



ATWINC15x0 Smart Device Kit

Wi-Fi® Smart Device Enablement Kit Developer's Guide

Introduction

This document describes the Wi-Fi Smart Device Enablement Kit development, which is supported by the ATWINC15x0 Wi-Fi Network Controller (WINC) module that enables the developer to demonstrate the functionalities of the ATWINC15x0 module for Internet of Things (IoT) applications.

This kit is pre-programmed with an application for demonstrating connectivity to the Microchip AWS® IoT account with the help of an Amazon Alexa® and a mobile application. The developer can collect the data to control the LEDs on the kit using cloud-based voice service virtual assistant such as Amazon Echo Dot®. The mobile application is used for board registration, network configuration, and controlling and monitoring the Wi-Fi Smart Device Enablement Kit.

For the demonstration shown in this document, the Wi-Fi Smart Device Enablement Kit is pre-configured with the following:

- Customized MCU firmware
- AWS cloud configuration
- Alexa Skill setting
- Mobile application configuration

However, the developers can create and set up their own private AWS account, configure MCU firmware, and build custom Alexa Skill with the help of this document.

Features

- ATWINC15x0, Qualified IEEE® 802.11 b/g/n Network Controller Module
- On-Board Host Microcontroller (SAML21G18B) for Easy Operation and Feature Demonstration
- On-Board CryptoAuthentication™ (ATECC608A) Device for Secure Connection to AWS
- On-Board Li-Ion/Li-Po Charge Management Controller (MCP73833) for Lithium Battery Charging
- On-Board High Power Supply Rejection (PSRR) Low Dropout (LDO) Regulator (MIC5317)
- On-Board Environment Sensor (BME280)
- On-Board Light Sensor (VEML6030)

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1. Quick References

1.1 Prerequisites

This section describes the prerequisites to develop an IoT application.

Software Prerequisites

- Atmel Studio 7 (for more details, refer to [8.1 Atmel Studio 7](#))
- SAM-BA[®] V2.18 (for more details, refer to [8.2 SAM Boot Assistance \(SAM-BA\)](#))
- Python[®] 3.6.x (for more details, refer to [8.3 Python 3.6.x](#))
Note: Python 3.7.x and Python 2.x are not supported.
- Python Package Manager (for more details, refer to [8.4 Python Package Manager](#))
- Wi-Fi Smart Device Enablement Kit Smartphone Applications:
 - Android™ – <https://play.google.com/store/apps/details?id=com.amazonaws.mchp.awsprovisionkit>
 - iOS – <https://itunes.apple.com/app/id1460552937>
- AWS Service – AWS IoT, AWS Lambda, AWS DynamoDB, AWS IAM
- Alexa Skill Design

Hardware Prerequisites

- Wi-Fi Smart Device Enablement Kit
- Android phone: Android version 6.0 or above
- iOS phone: iOS version 9.3 or above
- Wi-Fi Router
- Echo Dot
- UART Debug Interface

Release Package

The release package is available at <https://github.com/MicrochipTech/winc1500-wifi-smart-device-enablement-kit-aws-cloud>.

- MCU Firmware – located in `/mcu-firmware` directory.
- Microchip Wi-Fi Smart Device Enablement Kit mobile applications source files are available in `/mobile-app` folder of the release package.
- Python Provision Scripts – located in `/ProvisionScripts` directory.
- Lambda Functions – located in `/lambda-function` directory.
- Hardware PCB Files – located in `/pcb-files` directory.

1.2 Reference Documentation

For further study, refer the following:

- Wi-Fi[®] Smart Device Enablement Kit User's Guide ([DS50002880](#))
- ATWINC15x0 IEEE[®] 802.11 b/g/n SmartConnect IoT Module Datasheet ([DS70005304](#))
- SAM L21 Family Datasheet ([DS60001477](#))

- ATECC608A CryptoAuthentication™ Device Summary Datasheet ([DS40001977](#))

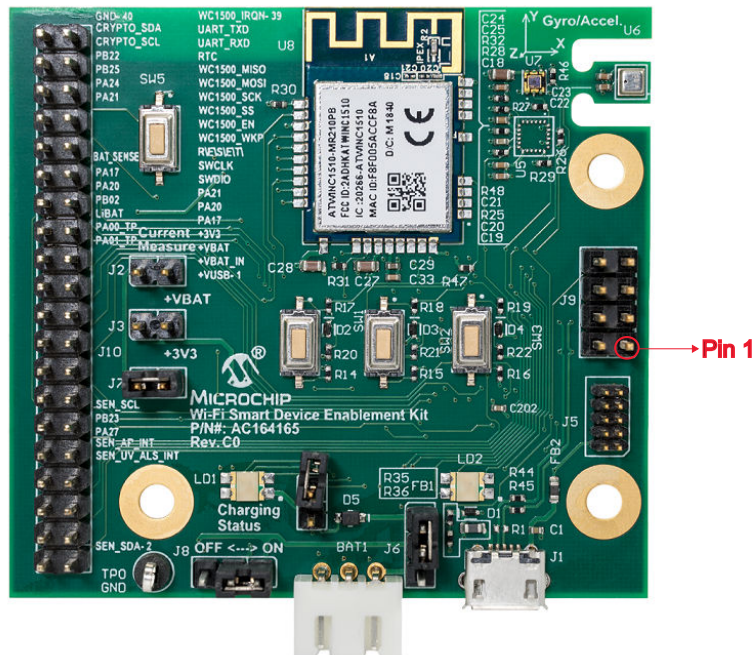
2. UART Debug Interface

The Wi-Fi Smart Device Enablement Kit has debug UART pins for the host MCU (SAML21G18B) and WINC1510 Wi-Fi module. The pins are connected to the J9 connector; the developer can use a USB-to-UART converter to connect a computer and the board Debug UART to capture the MCU or WINC1510 log.

Table 2-1. Pin Details

Pin	Function
3	MCU_DEBUG_UART_RXD
5	MCU_DEBUG_UART_TXD
4	WINC1510_DEBUG_UART_RXD
6	WINC1510_DEBUG_UART_TXD
7	GND

Figure 2-1. Header Description



A terminal emulator can help in diagnosing problems or verify if the device code is running properly. There are a variety of terminal emulators available for Windows®, macOS®, and Linux®. The developer must connect the device to computer before connecting a terminal emulator to the device.

Use these settings for the terminal emulator:

Table 2-2. Terminal Setup

Terminal Settings	Value
Port	Depends on platform and other devices connected to the computer.

.....continued

Terminal Settings	Value
BAUD rate	115200
Data	8 bit
Parity	none
Stop	1 bit
Flow control	none

Below is the application boot-up log:

Figure 2-2. Boot-Up Log

```

COM10 - Tera Term VT
File Edit Setup Control Window Help

Initializing Wi-Fi Smart Device Enablement Kit
cpu_freq=48005120

Firmware version: 1.0.1
status = 0
AWS_STATE_ATECCx080A_INIT

wifiInit In
  (APP)<INFO>Chip ID 1503a0
  (APP)<INFO>DriverVerInfo: 0x13521352
  (APP)<INFO>Firmware ver : 19.5.2 Sunrev 14274
  (APP)<INFO>Firmware Build Jan 26 2017 Time 22:13:34
  (APP)<INFO>Firmware Min driver ver : 19.3.0
  (APP)<INFO>Driver ver: 19.5.2
  (APP)<INFO>Driver built at Mar 13 2019 22:09:39

MAC Address: F8:F0:05:AC:C9:F7

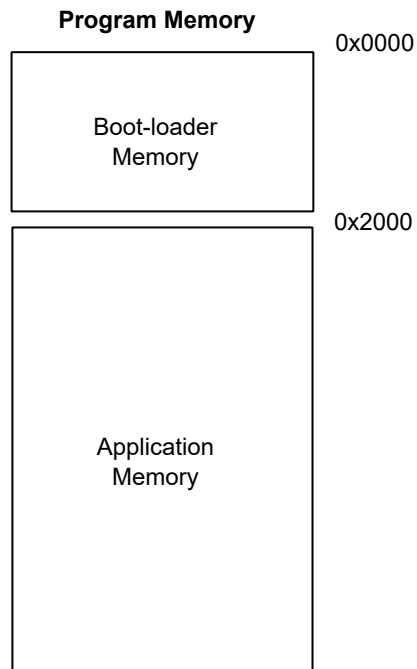
gAwsMqttClientId Address: f8f005acc9f7
use default SSID

gDefaultSSID=LucNetwork_HiSpeed_24, pw=luc4614193, auth=2, ssidlen=21, pslen=10
, ret = 0
ecc_transfer_certificates, g_thing_name = 775733aafaca37f9bd2dd7e94158b2558e274107
provisioning_get_ssid, ssid = mchp_demo
provisioning_get_password, password = mchp5678
nuds_read start
num_page_size = 64
num no_of_page = 4096
wifi_cb: M2M_WIFI_REQ_DHCP_CONF: IP is 172.20.10.5
Received time
Connecting...Received time
Host IP is 34.204.236.48
(APP)<INFO>Socket 0 session ID = 1
Successfully connected.
Subscribing...Subscription success
Subscribing...Subscription success
DBG: temperature = 3004, humidity = 47, uv = 27027000, pressure = 1006
  
```

3. Boot-Loader Firmware

Boot-loader allows the developer to program MCU firmware through a USB port without Atmel-ICE programmer. Boot-Loader mode is triggered by pressing and holding SW1 switch before powering-up the board. The SAM-BA V2.18 GUI (8.2 SAM Boot Assistance (SAM-BA)) is used for loading a firmware to the board through USB port. The boot-loader is stored in memory address 0x0-0x2000. The memory address for an application firmware start is 0x2000.

Figure 3-1. Program Memory



The boot-loader can be re-used even after modifying the application firmware and programming a new application firmware to the kit using the SAM-BA V2.18 tool.

The boot-loader is not required if the developer uses Atmel-ICE Debugger to load firmware to the board instead of the SAM-BA V2.18. In this case, set the starting address of the application firmware to 0x0000.

Note: By default, the board is pre-programmed with the boot-loader to enable the developer to upgrade the application firmware through a USB port without an Atmel ICE programmer.

3.1 Programming Procedure

This section describes how to program the board with the boot-loader. The boot-loader image is available in the `/boot-loader/` directory of the release package. The user can use the Atmel ICE programming tool to program the boot-loader to the board. The Atmel ICE tool is available at <https://www.microchip.com/developmenttools/ProductDetails/atatmel-ice>.

1. Connect Atmel ICE (see [Atmel ICE](#)) to the board SWD interface connector (J5).

ATWINC15x0 Smart Device Kit

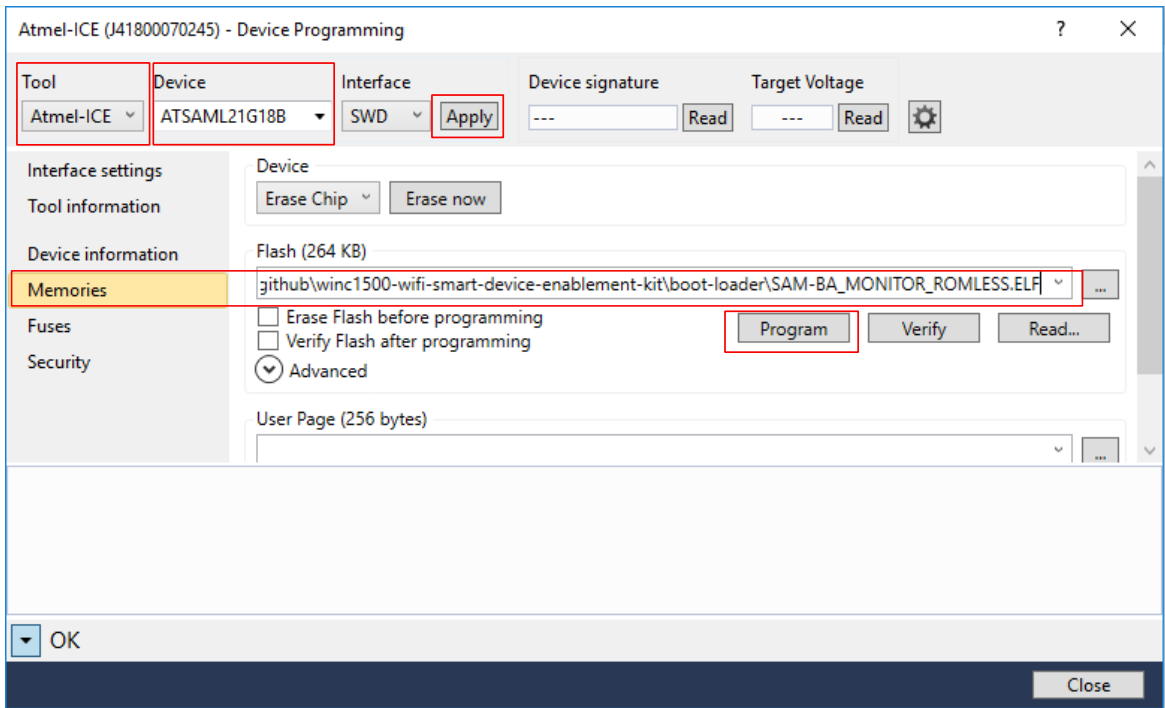
Boot-Loader Firmware

Figure 3-2. Atmel ICE Connected to the Board SWD Interface Connector (J5)



2. Launch Atmel Studio, select *Tools > Device Programming*.
3. Select “Tool” as *Atmel-ICE* and “Device” as *ATSAML21G18B*.
4. Click **Apply**.
5. In **Memories** tab, fill *SAM-BA_MONITOR_ROMLESS.ELF* in the “Flash” field. The .ELF file is available in the */boot-loader* directory and <https://github.com/MicrochipTech/winc1500-wifi-smart-device-enablement-kit-aws-cloud/tree/master/boot-loader>.
6. Click **Program**.

Figure 3-3. Boot Loader Firmware



4. Application Firmware

The application firmware is used to demonstrate connectivity to AWS IoT. The firmware connects the board to AWS IoT cloud, updates the sensor data and obtains the LED state to AWS Shadow by publishing and subscribing to the AWS Shadow MQTT topics.

The MCU application firmware source codes are available in the [mcu-firmware/](#) directory of the release package. This directory contains following project solution files.

- `saml21g18b_sensor_board_demo_ECC.atstln` – This project is used for performing AWS account provisioning. A private key is generated for the authentication with the AWS cloud and the AWS account credentials are stored in the ECC608. The developer needs to program this project code to the board to migrate the board and connect to the private AWS account. Python scripts are available in the `ProvisionScripts/` directory to perform AWS account provision. For more details, refer to [6. AWS Provision Setup](#).
- `saml21g18b_sensor_board_demo_JITR.atstln` – This project is used in the normal application. A board running this firmware can connect to AWS IoT, publish and subscribe AWS IoT Shadow Topics.

For firmware development, at first, the developer needs to program the code of `saml21g18b_sensor_board_demo_ECC.atstln` to provision the board to the private AWS account. Then, customize the application in `saml21g18b_sensor_board_demo_JITR.atstln` and program this project to the board.

4.1 Application Firmware Compilation Procedure

1. Download release package files from <https://github.com/MicrochipTech/winc1500-wifi-smart-device-enablement-kit-aws-cloud> and copy the source file to the C drive (C:/) root folder.
2. Launch Atmel Studio 7.0.
3. Click on *File > Open > Project...*
4. Select project to open `mcu-firmware/saml21g18b_sensor_board_demo_JITR.atstln` or `mcu-firmware/saml21g18b_sensor_board_demo_ECC.atstln` files.
5. By default, the starting address of the application firmware is 0x2000 as the board is pre-programmed with a boot-loader. The starting address of boot-loader is 0x0.
 - If Atmel ICE is used for programming the firmware to the board; the developer need not use the boot-loader and starting address of the application firmware must be set back to 0. Skip this step if boot-loader is used for programming the firmware.
 - Perform the following steps on the project solution to set the starting address of the application firmware:
 1. Launch Atmel Studio.
 2. *Open > Right click > Properties > Toolchain > ARM/GNU Linker > Miscellaneous .*
 3. Modify "WI,--section-start=.text=0x2000" to "WI,--section-start=.text=0x0000" in the Linker Flag.
6. Click *Build > Rebuild Solution* to compile the source code and generate binary files.

Note: Generated binary files are to be stored in the `C:\github\winc1500-wifi-smart-device-enablement-kit-aws-cloud\mcu-firmware\saml21g18b_sensor_board_demo\Debug` directory.

4.2 Application Firmware Programming Procedure

Use one of the following to program the application firmware to the board:

- Program through USB Port (J1)
- Program through Atmel ICE programming tool

Tools:

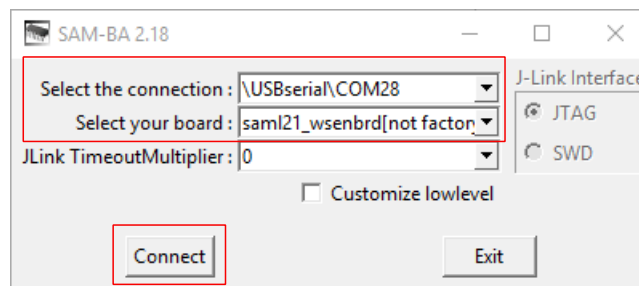
- Atmel-ICE: <https://www.microchip.com/developmenttools/ProductDetails/ataatmel-ice>
- SAM-BA V2.18: [8.2 SAM Boot Assistance \(SAM-BA\)](#)

Method 1: Programming through USB and J1 connector

Perform the following steps for programming through USB and J1 connector:

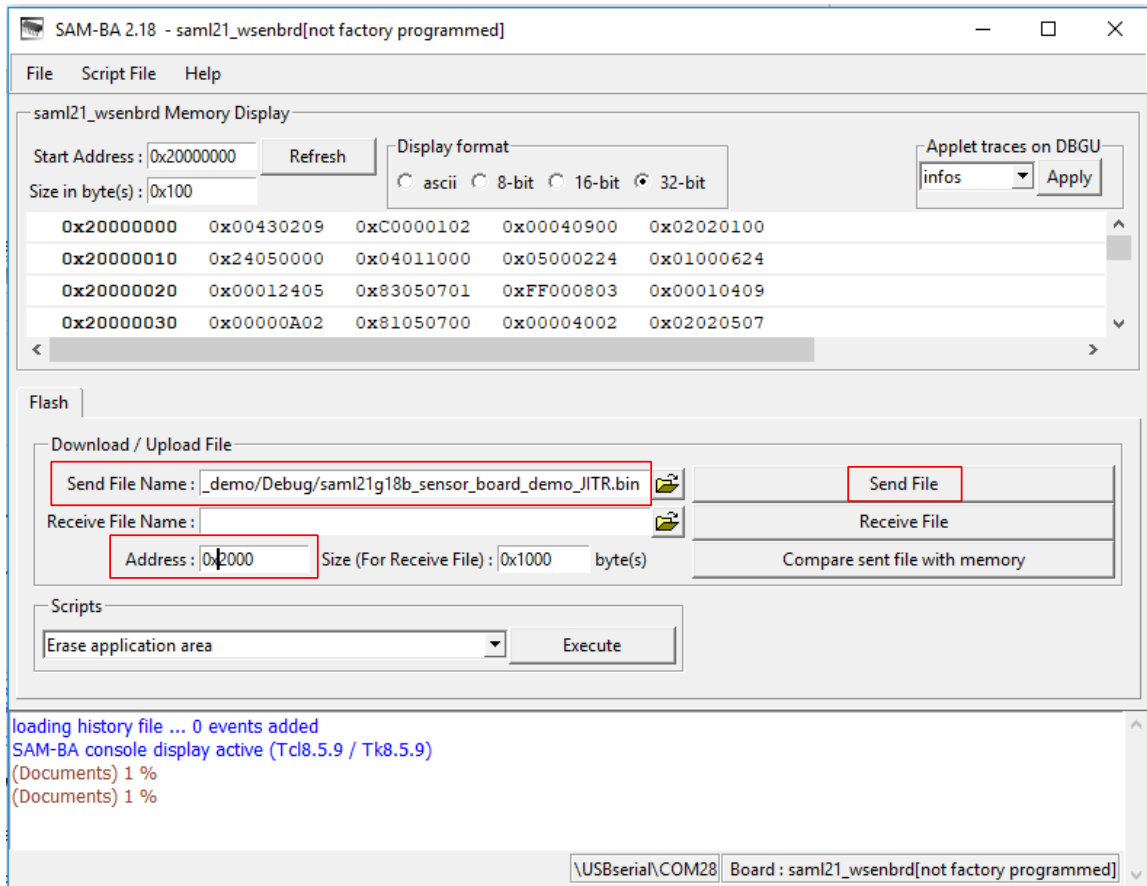
1. Connect USB cable with the PC and the Wi-Fi Smart Device Enablement Kit J1 connector.
2. Press and hold SW1 on the board during power-up. The LD2 LED turns off if the board successfully triggers the boot-loader.
3. Launch SAM-BA V2.18 on PC.
4. Set the connection to `\USBserial\COMx` and the board (`saml21_wsenbrd`).

Figure 4-1. SAM-BA 2.18



5. Click **Connect** to add address and firmware bin file.
6. In the **Flash** tab, set the bin file name in “Send File Name” and the “Address.”
7. Click **Send File** to program the bin file to the Wi-Fi Smart Device Enablement Kit.

Figure 4-2. UI Parameters



Method 2: Programming with the Atmel ICE tool

If Atmel ICE is used for programming the application to the board, set the starting address to 0x0000. For more details, refer to the [4.1 Application Firmware Compilation Procedure](#).

Perform the following steps for programming through the Atmel ICE tool:

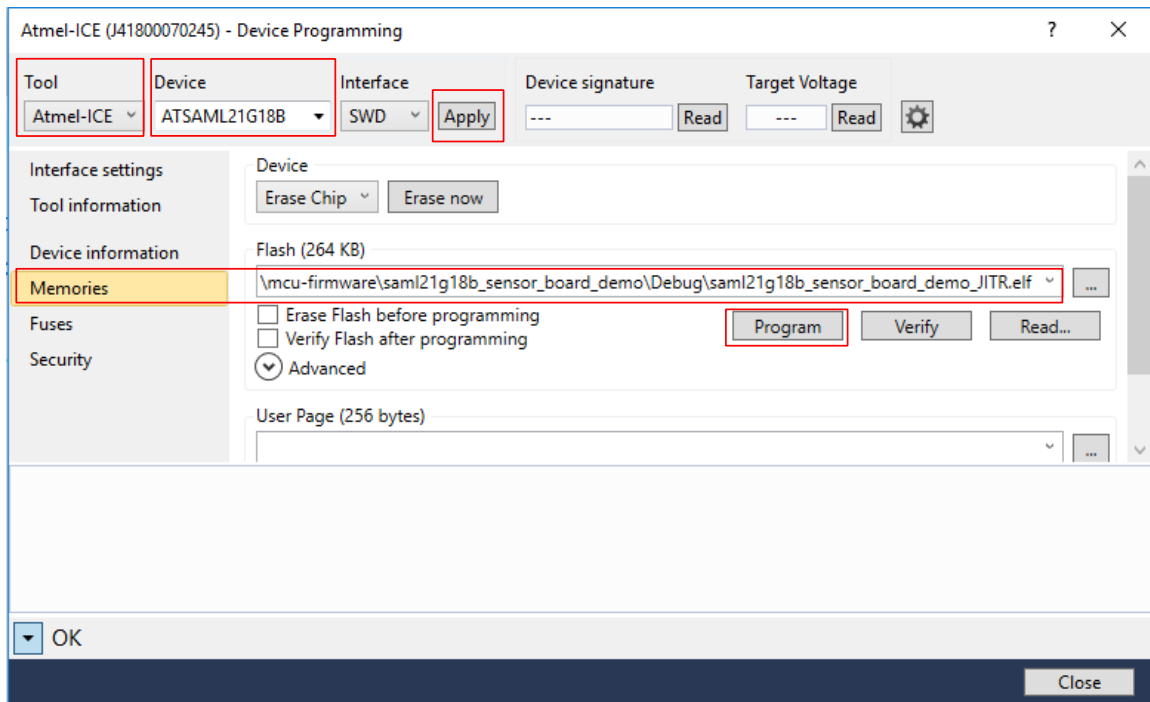
1. Connect Atmel ICE to the board as shown in the following figure.

Figure 4-3. Atmel ACE Connected to Board



2. Launch Atmel Studio, and select *Tools > Device Programming*.
3. Select Atmel-ICE as "Tool" and ATSAML21G18B as "Device."
4. Click **Apply**.
5. Select "Memories" and the application firmware in "Flash" as highlighted in the following figure.
6. Click **Program**.

Figure 4-4. Atmel - ICE

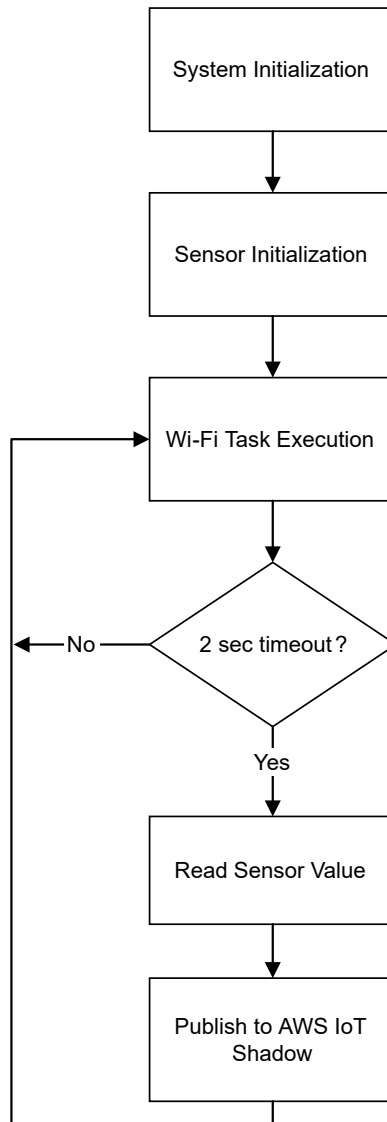


4.3 Operation

4.3.1 Application Flow

When the power is on, the Wi-Fi Smart Device Enablement Kit goes through the initialization phase where the MCU's internal system, WINC15x0 and all the connected sensors are initialized. After this phase, the board attempts to connect to the configured AP. LD2 blinks in blue every 500 ms during this process. When the board successfully connects to the AP and gets the IP address, LED blinks in blue every 100 ms. Then the board attempts to connect to the AWS IoT. After successful connection to the cloud, LD2 remains in steady blue. The board checks the sensor data every two seconds. If the sensor data is changed the data is published to AWS IoT Shadow, and the developer can use a mobile application or speak to Alexa-enabled device (for example, Echo Dot) to check the sensor values, and LED LD2 color.

