

Computer network

Design of a Structured Computer Network



Academic Year 2023-2024

Degrees in

- Electrical Engineering and Computers
- Computer Science and engineering

0 – GENERAL INDEX

1. INTRODUCTION	3
2 – OBJECTIVES	3
3 - DESCRIPTION OF THE PROJECT SITE	4
4 - PROJECT PREPARATION.....	6
5 - IP ADDRESSING.....	7
6 - SIMULATION IN PACKET TRACER.....	8
7 - EXTRAS IN THE PROJECT.....	9
8 - DOCUMENTATION TO BE PRESENTED	9
9 - PROJECT PRESENTATION.....	10

0.1 - INDEX OF FIGURES

Figure 1 - entrance lobby 4

0.2 - TABLE INDEX

Table 1 - Designation of rooms	5
Table 2 - Forecast of allocation of employees/Equipment by room and by function	5
Table 3 - Distribution of workstations and various equipment across rooms.	7

1. INTRODUCTION

At the end of the practical work in the Computer Networks laboratories, Students must be able to design, configure and implement a computer network for a company or institution, with greater or lesser complexity.

Structured cabling consists of a physical topology, where network cabling is organized into hierarchical levels interconnected in accordance with standards. Experience in structured cabling, as an essential component of a structured network, is essential for professionals in the field of computer networks. Many day-to-day tasks involve designing or repairing structured network cabling and/or configuring/monitoring active equipment.

2 – OBJECTIVES

This project has two fundamental objectives:

- On the one hand, it is intended that Students carry out a practical application of the material taught in the Computer Networks discipline, providing them with a practical project component,
- On the other hand, it is intended that Students acquire a solid knowledge of the design of a structured computer network, in its various aspects. Students should know, for example:
 - Analyze the functional areas of a company and divide the network into subnetworks;
 - Propose an appropriate IP addressing scheme;
 - Recommend passive and active cabling and equipment;
 - Locate equipment, network sockets and cable routing;
 - Propose a configuration for active equipment.
 - Draw the logical diagram of the network

3 - DESCRIPTION OF THE PROJECT SITE



Figure 1- Start Consulting entrance lobby.

The company *Start Consulting* is building a new development hub, the plan of which is shown in the Annex. It is intended that it is equipped with a network infrastructure suited to your needs, with appropriate cabling.

The new building will have **full wireless coverage**.

This new hub will have a total of **20 employees, in person**, and a **coworking area** for the company's **employees who work remotely** and whose internet connection will be made via Wi-Fi.

It is planned to place **4 vending machines** in the Hall (room 1).

In the **Technical Room** (room 10), where the rack is located, connections must also be identical to those in the other rooms.

The network is divided into **coworking space**, which should be built as if it were a delegation, the **development hub** a **headquarters** and an **R&D laboratory**. Despite sharing the same building, **the coworking space and the development hub must be interconnected by fiber connection, as well as the headquarters and the R&D laboratory**. The headquarters and laboratory will have their own network, which is not the subject of this project. However, the student will have to interconnect the four networks and place a PC on each of the headquarters and laboratory networks in order to test connectivity.

To better plan the network, Figure 2 shows a plan with the identification of the spaces and Table 1 indicates the intended use for each of the rooms.

