IPS Instituto Politécnico de Setúbal
Escola Superior de Tecnologia de Setúbal

Computer network

Degree in Computer Engineering
Degree in Electrical Engineering

Computer Networks Project

Academic Year 2023-2024

1. GENERAL INDEX

1.1. INDEX OF FIGURES

1.2. TABLE INDEX

2. INTRODUCTION

Within the scope of the Curricular Unit of **Computer Networks,** of Computer Engineering, it was launched a challenge to students aiming at the practical application of the knowledge acquired for the obtaining approval in the Curricular Unit.

The project, carried out in a group, had as its starting point a needs analysis, followed by using CISCO simulation software, **CISCO Packet Tracer.**

The objective is to design and implement the ideal network infrastructure for a **new building of the Development and Coworking Hub** of the company **Start Consulting,** guaranteed efficient communication with the **Headquarters building** and the **R&D Laboratory.**

This project aimed to consolidate the knowledge acquired in the Curricular Unit of Networks Computers, through the design, configuration and implementation of a network for the company with complex requirements.

It was necessary to develop both the physical topology and the logical topology of the network, considering the different functional areas and proposing an appropriate IP addressing scheme.

In addition, the necessary cabling infrastructure was recommended, as well as the equipment active and passive, presenting suggested configurations. Experience in structured cabling was highlighted as fundamental for professionals in the area of computer networks, being considered an essential element for a well-structured network.

3. OBJECTIVES TO BE FULFILLED

The primary objectives of this project are to ensure fluid communication at all levels.
This implies an efficient exchange of information between the different work areas at Headquarters, as well as as between the Headquarters, the R&D Laboratory and the new building of the Development and Coworking, establishing a two-way flow.

Once this first objective has been achieved, the focus turns to organization and preparation for possible expansions of the team. Therefore, it means structuring the rooms in order to accommodate a greater number of employees than currently exist.

Finally, it is crucial to obtain a deep understanding of how networks work, aiming to potential future benefits.

4. PROJECT DESCRIPTION

As mentioned, we were proposed the design, configuration and implementation of a network of computers for a company with greater complexity, in this case, the company ***Start Consulting.***

4.1. PROJECT SITE DESCRIPTION

Start *Consulting* is a company that is building a new development hub, where In this project we created a network infrastructure suited to your needs.

Figure 1 - Entrance lobby Start Consulting

This company divides its production in the **headquarters building,** the **R&D laboratory** and the **new building of the development and coworking hub,** which will have full *wireless* coverage .

The new building is divided into a coworking space and a development hub. Contains a total of 31 (thirty-one) employees, of which 10 (ten) are in the development hub, and 21 (twenty-one) are in the coworking space.

4.2. PROJECT MANAGEMENT

When preparing this project, we used *Trello* to manage the tasks of each group member and we also used *GitHub* to control project versions.

Trello is a kanban style web application , this style is widely used by *large* companies and is a scheduling system that allows for organized production, in a timely manner. reduced.

Figure 2 - Logo of Trello

GitHub is a platform that allows developers to create, store, and *control* your code or project. This platform mainly provides distributed version control through the *Git system.*

Figure 3 - Company logo GitHub

With these tools we are able to maintain consistency in the work done and a efficiency in project production.

5. COMPANY PLANT

For a better understanding, we present the plan in Figure 4 with identification of the spaces (presented in Table 1 with the designation of the rooms).

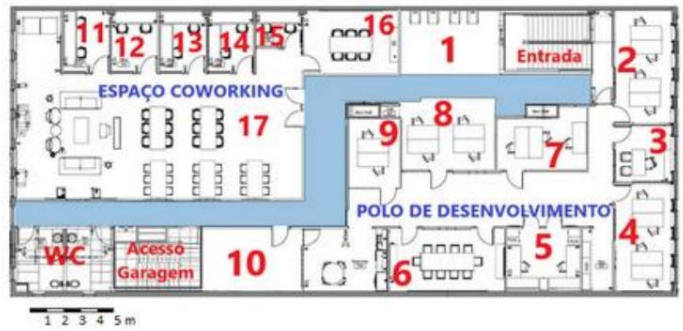


Figure 4 - Plan with room identification

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

Table 1 - Room designation

6. DISTRIBUTION OF JOBS

In this project, the workstation represents two devices, these being a computer (PC), connected to an IP phone that connects to the network jack.

Number of jobs	Corresponding Rooms
1 workstation	Room 3 and 10
2 Jobs	Rooms 5, 9, and 11 to 15
3 Jobs	Room 7
4 jobs each	Room 2, 4 and 8

Table 2 – Distribution of jobs

7. LOGICAL TOPOLOGY OF THE NETWORK

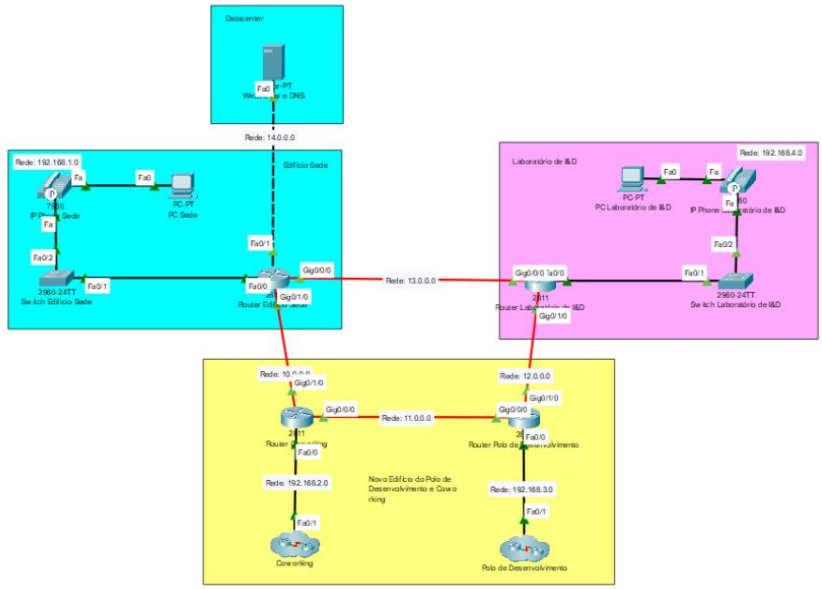


Figure 5 – Logical View of the Packet Tracer

This project is made up of four main networks: the network of the company's headquarters building (192.168.1.0), the R&D laboratory network (192.168.4.0) and the new Start company building Consulting that has two sectors, both having their own router - the development hub (192.168.3.0) and the coworking space (192.168.2.0).

In the headquarters building network there is a router that contains the DHCP protocol, a switch and a workstation (PC and IP Phone). Although the DataCenter is part of the same building, the DNS server is part of a separate network (14.0.0.0).

The R&D laboratory network only has one router, one switch and one workstation.

