Second Midterm. Xarxes de Computadors (XC), Grau en Enginyeria Informàtica		24/05/18	Spring 2018
NAME (in CAPITAL LETTERS):	**FAMILY NAME (in CAPITAL LETTERS):**	**GROUP:**	**DNI/NIE:**

Time: 1hour and 30 minutes. The quiz will be collected in 20 minutes.

Test (3 points). Multiple choice questions (any number of correct answers).
Score: Half value if there is one error and 0 if there are more than one error.

1- The end-to-end propagation delay between a client and a server is 1 ms. There is one router in-between and the capacity of the output queue is 6MB ($6*10^6$ bytes). The output link rate is 10 Mbps. The estimation of the minimum and maximum RTT ("round trip time") is:
- ☐ Minimum RTT is 1ms.
- ☐ Maximum RTT is 5'8ms.
- ☐ Minimum RTT is 6ms and maximum RTT is 48ms.
- ☐ Minimum RTT is 2ms and maximum RTT is 48ms.

2. About window protocols (ARQ).
- ☐ A Stop&Wait protocol provides the maximum efficiency when it uses the optimal window size.
- ☐ When the size of the reception window is F>1, the receiver accepts out of order PDU (Protocol Data Unit).
- ☐ When the size of the reception window is F>1, the transmission window size is 2F.
- ☐ The size of the transmission window is the maximum number of unacknowledged PDUs.

3. About TCP.
- ☐ The maximum number of connections from a client is limited by the number of available ports.
- ☐ The maximum number of connections a server may accept is limited by the number of available ports.
- ☐ A device may establish TCP connections to itself.
- ☐ The protocol uses accumulated acknowledgements counting segments.

4. About the following fragment of TCP traffic:
```
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
```
- ☐ The size of the data field of the segment for the client (MSS) is 1500 bytes.
- ☐ The client's transmission window size is 64240 bytes.
- ☐ The server's reception window size is 64240 bytes.
- ☐ Up to the time of this capture the server has sent 1636 bytes.

5. About TCP.
- ☐ If there are no losses the transmission windows grows continuously.
- ☐ If there are no losses the congestion windows grows continuously.
- ☐ If there are no losses the transmission since the connection establishment the protocol remains in "Slow Start".
- ☐ If there are no losses the advertised window limits the maximum throughput.

6. Check the correct sentences.
- ☐ The Ethernet MTU ("Maximum Transmission Unit") is 1500 bytes; that is, the maximum size of the data field of the frame is 1500 bytes.
- ☐ The MAC header of the WLAN frame may contain more than two Ethernet addresses.
- ☐ The access point of a WLAN manages the retransmissions of the frames after the collisions.
- ☐ In a WLAN (in infrastructure mode) all the frames go through the access point; that is, there is no direct communication between two stations.

7. Check the correct sentences.
- ☐ In local area networks the maximum end-to-end propagation delay is an important factor for the efficiency.
- ☐ Each port of an Ethernet switch is a collision domain.
- ☐ An Ethernet switch always retransmits all the frames to all its ports.
- ☐ When the flow control is on, an Ethernet switch discards the frames that above the established threshold.

8. Check the correct sentences referred to an Ethernet switch with VLAN.
- ☐ All frames are forwarded through all the ports of the same VLAN.
- ☐ STP ("Spanning Tree") avoids loops between VLANs disabling some ports.
- ☐ 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.

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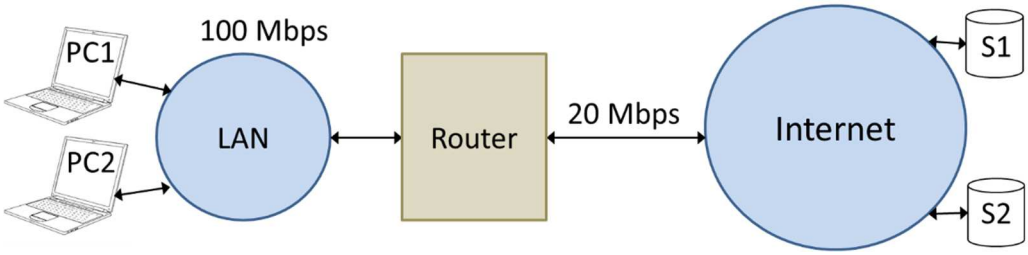
EXERCICE 1 (4 points)

We have two computers (PC1 and PC2) connected to a LAN with transmission speed of 100 Mbps. The LAN is connected to a Router with 20 Mbps to access to Internet.



PC1 and PC2 establish 2 TCP connections with servers S1 and S2, respectively, to download from them very big files at the maximum possible speed. The agreed MSS is 1448 bytes and the measured RTT is 100 ms.

REPLY **REASONABLY**, AND IN THE SPACE PROVIDED, THE FOLLOWING QUESTIONS:

A. (0,4 points) Suppose we do not use IEEE LLC, so we have 1,500 bytes for an IP datagram including a TCP segment. Why could it happen that the MSS is 1,448 bytes instead of 1,460 (obtained by discounting 1,500 the number of bytes needed for the fixed IP and TCP headers)?

