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Departamento de Electrónica, Sistemas e Informática

ESPECIALIDAD EN SISTEMAS EMBEBIDOS

"CRC 32 and AES 128"

Practice 1

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1. Introduction

1.1. CRC32

Cyclic Redundancy Check is a powerful algorithm (technique) used to verify integrity and detect changes between source and target digital data. The CRC generates an initial checksum of the data in memory that can be later compared with the calculated checksum for mismatch. A checksum mismatch can indicate an otherwise undetectable memory fault. The number after CRC is a reference of the number of bits to storage the calculated checksum. The checksum is the residue of the division (XOR bitwise operation) between the original data and a polynomial number (coefficients), this polynomial is usually 8 (CRC8), 16 (CRC32) or 32 (CRC32) bits.

1.2. AES128

Advanced Encryption Standard is a technique capable of using cryptographic keys of 128/192/256 bits to encrypt and decrypt data, based in Rijndael algorithm. An algorithm that uses a key is, in general, much more secure. If the algorithm itself is secure in its design, then the data is secure (as long as the key is secure) even if the encryption algorithm is known. The only way to decipher the message is through the use of the correct key. There are two basic types of keys: Symmetric and Public. In a symmetric key algorithm, both encryption and decryption processes use the same key, which must be kept secret. In a public key system, two keys are used: one public (used to cipher messages) and another, private and secret (used to decipher the message).

1.3. Requirements

1. CRC 32 bits

The new protocol layer must provide verification of the data integrity using a CRC32 checksum.

2. AES 128 bits

The message must be cypher with a 128 bits AES.

3. Ethernet and TCP/IP

The new layer must be implemented as a C language library and testing by using an Ethernet and TCP/IP Python script.

4. Nodes Functionalities

Every node must be capable of transmit and receive messages through the new layer

5. Testing

Implement an application to transmit 8 different (size and data) data packages in both directions.

2. Methodology

2.1 Requirement 1

In order add the CRC functionality in the base project, we need to add the driver files, because CRC is performed by hardware in K64F board. As Figure 1 shows, .c and .h files are already in the project and can be used to add CRC functionality by including the header file "fsl_crc.h" anywhere you needed. In this project I added the header file in aes.c file.

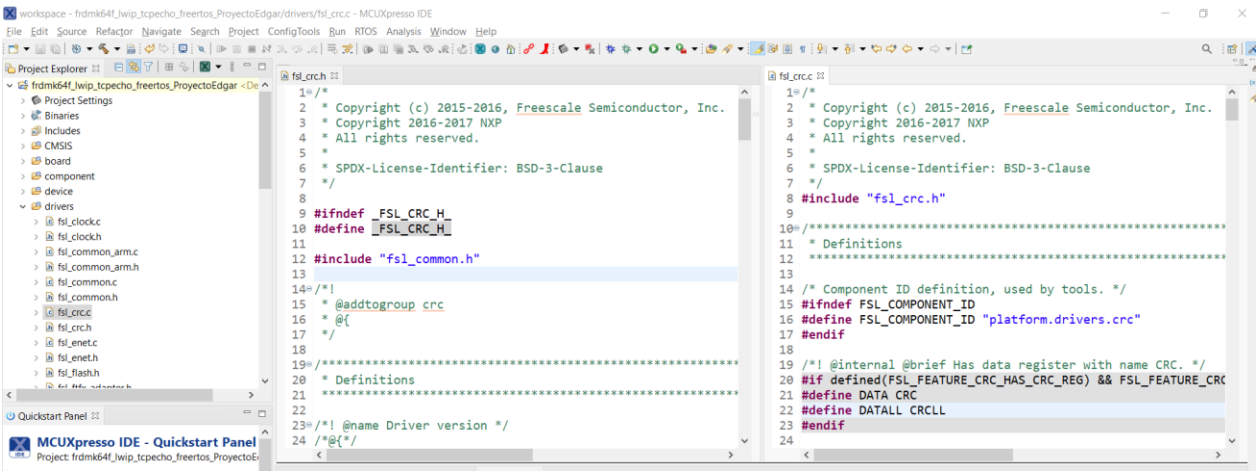


Figure 1. CRC driver files.

