



arm

Building the  
Internet of Trust  
*Not Threats*

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# Arm is the architecture of choice for the Internet of Things

## About Arm

The architects of global possibilities

- + Founded in 1990
- + HQ in Cambridge UK with global offices across Asia, Europe and US
- + Acquired by Softbank Group Corp. in 2016

**~6,000**

Employees with major presence in China and wider APAC

**\$1.8B**  
in FY17 revenue

**125B+**

Arm-based chips shipped to date and counting

**70%**  
of the world's population uses  
Arm technology

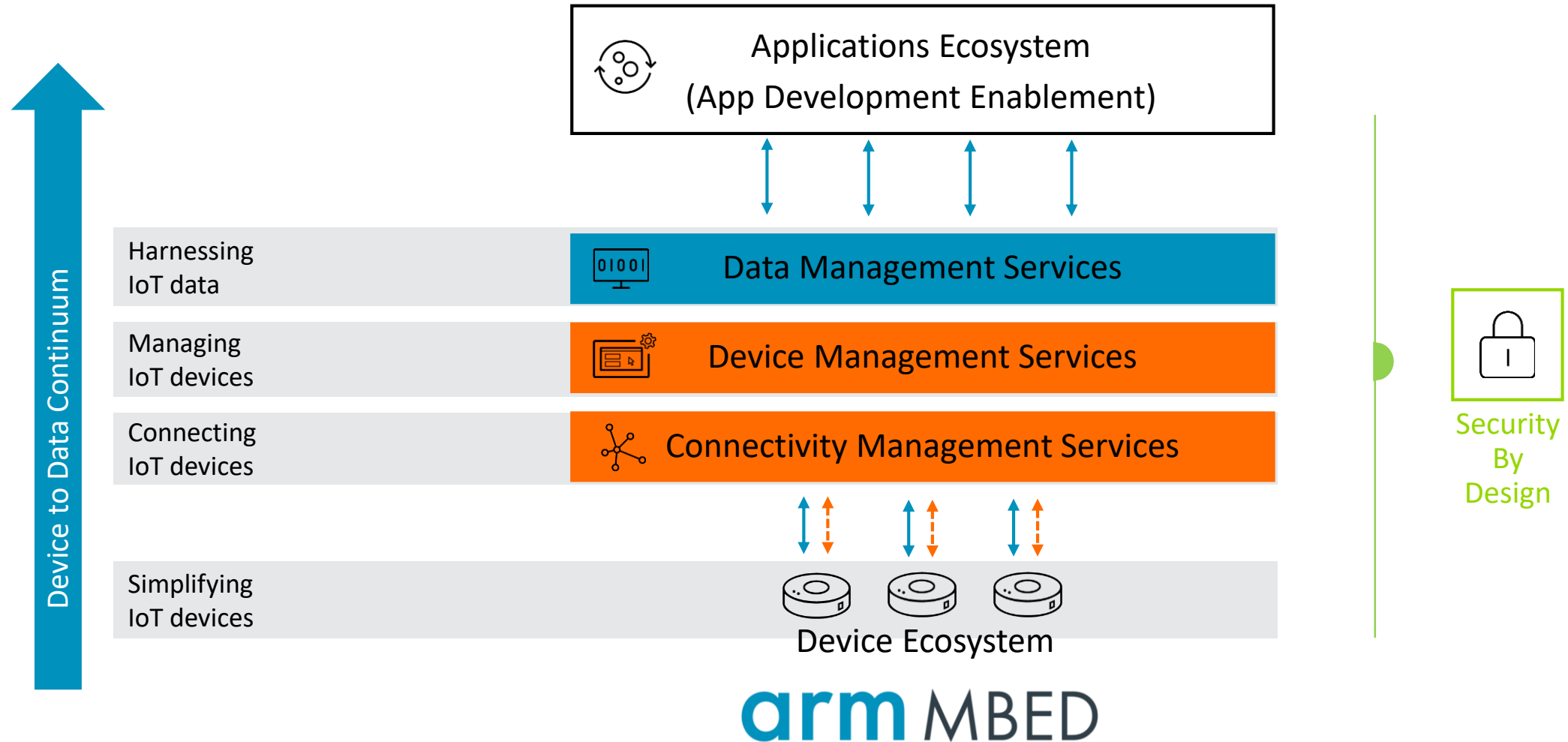
**1,000+**  
Partner ecosystem

**90%**  
of wearables powered  
by Arm-based SoCs

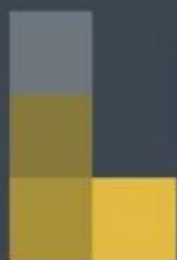
**>95%**  
of world's smartphones are  
based on Arm

# Create a Vibrant Applications Ecosystem

Supports a world class IOT journey/experience across sectors



# The Cost of Security Inaction is Significant



>300%

Increase in malware loaded onto IoT devices<sup>2</sup>



29%

Increase in industrial control system vulnerabilities<sup>1</sup>



600%

Increase in IoT device attacks<sup>1</sup>



\$6 trillion

Cost of damage related to cybercrime by 2021<sup>3</sup>

1 – Symantec Internet Security Threat Report 2018

2 – Kaspersky Labs, New Trends in the World of IoT Threats 2018

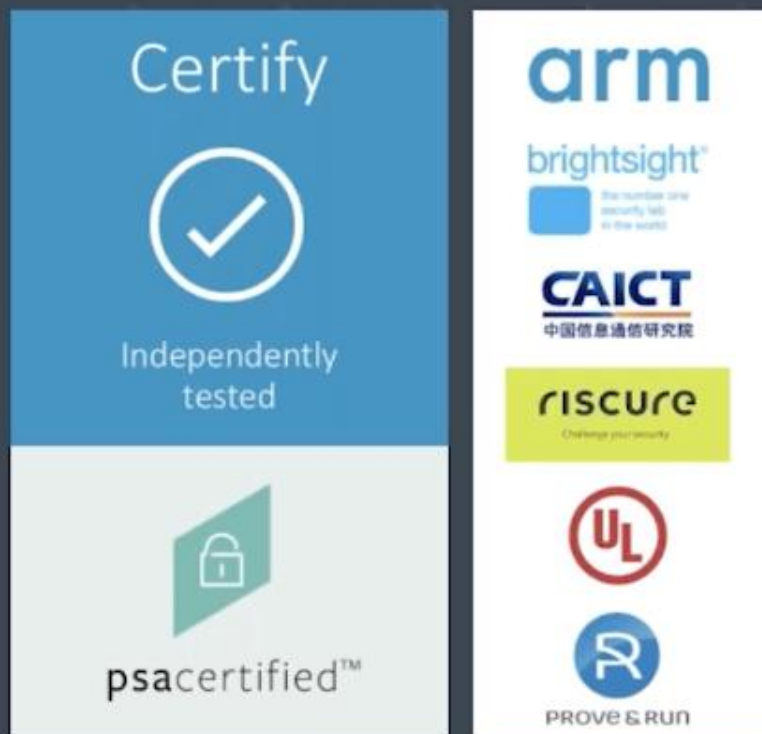
3 – Annual Cyber Crime Report, Cyber Security Ventures 2019



