CK-RX65N

SIM activation, Creating the trial account and using Dashboard with RYZ014A or Ethernet Application for AWS - Getting Started Guide

Introduction

This document describes a system that uses the CK-RX65N V1 Cloud Kit board from Renesas. This system incorporates the CK-RX65N V1 running Amazon FreeRTOS and via Ethernet/Cellular connection. It visualizes HS3001, ZMOD4410, ZMOD4510, OB1203, ICP10101 and ICM20948 sensor information on Amazon Web Services (AWS) and controls LEDs on the board. In addition, this application note also describes several feature options for users when using CK-RX65N V1 Cloud Kit with AWS: OTA (Over-The-Air) feature **(section 6)** and Fleet Provisioning feature **(section 7).**

This document shows two methods of connectivity for CK-RX65N V1. The first one is the Ethernet, and the second is the Cellular CAT M1 using RYZ014A.

In addition, this document describes the following:

- How to activate the SIM card that is contained with the CK-RX65N V1.
- How to create the 10 USD free trial account for AWS.
- How to operate and install the information of certification for cloud.
- How to see and run the sensor data on the dashboard.
- How to use OTA feature to update firmware via Cloud.
- How to use Fleet Provisioning via Cloud.

Note: Renesas announced the discontinuation of the Sequans-sourced LTE module, part number RYZ014A, and will no longer be shipping this product. If you have this in a current design or production, the Sequans part numbers, GM01Q is a pin and functionally compatible replacement for RYZ014A. Below is the cellular driver alternate product.

- RYZ014A Cellular control module: Sequans GM01Q is the compatible module.

Regarding EOL notice of the RYZ014A, please see:
[The link] https://www.renesas.com/document/eln/plc-240004-end-life-eol-process-select-part-numbers
[The product page] https://www.renesas.com/products/wireless-connectivity/cellular-iot-modules/ryz014a-lte-cat-m1-cellular-iot-module

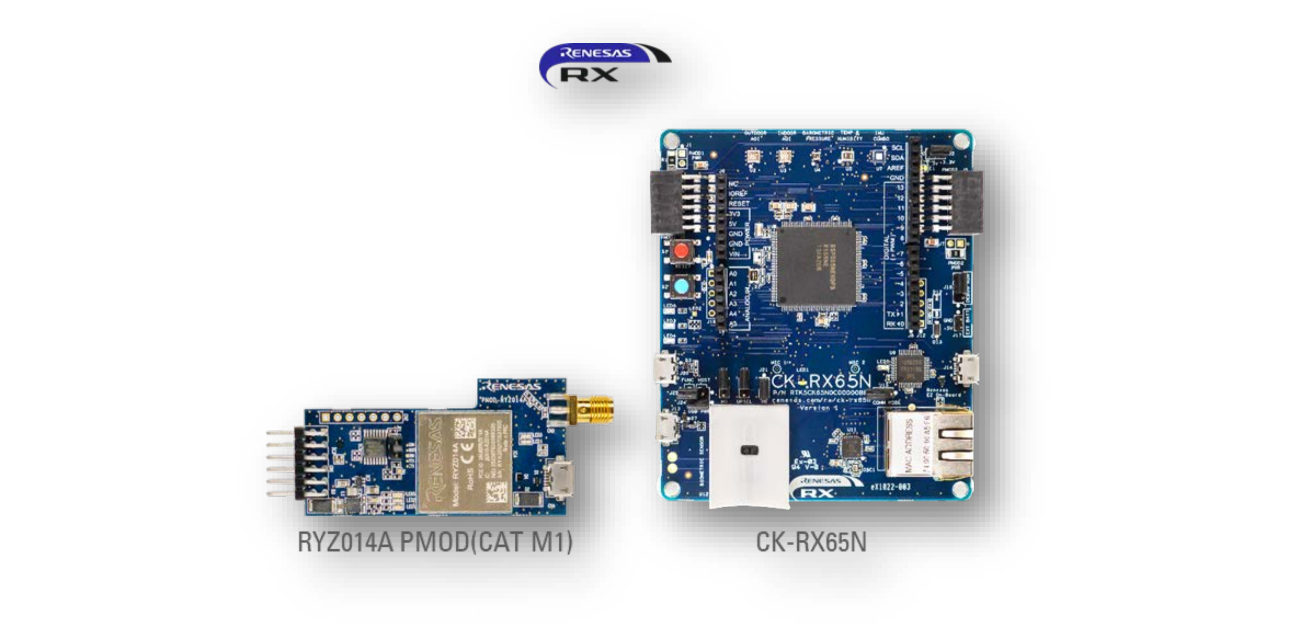


Figure 1. CK-RX65N V1 (with RYZ014A Pmod)

Contents

1. Terms

Terms used in this document are explained below.

Table 1. Terms

Term	Meaning
AWS	AWS Amazon Web Service
Pmod	Peripheral Module
MQTT	Message Queuing Telemetry Transport
OTA	Over-The-Air
TLS	Transport Layer Security
UUID	Unique ID for each kit

2. Preparation

2.1 Hardware Configuration

The hardware configuration of the demo project is listed in the table below.

Table 2. Hardware Configuration

Item	Content	Description
CK-RX65N V1 Cloud Kit	Target board for CK-RX65N V1	Please see detail at: https://www.renesas.com/rx/ck-rx65n
RYZ014A Cellular Pmod module	SIM card	This Pmod is contained with CK-RX65N V1 kit with SIM card
PC	Windows® 10 Google Chrome / Microsoft Edge	Recommended OS. Web browser used.

2.2 Software Configuration

The software configuration of the demo project is listed in the table below.

Table 3. Software Configuration

Item	Content	Version
Integrated development environment	e2 studio (e² studio | Renesas)	2024-01
Compiler	CC-RX (CC-RX Compiler)	V3.05
Communication Software	Tera term (Tera Term - Download (softonic.com))	Version 4.99
Emulator	E2 emulator Lite (on-board)	-
RTOS	AWS FreeRTOS	V202210.01
Python	(Please see detail at: **6.2.1**)	V3.11.0 or later
Keygen tool	Win64 OpenSSL (Please see detail at: **6.2.2**)	V3.0.12
Flash programming tool	Renesas Flash Programmer (Renesas Flash Programmer (Programming GUI) | Renesas)	V3.12.00
Renesas Image Generator	Supplied with Firmware Update module Rev.2.01 (Please see detail at: **6.2.3**)	V3.02

2.3 Tera term Setting

Table 4. Tera term Setting

Item	Settings
Baud rate	115200
Data length	8
Parity	None
Stop bits	1
Flow Control	None

3. System Diagram

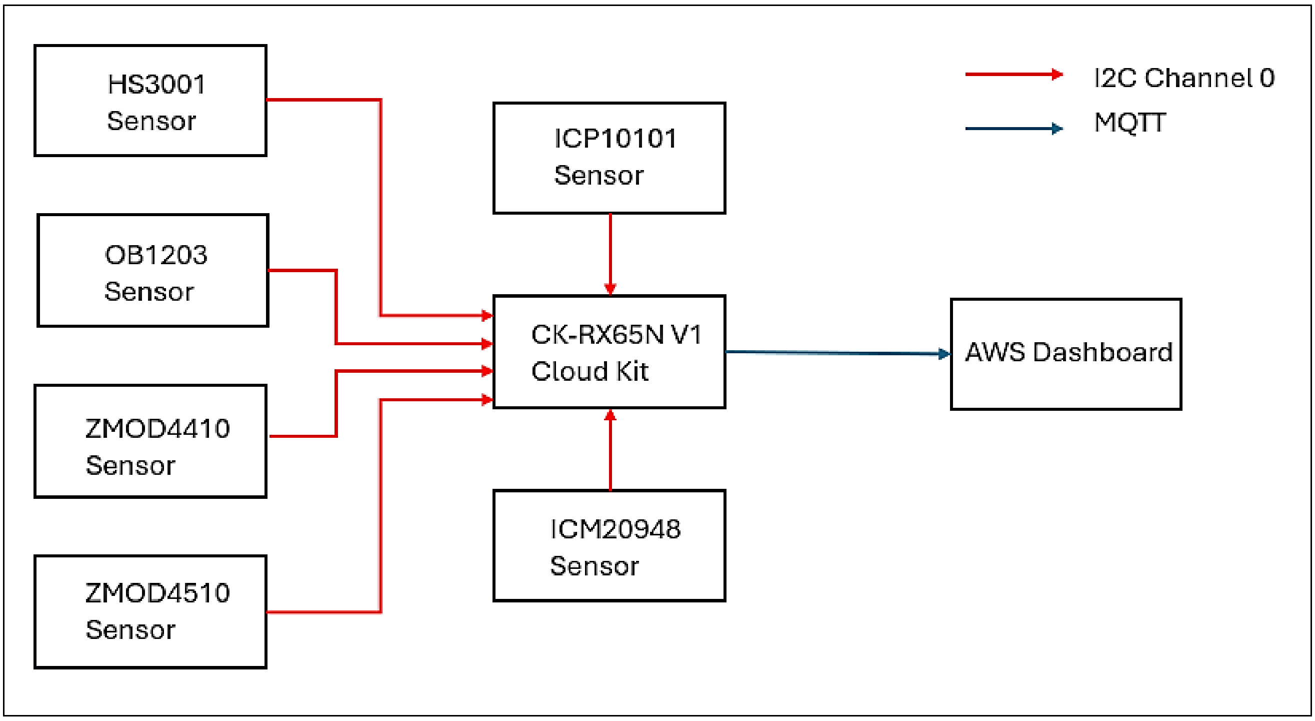


Figure 2. System Diagram

Note: The 9-AXIS MEMS Motion Tracking Sensor TDK ICM-20948 is not fitted on this CK-RX65N board due to shortages in component availability (For more information: CK-RX65N v1 – Release Note (renesas.com))

4. Cloud Connectivity Application Example

4.1 Overview

This application project demonstrates the use of Driver, Middleware and RTOS components, FIT configurator on Renesas RX65N MCU to establish AWS Cloud connectivity using Ethernet/Cellular. It illustrates how the cloud service provider is configured and operated.

This documentation illustrates Subscribe and Publish communications between MQTT Client and MQTT Broker, on-demand publication of sensor data, and asynchronous publication of a "sensor data" event from the MCU to the Cloud.

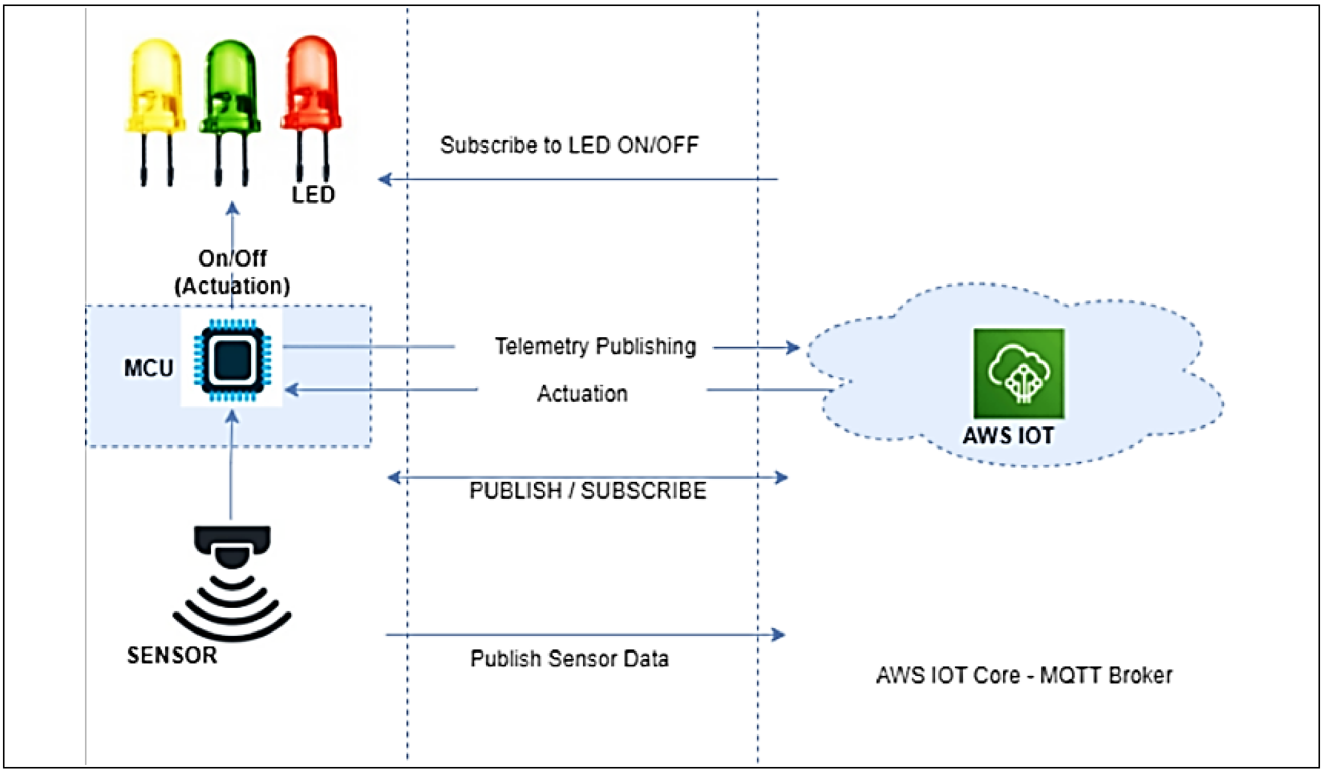


Figure 3. MQTT Publish/Subscribe to/from AWS IoT Core

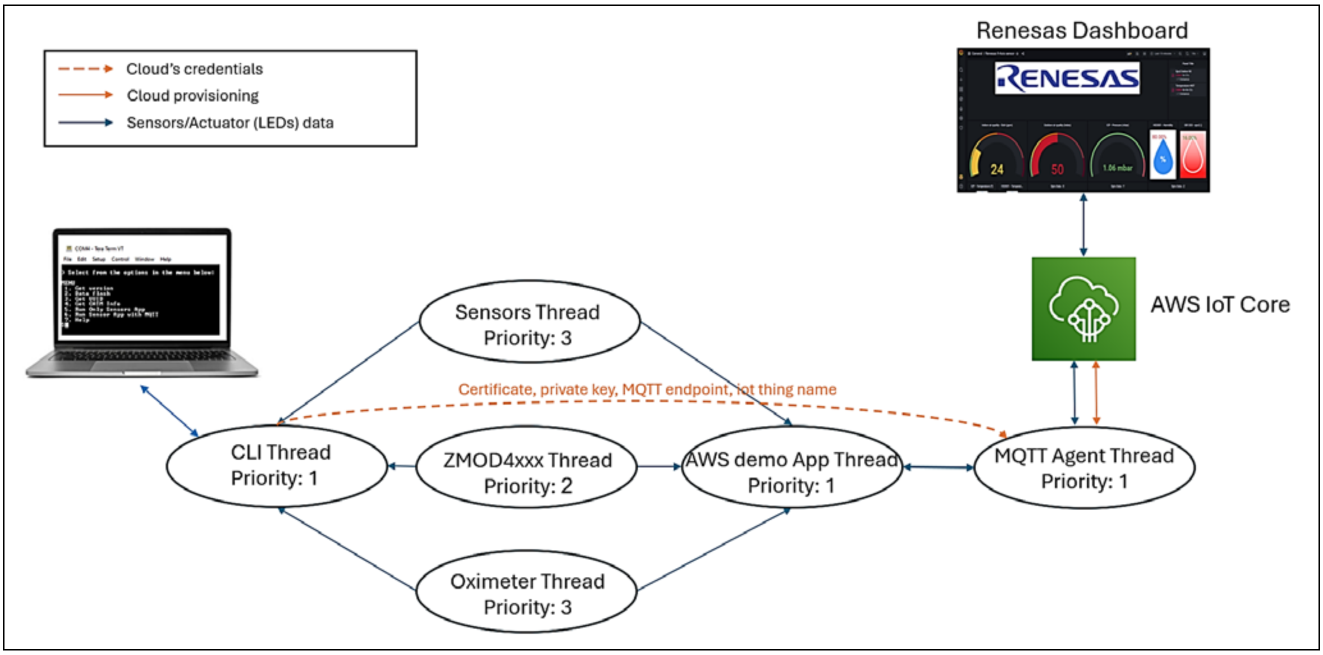
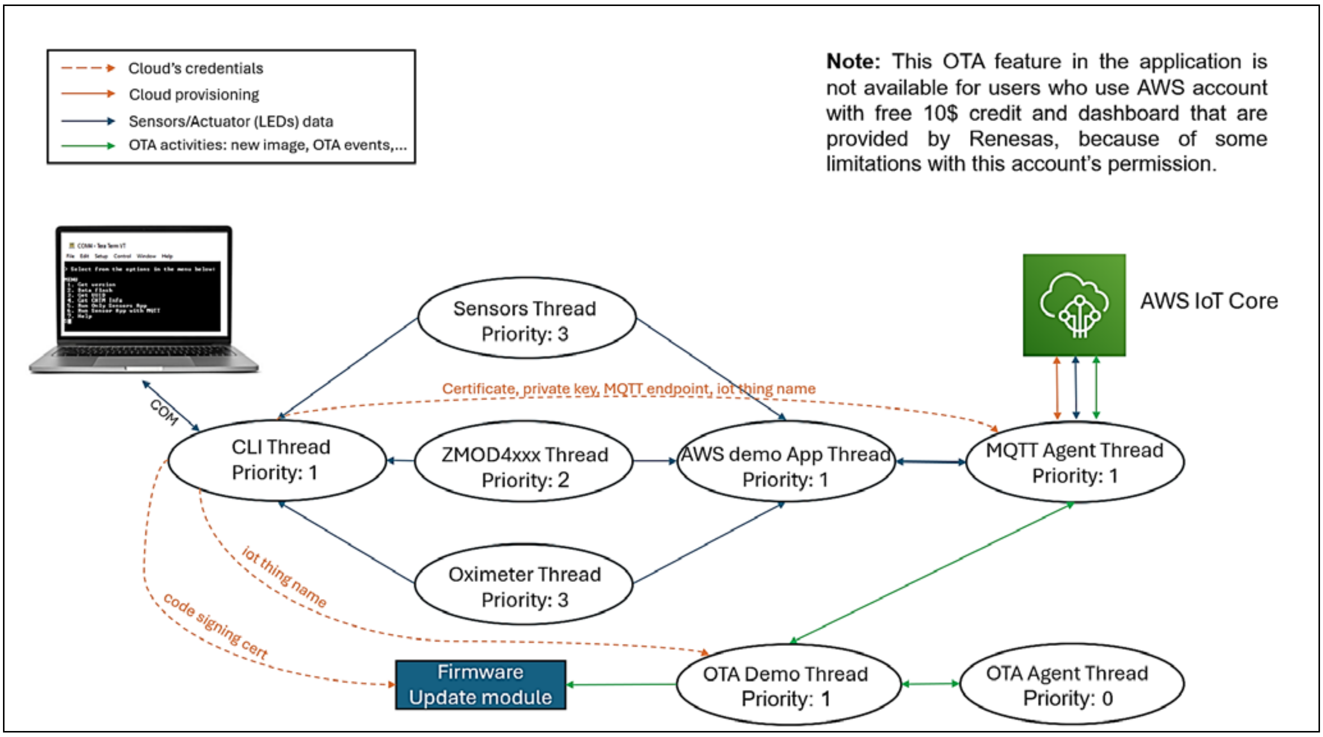


