Tutored INTERNSHIP REPORT

Quectel Interface Solution Design & Implementation
EG9X Module

Achieved by

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Abstract:

Our world today is more and more relying on radio communications. One of the most important parts of the radio chain is the communication module, we can find this module nowadays in every cellphone, computer, car and other machines that needs communication and access to a larger network. During this project our work was to design and implement an interface solution that facilitate the usage of such modules for regular users and to prevent them from entering inside the technical details and coding. This interface is composed of 4 main parts that we will mention them in other parts of this report. The interface targets are all Quectel EG9x modules.

<u>Key Words:</u> Quectel EG9x, Python, PyQT, QT designer, Serial communications, MQTT, GSM/3G/LTE M1, GitHub, VS code.

Academic context:

This tutored project coincides with the mandatory module of the 3rd and final year at our school Higher School of Communications of Tunis (Sup'Com).

The students in this module must work on one of many projects proposed by our teachers, within companies and universities laboratories in Tunisia and abroad.

Our team is composed of Hermassi Nadir and Soula Iheb Omar, our job is to deliver a demo of the proposed subject and a report that resume the solution functionalities and future implementations.

Host Establishment:

Comelit R&D is an Tunisian Italian company with more than 50 years of development and production of intercoms, videophones, video surveillance, home automation systems and intrusion alarm systems. Comelit products are sold in over 70 countries worldwide through an extensive technical and sales network. Their quality is guaranteed by leading-edge technological research, ongoing optimization of functional and application processes and purebred Italian design.

Table of Contents

1.Objective

The objective of our work is to Design and Implement an interface to allow users to interact with the BG9X module via serial communication.

The interface will cover 4 main parts:

The first part will be the home page where the user will press a button to connect to the module and retrieve the different information of the module such as Firmware version, Network connectivity, Module reference model and so on that will be detailed later.

The second part will be the SMS page which will allow users to read,delete or send sms messages through this interface.

The third part will be the phone call page where the user can make and receive calls.

The last part will cover the Mqtt connectivity where the user will manage to make connection to Mqtt brokers to exchange informations.

2.Introduction

2.a.Quectel EG9x overview

Figure 1 - Quectel EG91Y Module

EG91Y is an embedded LPWA (LTE Cat M1/LTE Cat NB1/EGPRS) wireless communication module. It provides data connectivity on LTE-TDD/LTE-FDD/GPRS/EGPRS networks, and supports half-duplex operation in LTE networks.

EG91Y is a high-performance LPWA module with low power consumption.

EG9x is a series of embedded 4G wireless communication module with receive diversity. It supports LTEFDD/WCDMA/GSM wireless communication, and provides data connectivity on LTE-FDD, DC-HSDPA,HSPA+, HSDPA, HSUPA, WCDMA, EDGE and GPRS networks.

2.b.PyQT overview

PyQt is **a Python binding for Qt**, which is a set of C++ libraries and development tools that include platform-independent abstractions for Graphical User Interfaces (GUI), as well as networking, threads, regular expressions, SQL databases, SVG, OpenGL, XML, and many other powerful features.

2.c.AT commands overview

In AT commands, AT stands for Attention and these commands are used for controlling MODEMs. These types of commands are taken from the commands like Hayes. The Hayes-commands mainly used in the Hayes smart modems. These commands are indicated with the term AT to specify the attention from MODEM. These commands are mainly used in the devices which use machine-to-machine communication to communicate with a PC. These devices consist of a subset of the Hayes command set with other extensive AT commands.

These commands are used in GSM, GPRS, or mobile phone MODEMs can be used to access the information as well as services which include the following.

- ✦ The information & configuration related to phone otherwise SIM card & MODEM.
- ✦ The services like SMS, MMS and Fax services.
- ✦ Voice and data link on a mobile network.

The basic commands are called as the Hayes subset commands and the commands which are exact to a GSM network are known as extended AT Commands.

3.Achieved Work

The user have to interact with the developed interface solution to send or receive different information such as the module information which will be displayed on the Home page via the Home Class, added to that, the user can manage to send,read or delete messages stored either on the SIM card or the equipement via the SMS Class through SMS page on the interface.Finally, a user may also make or receive Calls via Phone Call Class and open mqtt connectivity with the Mqtt Class through the simplified Mqtt page on the developed interface solution.

