Universidade de Aveiro
Licenciatura em Engenharia de Computadores e Informática

Theoretical Exam - Redes de Comunicações II

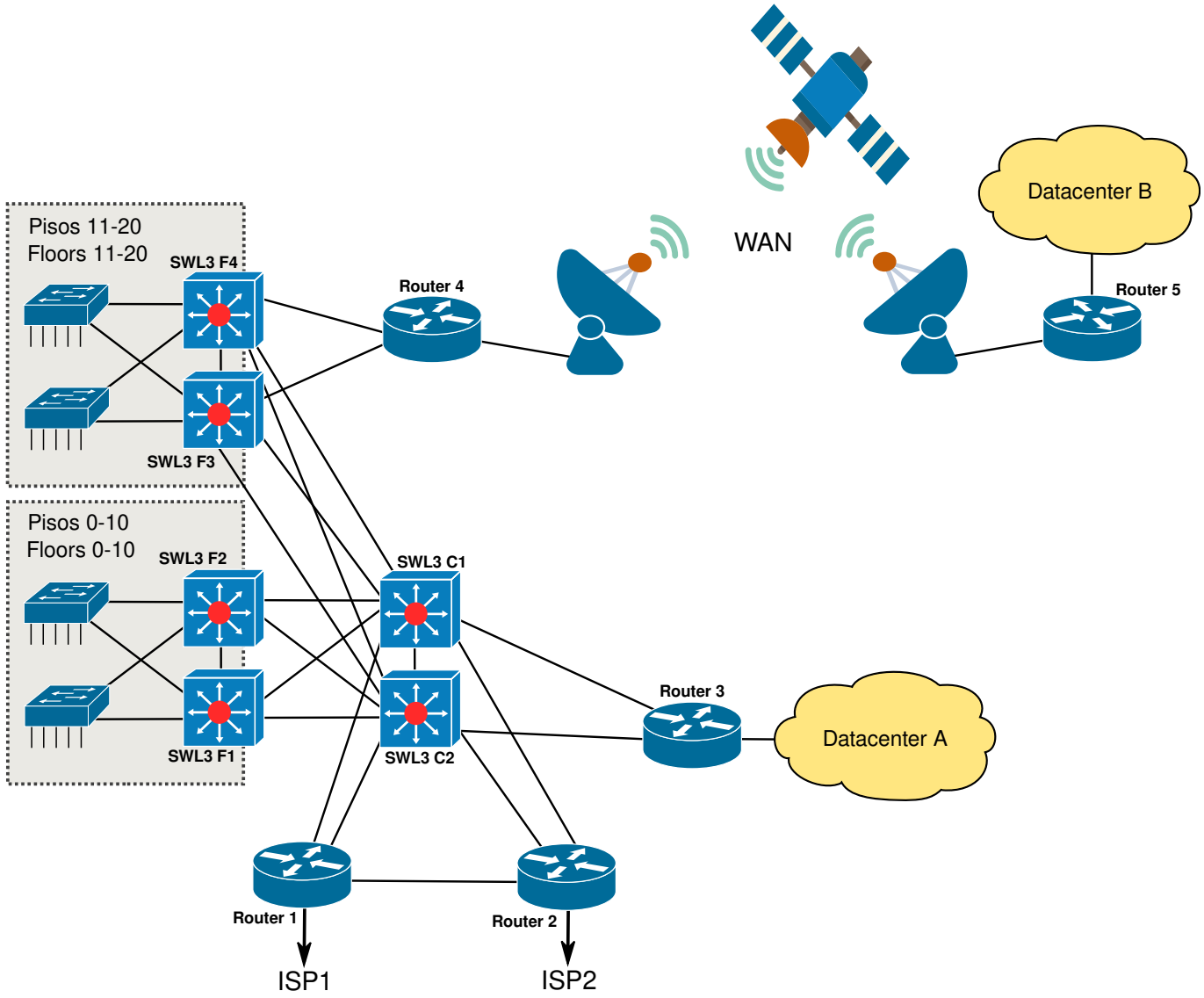
July 1st 2022

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

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

1. Identify end-to-end VLANs, justify. (1.5 points)
2. In the SWL3 C1 IPv4 routing table, how many default routes are there? (1.5 points)
3. Propose a possible change in the OSPF protocol configurations to ensure that traffic to the Internet is routed preferentially to Router 1. (1.5 points)
4. Propose a possible change in OSPF protocol configurations to ensure that traffic to Datacenter A that arrives at Layer 3 switches F1, F2, F3 and F4 is routed preferentially through SWL3 C1. (1.5 points)
5. Changing only the configuration of Router 4, propose a forwarding solution that guarantees bidirectional IPv4 connectivity of the entire network with Datacenter B that has the 192.136.1.0/23 network. (2.0 points)
6. Propose a complementary routing solution that ensures that IPv4 traffic from VLAN 2 to Datacenter B (192.136.1.0/23) is routed first to Router 1 and then forwarded via the WAN link. (2.0 points)
7. Based on the analysis, introduction and/or manipulation of attributes of MP-BGP routes, explain how you can guarantee the following routing requirements of this company/operator:
   a) AS2000 is not an autonomous transit system. (1.5 points)
   b) Traffic to external IP networks should be routed through Routers 1 and 2 preferably to AS 10002 (ISP2) and only if this neighborhood fails should it route traffic through AS 10001 (ISP1). (1.0 points)
   c) AS2000 received by MP-BGP advertisements from a (specific) IP network in Brazil through several disjoint paths. It is intended that the traffic forwarded by Routers 1 and 2, for this network in Brazil, never passes through operators other than ones from the USA. (1.5 points)
8. Consider a scenario where this company's core network supports MPLS using the LDP protocol.
   a) Describe the exchange of messages, and their generic content, in the establishment of the MPLS domain with LDP. (2.0 points)
   b) Describe which protocols/mechanisms will have to be activated in order to establish an MPLS tunnel with guaranteed bandwidth between two points in the network. (2.0 points)
9. Explain how a SIP voice call is forwarded between two different domains (two different companies). (2.0 points)

- Access ports for VLANs 1,2,3 and 4 are configured on Layer 2 switches on floors 0-10. Access ports for VLANs 1, 6 and 7 are configured on Layer 2 switches on floors 11-20;
- 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, 3 and 101;
- There is a satellite WAN connection that supports IPv4 connections between the company's network and a remote datacenter (Datacenter B);
- Layer3 switches and routers 1 to 4 have OSPFv2 and OSPFv3 protocol processes (with identifier 1) active on all internal IP networks (excludes the WAN network);
- All interfaces, except for VLAN 101 interfaces, are configured as passive in OSPF processes. Therefore, VLAN 101 is an interconnection VLAN between the distribution and the network core, 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 80 (E2 type) and 50 (E1 type), respectively;
- All interfaces have an OSPF cost of 1;



- Router 5 does not support any dynamic forwarding protocol, it just has a default/default static IPv4 route to Router 4.
- Routers 1 through 4 and Layer 3 switches do not have static routes configured.
- This company is an MP-BGP autonomous system (AS2000) and has MP-BGP peering agreements with ISP1 (AS10001) and ISP2 (AS10002).