Figure 4. Thread Diagram

Application also supports:

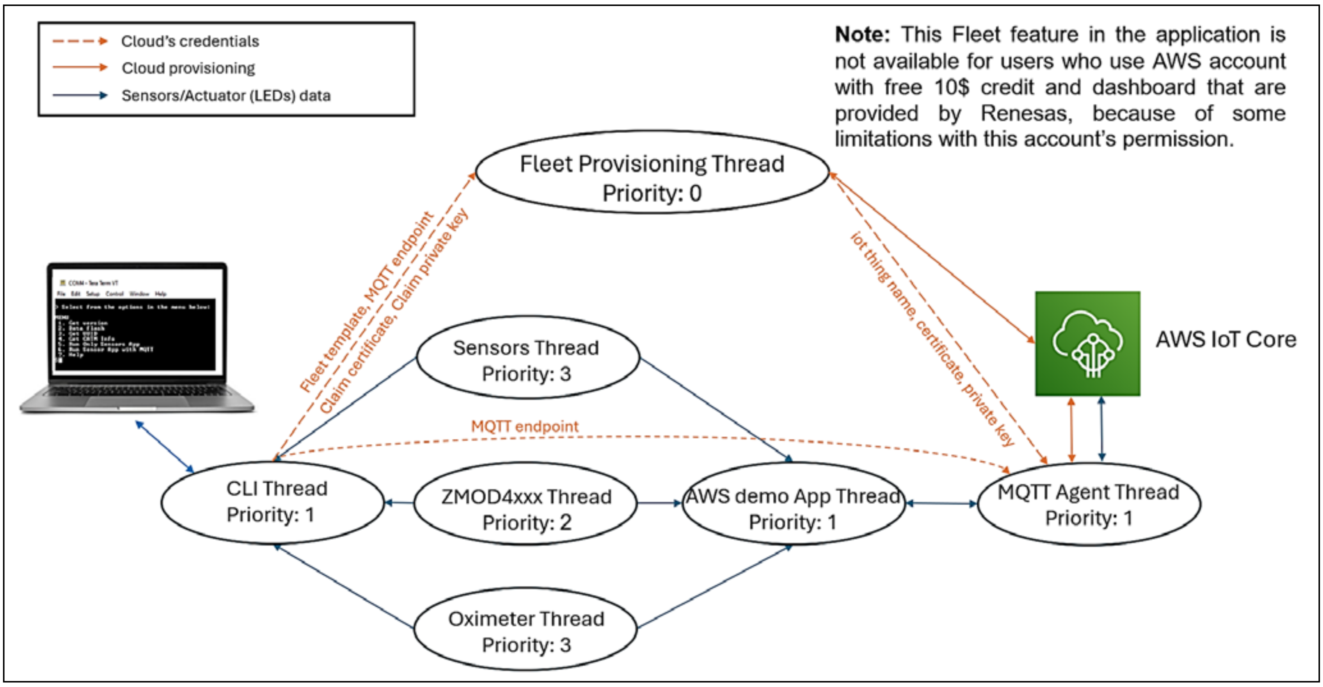
- OTA over MQTT feature for updating new firmware (please refer to the section **6. OTA over MQTT):**



Note: This OTA feature in the application is not available for users who use AWS account with free 10$ credit and dashboard that are provided by Renesas, because of some limitations with this account's permission.

Figure 5. Thread Diagram when enabling OTA feature

- Fleet Provisioning (please refer to the section **7. Fleet Provisioning**):



Note: This Fleet feature in the application is not available for users who use AWS account with free 10$ credit and dashboard that are provided by Renesas, because of some limitations with this account's permission.

Figure 6. Thread Diagram when enabling Fleet feature

4.2 MQTT/TLS Application Software Overview

The following files from these application projects serve as a reference as shown in Table 5.

Table 5. Application Project File

No.	Filename	Purpose
1.	src/application_code/main.c	Contains initialization code of the connection, provisioning cloud credentials used in Cloud Connectivity, main function of application.
2.	src/application_code/user_init.c	Contains initialization functions.
3.	src/application_code/CommandLine/cli_thread_entry.c	Contains data structures and functions used in CLI thread.
4.	src/application_code/CommandLine/common_init.h	Contains macros, data structures, and functions prototypes used to initialize common in the project.
5.	src/application_code/CommandLine/console.c	Contains data structures and functions used to print data on console using UART
6.	src/application_code/CommandLine/console.h	Contains the function prototypes used to print data on console using UART
7.	src/application_code/CommandLine/menu_flash.c	Contains data structures and functions used to provide CLI flash memory related menu
8.	src/application_code/CommandLine/menu_flash.h	Contains the function prototypes and macros used to provide CLI flash memory related menu
9.	src/application_code/CommandLine/menu_kis.c	Contains functions to get the application's version, get UUID and help option for main menu on CLI
10.	src/application_code/CommandLine/menu_kis.h	Contains the function prototypes and macros used to get application's version, get UUID and help option for main menu on CLI
11.	src/application_code/CommandLine/menu_main.c	Contains data structures and functions used to provide CLI main menu options
12.	src/application_code/CommandLine/menu_main.h	Contains the function prototypes and macros used to provide CLI main menu options
13.	src/application_code/CommandLine/common_utils.h	Contains macros, data structures, and functions prototypes commonly used across the project.
14.	src/application_code/CommandLine/r_typedefs.h	Contains typedefs used in application
15.	src/application_code/sensor_thread_entry.c	Contains the code for sensor thread (HS3001, ICP10101 and ICM20948)
16.	src/application_code/ICM20948/icm20948.c	Contains the code for the 9-Axis MEMS Motion Tracking™ Sensor
17.	src/application_code/ICM20948/icm20948.h	Contains the Data structure function prototypes for the 9-Axis MEMS Motion Tracking™ Sensor
18.	src/application_code/ICM20948/icm_i2c.c	Contains the I2C code to communicate with 9-Axis MEMS Motion Tracking™ Sensor
19.	src/application_code/ICM20948/icm_i2c.h	Contains the I2C function prototypes to communicate with 9-Axis MEMS Motion Tracking™ Sensor
20.	src/application_code/ICP10101/ICP_20100.c	Contains the code for Barometric Pressure and Temperature Sensor

No.	Filename	Purpose
21.	src/application_code/ICP10101/ICP_20100.h	Contains the data structure and function prototypes for Barometric Pressure and Temperature Sensor
22.	src/application_code/OB1203/RX_OB1203.c	Contains data structures and functions used for the oximeter sensor
23.	src/application_code/OB1203/ob1203_bio.c	Contains the Data structure for the oximeter sensor
24.	src/application_code/OB1203/ob1203_bio_rx.c	Contains data structures and functions used for the oximeter sensor
25.	src/application_code/OB1203/ob1203_bio.h	Contains the Data structure and function prototypes for the oximeter sensor
26.	src/application_code/OB1203/KALMAN/kalman.c	Contains algorithm for Heart Rate, Blood Oxygen Concentration, Pulse Oximetry, Proximity, Light and Color Sensor sample calculations
27.	src/application_code/OB1203/KALMAN/kalman.h	
28.	src/application_code/OB1203/SAVGOL/SAVGOL.c	
29.	src/application_code/OB1203/SAVGOL/SAVGOL.h	
30.	src/application_code/OB1203/SPO2/SPO2.c	
31.	src/application_code/OB1203/SPO2/SPO2.c	
32.	src/application_code/HS3001/RX_HS3001.c	Contains the code and function for Renesas Relative Humidity and Temperature Sensor.
33.	src/application_code/HS3001/RX_HS3001.h	Contains the common data structure's function prototypes for the Renesas Relative Humidity and Temperature sensors.
34.	src/application_code/ZMOD4x10/RX_ZMOD4XXX_Common.c	Contains the common code for the Renesas ZMOD sensors
35.	src/application_code/ZMOD4x10/RX_ZMOD4XXX_Common.h	Contains the common data structure's function prototypes for the Renesas ZMOD sensors
36.	src/application_code/ZMOD4x10/RX_ZMOD4XXX_IAQ1stGen.c	Contains the common code for the Renesas ZMOD Internal Air Quality sensors
37.	src/application_code/ZMOD4x10/RX_ZMOD4XXX_OAQ1stGen.c	Contains the common code for the Renesas ZMOD Outer Air Quality sensors
38.	src/application_code/frtos_skeleton/ob1203_thread.c	Contains the OB1203 sensor thread (for oximeter sensor)
39.	src/application_code/frtos_skeleton/sensor_thread.c	Contains the sensor's thread (for Renesas Relative Humidity and Temperature Sensor, Barometric Pressure and Temperature Sensor and the 9-Axis MEMS Motion Tracking™ Sensor)
40.	src/application_code/frtos_skeleton/zmod_thread.c	Contains the ZMOD's thread (for Renesas ZMOD Internal Air Quality sensors)
41.	src/application_code/frtos_skeleton/task_function.h	Contains the common data structure's function prototypes for thread
42.	src/application_code/frtos_startup/freertos_object_init.c	Contains the source code for FreeRTOS thread
43.	src/application_code/frtos_startup/freertos_start.c	Contains FreeRTOS user-defined functions

No.	Filename	Purpose
44.	src/application_code/frtos_startup/freertos_start.h	FreeRTOS's user-defined functions header file
45.	src/application_code/frtos_config/*.h	Contains FreeRTOS configuration header file.
46.	src/application_code/sensorsData.h	Contains the common data structure's function prototypes for sensors
47.	Demos/SimplePubSub/simple_pub_sub_task.c	Contains code and functions used in MQTT interface for Cloud Connectivity.
48.	Demos/mqtt_agent/mqtt_agent_task.c	Contains the code for running the MQTT task
49.	Demos/OtaOverMqtt/OtaOverMqttDemoExample.c	Contains function for running OTA over MQTT
50.	Demos/Fleet_Provisioning_With_CSR_Demo	Contains function for running Fleet Provisioning
51.	Demos/cli/serial.c	Contains function for serial communication.
52.	Demos/cli/serial.h	Contains the common data structure's function prototypes for serial.c
53.	Demos/include/*.h	Contains the common data structure's function prototypes for demo function.

Note: The above table only lists some important files in applications.

5. Connection to AWS

AWS account is necessary to connect CK-RX65N V1 Cloud Kit to AWS.

Note: Renesas provides 10 USD of AWS account credit to users who buy the CK-RX65N V1 and this 10 USD credit cannot be used for an existing account.

This document covers two ways of connecting to the AWS account:

Case 1: For users who want to use trial AWS account with 10 USD credits and Renesas Dashboard, please refer to section **5.2 For Users Using the Provided Dashboard and AWS Account of Kit** to get this AWS account**.**

Case 2: For users who already have an AWS account and want to use it instead of trial account, please skip section **5.2 For Users Using the Provided Dashboard and AWS Account of Kit** and refer to section **5.4 For Users Using Their Own AWS Account** to use the account with the application.

5.1 Hardware Preparation and Import the Project

5.1.1 Hardware Preparation

- Connect micro-USB cables to debug port (J14 on the CK-RX65N V1 board)
- Connect micro-USB cables to serial port (J20 on the CK-RX65N V1 board)
- Connect Ethernet cable to the connector (J18) on the board.
- **Set the Jumper of J16 “Debug”**

Note**:** In case user runs the RYZ014A Cellular Application, please skip the Ethernet’s setting and connect the RYZ014A Cellular Pmod module which is inserted SIM card to the Pmod 1.

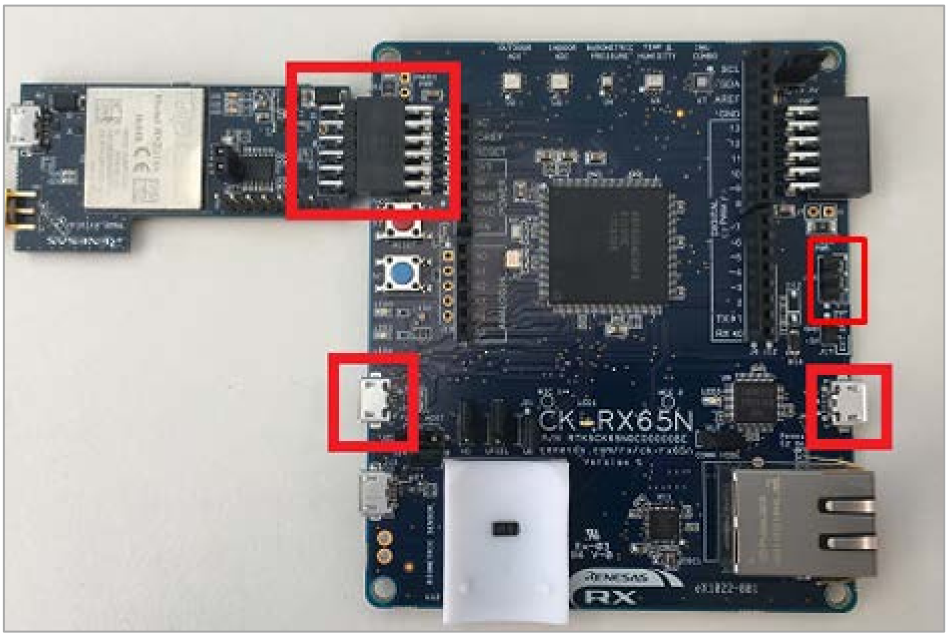
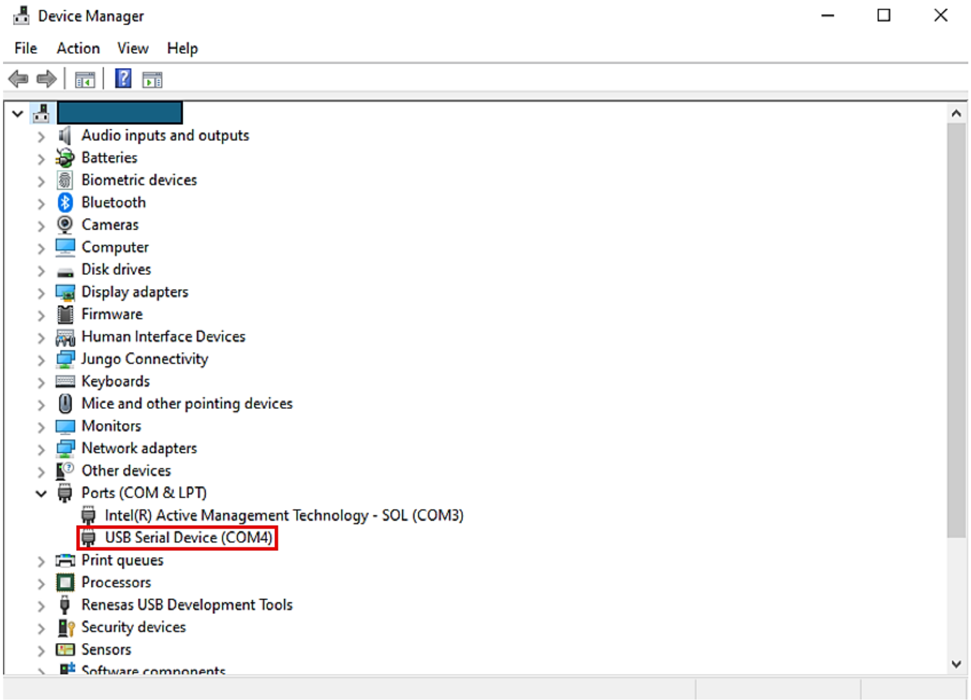


Figure 7. Connecting the USB and RYZ014A Pmod

5.1.2 Connecting the Board to the Serial Port Console of the PC

1. On the host PC, open Windows Device Manager. Expand **Ports (COM & LPT)**, locate **USB Serial Device (COMxx)** and note down the COM port number for reference in the next step.

