SAMSUNG
ARTIK™ Modules

Samsung Training Lab
ARTIK Cloud and 055s

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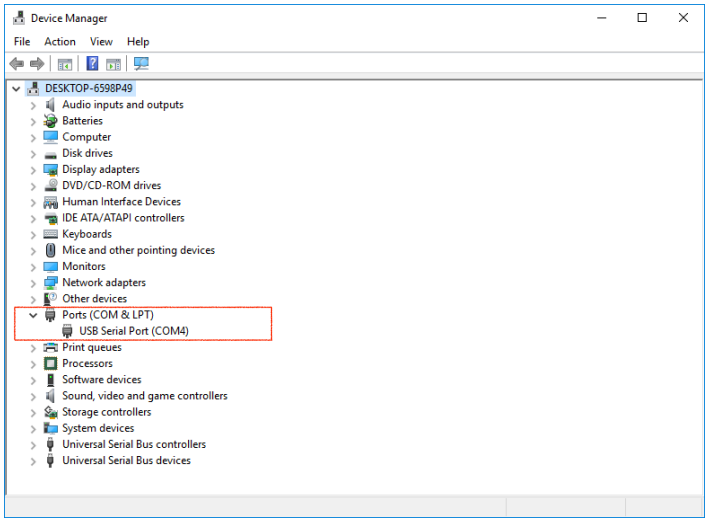
Introduction

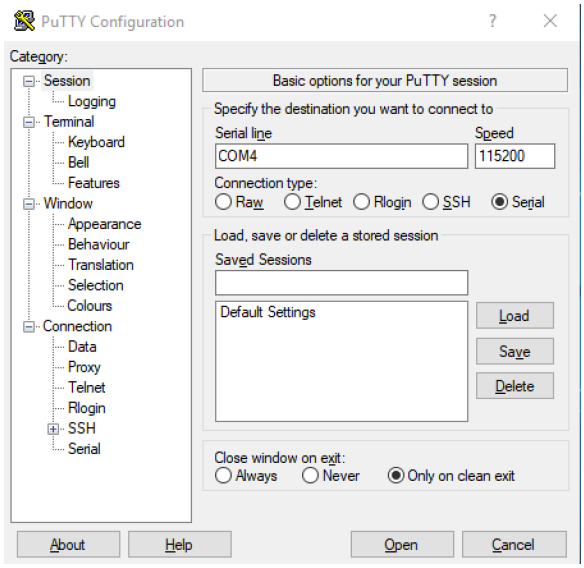
This hands-on lab is intended to explain the process of onboarding an ARTIK 055s powered device. We will explain how to connect the ARTIK 055s to the ARTIK cloud service using ARTIK SDK example code and the ARTIK on-boarding mobile app. Once the ARTIK 055s is on-boarded to the ARTIK cloud service, the user can turn on/off LEDs on the ARTIK 055s board using ARTIK Cloud Orchestration Engine.

1. Connect ARTIK 055s development board to your host machine using an USB cable.

2. Find your serial device in your Device Manager / Ports and remember the COM port your ARTIK board is using. In our example, the board uses COM4 port.



3. On Windows host machine, please install and launch a serial console application PuTTY.. Select “Serial” as the Connection type, use the COM port number you find from Device Manager and Speed 115200 for serial access.

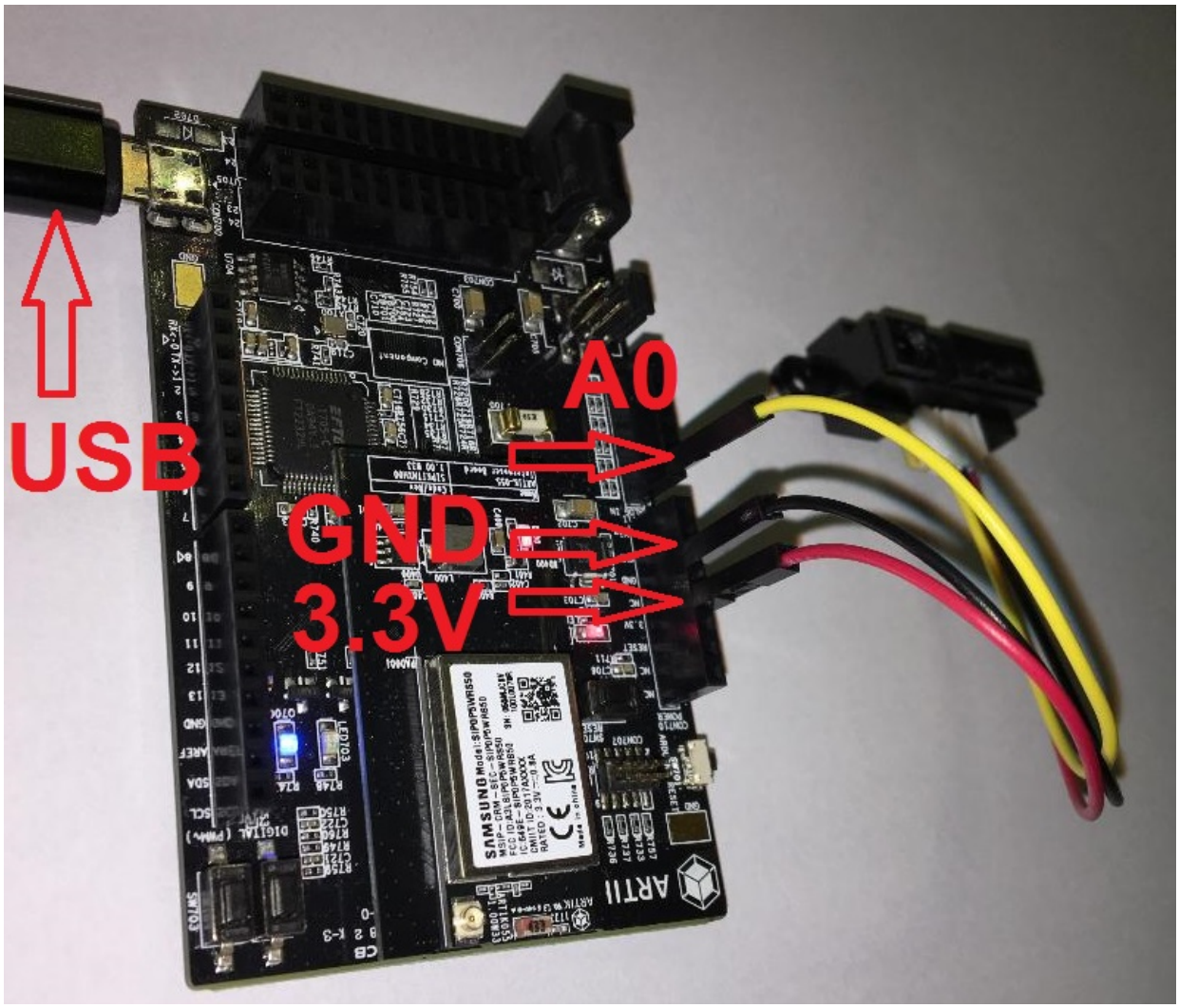


For Mac users, you can use the built-in *screen* utility to access the serial console. Normally the device name ends with `141B` or `142B`.

```
screen /dev/cu.usbserial-XXXXXXX 115200
```

Hardware set up

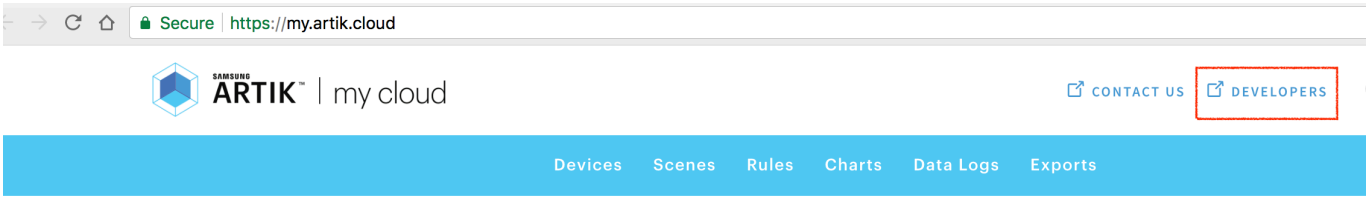
1. Connect the USB cable to ARTIK 055S board and your host machine.
2. Connect the IR distance sensor as shown below:
   Yellow wire: A0
   Black wire: GND
   Red wire: 3.3V



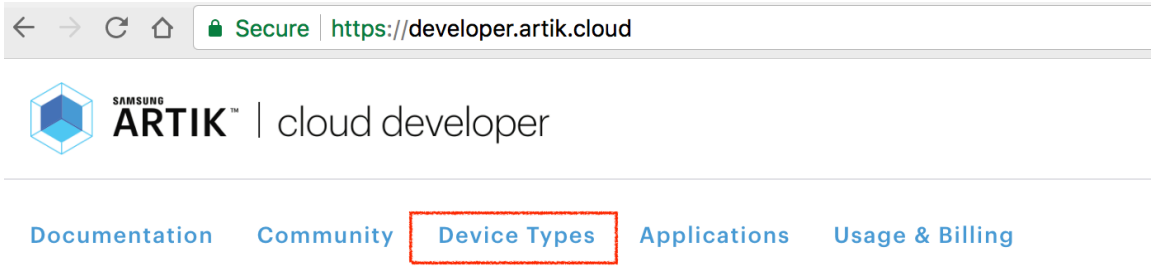
Lab 1: Create a Device Type

In this lab, we are going to create a device type in ARTIK Cloud. Once you have the device type, we will show you how to connect to this device type from your ARTIK devices in the following labs.

1. Open the Developer portal of ARTIK Cloud by using this URL https://developer.artik.cloud/ or by clicking on “ARTIK CLOUD DEVELOPERS” from ARTIK Cloud user portal.

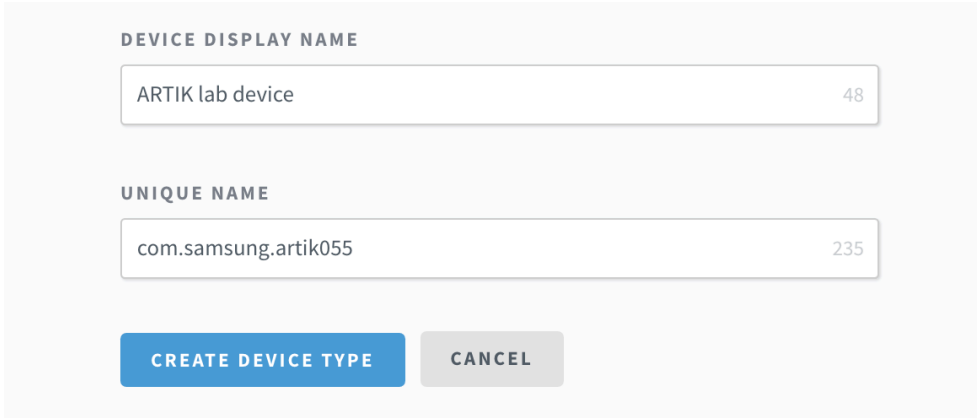


2. Click on Device Types



3. Click on “+NEW” button

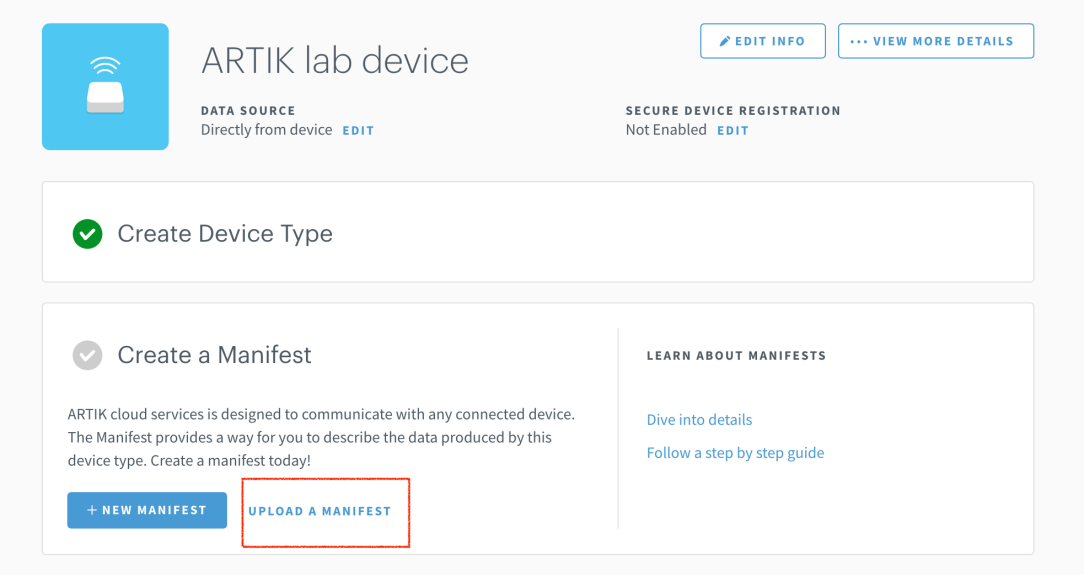
4. Give your device type a Device Display Name such as “your_company lab device” (eg. ARTIK lab device) and give it an unique name such as com.your_company.your_project_device (eg. com.samsung.artik055) , then click on “CREATE DEVICE TYPE”. This will enable us to create a digital representation for our device type in ARTIK Cloud. (compare this to reserving a name space for a data type in programing languages)



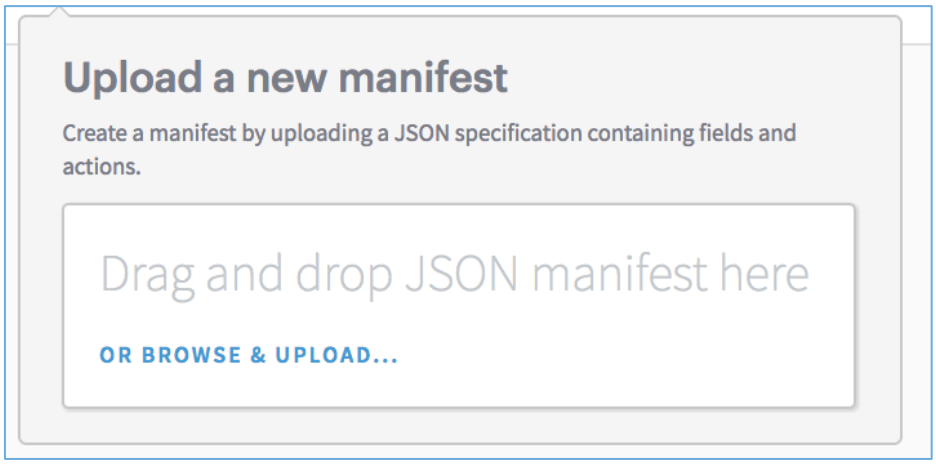
5. Now a name space is reserved for the device type. Actual definition of the device type needs to be done further. This is done using a **Manifest**. A Manifest is the representation of a device's data properties in ARTIK cloud. Any data, a device produces and sends to ARTIK cloud are represented as "Device Fields". Any data, the device can respond to is represented as "Actions". An action can have parameters as well, like an argument.