Figure 4-5. Application Flowchart



4.3.2 Cloud Connection

The host MCU runs AWS IoT SDK to connect the board to AWS IoT cloud. The AWS IoT SDK includes cloud connection API and MQTT pub/sub API. MQTT Client ID is needed for the connection and Subject Key Identifier (SKI) of the device certification is used as the MQTT Client ID. The board connects to AWS IoT cloud with TLS 1.2 RSA cipher suite. Device certificate and private key are stored in ECC608 CryptoAuthentication device. WINC15x0 uses the certificate and key in ECC608 to perform the authentication with the AWS IoT cloud.

4.3.3 Data Exchange

The board uses MQTT protocol to exchange the data with AWS cloud and mobile application. AWS IoT acts as a MQTT broker; mobile application and sensor board act as MQTT Publisher and Subscriber. AWS IoT Device Shadow service is used to store and retrieve the current state information of the board. The board updates sensor and LED data to the AWS IoT by publishing MQTT message to Shadow MQTT */update* topics and get the LED latest state from AWS IoT by subscribing Shadow MQTT */update/*

delta topics. The mobile application controls the LED color by publishing MQTT message to Shadow MQTT */update* topics, and get the sensor data by subscribing Shadow MQTT */update/delta* topics.

The Shadow document of the Wi-Fi Smart Device Enablement Kit is shown as below:

```
{
  "reported": {
    "macAddr": "f8f005accfad",
    "uv": 427000,
    "COUNT": 34,
    "hum": 48,
    "pressure": 1017,
    "temp": 2468,
    "BUTTON_3": 0,
    "BUTTON_1": 1,
    "BUTTON_2": 1,
    "LED_R": 1,
    "LED_G": 0,
    "LED_B": 1,
    "LED_INTENSITY": 21,
    "Light": 1
  }
}
```

4.3.4 Sensor Detection

Firmware reads the environment sensor and light sensor, every two seconds in an infinite loop. The updated sensor data is sent to the AWS IoT cloud.

Environment sensor:

- Detects temperature, humidity and pressure
- I2C address: 0x77

Light sensor:

- Detects the light intensity
- I2C address: 0x10

4.3.5 Board Registration and Network Configuration

The board registration and network configuration take place in the following way:

- The developer can perform board registration and network configuration on the mobile application.
- The board connects to the network and allows control/monitoring of the board using the mobile application account.
- During this process, the developer needs to press and hold SW3 button for 5 seconds, LED LD2 blinks in red color when the board enters the board registration and network configuration mode.
- In this mode, the board changes to Wi-Fi AP mode, broadcasted with SSID named "WiFiSmartDevice_F8F005XXXXXX", where "XXXXXX" is the last hex value of the MAC address. Then, mobile application acts as a Wi-Fi station to connect the board. TCP tunnel with port 8899 is created. Target Network SSID and passphrase are transferred from the mobile application to the board in this tunnel. When the board successfully gets the SSID and passphrase, it changes to Wi-Fi Station mode and connects to the target AP using the Wi-Fi credential.
- In this process, Device Thing ID is also transferred from the board to the mobile application. When the mobile application gets the Device Thing ID, it stores the Device Thing ID with the mobile application account ID and board device name to a table in AWS DynamoDB.
- When the developer signs in to the mobile application, the mobile application scans the table in AWS DynamoDB to display the board information that corresponds to its mobile application account ID.

4.3.6 Alexa Voice Control

Voice control feature is added to the board by using Amazon Alexa. The developer can speak to an Alexa-enabled device (for example, Echo Dot) to get the board sensor data or control LED LD2 color. When the developer speaks to the Alexa-enabled device, the voice is streamed to the Alexa cloud for processing and then sent the directives in JSON format to AWS Lambda. There is a Lambda function to handle the directives. The directives include an access token which contains the mobile application account ID. The Lambda function scans the table in AWS DynamoDB to look for the Device Thing ID that belongs to the mobile application account ID. Then, the code in Lambda function updates the value to AWS IoT Shadow or get the AWS IoT Shadow of the device to control the LED LD2 or report the sensor data to Alexa cloud and output to the Alexa-enabled device.

There are two Alexa skills with different features for the Wi-Fi Smart Device Enablement Kit:

1. Alexa Smart Home Skill - the name of this skill is Microchip Wi-Fi Smart Device Smart Home Skill.
2. Alexa Custom Skill - the name of this skill is Microchip Sensor Board Skill.

The Lambda function source files of Microchip Wi-Fi Smart Device Smart Home Skill can be found in the directory `/lambda-function/alexa-smart-home-skill` while the Lambda function source files of Microchip Sensor Board Skill can be found in the directory `/lambda-function/alexa-custom-skill`.

Table 4-1. Microchip Wi-Fi Smart Device Smart Home Skill

Function	Voice command
Turn On/ Off LED LD2	Turn on/ off <DEVICE_NAME>
Adjust light intensity of LED LD2	Set the power to [0 - 100]% on <DEVICE_NAME>

Table 4-2. Microchip Sensor Board Skill

Function	Voice command
Turn on/off LED LD2	Turn light on/off
Turn LED LD2 to different color	Turn light blue/green/red/yellow/white/cyan/magenta
Get LED LD2 color	What is the light color?
Get LED LD2 on/off state	What is the light state?
Get button (SW1, SW2, SW3) status	What are the button states?
Get temperature/humidity from the kit	What is the temperature/humidity?
Assert the Port A 17/ 20 or 21 GPIO to high/low	Set/Clear Port A 17/20/21
Assert the Port B 22/23 to high/low	Set/Clear Port B 22/23

4.3.7 Mobile Application Control

Mobile application controls the board by publishing MQTT message to Shadow MQTT `/update` topics, and get the sensor data by subscribing Shadow MQTT `/update/delta` topics.

4.4 Software Customization

4.4.1 Architecture

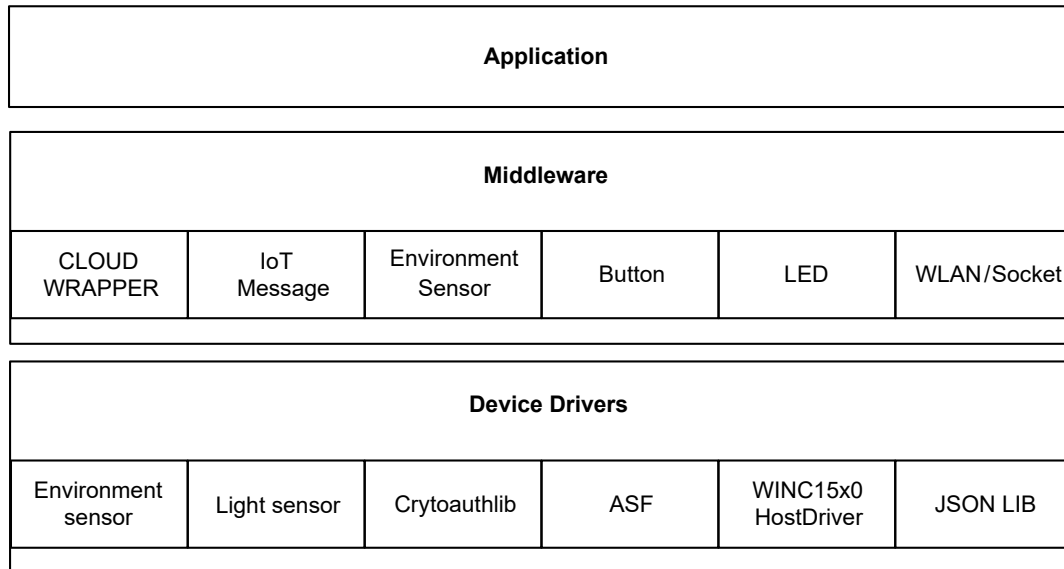
MCU firmware application starts with `main.c` file. It then runs into a while loop after board initialization. The while loop keeps running the following functions:

- `wifiTaskExecute()` – to handle all the Wi-Fi related functions including the cloud connection, message exchange between the cloud, network configuration, and so on.
- `buttonTaskExecute(ms_ticks)` – to check the button state and trigger the callback function.
- `env_sensor_execute()` – to read the sensor value and trigger the callback function.

The following figure shows the firmware architecture. There are middleware modules between the application layer and the device drivers layer. Developers can easily develop the application by using middleware APIs to configure the device drivers. Device drivers layers include:

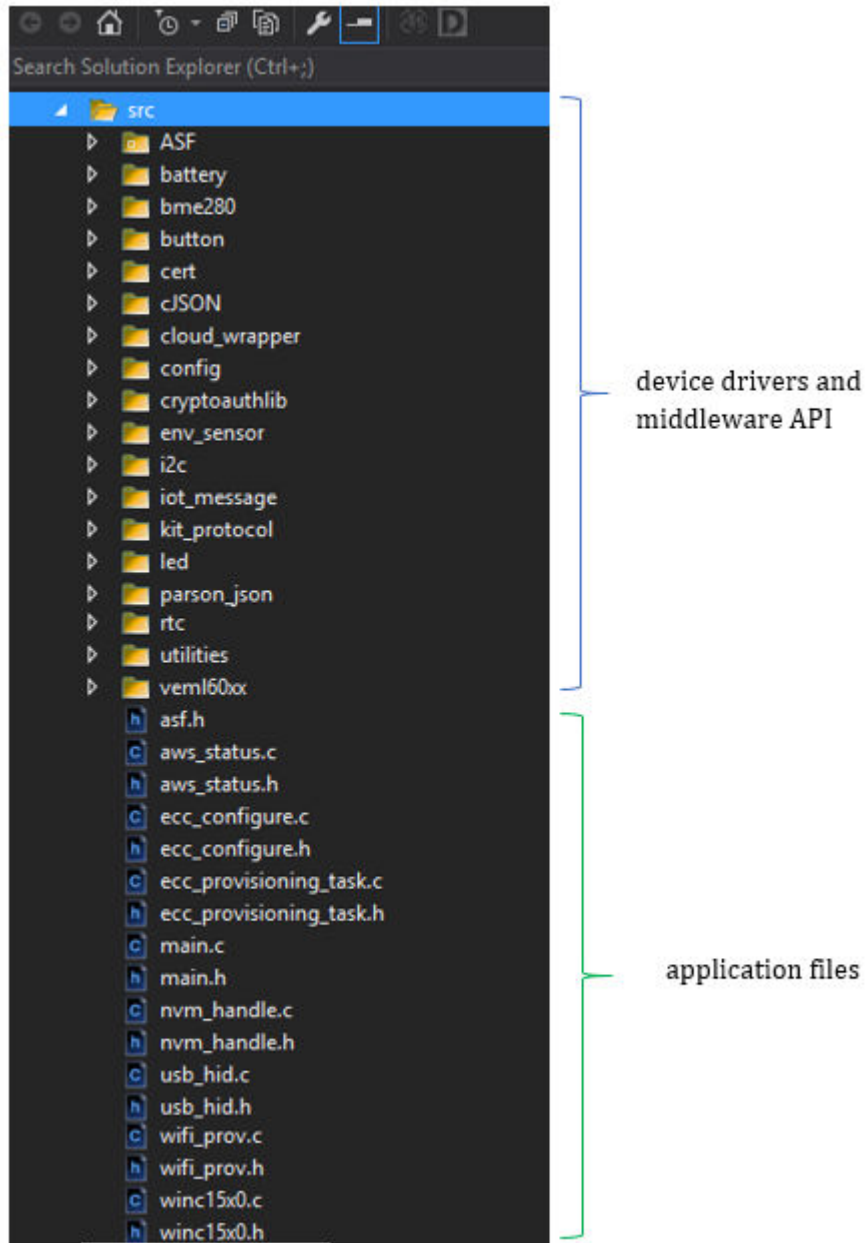
- WINC15x0 Wi-Fi module host driver
- Environment sensor driver
- Light sensor driver
- Cryptoauthlib for ECC608
- ASF
- JSON library

Figure 4-6. Firmware Architecture



4.4.2 Folder Structure

Figure 4-7. Folder Structure



4.4.3 Middleware APIs

The following table shows the middleware APIs.

Table 4-3. Middleware APIs

Middleware Modules	Files	Function
CLOUD_WRAPPER	cloud_wrapper.h	Connect/ disconnect cloud, publish/ subscribe MQTT channel

.....continued		
Middleware Modules	Files	Function
IOT_MESSAGE	iot_message.h	Generate or parson JSON message to/ from the AWS Shadow
BUTTON	Button.h	Read button value
LED	Led.h	Control LED LD2 color and blinking behavior.
ENV_SENSOR	env_sensor.h	Read sensor value
WLAN	m2m_wifi.h	WLAN features like AP scanning, AP connection, and so on. This function is available at https://asf.microchip.com/docs/latest/saml21/html/m2m__wifi_8h.html .
SOCKET	socket.h	Network socket API. This function is available at https://asf.microchip.com/docs/latest/saml21/html/socket_8h.html .

1. CLOUD_WRAPPER

- Cloud_RC cloud_connect(char* hostname, char* mqtt_client_id);
Usage: Connects AWS IoT cloud.

Parameters:

- Hostname [input] pointer of AWS IoT Endpoint hostname
- mqtt_client_id [input]AWS IoT Thing ID

Return: 0: success

Other value: fail;

- Cloud_RC cloud_disconnect();
Usage: Disconnects AWS IoT cloud.

Parameters: NA

Return: 0: success;

Other value: fail;

- Cloud_RC cloud_mqtt_publish(char* channel, void* message);
Usage: Publishes MQTT message to AWS IoT.

Parameters:

- Channel [input]MQTT topic that the message published to
- Message[input]message that publish to the AWS IoT MQTT broker

Return: 0: success;

Other value: fail;

- Cloud_RC cloud_mqtt_subscribe(char* channel, void* cb);
Usage: Subscribe AWS IoT MQTT topic.

Parameters:

- Channel [input]MQTT topic for subscription

- `cb [input]` callback function that is trigger when MQTT message is received from the subscribe MQTT topic

Return: 0: success;

Other value: fail;

- `Cloud_RC cloud_mqtt_yield(int timeout);`

Usage: This is used by the MQTT client to manage PING requests to monitor the health of the TCP connection as well as periodically check the socket receive buffer for subscribe messages.

Parameters:

- `timeout[input]` Maximum number of milliseconds to pass thread execution to the client

Return: 0: success;

Other value: fail;

2. IOT_MESSAGE

- `cJSON* iot_message_reportInfo_shadow(char* device_type, char* mac_addr, int report_data_num, NodeInfo data_info[]);`

Usage: Generates AWS IoT Shadow report message.

Parameters:

- `device_type[input]` Name of the device type
- `mac_addr[input]` MAC address of the device
- `report_data_num[input]` number report items
- `data_info[input]` data of the report items

Return: JSON message;

Other value: fail;

3. BUTTON

- `void initialise_button(void);`

Usage: Initializes GPIO for button detection.

- `void buttonTaskExecute(unsigned long tick)`

Usage: Executes button detection, called in a while loop to poll the button every a period.

Parameters:

- `tick[input]` systick value

- `int regButtonShortPressDetectCallback(void* cb, int button);`

Usage: Register callback function for the button short press detect.

Parameters:

- `cb [input]` callback function trigger when short press button is detected
- `button[input]` 1: SW1; 2: SW2; 3: SW3

Return: socket index

- `int unRegButtonShortPressDetectCallback(int sock, int button)`

Usage: Unregister callback function for the button short press detect.

Parameters:

- `sock [input]` socket index that represent the registration

- button[input] 1: SW1; 2: SW2; 3: SW3

Return: 0: success; -1: fail

- int regButtonLongPressDetectCallback(void* cb, int button);
Usage: Register callback function for the button short press detect.

Parameters:

- cb [input]callback function trigger when long press button is detected
- button[input] 1: SW1; 2: SW2; 3: SW3

Return: socket index;

- int unRegButtonLongPressDetectCallback(int sock, int button);
Usage: Unregister callback function for the button long press detect.

Parameters:

- sock [input]socket index that represent the registration
- button[input] 1: SW1; 2: SW2; 3: SW3

Return: 0: success; -1: fail;

4. LED

- void initialise_led(void);
Usage: Initializes GPIO for LED control.

Parameters: N/A

- void led_ctrl_set_color(Led_Color color, Led_Mode mode);
Usage: Set LED color and mode.

Parameters:

- color [input]LED color options
- mode[input] LED mode: on/off/ blink normal/blink fast/blink slow

- void led_ctrl_set_mode(Led_Mode mode);
Usage: Set LED blink mode.

Parameters:

- mode[input] LED mode: on/ off/ blink normal/blink fast/blink slow

- void toggleLED(void);
Usage: Toggle LED on/off state.

Parameters: N/A

- Led_Color led_ctrl_get_color(void)
Usage: Gets LED color.

Parameters: N/A

Return: Led_Color

5. ENV_SENSOR

- void env_sensor_data_init(void);
Usage: Gets the initialize value of the environment sensor and light sensor.

Parameters: N/A

- void env_sensor_execute(void)

Usage: Executes sensor value detection, called in a while loop to poll the sensor data every a period, trigger callback function when sensor data need to publish to cloud.

Parameters: N/A

– void register_env_sensor_udpate_callback_handler(void* cb)

Usage: Register callback function for the environment and light sensor data.

Parameters:

- cb [input]callback function

5. AWS Setup

Note: The steps mentioned in this section may vary, based on the updates from Amazon. Refer to the Amazon guides for the latest step-by-step procedure.

Developers can follow [10. Appendix C: AWS CloudFormation to Setup Cloud](#) instead of this section to set up AWS cloud. AWS CloudFormation feature allows easy and convenient way to set up the cloud by uploading template code to cloud rather than creating and configuring the cloud step-by-step.

5.1 Create and Administrate AWS account

5.1.1 Create AWS Account

Perform the following steps to create an AWS account:

1. Go to <https://aws.amazon.com/>.
2. Click the **Create an AWS Account** button to create an AWS account.
3. After a successful creation, click **Sign In to the Console** and enter the username and password to sign in to AWS account.

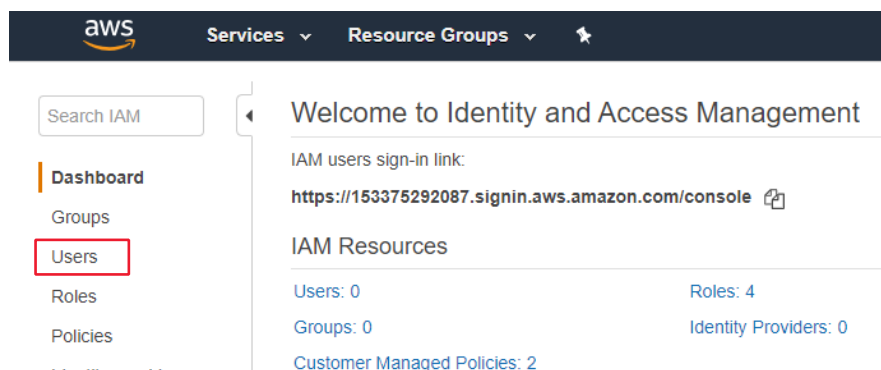
5.1.2 Create IAM User and Group

AWS Identity and Access Management (IAM) is used to manage and control AWS services and resources. The best practice to access AWS resources is to use IAM user account with limited permission instead of using a root user account. As a root user account can access all the AWS resource including the billing information. It is better to protect the root user access key.

Below are the steps to create IAM user account and group for this project. The IAM user account name is *ZTUser* and belongs to *ZTGroup*. This account is used for all the settings in this section.

1. Go to <https://console.aws.amazon.com/iam>.
2. Select **Users**.

Figure 5-1. User Selection



3. From the "Users" management page, click **Add User** at the top of the page. When the "Add user - Step 1: Details" page displays, enter the following information:
 - 3.1. Set user details as follows:
 - Username: ZTUser
 - 3.2. Select AWS access type:
 - Access type

1. Tick “Programmatic access” and “AWS Management Console access” check boxes.
- Console password:
 1. Select “Custom password”.
 2. Enter a password for ZTUser.
 3. Uncheck “Require password reset” check box.
 4. Record the password for logging in to the console later.

Note: The fields with asterisk (*) are mandatory.

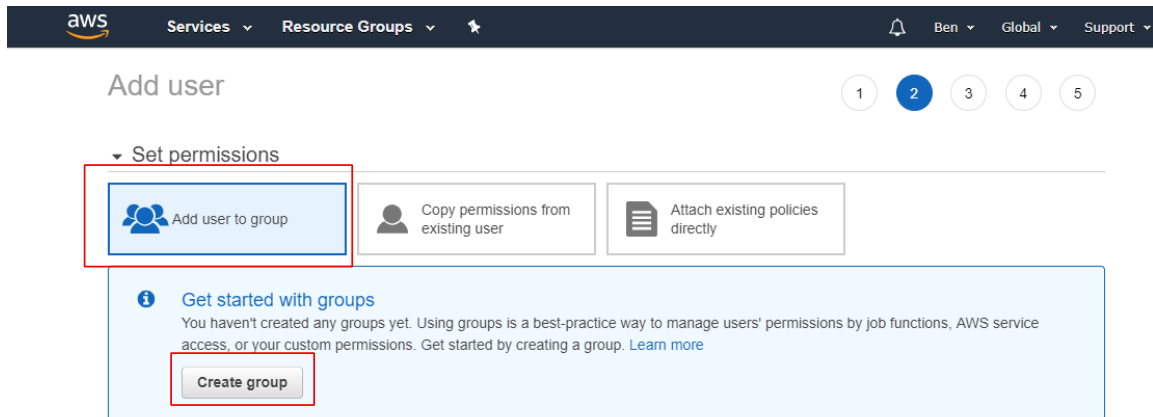
4. Click **Next: Permissions**.

Figure 5-2. Adding a New User and Selecting AWS Access Type

The screenshot shows the AWS IAM console 'Add user' page. The 'Set user details' section has 'User name*' set to 'ZTUser'. The 'Select AWS access type' section has 'Programmatic access' and 'AWS Management Console access' checked. The 'Console password*' section has 'Custom password' selected. The 'Require password reset' checkbox is unchecked. A 'Next: Permissions' button is highlighted at the bottom right.

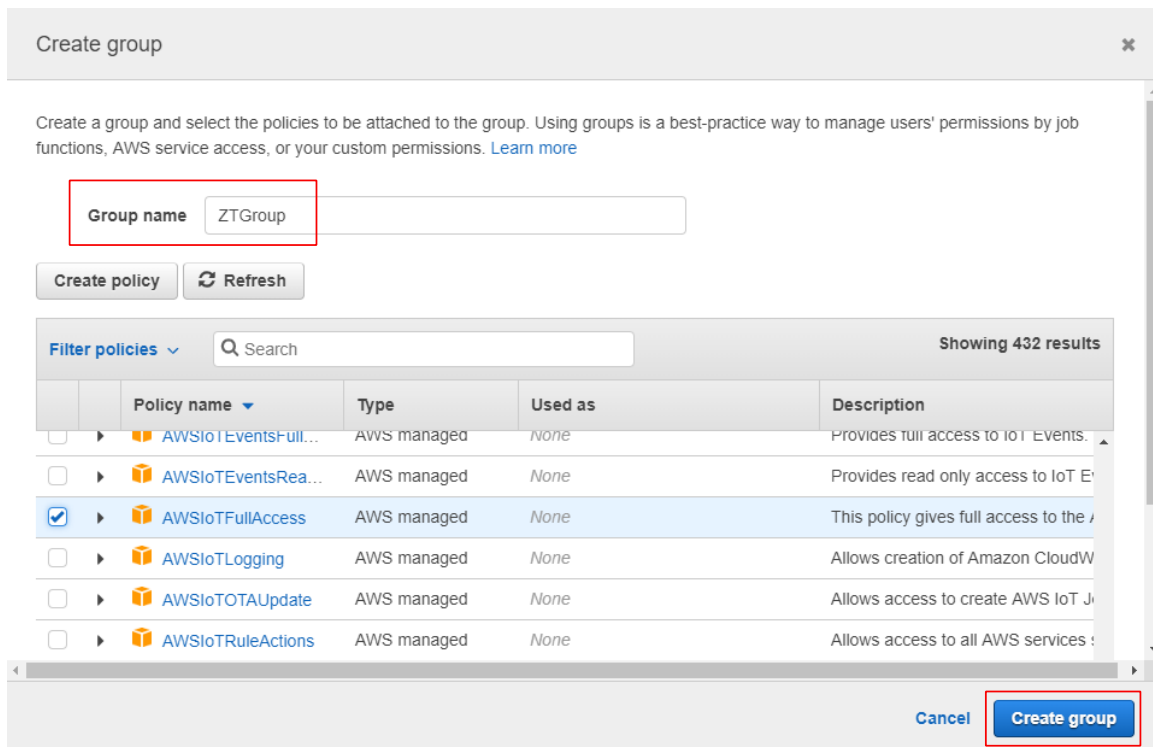
5. Create a new group for the AWS account.
6. Select “Add user to group” for adding a new user.
7. Click **Create group**.