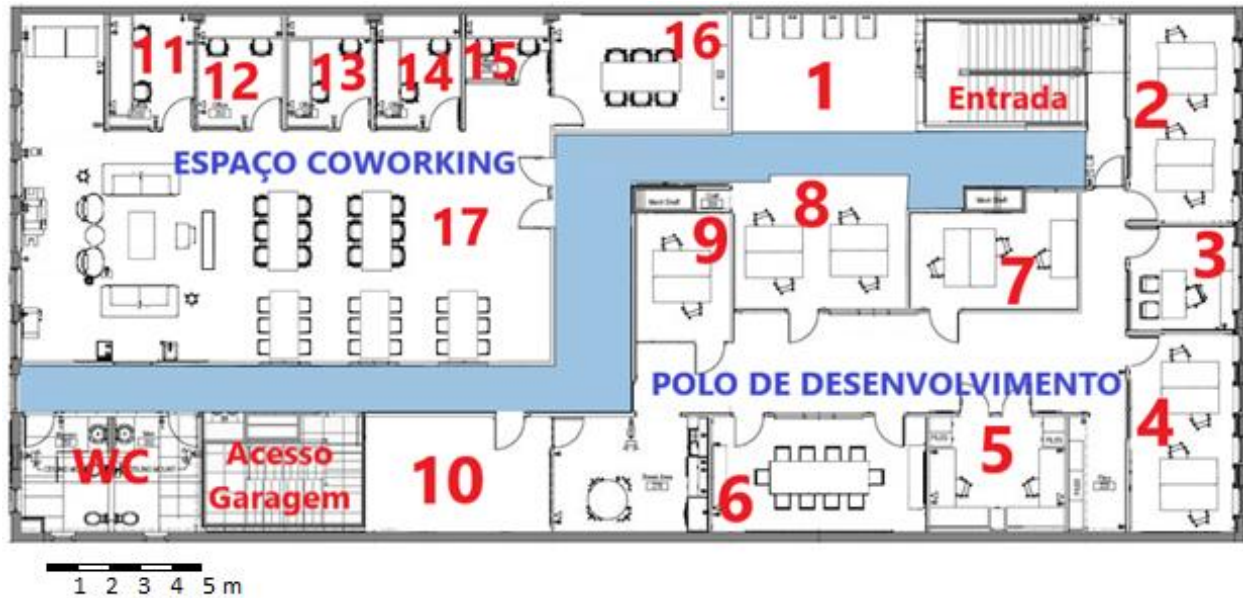


Figure 2- Plans with room identification

Table 1- Room designation

Living room	Intended Use
01	Hall
02	Development National Projects
03	Administration
04 and 05	Development International Projects
06	Meeting room
07 and 08	Development National Projects
09	IT and application support room
Polo Development Corridor	Network Printers
10	Backstage/Technical Room
11 to 15	Isolated coworking rooms
16	Coworking meeting room
17	Large coworking room

Table 2- Forecast of allocation of employees/Equipment by room and by function

Living room	Number of employees	Functions
02	4	National Projects
03	1	Administration
04	4	International Projects
05	two	International Projects
07	3	National Projects
08	4	National Projects
09	two	IT and application support
10	1	Behind the Scenes
Development Hub Corridor	2 Network Printers	Print
11 to 15	2 Workstations in each	Isolated coworking
17	1 Network Printer	Coworking printing

4 - PROJECT PREPARATION

Create a network project to be delivered to the Smart Consulting company. It must contain:

1. A **general description of the network** and identification of the premises used;
2. The **Physical Topology** with clear indication (on the plan) of the position of the sockets, cable passages and the location of the rack;
3. The **logical topology** of the network;
4. **Wireless coverage** across the entire floor, reinforced in the expanded coworking area. WiFi users will be **employees in person and remotely** and everyone will have access to the external network
5. The **Webserver** , installed in the company's **Headquarters Datacenter**, will have **HTTP and DNS** services active . It must contain a page with the company's presentation, which will be accessed via the URL ***http://www.startconsulting.pt*** . The **DNS service** must be provided on this same server , which must be configured on all stations throughout the network.
6. **VLAN** for network printers;
7. **VLAN** for IP phones;
8. **VLAN** for managing network equipment;
9. **VLAN** for WiFi;
10. **VLAN** for Vending Machine;
11. **VLANs** dedicated to various types of employees, depending on their role;
12. **VLAN** for the coworking space;
13. **Other VLANs** that you deem necessary;
14. **Identification of IP addressing for each VLAN** , with a description of its purpose, specifying **how many** addresses are used and the resulting **gaps** . The addressing plan for each network is indicated in the **IP Addressing section** below.
15. A **list of** passive and active equipment to be used;

16. A possible **organization for the backstage** , I recommend using Packet Tracer's Physical mode;
17. The **identification algorithm** and a table of all network sockets;
18. **Trunks** Identification ;
19. **budget** estimate .

Start by proposing a distribution of workstations and other equipment that requires a network connection across the company's various rooms. Follow the suggestion in Table 2. In table 3, you must indicate per room the workstations (PC and telephone) and other equipment necessarily connected to the data network (projectors, servers, test equipment, vending machine, ...). You must foresee a number of necessary outlets, always adding extra outlets (spaces) in accordance with best practices.

Table 3- Distribution of workstations and various equipment across rooms.

