TrustFLEX Step by Step Guide Accessory Asymmetric Authentication

Table of Contents

1 Introduction

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

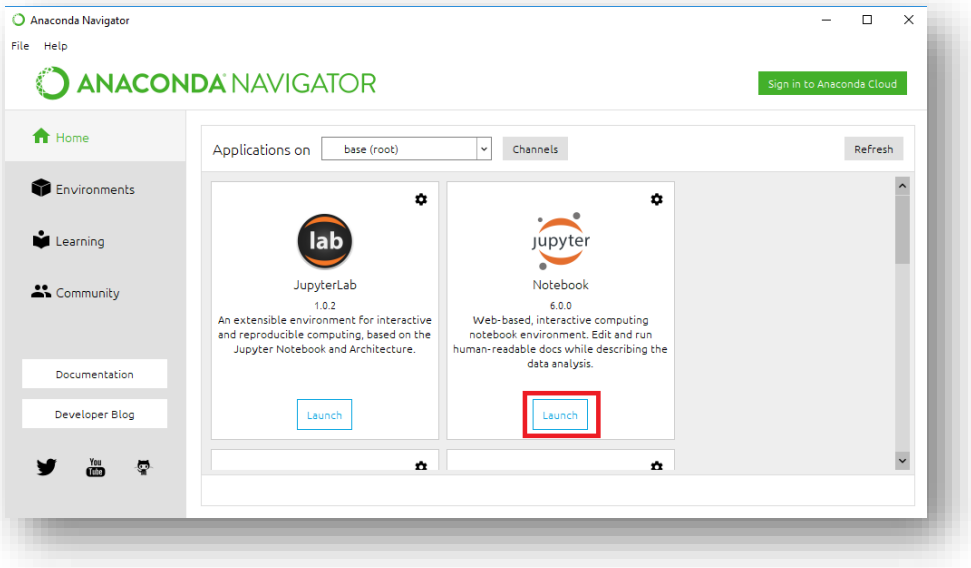
1.1 Getting started with Jupyter Notebook Tutorials

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 the Anaconda Navigator main window.



1.2 Jupyter Notebook Basics

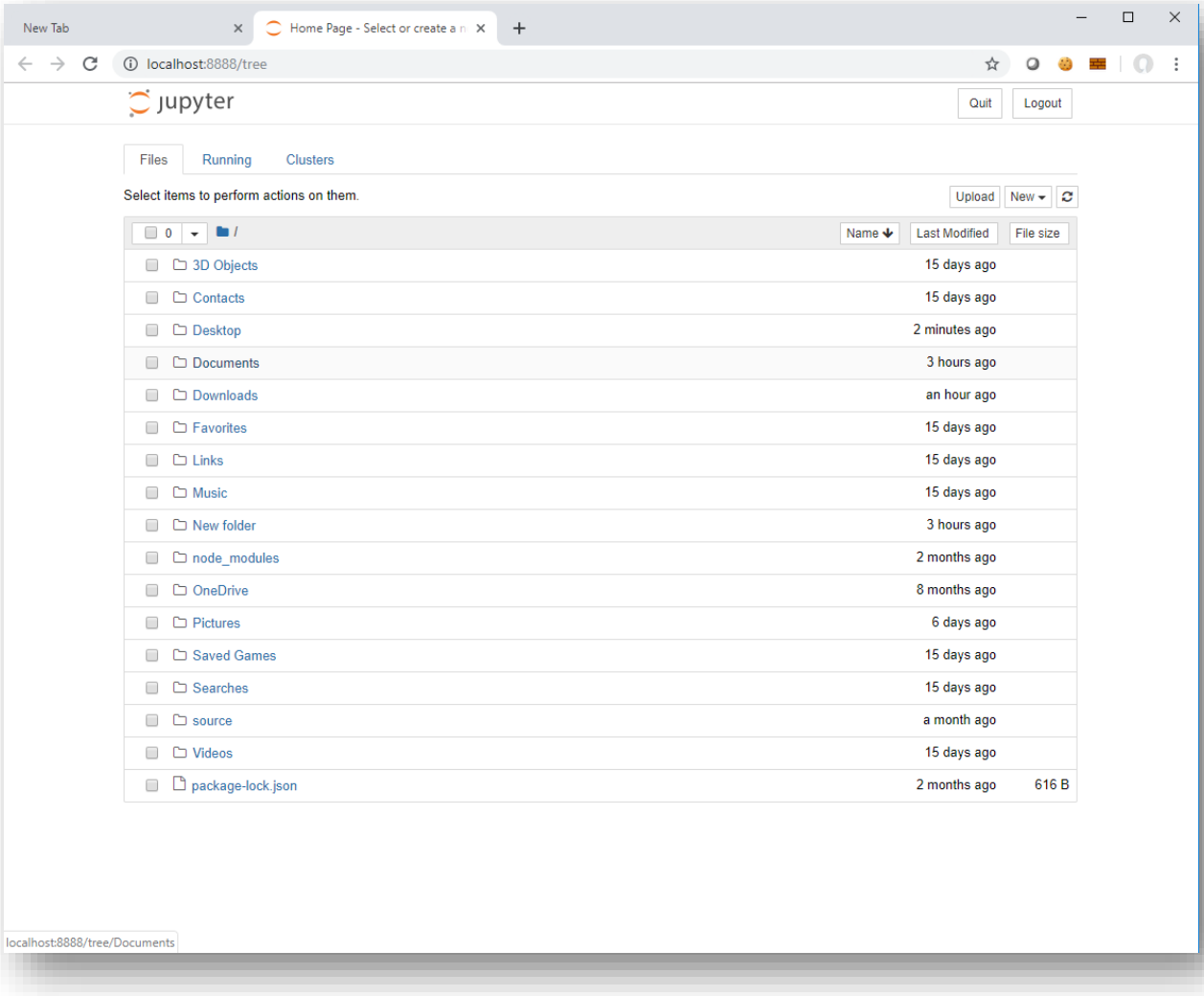
It is recommended to become familiar with Jupyter basic concepts with the online documentation, https://jupyter-notebook.readthedocs.io/en/stable/examples/Notebook/Notebook%20Basics.html

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 to the 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.

