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# STM32U5 Azure IoT Hands-on

Alnur ELBERIER

October 2022

# Agenda

1 Download Material

2 Check Requirements

3 Hardware

4 Security

5 X-Cube-Azure Walkthrough

6 Board Distribution

7 Hands-On

8 Option Byte Reset

# Download Material

# Workshop Material

Please choose one of download options below

## Option 1: Zip Download Link

- <https://tinyurl.com/st-iot>

## Option 2: Clone GitHub Repo

- `git clone https://github.com/AlnurElberier/ST\_Azure\_Workshop\_2022.git`

# Check Requirements

# Workshop Requirements

- Windows
- Python3
  - Pyserial
- Azure CLI
- STM32CubeProgrammer
- Git Hub
- X-CUBE-AZURE

# Pre-Requisite Check Script

- Navigate to the ST\_Azure\_Workshop folder you just downloaded
- Double click the AzCheckPrereq.bat script

Name	Date modified	Type	Size
AzCheckPrereq.bat	9/15/2022 12:58 PM	Windows Batch File	2 KB
IoT_Central_Workshop.pdf	9/15/2022 12:58 PM	Microsoft Edge P...	5,808 KB
STM32U5 Azure IoT Hands-on_9_15_22.pdf	9/15/2022 12:58 PM	Microsoft Edge P...	1,144 KB

```
C:\WINDOWS\system32\cmd.exe
STM32CubeProgrammer Successfully Installed
Python 3.10.7
Python Successfully Installed
Requirement already satisfied: pyserial in c:\users\alnur elberier\scoop\persist\python\lib\site-packages (3.5)
azure-cli 2.34.1 *
core 2.34.1 *
telemetry 1.0.6 *
Extensions:
account 0.2.3
azure-iot 0.17.1
Dependencies:
msal 1.16.0
azure-mgmt-resource 20.0.0
Python location 'C:\Program Files (x86)\Microsoft SDKs\Azure\CLI2\python.exe'
Extensions directory 'C:\Users\alnur elberier\.azure\cliextensions'
Python (Windows) 3.8.9 (tags/v3.8.9:a743f81, Apr 6 2021, 13:22:56) [MSC v.1928 32 bit (Intel)]
Legal docs and information: aka.ms/AzureCliLegal
AZ CLI Successfully Installed
```

