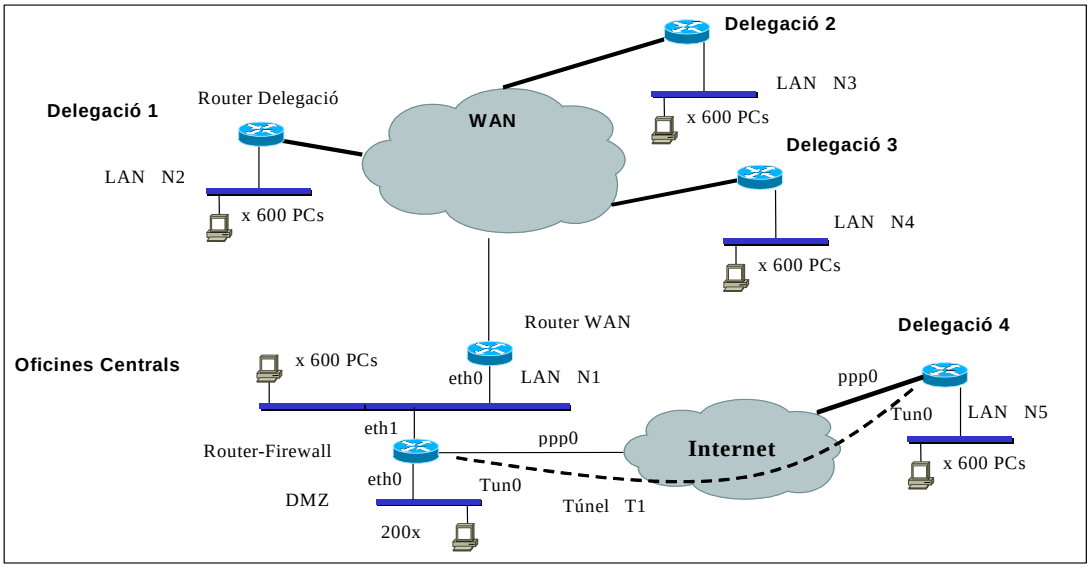
| Examen final de Xarxes de Computadors (XC) - Problemes | 19/6/2009 |
|---|---|

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

**Problem 1. (2,5 punts) FULL 1.**

We have a company with Headquarters and 4 Offices that we want to connect with IP level. One of the delegations is in another continent and it is decided to connect it to the Central Offices across the Internet. For the other 3 delegations it is decided to have a private WAN with an operator. In the Central Offices we will have also a connection to the Internet and a DMZ zone to place public servers. In the following picture you have how the connectivity of the nets would remain:




It is wanted to make subnetting over the range 10.10.0.0/16, with a unique IP net with at least of 600 addresses for each net N1-N5 (with lowest addresses for the Ni net with smallest i). For the DMZ we want to have at least 200 addresses 192.168.0.x. For the ppp links of headquarters and delegation 4 the ISP has assigned the addresses 200.200.10.1/32-200.200.10.2/32 and 200.200.10.3/32-200.200.10.4/32 respectively (lowest addresses for the side of Internet). For the tunnel T1 we want to use the address range 172.35.0.0/24 (lowest addresses for the side of headquarters). We want to use RIPv2. In the DMZ there is the DNS server that uses the company and 2 web page servers.

**1.A** (0,7 points) a) Propose IP addresses for the nets N1-N5 while indicating @IPnetwork/netmask (with dotted notation and with the most restrictive mask). b) Write the maximum number of addresses that we are able to use for hosts for each net Ni. c) Justify if the addresses IP 10.10.0.255 and 10.10.1.0 will be valid addresses for hosts. d) For the DMZ write the necessary minimum mask and the maximum number of hosts that are able to put a valid address.

**1.B** (0,5 points) Write the routing table in the del Router-Firewall writing @IPnetwork/mask bits, Gateway, Interface, RIP Metric. You can suppose that RIP is not using route summarization (write your assumptions).

**1.C** (0,2 points) You can suppose that split-horizon is used. Write the update message that Router-Firewall will send across the tunnel.

**1.D** (0.4 points) If we obtain in the Router-Firewall the following table after we execute "show ip nat translation":

| Pro | Inside global | Inside local | Outside local | Outside global |
|---|---|---|---|---|
| Tcp | 200.200.10.1:80 | 192.168.0.3:80 | -- | -- |
| Tcp | 200.200.10.1:8080 | 192.168.0.4:80 | -- | -- |

a) Justify the mechanism activated in the Router-Firewall and why 2 different ports (80 and 8080) are used.
b) Justify what entry will be added in the table if the host 10.10.10.10 executes a ping to the host 200.200.200.200 in Internet. Write your assumptions.