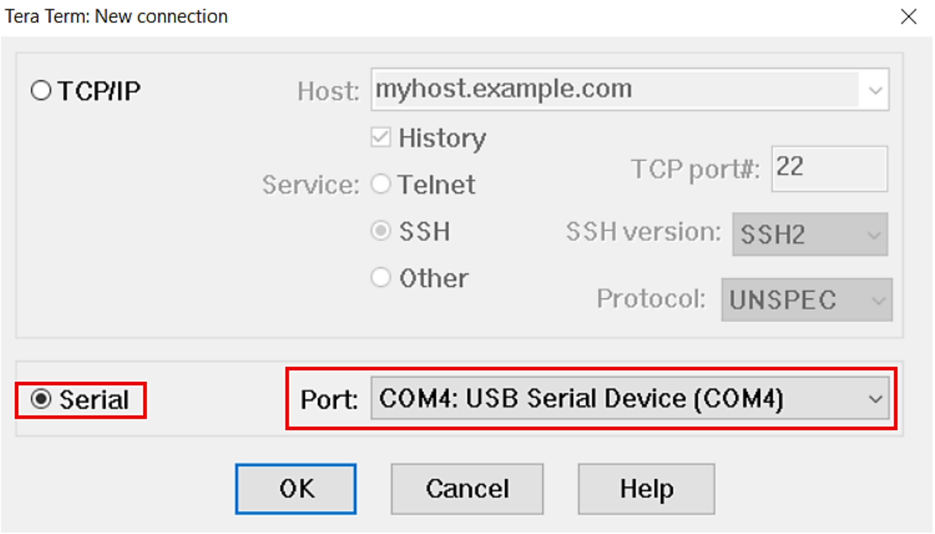
Note: USB Serial Device drivers are required to communicate between the CK-RX65N V1 board and the PC.



[redacted]
- Audio inputs and outputs
- Batteries
- Biometric devices
- Bluetooth
- Cameras
- Computer
- Disk drives
- Display adapters
- Firmware
- Human Interface Devices
- Jungo Connectivity
- Keyboards
- Mice and other pointing devices
- Monitors
- Network adapters
- Other devices
- Ports (COM & LPT)
  - Intel(R) Active Management Technology - SOL (COM3)
  - USB Serial Device (COM4)
- Print queues
- Processors
- Renesas USB Development Tools
- Security devices
- Sensors
- Software components

Figure 8. USB Serial Device in Windows Device Manager

2. Open Tera Term select **New connection** and select **Serial** and **COMxx: USB Serial Device (COMxx)** and click **OK**.


Tera Term: New connection

○ TCP/IP Host: myhost.example.com

☑ History

Service: ○ Telnet TCP port#: 22

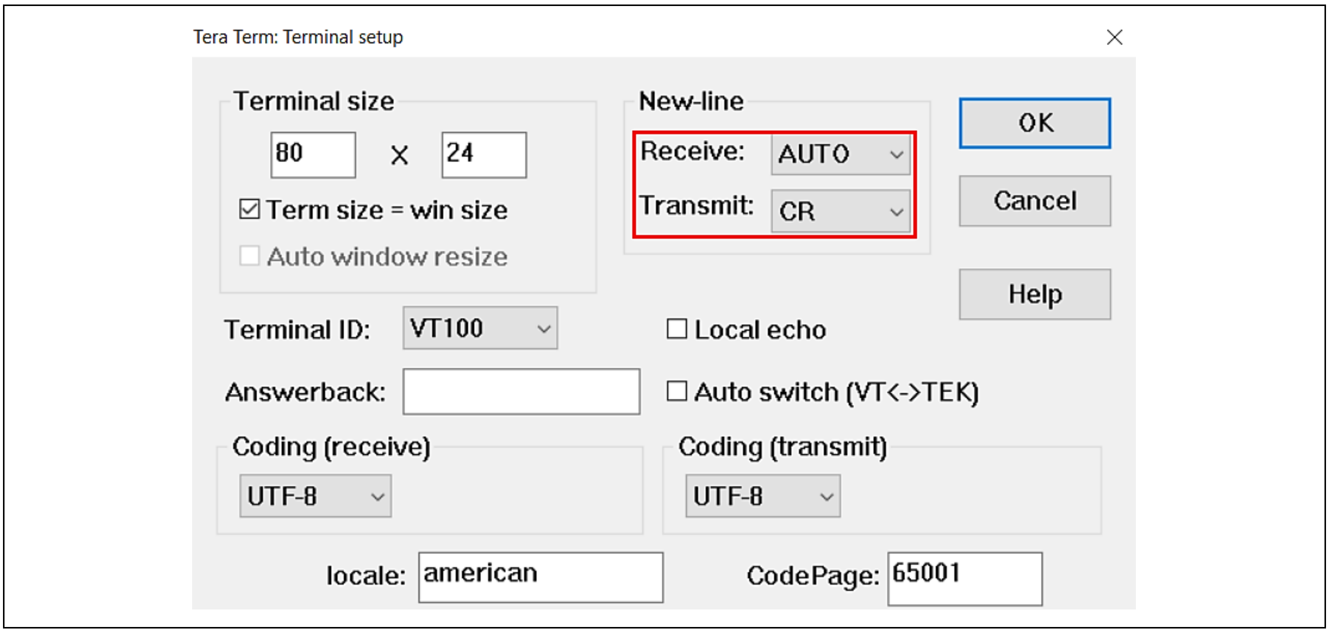
● SSH SSH version: SSH2

○ Other Protocol: UNSPEC

● Serial Port: COM4: USB Serial Device (COM4)

Figure 9. Selecting the Serial Port on Tera Term

3. Using the Setup menu, select **Setup** > **Terminal…** and select “**AUTO**” as Receive, select “**CR**” as Transmit, as shown below.



Tera Term: Terminal setup

Terminal size: 80 X 24

☑ Term size = win size

□ Auto window resize

New-line

Receive: AUTO

Transmit: CR

Terminal ID: VT100

Answerback:

□ Local echo

□ Auto switch (VT<->TEK)

Coding (receive): UTF-8

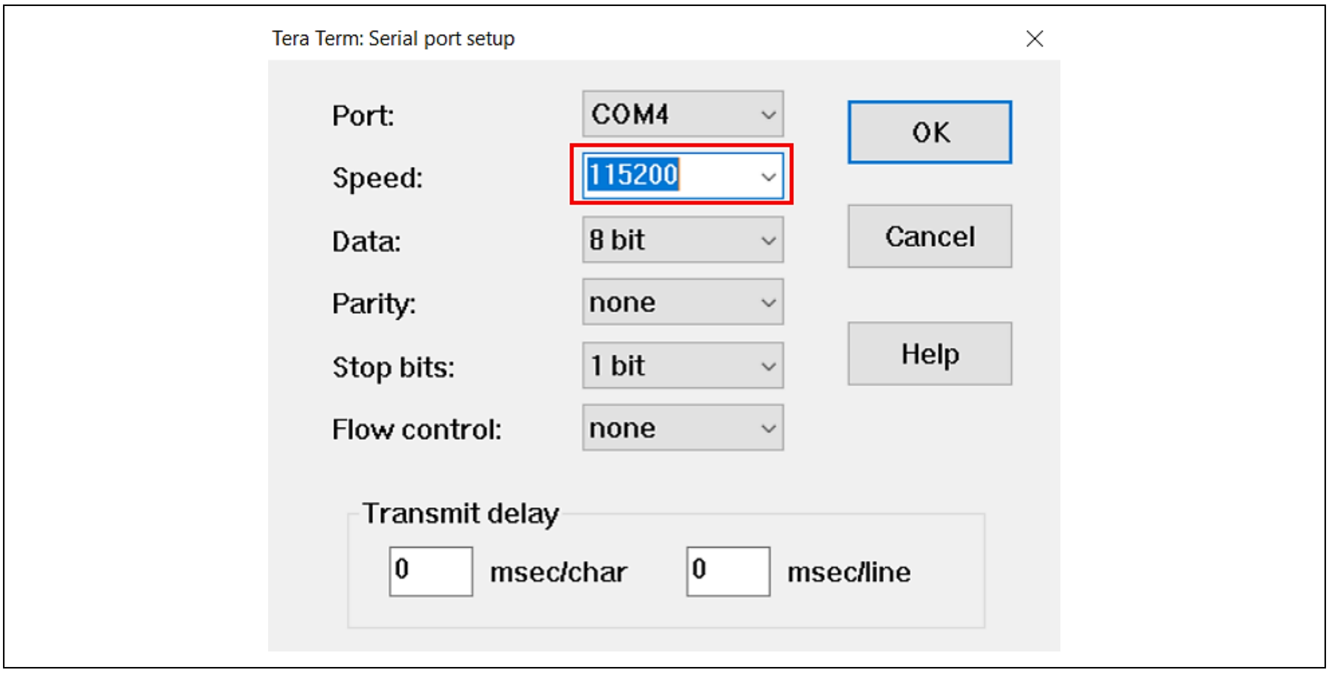
Coding (transmit): UTF-8

locale: american

CodePage: 65001

Figure 10. Select Receive: “Auto” and Transmit: “CR” on the Terminal Setting

4. Using the **Setup** menu pull-down, select **Serial port…** and ensure that the speed is set to 115200, as shown below.



Tera Term: Serial port setup

Port: COM4

Speed: 115200

Data: 8 bit

Parity: none

Stop bits: 1 bit

Flow control: none

Transmit delay

0 msec/char 0 msec/line

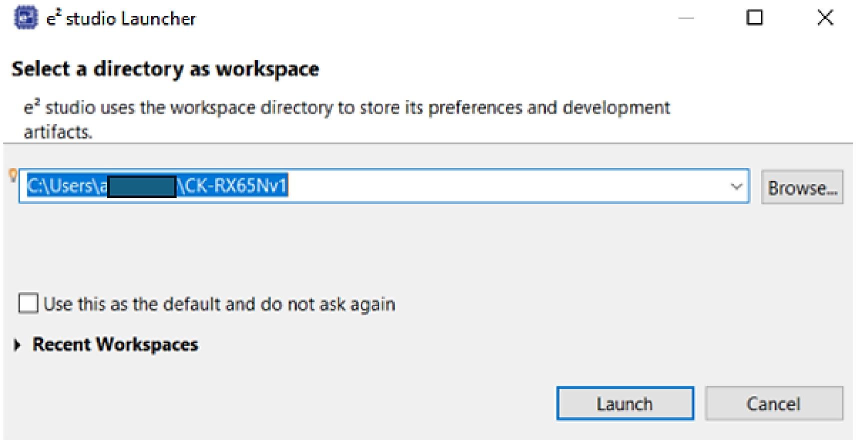
Figure 11. Select 115200 on the Speed Pulldown

5.1.3 Importing the Project

Use the following steps to prepare the software for the demo program:

1. Extract the project files from the archive and copy them to the C drive.
   Please unzip the project file to **a short path of your PC**.
   If the path is deep, a build error may occur due to the file path length issue.

2. Launch e^2 studio and specify a workspace directory and click **Launch.**



Select a directory as workspace

e² studio uses the workspace directory to store its preferences and development artifacts.

C:\Users\a[redacted]\CK-RX65Nv1

□ Use this as the default and do not ask again

Recent Workspaces

Figure 12. Launch e^2 studio

3. Select **File** > **Import**….

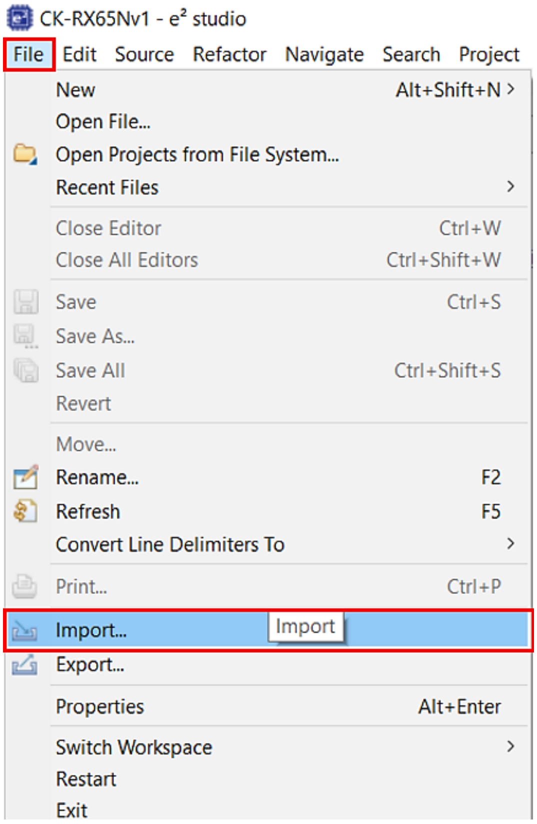
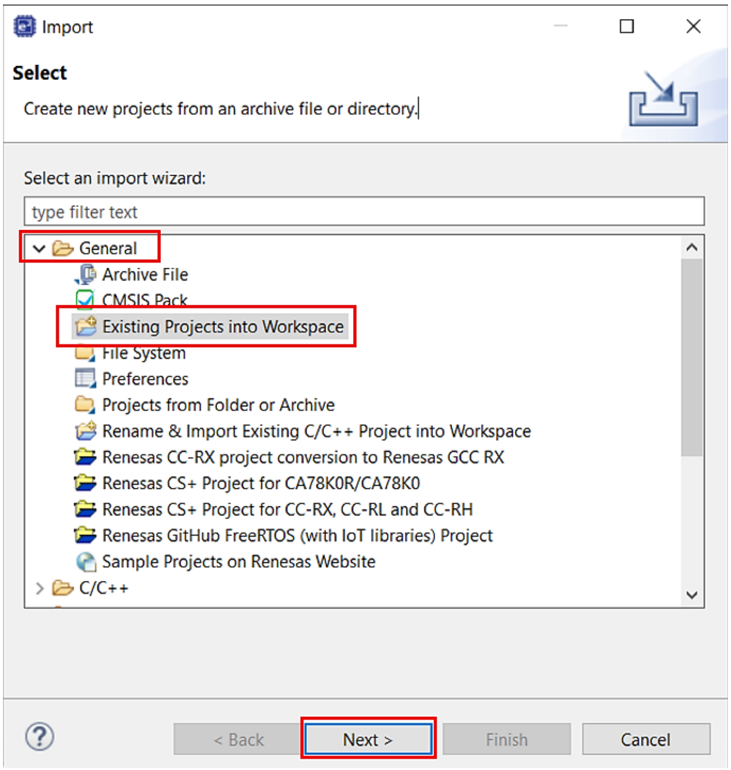


Figure 13. Select Import

4. Click **General > Existing Projects into Workspace > Next**.



Import

Select

Create new projects from an archive file or directory.

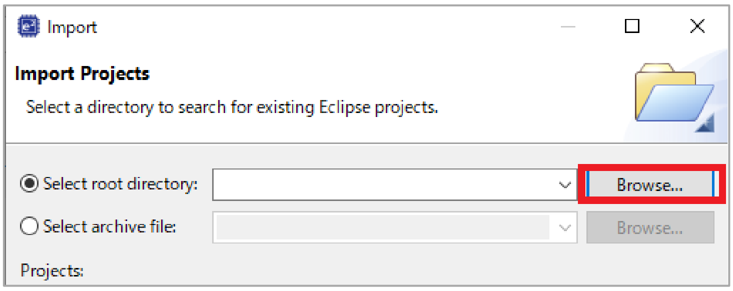
Select an import wizard:

type filter text

- General
  - Archive File
  - CMSIS Pack
  - Existing Projects into Workspace
  - File System
  - Preferences
  - Projects from Folder or Archive
  - Rename & Import Existing C/C++ Project into Workspace
  - Renesas CC-RX project conversion to Renesas GCC RX
  - Renesas CS+ Project for CA78K0R/CA78K0
  - Renesas CS+ Project for CC-RX, CC-RL and CC-RH
  - Renesas GitHub FreeRTOS (with IoT libraries) Project
  - Sample Projects on Renesas Website
- C/C++

Figure 14. Select Existing Projects into Workspace

5. Click **Browse**…, then specify the root directory as described later in this section.



Import

Import Projects

Select a directory to search for existing Eclipse projects.

● Select root directory:

○ Select archive file:

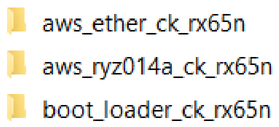
Projects:

Figure 15. Find the Project

You can choose two types of connectivity when importing the project.
Please go to **"[Project Root folder]\Projects"** folder.

Table 6. Details of Each Project

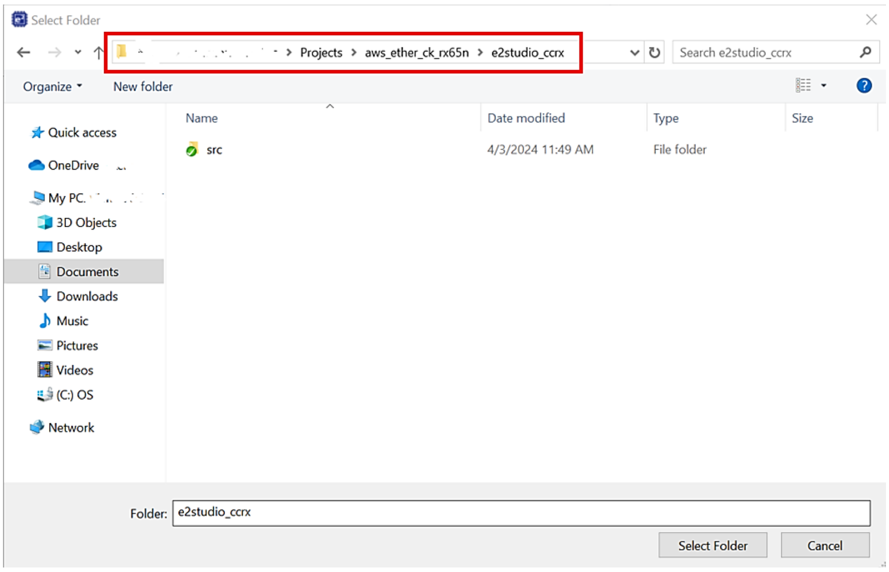
Project Name	Compiler	Connectivity
aws_ether_ck_rx65n	CC-RX	Ethernet
aws_ryz014a_ck_rx65n		Cellular
boot_loader_ck_rx65n (for OTA)		-



aws_ether_ck_rx65n
aws_ryz014a_ck_rx65n
boot_loader_ck_rx65n

Figure 16. Project Files

This example uses “**aws_ether_ck_rx65n**” as the ethernet project.
Open the **“[Project Root folder]\Projects\aws_ether_ck_rx65n\e2studio_ccrx”** folder.