Figure 5-3. Create Group



8. From the Create group window, enter the group name: *ZTGroup*.
9. Select the following policy types:
 - “AWSIoTFullAccess”
 - “AWSLambdaFullAccess”
 - “AmazonCognitoPowerUser”
 - “IAMFullAccess”
 - “AmazonDynamoDBFullAccess”
10. After selecting the policies, click **Create Group**.

Figure 5-4. Adding Policies to a Group



11. In the Set permissions page, the ZTGroup is preselected. This sets permissions for user ZTUser to group policies specified to ZTGroup. Click **Next: Tags**.

Figure 5-5. Setting Permissions

The screenshot shows the AWS IAM console 'Add user' page. The navigation bar includes the AWS logo, 'Services', 'Resource Groups', and user information. The page title is 'Add user' with progress indicators 1 through 5, where 2 is active. Under 'Set permissions', three options are shown: 'Add user to group' (selected), 'Copy permissions from existing user', and 'Attach existing policies directly'. Below this, a search bar and a table of groups are visible. The table has columns for 'Group' and 'Attached policies'. One row is highlighted with a red border, showing 'ZTGroup' with a checkmark and 'AWSLambdaFullAccess and 3 more' policies. At the bottom right, there are 'Cancel', 'Previous', and 'Next: Tags' buttons, with 'Next: Tags' highlighted by a red box.

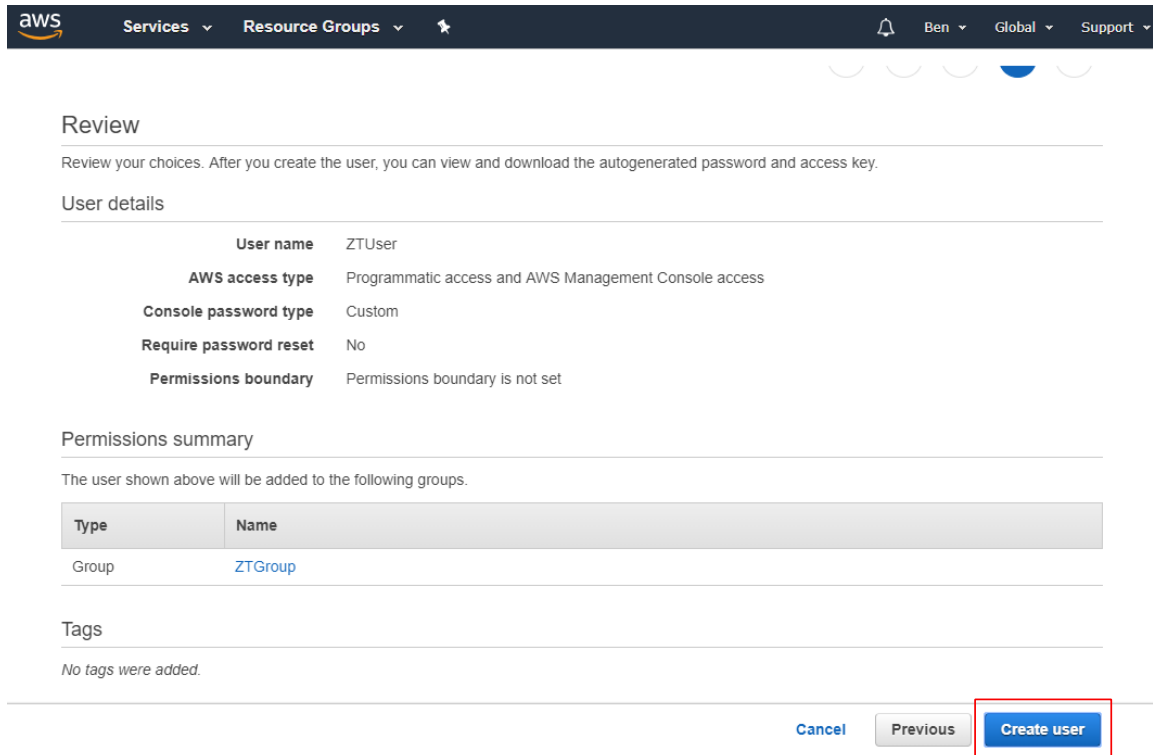
12. This is an optional step and to skip this part, click **Next: Review**.

Figure 5-6. Adding Tags

The screenshot shows the AWS IAM console 'Add user' page. The navigation bar is the same as in Figure 5-5. The page title is 'Add user' with progress indicators 1 through 5, where 3 is active. Under 'Add tags (optional)', there is a text area for 'IAM tags are key-value pairs you can add to your user. Tags can include user information, such as an email address, or can be descriptive, such as a job title. You can use the tags to organize, track, or control access for this user. Learn more'. Below this is a table with columns 'Key', 'Value (optional)', and 'Remove'. The 'Key' column has a text input field with the placeholder 'Add new key'. Below the table, it says 'You can add 50 more tags.' At the bottom right, there are 'Cancel', 'Previous', and 'Next: Review' buttons, with 'Next: Review' highlighted by a red box.

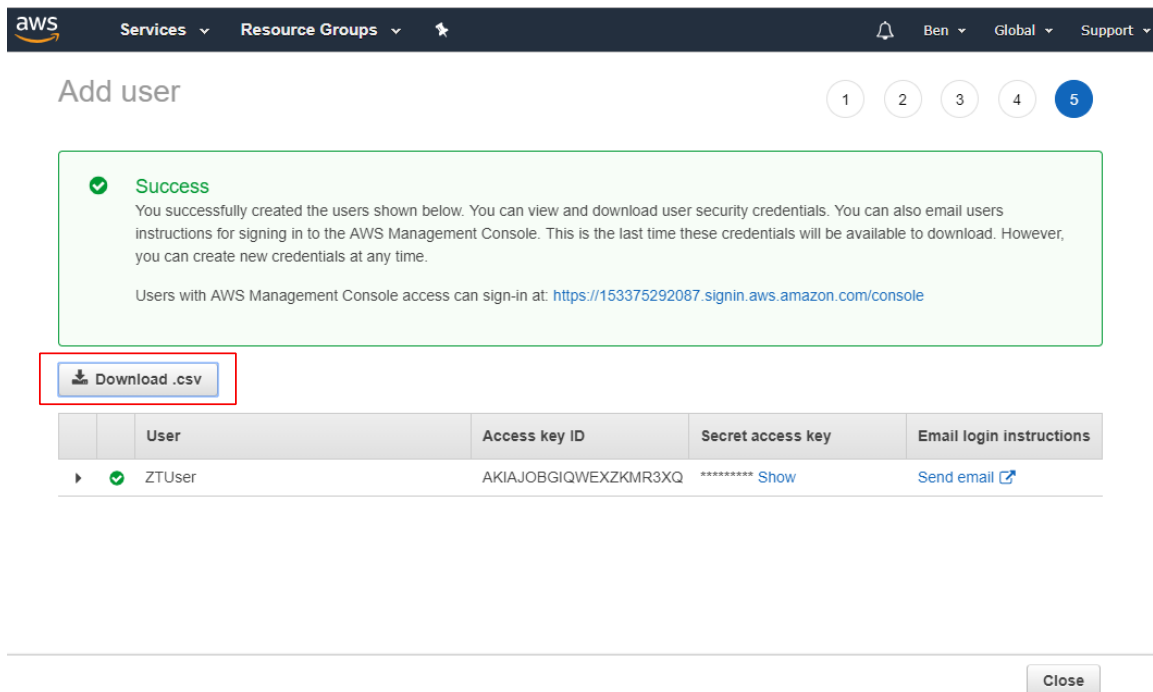
13. Verify the details and click **Create user** to create the user account.

Figure 5-7. Reviewing User Details and Creating a User



14. AWS creates a unique account sign-in URL and access credentials (Access key ID and Secret access key). To download and save the account information file, click **Download .csv**. These credentials are used to configure the settings under ZTUser account later.

Figure 5-8. Successful User Creation Window



5.1.3 Create Policy and Role for JITR

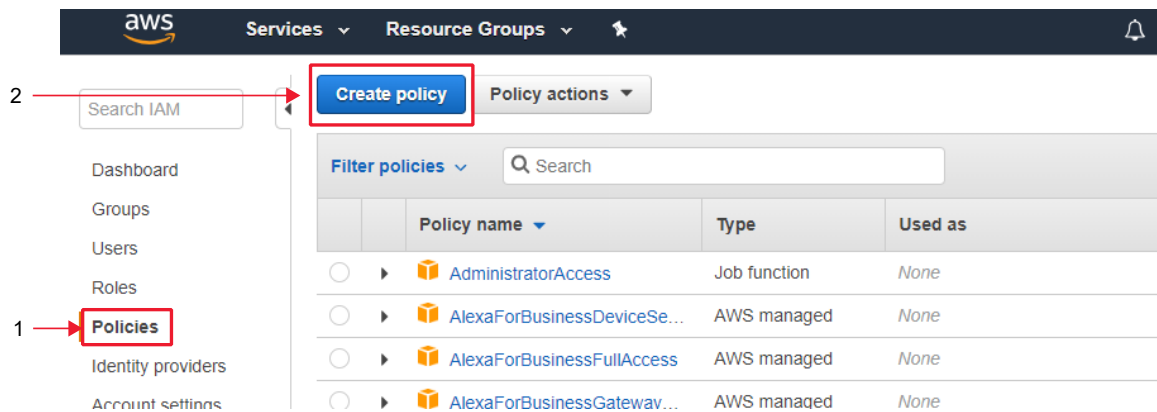
Just-In-Time Registration (JITR) allows the user to register a device at the time of connection. JITR reduces the manufacturing burden of registering a device with AWS before it is connected. In later steps, create a Lambda function that is responsible for registering new devices. The following are the steps to create a custom policy and role that is used by the JITR Lambda function:

Create Policy

To create policy, perform the following steps:

1. Go to <https://console.aws.amazon.com/iam>.
2. Click "Policies".
3. From the Policies page, click **Create Policy**.

Figure 5-9. Policy Creation

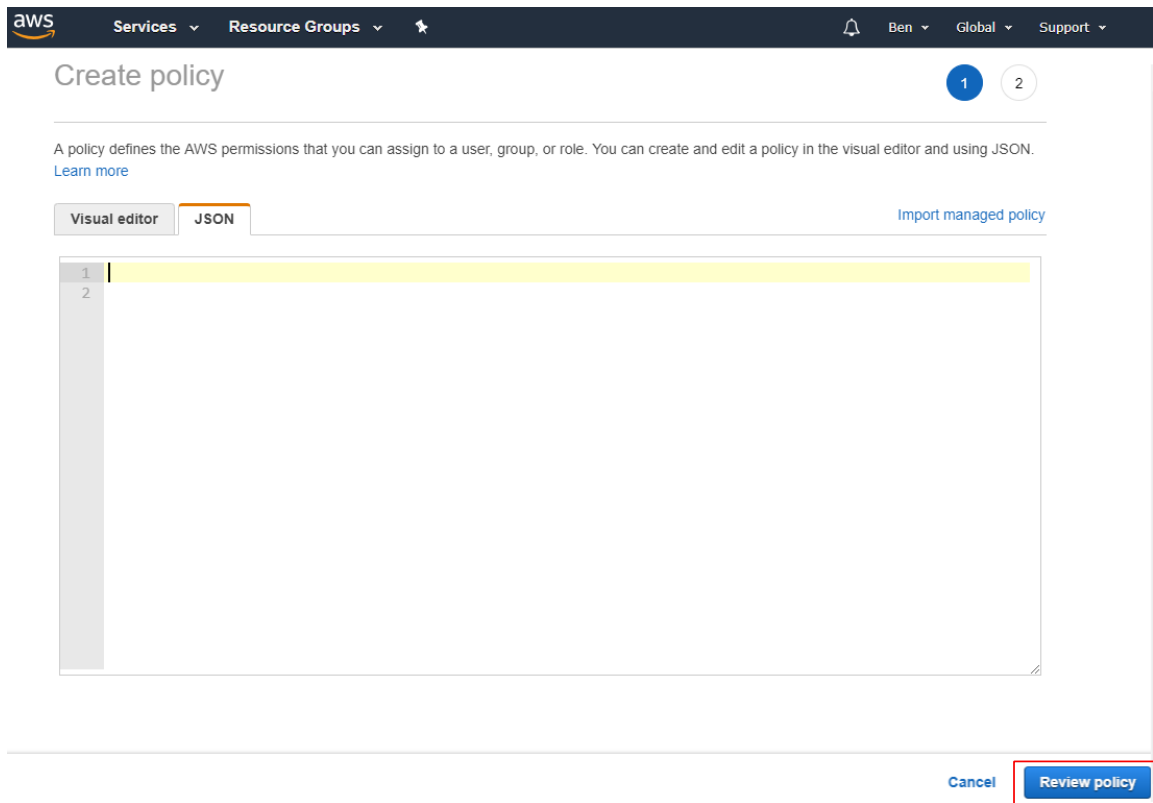


4. Select **JSON**. Copy and paste the following code and click **Review Policy**.

Figure 5-10. Policy Review

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "iot:UpdateCertificate",
        "iot:CreatePolicy",
        "iot:AttachPrincipalPolicy",
        "iot:CreateThing",
        "iot:CreateThingType",
        "iot:DescribeCertificate",
        "iot:DescribeCaCertificate",
        "iot:DescribeThing",
        "iot:DescribeThingType",
        "iot:GetPolicy",
        "iot:CreateThingGroup",
        "iot:AddThingToThingGroup"
      ],
      "Resource": "*"
    }
  ]
}
```

Figure 5-11. Policy Review



5. Enter the policy name as *ZTLambdaJITRPolicy* in the “Name” field. Click **Create policy**.

Figure 5-12. Create Policy

aws Services Resource Groups

Create policy

1 2

Review policy

Name*

Use alphanumeric and '+-,@,_' characters. Maximum 128 characters.

Description

Maximum 1000 characters. Use alphanumeric and '+-,@,_' characters.

Summary

Service	Access level	Resource	Requested permissions
Allow (1 of 172 services) Show remaining 171			
IoT	Limited: Read, Write, Permissions management, Tagging	All resources	None

Cancel Previous **Create policy**

Create Roles

To create roles, perform the following steps:

1. Go to <https://console.aws.amazon.com/iam>.
2. Click **Roles**.
3. In the Roles page, click **Create Role**.
4. Under "Select type of trusted entity", select **AWS Service** and select "Lambda" service. Click **Next: Permissions**.

Figure 5-13. Select Type of Trusted Entity

The screenshot shows the AWS IAM console interface for creating a role. The top navigation bar includes the AWS logo, 'Services', 'Resource Groups', and user information. The main heading is 'Create role' with a progress indicator showing four steps, with the first step '1' being active. Below the heading, the section 'Select type of trusted entity' offers four options: 'AWS service' (highlighted with a red box), 'Another AWS account', 'Web identity', and 'SAML 2.0 federation'. A description below states: 'Allows AWS services to perform actions on your behalf. Learn more'. The next section, 'Choose the service that will use this role', lists various AWS services in a grid. 'Lambda' is selected and highlighted with a red box. At the bottom right, there are 'Cancel' and 'Next: Permissions' buttons, with the latter highlighted by a red box.

5. Attach the following policies:
 - AWSLambdaBasicExecutionRole
 - AWSXrayWriteOnlyAccess
 - ZTLambdaJITRPolicy
6. Click **Next Step**.
7. Set Role name as *ZTLambdaJITRRole*.
8. Click **Create role**.

Figure 5-14. Creating Role

Create role 1 2 3 4

Review

Provide the required information below and review this role before you create it.

Role name* Use alphanumeric and '+,=, @, _' characters. Maximum 64 characters.

Role description Maximum 1000 characters. Use alphanumeric and '+,=, @, _' characters.

Trusted entities AWS service: lambda.amazonaws.com

Policies

- [AWSLambdaBasicExecutionRole](#)
- [AWSXrayWriteOnlyAccess](#)
- [ZTLambdaJITRPolicy](#)

Permissions boundary Permissions boundary is not set

No tags were added.

* Required Cancel Previous Create role

5.1.4 Configure AWS CLI

In the following section, use ZTUser account to configure the cloud settings and provision the board to AWS User account. While performing the AWS account provision, the user needs to configure AWS Command Line Interface (CLI) before running Python scripts.

The following are the steps to configure AWS CLI with ZTUser credentials:

1. Download and install the AWS CLI tool from <https://aws.amazon.com/cli/>.
2. Run the following command: `aws configure --profile ZTUser` in the Command Prompt.
3. Enter the Access Key ID and Secret Access Key of ZTUser account when prompted. Copy and paste the credentials to avoid any typing mistakes.
4. Observe the following results on the Command Prompt window:

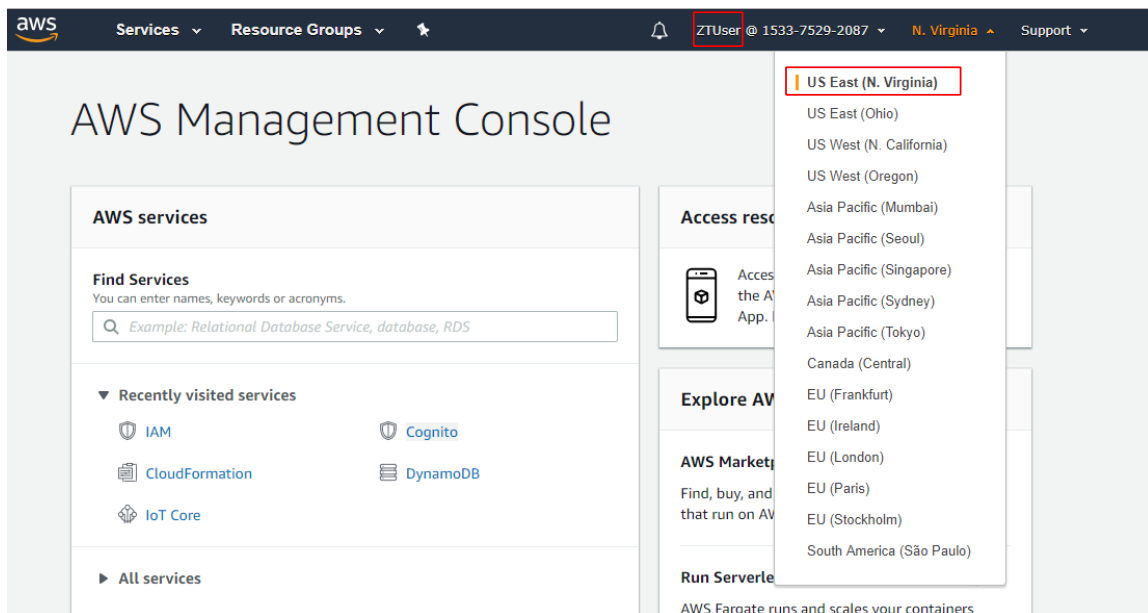
```
>aws configure --profile ZTUser
AWS Access Key ID [None]: ACCESSKEYID
AWS Secret Access Key [None]: SECRETACCESSKEY
Default region name [None]: us-east-1 ( <-- Enter the region that you selected )
Default output format [None]:
```

5.2 AWS IoT Just-in-Time Registration Setup

Use the ZTUser account to configure AWS IoT settings.

1. Open a web browser and go to the user sign-in URL that was assigned when you created ZTUser. The URL will have the following format:
 - <https://xxxxxxxxxxxxx.signin.aws.amazon.com/console>, where xxxxxxxxxxxxxx is the account ID
 - Enter the User Name *ZTUser*.
 - Enter the Password set when creating the user account.
2. Once logged in, change your region to the one closest to you by selecting the region menu (upper-right, left of support menu). In the following steps **US East (Virginia)** is selected. There are only 4 regions that can support the Lambda function for Alexa skills. Make sure to select the following four regions:
 - Asia Pacific (Tokyo)
 - EU (Ireland)
 - US East (N. Virginia)
 - US West (Oregon)

Figure 5-15. List of Countries

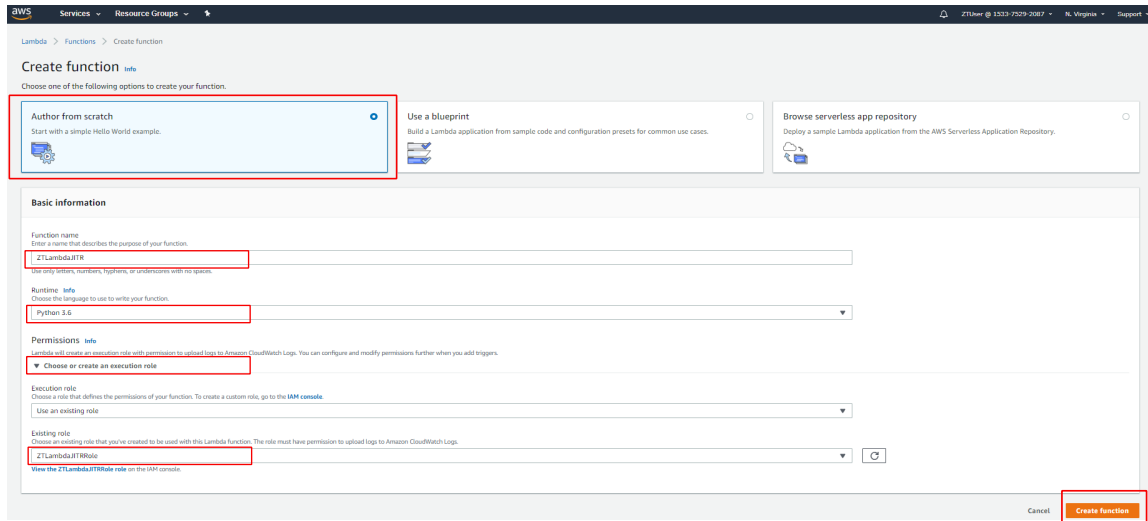


Create Lambda function

Perform the following steps to create the JITR Lambda function.

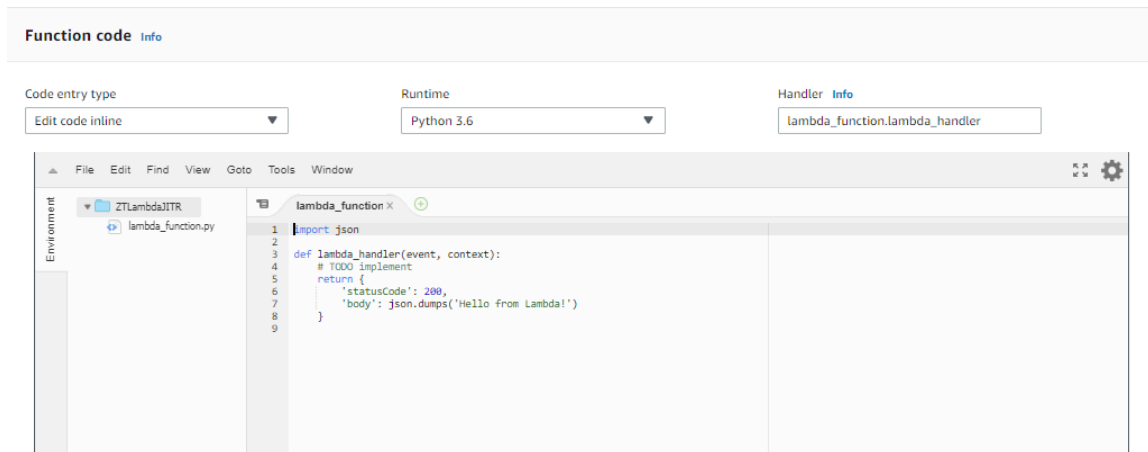
1. Click <https://console.aws.amazon.com/lambda>. The JITR Lambda function is code that is called from AWS IoT when a new device attempts to connect but is not registered yet. It is the function's responsibility to perform the actual registration of the device with AWS IoT.
2. Click **Create Function**.
3. Select "Author from scratch". Type the name of the new function in the "Name" field "ZTLambdaJITR".
4. Select "Python 3.6" under the "Runtime" field, select "Choose an existing role" under the 'Role' field, and select the previously created "ZTLambdaJITRRole" under the 'Existing role' field.
5. Click **Create Function**.

Figure 5-16. Creating a Function



6. Copy and paste the code from `lambda-function/zl-lambda-jitr/ZTLambdaJITR.py` to the code entry area of the Lambda function.

Figure 5-17. Adding a Functional Code



7. Save changes to the Lambda function code.

Create IoT Rules Engine

While the Lambda function performs the registration, it needs to be triggered by an event. The following instructions creates a rule, which runs the Lambda function when a device connects for the first time.

1. Click <https://console.aws.amazon.com/iot>.
2. Go to the 'Act' section from the menu.
3. Click the 'Create a rule' button.
4. Fill in the following fields:
 - Name: ZeroTouchJustInTimeRegistration
 - SQL version: 2016-03-23
 - Rule query statement: `Select * FROM '$aws/events/certificates/registered/##'`
 - Condition:

Figure 5-18. Creating a Rule

Create a rule

Create a rule to evaluate messages sent by your things and specify what to do when a message is received (for example, write data to a DynamoDB table or invoke a Lambda function).

Name
ZeroTouchJustInTimeRegistration

Description

Rule query statement
Indicate the source of the messages you want to process with this rule.

Using SQL version
2016-03-23

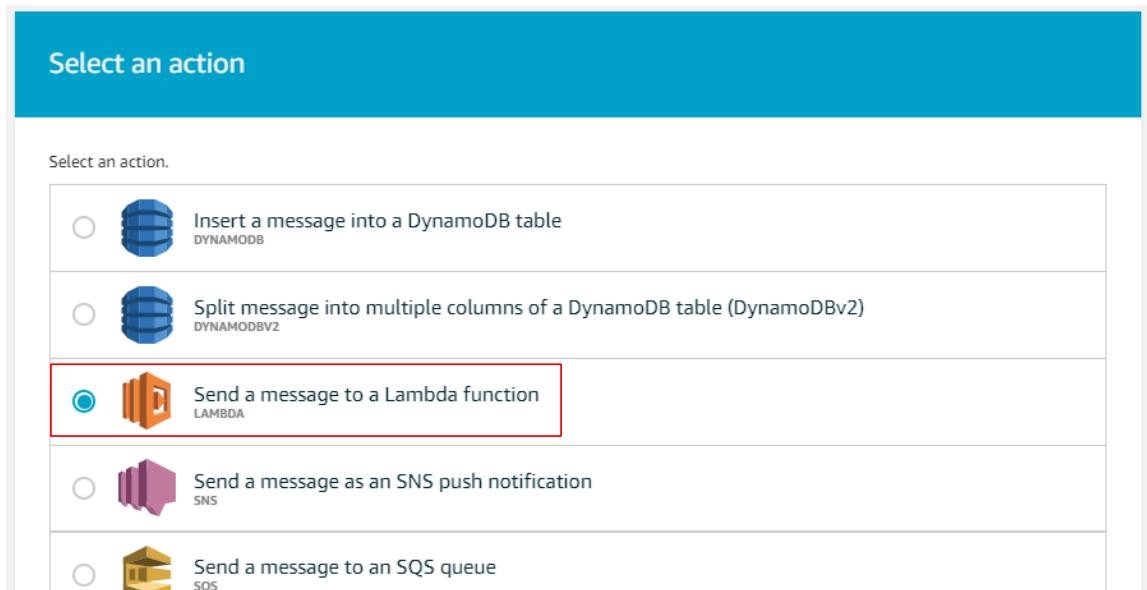
Rule query statement
SELECT <Attribute> FROM <Topic Filter> WHERE <Condition>. For example: SELECT temperature FROM 'iot/topic' WHERE temperature > 50. To learn more, see [AWS IoT SQL Reference](#).