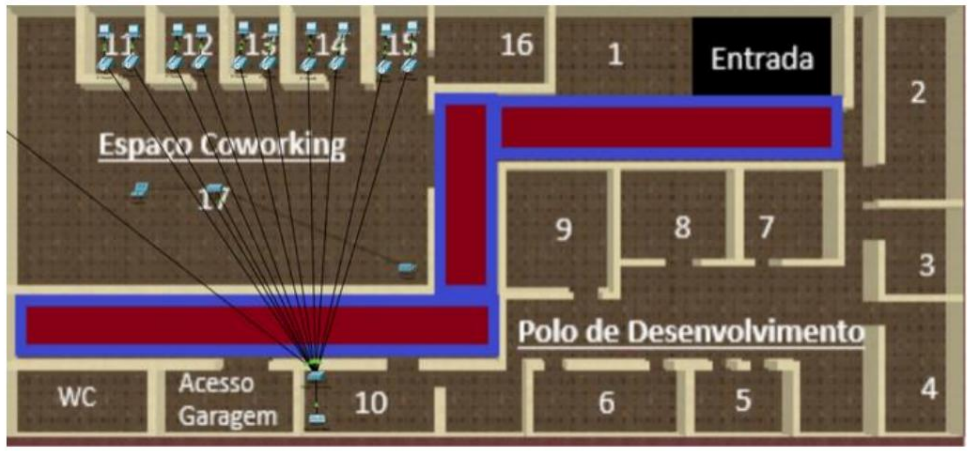


Figure 6 – Logical View of the Coworking Space Network

In the Coworking Space network, we have a switch that is connected to 10 workstations (PC and IP Phone), a Wireless LAN Controller and an Access Point. The Access Point establishes the connection to the network on a printer and a laptop. The WLC controls the VLANs on wireless connections, making so that there is differentiation of devices.

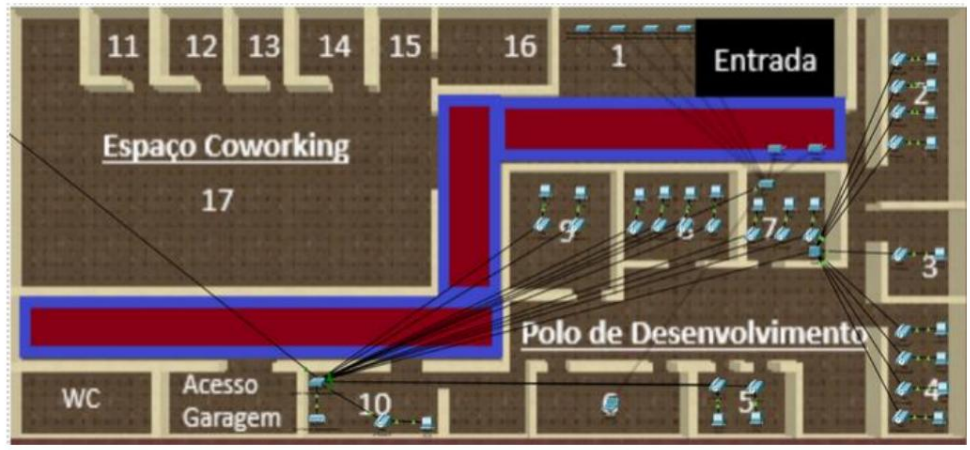


Figure 7 – Logical View of the Development Hub Network

In the Development Hub network, just like in the Coworking network, we have a switch that connects to a Wireless LAN Controller and an Access Point that establishes the connection to the network in 4 *vending machines,* 2 printers and a laptop. The switch is also connected to 21 jobs, 9 of which from a *Hub.*

8. PHYSICAL TOPOLOGY OF THE **NETWORK**

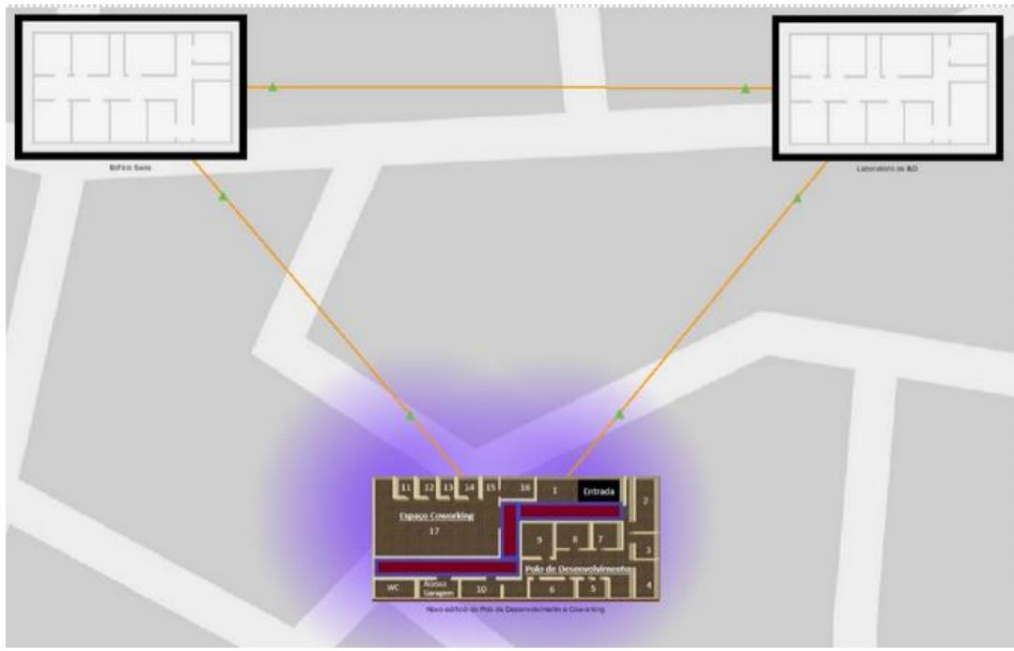


Figure 8 – Physical View of Connections between buildings

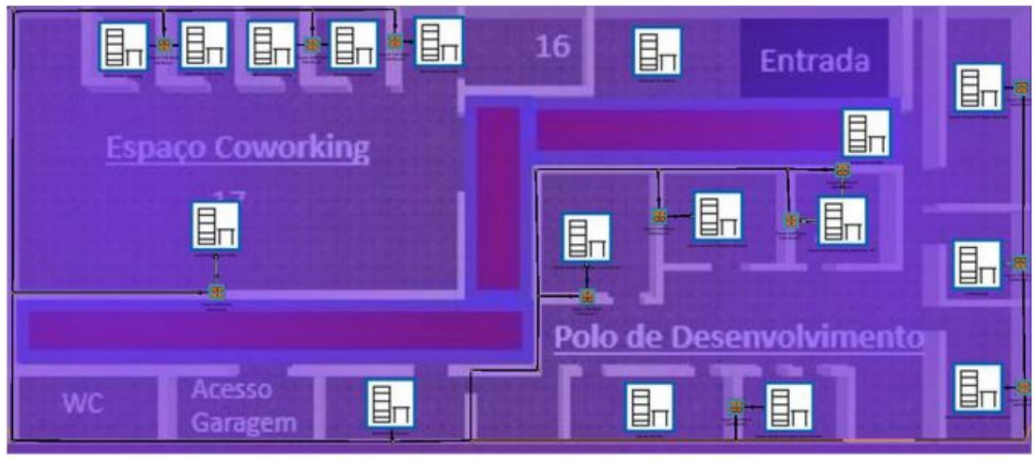


Figure 9 – Physical view of the new building Start Consulting

In the attached figure, the physical mode of the networks in the new building can be seen, including the Wi-Fi coverage of the Access Points (in purple), and 12 RJ45 connection sockets that establish the connection between workstations with the frame in room 10.

