# XC entrega 1

## Problema 1 (examen 2017+ c1)

a) N1 = 13 → 4 bits
N2 = 8 → 3 bits
N3 = 20 → 5 bits
N4 = 10 → 4 bits
N5 = 24 → 5 bits

$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$

| Xarxa | NetID | HostID | Dir. de red | Broadcast |
|---|---|---|---|---|
| | 160.0.0.1 | xxx xxxx | | +($2^5$ - 1) |
| N5 | 160.0.0.1 | 01x xxxx | 160.0.0.128/27 | 160.0.0.159 |
| N3 | 160.0.0.1 | 10x xxxx | 160.0.0.160/27 | 160.0.0.191 |
| N4 | 160.0.0.1 | 001 xxxx | 160.0.0.192/28 | 160.0.0.207 |
| N1 | 160.0.0.1 | 000 xxxx | 160.0.0.208/28 | 160.0.0.223 |
| N2 | 160.0.0.1 | 110 0xxx | 160.0.0.224/29 | 160.0.0.231 |

## Problema 1 col·lecció

a) En libreta

b)

192.168.8.64 = 32 - 6 = /26

0000 1000 . 0100 0000

6 bits

N. assig IP = $2^6$ - 2 = 62

Pq -2 ?

128 = 1000 0000 → 32 - 7 = /25

7 bits

N. assig IP = $2^7$ - 2 = 126

... 0000 1000 . 1000 0000 = 8.128

↳ 128 + $2^7$ = 256

32 - 8 = /24

0000 0001 0000 0000
... 1000 . ...

9 0000 0000

8 bits

c) mask/18

32 - 18 = 14

$2^{14}$ = 16384 →

Net pref: 80.80.128.0/18

0101 0000 . 0101 0000 . 1011 0101 . 1011 0010

14 bits → to 0 to get network

,255

Network → los bits de h a 0
Broadcast → los bits de h a 1

c) Network = 80.80.128.0/18
Broadcast = 80.80.191.255
HostMin = 80.80.128.1
Host Max = 80.80.191.254
Hosts INet = 16382 → $2^{14} - 2$

## Problem 1 2018p-c1

a)

| | | |
|---|---|---|
| RAe1 | 192.168.0.0/30 | 192.168.0.1 - 192.168.0.2 |
| RAe2 | 192.168.0.4/30 | 192.168.0.5 - 192.168.0.6 |
| RBe0 | 192.168.0.8/30 | 192.168.0.9 y 0.10 |
| RBe1 | 192.168.0.12/30 | 0.13 y 0.14 |
| RCe3 | 192.168.0.16/30 | 0.17 & 0.18 |
| RCe4 | 192.168.0.20/30 | 0.21 & 0.22 |

# Unit IP Protocol

**Problem 1.** *(2014p-c1)*

We have the private address bloc 192.168.8.0/22. The network manager defines a sub-network X1 with the network prefix 192.168.8.0/26

a) How many IP interfaces can be configured? Which is the range of IP addresses that may be assigned?

① 32 - 22 = 10 → $2^{10} - 2 = 1022$ → 192.168.8.1 - 192.168.11.254

② 32 - 26 = 6 → $2^6 - 2 = 62$ → 192.168.8.1 - 192.168.8.62

Once sub-network X1 is defined, make the addressing plan splitting the rest of the address bloc with the minimum number of sub-networks; that is with the biggest network size.

b) Complete the following table with all the sub-networks.

| Sub-Network | Sub-Network prefix | Mask /n | Number of assignable IP addresses | Address for the sub-network router |
|---|---|---|---|---|
| X1 | 192.168.8.0 | /26 | 62 | 192.168.8.1 |
| ~~X2~~ | 192.168.8.64 | /26 | 62 | 192.168.8.65 |
| X3 | 192.168.8.128 | /25 | 126 | 192.168.8.129 |
| X4 | 192.168.9.0 | /24 | 254 | 192.168.9.1 |

+ $2^6$

Sub-network X1 is connected to the Internet through router R1, as shown in the figure.

