TrustFLEX Step by Step Guide Azure IoT with Custom PKI

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1 Introduction

This document gives a detailed walk through of the custom public key infrastructure use case implementation. If familiar with Jupyter Notebook, can skip this section and move to Section 2.

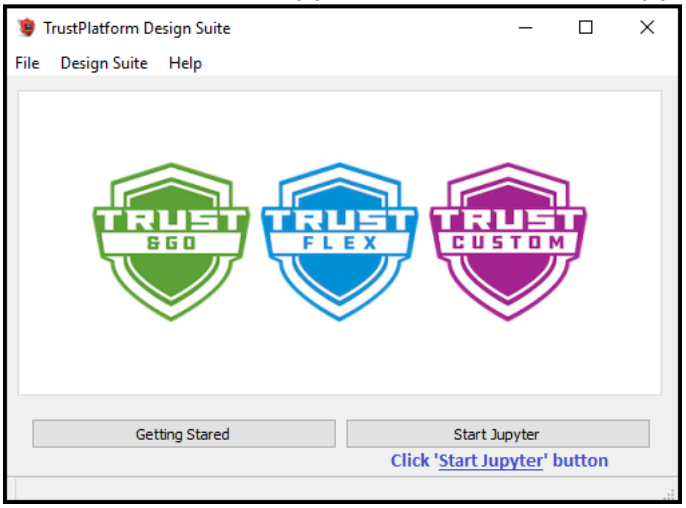
1.1 Getting started with Jupyter Notebook Tutorials

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.

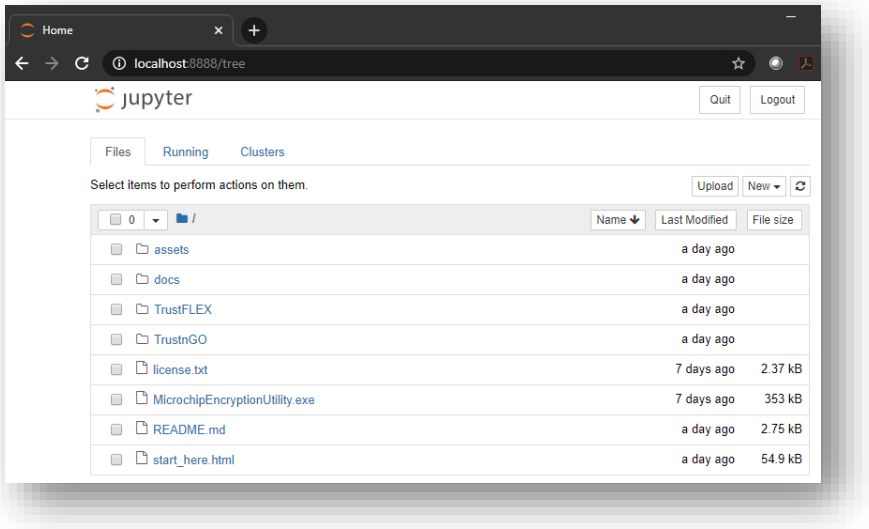
Jupyter notebooks are mainly used to explain/evaluate code in an interactive way.

1.1.1 Starting Jupyter Notebook

Jupyter notebook can be launched from Trust Platform GUI Main window. Run START -> Trust Platform x.x.x icon. Click on 'Start Jupyter' button to launch Jupyter local server.



Clicking on Start Jupyter should be web browser tab like below,



1.2 Jupyter Notebook Basics

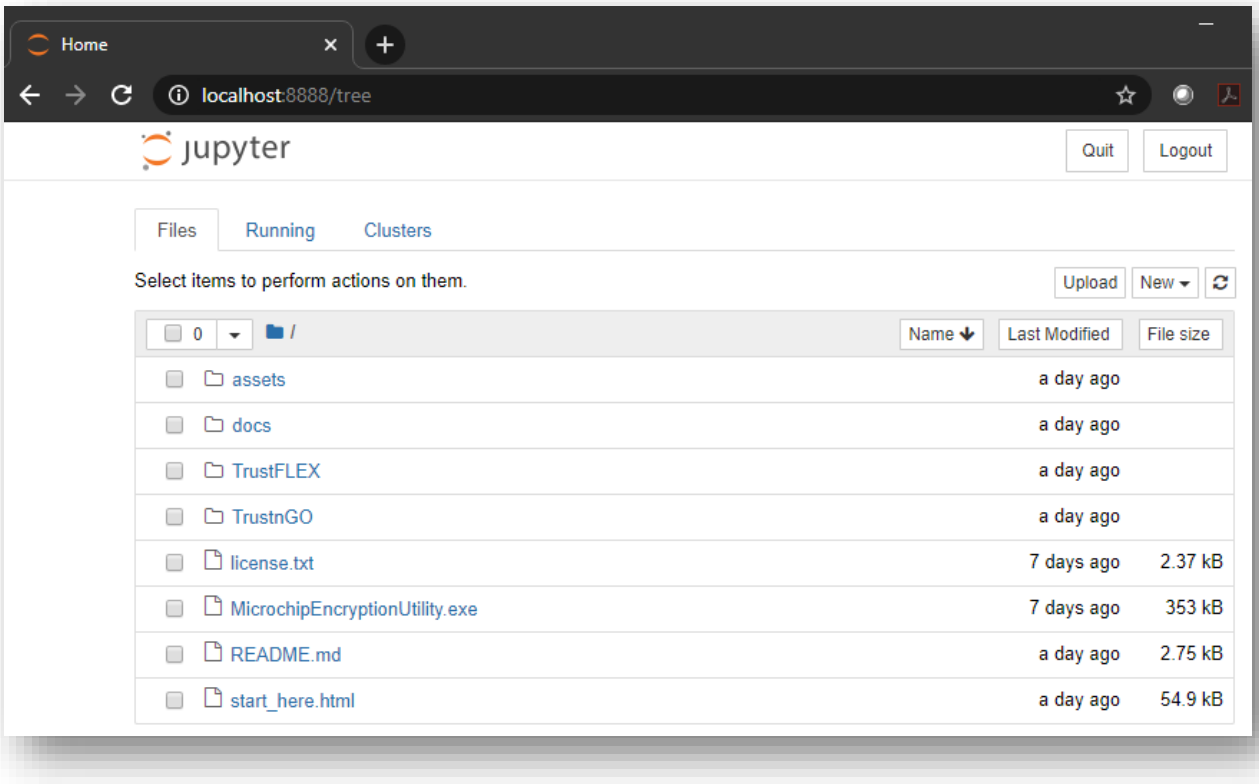
It is recommended to become familiar with Jupyter basic concepts with the online documentation, https://jupyter-notebook.readthedocs.io/en/stable/examples/Notebook/Notebook%20Basics.html

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 sub-directories in the notebook list, you can navigate your file system.