```
1 select * FROM '$aws/events/certificates/registered/#'
```

`$aws/events/certificates/registered/#` is a special administrative MQTT topic that AWS IoT will publish to when a device connects with a certificate that hasn't been seen before but has been signed by a CA that was registered in the account. The `#` at the end indicates we want to trigger this rule for any CA registered with the account.

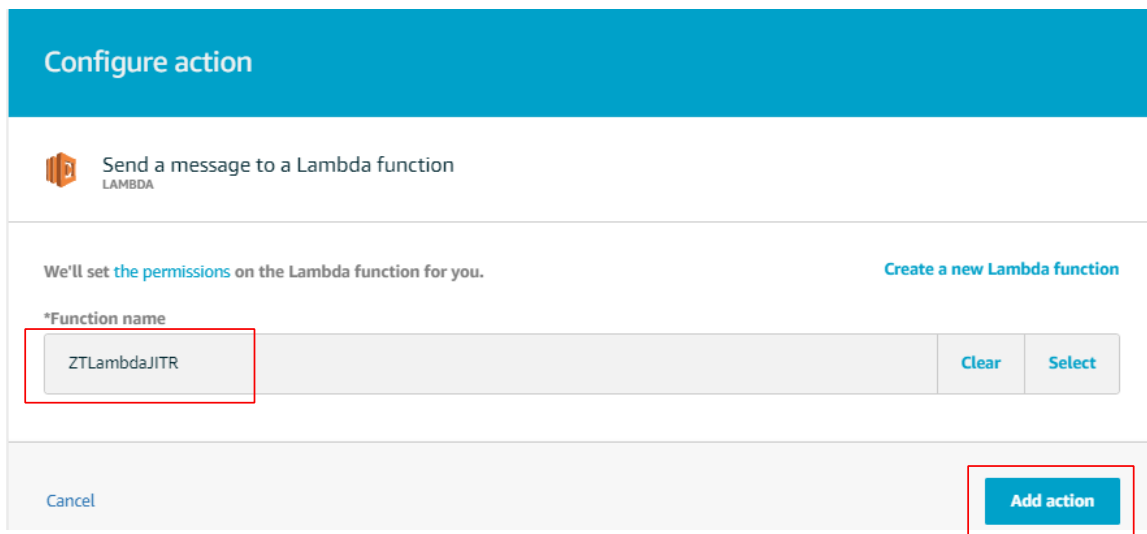
5. Click **Add action**.
6. Select **Send a message to a Lambda Function**.

Figure 5-19. Selecting an Action for a Rule



7. Click **Configure action**.
8. Select the “ZTLambdaJITR” function.

Figure 5-20. Configure Action



9. Click **Add action** and **Create rule** to finish the action.

5.3 AWS IoT Mobile App Setup

1. Click <https://console.aws.amazon.com/iot/>.
2. Click **Secure**, and **policies** in left panel.
3. Click **Create**.
4. Type in policy name (example: WiFiSmartDeviceAppPolicy). Note down this policy name, as this string will be used in the demo mobile app source code, when making the attach policy API call.

The following is an example for the policy. This policy allows access to all topics under your AWS IoT account. Copy/paste the following text to policy statement.

5. Select **Advance mode** to add statements.

Figure 5-21. Adding Statements using Advanced Mode Option

The screenshot shows the 'Create a policy' interface in the AWS IoT console. At the top, there is a blue header with the text 'Create a policy'. Below this, a brief instruction explains that a policy defines authorized actions on resources. A text input field for the policy name contains 'WiFiSmartDeviceAppPolicy'. The 'Add statements' section is active, indicated by a red box around the 'Advanced mode' button. It shows a form for adding a statement with fields for 'Action' (containing a placeholder), 'Resource ARN' (containing a placeholder), and 'Effect' (with radio buttons for 'Allow' and 'Deny'). A 'Remove' button is also present. At the bottom of the form area is an 'Add statement' button.

6. Add the following example policy to the policy statement to allow access to all topics under the specific AWS IoT account.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "iot:Connect",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": "iot:Publish",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": "iot:Subscribe",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": "iot:Receive",
      "Resource": "*"
    }
  ]
}
```

```
]
}
```

7. Click **Create**.

5.4 Amazon Cognito Setup

Amazon Cognito is used to provide user identity for the product end users, including sign-up, sign-in features. With Amazon Cognito, user can sign-up and sign-in the account using mobile application and control the boards.

Perform the following steps to set up Amazon Cognito:

1. Go to Amazon Cognito Console in AWS cloud <https://console.aws.amazon.com/cognito/>.
2. Click **Manage User Pools** to open **Your User Pools** browser.
3. Click **Create a user pool**.
4. Enter pool name as *WiFiSmartDeviceUserPool* and select *Review defaults*.
5. Click **Create pool** to create the user pool.
6. Select "App clients" in the left panel and click **Add an app client** to create App Client "WiFiSmartDeviceForAlexaSmartHomeSkill" in the user pool just created.
7. Tick the "Generate client secret" check box.
8. Click **Create app client**.

Figure 5-22. Creating Smart Home App Client

App client name
WiFiSmartDeviceForAlexaSmartHomeSkill

Refresh token expiration (days)
30

Generate client secret

Enable sign-in API for server-based authentication (ADMIN_NO_SRP_AUTH) [Learn more.](#)

Only allow Custom Authentication (CUSTOM_AUTH_FLOW_ONLY) [Learn more.](#)

Enable username-password (non-SRP) flow for app-based authentication (USER_PASSWORD_AUTH) [Learn more.](#)

[Set attribute read and write permissions](#)

9. Select "App clients settings".
10. In App Client setting of "WiFiSmartDeviceForAlexaSmartHomeSkill", tick the "Cognito User Pool" check box.
11. Additionally tick the "Authorization code grant", "phone", "email", "openid", "aws.cognito.signin.user.admin", and "profile" check boxes.
12. Add the Callback URL with all the Alexa Smart Home Skill Re-direct URL. This URL can be found when you create Alexa Smart Home Skill in [7.1 Microchip Wi-Fi Smart Device Smart Home Skill Setup](#).
13. Add <https://www.google.com> in the "Sign out URL" field.
14. Click **Save changes**.

Figure 5-23. App Client Configuration for Smart Home Skill

App client **WiFISmartDeviceForAlexaSmartHomeSkill**
ID g1d49qsp98s98itgutuk9oj2m

Enabled Identity Providers Select all
 Cognito User Pool

Sign in and sign out URLs
Enter your callback URLs below that you will include in your sign in and sign out requests. Each field can contain multiple URLs by entering a comma after each URL.
Callback URL(s)
Sign out URL(s)

OAuth 2.0
Select the OAuth flows and scopes enabled for this app. [Learn more about flows and scopes.](#)

Allowed OAuth Flows
 Authorization code grant Implicit grant Client credentials

Allowed OAuth Scopes
 phone email openid aws.cognito.signin.user.admin profile

Cancel Save changes

15. Select "App clients" and click **Add an app client** to create App Client "WiFISmartDeviceForAlexaCustomSkill" in the User Pool just created.
16. Select "Generate client secret" check-box.
17. Click **Create app client**.

Figure 5-24. Creating Custom App Client

App client name
WiFISmartDeviceForAlexaCustomSkill

Refresh token expiration (days)
30

Generate client secret

Enable sign-in API for server-based authentication (ADMIN_NO_SRP_AUTH) [Learn more.](#)

Only allow Custom Authentication (CUSTOM_AUTH_FLOW_ONLY) [Learn more.](#)

Enable username-password (non-SRP) flow for app-based authentication (USER_PASSWORD_AUTH) [Learn more.](#)

Set attribute read and write permissions

Cancel Create app client

18. Select "App clients settings".
19. In App Client setting of "WiFISmartDeviceForAlexaCustomSkill", select the following check-boxes:
 - "Cognito User Pool"
 - "Authorization code grant"
 - "phone"
 - "email"
 - "openid"
 - "aws.cognito.signin.user.admin"

- "profile"
20. Fill in Callback URL with all the Alexa Custom Skill Re-redirect URL. This URL can be found when you create Alexa Custom Skill in [7.2 Microchip Wi-Fi Sensor Board Skill Setup](#) . Fill in "Sign out URL", fill in <https://www.google.com>.
 21. Click **Save changes**.

Figure 5-25. App Client Configuration for Custom Skill

App client WiFISmartDeviceForAlexaCustomSkill
ID 6ldtfce4lsf40ntu5mku6k4ps

Enabled Identity Providers Select all

Cognito User Pool

Sign in and sign out URLs
Enter your callback URLs below that you will include in your sign in and sign out requests. Each field can contain multiple URLs by entering a comma after each URL.

Callback URL(s)

Sign out URL(s)

OAuth 2.0
Select the OAuth flows and scopes enabled for this app. [Learn more about flows and scopes.](#)

Allowed OAuth Flows
 Authorization code grant Implicit grant Client credentials

Allowed OAuth Scopes
 phone email openid aws.cognito.signin.user.admin profile

22. Select "Domain Name", type the domain name. Click **Save Changes**. Change the domain name if the domain name is already used by another.

Figure 5-26. Adding a Cognito Domain Name

WiFISmartDeviceUserPool

General settings

- Users and groups
- Attributes
- Policies
- MFA and verifications
- Advanced security
- Message customizations
- Tags
- Devices
- App clients
- Triggers
- Analytics
- App integration
 - App client settings
 - Domain name**
 - UI customization
 - Resource servers
 - Federation

What domain would you like to use?

Type a domain prefix to use for the sign-up and sign-in pages that are hosted by Amazon Cognito. The prefix must be unique across the selected AWS Region. Domain names can only contain lower-case letters, numbers, and hyphens. [Learn more about domain prefixes.](#)

Amazon Cognito domain
Prefixed domain names can only contain lower-case letters, numbers, and hyphens. [Learn more about domain prefixes.](#)

Domain prefix
 .auth.us-east-1.amazonaws.com

Your own domain
This domain name needs to have an associated certificate in [AWS Certificate Manager \(ACM\)](#). You also need the ability to add an alias record to the domain's hosted zone after it's associated with this user pool. [Learn more about using your own domain.](#)

23. Select "Users and groups" and click **Create user**.

Figure 5-27. Selecting a Users and Groups and Creating a User Credentials

The screenshot shows the AWS Cognito console interface for a user pool named 'WiFiSmartDeviceUserPool'. The 'Users and groups' section is selected in the left-hand navigation menu. The 'Users' tab is active, and the 'Create user' button is highlighted with a red box. A modal dialog box titled 'Create user' is open, displaying the following fields and options:

- Username (Required):** A text input field containing 'testuser1'.
- Send an invitation to this new user?:** An unchecked checkbox with two sub-options: 'SMS (default)' and 'Email', both also unchecked.
- Temporary password:** A text input field containing '.....'.
- Phone Number:** An empty text input field.
- Mark phone number as verified?:** An unchecked checkbox.
- Email:** An empty text input field.
- Mark email as verified?:** An unchecked checkbox.

A blue 'Create user' button is located at the bottom of the modal dialog.

24. Fill in the user information as follows, and click **Create user**.
25. Click <https://console.aws.amazon.com/cognito/> to visit Amazon Cognito Console in AWS cloud.
26. Click **Manage Identity Pools**.
27. Click **Create new identity pool**.
28. Type Identity pool name as "WifiSmartDeviceIdentityPool".
29. In "Authentication providers" of the Identity pool setting, select "Cognito". Type the "user pool ID" and the "App client ID" of "WiFISmartDeviceForAlexaCustomSkill " (The user pool ID and App client ID is found in the user pool setting page).

Figure 5-28. Authentication Providers

▼ Authentication providers ⓘ

Amazon Cognito supports the following authentication methods with Amazon Cognito Sign-In or any public provider. If you provide providers, you can specify your application identifiers here. Warning: Changing the application ID that your identity pool is linked to is not supported by Amazon Cognito. [Learn more about public identity providers.](#)

Cognito Amazon Facebook Google+ Twitter / Digits OpenID SAML Custom

Configure your Cognito Identity Pool to accept users federated with your Cognito User Pool by supplying the User Pool ID and App client ID.

User Pool ID
ex: us-east-1_Ab129faBb

App client id
ex: 7lhkkfbfb4q5kpp90urfao

30. Click **Create Pool**. While creating the identity pool, Cognito helps setup two roles in Identity and Access Management (IAM). The example format for the names are: `Cognito_<Identity_Pool_Name>Auth_Role` and `Cognito_<Identity_Pool_Name>Unauth_Role`. Click **View Details** to see details on the console.

Figure 5-29. Roles Setup

▼ Hide Details

Role Summary ⓘ

Role Description Your authenticated identities would like access to Cognito.

IAM Role

Role Name

▶ View Policy Document

Role Summary ⓘ

Role Description Your unauthenticated identities would like access to Cognito.

IAM Role

Role Name

▶ View Policy Document

31. Click **Allow** to create the roles.

32. The user needs to attach a policy to the authenticated role to setup permissions to access the required AWS IoT APIs.
 - 32.1. Create the IAM Policy shown as follows in the IAM Console and attach it to the authenticated role.
 - 32.2. Search for the pool name in the IAM console which was created, and click the link for the auth role.
 - 32.3. Click **Attach Policies** and add the following policy using the JSON tab.
 - 32.4. Click **Review Policy** and give the policy a descriptive name.
 - 32.5. Click **Create Policy**. This policy allows the sample app to create a new certificate (including private key) and attach a policy to the certificate.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "iot:AttachPrincipalPolicy",
        "iot:CreateKeysAndCertificate"
      ],
      "Resource": [
        "*"
      ]
    }
  ]
}
```

Add "AmazonDynamoDBFullAccess" policy to authenticated role.

5.5 Amazon DynamoDB Setup

DynamoDB Table is used to store the user account ID, Device Thing ID and the device name. The Mobile App saves this information to the DynamoDB table during the process of board registration. The information in this table is for the Alexa voice control feature. When the user speaks to an Alexa Enabled device (for example, Echo dot), Alexa Cloud sends directives to the Lambda function in the AWS account, and the Lambda function scans this table to control the corresponding Thing Shadow.

Steps:

1. Click <https://console.aws.amazon.com/dynamodb>.
2. Click **Create Table**.
3. Enter *SensorBoardAcctTable* in the "Table name" field, and *thingID* (String) in the "Primary key" field.

Figure 5-30. Creating a DynamoDB Table

Create DynamoDB table Tutorial ?

DynamoDB is a schema-less database that only requires a table name and primary key. The table's primary key is made up of one or two attributes that uniquely identify items, partition the data, and sort data within each partition.

Table name* ? ← Set table name to *SensorBoardAcctTable*

Primary key* Partition key

String ? ← Set Primary key to *thingID*

Add sort key

5.6 AWS Lambda Setup

Lambda functions are needed to process the directives received from Alexa Skills. There are two Alexa Skills for the Wi-Fi Smart Device Enablement Kit (Microchip Wi-Fi Smart Device Smart Home Skill and Microchip Sensor Board Skill). Each Alexa Skill needs one Lambda function for processing the directives. Details of the skills are described in [4.3.6 Alexa Voice Control](#).

5.6.1 Lambda Setup for Microchip Wi-Fi Smart Device Smart Home Skill

Lambda function code for this Smart Home Skill is available in the `\lambda-function\alex-smart-home-skill` directory.

Perform the following steps to set up Lambda for Microchip Wi-Fi Smart Device Smart Home Skill:

1. Go to AWS Lambda Console in AWS cloud <https://console.aws.amazon.com/lambda>.
2. Click **Create Function**.
3. Select "Author from scratch" and fill in the following:
 - 3.1. A name for the Lambda function. For example: "WiFi-Smart-Device-Kit-Smart-Home-Skill".
 - 3.2. Select "Node.js 6.10" from the "Runtime" drop down.
4. Select a role for the Lambda function from the "Roles" field (user can create a Role in IAM console, the role must have "AWSLambdaFullAccess" and "CloudWatchLogsFullAccess" policy). The following figure shows the "lambda_basic_execution" role.
5. Go to IAM console, select "Roles" and select "lambda_basic_execution" role. Attach policy "AWSLambdaFullAccess" and "CloudWatchLogsFullAccess".

Figure 5-31. Creating a Lambda Function

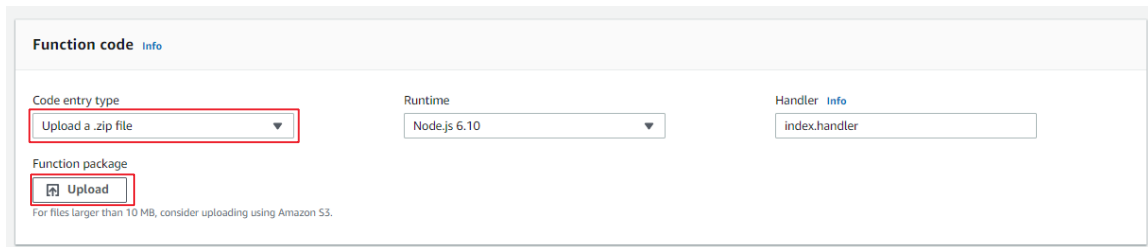
The screenshot shows the 'Create function' page in the AWS Lambda console. At the top, there are three options: 'Author from scratch' (selected), 'Use a blueprint', and 'Browse serverless app repository'. Below this is the 'Basic information' section with the following fields:

- Function name:** WiFi-Smart-Device-Kit-Smart-Home-Skill
- Runtime:** Node.js 6.10
- Permissions:** Choose or create an execution role. The dropdown menu shows 'Use an existing role' selected, and the 'Existing role' dropdown shows 'lambda_basic_execution'.

At the bottom right, there are 'Cancel' and 'Create function' buttons.

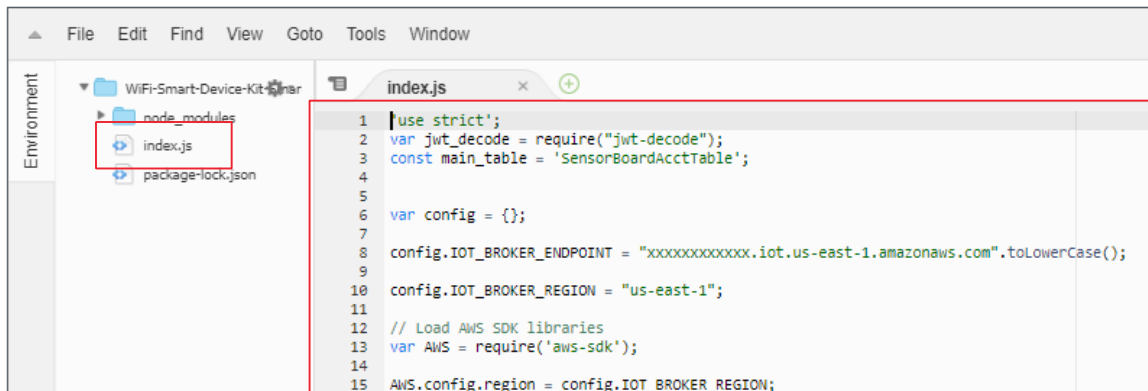
- After creating the Lambda function, upload the function code to the Lambda function. As the function code includes a number of files, the user can upload the code as a zip file as explained in the following steps.
 - Select "Upload a .ZIP file" at "Code entry type".
 - Select `\lambda-function\alexa-smart-home-skill\alexa-smart-home-skill.zip` and click **Save**.

Figure 5-32. Uploading a Lambda Function Code



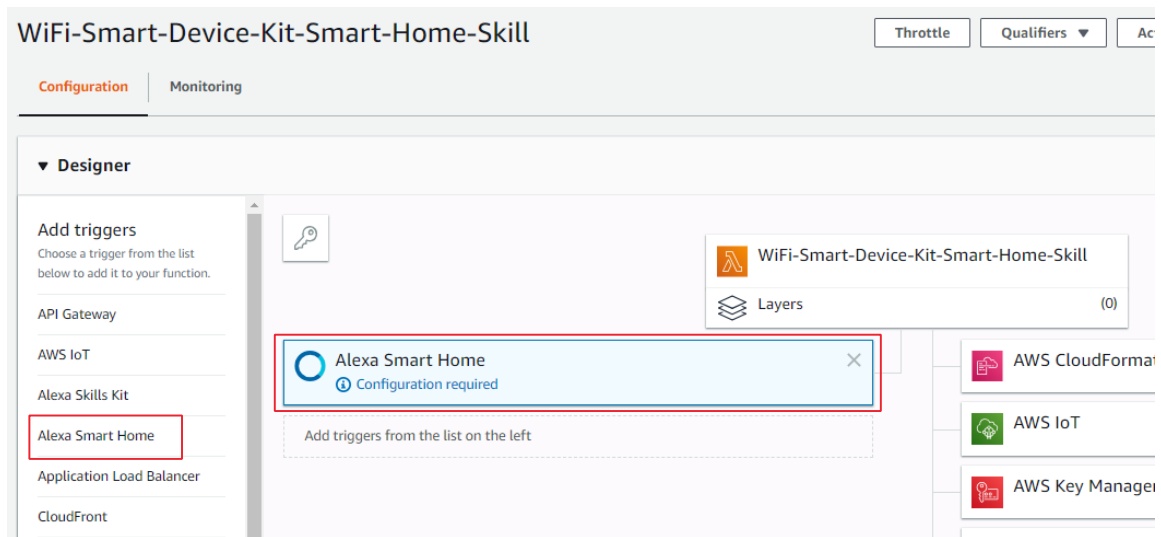
- In "Function code", edit `index.js` to add the AWS IoT Endpoint and the Region. The AWS IoT Endpoint can be found from the Settings page of AWS IoT Console.

Figure 5-33. Editing index.js



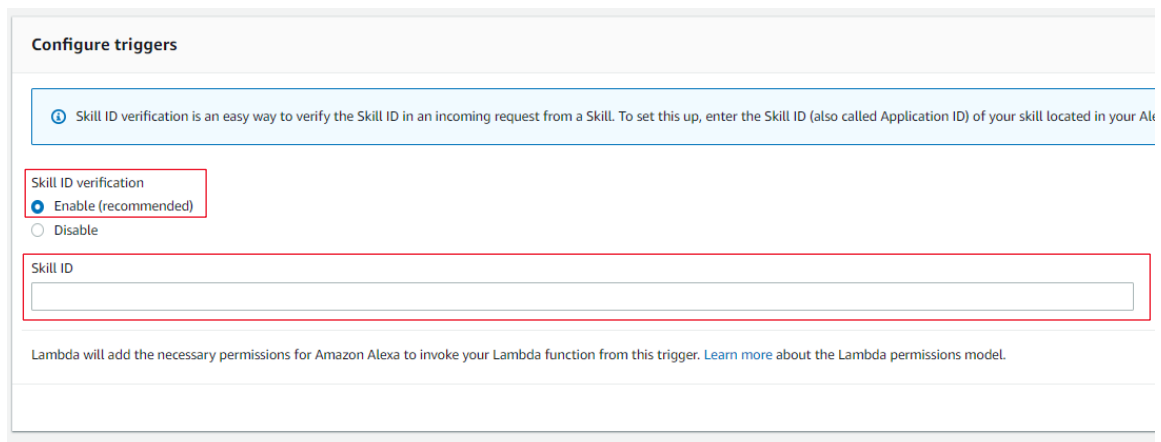
- Add triggers "Alexa Smart Home", as shown in the following figure:

Figure 5-34. Adding Triggers



9. Add the skill ID in “Skill ID” field, and select “Enable” in “Skill ID verification”. Alexa Skill ID can be found in the Alexa Skill configuration page, refer to [7. Alexa Skill Setup](#). User can fill this information later after creating the Alexa skill.

Figure 5-35. Configuring Triggers



10. Click **Save**.

5.6.2 Lambda Setup for Microchip Wi-Fi Sensor Board Skill

Lambda function code for Custom Skill is available in the `\lambda-function\alexa-custom-skill` directory.

Perform the following steps to setup Lambda for Microchip Wi-Fi sensor board skill:

1. Go to AWS Lambda Console in AWS cloud <https://console.aws.amazon.com/lambda>.
2. Click **Create Function**.
3. Select "Author from scratch" and add a name for the Lambda function. The name can be “WiFi-Smart-Device-Kit-Custom-Skill”.
4. Select "Node.js 6.10" for "Runtime".

5. Select a Role for the Lambda function (user can create a Role in IAM, the role must have "AWSLambdaFullAccess" and "CloudWatchLogsFullAccess" policy). In the following figure, "lambda_basic_execution" role is created.
6. Go to IAM console, select "Roles", select "lambda_basic_execution" role. Attach policy "AWSLambdaFullAccess" and "CloudWatchLogsFullAccess" to this role.

Figure 5-36. Creating a Lambda Function for Custom Skill

The screenshot shows the 'Create function' page in the AWS Lambda console. At the top, there are two main options: 'Author from scratch' (selected) and 'Use a blueprint'. Below this is the 'Basic information' section, which includes a 'Function name' field with the value 'WiFi-Smart-Device-Kit-Custom-Skill' and a 'Runtime' dropdown menu set to 'Node.js 6.10'. The 'Permissions' section is expanded to show 'Choose or create an execution role'. Under 'Execution role', the 'Existing role' dropdown is set to 'lambda_basic_execution'. A link below the dropdown reads 'View the lambda_basic_execution role on the IAM console.'

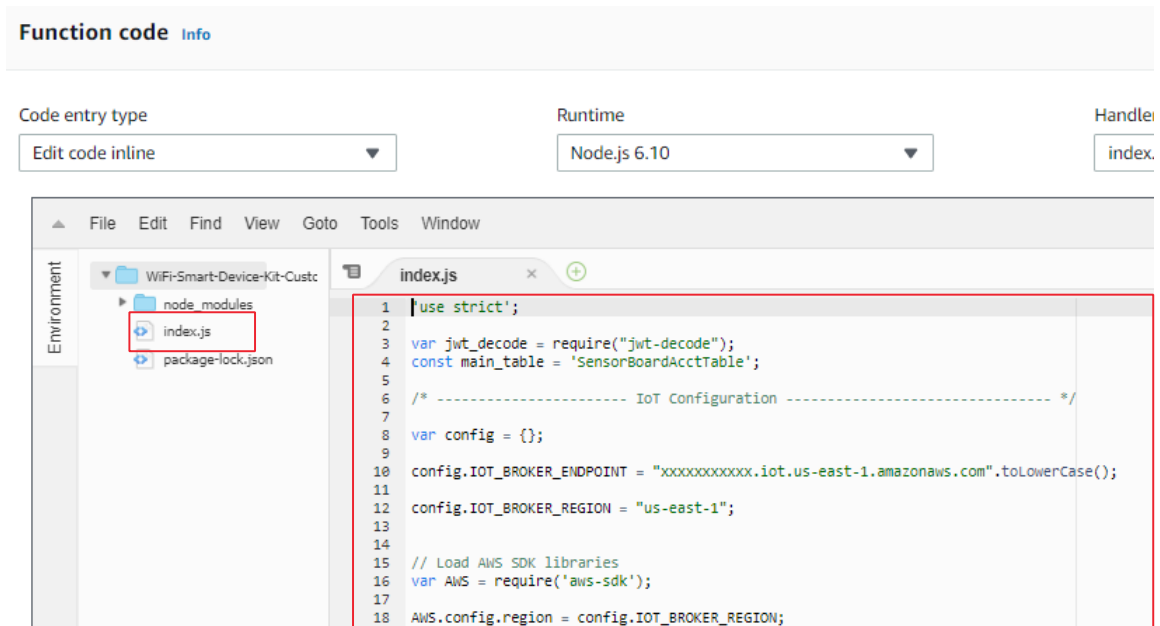
7. After creating the Lambda function, upload the function code to the Lambda function. As the function code includes a number of files, you can upload the code as a zip file.
 - Select "Upload a .ZIP file" at "Code entry type".
 - Select `\lambda-function\alexa-custom-skill\alexa-custom-skill.zip` and click **Save**.

Figure 5-37. Uploading a Lambda Function Code



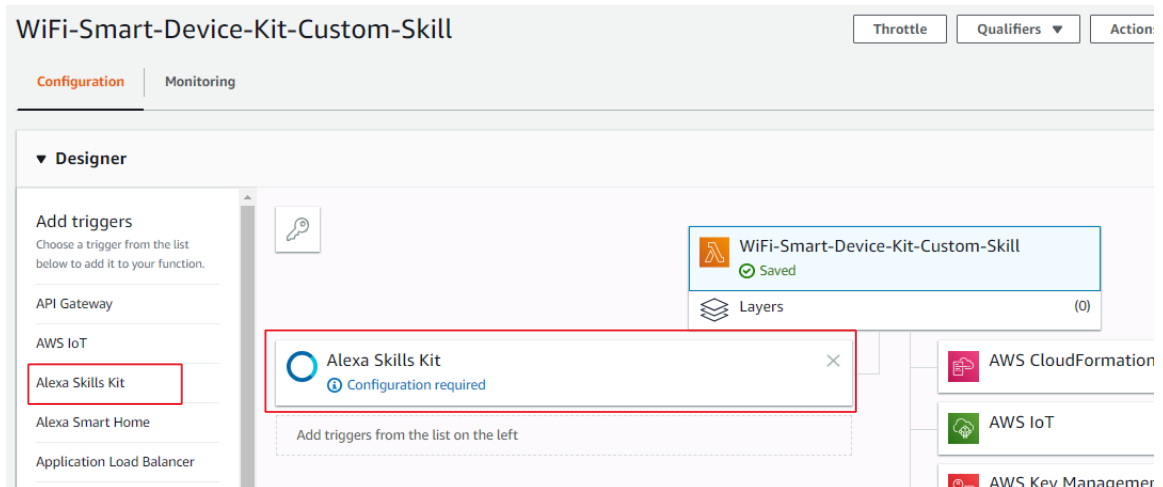
8. In "Function code", edit `index.js` to add the AWS IoT Endpoint and the Region. The AWS IoT Endpoint can be found from the Settings page of AWS IoT Console.

Figure 5-38. Editing `index.js`



9. Add the trigger "Alexa Skill Kit" as shown in the following figure:

Figure 5-39. Adding Triggers



10. Add the Skill ID in the “Skill ID” field, and enable the skill in skill configuration. Alexa Skill ID can be found in Alexa Skill configuration page (refer to 7. [Alexa Skill Setup](#)). The user can fill this information later after creating the Alexa skill.

Figure 5-40. Configuring Triggers

Configure triggers

④ Skill ID verification is an easy way to verify the Skill ID in an incoming request from a Skill. To set this up, enter the Skill ID (also called Application ID) of your skill located in your Alexa Skill configuration page.

Skill ID verification

Enable (recommended)

Disable

Skill ID

Lambda will add the necessary permissions for Amazon Alexa to invoke your Lambda function from this trigger. [Learn more](#) about the Lambda permissions model.

11. Click **Save**.

6. AWS Provision Setup

The Wi-Fi Smart Device Enablement Kit is pre-programmed with the credentials required to connect and communicate with the Microchip AWS IoT account. The pre-programmed AWS account credentials are lost after re-programming the board. The user needs to migrate the board to connect to the private AWS account for customization. This section shows the steps to provision the board to connect to the private AWS account created in [5. AWS Setup](#).

These are the following steps for the AWS provisioning procedure:

1. Create and register the signer CA to AWS IoT account.
2. Request a Certificate Signing Request (CSR) from the board.
3. Create a device certificate using the CSR and signer CA.
4. Send the device certificate, signer certificate and AWS connection information to the board.

The Python scripts in the [/ProvisionScripts](#) directory are used to perform the above tasks.

Perform the following steps:

1. Open Command Prompt, go to [/ProvisionScripts](#) folder and input the Python command: `python _CreateCertsAndRegister2AWS.py --profile <your-aws-cli-profile name>`
Note: Make sure to install and configure AWS CLI tool with your AWS account (ZTUser). The profile name of your account can be found in `~/.aws/credentials`. The steps to configure AWS CLI can be found in [5.1.4 Configure AWS CLI](#).

This command performs the following tasks:

- 1.1. Creates a certCA (`rootCA.crt`) with its private key (`root-ca.key`, if this one already exists it reuses it)
- 1.2. Creates a signing certificate (`signer-ca.csr`) and its private key (`signer-ca.key`, if this one already exists it reuses it)
- 1.3. The root-ca signs the `signer-ca.csr` and creates `signer-ca.crt`.
- 1.4. This `signer-ca.crt` is then uploaded to the AWS IoT account.
2. Program the firmware of the project `saml21g18b_sensor_board_demo_ECC.atsln` to the board. Refer to [4.1 Application Firmware Compilation Procedure](#) for programming the firmware procedure. Project `saml21g18b_sensor_board_demo_ECC.atsln` is used to perform AWS account provision. The developer needs to program this project code to the board to perform AWS account provision to migrate the board to connect with the private AWS account.
3. LED LD2 on board will blink in yellow color.
4. Open Command Prompt, go to [/ProvisionScripts](#) folder and input the `_Commission_WiFi_ECC_2AWS.py` Python command, enter SSID and password. This command performs the following tasks:
 - 4.1. Script commission the ECC608 with SSID and password for the Wi-Fi connection.
 - 4.2. Script request the ECC608 to generate a signing certificate (with its private key remaining private in the ECC).
 - 4.3. The script receives the CSR and signs it with the signer-ca private key.
 - 4.4. Script sends it back to the ECC608 that stores it.
5. Program the firmware of the project `saml21g18b_sensor_board_demo_JITR.atsln` to the board.

Figure 6-1. Console Log

