

| Examen final de Xarxes de Computadors (XC), Grau en Enginyeria Informàtica | | 17/6/2014 | Primavera 2014 |
|--|---------|-----------|----------------|
| NAME: | SURNAME | GROUP | DNI |

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

Quiz (2,5 points) All questions are multi-answer: 0,25 points if correct, half if one error, 0 otherwise.

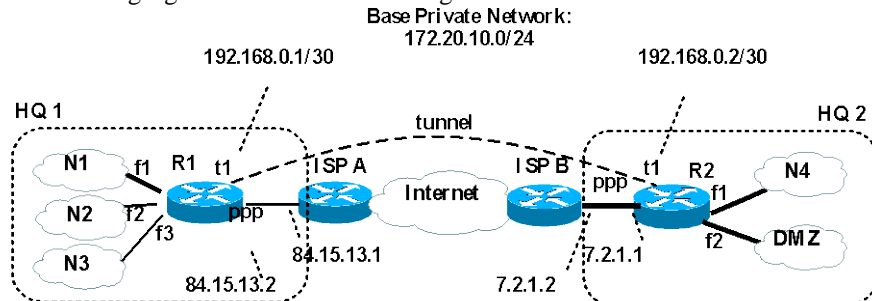
| | |
|--|---|
| <p>1. We want to download and visualize in a browser a HTML document, which includes 20 embedded references to images. 10 of the images are located on the same server than the document. The other are located on another external server. In this scenario the number of TCP connections required is:</p> <p><input type="checkbox"/> 21 TCP connections TCP in non-persistent HTTP mode</p> <p><input type="checkbox"/> 1 TCP connection in persistent HTTP mode without pipelining</p> <p><input type="checkbox"/> 20 TCP connections in non-persistent HTTP mode</p> <p><input type="checkbox"/> 2 TCP connections in persistent HTTP mode without pipelining</p> | <p>2. Which ones of the following statements are true:</p> <p><input type="checkbox"/> SMTP protocol is used between SMTP servers</p> <p><input type="checkbox"/> SMTP protocol is used between clients and SMTP servers</p> <p><input type="checkbox"/> SMTP provides means to manage the contents of the user's inbox</p> <p><input type="checkbox"/> POP3 manages folders locally while IMAP allows for the management of remote folders on the server</p> |
| <pre>(1) 172.168.137.128.39599 > 150.214.5.135.80: . ack 2921 win 5840 150.214.5.135.80 > 172.168.137.128.39599: . 2921:4381(1460) ack 437 win 5240 150.214.5.135.80 > 172.168.137.128.39599: . 4381:5841(1460) ack 437 win 5240 150.214.5.135.80 > 172.168.137.128.39599: . 5841:7301(1460) ack 437 win 5240 150.214.5.135.80 > 172.168.137.128.39599: . 7301:8761(1460) ack 437 win 5240 172.168.137.128.39599 > 150.214.5.135.80: . ack 8761 win 1460 (2) 150.214.5.135.80 > 172.168.137.128.39599: . 8761:10221(1460) ack 437 win 5240 150.214.5.135.80 > 172.168.137.128.39599: . 10221:10571(350) ack 437 win 5240 172.168.137.128.39599 > 150.214.5.135.80: . ack 10221 win 5840 150.214.5.135.80 > 172.168.137.128.39599: . 10221:10571(350) ack 437 win 5240 150.214.5.135.80 > 172.168.137.128.39599: . 10221:10571(350) ack 437 win 5240 172.168.137.128.39599 > 150.214.5.135.80: . ack 10571 win 5840 150.214.5.135.80 > 172.168.137.128.39599: F 614268001:614268001(0) ack 437 win 5240 (3) 172.168.137.128.39599 > 150.214.5.135.80: F 437: 437(0) ack 614268002 win 36240 150.214.5.135.80 > 172.168.137.128.39599: . ack 438 win 5240</pre> | |
| <p>3. Based on the previous dump, indicate what statements are true considering that the dump was captured on the server (port 80):</p> <p><input type="checkbox"/> The congestion window at time (1) was 4 segments at least</p> <p><input type="checkbox"/> If the time spent between (1) and (2) is 200ms, it can be said that the speed at which the client application consumes data during this interval is roughly 58.4Kbps.</p> <p><input type="checkbox"/> In this dump, 3 lost segments can be identified</p> <p><input type="checkbox"/> In this dump, 2 lost segments can be identified</p> | <p>4. We are given a scenario in which 5 hubs are connected to a switch using 100Mbps links. Each hub is connected also to 10 stations using 10Mbps links. The efficiency of the hub is 100%. No VLANs are configured. Flow Control is activated. In these circumstances:</p> <p><input type="checkbox"/> The collisions domain for each machine contains 9 more machines</p> <p><input type="checkbox"/> The broadcast domain for each machine contains 9 more machines</p> <p><input type="checkbox"/> If all machines connected to 4 of the hubs send data at maximum speed to another machine connected the fifth hub (from which no other machines transmit data), the effective speed of the transmission will be 250Kbps.</p> <p><input type="checkbox"/> Hubs and switches are devices of level 2</p> |