# PSA Certified

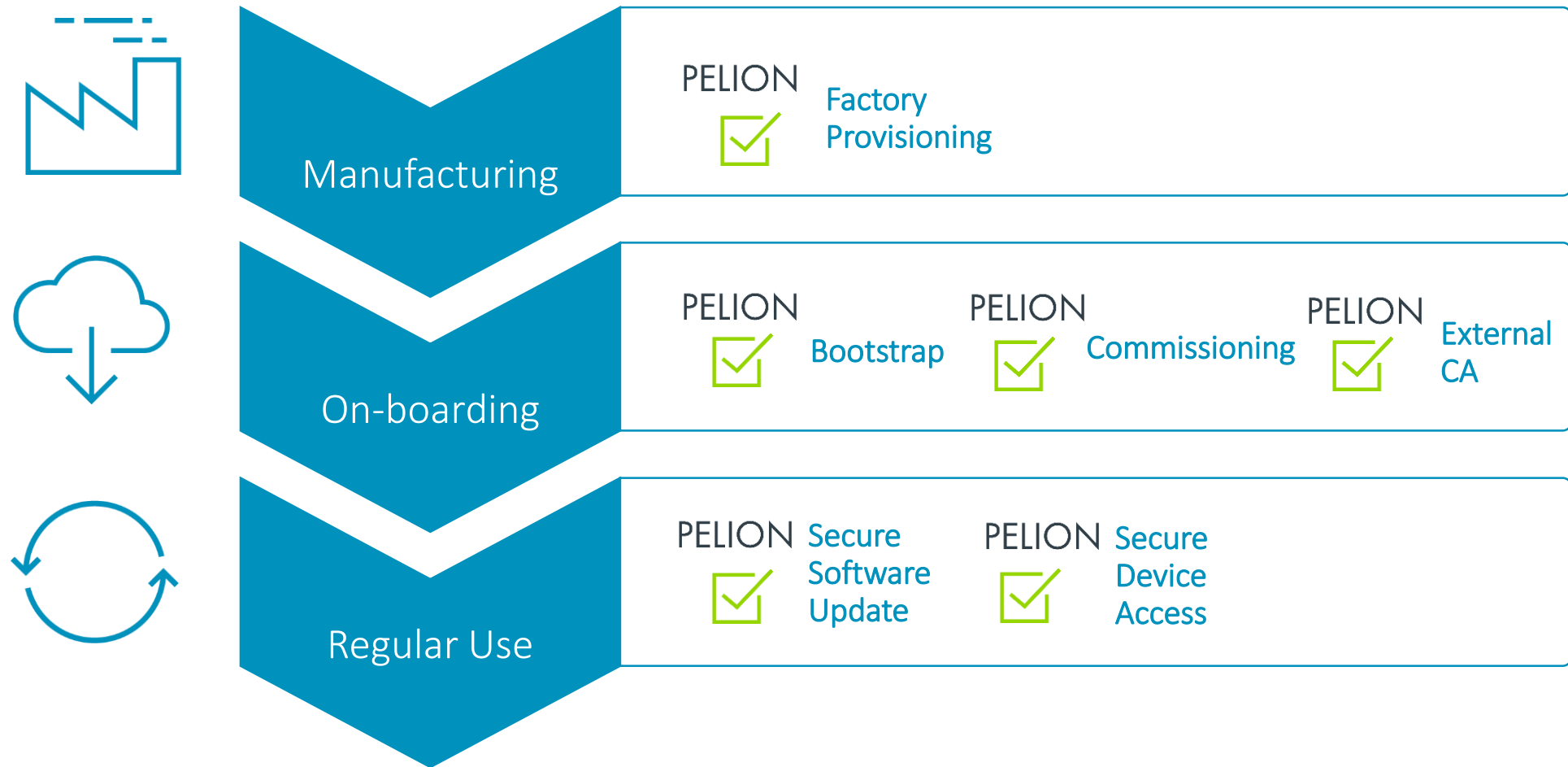
Independent evaluation scheme → [PSACertified.org](https://PSACertified.org)

Developed by



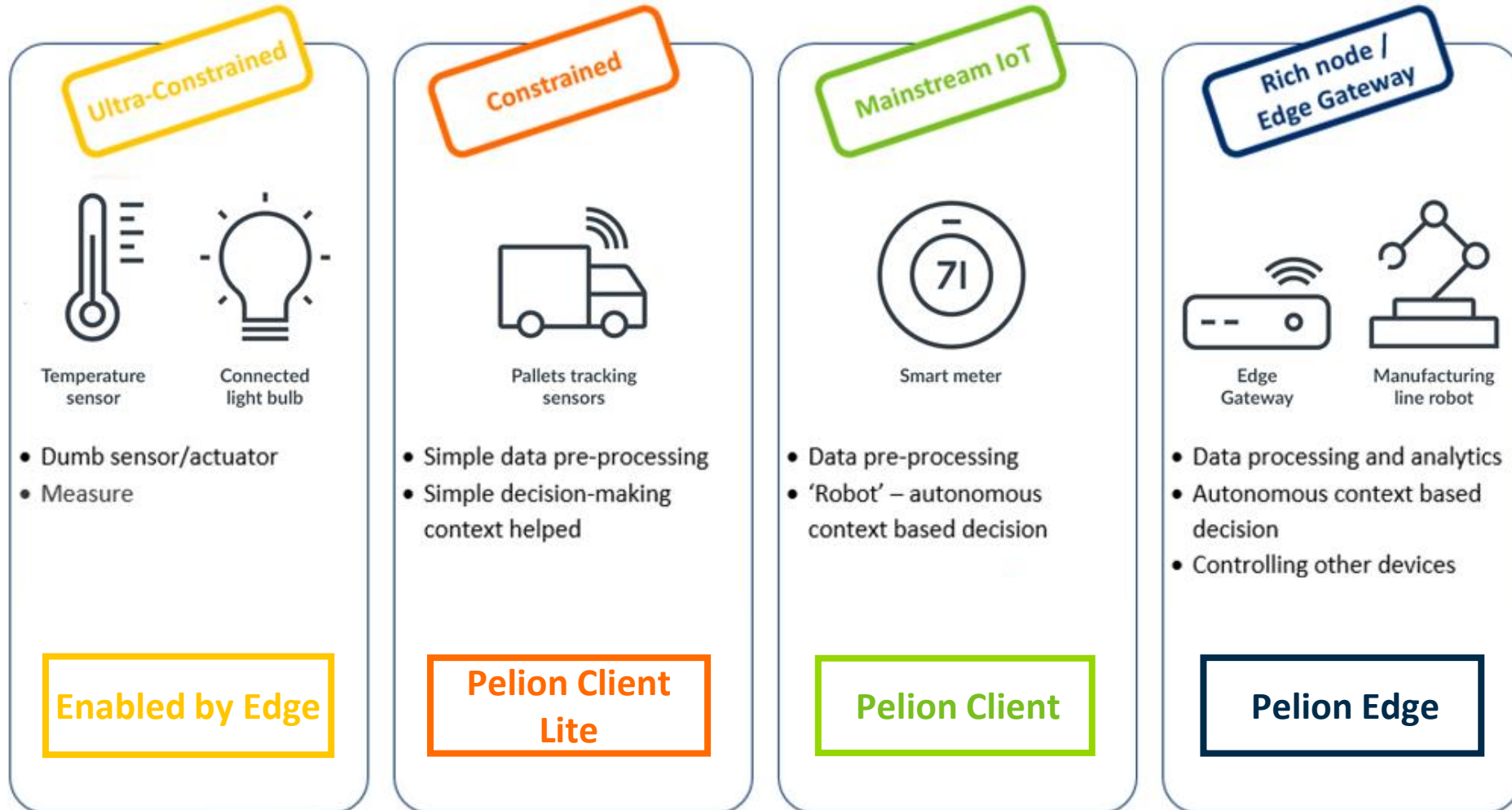
- **PSA Certified** provides three **progressive** levels of assurance and robustness (Level 1, 2, 3)
  - Based on PSA-RoT
- **PSA Functional API Certified** enables ecosystem software compatibility to PSA standards, independent of hardware platforms

# Secure all stages of device life-cycle











# Any Device - IoT Device Classes

A landscape of multiple verticals, wide range of use cases and wide variety of devices



