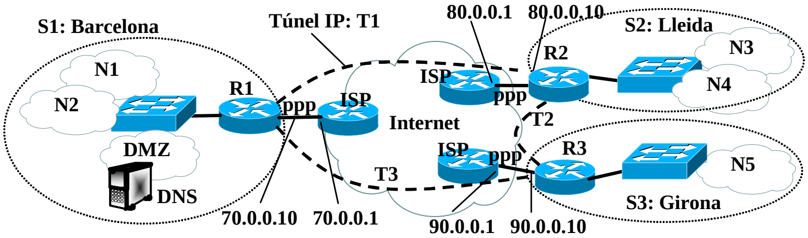
Examen final de Xarxes de Computadors (XC) - Problemes	13/6/2008	Quadrimestre de primavera de 2008

Answer the problems in separate sheets. Justify your answers. The revision date will be published in the racó.

Problema 1. (2,5 points)



IP public addresses:
IP-R1: 70.0.0.10, ISP: 70.0.0.1
IP-R2: 80.0.0.10, ISP: 80.0.0.1
IP-R3: 90.0.0.10, ISP: 90.0.0.1
200.0.0.0/27

Number of stations:
N1: 750
N2: 150
N3: 100
N4: 350
N5: 100
DMZ: 4 servers

The corporate network of the figure is composed of a VPN with 3 sites (S1, S2, S3) connected with IP tunnels. In each site there is a router (like the CISCO routers used in the lab) connected to using a trunk to a switch where there are VLANs for the connected IP networks. All routers have DHCP servers. Assume that the connection with the ISPs is done using ppp links with the addresses shown in the figure. Additionally, there have been purchased the addresses 200.0.0.0/27 to the ISP in site S1. The addresses 200.0.0.0/27 are to be used in the DMZ network (the ones having the lower numerical value), and to have Internet access with PAT (the maximum possible number of addresses). The figure shows the number of stations that there will be in each IP network. It is required that all stations have Internet access, and all connections initiated from any station in the corporate network to the Internet crosses the router R1. In the network it will be used RIPv2. We want to add manually the minimum number of static routes. We want also that the IP addresses of router R1 will have the hostid=1 in all the interfaces where it is possible, in router R2 hostid=2 and in router R3 hostid=3. Answer the following questions, assuming a value for all the data that may be missing. Justify your assumptions.

1.A (0,5 points) Propose an addressing scheme indicating: (i) The address of each IP network in the form @IP/number of bits of the mask. Give also the mask in dotted notation. Say how many stations could be connected in each of the networks N1,...N5 and DMZ you have defined. (ii) Say which configuration do you assume for the IP address in the tunnel. (iii) Say which address rang will be used to access the Internet with PAT, in the format: initial @IP – final @IP.

1.B (0,5 points) Say if any static router should have been added. Say which will be the routing tables of R1, R2, R3 when RIP has converged. For each entry give: Destination/mask in bits, Gateway, interface and RIP metric.

1.C (0,25 points) Say which will be the contents of the RIP messages received by R2 is split horizon is used.

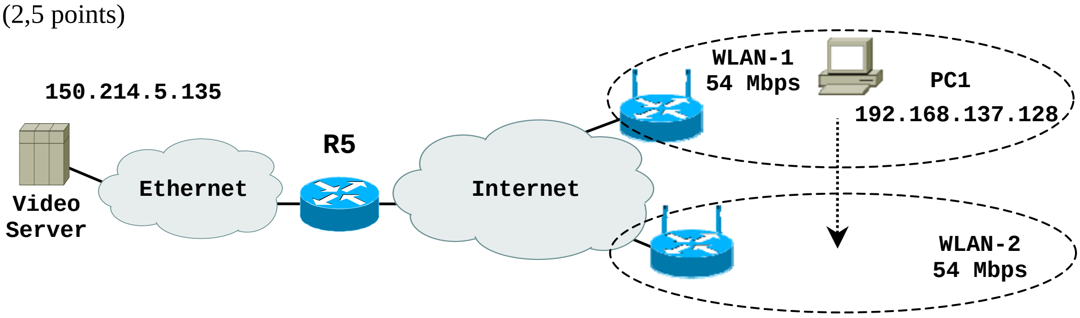
1.D (0,5 points) (i) Say which protocols will be able to reach the Internet with PAT, and the fields of the packets which are possibly modified when are sent to the Internet by the PAT-router. (ii) Say what limitation PAT will have on the maximum number of simultaneous connections to the Internet for each of these protocols. Compute what is the maximum, explain what assumptions you do.

