University of Aveiro
Licenciatura em Engenharia Informática

Exam of Networks and Services – January 22nd, 2021

Duration: 2h30m. Carefully justify all your answers.

1. Regarding the network in the annex, consider that: (i) all connections between layer 2 switches (layer 2-layer 2) and between layer 2 and layer 3 switches (layer 2-layer 3) are inter-switch/trunk ports, (ii) all connections between layer 3 switches are used using layer 3 (routing); (iii) the Spanning Tree Protocol (STP) is active in all switches/bridges. In both L3 switches the switching module corresponds to ports f1/0-15. Consider that VLANs 1, 21, 22 e 23 are configured.

a) For the Spanning-tree process of VLAN 1 (SW1 to SW6 and SWL3A), identify and justify which is the root switch/bridge, which is the root path cost of each switch/bridge and which are the root ports, the designated ports and the blocked ports at each switch/bridge. Justify your answer. (2.5 points)
Note: the STP priority and the MAC address are indicated next to the corresponding switch/bridge, while the STP cost of all ports is located between parenthesis next to the corresponding port.

b) In order to perform load balancing between the upper part (odd switches) and the lower part (even switches) of the network, identify the changes that you should make in the configurations of the different equipments to fulfill this requirement. Justify your answer. (2 points)

c) If switch 4 fails, explain the reconfiguration process of the spanning tree associated to VLAN 1. (1 point)

2. Consider that this company has the range of public IPv4 addresses 195.1.1.0/25, will use the range of private IPv4 addresses 10.10.0.0/16 and the range of IPv6 addresses IPv6 2001:2001:2001::/60. Consider also that Routers 1 to 3 and Switches L3 SWL3A and SWL3B are configured with the routing protocols OSPFv2 and OSPFv3. Assume that Router 1 is announcing a default route of the E2 type with metric 10, both in IPv4 and IPv6.

a) Define public and/or private IPv4 sub-networks (network identifier and subnet mask) for all LANs and VLANs assuming that there are some services running at terminals/servers that need public IPv4 addresses, namely: VLAN 1 has a maximum of 16 terminals that need public addresses; VLAN 21 has a maximum of 10 terminals that need public addresses; VLAN 23 has a maximum of 8 terminals that need public addresses; DMZ needs 2 public addresses; Datacenter needs 4 public addresses; the NAT/PAT mechanism needs 3 public addresses. (2.5 points)

b) Which is the IPv4 routing table of SWL3A? Note: Identify the networks, IP addresses and interface names by and explicit alphanumeric identifier (ex: netIPv4VLAN1, addIPv4eth0Router1, intEth0Router1). (2.5 points)

c) Which is the IPv6 routing table of Router 2? Note: Identify the networks, IP addresses and interface names by and explicit alphanumeric identifier (ex: netIPv4VLAN1, addIPv4eth0Router1, intEth0Router1). (2.0 points)