# Getting Started – It's easy

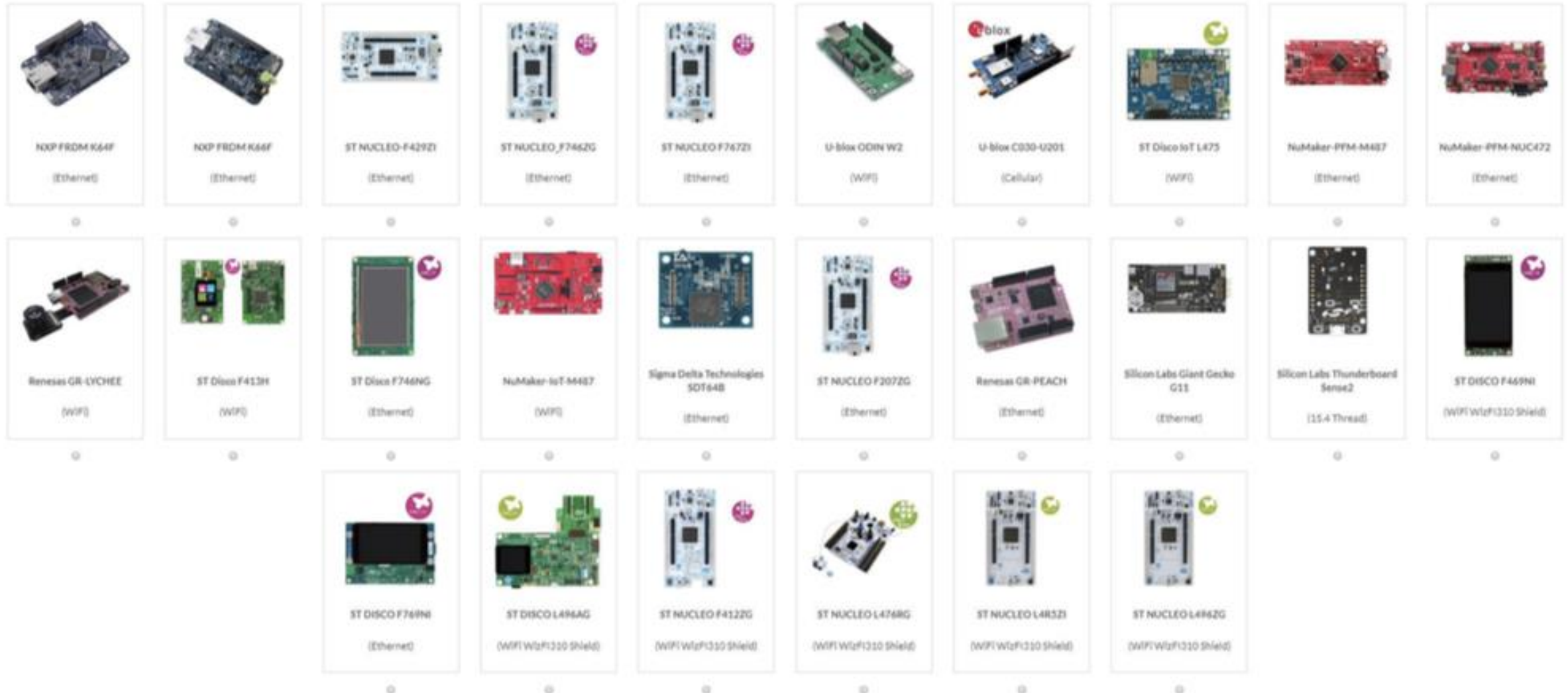
[www.pelion.com](http://www.pelion.com)

- **Pelion Device Management Free Tier** enables you to gain free hands-on experience with the Pelion Device Management platform.
  - Free Tier main offering:
    - 100 registered devices, 200 updates per month, 300k transactions per month
- **Connect to Pelion Device Management in four simple steps**
  -  STEP 1: Import the example application to the Mbed Online Compiler
  -  STEP 2: Give the application access to your Pelion Device Management account
  -  STEP 3: Put the application on your device
  -  STEP 4: See the device resources in Pelion Device Management Portal
- **Update your device in four simple steps**
  -  STEP 1: Make changes to the example application in the Online Compiler
  -  STEP 2: Publish your changed application as a firmware update
  -  STEP 3: Apply the firmware update to the device with a campaign from the Device Management Portal
  -  STEP 4: See the updated device in the Device Management Portal



# Select your Mbed Enabled board

150 DEVELOPMENT BOARDS !!



# Join / Select from MBED OS Devices Community

<https://www.mbed.com/built-with-mbed/>

ADIANTECH

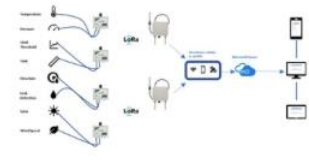


## LoRa IoT Solution Starter Kit

### Summary

- Connectivity: LoRa
- MCU: Arm Cortex M4 @ 80MHz
- Memory: 256KB Flash, 64KB RAM
- Silicon vendor...

VolleyBoast



## Industrial Monitoring Service

### Summary

- Connectivity: LoRa
- MCU: Arm Cortex M3 @ 96MHz
- Memory: 512KB Flash, 128KB RAM
- Silicon vendor...

[Read more](#)

MX



## Smart door locks

### Summary

- Connectivity: WiFi/NB-IoT
- MCU: Arm Cortex M4 @ 160MHz
- Memory: 32Mbit Flash, 288KB RAM
- Silicon vendor...

SOLARIS OFFGRID



## Solar Charge Controller

### Summary

- Connectivity: None
- MCU: Arm Cortex M3, 72MHz
- Memory: 128KB Flash, 20KB RAM
- Silicon vendor...

Bluebird



## Air Quality Sensors

### Summary

- Connectivity: WiFi
- MCU: Arm Cortex M+ @ 20MHz
- Memory: 64KB Flash, 8KB SRAM
- Silicon vendor...

[Read more](#)

PURRMETRIX



## Indoor Environment Monitoring

### Summary

- Connectivity: Ethernet and 433MHz
- MCU: Arm Cortex M3, 96MHz
- Memory: 512KB Flash, 32KB RAM...

[Read more](#)

CARTESIAM.AI



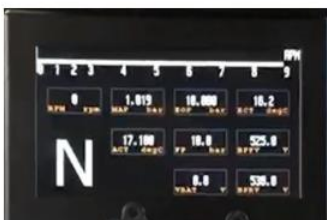
## Predictive Industrial Maintenance

### Summary

- Connectivity: LoRa
- MCU: Arm Cortex M3 @ 48MHz
- Memory: 128KB Flash, 16KB RAM
- Silicon vendor...

[Read more](#)

ZBOROWSKI AUTOMOTIVE



## Automotive Dashboard

### Summary

- Connectivity: CAN
- MCU: Arm Cortex M4 @ 80MHz
- Memory: 1MB Flash, 128KB RAM
- Silicon vendor...

[Read more](#)

withthegrid



## District Heating Leak Detector

### Summary

- Connectivity: GPRS/NB-IoT
- MCU: Arm Cortex M4+FPU @ 168MHz
- Memory: 1MB Flash, 196KB RAM...

[Read more](#)



## Grain Dryer

### Summary

- Connectivity: Ethernet
- MCU: Arm Cortex M4, 180MHz
- Memory: 2MB Flash, 256+4KB KB RAM...

[Read more](#)

Embedded Planet



## Multisensor Industrial Asset Monitor

### Summary

- Connectivity: LoRa, NFC, BTLE, CAT M1, NB-IoT
- MCU: Arm Cortex M4F, 64MHz
- Memory: 1MB...