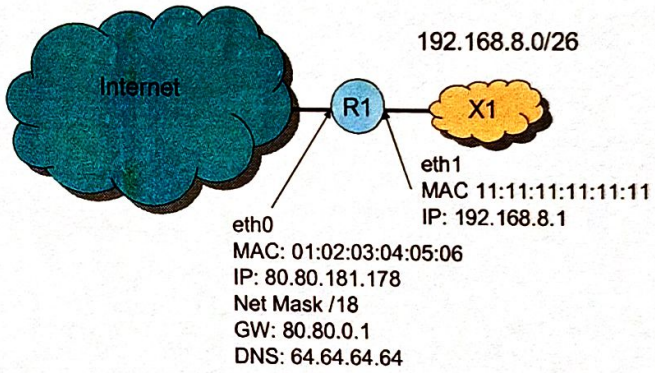
c) Considering the configuration of the interface eth0 shown in the figure, which is the network prefix?

Give the network prefix using the decimal dotted / mask notation to which the address 80.80.181.178/18 belongs.

Which is the "broadcast" address for this sub-network?

Net prefix = 80.80.128.0 / 18

Broadcast = 80.80.191.255




d) Complete the routing table for router R1:

| Destination network | Mask /bits | Router (IP gw) | interface |
|---|---|---|---|
| 192.168.8.0 (X1) | 26 | 192.168.8.1 | eth1 |
| 80.80.128.0 | 18 | 80.80.0.1 | eth0 |

↳ 80.80.181.178 que es IP gw

R1 performs NAT (sub-network X1 has private addresses). R1 is the DHCP too and allows automatic configuration of the terminals in X1.

Terminal A belongs to sub-network X1 and executes the command "ping www.upc.edu".

Terminal A IP address is 192.168.8.8, its MAC address is aa:aa:aa:aa:aa:aa, and its ARP table is empty.

Be aware that R1 performs NAT. DNS will answer that the IP address for UPC's web server is 147.83.2.135.

e) Complete the following table with the sequence of frames and IP datagrams transmitted through router R1until the first "echo" response comes back to terminal A.

For the sake of simplicity, use the following notation for the pairs IP address and MAC address:

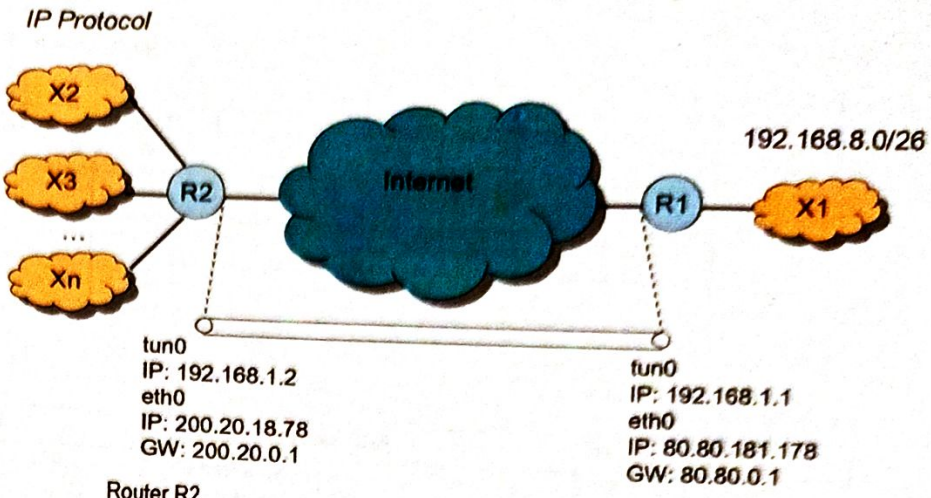
Terminal A: A, a. Router R at interface eth0: R0, r0. Router R at interface eth1: R1, r1. DNS server: D, d.

ISP router (GW): G, g. Web server at UPC: U, u.

| Ethernet Header | | ARP Message | | IP Header | | IP packet |
|---|---|---|---|---|---|---|
| MAC source | MAC destination | Type Req/Resp | Solicited IP address | IP source | IP destination | Contents |
| | | | | | | |
| | | | | | | |

?

