



AmebaPro2 Amazon FreeRTOS-LTS - Getting Started Guide



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USING THIS DOCUMENT

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

1 Configure AWS IoT Core

1.1 Set up your AWS account and Permissions

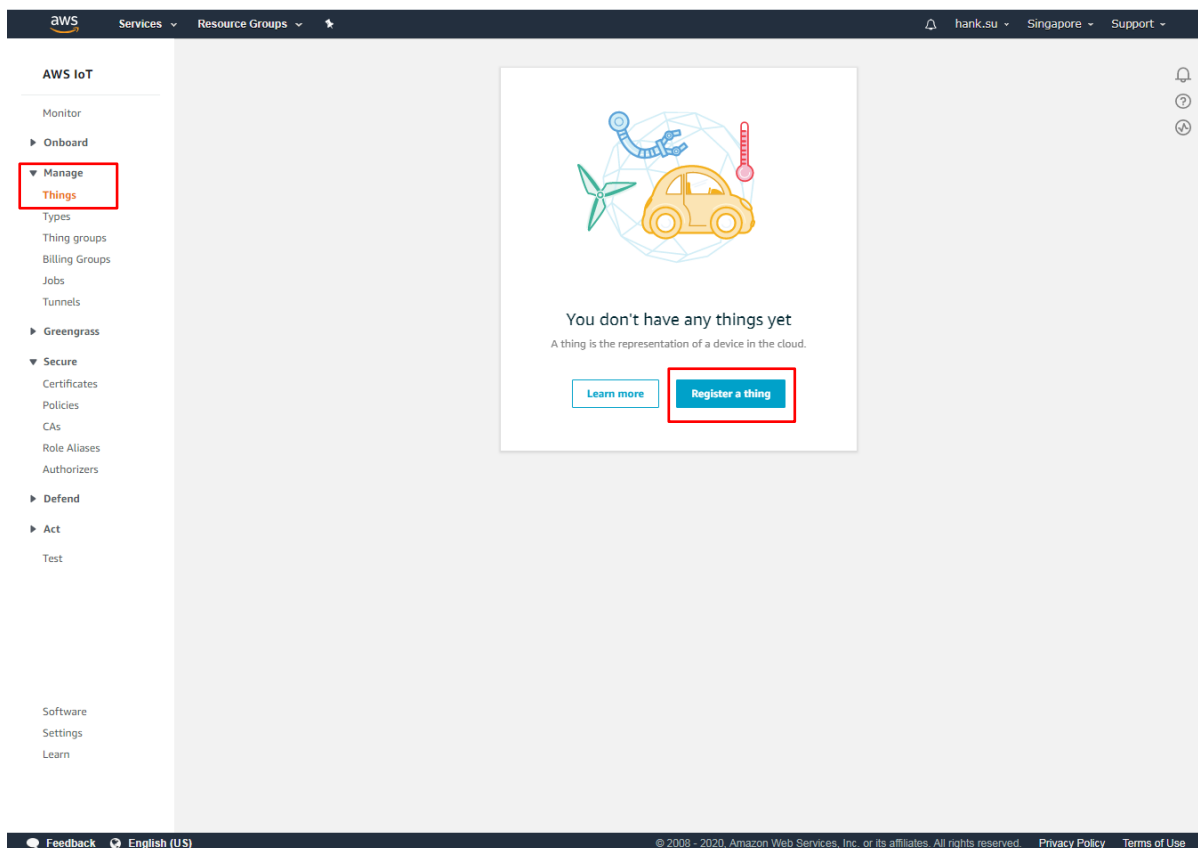
Refer to the instructions at Set up your AWS Account <https://docs.aws.amazon.com/iot/latest/developerguide/setting-up.html>. Follow the steps outlined in these sections to create your account and a user and get started:

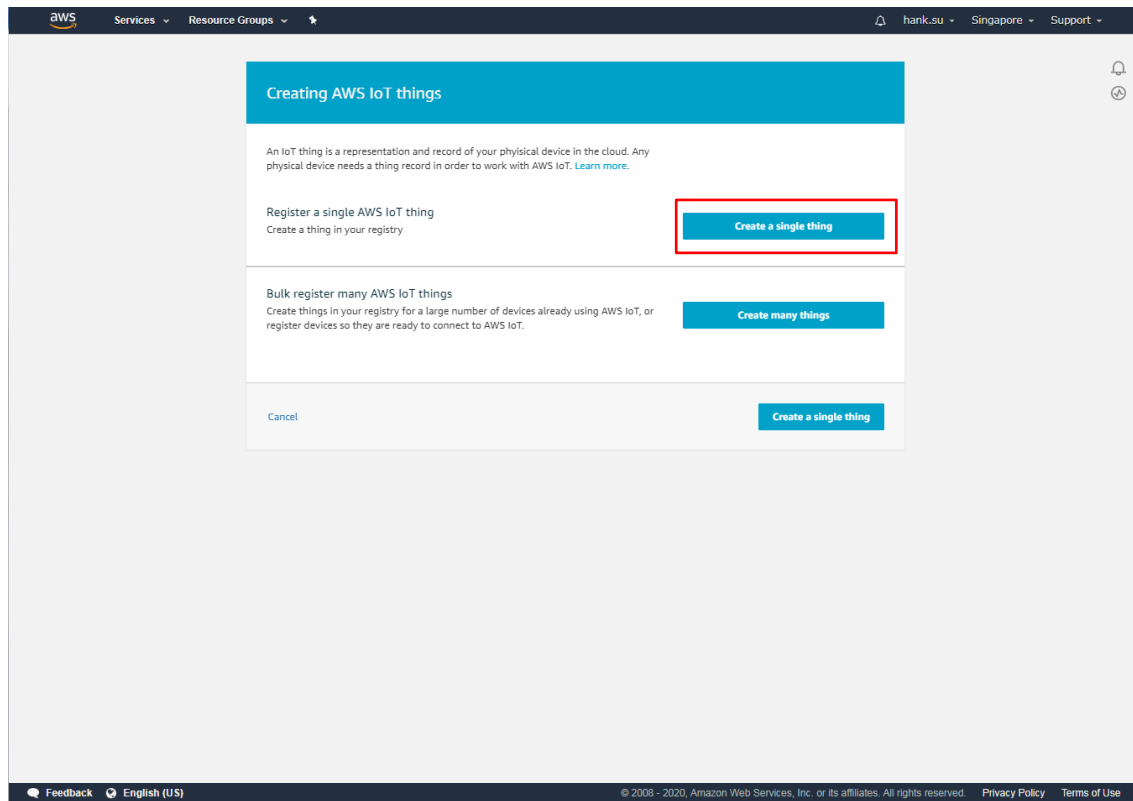
- Sign up for an AWS account
- Create a user and grant permissions
- Open the AWS IoT console

Please pay special attention to the Notes in AWS webpage.

1.2 Create a New Device

To create a new device, navigate to Manage -> Things in the left-hand navigation menu. Then click “Register a thing”.