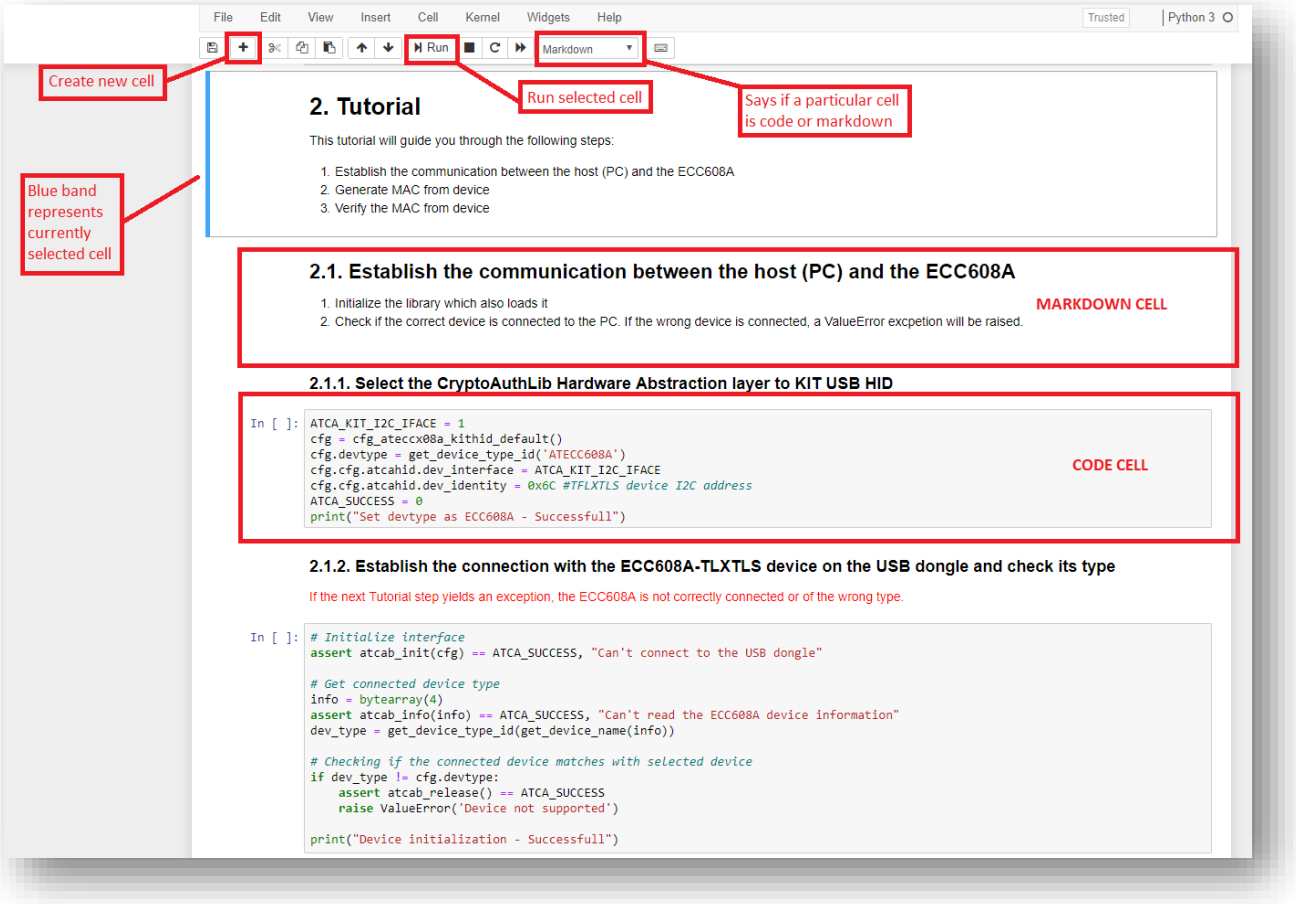


1.3 Introduction to Jupyter Notebook GUI.

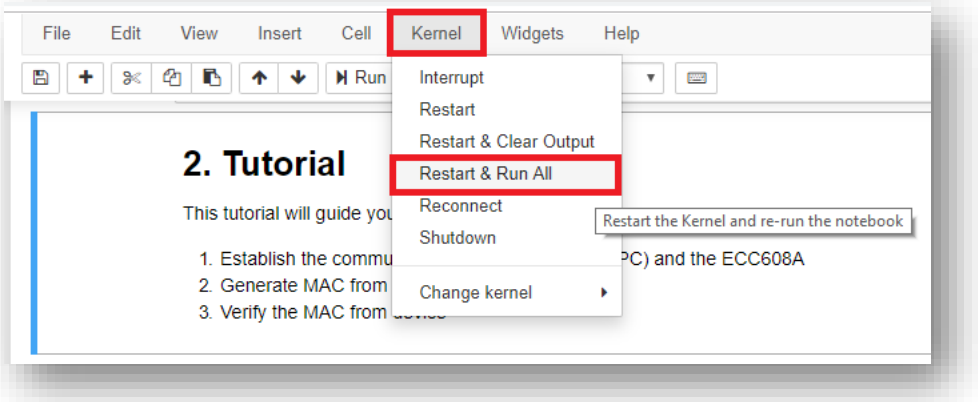
Jupyter Notebooks contain cells where you can either write code or markdown text. Notebooks contain multiple cells, some set as code and others markdown. Code cells contain code that can be executed live, and markdown contains text and images to explain the code.

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 Trust Platform Design Suite comes with Notebook Tutorials to easily prototype popular use cases for TrustFLEX. Here is the list of Jupyter Notebook Tutorials.

Jupyter Notebook Tutorials	**Relative Path**	**Applicable Devices**
Resource Generation	TrustFLEX\00_resource_generation\TFLXTLS_resource_generator.ipynb	TrustFLEX
Accessory Authentication	TrustFLEX\01_accessory_authentication\notebook\ TFLXTLS_accessory_authentication.ipynb	
Firmware Validation	TrustFLEX\02_firmware_validation\notebook\ TFLXTLS_firmware_validation.ipynb	
GCP Connect	TrustFLEX\03_gcp_connect\notebook\TFLXTLS_GCP_connect.ipynb	
IP Protection	TrustFLEX\04_ip_protection\notebook\ TFLXTLS_IP_protection.ipynb	
Secure Public Key Rotation	TrustFLEX\05_public_key_rotation\notebook\ TFLXTLS_public_key_rotation.ipynb	
AWS Custom PKI	TrustFLEX\06_custom_pki_aws\notebook\ TFLXTLS_aws_connect.ipynb	
Azure Connect	TrustFLEX\07_custom_pki_azure\notebook\ TLFXTLS_azure_connect.ipynb	
Accessory Asymmetric Authentication	TrustFLEX\08_asymmetric_authentication\notebook\ TFLXTLS_asymmetric_authentication.ipynb	

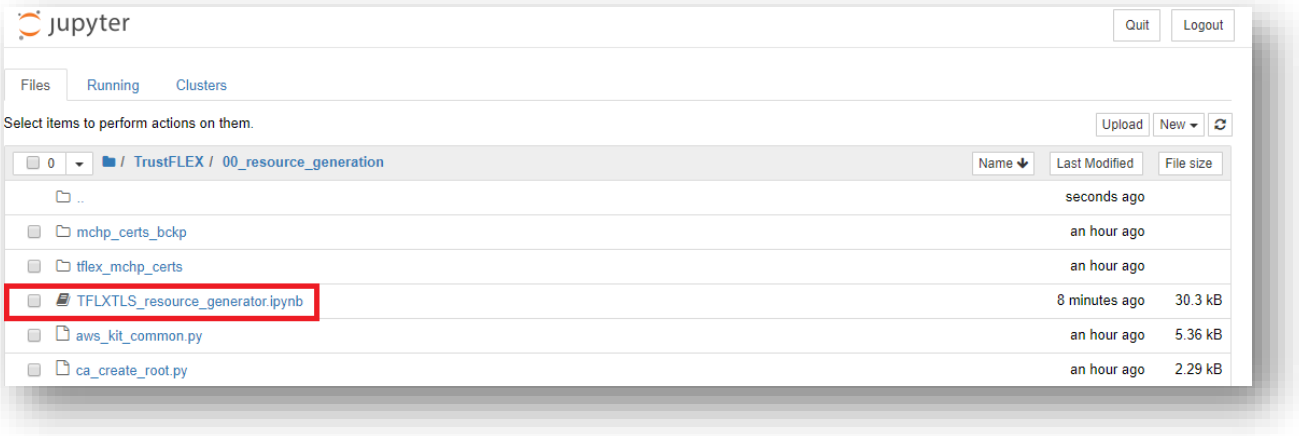
3 Resource Generation Notebook

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

TrustFLEX devices come with pre-programmed 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 data in them.

