

**Universidade de Aveiro**  
**Licenciatura em Engenharia de Computadores e Informática**  
Theoretical Exam (Recurso) - Redes de Comunicações II  
July 15<sup>th</sup> 2022

Duration: 2h30m. No consultation. Carefully justify all answers.

Considering the hierarchical network design model and the attached company network:

1. Identify the local VLANs, justify.(1.5 points)
2. Assuming that VLANs 4 and 8 have different Spanning-Tree (SPT) processes active. Identify, for each of the SPT processes, which is the ideal Switch to be its root. Present the solution to ensure this result.(1.5 points)
3. In Router 1's IPv4 routing table, how many routes are there to the 192.168.96.0/20 network and with which cost? (1.5 points)
4. Propose a possible change in the OSPF protocol settings to ensure that traffic to the Internet is preferably forwarded to Router 2. (1.5 points)
5. Propose a possible change in the configurations of the OSPF protocols in order to guarantee that the traffic that arrives at Router 5 (to outside the Datacenter A) is preferentially routed through SWL3 C1. (1.5 points)
6. Changing only the configuration of Router 5, propose a forwarding solution that guarantees bidirectional IPv4 connectivity to the IPv4 networks of the Datacenter A's virtual network (192.168.200.0/24 and 192.168.210.0/24). (2.0 points)
7. Propose a complementary IPv4 routing solution that ensures that traffic from VLAN 8 to the Datacenter A (192.168.96.0/20), and vice versa, is first routed to Router 3 and only then forwarded to its destination. (2.0 points)
8. Based on the analysis, introduction and/or manipulation of MP-BGP announcements and attributes of MP-BGP routes, explain how you can guarantee the following routing requirements of this company/operator:
  - a) AS2000 is a transit autonomous system (for both peers) (1.5 points)
  - b) AS2000 received by MP-BGP announcements from a (specific) IP network in the USA through several disjoint paths. It is intended that the traffic forwarded by Routers 1 and 2, for this network in the USA, should never be sent by AS 10002 (ISP2). (1.5 points)
  - c) AS2000 received by MP-BGP advertisements from IP networks in Australia through several disjoint paths. It is intended that the traffic routed by Routers 1 and 2, for these networks in Australia, should be preferably sent by operators that are not from Russia or China. (1.5 points)
9. Explain what changes you will need to make in the company's network settings in order to create an MPLS tunnel, with a guaranteed bandwidth of 20 Mbps between Datacenter A and B, for traffic between networks 192.168.96.0/20 and 10.10.0.0/24. (2.0 points)
10. The company will install a SIP VoIP system. Explain the changes to be made to the company's DNS server (companyX.pt domain) and how VoIP SIP calls from the exterior will be routed to the company's server. (2.0 points)

- Access ports for VLANs 1,4,5,6 are configured on the Layer 2 switches in Building A. Access ports for VLANs 1,8,9 are configured on the Layer 2 switches in Building B;
- Interfaces between Layer 3 switches are Layer 2 ports (switching) and interfaces between Layer 3 switches and routers are Layer 3 ports;
- Connections between Layer2 switches and Layer3 switches F1 to F4 are made using trunk/inter-switch connections with transport permission for all VLANs;
- Links between Layer3 switches F1 to F4 and Layer 3 switches C1 and C2 are made using trunk/inter-switch connections with transport permission only for VLANs 1, 8 and 101;
- There are two Datacenters (A and B). In Datacenter A, a virtual network with 2 IPv4 prefixes is implemented;
- Layer3 switches and routers 1 to 5 have OSPFv2 and OSPFv3 protocol processes (with identifier 1) active on all internal IP networks;
- All interfaces, except for VLAN 101 interfaces, are configured as passive in OSPF processes. VLAN 101 is thus an interconnection VLAN between the distribution and the core of the network, through which IP routes are dynamically exchanged and learned;
- Internet access routers (Routers 1 and 2) are announcing (by OSPF) default routes with a base metric of 100 (E1 type);
- All interfaces have an OSPF cost of 1;
- Router 6 is a virtual machine and does not support any dynamic forwarding protocol, it just has a default static IPv4 route to Router 5.
- Routers 1 through 5 and Layer 3 switches do not have static routes configured.
- This company is an autonomous MP-BGP (AS2000) system and has MP-BGP peering agreements with ISP1 (AS10001) and ISP2 (AS10002).