# Hardware



# STM32U5 Microcontrollers

The new reference for secure and smart IoT applications



## Higher Security

Certified PSA L3 and SESIP L3

## Lower Power

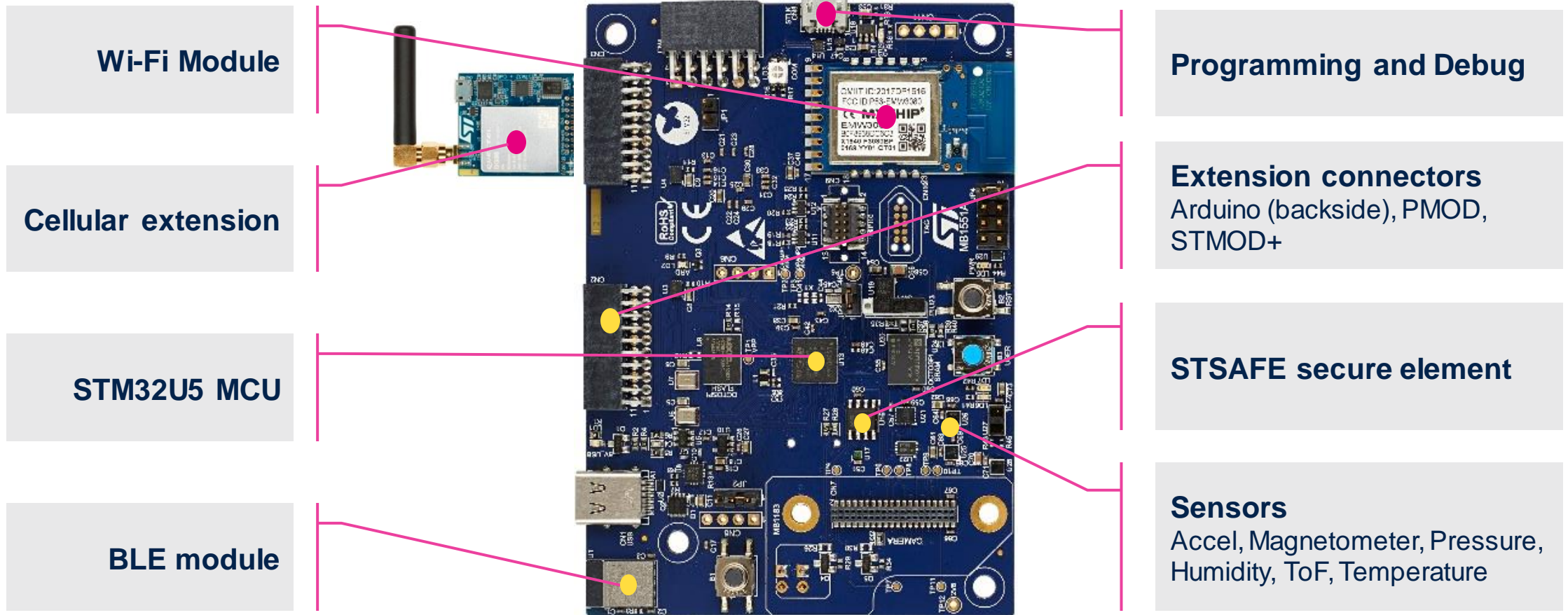
58 ULPMark-CM

## Richer applications

Cortex-M33 @160MHz, extended features set

# STM32U5 IoT Kit

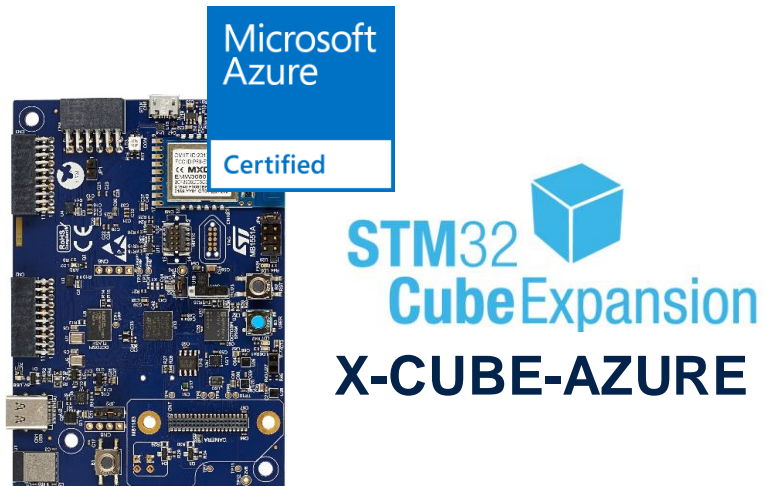
Your reference board for IoT Proof-of-Concept



[B-U585H-IOT02A](#)

# Azure IoT on STM32U5

**X-CUBE-AZURE reference integration simplifying your development**



**Certified for Microsoft Azure plug and play**

**Leveraging ARM Trusted Firmware-M (TF-M)**

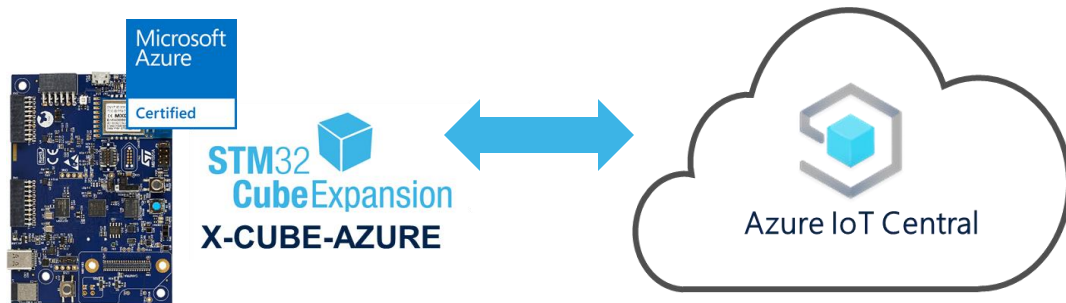
**Based on AzureRTOS middleware**

**Supporting WIFI and Cellular (Cat M1)**

**using STSAFE for simpler provisioning and even higher security**

# Azure IoT on STM32U5

## Reference implementation supporting Azure IoT and app Services



### Azure IoT Central

Data visualization and analysis, device management and

### Azure IoT Hub

device provisioning services

### IoT plug and Play

### Device update for IoT Hub (public preview)

### Microsoft Defender for IoT

# Azure IoT Central Quick Connect

## Abstracts Firmware customization and registration process

- Allows Cloud IoT/Data architects to focus on developing power of the Cloud IoT platform proof of concepts.
- Connect to Microsoft Azure IoT Central and perform telemetry in minutes
- Solution Components:
  - *B-U585I-IOT02A Discovery Kit*
  - *Reference Binary*
  - *Quick connect scripts*
  - *Cloud visualization*