   A Manifest can be created step-by-step using an intuitive user interface or by simply uploading from a JSON file. The steps below explain the creating a Manifest from a JSON file.

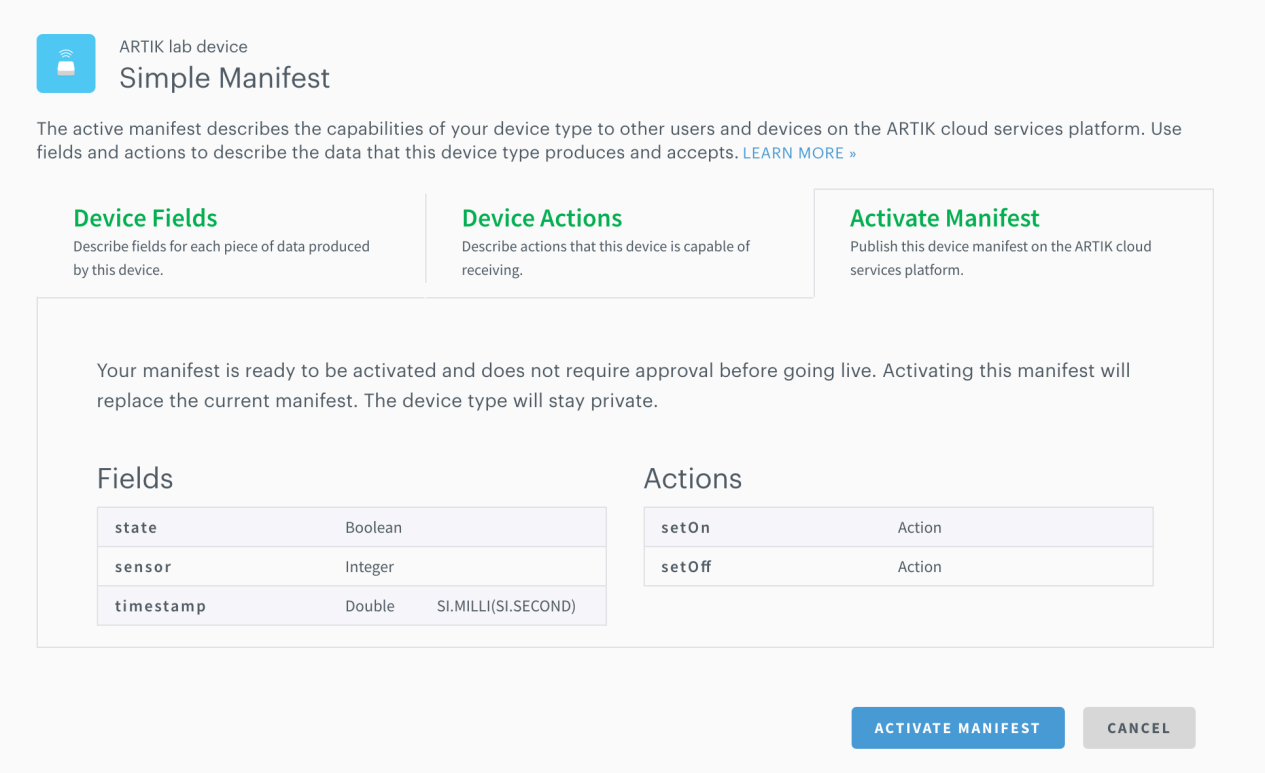
   To create a manifest from a JSON file, select UPLOAD A MANIFEST.



4. Upload the provided manifest file (com.samsung.artik055.json), for reference the contents of the manifest file is available in the appendix A

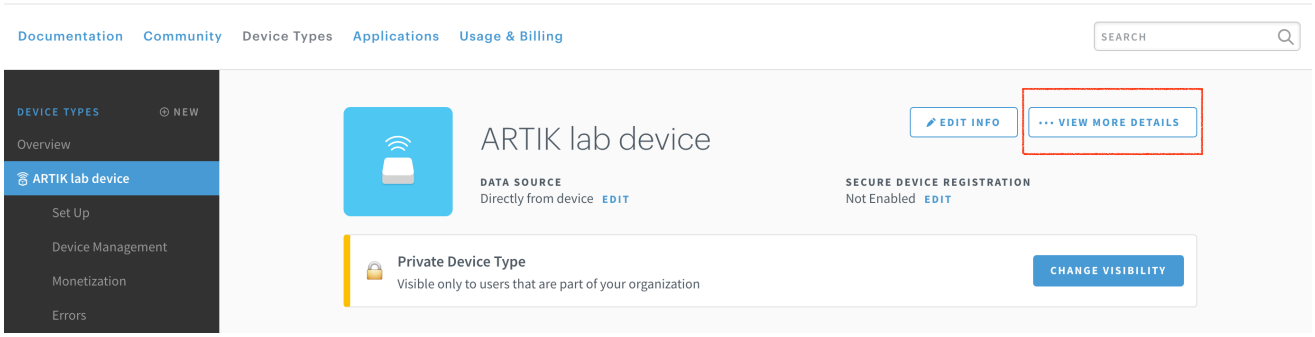


5. Upon uploading the JSON file, make sure the Manifest is as shown below. This Manifest represents a device that can send data to ARTIK Cloud for LED state, distance sensor reading and a timestamp. And it can also receive "setOn" and "setOff" actions from ARTIK Cloud in order to toggle the LED on the board.

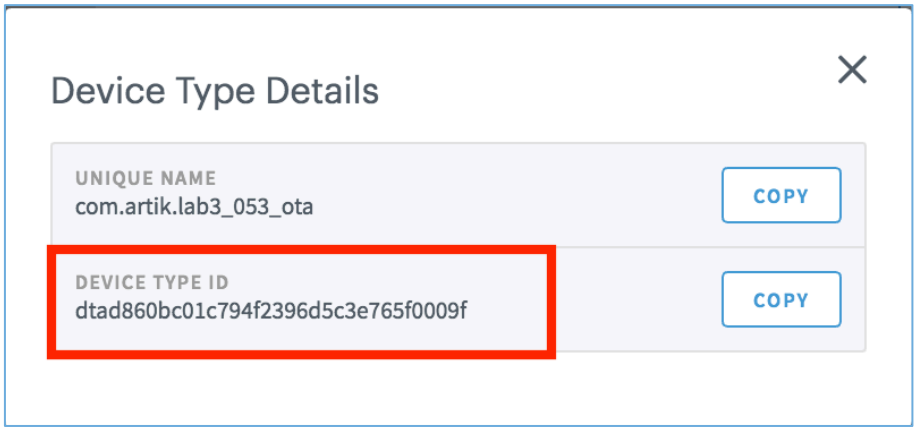


6. Then activate the manifest, by clicking on the “ACTIVATE MANIFEST” button.

7. Make sure a device type is created. Access “VIEW MORE DETAILS” and copy the device type ID created

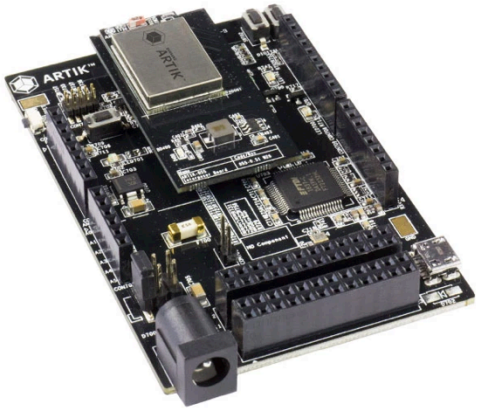


8. Make a note of the device type ID created. The Device type ID is dt_____ <please fill in>



9. Congratulations you have successful represented your device in ARTIK Cloud.

Lab 2: Onboard an ARTIK 055s

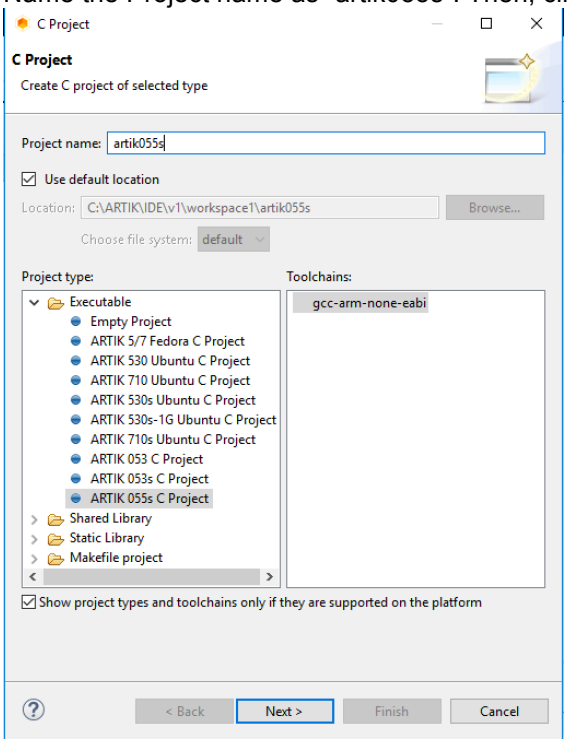


2.1 Install ARTIK IDE/SDK

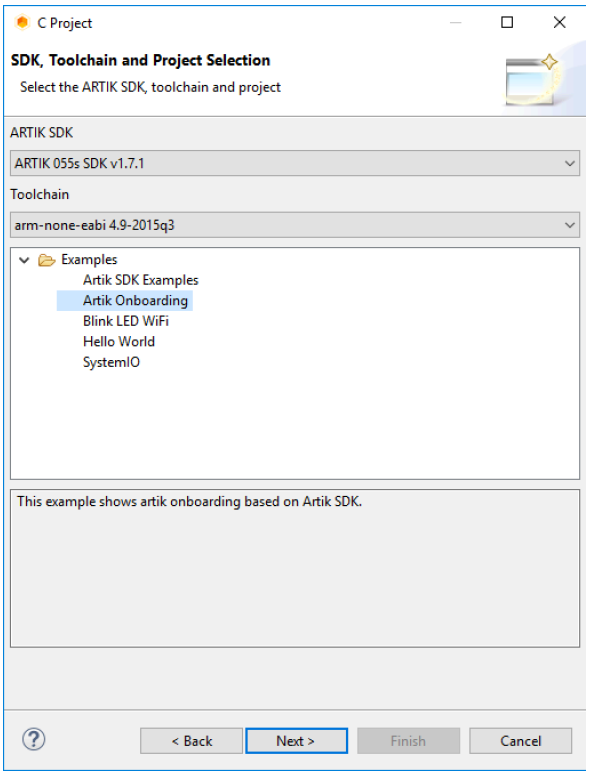
Please follow the instructions at https://developer.artik.io/documentation/developer-guide/artik-ide/install-ide.html to set up your development environment.

2.2 Build an Application for ARTIK055s

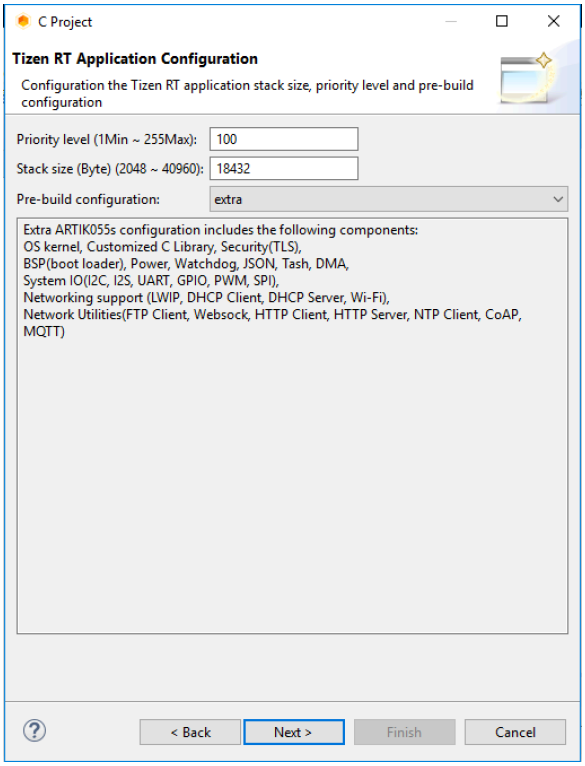
1. Launch your ARTIK IDE, go to File->New->C Project.
2. In the “C Project” dialog, select “ARTIK 055s C project”, and choose “gcc-arm-none-eabi” as the default toolchain. Name the Project name as “artik055s”. Then, click Next.



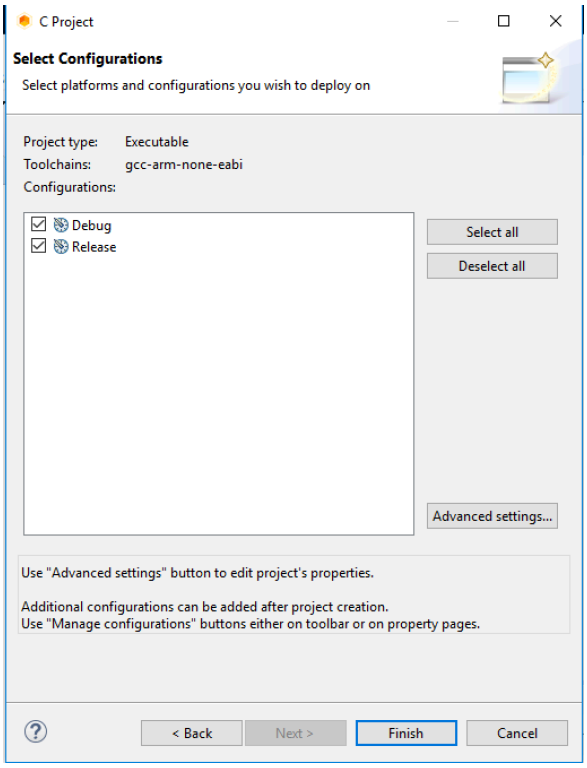
3. In “SDK, Toolchain and Project Selection” dialog, select “ARTIK 055s SDK v1.7.1” as the target SDK version. Click on “Artik Onboarding” example, we will use this example as our template to generate onboarding application. Then, click Next.