2.2 Requirement 2

This functionality is hardware implement as well, the base project has already the files to perform AES encryption, when a message was received the first step is to calculate the CRC to verify the data integrity, if the calculated CRC is equal to the added CRC then the program decrypt the message and erase the added CRC from the message, otherwise a message is printed in screen warning the user about data corruption and delete the received message. When a message will be sent, the first step is to encrypt the message, after this the CRC must be calculated and added to the message.

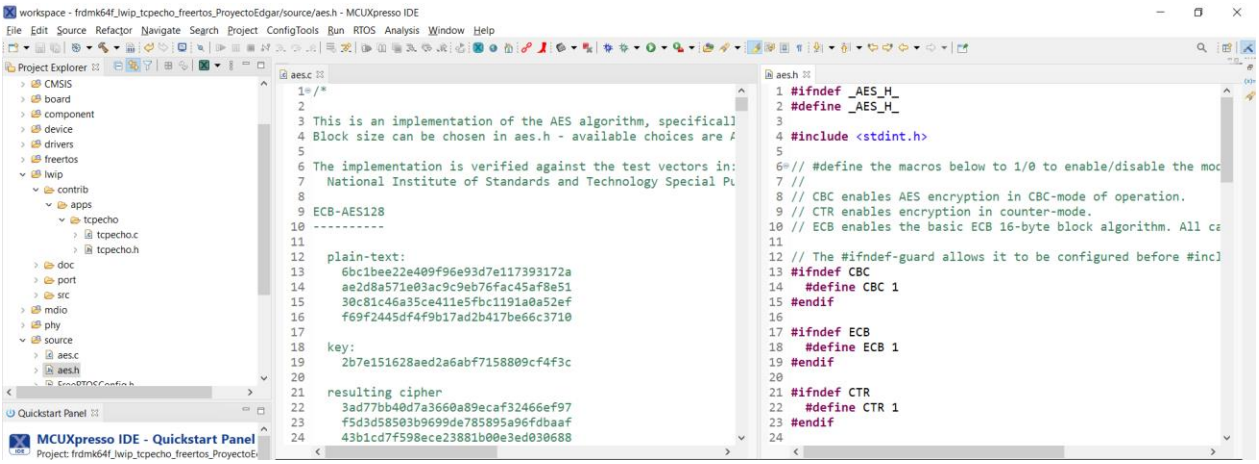


Figure 2. AES files.

2.3 Requirement 3

The CRC and AES functionalities were added with the files "aes.c" and "fsl_crc.c" and the header files "aes.h" and "fsl_crc.h", by adding these files in any project users must be able to use CRC and AES using the API functions created (aes_send_task and aes_recv_task)and located in "aes.c" file.

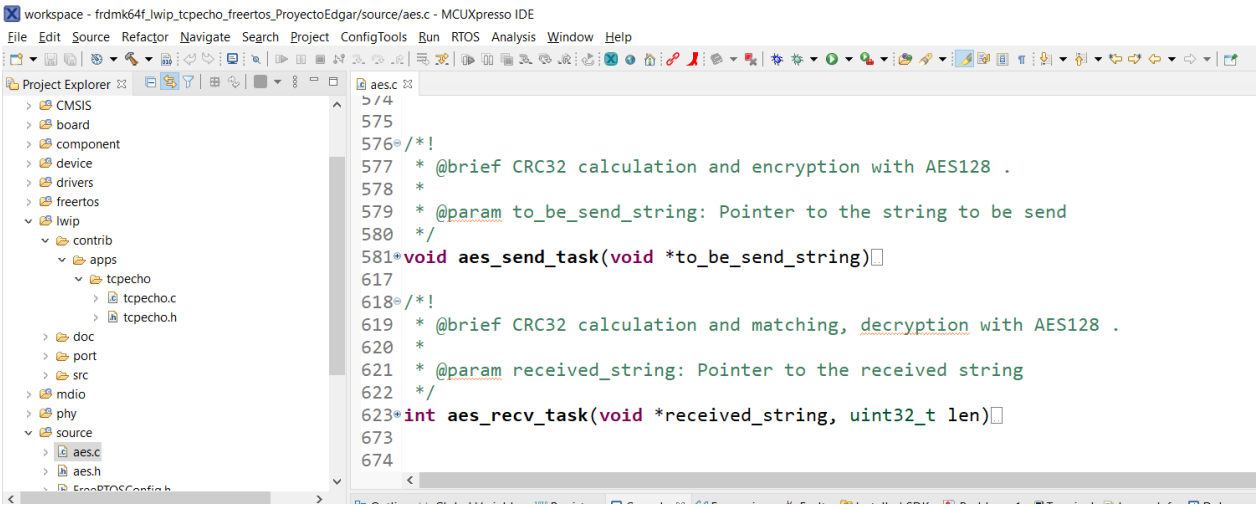


Figure 3. AES created API´S.

