Universidade de Aveiro
Licenciatura em Engenharia de Computadores e Informática
Exame Final de Redes de Comunicações 1 – 11 de Fevereiro de 2022

Duration: 2:00 hours. With no extra reading. Carefully justify your answers.

Consider that you were hired to be the network manager of a company network. The characteristics of the network are the following:

- The company network has 2 sub-networks with private addressing, and a connection to the outside through R1, with the connection to the Internet emulated by R2;
- In each switch port and in each router interface there is an identifier;
- In each terminal or network interface there is an IP address;
- R1 has a DHCP server to allocate addresses inside the company network;
- R1 has a default route to the internet and has NAT/PAT correctly configured;
- R2 has a route for the company network through R1.

1. PC1 and PC2 cannot communicate. What can be the reason? In this situation, and considering initially ARP and switching tables empty, is it possible that *switch* 1 learns the port associated to each PC 1 and 2? Justify. (2.0 points)
   Answer: PC2 has a wrong address (an address from the lower network). If a default gw is configured, PC1 will try to communicate through R1 (which sends a ARP Request for PC2 in the lower network, which is never answered), switch 1 learns the port of PC1; if a default gw is not configured, no packet is sent, and no learning is made.
2. Considering that the problem of the previous question is correctly solved, propose, justifying, addresses for the interfaces of R1 (values x and y) to provide communication between PC1 and PC3. (1.5 points)
   Answer: 1<=x<=62, except 60 and the one of PC2, when it is corrected; 65<=y<=126, except 112.
3. Considering the communication in the previous question 2, which are the entries in the switching table of *switch* 1? (1.5 points)
   Answer: Port e01 – MAC PC1; Port e2 – MAC f0/0 R1; MAC of interfaces from different networks are never known in another network – MAC is local!
4. In an available interface of *switch* 2 we connect an access point of a wireless network. However, while the users connect to the network, the performance of the network decreases (large transmission delays). Explain a possible reason for this observation, and also a possible solution to solve it. (2.0 points)
   Answer: More users → More traffic → More collisions; Include collision avoidance through RTS/CTS.
5. The leasing time of the DHCP has a time specified by the network manager. How would you adjust this time in the case you have many users moving, entering and leaving the network? Justify. (1.5 points)
   Answer: Low leasing time: when the terminal leaves the network, it does not renew, so it is released in a smaller time to be available for the others to come.
6. Considering NAT/PAT in R1 for the communication of PC1, 2 and 3 with the outside (and considering the problem in question 1 solved), can the private addresses be dynamically allocated through DHCP? Present an example of a transition table with a NAT pool of 200.0.0.128/25. (1.5 points)
   Answer: Yes, DHCP can allocate private or public addresses, and these can be dynamic because the communication is from the inside to the outside. Table: private addresses and ports associated to some of the addresses of the given public pool and ports.

7. Considering that in IPv6 you may have many more addresses than in IPv4, explain how a terminal can acquire its own address and communicate with the Internet. (2.0 points)
   Answer: 2 parts of the address: terminal part given by the MAC address or pseudo-randomly calculated; network prefix given by the router in router advertisement messages.
8. It is detected a problem in the TCP configuration, that makes the transmission rate to be very low. It was discovered that the problem is related to the low timeout value when detecting lost packets. Justify why a small timeout can lead to a small transmission rate. (1.5 points)
   Answer: Low timeout, probably expiring before the ACK arrives to the data sender; packet is considered as lost when probably it was received and the ACK is to be received; re-send the packet and decrease the congestion window to 1 → very low transmission rate.
9. Even after all configurations are correct, the TCP transmission rate cannot exceed 60% of the links capacity. Considering that there are also services running through UDP in the same links, can you understand what may be avoiding TCP to have a higher rate? Justify. (2.0 points)
   Answer: UDP needs 40% of the network, and it does not decrease its rate. TCP will increase the window rate, and whenever it will have losses, it will be decreasing its rate (to half the one before in the case of 3 duplicated ACKs, or to 1 in the case of timeout). Therefore, the rate will never exceed 60%, because it will adjust, through the losses and the TCP algorithms, to the available bandwidth.
10. Considering that you want to contact a server that is near your network, would you prefer a DNS with an iterative or recursive resolution? Justify. (1.5 points)
    Answer: Iterative: the problem of iterative is the several round trip times to go from the local DNS server to the several levels of servers. Since they are close, these round trip times are small.
11. Is it possible in PC4, running an HTTP server, to have simultaneous sessions with PCs 1 and 2? Justify with a proposal of a solution. (1.5 points)
    Answer: Yes, PC1 and PC2 have different addresses and/or different ports given by NAT/PAT, so the connections can be differentiated by the source IP address and/or source ports.
12. In which cases can TFTP have a performance similar to the one of FTP? Justify (1.5 points)
    Answer: TFTP has packet control and retransmission, and is reliable!!! It goes through UDP, so it is TFTP, the application itself, that performs the control.
    However, TFTP sends 1 packet only each time and waits for the ACK, to be able to send the next data packet. Therefore, they have similar performance when FTP (through TCP) can only send 1 packet at a time and waits for an ACK, that is, when the TCP congestion window is 1.
    Possibilities: Many losses and the TCP window of FTP is always decreasing to 1; large delay and the window is always very small; only 1 packet to be sent in the file.