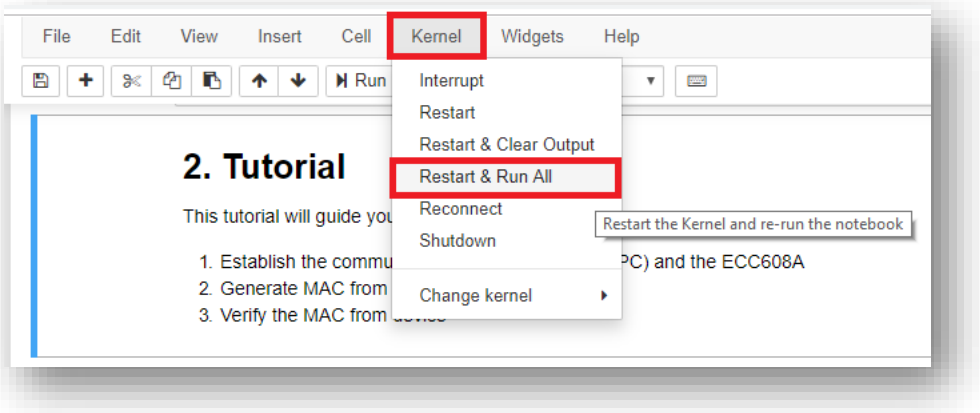
The Resource Generator Notebook will create development keys and certificates for all slots that can be further customized. Keys and Certificate chains are stored in the PC filesystem. These keys should never be used for production purposes as their generation is not handled in a secure environment. 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

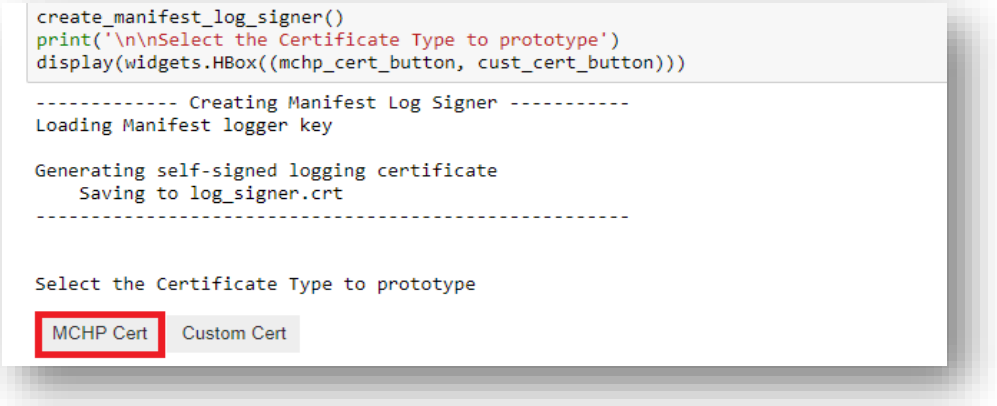
Note: Before executing the cells on Crypto Trust Platform, its required to have factory default program running on SAMD21 of Trust Platform. Refer to 4.3 CryptoAuth TrustPlatform Factory reset section for reloading default program.



Crypto Resource Generator notebook is common for all the use case which comes with option to load the signer certificate and device certificate.

So, it will execute and prompt you to choose between MCHP certificate and a custom certificate chain, press "MCHP Cert" option for this use case.

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.



The output log should look like this.

```
----------------------------------------
MCHP Certs processing...
MCHP certificates found in the device

Backing up certificates from device

Backing up certificates from device - Success

--------------------------------------------------
Root Certificate:
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number:
            77:d3:6d:95:6e:c8:ae:62:05:e5:8e:3a:cb:98:5a:81
        Signature Algorithm: ecdsa-with-SHA256
        Issuer: O = Microchip Technology Inc, CN = Crypto Authentication Root CA 002
        Validity
            Not Before: Nov  8 19:12:19 2018 GMT
            Not After : Nov  8 19:12:19 2058 GMT
        Subject: O = Microchip Technology Inc, CN = Crypto Authentication Root CA 002
        Subject Public Key Info:
            Public Key Algorithm: id-ecPublicKey
                Public-Key: (256 bit)
                pub:
                    04:bd:54:e6:6d:e3:87:54:84:00:6b:53:ae:15:80:
                    d5:0a:a0:69:e7:8a:df:55:78:d8:5c:e2:d5:4d:d5:
                    b8:30:29:6b:ff:dd:6e:6f:72:56:fb:d9:9e:f1:a1:
                    16:b1:1d:33:ad:49:10:3a:a1:85:87:39:dc:fa:e4:
                    37:e1:9d:63:4e
                ASN1 OID: prime256v1
                NIST CURVE: P-256
        X509v3 extensions:
            X509v3 Subject Key Identifier:
                7A:ED:7D:6D:C6:B7:78:9D:B2:38:01:A5:E8:4A:8C:B0:A4:0E:2A:8C
            X509v3 Authority Key Identifier:
                keyid:7A:ED:7D:6D:C6:B7:78:9D:B2:38:01:A5:E8:4A:8C:B0:A4:0E:2A:8C

            X509v3 Basic Constraints: critical
                CA:TRUE
    Signature Algorithm: ecdsa-with-SHA256
         30:45:02:21:00:a1:dc:63:45:90:ec:81:9e:e1:de:5b:81:12:
         65:51:ad:d4:c2:c4:f8:e5:95:28:2e:e0:4b:e7:68:ec:7c:02:
         73:02:20:3e:6b:a7:4e:9e:4c:0a:d6:8c:24:b0:fb:2e:e7:93:
         d2:e6:be:94:65:ca:15:d0:ea:5b:c8:7f:55:79:99:5c:ad
-----BEGIN CERTIFICATE-----
MIIB8TCCAZegAwIBAgIQd9NtlW7IrmIF5Y46y5hagTAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBSb290IENBIDAwMjAgFw0xODExMDgxOTEyMTlaGA8y
MDU4MTEwODE5MTIxOVowTzEhMB8GA1UECgwYTWljcm9jaGlwIFRlY2hub2xvZ3kg
SW5jMSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gUm9vdCBDQSAwMDIw
```

WTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAAS9VOZt44dUhABrU64VgNUKoGnnit9V
eNhc4tVN1bgwKWv/3W5vclb72Z7xoRaxHTOtSRA6oYWHOdz65DfhnWNOo1MwUTAd
BgNVHQ4EFgQUeu19bca3eJ2yOAGl6EqMsKQOKowwHwYDVR0jBBgwFoAUeu19bca3
eJ2yOAGl6EqMsKQOKowwDwYDVR0TAQH/BAUwAwEB/zAKBggqhkjOPQQDAgNIADBF
AiEAodxjRZDsgZ7h3luBEmVRrdTCxPjllSgu4EvnaOx8AnMCID5rp06eTArWjCSw
+y7nk9LmvpRlyhXQ6lvIf1V5mVyt
-----END CERTIFICATE-----

Validate Root Certificate:
OK

Signer Certificate:
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number:
            79:0a:a7:d5:7d:73:dc:e9:6d:65:db:66:8b:76:b2:5e
        Signature Algorithm: ecdsa-with-SHA256
        Issuer: O = Microchip Technology Inc, CN = Crypto Authentication Root CA 002
        Validity
            Not Before: Dec 14 19:00:00 2018 GMT
            Not After : Dec 14 19:00:00 2049 GMT
        Subject: O = Microchip Technology Inc, CN = Crypto Authentication Signer F600
        Subject Public Key Info:
            Public Key Algorithm: id-ecPublicKey
                Public-Key: (256 bit)
                pub:
                    04:76:47:41:70:b2:63:e7:99:54:bc:85:bb:12:e9:
                    fe:70:0c:5b:8d:d4:d6:93:45:98:c2:29:a7:68:02:
                    0e:4e:0b:6d:48:75:d0:ed:a1:ee:f6:5f:91:5f:c6:
                    b1:16:46:c5:a1:ca:63:1f:62:55:68:74:47:69:c5:
                    de:83:b5:89:6a
                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:
                FB:DC:AA:12:8A:FA:C1:B5:92:8F:CD:AB:11:DB:09:3E:CF:4D:BE:F6
            X509v3 Authority Key Identifier:
                keyid:7A:ED:7D:6D:C6:B7:78:9D:B2:38:01:A5:E8:4A:8C:B0:A4:0E:2A:8C