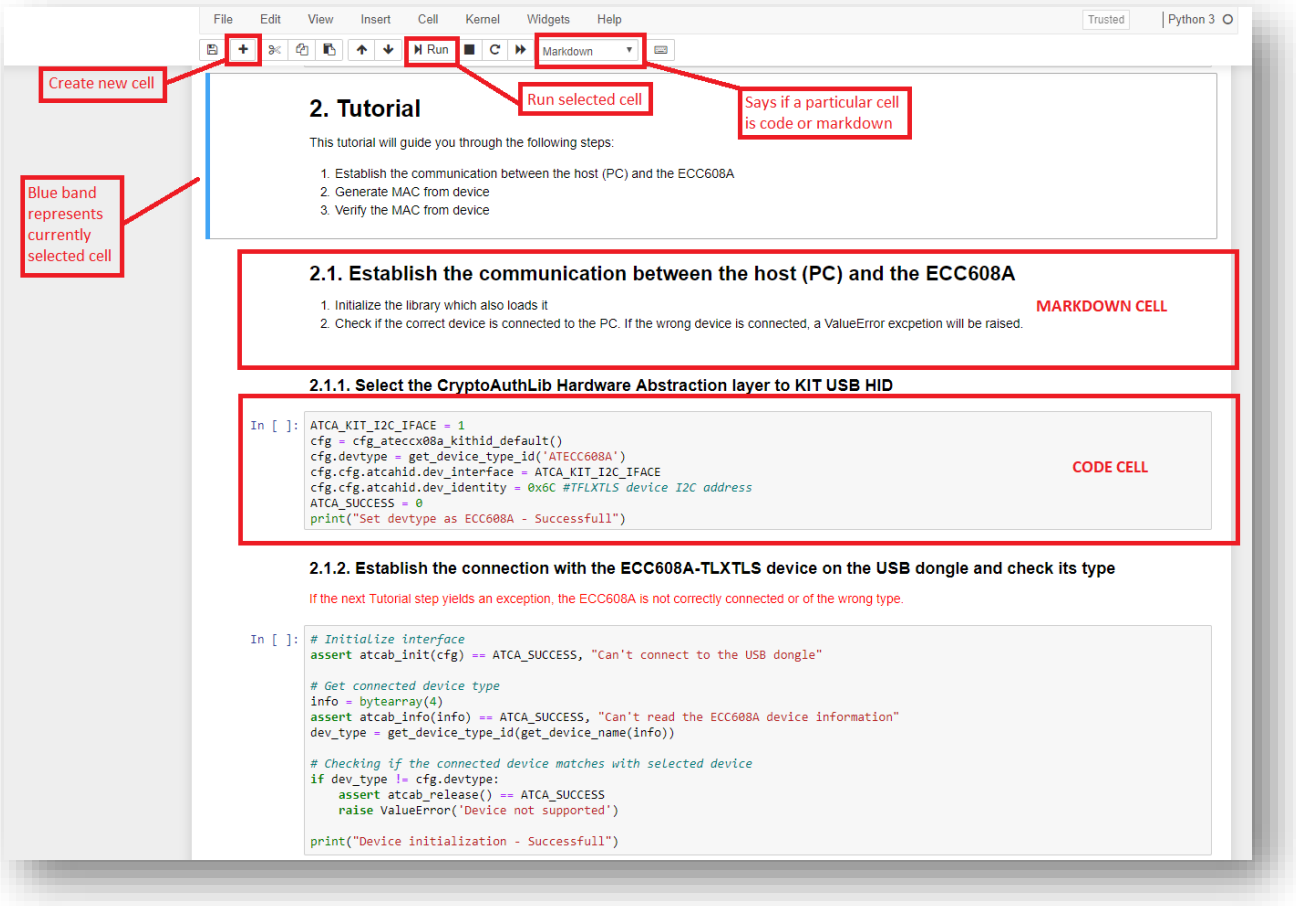


1.3 Introduction to Jupyter Notebook GUI.

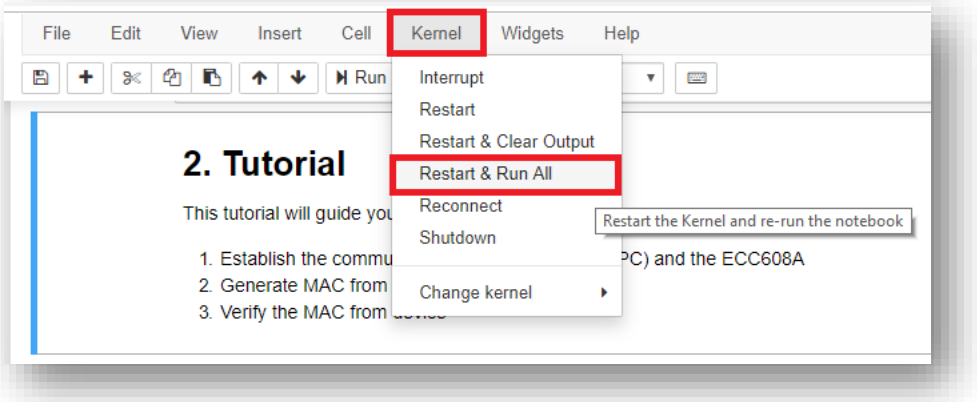
Jupyter Notebooks contain cells where you can either write code or markdown text. Notebooks contain multiple cells, some set as code and others markdown. Code cells contain code that can be executed live, and markdown contains text and images that explains the code.

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 Trust Platform Design Suite comes with several notebook tutorials to easily prototype popular use cases for TrustFLEX and Trust&Go devices. Here is the list of Jupyter Notebook Tutorials.

Jupyter Notebook Tutorials	**Relative Path**	**Applicable Devices**
Manifest Generation	TrustnGO\00_resource_generation\TNGTLS_manifest_file_generation.ipynb	Trust&GO
GCP Connect	TrustnGO\05_cloud_connect\notebook\gcp\TNGTLS_GCP_connect.ipynb	Trust&GO
AWS Connect	TrustnGO\05_cloud_connect\notebook\aws\TNGTLS_aws_connect.ipynb	Trust&GO
Azure Connect	TrustnGO\05_cloud_connect\notebook\azure\ TNGTLS_azure_connect.ipynb	Trust&GO
Resource Generation	TrustFLEX\00_resource_generation\TFLXTLS_resource_generator.ipynb	TrustFLEX
Accessory Authentication	TrustFLEX\01_accessory_authentication\notebook\ TFLXTLS_accessory_authentication.ipynb	TrustFLEX
Firmware Validation	TrustFLEX\02_firmware_validation\notebook\ TFLXTLS_firmware_validation.ipynb	TrustFLEX
IP Protection	TrustFLEX\04_ip_protection\notebook\ TFLXTLS_IP_protection.ipynb	TrustFLEX
Secure Public Key Rotation	TrustFLEX\05_public_key_rotation\notebook\ TFLXTLS_public_key_rotation.ipynb	TrustFLEX
Asymmetric authentication	08_asymmetric_authentication\notebook\ TFLXTLS_asymmetric_authentication.ipynb	TrustFLEX
GCP Connect	TrustFLEX\10_cloud_connect\notebook\gcp\TFLXTLS_GCP_connect.ipynb	TrustFLEX
AWS Custom PKI	TrustFLEX\10_cloud_connect\notebook\aws\ TFLXTLS_aws_connect.ipynb	TrustFLEX
Azure Connect	TrustFLEX\10_cloud_connect\notebook\azure\ TLFXTLS_azure_connect.ipynb	TrustFLEX

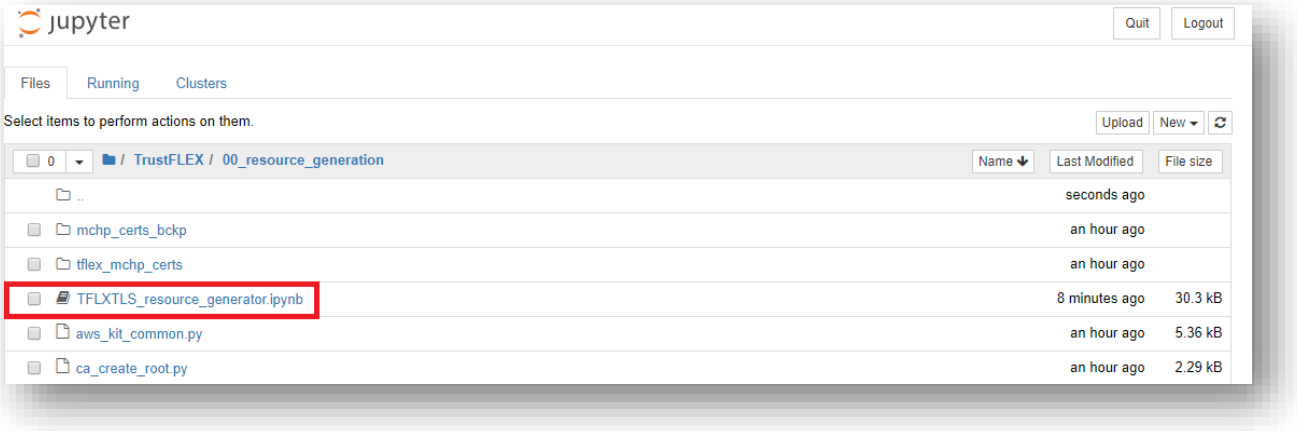
3 Resource Generation Notebook

TFLXTLS device is one of the three devices available in the Crypto Auth Trust Platform Board.

TrustFLEX devices come pre-programmed with certificates in slots 10, 11 and 12, also slots 0-4 have pre-generated private keys, other than the mentioned slots all the other slots have no meaningful data in them.

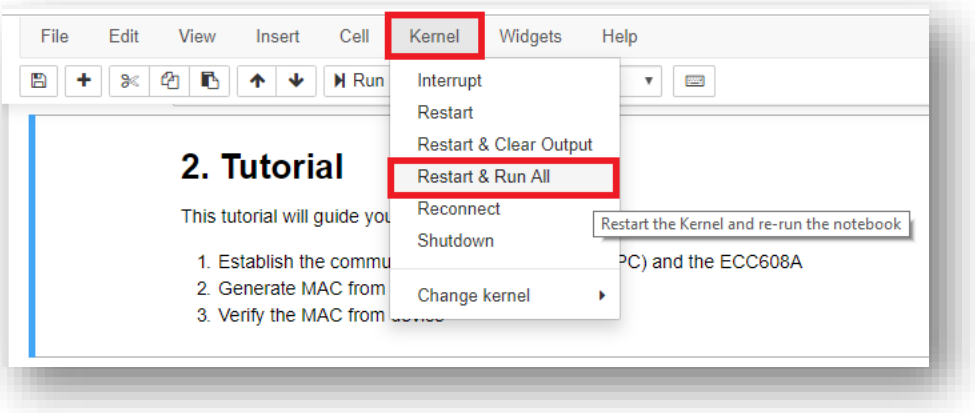
The Resource Generator Notebook will create development keys and certificates for all slots that can be further customized. Keys and Certificate chains are stored in the PC filesystem. These keys should never be used for production purposes as their generation is not handled in a secure environment. These development keys will be later used by the other notebooks to implement the various pre-defined use cases.