9. WIFI COVERAGE

Access *Points* aim to expand the Wireless network so that any new device you can connect to the network anywhere in a place without any cable connection.

WIFI coverage in the new building is provided by 2 (two) *Access Points,* each having a *range* of 24.76 (twenty-four point seventy-six) meters, which is enough to cover the building whole.

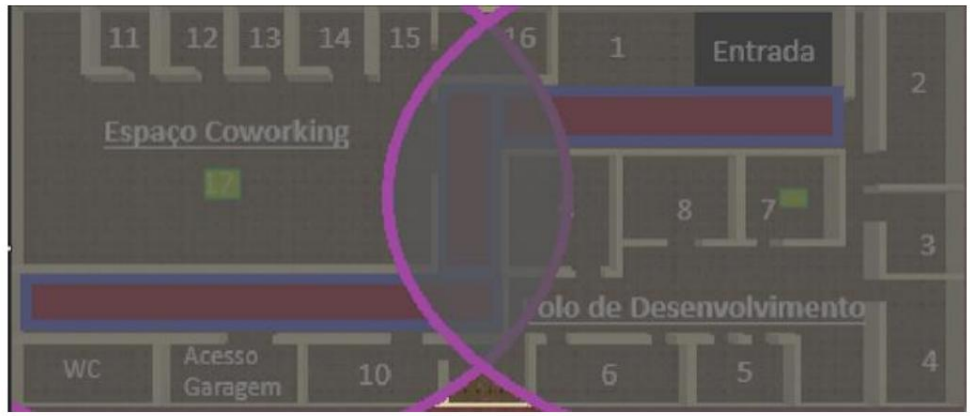


Figure 10 – WiFi coverage of the new building

Image	Subtitle
	Represents the Access *Point*
	Represents the circumference of Wi-Fi coverage

Table 3 – Image caption of the new building's WiFi coverage

10. IDENTIFICATION OF VLAN'S

We were asked that all *VLANs* that are in use are properly identified, this Identification facilitates possible network maintenance.

In this case, we chose to organize the *VLAN's* by use in all buildings, but divided by network of each building.

VLAN	Name
10	Date
20	Telephones
30	Printers
40	Vending Machines
50	Coworking Space
60	Network Equipment
70	WiFi

Table 4 – Identification of VLAN's

11.TRUNKS IDENTIFICATION

A *VLAN Trunk* makes it possible to transport more than one *VLAN,* so that it is possible to exchange data to each other. They are established between different *Switches .*

Identification	Trunk Port Switch Ports		VLANs
Switch Headquarters Building	f0/1	f0/2	10, 20
Switch R&D Laboratory	f0/1	f0/2	10, 20
Switch Coworking	f0/1	f0/2 – f0/11	20, 50
Switch Pole Development	f0/1	f0/2 – f0/14	10, 20
Access Point Pole Development	gig0	f0/16	30, 40, 70
Access Point Coworking	gig0	f0/16	30, 70

Table 5 – Identification of Trunks

12.IDENTIFICATION OF OUTLETS

Workstations need a connection point to be part of the network. Is for
That's what RJ45 socket assemblies are for .

The network sockets we used on the *Packet Tracer* are quadruple, but as this type of socket was difficult to find in website catalogs, we began to refer to wall mounting as
a pair of double sockets.

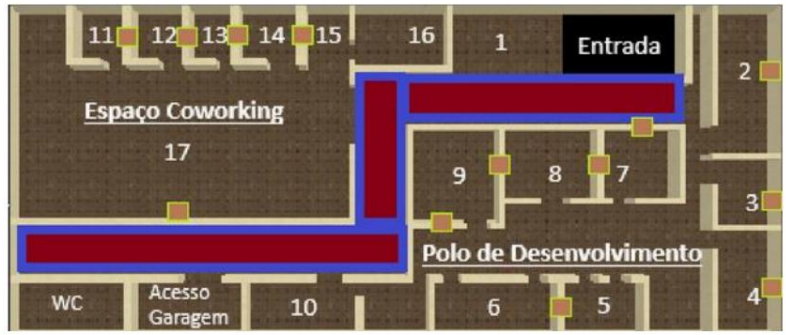


Figure 11 – Identification of sockets

Image	Subtitle
	Represents two double RJ45 network sockets

Table 6 – Caption of the socket identification image

13. **IP VLAN ADDRESSING**

At this point we can find the VLANs required for the project:

ID	VLAN's	Network Bits	Network Mask	Busy IP	Valid IPs	Default-Gateway
1	Default	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.0/192.168.X.31	192.168.X.1 – 192.168.X.30	192.168.X.31
10	Date	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.32/192.168.X.63	192.168.X.33 – 192.168.X.62	192.168.X.63
20	Telephones	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.64/192.168.X.95	192.168.X.65 – 192.168.X.94	192.168.X.95
30	Printers	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.96/192.168.X.127	192.168.X.97 – 192.168.X.126	192.168.X.127
40	Maquinas_Vending	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.128/192.168.X.159	192.168.X.129 – 192.168.X.158	192.168.X.159
50	Espaco_Coworking	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.160/192.168.X.191	192.168.X.161 – 192.168.X.190	192.168.X.191
60	Equipment_Network	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.192/192.168.X.223	192.168.X.193 – 192.168.X.222	192.168.X.223
70	WiFi	2^5 = 32	32-5 = **\27** 255,255,255,224	192.168.X.224/192.168.X.255	192.168.X.225 – 192.168.X.254	192.168.X.255

Table 7 – VLAN identification and IP addresses.

13.1. IP ADDRESSING SCHEME

The following map was considered to help choose the IP address.

