

Weekly Homework no. 3 (WH₃)

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Published on: 3rd - April- 2020

Submission date: 17th-April-2020

Submit via: foces.informatica.unileon@gmail.com

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 grade to Term 1, note Weekly Homework does not count to the passing grade which is based exclusively on the official exams. The Weekly Homework is a valuable means for you to remain fully involved with the course while away from campus, moreover, each WH assignment contributes to the supplementary component of your grade.
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.
6. For the first time in the distance education mode for this course, the weekly homework (WH) contains a block of *practice exercises*. Make sure that you fully understand the procedures to *access the remote network* in Lab B6 which are explained right below.

Instructions for accessing Lab B6 Remote Network

I have configured a subnet in Lab B6 for remote access so the students enrolled in CN in 2020 can do their practices in an environment that resembles as much as possible the physical lab network environment. Note, however, that you'll not be able to access the Internet back from the internal network; this is so for reasons related to keeping the network safe from a cybersecurity standpoint. Nevertheless, the internal network will result sufficient for your practices that we have to complete in April. For the month of May, I'll redesign it and will let you know about the changes on time for the new practices. For this time, please, be patient and send me feedback quickly in case something is not operating as expected.

Access to Internal Network 2 (Net₂) in Lab B6 entails a simple ssh connection to paloalto.unileon.es at TCP port 50500. The ssh tunnel initiated in Net₁ will forward your ssh connection request to host 192.168.86.11 in Net₂, transparently. Host with IP address 192.168.86.11 is your access point to Net₂. That address is a private address which is not *directly accessible* from Internet, consequently, if you attempt to access it from a general location in Internet, the results will be undetermined. These facilities will be available on **Thursdays** (From **16:00 to 20:00**) or upon request to foces.informatica.unileon@gmail.com. Since Thursday 9th-april-2020 is a holiday, I will open the remote access to Lab B6 the following dates and times as a compensation:

- Monday the 6th/April from 12:30 to 14:30
- Tuesday the 7th/April from 12:30 to 14:30
- Wednesday the 8th/April from 12:30 to 14:30.