Within the Jupyter Dashboard, navigate **TrustFLEX\00_resource_generation** folder to open **TFLXTLS_resource_generator.ipynb** notebook



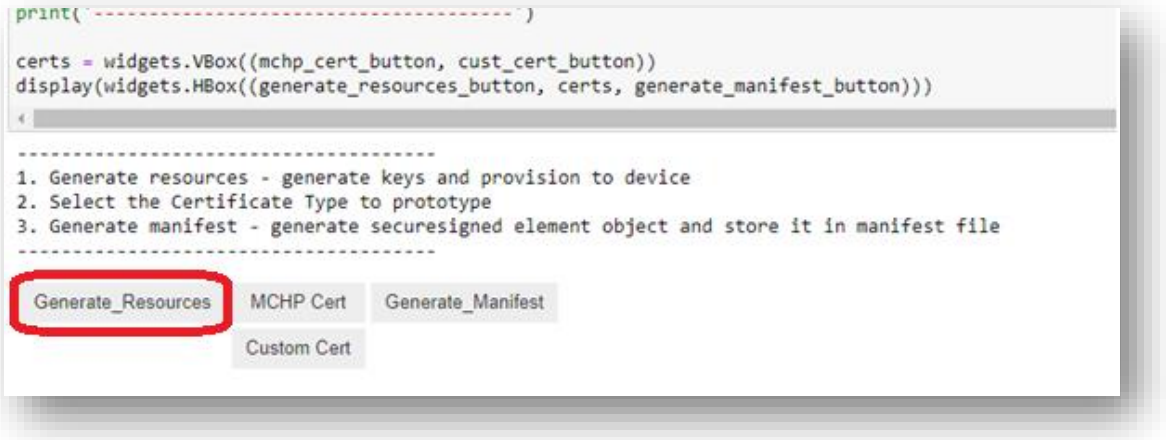
Run all cells of the Crypto Resource Generator Notebook: Kernel->Restart & Run All

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



Crypto Resource Generator notebook is common for all the use case which comes with option to load the signer certificate and device certificate. The Notebook will generate several keys and certificates. Make sure you have an error free output before continuing to the next steps of the training. Following are 3 different things can be performed,

1. Generating resources to general key slots



The output log should resemble this:

```
-----------------------------------------
Slot 0 is a private key slot, no action required
Slot 1 is a private key slot, no action required
Slot 2 is a private key slot, no action required
Slot 3 is a private key slot, no action required
Slot 4 is a private key slot, no action required
```

Slot 6 is a secret key, created slot_6_secret_key.pem and programmed

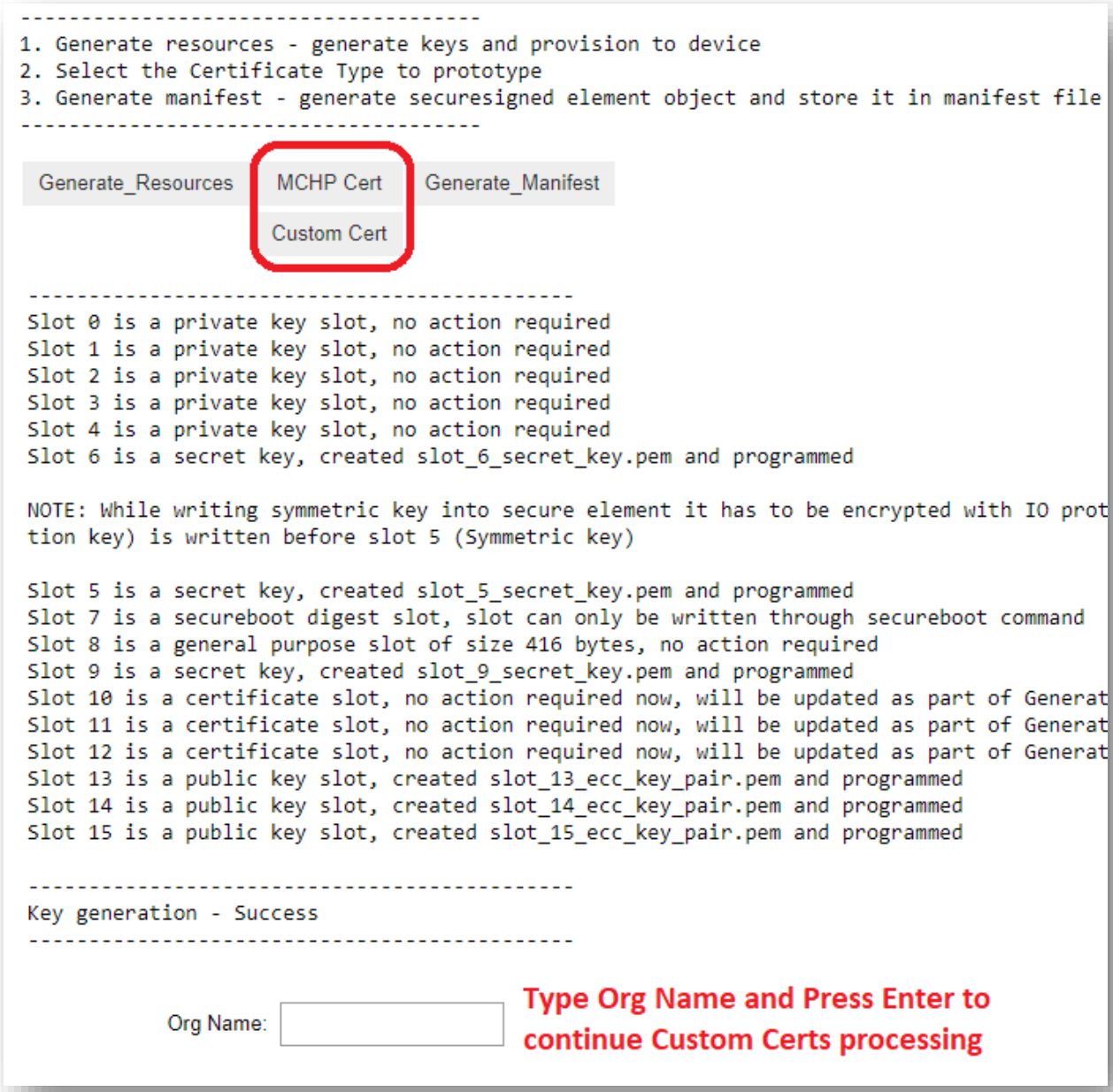
NOTE: While writing symmetric key into secure element it has to be encrypted with IO prote ction key. So here, Slot 6 (IO protection key) is written before slot 5 (Symmetric key)

Slot 5 is a secret key, created slot_5_secret_key.pem and programmed
Slot 7 is a secureboot digest slot, slot can only be written through secureboot command
Slot 8 is a general purpose slot of size 416 bytes, no action required
Slot 9 is a secret key, created slot_9_secret_key.pem and programmed
Slot 10 is a certificate slot, no action required now, will be updated as part of Generate Certi ficates
Slot 11 is a certificate slot, no action required now, will be updated as part of Generate Certi ficates
Slot 12 is a certificate slot, no action required now, will be updated as part of Generate Certi ficates
Slot 13 is a public key slot, created slot_13_ecc_key_pair.pem and programmed
Slot 14 is a public key slot, created slot_14_ecc_key_pair.pem and programmed
Slot 15 is a public key slot, created slot_15_ecc_key_pair.pem and programmed

---
Key generation - Success
---

2. Generating MCHP or Custom Certificates

   On selecting Custom certificates, it prompts to enter the organization name, enter the name that will be used as an Organization Name in the certificate template. The name length is limited to 24 characters.



