Second Midterm. Xarxes de Computadors (XC), Grau en Enginyeria Informàtica		10/12/2017	Fall 2018
NAME (in CAPITAL LETTERS):	FAMILY NAME (in CAPITAL LETTERS):	GROUP:	DNI/NIE:

Time: 1hour and 30 minutes. The quiz will be collected in 25 minutes.

Test (3 points).
Multiple choice questions (one or more correct answers). Half value if there is one error and 0 if there are more errors.

1. The end to end propagation time between two devices, A and B, is 5ms. A sends data to B. Along the path there are two routers with an output queue size of 1MB ($1*10^6$ bytes). The bitrate of all the links is 10 Mbps. The packet size is 10.000 bits. For simplicity consider that the ACK packets are very small and they do not experience congestion in their way back to A. Routers and links are shared by other users sending information in the direction from A to B.
Make an estimation of the RTT ("*round trip time*") minimum and maximum values.
- ☐ Minimum RTT: 13ms.
- ☐ Maximum RTT: 801ms.
- ☐ Minimum RTT 10ms and maximum RTT 800ms.
- ☐ Maximum RTT: 1611ms.

2. About TCP protocol.
- ☐ The initial sequence number of the server is fixed by the client during connection setup phase (*Three Way Handshaking*).
- ☐ The *awnd* field of the header tells the number of bytes received and that are not acknowledged yet.
- ☐ When the receiver gets a new segment it always sends an acknowledgement (ACK). Notice: the receiver does not implement "*delayed ack*".
- ☐ El protocol uses cumulative acknowledgements telling the sequence number of the first byte it is waiting for.

3. About TCP protocol.
- ☐ When there are no loses the advertised window by the receiver limits the transmission window of the sender.
- ☐ In all cases, the reception of a duplicated ACK implies that a segment was lost.
- ☐ If there are no loses from the beginning of the connection the protocol remains in "*Slow Start*" estate.
- ☐ During the "Slow Start" estate the reception of a non-duplicated ACK makes that the congestion window is incremented by 1 MSS unless it reaches the *ssthres*.

4. About the following capture of TCP traffic:

```
12:30:37.069541 IP 147.83.34.125.17788 > 147.83.32.82.80: S 3473661146:3473661146(0) win 5840 <mss
                1460,sackOK,timestamp 296476754 0,nop,wscale 7>
12:30:37.070021 IP 147.83.32.82.80 > 147.83.34.125.17788: S 544373216:544373216(0) ack 3473661147 win 5792 <mss
                1460,sackOK,timestamp 1824770623 296476754,nop,wscale 2>
12:30:37.070038 IP 147.83.34.125.17788 > 147.83.32.82.80: . ack 1 win 46 <nop,nop,timestamp 296476754
                1824770623>
```

- ☐ The segment's data filed of the client (MSS) is 1500 bytes.
- ☐ The available space at the reception queue of the client once the connection has been established is 5888 bytes.
- ☐ The available space at the reception queue of the client once the connection has been established is 747520 bytes.
- ☐ The RTT is 0.480ms approximately.

5. Tick the correct sentences.
- ☐ In CSMA/CD local area networks the maximum end to end distance is an important performance parameter because it is related with the collision probability.
- ☐ Each port of an Ethernet switch determines a collision domain.
- ☐ If the flow control of the Ethernet switch is not activated all ports must have the same bitrate.
- ☐ If the flow control of the Ethernet switch is activated it may limit transfer rate of some ports.

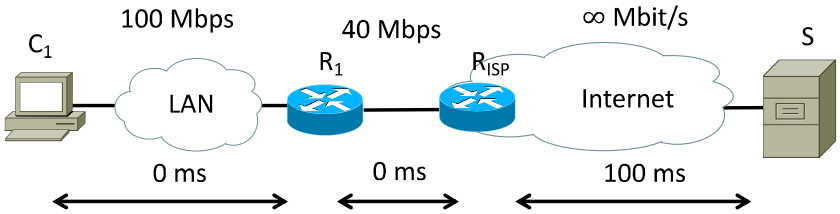
6. About an Ethernet switch with VLANs. Tick the correct sentences.
- ☐ Ethernet frames are retransmitted through all the port of the same VLAN.
- ☐ A mode "*trunk*" port allows to exchange Ethernet frames among VLANs (Forward one frame from a VLAN to another).
- ☐ *Broadcast* frames are retransmitted through all the ports of the same VLAN.
- ☐ *Broadcast* IP packets are retransmitted through all the ports of all the VLANs.

7. Tick the correct sentences.
- ☐ *Wireless* LAN (WLAN) use CSMA/CA (*Collision Avoidance*) instead of CSMA/CD (*Collision Detection*).
- ☐ A WLAN station after transmitting a frame waits for the acknowledgement from the receiver.
- ☐ The header of a 802.11 (WLAN) frame contains up to four MAC address fields.
- ☐ In a WLAN in infrastructure mode all frames go through the AP (*Access Point*).

Segon control de Xarxes de Computadors (XC), Grau en Enginyeria Informàtica		10/12/18	Tardor 2018
NOM (en MAJÚSCULES):	**COGNOMS (en MAJÚSCULES):**	**GRUP:**	**DNI:**

Duració: 1h 30 minuts. El test es recollirà en 25 minuts.

P1 (4 points) Consider the system in the figure. A host C_1 is connected to a LAN FastEthernet. The LAN is connected to the router R_1 which is connected to Internet at 40 Mbps for both directions through the router R_{ISP}. The host C_1 establishes a TCP connection over Internet with the server S to download a large file. The bitrate achieved in Internet is higher than the rest and can be considered infinite. On the contrary, Internet introduces a round trip latency (RTT) of 100ms, while it can be approximated to 0 ms for the internal networks.