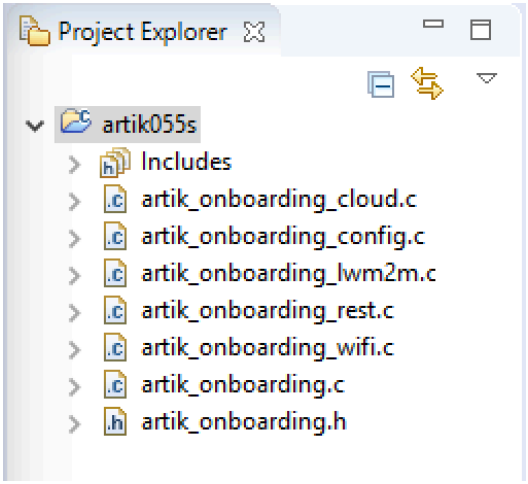
4. In “Tizen RT Application Configuration” dialog, use the default Priority level and Stack Size settings. Change the Pre-build configuration to “extra”, then click Next.



5. In “Select Configurations” dialog, keep the default Debug and Release builds settings, and click Finish.

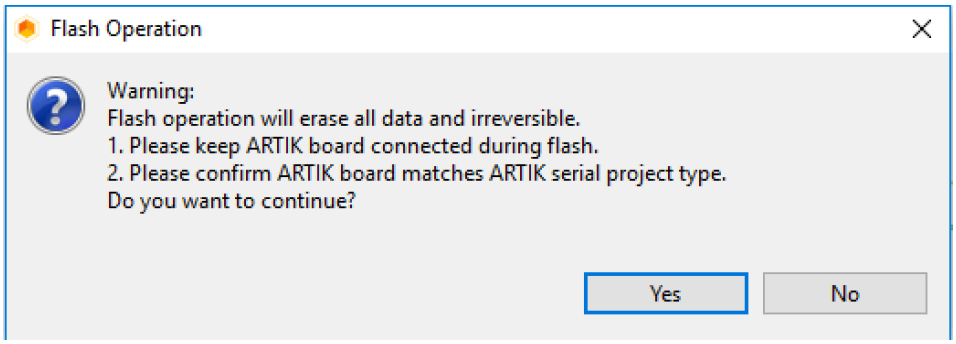


6. Now you have an application artik055s created in your IDE Project Explorer.

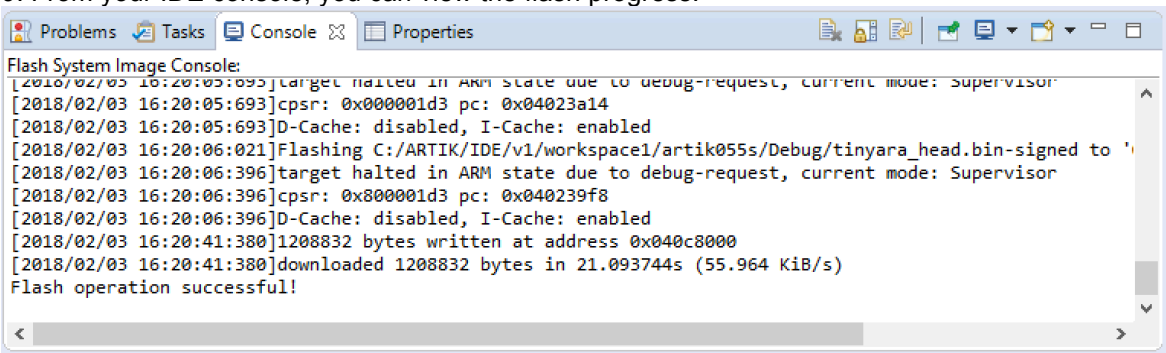


7. Build the application by selecting Project->Build Project. You can see the build log from the IDE Console tab.
8. Once you have a successful build, connect your ARTIK 055s board to your laptop by using an USB cable, click the "Flash System Image" button  to flash the newly built image to the board.

   As a precaution, a warning dialog will pop up to confirm you want to flash the device and make sure your ARTIK board matches ARTIK serial project type. Click "Yes" to proceed.



9. From your IDE console, you can view the flash progress.



2.3 Prepare ARTIK 055s Board for Onboarding

1. Push the Reset button.

2. From your serial console, you should be able to see the message below when the board boots up.

```
U-Boot 2017.01-00013-g814fa7d (Jan 08 2018 - 15:17:26 +0900)

CPU:   Exynos200 @ 320 MHz
Model: ARTIK-05x based on Exynos T20
DRAM:  1.3 MiB
WARNING: Caches not enabled
BL1 released at 2017-3-13 15:00
SSS released at 2017-09-12
WLAN released at 2017-12-21
Flash: 8 MiB
*** Warning - bad CRC, using default environment

In:    serial@80180000
Out:   serial@80180000
Err:   serial@80180000
Autoboot in 50 milliseconds
gpio: pin gpg16 (gpio 46) value is 1
## Starting application0at 0x040C8020 ...
s5j_sflash_init: FLASH Quad Enabled
i2c_uioregister: Registering /dev/i2c-0
i2c_uioregister: Registering /dev/i2c-1
System Information:
        Version: 1.0
        Commit Hash: 412a99dfeef802237d9463b9fb292a0f1fcacda6
        Build User: ARTIK@Samsung
        Build Time: 2018-01-16 20:24:06
        System Time: 01 Jan 2010, 00:00:00 [s] UTC Hardware RTC
Support
TASH>>Onboarding service version 1.7.1
Starting supplicant in foreground...
Starting AP ARTIK_286d974094ec
Web server started
ARTIK Onboarding Service started
```

3. Press <Enter> to enter TASH shell, we will manually configure some onboarding parameters.

4. From the ARTIK 055s TASH shell, reset the onboarding configuration. The device_type_id is associated with a default device type.

```
TASH>>onboard reset
Onboarding configuration was reset.
Reboot the board to return to onboarding mode

TASH>>onboard config
Wifi:
        ssid:
        passphrase:
        secure: false
        NTP server: 0.pool.ntp.org
Cloud:
        device_id: null
        device_token: null
        device_type_id: dt2d93bdb9c8fa446eb4a35544e66150f7
Lwm2m:
        is_ota_update: 0
```

5. Register ARTIK 055s to the device type you created in Lab 1. Replace the device id by using the device type id you saved. Reboot the board.

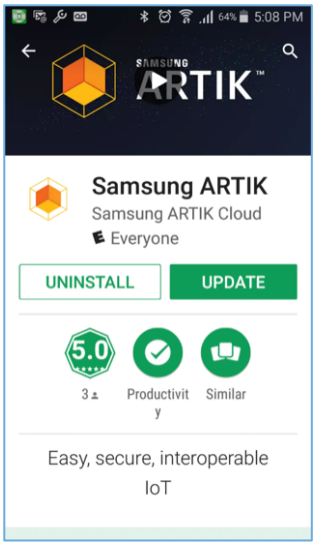
```
TASH>>onboard dtid dt36cebd13947147b5a5381e2310ce8264
TASH>>reboot
```

6. Note that the ARTIK onboarding service has started.

```
TASH>>Onboarding service version 1.7.1
Starting supplicant in foreground...
Starting AP ARTIK_286d97409408
Web server started
ARTIK Onboarding Service started
```

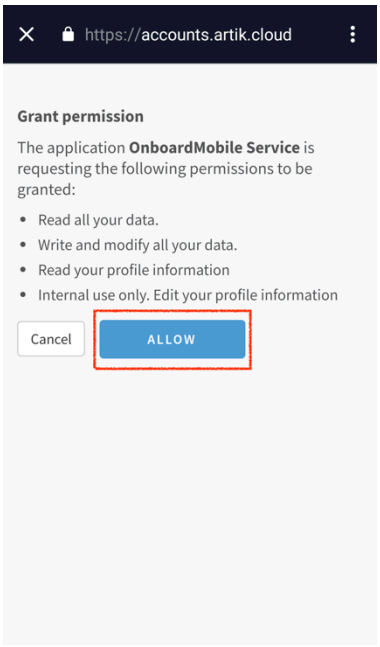
2.4 Samsung ARTIK Onboarding Application

1. Download Samsung ARTIK App to your mobile device:

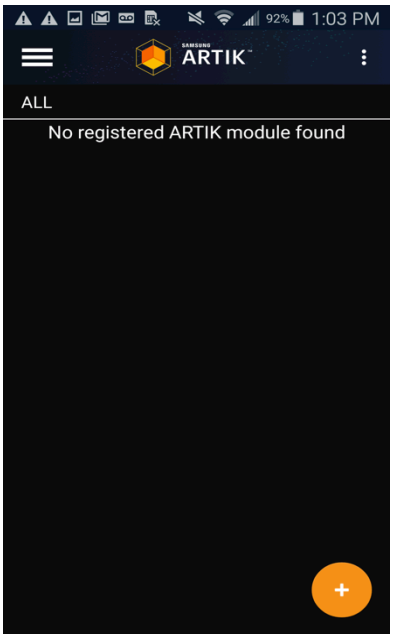


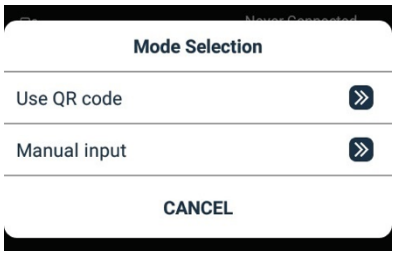
- For Android phones, the app can be downloaded from Google Play.
- For iPhone, the app can be found at the iTunes App Store (search for Samsung ARTIK). The app logo looks like:

2. Launch ARTIK app on your mobile phone, sign in with your own account and grant permission to the onboarding app.



3. Click the “+” button to add a device.

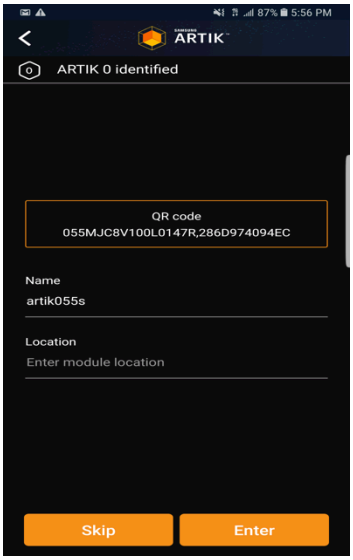




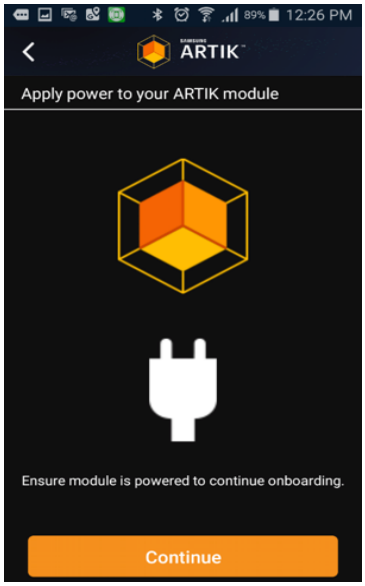
3. Press the arrows next to Use QR Code.

4. Scan the QR code.

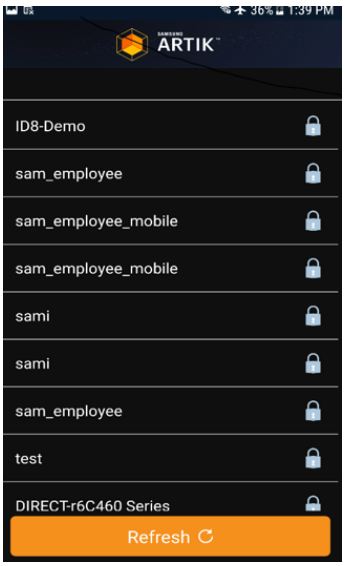
5. Enter a device name in the Name field and press Enter.



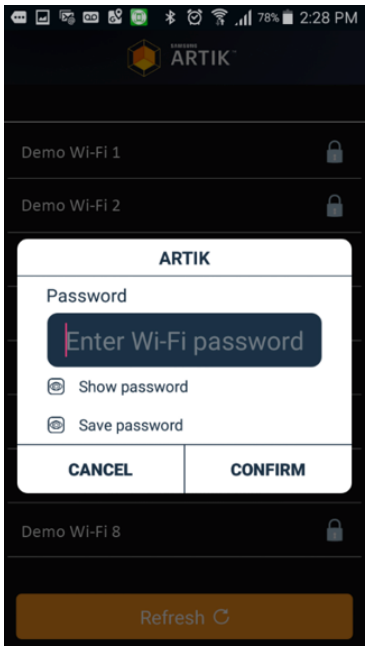
6. Press Continue



7. Select the WiFI SSID that you want your ARTIK 055s to connect to.

8. 

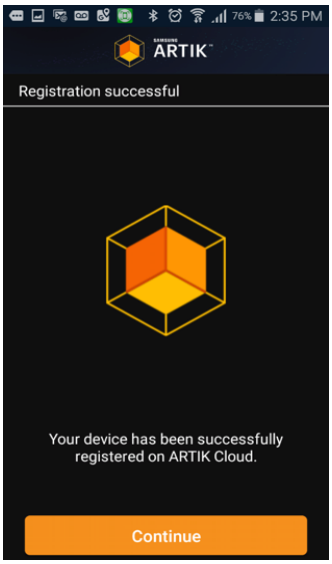
9. Enter the password and press Confirm.