Creating AWS IoT things

An IoT thing is a representation and record of your physical device in the cloud. Any physical device needs a thing record in order to work with AWS IoT. [Learn more.](#)

Register a single AWS IoT thing
Create a thing in your registry

Create a single thing

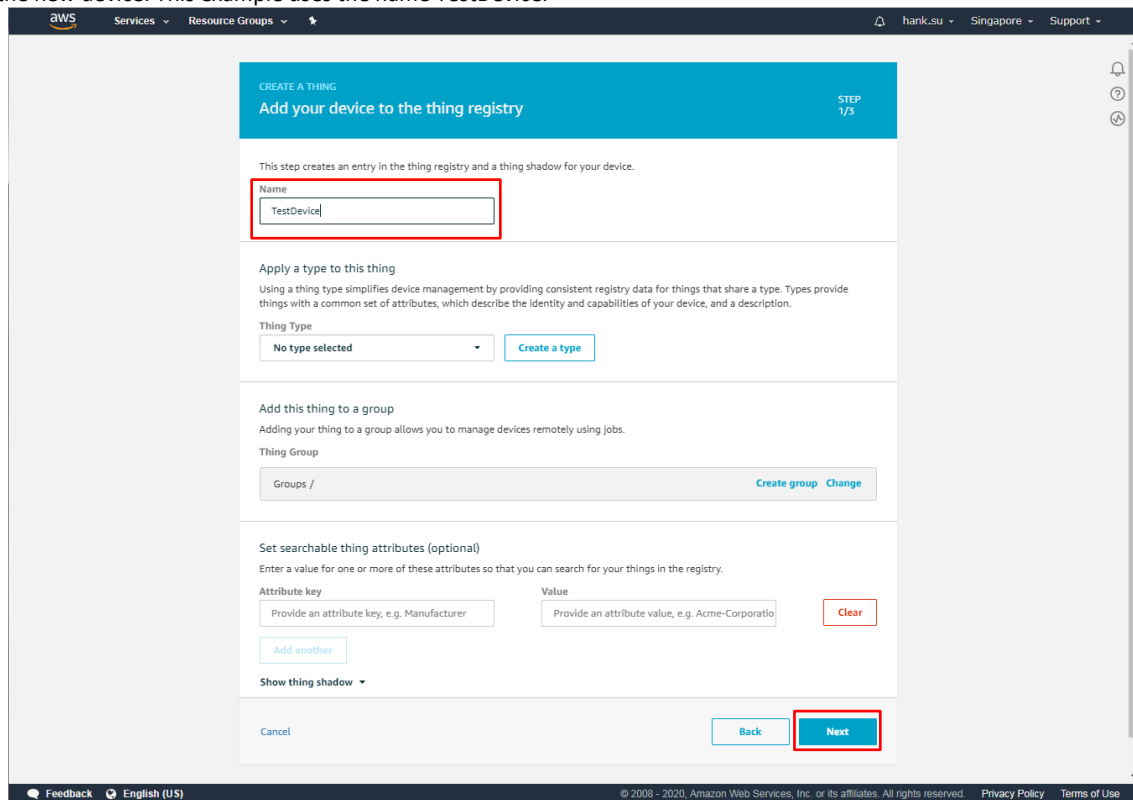
Bulk register many AWS IoT things
Create things in your registry for a large number of devices already using AWS IoT, or register devices so they are ready to connect to AWS IoT.

Create many things

Cancel **Create a single thing**

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Then, name the new device. This example uses the name TestDevice.



CREATE A THING STEP 1/5

Add your device to the thing registry

This step creates an entry in the thing registry and a thing shadow for your device.

Name
TestDevice

Apply a type to this thing
Using a thing type simplifies device management by providing consistent registry data for things that share a type. Types provide things with a common set of attributes, which describe the identity and capabilities of your device, and a description.

Thing Type
No type selected **Create a type**

Add this thing to a group
Adding your thing to a group allows you to manage devices remotely using Jobs.

Thing Group
Groups / **Create group** **Change**

Set searchable thing attributes (optional)
Enter a value for one or more of these attributes so that you can search for your things in the registry.

Attribute key
Provide an attribute key, e.g. Manufacturer

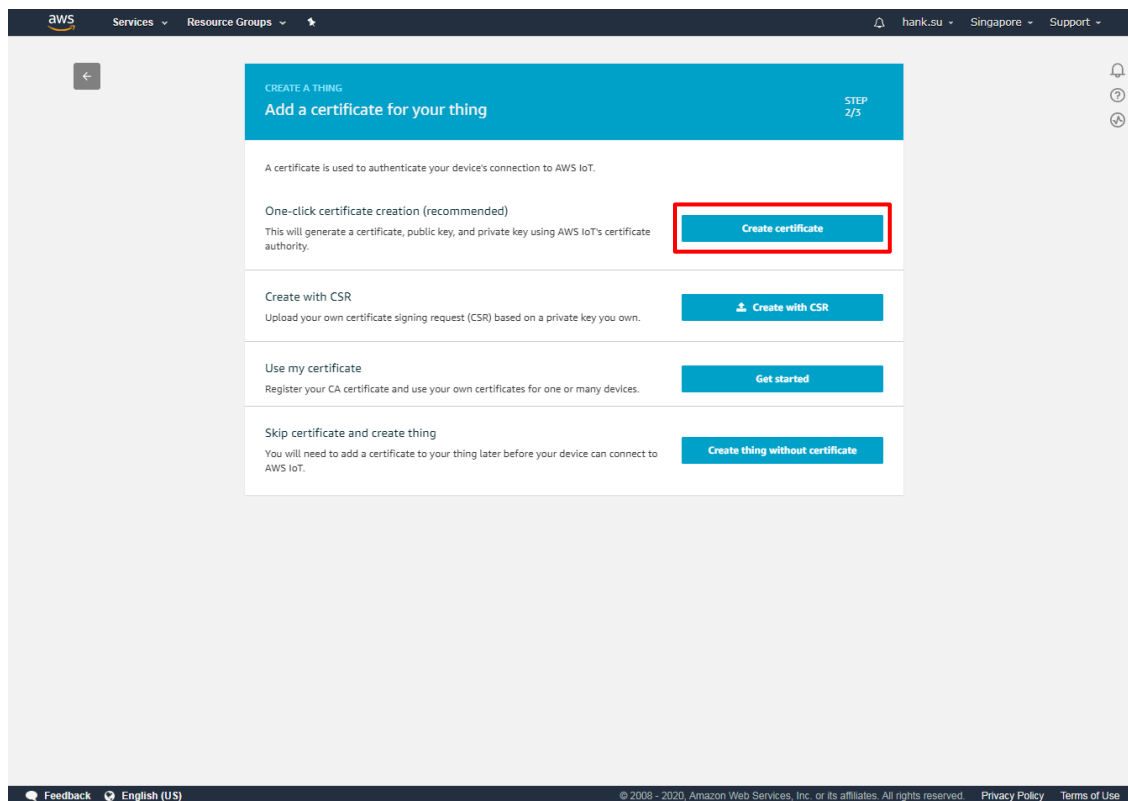
Value
Provide an attribute value, e.g. Acme-Corporatio **Clear**

