Ministry of Education
Imam Abdulrahman bin Faisal University
Computer Science department

جامعة الإمام عبد الرحمن بن فيصل
IMAM ABDULRAHMAN BIN FAISAL UNIVERSITY

COMMUNICATION AND NETWORKING FUNDAMENTAL

RAILWAY NETWORK

STUDENT NAME:	STUDENT ID:
Hajer Abdulrahman Al-Saadan	2210003576
Lojain Hafez Alibrahim	2220001991
Elaf Mohammed Aljaramez	2220000917
Raghad Ali alzahrani	2220002910

Instructors:

L.Ashwag Alotyyan - Mrs. Maha Alghamdi - Mrs. Sarah Alqarn

Academic year 1445 – 2023/2024

Abstract:

The dynamic world of contemporary transportation infrastructure is ours to explore and learn from! The demand for effective and dependable transportation networks has never been higher than it is in the fast-paced, globally connected society of today. Railways have long been a mainstay of transportation, and with the incorporation of advanced technology, the industry is about to undergo a transformation. In this project, we set out on a quest to learn more about the development of a modern railway network that is seamlessly integrated using mobile technology by Packet Tracer to boost energy efficiency as one of the main factors. Consider a railway network where trains interact with one another and with central authority, assuring efficient operations, safety, and resource management. By combining traditional railway engineering with the miracles of modern networking, this revolution is made feasible. As we delve into the intricacies of designing, simulating, and managing a railway network that can be monitored and controlled right from a smartphone. The foundational ideas of networking, energy efficiency optimization, and network interconnection using IOT will all be covered too.

Introduction:

A network is defined as a group of devices connected to exchange data with each other. In addition to the number of devices they contain, networks differ in terms of type and division based on the geographic area they cover. Because of the useful services they offer, like connecting various devices to the Internet so that everyone can access and browse its websites regardless of location, each network has a specific purpose and coverage area. This has led to the development of new concepts in the computer industry, like databases. But the ill-prepared network could cost the company a lot of money. The most economical and efficient form of transportation, according to users, is rail. Therefore, creating a network with high security and high-quality performance is extremely important. We used approach allows the network administrator to monitor both inbound and outbound traffic while adhering to certain security guidelines. We make use of the various routing protocols and networking environment security ideas in this reasoning. It can display the correct packet flow from one Railway Office department to the other departments. The Railway Office is separated into various Departments that go by the names of Ticket counter, security departments, IT departments, HR department, Accounts Department. The project consists of the Access Control & Network Address Translation concept for security purpose. One department has a gateway that communicates with the Internet service provider (ISP), receives data, sends it to the router to translate and distribute to the wireless devices. In other words, with a gateway, Railway gets wireless Internet access (Wi-Fi). In the security Department we used A multilayer switch, it is not the same as the Data Link Layer (DLL) that switches often employ; rather, it is a network device that can function at higher layers of the OSI reference model. At extremely rapid speeds, a multilayer switch can carry out both switch and router duties. To controls access to computer resources, enforces policies, and audits usage we used Authentication, authorization, and accounting (AAA).

DEVICE NAME:	QUANTITY:
PC'S	17
Laptop	8
Switch	12
Router	6
Wireless Switch	1
Ip Phone	3
Access Point	5
Multilayer Switch	1
Sniffer	1
Server	12
Home Getaway	3
AC	5
Security Camera	5
Door	5
Window	5
Motion Detector	1
Smoke Detector	1
Siren	1
Speaker	1
Printer	6
Smart Phone	3

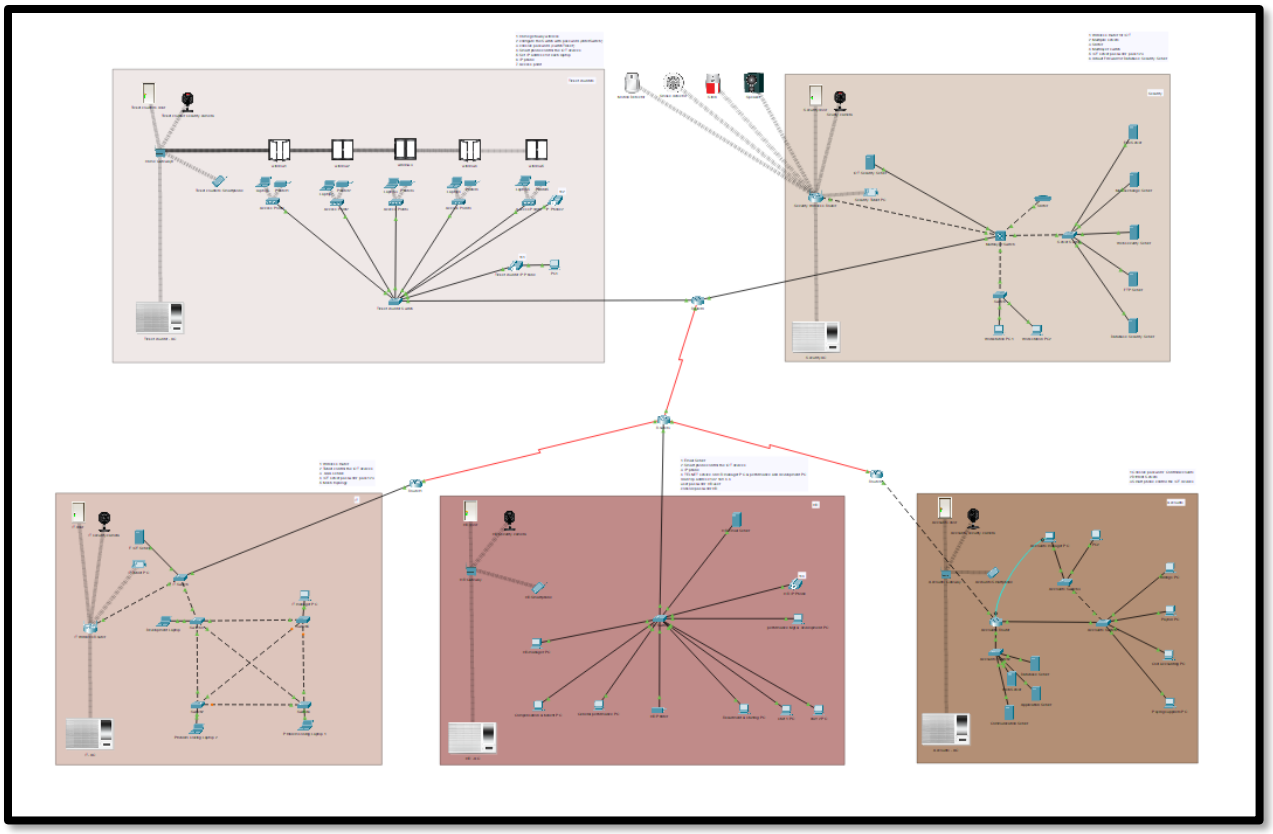
Tablet	2
Straight Wire	51
Wireless	39
Serial Wire	3
Cross Wire	14
Console Cable	1
Serial Wire Connection	3
Cross Wire Connection	more than 10
Wireless connection	more than 30
Straight Wire Connection	more than 20