# Security



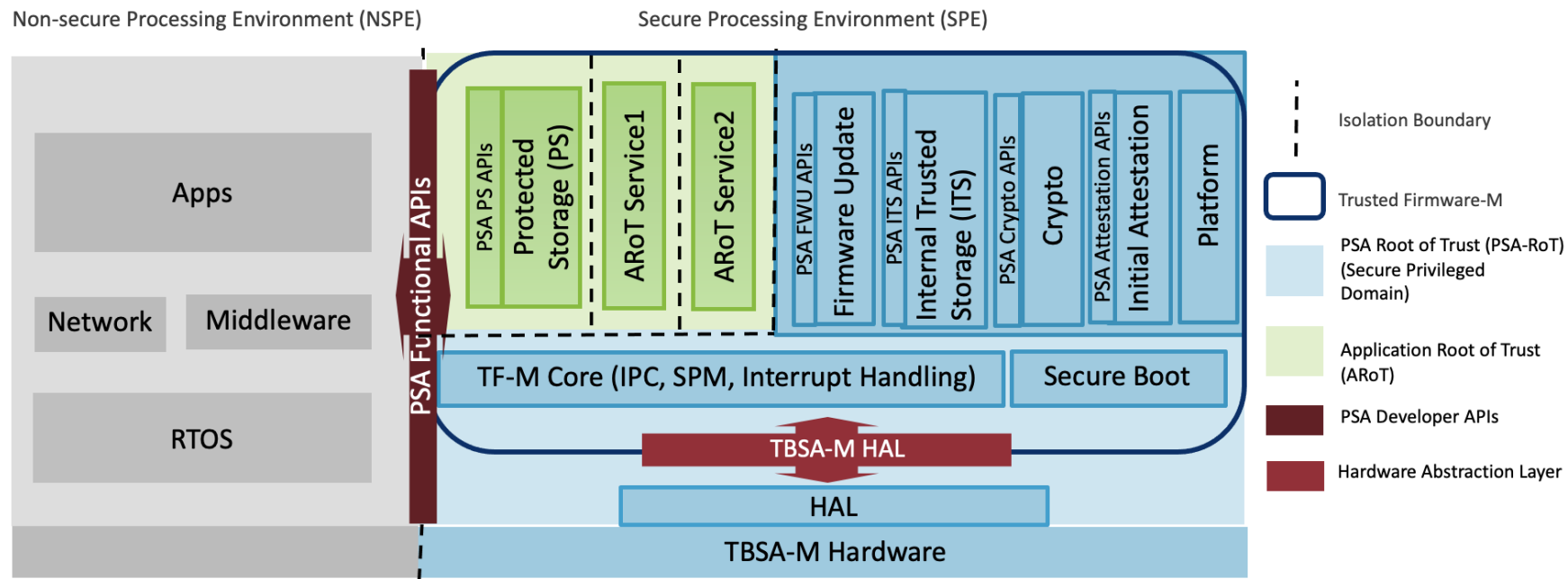
## Azure RTOS + ST U5 Security Overview

Using ST's Secure, Ultra Low Power, Sensor to Cloud Reference Hardware



# Trusted Firmware-M (TF-M)

- Trusted Firmware for Cortex M (TF-M) implements the Secure Processing Environment (SPE) for Armv8-M, Armv8.1-M
- **Trusted Firmware-M consists of:**
  - Secure Boot , Control the isolation, communication and execution within SPE and with NSPE
  - Crypto, Internal Trusted Storage (ITS), Protected Storage (PS) and Attestation secure services





# Directory Walk-Through X-CUBE-AZURE

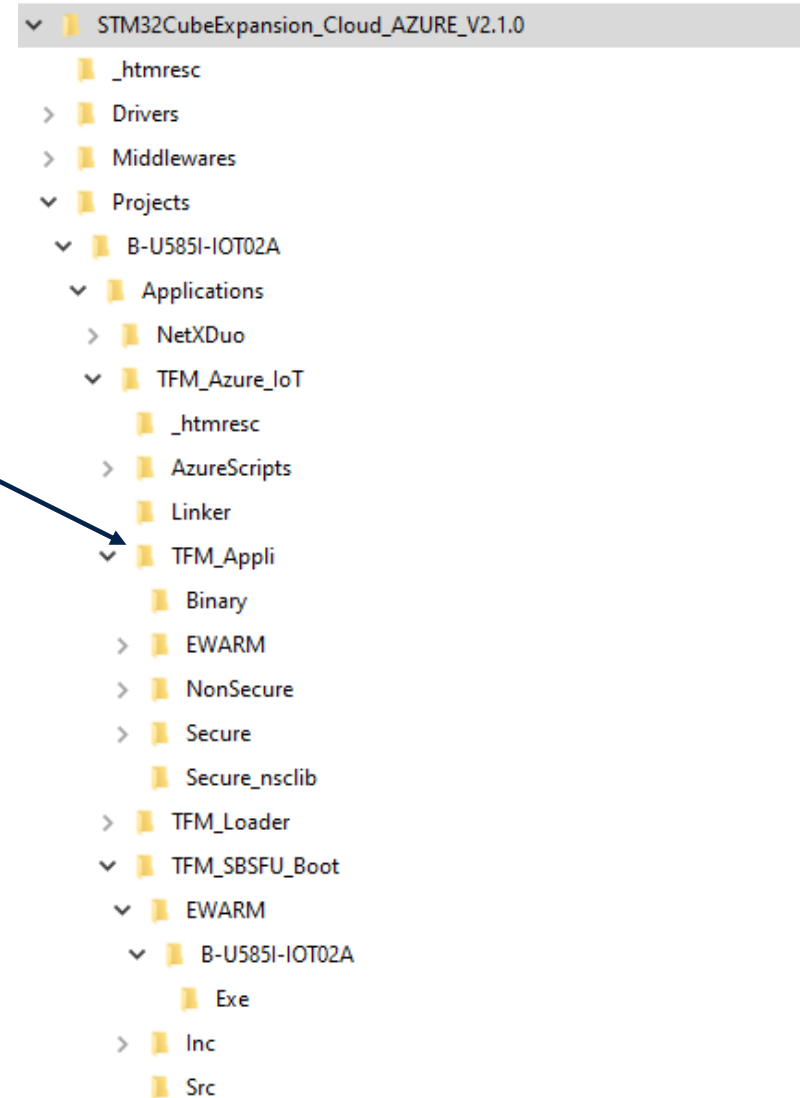
# X-CUBE-AZURE Root Directory

- Drivers
  - BSP, CMSIS, and HAL Drivers
- Middlewares
  - Both ST and Third-Party Middleware
- Projects
  - Sample Projects and applications
- Utilities
  - Additional software and patches

This PC > Windows (C:) > STM32CubeExpansion_Cloud_AZURE_V2.1.0				
Name	Date modified	Type	Size	
_htmresc	9/23/2022 1:20 PM	File folder		
Drivers	9/23/2022 1:14 PM	File folder		
Middlewares	9/23/2022 1:17 PM	File folder		
Projects	9/23/2022 1:20 PM	File folder		
Utilities	9/23/2022 1:20 PM	File folder		
Package_license.html	6/13/2022 1:45 PM	Chrome HTML Do...	31 KB	
Package_license.md	6/13/2022 1:44 PM	MD File	31 KB	
Release_Notes.html	8/17/2022 4:30 PM	Chrome HTML Do...	65 KB	