Add another

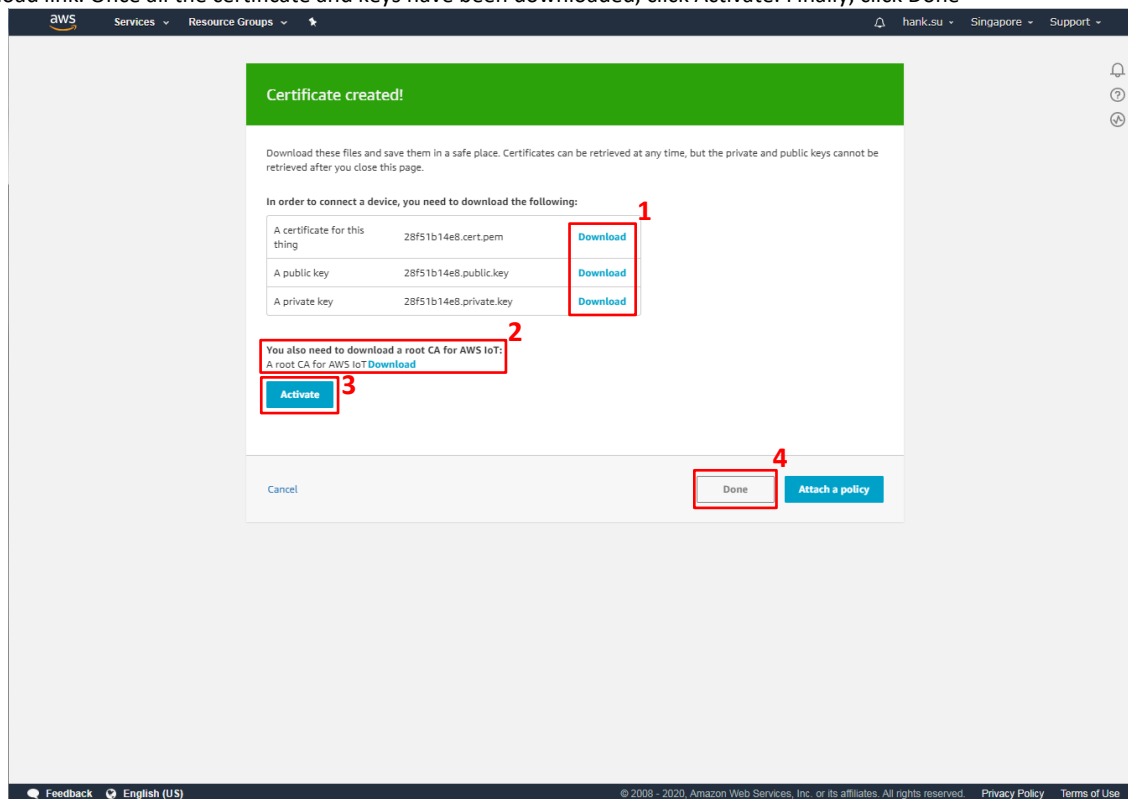
Show thing shadow ▾

Cancel **Back** **Next**

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Download the certificate, public key, and private key for the device by clicking Download. Next, download the root CA for AWS IoT by clicking to the Download link. Once all the certificate and keys have been downloaded, click Activate. Finally, click Done



CA certificates for server authentication

Depending on which type of data endpoint you are using and which cipher suite you have negotiated, AWS IoT Core server authentication certificates are signed by one of the following root CA certificates:

VeriSign Endpoints (legacy)

- RSA 2048 bit key: [VeriSign Class 3 Public Primary G5 root CA certificate](#)

Amazon Trust Services Endpoints (preferred)

Note

You might need to right click these links and select **Save link as...** to save these certificates as files.

- RSA 2048 bit key: [Amazon Root CA 1](#)
- RSA 4096 bit key: Amazon Root CA 2. Reserved for future use.
- ECC 256 bit key: [Amazon Root CA 3](#)
- ECC 384 bit key: Amazon Root CA 4. Reserved for future use.

These certificates are all cross-signed by the [Starfield Root CA Certificate](#). All new AWS IoT Core regions, beginning with the May 9, 2018 launch of AWS IoT Core in the Asia Pacific (Mumbai) Region, serve only ATS certificates.

On this page

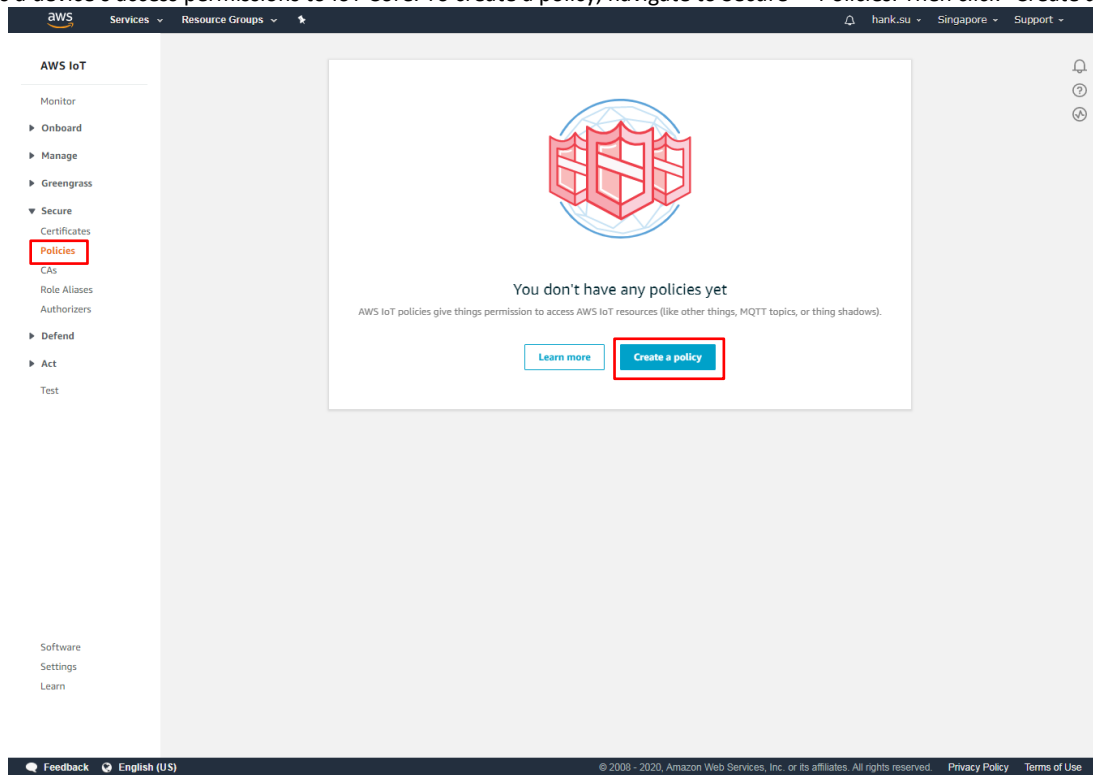
Endpoint types

CA certificates for server authentication

Server authentication guidelines

1.3 Create a policy

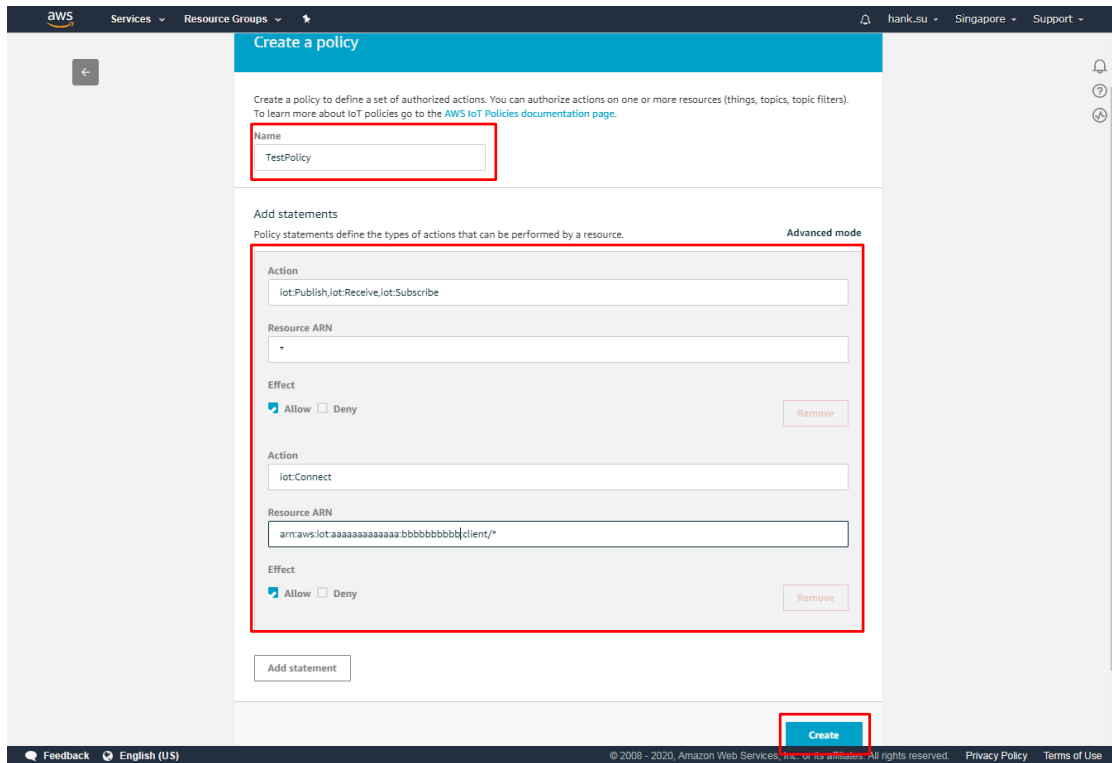
A policy defines a device's access permissions to IoT Core. To create a policy, navigate to Secure -> Policies. Then click "Create a policy"