```
C:\github\aws-iot-winc1500-secure-wifi-board-included-source-files\ProvisionScripts>python _Commission_WiFi_ECC_2AWS.py
--ssid demo_AP --password 5F79C0ED

Opening AWS Zero-touch Kit Device

Initializing Kit
ATECC508A SN: 01231F45F9F9CE19EE

Setting WiFi Information

Done setting WiFi

Opening AWS Zero-touch Kit Device

Initializing Kit
ATECC508A SN: 01231F45F9F9CE19EE
ATECC508A Public Key:
X: AF83758E311E0C8EA0D7C26F6999AD22AA95AE230F2F410B82596CFF024D83B0
Y: 12F4265DF1820CC123E2F985E91CAA3D4407EAF5F23809DC68D1E925F79C0ED

Loading root CA certificate
Loading from root-ca.crt

Loading signer CA key
Loading from signer-ca.key

Loading signer CA certificate
Loading from signer-ca.crt

Requesting device CSR
Saving to device.csr

Generating device certificate from CSR
Saving to device.crt

Provisioning device with AWS IoT credentials

Done
```

6. LED LD2 blinks in normal speed at the beginning; this indicates that the board is trying to connect to AP. Then, LED LD2 blinks faster in blue color, this indicates that the board is successfully connected to the AP and gets the IP address. Lastly, LED LD2 turns steady blue, which indicates that the board is successfully connected to the AWS cloud.
7. If commissioning other Sensor Board, follow the above steps (2-6). There is no need to create a new CERT.

7. Alexa Skill Setup

The user needs to create Alexa skills at <https://developer.amazon.com> to use this project. This project supports Smart Home Skill (Microchip Wi-Fi Smart Device Smart Home Skill) and Custom Skill (Microchip Wi-Fi Sensor Board Skill). The following sections show the different settings of these skills.

7.1 Microchip Wi-Fi Smart Device Smart Home Skill Setup

1. To create Alexa Skill, go to Amazon developer website <https://developer.amazon.com/home.html>.
2. Log in with the Amazon developer credentials. If not registered, register and set the credentials.
3. Go to *Alexa > Alexa Skills Kit > Create Skill*.
4. Add “Skill name” as *Wi-Fi Smart Device Smart Home Skill*, choose model as “Smart Home” and click the **Create skill** button.

Figure 7-1. Creating a New Smart Home Skill in Alexa

Create a new skill

Screenshot of the 'Create a new skill' form in the Alexa Developer Console. The 'Skill name' field is highlighted with a red box and contains the text 'Wi-Fi Smart Device Smart Home Skill'. Below it, the 'Default language' dropdown menu is set to 'English (US)'.

Choose a model to add to your skill

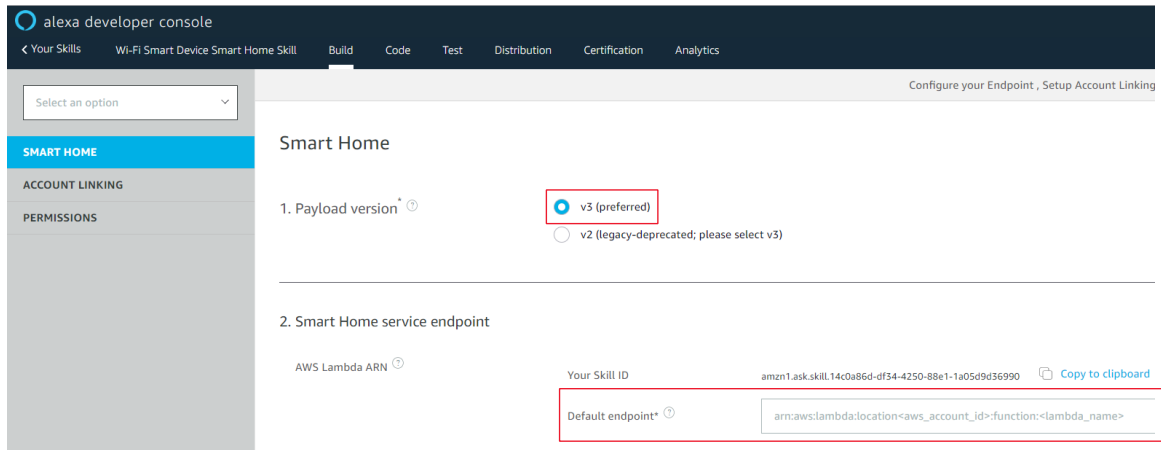
There are many ways to start building a skill. You can design your own custom model or start with a pre-built model. Pre-built models are interaction models that contain a package of intents and utterances that you can add to your skill.

Screenshot of the 'Choose a model to add to your skill' page in the Alexa Developer Console. Four model options are shown: Custom, Flash Briefing, Smart Home, and Music. The 'Smart Home' model is highlighted with a red box and a blue 'SELECTED' banner.

5. In the Smart Home page, choose the following settings:

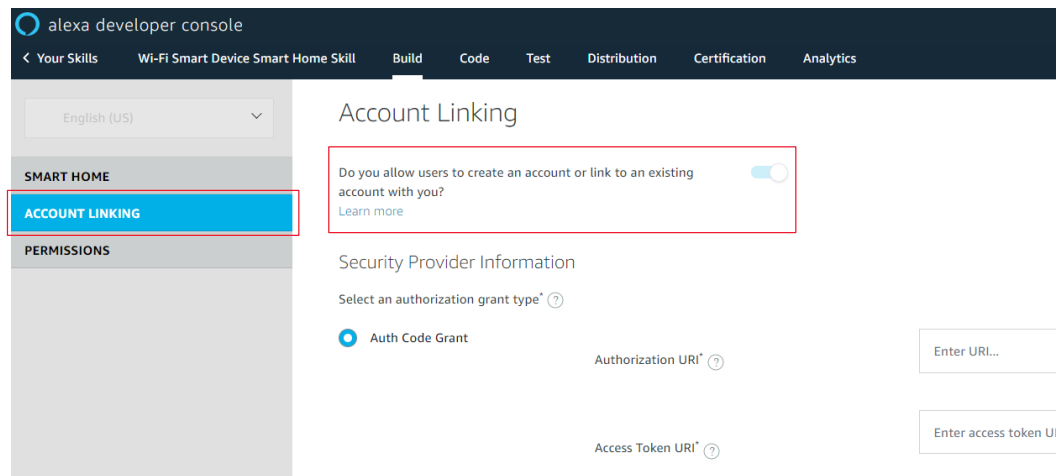
- In “Payload version.”, select v3.
- Fill in AWS Lambda ARN to “Default endpoint*”.
 - The Lambda ARN can be found from the AWS Lambda function settings page (refer to [5.6.1 Lambda Setup for Microchip Wi-Fi Smart Device Smart Home Skill](#)).
 - Click the **Save** button in the upper right corner.
 - **Note:** User needs to perform step 8 and step 9 in [5.6.1 Lambda Setup for Microchip Wi-Fi Smart Device Smart Home Skill](#) before clicking the **Save** button, otherwise, it fails to save the endpoints. The Skill ID can be found in the following screen)

Figure 7-2. Payload Selection and Adding a Default Endpoint



6. Select Account Linking from the left panel. The skill is needed to be linked to the Cognito user pool app client "WiFiSmartDeviceForAlexaSmartHomeSkill" that you set in [5.4 Amazon Cognito Setup](#).
 - To link the account, use the following settings:
 - Authorization URI: `https://<Domain_Name_Of_Cognito_User_Pool>/login`
 - Access Token URI: `https://<Domain_Name_Of_Cognito_User_Pool>/token`
 - Client ID: `<User_Pool_App_Client_ID>`
 - Client Secret: `<User_Pool_App_Client_Secret>`
 - Client Authentication Scheme: HTTP Basic
 - Scope: profile

Figure 7-3. Linking an Account



7. Redirect URLs in the Account Linking page are used as Callback URLs. These URLs must be filled in the Callback URLs of the Cognito user pool app client "WiFiSmartDeviceForAlexaSmartHomeSkill". For more details, refer to [5.4 Amazon Cognito Setup](#).

Figure 7-4. Redirect URLs

Default Access Token Expiration Time ?

Redirect URLs ?

https://alexa.amazon.co.jp/api/skill/link [REDACTED]

https://layla.amazon.com/api/skill/link [REDACTED]

https://pitangui.amazon.com/api/skill/link [REDACTED]

8. Click the **Save** button.
9. Go to **Distribution** tab, enter the following information:
 - “Public Name”: <Your Skill Name>
 - “One Sentence Description”: test
 - “Detailed Description”: test
 - “Example Phrases”: Alexa, set the power to 60% on device
 - Upload Small Skill Icon (108 x 108 pixel)
 - Upload Large Skill Icon (512x512 pixel)
 - “Category”: Smart Home
 - “Keywords”: Sensor
 - “Privacy Policy URL”: <http://microchip.com>
 - “Terms of Use URL”: <http://microchip.com>
10. Click the **Save and continue** button.
11. Go to Privacy & Compliance page and fill the following values:
 - Does this skill allow users to make purchases or spend real money? * - **No**
 - Does this Alexa skill collect users' personal information? * - **No**
 - Is this skill directed to or does it target children under the age of 13? * - **No**
 - Does this skill contain advertising? * - **No**
 - Export Compliance * - tick the check box
 - Testing Instructions * - type **Test**
12. Click the **Save and Continue** button.

Figure 7-5. Privacy & Compliance Page

alex developer console

< Your Skills Wi-Fi Smart Device Smart Home Skill Build Code Test Distribution Certification Analytics

Skill Preview
English (US)

Privacy & Compliance
Gettin' legal with it.

Availability

Does this skill allow users to make purchases or spend real money? *

Yes
 No

Does this Alexa skill collect users' personal information? *

For example: anything that can identify the user such as name, email, password, phone number, birth date, etc.

Yes
 No

Is this skill directed to or does it target children under the age of 13? *

Please indicate if this skill is directed to children under the age of 13 (for the United States, as determined under the Children's Online Privacy Protection Act (COPPA)). Not sure? Learn More.

Yes
 No

Does this skill contain advertising? *

Yes
 No

Export Compliance *

I certify that this Alexa skill may be imported to and exported from the United States and all other countries and regions in which we operate our program or in which you've authorized sales to end users (without the need for us to obtain any license or clearance or take any other action) and is in full compliance with all applicable laws and regulations governing imports and exports, including those applicable to software that makes use of encryption technology.

Testing Instructions *

Please detail any special instructions our team will need in order to test your skill. Include any account or hardware requirements. If your skill requests permissions, include ways to test these permissions requests. This information is NOT displayed to customers.

test

Save and continue

13. In the Availability page, click the **Save and continue** button.
14. With the correct settings and values, Validation page displays “Zero errors found” message.

Figure 7-6. Validation Page

Validation

Functional test

Submission

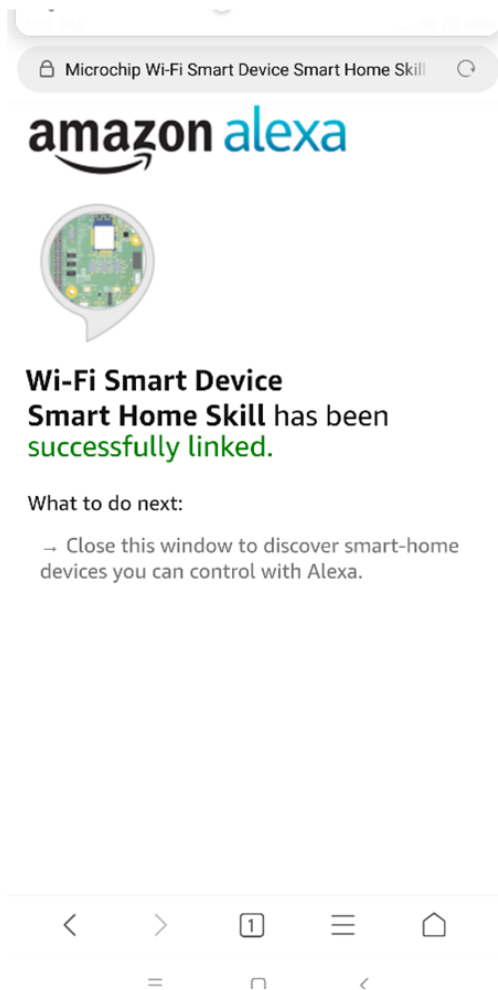
Validation

Zero errors found.

15. Login to the Alexa mobile application with the Alexa account.
 - Alexa mobile application can be download from below link:
 - For Android devices: https://play.google.com/store/apps/details?id=com.amazon.dee.app&hl=zh_HK
 - For iOS devices: <https://itunes.apple.com/us/app/amazon-alexa/id944011620?mt=8>
16. On the Alexa mobile application, select *Skill* -> *Your Skills*. The Alexa Skill that is created can be found on the application.
17. Enable the skill by logging in with Cognito user account.

18. The user can see following message on the application if the skill is successfully enabled and linked to Amazon Cognito.

Figure 7-7. Mobile App Window



7.2 Microchip Wi-Fi Sensor Board Skill Setup

1. To create Alexa Skill, go to Amazon developer website <https://developer.amazon.com/home.html>.
2. Log in with the Amazon developer credentials. If not registered, register and set the credentials.
3. Select *Alexa > Alexa Skills Kit > Create Skill*.
4. Add "Skill name" as *WiFi Sensor Board Skill*, choose model as "Custom" and click the **Create skill** button.

Figure 7-8. Creating a New Custom Skill in Alexa

alex developer console

Create a new skill

Skill name

23/50 characters

Default language

English (US) ▾

More languages can be added to your skill after creation

Choose a model to add to your skill

There are many ways to start building a skill. You can design your own custom model or start with a pre-built model. Pri

Custom

Design a unique experience for your users. A custom model enables you to create all of your skill's interactions.

SELECTED

Flash Briefing

Give users control of their news feed. This pre-built model lets users control what updates they listen to.

"Alexa, what's in the news?"

Smart Home

Give users control of the home devices. This pre-built model lets users turn off the other devices without

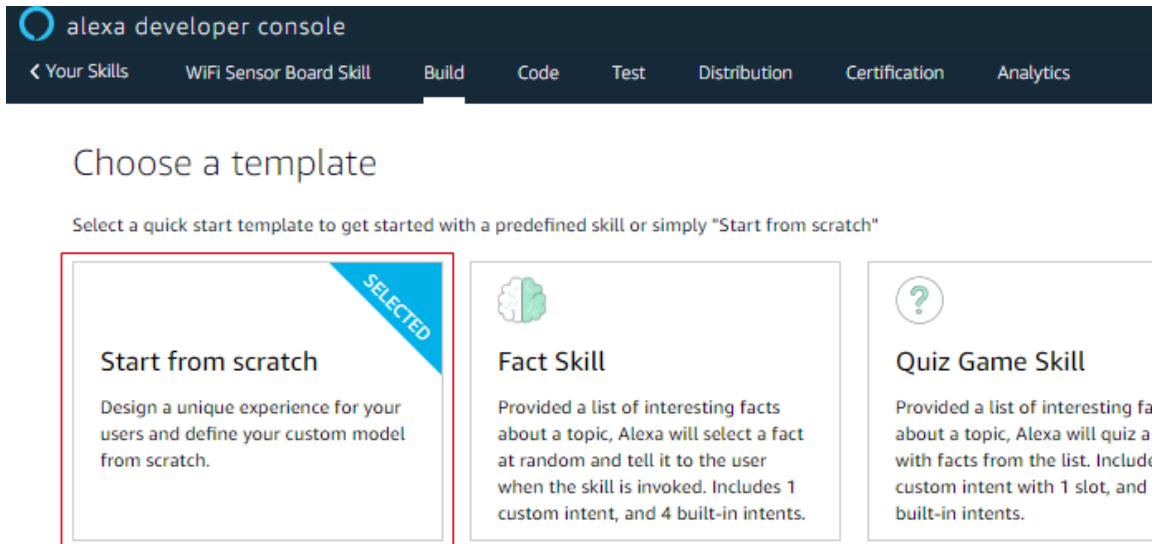
"Alexa, turn on the ki

Choose a method to host your skill's backend resources

You can self host your backend resources or you can have Alexa host it for you. If you decide to have Alexa host your skill console.

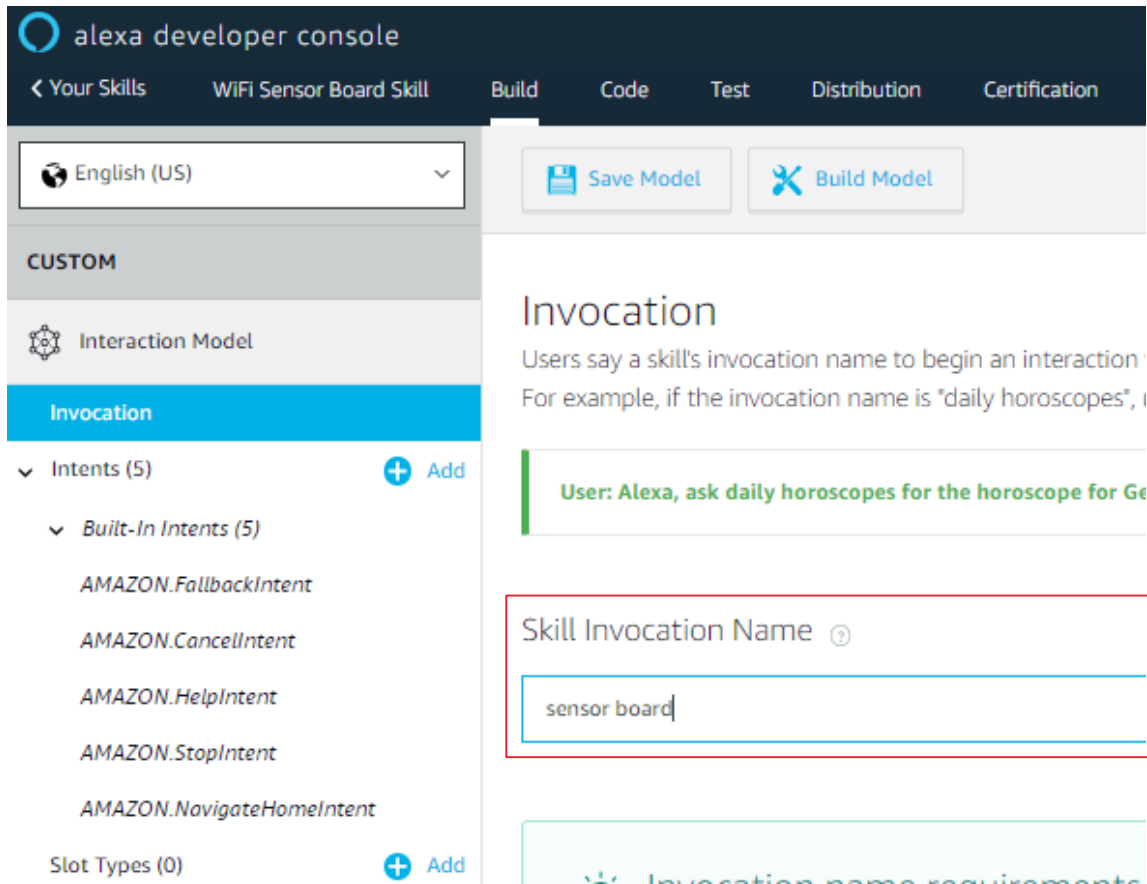
5. In the Custom page, choose the template as "Start from scratch".

Figure 7-9. Choosing Start from Scratch Template



6. Add the "Skill Invocation Name".

Figure 7-10. Skill Invocation Name



7. Go to JSON Editor page, drag and drop the custom skill JSON file from the `alexa-skill1/` folder to JSON Editor.
8. Click **Save Model**.

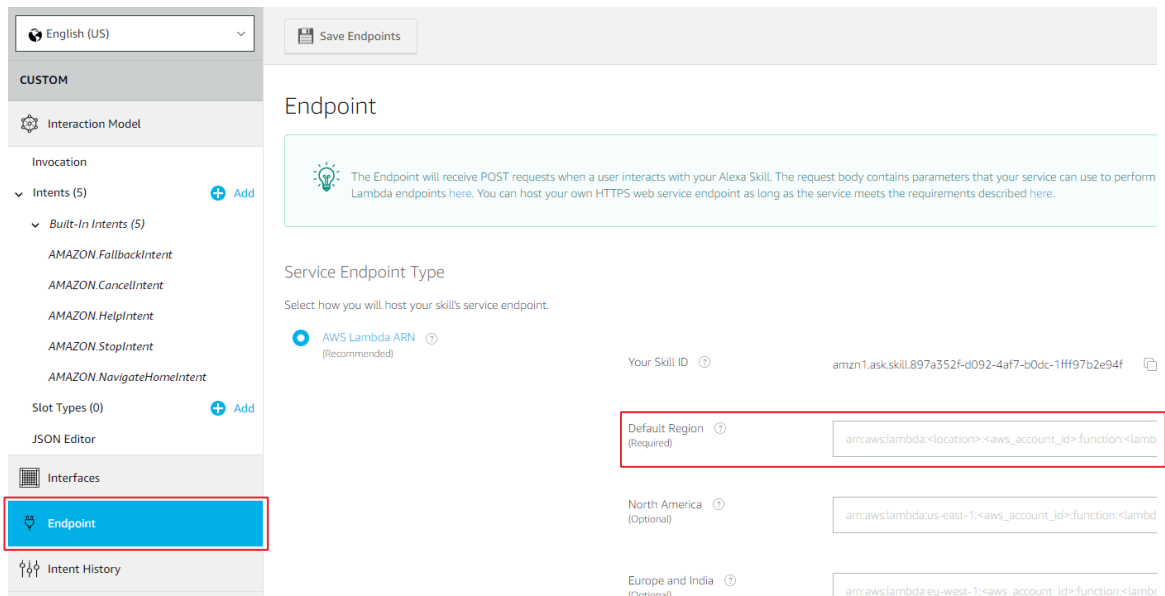
Figure 7-11. Saving the Model

The screenshot shows the Alexa Skill Builder interface. At the top, there is a language selector set to "English (US)" and two buttons: "Save Model" (highlighted with a red box) and "Build Model". Below the language selector is a "CUSTOM" section with a gear icon and "Interaction Model". A list of intents is shown under "Intent (5)", including "AMAZON.FallbackIntent", "AMAZON.CancelIntent", "AMAZON.HelpIntent", "AMAZON.StopIntent", and "AMAZON.NavigateHomeIntent". Below the intents is a "Slot Types (0)" section with an "Add" button. The "JSON Editor" is highlighted with a red box and is active, displaying the following JSON code:

```
1 {
2   "interactionModel": {
3     "languageModel": {
4       "invocationName": "sensor board",
5       "intents": [
6         {
7           "name": "AMAZON.FallbackIntent",
8           "samples": []
9         },
10        {
11          "name": "AMAZON.CancelIntent",
12          "samples": []
13        },
14        {
15          "name": "AMAZON.HelpIntent",
16          "samples": []
17        },
18        {
19          "name": "AMAZON.StopIntent",
20          "samples": []
21        },
22        {
23          "name": "AMAZON.NavigateHomeIntent",
24          "samples": []
25        }
26      ],
27      "types": []
28    }
29  }
```

9. Go to Endpoint page, fill the following Default Region:
 - AWS Lambda ARN – the Lambda ARN can be found from the AWS Lambda function setting page in [5.6.1 Lambda Setup for Microchip Wi-Fi Smart Device Smart Home Skill](#).
10. Default Region
11. Click **Save Endpoints**.

Figure 7-12. Saving Endpoints

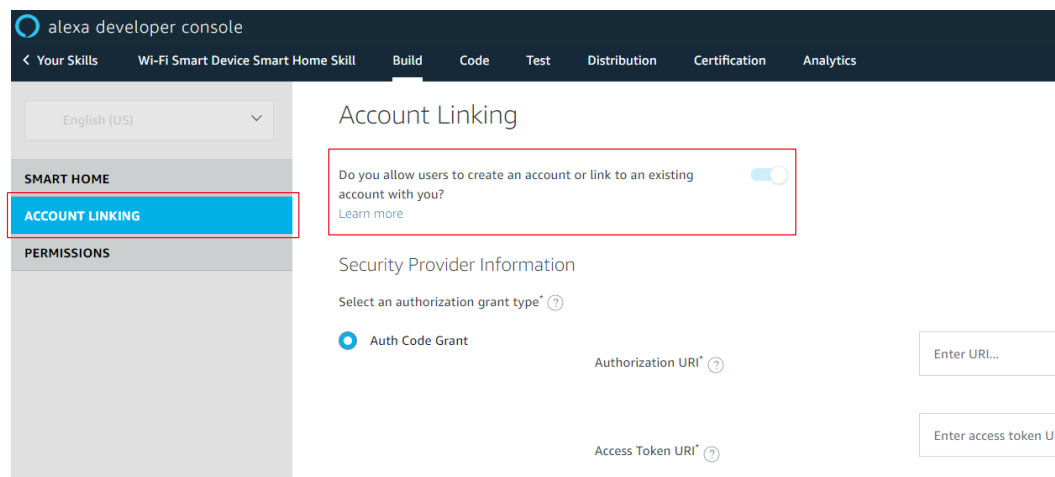


12. Go to Account Linking page and enable the Account Linking. The Skill must be linked to the Cognito user pool app client `Wi-Fi-Smart-Device-Smart-Home-Skill`. For more details on the Amazon Cognito user pool app client, refer to [5.4 Amazon Cognito Setup](#).

– To link the account, use the following settings:

- “Authorization URL”: `https://<Domain_Name_Of_Cognito_User_Pool>/login`
- “Access Token URL”: `https://<Domain_Name_Of_Cognito_User_Pool>/token`
- “Client ID”: `<User_Pool_App_Client_ID>`
- “Client Secret”: `<User_Pool_App_Client_Secret>`
- “Client Authentication Scheme”: HTTP Basic
- “Scope”: profile

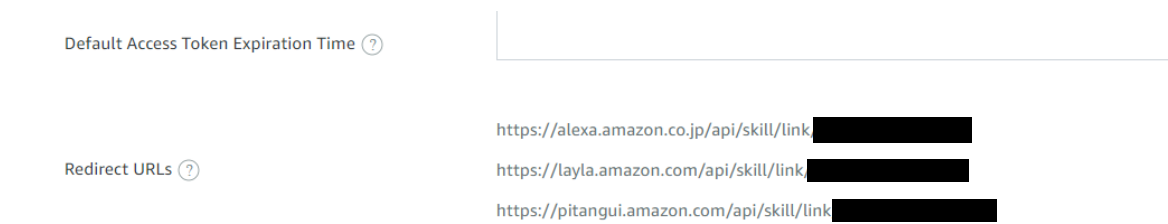
Figure 7-13. Linking an Account



13. Redirect URLs in the Account Linking page are used as Callback URLs. These URLs must be filled in the Callback URLs of the Cognito user pool app client

WiFiSmartDeviceForAlexaSmartHomeSkill. For more details, refer to [5.4 Amazon Cognito Setup](#).

Figure 7-14. Redirect URLs



Default Access Token Expiration Time ?

Redirect URLs ?

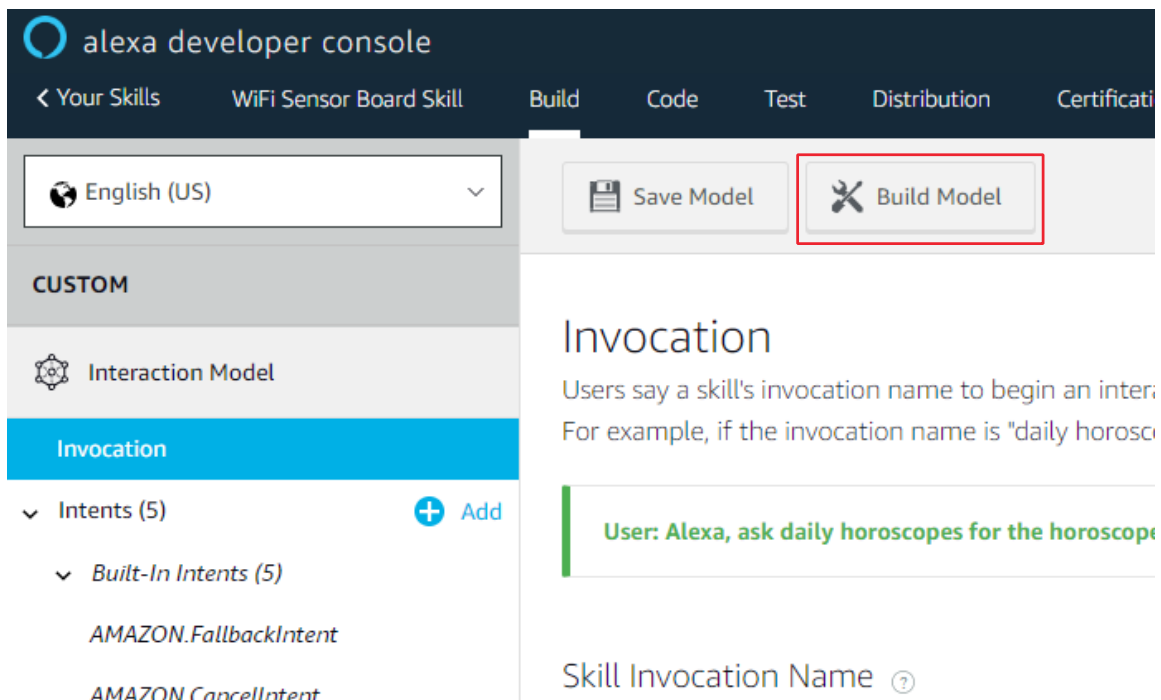
https://alexa.amazon.co.jp/api/skill/link [REDACTED]

https://layla.amazon.com/api/skill/link [REDACTED]

https://pitangui.amazon.com/api/skill/link [REDACTED]

14. Click the **Save** button.
15. Go to **Build** tab, select “Invocation” in the left panel, click **Build Model**.

Figure 7-15. Build Model



16. Go to **Distribution** tab, enter the following information:
17. Click the **Save and continue** button.
 - “Public Name”: <Your Skill Name>
 - “One Sentence Description”: test
 - “Detailed Description”: test
 - “Example Phrases”: Alexa, set the power to 60% on device
 - Upload Small Skill Icon (108 x 108 pixel)
 - Upload Large Skill Icon (512x512 pixel)
 - “Category”: Education & Reference
 - “Keywords”: Sensor
 - “Privacy Policy URL”:<http://microchip.com>
 - “Terms of Use URL”:<http://microchip.com>

- Go to Privacy & Compliance page and fill the following values:
 - Does this skill allow users to make purchases or spend real money? * - **No**
 - Does this Alexa skill collect users' personal information? * - **No**
 - Is this skill directed to or does it target children under the age of 13? * - **No**
 - Does this skill contain advertising? * - **No**
 - Export Compliance * - tick the check box
 - Testing Instructions * - type **Test**
- Click the **Save and continue** button.

Figure 7-16. Privacy & Compliance Page

The screenshot shows the 'Privacy & Compliance' page in the Alexa Skill Setup interface. The page has a dark blue navigation bar at the top with tabs for 'Your Skills', 'WIFI Sensor Board Skill', 'Build', 'Code', 'Test', 'Distribution', 'Certification', and 'Analytics'. The main content area is titled 'Privacy & Compliance' and includes several questions with radio button options. The 'No' option is selected for all questions. A text input field for 'Testing Instructions' contains the word 'test'. A 'Save and continue' button is located at the bottom right.

- In the Availability page, click the **Save and continue** button.
- With the correct settings and values, Validation page displays “Zero errors found” message.

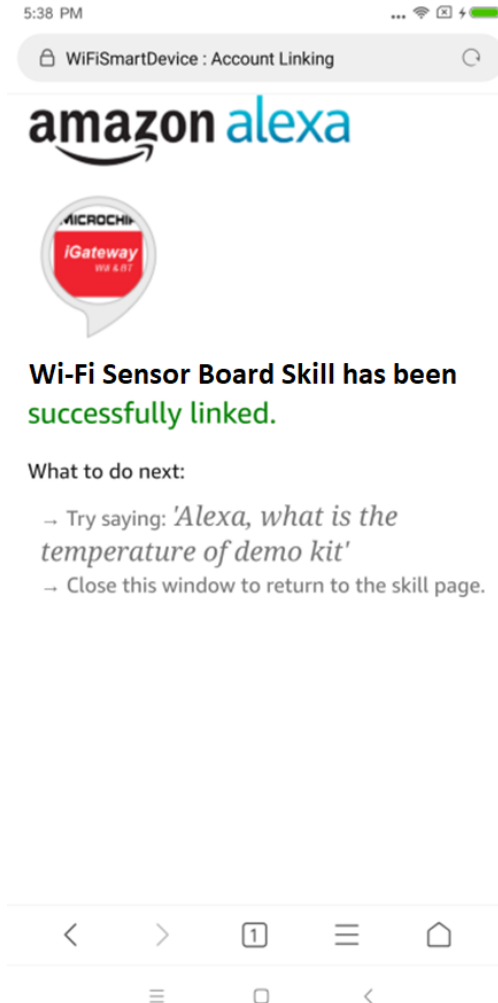
Figure 7-17. Validation Page

The screenshot shows the 'Validation' page in the Alexa Skill Setup interface. The page has a dark blue navigation bar at the top with tabs for 'Validation', 'Functional test', and 'Submission'. The main content area is titled 'Validation' and displays a green checkmark icon followed by the text 'Zero errors found.'

- Log in to your Alexa mobile application with your Alexa account.
 - Alexa mobile application can be downloaded from the link below:

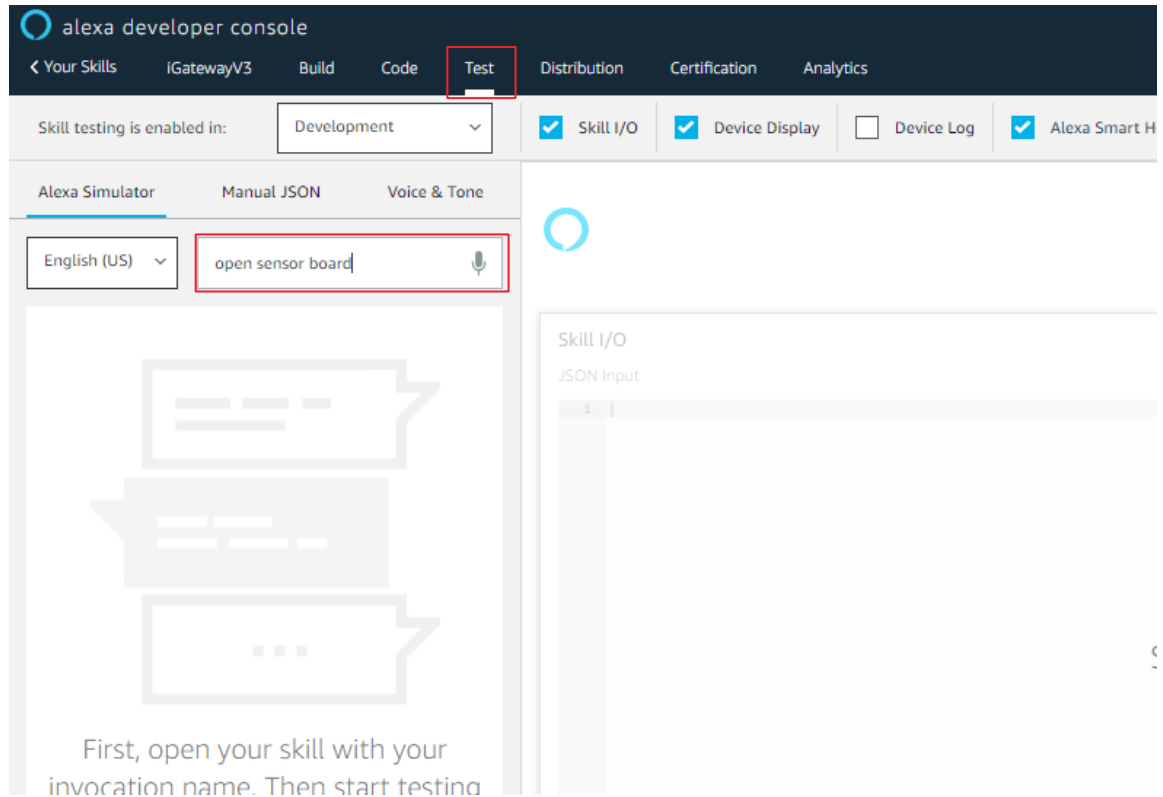
- For Android devices: https://play.google.com/store/apps/details?id=com.amazon.dee.app&hl=zh_HK.
 - For iOS devices: <https://itunes.apple.com/us/app/amazon-alexa/id944011620?mt=8>
23. On the Alexa mobile phone application, select *Skill* -> *Your Skills*.
 24. The Alexa Skill that is created can be found on the application.
 25. Enable the Skill by logging in with Cognito user account.
 26. The user can see following message on the application if the skill is successfully enabled and linked to Amazon Cognito.

Figure 7-18. Mobile App Window



27. Select "Test" in the upper panel and type "open sensor board" to test the skill.

Figure 7-19. Testing the Skill



28. The welcome response sentence, "Welcome to Microchip Sensor board Skill..." is set in the Lambda function. It indicates that the Alexa skill can successfully connect to the Lambda function.

Figure 7-20. Simulator Response

The screenshot displays the Alexa Simulator interface. At the top, it indicates that skill testing is enabled in the 'Development' environment, with checkboxes for 'Skill I/O' and 'Device Display' both checked. The interface is divided into three tabs: 'Alexa Simulator', 'Manual JSON', and 'Voice & Tone'. The 'Alexa Simulator' tab is active, showing a language selection of 'English (US)' and a microphone icon with the text 'Type or click and hold the mic'. A blue speech bubble on the left contains the text: 'Welcome to Microchip Sensor board Skill. This skill is used to control and get the sensor data from WINC1500 Secure Wi-Fi Board showed in Microchip Master workshop'. A grey speech bubble on the right contains the text: 'open sensor board'. On the right side of the simulator, a blue speech bubble contains the text: 'Welcome to Microchip Sensor'. Below this, the 'Skill I/O' section shows the 'JSON Input' with a pre-formatted JSON object:

```
1 {
2   "version": "1.0",
3   "session": {
4     "new": false,
5     "sessionId": "amzn1.",
6     "application": {
7       "applicationId":
8     },
9     "attributes": {
10      "Session": "New
11    },
12    "user": {
13      "userId": "amzn1
```

8. Appendix A: Software Installation

The developer needs to install these software/tools for Wi-Fi Smart Device Enablement Kit firmware development or cloud configuration:

8.1 Atmel Studio 7

Install Atmel Studio 7 to compile the firmware project files in the `mcu-firmware/` folder. Download the installation file from: <http://www.microchip.com/mplab/avr-support/atmel-studio-7>

8.2 SAM Boot Assistance (SAM-BA)

Install SAM-BA V2.18 to program the firmware with boot-loader over the USB port. Download the installation file from: <https://www.microchip.com/developmenttools/ProductDetails/atmel%20sam-ba%20in-system%20programmer>

After installation, the developer needs to configure the GUI with the following steps to make it work with the ATWINC15x0 Secure Wi-Fi Board:

1. Copy the folder `saml21_wsenbrd\` to `C:\Program Files (x86)\Atmel\sam-ba_2.18\tcl_lib` from the release package.
2. Rename `boards.tcl` to `boards_old.tcl` in `C:\Program Files (x86)\Atmel\sam-ba_2.18\tcl_lib`.
3. Copy `boards.tcl` in `sam-ba` folder to `C:\Program Files (x86)\Atmel\sam-ba_2.18\tcl_lib`.

8.3 Python 3.6.x

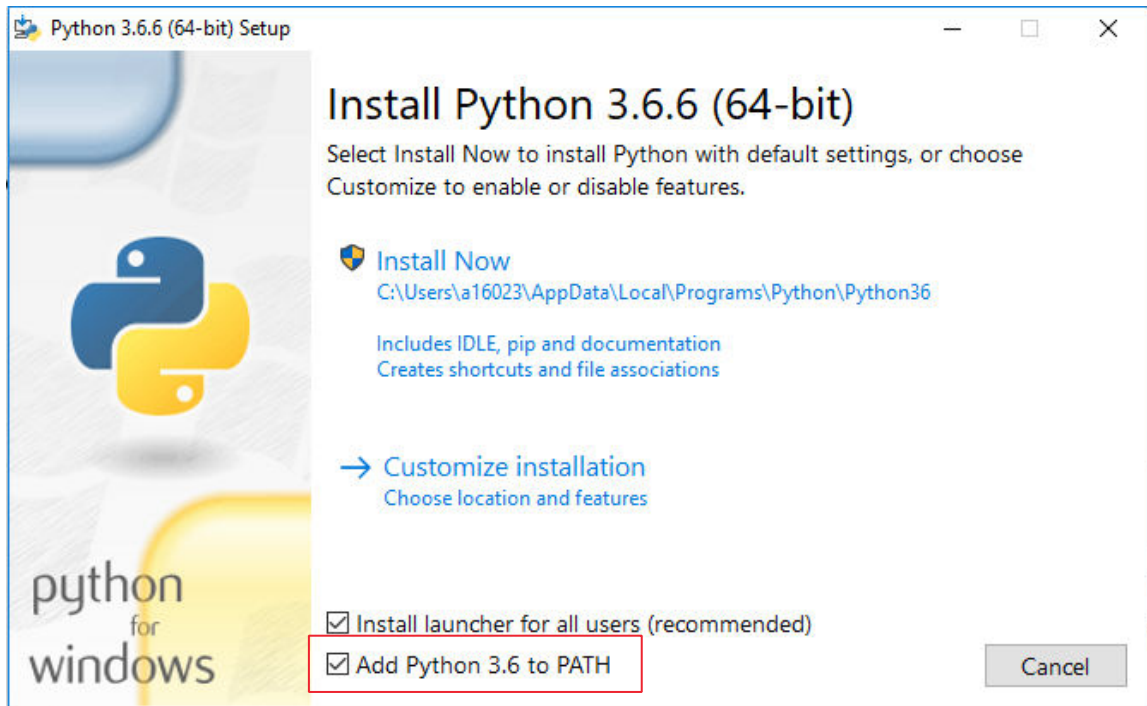
The user needs to use Python scripts to provision the Secure Wi-Fi Board to the network and the board to the user account. The user can view the Python scripts to see the detailed steps involved. Download the installation file from: <https://www.python.org/downloads/release/python-366/>

Note: Python 3.7.x and Python 2.x are not supported.

Perform the following steps for installation:

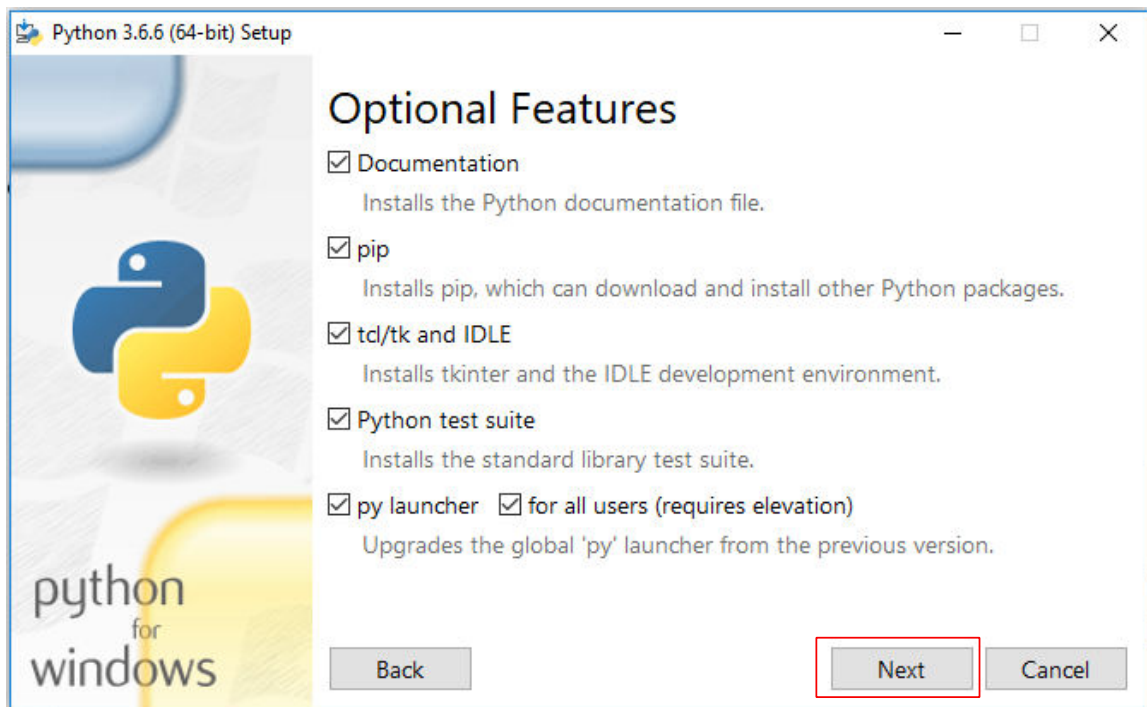
1. When installing Python 3.6.x, select 'Add Python 3.6 to PATH'.

Figure 8-1. Adding the Path



2. Choose 'Customize Installation' and make sure everything is selected.
3. Click **Next**.

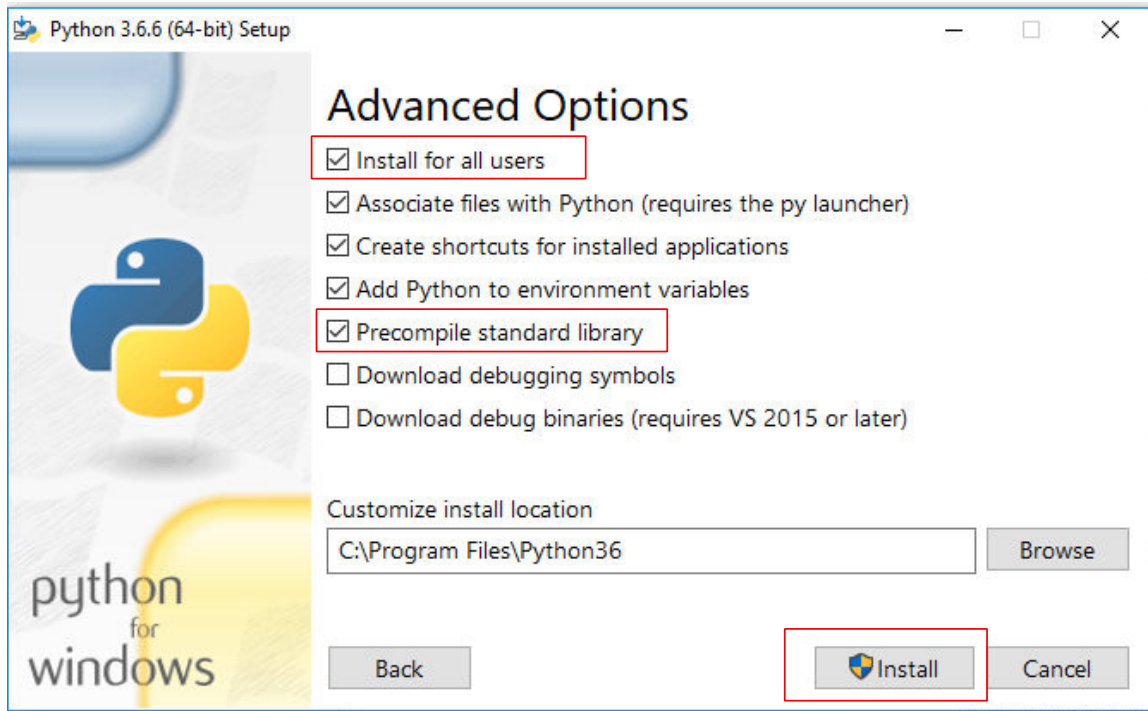
Figure 8-2. Customizing Installation



4. Select "Install for all users" and "Precompile standard library".

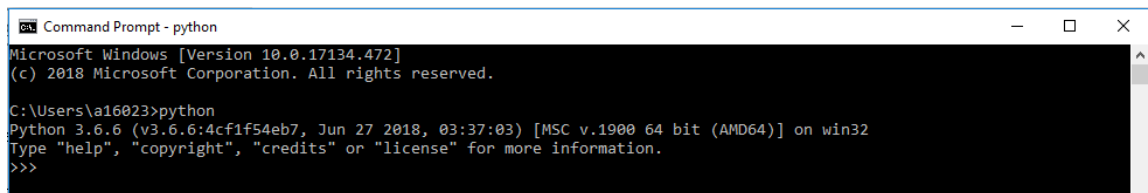
5. Click **Install**.

Figure 8-3. Installation Setup



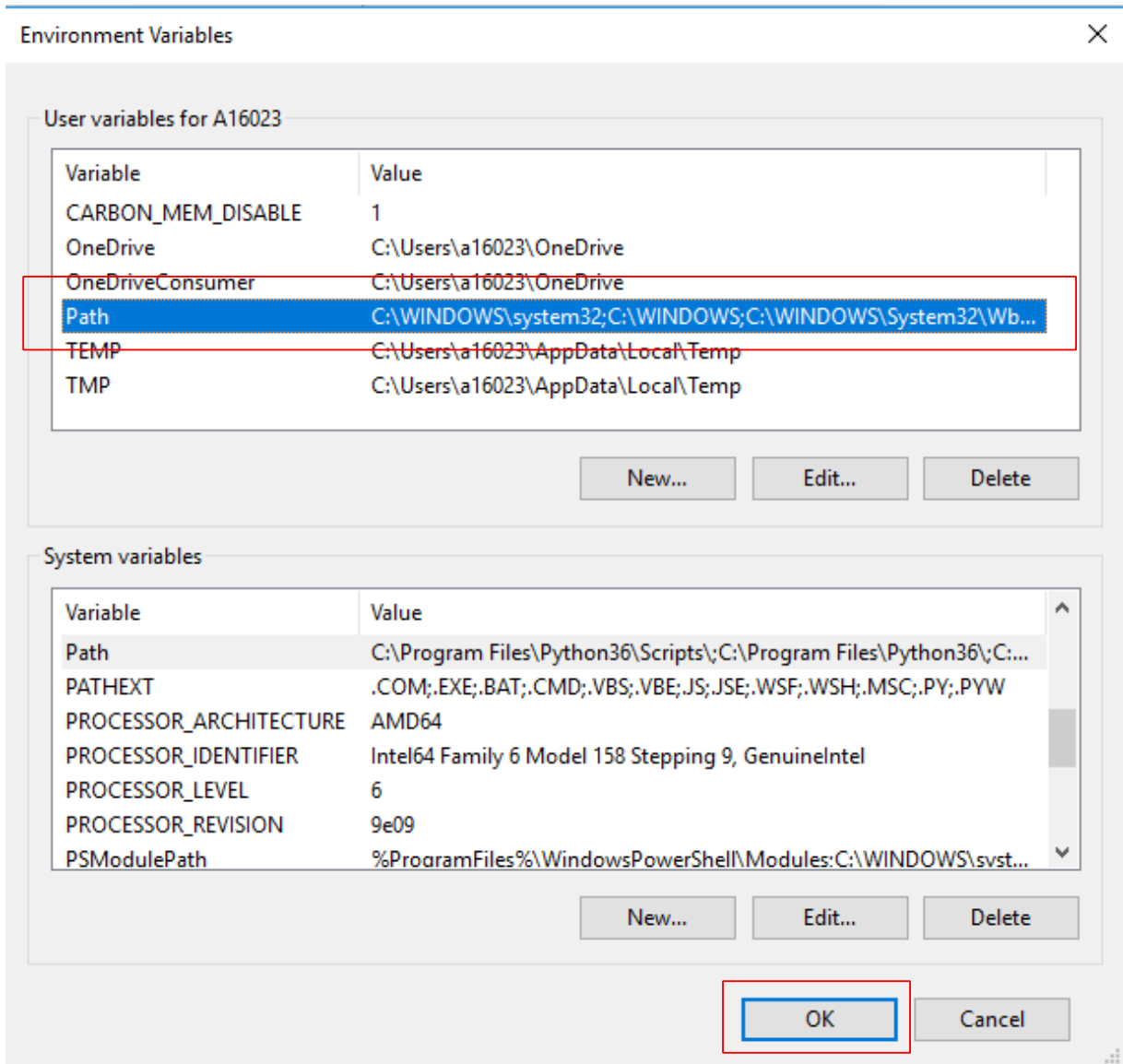
6. After the successful installation, the user needs to ensure that the PC is using the correct Python version. Check it by typing “python” on Windows Command Prompt.

Figure 8-4. Python Version on the Command Prompt



7. For Windows PC, if the Python version is not correct, the user can check if only Python 3.6 is added in the Environment Variable Path. Remove other Python tools which are added to the Environment Variable Path.
8. To check the Environment Variable, press the <Windows key>.
9. Go to *System > Advanced system settings*.
10. In the **Advanced** tab, click **Environment Variables...** and select the Path under “User variables” and “System variables.”
11. Click **OK**.

Figure 8-5. Setting Up the Path Variable



8.4 Python Package Manager

Perform the following steps to use Python Package Manager (PyPM) to install the required packages:

1. Locate `requirements.txt` in the `/ProvisionScripts` directory.
2. Open the Start menu and search for 'cmd.'
3. Right-click on 'Command Prompt' and select 'Run as Administrator.'
4. In command prompt, navigate to the directory and run the following command: `pip install -r requirements.txt`.

9. Appendix B: Mobile Application Configuration

9.1 Android Application

The mobile application source files are available in the `/mobile-app/android` directory of the [release package](#).

The developer needs to configure the mobile application to connect to the AWS account. For this purpose, change the default value in `/src/com/amazonaws/mchp/awsprovisionkit/utils/ConfigFileConstant.java` directly in the mobile application source files and compile to build the apk file.

The file contains the fields below. The developer can get all these settings in the AWS account after the AWS cloud setup.

```
//=====
// User need to set below parameters to your AWS account credentials
//=====

public static final String CUSTOMER_SPECIFIC_ENDPOINT_DEFAULT_VAL = "xxxxxx.us-
east-1.amazonaws.com";
public static final String COGNITO_POOL_ID_DEFAULT_VAL = "us-east-1:xxx-xxxxx-xxxx-xx-
xxxxxxxxxx";
public static final String AWS_IOT_POLICY_NAME_DEFAULT_VAL = "xxx"
// e.g. "AWS_IOT_POLICY_NAME";
public static final String AWS_IOT_REGION_DEFAULT_VAL = "xxx" // e.g. "us-east-1";
public static final String COGNITO_USER_POOL_ID_DEFAULT_VAL = "xxx" // "us-
east-1 xxxxxxxx";
public static final String COGNITO_REGION_DEFAULT_VAL = "xxx" // e.g. "us-east-1";
public static final String COGNITO_CLIENT_ID_DEFAULT_VAL = "xxxxxxxxxxxxxxxxxxxxxxxx";
public static final String COGNITO_CLIENT_SECRET_DEFAULT_VAL = "xxxxxxxxxxxxxxxxxxxx";
public static final String DB_TABLE_NAME_DEFAULT_VAL = "SensorBoardAcctTable";
```

Instead of modifying the `ConfigFileConstant.java` file and building the apk, the developer can modify the `config.txt` file in the smartphone after installing the mobile application. The file is located in `/SDCARD/Android/data/com.amazonaws.mchp.awsprovisionkit/files/MyFileStorage/` and contains the fields below.

```
CUSTOMER_SPECIFIC_ENDPOINT=xxx // e.g. xxxx.us-east-1.amazonaws.com
COGNITO_POOL_ID=xxx // e.g. us-east-1:xxxxxx-xxxxxxxx-xxxx-xxxxxxxxxx
AWS_IOT_POLICY_NAME=xxx // e.g. "AWS_IOT_POLICY_NAME";
AWS_IOT_REGION=xxxx // e.g. us-east-1
COGNITO_USER_POOL_ID=xxx // e.g. us-east-1 xxxxxxxxxxxxx
COGNITO_REGION= xxx // e.g. us-east-1
COGNITO_CLIENT_ID=xxxxxxxxxxxxxxxxxxxx
COGNITO_CLIENT_SECRET=xxxxxxxxxxxxxxxxxxxx
```

- **CUSTOMER_SPECIFIC_ENDPOINT**
This is the AWS IoT EndPoint, which can be found in the setting page of AWS IoT console.
- **COGNITO_POOL_ID**
This is the AWS Cognito Identity pool ID after creating the Cognito Identity pool.
- **AWS_IOT_POLICY**
This is the AWS IoT policy name used for the mobile application to access AWS IoT resources.
- **AWS_IOT_REGION**
This is the AWS IoT Region.
- **COGNITO_USER_POOL_ID**

This is the Cognito user pool ID after creating the Cognito user pool.

- **COGNITO_REGION**
This is the Cognito region.
- **COGNITO_CLIENT_ID**
This is the App client ID configured in the Cognito user pool.
- **COGNITO_CLIENT_SECRET**
This is the "WiFISmartDeviceForAlexaSmartHomeSkill" or "WiFISmartDeviceForAlexaCustomSkill" App client secret configured in the Cognito user pool.

9.2 iOS Application

The mobile application source files are available in the `/mobile-app/ios/` directory of the [release package](#).

The developer needs to configure the mobile application to connect to the AWS account. For this purpose, the developer can change the default value in `mobile-app/ios/CognitoYourUserPoolsSample/Constants.swift` directly in the mobile application source files and compile the source code.

The file contains the fields below. The developer can get all these settings in the AWS account after the AWS cloud setup.

```
//=====
// User need to set below parameters to your AWS account credentials
//=====

let CognitoIdentityUserPoolId = "xxxxx" // e.g. "us-east-1_xxxxxx"
let CognitoIdentityUserPoolAppClientId = "xxxxx"
let CognitoIdentityUserPoolAppClientSecret = "xxxxx"
let CognitoRegion = "xxxxx" // e.g. "us-east-1"
let PoolId = "xxxxx" // e.g. "us-east-1:c4f36b6a-84c7-4acd-b143-0665f9fbd9f9"

let AWSRegion = AWSRegionType.USEast1 // e.g. AWSRegionType.USEast1
let IOT_ENDPOINT = "xxxxx" // e.g. "https://xxxxxxx.iot.us-east-1.amazonaws.com"
let PolicyName = "xxxxx" // e.g. "secure-wifi-board-mobile-app-policy"
```

- **IOT_ENDPOINT**
This is the AWS IoT EndPoint, which can be found in the setting page of AWS IoT console.
- **PoolId**
This is the AWS Cognito Identity pool id, which can be retrieved when you create the Cognito Identity pool.
- **PolicyName**
This is the AWS IoT policy name used for the mobile app to access AWS IoT resources.
- **AWSRegion**
This is the AWS IoT Region.
- **CognitoIdentityUserPoolId**
This is the Cognito user pool id after creating the Cognito user pool.
- **CognitoRegion**
This is the Cognito region.
- **CognitoIdentityUserPoolAppClientId**

ATWINC15x0 Smart Device Kit

Appendix B: Mobile Application Configurati...

This is the “WiFISmartDeviceForAlexaSmartHomeSkill” or “WiFISmartDeviceForAlexaCustomSkill” App client ID configured in the Cognito user pool.

- CognitoIdentityUserPoolAppClientSecret

This is the “WiFISmartDeviceForAlexaSmartHomeSkill” or “WiFISmartDeviceForAlexaCustomSkill” App client secret configured in the Cognito user pool.

10. Appendix C: AWS CloudFormation to Setup Cloud

AWS CloudFormation gives developers an easy way to create and manage a collection of related AWS resources by a template code in either YAML or JSON format. Developers can use AWS CloudFormation via browser console or AWS Command Line Interface (CLI). This service allows easy cloud configuration by uploading the template code to cloud rather than creating and configuring the cloud step by step.

In this project, developers can use AWS CloudFormation to create and configure all the AWS resources that are needed for the Wi-Fi Smart Device Enablement Kit. The AWS resources created in this chapter are the same as the resources created in [5. AWS Setup](#).

All the template codes used for AWS CloudFormation can be found in the `cloud-formation-templates\` directory and the template codes are coded in YAML format.

After finishing all the steps in this chapter, developers can successfully set up the AWS Cloud and refer to [6. AWS Provision Setup](#) to provision the Wi-Fi Smart Device Enablement Kit to the AWS Cloud account setup in this chapter. Refer to [7. Alexa Skill Setup](#) to finish the remaining steps to create the Alexa Skills.

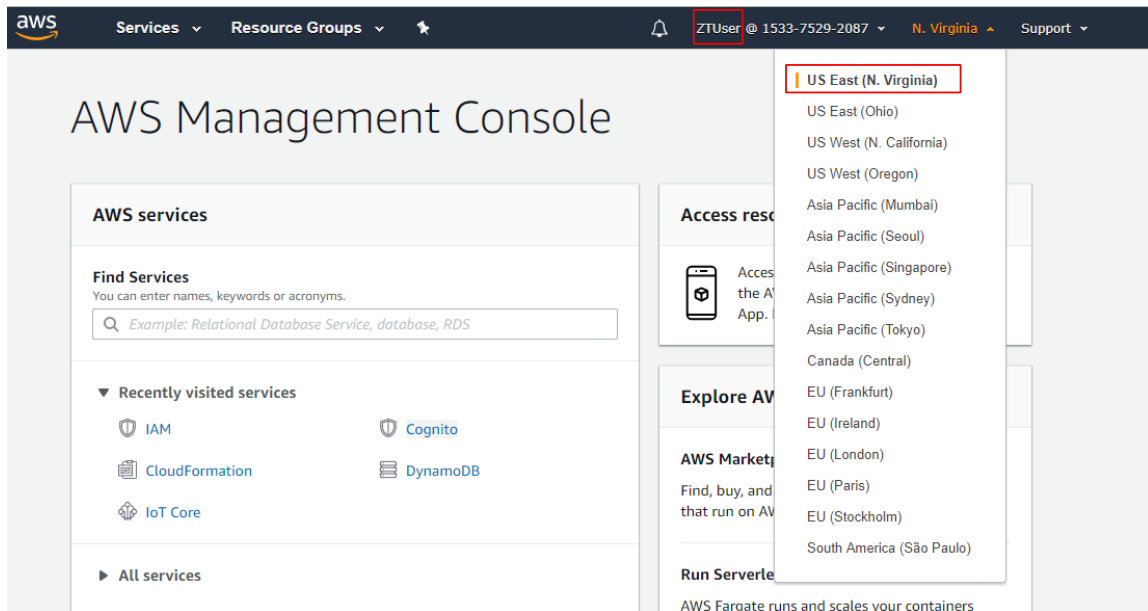
Note:

1. To get the Smart Home Skill ID, perform the steps mentioned in [7.1 Microchip Wi-Fi Smart Device Smart Home Skill Setup](#) and refer to the [Figure 7-2](#).
2. To get the Custom Skill ID, perform the steps mentioned in [7.2 Microchip Wi-Fi Sensor Board Skill Setup](#) and refer to the [Figure 7-2](#).

10.1 Create IAM User for the Project

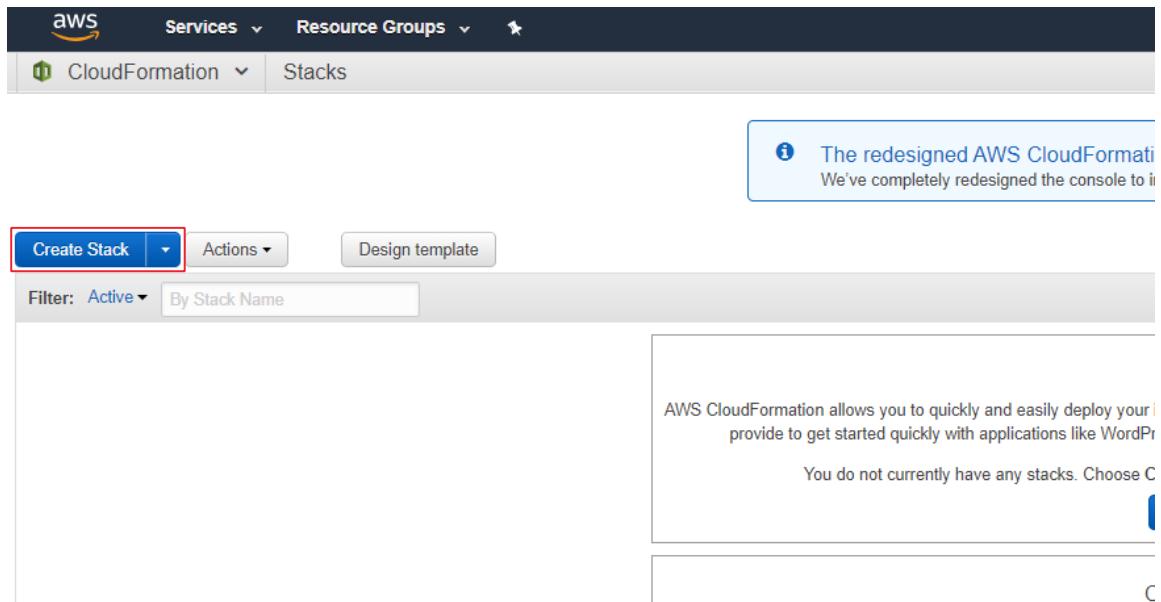
1. After creating the AWS account in [5. AWS Setup](#), go to <https://aws.amazon.com/> and log in to the AWS account with root account credentials.
2. Once logged in, change your region to the one closest to you by selecting the region menu (for example, US East Virginia). Alexa skills support only the following regions:
 - Asia Pacific (Tokyo)
 - EU (Ireland)
 - US East (N. Virginia)
 - US West (Oregon)

Figure 10-1. Selecting the Region



3. Go to <https://console.aws.amazon.com/cloudformation> and click the **Create Stack** drop-down.

Figure 10-2. Creating a Stack



4. Select "Upload a template to Amazon S3" and choose the `\cloud-formation-templates\create_IAM.template.yaml`.

Figure 10-3. Uploading a Template

Select Template

Select the template that describes the stack that you want to create. A stack is a group of related resources that you manage as a single unit.

Design a template Use AWS CloudFormation Designer to create or modify an existing template. [Learn more.](#)

Design template

Choose a template A template is a JSON/YAML-formatted text file that describes your stack's resources and their properties. [Learn more.](#)

Select a sample template

Upload a template to Amazon S3

Choose File No file chosen

Specify an Amazon S3 template URL

5. Click the **Next** button.
6. Enter "Stack name" as *createIAM*.
7. Enter "UserPassword" as *ZTUser*.
8. Click the **Next** button to continue.

Figure 10-4. Stack Name and Parameters

Specify Details

Specify a stack name and parameter values. You can use or change the default parameter values, which are defined in the AWS CloudFormation template. [Learn more.](#)

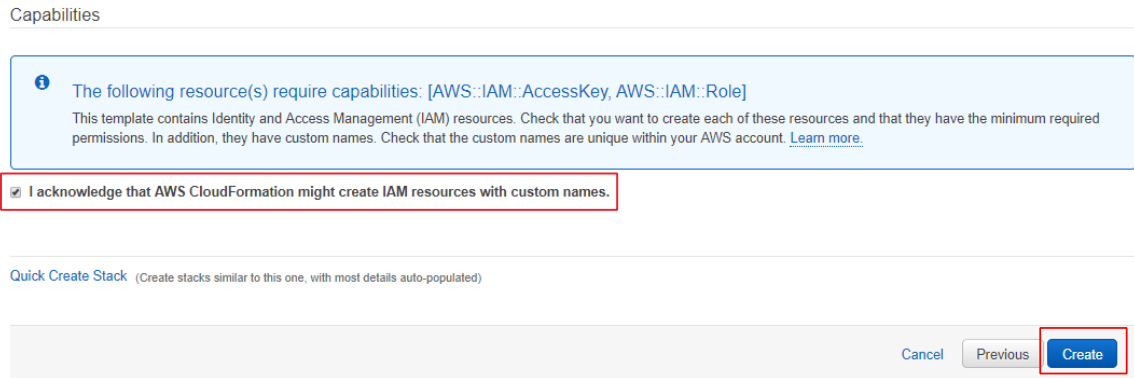
Stack name	<input type="text" value="createIAM"/>
------------	--

Parameters

UserName	<input type="text" value="ZTUser"/>	Username of the account the kit will be run from.
UserPassword	<input type="text" value="xxxxxxxx"/>	Password of the account the kit will be run from.

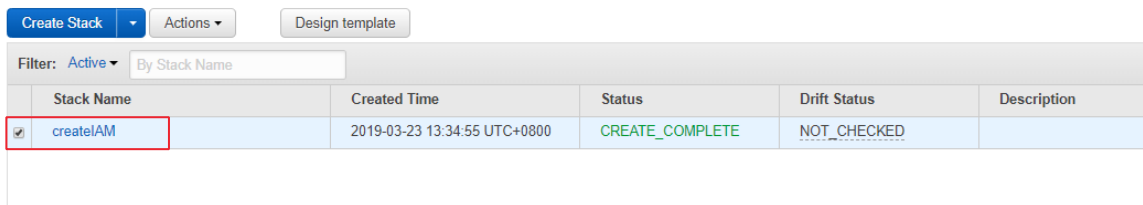
9. Tick the highlighted check box and click the **Create** button.

Figure 10-5. Acknowledgment



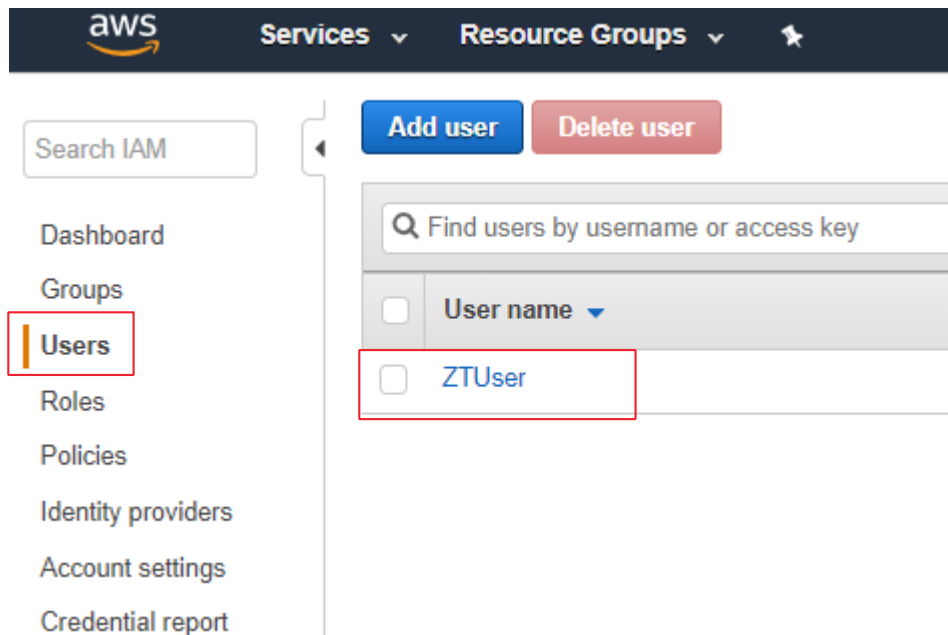
10. After sometime, the status of “createlAM” stack changes to “CREATE_COMPLETE”.

Figure 10-6. Stack Status



11. Go to IAM Console <https://console.aws.amazon.com/iam/>.
12. Select “ZTUser” from the “Users” in the left panel under the User name.

Figure 10-7. User Selection



13. Click ZTUser > Security Credentials. Click the **Create access key** button.

Figure 10-8. ZTUser Security Credentials

Users > ZTUser

Summary

User ARN `arn:aws:iam::153375292087:user/ZTUser` 

Path `/`

Creation time 2019-03-23 13:35 UTC+0800

Permissions

Groups

Tags

Security credentials

Access A

Sign-in credentials

Summary • Console sign-in link: <https://console.aws.amazon.com/>

Console password Enabled (never signed in) | [Manage](#)

Assigned MFA device Not assigned | [Manage](#)

Signing certificates None 

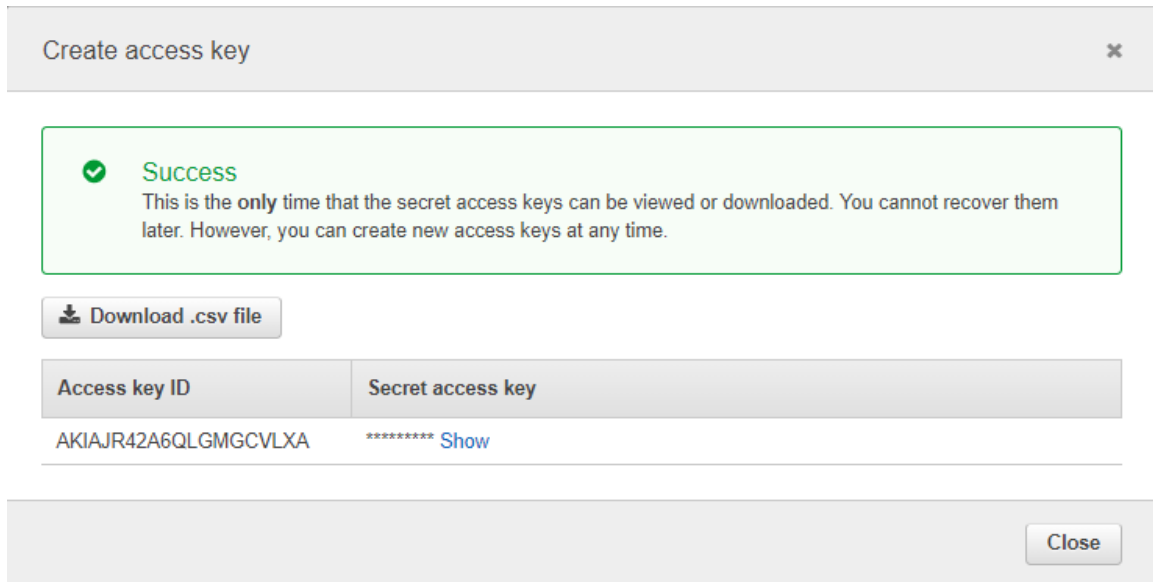
Access keys

Use access keys to make secure REST or HTTP Query protocol requests to AWS. We recommend frequent key rotation. [Learn more](#)

Create access key

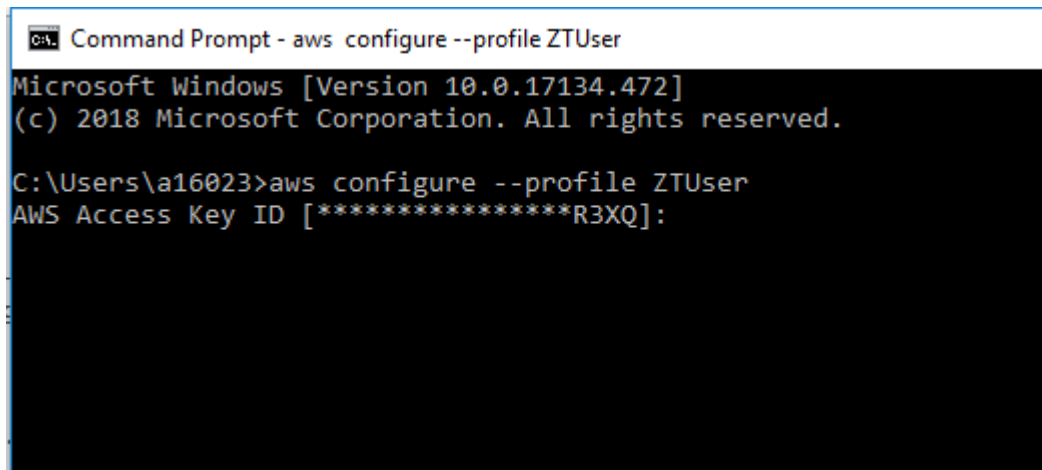
14. "Access key ID" and "Secret access key" are created. Copy the Access key ID and Secret access key for the following configurations.

Figure 10-9. Access Key ID and Secret Access Key



15. Install AWS CLI to your PC by following the steps in [5.1.4 Configure AWS CLI](#).
16. Open Command Prompt and run the following command: `aws configure --profile ZTUser`.
17. Enter the Access Key ID and Secret Access Key of ZTUser account when prompted.

Figure 10-10. Configuring Access Key ID and Secret Access Key



18. Observe the following results.