Below is a diagram use case for the developed solution to control the module through Serial Communication.
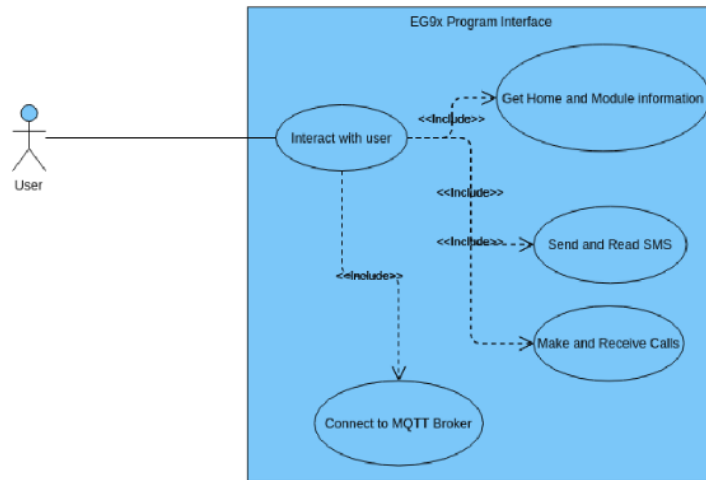
Figure 2 - Simplified Interface use case diagram

The user should interact with the program through buttons to make request to the EG9x module.

Get Home and Module information from QuectelEG95 Class.

QuectelEG95

serial

activatePdpContext(args)
checkResponse(data)
closeSocketService(args)
configureParamTcpIPContext(args)
definePDPConntext(args)
desactivatePdpContext(args)
deviceModule()
firmwareVersion()
grpsNetworkStatus(args)
networkRegistration(args)
openSocketService(args)
operatorSelection(args)
ping(args)
preferredOperator(args)
requestManufacturerId()
sendATCommand(command, args)
setPhoneFunctionality(args)
siggnalQualityReportAndQuery(args)
simCardICCID()
simCardIMSI()
socketServiceStatus(args)

Figure 3 - QuectelEG95 Home Class Methods

Send,Read and Delete SMS with SMS Class.

QuectelEG95SMS

serial

DELETE_SMS(args)
GET_SMS_STORAGE_AREA()
GetSMSMode()
READ_LIST_MESSAGE(args)
SET_SMS_STORAGE_AREA(args)
SMS_Event_Reporting_Conf(args)
SendSMS()
SetSMSChar(args)
SetSMSMode(args)
checkResponse(data)
sendATCommand(command, args)

Figure 4 - QuectelEG95 SMS Class Methods

Make and Receive Calls from Call QuectelEG95Call Class.

6

QuectelEG95Call

CalledNumbers : list
serial

AnswerCall()
AutomaticAnswerBeforeRings(number)
Call()
CancelCall()
HungUpCall()
Ringing()
SwitchCommandToData()
SwithDataToCommand()
VoiceOverUSB(args)
checkResponse(data)
sendATCommand(command, args)

Figure 5 - QuectelEG95 Call Class methods

Connect to MQTT Broker from QuectelEG95Mqtt Class.

QuectelEG95Mqtt

serial

CloseNetworkMqtt(args)
ConfigureCertificate(args)
ConfigureReceiveMode(args)
ConnectMqtt(args)
DisconnectMqtt(args)
OpenNetworkMqtt(args)
PublishMqtt(args)
ReadMessageMqtt(args)
StoreCertificate(args)
SubscribeMqtt(args)
UnsebscribeMqtt(args)
checkResponse(data)
sendATCommand(command, args)

Figure 6 - QuectelEG95 Mqtt Class methods

Read Data from Serial communication with usbInit Class.

usbInit

serial : Serial

closePort()
get()
readData()

Figure 7 - UsbInit Serial Communication Class methods

3.a. Home Interface

The is the home page where the user could get information of the EG9x module when clicked on Connect button.