NOTE – this policy grants unrestricted access for all iot operations, and is to be used only in a development environment. For non-dev environments, all devices in your fleet must have credentials with privileges that authorize intended actions only, which include (but not limited to) AWS IoT MQTT actions such as publishing messages or subscribing to topics with specific scope and context. The specific permission policies can vary for your use cases. Identify the permission policies that best meet your business and security requirements.

For sample policies, refer to <https://docs.aws.amazon.com/iot/latest/developerguide/example-iot-policies.html>.

Also refer to <https://docs.aws.amazon.com/iot/latest/developerguide/security-best-practices.html>



Create a policy

Create a policy to define a set of authorized actions. You can authorize actions on one or more resources (things, topics, topic filters). To learn more about IoT policies go to the [AWS IoT Policies documentation page](#).

Name
TestPolicy

Add statements
Policy statements define the types of actions that can be performed by a resource. Advanced mode

Action
iot:Publish,iot:Receive,iot:Subscribe

Resource ARN
*

Effect
☒ Allow ☐ Deny Remove

Action
iot:Connect

Resource ARN
arn:aws:iot:aaaaaa:bbbbbb:client/*

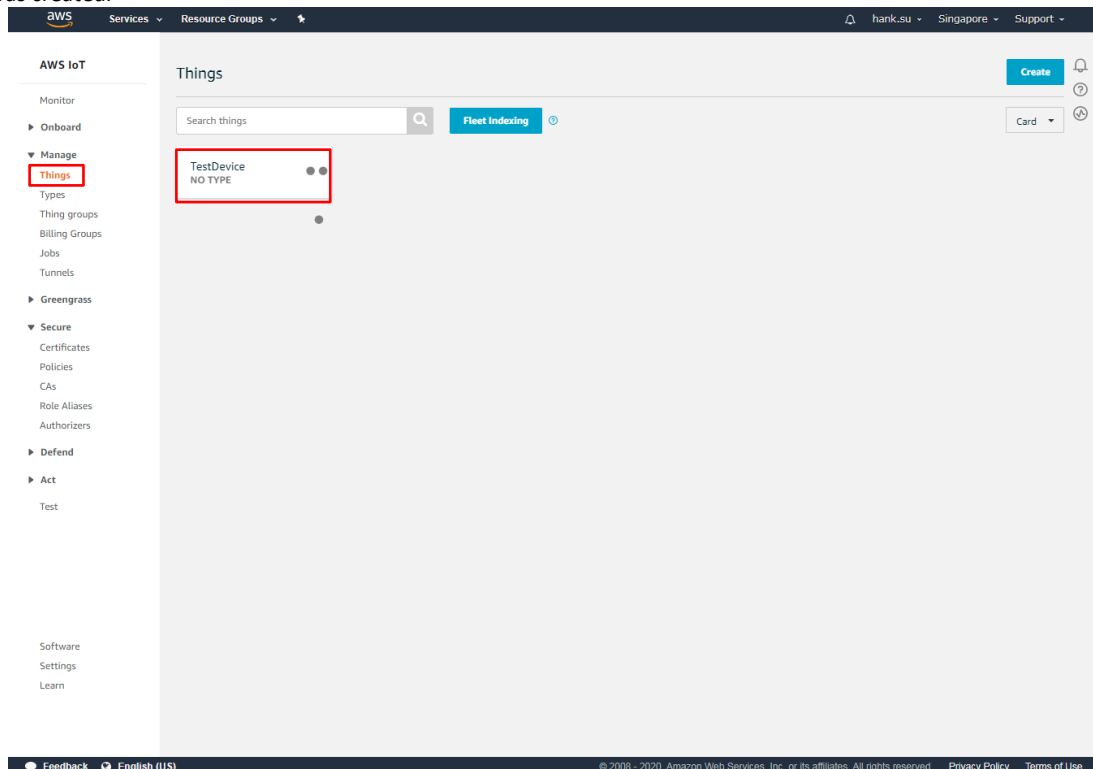
Effect
☒ Allow ☐ Deny Remove

Add statement

Create

1.4 Attach Policy

The last step to configuring the device is attaching a policy. To attach a policy to new device, navigate to Manage -> Things. Then click on the device which was created.