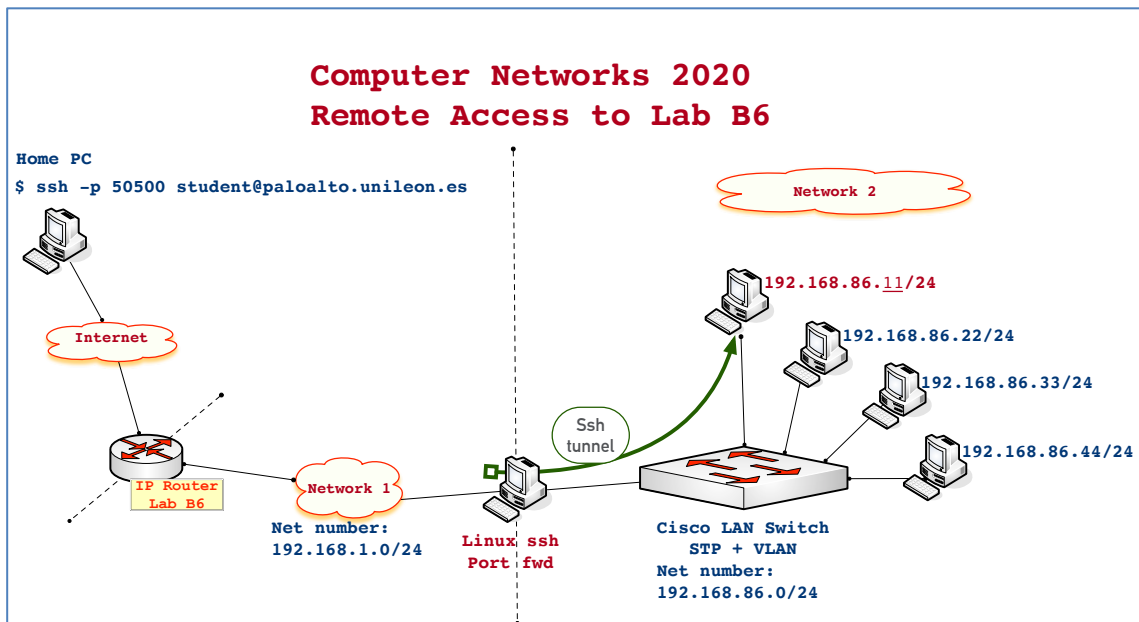


Figure1. Network 2 offers 4 hosts for practicing programming with Raw Sockets

Test the connectivity with Net₂ from your Linux host at your home by following this outline:

1. Let's connect with Net₂, now, by composing the following command in a terminal window in your Linux -note, you will have to replace student0 by your real login name at host 192.168.86.11. In practice 1 (Network Interfaces, etc) you can find examples about ssh and scp (Assume the shell prompt in your Linux host is [my pc] \$):).

```
[my pc] $ ssh -p 50500 student0@paloalto.unileon.es
```

2. When prompted, type your password. Now, you can type several simple commands to acquaint yourselves with the Linux system in this host. Observe the results are what you expect:

```
[internal 11] $ id
[internal 11] $ whoami
[internal 11] $ who
[internal 11] $ pwd
[internal 11] $ date
[internal 11] $ ifconfig
[internal 11] $ uname -a
```

3. Break your connection by composing the combination ctrl-D or by typing the exit command:

```
[internal 11] $ exit
```

4. Net₂ is not connected to Internet except via the ssh tunnel, consequently, you will not be able to download files from any host within it, however, you can upload files to your account in host 192.168.86.11. Fortunately, the ssh tunnel allows ssh virtual terminal connections *and* also scp remote copying of files -both, ssh and scp use the same application protocol, ssh. Let's upload a local file *myfile* to your account in 192.168.86.11:

```
[my pc] $ ls  
myfile
```

```
[my pc] $ scp -P 50500 myfile student0@paloalto.unileon.es:copyofmyfile
```

5. Type your student0 password when prompted to do so.

Now, let's check that the file was successfully uploaded. We'll connect again with host 192.168.86.11 in Net₂:

```
[my pc] $ ssh -p 50500 student0@paloalto.unileon.es
```

6. When prompted, type your password, observe the prompt from the remote host and check the file was successfully uploaded:

```
[internal 11] $ ls  
copyofmyfile
```

7. Close your session:

```
[internal 11] $ exit
```

So far, we have checked the connectivity with host 192.168.86.11 in Net₂ by using ssh and scp commands. Now, we are ready to do the practice exercises for WH₃.

Weekly Homework (WH₃)

This section is to be included in your homework submission. These exercises will be assessed and will count to your Term 1 supplementary grade (Not toward the pass grade but only to the supplementary grade). You must submit your original work and cite sources in case you used some.

Base documentation

1. **Presentations for sections 1 and 2 from Chapter 2**, corresponding to the lecture of last Thursday:

<http://paloalto.unileon.es/cn/lect/CN-Ch2-2020-Section1.pdf>
<http://paloalto.unileon.es/cn/lect/CN-Ch2-2020-Section2.pdf>

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

Exercises and examples about the lectures

1. **What sentinel marks the end-of-frame in an Ethernet frame?** Explain your answer.
2. **Hosts A and B are located at the edges of an Ethernet network that has a length of 2500 m.** What is the network Rtt attained when A sends a few bits to host B?
3. **How many bits can host A (Or any other host) can send in an period of time equal to the Rtt?** Recall that the transmission speed in the original Ethernet is 10 Mbps.
4. **One of the stations that comprise an HDLC point-to-point link wishes to transmit the bit-string 10111011011110101010** to the station on the other end. Explain what the transmitter sends on the line and what the receiver's behavior is.
5. **Explain the transparency mechanism used in the BiSync protocol.**
6. **What sentinels are used in the HDLC protocol? What do they mark?**
7. **What is the organization responsible for managing the allocation of 802.3 MAC addresses? What three types of MAC addresses exist? Explain the purpose of each type.**