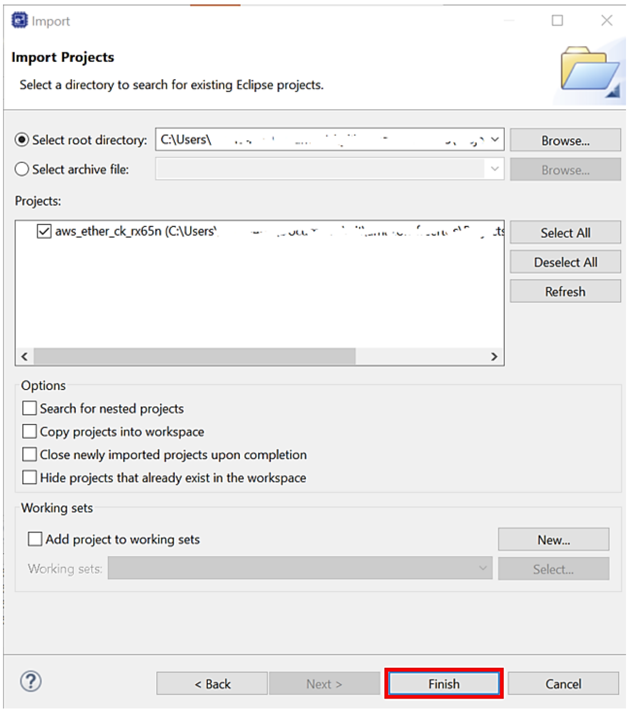


Name	Date modified	Type	Size
src	4/3/2024 11:49 AM	File folder	

Folder: e2studio_ccrx

Figure 17. Select the Project Folder

Finally, click **Finish**.
Note: Make sure that the **Copy projects into workspace** option is unchecked.



Import Projects

Select a directory to search for existing Eclipse projects.

● Select root directory: C:\Users\

○ Select archive file:

Projects:

☑ aws_ether_ck_rx65n (C:\Users\

Options

□ Search for nested projects
□ Copy projects into workspace
□ Close newly imported projects upon completion
□ Hide projects that already exist in the workspace

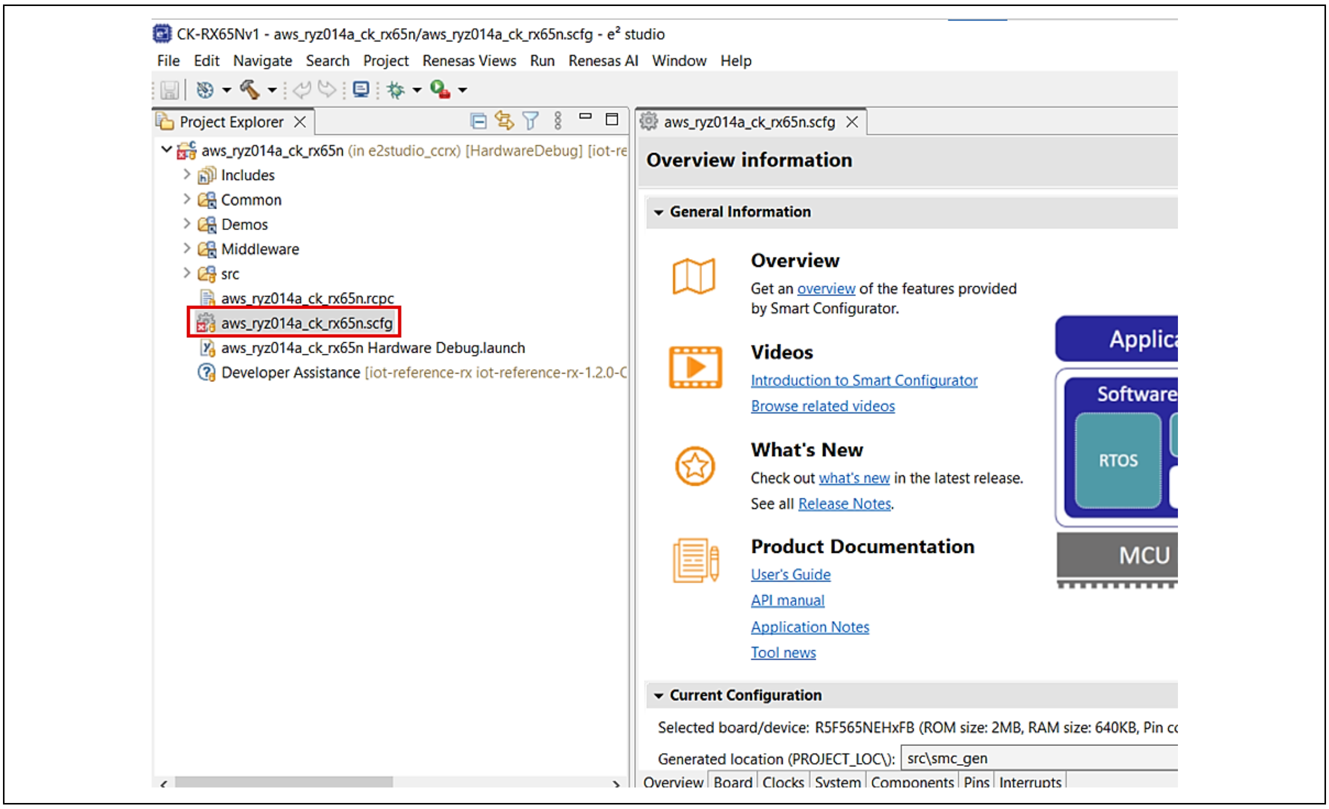
Working sets

□ Add project to working sets

Working sets:

Figure 18. Finish Importing the Project

6. Check and set the SIM card information. **(In case of using cellular application)**
   Double click “**aws_ryz014a_ck_rx65n.scfg”** to open the smart configurator.


CK-RX65Nv1 - aws_ryz014a_ck_rx65n/aws_ryz014a_ck_rx65n.scfg - e² studio
File Edit Navigate Search Project Renesas Views Run Renesas AI Window Help
Project Explorer
aws_ryz014a_ck_rx65n (in e2studio_ccrx) [HardwareDebug] [iot-re
Includes
Common
Demos
Middleware
src
aws_ryz014a_ck_rx65n.rcpc
aws_ryz014a_ck_rx65n.scfg
aws_ryz014a_ck_rx65n Hardware Debug.launch
Developer Assistance [iot-reference-rx iot-reference-rx-1.2.0-C
aws_ryz014a_ck_rx65n.scfg
Overview information
General Information
Overview
Videos
Introduction to Smart Configurator
Browse related videos
What's New
Product Documentation
User's Guide
API manual
Application Notes
Tool news
Applic
Software
RTOS
MCU
Current Configuration
Overview Board Clocks System Components Pins Interrupts

Get an overview of the features provided by Smart Configurator.

Check out what's new in the latest release.

See all Release Notes.

Selected board/device: R5F565NEHxFB (ROM size: 2MB, RAM size: 640KB, Pin c

Generated location (PROJECT_LOC\): src\smc_gen

Figure 19. Open the Smart Configurator

If using Cellular application, please check following configurations for SIM card of cellular driver:

Table 7. Information for Setting SIM of Cellular Driver When Using Truphone SIM Card in the Kit

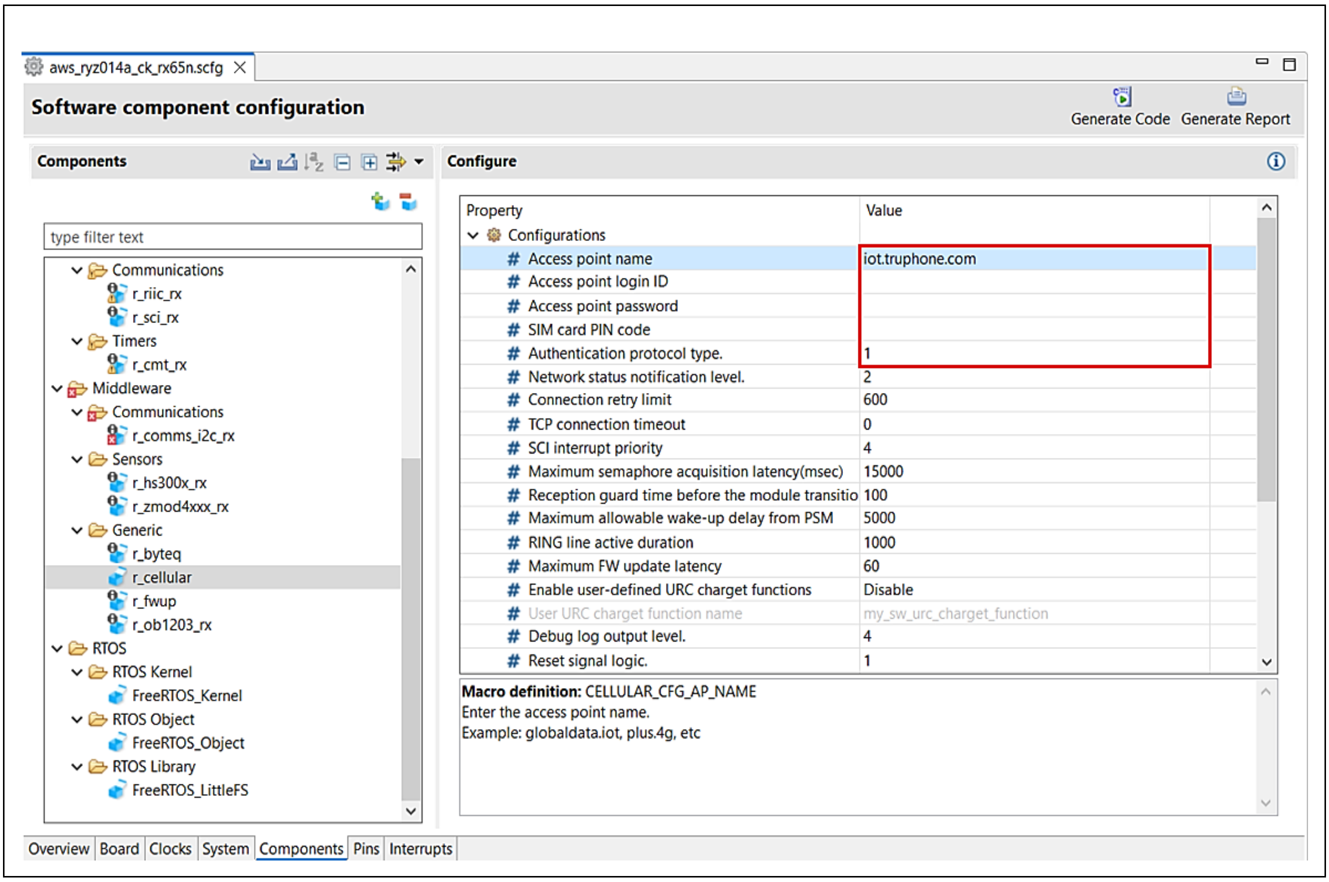
Items	**Truphone**
APN (Access point name)	iot.truphone.com
UserID (Access point login ID)	(Null)
Password (Access point password)	(Null)
SIM card PIN code	(Null)
Authentication protocol type	1 (PAP)

Note: Please use the configuration of the included SIM card.

Set the above configuration values when using the SIM contained in the kits.

If you are using a different SIM card, please set the value provided by the SIM provider.

Choose “**Components > Middleware > Generic > r_cellular**”:



Property	Value
Configurations	
# Access point name	iot.truphone.com
# Access point login ID	
# Access point password	
# SIM card PIN code	
# Authentication protocol type.	1
# Network status notification level.	2
# Connection retry limit	600
# TCP connection timeout	0
# SCI interrupt priority	4
# Maximum semaphore acquisition latency(msec)	15000
# Reception guard time before the module transitio	100
# Maximum allowable wake-up delay from PSM	5000
# RING line active duration	1000
# Maximum FW update latency	60
# Enable user-defined URC charget functions	Disable
# User URC charget function name	my_sw_urc_charget_function
# Debug log output level.	4
# Reset signal logic.	1

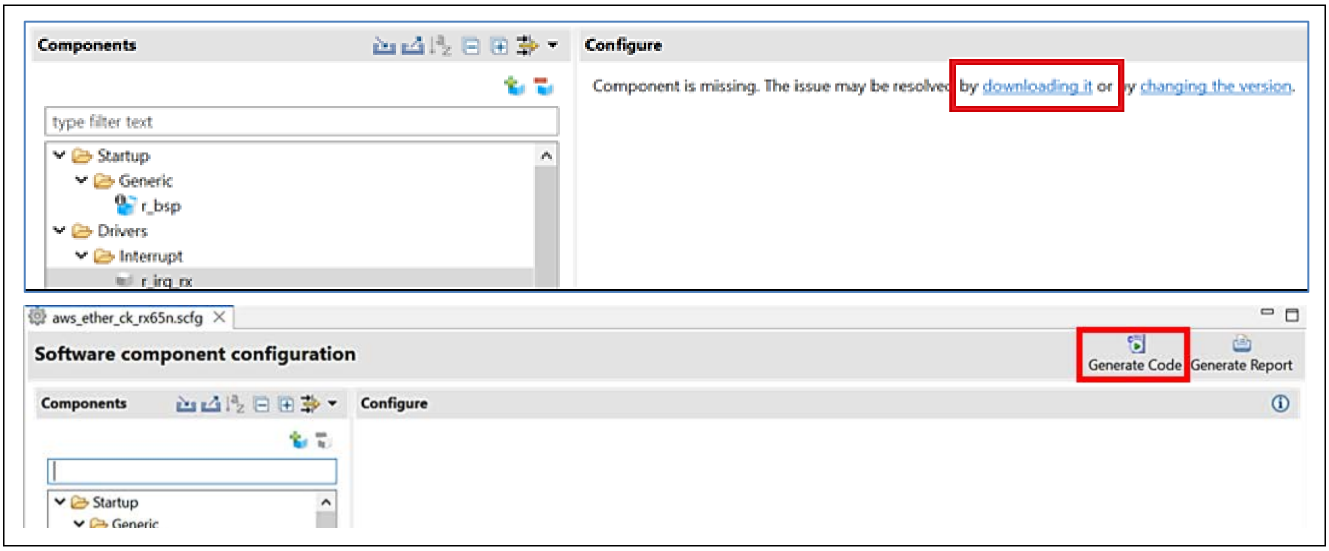
Macro definition: CELLULAR_CFG_AP_NAME
Enter the access point name.
Example: globaldata.iot, plus.4g, etc

Figure 20. Set the SIM Information when Using Contained SIM Card in the Kit

7. Execute code generation.

If you have changed the Smart Configurator settings, click **Generate Code**.

Note: If the user’s environment does not have the FIT component’s version that matches the application, please download it by choosing **aws_ether_ck_rx65n.scfg** > **Components** > **downloading it**



Component is missing. The issue may be resolved by downloading it or by changing the version.

Figure 21. Generate Code

Table 8 shows the common configurations of each component in Projects.