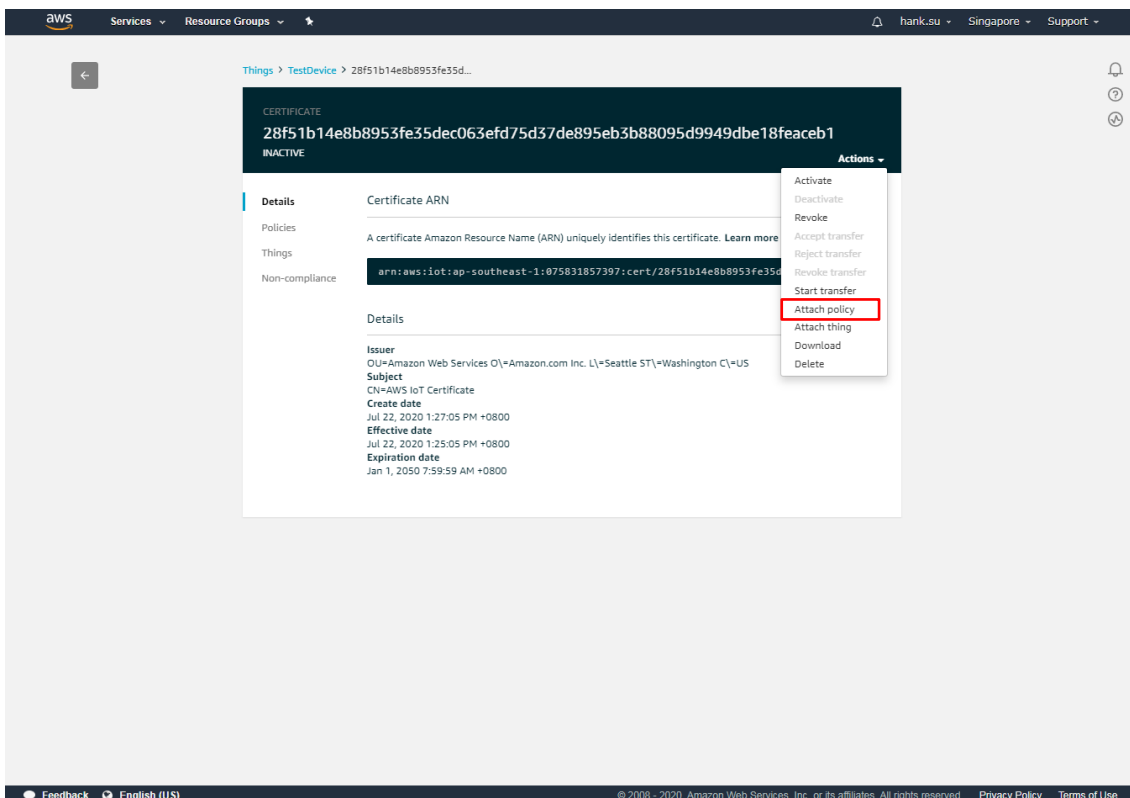
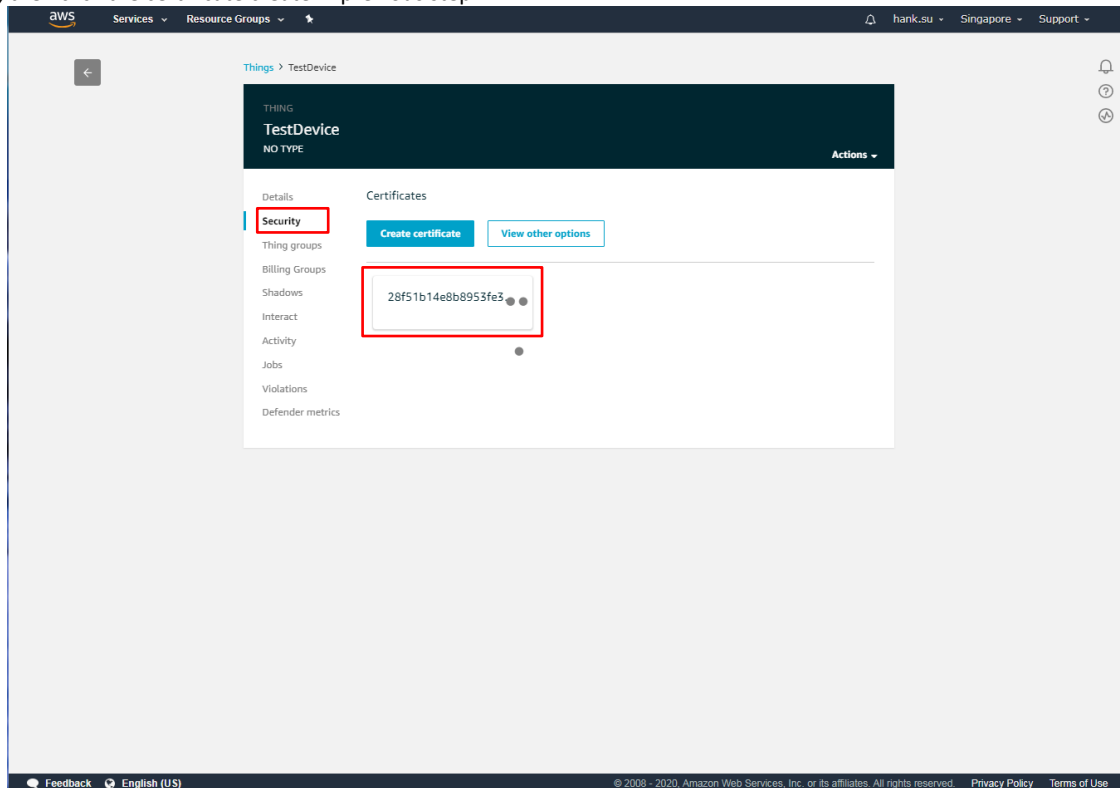


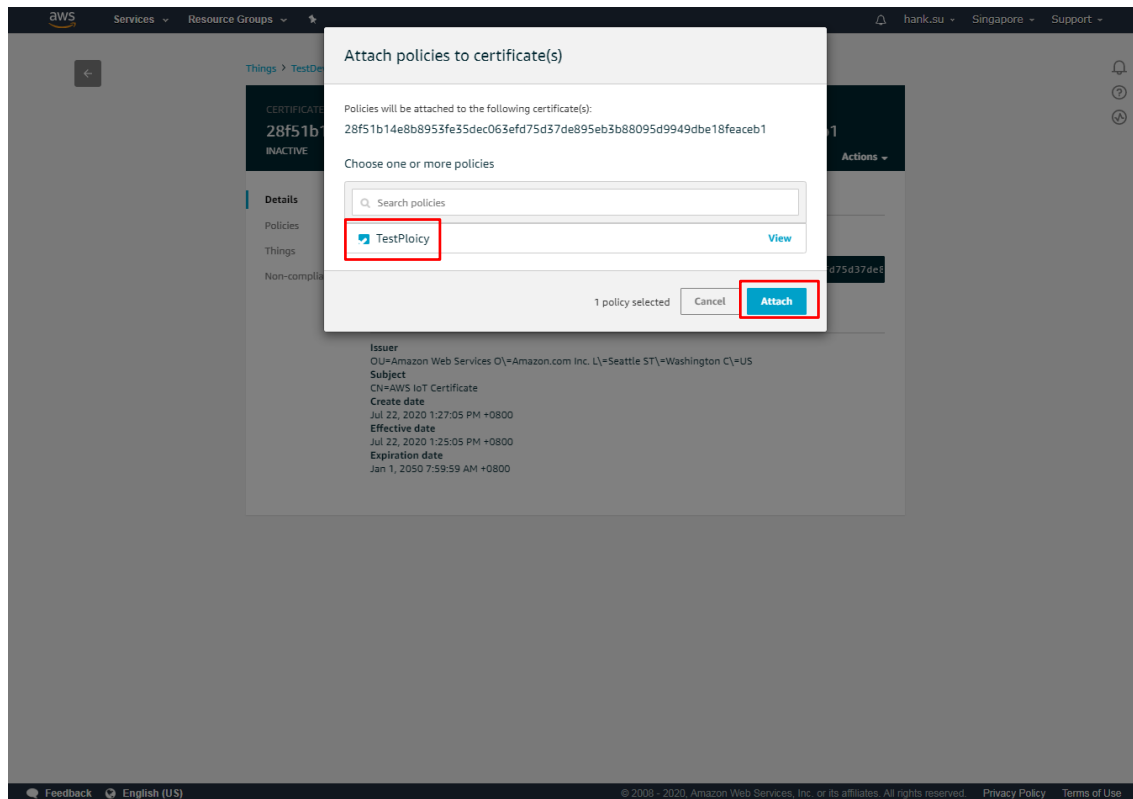
Things

Search things Q Fleet indexing

TestDevice
NO TYPE

Click Security, then click the certificate create in previous step.