B. (0,4 points) With the available data, at what speed could both servers transmit?

C. (0,5 points) For the transmission from S1 to PC1, suppose there have been no losses and it has been transmitting for some time. How much should be the value of the advertised window *awnd* for TCP to limit the speed to 926,720 bps. Which machine sends that value of the advertised window *awnd*?

Suppose that in a given moment of the data transfer from S2 to PC2, the following capture is made:
(The columns represent: 1) Interchange's line number, 2) IP address and port of the sender, 3) IP address and port of the receiver, 4) (if there are data) Sequence number : Sequence number of the next segment, 5) ACK number, 6) Advertised-window size.

```
1)        2)                  3)              4)              5)          6)
1.  10.1.0.3.1059 > 10.2.0.1.80:                ack 26277   win 23168
2.  10.2.0.1.80 > 10.1.0.3.1059: 26277:27725    ack 93      win 32120
3.  10.2.0.1.80 > 10.1.0.3.1059: 27725:29173    ack 93      win 32120
4.  10.2.0.1.80 > 10.1.0.3.1059: 30621:32069    ack 93      win 32120
5.  10.2.0.1.80 > 10.1.0.3.1059: 32069:33517    ack 93      win 32120
6.  10.1.0.3.1059 > 10.2.0.1.80:                ack 29173   win 23168
7.  10.2.0.1.80 > 10.1.0.3.1059: 33517:34965    ack 93      win 32120
8.  10.2.0.1.80 > 10.1.0.3.1059: 34965:36413    ack 93      win 32120
9.  10.2.0.1.80 > 10.1.0.3.1059: 36413:37861    ack 93      win 32120
10. 10.1.0.3.1059 > 10.2.0.1.80:                ack 29173   win 23168
11. 10.1.0.3.1059 > 10.2.0.1.80:                ack 29173   win 23168
12. 10.1.0.3.1059 > 10.2.0.1.80:                ack 29173   win 23168
13. 10.2.0.1.80 > 10.1.0.3.1059: 29173:30621    ack 93      win 32120
14. 10.1.0.3.1059 > 10.2.0.1.80:                ack 37861   win 23168
15. 10.2.0.1.80 > 10.1.0.3.1059: 37861:39309    ack 93      win 32120
```

D. (0,5 points) What segments can we be sure are lost?

Suppose that there were no losses before the captured sequence. With the available data, it can be verified that at the end of the sequence the transmission (real) window has reached the value of the *awnd*. **To answer the following questions it may be useful to draw the evolution of the windows.**

E. (0,4 points) What is the value of the advertised window *awnd*?

F. (0,4 points) What is the value of the threshold (*sshthres*) at the end of the captured sequence?

G. (0,5 points) How many seconds after the interchange of line 13 the threshold is reached?

H. (0,5 points) How many more seconds are needed to reach the advertised window?

I. (0,4 points) What would be the average speed since interchange 13 until reaching *awnd*?

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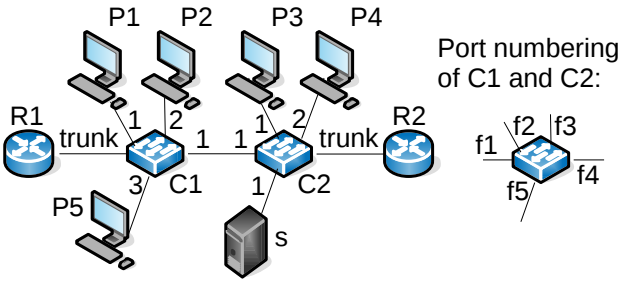
Duration: 1h30m. The quiz will be collected in 20 minutes. Answer in the same questions sheet.

Problem 2 (3 points)

In the network of the figure all the links are Fastethernet (100 Mbps). The numbers of the ports of the C1 and C2 switches indicate the VLAN-ID that has been configured in each port. The only trunks that have been configured are between routers and switches. The IP level is configured to have connectivity between all devices. The default router of each PC P1 ... P5 is configured so that the number of devices to cross to reach the server S is as small as possible.



1. (1 point) Say the network devices and in what order a datagram from the PC will follow to reach S (eg. C1-R1-C1...).

P1:
P2:
P3:
P4:
P5:

2. (1 point) Suppose that the MAC tables of the switches are empty. From P1 it is done a ping to his IP network broadcast address, and answer all the devices from his IP network. Say what the contents of the MAC table of the switches after ping will be. Use the name of the device to refer to the MAC address (eg. P1, ...). Fill the rows you need.

Taula MAC C1			Taula MAC C2		
MAC	Port	VLAN	MAC	Port	VLAN

3. (1 point) Assume that all PCs send information at the maximum throughput allowed by the network to the server S with a TCP connection each. The switches have the flow control activated. Compute, approximately, the throughput that each PC will achieve.

P1
P2
P3
P4
P5