Trust&Go Step by Step Guide -
Loading Manifest & Connect to AWS-IoT

Table of Contents

1 Introduction

This document explains step by step process involved in uploading a manifest file to AWS cloud. If you are already familiar with Jupyter Notebook you can skip this section and move to Section 2.

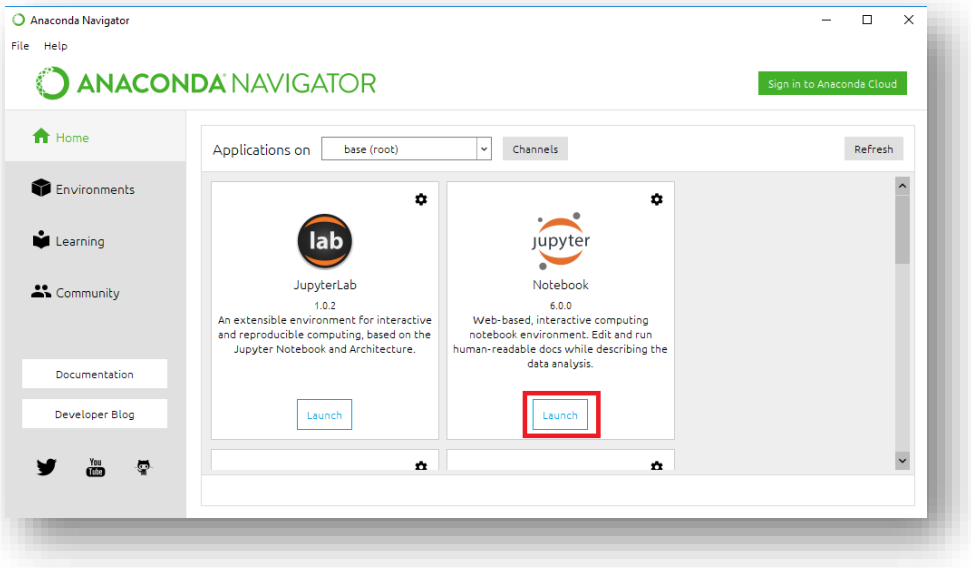
1.1 Getting started with Jupyter Notebook Tutorials

Jupyter Notebook is open source web application which allows you to create documents that contain code that you can execute in place as well as narrative text. It provides GUI elements, ability to execute code in place, ability to add images and gives it the look and feel that normal code files lack.

Jupyter notebooks are mainly used to explain/evaluate code in an interactive way.

1.1.1 Starting Jupyter Notebook

Jupyter notebook can be launched from the Anaconda Navigator main window.



1.2 Jupyter Notebook Basics

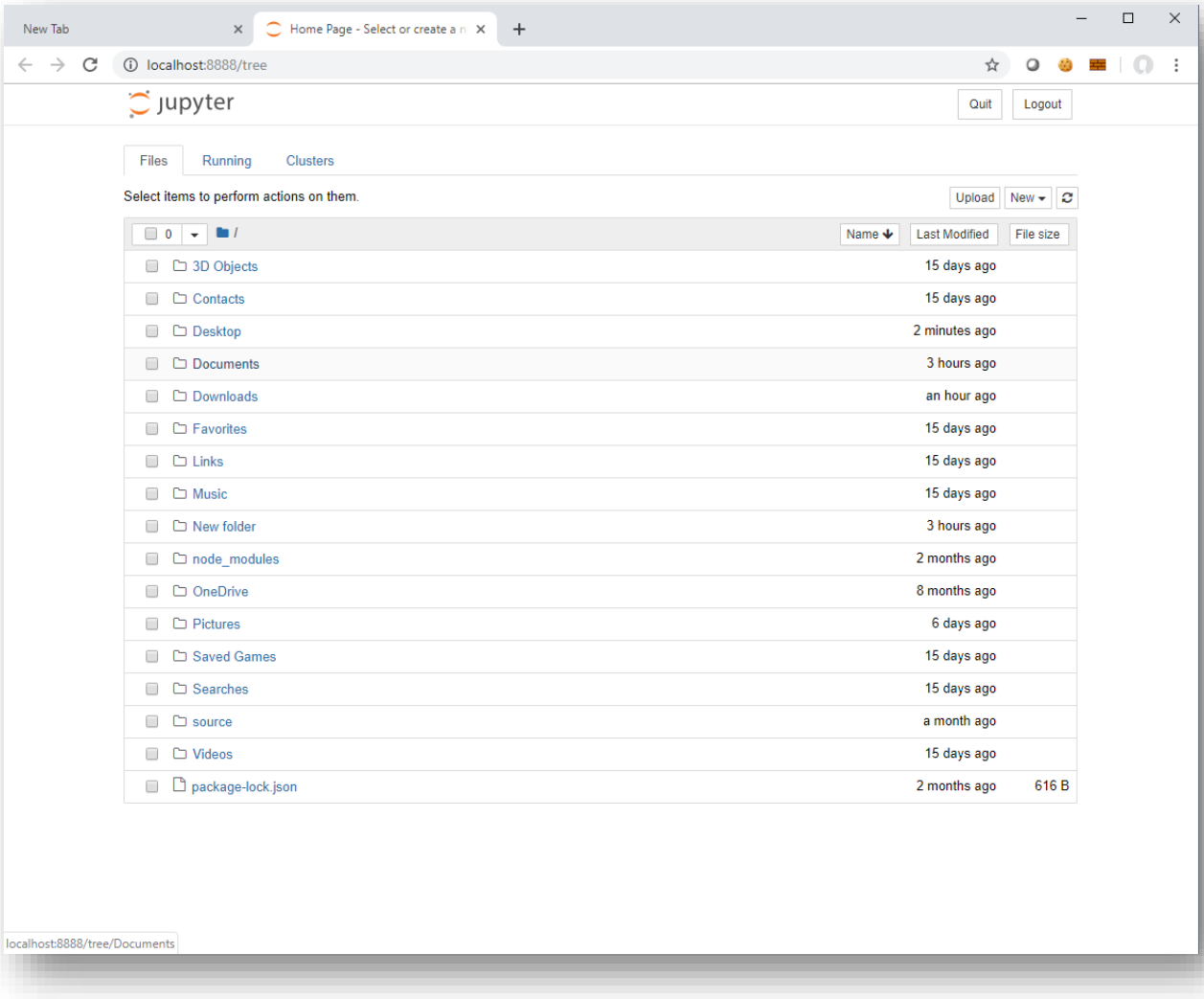
It is recommended to become familiar with Jupyter basic concepts with the online documentation, https://jupyter-notebook.readthedocs.io/en/stable/examples/Notebook/Notebook%20Basics.html

Some of the content is duplicated here for convenience. The online documentation should always be used as a reference.

1.2.1 The Notebook dashboard

When you first start the notebook server, your browser will open Notebook dashboard. The dashboard serves as a home page for the notebook. Its main purpose is to display the Notebooks and files in the current directory.

For example, here is a screenshot of the Jupyter dashboard. The top of the notebook list displays clickable breadcrumbs of the current directory. By clicking on these breadcrumbs or on sub-directories in the notebook list, you can navigate your file system.