# X-CUBE-AZURE Directory Structure

- Project directory containing application code and documentation



# X-CUBE-AZURE TFM\_Azure\_IoT

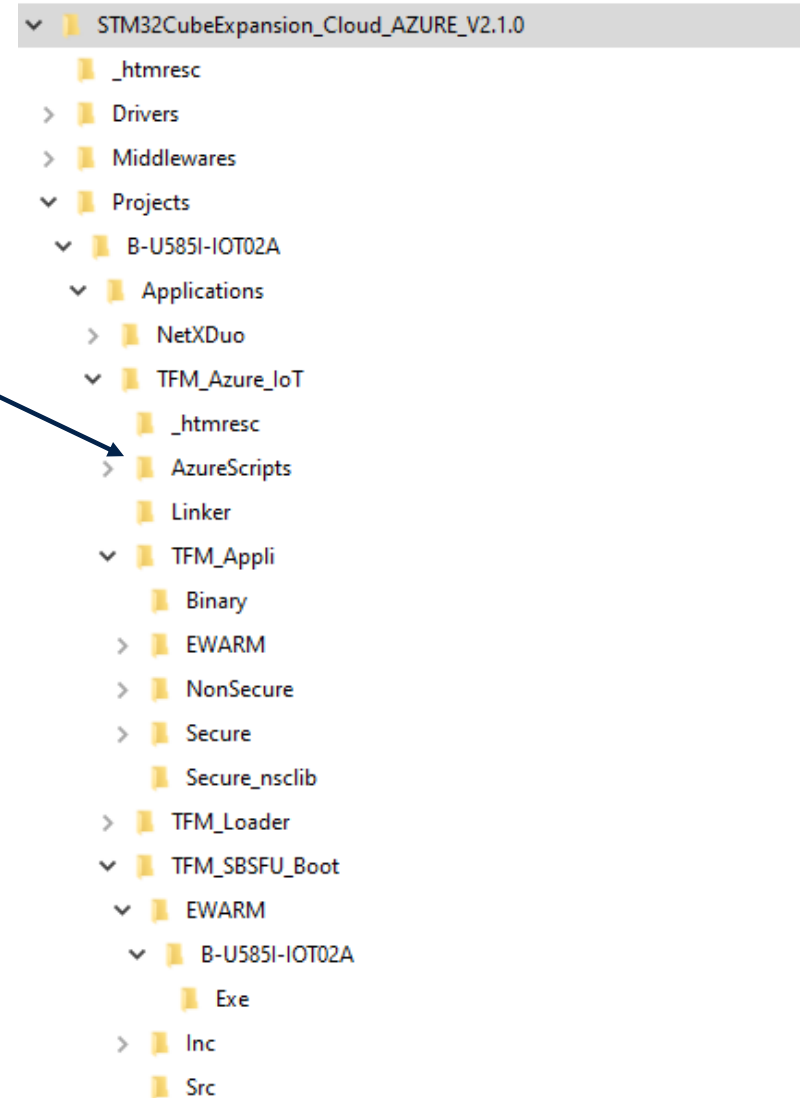
- Azure Scripts
  - Supporting software
- Linker
- TFM\_Appli
  - Main application
- TFM\_Loader
- TFM\_SBSFU\_Boot
  - Boot firmware and scripts
- azure-rtos.eww
  - EWARm project shortcut

> This PC > Windows (C:) > STM32CubeExpansion_Cloud_AZURE_V2.1.0 > Projects > B-U585I-IOT02A > Applications > TFM_Azure_IoT				
Name	Date modified	Type	Size	
_htmresc	9/23/2022 1:20 PM	File folder		
AzureScripts	9/23/2022 1:19 PM	File folder		
Linker	9/23/2022 1:19 PM	File folder		
TFM_Appli	9/23/2022 1:19 PM	File folder		
TFM_Loader	9/23/2022 1:20 PM	File folder		
TFM_SBSFU_Boot	9/23/2022 1:20 PM	File folder		
azure-rtos.eww	6/9/2022 1:48 PM	IAR IDE Workspace	2 KB	
q_a.txt	6/9/2022 1:48 PM	Text Document	3 KB	
readme.html	8/17/2022 4:02 PM	Chrome HTML Do...	28 KB	
README.md	8/17/2022 4:02 PM	MD File	24 KB	