2 Configure AmebaPro2 Amazon FreeRTOS

2.1 Download FreeRTOS-LTS Library Source Code from Github

Open source link: <https://github.com/ambiot/amazon-freertos/tree/amebaPro2-9.x-202107.00-LTS>
branch: **amebaPro2-9.x-202107.00-LTS**

2.1.1 Download Source Code of Required Libraries to SDK

Go to “AmebaPro2_SDK/project/realtek_amebapro2_v0_example/src”:

```
$ cd project/realtek_amebapro2_v0_example/src
$ git clone --recurse-submodules -b amebaPro2-9.x-202107.00-LTS https://github.com/ambiot/amazon-freertos.git aws_iot_freertos_Its
```

2.1.2 Modify FreeRTOSConfig.h

Copy & paste below configurations to the end of FreeRTOSConfig.h:

```
/* Sets the length of the buffers into which logging messages are written - so
 * also defines the maximum length of each log message. */
#define configLOGGING_MAX_MESSAGE_LENGTH 512

/* Set to 1 to prepend each log message with a message number, the task name,
 * and a time stamp. */
#define configLOGGING_INCLUDE_TIME_AND_TASK_NAME 1

/* Map the FreeRTOS printf() to the logging task printf. */
/* The function that implements FreeRTOS printf style output, and the macro
 * that maps the configPRINTF() macros to that function. */
#define configPRINTF( X ) vLoggingPrintf X

/* Non-format version thread-safe print. */
#define configPRINT( X ) vLoggingPrint( X )

/* Map the logging task's printf to the board specific output function. */
#define configPRINT_STRING( X ) printf( X )

#define iotconfigUSE_PORT_SPECIFIC_HOOKS
```

2.1.3 Configure MbedTLS Setting

In this project, we use mbedtls-2.16.6, same as KVS webrtc. Set mbedtls version to 2.16.6 in “project/realtek_amebapro2_v0_example/GCC-RELEASE/application_ntz/CMakeLists.txt”

```
set(mbedtls "mbedtls-2.16.6")
```

You have to modify some mbedtls config before running aws-iot demo, go to “component\ssl\mbedtls-2.16.6\include\mbedtls\config_rsa.h” check the following setting:

```
#define MBEDTLS_THREADING_ALT
// #define MBEDTLS_DEBUG_C
#define MBEDTLS_THREADING_C
```

The default mbedtls version of AmebaPro2 is 3.0.0. However, for the aws iot demo, we use mbedtls version 2.16.6 in default. It might be easier for user to use it with AWS KVS service now.

If user want to use the aws-iot with mbedtls-3.0.0 or mbedtls-2.4.0, user can compare the config file between mbedtls-2.16.6 and mbedtls-3.0.0, mbedtls-2.4.0

2.1.4 Multiple Definition Issue

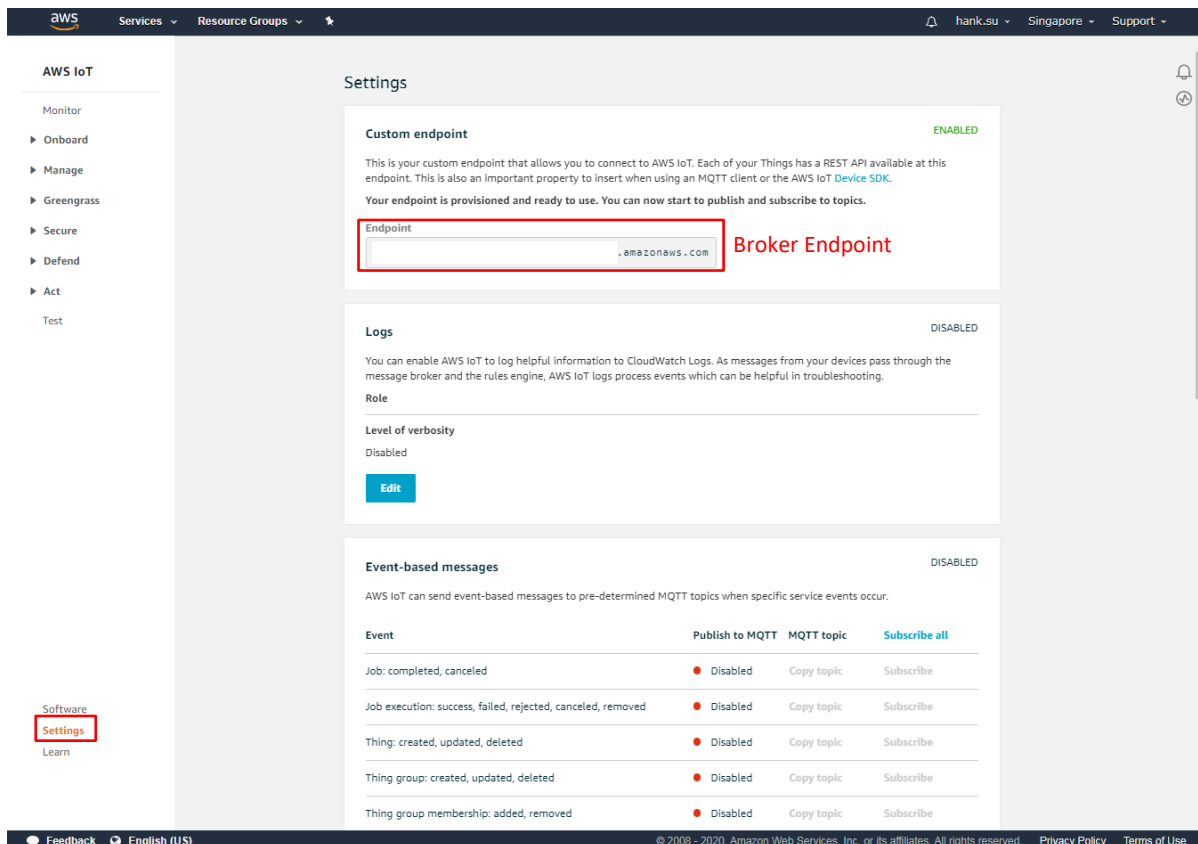
There might be multiple definition of “vApplicationGetIdleTaskMemory” and “vApplicationGetTimerTaskMemory”.

Since aws demo runner have the same function that have been defined in SDK, so we should comment one of them, go to “component\os\freertos\freertos_cb.c” and comment these two functions

```
//void vApplicationGetIdleTaskMemory(...)
//{
//    ...
//}

//void vApplicationGetTimerTaskMemory(...)
//{
//    ...
//}
```

2.2 Get Broker Endpoint by AWS IoT Core



The screenshot shows the AWS IoT Core Settings page. The 'Custom endpoint' section is highlighted with a red box and labeled 'Broker Endpoint'. The 'Logs' and 'Event-based messages' sections are also visible.

Custom endpoint ENABLED

This is your custom endpoint that allows you to connect to AWS IoT. Each of your Things has a REST API available at this endpoint. This is also an important property to insert when using an MQTT client or the AWS IoT [Device SDK](#). Your endpoint is provisioned and ready to use. You can now start to publish and subscribe to topics.

Endpoint **Broker Endpoint**

Logs DISABLED

You can enable AWS IoT to log helpful information to CloudWatch Logs. As messages from your devices pass through the message broker and the rules engine, AWS IoT logs process events which can be helpful in troubleshooting.

Role

Level of verbosity

Disabled

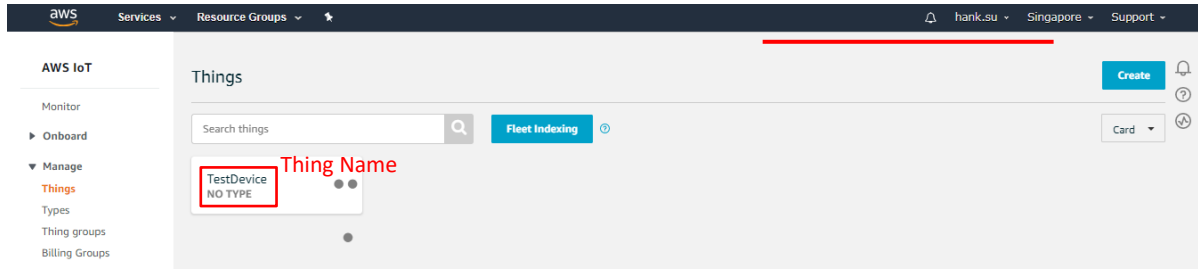
[Edit](#)

Event-based messages DISABLED

AWS IoT can send event-based messages to pre-determined MQTT topics when specific service events occur.

