

<b>Final exam. Xarxes de Computadors (XC), Grau en Enginyeria Informàtica</b>		<b>20/01/2017</b>	<b>Fall 2016</b>
<b>NAME (CAPITAL LETTERS):</b>	<b>FAMILY NAME (CAPITAL LETTERS):</b>	<b>GROUP:</b>	<b>ID# (DNI/NIE):</b>

Duration: 2h 45 minutes. The Quiz will be collected in 30 minutes.

### Test (2.5 points).

All questions are multiple choice. Count as half if there is one error, 0 if more than one error.

#### 1. About the TCP/IP architecture,

- ☐ The IP address identifies the network interface of a device and the port number identifies the application
- ☐ The architecture follows the hierarchical model of functional layers defined by ISO/OSI where the IP and TCP layers match the network and transport functional layers, respectively
- ☐ All network devices implement both IP and TCP protocols
- ☐ The IP protocol provides a reliable communication

#### 2. About IP protocol

- ☐ When a router discards a datagram it sends an ICMP message always
- ☐ The IP protocol establishes an end to end connection
- ☐ Each time a datagram crosses a router the value of the TTL field is decremented by 1
- ☐ The "checksum" field is computed including all the fields in the IP header and the data field

#### 3. About ARP protocol

- ☐ It sends a broadcast datagram to discover the IP address of a device
- ☐ It sends a broadcast datagram to discover the default router of the IP subnetwork
- ☐ It sends an Ethernet frame with its own MAC address as destination address
- ☐ It sends a broadcast Ethernet frame to discover the MAC address of a device

#### 4. About TCP

- ☐ Its header includes a sequence number field
- ☐ The awnd (advertised window) field tells the number of unacknowledged bytes
- ☐ The SYN bit (flag) identifies the start of a connection
- ☐ The TWH (Three Way Handshake) takes 2 RTT

#### 5. About TCP

- ☐ If no segments are lost the congestion window (cwnd) grows until it reaches the value of the advertised window (awnd) and the protocol stays in the Slow Start phase always
- ☐ When a segment is lost its retransmission starts after the RTO (Retransmission Timeout)
- ☐ During connection set-up the value of MSS (Maximum Segment Size) is established
- ☐ During the Congestion Avoidance phase the window increments, approximately, by 1 segment (MSS bytes) for each RTT

#### 6. About the DNS protocol

- ☐ All DNS clients (user's devices) must know the IP addresses of the "root" servers
- ☐ All DNS clients (user's devices) must know the IP address of a DNS server (either local or from the ISP)
- ☐ When a DNS server does not have the required information it sends an iterative DNS Request message to the root server
- ☐ A local DNS server behaves as a client of the DNS root servers and TLD servers

#### 7. A HTTP 1.1 (persistent) client

- ☐ May establish more than one TCP connections when communicating with the same or different HTTP servers
- ☐ Establishes a TCP connection for each requested object
- ☐ Uses the commands GET and POST to request contents from the HTTP server
- ☐ May establish a secure connection with the server using HTTPS

#### 8. About UNICODE

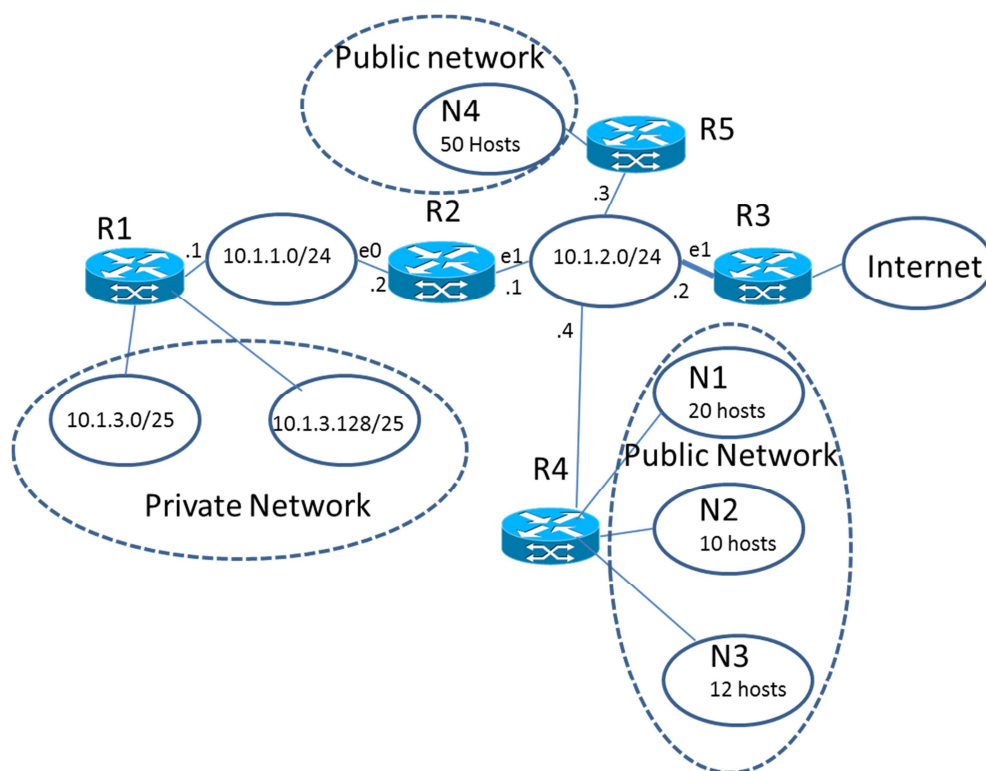
- ☐ One character is always coded using 32 bits
- ☐ Defines a unique code for each character and graphic symbol using 7 bits per byte
- ☐ A character coded with UTF-8 may require one, two, three or four bytes.
- ☐ One of the charset MIME may use is UTF-8