<table>
<tr><td rowspan="20">.0 (1-126)</td><td rowspan="10">.0 (1-62)</td><td rowspan="5">.0 (1-30)</td><td rowspan="3">.0 (1-14)</td><td rowspan="2">.0 (1-6)</td><td>.0 (1-2)</td></tr>
<tr><td>.4 (5-6)</td></tr>
<tr><td rowspan="2">.8 (9-14)</td><td>.8 (9-10)</td></tr>
<tr><td>.12 (13-14)</td></tr>
<tr><td rowspan="3">.16 (17-30)</td><td rowspan="2">.16 (17-22)</td><td>.16 (17-18)</td></tr>
<tr><td>.20 (21-22)</td></tr>
<tr><td rowspan="2">.24 (25-30)</td><td>.24 (25-26)</td></tr>
<tr><td>.28 (29-30)</td></tr>
<tr><td rowspan="5">.32 (33-62)</td><td rowspan="2">.32 (33-46)</td><td rowspan="2">.32 (33-38)</td><td>.32 (33-34)</td></tr>
<tr><td>.36 (37-38)</td></tr>
<tr><td rowspan="3">.48 (49-62)</td><td rowspan="2">.40 (42-46)</td><td>.40 (41-42)</td></tr>
<tr><td>.44 (45-46)</td></tr>
<tr><td rowspan="2">.48 (49-54)</td><td>.48 (49-50)</td></tr>
<tr><td>.52 (53-54)</td></tr>
<tr><td rowspan="10">.64 (65-126)</td><td rowspan="5">.64 (65-94)</td><td rowspan="3">.64 (65-78)</td><td rowspan="2">.64 (65-70)</td><td>.64 (65-66)</td></tr>
<tr><td>.68 (69-70)</td></tr>
<tr><td rowspan="2">.72 (73-78)</td><td>.72 (73-74)</td></tr>
<tr><td>.76 (77-78)</td></tr>
<tr><td rowspan="3">.80 (81.94)</td><td rowspan="2">.80 (81-86)</td><td>.80 (81-82)</td></tr>
<tr><td>.84 (85-86)</td></tr>
<tr><td rowspan="2">.88 (89-94)</td><td>.88 (89-90)</td></tr>
<tr><td>.92 (93-94)</td></tr>
<tr><td rowspan="5">.96 (97-126)</td><td rowspan="3">.96 (97-110)</td><td rowspan="2">.96 (97-102)</td><td>.96 (97-98)</td></tr>
<tr><td>.100 (101-102)</td></tr>
<tr><td rowspan="2">.104 (105-110)</td><td>.104 (105-106)</td></tr>
<tr><td>.108 (109-110)</td></tr>
<tr><td rowspan="3">.112 (113-126)</td><td rowspan="2">.112 (113-118)</td><td>.112 (113-114)</td></tr>
<tr><td>.116 (117-118)</td></tr>
<tr><td rowspan="2">.120 (121-126)</td><td>.120 (121-122)</td></tr>
<tr><td>.124 (125-126)</td></tr>
<tr><td rowspan="3">.128 (129-254)</td><td rowspan="3">.128 (129-190)</td><td rowspan="3">.128 (129-158)</td><td rowspan="3">.128 (129-142)</td><td rowspan="2">.128 (129-134)</td><td>.128 (129-130)</td></tr>
<tr><td>.132 (133-134)</td></tr>
<tr><td>.136 (137-142)</td><td>.136 (137-138)</td></tr>
</table>

					.140 (141-142)
			.144 (145-158)	**.144** (145-150)	**.144** (145-146)
					.148 (149-150)
				.152 (153-158)	**.152** (153-154)
					.156 (157-158)
		.160 (161-190)	**.160** (161-174)	**.160** (161-166)	**.160** (161-162)
					.164 (165-166)
				.168 (169-174)	**.168** (169-170)
					.172 (173-174)
			.176 (177-190)	**.176** (177-182)	**.176** (177-178)
					.180 (181-182)
				.184 (185-190)	**.184** (185-186)
					.188 (189-190)
	.192 (193-254)	**.192** (193-222)	**.192** (193-206)	**.192** (193-198)	**.192** (193-194)
					.196 (197-198)
				.200 (201-206)	**.200** (201-202)
					.204 (205-206)
			.208 (209-222)	**.208** (209-214)	**.208** (209-210)
					.212 (213-214)
				.216 (217-222)	**.216** (217-218)
					.220 (221-222)
		.224 (225-254)	**.224** (225-238)	**.224** (225-230)	**.224** (225-226)
					.228 (229-230)
				.232 (233-238)	**.232** (233-234)
					.236 (237-238)
			.240 (241-254)	**.240** (241-246)	**.240** (241-242)
					.244 (245-246)
				.248 (249-254)	**.248** (249-250)
					.252 (253-254)

Table 8 – Division of IP Addresses.

Date
Telephones
Printers
Maquinas_Vending
Espaco_Coworking
Equipment_Network
WiFi

Table 9 – Identification of the division of IP Addresses.

14.BEHIND THE SCENES

The Rack is a cabinet that contains active equipment such as the Switch and Router and some passive equipment such as Patch Panels and power strips.

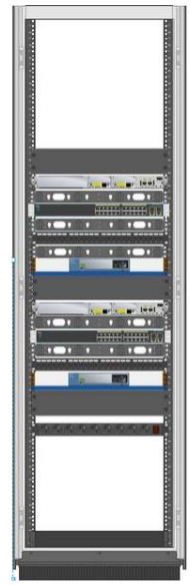


Figure 12 – Backstage of the Technical Room (Room 10)

14.1. LIST OF ACTIVE AND PASSIVE EQUIPMENT

Active Equipment:

- Routers
- Switches
- Access Points
- Server

Passive Equipment:

- Sockets

• Behind the Scenes

- Cables
- Internet cable ends

14.2. PATCH PANELS

Patch *Panels* are panels that are placed behind the scenes to allow better cable organization, for adding cables or facilitating maintenance.

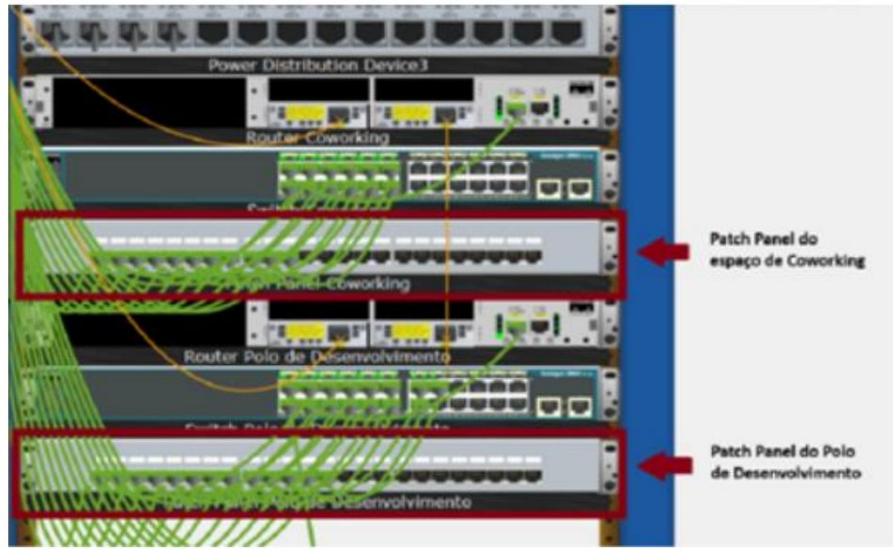


Figure 13 – Demonstration of Patch Panels behind the scenes in the Technical Room

The connection leaves the *Switch* port and enters the *Patch Panel* (from the front), then leaves the *Patch Panel* (from the back) until it connects to a *Copper Wall Mount.*

15.BUDGET

15.1. BUDGET RESEARCH

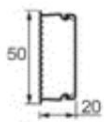
The main companies for the forecast budget research were:

- Leroy Merlin
- Mauser
- Legrand
- Senetic

15.2. EXPECTED BUDGET

The expected budget can be found in the following table:

Image	Equipment	Description	Price per unit	Quantity	Total Price
	24 port switch	Catalyst 2960-24TT-L Switch	€203.92	two	€407.84
	Router 2811	Series ISR	€861	two	€1,722
	Printer	Multifunctional Mono Xerox b225v/dni	€147.60	3	€442.80
	Vending Machines	Snack Vending machine	€1000	4	€4,000
	Access Points	Cisco Catalyst 9115AXE	€553.55	two	1 €107.10
	Hub	HUB 12 Ports RJ45 CAT5e	€21.99	1	€21.99
	IP Phones	Cisco 7841 IP phone Black, Silver 4 lines LCD	€142.51	31	€4,417.81
	PCs	WORKSTATION LENOVO THINKSTATION P310 i7-6700 16GB	€399.99	31	12 €399.69

		RAM 480GB QUADRO SSD K2200-4GB			
	Tables	Secretary	€150	34	5,100€
	PatchPanel	24 RJ45 ports Cat5e UTP for 19'' rack	€29.15	3	€87.45
	Rack	Cabinet 19'' wall rack 22U 570x1100x450 mm	€249.58	two	€499.16
	DOUBLE socket network RJ45	8WAYS for embedding - ARMORED Cat5e	€9.02	24	€216.48
	Cat.5e UTP Cable	CAT5e U/UTP 1.0m - white	€0.63 (80+) €0.70 (15+) €1.05 (1+)	141 m	€93.45
	RJ45 Plug Armored	8P/8C - Cat5e	€0.31	167	€51.77
	DLP-S Frame	Frame 50x20mm 1 compartment O (legrand 638160 2024)	€2.33 (2 m)	118.5m	€138.05

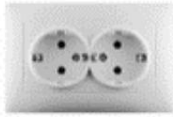
	DLP-S Angle Interior	ANGLE INTERIOR 50X20MM (legrand 638161 2024)	€0.70	13	€9.10
	DLP-S Angle Exterior	ANGLE OUTDOOR 50X20MM (legrand 638162 2024)	€0.75	1	€0.75
	DLP-S Top	TOP 50X20 MM (legrand 638165 2024)	€0.59	10	€5.90
	Double Socket	2P+T LEXMAN LIKA WHITE	€6.59	35	€230.65
	Socket strip	Fonestar FRP-8M	€25.75	two	€51.50
	Wireless LAN Controller	Controller network Omada - TP-Link OC200	€96.96	two	€193.92
Total price					€31,197.41

Table 10 – Expected Budget

16. SIMULATION IN PACKET TRACER

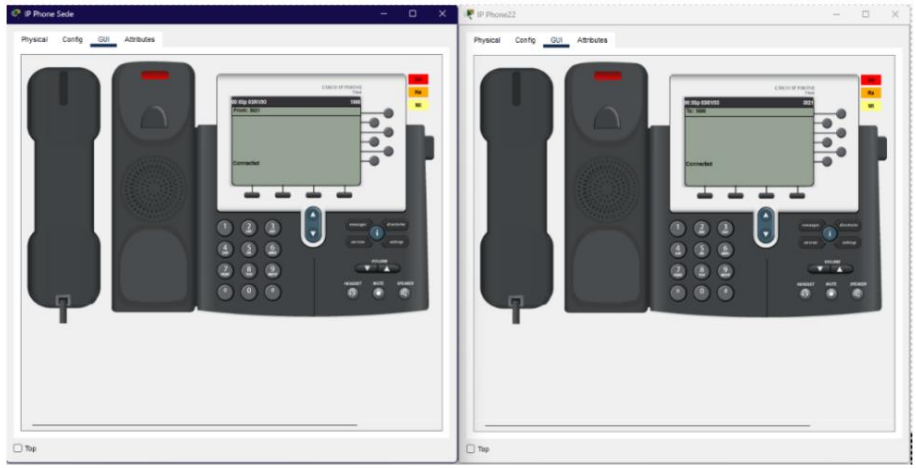


Figure 14 – Connection between VoIP phones at Headquarters and the Development Hub

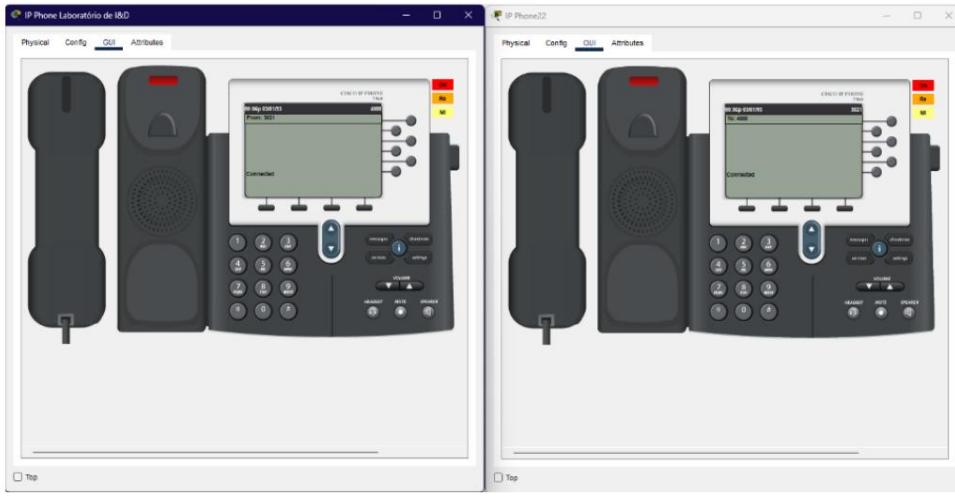


Figure 15 – Connection between VoIP phones in the Laboratory and the Development Hub