The testing set was performed with the K64F as a server and executing the python script as a client, but the inverse functionality is implemented as well by setting the next Macro definitions to 1 and executing the server python script, located in "tcpecho.c" file.

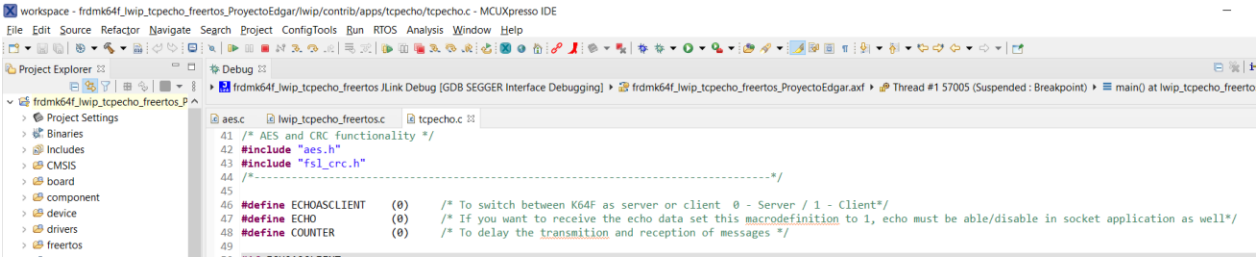
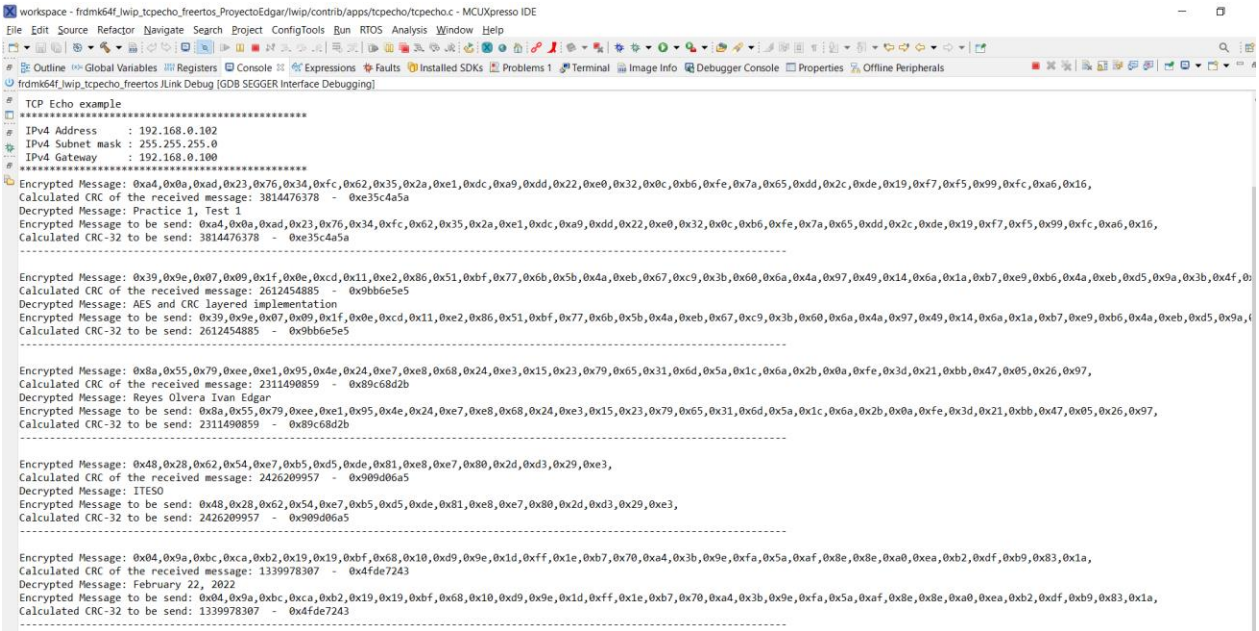


Figure 4. Macro-definitions to switch between server and client.