# X-CUBE-AZURE Directory Structure

- Script directory that contains all the files pertaining to this hands-on



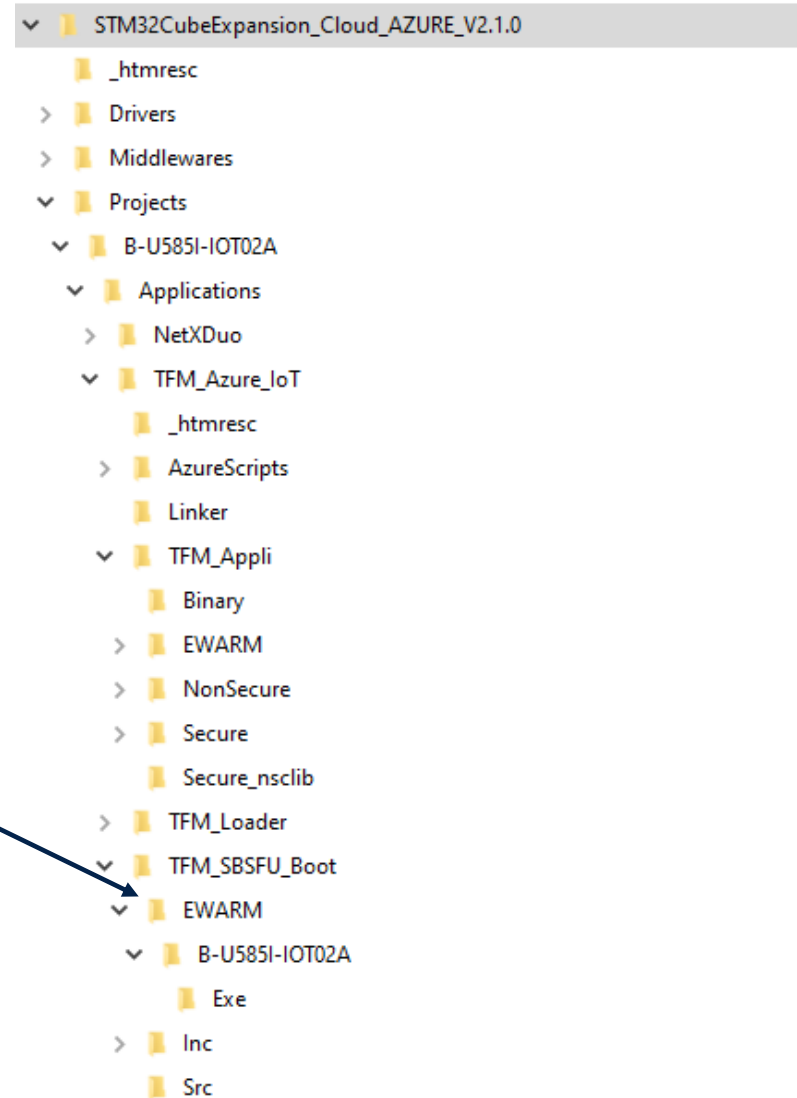
# X-CUBE-AZURE TFM\_Azure\_IoT\AzureScripts\

- Config.json
  - Configuration file for Quick Connect Script
- Requirements.txt
  - Python library requirements
- STM32U5\_QuickConnect.py
  - Quick connect script for connecting B-U585I-IOT02A to Azure IoT Central

This PC > Windows (C:) > STM32CubeExpansion_Cloud_AZURE_V2.1.0 > Projects > B-U585I-IOT02A > Applications > TFM_Azure_IoT > AzureScripts				
Name	Date modified	Type	Size	
AZCLI_Scripts	9/19/2022 7:30 AM	File folder		
Config.json	6/17/2022 12:40 AM	JSON File	1 KB	
readme.txt	6/16/2022 5:20 AM	Text Document	2 KB	
requirements.txt	6/9/2022 4:48 AM	Text Document	1 KB	
STM32U5_AZ_QuickConnect.py	9/19/2022 7:14 AM	PY File	19 KB	

# X-CUBE-AZURE Directory Structure

- Utility script directory used to set option bytes and flash firmware



# X-CUBE-AZURE TFM\_Azure\_IoT\TFM\_SBSFU\_Boot\EWARM

- regression.bat
  - Script to set option bytes on board
- TFM\_UPDATE.bat
  - Flashing Script
- STM32CubeProg\_Reset.bat
  - Script to reset board
- STM32U5\_TrustZone\_Disable.bat
  - Script to disable TZ option byte

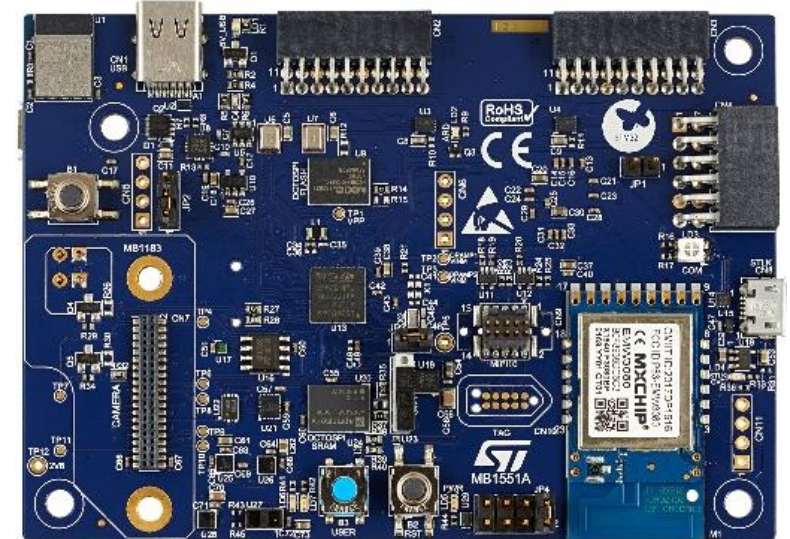
This PC > Windows (C:) > STM32CubeExpansion_Cloud_AZURE_V2.1.0 > Projects > B-U585I-IOT02A > Applications > TFM_Azure_IoT > TFM_SBSFU_Boot > EWARM			
Name	Date modified	Type	Size
B-U585I-IOT02A	9/19/2022 7:30 AM	File folder	
dataimg.bat	9/19/2022 6:45 AM	Windows Batch File	7 KB
hardening.bat	9/19/2022 6:45 AM	Windows Batch File	2 KB
keygen.bat	6/9/2022 4:48 AM	Windows Batch File	5 KB
postbuild.bat	6/9/2022 4:48 AM	Windows Batch File	10 KB
prebuild.cmd	6/9/2022 4:48 AM	Windows Command Script	1 KB
Project.ewd	8/16/2022 6:12 AM	EWD File	53 KB
Project.ewp	6/9/2022 4:48 AM	EWP File	52 KB
Project.eww	6/9/2022 4:48 AM	IAR IDE Workspace	1 KB
regression.bat	9/19/2022 6:45 AM	Windows Batch File	3 KB
STM32CubeProg_Reset.bat	6/9/2022 4:48 AM	Windows Batch File	2 KB
STM32U5_TrustZone_Disable.bat	6/9/2022 4:48 AM	Windows Batch File	2 KB
stm32u585xx_bl2.icf	6/9/2022 4:48 AM	ICF File	3 KB
TFM_UPDATE.bat	9/19/2022 6:45 AM	Windows Batch File	3 KB