The Methodology

Setting Up the Topologies:

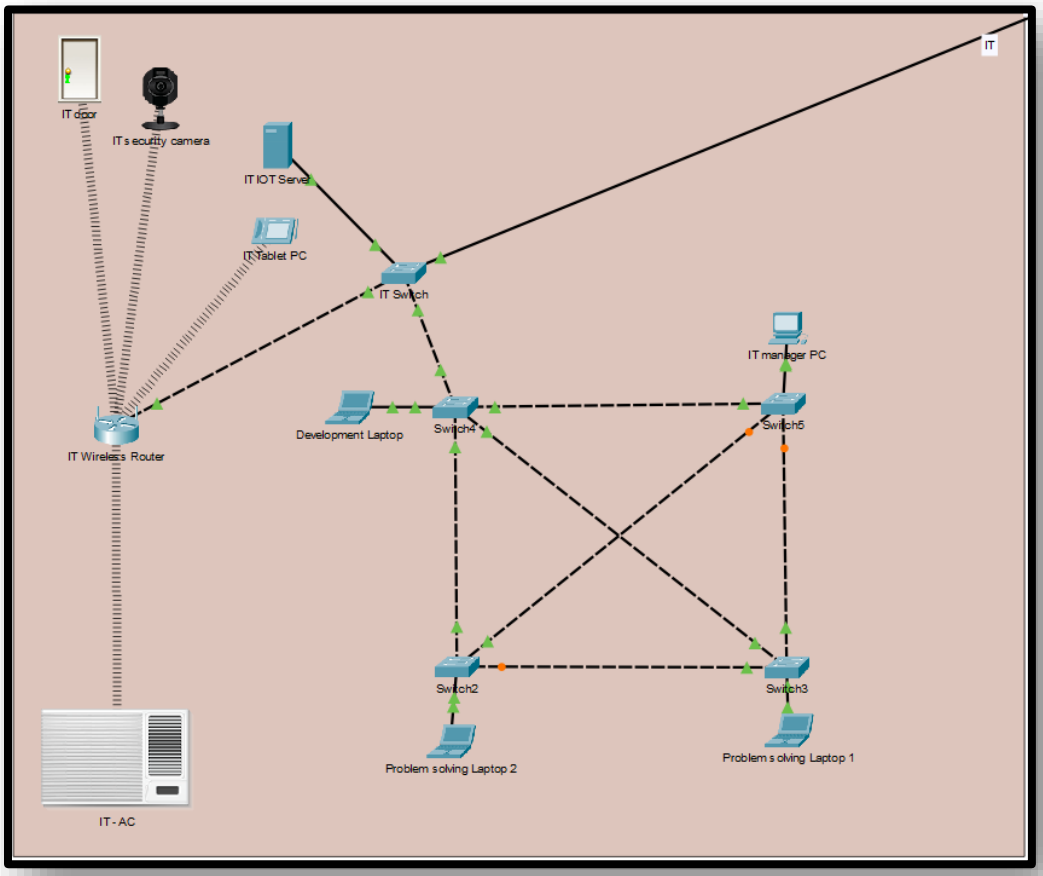
Our Final Railway Networks:

Using Cisco Packet Tracer, we created a secure, functional, and integrated railway network for our project. We were able to simulate the network design by using the features of the application. Using the appropriate tools and protocols in the right devices for the needed purposes is an important component of an effective network.



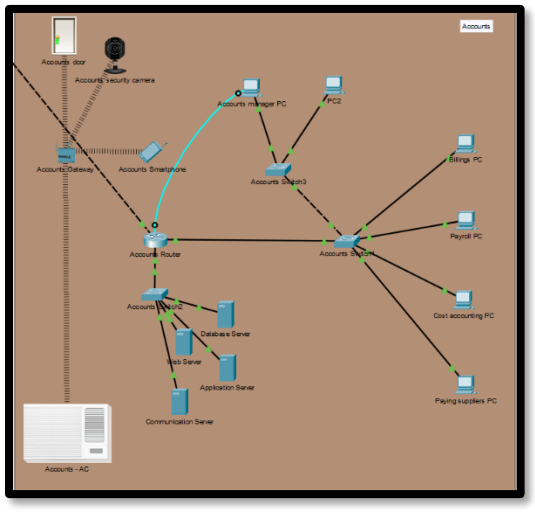
Mesh Topology:

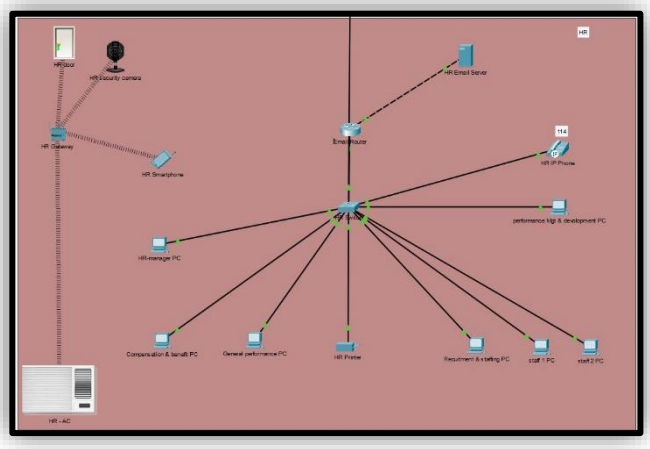
We used mesh topology to connect each device to every device in the network to increase flexibility.