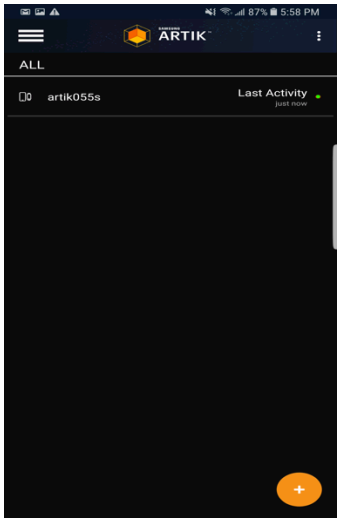
10. Now, from your ARTIK055s serial console, you should be able to see messages below:

```
TASH>>Onboarding service version 1.7.1
Starting supplicant in foreground...
Starting AP ARTIK_286d974094ec
Web server started
ARTIK Onboarding Service started
New Station connected
1 station connected
New Station connected
1 station connected
GET /v1.0/wifi/accesspoints
POST /v1.0/wifi/config
Web server stopped
Start station connection
Starting supplicant in foreground...
Connected to Access Point
Start DHCP client
Start NTP client
Start webserver cloud API
Web server started
Start MDNS service
GET /v1.0/artikcloud
POST /v1.0/artikcloud
Web server stopped
Start websocket to ARTIK Cloud
Websocket successfully connected
ARTIK Cloud connection started
Start LWM2M connection to ARTIK Cloud
LWM2M connection started
```

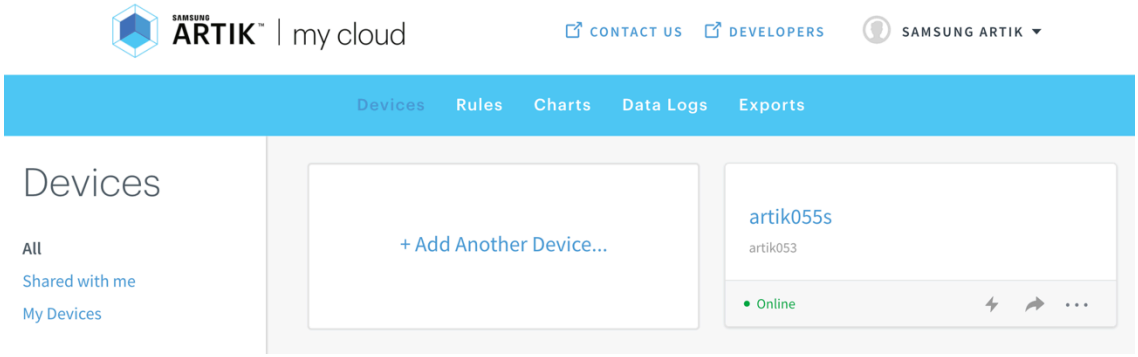
11. After registration is successful, click Continue.



12. New device shows up.



The ARTIK 055s has been successfully on-boarded to the Cloud. From your ARTIK Cloud portal, you can see the newly onboarded ARTIK 055s device.

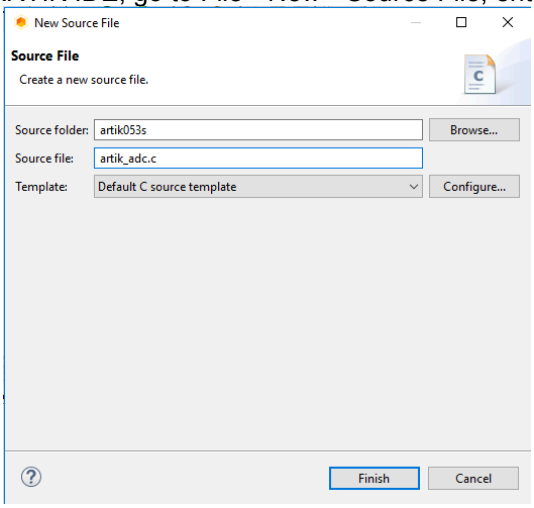


Lab 3: Steam Telemetry Data and Integrate Orchestration Engine

In this lab, we will extend the application from lab 1. Add a new thread to collect sensor data, and stream sensor data to ARTIK cloud service. We will also use ARTIK cloud service orchestration engine to turn on or off LED onboard based on the streamed sensor reading.

3.1 Extend Onboarding Application to Stream Telemetry Data

1. From your ARTIK IDE, go to File->New->Source File, enter artik_adc.c as the source file name, and click “Finish”.



2. Here is what you need to include in your artik_adc.c. In this file, we only have one function defined, which reads distance sensor data from the analog pin A0.

```c
#include <stdio.h>
#include <string.h>

#include <artik_module.h>
#include <artik_error.h>
#include <artik_adc.h>

#include "artik_onboarding.h"

int ReadSensor(int pin)
{
	artik_adc_module *adc = NULL;
	artik_adc_handle handle = NULL;
	artik_adc_config config;
	artik_error err = S_OK;
	int val = 0;
	char name[16] = "";
	int ret = 0;

	adc = (artik_adc_module *)artik_request_api_module("adc");
	if (!adc) {
		fprintf(stderr, "ADC module is not available\n");
		return -1;
	}

	memset(&config, 0, sizeof(config));
	config.pin_num = pin;
	snprintf(name, 16, "adc%d", config.pin_num);
	config.name = name;

	err = adc->request(&handle, &config);
	if (err != S_OK) {
	  fprintf(stderr, "Failed to request ADC %d (%d)\n", config.pin_num, err);
	  ret = -1;
	  goto exit;
	}

	err = adc->get_value(handle, &val);
	if (err != S_OK) {
	  fprintf(stderr, "Failed to read ADC %d value (%d)\n", config.pin_num, err);
	  adc->release(handle);
	  ret = -1;
	  goto exit;
	}

	fprintf(stdout, "ADC%d=%d\n", config.pin_num, val);
	adc->release(handle);

exit:
	artik_release_api_module(adc);
	return val;
}
```

3. Now, we will extend the onboarding flow to stream the sensor data. Go to `artik_onboarding_cloud.c`, add the code below before function `artik_error StartCloudWebsocket(bool start)`.

In these functions, we will start a new thread to collect sensor data at 10 seconds interval, construct the message into JSON format and post the data to ARTIK Cloud service. For the purpose of the exercise, we will only send sensor data 10 times.

```
static pthread_addr_t start_streaming(pthread_addr_t arg)
{
    int num_posts=0;
    int i=0;
    struct timespec timestamp;

    printf("Start streaming sensor data\n");
    for(i=0; i<num_posts;i++) {
      int val = ReadSensor(0);
      char message[100] = "";

      clock_gettime(CLOCK_REALTIME, &timestamp);
      snprintf(message, 100, "{\"sensor\":%d, \"timestamp\":%ld}",
val, timestamp.tv_sec);
       printf(message);
       SendMessageToCloud(message);
      usleep(10000 * 1000);
    }
}

artik_error StartStreaming()
{
     artik_error ret = S_OK;
     static pthread_t tid;
     pthread_attr_t attr;
     int status;

     pthread_attr_init(&attr);
     pthread_attr_setschedpolicy(&attr, SCHED_RR);
     pthread_attr_setstacksize(&attr, 16 * 1024);

     status = pthread_create(&tid, &attr, start_streaming, NULL);
     if (status) {
       printf("Failed to create thread for sensor streaming\n");
       ret = E_NO_MEM;
       goto exit;
     }
     pthread_setname_np(tid, "streaming start");
     pthread_join(tid, NULL);
     printf("Sensor Streaming successfully connected\n");

exit:
    return ret;
}
```

4. In artik_onboarding.h, add ReadSensor() function definition. Scroll to the bottom of the file, and add the lines below right after `#define ARRAY_SIZE(a) (sizeof(a)/size((a)[0]))`

```
/* ADC Reading */
int ReadSensor(int);
artik_error StartStreaming();
```

5. In artik_onboarding.c, look for line "`if (StartLwm2m(true) == S_OK) {`" in function **`static`** `pthread_addr_t` **`start_onboarding`**`(pthread_addr_t arg)` , extend the logic to invoke StartStreaming().The bold lines are what we added to the existing flow. This piece of code is called the first time when you onboard your ARTIK 055s device.

```
if (StartLwm2m(true) == S_OK) {
  if (StartStreaming() == S_OK) {
     printf("ARTIK Cloud connection started\n");
     goto exit;
  } else {
     printf("Failed to stream sensor data\n");
  }
} else {
  printf("Failed to start DM connection, switching back to
onboarding mode\n");
}
```

6. In artik_onboarding_rest.c, look for **`static`** `pthread_addr_t` **`start_websocket`**`(pthread_addr_t arg)`, and invoke `StartStraming()`as highlighted below. This piece of code is invoked every time you reboot your device after the device is onboarded.

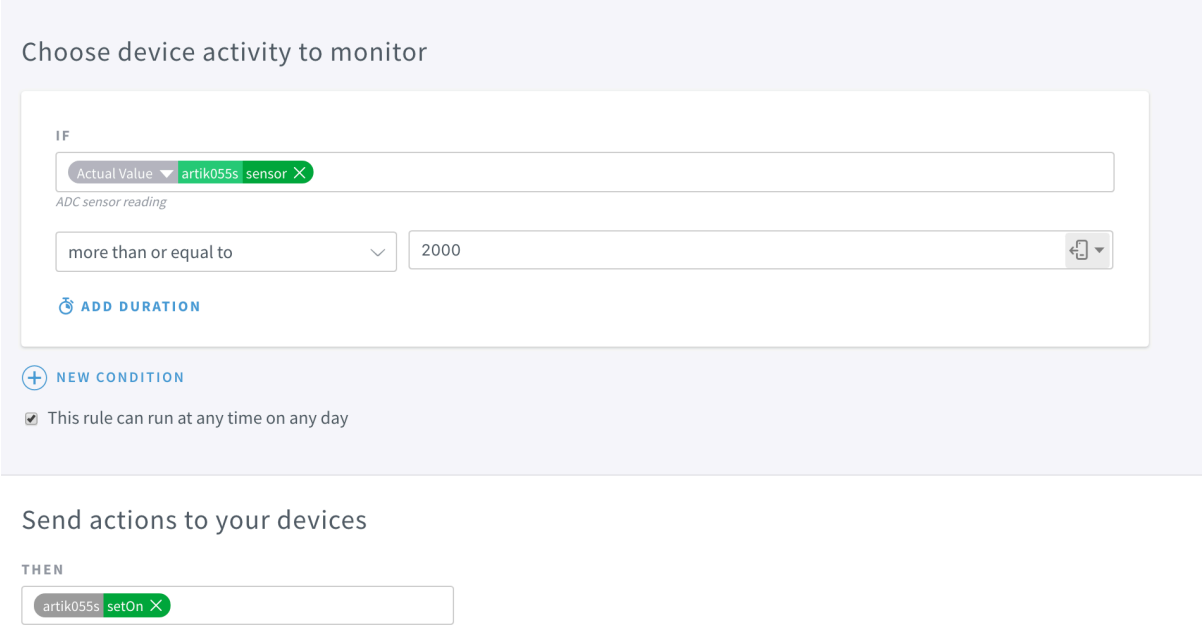
```
static pthread_addr_t start_websocket(pthread_addr_t arg)
{
     StartMDNSService(false);
     StartWebServer(false, API_SET_CLOUD);
     if (StartCloudWebsocket(true) == S_OK)
          printf("ARTIK Cloud connection started\n");
     if (StartStreaming() == S_OK)
          printf("Start Streaming to ARTIK Cloud\n");
     if (StartLwm2m(true) == S_OK)
          printf("LWM2M connection started\n");

     return NULL;
}
```

Compile the code.

3.2 Define Rules Engine

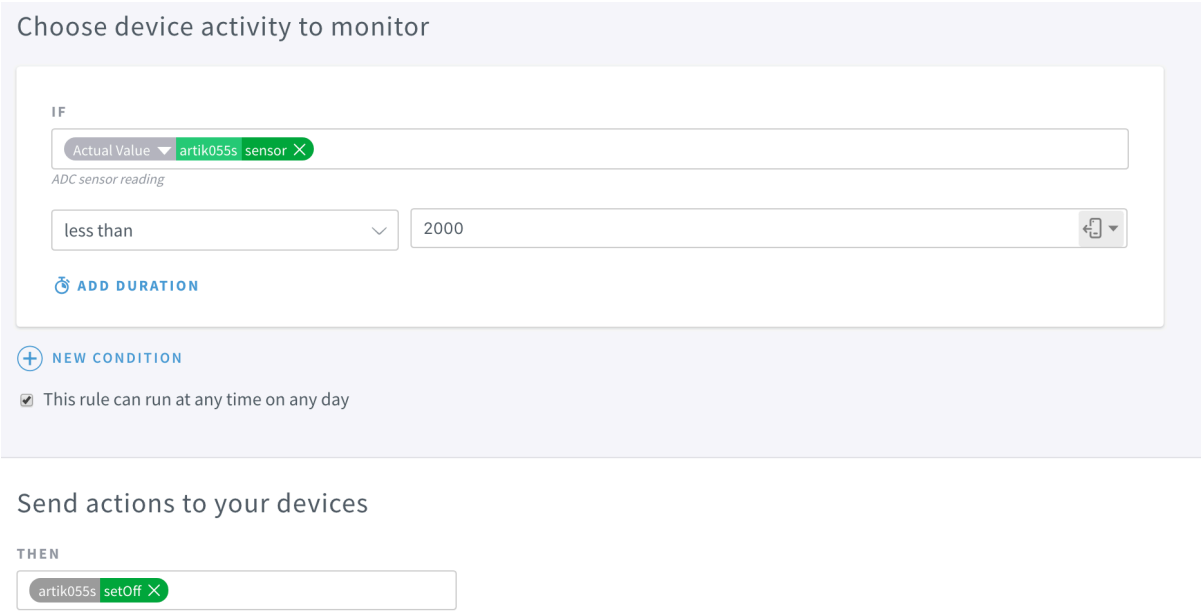
1. Now, we are going to add Rules to the Cloud. Go to Rules from ARTIK Cloud portal, click “CREAT A NEW RULE“ button if you don’t have any existing rules, or “+New Rule” button to add new rules.

Distance sensor reading increases when you move your hand close to the sensor. In the new rule we define, we will check if the sensor reading is more than or equal to 2000. If the value reaches the 2000 threshold, we will trigger the artik055 setOn action, which turns on the blue LED on the board(LED702).

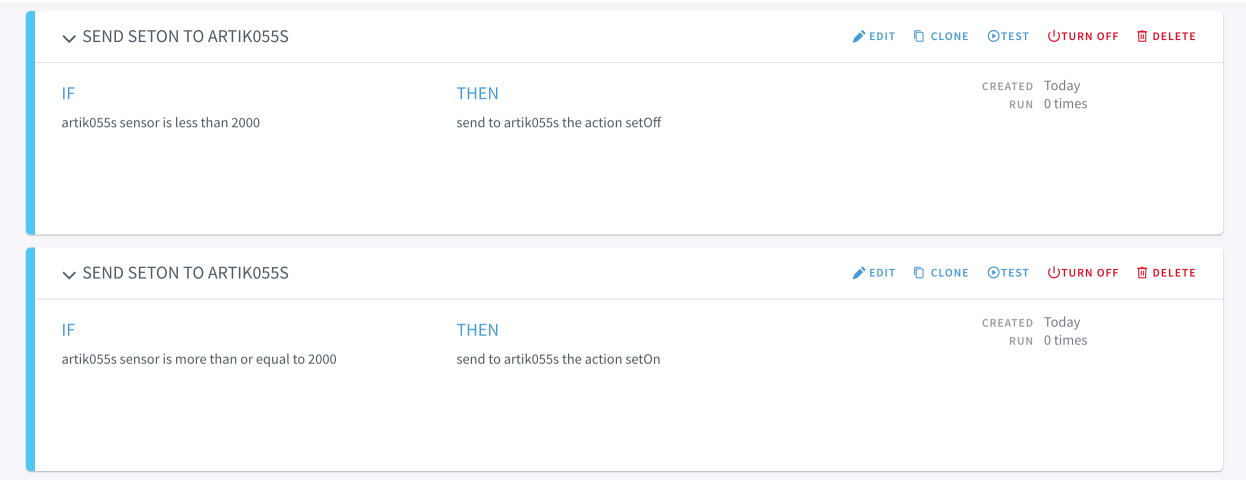


Click “Save Rule” button once you are done.