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### Problem 1 (2.5 points)

A business organization has a network as shown in the following diagram:



This network has been designed using private addressing, as indicated in the figure, and also using public addressing for networks N1, N2, N3 and N4. the network administrator has contracted with an ISP the range 220.10.0.0/25 for public networks taking into account the number of hosts shown in the figure.

- a) Justify whether the IP public range allows the configuration of the networks using public addressing (0.25 points)

- b) Fill in the following table with the most suitable distribution of public addresses (0.5 points)

Network	Number of IP addresses needed	Number of host-ID bits needed
N4		
N1		
N3		
N2		

- c) Specify the IP addresses decided for each network. Fill in the table using the addresses ordered numerically, lower to higher (0.5 points)

Network	IP address (model indicated below)*	Mask	IP address
Contracted address	220.10.0.0XXXXXXX	/25	220.10.0.0
N4			
N1			
N3			
N2			

\* Put the IP address in this column with the last octet in binary to facilitate the calculation

- d) If you later wish to merge the networks N2 and N3 indicate the resulting IP addressing . (0.25 points)

Network	IP Address (model indicated before)	Mask	IP Address
N3+N2			

- e) If the RIPv2 routing protocol is activated across the network, provide the routing table of R2 when RIP has converged. Use the hostid and interfaces shown in the figure (0.5 points)

Network/mask	GW (@IP)	Interface	Metric

- f) Specify the ACL output in the e1 interface of R3 if the rules are that Internet external users can only access to TCP port 80 of N1 + N2 + N3 + N4, and hosts both of our public and private network can access any server on the Internet. (0.5 points)

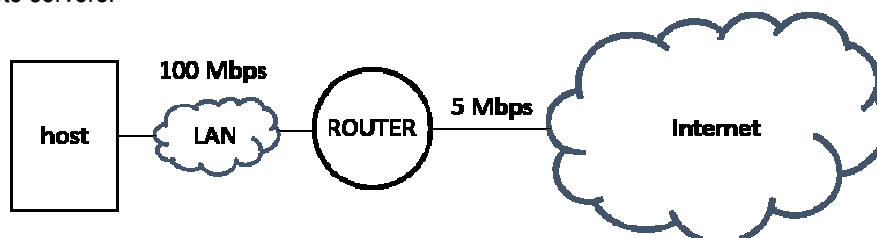
Action	Protocol	Source: @ IP/mask port	Destination: @ IP/mask port

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### Problem 2 (1.5 points)

A computer is connected via Fast Ethernet to the access Router and the Internet. The Internet connection is 5 Mbps. The computer transfers 5 files towards 5 remote servers simultaneously. The transfer program is FTP (File Transfer Program) which uses TCP connections. Four of the files have a size of 10GB and the size of the fifth file is 100GB. There is no congestion neither in the Internet nor at the remote servers.



a) (0.5 points) Find the average transmission rate for each file and make an estimation of the total time needed for completing the transfers considering optimal conditions. For the calculations, 1GB is  $10^9$  bytes.

There is a single TCP connection between the HOST and a remote server transferring a very large file (100GB). Assume that when the window reaches 50 segments there are losses.

The MSS is 1250 bytes, the estimated RTT is 100 ms. and the retransmission timeout (RTO) is 200 ms.

b) (0.25 points) Determine the ssthres value after the first retransmission of a segment

c) (0.25 points) Draw a time diagram showing the evolution of the TCP window since the beginning of the connection. Show the SS (Slow Start) and CA (Congestion Avoidance) periods.

d) (0.25 points) Find out the number of RTT between two lost segments (TCP cycle).