Table 8. Components Configuration

No	Component	Configuration
1	**Startup→Generic→r_bsp (v7.20)**	User stack setting: **2 stacks**
		User stack size:**0x2000**
		Interrupt stack size: **0x400**
		Heap size: **0x1000**
		Initializes C input and output library functions: **Enable**
		Enable user stdio charget function: **Use BSP charget() function**
		User stdio charget function name: **my_sw_charget_function**
		Enable user stdio charput function: **Use BSP charput() function**
		User stdio charput function name: **my_sw_charput_function**
		Software Interrupt Unit1 (SWINT1): **Unused**
		Software Interrupt Unit2 (SWINT2): **Unused**
		Serial terminals select: **Enable**
		Channel for serial terminal: **Channel 5**
		Bitrate for serial terminal: **115200**
		Interrupt priority for serial terminal: **Priority level 15 (highest)**
2	**Drivers→Interrupt→r_irq_rx (v4.10)**	Locking function for IRQ APIs: **Enable**
		Resources → ICU: IRQ0 Pin: IRQ1 Pin: ✓ IRQ2 Pin: ✓ IRQ3 Pin: IRQ4 Pin: IRQ5 Pin: IRQ6 Pin: IRQ7 Pin: ✓ IRQ8 Pin: IRQ9 Pin: IRQ10 Pin: IRQ11 Pin: IRQ12 Pin: IRQ13 Pin: ✓ IRQ14 Pin: ✓ IRQ15 Pin: ✓
3	**Drivers→A/D Converter→r_s12ad_rx (v5.00)**	Resources→S12AD→S12AD1: ✓ →AN115 Pin: ✓ →AN117 Pin: ✓
4	**Drivers→Memory→r_flash_rx (v5.00)**	Enable code flash programming: **Includes code to program ROM area**
		Enable BGO/Non-blocking data flash operations: **Enable BGO (background operations/interrupt) mode**
		Enable BGO/Non-blocking code flash operations: **Enable BGO (background operations/interrupt) mode**
		Enable code flash self-programming: **Programming code flash while executing from another segment in ROM**

No	Component	Configuration
5	**Drivers→Security→r_tsip_rx (v1.17.l)**	-
6	**Drivers→Communications→r_ether_rx (v1.23)** (For Ethernet project only)	Ethernet interface: **RMII (Reduced Media Independent Interface)**
		PHY-LSI address setting for ETHER0: **5**
		The register bus of PHY0 for ETHER0/: **Use ETHER0**
		The polarity of the link signal output by the PHY-LSI: **Rise -> Fall**
		Use ICS1894032 of the Renesas Electronics Corporation: **Used**
7	**Drivers→Communications→r_riic_rx (v2.50)**	MCU supported channels for CH0: **Supported**
		CH0 RIIC bps(kbps): **400**
		Resources→RIIC RIIC0: ✓ • SCL0 Pin: ✓ **Used** • SDA0 Pin: ✓ **Used**
8	**Drivers→Communications→r_sci_iic_rx (v2.50)**	MCU supported channels for CH0: **Supported**
9	**Drivers→Communications→r_sci_rx (v4.40)**	Include software support for channel 5: **Include**
		Include software support for channel 6: **Include** (For RYZ014A project only)
		ASYNC mode TX queue buffer size for channel 5: **80**
		ASYNC mode TX queue buffer size for channel 6: **2180** (For RYZ014A project only)
		ASYNC mode RX queue buffer size for channel 5: **80**
		ASYNC mode RX queue buffer size for channel 6: **8192** (For RYZ014A project only)
		Transmit end interrupt: **Enable** (For RYZ014A project only)
		GROUPBL0 (ERI, TEI) interrupt priority: **3**
		Resources→SCI →SCI5**:** ✓ • RXD5/SMISO5/SSCL5 Pin: ✓ **Used** • TXD5/SMOSI5/SSDA5 Pin: ✓ **Used** →SCI6: ✓ (For RYZ014A project only) • RXD6/SMISO6/SSCL6 Pin: ✓ **Used** • TXD6/SMOSI6/SSDA6 Pin: ✓ **Used** • CTS6#/RTS6#/SS6# Pin: ✓ **Used**
10	**Drivers→Timers→r_cmt_rx (v5.40)**	CMT interrupts priority level: **4**
11	**Middleware→ Communications→r_comms_i2c_rx (v1.21)**	Number of I2C Share Buses: **1**
		Number of I2C Communication Devices: **7**
		I2C Driver Type for I2C Shared Bus0: **RIIC** Channel No. for I2C Shared Bus0: **0**
		I2C Shared Bus No. for I2C Communication Device0: **I2C Shared Bus0** Slave address for I2C Communication Device0: **0x44** Callback function for I2C Communication Device0: **rm_hs300x_callback0**

No	Component	Configuration
		I2C Shared Bus No. for I2C Communication Device1: **I2C Shared Bus0** Slave address for I2C Communication Device1: **0x32** Callback function for I2C Communication Device1: **rm_zmod4xxx_callback0**
		I2C Shared Bus No. for I2C Communication Device2: **I2C Shared Bus0** Slave address for I2C Communication Device2: **0x33** Callback function for I2C Communication Device2: **rm_zmod4xxx_callback1**
		I2C Shared Bus No. for I2C Communication Device3: **I2C Shared Bus0** Slave address for I2C Communication Device3: **0x53** Callback function for I2C Communication Device3: **rm_ob1203_callback0**
		I2C Shared Bus No. for I2C Communication Device4: **I2C Shared Bus0** Slave address for I2C Communication Device4: **0x53** Callback function for I2C Communication Device4: **rm_ob1203_callback1**
		I2C Shared Bus No. for I2C Communication Device5: **I2C Shared Bus0** Slave address for I2C Communication Device5: **0x63** Callback function for I2C Communication Device5: **comms_i2c_callback_icp**
		I2C Shared Bus No. for I2C Communication Device6: **I2C Shared Bus0** Slave address for I2C Communication Device6: **0x68** Callback function for I2C Communication Device6: **comms_i2c_callback_icm**
12	**Middleware→Sensors→r_hs300x_rx (v1.22)**	Number of HS300x Sensors: **1**
		Data types from HS300x Sensor: **Humidity and Temperature**
		I2C Communication device No. for HS300x sensor device0: **I2C Communication Device0**
		Callback function for HS300x sensor device0: **hs300x_callback**
13	**Middleware→Sensors→r_zmod4xxx_rx (v1.20)**	Number of ZMOD4xxx Sensors: **2**
		Operation mode of ZMOD4XXX Sensor0: **IAQ 1st Gen. (Continuous)**
		I2C Communication device No. for ZMOD4XXX sensor devices: **I2C Communication Device1**
		I2C callback function for ZMOD4XXX sensor device0: **zmod4xxx_user_i2c_callback0**
		IRQ callback function for ZMOD4XXX sensor device0: **zmod4xxx_user_irq_callback0**
		Enable IRQ from ZMOD4XXX sensor device 0: **Enabled**
		IRQ number for ZMOD4XXX sensor device0: **IRQ14**
		IRQ interrupt priority for ZMOD4XXX sensor device0: **10**
		Operation mode of ZMOD4XXX Sensor1: **OAQ 1st Gen.**

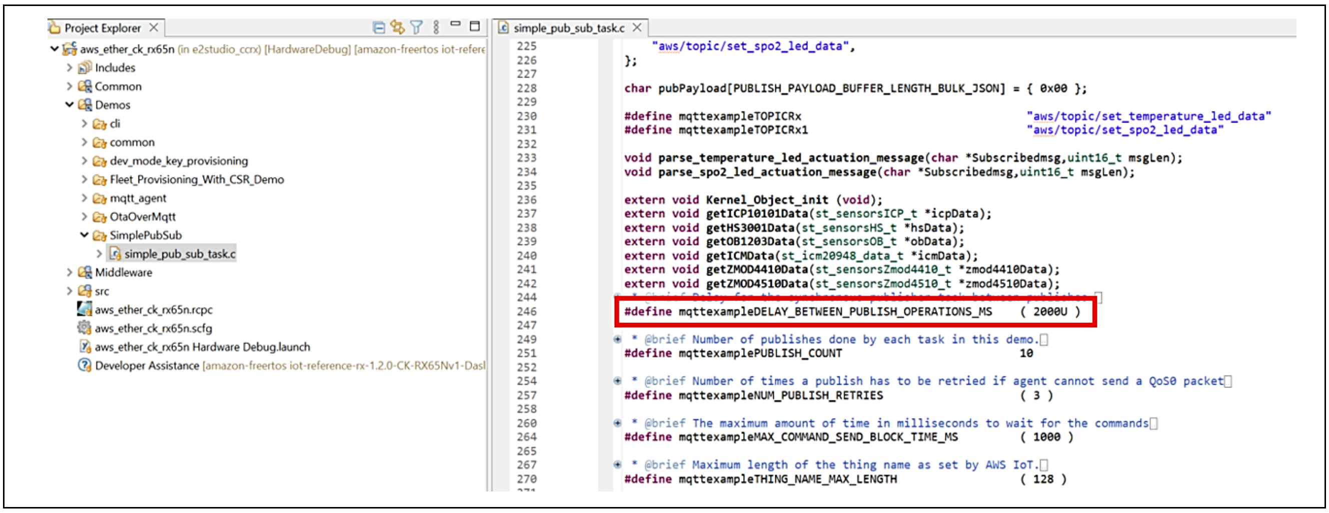
No	Component	Configuration
		I2C Communication device No. for ZMOD4XXX sensor devices: **I2C Communication Device2**
		I2C callback function for ZMOD4XXX sensor device1: **zmod4xxx_user_i2c_callback1**
		Enable IRQ from ZMOD4XXX sensor device 1: **Enabled**
		IRQ callback function for ZMOD4XXX sensor device1: **zmod4xxx_user_irq_callback1**
		IRQ number for ZMOD4XXX sensor device1: **IRQ13**
		IRQ interrupt priority for ZMOD4XXX sensor device0: **5**
14	**Middleware→Generic→r_byteq (v2.00)**	Memory allocation for queue control blocks: **Static memory allocation**
		Number of static queue control block: **32**
15	**Middleware→Generic→r_cellular (v1.11)** (For RYZ014A project only)	Access point name: **iot.truphone.com** Note: Depending on SIM Card information
		Access point login ID: - Note: Depending on SIM Card information
		Access point password: **-** Note: Depending on SIM Card information
		SIM card PIN code: **-** Note: Depending on SIM Card information
		Authentication protocol type: **1**
		Network status notification level: **2**
		Reset signal logic: **1**
		SCI Channel: **6**
		UART hardware flow control: **CTS(Hardware), RTS(Software)**
		RTS port number: **PORT0**
		RTS pin number: **BIT2**
		Reset port number: **PORT5**
		Reset pin number: **BIT5**
		IRQ Number: **4**
16	**Middleware→Generic→r_fwup (v2.01)**	Select the update mode: **Dual bank**
		Select the function mode: **user for User program**
		Main area start address: **0xFFF00000**
		Buffer area start address: **0xFFE00000**
		Install area size: **0xF0000**
17	**MIddleware→Generic→r_ob1203_rx (v1.01)**	Number of OB1203 Sensors: **2**
		Sensor mode of OB1203 Sensor device0: **Proximity sensor mode**
		I2C Communication device No. for OB1203 sensor device0: **I2C Communication Device 3**
		I2C callback function for OB1203 sensor device0: **ob1203_comms_i2c_callback**
		Enable IRQ from OB1203 sensor device0: **Enabled**
		IRQ callback function for OB1203 sensor device0: **ob1203_irq_callback**
		IRQ number for OB1203 sensor device0: **IRQ15**
		IRQ trigger for OB1203 sensor device0: **Falling**
		IRQ interrupt priority for OB1203 sensor device0: **Priority 14**
		Sensor mode of Ob1203 Sensor device1: **PPG sensor mode**

<table>
<tr><th>No</th><th>Component</th><th>Configuration</th></tr>
<tr><td></td><td></td><td>I2C Communication device No. for OB1203 sensor device1: **I2C Communication Device 4**</td></tr>
<tr><td></td><td></td><td>I2C callback function for OB1203 sensor device1: **ob1203_comms_i2c_callback**</td></tr>
<tr><td></td><td></td><td>Enable IRQ from OB1203 sensor device1: **Enabled**</td></tr>
<tr><td></td><td></td><td>IRQ callback function for OB1203 sensor device1: **ob1203_irq_callback**</td></tr>
<tr><td></td><td></td><td>IRQ number for OB1203 sensor device1: **IRQ15**</td></tr>
<tr><td></td><td></td><td>IRQ trigger for OB1203 sensor device1: **Falling**</td></tr>
<tr><td></td><td></td><td>IRQ interrupt priority for OB1203 sensor device1: **Priority 14**</td></tr>
<tr><td>18</td><td>**RTOS→RTOS Kernel→FreeRTOS_Kernel (V202210.01)**</td><td>RTOS scheduler: **Preemptive**</td></tr>
<tr><td></td><td></td><td>Maximum number of priorities to the application task: **7**</td></tr>
<tr><td></td><td></td><td>The frequency of the RTOS tick interrupt: **(TickType_t) 1000**</td></tr>
<tr><td></td><td></td><td>The size of the stack used by the idle task: **768**</td></tr>
<tr><td></td><td></td><td>The configTOTAL_HEAP_SIZE_N: **256**</td></tr>
<tr><td></td><td></td><td>The maximum permissible length of name: **12**</td></tr>
<tr><td></td><td></td><td>Idle should yield: ✓ **Enabled**</td></tr>
<tr><td></td><td></td><td>Mutex functionality: ✓ **Enable**</td></tr>
<tr><td></td><td></td><td>Counting semaphore functionality: ✓ **Enable**</td></tr>
<tr><td></td><td></td><td>Software timer functionality: ✓ **Enable**</td></tr>
<tr><td></td><td></td><td>Priority of the software timer task: **6**</td></tr>
<tr><td></td><td></td><td>The length of the software timer command queue: **5**</td></tr>
<tr><td></td><td></td><td>Kernel interrupt priority: **1**</td></tr>
<tr><td></td><td></td><td>Maximum syscall interrupt priority: **4**</td></tr>
<tr><td></td><td></td><td>Tick vector: **_CMT0_CMI0**</td></tr>
<tr><td></td><td></td><td>Record stack high address: ✓ **Enable**</td></tr>
<tr><td></td><td></td><td>Dynamic allocation: ✓ **Enable**</td></tr>
<tr><td></td><td></td><td>Static allocation: ✓ **Enable**</td></tr>
<tr><td>19</td><td>**RTOS→RTOS Object→FreeRTOS_Object (V202210.01)**</td><td><table>
<tr><th>Initialize</th><th>Task Code</th><th>Task Handler</th><th>Priority</th><th>Stack Size</th></tr>
<tr><td>kernel start</td><td>zmod_thread</td><td>handle_zmod_thread</td><td>2</td><td>1024</td></tr>
<tr><td>kernel start</td><td>ob1203_thread</td><td>handle_ob1203_thread</td><td>3</td><td>1024</td></tr>
<tr><td>kernel start</td><td>sensor_thread</td><td>handle_sensor_thread</td><td>3</td><td>2048</td></tr>
</table></td></tr>
<tr><td>20</td><td>**RTOS→RTOS Library→FreeRTOS_LittleFS (V202210.01)**</td><td>.block_count: **70**</td></tr>
</table>

8. Data Publishing Interval Settings (Optional)

Data publish interval can be set by the user. The default publishing interval time is 2 seconds. “Demos/SimplePubSub/simple_pub_sub_task.c” file has the macro to change the publish time interval.

```
#define mqttexampleDELAY_BETWEEN_PUBLISH_OPERATIONS_MS (2000U)
```


Project Explorer
aws_ether_ck_rx65n (in e2studio_ccrx) [HardwareDebug] [amazon-freertos iot-refere
Includes
Common
Demos
cli
common
dev_mode_key_provisioning
Fleet_Provisioning_With_CSR_Demo
mqtt_agent
OtaOverMqtt
SimplePubSub
simple_pub_sub_task.c
Middleware
src
aws_ether_ck_rx65n.rcpc
aws_ether_ck_rx65n.scfg
aws_ether_ck_rx65n Hardware Debug.launch
Developer Assistance [amazon-freertos iot-reference-rx-1.2.0-CK-RX65Nv1-Dasl
simple_pub_sub_task.c

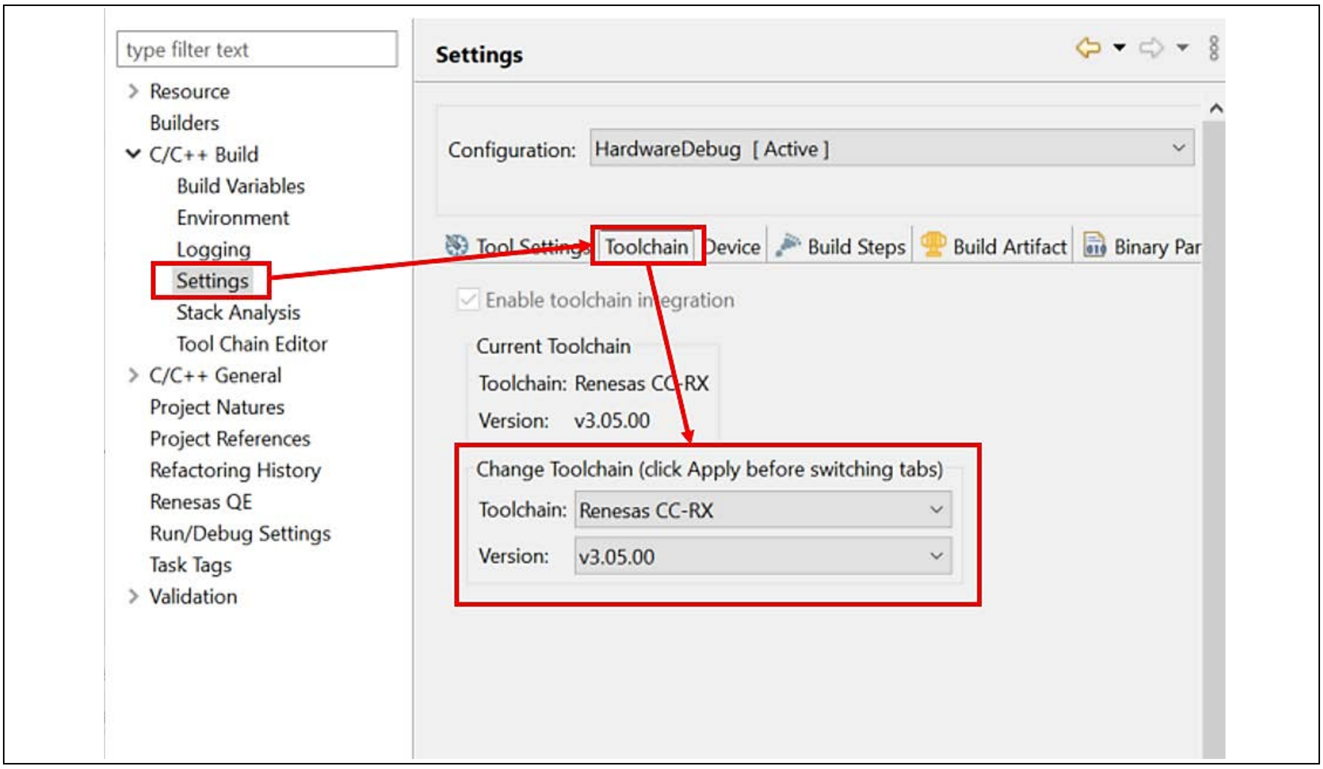
```
    "aws/topic/set_spo2_led_data",
};

char pubPayload[PUBLISH_PAYLOAD_BUFFER_LENGTH_BULK_JSON] = { 0x00 };

#define mqttexampleTOPICRx                                  "aws/topic/set_temperature_led_data"
#define mqttexampleTOPICRx1                                 "aws/topic/set_spo2_led_data"

void parse_temperature_led_actuation_message(char *Subscribedmsg,uint16_t msgLen);
void parse_spo2_led_actuation_message(char *Subscribedmsg,uint16_t msgLen);

extern void Kernel_Object_init (void);
extern void getICP10101Data(st_sensorsICP_t *icpData);
extern void getHS3001Data(st_sensorsHS_t *hsData);
extern void getOB1203Data(st_sensorsOB_t *obData);
extern void getICMData(st_icm20948_data_t *icmData);
extern void getZMOD4410Data(st_sensorsZmod4410_t *zmod4410Data);
extern void getZMOD4510Data(st_sensorsZmod4510_t *zmod4510Data);
 * @brief Delay for the synchronous publisher task between publishes.
#define mqttexampleDELAY_BETWEEN_PUBLISH_OPERATIONS_MS    ( 2000U )

 * @brief Number of publishes done by each task in this demo.
#define mqttexamplePUBLISH_COUNT                            10

 * @brief Number of times a publish has to be retried if agent cannot send a QoS0 packet
#define mqttexampleNUM_PUBLISH_RETRIES                      ( 3 )

 * @brief The maximum amount of time in milliseconds to wait for the commands
#define mqttexampleMAX_COMMAND_SEND_BLOCK_TIME_MS           ( 1000 )

 * @brief Maximum length of the thing name as set by AWS IoT.
#define mqttexampleTHING_NAME_MAX_LENGTH                    ( 128 )
```