2. We will create a corresponding rule to turn off the LED on the board once you move your hands away from the sensor.



3. Here are the rules we created:



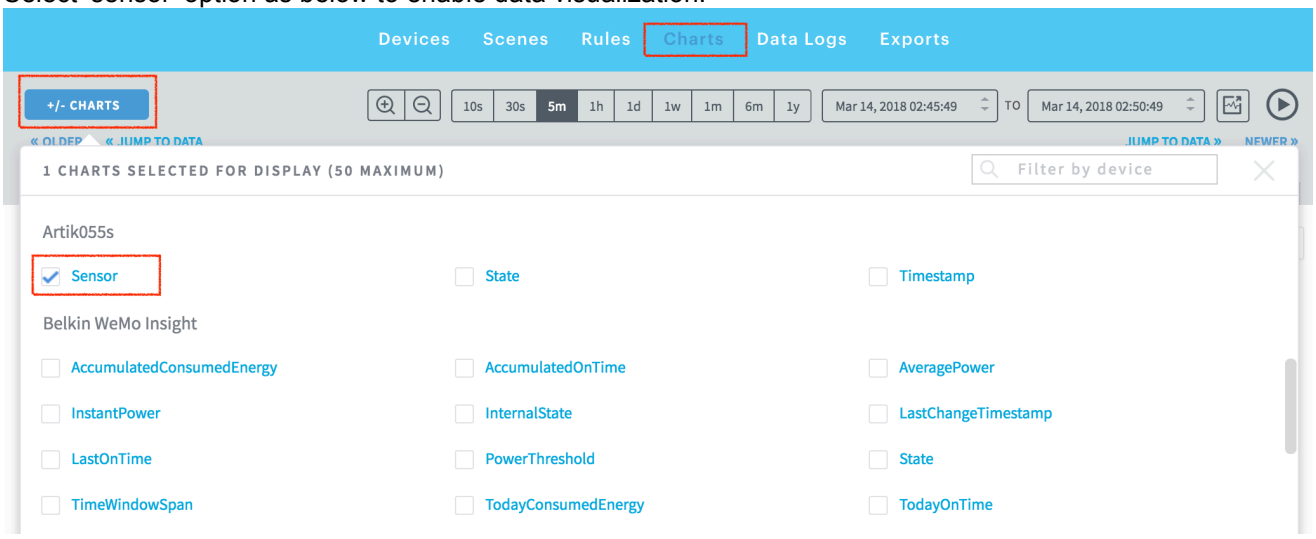
3.3 Use Rules Engine to Trigger Device Actions

1. Now, go back to our IDE and reflash the board. Click “Flash System Image” button  to flash the built image to the board.

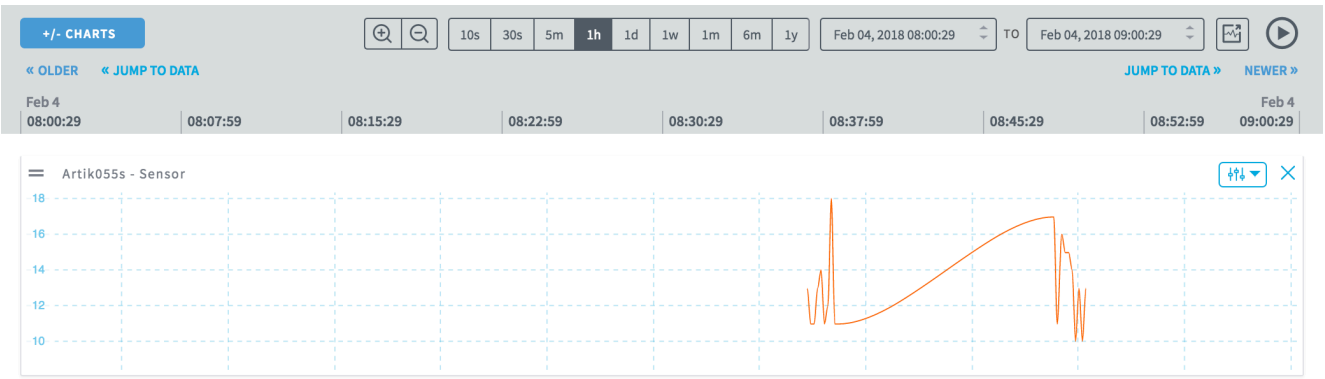
2. Reboot the board, from your serial console, you should be able to see messages like below.

```
TASH>>Onboarding service version 1.7.1
Starting supplicant in foreground...
Connected to Access Point
Start DHCP client
Start NTP client
Start websocket to ARTIK Cloud
Websocket successfully connected
Start LWM2M connection to ARTIK Cloud
Start streaming sensor data
ADC0=71
{"sensor":71, "timestamp":1521512079}ADC0=2752
{"sensor":2752, "timestamp":1521512089}ADC0=94
{"sensor":94, "timestamp":1521512099}ADC0=2765
{"sensor":2765, "timestamp":1521512109}ADC0=166
{"sensor":166, "timestamp":1521512119}ADC0=215
{"sensor":215, "timestamp":1521512129}ADC0=117
{"sensor":117, "timestamp":1521512139}ADC0=52
{"sensor":52, "timestamp":1521512149}ADC0=23
{"sensor":23, "timestamp":1521512159}ADC0=2748
{"sensor":2748, "timestamp":1521512169}
Sensor Streaming successfully connected
ARTIK Cloud connection started
```

Select ‘sensor’ option as below to enable data visualization.



From ARTIK Cloud portal, you can see the streamed sensor data. The LED on the board will be turned on and off based on the rules you defined.



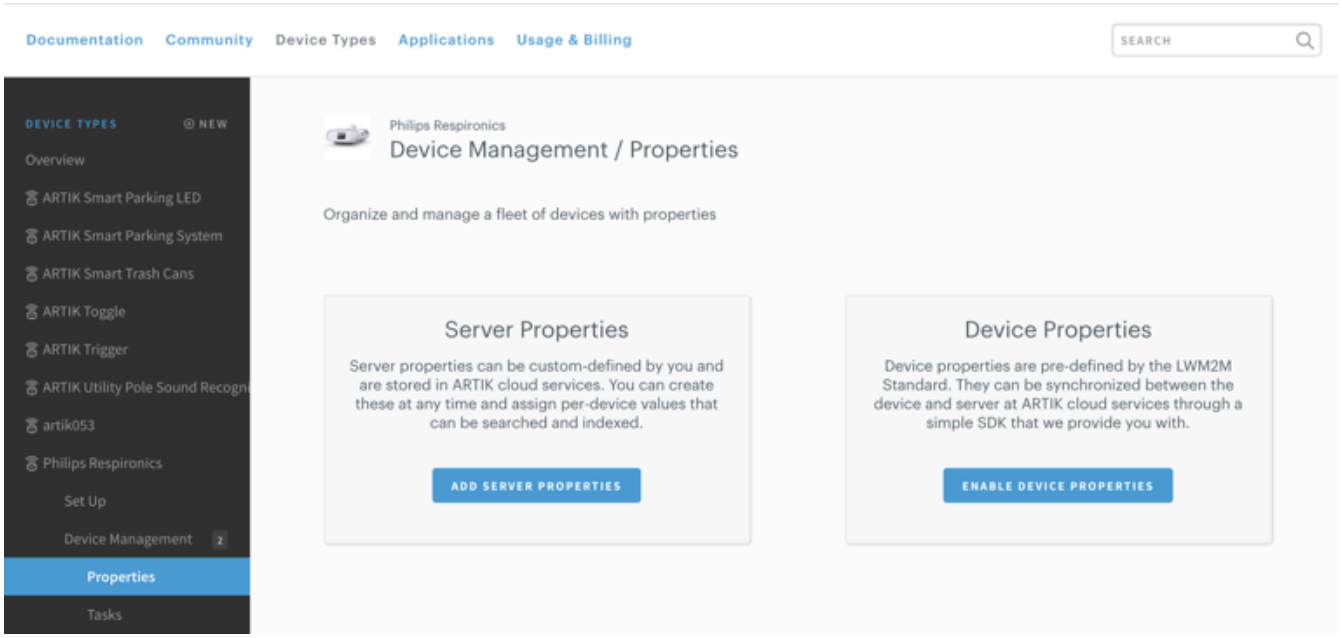
Lab 4: OTA solution

4.1 Enable Device Management and OTA Capabilities

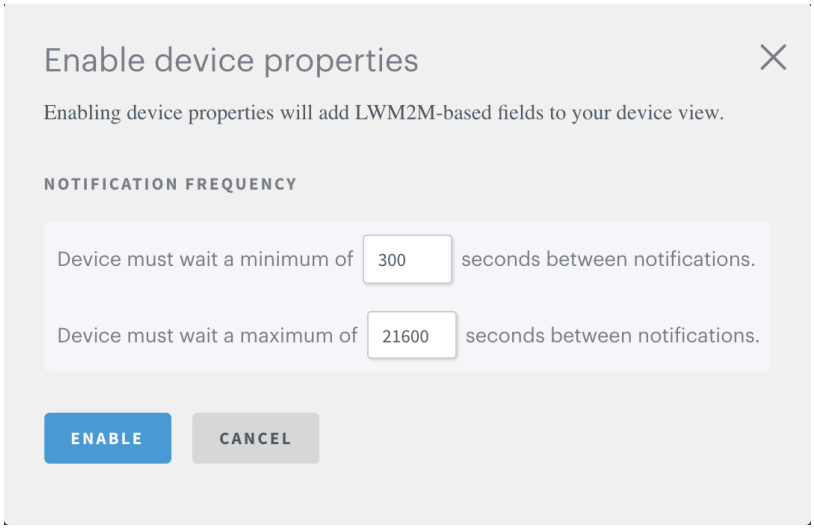
In this section, we will enable device management and Over-The-Air update capabilities for this device

1. Open the Developer portal of ARTIK cloud by using this URL https://developer.artik.cloud/ or by clicking on “ARTIK CLOUD DEVELOPERS” and open the list of device types.

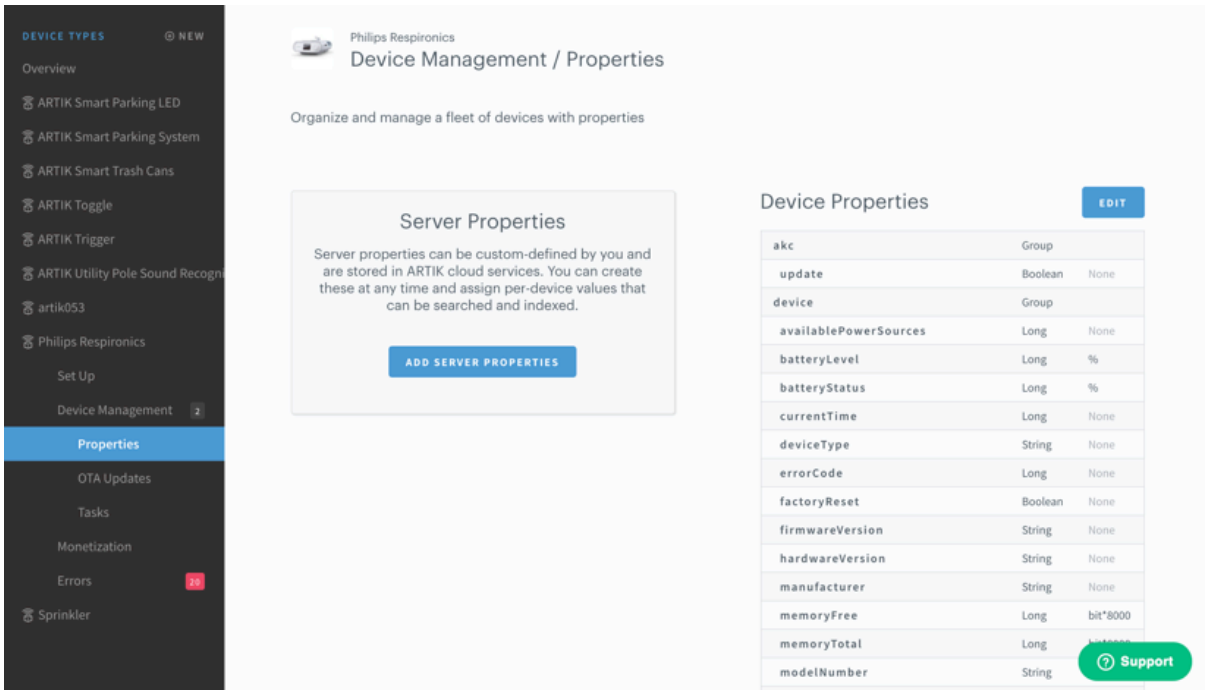
2. Under the new device type created, go to “Device Management -> Properties ” and click on “ENABLE DEVICE PROPERTIES” to enable Light Weight Machine 2 Machine (LWM2M) based device management