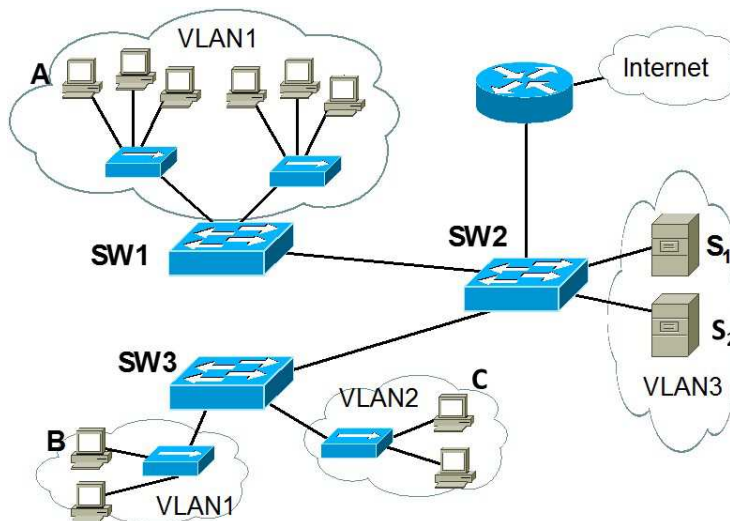
e) (0.25 points) Estimate the average transmission rate in steady state.

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### Problem 3 (1.5 points)

All the computers are connected at 100 Mbps (Fast Ethernet) while the links SW1-SW2, SW3-SW2, SW2-R, SW2-S1 and SW2-S2 are 1 Gbps links.



All VLAN1 computers (networks A and B) are downloading information from server S1. VLAN2 computers (network C) are inactive.

a) (0.25 points) Identify the MAC addresses stored in the MAC address table corresponding to the following switch ports:

a1) SW2: port S1

a2) SW2: port SW1

a3) SW2: port SW3

a4) SW2: port Router

a5) SW1: port SW2

b) (0.25 points) Which links must be in “trunk” mode and which VLANs must be configured in each one?

All PC (VLAN 1 and VLAN 2) are downloading data from server S1 simultaneously using TCP. Consider that the performance of a "hub" is 80% and that of the switches is 100%.

c) (0.5 points) Identify the bottlenecks, how flow control operates at the switches and what is the download transfer rate of each PC (6 in network A, 2 in network B and 2 in network C).

With the aim of improving the overall performance, all hubs are removed and the PCs are connected directly to the switches at 100 Mbps.

Let us suppose that all PC download information from both servers at the same time at the maximum bit rate.

d) (0.5 points) Identify the bottlenecks, how flow control operates at the switches and what is the downloading transfer rate of each PC (6 in network A, 2 in network B and 2 in network C).

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#### Problem 4 (2 points)

We want to send from a host (h1.upc.edu) an email message to x@y.org that includes a short greeting text in Catalan or Spanish and a document in PDF format. Assume that our mail server is smtp.upc.edu.

Consider the hosts: (a) h1.upc.edu, (b) smtp.upc.edu, (c) dns.upc.edu, (d) dns.y.org. Assume that all DNS caches are empty.

a) (0.25 pt) List the sequence of DNS and SMTP requests and responses sent and received by h1.upc.edu required to deliver the message to smtp.upc.edu.

Destination	Protocol	Description request	Description response
c	DNS	Recursive request, record A of <b>b</b>	

b) (0.25 pt) Indicate which DNS request and responses can send and receive smtp.upc.edu to decide to deliver the message to the mailbox of the final recipient.

c) (0.5 pt) Indicate the structure (MIME headers) that forms the body of the message.

MIME-Version: 1.0

Content-Type: multipart/\_\_\_\_\_; boundary=\_\_\_\_\_

--BB

Content-Type: text/plain; charset=\_\_\_\_\_

Content-Transfer-Encoding: \_\_\_\_\_

--BB

Content-Type: application/\_\_\_\_\_

Content-Transfer-Encoding: \_\_\_\_\_

JVBERi0xLjUKJbXtrvsKMyAwIG9iago8PCAvTGVuZ3RoIDQgMCBSCiAgIC9GaWx0ZXIgL0Zs...

dHhyZWYKNzI4OTUKJSVFT0YK

--BB--

d) (0.25 pt) How does the recipient know which character set to be used to present the text of the message?

e) (0.25 pt) Which protocols can the mailbox owner of x@y.org use to read the message?