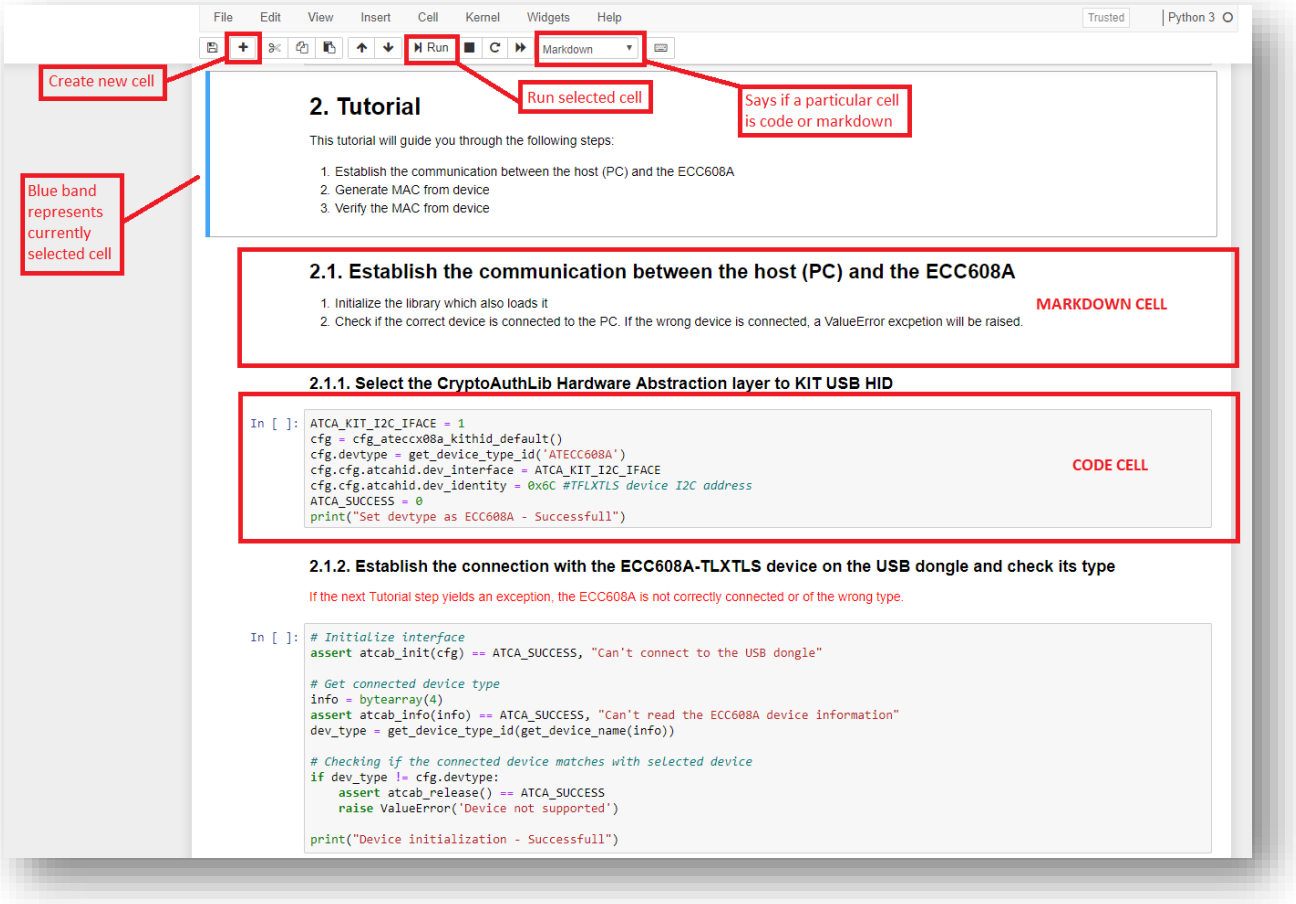


1.3 Introduction to Jupyter Notebook GUI.

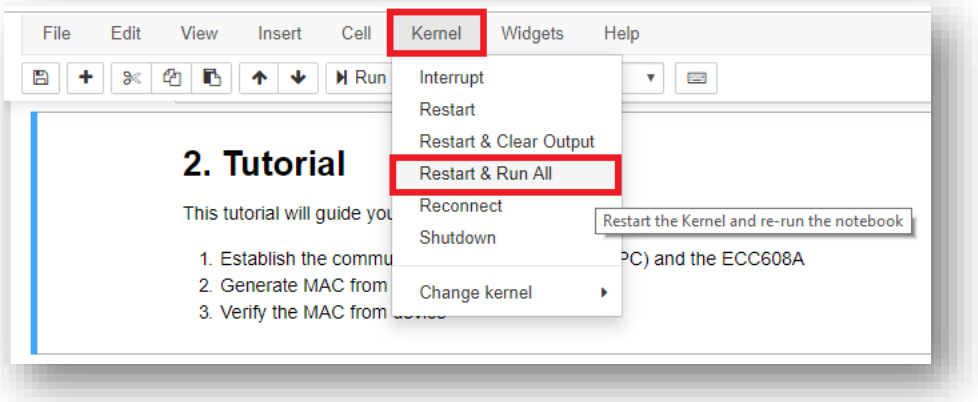
Jupyter Notebooks contain cells where you can either write code or markdown text. Notebooks contain multiple cells, some set as code and others markdown. Code cells contain code that can be executed live, and markdown contains text and images to explain the code.

Below image shows some options in a typical Jupyter Notebook. Individual cells can be executed by pressing on the RUN button as shown in the below image.

All cells in the Notebook can be executed in order by **Kernel->Restart & Run All**.



To run all cells in sequence.



2 Jupyter Notebook Tutorials

The TrustPlatform Design Suite comes with a Notebook Tutorials to easily prototype popular use cases for Trust&GO devices. Here are the available Jupyter Notebook Tutorials.

Jupyter Notebook Tutorials	**Relative Path**	**Applicable Devices**
Manifest Generation	TrustnGO\00_resource_generation\TNGTLS_manifest_file_generation.ipynb	Trust&GO
AWS Connect	TrustnGO\01_aws_connect\notebook\ TNGTLS_aws_connect.ipynb	Trust&GO
GCP Connect	TrustnGO\02_gcp_connect\notebook\TNGTLS_GCP_connect.ipynb	Trust&GO

3 Manifest Generation Notebook

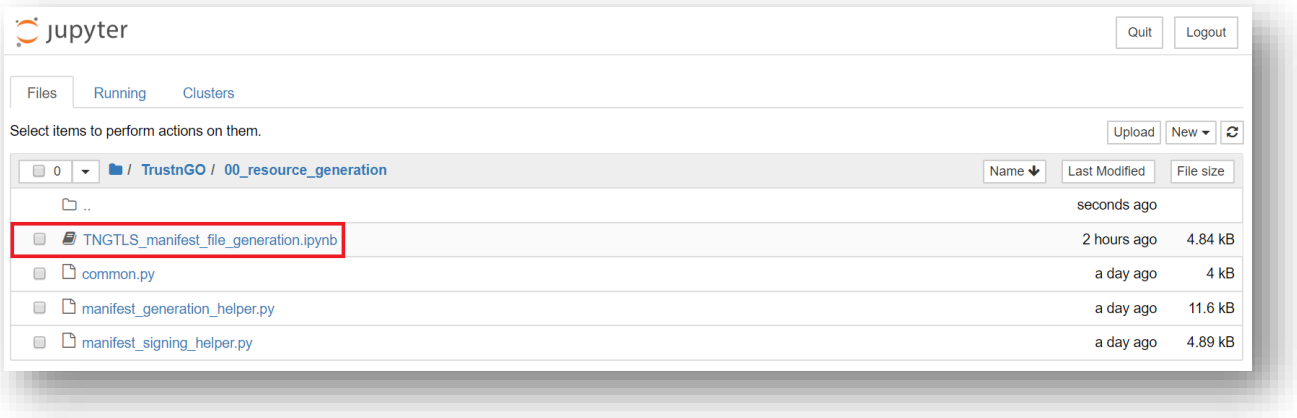
Trust&GO device is one of the three devices available in the Trust Platform USB Dongle Board.

Trust&GO devices come with pre-programmed certificates in slots 10, 11 and 12, also slots 0-4 have pre-generated private keys, other than the previously mentioned slots all the other slots are locked.

The secure element manifest format is designed to convey the unique information about a device including its unique ID (e.g. serial number), public keys, and certificates. The manifest file generated can be used to register the device to cloud providers.

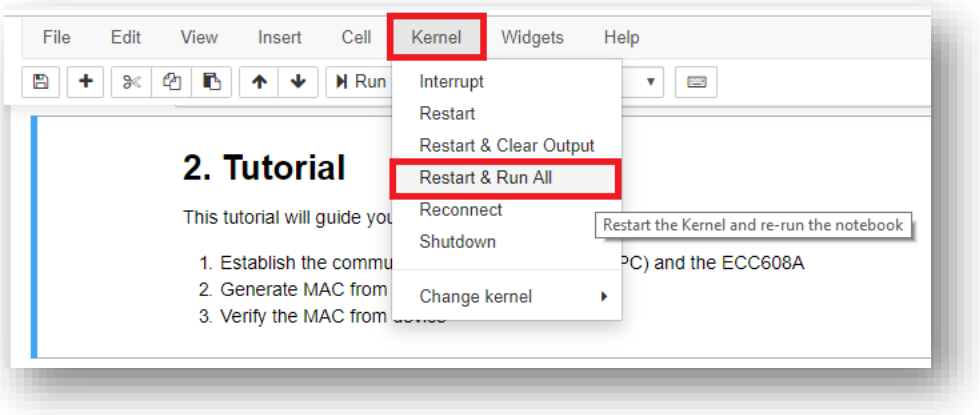
By default, Jupyter starts in Users directory ($HOME for MacOS or Linux systems). For the remainder of this document, it will be assumed that the trust_platform folder is contained in Users directory. If this is not the case, please move trust_platform folder to your Users directory

Within the Jupyter Dashboard, navigate **trust_platform\DesignTools\ TrustnGO\00_resource_generation** folder to open **TNGTLS_manifest_file_generation.ipynb**



Run all cells of the TNGTLS_manifest_file_generation Notebook: Kernel->Restart & Run All

Note: Before executing the cells on Crypto Trust Platform, its required to have factory default program running on SAMD21 of Trust Platform. Refer to [4.3 CryptoAuth TrustPlatform Factory reset] section for reloading default program.