1.E (0,25 points) Assume that a host is booted in network N1. Explain the messages that will be generated until the host has been configured. Say what will be the source/destination addresses in the DHCP messages, and the entries that will be in the ARP tables (if any).

1.F (0,25 points) Assume that all ARP tables are empty and that one station in N4 executes the command ping www.upc.edu. Say all devices in the corporate network that will have modified their ARP table, how many entries there will be and what will be their value when the host receives the echo reply.

1.G (0,25 points) Assume the DNS cache is empty and one station in N4 executes the command ping www.upc.edu. Say all DNS messages that will be generated indicating who is sending the message, who is the destination, if it is a query/response message, and the relevant information carried by the message.

Problema 2. (2,5 points)



A client PC1 is connected to Internet through a WLAN network at 54 Mbps while a video server is connected to Internet through an Ethernet network at 10 Mbps. Assume that the transmission bitrate in Internet is higher than the two local networks. Also assume that all devices have an efficiency of 100% and the buffers of the router and the access point have infinite capacity. PC1 starts a TCP connection (the *window scale* option is inactive) with the video server. The propagation time of the connection is of 50 ms. Please, answer to the following questions (***justify the answers***):

2.A A dump trace was captured and shown below. Knowing that there are no losses, determine: 1) The MSS of the TCP connection between server and PC1, 2) The size of the transmission window once the transient period ends, 3) The effective transmission rate, and 4) The duration (approximately) of the video downloading.

Answer the problems in separate sheets. Justify your answers. The revision date will be published in the racó.

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...
150.214.5.135.80 > 192.168.137.128.39599: P 726852531:726853991(1460) ack 1637 win 5240
192.168.137.128.39599 > 150.214.5.135.80: . ack 726853991 win 64240
150.214.5.135.80 > 192.168.137.128.39599: . 726853991:726855451(1460) ack 1637 win 5240
192.168.137.128.39599 > 150.214.5.135.80: . ack 726855451 win 64240
150.214.5.135.80 > 192.168.137.128.39599: . 726855451:726856911(1460) ack 1637 win 5240
192.168.137.128.39599 > 150.214.5.135.80: . ack 726856911 win 64240
150.214.5.135.80 > 192.168.137.128.39599: F 726856911:726857231(320) ack 1637 win 5240
192.168.137.128.39599 > 150.214.5.135.80: F 1637: 1637(0) ack 726857231 win 64240
150.214.5.135.80 > 192.168.137.128.39599: . ack 1638 win 5240
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2.B Identify where (server or PC1) the trace dump was captured.

2.C Suppose now that other 4 servers in the Ethernet network were transmitting simultaneously to other different clients. Determine in this scenario the effective transmission rate of the server-PC1 TCP connection, and the duration of the video downloading.

2.D Taking into account the original scenario, suppose that the *window scale* option is active with a multiplication factor of the advertised window of 4. Determine for this scenario the effective transmission rate, and the duration of the video downloading.

2.E Taking into account the original scenario, suppose that, in the middle of the downloading and at its maximum effective transmission rate, PC1 moves from WLAN-1 to WLAN-2. During the transition, some segments get lost. Draw a graph that clearly shows the evolution of the transmission window (*y-axis*: transmission window, *x-axis*: time) starting from the first lost segment until 1.5 seconds in the new WLAN-2. Clearly show in the graph the *slow-start* and *congestion-avoidance* phases and the value of the *sstresh*. Assume that TCP does not use *fast-retransmission/fast-recovery* and the RTO time-out is of 200 ms.

2.F Draw again the previous graph but now assume that a segment is lost in WLAN-2 each time the congestion window arrives to 23360 bytes.

Problema 3. (2,5 puntos)

We have 3 clients connected to a Fastethernet Hub (100 Mbps) that, in turn, is connected to a Switch that is also connected to a Server. We will consider the sending of TCP data segments from the clients to the servers and we will ignore the sending of ACKs. We will also suppose that the propagation times are 0. Remember that an Ethernet frame includes a preamble of 8 bytes, 12 bytes of addresses, 2 bytes for control, the payload and 4 bytes for CRC. The IPG has 12 bytes and the JAM has 4 bytes.

3.A (0,25 points) If only **one** client sends data to the server, calculate the maximum efficiency (of Ethernet's user data) of the Hub.

3.B (0,25 points) Now suppose that the station sends data in a wifi WLAN. Would it be possible to reach an efficiency similar to the previous one? Clearly explain which would be the reasons of the difference.