| <p>5. Which ones of the following statements are true:</p> <p><input type="checkbox"/> CSMA/CD is disabled in Half-Duplex environments because in these conditions there is no collision domain</p> <p><input type="checkbox"/> The sending of the preamble of a frame is never interrupted, even in the case that collisions are detected</p> <p><input type="checkbox"/> The time to establish an Ethernet connection is 1.5RTT</p> <p><input type="checkbox"/> Flow Control in IEEE 802.3 for Full -Duplex environments is enforced using PAUSE frames</p> | <p>6. Based on the previous dump, indicate what statements are true considering that the dump was captured on the server (port 80):</p> <p><input type="checkbox"/> At time (3), the server is in state ESTABLISHED</p> <p><input type="checkbox"/> At time (3), the server is in state FIN_WAIT_1</p> <p><input type="checkbox"/> At time (3), the server is in state FIN_WAIT_2</p> <p><input type="checkbox"/> At time (3), the code of the server has already invoked the call close()</p> |
| <p>7. A router has 3 interfaces for the DMZ (eth0), the internal network (eth1) and Internet (ppp0). What entries of an ACL are not incompatible with giving full connectivity to the DMZ while the systems of the private network can't receive connections and only have access to the DMZ and to HTTP servers of Internet?</p> <p>(Iface - IN/OUT - IP (src - dst) - Port (Src - Dst) - Established? - OK/Deny)</p> <p><input type="checkbox"/> ppp0 - IN - [ANY - DMZ] - [ANY - ANY] - OK</p> <p><input type="checkbox"/> eth1 - OUT - [ANY - ANY] - [ANY - 80] - Established - OK</p> <p><input type="checkbox"/> eth1 - IN - [ANY - ANY] - [ANY - 80] - OK</p> <p><input type="checkbox"/> eth1 - OUT - [ANY - ANY] - [ANY - 80] - Deny</p> | <p>8. Which ones of the following statements about RIP are true:</p> <p><input type="checkbox"/> Convergence time depends of the diameter of the network (maximum distance between two most far distant routers)</p> <p><input type="checkbox"/> Convergence time exclusively depends of the total number of routers in the network</p> <p><input type="checkbox"/> Split Horizon and Poisson Reverse are two complementary techniques</p> <p><input type="checkbox"/> Split Horizon and Poisson Reverse are two incompatible techniques</p> |
| <p>9. To which ones of the following list of networks does not belong to the address 12.129.7.8 (assuming a CIDR mode)?</p> <p><input type="checkbox"/> 12.128.0.0/8</p> <p><input type="checkbox"/> 12.0.0.0/9</p> <p><input type="checkbox"/> 12.128.0.0/24</p> <p><input type="checkbox"/> 12.128.0.0/23</p> | <p>10. Which ones of the following statements about DNS are true:</p> <p><input type="checkbox"/> ROOT DNS servers operate in recursive mode</p> <p><input type="checkbox"/> ROOT DNS servers operate in non-recursive mode</p> <p><input type="checkbox"/> The MX record is commonly used by SMTP servers in relay mode</p> <p><input type="checkbox"/> The MX record is commonly used by POP3 servers in relay mode</p> |

