Examen final de Xarxes de Computadors (XC), Grau en Enginyeria Informàtica		22/6/2016	Primavera 2016
Name:	**Surname:**	**Group**	**DNI**

Duration: 2h45m. The quiz will be collected in 30m. Answer the problems in the same exam sheet.

Quiz (2,5 points). All questions are multiple choice: Count as half if there is one error, 0 if more.

1. Indicate which statements for the network 192.168.200.0/21 are true:
- ☐ It can be divided into 16 subnets with 7 bits of host.
- ☐ It can be divided into 16 subnets with 8 bits of host.
- ☐ It can be divided into 8 subnets with 8 bits of host.
- ☐ It can be divided into 8 subnets with 9 bits of host.

2. In a network using the RIPv2 protocol:
- ☐ The default path to the Internet can configured by RIP.
- ☐ The default path to Internet should be configured manually.
- ☐ Static routes are unnecessary.
- ☐ RIP assigns network addresses to the interfaces.

3. Indicate which statements are true about DNS and its name servers:
- ☐ It is advisable to have at least two servers for a domain.
- ☐ The forward (name→address) and reverse (addr→name) resolution is managed by the same server.
- ☐ The forward and reverse resolution is managed by different servers.
- ☐ If a "resource record" checked previously has not expired it is reused without checking with any server for the domain.

4. Indicate which statements are true about TCP:
- ☐ A RST restarts the connection.
- ☐ A RST terminates the connection.
- ☐ A RTO terminates the connection.
- ☐ A FIN terminates the connection.

5. Indicates which statements are true about TCP connections:
- ☐ The initial sequence number is determined by the receiver.
- ☐ The advertised window is determined by the receiver.
- ☐ The congestion window is determined by the receiver.
- ☐ The next byte expected is determined by the sender.

6. Indicate which statements are true about an Ethernet switch:
- ☐ The MAC table is automatically built from the destination addresses of the frames.
- ☐ The MAC table is automatically built from the source addresses of the frames.
- ☐ Broadcast frames that arrive are sent to all ports on the switch of any VLAN.
- ☐ Broadcast frames that arrive are sent to all ports on the switch in the same VLAN.

7. Indicates which statements are true about media access protocols in local networks:
- ☐ CSMA/CA is used in access points and CSMA/CD in hubs.
- ☐ CSMA/CA is used in switches and CSMA/CD in hubs.
- ☐ CSMA/CA detects collisions when they occur.
- ☐ CSMA/CD detects collisions when they occur.

8. About objects exchanged in message-oriented protocols like SMTP or HTTP:
- ☐ Can be delimited by a "boundary" sequence in SMTP.
- ☐ You can define a "boundary" sequence in HTTP.
- ☐ Are usually encoded with 7 bits in SMTP.
- ☐ Are usually delimited by the length in SMTP.

9. Indicate which statements are true about HTTP:
- ☐ The content may be compressed.
- ☐ Binary content has to be transformed to text.
- ☐ More than one object can be transferred in a TCP connection.
- ☐ Multipart MIME objects can be transferred.

10. Indicate which statements are true about XML:
- ☐ The elements are extensible but not attributes.
- ☐ Attributes are extensible but not elements.
- ☐ Elements can contain other elements.
- ☐ Attributes can contain other attributes.

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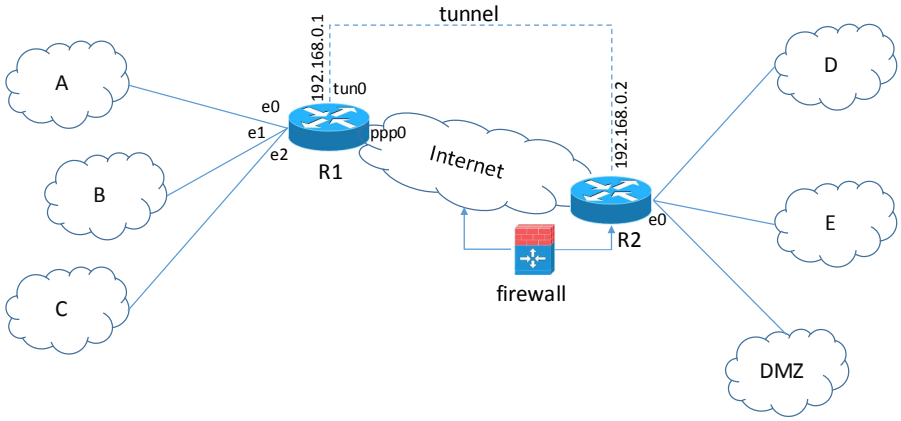
Problem 1 (2'5 points)