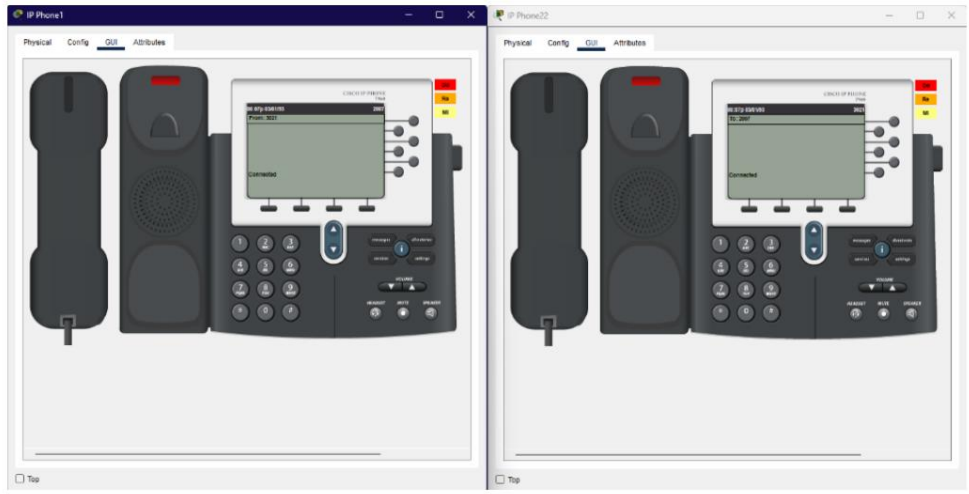


Figure 16 – Connection between Coworking and Development Hub VoIP Phones

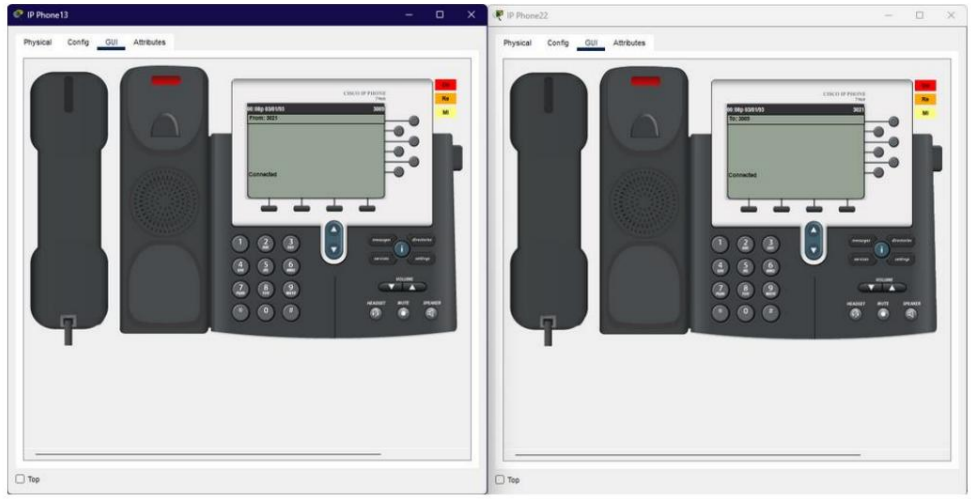


Figure 17 – Connection between VoIP Phones at the Development Hub

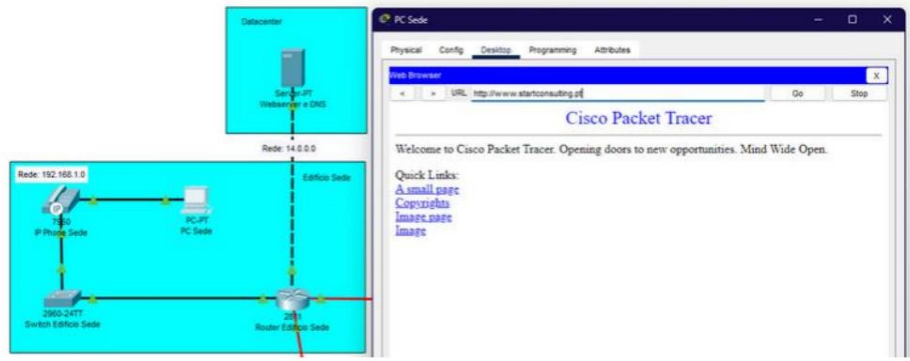


Figure 18 – Enter Web site of the company through a PC at Headquarters

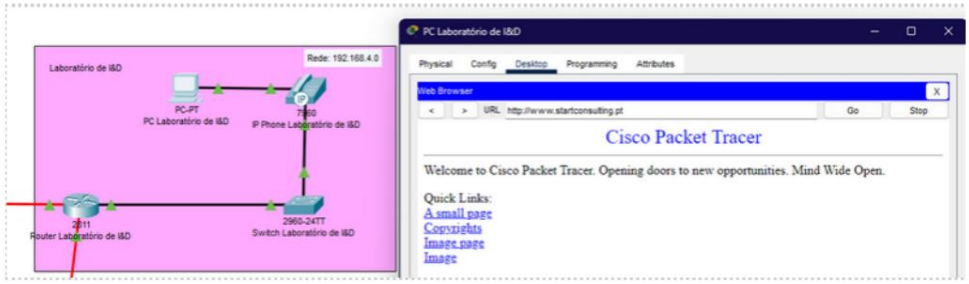


Figure 19 – Enter Web site of the company through a Laboratory PC

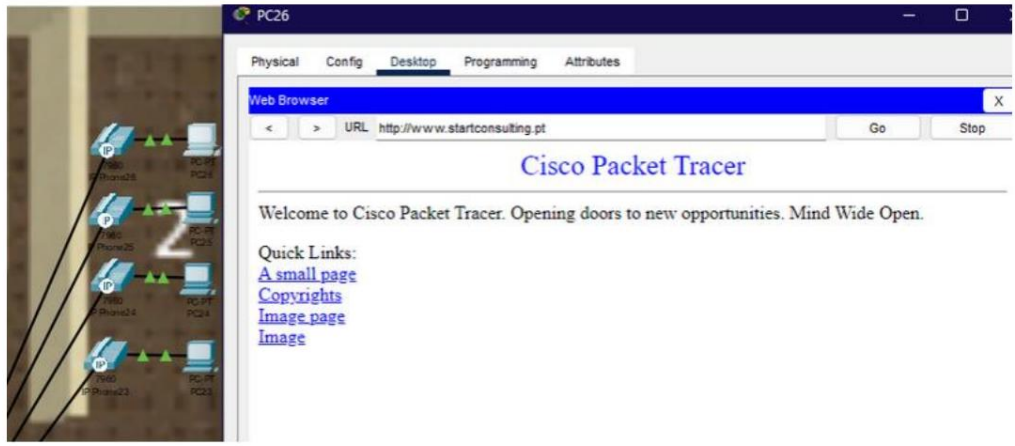


Figure 20 – Enter Web site of the company through a Development PC

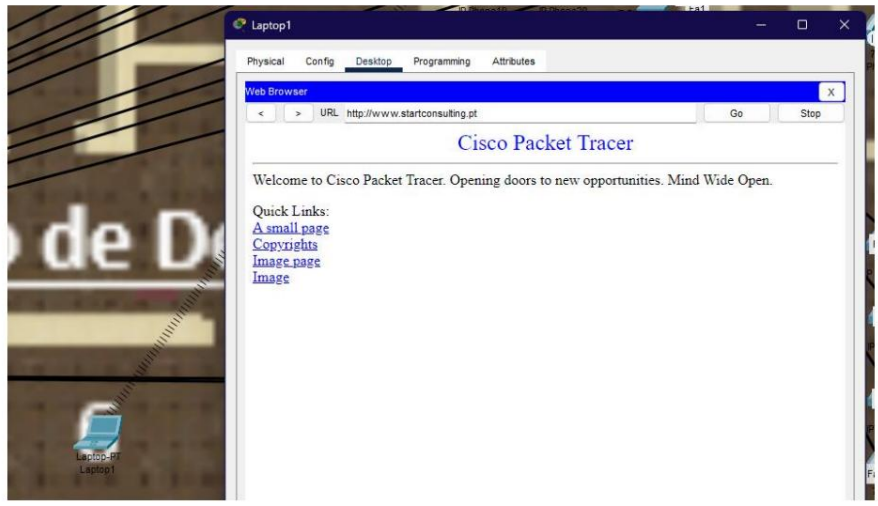


Figure 21 – Enter Web site of the company through a Laptop of Development

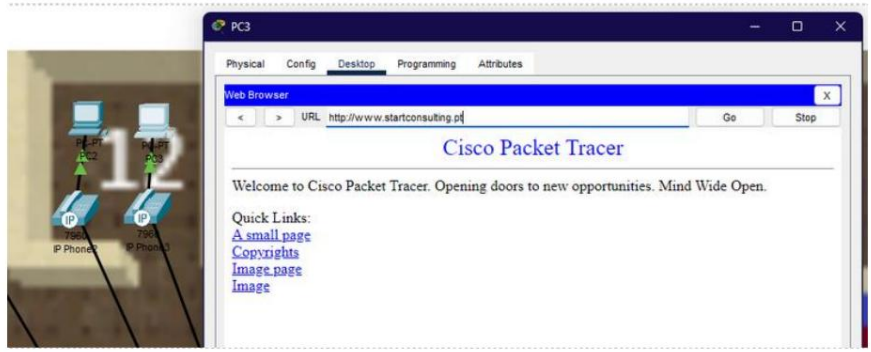


Figure 22 – Enter Web site of the company through a PC in the Coworking space

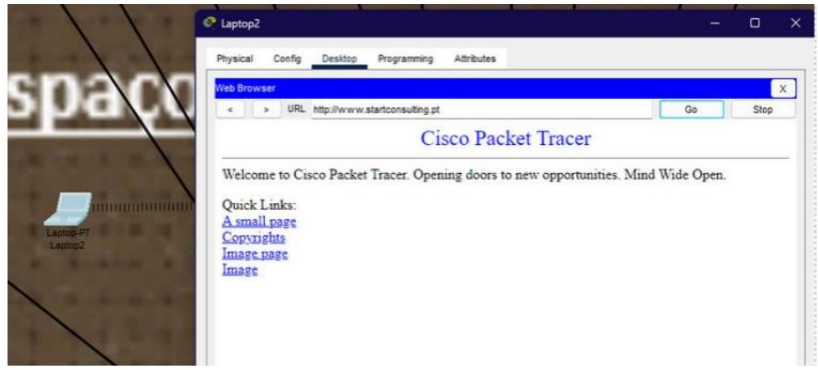


Figure 23 – Enter Web site of the company through a Laptop from Coworking

17.CONCLUSION

The execution of this project provided a deeper understanding of the process of design, develop and implement a network infrastructure. Despite its apparent simplicity, on several occasions, proved to be challenging, and at times, complex.

However, thanks to the diverse skills acquired in the classroom, we were able to advance significantly in the project. From configuring devices, such as **computers, Switches, Routers,** and even the **server,** until the implementation of additional resources, such as **VoIP phones,** configuring the **DHCP service** and configuring **Access Points** (using the *Wireless LAN Controller* and *Light Access Points).*

These extra contributions enriched the project and added value to its evaluation. Just two additional aspects outlined in the statement **were not concluded,** namely the **configuration of PAT (NAT)** and **ACLs.**

We found greater challenges in integrating VLANs into Access Points, although the physical installation of the equipment was simple and straightforward, configuring them for communication mutual support proved problematic.

Regarding other aspects of the project, we faced few difficulties and managed to meet established expectations.

Finally, although the project was laborious due to the amount of configuration necessary, it was an interesting and enriching experience, providing a solid understanding the foundations (and concepts) of network infrastructures, especially for those without previous experience in this field.

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19.SETTINGS

The following points are dedicated to the configurations of some equipment/devices, namely the **Headquarters Router** and the **Switches of the Coworking space and the development.**

19.1. HEADQUARTERS **ROUTER CONFIGURATION :**

The following configuration is displayed on the company's **Headquarters Router ,** it runs at *startup-config* and *running-config:*

```
Current configuration: 3790 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
!router name creation !

hostname Router_Edificio_Sede

! !ssh encryption key creation
!
enable secret 5 $1$mERr$TR/UEo8fSF0atHEQvRBbV/
!
!exclusion of addresses for DHCP !

ip dhcp excluded-address 192.168.1.1
ip dhcp excluded-address 192.168.1.33
ip dhcp excluded-address 192.168.1.65
ip dhcp excluded-address 192.168.1.97
ip dhcp excluded-address 192.168.1.129
ip dhcp excluded-address 192.168.1.161
ip dhcp excluded-address 192.168.1.193
ip dhcp excluded-address 192.168.1.225
!
!different DHCP pools for each vlan
!
ip dhcp pool Phones
```

```