Below is a sequence diagram of how the process exactly works to get module information (EG95 Module) displayed on the Home interface of our program.
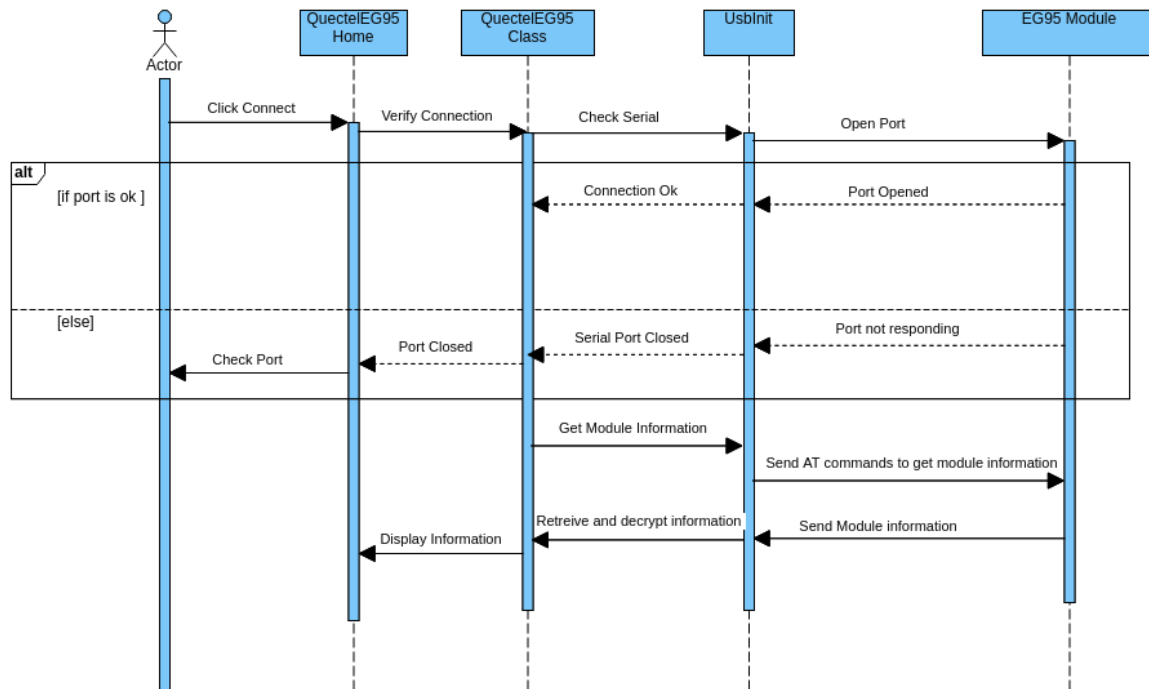
Figure 8 - Simplified Sequence Diagram for Home Interface

The communication is a Serial communication with UART protocol that's why we should always check if the module is well connected to the host to start exchanging AT Commands , when the user press a button, a function gets called from a specific class that will grab all the arguments and pass a full AT command or send a sequence of AT Commands to the module to finally deliver back the information through UART protocol to the class where it will be decrypted by a specific function and display data on the Interface.

Data is being sent as bytes through Serial communication so we needed to convert data from bytes to string to get treated and displayed nicely.

3.b. SMS

This is the SMS page where the user could Send, Read or Delete SMS of SIM Card.

Below is a sequence diagram example of how the process works to Send, Read or Delete SMS messages and how Status and SMS are displayed on the interface of our program.
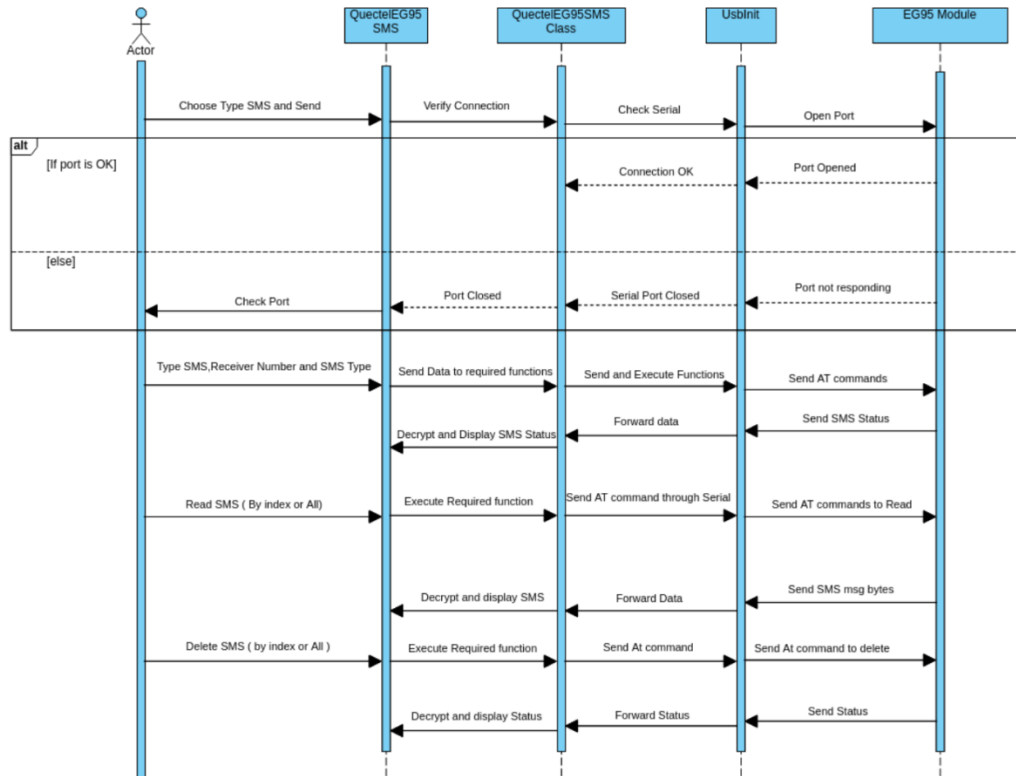
Figure 9 - Simplified Sequence Diagram for SMS Interface