# Board Distribution

# Loaner Board Handout & Return

- **Please Take Note:** Due to supply limitations, ST will need to reuse the boards in this workshop for our near-team future workshops.
- **Board Logistics**
  - ST will hand out boards & USB cables
  - Please remove boards from packaging
    - Cardboard box can be put in the recycle bin
    - Please keep the antistatic bag for when board is returned
  - Enjoy the workshop
  - At the end of workshop, ST will provide a **voucher** to purchase the same board at **discounted price** from a **dedicated store reserved specifically for workshop participants** when we collect the boards
- **We appreciate your understanding and thank you for your cooperation!**



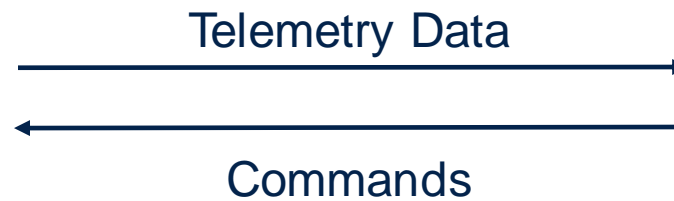
# Hands-On: Quick Connect

# Goal

- Create an [Azure IoT Central application](#) and connect the [B-U585I-IOT02A - Discovery kit for IoT node](#) for bi-directional communication



