Universidad de León
Bachelor Degree on Computer Science and Engineering
Course on Computer Networks

Weekly Homework no. 5 (WH5-Lecture)

Note that this WH covers only the material given in the Lecture of Thursday 30th – April-2020. ***WH5-Practice*** *will be published on Saturday 2nd-May-2020.*

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Format: Only **pdf** format is accepted. Include your name and ID in the document.

--- Study Guide ---

1. **To be read carefully**: These weekly homework assignments do count to the supplementary component of your final grade according to the official Course Guide updated on 21st-April. The Weekly Homework is a valuable means for you to remain fully involved with the course while away from campus.

2. At all times, have the textbook by Peterson & Davie at hand. Most of the material that we have taught so far belongs in book chapters 1 and 2. Find the 6th edition to the book, here:

   https://github.com/SystemsApproach/book/releases/download/v6.1/book.pdf

3. A key resource as you study the lessons contained in the assigned presentations is the Questionnaires, which you can find at the following link under section titled "Questionnaires"

   http://paloalto.unileon.es/cn/

4. Check out the Questionnaires that are to be solved this week and which are listed in the deliverables section, below. By this time, all the course topics needed for these questionnaires have been taught in the Lectures or proposed for self-study while we are away from campus.

Try to resolve the relevant exercises on your own; only after working your solutions is it acceptable to consult the solutions published in paloalto.unileon.es/cn. I may ask you to submit your personal solution to some exercise from some Q in which case I expect that you add some value to the solution that was already published by me.

5. If you need assistance, contact me via the email given above; I recommend that you send your comments and your questions to the **class forum** in the Agora.

Weekly Homework (WH_5)

*This section **is** to be included in your homework submission. These exercises will be assessed. You must submit your original work and cite sources in case you used some.*

Base documentation

1. **Lecture slides:**

   http://paloalto.unileon.es/cn/lect/CN-LAN-Switching.pdf

2. **Various CN Questionnaires and past exams at paloalto.unileon.es/cn**

Exercises and examples about the lectures

1. **MAC addressing**

   a. Would it be useful to avail a NIC that has no MAC address?

   b. Commercial NICs have only one MAC address stored in stable storage. Is that MAC unique?

   c. Can additional MAC addresses be stored in the NIC, is that technically possible?

2. **The Destination MAC of an Ethernet frame is ff:ff:ff:ff:ff:ff. This frame** is received by a NIC.

   a. Is the frame accepted by the NIC?

b. If it is in fact accepted, what will the NIC do with that frame if the receiving NIC is installed in a LAN Switch? Justify your answer and include the relevant protocol stack in it.

c. Again, if the frame is in fact accepted, what will the NIC do with that frame if the receiving NIC is installed in a Linux PC? Justify your answer and include the relevant protocol stack in it.

d. Regarding the preceding two questions and considering the context for this exercise, can you tell what protocol will be the ultimate destination for the frame's payload?

3. **Modern NICs offer an operation mode that allows the NIC to accept all** the received frames.

   a. **What's the technical name to that mode?**

   b. **Investigate what mechanisms are available to set the mode** referenced in this exercise.

   c. **What is the usefulness of setting a NIC in the mode referenced** above?

4. **In chapter 1, we introduced the Internet Architecture (IA) and explained** that Service Interfaces can be used by programmers when they want to access the services provided by a layer. What's the technical name of the *Service Interface* for accessing the Ethernet Datalink? Since Ethernet Datalink stands at IA Layer 1, in this question, we are referring to the Layer-1 Service Interface. In the conceptual protocol stack in Fig. 1, we are asking about SIF 1 (Service InterFace 1).