[Read more](#)

AAEON



## Smart Street Lighting

### Summary

- Connectivity: NB-IoT
- MCU: Arm Cortex M4 @ 180MHz
- Memory: 2MB Flash, 256KB SRAM
- Silicon vendor...

[Read more](#)

arm

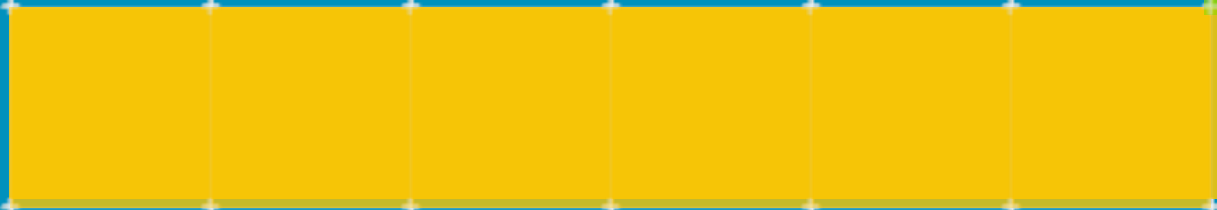
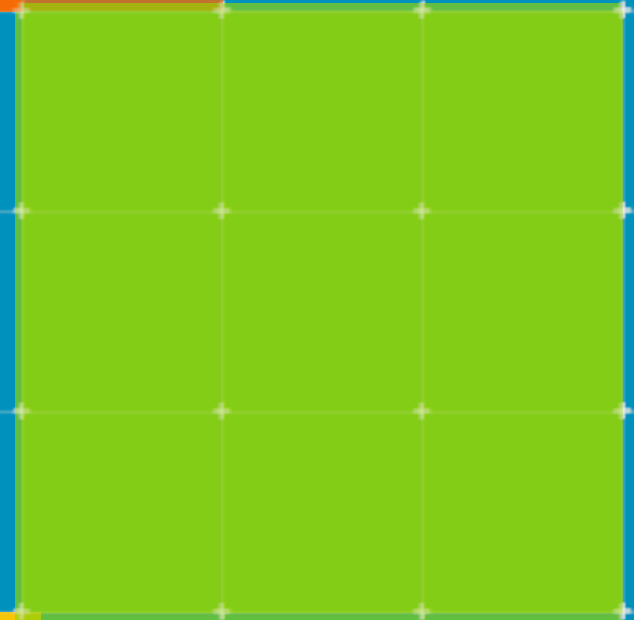


A woman with dark hair, wearing a brown jacket and a blue patterned scarf, is looking down at a smartphone. The background is a blurred mountain landscape. The image has a grid of small white plus signs overlaid on it.

arm

# ASEAN Makerthon: Connect to Pelion Device Management

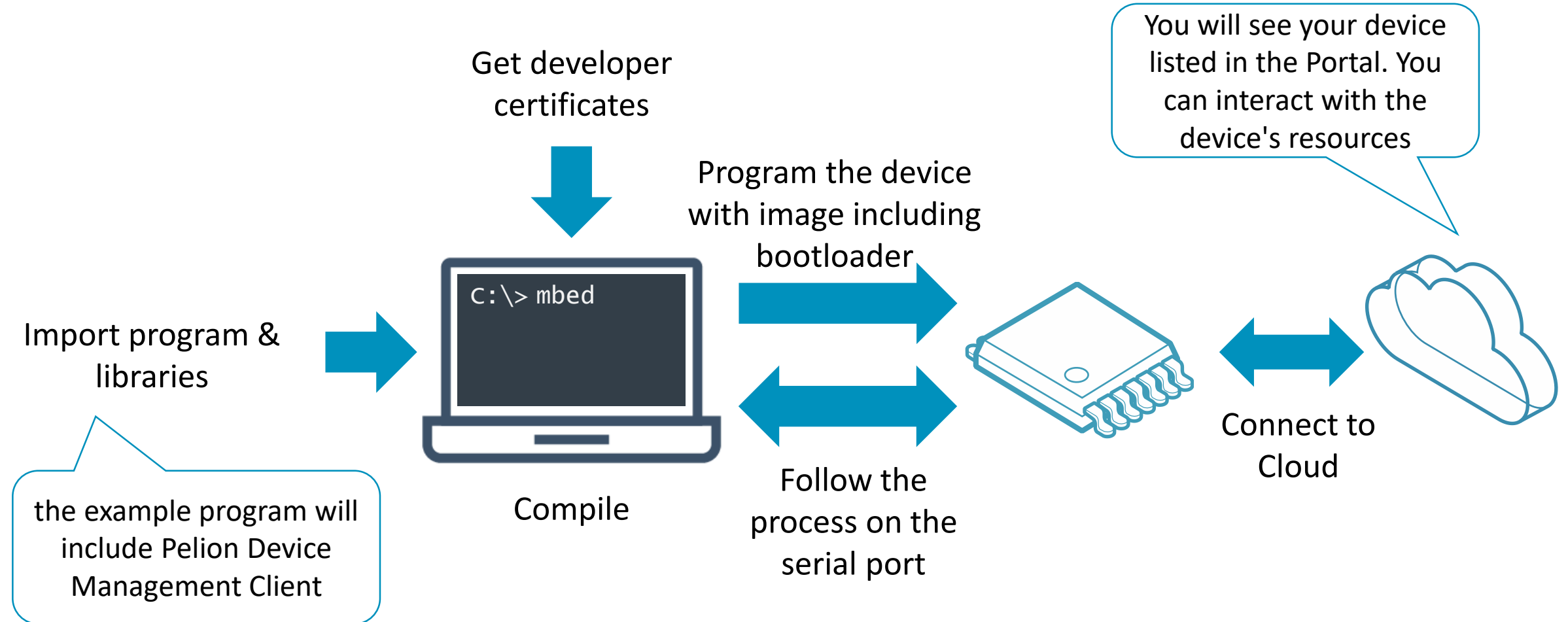
# Section Aims



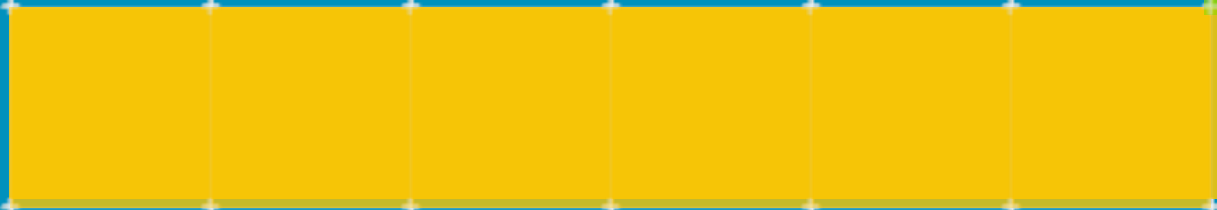
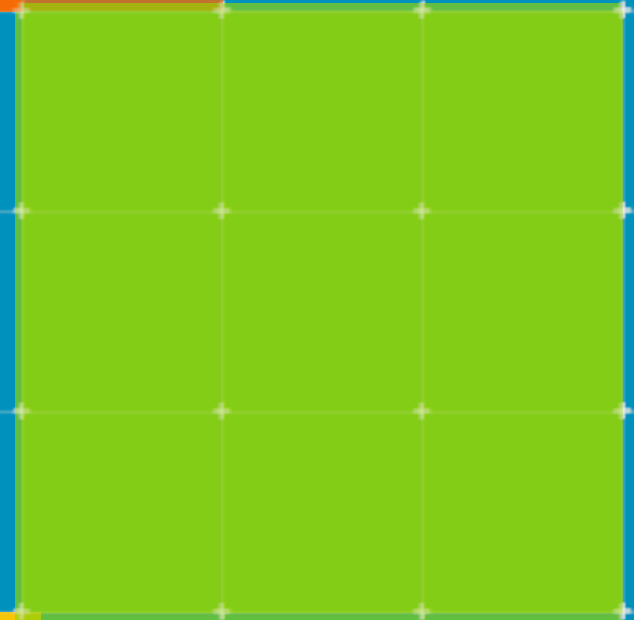


