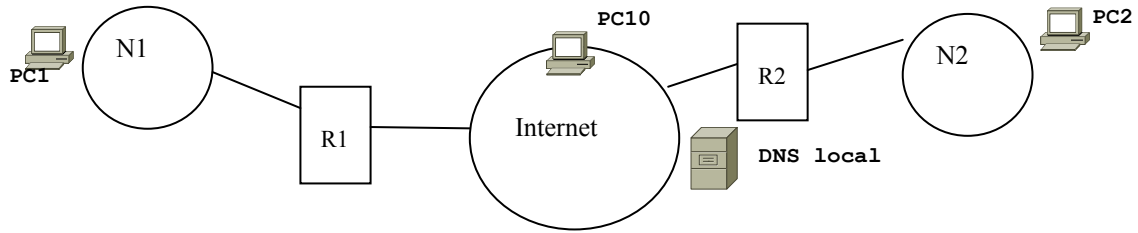


Group the problems 1 and 2 in separated sheets, and answer the problem 3 in the same questions sheet. Justify your answers. The review date will be announced in the Racó. Duration: 2h45. The quiz will be collected after 30 minutes.

Problema 1. (2,5 points) **FULL 1.**

We have the following configuration:



Networks N1 and N2 belong to organization O and are connected through a tunnel. In both networks we want to have sub-networks using the private addresses range 10.0.0.0/24. To configure the tunnel we want to use the address 192.168.0.0/24. On the other hand, the public interfaces of Routers R1 y R2 have been assigned addresses 200.0.0.1/24 and 200.0.0.2/24, respectively. The local DNS server of both N1 and N2 owns address 200.1.0.2, and PC10, which is out of N1 and N2 networks, owns address 200.100.100.100.

1) We want to design an address space for all the networks in organization O. In particular, we want to have, in N2, a sub-network with up to 100 machines and to use the rest of addresses to structure N1 with the highest possible number of sub-networks.

- 1.1) Provide the addresses and masks (with format “/n”) of all the sub-networks (N1 and N2). (Note: Assign addressess with lower numbers to the networks with more machines).
- 1.2) Which is the maximum number of sub-networks in N1?
- 1.3) How many addresses will not be assigned to any machine?

2) With the available information and with the needed justified assumptions, provide the routing table of Router R1, with the following format:

Destination network | Interface | Gateway | Metrics

3) If PC1 PINGS to PC2 (assuming that we already have all the needed information to send the ICMP output message),

- 3.1) Represent the structure of the first frame that will leave R1 towards PC2, including all headers and user data fields.
- 3.2) What will be the value of the following fields of the datagram header contained in the previous frame?:
 - destination address,
 - source address,
 - protocol,
 - offset.

4) In a given moment, all ARP tables of N1 are empty (we just started up the machines) and the local DNS server has no information. PC1 pings “ping PC10.xc.com”, being “PC10.xc.com” the name of the machine identified as PC10, and PC1 does not know the address.

4.1) Complete the following table with information of the frames travelling through N1 until the ping ends.

Notes:

Every row of the table should correspond to one frame.

Some columns do not apply in some frames (indicate this with “-“).

If physical addresses are needed (columns 3 and 4), give them any identifier; for IP addresses (columns 5 and 6), use a possible one.

In column “ARP Message” (column 2), it is enough to indicate if it is a request (“Req”) or a response (“Resp”).

In column “Transport” (column 8), indicate which kind of transport protocol is used (UDP or TCP), if any.

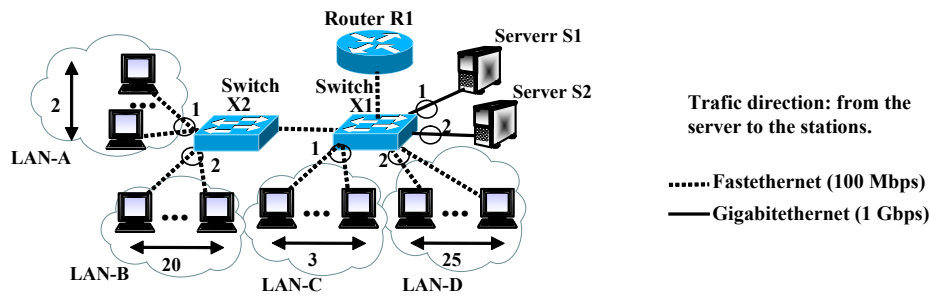
In column 9 indicate 1) if before sending the frame a routing table has been checked, 2) which one, 3) which question has been made and 4) which answer has been obtained.