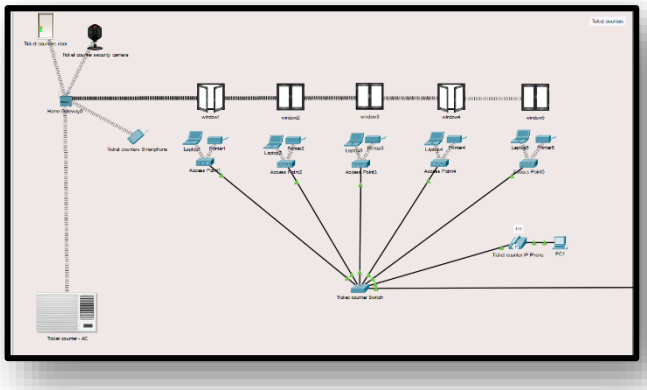


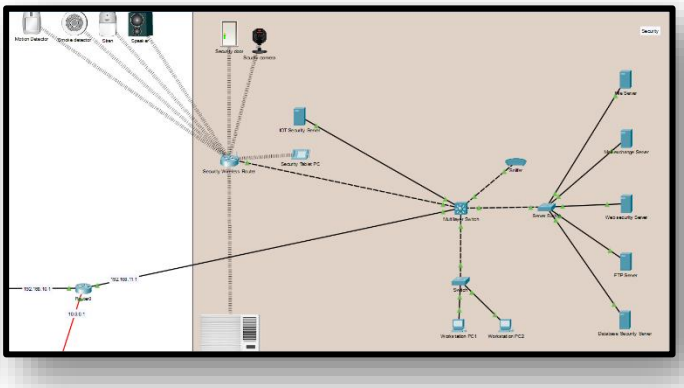
Star Topology:

Star topology is the most effective topology in our network to reduce the costs and facilitate the installing.







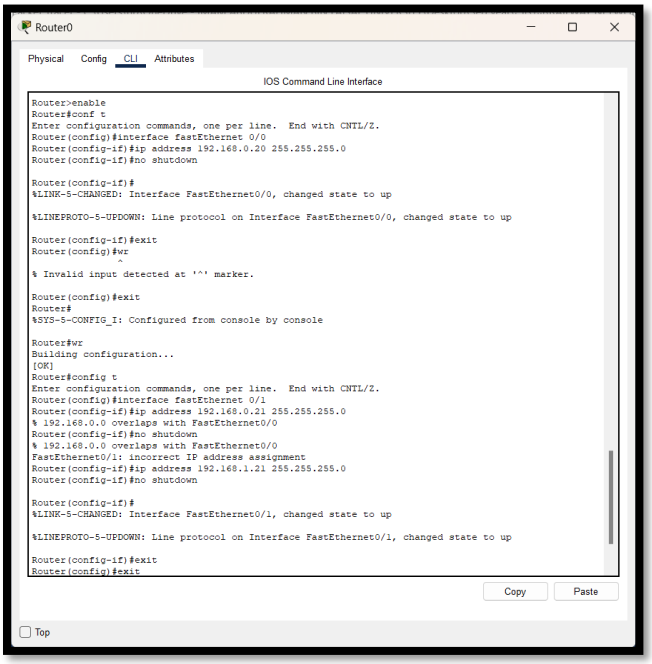


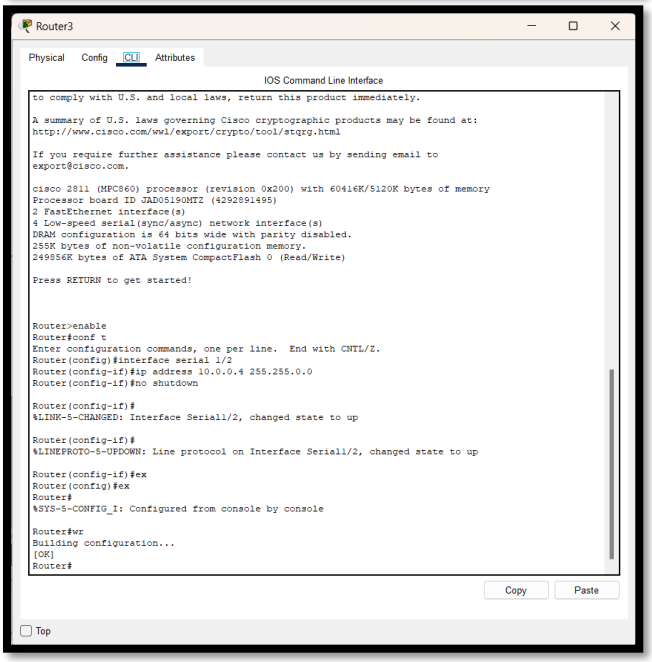
Addressing Table:

Device	Interface	IP Address	Subnet Mask	Default Gateway
Router 0	Fa0/0 Fa0/1 Se1/0	192.168.10.1 192.168.11.1 10.0.0.1	255.255.255.0 255.255.255.0 255.255.0.0	NA
Workstation PC1	NIC	15.0.0.6	255.0.0.0	15.0.0.1
Workstation PC2	NIC	15.0.0.7	255.0.0.0	15.0.0.1
IOT Security Server	NIC	192.168.0.11	255.255.255.0	192.168.0.2
Security Wireless Router	NIC	192.168.0.2	255.255.255.0	192.168.0.2
File Server	NIC	15.0.0.9	255.0.0.0	15.0.0.1
Mail exchange Server	NIC	15.0.0.2	255.0.0.0	15.0.0.1
Web security Server	NIC	15.0.0.3	255.0.0.0	15.0.0.1
FTP Server	NIC	15.0.0.4	255.0.0.0	15.0.0.1
Database Security Server	NIC	15.0.0.5	255.0.0.0	15.0.0.1
Router 3	Se1/0 Se1/1 Se1/2 Fa0/0	10.0.0.2 192.168.13.3 192.168.17.7 192.168.14.4	255.255.0.0 255.255.255.0 255.255.255.0 255.255.255.0	NA
Router 1	Fa0/0 Se1/0	192.168.12.1 192.168.13.2	255.255.255.0 255.255.255.0	NA
Router 2	Fa0/0 Se1/0	192.168.19.9 192.168.17.8	255.255.255.0 255.255.255.0	
IT IOT Server	NIC	192.168.12.2	255.255.255.0	192.168.12.1
IT Wireless Router	NIC	192.168.12.10	255.255.255.0	192.168.12.2
HR Email Server	NIC	192.168.14.120	255.255.255.0	192.168.14.4
Email Router	Gig0/0 Gig0/1	192.168.4.3 192.168.3.1	255.255.255.0 255.255.255.0	NA
Accounts Router	Fa0/0 Fa0/1	192.168.5.3 192.168.4.1	255.255.255.0 255.255.255.0	NA
HR-manager PC	NIC	192.168.14.5	255.255.255.0	192.168.14.4
Performance &devolopment PC	NIC	192.168.14.6	255.255.255.0	192.168.14.4
Ticket counter IP Phone	Vlan 1	192.168.10.2	255.255.255.0	192.168.10.1
IP phone 2	Vlan 1	192.168.10.3	255.255.255.0	192.168.10.1
PC1	NIC	192.168.10.6	255.255.255.0	192.168.10.1

Router Configuration:

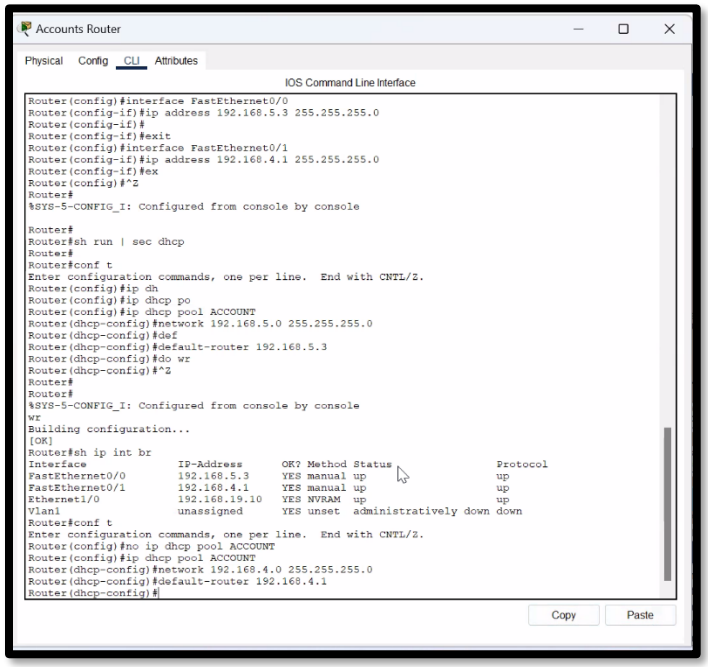
In Router 0 and 3, we configured the interfaces in the CLI as shown in the figure below.





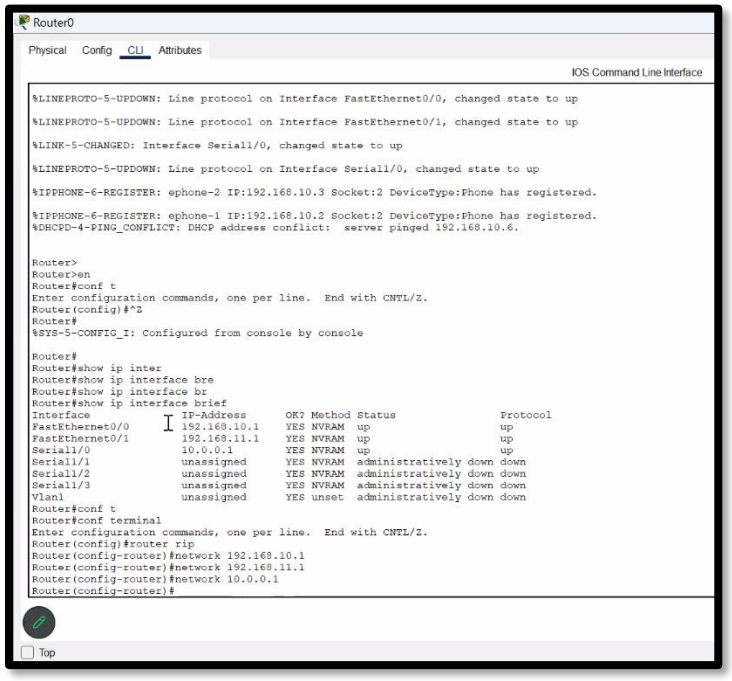
DHCP Protocol:

In the accounts router we used the DHCP protocol to facilitate assigning address to the devices.



RIP Protocol:

In the figure below the steps of using the RIP protocol in all the routers to success the ping between all the departments.



User password on Switch:

We set *switchTicket* for the user password, and set *enterSwitch* for the console password, then we encrypted both of them so when someone write *show running config* command, he cannot know the passwords.

```
Switch>enable
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#enable password enterSwitch
Switch(config)#exit
```