network 192.168.1.64 255.255.255.224
default-router 192.168.1.65
option 150 ip 192.168.1.65
ip dhcp pool Headquarters
network 192.168.1.0 255.255.255.0
default-router 192.168.1.1
dns-server 14.0.0.2
domain-name www.startconsulting.pt
ip dhcp pool Data
network 192.168.1.32 255.255.255.224
default-router 192.168.1.1
dns-server 14.0.0.2
domain-name www.startconsulting.pt
ip dhcp pool Printers
network 192.168.1.96 255.255.255.224
default-router 192.168.1.97
ip dhcp pool Maquinas_Vending
network 192.168.1.128 255.255.255.224
default-router 192.168.1.129
ip dhcp pool Espaco_Coworking
network 192.168.1.160 255.255.255.224
default-router 192.168.1.161
ip dhcp pool Equipment_Network
network 192.168.1.192 255.255.255.224
default-router 192.168.1.193
ip dhcp pool wifi
network 192.168.1.224 255.255.255.224
default-router 192.168.1.225
dns-server 14.0.0.2
domain-name www.startconsulting.pt
!
!
!
ip cef
on ipv6 cef
!
!
!
username admin secret 5 $1$mERr$TR/UEo8fSF0atHEQvRBbV/
```

```
!
!
license udi pid CISCO2811/K9 sn FTX10170QZ3-
!
!
!
!
!
!
!
!# of authentication attempts (2) before ssh times out (15)
!
ip ssh authentication-retries 2
ip ssh timeout 15
ip domain-name sede.pt
!
!activation of spanning tree mode !

spanning-tree mode pvst
!
!
!
!
!configuration of the f0/0 interface and sub-interfaces corresponding to !different vlans

!
interface FastEthernet0/0
ip address 192.168.1.1 255.255.255.224
ip helper-address 192.168.1.1
auto duplex
speed auto
!
interface FastEthernet0/0.10
encapsulation dot1Q 10
ip address 192.168.1.33 255.255.255.224
!
interface FastEthernet0/0.20
encapsulation dot1Q 20
ip address 192.168.1.65 255.255.255.224
!
```

```
interface FastEthernet0/0.30
encapsulation dot1Q 30
ip address 192.168.1.97 255.255.255.224
!
interface FastEthernet0/0.40
encapsulation dot1Q 40
ip address 192.168.1.129 255.255.255.224
!
interface FastEthernet0/0.50
encapsulation dot1Q 50
ip address 192.168.1.161 255.255.255.224
!
interface FastEthernet0/0.60
encapsulation dot1Q 60
ip address 192.168.1.193 255.255.255.224
!
interface FastEthernet0/0.70
encapsulation dot1Q 70
ip address 192.168.1.225 255.255.255.224
!
!interface configuration f0/1, gig0/0/0 and gig0/1/0
!
FastEthernet0/1 interface
ip address 14.0.0.1 255.0.0.0
auto duplex
speed auto
!
interface GigabitEthernet0/0/0
ip address 13.0.0.1 255.0.0.0
!
interface GigabitEthernet0/1/0
ip address 10.0.0.1 255.0.0.0
!
Vlan1 interface
no ip address
shutdown
!
!activation of the RIP protocol
!
```

```
rip router
network 10.0.0.0
network 11.0.0.0
network 12.0.0.0
network 13.0.0.0
network 14.0.0.0
network 192.168.1.0
network 192.168.2.0
network 192.168.3.0
network 192.168.4.0
!
classless ip
!
ip flow-export version 9
!
!message of the day banner
!
motd banner ^C
**************************************
********** RESTRICTED ACCESS ***********
******** ROUTER: HEADQUARTERS BUILDING *******
**************************************
^C
!
!
!configuration of VOIP phones
!
dial-peer voice 1 voip
destination-pattern 4...
session target ipv4:13.0.0.2
!
dial-peer voice 2 voip
destination-pattern 2...
session target ipv4:10.0.0.2
!
dial-peer voice 3 voip
destination-pattern 3...
session target ipv4:12.0.0.2
!
```

```
telephony-service
max-ephones 2
max-dn 2
ip source-address 192.168.1.65 port 2000
auto assign 1 to 2
!
ephone-dn 1
number 1000
!
ephone 1
device-security-mode none
mac-address 00D0.FFA2.81C9
type 7960
button 1:1
!
line con 0
password 7 0832494A0C
synchronous logging
Login
!
line aux 0
!
line vty 0 4
local login
transport input ssh
!
!
!
end
```