# Aims of this section

Connect a device to Pelion Device Management



# Pre-requisites



# Pre-requisites

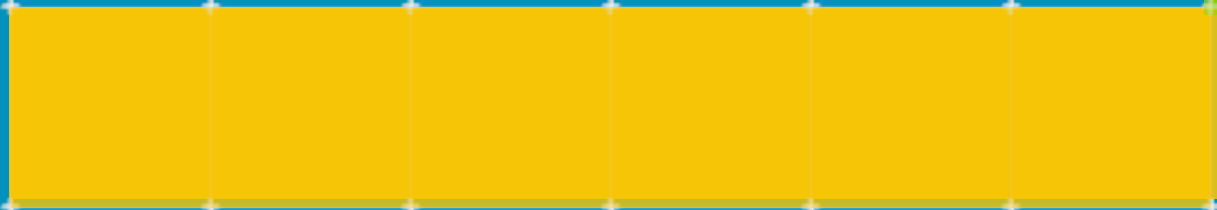
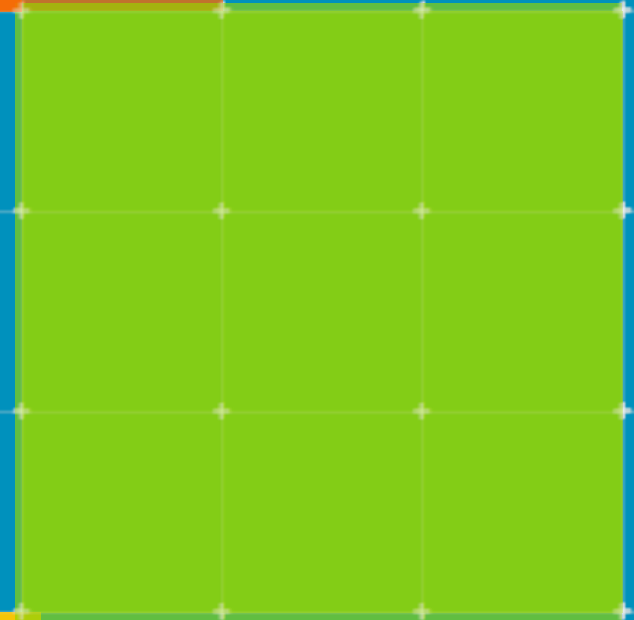
- You will be need to
- Have a **GitHub** account, and **git** 1.9.5 or above installed
- Have **GNU Arm Embedded** compiler for Cortex-M installed
  - <https://developer.arm.com/tools-and-software/open-source-software/developer-tools/gnu-toolchain/gnu-rm/downloads>
  - Officially supported version: 6-2017-q1-update
- have the **Mbed CLI** and supporting tools installed
  - <https://os.mbed.com/docs/mbed-os/v5.14/tools/installation-and-setup.html>
  - If you are working in a Linux VM with **Python** 3.6 or above and pip installed, just install with 'pip install mbed-cli'

# Pre-requisites (cont.)

- have a Pelion Portal account
  - so that you have an account that the device can register to
  - so that you can see your registered device in the Portal
  - if you haven't get the free-tier account, you can get it here:
    - <https://os.mbed.com/pelion-free-tier/>
  - Keyword: **Pelion Quick Connect**
- have a serial port program. We suggest
  - CoolTerm for Mac
  - PuTTY or TeraTerm for Windows
- If you are using Windows 10, you will need to install the serial port driver for DAPLink
  - [http://os.mbed.com/media/downloads/drivers/mbedWinSerial\\_16466.exe](http://os.mbed.com/media/downloads/drivers/mbedWinSerial_16466.exe)
  - Keyword: **DAPLink driver**



# Instructions



# Overview

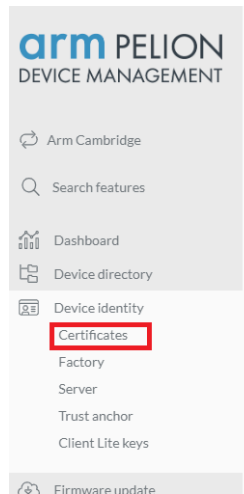
- In this section on you will
- import the example Mbed OS program that includes Device Management Client
- download "developer mode" certificates from the portal, and create firmware update credentials
- build the example program using those certificates
- program the device
- the device will connect to Pelion Device Management
  - you will be able to follow the progress on the serial port

# Get the code

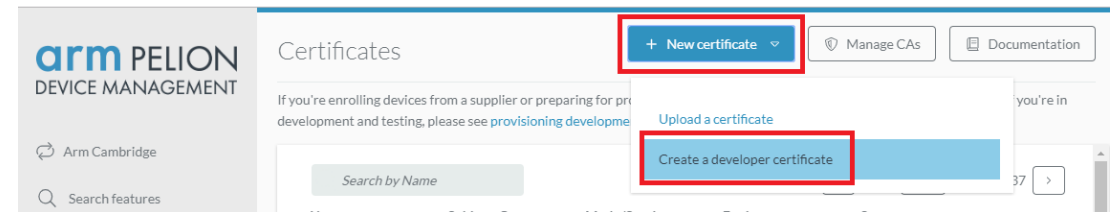
- Get the Pelion Device Management Client Example
  - Mbed-CLI
    - `mbed import https://github.com/ARMmbed/mbed-cloud-client-example` (HTTP)
    - `mbed import git@github.com:ARMmbed/mbed-cloud-client-example.git` (SSH)
  - Git+Mbed-CLI:
    - `git clone https://github.com/ARMmbed/mbed-cloud-client-example` (HTTP)
    - `git clone git@github.com:ARMmbed/mbed-cloud-client-example.git` (SSH)
    - `cd mbed-cloud-client-example`
      - If you are compiling in Windows, please rename this folder to a shorter name, such as PDMC\_App
    - `mbed deploy`
  - Check release version
    - `mbed releases`
  - Update to a specific version
    - `mbed update 4.0.0`
    - Pelion DM Example 4.1.0 was released last Friday

# Download Developer Certificate

- Login to <https://portal.mbedcloud.com/>
- Navigate to “Device Identity -> Certificates”



- Click on “New Certificate” on the top-right of the page
- Then click on “Create a developer certificate”





# Download Developer Certificate (cont.)

- Name the certificate and click on “Create certificate”

Create a developer certificate

Name  
ASEAN Alvin Test Cert

Description (optional)

Create certificate Cancel

- Click on the download icon to download the certificate C file

- File name:  
mbed\_cloud\_dev\_credentials.c

Certificate details

ASEAN Alvin Test Cert

Add description

Active  
This certificate is valid.