3.C (1 point) Now consider that **two** stations send data continuously to the Server (in the initial Fastethernet case). Suppose that one of the stations does not work properly and uses the following *backoff* algorithm:

Let's call N the number of retransmissions of the same frame (i.e., N=1 in the first retransmission after the first collision, etc.). The *backoff* time is:

$$t_b = \begin{cases} n\, T_s \text{, if } N = 1 \\ 0 \text{ , if } N > 1 \end{cases}$$

where n is a random variable that takes the values {0, 1} with equal probability, and T_s is the transmission time of 512 bits.

Calculate approximately the speed that every station will achieve. Justify the reasoning and the simplifications taken.

3.D (0,5 points) Now suppose that the two stations work properly, that station A sends 50 MBytes and station B sends 20 MBytes, and that the Hub efficiency is 80%, (i) calculate how much time each station will take to send all data; (ii) where is the flow control needed? Which are the used mechanisms for that? (iii) what changes if it is the Server who sends towards the stations?

3.E (0,5 puntos) Now suppose that the Switch supports VLANs, that the previous configuration is the VLAN1, the Switch also has connected a Server S2 to a port of the VLAN2 and that, in addition, there is a Router with a port in Trunk mode. If station A send data to server S1 (the previous one), but station B sends data to Server S2, (i) how much time is needed to send all the data? (ii) if the sending is done by the servers, (iii) do flow control mechanisms change with respect the previous question?

Examen final de Xarxes de Computadors (XC) - Test		13/6/2008
NAME:	SURNAME	PASSPORT

The questions may have more than one correct answer. In the questions with more than one correct answer, one error reduce the mark in 0,125 points, with more errors the mark is 0. The questions with no answer have a mark of 0. All questions have at least on correct answer.

Qüestió 1 (0,25 punts)
In a transmission line, it is possible to increase distance range...

- ☐ increasing transmitted power
- ☐ decreasing noise
- ☐ increasing the bandwidth
- ☐ using amplifiers
- ☐ using repeaters

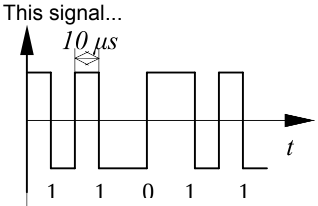
Qüestió 2 (0,25 punts)
On a 10 km line, with 3 dB/km attenuation, Ps = 1W and a receiver sensitivity of 1 µW...

- ☐ ...amplifiers are not needed
- ☐ ...total attenuation is 100 dB
- ☐ ...only 2 amplifiers are needed
- ☐ ...maximum reachable distance of 20 km

Qüestió 3 (0,25 punts)
In a line with SNR = 0 dB…

- ☐ there is no signal
- ☐ there is no noise
- ☐ C = BW
- ☐ is not able to transmit signal

Qüestió 4 (0,25 punts)
This signal...



- ☐ is NRZ
- ☐ there is no D.C.
- ☐ v_t = 100 kbps
- ☐ is a digital modulation

Qüestió 5 (0,25 punts)
In a link with sliding window and selective repeat

- ☐ implements stop & wait
- ☐ there is no flow control
- ☐ an erroneous frame, implies retransmission of all following frames
- ☐ with piggybacking optimal window size is equal or greater than without

Qüestió 6 (0,25 punts)
What is true about Ethernet?:

- ☐ implements error detection
- ☐ supports broadcast
- ☐ in FDX there is no CSMA/CD
- ☐ payload could be shorter than 46 bytes

Qüestió 7 (0,25 punts) (single response)
Select the transmission medium with higher bandwidth:

- ☐ twisted pair
- ☐ coax
- ☐ single mode optical fibre
- ☐ multimode optical fibre

Qüestió 8 (0,25 punts)
Select connection oriented protocols:

- ☐ Ethernet
- ☐ IP
- ☐ TCP
- ☐ UDP

Qüestió 9 (0,25 punts)
If we connect a 10/100 Mbps hub and 10 Mbps FDX switch:

- ☐ the link connecting them will have a rate of 10 Mbps FDX
- ☐ the rate of all the other ports of the hub will be 10 Mbps FDX
- ☐ all other switch ports will be 10 Mbps FDX
- ☐ connectivity between hub and switch will not be possible

Qüestió 10 (0,25 punts)
If we send a single byte through a TCP socket:

- ☐ the sequence id will be 1
- ☐ the sequence id will be 0
- ☐ a segment with a payload of a single byte will be sent
- ☐ system will wait till a full MSS could be filled