Network and Services Exam - Answers
January 18, 2023

1a)

Root switch/bridge is Switch 5, because it has the lowest ID (priority equal to 6998h and MAC Address 00:11:11:11:11:11).

	Root Path Cost	Root port	Designated ports	Blocked ports
Switch 1	5	1	2,3,4	--
Switch 2	10	1	2,3	4
Switch 3	20	1	--	2,3
Switch 4	15	2	3,4	1
Switch 5	**0**	**--**	**1,2,3,45**	**--**
SWL3 A	5	F1/0	--	--
SWL3 B	5	F1/0	--	--

1b) Possible improvements:

- Change the root bridge to SWL3A or SWL3B. Since these switches enable connectivity to the majority of the company IP networks, it is more efficient if one of them is the root bridge and the Default Gateway of the VLANs terminals.
- Besides, SW5 is a single point of failure, since there is no connection between switches 1 and 3 and layer 3 switches SWL3 A and B. So, we should add those connections.
- Another possibility is to configure the Rapid Spanning Tree protocol instead of the traditionl Spanning Tree, because topology changes are faster.

1c)

PCA will send an ICMPv6 Neighbor-Solicitation message to the destination Solicited-Node multicast address, having as source address its IPv6 Global address, with the objective of obtaining the physical address of the Default Gateway (address of the VLAN 3 interface of SWL3A). It will receive as the answer an ICMPv6 Neighbor-Advertisement message including the required MAC address. After this interaction, terminal will send an ICMPv6 ECHO REQUEST packet to the Global address of the VLAN3 interface of SWL3A.
This switch will repeat the same process to discover the MAC address of PCB, and then it will send it the ICMPv6 ECHO REQUEST packet to his IPv6 Global address.
PCB will repeat the process to send the ICMPv6 ECHO REPLY message, taking into account that his Default Gateway is the VLAN2 interface of SWL3B. So, it will send an ICMPv6 Neighbor-Solicitation message to the destination Solicited-Node multicast address, having as source address its IPv6 Global address, with the objective of obtaining the physical address of the Default Gateway (address of the VLAN 2 interface of SWL3B). It will receive as the answer an ICMPv6 Neighbor-Advertisement message including the required MAC address. After this interaction, terminal will send an ICMPv6 ECHO REQUEST packet to the Global address of the VLAN3 interface of SWL3A.

2a)
PÚBLIC:

VLAN 2 needs **15** public IPv4 addresses, so the subnet must have a size of **32** available addresses (15+2 routers+ID+Broadcast=19 → 32); mask **/27**.

VLAN 3 needs **8** public IPv4 addresses, so the subnet must have a size of **16** available addresses (8+2 routers+ID+Broadast=12 → 16); mask **/28**.

DMZ needs **6** public IPv4 addresses, so the subnet must have a size of **16** available addresses (6+1 router+ID+Broadast=9 → 16); mask **/28**.

DC needs **8** public IPv4 addresses, so the subnet must have a size of **16** available addresses (8+4 routers+ID+Broadast=14 → 16); mask **/28**.

NAT needs **4** public IPv4 addresses, so the subnet must have a size of **8** available addresses (4+ID+Broadast=6 → 8); mask **/29**.

By subnetting network 193.132.132.128/25:

193.132.132.1xx/27, where xx can be 00, 01, 10 or 11, we obtain the following subnetworks:

VLAN2	**193.132.132.128/27**
	193.132.132.160/27
	193.132.132.192/27
	193.132.132.224/27

By subnetting network 193.132.132.160/27:

194.4.4.101x/28, where x can be 0 or 1, we obtain the following subnetworks:

VLAN3	**193.132.132.160/28**
DMZ	**193.132.132.176/28**

By subnetting network 193.132.132.192/27:

193.132.132.110x/28, where x can be 0 or 1, we obtain the following subnetworks:

DC	**193.132.132.192/28**
	193.132.132.208/28

By subnetting network 193.132.132.208/28:

193.132.132.1101x/29, where x can be 0 or 1, we obtain the following subnetworks:

NAPT	**193.132.132.208/29**
FREE	**193.132.132.216/29**

The following network remains free:

FREE	**193.132.132.224/27**

PRIVATE:

All LANs need private networks (we can assume a /24 subnet mask for all (V)LANs and for the point-to-point connections). Assuming the given network, 10.10.0.0/16, we will assign IPv4 networks of the format 10.10.x.0/24.