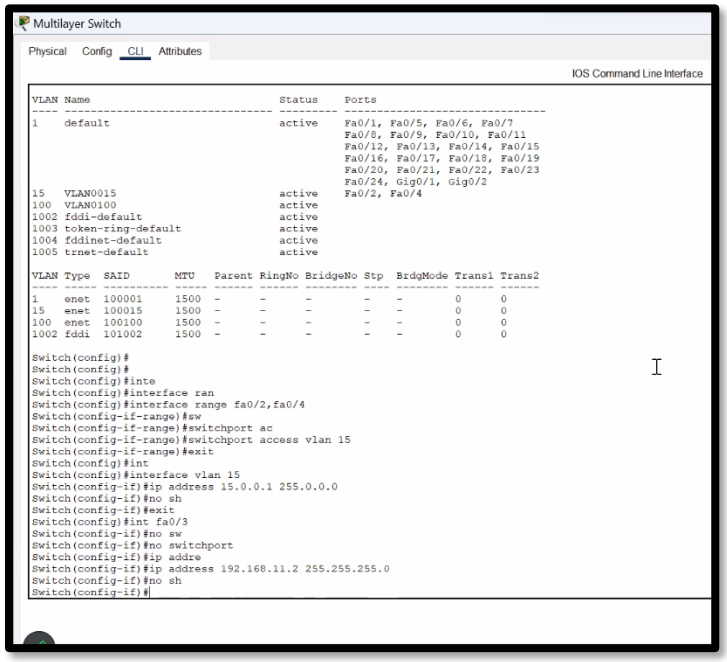
```
Switch>enable
Password:
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#enable secret enterSwitch
The enable secret you have chosen is the same as your enable password.
This is not recommended.  Re-enter the enable secret.
Switch(config)#exit
```

```
Switch>
Switch>enable
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#line console 0
Switch(config-line)#login
% Login disabled on line 0, until 'password' is set
Switch(config-line)#password switchTicket
Switch(config-line)#exit
Switch(config)#exit
```

```
User Access Verification

Password:

Switch>enable
Password:
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#service passwoed-encryption
                  ^
% Invalid input detected at '^' marker.

Switch(config)#service password-encryption
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#show running config
                ^
% Invalid input detected at '^' marker.

Switch#show running-config
Building configuration...

Current configuration : 2391 bytes
!
version 15.0
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname Switch
!
enable secret 5 $1$mERr$2Lct3ZUM83rTUn0PaKYTl/
enable password 7 0824425A0C0B36001B1F0F0C
!
!
!
!
!
```

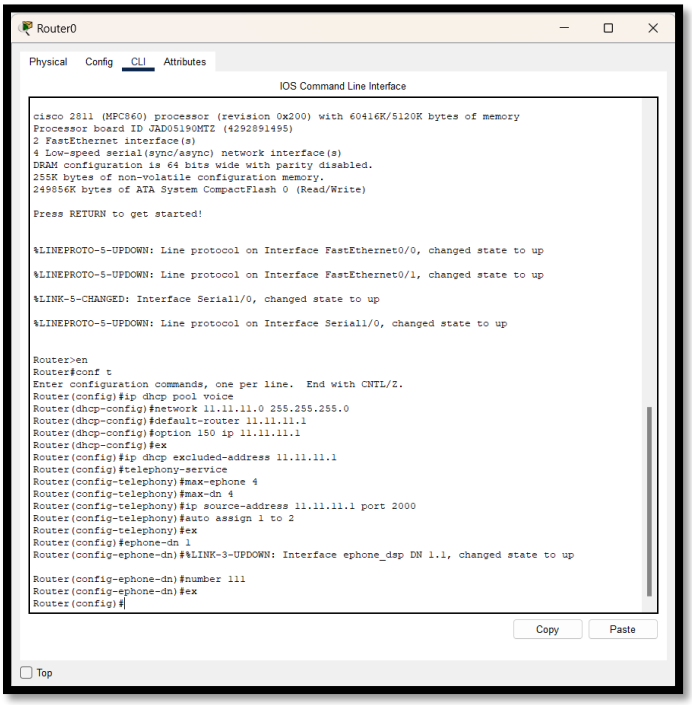
Vlan on Switches:

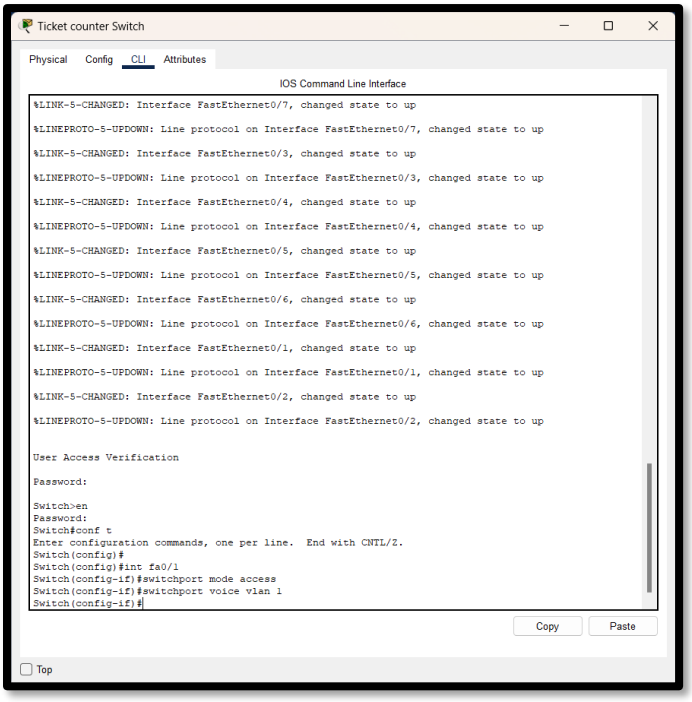
Here we activate the vlan 15 on all switches in the security department to facilitate and success sending messages from and to this department.



IP Phone configuration:

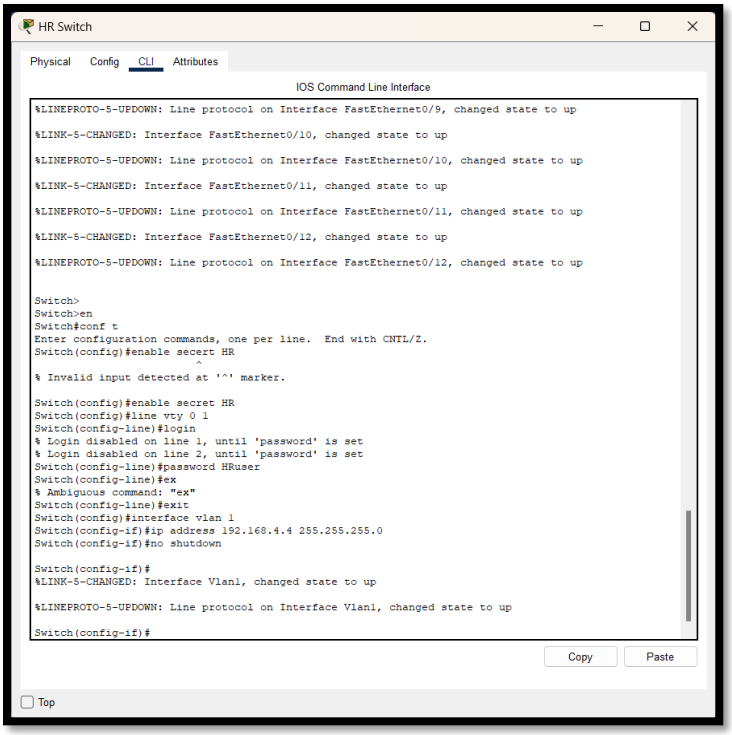
We used 3 Ip phones, 2 of them are in the Ticket counter department for people who want to buy an online ticket, and the third is in the HR department so when they need to call someone outside the railway. The configuration is done on the router and switch CLI.