Practice Exercises

8. **Getting acquainted with Net₂.** The internal network is actually a subnet of the whole Lab B6 network. It contains 4 Linux hosts. Host 192.168.86.11 is the only one that can be remotely accessed via the tunnel. In the periods of time when access to Net₂ is permitted, the other hosts (192.168.86.22, 192.168.86.33 and 192.168.86.44) will not necessarily be powered up. If you need to power up some of those hosts for doing the practice exercises, you'll have to send it a particular ethernet frame conventionally known as *Magic Packet*. We'll build a simple program for sending the magic packet on WH₄; for the time being, we'll simply use a program that sends the magic packet to the MAC address of the NIC used by host 192.168.86.22 (The file name to this program is `send-magic-`

to-22). Program `send-magic-to-22` will help you get acquainted with the magic packet technology in preparation for WH₄.

9. **Download program `send-magic-to-22` to your own home pc host.** We want to check the standard structure of a magic packet with Wireshark. Start a new Wireshark trace and enter the display filter “Wol” (Wol stands for Wake-On Lan, which represents the possibility of waking up a PC remotely when you send it a Magic Packet).
10. **Run `send-magic-to-22`.** The program will request that you include in the command line the name of the network interface that is to be used for sending the magic packet through. You need root privileges to run this program since it creates a *datalink pf_packet raw socket*, then execute it with `sudo`.
11. **Include a screen dump illustrating the trace that Wireshark captured.** The trace should be limited to *magic packet*; as we commented above, you enter a Wireshark display filter “wol”. Highlight the Ethernet destination address contained in the relevant frame.
12. **A magic packet is intended to power up (Or, wake up, if you will) a computer in your local network.** The payload of a magic packet contains 16 copies of the MAC address of the network adaptor used by the computer you want powered-up. Check that the WS trace that you obtained actually contains the 16 copies of the destination MAC address.
13. **Instead of doing `sudo` for executing `send-magic-to-22`,** you can alternately assign `send-magic-to-22` the capability of creating raw sockets. After you assign a program a capability, you can execute it without `sudo` or without any other form of superuser execution, as far as the concrete capability is concerned. You can simply type the command name and it will run and report no error related to the program’s having that capability. In Linux, you can attribute a file a capability with command `setcap` as in the example that comes next. A capability, in fact belongs to a running thread which can inherit the capability from an executable file. In our case, we’ll apply the `CAP_NET_RAW` capability to program `send-magic-to-22` by executing the following command¹:

```
[my pc] $ sudo setcap 'CAP_NET_RAW=epi' send-magic-to-22
```

14. **Now, you can execute `send-magic-to-22` directly.** Check that you can execute the `send-magic-to-22` program without `sudo` and capture the WS trace again, which should be exactly equal to the one that we obtained in the exercise no. 10. The execution of `send-magic-to-22` should power-up no pc in your home network, because, the MAC address sent by the program should not be used by any host network adapter except a specific host in Net₂. Next week, I’ll show you how you

¹ Check out POSIX capabilities by skimming the man page for capabilities(7)

can power up any pc in Net₂ by programming in C the sending of the *magic packet*. Note that for you to be able to power up on of Net₂ pc's, the program that you execute must have capability `CAP_NET_RAW`, and the assignment of capabilities can only be done root or an equivalent user. In Net₂, student's login users cannot change a program's capabilities like we did above, however, somehow, I will myself do it for you whenever you need it, flexibly, comfortably and *securely*. Next week.

15. **In the traces that you have obtained in the preceding steps**, what is the SRC MAC address contained in the magic packets. Is it the MAC address of your NIC? Check it with `ifconfig`.
16. **Tell the ethertype contained in the WS captures**. Is that ethertype reserved? Conduct a search in IANA to see whether the ethertype value is reserved or not. Write down its value in Hex.