Event	Publish to MQTT	MQTT topic	Subscribe all
Job: completed, canceled	Disabled	Copy topic	Subscribe
Job execution: success, failed, rejected, canceled, removed	Disabled	Copy topic	Subscribe
Thing: created, updated, deleted	Disabled	Copy topic	Subscribe
Thing group: created, updated, deleted	Disabled	Copy topic	Subscribe
Thing group membership: added, removed	Disabled	Copy topic	Subscribe

2.3 Get Thing Name



2.4 Setup IoT Core Information with AmebaPro2 Amazon FreeRTOS

Setup BROKER_ENDPOINT, THING_NAME, WIFI_SSID, PASSWORD in

["project/realtek_amebapro2_v0_example/src/aws_iot_freertos_lts/demos/include/aws_clientcredential.h"](#)

```
#define clientcredentialMQTT_BROKER_ENDPOINT      "xxxxxxxxxxxxxxxxx.amazonaws.com"
/*
 * @brief Host name.
 * @todo Set this to the unique name of your IoT Thing.
 */
#define clientcredentialIOT_THING_NAME          "TestDevice"
/*
 * @brief Port number the MQTT broker is using.
 */
#define clientcredentialMQTT_BROKER_PORT        8883
/*
 * @brief Port number the Green Grass Discovery use for JSON retrieval from cloud is using.
 */
#define clientcredentialGREENGRASS_DISCOVERY_PORT  8443
/*
 * @brief Wi-Fi network to join.
 * @todo If you are using Wi-Fi, set this to your network name.
 */
#define clientcredentialWIFI_SSID                "TestAP"
/*
 * @brief Password needed to join Wi-Fi network.
 * @todo If you are using WPA, set this to your network password.
 */
#define clientcredentialWIFI_PASSWORD            "password"
/*
 * @brief Wi-Fi network security type.
 *
 * @see WiFiSecurity_t.
 *
 * @note Possible values are eWiFiSecurityOpen, eWiFiSecurityWEP, eWiFiSecurityWPA,
 * eWiFiSecurityWPA2 (depending on the support of your device Wi-Fi radio).
 */
#define clientcredentialWIFI_SECURITY            eWiFiSecurityWPA2
#endif /* ifndef __AWS_CLIENTCREDENTIAL_H__ */
```

2.4.1 Setup Thing's Private Key and Certificate

Fill keyCLIENT_CERTIFICATE_PEM and keyCLIENT_PRIVATE_KEY_PEM in

["project/realtek_amebapro2_v0_example/src/aws_iot_freertos_lts/demos/include/aws_clientcredential_keys.h"](#) by xxxxxxxx-certifiacte.pem and xxxxxxxx-private.pem.key.

It can done by [CertificateConfigurator.html](https://raw.githubusercontent.com/aws/amazon-freertos/202107.00/tools/certificate_configuration/CertificateConfigurator.html) and it can be downloaded from “https://raw.githubusercontent.com/aws/amazon-freertos/202107.00/tools/certificate_configuration/CertificateConfigurator.html”

Final aws_clientcredential_keys.h overview.

[illegible]

2.4.2 Enable FreeRTOS demo on AmebaPro2

For example, if you would like to run MQTT mutual authentication demo, please find [aws_demo_config.h](#) in “[project/realtek_amebapro2_v0_example/src/aws_iot_freertos_lts/vendors/realtek/boards/amebaPro2/aws_demos/config_files](#)” and enable **CONFIG_CORE_MQTT_MUTUAL_AUTH_DEMO_ENABLED**

```
//#define CONFIG_CORE_HTTP_MUTUAL_AUTH_DEMO_ENABLED
#define CONFIG_CORE_MQTT_MUTUAL_AUTH_DEMO_ENABLED
//#define CONFIG_DEVICE_SHADOW_DEMO_ENABLED
//#define CONFIG_JOBS_DEMO_ENABLED
```

Now you can start to compile AmebaPro2 Amazon FreeRTOS project !

3 Compile AmebaPro2 Amazon FreeRTOS

3.1 Compile Program with GCC Toolchain

Run following commands to build the image with option ``-DEXAMPLE=amazon_freertos``

```
$ cd project/realtek_amebapro2_v0_example/GCC-RELEASE
$ mkdir build
$ cd build
$ cmake .. -G"Unix Makefiles" -DCMAKE_TOOLCHAIN_FILE=../toolchain.cmake -DEXAMPLE=amazon_freertos
$ cmake --build . --target flash
```

After successfully build, there should be an image file **flash_ntz.bin** located in "build/" directory.

3.2 Download image to AmebaPro2

Use image tool to download the image to AmebaPro2.

4 MQTT Demo

4.1 Run MQTT Demo

Default setting of SDK are enable MQTT demo. Once the AmebaPro2 EVB has rebooted, the application will automatically start run MQTT demo and communicate to IoT Core.

```
[Driver]: set ssid [RealEZ]
[RF] [RFK] Tx pause!!
[Driver]: start auth to 
[Driver]: auth alg = 2
[Driver]: auth success, start assoc
[Driver]: association success(res=28)
[Driver]: wlan0: DL RSVD page success! DLBcnCount:1, poll:1
0 301 [example_ama] Write certificate...
1 408 [iot_thread] [INFO][DEMO][408] -----STARTING DEMO-----
2 414 [iot_thread] [INFO][INIT][414] SDK successfully initialized.
```

...


```
Interface 0 IP address : 192.168. [redacted]
3 53555 [iot_thread] [INFO] [DEMO][53555] Successfully initialized the demo. Network type for the demo: 1

4 53564 [iot_thread] [INFO] Creating a TLS connection to [redacted]-ats.iot.ap-southeast-1.amazonaws.com:8883.
5 54778 [iot_thread] [INFO] Creating an MQTT connection to [redacted]-ats.iot.ap-southeast-1.amazonaws.com.
6 54909 [iot_thread] [INFO] Packet received. ReceivedBytes=2.
7 54913 [iot_thread] [INFO] CONNACK session present bit not set.
8 54919 [iot_thread] [INFO] Connection accepted.
9 54924 [iot_thread] [INFO] Received MQTT CONNACK successfully from broker.
10 54930 [iot_thread] [INFO] MQTT connection established with the broker.
11 54937 [iot_thread] [INFO] An MQTT connection is established with [redacted]-ats.iot.ap-southeast-1.amazonaws.com.
12 54949 [iot_thread] [INFO] Attempt to subscribe to the MQTT topic ameba-ota/example/topic.
13 54956 [iot_thread] [INFO] SUBSCRIBE sent for topic ameba-ota/example/topic to broker.
14 55070 [iot_thread] [INFO] Packet received. ReceivedBytes=3.
15 55074 [iot_thread] [INFO] Subscribed to the topic ameba-ota/example/topic with maximum QoS 1.
16 56082 [iot_thread] [INFO] Publish to the MQTT topic ameba-ota/example/topic.
17 56087 [iot_thread] [INFO] Attempt to receive publish message from broker.
18 56241 [iot_thread] [INFO] Packet received. ReceivedBytes=2.
19 56246 [iot_thread] [INFO] Ack packet deserialized with result: MQTTSuccess.
20 56252 [iot_thread] [INFO] State record updated. New state=MQTTPublishDone.
21 56259 [iot_thread] [INFO] PUBACK received for packet Id 2.
22 56265 [iot_thread] [INFO] Packet received. ReceivedBytes=39.
23 56270 [iot_thread] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
24 56280 [iot_thread] [INFO] State record updated. New state=MQTTPubAckSend.
25 56286 [iot_thread] [INFO] Incoming QoS : 1

...

248 122674 [iot_thread] [INFO] Demo run is successful with 3 successful loops out of total 3 loops.
249 123681 [iot_thread] [INFO] [DEMO][123681] Demo completed successfully.

Deinitializing WIFI ...
WIFI deinitialized250 123809 [iot_thread] [INFO] [INIT][123809] SDK cleanup done.

251 123813 [iot_thread] [INFO] [DEMO][123813] -----DEMO FINISHED-----
```

4.2 Monitoring MQTT Messages on the Cloud

To subscribe to the MQTT topic with the AWS IoT MQTT client

1. Sign in to the AWS IoT console.
2. In the navigation pane, choose Test to open the MQTT client.
3. In Subscription topic, enter “+/example/topic”, and then choose Subscribe to topic.