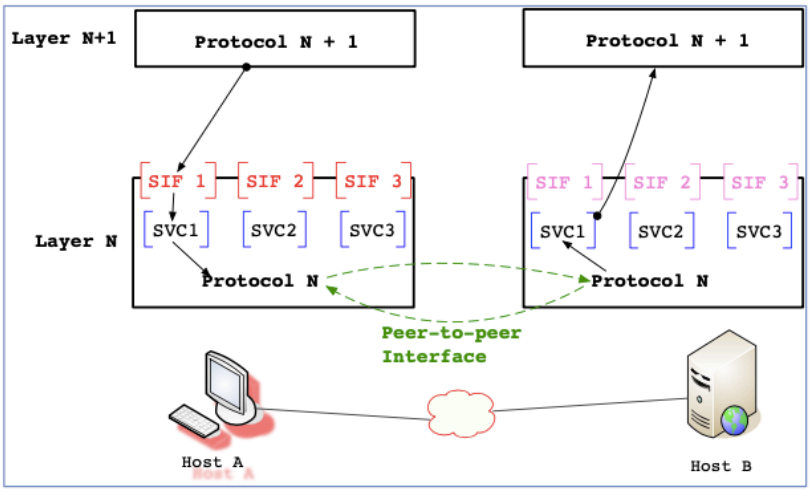

Figure 1. From lesson http://paloalto.unileon.es/cn/lect/CN-Ch1-2018-Section1.pdf

5. **The learning algorithm executed by a LAN Switch starts by recording** the Source MAC contained in each received frame.

   a. Discuss why that is what must be done

   b. Linux' Sockets PF_PACKET interface has two modes of operation available for the programmer to choose from (DGRAM and SOCK_RAW). When SOCK_RAW mode is chosen, the programmer can send whatever Ethernet header she wishes, including the Source MAC address. Using this mode, a frame can carry a *fake* Source MAC address. Discuss how this would affect a receiving switch learning algorithm.

   c. Discuss the usefulness of having a Learning Switch learn destination MAC addresses along with Source MAC addresses.

6. **Under what two circumstances does a LAN switch flood a frame?**

7. **LAN switching. Apply the LAN Switch learning algorithm explained** in slide no. 11 to the following exercises.

   a. The *Extended LAN* in **Fig. 2**. is comprised of bridges B_0 through B_3 and hosts H_a through H_f. When the whole Extended LAN is initialized, all the forwarding tables are empty, then, the following six transmissions are undertaken by the hosts. You are asked to **explain the evolution** of the forwarding tables of each bridge over the time it takes to complete the six transmissions.

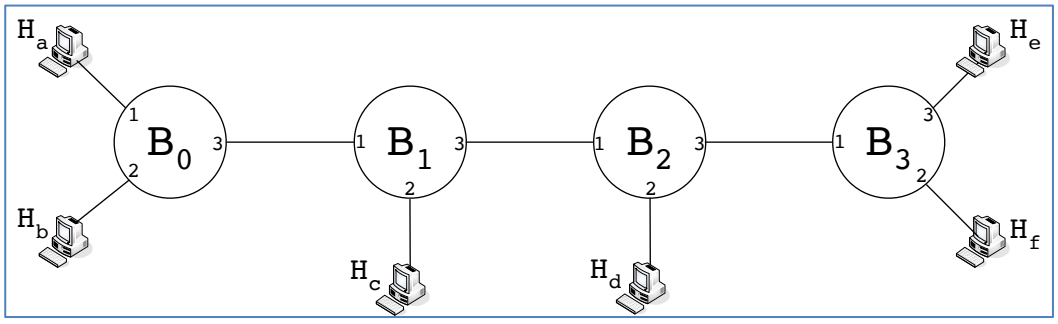

Figure 2. Extended LAN for exercise 2.a.

List of transmissions:

1. H_a transmits a frame to H_z which is not connected
2. H_f transmits a frame to H_e
3. H_e transmits a frame to H_f
4. H_c transmits a frame to H_b
5. H_a transmits a frame to H_c
6. H_b transmits a frame to H_c

b. Consider now the Extended LAN in **Fig. 3** which is the same as that in **Fig. 2** but having a loop between bridges B_1 and B_2. Do the same calculations that you did in the preceding case. Have you found some instability in the evolution of the forwarding tables?