A company organized into five departments (A, B, C, D and E) of equal size, decides to set up its infrastructure using a combination of private and public IP addresses. Private addresses are used for the work stations and the public IPs are used for the DMZ. The base range for the private network is 10.0.0.0/8. The public range is 212.13.14.16/28. Departments B and C are part of the same location in the company, while the D and E departments, as well as the DMZ are in part of a different location. The connection between the locations is performed via a tunnel through the public Internet. Two routers manage the company inbound and outbound traffic. The tunnel is configured using two addresses of the range 192.168.0.0/24. The following diagram shows the configuration described above. All inbound and outbound traffic to the Internet (which runs out of the tunnel encapsulation) goes through R2, where the corporate firewall is implemented.



a) Propose an addressing scheme that satisfies the above requirements. The networks of all departments will be the same size and will accommodate 100 machines each. Assign networks to departments in alphabetical order (first network for A, the last for E), and make the ranges of the networks are so tight as possible to the current size of the departments.

Network	Address / mask	Broadcast
A		
B		
C		
D		
E		
Tunnel	192.168.0.0/24	
DMZ	212.13.14.16 / 28	

b) Show the contents of the Routing table of R1. All Machines in the network must be able to reach the Internet through the firewall. Use default routes if possible. The routers of the ISP that provides Internet connectivity to the company are 'R1_ISP' and 'R2_ISP' for R1 and R2 correspondingly.

Address	Mask	Gateway	Interface

c) In the case an intruder gains access to any of the DMZ machines, we want to avoid the possibility that this machine could be used afterwards to launch an attack to other machines (inside the company or external). For this reason, a series of firewall policies are implemented to limit the potential damage in case of such attack. For the case of **inbound traffic to interface e0 of R2** (that is generated in the DMZ), indicate what packages should be allowed so that the machines in the company could connect to the corporate Web server (IP 212.13.14.17, port 80) and SMTP server (IP 212.13.14.18, port 25). At the same time, it must be guaranteed that no connections could be initiated from any machine in the DMZ. The two machines of the DMZ must be freely accessible from the Internet as well. Remember that this ACL is only for the inbound traffic for interface e0 in R2. Assume that any other necessary rules have been established in other interfaces as needed. Remember to include a final rule (accepting or denying all traffic).

Source address	Destination Address	Source port	Destination port	Accept/Deny

d) Redo the previous table, but this time thinking about the **outbound traffic for e0 in R2** (heading toward the DMZ).

Source address	Destination Address	Source port	Destination port	Accept/Deny

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Problem 2 (2 points)

The following 22 lines show information about the final part of an interchange of TCP segments between a Client machine (called C) and a Server machine (called S). Line 16 hides many other lines.

Columns represent: **1)** Line number of the interchange, **2)** IP address and port of the sending machine, **3)** IP address and port of the receiving machine, **4)** Active flags (S, P, F, .), **5)** *(if there are data)* Sequence number **:** Sequence number of the following segment **(**segment data size**)**, **6)** ACK number, **7)** Advertised window size.

```
1)          2)                   3)        4)          5)                 6)          7)
    ........................................................................
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(1448) ack 93    win 32120
3.  10.2.0.1.80 > 10.1.0.3.1059: . 27725:29173(1448) ack 93    win 32120
4.  10.2.0.1.80 > 10.1.0.3.1059: . 30621:32069(1448) ack 93    win 32120
5.  10.2.0.1.80 > 10.1.0.3.1059: . 32069:33517(1448) 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(1448) ack 93    win 32120
8.  10.2.0.1.80 > 10.1.0.3.1059: . 34965:36413(1448) ack 93    win 32120
9.  10.2.0.1.80 > 10.1.0.3.1059: . 36413:37861(1448) 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(1448) 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(1448) ack 93    win 32120
16. .......................................................
17. 10.2.0.1.80 > 10.1.0.3.1059:FP 499773:500213(440)ack 93    win 32120
18. 10.1.0.3.1059 > 10.2.0.1.80: .                  ack 493981 win 23168
19. 10.2.0.1.80 > 10.1.0.3.1059: . 493981:495429(1448) ack 93  win 32120
20. 10.1.0.3.1059 > 10.2.0.1.80: .                  ack 500214 win 23168
21. 10.1.0.3.1059 > 10.2.0.1.80: F 93:93(0)         ack 500214 win 23168
22. 10.2.0.1.80 > 10.1.0.3.1059: .                  ack 94     win 32120
```

2.A (0,25 points) If port 1059 corresponds to machine C and port 80 corresponds to machine S, which machine is sending a file? Identify at least one line that justifies the answer.

2.B (0,25 points) How many data segments, at least, have been send before line 1?

2.C (0,25 points) With the available information, which data segments may have been lost and therefore have been retransmitted?

2.D (0,25 points) If there are no losses between lines 14 and 17, and assuming that the RTT is equal to 100 ms, how many segments have been transmitted?