    Signature Algorithm: ecdsa-with-SHA256
         30:46:02:21:00:c6:30:31:e9:a9:8b:30:4e:68:7e:06:c5:39:
         79:2a:c5:7a:5c:01:4d:30:17:de:dc:d2:7d:d5:1d:cd:86:37:
         ff:02:21:00:c6:a2:2c:6e:b1:ae:5f:85:91:49:cb:5d:e7:77:
         8b:a3:f3:0b:e9:3d:9b:80:6f:94:bf:3d:90:a5:84:78:61:dc
-----BEGIN CERTIFICATE-----
MIICBTCCAaqgAwIBAgIQeQqn1X1z3OltZdtmi3ayXjAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBSb290IENBIDAwMjAgFw0xODEyMTQxOTAwMDBaGA8y

MDQ5MTIxNDE5MDAwMFowTzEhMB8GA1UECgwYTWljcm9jaGlwIFRlY2hub2xvZ3kg
SW5jMSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gU2lnbmVyIEY2MDAw
WTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAAR2R0FwsmPnmVS8hbsS6f5wDFuN1NaT
RZjCKadoAg5OC21IddDtoe72X5FfxrEWRsWhymMfYlVodEdpxd6DtYlqo2YwZDAO
BgNVHQ8BAf8EBAMCAYYwEgYDVR0TAQH/BAgwBgEB/wIBADAdBgNVHQ4EFgQU+9yq
Eor6wbWSj82rEdsJPs9NvvYwHwYDVR0jBBgwFoAUeu19bca3eJ2yOAGl6EqMsKQO
KowwCgYIKoZIzj0EAwIDSQAwRgIhAMYwMempizBOaH4GxTl5KsV6XAFNMBfe3NJ9
1R3Nhjf/AiEAxqIsbrGuX4WRSctd53eLo/ML6T2bgG+Uvz2QpYR4Ydw=
-----END CERTIFICATE-----

Validate Signer Certificate:
OK

Device Certificate:
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number:
            5a:cb:a3:f7:cf:bf:c5:28:92:cd:e1:9f:a3:ac:9d:17
        Signature Algorithm: ecdsa-with-SHA256
        Issuer: O = Microchip Technology Inc, CN = Crypto Authentication Signer F600
        Validity
            Not Before: Aug 21 22:00:00 2019 GMT
            Not After : Aug 21 22:00:00 2047 GMT
        Subject: O = Microchip Technology Inc, CN = 0123867D566FFB7701 ATECC
        Subject Public Key Info:
            Public Key Algorithm: id-ecPublicKey
                Public-Key: (256 bit)
                pub:
                    04:fc:57:67:b6:fb:ae:50:60:ca:96:5a:ef:41:b1:
                    c5:d6:a1:60:61:87:8e:a4:78:f4:4d:18:d0:76:9d:
                    ad:62:24:b3:68:c2:1a:62:cb:0a:fd:ef:f5:b4:0c:
                    e3:55:ec:f0:40:bb:41:83:61:02:ef:20:3c:63:93:
                    32:d4:90:41:ab
                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:
                43:9E:4F:45:79:35:CE:DC:D4:35:B9:4F:4A:23:69:E1:2D:89:33:04
            X509v3 Authority Key Identifier:
                keyid:FB:DC:AA:12:8A:FA:C1:B5:92:8F:CD:AB:11:DB:09:3E:CF:4D:BE:F6

    Signature Algorithm: ecdsa-with-SHA256
         30:45:02:21:00:83:32:78:25:9c:5a:07:7c:4a:04:f8:b5:c4:
         57:d6:08:70:ee:c3:d4:79:9c:b6:14:8e:5e:86:54:38:50:cf:
         ec:02:20:58:e1:cf:e1:f6:e2:17:08:c3:5a:fc:86:91:31:ef:
         65:09:e0:e4:ba:7e:02:8e:4c:49:d1:4b:e3:ac:35:33:f7
-----BEGIN CERTIFICATE-----
MIIB9TCCAZugAwIBAgIQWsuj98+/xSiSzeGfo6ydFzAKBggqhkjOPQQDAjBPMSEw

HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBTaWduZXIgRjYwMDAgFw0xOTA4MjEyMjAwMDBaGA8y
MDQ3MDgyMTIyMDAwMFowRjEhMB8GA1UECgwYTWljcm9jaGlwIFRlY2hub2xvZ3kg
SW5jMSEwHwYDVQQDDBgwMTIzODY3RDU2NkZGQjc3MDEgQVRFQ0MwWTATBgcqhkjO
PQIBBggqhkjOPQMBBwNCAAT8V2e2+65QYMqWWu9BscXWoWBhh46kePRNGNB2na1i
JLNowhpiywr97/W0DONV7PBAu0GDYQLvIDxjkzLUkEGro2AwXjAMBgNVHRMBAf8E
AjAAMA4GA1UdDwEB/wQEAwIDiDAdBgNVHQ4EFgQUQ55PRXk1ztzUNblPSiNp4S2J
MwQwHwYDVR0jBBgwFoAU+9yqEor6wbWSj82rEdsJPs9NvvYwCgYIKoZIzj0EAwID
SAAwRQIhAIMyeCWcWgd8SgT4tcRX1ghw7sPUeZy2FI5ehlQ4UM/sAiBY4c/h9uIX
CMNa/IaRMe9lCeDkun4CjkxJ0UvjrDUz9w==
-----END CERTIFICATE-----

Validate Device Certificate:
OK

Generated the manifest file 0123867d566ffb7701_manifest.json
MCHP Certificate processing completed successfully

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

After running this Notebook, it generates the required resources and program data zone with generated secrets, keys and certificates.

For this use case, Signer and Device certificates are required along with Root Public Key. When the MCHP certificates are available on device, MCHP cert definition files to be used. When the Cust certificates are generated and loaded to device, generated definition files to be used.

4 Use Case Prototyping

This hands-on lab is intended to demonstrate the usage of host to authenticate Accessory device. It uses asymmetric authentication where host reads certificates from accessory to validate chain of trust, followed by device private key.

This process uses a challenge-response model. In this model, host authenticates the accessory device based on response. Response (Signature) is calculated on the accessory device to prove that it holds the private key associated to its certificate shared to the host. Then the response will be verified by the host using Public key in Device certificate to authenticate the accessory.