If all the steps ran without errors, you will see result as shown below.

```
Loading logger key

Generating self-signed logging certificate
    Saving to log_signer.crt
-------------------------------------------
TNG Root Certificate:
Crypto Authentication Root CA 002
-----BEGIN CERTIFICATE-----
MIIB8TCCAZegAwIBAgIQd9NtlW7IrmIF5Y46y5hagTAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBSb290IENBIDAwMjAgFw0xODExMDgxOTEyMTlaGA8y
MDU4MTEwODE5MTIxOVowTzEhMB8GA1UECgwYTWljcm9jaGlwIFRlY2hub2xvZ3kg
SW5jMSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gUm9vdCBDQSAwMDIw
WTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAAS9VOZt44dUhABrU64VgNUKoGnnit9V
eNhc4tVN1bgwKWv/3W5vclb72Z7xoRaxHTOtSRA6oYWHOdz65DfhnWNOo1MwUTAd
BgNVHQ4EFgQUeu19bca3eJ2yOAGl6EqMsKQOKowwHwYDVR0jBBgwFoAUeu19bca3
eJ2yOAGl6EqMsKQOKowwDwYDVR0TAQH/BAUwAwEB/zAKBggqhkjOPQQDAgNIADBF
AiEAodxjRZDsgZ7h3luBEmVRrdTCxPjllSgu4EvnaOx8AnMCID5rp06eTArWjCSw
+y7nk9LmvpRlyhXQ6lvIf1V5mVyt
-----END CERTIFICATE-----

TNG Root Public Key:
-----BEGIN PUBLIC KEY-----
MFkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDQgAEvVTmbeOHVIQAa1OuFYDVCqBp54rf
VXjYXOLVTdW4MClr/91ub3JW+9me8aEWsR0zrUkQOqGFhznc+uQ34Z1jTg==
-----END PUBLIC KEY-----

Validate Root Certificate:
OK

TNG Signer Certificate:
```

Crypto Authentication Signer F650

```
-----BEGIN CERTIFICATE-----
MIICBTCCAaqgAwIBAgIQXq+LlUM+59R+ghDLOUZt9jAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBSb290IENBIDAwMjAgFw0xODEyMTQxOTAwMDBaGA8y
MDQ5MTIxNDE5MDAwMFowTzEhMB8GA1UECgwYTWljcm9jaGlwIFRlY2hub2xvZ3kg
SW5jMSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gU2lnbmVyIEY2NTAw
WTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAAQ0+NCCMIsP1mgeq44ZH4wI0LCUx5XP
Atnj+zx5PVyM3UVsyxbIJVjdXtpLcVeu+ppdmx+bqmkNhsUisuM15YWdo2YwZDAO
BgNVHQ8BAf8EBAMCAYYwEgYDVR0TAQH/BAgwBgEB/wIBADAdBgNVHQ4EFgQUez8a
2pJ0BswCd7+jBb/pF6hpN2gwHwYDVR0jBBgwFoAUeu19bca3eJ2yOAGl6EqMsKQO
KowwCgYIKoZIzj0EAwIDSQAwRgIhANglSKC/j2XeGOwo81d5DP7rX5QZAOeIHGL2
3pOP1ZZ4AiEA3BvC7uNsPbOMB7ejzh7qGEZHsVeIUj1W5qDCHaE3dhM=
-----END CERTIFICATE-----

TNG Signer Public Key:
-----BEGIN PUBLIC KEY-----
MFkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDQgAENPjQgjCLD9ZoHquOGR+MCNCwlMeV
zwLZ4/s8eT1cjN1FbMsWyCVY3V7aS3FXrvqaXZsfm6ppDYbFIrLjNeWFnQ==
-----END PUBLIC KEY-----

Validate Signer Certificate:
OK

TNG Device Certificate:
012342BB675DC30501 ATECC
-----BEGIN CERTIFICATE-----
MIIB9DCCAZugAwIBAgIQcBavDLb0rUEubjNYid+cgzAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBTaWduZXIgRjY1MDAgFw0xOTA3MTgyMTAwMDBaGA8y
MDQ3MDcxODIxMDAwMFowRjEhMB8GA1UECgwYTWljcm9jaGlwIFRlY2hub2xvZ3kg
SW5jMSEwHwYDVQQDDBgwMTIzNDJCQjY3NURDMzA1MDEgQVRFQ0MwWTATBgcqhkjO
PQIBBggqhkjOPQMBBwNCAASNhEOPDUOPfKQ48u2dlcDqMj5m9SZT5uoksecKBUnI
AX1sI4PSQHSV6C41VQYYJunUUbDOsxzePke00G9upoDIo2AwXjAMBgNVHRMBAf8E
AjAAMA4GA1UdDwEB/wQEAwIDiDAdBgNVHQ4EFgQUtsii7XrO06ywT4FFKuiL5bus
93kwHwYDVR0jBBgwFoAUez8a2pJ0BswCd7+jBb/pF6hpN2gwCgYIKoZIzj0EAwID
RwAwRAIgD5lQEiQ4mIW7t72/49wb3Db+uQlzHJJd6yvpn2HR8MUCIGVSy8W34RAE
XyaoprS27LvwmoEw0AKX2hat4wFH99nu
-----END CERTIFICATE-----

TNG Device Public Key:
-----BEGIN PUBLIC KEY-----
MFkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDQgAEjYRDjw1Dj3ykOPLtnZXA6jI+ZvUm
U+bqJLHnCgVJyAF9bCOD0kB0leguNVUGGCbp1FGwzrMc3j5HtNBvbqaAyA==
-----END PUBLIC KEY-----

Validate Device Certificate:
OK

reading slot 0 public key
reading slot 1 public key
reading slot 2 public key
reading slot 3 public key
reading slot 4 public key
```

```
Generated the manifest file 012342bb675dc30501_manifest.json
```

The Notebook will be used to generate a manifest file which can be uploaded into the public cloud provider of your choice (Google GCP, AWS IoT and soon to be supported Microsoft Azure). TNGTLS Manifest Generation notebook needs to be run for all Trust&Go example Notebooks that require a Manifest file.

4 Use Case Prototyping

This hands-on lab is intended to demonstrate the usage of Trust&GO to secure an AWS IoT connection based on a custom PKI.

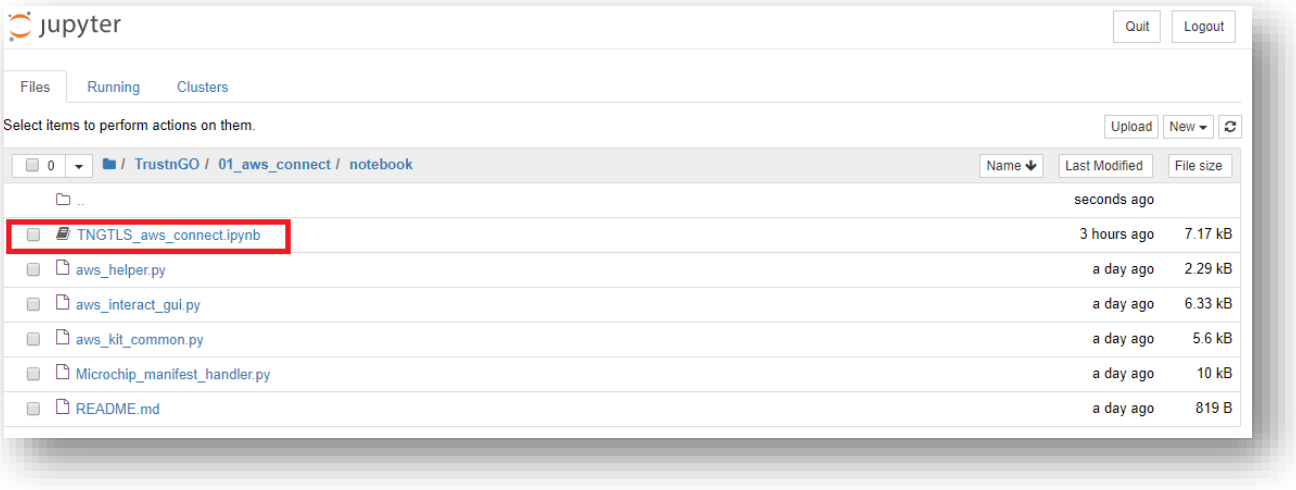
Here are the steps that will be required to complete this Tutorial:

- Configure AWS CLI
- Upload Manifest File
- Build the AWS IoT device source code and flash it to the USB Dongle Board