As figure 5 show, we tried several messages and every time the program performed the expected functionality.



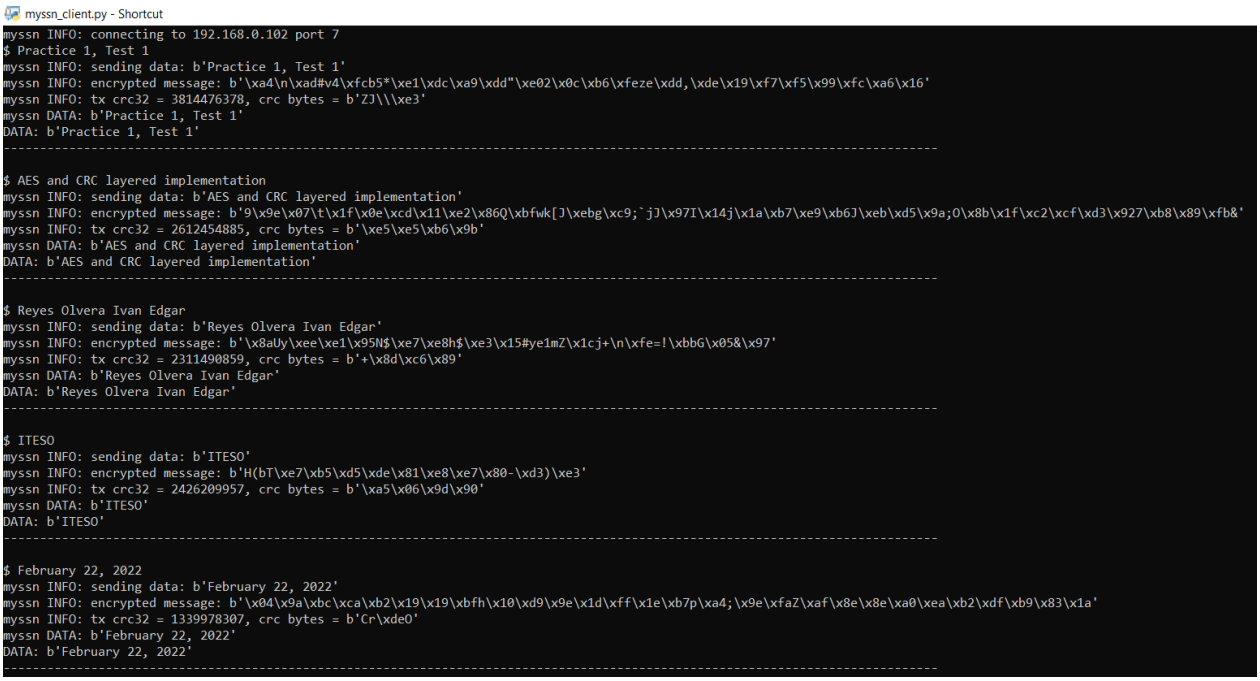


Figure 5. Testing set.

2.4 Requirement 4

This requirement Will be show in the Test section.

3. TESTS

This test could be done easily by programming the K64F board as a client and sending in a for cycle 8-character arrays, but the python server script does not work, I tried several IP addresses, but it always showed the same error as in figure 6, when it did not show the error, it simply did not connect to the board. So I ran the test as the requirement 3, the figure 7 show the results.