The output log should resemble this:

```
-------------------------------------------
Custom Certs processing...
Device contains custom device and signer certificates
Building new root certificate
Building new signer csr certificate
Building new signer certificate
Read device serial number...OK (SN: 01233E8A1491F2A601)
```

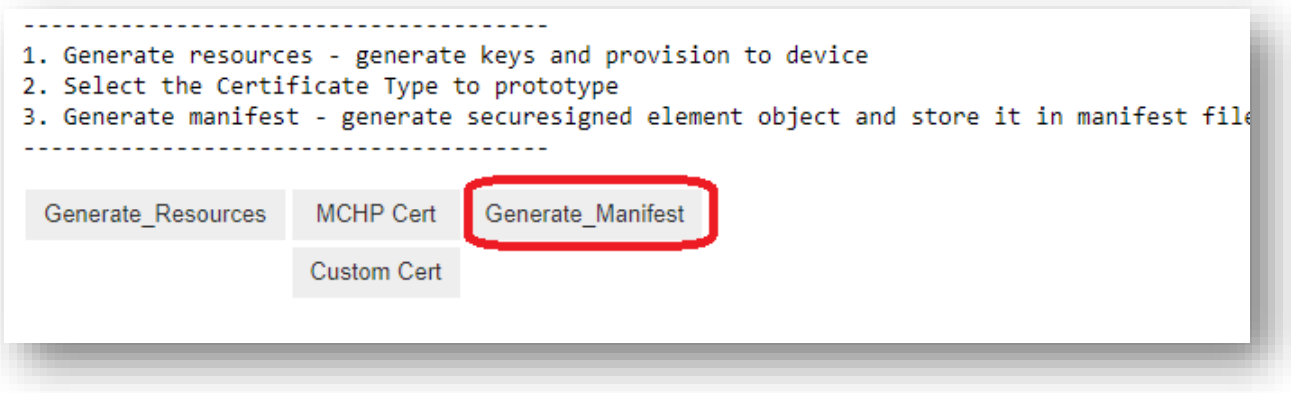
```
Read device public key from slot 0...OK (Public Key: CF1988BC3A6C252026FE70FB34397AD
85A39AE811C722BFA6E5EC1E9CDA9133B3F0E91FD3877F25B8C893B311BAF0203CB5100C
4CDABEBAFDAF3EBD550B00125)
Generating device certificate...OK (saved to device_01233E8A1491F2A601.crt)
Saving signer certificate to device...OK
Saving device certificate to device...OK
Thing ID eabc56113c70227a18c0a62f7c285fc68d75f9cd

-------------------------------------------
Custom certificate generation and provisioning - SUCCESS
-------------------------------------------

Validate root certificate...OK
-----BEGIN CERTIFICATE-----
MIIByjCCAW+gAwIBAgIQeoueybRh8XWwzOkoixtW1jAKBggqhkjOPQQDAjA7MQ0w
CwYDVQQKDAR0ZXN0MSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gUm9v
dCBDQSAwMDIwIBcNMjAwNzAxMDgwNTE5WhgPMjA2MDA2MjEwODA1MTlaMDsxDTAL
BgNVBAoMBHRlc3QxKjAoBgNVBAMMIUNyeXB0byBBdXRoZW50aWNhdGlvbiBSb290
IENBIDAwMjBZMBMGByqGSM49AgEGCCqGSM49AwEHA0IABFf6qcSyPv8iY0uccoTX
SlSstaz0ECCUxXUoqky8Xo40vsOCbPPt5QtlvNHnyy8tAbwza6DsAiz2sGLzDI5h
QhqjUzBRMB0GA1UdDgQWBBRHVPQoljiq65JOG4vu5l32JzmkSTAfBgNVHSMEGDAW
gBRHVPQoljiq65JOG4vu5l32JzmkSTAPBgNVHRMBAf8EBTADAQH/MAoGCCqGSM49
BAMCA0kAMEYCIQCB7FKx5K33xK9E0PsWGKZRaaQxxSRypC66y4hVqWVmMAIhAMlG
22zNUKPHccHQxfQssYH5LfR5SVE+WC3Hyxem/EVj
-----END CERTIFICATE-----

Certificate:
   Data:
      Version: 3 (0x2)
      Serial Number:
         7a:8b:9e:c9:b4:61:f1:75:b0:cc:e9:28:8b:1b:56:d6
      Signature Algorithm: ecdsa-with-SHA256
      Issuer: O=test, CN=Crypto Authentication Root CA 002
      Validity
         Not Before: Jul  1 08:05:19 2020 GMT
         Not After : Jun 21 08:05:19 2060 GMT
      Subject: O=test, CN=Crypto Authentication Root CA 002
      Subject Public Key Info:
         Public Key Algorithm: id-ecPublicKey
            Public-Key: (256 bit)
            pub:
               04:57:fa:a9:c4:b2:3e:ff:22:63:4b:9c:72:84:d7:
               4a:54:ac:b5:ac:f4:10:20:94:c5:75:28:aa:4c:bc:
               5e:8e:34:be:c3:82:6c:f3:ed:e5:0b:65:bc:d1:e7:
```

```
                cb:2f:2d:01:bc:33:6b:a0:ec:02:2c:f6:b0:62:f3:
                0c:8e:61:42:1a
            ASN1 OID: prime256v1
            NIST CURVE: P-256
        X509v3 extensions:
            X509v3 Subject Key Identifier:
                47:54:F4:28:96:38:AA:EB:92:4E:1B:8B:EE:E6:5D:F6:27:39:A4:49
            X509v3 Authority Key Identifier:
                keyid:47:54:F4:28:96:38:AA:EB:92:4E:1B:8B:EE:E6:5D:F6:27:39:A4:49

            X509v3 Basic Constraints: critical
                CA:TRUE
    Signature Algorithm: ecdsa-with-SHA256
        30:46:02:21:00:81:ec:52:b1:e4:ad:f7:c4:af:44:d0:fb:16:
        18:a6:51:69:a4:31:c5:24:72:a4:2e:ba:cb:88:55:a9:65:66:
        30:02:21:00:c9:46:db:6c:cd:50:a3:c7:71:c1:d0:c5:f4:2c:
        b1:81:f9:2d:f4:79:49:51:3e:58:2d:c7:cb:17:a6:fc:45:63


Validate signer certificate...OK
-----BEGIN CERTIFICATE-----
MIIB3TCCAYKgAwIBAgIQV/RpeXxWfquIIYFCFTDc/TAKBggqhkjOPQQDAjA7MQ0w
CwYDVQQKDAR0ZXN0MSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gUm9v
dCBDQSAwMDIwIBcNMjAwNzAxMDgwMDAwWhgPMjA0MDA3MDEwODAwMDBaMDsxDTAL
BgNVBAoMBHRlc3QxKjAoBgNVBAMMIUNyeXB0byBBdXRoZW50aWNhdGlvbiBTaWdu
ZXIgRkZGRjBZMBMGByqGSM49AgEGCCqGSM49AwEHA0IABCEubbOfXDakettxvfKu
kfG5UhQNDHrPrZiURytSZmQ8p38VacZ682akSAC6XQYDzhiy5/5O4eAHBCuN5rOt
vnOjZjBkMA4GA1UdDwEB/wQEAwIBhjASBgNVHRMBAf8ECDAGAQH/AgEAMB0GA1Ud
DgQWBBRycA/sc+NWXwp0wLudepyPtQtzFzAfBgNVHSMEGDAWgBRHVPQoljiq65JO
G4vu5l32JzmkSTAKBggqhkjOPQQDAgNJADBGAiEA1ThacjiYboKYh69+NllQKiX2
wb7Jztq8zMsY61H/NkYCIQDQc2TQfOl9HBDUoDzUtTZNgIksElkU7ysiSgBhumAA
zQ==
-----END CERTIFICATE-----

Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number:
            57:f4:69:79:7c:56:7e:ab:88:21:81:42:15:30:dc:fd
        Signature Algorithm: ecdsa-with-SHA256
        Issuer: O=test, CN=Crypto Authentication Root CA 002
        Validity
            Not Before: Jul  1 08:00:00 2020 GMT
            Not After : Jul  1 08:00:00 2040 GMT
```

```
        Subject: O=test, CN=Crypto Authentication Signer FFFF
        Subject Public Key Info:
            Public Key Algorithm: id-ecPublicKey
                Public-Key: (256 bit)
                pub:
                    04:21:2e:6d:b3:9f:5c:36:a4:7a:db:71:bd:f2:ae:
                    91:f1:b9:52:14:0d:0c:7a:cf:ad:98:94:47:2b:52:
                    66:64:3c:a7:7f:15:69:c6:7a:f3:66:a4:48:00:ba:
                    5d:06:03:ce:18:b2:e7:fe:4e:e1:e0:07:04:2b:8d:
                    e6:b3:ad:be:73
                ASN1 OID: prime256v1
                NIST CURVE: P-256
        X509v3 extensions:
            X509v3 Key Usage: critical
                Digital Signature, Certificate Sign, CRL Sign
            X509v3 Basic Constraints: critical
                CA:TRUE, pathlen:0
            X509v3 Subject Key Identifier:
                72:70:0F:EC:73:E3:56:5F:0A:74:C0:BB:9D:7A:9C:8F:B5:0B:73:17
            X509v3 Authority Key Identifier:
                keyid:47:54:F4:28:96:38:AA:EB:92:4E:1B:8B:EE:E6:5D:F6:27:39:A4:49

    Signature Algorithm: ecdsa-with-SHA256
        30:46:02:21:00:d5:38:5a:72:38:98:6e:82:98:87:af:7e:36:
        59:50:2a:25:f6:c1:be:c9:ce:da:bc:cc:cb:18:eb:51:ff:36:
        46:02:21:00:d0:73:64:d0:7c:e9:7d:1c:10:d4:a0:3c:d4:b5:
        36:4d:80:89:2c:12:59:14:ef:2b:22:4a:00:61:ba:60:00:cd


Validate device certificate...OK
-----BEGIN CERTIFICATE-----
MIIByDCCAW+gAwIBAgIQdxkpBswUT+e4dShL6tp00jAKBggqhkjOPQQDAjA7MQ0w
CwYDVQQKDAR0ZXN0MSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gU2ln
bmVyIEZGRkYwIBcNMjAwNzAxMDYwMDAwWhgPMjA0ODA3MDEwNjAwMDBaMC4xDTAL
BgNVBAoMBHRlc3QxHTAbBgNVBAMMFHNuMDEyMzNFOEExNDkxRjJBNjAxMFkwEwYH
KoZIzj0CAQYIKoZIzj0DAQcDQgAEzxmIvDpsJSAm/nD7NDl62Fo5roEcciv6bl7B
6c2pEzs/DpH9OHfyW4yJOzEbrwIDy1EAxM2r66/a8+vVULABJaNgMF4wDAYDVR0T
AQH/BAIwADAOBgNVHQ8BAf8EBAMCA4gwHQYDVR0OBBYEFOq8VhE8cCJ6GMCmL3wo
X8aNdfnNMB8GA1UdIwQYMBaAFHJwD+xz41ZfCnTAu516nI+1C3MXMAoGCCqGSM49
BAMCA0cAMEQCIANn/QrqxwmwrRsrcYyQpWJ0o4AxLzGoeCZjfJ5o0FAbAiBFne67
iEzuh6dqwrdQYvgB6+qTxfLyei1kwoFcfVnHvA==
-----END CERTIFICATE-----

Certificate:
```

```
Data:
    Version: 3 (0x2)
    Serial Number:
        77:19:29:06:cc:14:4f:e7:b8:75:28:4b:ea:da:74:d2
    Signature Algorithm: ecdsa-with-SHA256
    Issuer: O=test, CN=Crypto Authentication Signer FFFF
    Validity
        Not Before: Jul  1 06:00:00 2020 GMT
        Not After : Jul  1 06:00:00 2048 GMT
    Subject: O=test, CN=sn01233E8A1491F2A601
    Subject Public Key Info:
        Public Key Algorithm: id-ecPublicKey
            Public-Key: (256 bit)
            pub:
                04:cf:19:88:bc:3a:6c:25:20:26:fe:70:fb:34:39:
                7a:d8:5a:39:ae:81:1c:72:2b:fa:6e:5e:c1:e9:cd:
                a9:13:3b:3f:0e:91:fd:38:77:f2:5b:8c:89:3b:31:
                1b:af:02:03:cb:51:00:c4:cd:ab:eb:af:da:f3:eb:
                d5:50:b0:01:25
            ASN1 OID: prime256v1
            NIST CURVE: P-256
    X509v3 extensions:
        X509v3 Basic Constraints: critical
            CA:FALSE
        X509v3 Key Usage: critical
            Digital Signature, Key Agreement
        X509v3 Subject Key Identifier:
            EA:BC:56:11:3C:70:22:7A:18:C0:A6:2F:7C:28:5F:C6:8D:75:F9:CD
        X509v3 Authority Key Identifier:
            keyid:72:70:0F:EC:73:E3:56:5F:0A:74:C0:BB:9D:7A:9C:8F:B5:0B:73:17

Signature Algorithm: ecdsa-with-SHA256
     30:44:02:20:03:67:fd:0a:ea:c7:09:b0:ad:1b:2b:71:8c:90:
     a5:62:74:a3:80:31:2f:31:a8:78:26:63:7c:9e:68:d0:50:1b:
     02:20:45:9d:ee:bb:88:4c:ee:87:a7:6a:c2:b7:50:62:f8:01:
     eb:ea:93:c5:f2:f2:7a:2d:64:c2:81:5c:7d:59:c7:bc
```