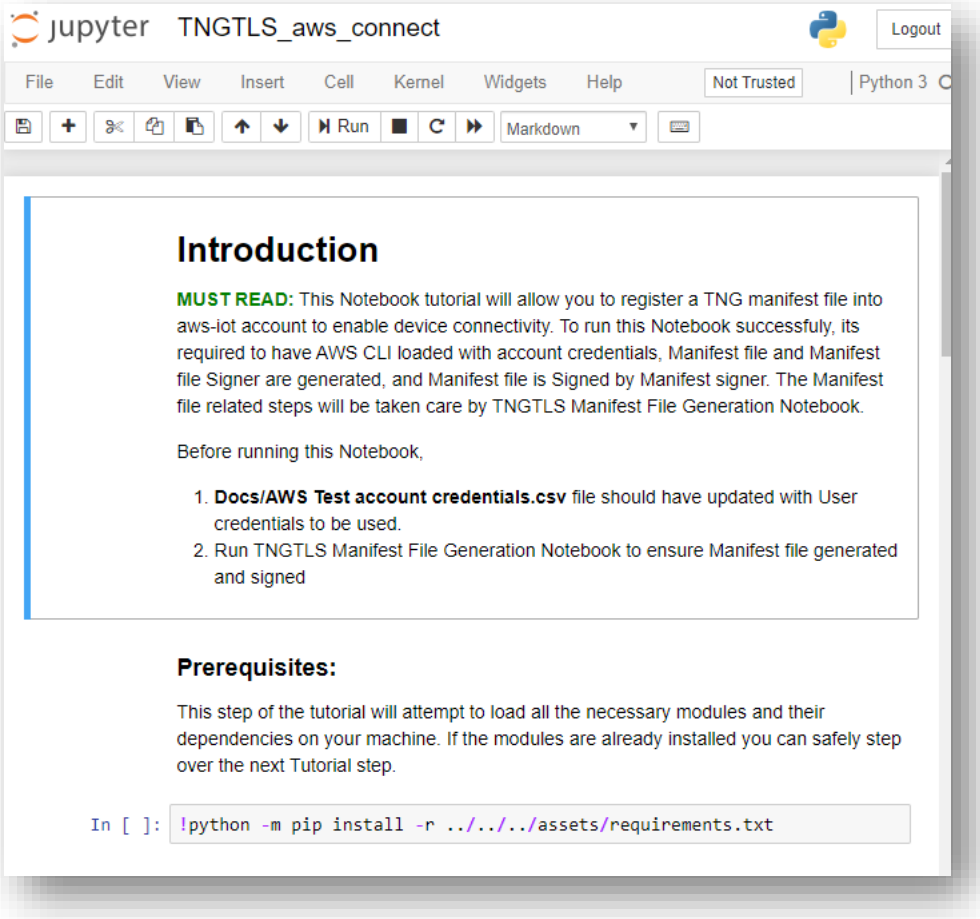
4.1 Running AWS IoT example on Jupyter Notebook

By running following step, we can configure AWS CLI and able to upload manifest file. To upload manifest file, we would be using the manifest file and logger file generated in the previous section 3. TNGTLS Manifest File generation notebook. The Manifest file contains information about the device including serial number, public keys and certificates.

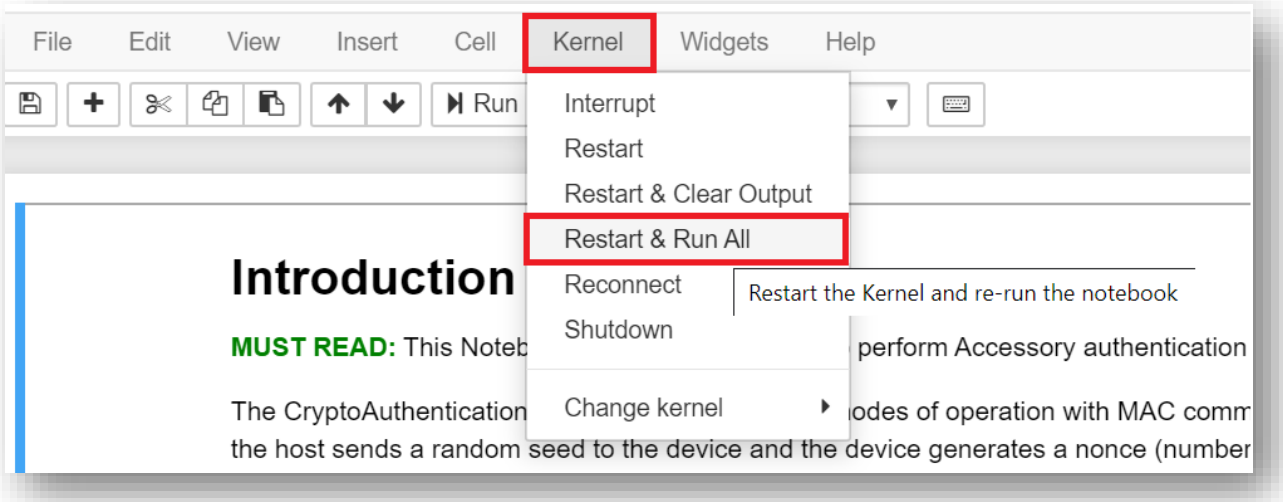
1. From the Jupyter Home page, navigate to **TrustnGO\01_aws_connect\notebook\TNGTLS_aws_connect.ipynb** notebook file and open it.



Opening the notebook from Jupyter home page should load the following on the browser.

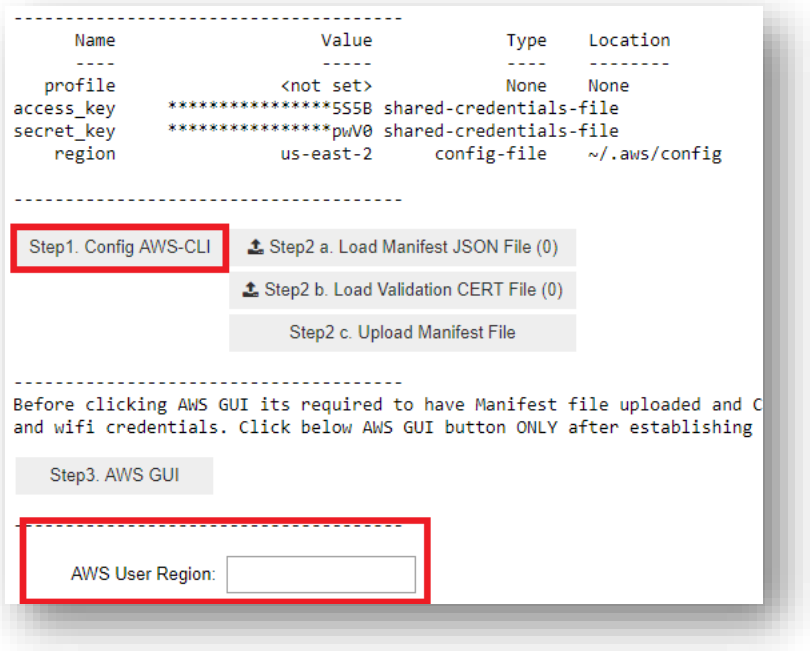


2. Run All cells by using Kernel -> Restart & Run all

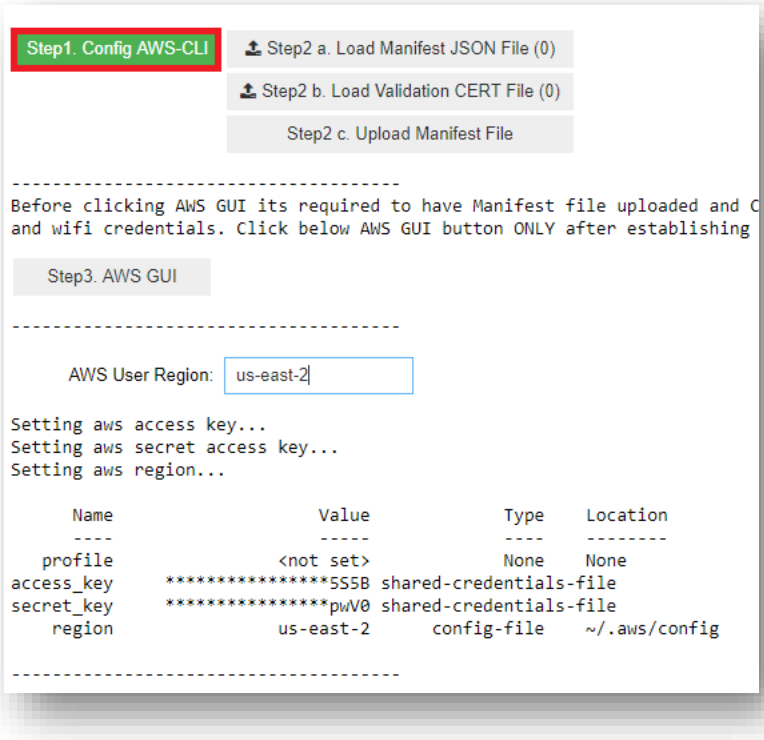


3. After running all cells in notebook, it will create four button 1. “Config AWS-CLI”, 2. “Load Manifest JSON File”, 3. “Load Validation CERT File” and 4. “AWS GUI”.
4. Press “**Config AWS-CLI**” button to configure AWS command line interface with AWS account credentials.

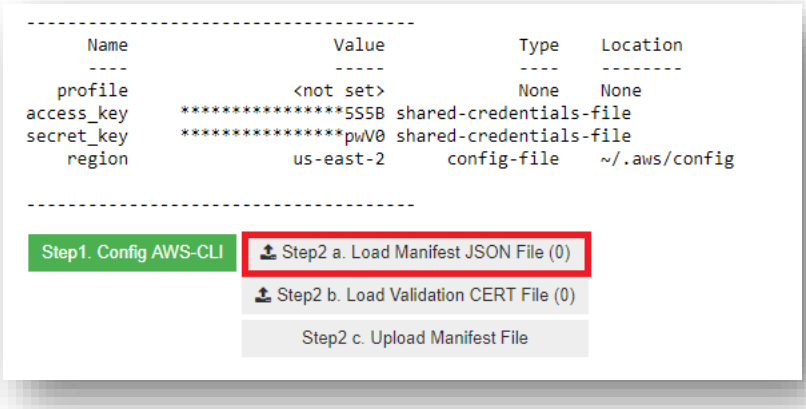
   Once you press the button, it will ask AWS User Region: where region name has to be mentioned as shown in below image.