19.2. SWITCH COWORKING SETUP :

The following configuration is displayed on the company's **Coworking Switch ,** it runs on *startup-config* and *running-config:*

```
Current configuration: 2459 bytes

!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
!creation of the name of the coworking switch
!
hostname Switch_Coworking
!
!ssh encryption key creation
!
enable secret 5 $1$mERr$RmUakHKLaj5Wd0/zBPcQz.
!
!# of authentication attempts (2) before ssh times out (15 seconds)
!
ip ssh authentication-retries 2
ip ssh timeout 15
ip domain-name cowork-switch.pt
!
username admin secret 5 $1$mERr$RmUakHKLaj5Wd0/zBPcQz.
!
!activation of spanning tree mode
!
spanning-tree mode pvst
spanning-tree extend system-id
!
!configuration of switch interfaces, changing the access mode to trunk and !association of interfaces with access (50 -
coworking) and voice (20) vlans
!
FastEthernet0/1 interface
switchport mode trunk
!
```

```
FastEthernet0/2 interface
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/3
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/4
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
FastEthernet0/5 interface
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/6
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
FastEthernet0/7 interface
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/8
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/9
switchport access vlan 50
switchport mode access
switchport voice vlan 20
```

```
!
interface FastEthernet0/10
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/11
switchport access vlan 50
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/12
switchport access vlan 50
switchport mode access
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
switchport mode trunk
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
FastEthernet0/20 interface
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
```

```
!
GigabitEthernet0/1 interface
!
GigabitEthernet0/2 interface
!
!Vlan1 configuration(default)
!
Vlan1 interface
ip address 192.168.2.5 255.255.255.224
!
ip default-gateway 192.168.2.1
!
!message of the day banner
!
motd banner ^C
**************************************
********** RESTRICTED ACCESS ***********
********* SWITCH: COWORKING **********
**************************************
^C
!
!
!
line con 0
password 7 08224359060B0E28011C05102923
synchronous logging
Login
!
line vty 0 4
local login
transport input ssh
line vty 5 15
Login
!
!
!
!
end
```

19.3. DEVELOPMENT **POLE SWITCH CONFIGURATION :**

The following configuration is presented on the company's **Development Pole Switch ,** runs in *startup-config* and *running-config:*

```
Current configuration: 2699 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
!creating the name of the development pole switch
!
hostname Switch_Development
!
!ssh encryption key creation
!
enable secret 5 $1$mERr$Q4UXwavQRE1INuHT3hUAq/
!
!# of authentication attempts (2) before ssh times out (15 seconds)
!
ip ssh authentication-retries 2
ip ssh timeout 15
ip domain-name develop-switch.pt
!
username admin secret 5 $1$mERr$Q4UXwavQRE1INuHT3hUAq/
!
!activation of spanning tree mode
!
spanning-tree mode pvst
spanning-tree extend system-id
!
!configuration of switch interfaces, changing the access mode to trunk and
!association of interfaces with access (10 - data) and voice (20) vlans
!
FastEthernet0/1 interface
switchport mode trunk
!
FastEthernet0/2 interface
```

```
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/3
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/4
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
FastEthernet0/5 interface
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/6
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
FastEthernet0/7 interface
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/8
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/9
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
```

```
interface FastEthernet0/10
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/11
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/12
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/13
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/14
switchport access vlan 10
switchport mode access
switchport voice vlan 20
!
interface FastEthernet0/15
switchport access vlan 70
switchport mode access
!
interface FastEthernet0/16
switchport mode trunk
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
FastEthernet0/20 interface
```

```
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
GigabitEthernet0/1 interface
!
GigabitEthernet0/2 interface
!
!vlan1 configuration(default)
!
Vlan1 interface
ip address 192.168.3.5 255.255.255.224
!
ip default-gateway 192.168.3.1
!
!message of the day banner
!
motd banner ^C
**************************************
********** RESTRICTED ACCESS ***********
*** SWITCH: DEVELOPMENT POLE **
**************************************
^C
!
!
!
line con 0
password 7 082549580C150A072D181B0D3E282C
synchronous logging
Login
!
line vty 0 4
local login
transport input ssh
```

```
line vty 5 15
Login
!
!
!
!
end
```

20. EQUIPMENT AUTHENTICATION

Building	Equipment	User mode	User mode via ssh	Privileged mode
Thirst	**router**	thirst	headquarters_admin	headquarters_admin
	Switch	headquarters_switch	headquarters_switch_admin	headquarters_switch_admin
Laboratory	**router**	laboratory	lab_admin	lab_admin
	Switch	lab_switch	lab_switch_admin	lab_switch_admin
Coworking	**router**	coworking	cowork_admin	cowork_admin
	Switch	cowork_switch	cowork_switch_admin	cowork_switch_admin
Pole Development	**router**	developer	develop_admin	develop_admin
	Switch	develop_switch	develop_switch_admin	develop_switch_admin

Table 11 – Table with active equipment authentications