3. Generating Manifest file



The output log should resemble this:

```
------------------------------------------------------
Generating manifest data...OK (saved to TFLXTLS_devices_manifest.json)
------------------------------------------------------
```

At the end of the execution, a Custom PKI chain will be generated on your PC and TrustFLEX device specific slots (10 through 12) will be overwritten with the custom certificates.

The Notebook has also generated a manifest file to be uploaded into the public cloud of your choice (Google GCP, AWS IoT and Microsoft Azure).

4 Use Case Prototyping

This hands-on lab is intended to demonstrate the usage of TrustFLEX to secure an Azure IoT connection based on a custom PKI.

The Azure IoT device reference implementation is provided as an MPLAB X project and the generation of a custom PKI is achieved through the execution of Jupyter Notebook Tutorials.

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

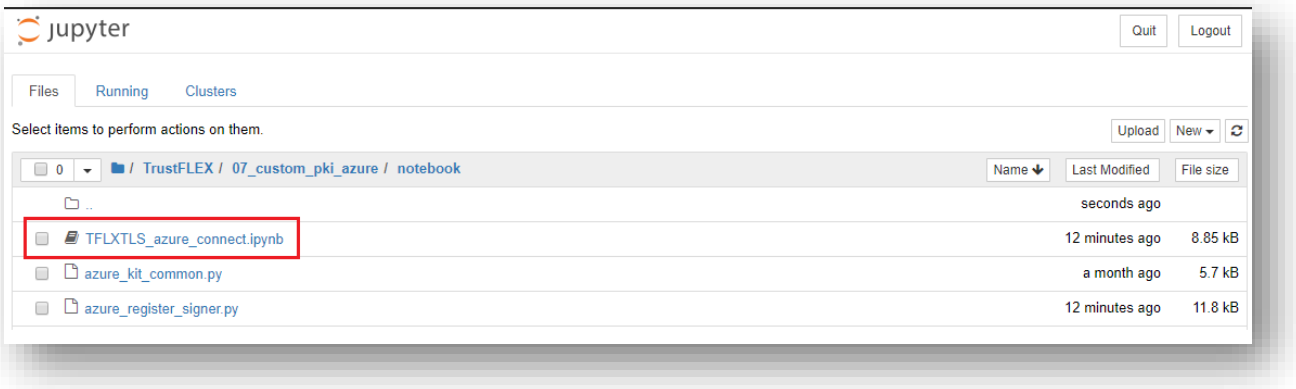
- Configure Azure CLI
- Register Custom PKI signer
- Build the Azure IoT device source code and flash it to the Crypto Auth Trust Platform board.

Note: It is required to have an Azure IoT test account setup. Instruction to setup the account quickly is provided in **docs\TrustFLEX_guide_Azure_demo_account_setup.pdf**. Once the account is setup, IoT hub HostName and Subscription ID should be updated in **docs\Azure_iot_hub_details.csv**

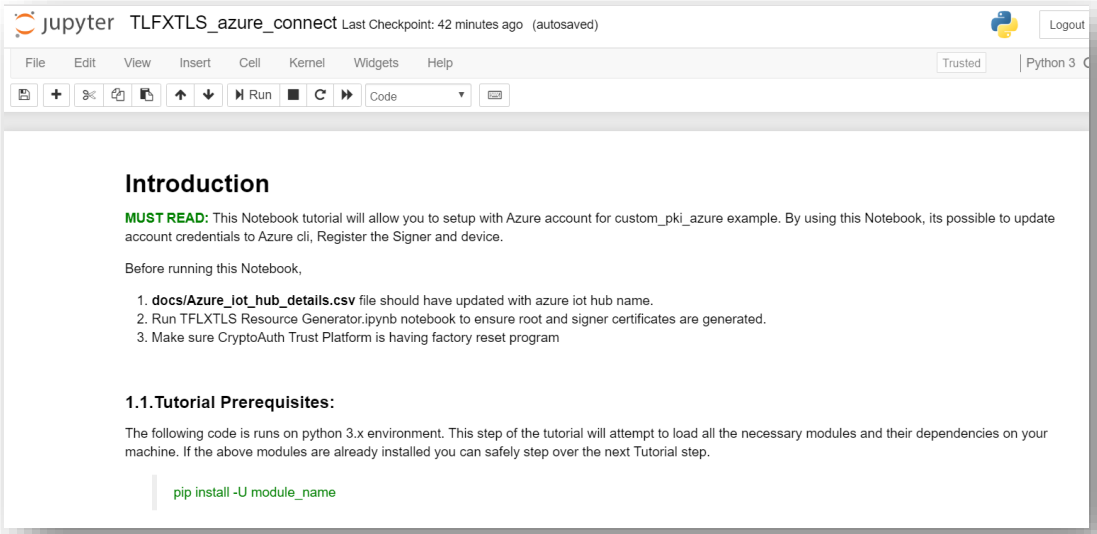
4.1 Running Custom PKI example on Jupyter Notebook

By running this following step, we can configure the Azure command line with Azure credentials, register the signer certificate to Azure IoT.

