

Practical Exercises 3

Surname: Hejhal

Name: Jakub

Degree (Ing. del Software/Ing. Informática/Ing. Computadores): Erasmus

Group (A/B/C): B

Exercise 1 (MAC/Linux). The command *ifconfig/ip* in MAC/Linux shows information about the network interfaces of your machine. Execute the following commands in a command shell:

MAC: `ifconfig; netstat -rn | grep "UGS" | awk '{print "Pasarela: " $2}'`

Linux: `ip ad sh; ip ro sh | grep "default" | awk '{print "Pasarela: " $3}'`

Search the information of your physical NIC, IP, netmask and default gateway. Write down the name of the NIC (the first word before the configuration information, it is usually like ethX, wlpXsY, enpXsY, enxX...) because we will use it for the next exercises (we refer to it as **Description**). What is the identifier of your network?

NIC id: wlp2s0

IP: 192.168.0.56

Mask: /24

Default Gateway: 192.168.0.1

Network ID: 192.168.0.0

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Exercise 2. Check the network information in Linux using the command `ifconfig` in a command shell. The output of this command shows the configuration of two NICs: one named **lo** and another whose name could vary (in the following, we will refer to this NIC as **realNIC**). Check the information of **lo**, what is the purpose of this NIC? Analyze the information of **realNIC**, taking into account its IP address and its netmask, is the virtual machine in the subnetwork (IPv4) of the host machine? Why?

The **lo** interface is a special, virtual NIC that computer uses to communicate with itself. All traffic sent to 127.0.0.1 is delivered to the computer itself.

RealNIC id: `enp0s3`

IP: `192.168.0.154`

netmask: `/24`

default gateway: `192.168.0.1`

Is the virtual machine in the subnetwork (IPv4) of the host machine? Why?

No, it's in the same network, because we selected the bridge mode in the Vbox setup. Bridge mode means Vbox will try to simulate hardware switch, so it will seem as if VM was physically connected to the same LAN as host PC.

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Execute the following commands (replace the work **realNIC** with the identifier of the NIC that you have found in exercise 2):

```
sudo /etc/init.d/network-manager stop
sudo kill -9 `cat /run/dhclient-realNIC.pid`
sudo ip address flush realNIC
sudo rm /etc/resolv.conf
```

The first command disables the network service, the second command disable the DHCP client, the third command frees the current IP of the NIC, and finally, the last command remove the configuration of the DNS protocol.

Exercise 3. Execute the ifconfig command again. What is the IP/netmask of **realNIC**? Why?

It doesn't have assigned IP/netmask, because we stopped the network-manager service along with the DHCP client, which is responsible for configuring the network interface corretly with IP, subnet mask, default gateway and DNS resolution server

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| **Exercise 4.** Configure the IP and the subnet mask in Linux with the following command:

| **sudo ifconfig realNIC ipAddr netmask mask**

| The values of **realNIC**, **ipAddr** and **mask** are the same of the exercise 2.

| [sudo ifconfig enp0s3 192.168.0.154 netmask 255.255.255.0](#)

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Exercise 5. Try to make a ping to each of the following hosts: (i) loopback (127.0.0.1); (ii) IP of your host machine; (iii) IP of your default gateway; and a (iv) machine outside the network (informatica.cv.uma.es and **150.214.54.249**). Which of them work and which do not?

Ping to loopback works

Ping to my host machine works as well

VM has no default gateway setup – routing table isn't setup correctly yet, it has no “default” record, so this question doesn't make sense, default gateway isn't defined yet.

Pinging machine outside of my LAN doesn't work (neither informatica.cv.uma.es nor 150.214.54.249)

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Exercise 6. The **route** command is used to look at host routing table and can be used to add or delete routes. Check the routing table (use the command **route**) of the virtual machine and reason about why some of the pings of exercise 5 work and others do not.

Loopback works, because loopback interface is always present regardless of the network configuration and 127.0.0.0/8 doesn't need any routes in the routing table

Ping to my host machine works because I set up the IP and subnet mask correctly and VM is set to work in bridged mode. It simulates the VM being connected to the same LAN as my host machine is connected to. Setting IP and subnet masks of an interface adds record to the routing table saying "send any traffic meant for network 192.168.0.0/24 directly to enp0s3"

Pinging informatica.cv.uma.es cannot work just yet because DNS resolution is switched off (we disabled DHCP, which would provide us with suitable DNS server)

Pinging 150.214.54.249 doesn't work, because VM doesn't have any default gateway setup and doesn't know how to route packets to 150.214.54.249. It only knows how to route 192.168.0.0/24 packets.