Sub-network X1 is connected with the rest of sub-networks X2 ... Xn through the Internet, as shown in the figure. To do this, a tunnel is configured between routers R1 and R2.




f) Complete the routing tables for routers R1 and R2.

Router R1

| Destination | Mask /bits | Router (IP gw) | Interf. |
|---|---|---|---|
| 192.168.8.0 (X1) | 26 | 192.168.8.1 | eth1 |
| | | | |

Router R2

| Destination | Mask /bits | Router (IP gw) | Interf. |
|---|---|---|---|
| 192.168.8.0 | 26 | 192.168.8.1 | tun0 |
| | | | |

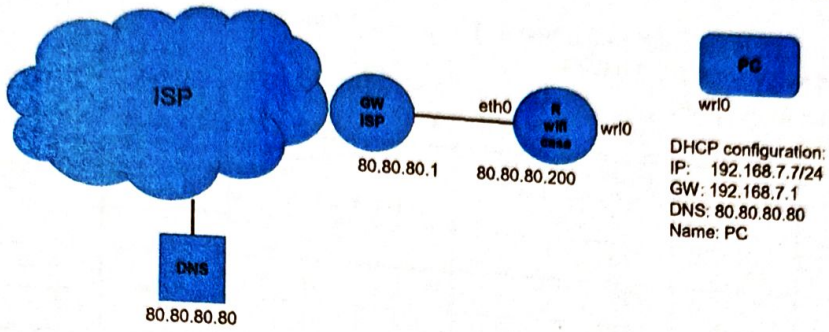
Terminal A (192.168.8.8) executes the command "ping 192.168.9.33".

g) Show the contents of the IP datagram going through the Internet. Be aware of the NAT and tunnel configurations.
Include the IP headers (IP source address, IP destination address) of the datagram in the Internet going from router R1 to router R2.

| External IP header | | Internal IP header | | |
|---|---|---|---|---|
| IP source | IP destination | IP source | IP destination | protocol |
| 80.80.181.178 | 200.20.18.78 | 192.168.8.8 | 192.168.9.33 | |

**Problem 2.** **(2015p)**

The figure shows a domestic network with and ADSL/cable router (**Router wifi casa**). The domestic network is WLAN using private IP addresses. PC is a wireless device; its interface is **wrl0** and uses DHCP for its configuration. The figure shows its configuration. The **router wifi casa** has two interfaces: the internal one WiFi (**wrl0**) and the external one to the ISP (**eth0**). The assigned IP addresses are shown in the figure.




a) Complete the routing table for *router wifi casa*.

| Destination network | Mask | Gateway | Interface |
|---|---|---|---|
| 192.168.7.0 | 24 | 192.168 | wrl0 |

b) The PC uses DHCP for its configuration. Show the sequence of **packets** exchanged between the PC and the DHCP server, which is located in *router wifi* casa.

| Source | Destination | Protocol | Transport protocol | DHCP Message |
|---|---|---|---|---|
| 0.0.0.0 | 255.255.255.255 | DHCP | UDP | Discover |

c) Complete the routing table of the PC once it is completely configured.

| Destination network | Mask | Gateway | Interface |
|---|---|---|---|
| 192.168.7.0 | 24 | ? | wrl0 |

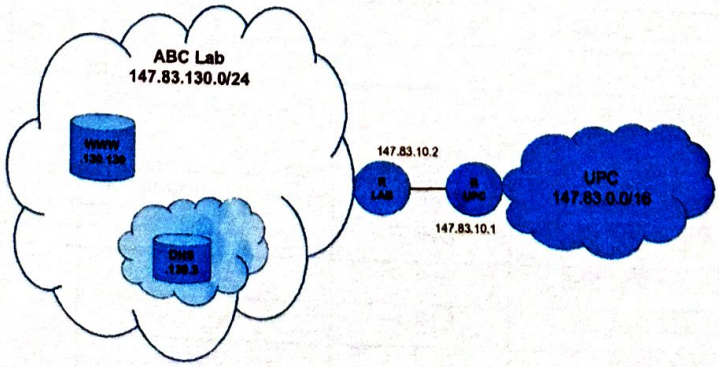
d) After the configuration of the PC, ARP and DNS tables are empty. From the PC, the user accesses "www.abclab.upc.edu". Complete the **sequence of frames** observed at the router interfaces **wrl0** and **eth0** until the **first TCP segment arrives from UPC server.**

Assume that the router is on since a long time ago. Take into account that the router performs PNAT.

