Network Architecture
Network Design Project

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- **The preliminary and final versions of the project must be demonstrated in person.**
- **The project must be documented in a AR page (2xA4) with: (I) network diagram, (ii) VLAN table with number and function, (iii) equipments lçist with type and number of ports, (iv) table with IP network prefixes assignt to each (V)LAN, and (v) a Gantt diagram for the project execution.**
- **The maximum grade for each phase is limited to 20 points.**

Objective: Elaborate the technical design, configuration and test of a telecommunications IP network for a medium/large size corporation.

Description:

- The corporation MetalTech LLC is a producer, consulting and engineering services provider in the area of casting of metal alloys. The corporation wants to remodel and expand their facilities in Aveiro, where it already has one one-story building dedicated to production, with two contiguous four-story buildings. It will also create two new branches in Lisbon and Chicago with one four-story building in each location.

- The network infrastructure and services will be built from scratch, except for the one-story building in Aveiro where there is an Ethernet network with special protection against heat and with IPv4-only support. The network of these building is not subject to change since it is managed by an external company, however it must be guaranteed access to the network to the rest of the company without overloading the memory of the (old) existing equipment. The diagram of the network and existing configuration is presented in annex.

- The first floor of each of the new Aveiro buildings is reserved for production monitoring and interaction systems and houses the company's datacenter. In the remaining buildings the first floor is reserved for commercial and customer support. The second floors of all new buildings are reserved for the commercial and customer support part. The third floors of all new building are reserved for the research and development area. The top floor of the new buildings are reserved for the administration offices.

    - Each floor reserved for the monitoring and interaction systems has: (i) 50 servers independent of the datacenter, (ii) 3 technical verification zones (machines/terminals) with 20 workstations each, (iii) two meeting rooms and (iv) a video conference room.

    - Each floor reserved for business and customer support includes: (i) 30 business rooms, (ii) 5 meeting rooms for customer contact via video conferencing, (iii) 20 customer support stations, (iv) a recreation room for workers and visitors.

    - Each floor reserved for research and development has: (i) 10 laboratories, each of which can hold up to 8 jobs; (Ii) 4 work rooms reserved for development engineers; (iii) a recreation room for workers.

    - The administration floor should accommodate 15 employees/administrators and have 3 video conference rooms.

- The company has all the communication services (data, voice and video) implemented over the IP protocol. Also consider that the company has a video surveillance system with IP network transmission.

- The company must have a datacenter (services and storage) in Aveiro that will support the company's

private and public activities: Administrative/planning (management archive), research (scientific archive and data processing) and provision of services to employees, customers and the Internet community in general.

- At the company's premises there should be a wireless network divided into three VLANs with different access permissions.
- The company has the IPv4 network 200.1.1.0/23 and the IPv6 network 2002:A:A::/48 for use in the new infrastructures.
- The company agreed with 2 Portuguese ISPs to provide Internet access in the facilities of Aveiro and Lisboa (ISP PT1 and ISP PT2) and with 2 American ISPs providing Internet access at the Chicago facilities (ISP PT1 and ISP PT2). The PT2 ISP does not yet support IPv6 addressing/forwarding. Both ISPs provide IP addresses for interconnection with their systems.
- ISP PT1 in Aveiro still provides a low-speed but high resiliency link, which should only be used when all other Internet connections fail.
- Confidentiality (at the network level) should be ensured in communication between the poles for the most sensitive traffic.
- The company owns the domains MetalTech.pt and MetalTech.com.

Tasks (1st phase)

- Design of the network architecture and physical mapping of the same. (6.0 points)
- Definition of characteristics / capabilities of network equipments. (3.0 points)
- Definition of the subdivision of networks at level 2 of the OSI model (VLAN). (5.0 points)
- Definition of IPv4 and IPv6 addressing. (5.0 points)
- Time planning for project execution [Gantt diagram]. (1.0 points)
- **Extras** (e.g. budget, non-network equipment, etc ...). (1.0 points)

Tasks (2nd phase)

- Configuration of the access layer and definition of the interconnection / addressing of equipment. (2.0 points)
- Configuration of virtual local area networks (VLAN) and trunks. (2.0 points)
- Configuration of IPv4 unicast routing, including the old network. (4.0 points)
- Configuring IPv6 unicast routing. (3.0 points)
- Implementation of mechanisms for translation of private addresses. Assuming that both accesses to the Internet are active and there is the possibility of asymmetric routing on the Internet. (1.0 points)
- Configuration of a DHCPv4 server for at least 4 VLANs. (1.0 points)
- Configuration of the company's DNS / DNSSEC server (s). (1.0 points)
- Configuration of IPv6 / IPv4 transition mechanisms. Assuming that it is necessary to ensure full IPv6 connectivity between the poles in the event of a complete failure of the ISP PT1. (2.0 points)
- Configuring secure connections between branches (and routing). (2.0 points)
- Implementation of QoS policies. (2.0 points)

## Extra tasks (2nd phase)

- Assuming that there are 2 IPTV channels for internal broadcasting on the company premises, configure the IP multicast broadcast service including IPv4 and IPv6 multicast routing. Configure multicast routing mechanisms to allow 2 channel broadcast to all televisions and playback terminals. (1.0 points)
- Monitor script (languages: bash, python, perl, javascript, java, etc ...) to detect the location (port / switch)

of a terminal based on its MAC address. (1.0 points)
- Configuration of a VPN server. (1.0 points)
- Configuration of one or more firewalls. (1.0 points)
- More advanced monitoring system [with load measurement in the connections, alarms in case of failure of an interface / link, detection of spoofing attacks, etc …]. (1.0 points)
- Configuration of a DHCPv6 server. (0.5 points)
- Etc...

Notes:
- Simulate the Internet with a Router that connects all ISPs, and each ISP's network with an L2 Switch. The exiting routing of the branches networks should be done by static routing (towards the Router that simulates the Internet).

Annex (existing network):
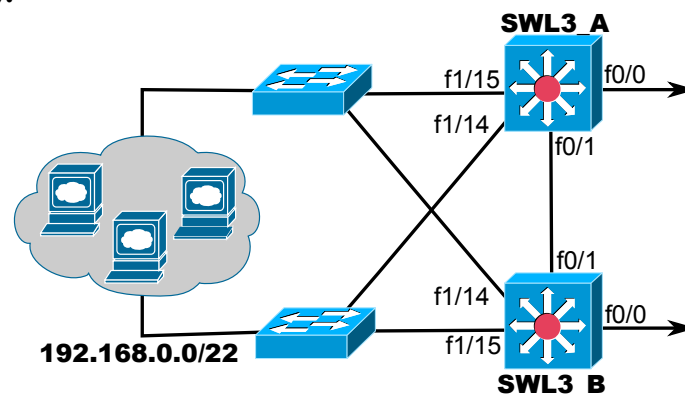
Configuration of SWL3_A e SWL3_B (x=10 for SWL3_A, and x=11 for SWL3_B):

```
interface f0/0
  ip address 192.168.100.x 255.255.255.0
  ip ospf 10 area 0
interface f0/1
  ip address 192.168.101.x 255.255.255.0
  ip ospf 10 area 0
interface vlan 1
  ip address 192.168.0.x 255.255.252.0
  ip ospf 10 area 0
interface fastEthernet 1/14
  switchport mode trunk
  switchport trunk encapsulation dot1q
interface fastEthernet 1/15
  switchport mode trunk
  switchport trunk encapsulation dot1q
```