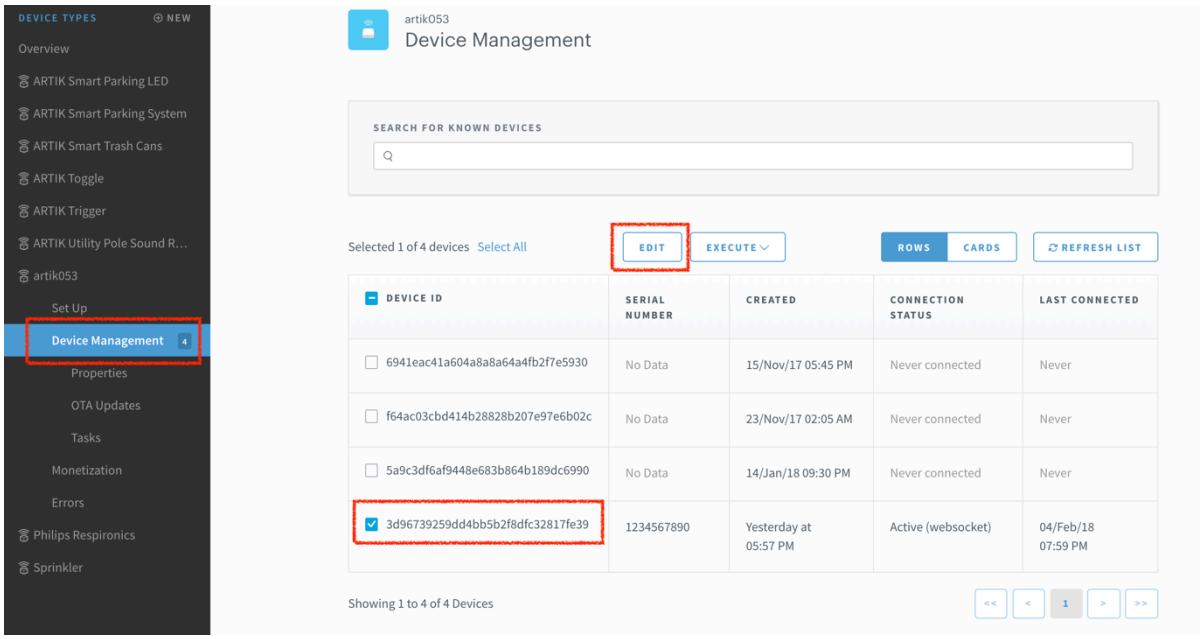
3. This provides an option for the device to connect with ARTIK Cloud at a determined frequency,

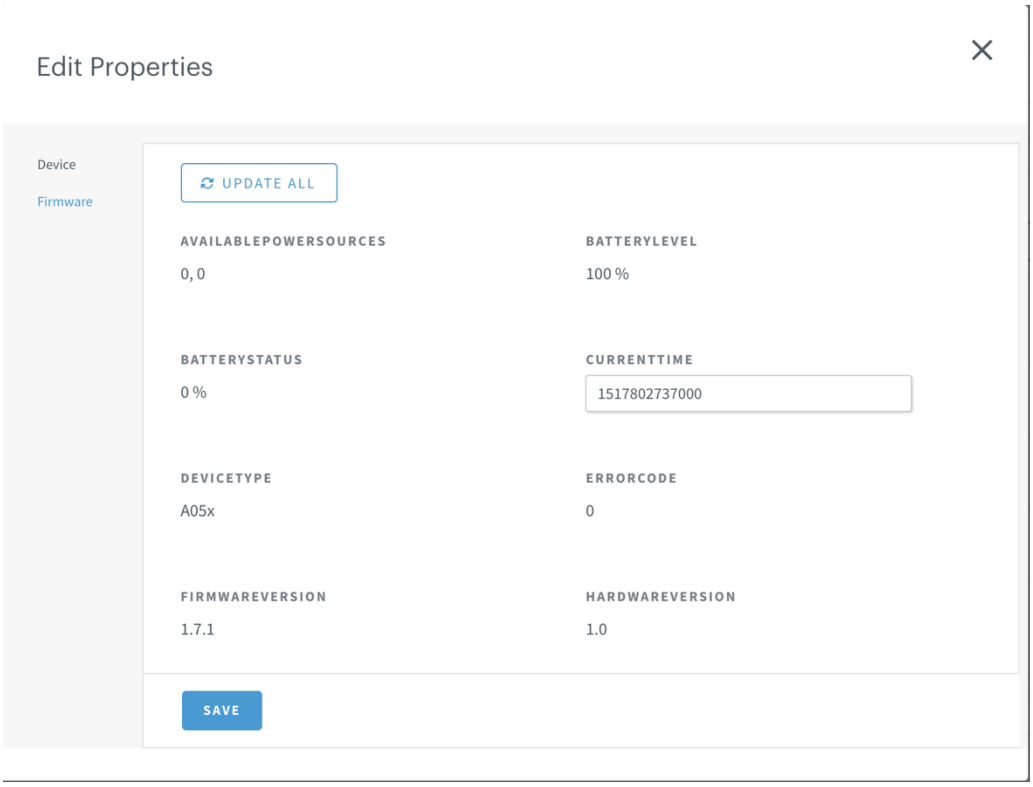


4. Upon successfully enabling the device properties, “OTA updates” will be available under device management for this device type and all the device properties will be available in ARTIK cloud. These properties are LWM2M device objects that are mirrored in ARTIK cloud from the device, based on the frequency defined earlier.



If you want to see an example of Device Properties, select Device Management of your device type on the left pane, click the Device ID of the connected device





4.2 Prepare an Update Package

Go back to ARTIK IDE, and open artik_onboarding.h. Change the ONBOARDING_VERSION from 1.7.1 to 1.7.2

```
#ifndef _ARTIK_ONBOARDING_H_
#define _ARTIK_ONBOARDING_H_

#define ONBOARDING_VERSION "1.7.2"

/*
 * Service states
 */
enum ServiceState {
STATE_IDLE,
STATE_ONBOARDING,
STATE_CONNECTING,
STATE_CONNECTED
};
```

Re-compile to generate the **tinyara_head.bin** binary.

Create a **script gen-ota-header.sh** like below on your host machine:

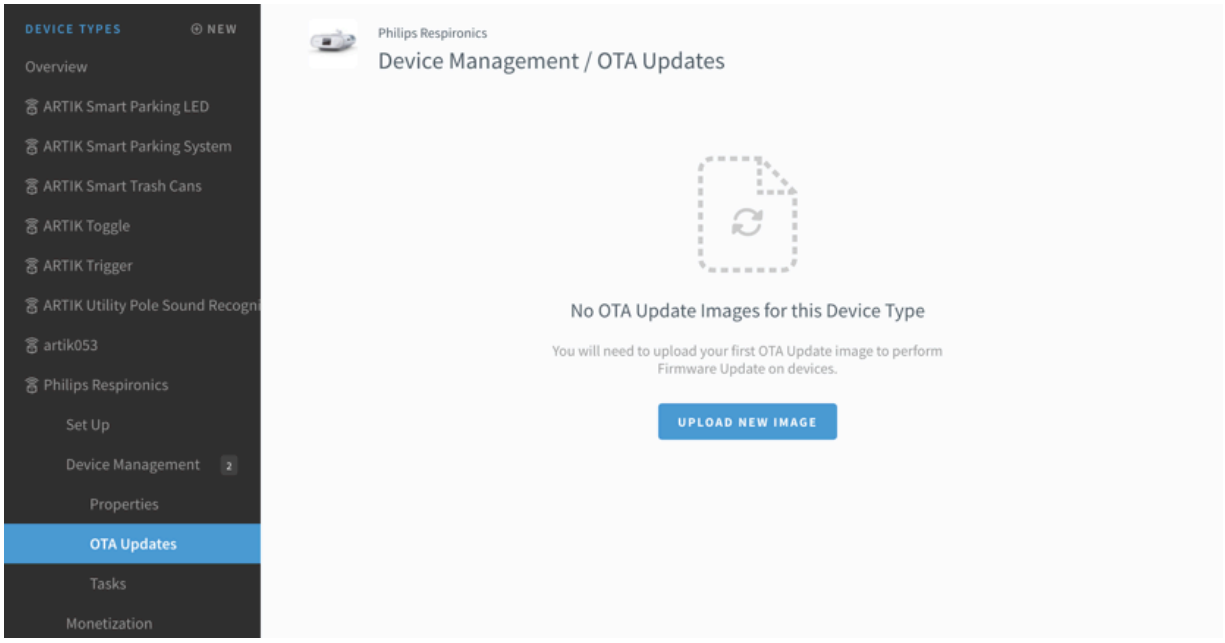
```
#! /bin/bash

INPUT=$1
OUTPUT=$2

if [ $# -ne 2 ]; then
    echo -n -e "Wrong number of parameters\n"
    echo -n -e "Usage: ${BASH_SOURCE} <input file> <output file>\n"
    exit 1;
fi

rm -f ${INPUT}.gz
rm -f ${OUTPUT}

gzip -k ${INPUT}

CRC32=$(crc32 ${INPUT}.gz)
SIZE=$(printf %08x $(wc -c ${INPUT}.gz | awk '{print $1}'))

dd if=${INPUT}.gz of=${OUTPUT} bs=1024 seek=4
echo -n -
e "\x${CRC32:6:2}\x${CRC32:4:2}\x${CRC32:2:2}\x${CRC32:0:2}" | dd of=${OUTPUT} bs=1
seek=4 conv=notrunc
echo -n -e "\x${SIZE:6:2}\x${SIZE:4:2}\x${SIZE:2:2}\x${SIZE:0:2}" | dd of=${OUTPUT}
bs=1 seek=0 conv=notrunc
```

Use this script (tested in Ubuntu and macOS) against the generated tinyara_head.bin to create a compressed OTA package with a proper header.

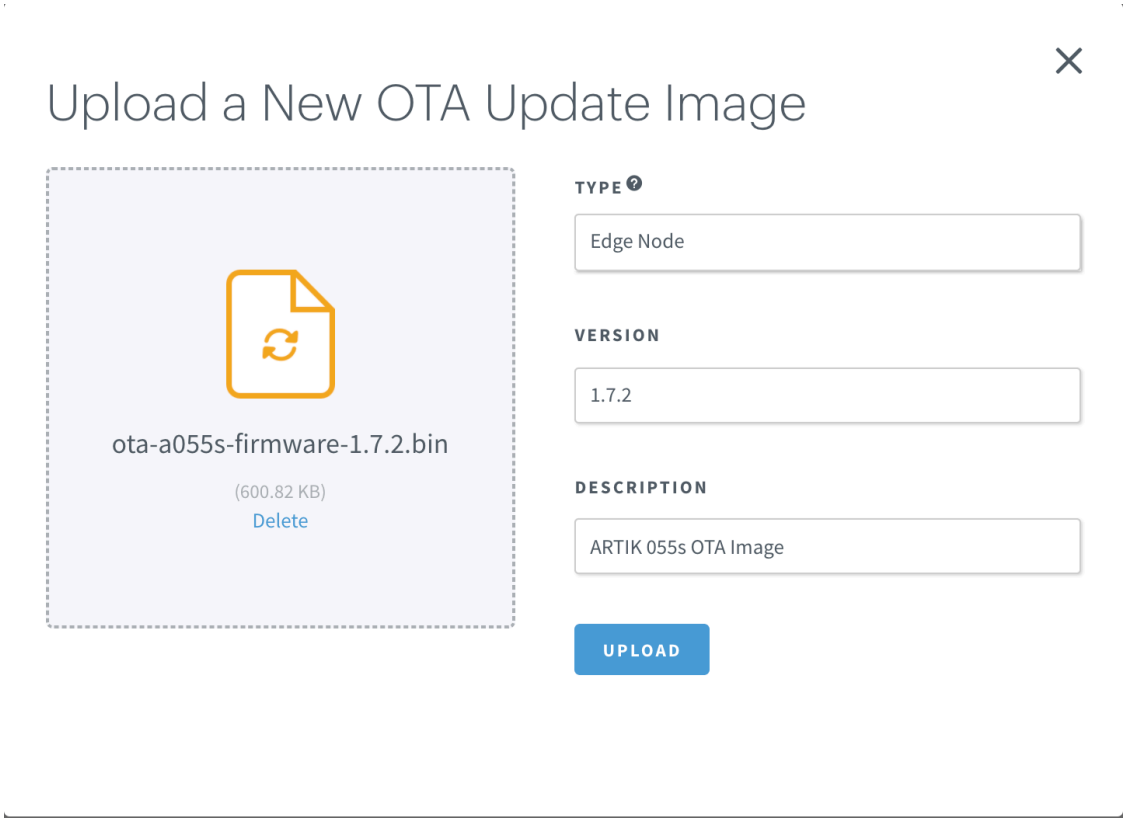
```
$ chmod +x gen-ota-header.sh
$ ./gen-ota-header.sh tinyara_head.bin ota-a055s-firmware-1.7.2.bin
596+1 records in
596+1 records out
611147 bytes transferred in 0.002236 secs (273305929 bytes/sec)
4+0 records in
4+0 records out
4 bytes transferred in 0.000153 secs (26133 bytes/sec)
4+0 records in
4+0 records out
4 bytes transferred in 0.000016 secs (250406 bytes/sec)
```

4.3 Upload OTA Image to ARTIK Cloud Service

1. Upload the generated package to ARTIK cloud. In ARTIK Cloud's developer portal, go to the Device Management tab of the relevant device type, then click the OTA Updates sub-tab, then click the UPLOAD NEW IMAGE button.