Blacklist

SUMMARY DEVICES (0) ATTRIBUTES

- Replace this file with the one stored under mbed-cloud-client-example

# Configuration for your board

- Master configuration file is mbed\_app.json
  - mbed-OS has defaults for every targets
  - target\_overrides specifies default values for all boards
    - You need to configure the Wi-Fi credentials here
  - <target name> tags specifies default values for a specific board

```
155 lines (155 sloc) | 9.77 KB
Raw Blame History

1 {
2   "macros": [
3     "ARM_UC_USE_PAL_BLOCKDEVICE=1"
4   ],
5   "target_overrides": {
6     "": {
7       "target.features_add"      : ["BOOTLOADER", "STORAGE"],
8       "platform.stdio-baud-rate" : 115200,
9       "platform.stdio-convert-newlines" : true,
10      "platform.stdio-buffered-serial" : true,
11      "platform.stdio-flush-at-exit"   : true,
12      "rtos.main-thread-stack-size"   : 5120,
13      "update-client.storage-locations" : 1,
14      "mbed-trace.enable"              : null,
15      "events.shared-stacksize"       : 2048,
16      "nsapi.default-wifi-security"    : "WPA_WPA2",
17      "nsapi.default-wifi-ssid"       : "\"SSID\"",
18      "nsapi.default-wifi-password"   : "\"Password\""
19    },
20    "Freescale": {
21      "lwip.mem-size" : 12500
22    },
23    "STM32F4": {
24      "lwip.pbuf-pool-size" : 16,
25      "lwip.mem-size"       : 12500
26    },
27    "K64F": {
28      "target.network-default-interface-type" : "ETHERNET",
29      "target.bootloader_img"                 : "tools/mbed-bootloader-k64f-block_device-kvstore-v4.0.0.bin",
30      "target.header_offset"                  : "0xa000",
31      "target.app_offset"                     : "0xa400",
32      "target.components_add"                 : ["SD"],
33      "update-client.bootloader-details"       : "0x00007188",
34      "update-client.application-details"      : "(40*1024)",
35      "update-client.storage-address"          : "(1024*1024*64)",
36      "update-client.storage-size"             : "((MBED_ROM_START + MBED_ROM_SIZE - APPLICATION_ADDR) * MBED_CONF_UPDATE_CLIENT_S",
37      "mbed-cloud-client.update-storage"       : "ARM_UCP_FLASHIAP_BLOCKDEVICE",
38      "storage_filesystem.internal_base_address" : "(32*1024)",
39      "storage_filesystem.rbp_internal_size"    : "(8*1024)",
40      "storage_filesystem.external_base_address" : "(0x0)",
41      "storage_filesystem.external_size"       : "(1024*1024*64)",
42      "storage.storage_type"                   : "FILESYSTEM",
43      "storage_filesystem.filesystem"          : "LITTLE",
44      "storage_filesystem.blockdevice"         : "SD"
45    },
46    "K66F": {
47      "target.network-default-interface-type" : "ETHERNET",
48      "target.bootloader_img"                 : "tools/mbed-bootloader-k66f-internal_flash-no_rot-v4.0.0.bin",
49      "target.header_offset"                  : "0x8000",
50      "target.app_offset"                     : "0x8400",
51      "rtos.main-thread-stack-size"          : 8192,
52      "update-client.bootloader-details"      : "0x4058",
```

# Our Reference Target

- Our reference target for this Makerthon is DISCO\_L475AG\_IOT01A
  - Modify the value of 'led-pinname' to "LED4"
  - Add the following section:

```
..
"DISCO_L475VG_IOT01A": {
    "target.macros_add"                : ["MBEDTLS_USER_CONFIG_FILE=\"mbedtlsConfig_mbedOS.h\""],
    "target.network-default-interface-type" : "WIFI",
    "target.bootloader_img"            : "tools/mbed-bootloader-disco_l475vg_iot01a-internal_qspif-kvstore.bin",
    "target.header_offset"             : "0x11000",
    "target.app_offset"                : "0x11400",
    "target.components_add"            : ["QSPIF", "WIFI_ISM43362"],
    "bootloader-size"                  : "(36*1024)",
    "ism43362.read-thread-stack-size"  : 1024,
    "mbed-client-pal.pal-max-frag-len" : 1,
    "mbed-client.sn-coap-max-blockwise-payload-size": 256,
    "mbed-cloud-client.update-storage" : "ARM_UCP_FLASHIAP_BLOCKDEVICE",
    "storage.storage_type"             : "TDB_INTERNAL",
    "storage_tdb_internal.internal_base_address": "(MBED_ROM_START + MBED_BOOTLOADER_SIZE)",
    "storage_tdb_internal.internal_size": "(2*16*1024)",
    "update-client.application-details": "(MBED_CONF_STORAGE_FILESYSTEM_INTERNAL_BASE_ADDRESS + MBED_CONF_STORAGE_FILESYSTEM_RBP_INTERNAL_SIZE)",
    "update-client.bootloader-details" : "0x800882c",
    "update-client.firmware-header-version": "2",
    "update-client.storage-address"     : "(MBED_CONF_STORAGE_FILESYSTEM_EXTERNAL_BASE_ADDRESS + MBED_CONF_STORAGE_FILESYSTEM_EXTERNAL_SIZE)",
    "update-client.storage-locations"  : 1,
    "update-client.storage-size"       : "((MBED_ROM_START + MBED_ROM_SIZE - APPLICATION_ADDR) * MBED_CONF_UPDATE_CLIENT_STORAGE_LOCATIONS)",
    "cellular.debug-at"                : false,
    "cellular.use-apn-lookup"          : false
}
```

# Our Reference Target

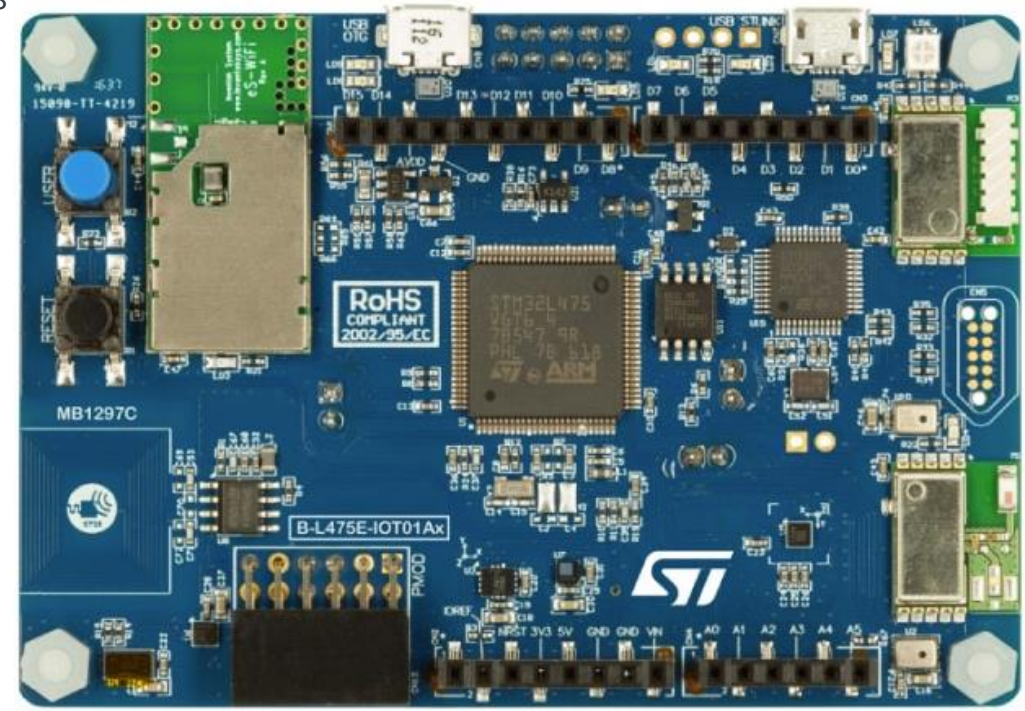
- Our reference target for this Makerthon is DISCO\_L475AG\_IOT01A
  - Here is the config:
  - [https://github.com/soleilplanet/ASEAN\\_2019](https://github.com/soleilplanet/ASEAN_2019)
    - file name: mbed\_app\_l475vg.json