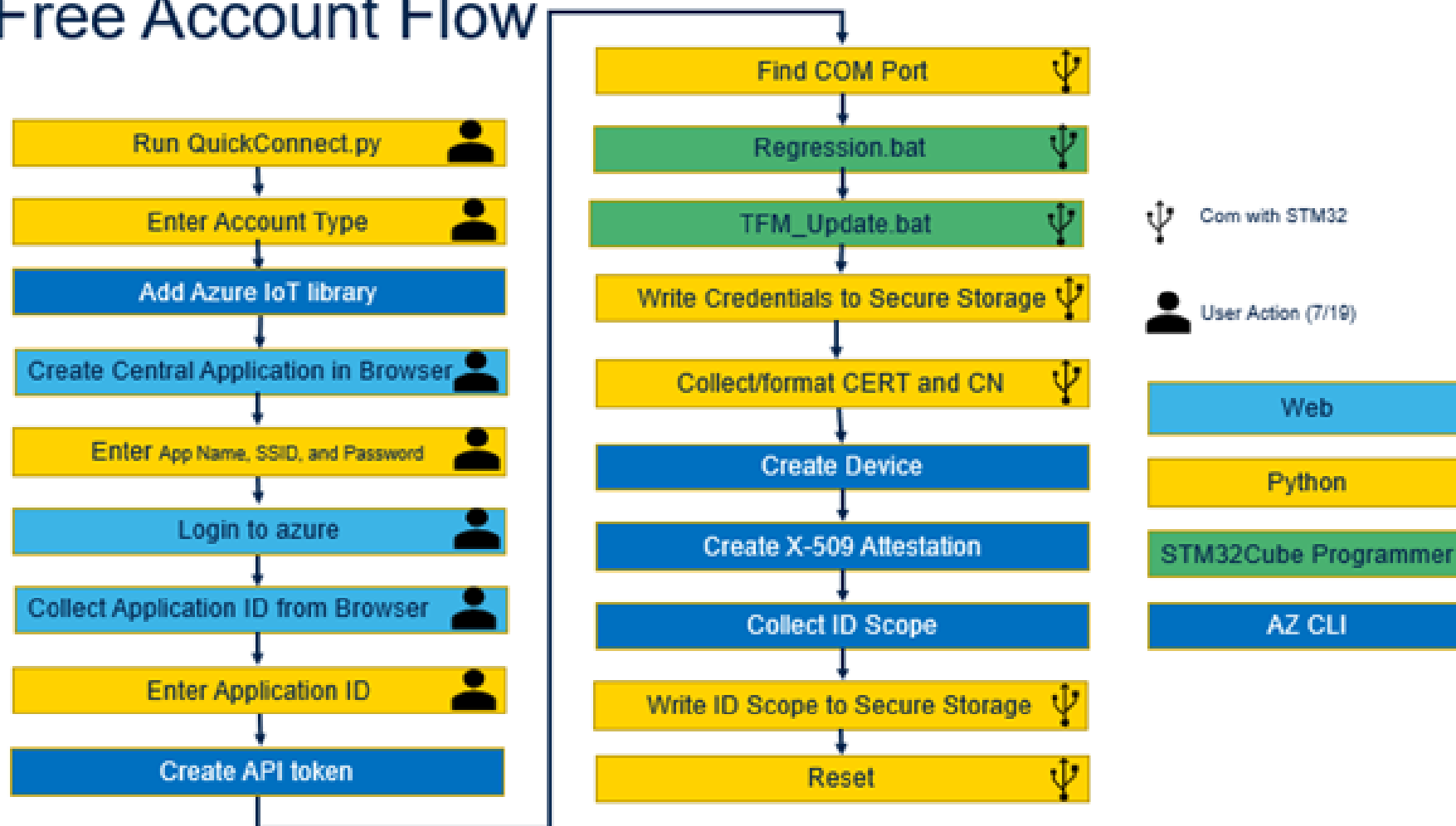
B-U585I-IOT02A



IoT Central Application

# Quick Connect Flow

## Free Account Flow



# Connect your board

- Connect your board to the PC



# Step 1: Running Quick Connect Script

- Navigate to C:\STM32CubeExpansion\_Cloud\_AZURE\_V2.1.0\Projects\B-U585I-IOT02A\Applications\TFM\_Azure\_IoT\AzureScripts

This PC > Windows (C:) > STM32CubeExpansion_Cloud_AZURE_V2.1.0 > Projects > B-U585I-IOT02A > Applications > TFM_Azure_IoT > AzureScripts				
Name	Date modified	Type	Size	
AZCLI_Scripts	9/19/2022 7:30 AM	File folder		
Config.json	6/17/2022 12:40 AM	JSON File	1 KB	
readme.txt	6/16/2022 5:20 AM	Text Document	2 KB	
requirements.txt	6/9/2022 4:48 AM	Text Document	1 KB	
STM32U5_AZ_QuickConnect.py	9/19/2022 7:14 AM	PY File	19 KB	

# Configuration File: Config.json

```
{ Config.json X
C: > STM32CubeExpansion_Cloud_AZURE_V2.1.0 > Projects > B-U585I-IOT02A > Applications > TFM_Azure_IoT > AzureScripts > {} Config.json > ...
1  {
2    "Entered": {
3      "Subscription": "y",
4      "AppName": "montreal-182796",
5      "SSID": "st_iot_demo",
6      "Password": "stm32u585",
7      "ResourceGroup": "montreal",
8      "Location": "eastus"
9    },
10   "Constant": {
11     "AppTemplateID": "",
12     "DevTemplateID": "",
13     "RoleName": "admin",
14     "TokenID": "adminToken",
15     "Endpoint": "global.azure-devices-provisioning.net"
16   },
17   "Generated": {
18     "AppID": "3b956b68-3849-4fb9-b8dd-e4e113fbb4f1",
19     "APIToken": "SharedAccessSignature sr=3b956b68-3849-4fb9-b8dd-e4e113fbb4f1&sig=KVbplyCo3QMe3I0SVY5zV
20     "Cert": "MIIBmjCCAT+gAwIBAgILAgnwz0Fa1CrCATkwCgYIKoZIzj0EAwIwTzELMAkGA1UEBhMCTkwHjAcBgNVBAoMFVNUTWl
21     "RegistrationID": "eval3-0209F0CF415AD42AC20139",
22     "IDScope": "0ne007B7BEE"
23   }
24 }
```



# Device Dashboard Walk-through

Connect

Devices

Device groups

Device templates

Analyze

Data explorer

Dashboards

Manage

Jobs

Extend


Rules

Connect

Manage template

Manage device

Devices > B-U585I-IOT02A > eval3-02090046215AD42AC20139



eval3-02090046215AD42AC20139

| Last data received: N/A

Status: Provisioned | Organization: morel

About

Manage Device

Overview

Commands

Raw data

Mapped aliases

Files

Button Counter, Temperature, Relative Humidity, Pressure

No data found  
Check your device or network connection, and make sure you're part of the device's org.

Button Counter

No data found  
Check your device or network connection, and make sure you're part of the device's org.

Temperature

No data found  
Check your device or network connection, and make sure you're part of the device's org.