Figure 22. Data Publishing Interval Settings (Optional)

9. Select **Project** > **Build All** and confirm that 0 errors are reported.

Note: Check the compiler setting before building project:

For both projects, from the **Projects** menu, select **Properties**, expand the **C/C++ Build** menu, and click **Settings**. On the **Toolchain** tab, confirm that the toolchain is **Renesas CC-RX**



Configuration: HardwareDebug [Active]

☑ Enable toolchain integration

Current Toolchain

Toolchain: Renesas CC-RX

Version: v3.05.00

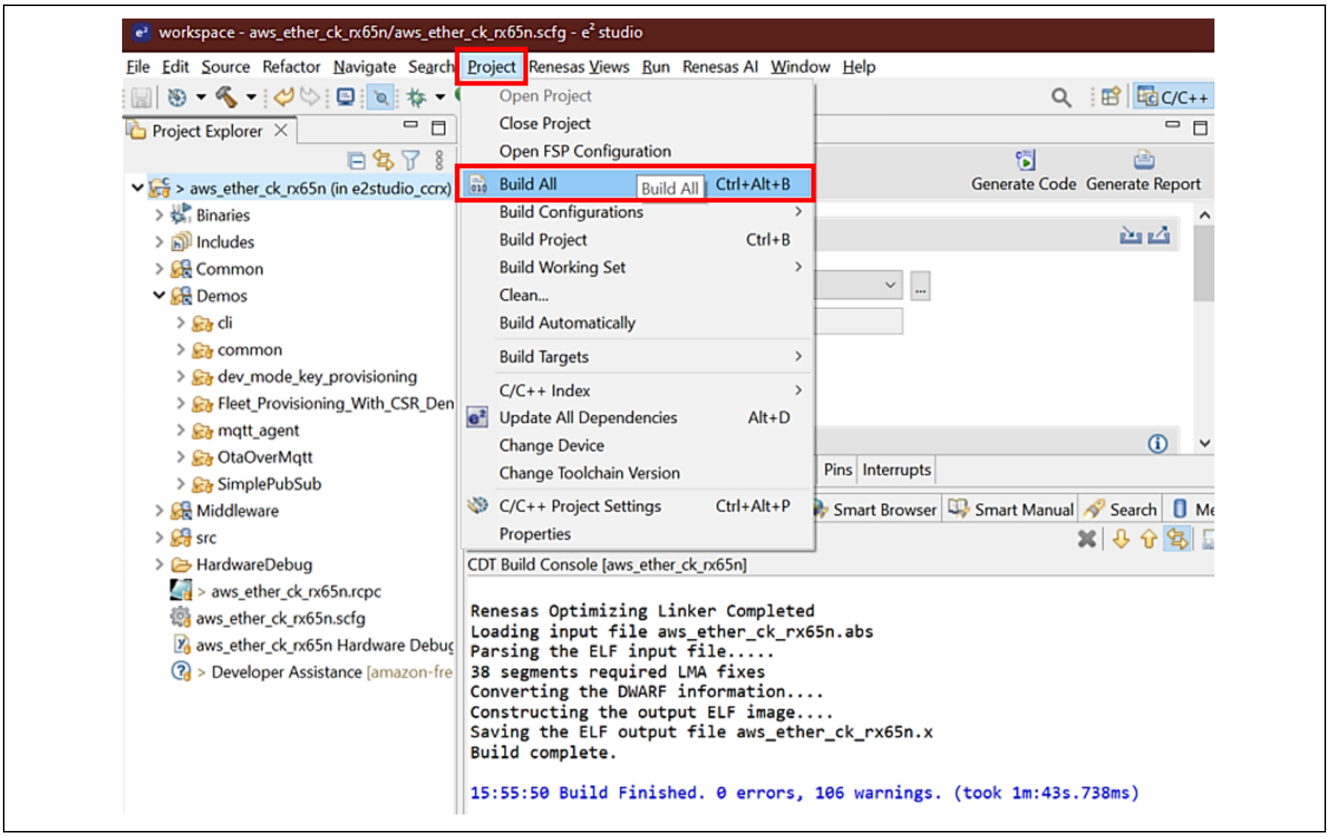
Change Toolchain (click Apply before switching tabs)

Toolchain: Renesas CC-RX

Version: v3.05.00

Figure 23. Project toolchain

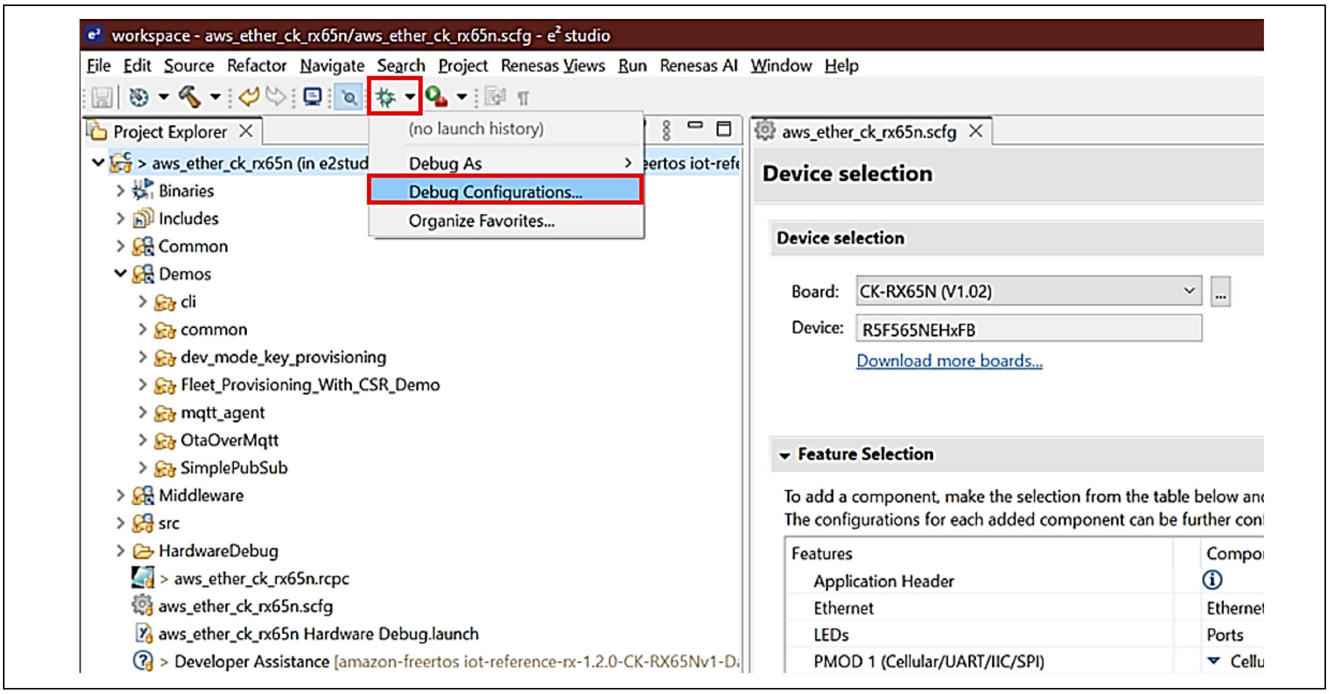
Note: Make sure to clean the project before building it for the first time. If a demo build error occurs after the initial build, clean the project again and then rebuild it.


workspace - aws_ether_ck_rx65n/aws_ether_ck_rx65n.scfg - e² studio
File Edit Source Refactor Navigate Search Project Renesas Views Run Renesas AI Window Help
Open Project
Close Project
Open FSP Configuration
Build All Ctrl+Alt+B
Build Configurations
Build Project Ctrl+B
Build Working Set
Clean...
Build Automatically
Build Targets
C/C++ Index
Update All Dependencies Alt+D
Change Device
Change Toolchain Version
C/C++ Project Settings Ctrl+Alt+P
Properties
Project Explorer
aws_ether_ck_rx65n (in e2studio_ccrx)
Binaries
Includes
Common
Demos
cli
common
dev_mode_key_provisioning
Fleet_Provisioning_With_CSR_Demo
mqtt_agent
OtaOverMqtt
SimplePubSub
Middleware
src
HardwareDebug
aws_ether_ck_rx65n.rcpc
aws_ether_ck_rx65n.scfg
aws_ether_ck_rx65n Hardware Debug
Developer Assistance [amazon-fre
Generate Code
Generate Report
Pins Interrupts
Smart Browser Smart Manual Search
CDT Build Console [aws_ether_ck_rx65n]

```
Renesas Optimizing Linker Completed
Loading input file aws_ether_ck_rx65n.abs
Parsing the ELF input file.....
38 segments required LMA fixes
Converting the DWARF information....
Constructing the output ELF image....
Saving the ELF output file aws_ether_ck_rx65n.x
Build complete.

15:55:50 Build Finished. 0 errors, 106 warnings. (took 1m:43s.738ms)
```

Figure 24. Build the Project

10. Debug Configuration


workspace - aws_ether_ck_rx65n/aws_ether_ck_rx65n.scfg - e² studio
File Edit Source Refactor Navigate Search Project Renesas Views Run Renesas AI Window Help
(no launch history)
Debug As
Debug Configurations...
Organize Favorites...
Project Explorer
aws_ether_ck_rx65n (in e2stud
Binaries
Includes
Common
Demos
cli
common
dev_mode_key_provisioning
Fleet_Provisioning_With_CSR_Demo
mqtt_agent
OtaOverMqtt
SimplePubSub
Middleware
src
HardwareDebug
aws_ether_ck_rx65n.rcpc
aws_ether_ck_rx65n.scfg
aws_ether_ck_rx65n Hardware Debug.launch
Developer Assistance [amazon-freertos iot-reference-rx-1.2.0-CK-RX65Nv1-D
aws_ether_ck_rx65n.scfg
Device selection
Device selection
Download more boards...
Feature Selection

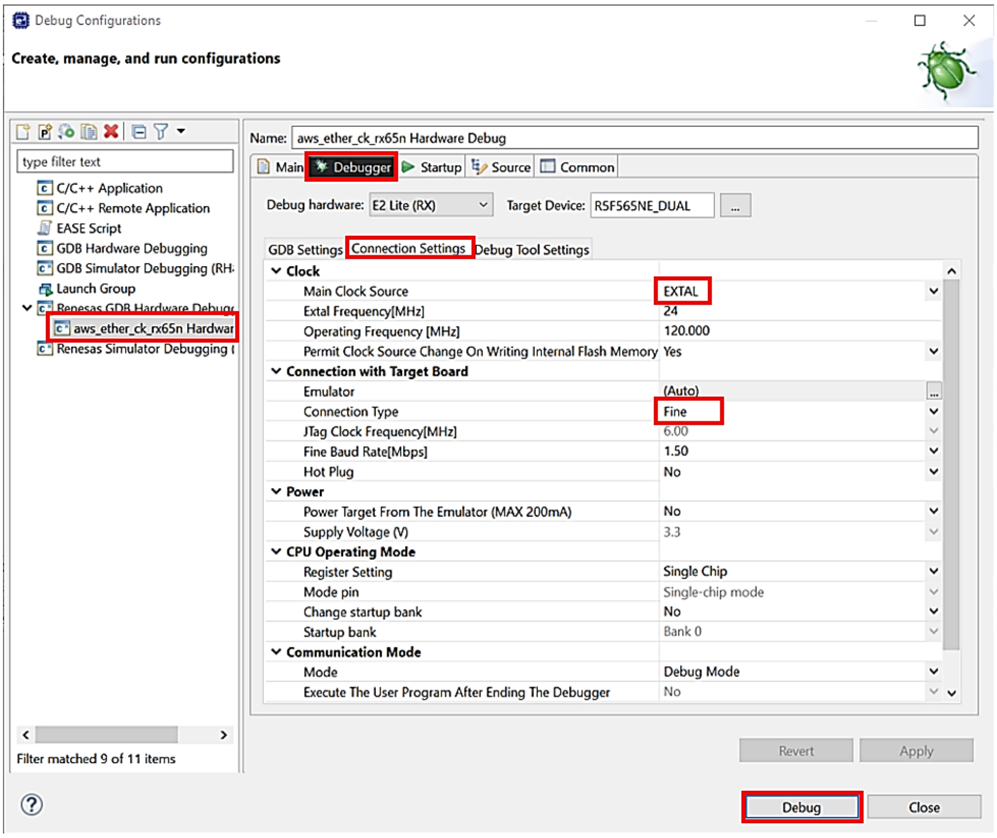
Board: CK-RX65N (V1.02)
Device: R5F565NEHxFB

To add a component, make the selection from the table below an
The configurations for each added component can be further con

Features	Compo
Application Header	ⓘ
Ethernet	Etherne
LEDs	Ports
PMOD 1 (Cellular/UART/IIC/SPI)	Cellu

Figure 25. Configuration Debugger (1/2)

Go to **aws_ether_ck_rx65n HardwareDebug > Debugger > Connection Settings** tab then configure for “Main Clock Source: **EXTAL**” and “Connection Type: **Fine**”.



Name: aws_ether_ck_rx65n Hardware Debug

Debug hardware: E2 Lite (RX)   Target Device: R5F565NE_DUAL

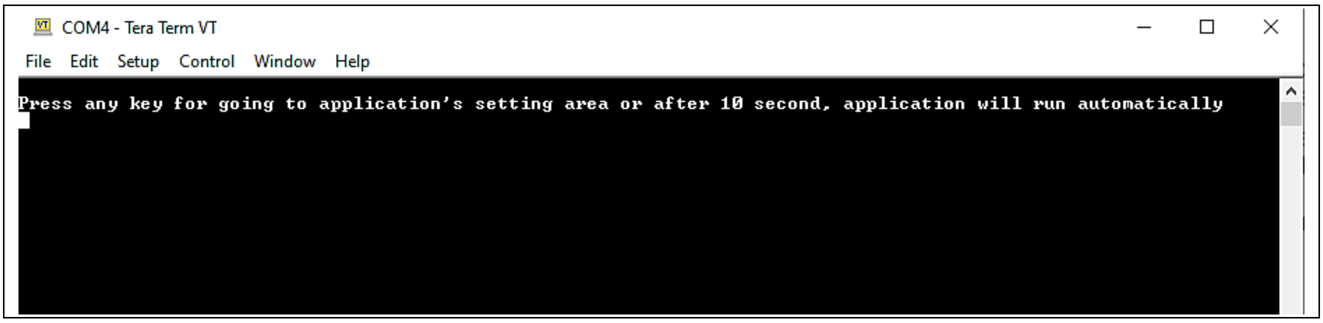
Clock	
Main Clock Source	EXTAL
Extal Frequency[MHz]	24
Operating Frequency [MHz]	120.000
Permit Clock Source Change On Writing Internal Flash Memory	Yes
Connection with Target Board	
Emulator	(Auto)
Connection Type	Fine
JTag Clock Frequency[MHz]	6.00
Fine Baud Rate[Mbps]	1.50
Hot Plug	No
Power	
Power Target From The Emulator (MAX 200mA)	No
Supply Voltage (V)	3.3
CPU Operating Mode	
Register Setting	Single Chip
Mode pin	Single-chip mode
Change startup bank	No
Startup bank	Bank 0
Communication Mode	
Mode	Debug Mode
Execute The User Program After Ending The Debugger	No

Figure 26. Configuration Debugger (2/2)

5.1.4 Running the Application Project

To run the Application project, use the following instructions.

The serial port console (Tera Term) of the PC set up in section **5.1.2** will display as below.

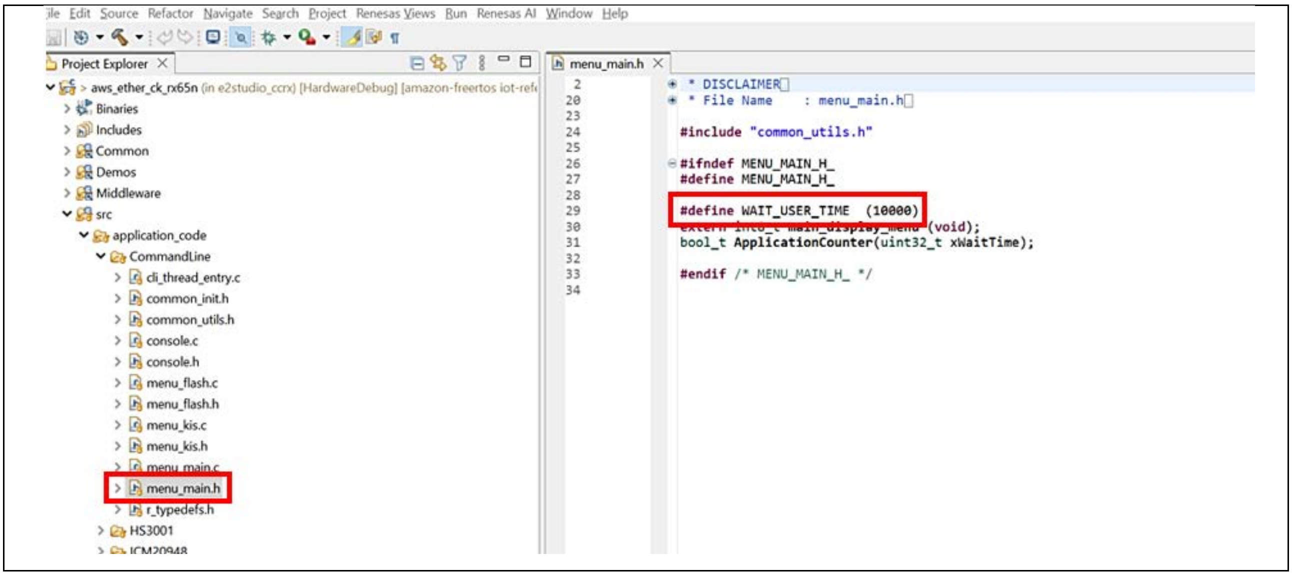


```
Press any key for going to application's setting area or after 10 second, application will run automatically
```

Figure 27. Start the Application

For the first-time users running the application, or for users who want to change the configuration, please press any key to set the necessary credentials for the application.