Column 1	2	3	4	5	6	7	8	9
Frame order	ARP			IP		ICMP	Transport	Routing
	Message	Addresses		Addresses		Message	UDP / TCP	table
	Req/Resp	Source	Dest	Source	Dest			used?

4.2) For the previous ping (ping PC10.xc.com), which DNS messages will go through Router R1? For every message (following their order) indicate: Kind (request/response), which request/response includes, who has generated it and who is the message destination. (Use a table).

Group the problems 1 and 2 in separated sheets, and answer the problem 3 in the same questions sheet. Justify your answers. The review date will be announced in the Racó. Duration: 2h45. The quiz will be collected after 30 minutes.

Problema 2. (2,5 points) FULL 2.



The network of the figure is composed of 50 stations and 2 servers. It have been configured 2 VLANs. The numbers in the switch ports show their VLAN. All ports are full duplex. All links are fastethernet, except the links with the servers which are gigabitethernet. The efficiency is 100%. Assume that all the stations uses a kind of applications that opens a TCP connection and download information from the server. Assume that the flux control at the switches is active and woks in an optimal way. Answer the following questions for each of the scenarios below (justify your answers and explain your assumptions):

- (i) Which are the bottleneck links.
- (ii) The throughput that will achieve a station of every LAN. Use the notation $v_{ef}^A, \dots, v_{ef}^D$ to refer to the throughput of a stations in LAN-A,...LAN-D.

- 2.A** (0,5 points) All stations access simultaneously to the server in its own VLAN.
- 2.B** (0,75 points) Repeat the point A assuming that the links X1-X2 is gigabitethernet. Say also what will be the traffic in the link X1-X2.
- 2.C** (0,75 points) Repeat the point A assuming that the control de flux of the switches is turned off.
- 2.D** (0,5 points) Repeat the point A assuming that the stations access to the server that it is not in their own VLAN (that is, the stations in VLAN1 access the server S2 and vice-versa).

Problema 3. (2.5 points).

3.A (0.75 points) A Go-back-N ARQ connection is established between two terminals. The bit-rate is 20 Mbps and the lengths of the PDUs and the acks are 1500 and 40 bytes, respectively. A ping between these two terminals shows a delay of 100 ms. The time-out is set to 110 ms. The bit error rate is 10^{-6} . Answer to the following questions:

- (i) Calculate the efficiency E of this system
- (ii) Calculate the effective bit-rate v_{ef} .
- (iii) Determine the optimal window W_{opt} .
- (iv) If the length of the PDUs can be shortened (for example to 100 bytes), would the efficiency E be higher?

3.B (1.25 points) The Go-back-N connection is now replaced by a TCP connection with a MSS of 1460 bytes. The ping still gives 100 ms. Answer to the following questions:

- (i) Considering that the window scale is disabled and there are no errors, determine if the effective bit-rate v_{ef} once TCP reaches a stable transmission window is higher or lower than the Go-back-N case.
- (ii) If the window scale is set to 8^1 , determine the new effective bit-rate v_{ef} .
- (iii) Assume now that the window scale is 2 and the system **always** losses a segment when the transmission window wnd reaches 64 MSS. Draw the evolution of the transmission window wnd as a function of the time (graph wnd vs. RTT) clearly indicating the values of the congestion window $cwnd$, the advertised window $awnd$ and the threshold $ssthresh$. Note that the transmission window wnd should present a periodic aspect. Assume that the time-out RTO is equal to the RTT.
- (iv) Determine approximately the mean value of the effective bit-rate v_{ef} in this last case. We suggest the use of the graph to intuitively calculate such value.

3.C (0.5 points) The TCP connection is now closed and a voice over IP application is opened. Such application uses UDP as a transport protocol and generates an UDP datagram containing 256 bytes of data each 100 ms. Answer to the following questions:

- (i) Determine the effective bit-rate v_{ef} .
- (ii) Determine the effective bit-rate v_{ef} assuming that 10% of the data are lost on average.