# Our Reference Target

- Device Capabilities

- 64-Mbit Quad-SPI (Macronix) Flash memory
- Bluetooth® V4.1 module (SPBTLE-RF)
- Sub-GHz (868 or 915 MHz) low-power-programmable RF module (SPSGRF-868 or SPSGRF-915)
- Wi-Fi® module Inventek ISM43362-M3G-L44 (802.11 b/g/n compliant)
- Dynamic NFC tag based on M24SR with its printed NFC antenna
- 2 digital omnidirectional microphones (MP34DT01)
- Capacitive digital sensor for relative humidity and temperature (HTS221)
- High-performance 3-axis magnetometer (LIS3MDL)
- 3D accelerometer and 3D gyroscope (LSM6DSL)
- 260-1260 hPa absolute digital output barometer (LPS22HB)
- Time-of-Flight and gesture-detection sensor (VL53L0X)
- 2 push-buttons (user and reset)
- USB OTG FS with Micro-AB connector
- Expansion connectors:
  - Arduino™ Uno V3
  - PMOD
- Flexible power-supply options: ST LINK USB VBUS or external sources
- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability: mass storage, virtual COM port and debug port



# Configuring WiFi

- Method 1:
  - Edit mbed\_app.json
    - "nsapi.default-wifi-security" : "WPA\_WPA2",
    - "nsapi.default-wifi-ssid" : "\"SSID\"",
    - "nsapi.default-wifi-password" : "\"Password\""
  - However, editing this file will force you do a clean build
- Method 2:
  - Find mbed-os/features/netsocket/NetworkInterfaceDefaults.cpp
  - In function `WiFiInterface::set_default_parameters()`, edit this line:
    - `set_credentials(MBED_CONF_NSAPI_DEFAULT_WIFI_SSID, MBED_CONF_NSAPI_DEFAULT_WIFI_PASSWORD, SECURITY);`
    - `set_credentials("SSID","Password", SECURITY);`
  - `MBED_CONF_NSAPI_DEFAULT_WIFI_SSID` is the "nsapi.default-wifi-ssid" you specified in mbed\_app.json
  - `MBED_CONF_NSAPI_DEFAULT_WIFI_PASSWORD` is the "nsapi.default-wifi-password" you specified in mbed\_app.json

# Configuring WiFi (cont.)

- SSID:
  - IC5G\_01
  - IC5G\_02
  - IC5G\_03
  - IC5G\_04
- Password
  - @Celcom5g
- Security
  - WPA2-Personal

# Build the code

- Now we build the Pelion DM example
  - Navigate to the root folder (mbed-cloud-client-example)
  - `mbed target DISCO_L475VG_IOT01A`
  - `mbed toolchain GCC_ARM`
  - `mbed compile`
- The built binary will be located at:
  - `BUILD/DISCO_L475VG_IOT01A/GCC_ARM/mbed-cloud-client-example.bin`
- You may list all possible configurations with this command:
  - `mbed compile --config`

# Flash the binary

- Connect your board with USB cable
- A “[DAPLink](#)” or “[DIS\\_L4IOT](#)” device will appear in your system as a mass storage device
- Drag and drop the binary file ([mbed-cloud-client-example.bin](#)) to the device
- You will see something like this:

```
Mbed Bootloader
No Update image
[DBG ] Active firmware up-to-date
booting...

Start Device Management Client
Using hardcoded Root of Trust, not suitable for production use.
Starting developer flow
Application ready. Build at: Nov 26 2019 19:43:18
Mbed OS version 5.14.1
mcc_platform_interface_connect()
Connecting with interface: WiFi
NSAPI_STATUS_CONNECTING
NSAPI_STATUS_GLOBAL_UP
IP: 192.168.1.27
Network initialized, registering...
Client registered
Endpoint Name: 016eaaddcceb000000000000100198b9b
Device Id: 016eaaddcceb000000000000100198b9b
█
```

connected to Pelion:

# On the Portal

arm PELION  
DEVICE MANAGEMENT

Search features

Dashboard

Device directory

Devices

Device groups

Device events

Enrolling devices

Device identity

Firmware update

Access management

Team configuration

Billing reports

Job management

Profile

Help

Language

Privacy

Devices

View and manage your devices.

Actions

1 - 10 of 10

Saved filters

Registered only

Lifecycle status: Enabled

Device type

Execution mode

Reset

Filters

Device ID	Endpoint name	Name	State	Device type	Execution mode	Date created	Date bootstrapped
016eaaddcceb0000000000198b9b	016eaaddcceb0000000000198b9b	016eaaddcceb0000000000198b9b	registered	Development	Development	Nov 27, 2019 1...	Nov 27, 2019 1...
016ea5ce574700... 195beb	016ea5ce574700... 195beb	016ea5ce574700000000...	deregistered	Development	Development	Nov 26, 2019 1...	Nov 26, 2019 1...
016ea1d9fef500... 193094	016ea1d9fef500... 193094	016ea1d9fef500000000...	deregistered	Development	Development	Nov 25, 2019 5...	Nov 25, 2019 5...
016ea1d009f300... 192e31	016ea1d009f300... 192e31	016ea1d009f300000000...	bootstrapped	Development	Development	Nov 25, 2019 5...	Nov 25, 2019 5...
016e62b3c75f00... 1810f8	016e62b3c75f00... 1810f8	016e62b3c75f00000000...	deregistered	Development	Development	Nov 13, 2019 1...	Nov 13, 2019 1...
016e593da48500... 17eef8	016e593da48500... 17eef8	016e593da48500000000...	deregistered	Development	Development	Nov 11, 2019 2...	Nov 11, 2019 2...
016e20f3bb9600... 176e5b	016e20f3bb9600... 176e5b	016e20f3bb9600000000...	deregistered	Development	Development	Oct 31, 2019 4...	Oct 31, 2019 4...
016e20c55a9300... 176e3b	016e20c55a9300... 176e3b	016e20c55a9300000000...	deregistered	Development	Development	Oct 31, 2019 3...	Oct 31, 2019 3...
016c84f114eb00... 100053	016c84f114eb00... 100053	016c84f114eb00000000...	deregistered	Development	Development	Aug 12, 2019 4...	Aug 12, 2019 4...
016c847becad00... 1003f2	016c847becad00... 1003f2	016c847becad00000000...	cloud_enrolling	Development	Development	Aug 12, 2019 2...	Aug 16, 2019 5...

Device details

016eaaddcceb0000000000100198b9b

016eaaddcceb0000000000100198b9b

SUMMARY

ATTRIBUTES

RESOURCES

EVENTS LOG

Connected

Registered

Lifecycle status

Name

Vendor ID

Class ID

Serial number

Execution mode

Date bootstrapped

Date created

Date modified

Trusted certificate

Device certificate

Directly connected device

Registered

Device has active registration

Enabled

This device has never been suspended

Suspend

016eaaddcceb0000000000100198b9b

6465765f6d616e756661637475726572

6465765f6d616e756661637475726572

0

Development (1)

Nov 27, 2019 — 9 minutes ago

Nov 27, 2019 — 9 minutes ago

Nov 27, 2019 — 9 minutes ago

Alvin DevCert

developer/bootstrap

Jul 11, 2029 — in 10 years

Select the device certificate to renew

Renew

30

2019 Arm Limited

arm

# On the Portal - Resources

Device details

016eaaddcceb0000000000100198b9b

016eaaddcceb0000000000100198b9b

SUMMARY

ATTRIBUTES

RESOURCES

EVENTS LOG

To find out about resources and subscribing to changes, read the documentation.