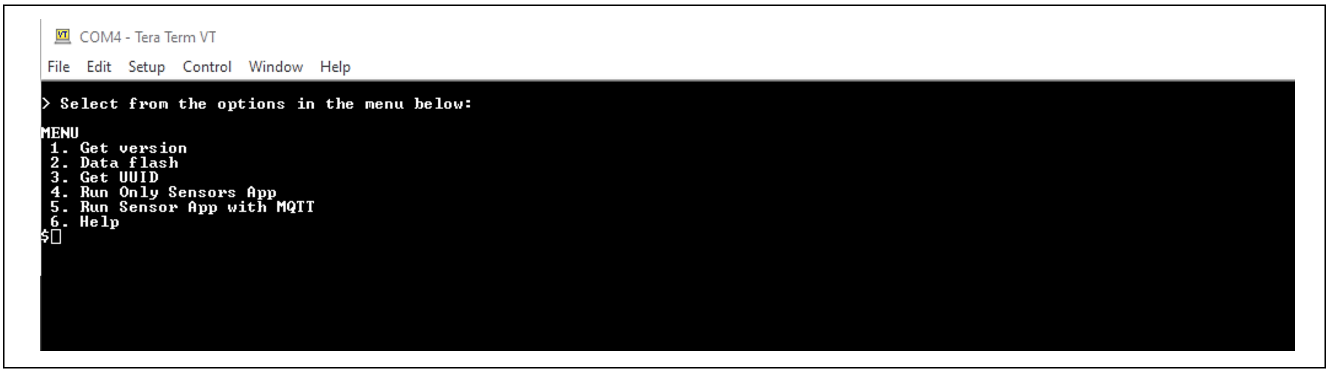
Note: After 10s, the application will automatically run the **“Run Sensor App with MQTT”** option from the application’s menu. User can modify this time value by changing the value of **WAIT_USER_TIME** macro in the file: **Projects\[Project folder]\e2studio_ccrx\src\application_code\CommandLine\menu_main.h** before building the project:



```
 * DISCLAIMER
 * File Name    : menu_main.h

#include "common_utils.h"

#ifndef MENU_MAIN_H_
#define MENU_MAIN_H_

#define WAIT_USER_TIME  (10000)
extern int8_t main_display_menu(void);
bool_t ApplicationCounter(uint32_t xWaitTime);

#endif /* MENU_MAIN_H_ */
```

Figure 28. Modify macro to Wait for User Input

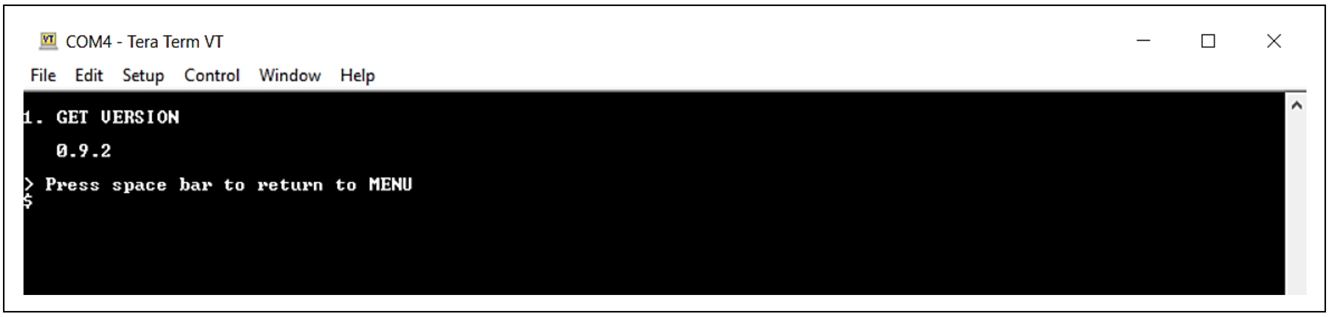
After pressing any key, the settings are as shown below.



```
> Select from the options in the menu below:

MENU
 1. Get version
 2. Data flash
 3. Get UUID
 4. Run Only Sensors App
 5. Run Sensor App with MQTT
 6. Help
$
```

Figure 29. Main Menu

Choose a number to select the commands. For example, when you press ‘**1**’, the firmware version of the application will be displayed as shown below. To return to the main menu, press the “space bar” key.

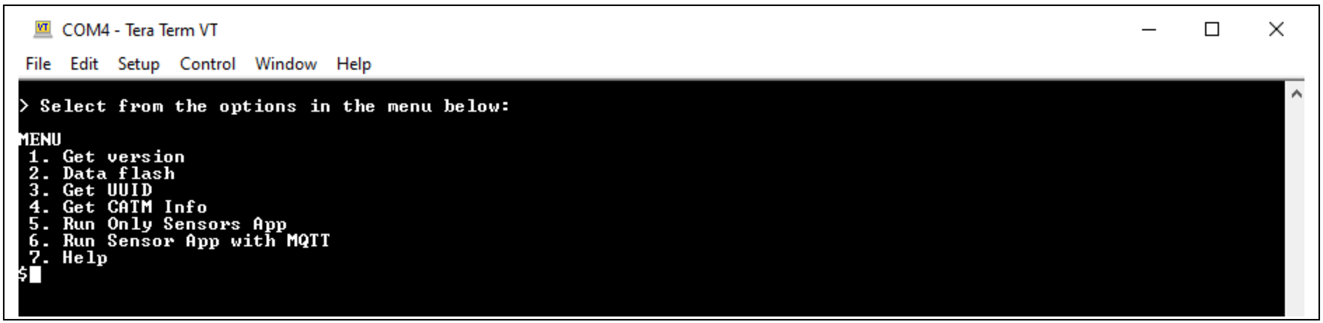


```
1. GET VERSION

   0.9.2

> Press space bar to return to MENU
$
```

Figure 30. Get Version Information

5.1.5 Activating SIM Card

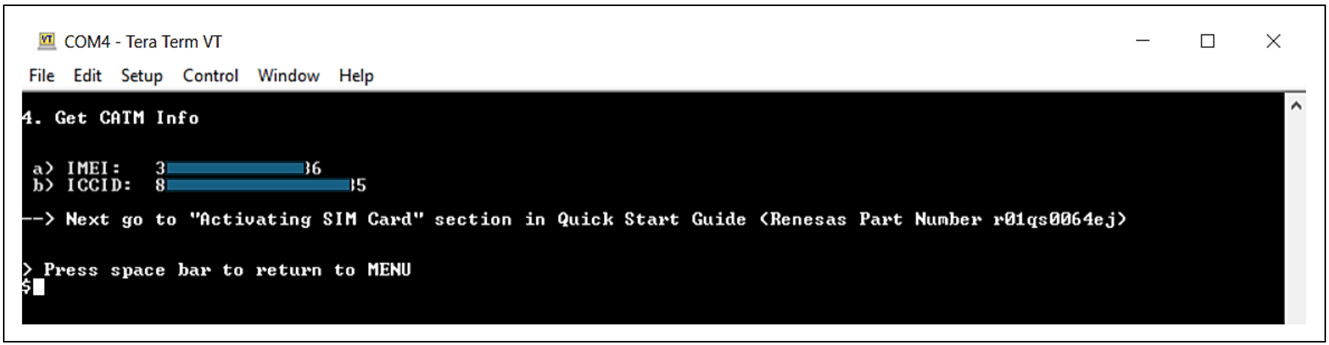
This section explains how to activate the SIM card that is contained in CK-RX65N V1 for using cellular application. If you use ethernet application, you can skip this step.



```
> Select from the options in the menu below:

MENU
 1. Get version
 2. Data flash
 3. Get UUID
 4. Get CATM Info
 5. Run Only Sensors App
 6. Run Sensor App with MQTT
 7. Help
$
```

Figure 31. Main menu of cellular application

From the main menu of cellular application shown in the above figure, press '**4**' to display CAT-M Information (IMEI & ICCID). This menu will communicate with the CAT-M module to obtain the IMEI and ICCID values needed for activating the SIM card. Upon success, the IMEI and ICCID values will be displayed on the terminal screen. The program will continue to attempt to communicate with the CAT-M module until it has successfully connected or timed out. The IMEI and ICCID values are used to activate the SIM card.



```
4. Get CATM Info

 a> IMEI:   3[redacted]6
 b> ICCID:  8[redacted]5

--> Next go to "Activating SIM Card" section in Quick Start Guide (Renesas Part Number r01qs0064ej)

> Press space bar to return to MENU
$
```

Figure 32. CAT-M Information

After completing the above steps, use the information to activate the SIM card.

Note: A Truphone or MicroAI SIM card is included in this kit.

Note: The MicroAI SIM card has been discontinued to support CK-RX65N. If a MicroAI SIM card was included in the kit, please contact Renesas support to request a replacement to a Truphone SIM card. A MicroAI SIM card can be identified by observing that the manufacturer's name is not printed on the card.

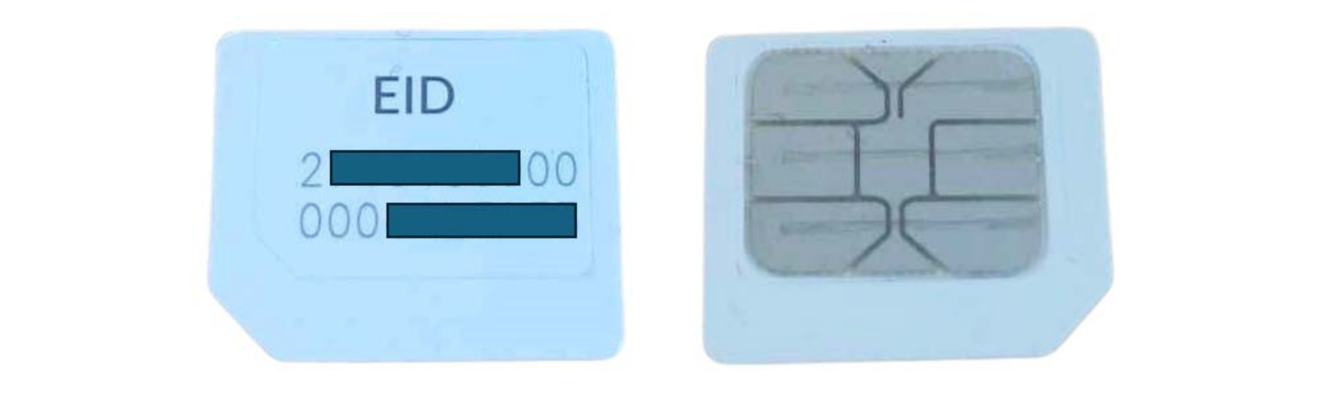
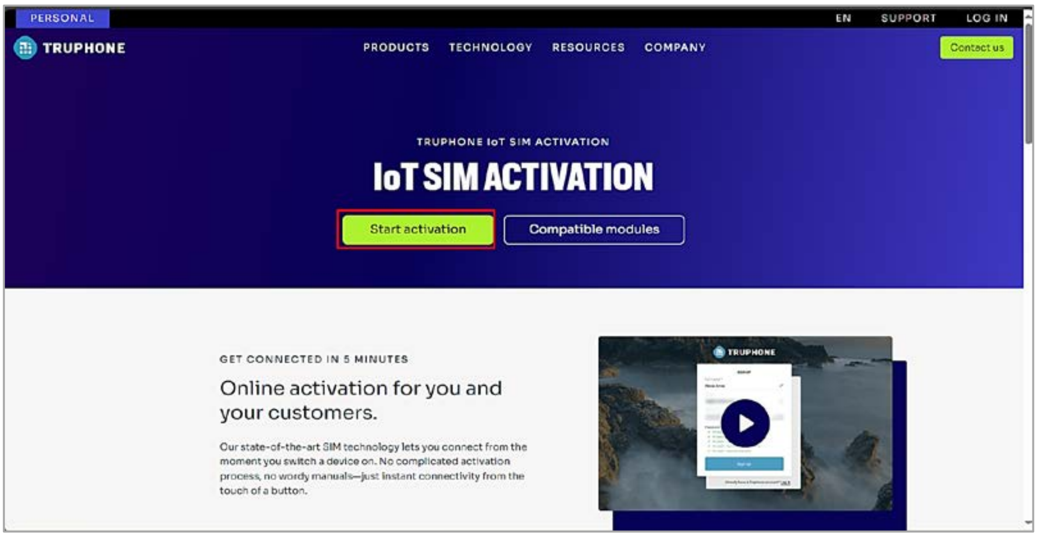


Figure 33. MicroAI SIM Card

Please activate the SIM card using the following steps:

To activate the included SIM card, please visit the Truphone SIM Activation platform at truphone.com/connectit and use the following steps:

1. On the Business page, click **Start activation** button under **IoT SIM Activation.**



TRUPHONE IoT SIM ACTIVATION

IoT SIM ACTIVATION

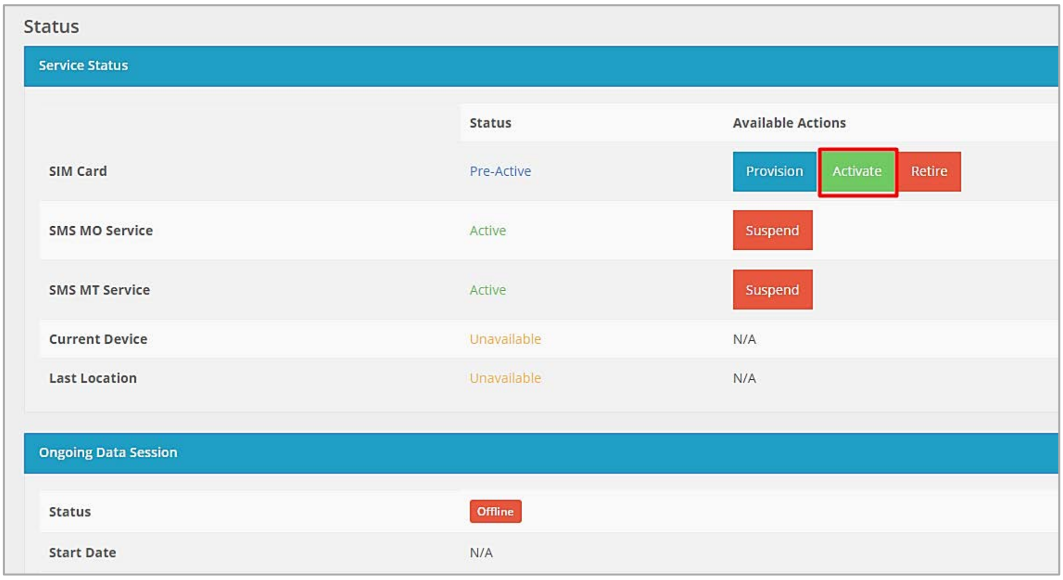
GET CONNECTED IN 5 MINUTES

Online activation for you and your customers.

Our state-of-the-art SIM technology lets you connect from the moment you switch a device on. No complicated activation process, no wordy manuals—just instant connectivity from the touch of a button.

Figure 34. Activating the SIM Card

2. Create a new Truphone Account by selecting **Sign up** (next to **Don’t have an account yet?**) and fill-in your full name, Email, and a password. Then click **Sign up** to create a new account.
3. Select **Personal** as the account type and press **Get Started**.
4. Verify your email by entering the activation code sent to your email account. (Note: check your Junk folder if the email is not received to your Inbox).
5. Complete the **Profile information** form – then select **Create account**.
6. Select **Activate SIMs** to activate your individual SIM by **ICCID** and **PUK** found on the SIM Card packaging. Note: The **ICCID** value can also be obtained when running cellular project. See the **ICCID** value in **Figure 32. CAT-M Information.** Fill other fields as needed.
7. You can open the page using the link https://account.truphone.com/login and select Home > SIM Cards > ICCID#xxx", and "Activate" the SIM from the status page as shown in **Figure 35. Activating the SIM Card on Truphone**, the status changes from Pre-Active to Active.



Status

Service Status

	Status	Available Actions
SIM Card	Pre-Active	Provision Activate Retire
SMS MO Service	Active	Suspend
SMS MT Service	Active	Suspend
Current Device	Unavailable	N/A
Last Location	Unavailable	N/A

Ongoing Data Session

Status	Offline
Start Date	N/A

Figure 35. Activating the SIM Card on Truphone

8. You will receive email confirmation when the SIM card activation is complete.
   The **CK-RX65N V1** kit and SIM card should be activated and can be validated on the Tera Term terminal.

   Note: The SIM card includes free credit for the first 90 days / 50 MB. After the free data charge is used up, communication charges will be incurred.

Disclaimer

The activation steps above are provided by the SIM provider, Truphone. They are the most current at the time of publishing this application note. If you need help activating your SIM card, contact Truphone support iot.truphone.com or Contact Support | Truphone.