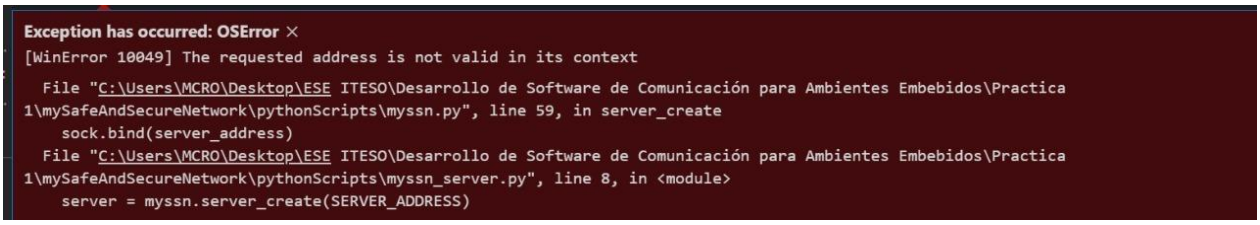


Figure 6. Python Server script error.

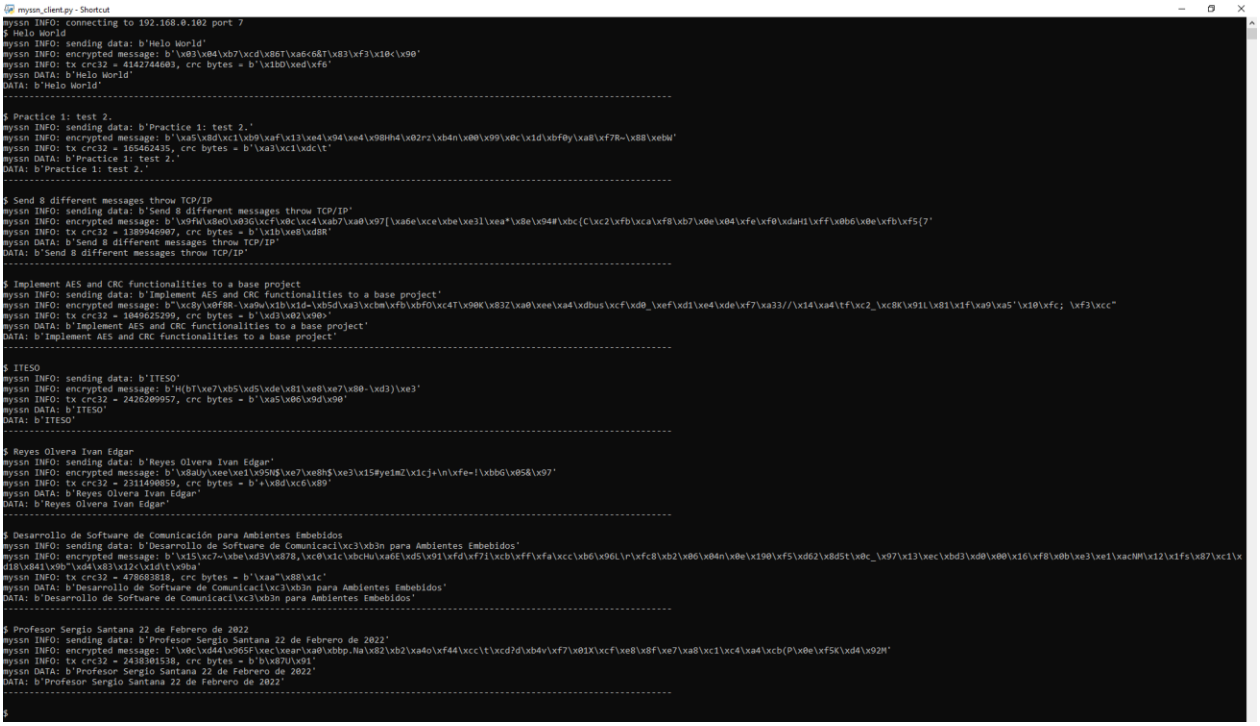


Figure 7. 8 different messages test.

4. CONCLUSIONS

The layered implementation has several advantages, by programming in modules portability between projects will be easier, the debugging is easier too, because you add a hole piece of software as a module then you know where to looking for any error if your program does not work after the module addition.

But if your program manages several functionalities as a module, then the interaction between the layers become complex and you could start to use functions of the upper layers in lower layers, and this is not allowed in layered programming.

The practice helped me to see this more clearly. The CRC and AES functionalities are really useful nowadays and take some time to implement them and learn their structure and algorithm was a good exercise.

The source code (MCU expresso project) could be found in the next GIT repository:

https://github.com/iereyesfi/Practice-1-AES-and-CRC..git