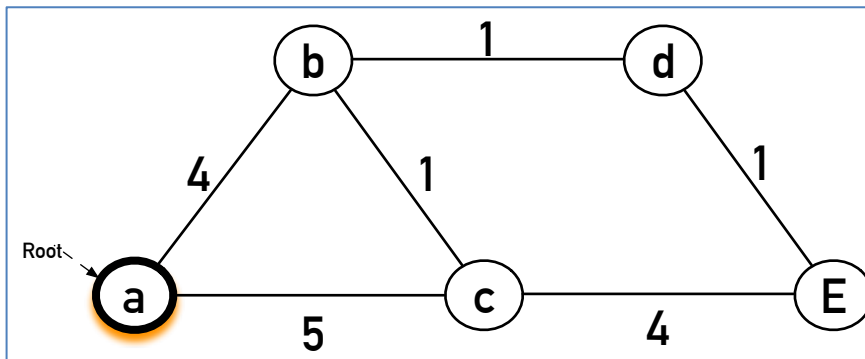

Figure 4. Internetwork