VLAN1	10.10.1.0/24
VLAN2	10.10.2.0/24
VLAN3	10.10.3.0/24
Datacenter	10.10.4.0/24
DMZ	10.10.5.0/24
SWL3A-R2	10.10.6.0/24
SWL3B-R1	10.10.7.0/24
R1-R2	10.10.8.0/24

The available IPv6 network is 2330:30:30::/60, so we will assign addresses that start with 2330:30:30:000x::/64 (the first 60 bits can not be changed). So, assuming /64 networks:

VLAN1	2330:30:30:1::/64
VLAN2	2330:30:30:2::/64
VLAN3	2330:30:30:3::/64
Datacenter	2330:30:30:4::/64
DMZ	2330:30:30:5::/64
SWL3A-R2	2330:30:30:6::/64
SWL3B-R1	2330:30:30:7::/64
R1-R2	2330:30:30:8::/64

2b) The following records should be added to the zone file (the names are hypothetical):

NS		**ns1**.xptoinov.pt
MX	10	**mail1**.xptoinov.pt
ns1	A	endIPv4_DNS
ns1	AAAA	endIPv6_DNS
mail1	A	endIPv4_mail1
mail1	AAAA	endIPv6_mail1

3. a)

Routing tables must include: protocol, network and mask, cost, IP address of next-hop and outgoing interface (layer 3 and not layer 2 ports!). Assuming that Router 2 is redistributing the static route to site B using a metric equal to 1 of the type E1:

O	network_DMZ [110/15], via eth2R1, interface eth1
OE1	network_siteB [110/6], via eth3R2, interface eth0
	via eth2R2, interface eth1
OE2	0.0.0.0/0, [110/10] , via eth3R2, interface eth0

via eth2R2, interface eth1
via eth2R1, interface eth1
via eth1SWL3B, interface eth1
via VLAN1SWL3B, interface VLAN1
via VLAN2SWL3B, interface VLAN2
via VLAN3SWL3B, interface VLAN3

b)

R network_DMZ [120/2], via eth3R1, interface eth0
via eth2R1, interface eth1
C network_DC,directly connected, interface eth1
R 0.0.0.0/0, [110/6] , via eth3R1, interface eth0
via eth2R1, interface eth1
via VLAN1SWL3A, interface VLAN1
via VLAN2SWL3A, interface VLAN2
via VLAN3SWL3A, interface VLAN3

c)
We must change OSPF costs:
- At SWL3A, increase the cost of interface **eth1** to **15**
- At SWL3B, increase the cost of interface **eth0** to **20,** increase the cost of interface **eth1 to 20. In this way, the shortest path will be through the VLAN interfaces**

4.
a) B 210.1.1.128/25 [20/0], via 10.0.0.5, eth0 (note that the networks of AS 12345 must be aggregated)

b) We must configure the MED (Multi-Exit Discriminator) attribute in Routers 1 e 2, assigning a lower value to Router 2. This attribute influences incoming traffic.

5)
Data exchange phase

Terminal A	**Server B**
TCP [DATA], 1400 bytes, SN=1001, AN=5000 →	
	←TCP [ACK], SN=2001, AN=2401
TCP [DATA], 1400 bytes, SN=2401, AN=5000 →	
	←TCP [ACK], SN=2001, AN=3801
TCP [DATA], 1400 bytes, SN=3801, AN=5000 →	
	←TCP [ACK], SN=2001, AN=5201
TCP [DATA], 600 bytes, SN=5201, AN=5000 →	
	←TCP [ACK], SN=2001, AN=5801

6)
In a blocking mode socket, code lines are executed sequentially but are blocked exactly at the instruction that executes a system call. In that point, the system must wait until the appropriate answer is received, a timeout occurs or an error is returned.
These sockets are appropriate in all situations where an answer from the sytem is crucial (for example, when a client establishes a TCP connection to a server). On the other side, a scenario where a client tries to establish multiple connections, completely independent from each other, is appropriate for using non blocking sockets.