3.c.Phone Call

Make Call Example:

Below is a sequence diagram example of how the process works to make a Call and starts a conversation through the program.
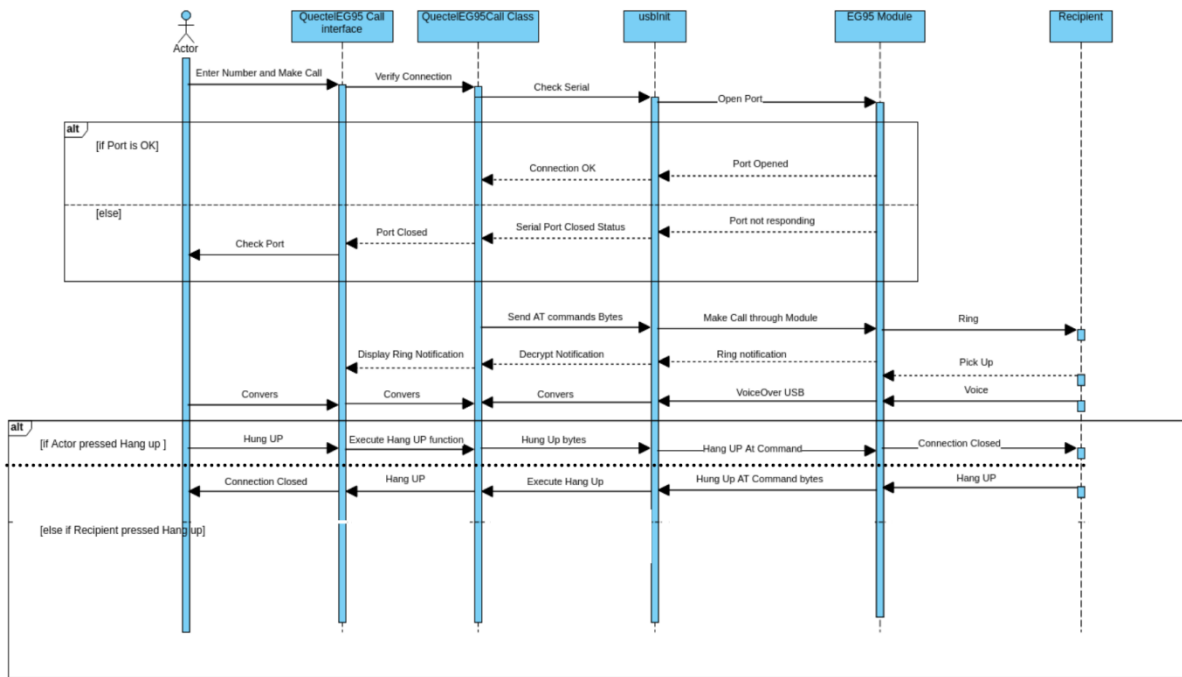
Figure 10 - - Simplified Sequence Diagram for Phone Call Interface and Call request

3.d.Mqtt

Make Publisher Example:

The user have to Enter correct information for Broker address, Port,Topic and Message then after pressing Connect the module should open a connection with the mqtt broker to start exchanging information through different topics.