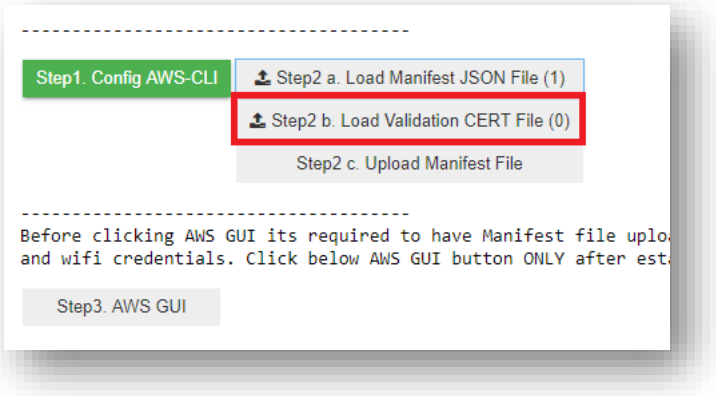
After enter your region press ‘enter’. On successful AWS CLI configuration, you will see the result as shown in below image



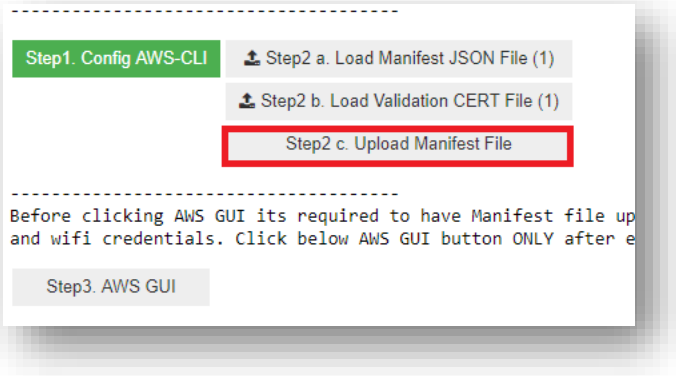
5. Press "**Load Manifest JSON File**" button, it will open file explorer window, there you need to navigate **TrustnGO\00_resource_generation** and choose the manifest file generated using TNG Manifest Generation Notebook.



6. Press "**Load Validation CERT File**" button, it will open file explorer window, there you need to navigate **TrustnGO\00_resource_generation** and choose the validation certificate file generated using TNG Manifest Generation Notebook.



7. Press "**Upload Manifest File**" button to upload manifest file to aws cloud.



Once it is successfully uploaded, the result will be as shown below.

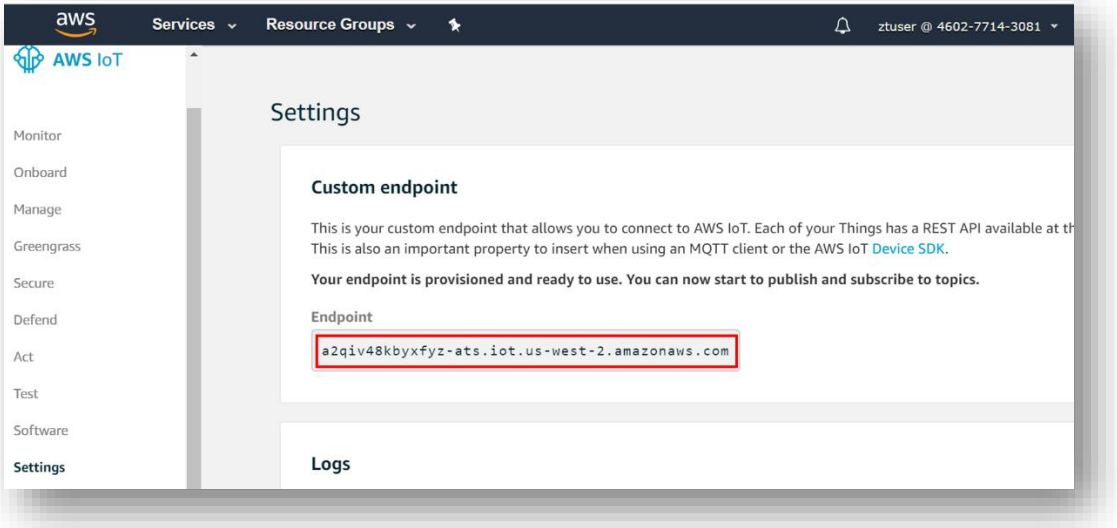
```
number of certificates: 1

Loading the manifest item
uniqueId: 01236c7dc62e6dc001
About to try certificate import
Response: {'ResponseMetadata': {'RequestId': '8a4596b5-b71c-49ad-a453-bedd44e281c8', 'HTTPStatusCode': 200, 'HTTPHeaders': {'da
te': 'Sat, 09 Nov 2019 13:29:31 GMT', 'content-type': 'application/json', 'content-length': '209', 'connection': 'keep-alive',
'x-amzn-requestid': '8a4596b5-b71c-49ad-a453-bedd44e281c8', 'access-control-allow-origin': '*', 'x-amz-apigw-id': 'C5LRQEEXPHcF
djw=', 'x-amzn-trace-id': 'Root=1-5dc6bf3b-a36debb6c3255f8972bddcbb'}, 'RetryAttempts': 0}, 'certificateArn': 'arn:aws:iot:us-w
est-2:460277143081:cert/461095d8771f95db78d442d2015415804e3093bcae3fd56d78a486aa5b7b59de', 'certificateId': '461095d8771f95db78
d442d2015415804e3093bcae3fd56d78a486aa5b7b59de'}
Certificate import complete - returning
MANIFEST_IMPORT SUCCESS arn:aws:iot:us-west-2:460277143081:cert/461095d8771f95db78d442d2015415804e3093bcae3fd56d78a486aa5b7b59d
e       arn:aws:iot:us-west-2:460277143081:thing/01236c7dc62e6dc001
number of thingIds to check: 1

Checking the manifest_item
uniqueId: 01236c7dc62e6dc001
Manifest was loaded successfully
```

Note down your unique id from the manifest upload log which is the **Thing name** of your device and is needed for AWS GUI step.

Once this step is completed, manifest file is successfully uploaded to AWS IoT.

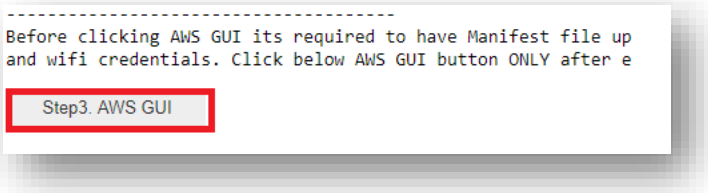
Continue to next steps when connecting to AWS using TNGTLS device.

8. Login to the AWS account, From Services select IoT core.In the IoT core, Click setting and note down your endpoint as highlighted below.This endpoint is needed for the embedded c project.



NOTE: Make sure that you executed C project successfully before executing the next step in the Jupyter notebook. To execute C project, refer "Running AWS IoT example on Embedded platform" next section.

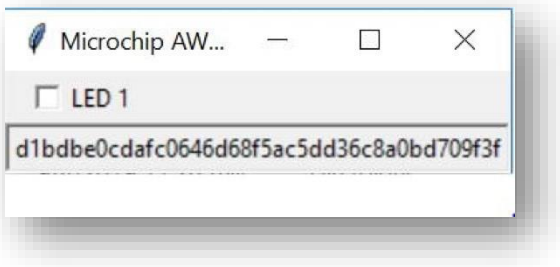
AWS GUI:
Code block of this step generates "**AWS GUI**" button.



Clicking the button asks for the Thing name.Enter the number which we noted from the previous step and press enter.

it will create a very basic graphical interface that will display the device ID and will allow to switch the board LED status.

Below screenshot display the graphical interface



Using this interface, Custom PKI CryptoAuth Trust Platform can able to communicate with AWS IoT. Upon successful communication, you have now a device connected to AWS IoT through a secure TLS session with a custom PKI using a Crypto Trust Platform.