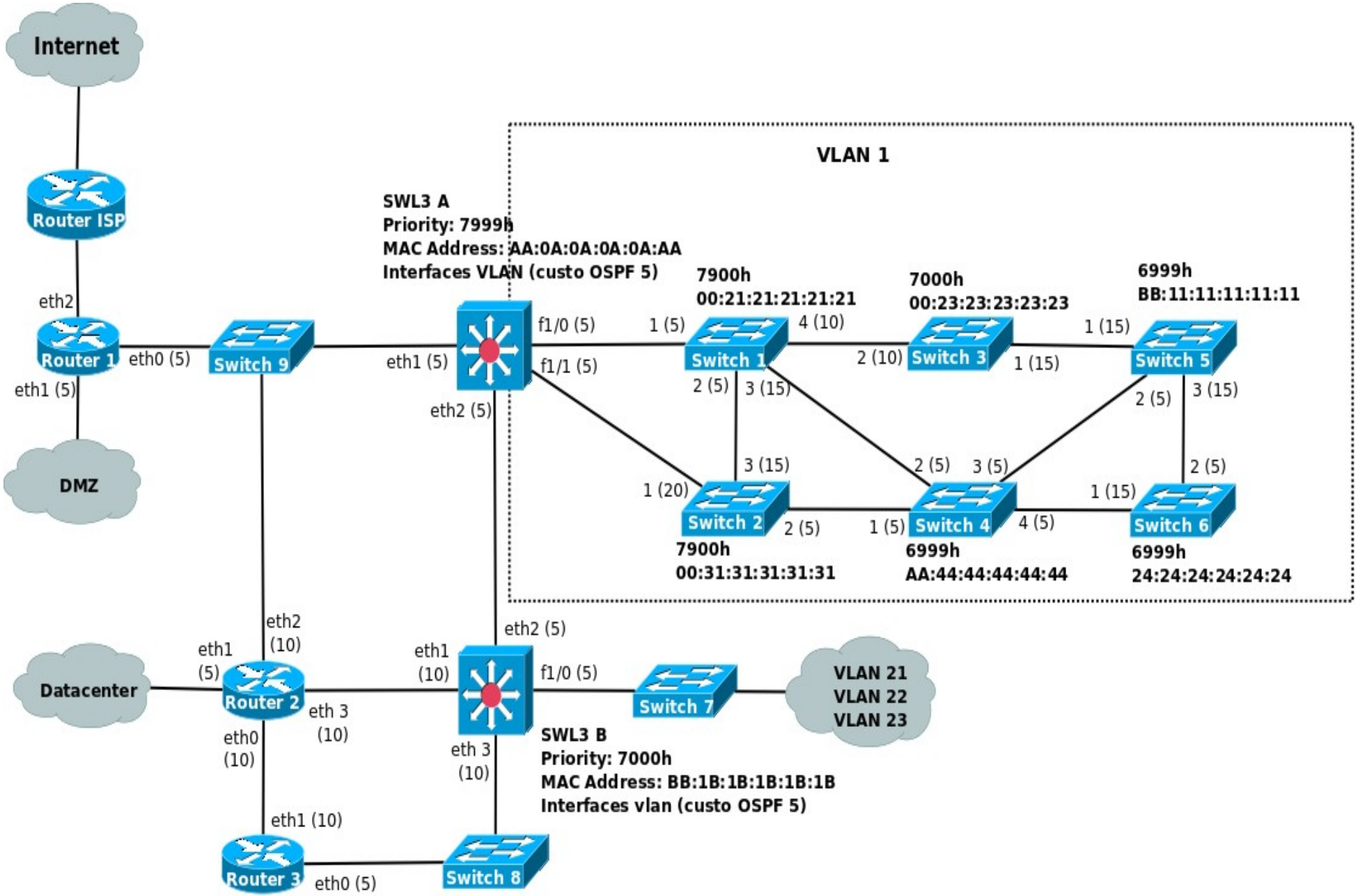
d) We want that any IP packet coming from VLAN 21 and destined to outside the company be preferentially routed through Router 3 (due to security reasons). Which configurations do you need to do in order to fulfill this requirement? (1.5 points)

e) In a communication from a terminal at VLAN 1 to a terminal at VLAN 22, specify which are the IP and MAC source and destination addresses in the connection between switches L3 A and B. (1 point)

f) Explain how the network should be designed/configured in order to allow terminals that only have private IPv4 addresses to have connectivity to the Internet. Also explain how can you have a Web server at VLAN 23 with an IPv4 private address providing a global scale (internet) service. (1.5 points)

g) Now, we want terminals at VLAN 23 to obtain their network configurations in an automatic way. Explain how can we implement this functionality, supposing that there is a specific computer that should always obtain the same network configuration. (1.5 points)

3. For security reasons, we want to assure that:
   a) VLAN 1 users must not have access to the Datacenter. Explain which configurations do we need in order to fulfill this requirement and in which equipments/interfaces. (1 point)
   b) users from VLANs 21, 22 and 23 should have a secure connection to the Datacenter. Explain which configurations do we need in order to fulfill this requirement and in which equipments. (1 point)


Internet
Router ISP
eth2
Router 1
eth0 (5)
Switch 9
eth1 (5)
DMZ
VLAN 1
SWL3 A
Priority: 7999h
MAC Address: AA:0A:0A:0A:0A:AA
Interfaces VLAN (custo OSPF 5)
eth1 (5)
f1/0 (5)
f1/1 (5)
eth2 (5)
7900h
00:21:21:21:21:21
7000h
00:23:23:23:23:23
6999h
BB:11:11:11:11:11
1 (5)
4 (10)
2 (10)
1 (15)
1 (15)
Switch 1
Switch 3
Switch 5
2 (5)
3 (15)
2 (5)
3 (15)
3 (15)
2 (5)
3 (5)
2 (5)
1 (20)
1 (15)
Switch 2
Switch 4
Switch 6
2 (5)
1 (5)
4 (5)
7900h
00:31:31:31:31:31
6999h
AA:44:44:44:44:44
6999h
24:24:24:24:24:24
Datacenter
eth2
(10)
eth1
(5)
Router 2
eth 3
(10)
eth0
(10)
eth1 (10)
Router 3
eth0 (5)
eth2 (5)
eth1
(10)
f1/0 (5)
eth 3
(10)
Switch 7
Switch 8
SWL3 B
Priority: 7000h
MAC Address: BB:1B:1B:1B:1B:1B
Interfaces vlan (custo OSPF 5)
VLAN 21
VLAN 22
VLAN 23