Exercise 7. To illustrate the use and functionality of the command *route* (/sbin/route), we can delete and add an entry to the routing table by doing the following:

- a) **Add entry (Direct delivery):** `sudo route add -net <net> netmask <mask> dev <device>`
- b) **Add entry (Indirect entry):** `sudo route add -net <net> netmask <mask> gw <gateway>`
- c) **Add entry (Default):** `sudo route add default gw <gateway>`
- d) **Delete entry (destination network):** `sudo route del -net <net> netmask <mask>`
- e) **Delete entry (default):** `sudo route del default`

Use these commands to make the following tasks:

- i) Add the default route using c) (use the same as your host machine). Check again the pings that failed in exercise 5 and explain why some of them now succeed.
- ii) Then, add to the `/etc/resolv.conf`¹ file the line `nameserver 8.8.8.8`. Do all the pings work now? Why do you think the pings formerly did not work, now work?

i) Default gateway is now defined, ip route says:

default 192.168.0.1 0.0.0.0 UD 0 0 0 enp0s3

So we can see our default gateway is 192.168.0.1

pinging default gateway works as expected, it is in our network 192.168.0.1/24 which we set up correctly.

Pinging 150.214.54.249 now works as well. VM now knows how to relay packet not meant for our LAN.

Pinging informatica.cv.uma.es still doesn't work, because DNS resolution is not setup.

ii)

Now everything works. We have set google's 8.8.8.8. server as our DNS nameserver and we can now resolve informatica.cv.uma.es and then ping the server.

¹ Use `sudo leafpad /etc/resolv.conf`

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Exercise 8. When a packet is sent outside your local network, the information of the routing table is queried two times.

1. To search the entry that corresponds to the final destination of the datagram. The destination is external to the subnet, so the datagram should be sent to the default gateway (the router).
2. To search the entry to reach our router (this entry will allow direct delivery of the datagram to the router because the router is in our subnetwork).

Check the routing table of your host machine (route PRINT -4 in Windows, netstat -rn in MAC and ip route show in Linux). Take a screenshot of the output routing table and highlight the following entries:

a) Entry that corresponds to the local interface network

b) Default entry

```
Terminal - fish /home/kubik
Welcome to fish, the friendly interactive shell
kubik@terminator ~-> ip route
default via 192.168.0.1 dev wlp2s0 proto dhcp metric 600
172.17.0.0/16 dev docker0 proto kernel scope link src 172.17.0.1 linkdown
192.168.0.0/24 dev wlp2s0 proto kernel scope link src 192.168.0.56 metric 600
kubik@terminator ~-> 
```


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Exercise 9. Develop a program to work with IPv4 addresses in dotted-decimal notation (X.X.X.X). The program receives as an input (or it requests to the user) an IPv4 address and do the following:

- a) To check that the address is valid
- b) To inform of the class of the IPv4 address (A, B, C, D or E).
- c) After a) and b), the program requests to the user the subnet mask (in prefix notation and it can assume that the mask is correct) and shows:
 - a. Subnet id
 - b. Broadcast address of the subnetwork
 - c. Number of IP available to identify hosts.
 - d. Range of addresses available for hosts (First host – Last host).

Example of use:

```
user@computer:~$ java P2 192.168.45.30 21
La IP es válida y de clase C
ID de red: 192.168.40.0
Máscara de red: 255.255.248.0
Broadcast: 192.168.47.255
Número de IPs para host: 2046
Rango: 192.168.40.1-192.168.47.254
```

Program is written in python3 and is named ip_info.py

Guidelines of the report

- Include in the same report all the exercises corresponding to Part 1.
- The front page must inform about: (i) list of the exercises included; (ii) data that identifies the student (i.e. name, group, etc). Please **use the template** provided in the Campus Virtual
- In the screenshots (using <alt>+<impr pant>) the student must mark those parts corresponding to what is requested by the exercise (using a drawing utility). Also add a brief text explaining what is shown.
- The student must upload the report in PDF.
- Upload a .zip file with the report and the file .pcap with the trace of the captured packets. Note that the report of practical exercises 1, 2 and 3 must be uploaded in the same .zip file.
- The report should include an explicative schema detailing the most significant parts of the code. You must deliver the source code (in independent files) jointly with the report.