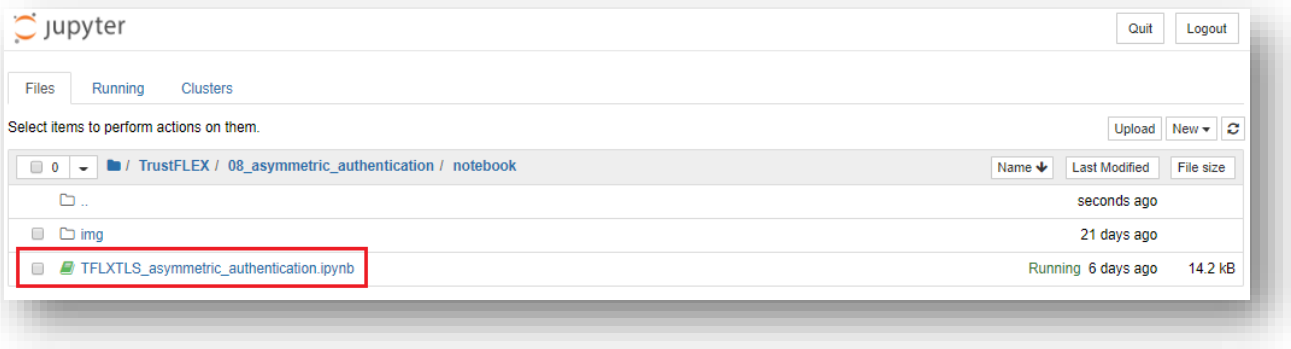
This lab is developed by simulating TrustFLEX device as Accessory and host to authenticate the accessory. Since Trust&GO use case demonstrate using MCHP certificates, here we would be Custom certificates to verify the authentication.

The resource generation for TrustFLEX device will load prototyping certificates to device along with custom certificates definition files.

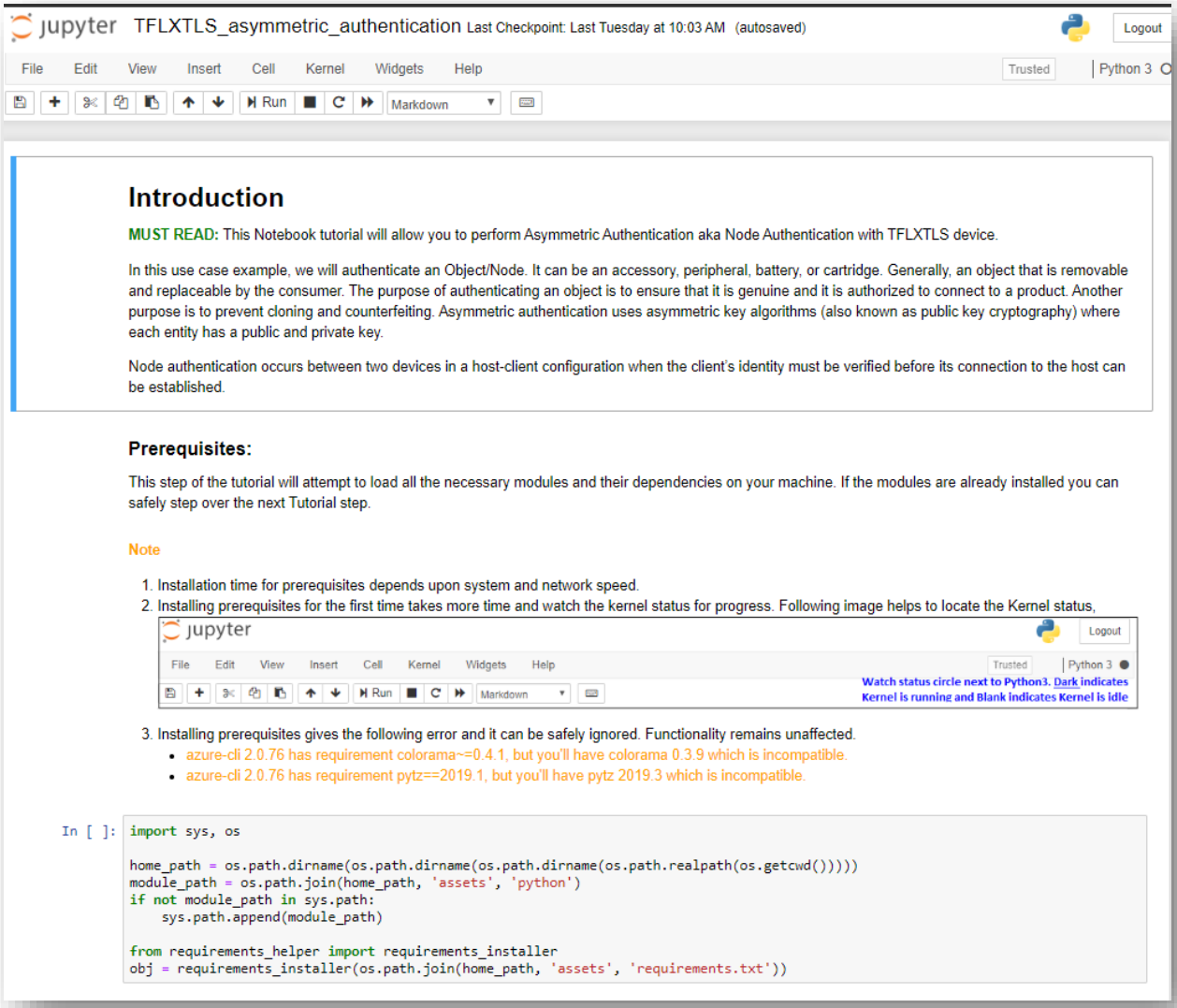
Following sections provides detail steps to execute the usecase both on Jupyter Notebook and on Embedded project

4.1 Running Accessory Asymmetric Authentication example on Jupyter Notebook:

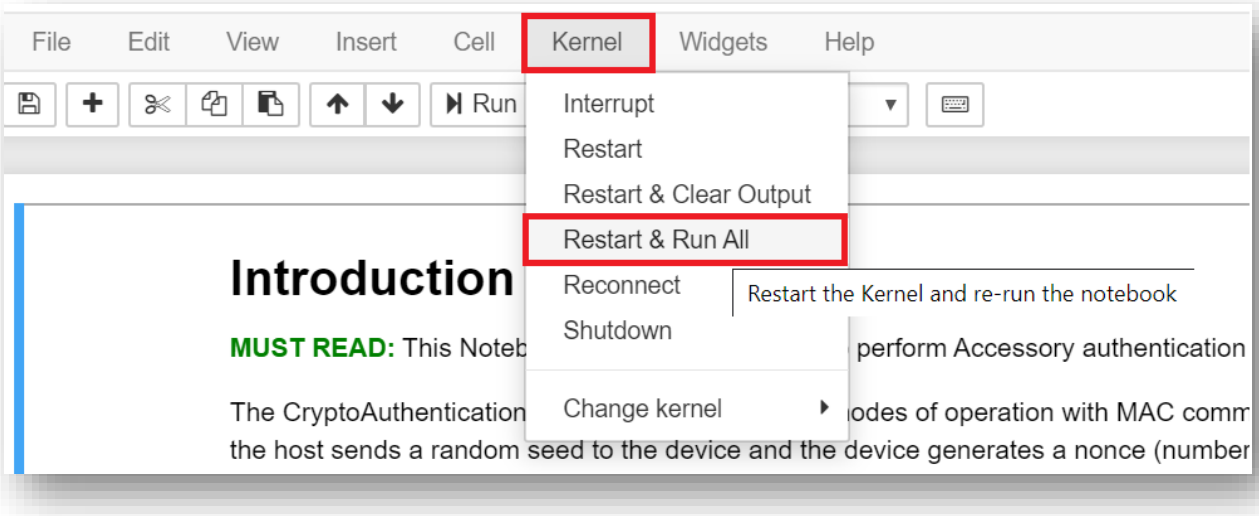
1. From the Jupyter Home page, navigate to **TrustFLEX\08_asymmetric_authentication\notebook\TFLXTLS_asymmetric_authentication.ipynb** notebook file and open it.