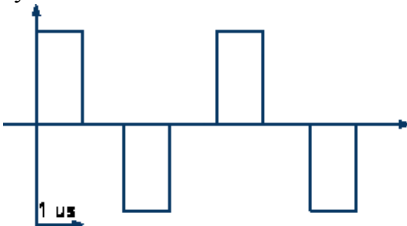
¹ It means that the advertised window $awnd$ is shifted 3 bits on the left in such a way that its value is multiplied by a factor of 2^3 .

NOM:

COGNOMS:

DNI:

All questions are multianswer: 0.25 points if the answer is correct, 0,125 if there is one error, 0 on the contrary.
The quiz will be collected after 30 minutes.

<p>Qüestió 1. A terminal receives signal mixed with noise, both noise and signal with the same power. Which of the following statements are derived from that:</p> <ul style="list-style-type: none"> <input type="checkbox"/> $C = BW_{\text{canal}}$ <input type="checkbox"/> There will be distortion <input type="checkbox"/> $SNR = 0 \text{ dB}$ <input type="checkbox"/> $SNR = 1 \text{ dB}$ <input type="checkbox"/> It is theoretically infeasible to properly decode the signal 	<p>Qüestió 2. This signal is a digital encoding that carries one bit per symbol:</p>  <ul style="list-style-type: none"> <input type="checkbox"/> Is a Bipolar encoding <input type="checkbox"/> transports 10101010 <input type="checkbox"/> $v_t = 1 \text{ Mbps}$ <input type="checkbox"/> direct current is present
<p>Qüestió 3. Which ones of these digital encodings can be used in a twisted pair?</p> <ul style="list-style-type: none"> <input type="checkbox"/> NRZ <input type="checkbox"/> B8ZS <input type="checkbox"/> Bipolar <input type="checkbox"/> Manchester 	<p>Qüestió 4. Which ones of these digital encodings allow to recover bit synch without any further mechanisms.</p> <ul style="list-style-type: none"> <input type="checkbox"/> NRZ <input type="checkbox"/> B8ZS <input type="checkbox"/> Bipolar <input type="checkbox"/> Manchester
<p>Qüestió 5. Mark all TCP states that a server can hold:</p> <ul style="list-style-type: none"> <input type="checkbox"/> SYN_SENT <input type="checkbox"/> SYN_RECV <input type="checkbox"/> FIN_WAIT2 <input type="checkbox"/> LAST_ACK 	<p>Qüestió 6. Mark all essential flags for a TCP connection (connection, transference and release). (Do not mark any optional flag)</p> <ul style="list-style-type: none"> <input type="checkbox"/> SYN <input type="checkbox"/> PSH <input type="checkbox"/> URG <input type="checkbox"/> ACK <input type="checkbox"/> FIN <input type="checkbox"/> RST
<p>Qüestió 7. Let us transfer a huge file between two terminals by IEEE802.11g, where no other terminal WiFi is present. Mark all valid assertions.</p> <ul style="list-style-type: none"> <input type="checkbox"/> v_{ef} shall be faster with AP than with ad-hoc mode <input type="checkbox"/> v_{ef} shall be faster if it could be possible to change to CSMA, than with CSMA/CA <input type="checkbox"/> v_t shall be 108 Mbps unless terminals were too far away <input type="checkbox"/> v_{ef} will depend on distance between terminals 	<p>Qüestió 8. Mark all pair connections that allow FDX (Full Duplex) link</p> <ul style="list-style-type: none"> <input type="checkbox"/> Terminal - Terminal <input type="checkbox"/> Hub - Terminal <input type="checkbox"/> Hub - Switch <input type="checkbox"/> Hub - Router
<p>Qüestió 9. Mark all systems that can originate ARP frames</p> <ul style="list-style-type: none"> <input type="checkbox"/> Terminal <input type="checkbox"/> Hub <input type="checkbox"/> Switch <input type="checkbox"/> Router 	<p>Qüestió 10. If we try establish a TCP connection to a currently disconnected terminal, mark all ICMP messages that will be issued due to that circumstance:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Host unreachable <input type="checkbox"/> Port unreachable <input type="checkbox"/> Protocol unreachable <input type="checkbox"/> Network unreachable