2.E (0,5 points) If there were no losses between lines 14 and 17, and assuming that the RTT is equal to 100 ms, **give an estimation** of the transmission speed, justifying the answer.

2.F (0,5 points) We know that there have been losses between lines 14 and 17. Assume now that the file being transmitted is bigger than the original one, and that the last segment is “504117:505117(1000)”.
Also asume that lines 17 to 20 change to:

```
17. 10.2.0.1.80 > 10.1.0.3.1059: . 499773:501221(1448) ack 93     win 32120
18. 10.1.0.3.1059 > 10.2.0.1.80: .                     ack 493981 win 23168
19. 10.2.0.1.80 > 10.1.0.3.1059: . 493981:495429(1448) ack 93     win 32120
20. 10.1.0.3.1059 > 10.2.0.1.80: .                     ack 501221 win 23168
```

Keeping the losses of the initial dump, and assuming that there are no more losses, **substitute** the original lines 20 to 22 by the needed lines to end the file transmission and to close the connection. **Also, indicate** the value of the congestion window in the lines where it changes and at the end of the connection.

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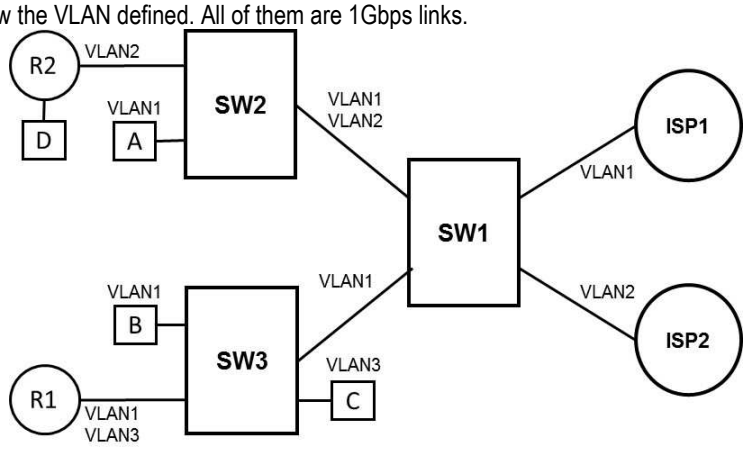
Problem 3 (1.5 points)

The figure shows a network including the configuration of the VLANs. VLAN1 provides access to the Internet via ISP1 and VLAN2 via ISP2. According with this configuration D has access to Internet via R2 and ISP2. The rest of the hosts (A, B and C) have access to the Internet via ISP1. The links in the figure show the VLAN defined. All of them are 1Gbps links.



For each of the following scenarios identify the bottleneck, how flow control applies, and what is the maximum transmission speed the host may achieve.

a) Hosts A, B and D send traffic towards the Internet. If host A sends 300Mbps and C does not generate traffic, What is the transmission speed B and D may achieve?

b) The same scenario as before but now host C sends traffic at its maximum speed.

c) Only hosts A and B send at their maximum speed towards host C. What is the maximum speed they may achieve?

d) Hosts A and B send at their maximum speed towards host C, and D transmits at its maximum speed to the Internet (ISP2). What is the maximum speed they may achieve?

e) In order to provide a "backup" access to Internet VLAN4 is setup between R1 and R2 (R1-SW3-SW1-SW2-R2) so that all traffic towards the Internet is redirected via ISP2 (R1 sends all the traffic via VLAN4 to R2). If the link SW1-ISP1 is down, host A sends 300Mbps and all the other hosts send at their maximum speed towards the Internet, what is the maximum speed they may achieve?

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Problem 4 (1,5 points)

Lets consider two hosts on the Internet: h1.upc.edu and www.xyz.com. Assume that the user in h1.upc.edu types the URL http://www.xyz.edu/catalogo.zip in his browser to receive a 1 Gbyte file.

Consider the hosts: (a) h1.upc.edu, (b) www.xyz.com, (c) dns.upc.edu, (d) dns.xyz.com, (e) a.root-server.net, (f) a.com-servers.net. Assume all the HTTP and DNS caches are empty and that all DNS queries are iterative (non recursive).

a) Enumerate the sequence of DNS, TCP and HTTP requests and responses sent and received by h1.upc.edu since typing the URL in the browser until the file has been completely received.

	Source	Dest.	Prot	Description of request	Description of response
1	a	c	DNS	Iterative request, register A for **b**	Reference to node **e**
2					
3					
4					
5					
6					
7					
8					

b) If the file transfer is interrupted (the TCP connection receives a RST) without completing the transfer, and the user again requests the same URL, indicate which steps may not repeat and under which condition.

c) If several days after downloading the file the user again requests the same URL, indicate what effect it will have in the transfer the presence of the "If-Modified-Since" HTTP header in the request if the file has not changed during that period.

d) How does the browser knows the HTTP server is sending a ZIP file instead of a JPG image?