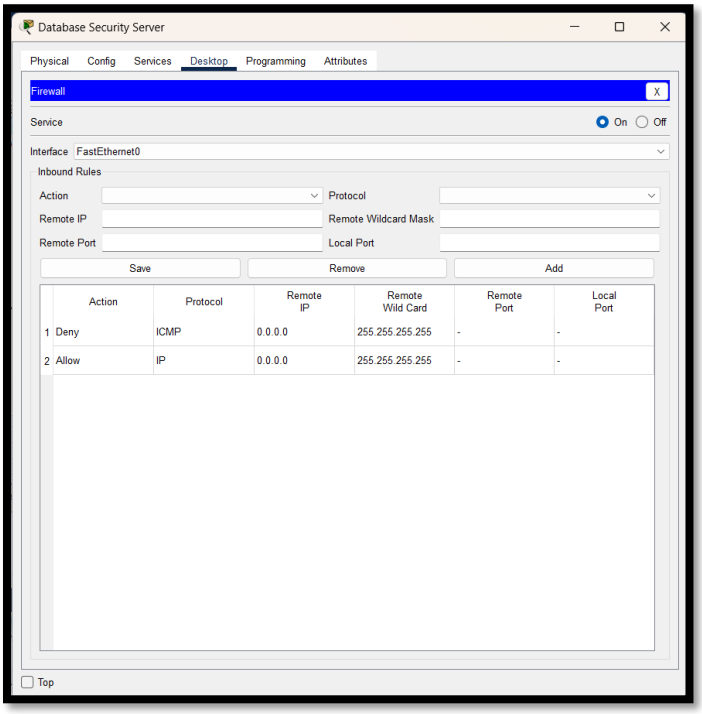
Telnet:

In the HR department, we used the telnet service to reduce the number of devices that can access and control the switch.



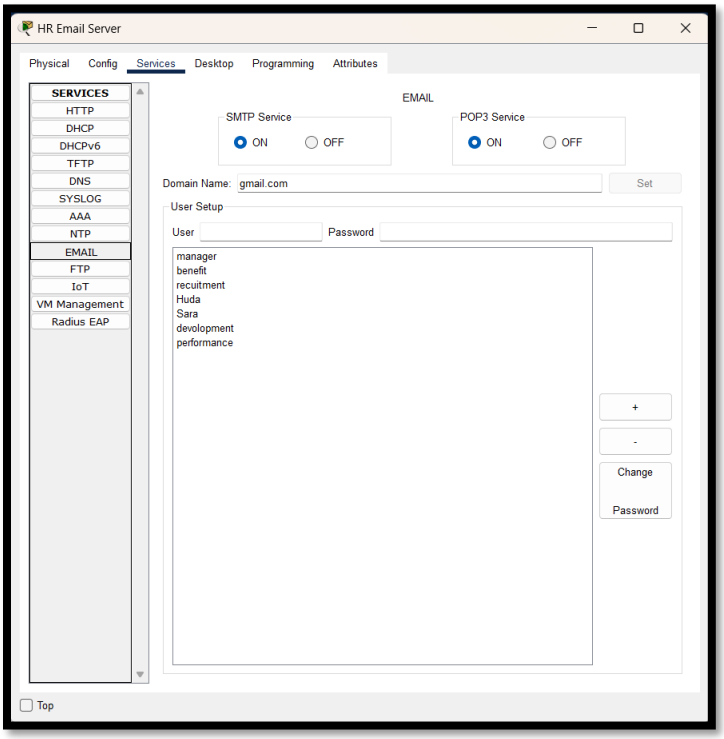
Firewalls:

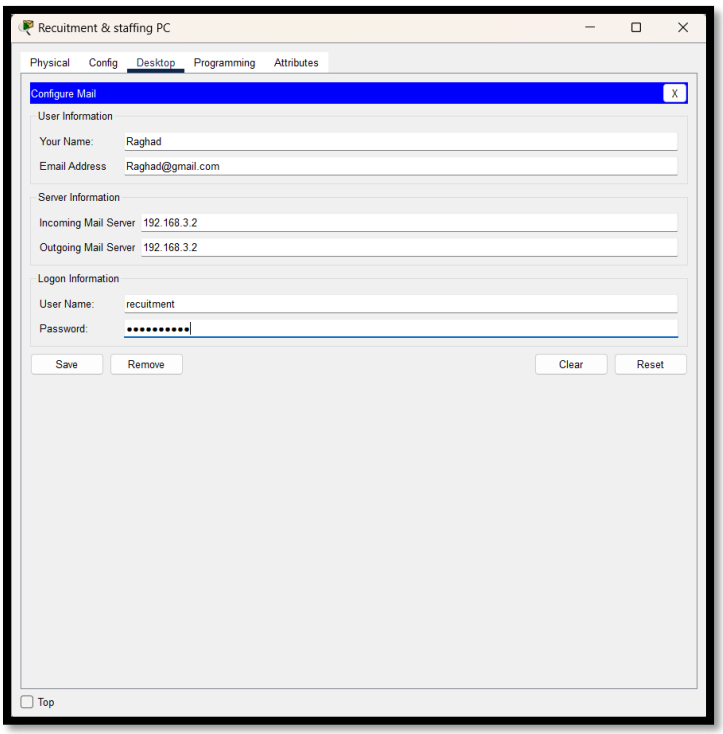
In securing our network and increasing efficiency from outsiders and hackers, we set up one default firewall. It is inside the database server directly.



