Segon Control de Xarxes de Computadors (XC), Grau en Enginyeria Informàtica		26/11/2015	Tardor 2015
Name:	**Surname:**	**Group**	**DNI**

Duration: 1h15m. The quiz will be collected in 20 minutes. Answer in the same questions sheet.

Test. (3 points) All questions are multiple choice: Count as half if there is one error, 0 if more.

1. In a transport protocol:
- ☐ UDP guarantees data integrity.
- ☐ TCP guarantees data integrity.
- ☐ UDP seeks to avoid network congestion.
- ☐ TCP discards out of order segments.

2. In an interactive connection, when applying the Nagle algorithm:
- ☐ Segments are sent when a segment (MSS) is full.
- ☐ Data is sent as it becomes available to be sent.
- ☐ Data is accumulated and sent when an ACK arrives.
- ☐ Data bytes are sent one by one.

3. The TCP sequence number:
- ☐ Indicates in an ACK the last byte received.
- ☐ Indicates in an ACK the next expected byte.
- ☐ It increments by one with the SYN and FIN.
- ☐ Its initial value is a random number.

4. In a TCP transfer, the retransmission timer (RTO):
- ☐ It is defined as 2 times the average RTT.
- ☐ It is defined as the average RTT + 4 times its variance.
- ☐ Doubles when retransmissions.
- ☐ It is not modified when there are retransmissions.

5. The size of the congestion window grows in the slow-start phase:
- ☐ Until the arrival of out of order acknowledgments (ACK).
- ☐ Until a loss is detected.
- ☐ Until the congestion window equals ssthresh.
- ☐ Until the congestion window equals ssthresh/2.

6. Indicate which statements are true for TCP:
- ☐ The slow-start growth phase ends when a segment loss is detected.
- ☐ The slow-start phase ends when the congestion window equals ssthresh.
- ☐ A slow-start phase begins when the there is a RTO timeout.
- ☐ During the slow-start growth phase the congestion window increases by a MSS when a new ACK arrives.

7. In TCP the size of the congestion window changes:
- ☐ With every segment sent.
- ☐ With every ACK confirming data.
- ☐ When the RTT changes.
- ☐ When the advertised window of the receiver (awnd or rwnd) changes.

8. Since a client initiates a connection until the server can send the first data bytes to the client (assuming a very high transfer rate and 100ms RTT) it takes:
- ☐ 50 ms
- ☐ 100 ms
- ☐ 150 ms
- ☐ 200 ms

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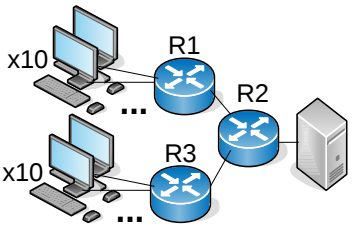
Problem 1 (7 points)



In the network of the figure there are 20 PCs (10 connected to R1 and 10 connected to R3) that send data to the server, each using a TCP connection and to the maximum throughput allowed by the network. Suppose the following: (1) all links are 10 Mbps; (2) the routers have a memory of 2 MB ($2\ 10^6$ bytes) which can store all datagrams pending to be transmitted (and are discarded the datagrams that arrive when the memory is exhausted); (3) all TCP sockets in the PCs and server have a reception buffer of 60 kB; (4) for the sake of simplification, assume all TCP and IP headers of 0 bytes and MSS equal to 1500 B; (5) propagation delays in the cables are 0; (6) the acks transmitted by the server are never lost and arrive immediately to the PCs; TCP always sends ack upon receiving data, only SS/CA is used and it is as efficient as possible (i.e. ack are sent immediately, the process time is 0, etc.); (7) connections are in steady state, i.e. it is long time since they were established. Justify briefly your answers: results without justification will not be accepted. Give your results using the boxes and with the indicated units.

1.1 (0,75 points) Say which will be the throughput, v_{ef}, that will achieve each TCP connection.

v_{ef}=	Mbps

1.2 (0,75 points) Say which will be the advertized window, awnd. Will it be necessary to use the window scale option?

awnd=	kB

1.3 (0,75 points) Say which will be, approximately, the buffer occupancy of the Routers R1, R2 i R3. Say how many bytes there will be approximately in each buffer. Will there be losses?

R1=	MB
R2=	MB
R3=	MB

1.4 (0,75 points) Compute what will approximately be the RTT of each TCP connection.

RTT=	s

1.5 (0,75 points) Suppose now (and in the remaining items) that it is desired to have an average RTT not larger than approximately 600 ms. To achieve this constrain, the buffer of the routers is reduced. What buffer size of routers R1, R2 and R3 should be configured? Assume that the buffer size is changed only in the routers where it is necessary.

R1=	MB
R2=	MB
R3=	MB

1.6 (0,75 points) Say whether losses will occur with the buffers configured in the previous item. What will be now the throughput, v_{ef}, achieved by each TCP connection?

v_{ef}= Mbps

1.7 (0,75 points) Compute what will be now, on the average, the window that will use each TCP connection ($\overline{W}$). Suppose that, on the average, in every RTT each TCP connection sends a number of bytes equal to the average window, $\overline{W}$.

$\overline{W}$= kB

1.8 (1 point) Draft a possible evolution of the congestion window (cwnd) used by TCP that fits the conditions stated in the previous items. Assume that the evolution of the cwnd is periodic, and draw one period. Indicate in the draft when it is in slow start (SS) and congestion avoidance (CA). Compute what will be the slow start threshold (ssth) and the maximum value that the cwnd will reach in each period ($cwnd_{max}$). Compute ssth and $cwnd_{max}$ such that the throughput and average window are those computed in the previous items. Assume in this calculus that the time in SS is much lower that in CA.

ssth= kB

$cwnd_{max}$ = kB

1.9 (0.75 points) Compute approximately what will the the duration of one period (T) in the previous draft.

T= s