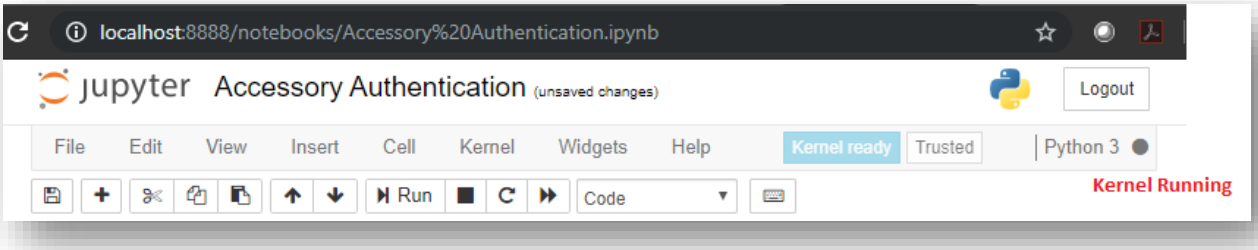
Opening the notebook from Jupyter home page should load the following on the browser,

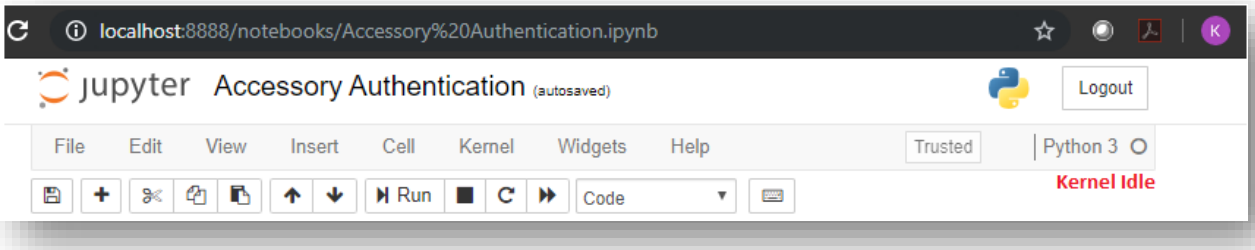


2. Run All Cells by using Kernel -> Restart & Run All



3. 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)





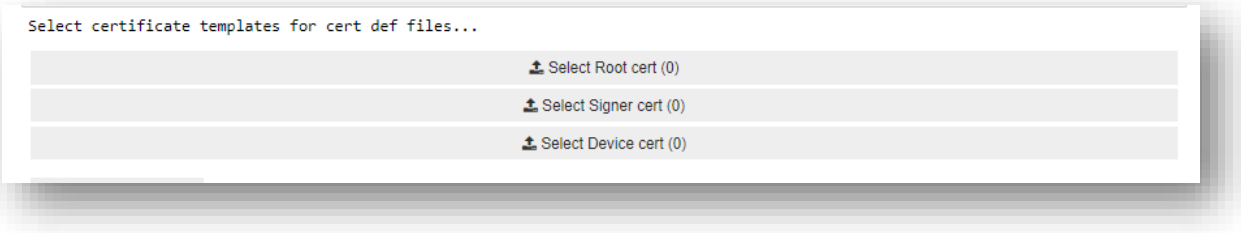
4. Navigate through different cells output for the description of the step and result from the execution.

5. There are 2 major steps in this lab
   Verify Certificate Chain
   The certificate chain verification process includes reading the certificates from device, validating its signatures using CA's Public Key.

   The host MCU contains the Root's Public Key stored on it. Certificate chain verification process starts by reading both Signer and Device certificates. Since, these certificates are stored as compressed certificates on the device, its required to rebuild them using certificate definition information.

These definition files can be regenerated based on the certificate templates.

Select certificate templates
On executing all the cells, the following buttons will be available to choose the certificate templates.

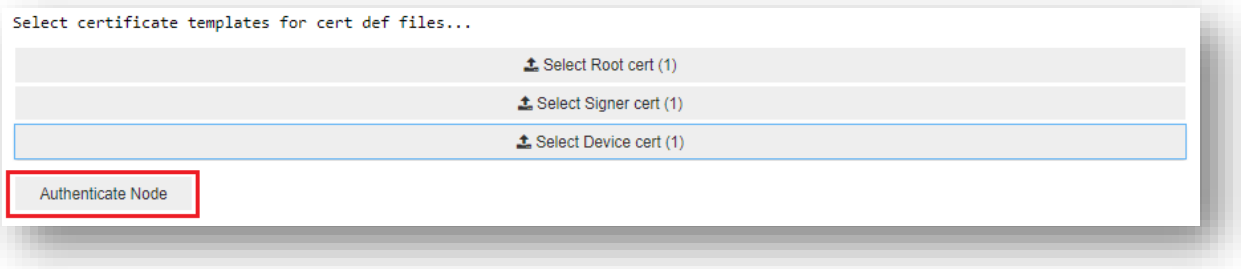


Since the root certificate or its details are not stored on Secure element, its required to provide the actual root that should be used to validate Signer certificate.

For Signer and Device certificates select the template certificates i.e. one generated in resource generation.

Authenticate Accessory/Node
In the above step, we have provided required certificates information to fetch and validate Signer and Device certificates from Secure element.

On clicking 'Authenticate Node' button, the process of rebuilding certificates, validation and Accessory authentication gets triggered.



Client Rebuild Certificates:
In this step Signer and Device certificate definitions will be regenerated based on root certificate and template certificates provided.

Once the definitions are generated, host triggers set of commands to know the max size of the certificate and read the actual certificates from secure element. One can see root, signer and device certificates in the log.

Host to verify certificate chain:
On reading the certificates, host starts certificate chain verification. This step is currently limited to signature verification only.

In the resource generation root certificate is created as self-signed certificate. Hence, root certificate is validated using its own public key. Once its validated, Signer certificate is validated using root public key and device certificate is validated using Signer public key provided in the signer certificate.

Challenge-Response-Verify:
Once the certificates are validated, its important to check the accessory holds the original private key used to generate device certificate signing request. This will be done through a challenge response method.

Host generates as random challenge and sends to accessory for signing. Accessory would sign the challenge using the private key used for Device CSR. Once, host receives the signature from accessory, it verifies the same using public key provided in the Device certificate.

The result will be success only if the private and public key corresponds to each other, this indicates the connected accessory is authentic.

In case if private key is not associated to public key in the device certificate, this verification step would fail, this indicates the connected accessory is not authentic.

Pressing the button, turns it Green or Red. Green indicates that the device is authenticated by host and Red indicates the authentication is failed.

4.2 Running Accessory Asymmetric Authentication example on Embedded platform

This usecase can also be executed on Embedded platform. Once the resources are generated, both Atmel Studio and MPLAB projects provided can be used to run the application on CryptoAuth Trust Platform.

Note: This usecase requires resource generation notebook executed prior to using embedded projects.

4.2.1 Atmel Studio

1. Open **asymmetric_auth.atsln** project by navigating to Atmel Studio -> File -> open -> **TrustFLEX\08_asymmetric_authentication\c\studio\asymmetric_auth.atsln**

2. The application source code asymmetric_auth.c is available at **TrustFLEX\08_asymmetric_authentication\c\asymmetric_auth.c.** Other supporting files can be found under **assets\dependencies**

3. Program the Crypto 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, the firmware will do Accessory Asymmetric Authentication operation. Depending on the result, the CryptoAuth Trust Platform board's status LED will blink at different rates.

   If succeeds, LED blinks once every second.
   If fails, LED blinks five times every second.