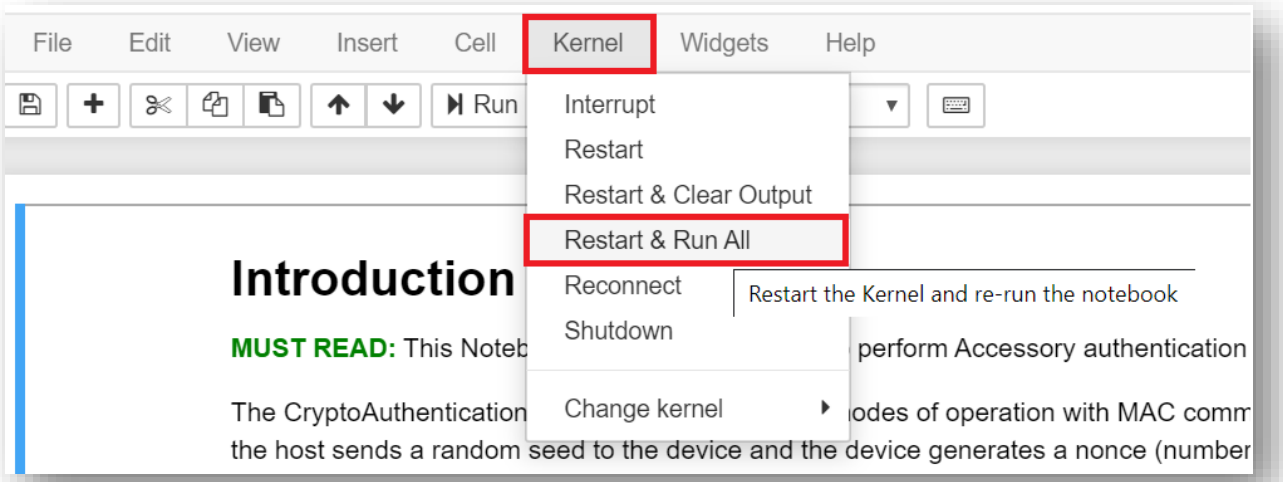
1. From the Jupyter Home page, navigate to **TrustFLEX\10_cloud_connect\notebook\azure\TFLXTLS_azure_connect.ipynb** notebook file and open it.



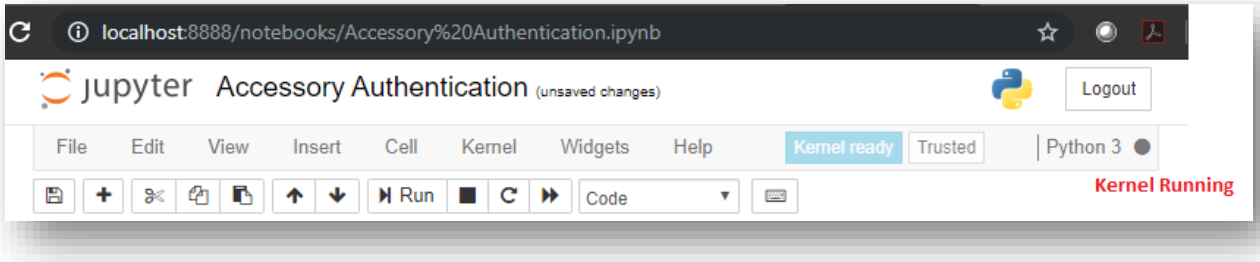
Opening the Jupyter notebook example should load the following on the browser.

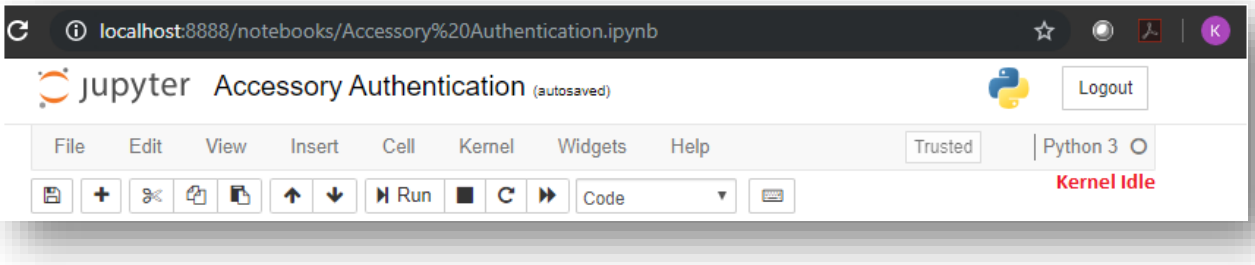


2. Run All Cells by using Kernel -> Restart & Run All



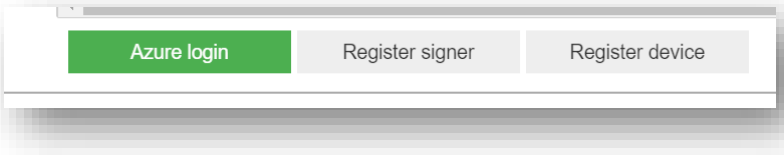
It may take a while to complete, wait for the kernel to complete all processing i.e. from Kernel Running to Kernel Idle state (Check circle above **RED** text)





3. Navigate through different cells output for the description of the step and result from the execution.

4. There are 3 major steps:
   <u>Configure Azure command line interface:</u>
   Before we can interact with Azure, we need to configure the tools with the appropriate Azure credentials. These credentials are composed of the **azure account login**. Clicking the button will open azure login portal in new tab in browser. Enter the credentials of your account and sign in.



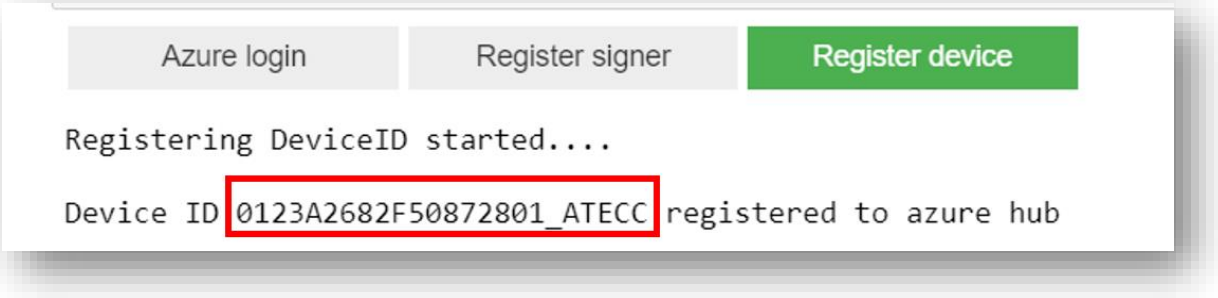
<u>Register Signer Module:</u>
Code block of this step generates "**Register signer**" button. Clicking the button, it registers the custom PKI signer module to the Azure account. To establish a secure communication with Azure IoT, we need to register the Custom PKI signer certificate to Azure IoT

Upon successful execution, the log should look like this.

Once this step is completed, signer module is successfully registered to Azure IoT.

Register Device:

Code block of this step generates "**Register Device**" button. Clicking the button Registers the device to the azure iot hub and output log should be as below.



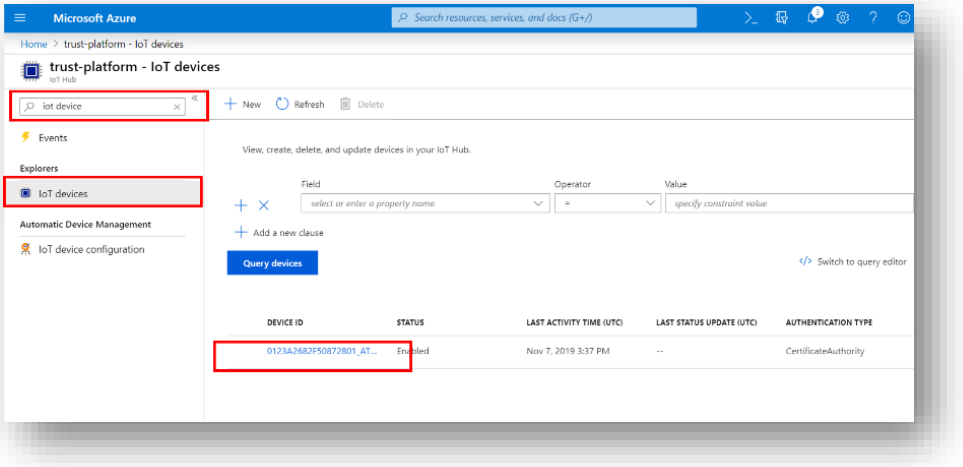
NOTE: Make sure that you executed C project successfully before executing the next step .To execute C project, refer "Running Azure IoT example on Embedded platform" section.