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Question 1. (2,5 punts)

A company takes the private base address 172.20.10.0/24 to organize its IP networks using the CIDR model. The company is composed of 4 departments (N1-N4) and a DMZ where the DNS, SMTP, POP3 and HTTP servers are located. Three of the networks are located in the headquarters (HQ) office HQ1, while the DMZ and the other network are located in HQ2. Both HQ offices will be connected by means of a tunnel. Both R1 and R2 use PAT to give Internet access to the machines of the company – for such purpose the routers overload their public addresses. Additionally, R2 uses DNAT (static PAT) to give access to the DMZ to other machines of the Internet – for such purpose it uses its public IP address. The DMZ can be reached from inside the company using the private base range. The following figure illustrates the existing scenario:



In this context, provide answers the following questions:

- a) Propose a network for N1-N4 and DMZ that matches the following requirements:

| Network | Required capacity (#PCs + router address) | Network Address | Mask | Broadcast |
|---------|--|------------------|-----------------|-----------|
| DMZ | 5 | 172.20.10.0 / 29 | 255.255.255.248 | |
| N1 | 12 | | | |
| N2 | 120 | | | |
| N3 | 56 | | | |
| N4 | 27 | | | |

- b) R1 and R2 build their routing tables by means of RIP. They don't propagate information about static entries and auto-summarization is not enabled. Each HQ office will get Internet access through the ISP available in the region where the office is located. Indicate what are the expected contents of the routing table of **R2** once RIP has converged. You can leave **network address indicated** (N1, N2...). The order of the entries in the routing table will not be considered in this question.

| Xarxa | Gateway | Interface | Mètrica RIP | Origen (local, RIP, estàtica) |
|-------|---------|-----------|-------------|-------------------------------|
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- c) For the two situations presented below, indicate what will be the composition (IP headers, including more relevant addresses) of an IP datagram going through R2 and traveling from the source to the destination address indicated. Suppose any missing information.

| Source | Destination | Composition | Composition |
|----------------------------|---|--------------|--------------|
| A computer in N1 | DNS server of the company (172.20.10.2) | Input of ppp | Output of f2 |
| A computer in the Internet | Web server of the company (172.20.10.3) | Input of ppp | Output of f2 |

- d) Explain what are the expected contents of the ARP cache table of a computer in N1 after it downloads a HTML document located in the web server of the company. The document contains embedded references to images stored on 5 different servers, all them located in the Internet. The ARP cache is initially empty. Indicate both the total number of entries on the table as well as the content of each one of the entries added.

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Question 2. (2 points)

Figure 1 shows the network configuration for a small company. The Internet connection is a cable connection at 20 Mbps. Ethernet switch 1 (sw1) has Fast Ethernet ports only (100 Mbps) and one 1 Gbps link to sw2. Ethernet switch 2 (sw2) has Gigabit ports only. Each WiFi Access Point (AP) supports 300 Mbps wireless connection and its efficiency is 70%. Each one of the 5 AP connects 10 laptops. Each one of the 5 switches (C1, .. C5) connects 10 terminals with Fast Ethernet (100 Mbps). Servers A and B are connected at Fast Ethernet to sw1.