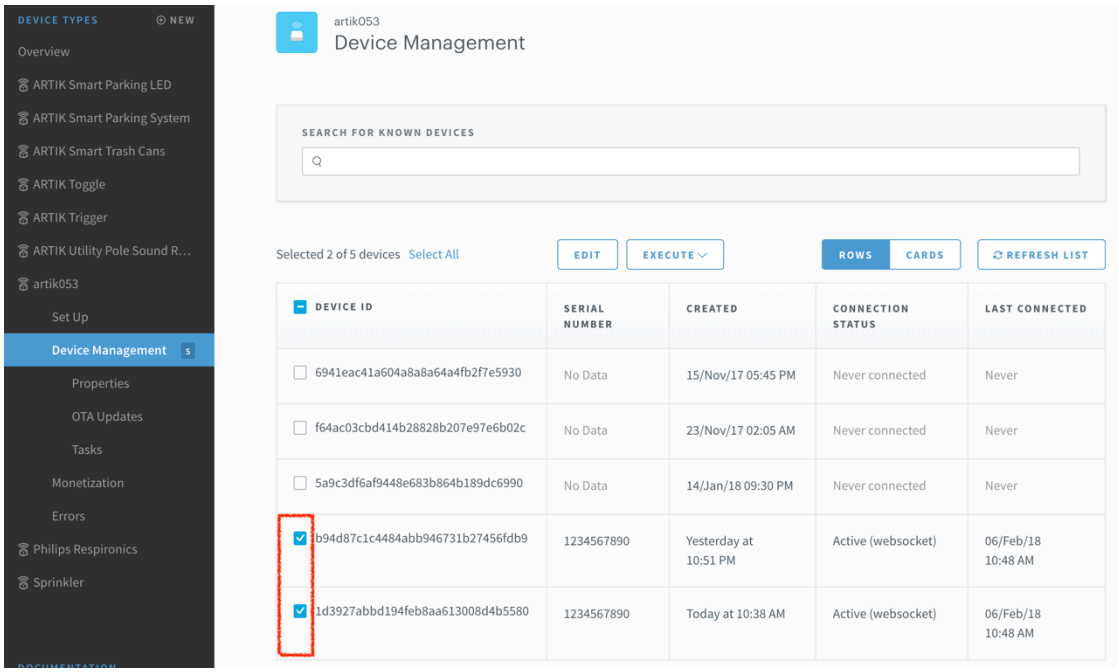
2. In the upload window, select Edge Node as the image type then enter the version for the package, this string must exactly match the one you set earlier with ONBOARDING_VERSION. Use the browse button to select the update package generated in step 3.2



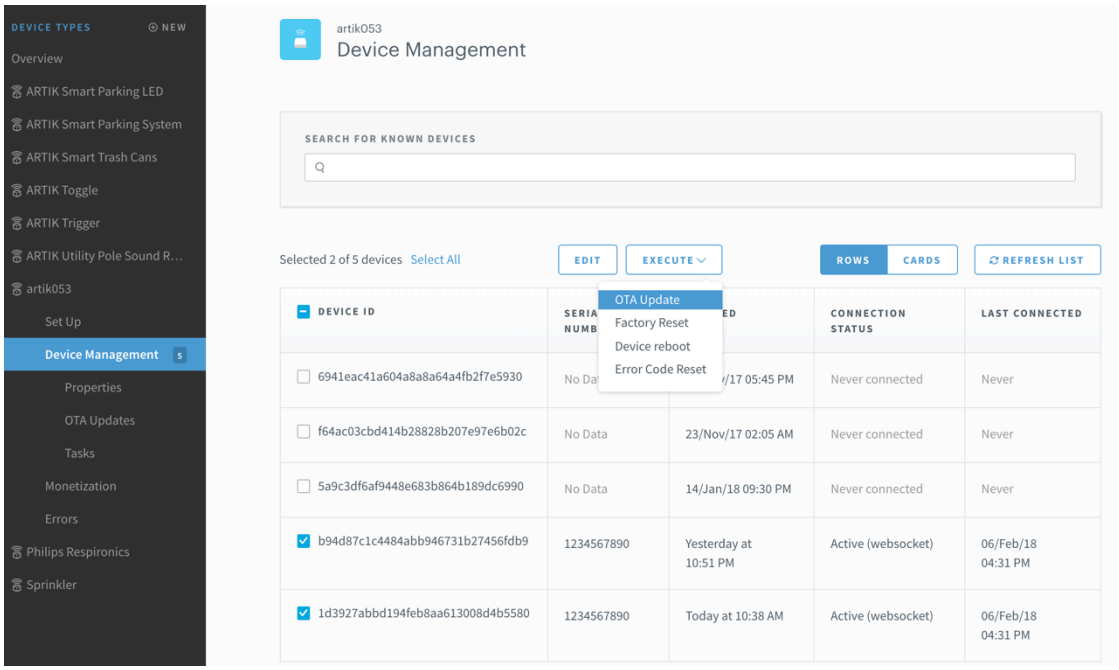
3. Click the Upload button to upload the image. You will see the new image in the list when upload is done.

4.4 Initiate OTA Update

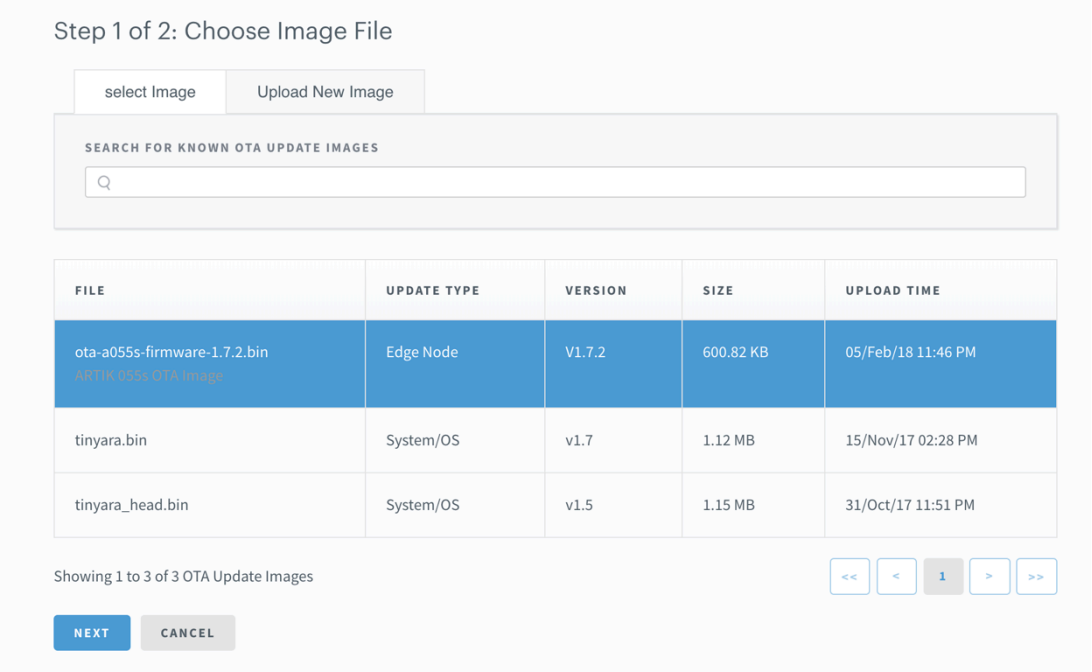
1. Go to Device Management, select the devices that will be upgraded.



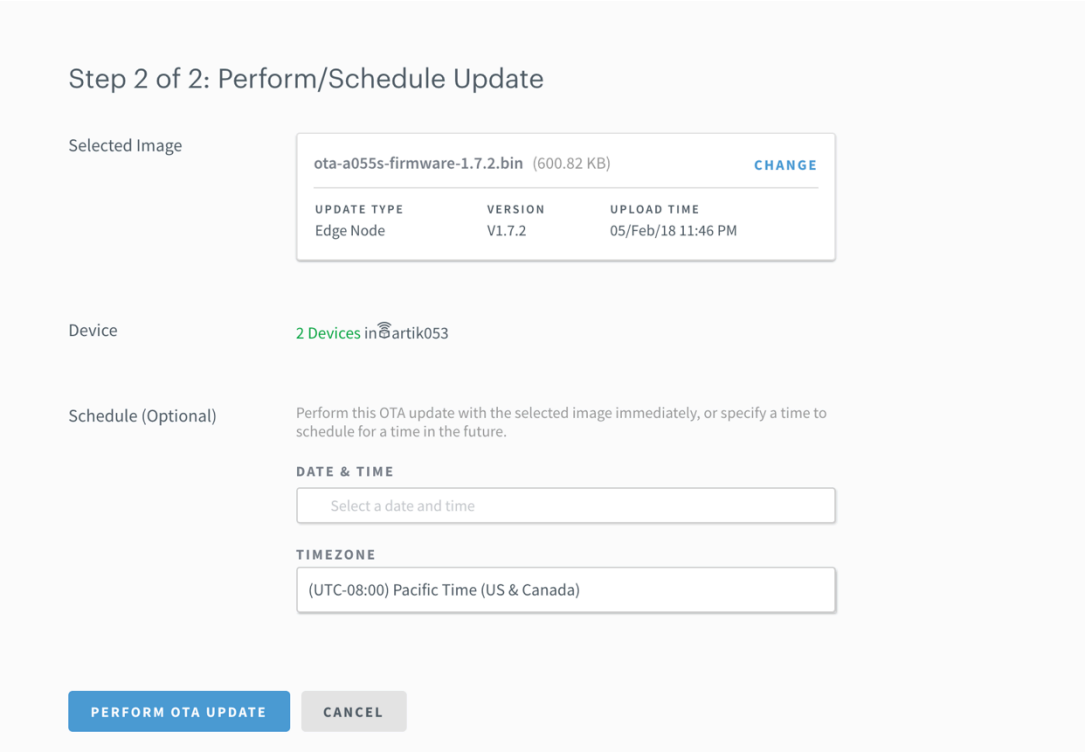
2. Click Execute and select OTA update option



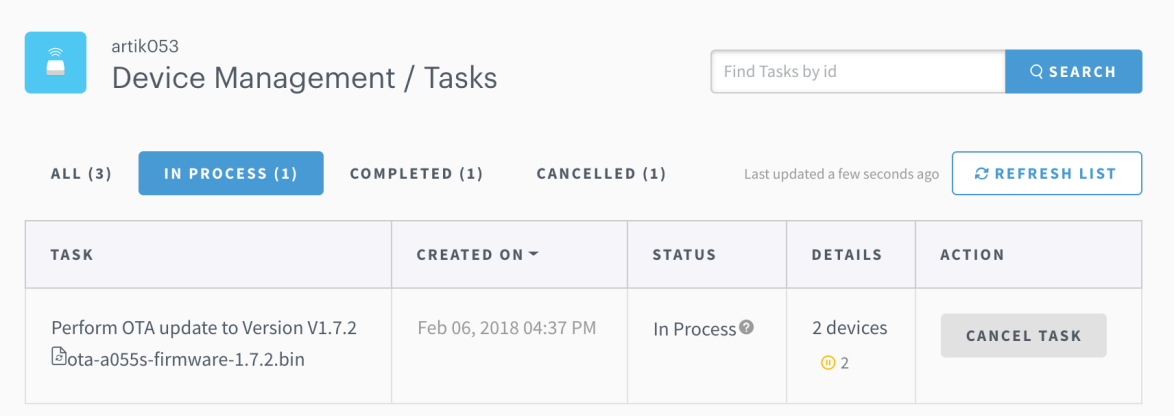
3. Select the package you want to update to, then click Next.



4. In step 2, select a date and time to schedule the update, or leave it empty to perform the update right away. Click PERFORM OTA UPDATE to start.



5. You can go to Device Management / Tasks to monitor the progress of your update.



Do NOT hit the 'CANCEL TASK' button when OTA is In Progress.

6. You will see the messages below on the device side. It indicates the LWM2M connection receives the resource change notification. A TLS connection is established with ARTIK Cloud and the image is downloaded automatically.

```
Downloading firmware from
https://api.artik.cloud/v1.1/updates/urls/a999da50b59e4e5792bd22d31171be88?tk=
KpFPXi2xEswMFR08hdhf6DbrIE%2BaoOkwbDFaqpaV%2BS%2BOdZDH0%2F82YAjloVyXqv0eeHC7zJ
KWRCPjQTuog4jQuMAB%2FybCHd%2FMhn6xizuDGA4%3D
with_tls='1', hostname='api.artik.cloud'
filename='/v1.1/updates/urls/a999da50b59e4e5792bd22d31171be88?tk=KpFPXi2xEswMF
R08hdhf6DbrIE%2BaoOkwbDFaqpaV%2BS%2BOdZDH0%2F82YAjloVyXqv0eeHC7zJKWRCPjQTuog4j
QuMAB%2FybCHd%2FMhn6xizuDGA4%3D'
New hostname='ota-updates.artik.cloud' filename='/artik-griffin-ota-images-
prod/prod/dt74e78682ad2c45db93ae3e2dfde76bcd/baefa541055b4f9ca9faba1564c15091?
Expires=1511395118&Signature=MHB5VzcweLhFnvcd~S8hM-
2~rHS8LNY8ZPnwlPpwZW9XmPMqQUfucfODtQWK9RYTuObPq2vquY-
bQkwSorVSwZQVTkDCUlVSeTzCdkp3opRfAxY5~ExcvFFtoLJ9VDjBf0p84JHGdzlYArdos8cBeeLtQ
sUb8Wz4qSAlcmrEjvZBiwXyB3CKBstIn9Lt1xfk-UZw5Q-
qVaqXlVEmTTHDKjQwEVnNJ0u~PSRha~tGElc9-
QjxzOfBorkVWzOwJ44pkTrmyXYJAIk8eMuDeEr8PUsbbic8-a-
6m7hWw4FxaE58244rj0uouL160Tjpq6fNKFtDslEAfsl5cd0fe5cXJQ__&Key-Pair-
Id=APKAIX7CUHNYD7CJPXOA'
Skip OTA header (header_size 0, len 0, remaining_header_size 4096)
Skip OTA header (header_size 4096, len 0, remaining_header_size 0)
```

7. Device will reboot automatically after the image update. And you can see the firmware image has been upgraded to 1.7.2

```
TASH>>Onboarding service version 1.7.2
Starting supplicant in foreground...
i2c_uioregister: Registering /dev/i2c-0
i2c_uioregister: Registering /dev/i2c-1
sssro_verify: PASS
Connected to Access Point
Start DHCP client
Start NTP client
Start websocket to ARTIK Cloud
Websocket successfully connected
Start LWM2M connection to ARTIK Cloud
ARTIK Cloud connection started
```

Lab 5: ARTIK SEE APIs

In this exercise, we will extend our app to support ARTIK SEE APIs. We will add a new TASH command for this.

5.1 Extend existing app to include multiple TASH shell commands

1. Add the 4 attached files to artik055s project. The 4 files are:

   - examples-api.c
   - command.c
   - command.h
   - security-api.c

You can simply drag and drop the files to your artik055s project.

2. Modify artik_onboarding.c to allow the application to create multiple TASH shell commands. Look for artik_onboarding_main() function, and added the bold lines below before and after.

```
#ifdef CONFIG_BUILD_KERNEL
int main(int argc, FAR char *argv[])
#else
int artik_onboarding_main(int argc, char *argv[])
#endif
```

3. Comment out the original int main(int argc, char *argv[]) function, which is at the bottom of artik_onboarding.c.

```
/*
int main(int argc, char *argv[])
{
#ifdef CONFIG_TASH
    // add tash commandh
tash_cmd_install("onboard", artik_onboarding_main, TASH_EXECMD_SYNC);
#endif

    artik_onboarding_main(argc, argv);

    return 0;
}
*/
```

Now, if you flash your ARTIK 055s device again, you should be able to see both `onboard` and `security` commands in TASH.

5.2 Key Management APIs

We can use Security Key Management APIs to retrieve factory injected certificates and keys, or generate your own certificate/key-pair.