Respond to the following questions, JUSTIFY the answers.

a) (0.5 points) With the available data, determine the bitrate that the host C_1 can achieve for downloading the file.

b) (0.5 points) For the transmission from S to C_1, suppose there have been no losses and it has been transmitting for some time. Suppose that the Window Scale Factor has not been activated and that the reception buffer of C_1 is 200 kbytes ($2x10^5$). Determine the effective bitrate that is achieved for the downloading in this case.

c) (0.75 points) If it were possible to use the Window Scale Factor, determine what would be the most appropriate value to take full advantage of the size of the reception buffer and what would be the effective bitrate in this case.

d) (0.75 points) If the reception buffer of C_1 was 1 Mbytes and a sufficient Window Scale was used to announce this size, determine the effective bitrate in this case

e) (0.75 points) Back to the case in point c), suppose that the MSS is de 1460 bytes and there are no losses. Determine the evolution of the transmission window of the server S from the first data sent and up to 10 RTT.

f) (0.75 points) Suppose now that all segments are lost when the transmission window is 8 MSS at 3 RTT. Once the RTO is expired, the server S retransmits all segments lost and all following ones with no more losses. Determine the evolution of the transmission window starting from the first segment sent after the loss and up to the reception of 10 new acks.

ack	**SS o CA**	**cwnd**	**awnd**	**ssthresh**	**wnd**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

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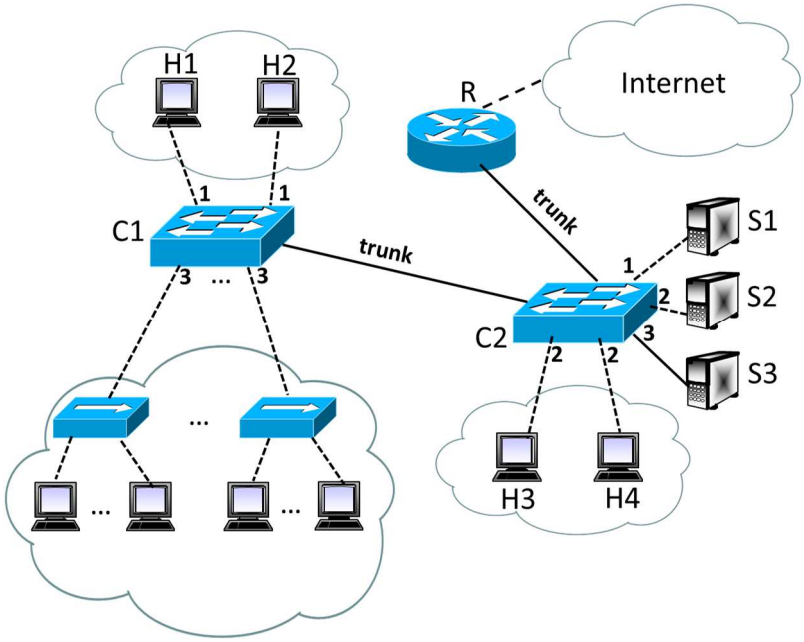
Exercise 2 (3 points)

We have the configuration of the figure with 3 VLANs, where a single router gives access to the Internet at 50 Mbps.

VLAN1 has two machines (H1 and H2) connected to switch C1 and an S1 server connected to switch C2. On the other hand, VLAN2 is similar, but with H3 and H4 connected to C2 and S2 to C2. VLAN3 has *m* hubs connected to switch C1. Each hub has *n* machines, the same for each hub. In addition, it has the S3 server connected to C2 like all other servers.

All ports are 100 Mbps except the two trunks (C1-C2 and C2-R) and the port of S3, which are 1 Gbps. We consider that the hubs have an efficiency of 80%, while that of the switches is 100%.



a) *(0.1 points)* If H1 sends a broadcast message, what machines will receive it?

b) *(0.1 points)* If H1 sends a message to S1, what machines and devices will it go through?

c) *(0.1 points)* If H3 sends a message to S1, what machines and devices will it go through?

d) *(0.1 points)* If one of the machines in VLAN3 (not S3) sends a message to S1, what machines and devices will it go through?

e) *(0.2 points)* If S1 sends data at maximum capacity at the same time to S2 and S3, at what speed can they receive them?

f) *(0.3 points)* If H3 sends data at its maximum capacity to S1, at what speed can it receive them?

g) *(0.3 points)* If H1 and H2 send data at maximum capacity at the same time to S2 and S3, at what speed can they receive them?

h) *(0.3 points)* If S1, S2 and S3 want to send data at maximum capacity at the same time to H1, H2, H3 and H4, at what speed can they receive them?

i) *(0.3 points)* If H1, H2, H3 and H4 want to send data at maximum capacity to a machine on the Internet (beyond the Router), at what speed can they transmit?

We want to optimize the number of VLAN3 machines and hubs so that port C1-C2 is maximized when all VLAN3 machines send data to their S3 server, and no one else sends.

j) *(0.3 points)* How much are *m* (number of hubs) and *n* (number of machines per hub) forcing both *m* and *n* to be greater than or equal to 2? What would be the maximum speed that the machines could reach?

k) *(0.3 points)* What device(s) should have to do flow control and how would it(they) do it?

Suppose that in VLAN3 we have 5 machines per hub and 20 hubs connected to C1. All machines send data to their S3 server at the same time.

l) *(0.3 points)* At what speed will each machine send?

m) *(0.3 points)* What device(s) should have to do flow control and how would it(they) do it?