Email:

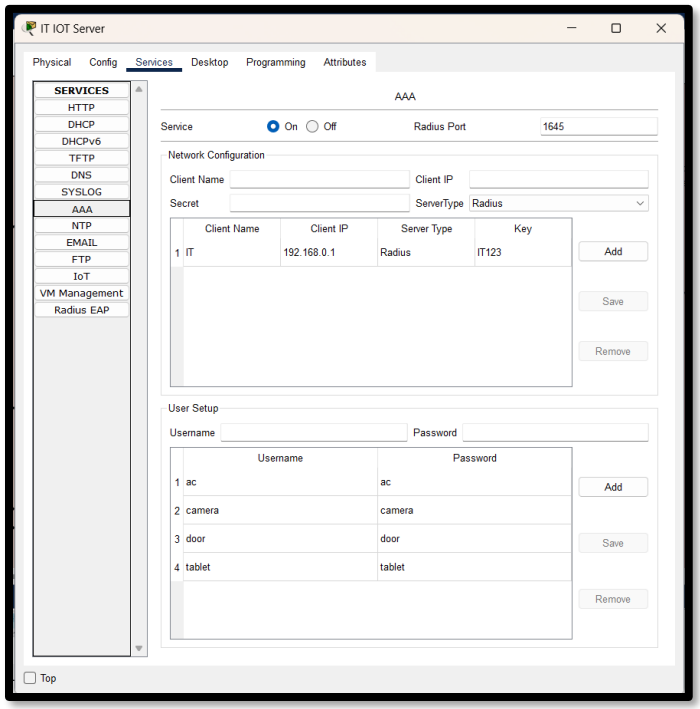
In HR department we decided to activate the Email service to facilitate the communication between the employees.

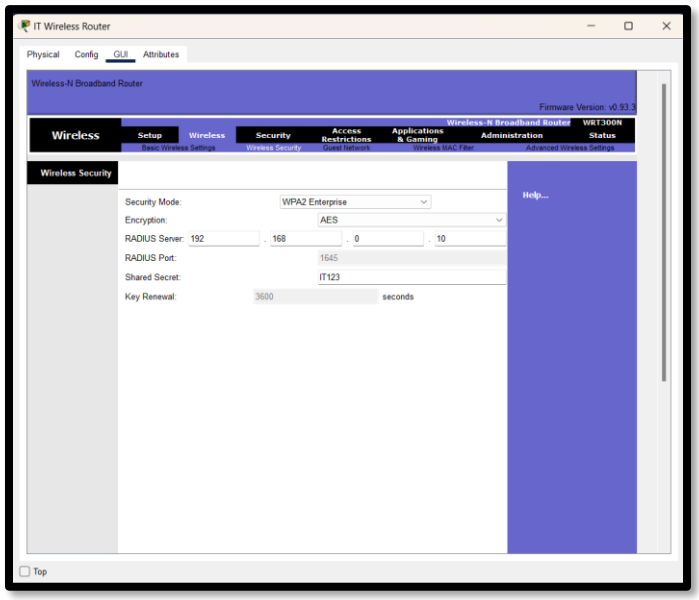




AAA service:

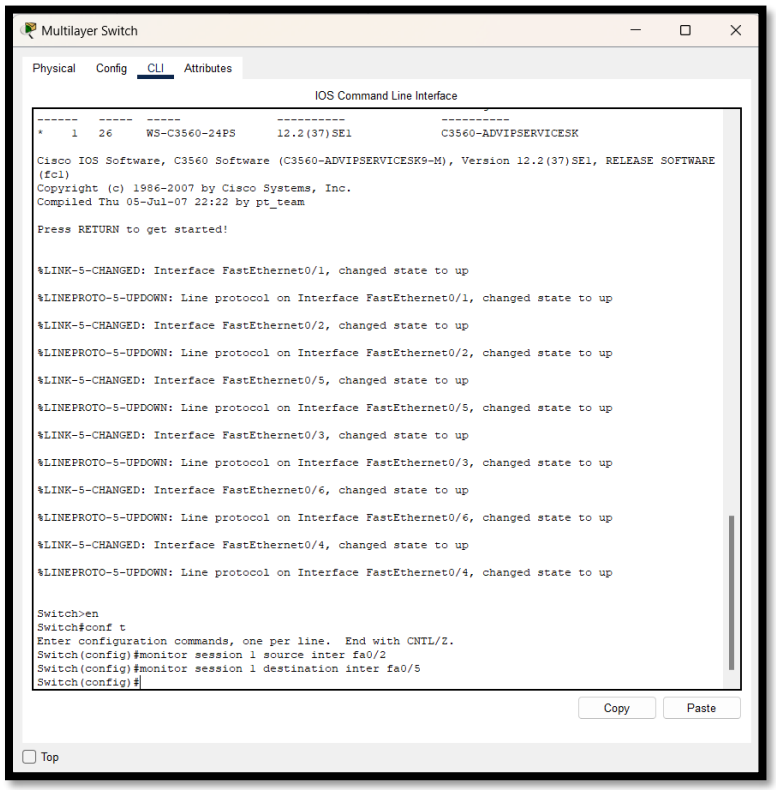
We used AAA service in the server to make an effective connection in the Security and IT departments between the wireless router and the IOT devices like the door and motion detector.





Sniffer:

To monitor incoming and outgoing messages from any device to any device with precise details, we set up a sniffer in the Security department.



Simulations and Results:

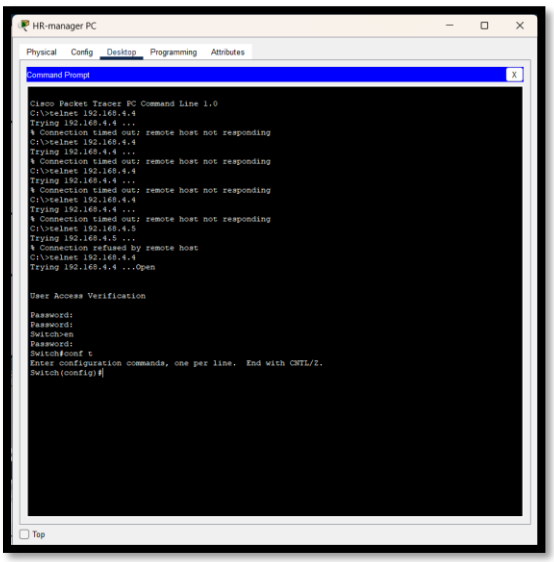
In these figures below a simple simulation of the services we used and explained before.