```
>aws configure --profile ZTUser
AWS Access Key ID [None]: <ACCESSKEYID>
AWS Secret Access Key [None]: <SECRETACCESSKEY>
Default region name [None]: us-east-1 ( <-- Enter the region that you selected )
```

10.2 Create Lambda Functions for Alexa

1. Edit the `\cloud-formation-templates\ createlambdaforalexa.template.yaml` file.

2. Add the Alexa Smart Home Skill ID (Wi-Fi Smart Device Smart Home Skill) from [7.1 Microchip Wi-Fi Smart Device Smart Home Skill Setup](#) in the argument `EventSourceToken`.

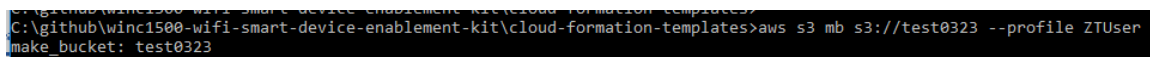
```
CloudFormationLambdaTriggerSmartHomeSkill:
  Type: 'AWS::Lambda::Permission'
  Properties:
    Action: 'lambda:InvokeFunction'
    FunctionName: !Ref CloudFormationLambdaForAlexaSmartHome
    Principal: 'alexa-connectedhome.amazon.com'
    EventSourceToken: 'amzn1.ask.skill.1d6f1f85-bf71-4340-8930-cdexxxxxxxxxxx'
```

3. Add the Alexa Custom Skill ID (Wi-Fi Sensor Board Skill) from [7.2 Microchip Wi-Fi Sensor Board Skill Setup](#) in the argument `EventSourceToken`.

```
CloudFormationLambdaTriggerCustomSkill:
  Type: 'AWS::Lambda::Permission'
  Properties:
    Action: 'lambda:InvokeFunction'
    FunctionName: !Ref CloudFormationLambdaForAlexaCustom
    Principal: 'alexa-appkit.amazon.com'
    EventSourceToken: 'amzn1.ask.skill.1d6f1f85-bf71-4340-8930-cxxxxxxxxxxxxxx'
```

4. Save the file after modification.
5. Open Command Prompt and go to the `\cloud-formation-templates\` directory. Run the command: `aws s3 mb s3://<YOUR BUCKET NAME> --profile ZTUser`.
Note: Ensure that the bucket name must be unique across all existing bucket names in Amazon S3 and must not contain uppercase or space characters.

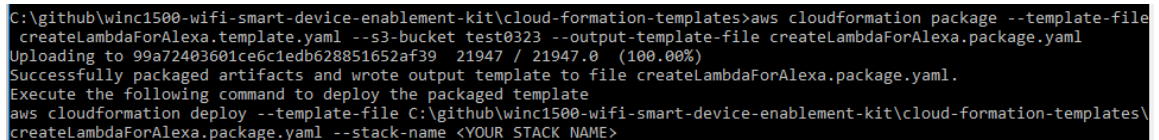
Figure 10-11. Console Log



```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws s3 mb s3://test0323 --profile ZTUser
make_bucket: test0323
```

6. Run command: `aws cloudformation package --template-file createLambdaForAlexa.template.yaml --s3-bucket <YOUR BUCKET NAME> --output-template-file createLambdaForAlexa.package.yaml`.

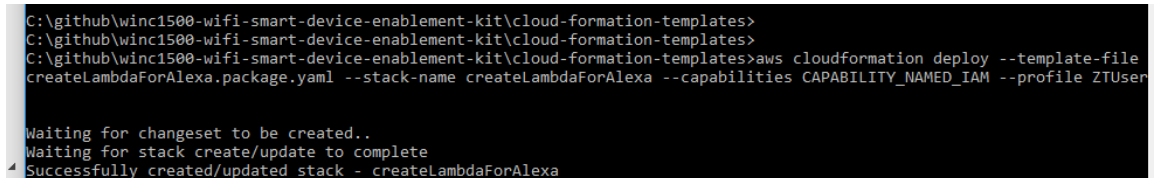
Figure 10-12. Console Log



```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation package --template-file
createLambdaForAlexa.template.yaml --s3-bucket test0323 --output-template-file createLambdaForAlexa.package.yaml
Uploading to 99a72403601ce6c1edb628851652af39 21947 / 21947.0 (100.00%)
Successfully packaged artifacts and wrote output template to file createLambdaForAlexa.package.yaml.
Execute the following command to deploy the packaged template
aws cloudformation deploy --template-file C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates\
createLambdaForAlexa.package.yaml --stack-name <YOUR STACK NAME>
```

7. Run command: `aws cloudformation deploy --template-file createLambdaForAlexa.package.yaml --stack-name createLambdaForAlexa --capabilities CAPABILITY_NAMED_IAM --profile ZTUser`.

Figure 10-13. Console Log



```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation deploy --template-file
createLambdaForAlexa.package.yaml --stack-name createLambdaForAlexa --capabilities CAPABILITY_NAMED_IAM --profile ZTUser

Waiting for changeset to be created..
Waiting for stack create/update to complete
Successfully created/updated stack - createLambdaForAlexa
```

8. Go to <https://console.aws.amazon.com/cloudformation> to find the Stack “createLambdaForAlexa”.

Figure 10-14. Status of createLambdaForAlexa

Stack Name	Created Time	Status	Drift Status	Description
createLambdaForAlexa	2019-03-23 14:23:16 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createIAM	2019-03-23 13:34:55 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	

- In the AWS Lambda console, “WiFi-Smart-Device-Kit-Custom-Skill” and “WiFi-Smart-Device-Kit-Smart-Home-Skill” are created. Go to AWS Lambda console, edit “WiFi-Smart-Device-Kit-Custom-Skill”. In “Function code”, edit `index.js` to input the AWS IoT Endpoint and the Region. The AWS IoT Endpoint can be found from the Settings page of AWS IoT console.

Figure 10-15. AWS Lambda Console

```

6  var config = {};
7
8  config.IOT_BROKER_ENDPOINT = "xxxxxxxxxxxxx.iot.us-east-1.amazonaws.com".toLowerCase();
9
10 config.IOT_BROKER_REGION = "us-east-1";
11
12 // Load AWS SDK libraries
13 var AWS = require('aws-sdk');
14

```

10.3 Create Amazon Cognito for Alexa

- Edit the `\cloud-formation-templates\createCognito.template.yaml` file. Add “CallbackURL” of “Wi-Fi Smart Device For Alexa Smart Home Skill” Cognito User Pool App Client from [7.1 Microchip Wi-Fi Smart Device Smart Home Skill Setup](#).

```

WiFISmartDeviceForAlexaSmartHomeSkillClientSettings:
  Type: 'Custom::CognitoUserPoolClientSettings'
  Properties:
    ServiceToken: !GetAtt CloudFormationCognitoUserPoolClientSettings.Arn
    UserPoolId: !Ref UserPool
    UserPoolClientId: !Ref WiFISmartDeviceForAlexaSmartHomeSkillClient
    SupportedIdentityProviders:
      - COGNITO
    CallbackURL: 'https://layla.amazon.com/api/skill/link/M2TDOWMJ3J2LNM,https://alexamicrochip.com/api/skill/link/M2TDOWMJ3J2LNM,https://pitangui.amazon.com/api/skill/link/M2TDOWMJ3J2LN'
    LogoutURL: 'https://www.google.com'
    AllowedOAuthFlowsUserPoolClient: true
    AllowedOAuthFlows:

```

- Add “CallbackURL” of “Wi-Fi Smart Device For Alexa Custom Skill” App Client from [7.2 Microchip Wi-Fi Sensor Board Skill Setup](#).

```

WiFISmartDeviceForAlexaCustomSkillClientSettings:
  Type: 'Custom::CognitoUserPoolClientSettings'
  Properties:
    ServiceToken: !GetAtt CloudFormationCognitoUserPoolClientSettings.Arn
    UserPoolId: !Ref UserPool
    UserPoolClientId: !Ref WiFISmartDeviceForAlexaCustomSkillClient
    SupportedIdentityProviders:
      - COGNITO
    CallbackURL: 'https://layla.amazon.com/api/skill/link/M2TDOWMJ3J2LNM,https://alexamicrochip.com/api/skill/link/M2TDOWMJ3J2LNM,https://pitangui.amazon.com/api/skill/link/M2TDOWMJ3J2LN'
    LogoutURL: 'https://www.google.com'

```

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```
AllowedOAuthFlowsUserPoolClient: true
AllowedOAuthFlows:
```

3. Add a unique name in the “Domain” of the AWS Cognito User Pool for successful cloud formation.

```
UserPoolDomain:
Type: 'Custom::CognitoUserPoolDomain'
Properties:
ServiceToken: !GetAtt CloudFormationCognitoUserPoolDomain.Arn
UserPoolId: !Ref UserPool
Domain: 'userpool-test-018903'
```

4. In the Command Prompt, run the command: `aws cloudformation package --template-file createCognito.template.yaml --s3-bucket <YOUR BUCKET NAME> --output-template-file createCognito.package.yaml`.

Figure 10-16. Console Log

```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation package --template-file
createCognito.template.yaml --s3-bucket test0323 --output-template-file createCognito.package.yaml
Uploading to d665b52fe7099d6eb2172b0a35e65a66 903 / 903.0 (100.00%)
Successfully packaged artifacts and wrote output template to file createCognito.package.yaml.
Execute the following command to deploy the packaged template
aws cloudformation deploy --template-file C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates\
createCognito.package.yaml --stack-name <YOUR STACK NAME>
```

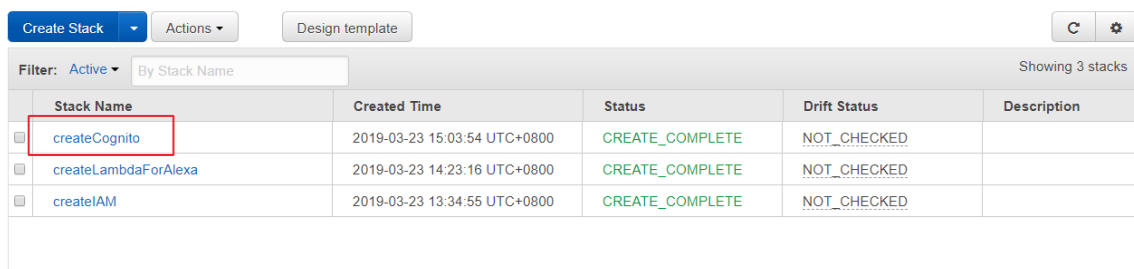
5. Run command: `aws cloudformation deploy --template-file createCognito.package.yaml --stack-name createCognito --capabilities CAPABILITY_NAMED_IAM --profile ZTUser`.

Figure 10-17. Console Log

```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation deploy --template-file
createCognito.package.yaml --stack-name createCognito --capabilities CAPABILITY_NAMED_IAM --profile ZTUser
Waiting for changeset to be created..
Waiting for stack create/update to complete
Successfully created/updated stack - createCognito
```

6. Go to <https://console.aws.amazon.com/cloudformation> and find the stack “createCognito”. A Cognito User Pool “WiFiSmartDeviceUserPool” and a Cognito Identity Pool “WiFiSmartDeviceIdentity” are successfully created. The developer can check this in the Amazon Cognito console.

Figure 10-18. Status of createCognito



Stack Name	Created Time	Status	Drift Status	Description
createCognito	2019-03-23 15:03:54 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createLambdaForAlexa	2019-03-23 14:23:16 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createIAM	2019-03-23 13:34:55 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	

10.4 Create AWS IoT Policy for Smartphone Application

This section provides the steps to create AWS IoT policy used for the mobile application to access AWS IoT resources. The policy name is WiFiSmartDeviceAppPolicy by default but it can be changed in the `create_iot_policy_mobile_app.template.yaml` file.

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1. In the Command Prompt, run command: `aws cloudformation package --template-file create_iot_policy_mobile_app.template.yaml --s3-bucket <YOUR BUCKET NAME> --output-template-file create_iot_policy_mobile_app.package.yaml.`

Figure 10-19. Console Log

```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation package --template-file
create_iot_policy_mobile_app.template.yaml --s3-bucket test0323 --output-template-file create_iot_policy_mobile_app.pac
kage.yaml

Successfully packaged artifacts and wrote output template to file create_iot_policy_mobile_app.package.yaml.
Execute the following command to deploy the packaged template
aws cloudformation deploy --template-file C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates\
create_iot_policy_mobile_app.package.yaml --stack-name <YOUR STACK NAME>
```

2. Run command: `aws cloudformation deploy --template-file create_iot_policy_mobile_app.package.yaml --stack-name createIoTPolicy --capabilities CAPABILITY_NAMED_IAM --profile ZTUser.`

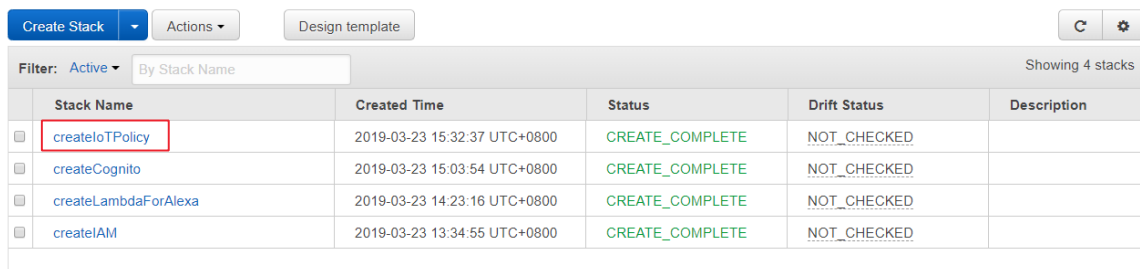
Figure 10-20. Console Log

```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation deploy --template-file
create_iot_policy_mobile_app.package.yaml --stack-name createIoTPolicy --capabilities CAPABILITY_NAMED_IAM --profile ZT
User

Waiting for changeset to be created..
Waiting for stack create/update to complete
Successfully created/updated stack - createIoTPolicy
```

3. Go to <https://console.aws.amazon.com/cloudformation> and find the new stack created using “createloTPolicy”. An AWS IoT Policy “WiFiSmartDeviceAppPolicy” is successfully created. The developer can check this in the AWS IoT console.

Figure 10-21. Status of createloTPolicy



Stack Name	Created Time	Status	Drift Status	Description
createloTPolicy	2019-03-23 15:32:37 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createCognito	2019-03-23 15:03:54 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createLambdaForAlexa	2019-03-23 14:23:16 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createIAM	2019-03-23 13:34:55 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	

10.5 Create AWS DynamoDB Table

Perform the following steps for creating AWS DynamoDB table:

1. In the Command Prompt, run command: `aws cloudformation package --template-file create_dynamodb.template.yaml --s3-bucket <YOUR BUCKET NAME> --output-template-file create_dynamodb.package.yaml.`

Figure 10-22. Console Log

```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation package --template-file
create_dynamodb.template.yaml --s3-bucket test0323 --output-template-file create_dynamodb.package.yaml

Successfully packaged artifacts and wrote output template to file create_dynamodb.package.yaml.
Execute the following command to deploy the packaged template
aws cloudformation deploy --template-file C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates\
create_dynamodb.package.yaml --stack-name <YOUR STACK NAME>
```

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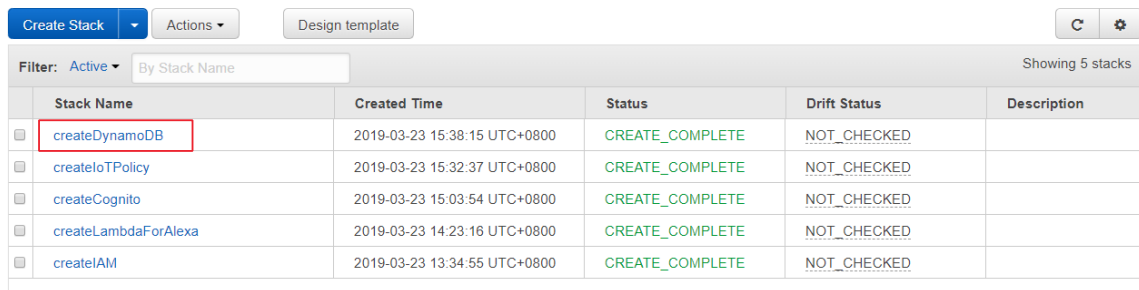
2. Run command: `aws cloudformation deploy --template-file create_dynamodb.package.yaml --stack-name createDynamoDB --capabilities CAPABILITY_NAMED_IAM --profile ZTUser.`

Figure 10-23. Console Log

```
C:\github\winc1500-wifi-smart-device-enablement-kit\cloud-formation-templates>aws cloudformation deploy --template-file
create_dynamodb.package.yaml --stack-name createDynamoDB --capabilities CAPABILITY_NAMED_IAM --profile ZTUser
Waiting for changeset to be created..
Waiting for stack create/update to complete
Successfully created/updated stack - createDynamoDB
```

3. Go to <https://console.aws.amazon.com/cloudformation> and find the stack “createDynamoDB”. A DynamoDB Table “SensorBoardAcctTable” is successfully created. Developer can check this in the AWS DynamoDB console.

Figure 10-24. Status of createDynamoDB



Stack Name	Created Time	Status	Drift Status	Description
createDynamoDB	2019-03-23 15:38:15 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createIoTPolicy	2019-03-23 15:32:37 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createCognito	2019-03-23 15:03:54 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createLambdaForAlexa	2019-03-23 14:23:16 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	
createIAM	2019-03-23 13:34:55 UTC+0800	CREATE_COMPLETE	NOT_CHECKED	

11. Document Revision History

Revision	Date	Section	Description
A	05/2019	Document	Initial Revision

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