Use the following natation: PC (192.168.7.7), wpc (PC's MAC address), RI (192.168.7.1), wri (internal interface MAC address), R (80.80.80.200), r (external interface MAC address), GW (80.80.80.1), gw (MAC address of the ISP's router), UPC (IP address of the web server), DNS (80.80.80.80), 53 for the DNS server's port, 80 for HTTP server's port, and P1, P2, P3, P4 for the NAT's dynamic ports.

| Router Interface | Ethernet | | | IP | | | | | Message Information |
|---|---|---|---|---|---|---|---|---|---|
| | Source | Destination | ARP Message | Source | Port | Destination | Port | Protocol | |
| | | | | | | | | | |
| | | | | | | | | | |

The figure shows the network at UPC's ABC Lab (147.83.130.0/24). Router RLAB connects ABC Lab to UPC's network. The IP address of the external interface of RLAB is 147.83.10.2.



e) The IP address assigned to the Lab's web server is 147.83.130.130/27.
What is its corresponding subnetwork (subnetwork address, broadcast address, and address for router RLAB)?
How many /27 subnetworks may be configured in the ABC Lab?

The subnetwork 147.83.130.192/26 is "moved" to the home. To do this, a tunnel is established between routers RLAB and router WifiCasa. The tunnel uses the subnetwork 10.0.0.0/30.

f) Complete the routing table for router RLAB.

que es Gateway

| Destination network | Mask | Gateway | Interface |
|---|---|---|---|
| 147.83.10.0 | /23 | | eth0 |
| 147.83.130.0 | /25 | 147.83.10.1 | eth1 |
| 147.83.130.128 | /26 | | eth2 |
| 147.83.130.192 | /26 | | eth3 |
| | | | |
| | | | |
| 0.0.0.0 | /0 | | eth4 |

g) Assume that ARP and DNS tables contain already the information needed. From the PC a user accesses the server "www.abclab.upc.edu". Complete the **sequence of frames** observed at the router's **wrl0** and **eth0** until **first TCP segment arrives from UPC server**.

Use the same notation than in d) plus RLAB (147.83.10.2).

| Router Interface | Ethernet header | | IP External header | | IP header | | | | | Message payload |
|---|---|---|---|---|---|---|---|---|---|---|
| | Source | Destination | Source | Destination | Source | Port | Destination | Port | Protocol | |
| | | | | | | | UPC | | TCP | |
| | | | | | | | | | TCP | |

h) In order to improve security the home network must have access to the Internet exclusively through the tunnel going via UPC ABC Lab. Assume that the routing table is configured accordingly. Complete the rules for the Firewall (ACL rules) for the interface eth0 of *router wifi casa*.

| Source IP | Source port | Destination IP | Destination port | Protocol | Action |
|---|---|---|---|---|---|
| RLAB | | home net | | ANY | ACCEPT |
| home net | | RLAB | | ANY | ACCEPT |

**Solution:**

a)

| Destination network | Mask | Gateway | Interface |
|---|---|---|---|
| 192.168.7.0 | /24 | | wrl0 |
| 80.80.80.0 | /24 (/x on 8 <= x <= 24) | | eth0 |
| 0.0.0.0 | /0 | 80.80.80.1 | eth0 |

b)

| Source | Destination | Protocol | Transport protocol | DHCP Message |
|---|---|---|---|---|
| 0.0.0.0 | 255.255.255.255 | DHCP | UDP | Discover |
| 192.168.7.1 | 255.255.255.255 | DHCP | UDP | Offer |
| 0.0.0.0 | 255.255.255.255 | DHCP | UDP | Request |
| 192.168.7.1 | 192.168.7.7 | DHCP | UDP | Ack |