- **In this figure below, the status of the massages sent and delivered is a success except for the first status because we set a firewall on the server.**

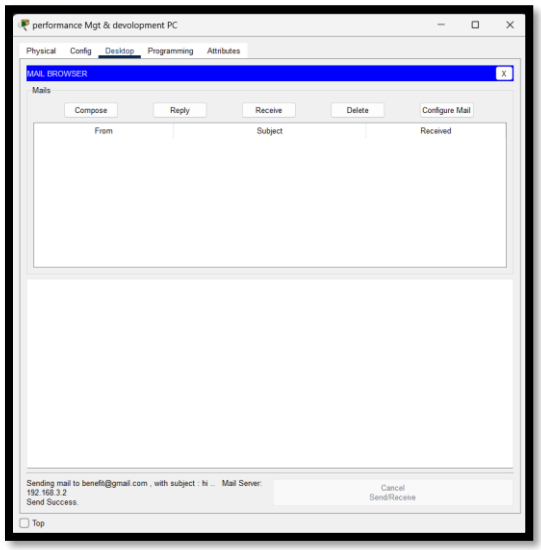
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Failed	Workstation PC2	Database Security Server	ICMP		0.000	N	7	(edit)	(delete)
	Successful	Recuitment & staffing PC	staff 1 PC	ICMP		0.000	N	8	(edit)	(delete)
	Successful	IT manager PC	Problem solving Laptop 2	ICMP		0.000	N	9	(edit)	(delete)
	Successful	HR-manager PC	performance Mgt & devolopme	ICMP		0.000	N	10	(edit)	(delete)

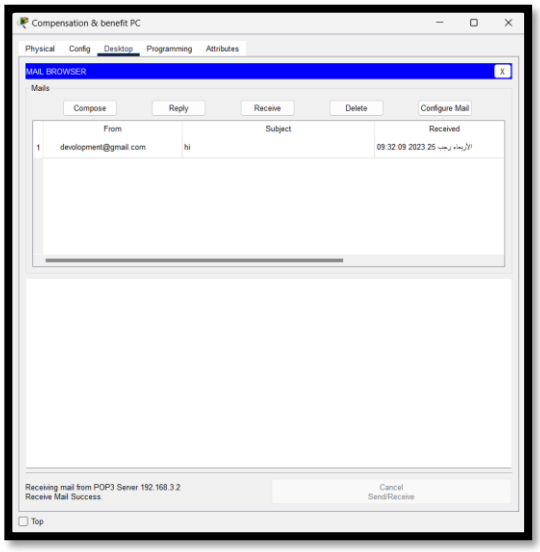
- **Here is the Ip phone simulation as it is ringing to the other one.**

- **The command prompt below is for the Telnet service from one of the authorized PC.**

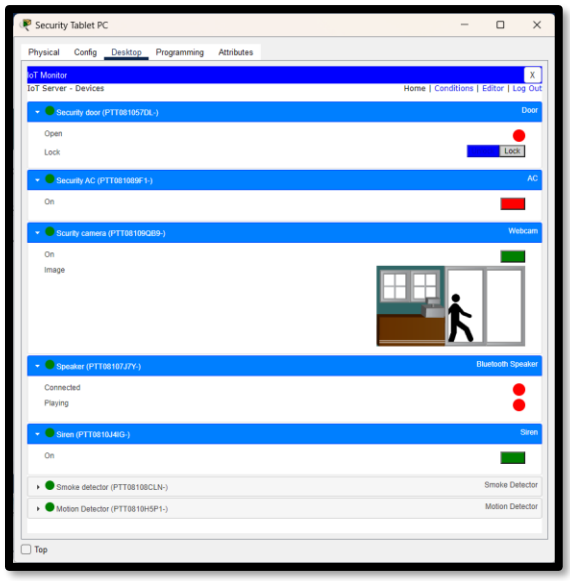


- **The two next figures are about the Email service, sending and receiving.**

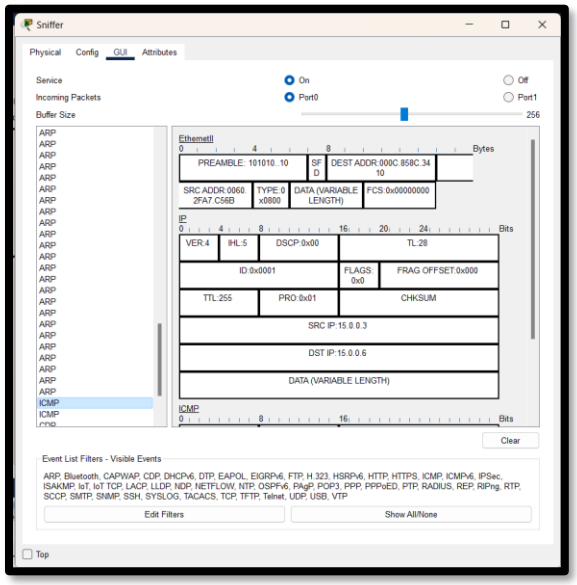




- **The Configured IOT devices by the wireless router and a server is controlled by a tablet.**



- **Down below a simple simulation of the sniffer work.**



Future Work:

Our project aspires to development in the future, and one of the most important developments that we seek to achieve is increasing the efficiency of the devices within the railway network. As well as facilitating communication to become more flexible between railway sections, with diversity in the use of topology So that each topology carries modern and distinctive technologies that help in the success of the network and make it easy to use and serve the railway.

Conclusion:

The project ensures the development of one of the most important developments on the railway networks. prepare a secure and effective network for the railway due to multiple attacks or terminating it for specific purposes by using routing protocols commonly used in today's networks: RIP. The Inside Railway server has been implemented to manage the work of the network and the internal network database in a better and accurate way, and this is the most important thing that will preserve the data. Firewall administration is an important topic in network security courses providing protection against outside cyber attackers by shielding your computer or network from malicious or unnecessary network traffic.

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