**1.E** E) (0.3 points) If we suppose that 100 hosts are connected in delegation 4 and that all ARP cache tables are empty, justify which messages ARP, UDP and ICMP will be generated and how many entries will be added in the ARP cache in the host executing the ping command when: a) one host in delegation 4 executes a broadcast ping; b) one host in delegation 4 executes a ping command to the name of a web server.

**1.F** (0.4 point) With the same assumptions that E) step and if there is a host PCx in delegation 4 with a wrong mask /16, justify which messages ARP, UDP and ICMP will be generated and how many entries will be added in the ARP cache in the host executing the ping command when: a) PCx executes a ping to the IP address of a host with not a wrong mask in delegation 4; b) PCx executes a ping to a host in headquarters; c) one host in headquarters executes a ping to the name of PCx.

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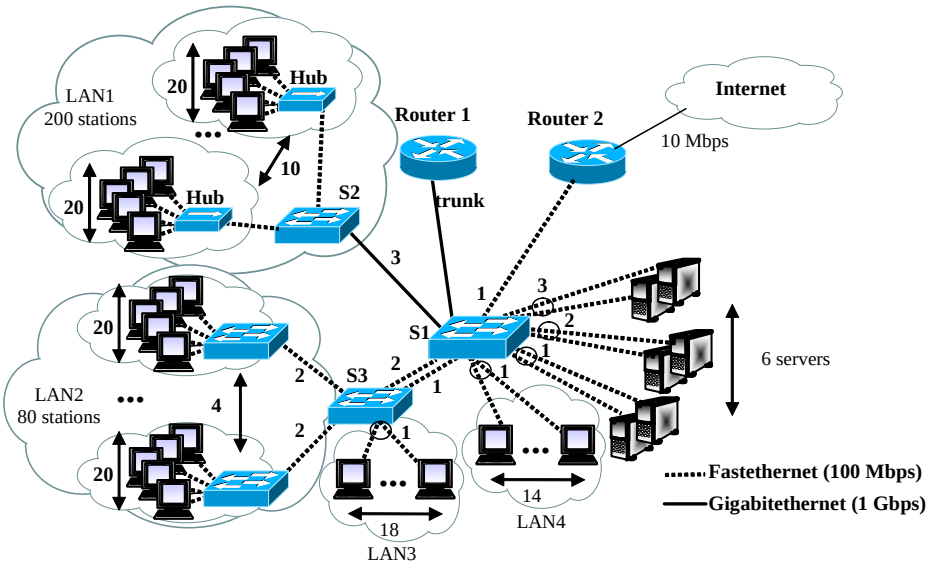
## Problem 2. (2,5 punts) FULL 2.




The network of the figure is composed of 312 stations and 6 servers. There have been configured 3 VLANs. The numbers in the switch ports say to which VLAN they belong to. All ports where it is possible support full duplex. All links are fastethernet except the link S1-S2 and S1-Router1, which are gigabitethernet, and the Internet access link, which is 10 Mbps in both directions. The maximum efficiency of the hubs is 80%. Suppose that all the stations use the same application that is described by: (i) uses TCP connections, (ii) can simultaneously access to several servers (iii) there are always information ready to be transmitted and received from the servers (iv) on the average receive and transmit the same amount of traffic.

Answer for each of the scenarios below the following questions: (Justify your answers and explain you assumptions)

(a) Which are the bottleneck links?

(b) The aggregated throughput sent by a station in every LAN (i.e. the sum of all the throughputs the station sends to the servers). Use the notation $v_{ef}^{1}$,...$v_{ef}^{4}$ for the throughput of a station in LAN1,...LAN4 respectively.

(c) Which will be the mechanisms that will regulate the throughput achieved by the stations?

**2.A** (1 point) All the stations simultaneously access to all the servers located in the same VLAN.

**2.B** (1 point) Assume (only for this point) that all the servers are in VLAN1, and that all stations simultaneously access to all the servers.

**2.C** (0,5 points) Assume that all the stations access to severs located in the Internet.

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| **NOM:** | **COGNOMS** | **DNI:** |

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**Problem 3. (2,5 points).**
There is a link between two islands in the South Pacific connected by a 2000 km long submarine cable ($v_p = 2 \cdot 10^8$ m/s). HDLC (an ARQ protocol with *Selective Repeat*) is used for the link layer, at $v_t = 10$ Mbps. Knowing the bit error rate, the HDLC interface card is configured with an MTU = 1000 B. We mesure $N_t = 1{,}1$ retransmissions by average under such conditions.