Here is a function to retrieve factory default certificate.

```
int security_factory_getcert(int argc, char **argv)
{
  int ret = 0, i = 0;
  struct fac_info cert[SEE_CERTNUM] = { {FACTORYKEY_ARTIK_CERT, "ARTIK
CERT"} };

  unsigned char buf[4096];
  unsigned int buf_len = 4096;

  while (i < SEE_CERTNUM) {
      printf("[%d] %s ... ", i, cert[i].name);
      buf_len = 4096;

       ret = see_get_certificate(buf, &buf_len, cert[i].id, CERT_PEM);
       if (ret != 0) {
          printf("get failed : %d\n", ret);
          i++;
          continue;
       }

      ret = print_crt(1, buf, buf_len);

      if (ret) {
           printf("parse failed : %x\n", -ret);
           i++;
           continue;
      }

      set_existence(cert[i].id);
      i++;
      printf("success\n");
  }

  return 0;

}
```

```
TASH>>security factorycert


 [0] ARTIK CERT ...
  - cert. version     : 3
  - serial number     : 59:42:F1:8F:AF:47:09:5A:0E:90:99:97:EB:32:E0:4B
  - issuer name       : C=KR, O=Samsung Semiconductor ARTIK, OU=ARTIK
Root CA, CN=ARTIK Root CA
  - subject name      : C=KR, O=Samsung Semiconductor ARTIK, OU=ARTIK
Root CA, CN=ARTIK Root CA
  - issued  on        : 2017-06-15 20:43:59
  - expires on        : 2067-06-15 20:43:59
  - signed using      : ECDSA with SHA256
  - EC key size       : 256 bits
  - basic constraints : CA=true
  - key usage         : Key Cert Sign, CRL Sign


  - cert. version     : 3
  - serial number     : 59:42:F5:7C:AC:C1:06:31:11:5F:E4:B0:C8:CC:12:2D
  - issuer name       : C=KR, O=Samsung Semiconductor ARTIK, OU=ARTIK
Root CA, CN=ARTIK Root CA
  - subject name      : C=KR, O=Samsung Semiconductor ARTIK, OU=ARTIK
High Security Device CA, CN=ARTIK High Security Device CA
  - issued  on        : 2017-06-15 21:00:44
  - expires on        : 2067-06-15 21:00:44
  - signed using      : ECDSA with SHA256
  - EC key size       : 256 bits
  - basic constraints : CA=true, max_pathlen=0
  - key usage         : Key Cert Sign, CRL Sign


  - cert. version     : 3
  - serial number     : 01:01:17:07:24:00:00:0A:D3
  - issuer name       : C=KR, O=Samsung Semiconductor ARTIK, OU=ARTIK
High Security Device CA, CN=ARTIK High Security Device CA
  - subject name      : C=KR, O=Samsung Semiconductor ARTIK, OU=ARTIK
High Security Device, CN=SIP-0P5WRS30 (01011707-2400-000a-d37e-
d4a58feefe97)
  - issued  on        : 2017-07-24 00:30:30
  - expires on        : 2047-07-24 00:30:30
  - signed using      : ECDSA with SHA256
  - EC key size       : 256 bits
  - key usage         : Digital Signature, Non Repudiation
  - ext key usage     : TLS Web Client Authentication, TLS Web Server
Authentication

success
```

5.3 Secure Storage APIs

Secure Storage APIs help us read/write data to data slots in secure storage. Here is the function that writes a string to secure storage data slot 0, then reads it back.

```
int security_read_write_secure_storage(int argc, char **argv)
{

  unsigned char input[30]="Samsung ARTIK Partner Training";
  unsigned int len=sizeof(input);
  unsigned char output [30];

  printf(". SEE Write to Secure Storage...\n");
  if (see_write_secure_storage(input, len, 0) != SEE_OK) {
    printf("Fail\n! see_write_secure_storage\n");
    return 1;
  }
  printf("Write %s to secure storage data slot 0\n", input);

  printf(". SEE Read from Secure Storage...\n");
  if (see_read_secure_storage(output, &len, 0)!= SEE_OK) {
    printf("Fail\n");
    return 1;
  }
  printf("Read secure storage data slot 0 : %s\n", output);
  return 0;
}
```

Run *security_api* with *securestorage*, and you should see the results below.

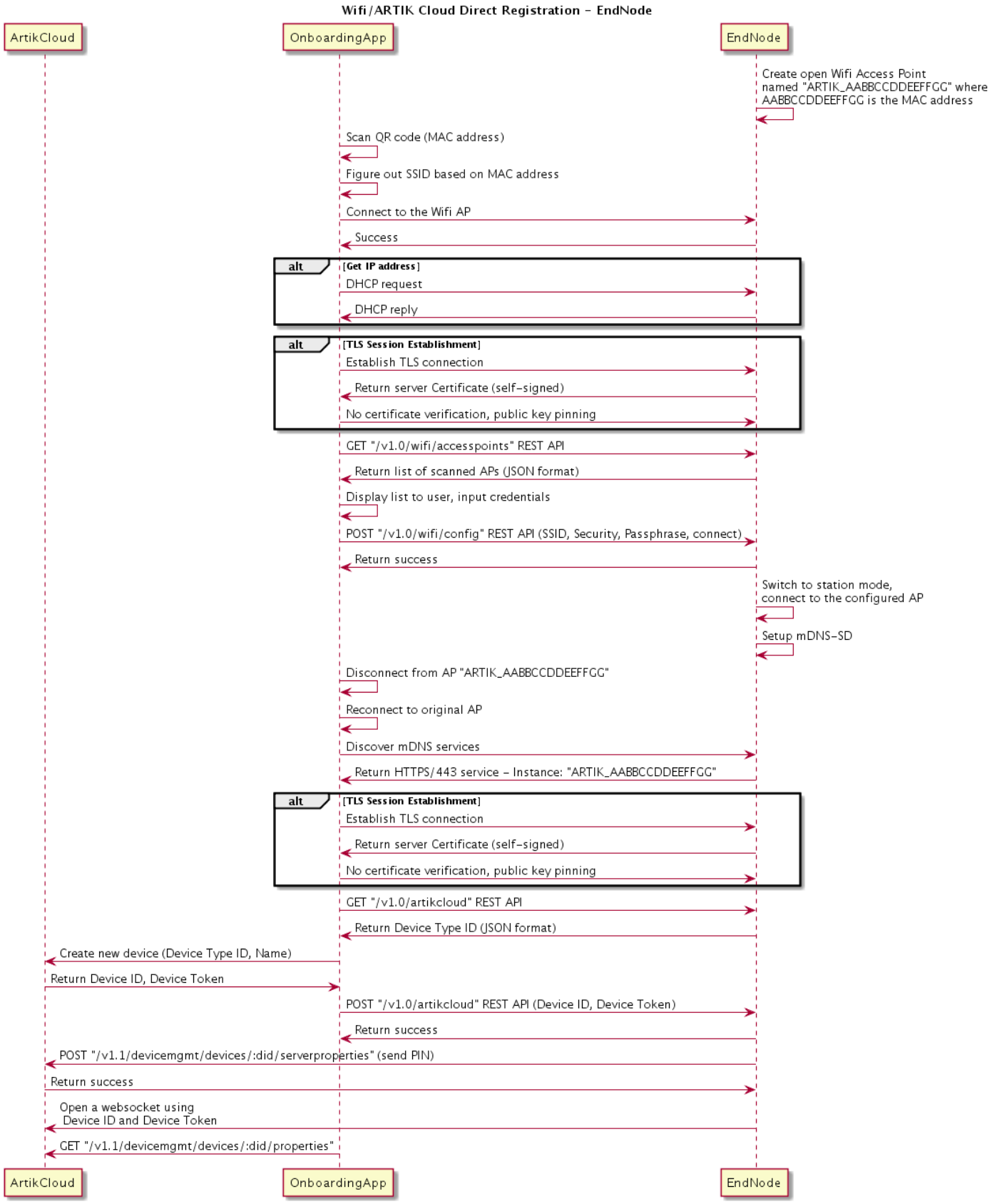
```
TASH >> security securestorage
. Write to Secure Storage...
Write Samsung ARTIK Partner Training to secure storage data slot 0
. Read from Secure Storage...
Read secure storage data slot 0 : Samsung ARTIK Partner Training
```

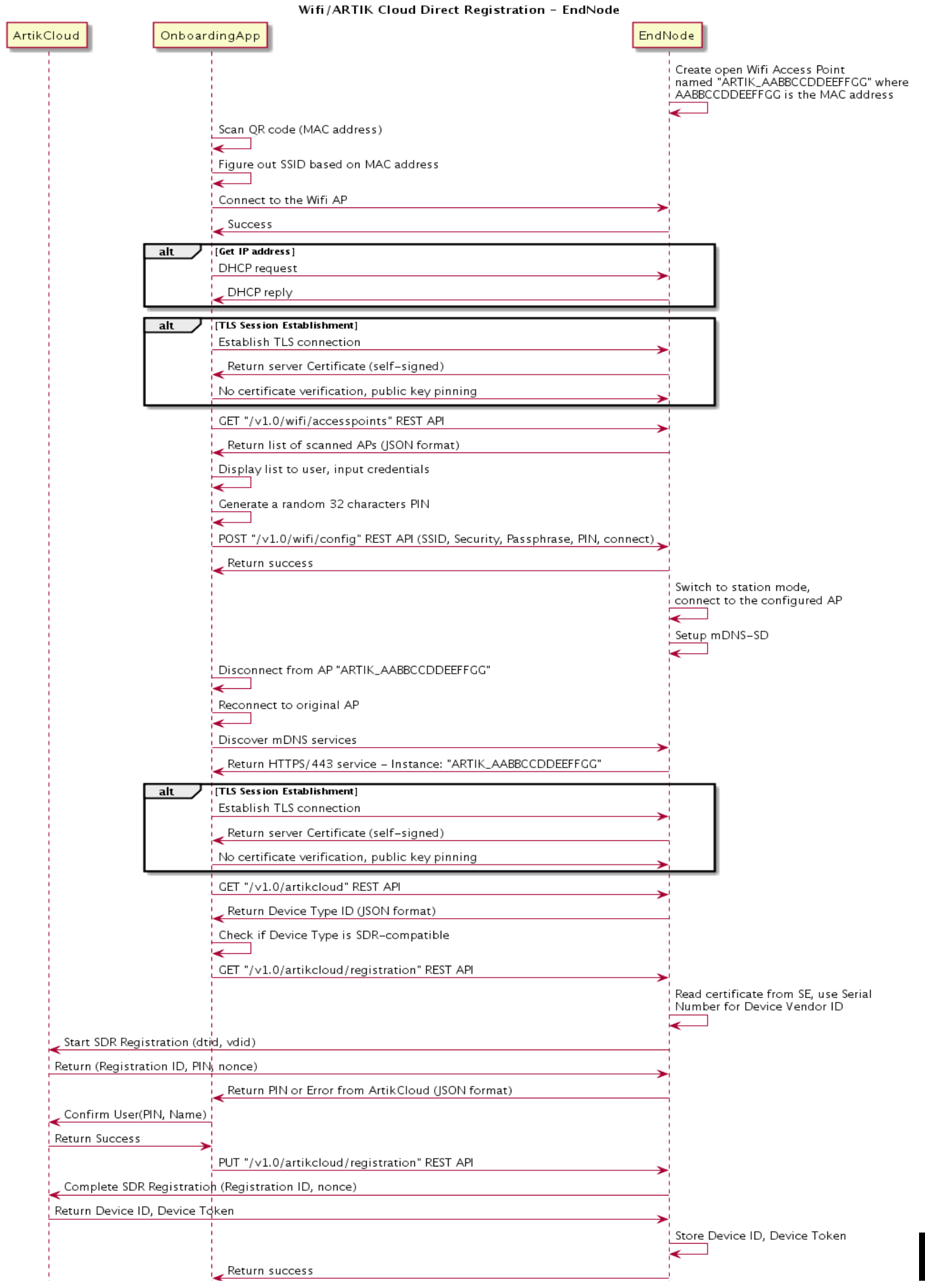
Appendix A – Create your own Device Type

This is the Manifest file for Lab 1 in JSON format.

```
{
  "fields": [
    {
      "name": "state",
      "type": "CUSTOM",
      "valueClass": "Boolean",
      "isCollection": false,
      "description": "LED state",
      "tags": []
    },
    {
      "name": "sensor",
      "type": "CUSTOM",
      "valueClass": "Integer",
      "isCollection": false,
      "description": "ADC sensor reading",
      "tags": []
    },
    {
      "name": "timestamp",
      "type": "TIMESTAMP",
      "valueClass": "Double",
      "isCollection": false,
      "tags": [],
      "unit": "SI.MILLI(SI.SECOND)"
    }
  ],
  "actions": [
    {
      "name": "setOn",
      "description": "Set state to On",
      "parameters": [],
      "isStandard": true,
      "type": "CUSTOM"
    },
    {
      "name": "setOff",
      "description": "Set state to Off",
      "parameters": [],
      "isStandard": true,
      "type": "CUSTOM"
    }
  ],
  "messageFormat": "json"
}
```

Appendix B – ARTIK Cloud Direct Onboarding Flow




Wifi/ARTIK Cloud Direct Registration – EndNode
ArtikCloud
OnboardingApp
EndNode
Create open Wifi Access Point named "ARTIK_AABBCCDDEEFFGG" where AABBCCDDEEFFGG is the MAC address
Scan QR code (MAC address)
Figure out SSID based on MAC address
Connect to the Wifi AP
Success
alt
[Get IP address]
DHCP request
DHCP reply
alt
[TLS Session Establishment]
Establish TLS connection
Return server Certificate (self-signed)
No certificate verification, public key pinning
GET "/v1.0/wifi/accesspoints" REST API
Return list of scanned APs (JSON format)
Display list to user, input credentials
Generate a random 32 characters PIN
POST "/v1.0/wifi/config" REST API (SSID, Security, Passphrase, PIN, connect)
Return success
Switch to station mode, connect to the configured AP
Setup mDNS-SD
Disconnect from AP "ARTIK_AABBCCDDEEFFGG"
Reconnect to original AP
Discover mDNS services
Return HTTPS/443 service – Instance: "ARTIK_AABBCCDDEEFFGG"
alt
[TLS Session Establishment]
Establish TLS connection
Return server Certificate (self-signed)
No certificate verification, public key pinning
GET "/v1.0/artikcloud" REST API
Return Device Type ID (JSON format)
Check if Device Type is SDR-compatible
GET "/v1.0/artikcloud/registration" REST API
Read certificate from SE, use Serial Number for Device Vendor ID
Start SDR Registration (dtid, vdid)
Return (Registration ID, PIN, nonce)
Return PIN or Error from ArtikCloud (JSON format)
Confirm User(PIN, Name)
Return Success
PUT "/v1.0/artikcloud/registration" REST API
Complete SDR Registration (Registration ID, nonce)
Return Device ID, Device Token
Store Device ID, Device Token
Return success

.