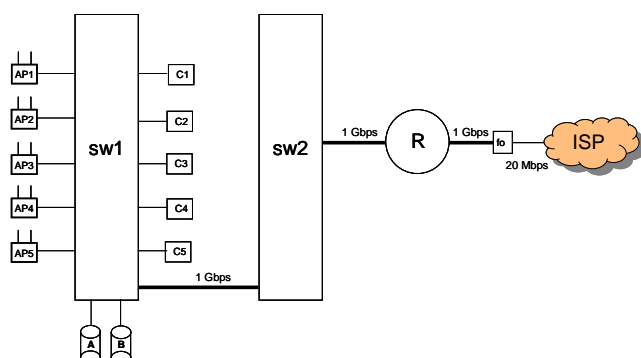


Figure 1

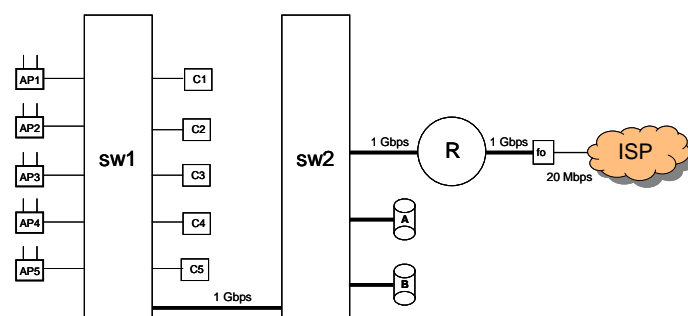


Figure 2

Consider that all laptops and terminals are downloading information continuously from both servers at the same time.

a) (0.5 points) What is the download speed for each laptop and terminal from each server?

With the aim of improving the efficiency servers A and B are moved to sw2 and are connected at 1 Gbps as shown in Figure 2.

b) (0.5 points) Now, what is the download speed for each terminal and laptop from each server? Explain how the flow control applies.

In order to isolate the departments two sub-networks are configured using two VLAN.

VLAN1 includes AP1, AP2, C1, C2, C3 and server A. VLAN2 includes AP3, AP4, AP5, C4, C5 and server B.

Consider that all laptops and terminals are downloading information continuously from both servers at the same time.

c) (0.5 points) Identify the bottlenecks and how the flow control applies. What is the download speed for each terminal and laptop from each server?

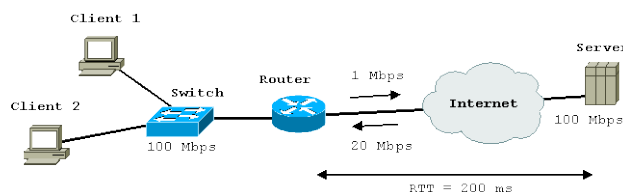
d) (0.5 points) If all terminals and laptops are downloading data from the Internet at the same time they are downloading from servers A and B, what is the download speed they can achieve? Specify the download speed from A, from B and from the Internet.

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Question 3. (2 punts)

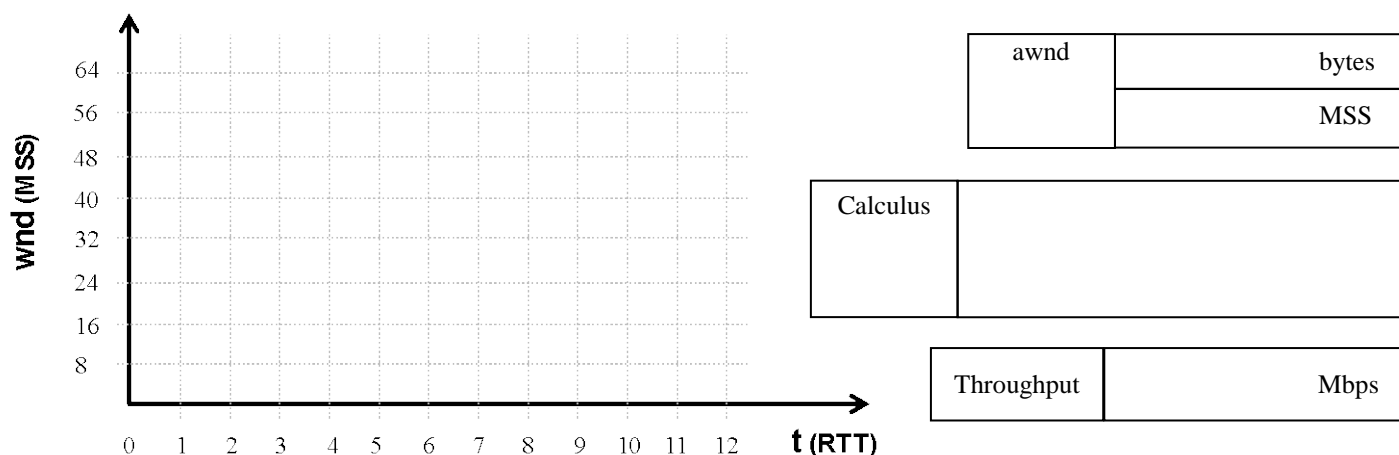
Client 1 and Client 2 are connected to Internet through the switch 100baseTX (efficiency 100%) and an ADSL Router. ADSL line has a downstream rate of 20 Mbps and an upstream one of 1 Mbps. A file repository Server is connected to an access line at 100 Mbps. We know that:



- MSS of TCP is 1460 bytes in both directions
- TCP only implements SS/CA and does not use any option
- RTT between Router and Server is 200 ms, the rest of delays are negligible
- Client 1 and Client 2's RX buffers are the maximum that can be used
- Server uses a pair of TX and RX buffers of 40kbytes per each TCP session
- there is no losses in Internet and the applications write and read very quick

We ask:

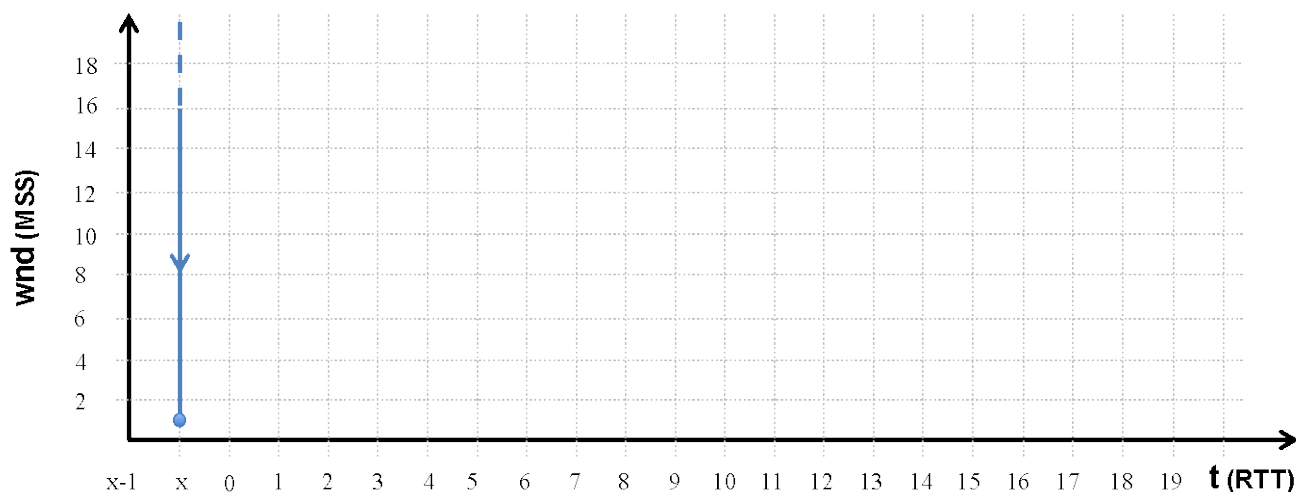
- a) Client 1 wants to download a file from the Server. Knowing that the Router has infinite buffers (approx.), depict the curve of the transmission window as a function of the time and compute the effective throughput once TCP is stable.



- b) While Client 1 is downloading the file, Client 2 begins to transmit a file to the Server. Compute the throughput of both TCP sessions when stable.

| | | | | | |
|--------------------|------------|-----|-------------|------------|----|
| Server -> Client 1 | Throughput | Mbp | Client 2 -> | Throughput | Mb |
|--------------------|------------|-----|-------------|------------|----|

- c) While Client 2 closes its session, Client 1 is still downloading the file. But the Router begins to loss datagrams. The first datagram is lost at $t=x$ when TCP is stable. Afterwards, the Router always losses the last datagram when the transmission window is 8 MSS. We ask to depict the curve of the transmission windows from $t=x$ and compute the average throughput of Client 1 in this situation. Do not forget to indicate the values of ssthresh. Consider $RTO = 2RTT$.



| | | | |
|----------|--|------------|------|
| Calculus | | Throughput | kbps |
|----------|--|------------|------|