Below is a sequence diagram example of how the process works to make a connection to mqtt brokers and starts the exchange of data over network through the program.
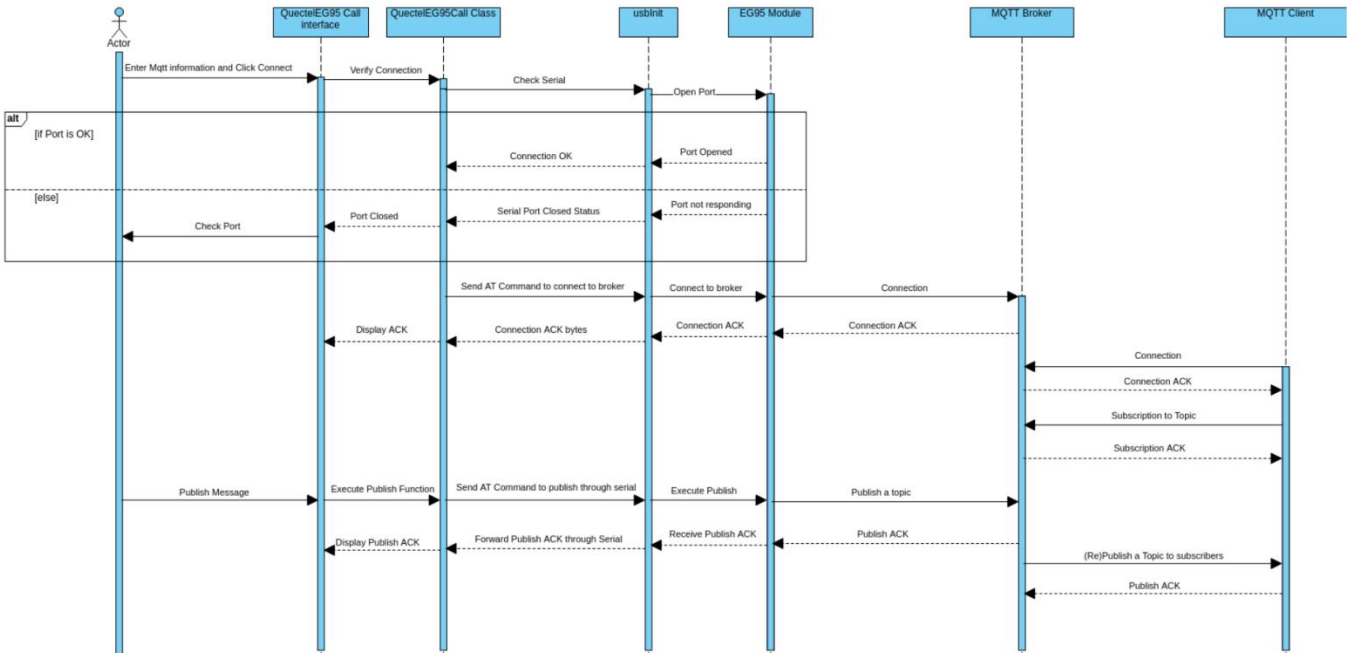
Figure 11 - Simplified Sequence Diagram for MQTT Interface and Publish request

4.Screenshots of The developed Interface solution
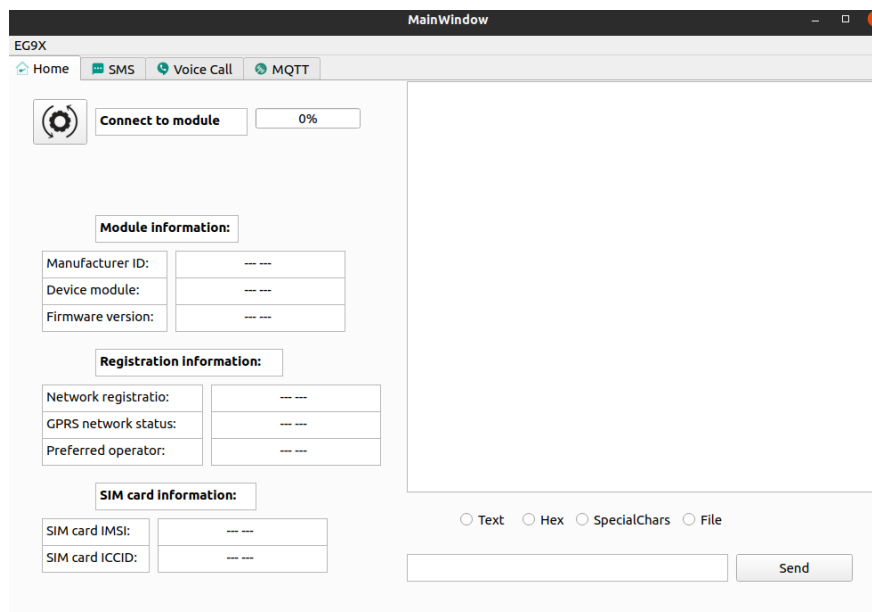
4.a.Home Interface Preview