4.2 Running AWS IoT example on Embedded platform

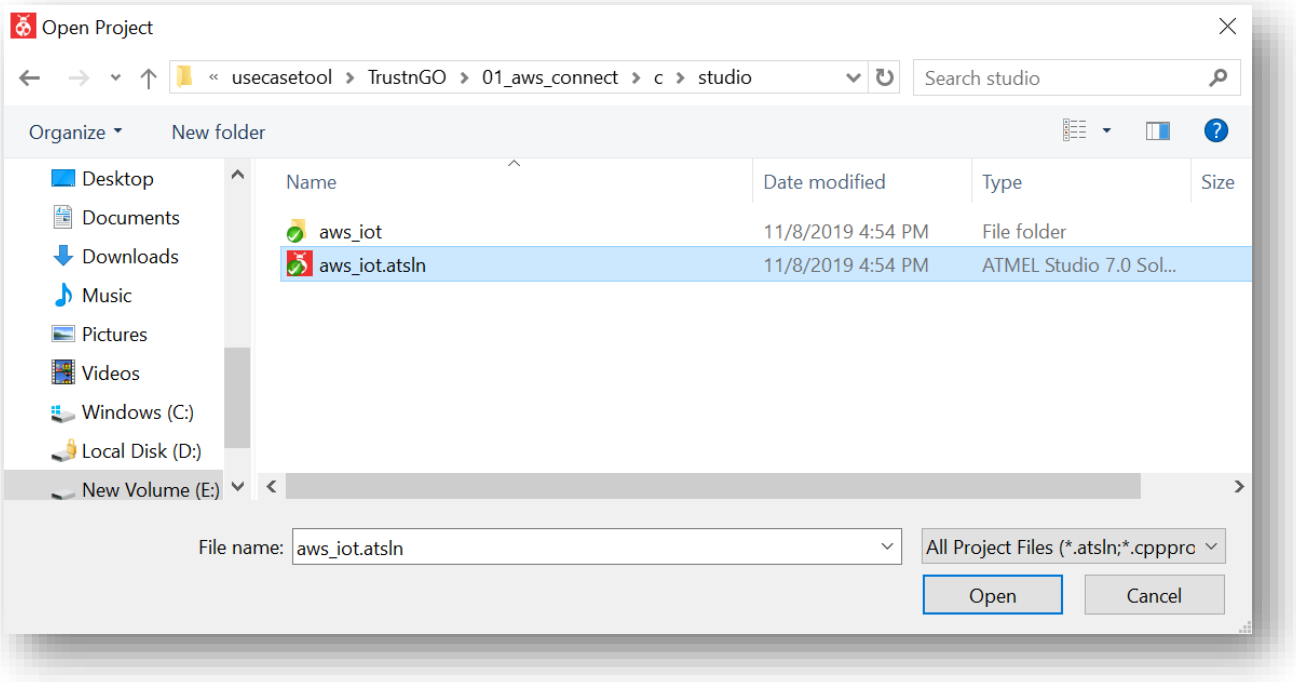
Once the resources are generated, both Atmel Studio and MPLAB projects provided can be used to run the use case on CryptoAuth Trust Platform.

This project can configure the Wi-Fi credentials, establish a TLS connection, subscribe to MQTT topic and establish communication but not upload manifest file to AWS IoT. It is required to use the AWS IoT Jupyter notebook to upload manifest file.

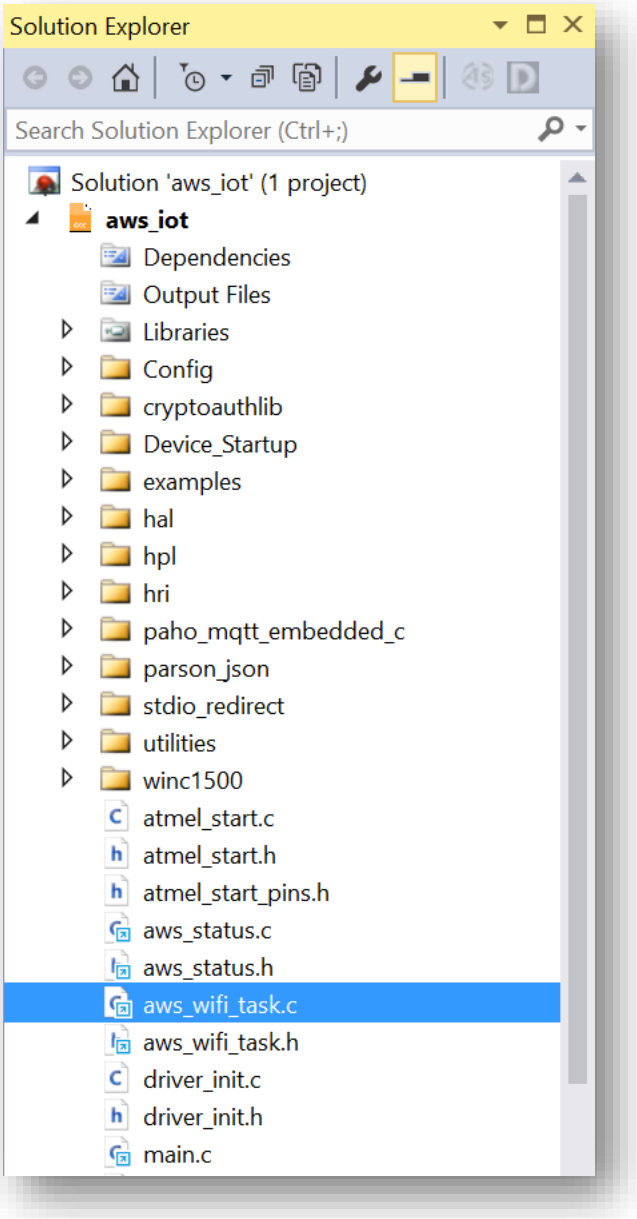
Once the manifest file uploaded to AWS IoT then these embedded projects can be executed.

4.2.1 Atmel Studio:

1. Open **aws_iot.atsln** project by navigating **TrustnGO\01_aws_connect\c\studio\ aws_iot.atsln**



2. In the project navigate to **aws_iot -> aws_wifi_task.c** file

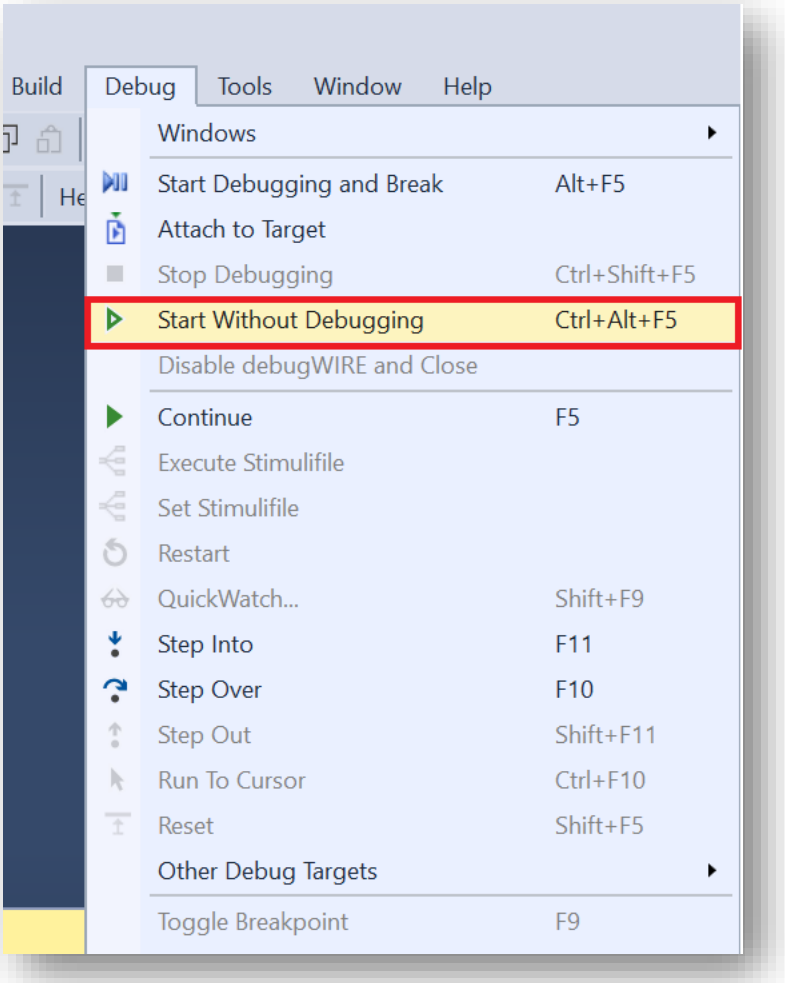


update the following constants before building the project:

- MAIN_WLAN_SSID
- MAIN_WLAN_PSK
- AWS_HOST_ENDPOINT

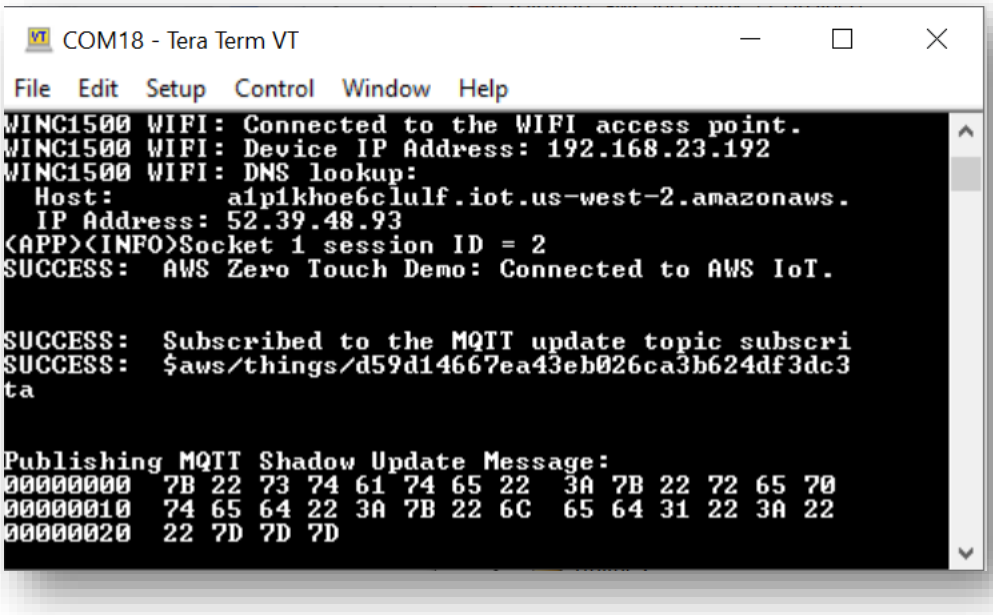
```
#define MAIN_WLAN_SSID      "xxxxxx"
#define MAIN_WLAN_AUTH      M2M_WIFI_SEC_WPA_PSK
#define MAIN_WLAN_PSK       "xxxxxxxxxx"

#define AWS_HOST_ENDPOINT   "xxxxxxx.iot.us-west-2.amazonaws.com"
```

3. Program the CryptoAuth Trust Platform by navigating to **Debug -> Start Without Debugging**



This step may take some time, wait for Atmel Studio to compile and program the device.

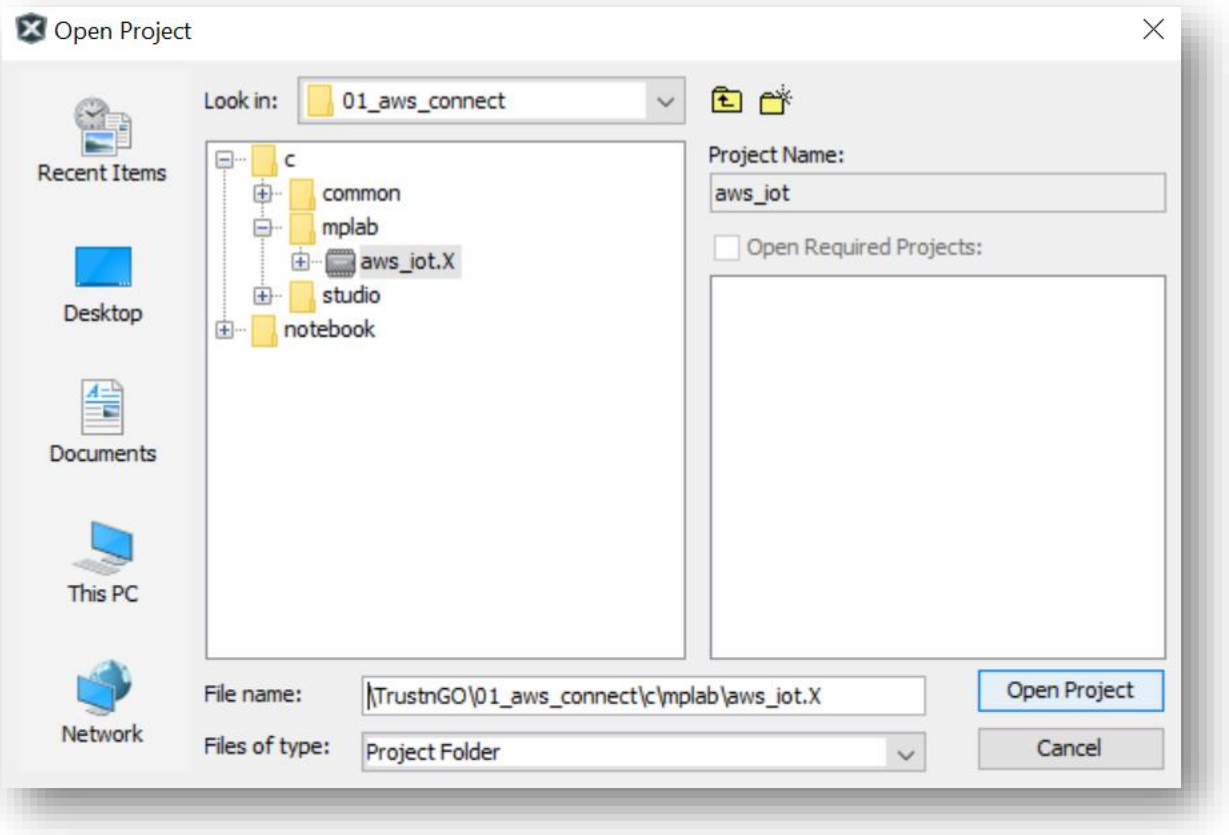
Once the programming is done, reset the hardware (press the reset button) and view the Console messages by using applications like 'Tera Term'. Open the application with the COM related to CryptoAuth Trust Platform with 115200-8-N-1 settings.



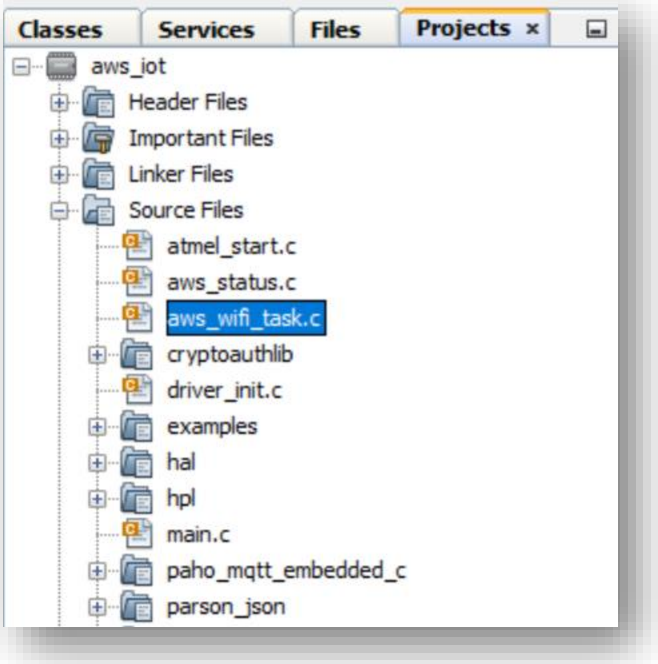
Once successfully programmed the CryptoAuth Trust Platform, now we can run the last step in the Jupyter Notebook. Just navigate to previous section 4.1 to run the last step (AWS GUI) in the Jupyter Notebook.

4.2.2 MPLAB:

1. Open **aws_iot.X** project by navigating to MPLAB -> File -> Open Project -> **TrustnGO\01_aws_connect\c\mplab \aws_iot.X**



2. Open **aws_wifi_task.c file** by navigating to **aws_iot -> Source Files -> aws_wifi_task.c**

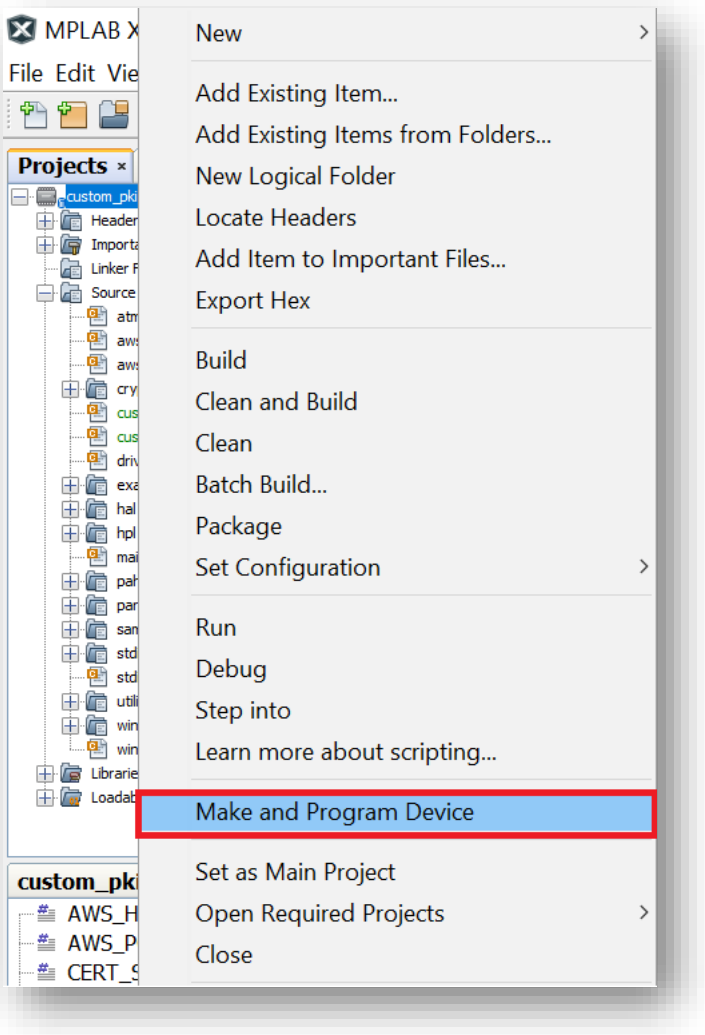


update the following constants before building the project:

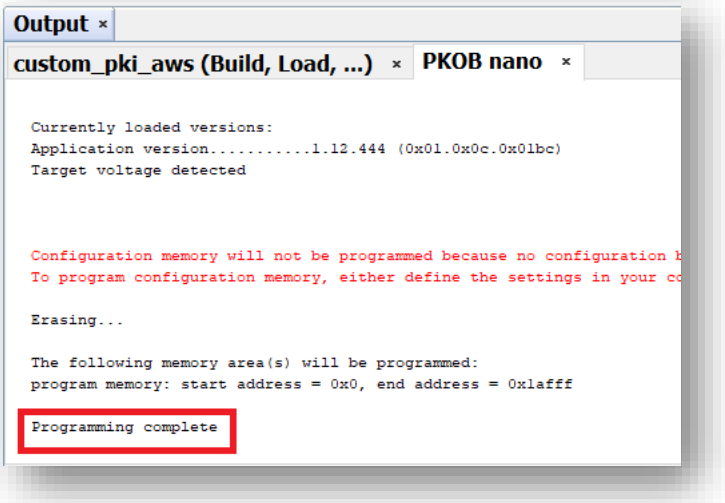
- MAIN_WLAN_SSID
- MAIN_WLAN_PSK
- AWS_HOST_ENDPOINT

```
49
50  #define MAIN_WLAN_SSID       "XXXXXXX"
51   #define MAIN_WLAN_AUTH      M2M_WIFI_SEC_WPA_PSK
52  #define MAIN_WLAN_PSK        "XXXXXXX"
53
54  #define AWS_HOST_ENDPOINT    "XXXXXXXXX.iot.us-west-2.amazonaws.com"
55
```

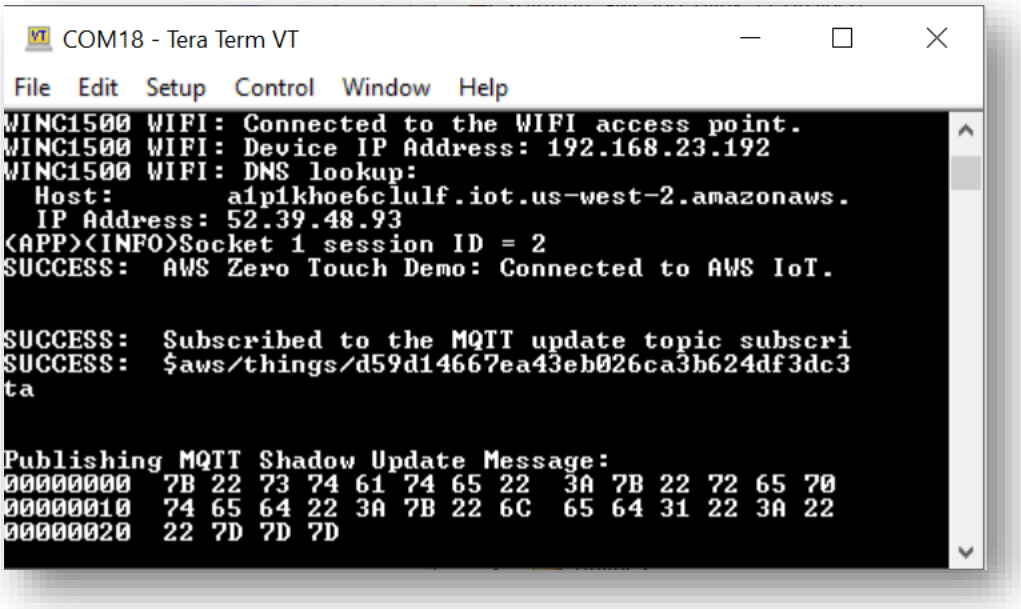
3. Program the CryptoAuth Trust platform by navigating to **aws_iot -> Make and Program Device**



This step may take some time, wait for MPLAB to program the device. Once it is done programming you will see "**Programming complete**" message in Output Window.



Once the programming is done, reset the hardware (press the reset button) and view the Console messages by using applications like 'Tera Term'. Open the application with the COM related to CryptoAuth Trust Platform with 115200-8-N-1 settings.



Once successfully programmed the CryptoAuth Trust Platform, now we can run the last step in the Jupyter Notebook. Just navigate to previous section 4.1 to run the last step (AWS GUI) in the Jupyter Notebook

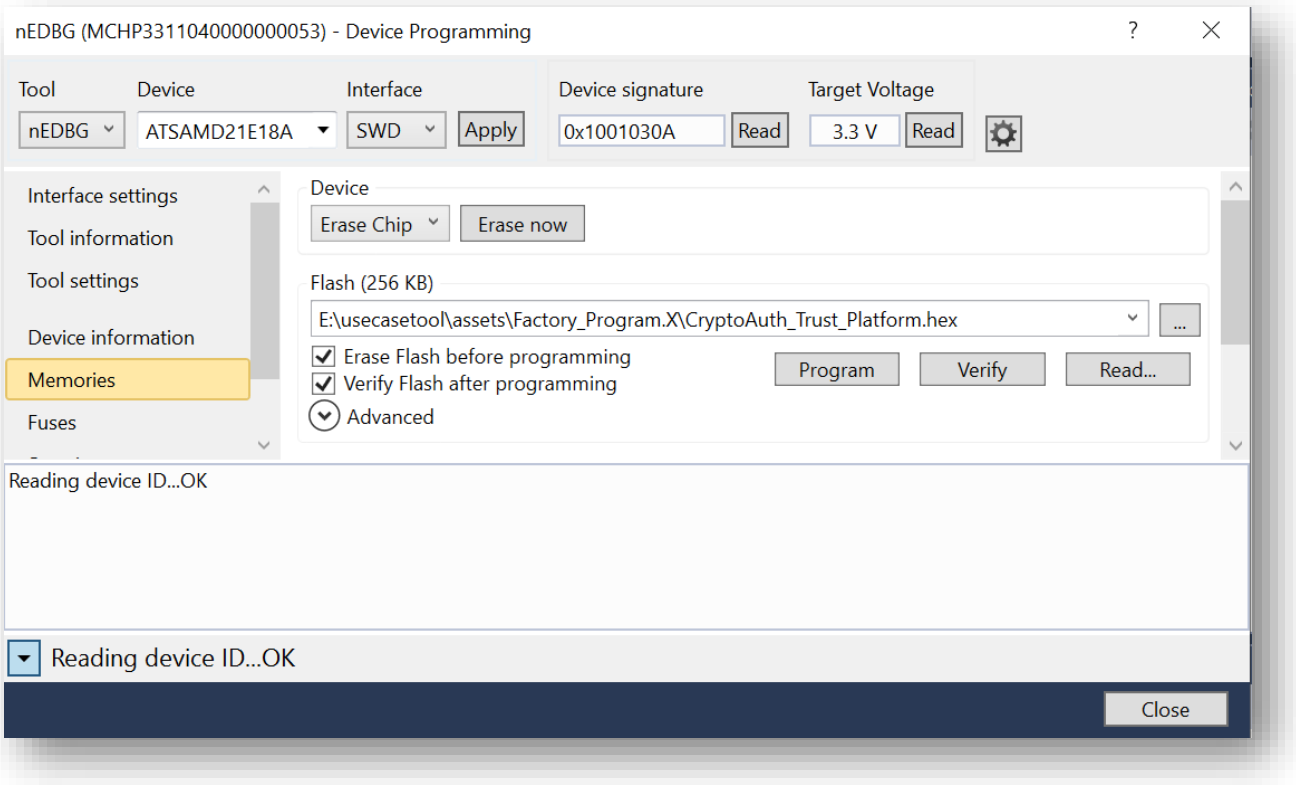
4.3 CryptoAuth TrustPlatform Factory reset

Once any of the embedded project is loaded to CrytoAuth TrustPlatform, the default program that enables interaction with TrustPlatform tools will be erased.

Before using the Platform with any other notebook or tools on PC, its required to reprogram the default .hex file. Default hex file is available at **assets\Factory_Program.X\CryptoAuth_Trust_Platform.hex**

To reprogram using Atmel Studio:

1. Navigate to AtmelStudio -> Tools -> Device Programming
2. Select Tool as nEDBG and Apply
3. Go to Memories and navigate to above path under Flash dropdown
4. Check both Erase Flash and Verify Flash
5. Click on Program



To reprogram using MPLAB:

1. Open **assets\Factory_Program.X** project in MPLAB IDE
2. Program the Crypto Trust platform by navigating to **CryptoAuth_Trust_Platform_Factory_Program -> Make and Program Device**

Now, Crypto Trust Platform contains factory programmed application that enables interactions with Notebooks and/or PC tools.

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