Additional data: the ACK frame length is 40 bit. The HDLC uses 3 bit for the sequence identifier field. Lets suppose that both terminals have infinite processing power.

a) which is the round-trip time? ($T_T$ ò RTT).

b) which is the optimal window?

c) from the given data calculate the frame efficiency ($E_f$)

d) calculate the Efficiency ($E_T$) of the link.

e) to improve compatibility with existent software, TCP/IP is chosen now, and as the bit error rate is considered not too bad, the HDLC error control is deactivated (only information or "I" HDLC frames are used).
Lets suppose that *Window Scale* is not used, and lets suppose that there are no transmission errors by now. Calculate the transmission rate ($v_{ef}$).

f) which value for *Window Scale* (multiplier for *awnd*) would you recommend? (there are no errors as in e) )

g) lets suppose that there are errors again now, and the bit error rate provides a long term *Slow Start Threshold* of just 2 MTU, and that there is a lost each time after 10 segments. Calculate the approximate effective rate (average transmission rate, $v_{ef}$).

h) the effective rate you calculated above is much lower than using an HDLC link control of a). In order to try to improve this result, we try to reactivate the error control procedures of HDLC, while keeping the TCP/IP stack on top of it (just to simplify, lets suppose that Window Scale is not used here). Which effective rate will we obtain now?

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| **NAME:** | **SURNAME** | **DNI:** |

**All questions have just one answer. 0.25 points if the answer is correct, 0 on the contrary.**
**The quiz will be collected after 30 minutes.**

*A datagram containing a TCP segment TCP with a MSS of 1460 bytes needs to go through a subnetwork with a MTU of 515 bytes. Assuming that fragmentation is allowed,*

1. how many datagrams reach the destination if there are no more fragmentations?
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4

2. what is the size (in bytes) of the smaller datagram that reaches the destination?
- ☐ 36
- ☐ 508
- ☐ 514
- ☐ 515

*The Routing table of a Router using RIP has the following entries:*
*Destination, Gateway, Metrics*
*A, G1, 2*
*B, G1, 3*
*C, G2, 4*
*D, G2, 3*

*Then, the following RIP message (Destination/Metrics) arrives from G1:* ***A/1, B/3, C/2, E/2****,*

3. The table changes to (only the modified rows):
- ☐ E, G1, 3
- ☐ B, G1, 4; E, G1, 3
- ☐ B, G1, 4; C, G1, 3; E, G1, 3
- ☐ A, G1,1; B, G1, 3; C, G1, 2; E, G1, 2

*A TCP communication has the following characteristics:*
*Advertised window = 4096 bytes; RTT = 200 ms; RTO = 400 ms; MSS = 1024 bytes.*
*If 10240 bytes are sent and the fourth segment is lost,*

4. What is the size of the real window at the end of the transmission (once all ACKs have been received)?
- ☐ 2048 bytes
- ☐ 4096 bytes
- ☐ 5120 bytes
- ☐ 8192 bytes

5. How much time is needed to send the 10240 bytes?
- ☐ 400 ms
- ☐ 800 ms
- ☐ 1200 ms
- ☐ 1400 ms

6. PC1 and PC2 share a FastEthernet hub connected to a Router. PC1 sends 50 Mbits and PC2 sends 20 Mbits, both simultaneously to a server behind the Router. When the 2 PCs send at the same time, we consider an Ethernet efficiency of 80%, on the contrary, it will be 100%. The total efficiency (rounded) of the network, measured from the beginning of the transmission until the end of the PC1 transmission, is:
- ☐ 80 %
- ☐ 85 %
- ☐ 90 %
- ☐ 100 %

7. We have a cable with an atenuation of 4 dB/km. We transmit a NRZ signal that is received at a distance of 12.5 km through that cable. What is the needed power for the signal transmission if we have 2 repeaters, one at a distance of 5 km an another at 10 km, both from the origin, both with 20 dB gain, if we want the signal to arrive not below 1 mW? Note: Assume that the repeaters have a sensibility of 0.1 mW.
- ☐ 1 mW
- ☐ 10 mW
- ☐ 100 mW
- ☐ 1 W

*We have a channel with SNR = 30 dB and bandwith = 100 kH. We transmit 4 different symbols through this cannel with the maximum possible modulation speed.*

8. How much is the symbol time?
- ☐ 1 microsecond
- ☐ 5 microseconds
- ☐ 10 microseconds
- ☐ 50 microseconds

9. How much is the transmission speed?
- ☐ 200 kbits/s
- ☐ 200 kHz
- ☐ 50 kBytes/s
- ☐ 600 kBytes/s

10. How much is the channel capacity?
- ☐ 300 kbits/s
- ☐ 1 Mbit/s
- ☐ 3 Mbits/s
- ☐ 300 kHz