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


COM32 - Tera Term VT
File Edit Setup Control Window Help
Device revision: 00 00 60 02
Device serial number: 01 23 29 79 CB 29 3B A5 01
CLIENT: Rebuilt Signer Certificate:
-----BEGIN CERTIFICATE-----
MIICBTCCAaqgAwIBAgIQeQqn1X1z3OltZdtmi3ayXjAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBSb290IENBIDAwMjAgFw0xODEyMTQxOTAwMDBaGA8y
MDQ5MTIxNDE5MDAwMFowTzEhMB8GA1UECgwYTWljcm9jaGlwIFR1Y2hub2xvZ3kg
SW5jMSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gU2lnbmVyIEY2MDAw
WTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAAR2R0FwsmPnmVS8hbsS6f5wDFuN1NaT
RZjCKadoAg5OC21IddDtoe72X5FfxrEWRsWhymMfY1VodEdpxd6DtY1qo2YwZDAO
BgNVHQ8BAf8EBAMCAYYwEgYDVR0TAQH/BAgwBgEB/wIBADAdBgNVHQ4EFgQU+9yq
Eor6wbWSj82rEdsJPs9NvvYwHwYDVR0jBBgwFoAUeu19bca3eJ2yOAG16EqMsKQO
KowwCgYIKoZIzj0EAwIDSQAwRgIhAMYwMempizBOaH4GxTl5KsV6XAFNMBfe3NJ9
1R3Nhjf/AiEAxqIsbrGuX4WRSctd53eLo/ML6T2bgG+Uvz2QpYR4Ydw=
-----END CERTIFICATE-----
CLIENT: Rebuilt Device Certificate:
-----BEGIN CERTIFICATE-----
MIIB9TCCAZugAwIBAgIQYlvNgfJuMqdIpWEADSpuWzAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBTaWduZXIgRjYwMDAgFw0xOTA3MzEyMTAwMDBaGA8y
MDQ3MDczMTIxMDAwMFowRjEhMB8GA1UECgwYTWljcm9jaGlwIFR1Y2hub2xvZ3kg
SW5jMSEwHwYDVQQDDBgwMTIzMjk3OUNCMjkzQkE1MDEgQURFQ0MwWTATBgcqhkjO
PQIBBggqhkjOPQMBBwNCAASZ2Oqd0R6AEDuObwxdFLwJjT16yq7HGqThiaLpkN0K
eG5qZOJl0HCPdBoWplEsDcw26q0X6uIMuqyrRTL883Reo2AwXjAMBgNVHRMBAf8E
AjAAMA4GA1UdDwEB/wQEAwIDiDAdBgNVHQ4EFgQUCwT6mxFlijOMO0UmHxvIo1ox
k8EwHwYDVR0jBBgwFoAU+9yqEor6wbWSj82rEdsJPs9NvvYwCgYIKoZIzj0EAwID
SAAwRQIgGnifKevE7ZIp2mpAQIW6OWHfitgH4uJlCof1DWkGb18CIQDii8oVy/HU
aLN9cpDc2FfRDRGf5UdU1ZR35Jv/I6VChw==
-----END CERTIFICATE-----
HOST: Signer certificate verified against root public key!
HOST: Device certificate verified against signer public key!
HOST: Generated challenge:
06 E6 31 DB 55 4B B3 62 3A 37 71 5F 21 19 2B F7
B5 B2 92 E3 2C 95 FB BB 77 FB 63 29 70 5C 2A 5F
CLIENT: Calculated response to host challenge:
4F DB B1 06 07 FC 6B 2B 7B 37 4E 00 99 03 19 B1
83 9E 41 D3 AE F1 86 14 E7 1A F6 6C 48 0E 8A 20
C2 CF 48 44 53 1E 35 90 0A 9C 58 93 55 D1 08 B1
95 93 4A 12 69 EC 04 63 CE 61 8A 15 58 13 01 D4
HOST: Device public key from certificate:
99 D8 EA 9D D1 1E 80 10 3B 8E 6F 0C 5D 14 BC 09
8D 3D 7A CA AE C7 1A A4 E1 89 A2 E9 90 DD 0A 78
6E 6A 64 E2 65 D0 70 8F 74 1A 16 A6 51 2C 0D CC
36 EA AD 17 EA E2 0C BA AC AB 45 32 FC F3 74 5E
HOST: Device response to challenge verified!
Accessory device authenticated successfully
Execution completed with status 00

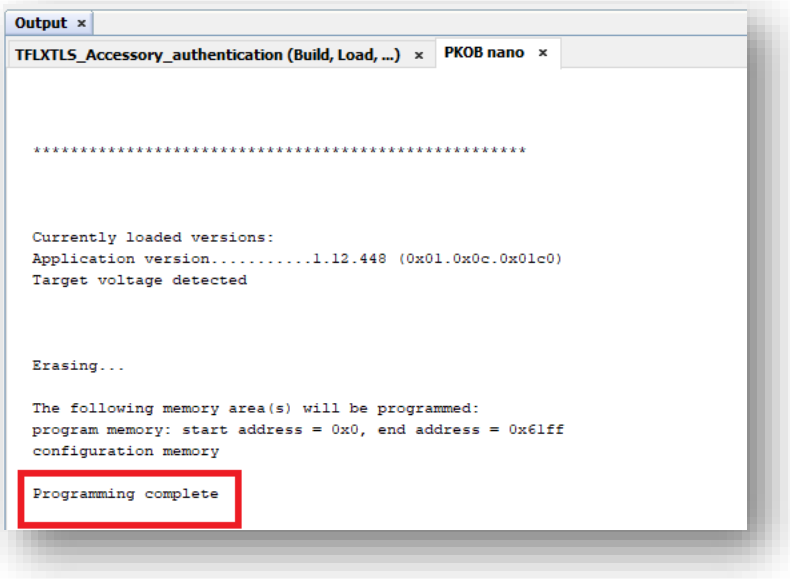
4.2.2 MPLAB:

1. Open **asymmetric_auth.X** project by navigating to MPLAB -> File -> Open Project -> **TrustFLEX\08_asymmetric_authentication\c\mplab\asymmetric_auth.X**

2. The application source code asymmetric_auth.c is available at **TrustFLEX\08_asymmetric_authentication\c\asymmetric_auth.c.** Other supporting files can be found under **assets\dependencies**

3. Program the Crypto Trust platform by navigating to **asymmetric_auth -> 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, the firmware will do Accessory Asymmetric Authentication operation. Depending on the output, the Cryptoauth Trust Platform board's status LED will blink at different rates.

If succeeds, LED blinks once every second.
If fails, LED blinks five times every second.