Relative Humidity

Pressure

# Welcome Microsoft for Cloud Hands-On

# Option Byte Reset

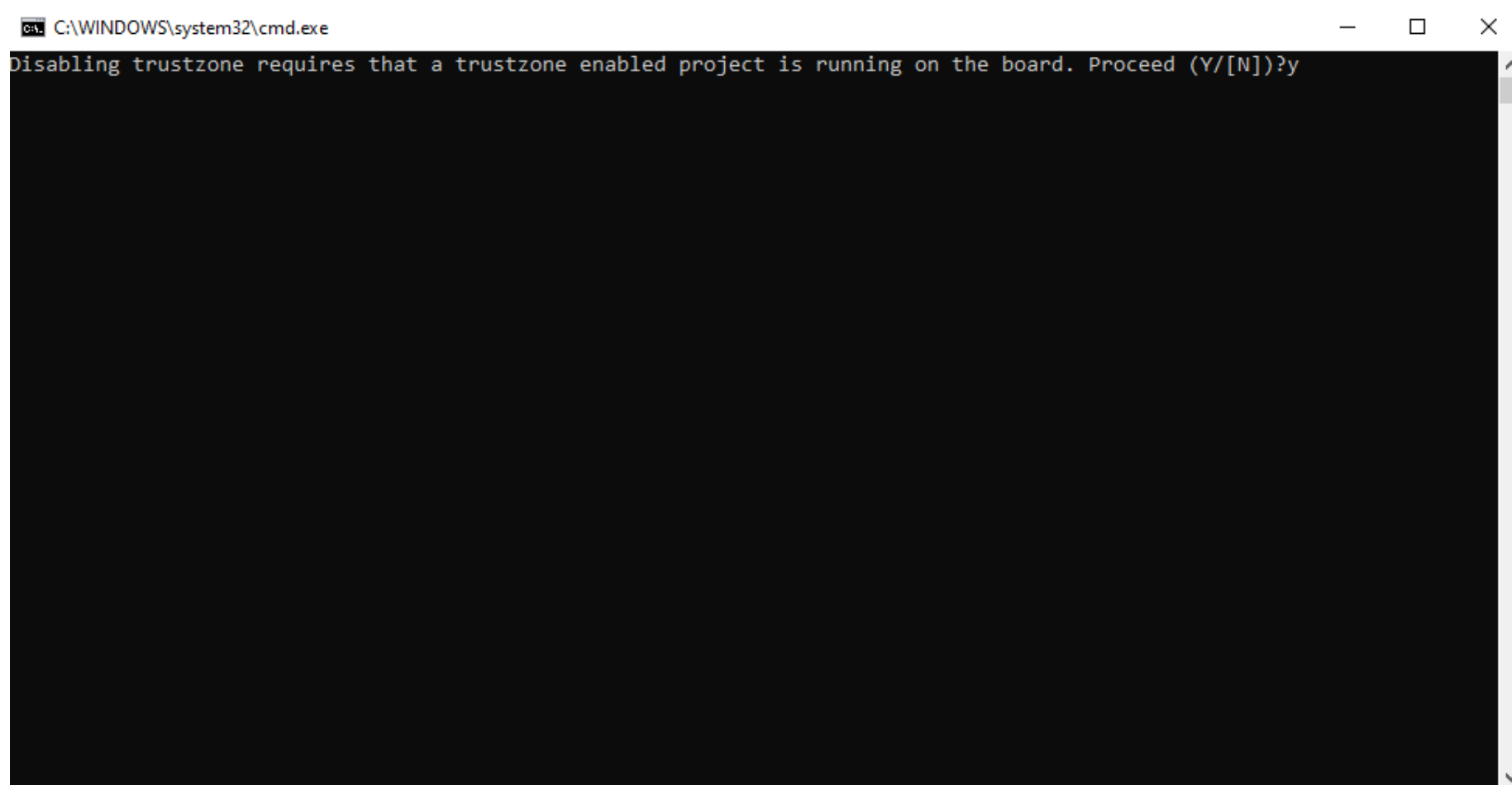
# Disabling Trust Zone

- Navigate to C:\STM32CubeExpansion\_Cloud\_AZURE\_V2.1.0\Projects\B-U585I-IOT02A\Applications\TFM\_Azure\_IoT\AzureScripts
- Double Click: STM32U5\_TrustZone\_Disable.bat

> This PC > Windows (C:) > STM32CubeExpansion_Cloud_AZURE_V2.1.0 > Projects > B-U585I-IOT02A > Applications > TFM_Azure_IoT > TFM_SBSFU_Boot > EWARM			
Name	Date modified	Type	Size
B-U585I-IOT02A	9/19/2022 7:30 AM	File folder	
dataimg.bat	9/19/2022 6:45 AM	Windows Batch File	7 KB
hardening.bat	9/19/2022 6:45 AM	Windows Batch File	2 KB
keygen.bat	6/9/2022 4:48 AM	Windows Batch File	5 KB
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STM32CubeProg_Reset.bat	6/9/2022 4:48 AM	Windows Batch File	2 KB
STM32U5_TrustZone_Disable.bat	6/9/2022 4:48 AM	Windows Batch File	2 KB
stm32u585xx_bl2.icf	6/9/2022 4:48 AM	ICF File	3 KB
TFM_UPDATE.bat	9/19/2022 6:45 AM	Windows Batch File	3 KB

# Disabling Trust Zone

- Enter 'y' in to CMD window prompt:



A screenshot of a Windows Command Prompt window. The title bar shows the path `C:\WINDOWS\system32\cmd.exe`. The command prompt displays the message: `Disabling trustzone requires that a trustzone enabled project is running on the board. Proceed (Y/[N])?y`. The prompt is followed by the letter 'y', indicating the user's response to the question.

# Disabling Trust Zone

C:\WINDOWS\system32\cmd.exe

```
Device name : STM32U575/STM32U585
Flash size  : 2 MBytes
Device type  : MCU
Device CPU   : Cortex-M33
BL Version   : 0x92
Debug in Low Power mode enabled
```

UPLOADING OPTION BYTES DATA ...

```
Bank      : 0x00
Address    : 0x40022040
Size       : 36 Bytes
```

100%

```
Bank      : 0x01
Address    : 0x40022068
Size       : 8 Bytes
```

100%

PROGRAMMING OPTION BYTES AREA ...

```
Bank      : 0x00
Address    : 0x40022040
Size       : 36 Bytes
```



# Additional Resources

- To create your own Azure Account
  - <https://azure.microsoft.com/>
- For additional ST support
  - <https://community.st.com/s/online-support>
- For additional Microsoft support
  - <https://learn.microsoft.com/en-us/azure/iot-fundamentals/iot-support-help>



# Our technology starts with You



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