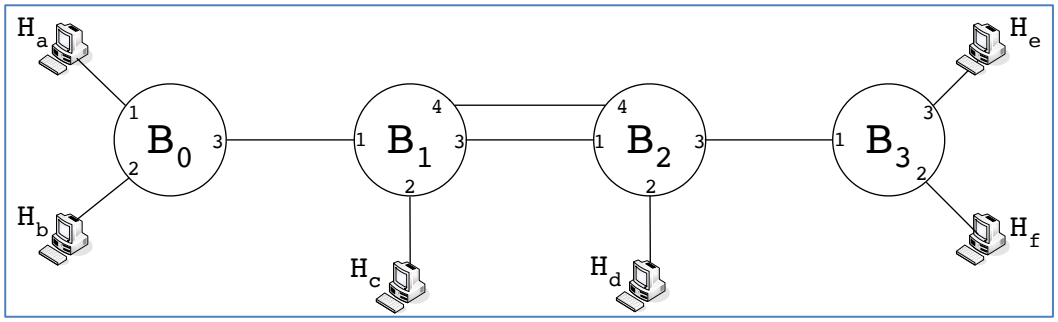

Figure 3. Extended LAN for exercise 2.b.

c. According to the results obtained, would you choose the Extended LAN in **Fig. 3** on the basis that it contains a redundant link which would prevent some failures from affecting the connection between B_1 and B_2. Explain your answer.

8. **A network is comprised of shared medium Ethernet segments S_1-S_4, each** connected to one port of a 4-port switch. Respond to the following questions:

   a. Draw a diagram of the resulting Extended LAN

   b. Host H in segment S_1 sends a frame which destination MAC is that of broadcast, explain which hosts will receive that frame

   c. How many broadcast domains there exist in the network?

   d. How many collision domains there exist in the network?

9. **What is a broadcast storm?**

   a. Why are broadcast storms to be avoided, altogether?

   b. What protocol/algorithm is used to prevent that broadcast storms occur?

10. **Thoroughly review the bridge learning/switching algorithm in slide** no. 11 of the lesson presentation above, then, solve the following textbook exercises (From P&D 5th edition -*not from the 6th edition*):

a. P&D 5th edition, Chapter 3, Exercise 17. **Find this exercise, solved in Spanish, in this URL in page number 8, exercise number 4 (Compose your solution in English):**

`http://paloalto.unileon.es/cn/notes/CN-ExRefSol2013.pdf`

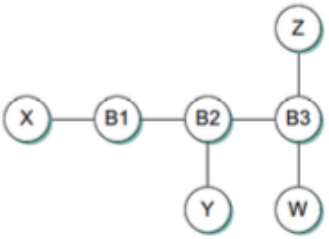

Figure 4. Extended LAN for exercise 10.a.

b. P&D 5th edition, Chapter 3, Exercise 15. **Develop** the evolution of the Forwarding Tables of each switch (B1, B2, B3 and B4) in the Extended LAN in **Fig. 4** as the ensuing frame transmissions take place (A, C and D are hosts):

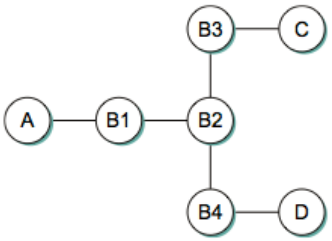

Figure 5. Extended LAN for exercise 10.b.

Transmission at t_0: A sends a correct frame to C. *Since the forwarding tables are empty now, B1 will flood the frame sent by A, therefore all switches learn A.*

Transmission at t_1: C sends a correct frame to A: *B3 learns C and, since it knows A, it will forward the frame to B2, which will forward it to B1, from which will be eventually delivered to A. Switches B3, B2 and B1 learn C.*

Transmission at t_2: D sends to C a correct frame: *B4 learns D, and since B4 has not learned C so far, B4 will flood this frame, thereby causing B2 to learn D. B2 will forward the frame to B3 which will learn D ,and finally, the frame will be delivered to C.*