Control Crypto Auth Trust Platform board LED from Azure Cloud

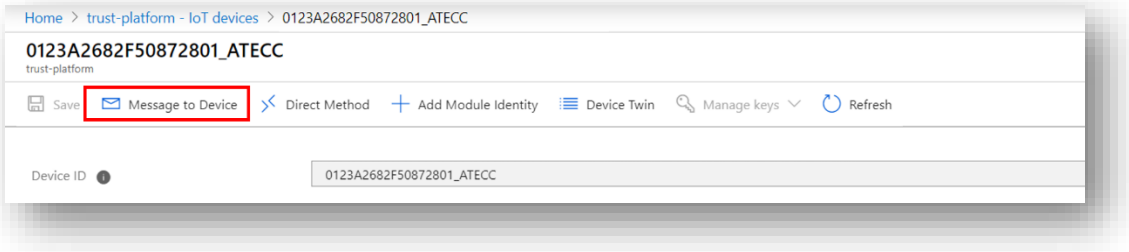
In this section we are going to control the status led on the Trust platform device from the Azure cloud.

1. In the https://portal.azure.com/ select your IoT hub created, search for iot device and select **IoT devices** from Explorers.

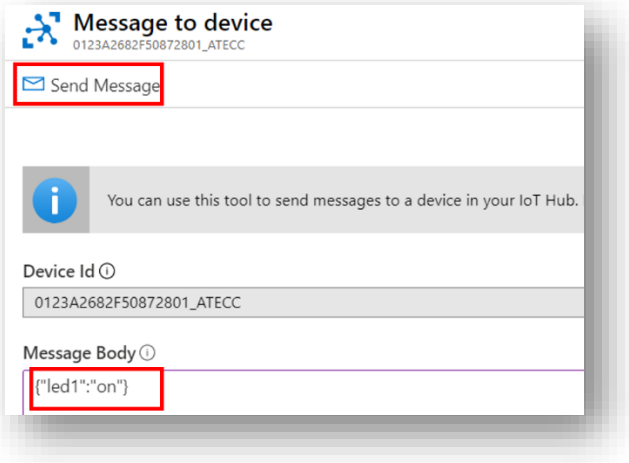
2. From the Device ID select the device id that want to be controlled. The Device ID Should be same as the highlighted one previous step **Register Device**



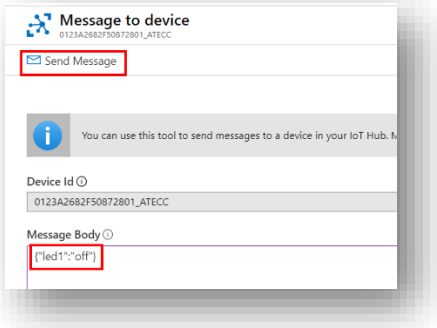
3. In the Device ID window, select the Message to Device



4. Now to Turn ON the led in the Trust platform board. Paste the message {"led1":"on"} to the message body and click Send Message.



5. Now to Turn OFF the led in the Trust platform board. Paste the message {"led1":"off"} to the message body and click Send Message



4.2 Running Custom PKI example on Embedded platform

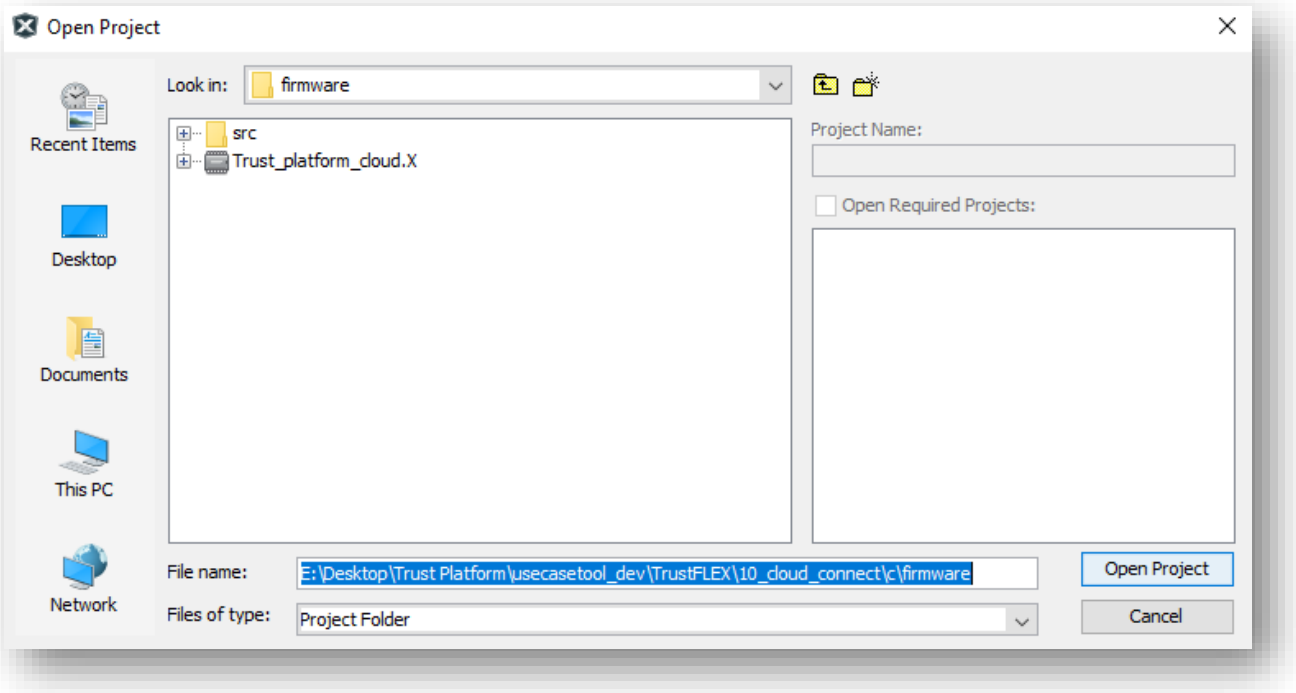
Once the resources are generated MPLAB projects provided can be used to run the use case on Crypto Auth Trust Platform.

This project can configure the Wi-Fi credentials, establish a TLS connection, subscribe to MQTT. It is required to use the Azure IoT Jupyter notebook to register the signer module.

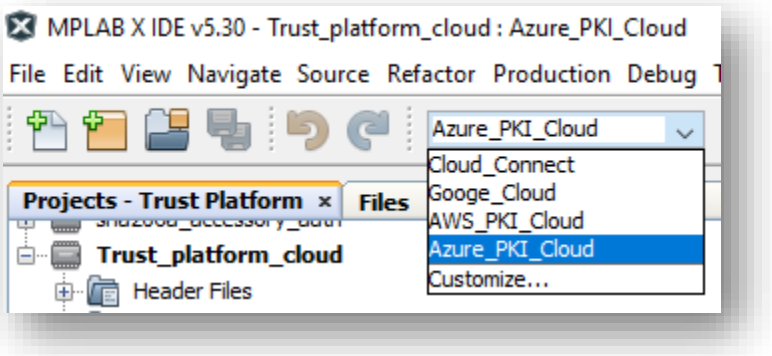
Prerequisite: It is required that WINC firmware is updated to latest version / version that is available in this package. Update the WINC firmware using package available in cloned repository at **assets\winc_firmware_upgrade**

4.2.1 MPLAB:

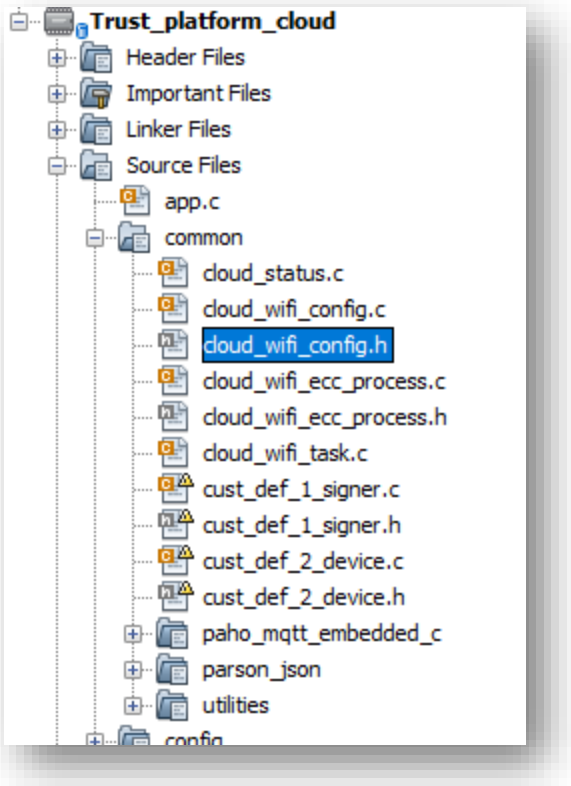
1. Open **Trust_platform_cloud.X** project by navigating to MPLAB -> File -> Open Project -> **TrustFLEX\10_cloud_connect\firmware**