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


COM32 - Tera Term VT
File Edit Setup Control Window Help
Device revision: 00 00 60 02
Device serial number: 01 23 29 79 CB 29 3B A5 01
CLIENT: Rebuilt Signer Certificate:
-----BEGIN CERTIFICATE-----
MIICBTCCAaqgAwIBAgIQeQqn1X1z3OltZdtmi3ayXjAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBSb290IENBIDAwMjAgFw0xODEyMTQxOTAwMDBaGA8y
MDQ5MTIxNDE5MDAwMFowTzEhMB8GA1UECgwYTWljcm9jaGlwIFR1Y2hub2xvZ3kg
SW5jMSowKAYDVQQDDCFDcnlwdG8gQXV0aGVudGljYXRpb24gU2lnbmVyIEY2MDAw
WTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAAR2R0FwsmPnmVS8hbsS6f5wDFuN1NaT
RZjCKadoAg5OC21IddDtoe72X5FfxrEWRsWhymMfY1VodEdpxd6DtY1qo2YwZDAO
BgNVHQ8BAf8EBAMCAYYwEgYDVR0TAQH/BAgwBgEB/wIBADAdBgNVHQ4EFgQU+9yq
Eor6wbWSj82rEdsJPs9NvvYwHwYDVR0jBBgwFoAUeu19bca3eJ2yOAG16EqMsKQO
KowwCgYIKoZIzj0EAwIDSQAwRgIhAMYwMempizBOaH4GxTl5KsV6XAFNMBfe3NJ9
1R3Nhjf/AiEAxqIsbrGuX4WRSctd53eLo/ML6T2bgG+Uvz2QpYR4Ydw=
-----END CERTIFICATE-----
CLIENT: Rebuilt Device Certificate:
-----BEGIN CERTIFICATE-----
MIIB9TCCAZugAwIBAgIQYlvNgfJuMqdIpWEADSpuWzAKBggqhkjOPQQDAjBPMSEw
HwYDVQQKDBhNaWNyb2NoaXAgVGVjaG5vbG9neSBJbmMxKjAoBgNVBAMMIUNyeXB0
byBBdXRoZW50aWNhdGlvbiBTaWduZXIgRjYwMDAgFw0xOTA3MzEyMTAwMDBaGA8y
MDQ3MDczMTIxMDAwMFowRjEhMB8GA1UECgwYTWljcm9jaGlwIFR1Y2hub2xvZ3kg
SW5jMSEwHwYDVQQDDBgwMTIzMjk3OUNCMjkzQkE1MDEgQURFQ0MwWTATBgcqhkjO
PQIBBggqhkjOPQMBBwNCAASZ2Oqd0R6AEDuObwxdFLwJjT16yq7HGqThiaLpkN0K
eG5qZOJl0HCPdBoWplEsDcw26q0X6uIMuqyrRTL883Reo2AwXjAMBgNVHRMBAf8E
AjAAMA4GA1UdDwEB/wQEAwIDiDAdBgNVHQ4EFgQUCwT6mxFlijOMO0UmHxvIo1ox
k8EwHwYDVR0jBBgwFoAU+9yqEor6wbWSj82rEdsJPs9NvvYwCgYIKoZIzj0EAwID
SAAwRQIgGnifKevE7ZIp2mpAQIW6OWHfitgH4uJlCof1DWkGb18CIQDii8oVy/HU
aLN9cpDc2FfRDRGf5UdU1ZR35Jv/I6VChw==
-----END CERTIFICATE-----
HOST: Signer certificate verified against root public key!
HOST: Device certificate verified against signer public key!
HOST: Generated challenge:
06 E6 31 DB 55 4B B3 62 3A 37 71 5F 21 19 2B F7
B5 B2 92 E3 2C 95 FB BB 77 FB 63 29 70 5C 2A 5F
CLIENT: Calculated response to host challenge:
4F DB B1 06 07 FC 6B 2B 7B 37 4E 00 99 03 19 B1
83 9E 41 D3 AE F1 86 14 E7 1A F6 6C 48 0E 8A 20
C2 CF 48 44 53 1E 35 90 0A 9C 58 93 55 D1 08 B1
95 93 4A 12 69 EC 04 63 CE 61 8A 15 58 13 01 D4
HOST: Device public key from certificate:
99 D8 EA 9D D1 1E 80 10 3B 8E 6F 0C 5D 14 BC 09
8D 3D 7A CA AE C7 1A A4 E1 89 A2 E9 90 DD 0A 78
6E 6A 64 E2 65 D0 70 8F 74 1A 16 A6 51 2C 0D CC
36 EA AD 17 EA E2 0C BA AC AB 45 32 FC F3 74 5E
HOST: Device response to challenge verified!
Accessory device authenticated successfully
Execution completed with status 00

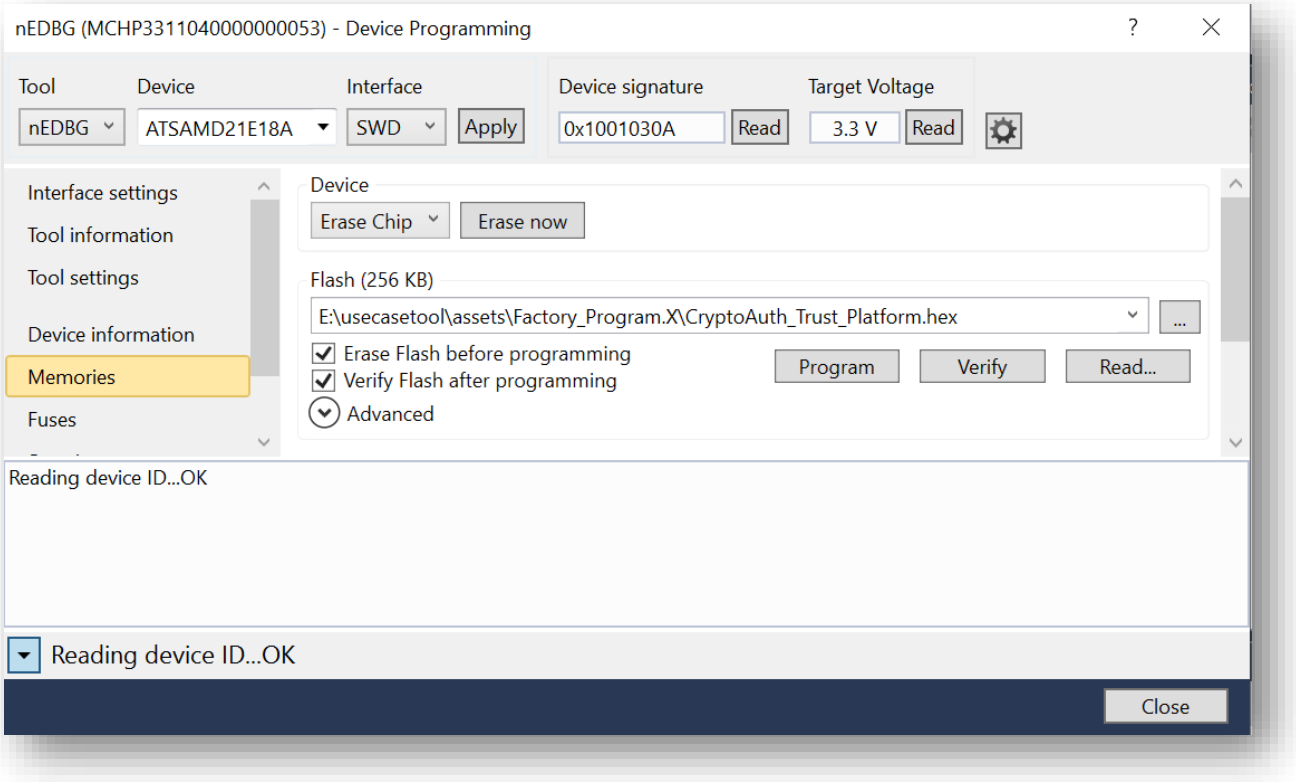
4.3 CryptoAuth TrustPlatform Factory reset

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

5 FAQ

1. **What are the reasons for "AssertionError: Can't connect to the USB dongle" error?**
   There are many possibilities like,
   1. Crypto Trust Platform is having different application than factory reset firmware. Refer to "CryptoAuth TrustPlatform Factory reset" section any usecase TrustFLEX Guide for reloading it
   2. Check the switch positions on Crypto Trust Platform and/or ATECC608A 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 "CryptoAuth TrustPlatform Factory reset" section any usecase TrustFLEX Guide for reloading it.

3. **Why does my C projects generates No such file or directory with ../../../ TFLXTLS_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

7. **How to know whether C project is executing on Trust Platform or not after programming?**
   Once the programming is done, the firmware will do use case operation. Depending on the use case operation's output, the Crypto Trust Platform board's status LED will blink at different rates.
   If use case operation succeeds, LED blinks once every second. If it fails, LED blinks five times every second.

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

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Norway - Trondheim
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