Search by Path, Name, Observ

Path	Name	Observable
/1	LwM2M Server	No
/1/0	LwM2M Server - 0	No
/1/0/0	Short Server ID	Yes
/1/0/1	Lifetime	Yes
/1/0/6	Notification Storing When Disabled or Offline	Yes
/1/0/7	Binding	Yes
/1/0/8	Registration Update Trigger	No
/3/0/0	Manufacturer	Yes
/3/0/1	Model Number	Yes
/3/0/2	Serial Number	Yes
/3/0/4	Reboot	No
/3/0/5	Factory Reset	No
/3/0/11	Error Code	Yes
/3/0/11/0	Error Code	Yes
/3/0/13	CurrentTime	Yes
/3/0/16	Supported Bindingand Modes	Yes
/3/0/17	Device Type	Yes
/3/0/18	Hardware Version	Yes
/3/0/21	Memory Total	Yes
/3200	Digital Input	No
/3200/0	Digital Input - 0	No





# Webapp – Getting Resource Values

- API URL: <https://api.us-east-1.mbedcloud.com>
- API Key:
  - You may obtain your API key on the portal, “Access management -> API keys -> New API key”
- REST APIs
  - <https://www.pelion.com/docs/device-management/current/service-api-references/device-management-connect.html>
  - Or Google with ‘**Pelion connect service API**’, it’s the first link

# Webapp – Getting Resource Values (cont.)

1. [Device Directory API](#): Stores device information and allows device management.
2. [Connect API](#): Allows web applications to communicate with devices.
3. [Connect Statistics API](#): Provides statistics about services through defined counters.
4. [Update Service API](#): Manages device firmware updates.
5. [Account Management API](#): Manages accounts and users, creates API keys, and uploads trusted certificates.
6. [Bootstrap API](#): Allows web applications to control the device bootstrapping process.
7. [Enrollment API](#): Allows users to claim ownership of a device that is not yet assigned to an account.
8. [Customer's third party CA API](#): Defines a third-party bootstrap certificate provider.
9. [Certificate enrollment API](#): Allows management of certificate renewal on devices.
10. [Billing API](#): Allows users to retrieve billing reports and service package details.

- For this event, #1 - #4 might be frequently used

# Webapp – Getting Resource Values (cont.)

Device Directory API: Stores device information and allows device management.

- DeviceDirectoryDevices
  - You may list all devices, get device info or update device info with this set of APIs
- DeviceDirectoryEvents
  - You may list all device events or retrieve an event on a specific device
- DeviceDirectoryFilterQueries
  - This API set is about getting device status, such as life time, device creation time, registration status, etc.
- DeviceDirectoryGroups
  - This API set allows you to manage devices in groups

# Webapp – Getting Resource Values (cont.)

Connect API: Allows web applications to communicate with devices.

- DeviceRequests
  - This API set allows you to get resource values
- Notifications
  - This API set allows you to setup notifications from the device to the webapp
- Subscriptions
  - This API set allows you to manage resource subscriptions

# Webapp – Getting Resource Values (cont.)

[Connect Statistics API](#): Provides statistics about services through defined counters.

- Statistics
  - GET /v3/metrics
  - This API group only have the API above, and it gives you account-specific statistics

# Webapp – Getting Resource Values (cont.)

[Update Service API](#): Manages device firmware updates.

- DeviceUpdateCampaigns
  - This API set allows you to manage update campaigns
- DeviceUpdateFirmwareImages
  - This API set allows you to manage images which are about to be pushed to the devices in update campaigns
- DeviceUpdateFirmwareManifests
  - This API set allows you manage manifest files which has the signature of the firmware images along with other image info

# Adding Resources (Device)

- Adding resources with Pelion Device Management Client

- First, declare a M2MResource object
  - `M2MResource* int_resource;`
- Use the Pelion DM Client instance
  - Already defined in the example:
    - `SimpleM2MClient mbedClient;`

- Resource path follows OMA object registry

- <http://www.openmobilealliance.org/wp/OMNA/LwM2M/LwM2MRegistry.html>
- Resource path format: <Object ID>/<Instance ID>/<Resource ID>
- For example
  - <http://www.openmobilealliance.org/tech/profiles/lwm2m/3304.xml>
  - object ID 3304 is reserved for Humidity
  - Resource ID 5700 is mandatory to object ID 3304, and its type must be float, indicating humidity sensor value
  - So, 3304/0/5700 indicates the value of the 1<sup>st</sup> humidity sensor on the device, 3304/1/5700 indicates the value of the 2<sup>nd</sup> humidity sensor on the device

```
▼<Resources>
  ▼<Item ID="5700">
    <Name>Sensor Value</Name>
    <Operations>R</Operations>
    <MultipleInstances>Single</MultipleInstances>
    <Mandatory>Mandatory</Mandatory>
    <Type>Float</Type>
    <RangeEnumeration/>
    <Units/>
    <Description>Last or Current Measured Value from the Sensor</Description>
  </Item>
  <Item ID="5701">
```



# Adding Resources (Device) cont.

- Add resource to Pelin DM Client instance
  - Definition:
    - `M2MResource* add_cloud_resource(uint16_t object_id, uint16_t instance_id, uint16_t resource_id, const char *resource_type, M2MResourceInstance::ResourceType data_type, M2MBase::Operation allowed, const char *value, bool observable, void *cb, void *message_status_cb) {`
  - Example:

```
int_resource = mbedClient.add_cloud_resource(15000, 0, 5501, "int_test_resource",
M2MResourceInstance::INTEGER, M2MBase::GET_ALLOWED, 0, true, NULL, (void*)notification_status_callback);
```
  - Path for this resource will be: 15000/0/5501, where object ID 15000 is not yet registered in OMA

# Adding Resources (Device) cont.

- Add resource to Pelin DM Client instance
  - Definition:
    - `M2MResource* add_cloud_resource(uint16_t object_id, uint16_t instance_id, uint16_t resource_id, const char *resource_type, M2MResourceInstance::ResourceType data_type, M2MBase::Operation allowed, const char *value, bool observable, void *cb, void *message_status_cb) {`
  - Data type supported: STRING, INTEGER, FLOAT, BOOLEAN, OPAQUE, TIME, OBJLINK
  - Operation supported:
    - NOT\_ALLOWED
    - GET\_ALLOWED, PUT\_ALLOWED, POST\_ALLOWED, DELETE\_ALLOWED
    - GET\_PUT\_ALLOWED, GET\_POST\_ALLOWED, PUT\_POST\_ALLOWED, GET\_DELETE\_ALLOWED, PUT\_DELETE\_ALLOWED, POST\_DELETE\_ALLOWED
    - GET\_PUT\_POST\_ALLOWED, GET\_PUT\_DELETE\_ALLOWED, POST\_DELETE\_ALLOWED, GET\_POST\_DELETE\_ALLOWED, PUT\_POST\_DELETE\_ALLOWED, GET\_PUT\_POST\_DELETE\_ALLOWED
  - observable: whether the webapp can subscribe value of this resource
  - cb: callback function for operations
  - message\_status\_cb: status notification callback function (e.g. notification of resource being subscribed)
- Now the resource has been added to the `mbedClient` instance
  - Then you may give it an initial value:
    - `int_resource->set_value(0);`

# Debug traces

- Sometimes we need to know more about what's going on underneath
  - mbed-trace is an internal logging system that logs everything inside the OS
  - "mbed-trace.enable": [null, true]
    - null to disable mbed-trace logs
    - true to enable mbed-trace logs
  - "trace-level": define trace level
    - TRACE\_LEVEL\_ERROR
    - TRACE\_LEVEL\_WARN
    - TRACE\_LEVEL\_INFO
    - TRACE\_LEVEL\_DEBUG

# arm

For questions regarding Pelion development, you may contact:

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Thank You

Danke

Merci

谢谢

ありがとう

Gracias

Kiitos

감사합니다

धन्यवाद

شكراً

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