1. Select Build configuration as Azure_PKI_Cloud



2. Open **cloud_wifi_config.h file** by navigating to **Trust_platform_cloud -> Source Files**



update the following constants before building the project:

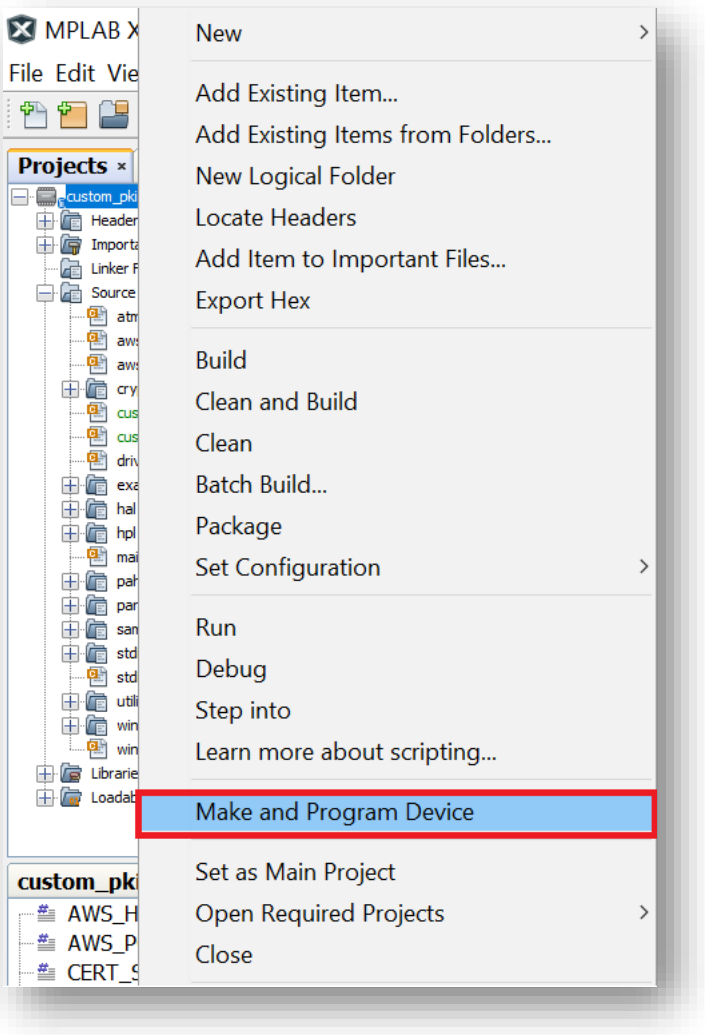
- MAIN_WLAN_SSID
- MAIN_WLAN_PSK
- CLOUD_ENDPOINT

```
#define WLAN_SSID                   "xxxxxxxxxxxx"
#define WLAN_AUTH_WPA_PSK
#define WLAN_PSK                    "xxxxxxxxxxxx"
```

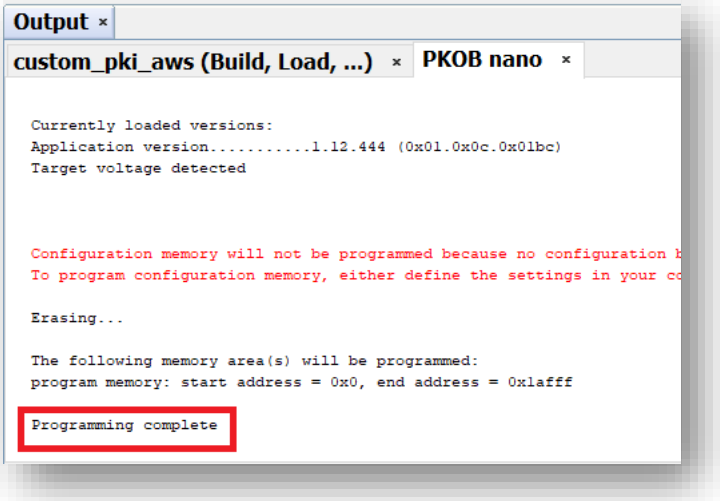
The Highlighted area in CLOUD_ENDPOINT string should have the Azure IOT Hub Name

```
#elif defined(CLOUD_CONFIG_AZURE)
    #define SSL_CIPHER_SUITE_SELECTION  SSL_ECC_ALL_CIPHERS
    #define CLOUD_ENDPOINT "xxxxxxxxxxxx.azure-devices.net"
```

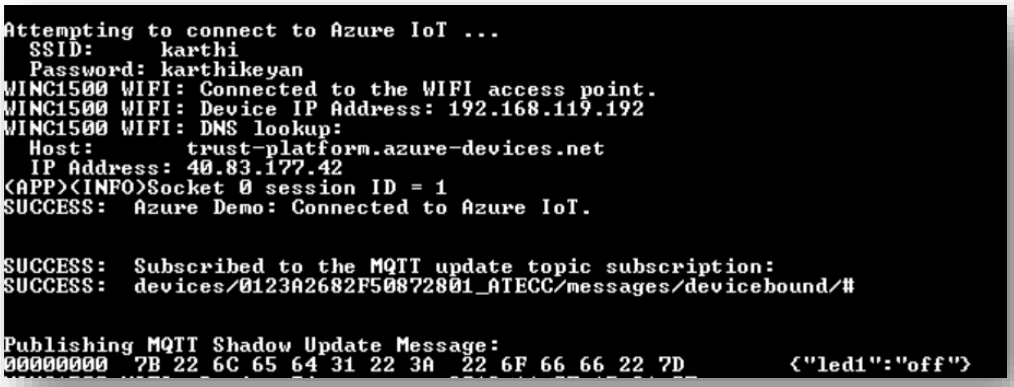
2. Program the Crypto Auth Trust platform by navigating to **Trust_platform_cloud -> Make and Program Device**



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.



4.3 Crypto Auth Trust Platform Factory reset

Once any of the embedded project is loaded to Crypto Auth Trust Platform, the default program that enables interaction with Trust Platform 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 in cloned repository at **assets\Factory_Program.X\CryptoAuth_Trust_Platform.hex**

If Trust Platform GUI is provided with MPLAB X IDE installation location, notebooks can program the Factory reset hex file if its not available by default.

This can also be done manually by MPLAB.

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**

5 FAQ

1. **What are the reasons for "AssertionError: Cannot connect to CryptoAuth Trust Platform, check USB connection" error?**
   There are many possibilities like,
   1. Crypto Trust Platform is having different application than factory reset firmware. Refer to "Crypto Auth Trust Platform Factory reset" section any usecase TrustFLEX Guide for reloading it
   2. Check the switch positions on Crypto Trust Platform and/or ATECC608B Trust board
      a. Correct Trust device should be connected and only one device of that type is allowed on the I2C bus. Multiple devices with same address results in error
   3. Check USB connections to Crypto Trust Platform

2. **How to reload factory default application to Crypto Trust Platform?**
   Refer to "Crypto Auth Trust Platform Factory reset" section any usecase TrustFLEX Guide for reloading it.

3. **Why does my C projects generates No such file or directory with ../../../00_resource_generation/?**
   C project generates this error when the resources are not generated prior to using embedded projects. Running the resource generation notebook ensures these files and secrets are generated.

4. **Before running any use case notebook and/or C project, why is it mandate to execute resource generation?**
   When resource generation notebook is executed, it generates and programs the required resources like secrets, keys and certificates. These are only prototyping keys and cannot be used for production. These keys will be used part of Usecase notebooks and C projects

5. **How to know the resources being used in a use case?**
   Refer to individual Usecase description html for details on transaction diagrams, resources being used and other details. The resources required for given use case is mentioned in INFER CRYPTOGRAPHIC ASSETS section.

6. **When should I select Custom certificates while doing resource generation?**
   Custom certificates are required when user wants to have their own root, signer instead of MCHP provided. The difference would be organization name, common name and validity are configurable

   It is also possible to view the Console messages by using applications like TeraTerm. Open the application with the COM related to Crypto Trust Platform with 115200-8-N-1 settings

7. **Why Azure demo application is not getting connected to cloud?**
   There are many possibilities like,
   a. Signer registration is not done to the account
   b. Device ID registration is not done to the account
   c. WiFi credentials are not populated or in correct in C project

d. Azure IOT Hub name is not populated or in-correct in C project

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