AWS IoT ×

Monitor

Activity

▶ Onboard

▶ Manage

▶ Greengrass

▶ Secure

▶ Defend

▶ Act

Test

Software

Settings

Learn

Documentation [↗](#)

☒ New console experience
[Tell us what you think](#)

AWS IoT > MQTT test client

MQTT test client [Info](#)

You can use the MQTT test client to monitor the MQTT messages being passed in your AWS account. Devices publish MQTT messages that are identified by topics to communicate their state to AWS IoT. AWS IoT also publishes MQTT messages to inform devices and apps of changes and events. You can subscribe to MQTT message topics and publish MQTT messages to topics by using the MQTT test client.

Subscribe to a topic

Topic filter [Info](#)

The topic filter describes the topic(s) to which you want to subscribe. The topic filter can include MQTT wildcard characters.

+/example/topic

▶ Additional configuration

Subscribe

Publish to a topic

Subscriptions	Topic
You have no topic subscriptions.	Subscribe to a topic to view incoming messages.

AWS IoT ×

Monitor

Activity

▶ Onboard

▶ Manage

▶ Greengrass

▶ Secure

▶ Defend

▶ Act

Test

Software

Settings

Learn

Documentation [↗](#)

☒ New console experience
[Tell us what you think](#)

Subscriptions

+/example/topic ♥ ✕

+/example/topic

Pause

Clear

Export

Edit

<div style="margin-bottom: 10px;">▼ ameba-ota/example/topic</div> <div style="border: 1px solid #ccc; padding: 2px;">Hello World!</div>	<div style="margin-bottom: 10px;">March 08, 2021, 17:14:36 (UTC+0800)</div>
<div style="margin-bottom: 10px;">▼ ameba-ota/example/topic</div> <div style="border: 1px solid #ccc; padding: 2px;">Hello World!</div>	<div style="margin-bottom: 10px;">March 08, 2021, 17:14:23 (UTC+0800)</div>
<div style="margin-bottom: 10px;">▼ ameba-ota/example/topic</div> <div style="border: 1px solid #ccc; padding: 2px;">Hello World!</div>	<div style="margin-bottom: 10px;">March 08, 2021, 17:14:21 (UTC+0800)</div>
<div style="margin-bottom: 10px;">▼ ameba-ota/example/topic</div> <div style="border: 1px solid #ccc; padding: 2px;">Hello World!</div>	<div style="margin-bottom: 10px;">March 08, 2021, 17:14:20 (UTC+0800)</div>
<div style="margin-bottom: 10px;">▼ ameba-ota/example/topic</div> <div style="border: 1px solid #ccc; padding: 2px;">Hello World!</div>	<div style="margin-bottom: 10px;">March 08, 2021, 17:14:17 (UTC+0800)</div>

5 Troubleshooting

If these steps don't work, look at the device log in the serial terminal. You should see some text that indicates the source of the problem.

For general troubleshooting information about Getting Started with FreeRTOS, see [Troubleshooting getting started](#).

5.1 ERROR: Invalid Key

Please check **WIFI_SSID** and **WIFI_PASSWORD** in in "project/realtek_amebapro2_v0_example/src/aws_iot_freertos_its/demos/include/aws_clientcredential.h"

```
Enter SSID for Soft AP started
3 1098 [example_a] Wi-Fi configuration successful.
4 1108 [iot_threa] [INFO ][DEMO][1108] -----STARTING DEMO-----

5 1115 [iot_threa] [INFO ][INIT][1115] SDK successfully initialized.

LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
WIFI deinitialized
Initializing WIFI ...
WIFI initialized

Joining BSS by SSID ...

ERROR:Invalid Key
ERROR: Can't connect to AP
Joining BSS by SSID ...

ERROR:Invalid Key
ERROR: Can't connect to AP
Joining BSS by SSID ...
```

5.2 Failed to establish new MQTT connection

Please check **clientcredentialMQTT_BROKER_ENDPOINT** in

"project/realtek_amebapro2_v0_example/src/aws_iot_freertos_its/demos/include/aws_clientcredential.h"

```
6 12508 [iot_threa] [INFO ][DEMO][12508] Successfully initialized the demo. Network type for the demo: 1
7 12517 [iot_threa] [INFO ][MQTT][12517] MQTT library successfully initialized.
8 12524 [iot_threa] [INFO ][DEMO][12524] MQTT demo client identifier is ameba-ota (length 9).
9 12624 [iot_threa] [ERROR][NET][12624] Failed to resolve [redacted].amazonaws.com.
10 12934 [iot_threa] [ERROR][MQTT][12934] Failed to establish new MQTT connection, error NETWORK ERROR.
11 12943 [iot_threa] [ERROR][DEMO][12943] MQTT CONNECT returned error NETWORK ERROR.
12 12951 [iot_threa] [INFO ][MQTT][12950] MQTT library cleanup done.
13 12957 [iot_threa] [ERROR][DEMO][12957] Error running demo.
Interface 0 IP address : 192.168.90.185
LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
14 13094 [iot_threa] [INFO ][INIT][13094] SDK cleanup done.
15 13099 [iot_threa] [INFO ][DEMO][13099] -----DEMO FINISHED-----
```

5.3 TLS_Connect fail

Please check **keyCLIENT_CERTIFICATE_PEM** and **keyCLIENT_PRIVATE_KEY_PEM** in

"project/realtek_amebapro2_v0_example/src/aws_iot_freertos_its/demos/include/aws_clientcredential_keys.h"

```
8 13501 [iot_threa] [INFO ][DEMO][13501] Successfully initialized the demo. Network type for the demo: 1
9 13511 [iot_threa] [INFO ][MQTT][13511] MQTT library successfully initialized.
10 13518 [iot_threa] [INFO ][DEMO][13518] MQTT demo client identifier is ameba-ota (length 9).
11 20102 [iot_threa] [ERROR][MQTT][20102] TLS Connect fail (0x7d4, [redacted].amazonaws.com)
13 20115 [iot_threa] [ERROR][NET][20115] Failed to establish new connection. Socket status: -1.
14 20424 [iot_threa] [ERROR][MQTT][20424] Failed to establish new MQTT connection, error NETWORK ERROR.
15 20433 [iot_threa] [ERROR][DEMO][20433] MQTT CONNECT returned error NETWORK ERROR.
16 20441 [iot_threa] [INFO ][MQTT][20441] MQTT library cleanup done.
17 20447 [iot_threa] [ERROR][DEMO][20447] Error running demo.
Interface 0 IP address : 192.168.90.185
LwIP_DHCP: dhcp stop.
Deinitializing WIFI ...
18 20586 [iot_threa] [INFO ][INIT][20586] SDK cleanup done.
19 20591 [iot_threa] [INFO ][DEMO][20591] -----DEMO FINISHED-----
```