Figure 12 - Home Interface Solution

4.b.SMS Interface Preview

Figure 13 - SMS Interface Solution

4.c.Voice Call Interface Preview
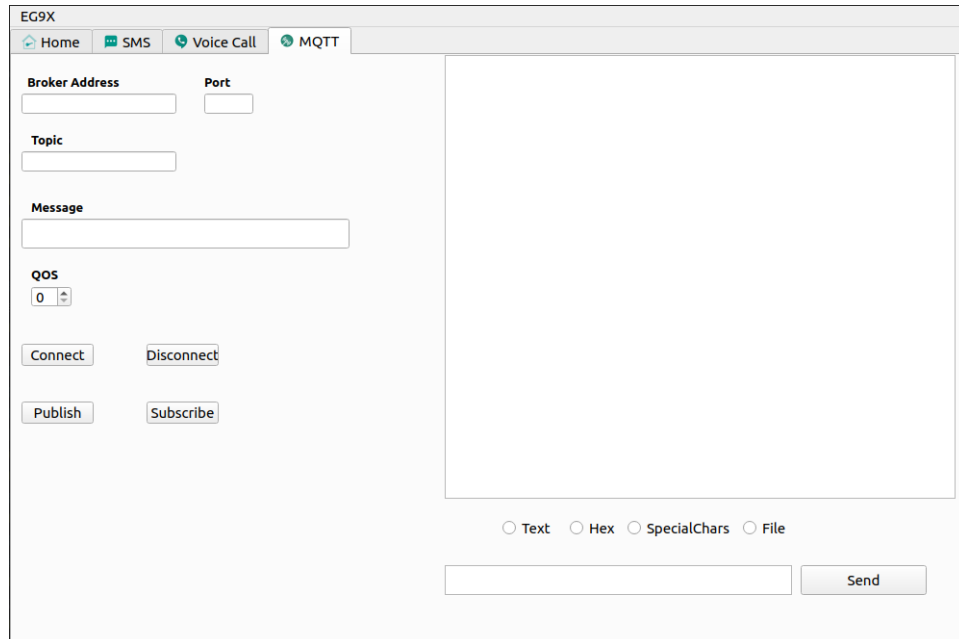
Figure 14 - Voice Call Solution

Figure 15 - Mqtt Interface Solution

5.Conclusion and perspectives:

With our interface any user can exploit the Quectel module easily without having to deal with AT commands manual, also it helps you adapt your communications based on the coverage rate.

The MQTT functionality can help the user communicate with local and online MQTT servers, via this protocol a lot of IoT applications can be created and you can use this interface in your solution.

Finally, we have seen that the Quectel module is very used today in many fields and applications, the brand new market for this module is the Automotive market which opens another new area of work and development with modules that can communicate over the 5G network which will be a very revolutionary technology. We hope to exploit in the next years in our future carrier such modules and take part of the innovation in this sector.

6.Acknowledgements:

We would first like to express our deepest appreciation to Comelit for giving us the chance to discover this new technology in the embedded field.

A special gratitude we would like to give to our mentors Mr. Walid Barreh, Senior Project Manager at Comelit R&D Tunisia and Mr.Khaled Grati, Professor at SUPCOM for the patient guidance, encouragement and advice they have provided us during this project.

We feel very grateful to make this project at this company and for having the chance to work on a very interesting topic.

7.Annexe:

You can take a look at our work and python scripts in this GitHub repository:

https://github.com/Hernado998/Quectel.EG95.Interface