Living room	Work stations	Other equipment	Double socket node (including gaps)	Number of ports connected to the Switch
X	two	1	4	3
y	4		8	8
Totals	6	1	12	11

5 - IP ADDRESSING

- **Headquarters** building, use the base network 192.168.1.0 /24
- In the new building, for the **coworking space** use the base network 192.168.2.0 /24;
- In the new building, for the **Development Hub** use the base network 192.168.3.0 /24;
- **R&D Laboratory** building, use the base network 192.168.4.0 /24
- For the **link between the Headquarters** router and the **coworking space router** , use the base network 10.0.0.0, with an appropriate mask, for a link of this type.
- For the **link between the coworking** space router and the **Development Hub router** , use the base network 11.0.0.0, with an appropriate mask, for a link of this type.
- For the **link between the Development Hub** router and the **Laboratory router** , use the base network 12.0.0.0, with an appropriate mask, for a link of this type.
- For the **link between the Laboratory router** and the **Headquarters router** , use the base network 13.0.0.0, with an appropriate mask, for a link of this type.
- For the **link between the Headquarters** router and the Webserver in the Datacenter, use the base network 14.0.0.0, with an appropriate mask.
- You must configure **the switches and routers** in the new building to allow them to be **accessed via telnet** only by users who know the passwords (equipment management VLAN).
- They must use 24-port switches.

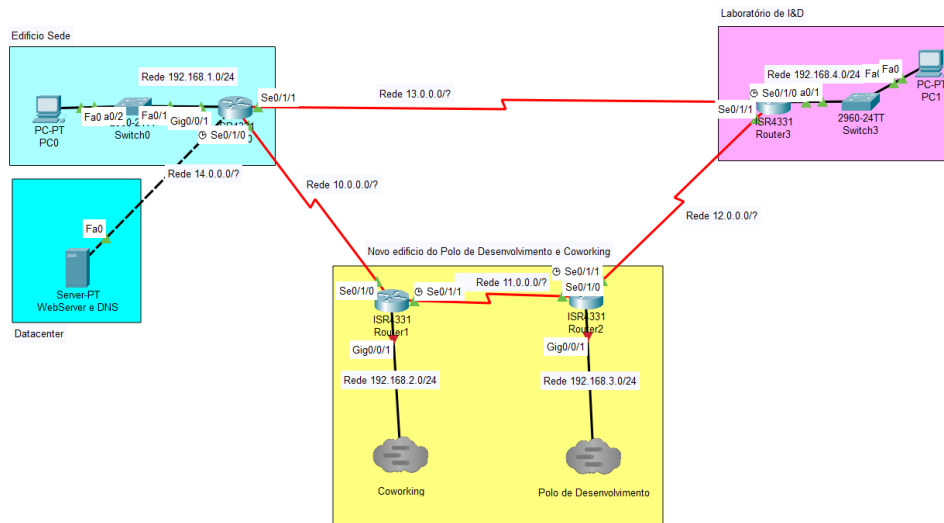


Figure 3- Network diagram proposal for Start Consulting

6 - SIMULATION IN PACKET TRACER

Design a network in *Packet Tracer* that has **the same topology** as the one proposed for the company *Start Consulting* , but which, however, must be simpler, particularly in terms of the total number of network access points. Always place **all VLANs on all switches** , representing only one post of that VLAN on each switch .

Include the network design in *Packet in the report Tracer* , as well as a summary of the tests carried out. Include in Annex, the configuration of *switches* and *routers* , duly commented.

7 - EXTRAS IN THE PROJECT

In order to get a higher grade on the project, you can implement the following extras:

1. Replacing Telnet with **SSH** for access to Switches and Routers;
1. **DHCP** server for VLAN hosts. The DHCP service must be **located on the headquarters router** ;
2. Connection of **VoIP phones** and configuration of CISCO's *Call Manager Express* , installed on *the new building's router*;
3. Configuring **PAT (NAT)** on the Router;
4. Configuration of **ACLs** for the **WiFi VLAN** not to communicate with others, but to communicate with the outside of the headquarters;

8 - DOCUMENTATION TO BE PRESENTED

NOTE: the delivered project must contain the minimum requirements, namely communication with the external network and the use of VLSM on the main site, complying with the address scheme proposed in the statement. Failure to comply with these requirements invalidates the project evaluation, which is classified as negative.

You must create a **zip file** with a report containing annexed active equipment configurations (in **PDF format**) and the Packet Tracer simulation file (**pkt**). The file name must be of the form:

Project_[teacher_initials]_[student_initials1_student_initials2].zip

For example, for students Carlos Sousa and João Costa, whose teacher is Teles Rodrigues, the file name is like:

Proj_TR_CS_JC.zip

You must upload this file to the Moodle project area. The maximum size is 2 MBytes

The deadline for delivering the project will be displayed on Moodle.

9 - PROJECT PRESENTATION

Each group will make a presentation of their project.

Non-functional simulations will not be evaluated, considering them as failed.

This presentation begins by discussing the report and analysis of the network functional simulation in Packet Tracer. Remote access to equipment via telnet or SSH and the operation of possible project extras will be tested.

Changes to the network will be requested, involving network and workstation configurations. **The execution of these tasks** will be evaluated and the classification of the project will also depend on it.