If you have a SIM card from any other provider then contact the technical support for that provider.

For any other issue that cannot be resolved please contact Renesas Support at Technical Support.

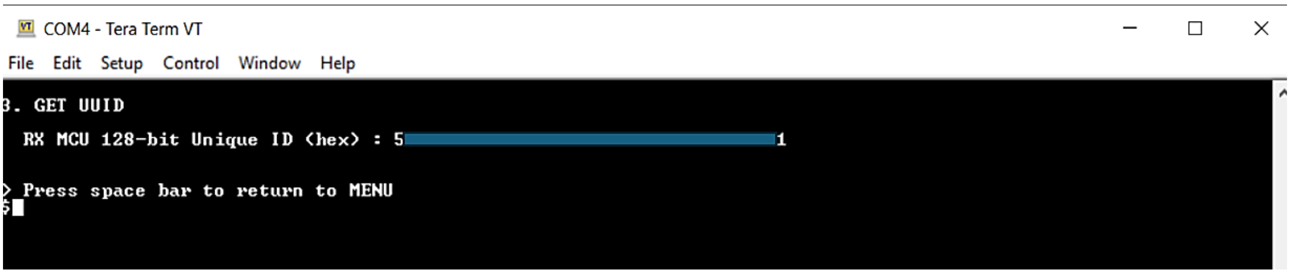
Note**:** The SIM card provider for the Quick Start Guide example project is Truphone. If you use any other SIM card provider, you must change the Access Point Name required for the SIM card provider in your global region (Please refer to the **6 Check and set the SIM card information** to re-configure). Failure to do so could result in the RYZ014A not connecting to the cellular network.

5.2 For Users Using the Provided Dashboard and AWS Account of Kit

This section explains getting the board "UUID" information, account registration, and accessing the dashboard.

5.2.1 Getting the Board UUID Information

Press '**3'** from the **Main Menu** to display board UUID. This displays the board UUID information on the console as shown in the screenshot below. You will need this information to register on the Cloud Dashboard.



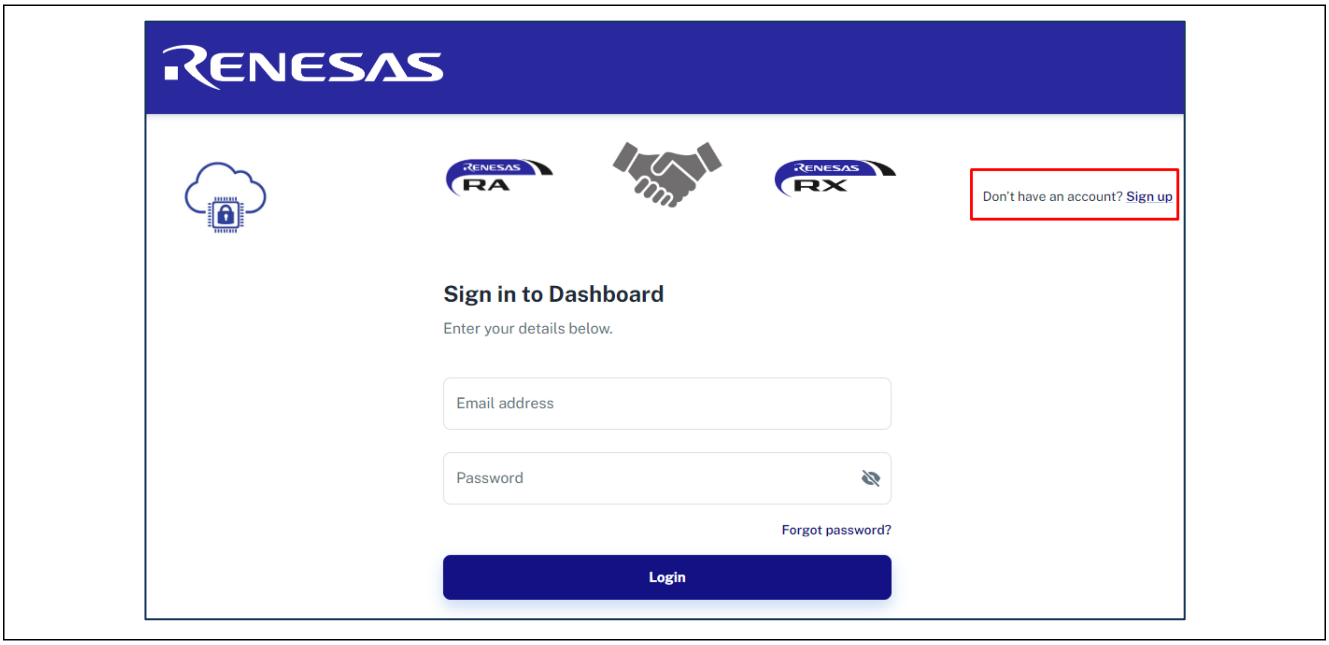
```
3. GET UUID
  RX MCU 128-bit Unique ID (hex) : 5[redacted]1

> Press space bar to return to MENU
$█
```

Figure 36. Getting Board UUID Information

5.2.2 Getting the Account 10 USD for Trial of AWS

1. Register/sign up at "https://renesas.cloud-ra-rx.com/" with **an email account that was not used previously for signing up to an AWS account.**

Note: The provided free credit starts being used when users register their email and UUID on this system. Renesas recommends disabling the AWS EC2 service when users do not use this system. Please refer to section **8.8** How to Enable/Disable EC2 Instance**.**



Don't have an account? Sign up

Sign in to Dashboard

Enter your details below.

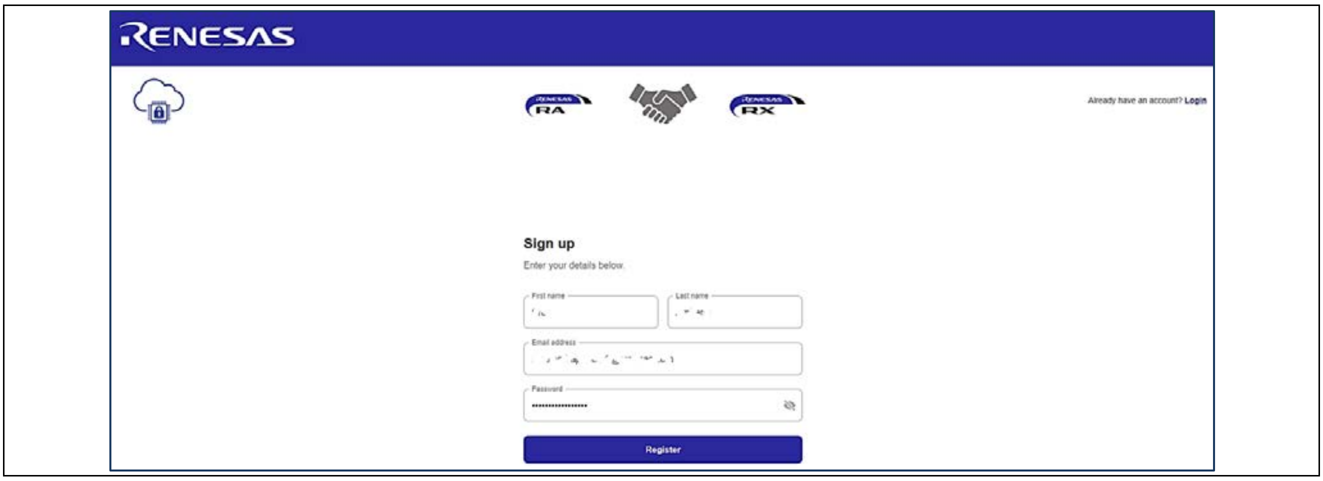
Email address

Password

Forgot password?

Login

Figure 37. Get the Account 10 USD for Trial of AWS (1/2)



Already have an account? Login

Sign up

Enter your details below.

First name

Last name

Email address

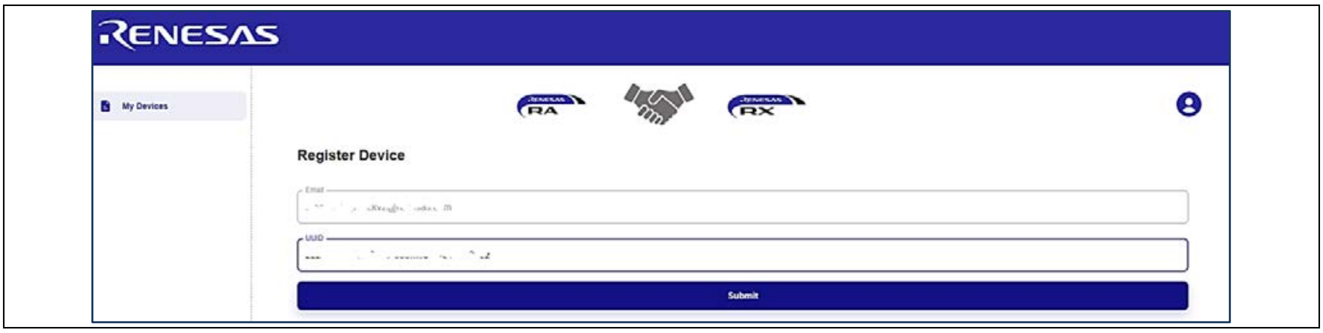
Password

Register

Figure 38. Get the Account 10 USD for Trial of AWS (2/2)

2. Wait for AWS verification email (it may take up to 10 minutes). Then, enter the email and UUID to register the kit as shown in the following window. You can get the UUID from section **5.2.1 Getting the Board UUID Information**

   Note: Only 1 device will be assigned to an account.



My Devices

Register Device

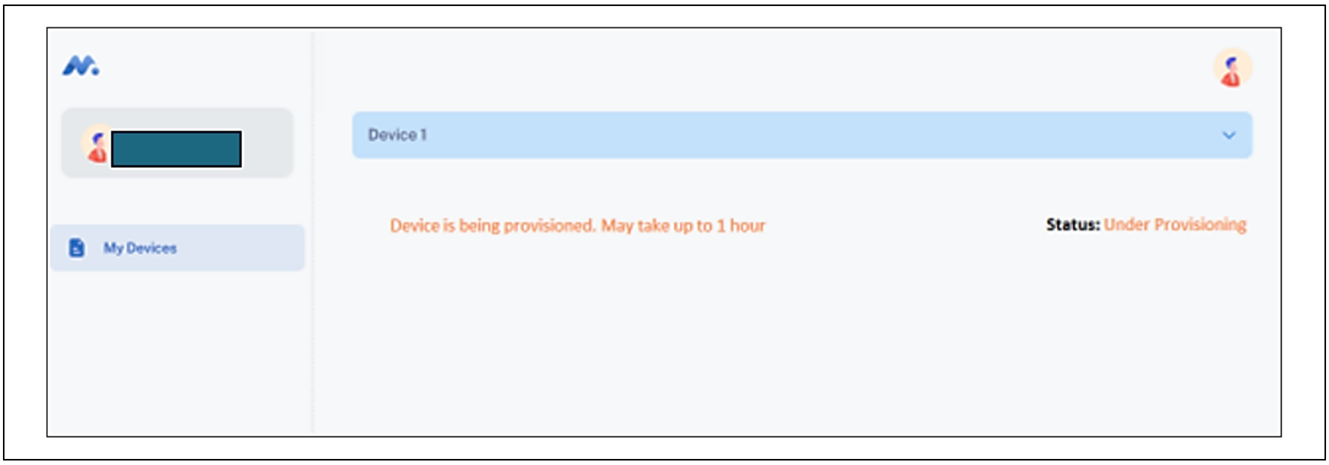
Email

UUID

Submit

Figure 39. Register Device

3. **Verify the AWS account** in your email that you registered.
4. Wait for the status change on the registration page or wait for provisioning to complete. Please refresh the page in case the "Registration in progress" screen still shows up.



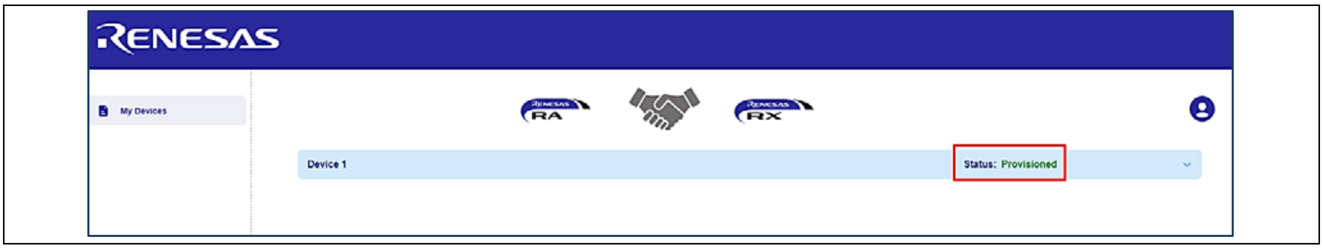
[redacted]

Device is being provisioned. May take up to 1 hour

Status: Under Provisioning

Figure 40. Dashboard Build In Progress

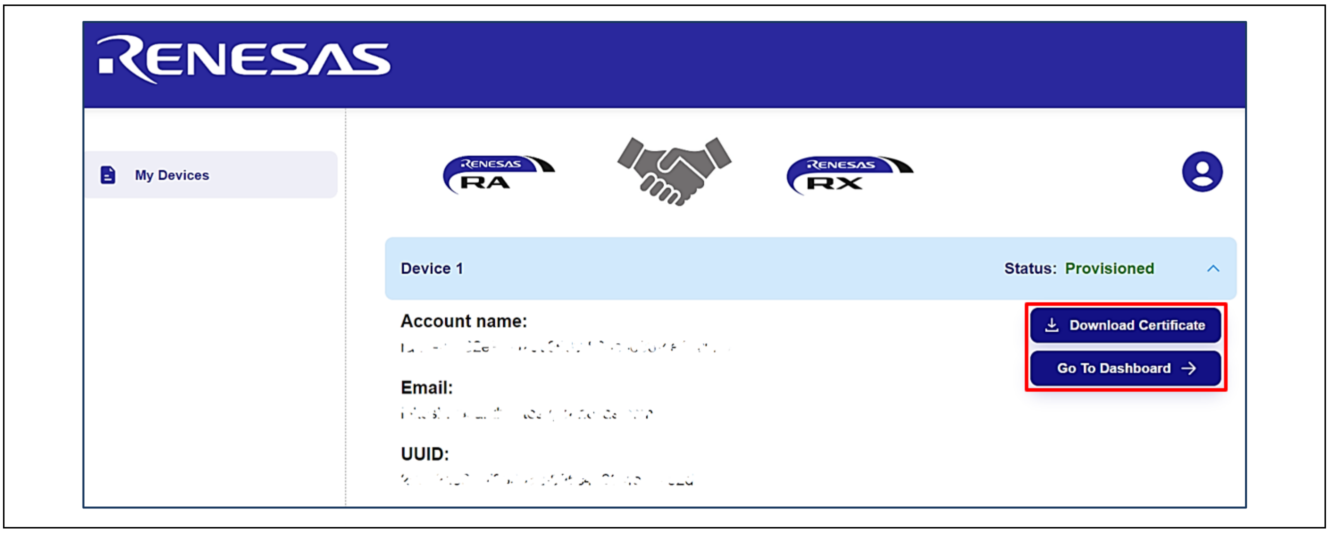
5. Once the account status shows up as active on the registration page, click on the device to see device UUID.



Status: Provisioned

Figure 41. Active Device

6. After finishing the progress, you can get the connection certificate using the "Download Certificate" button. This is used for installation on the application demo of kits that you got in the previous step.



Status: Provisioned

Account name:
[redacted]

Email:
[redacted]

UUID:
[redacted]

Figure 42. Dashboard Build Complete

7. Click “**Go To Dashboard**” to access the dashboard. First time users will access the dashboard with credentials “**admin**” **for both username and password** and will be directed to change the password. Once completed, users can access the dashboard.

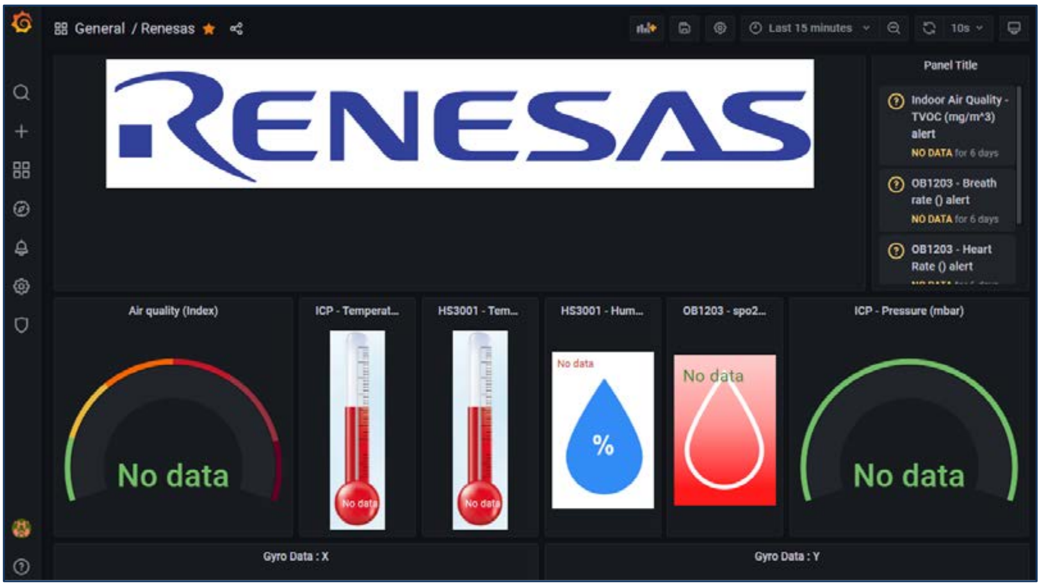


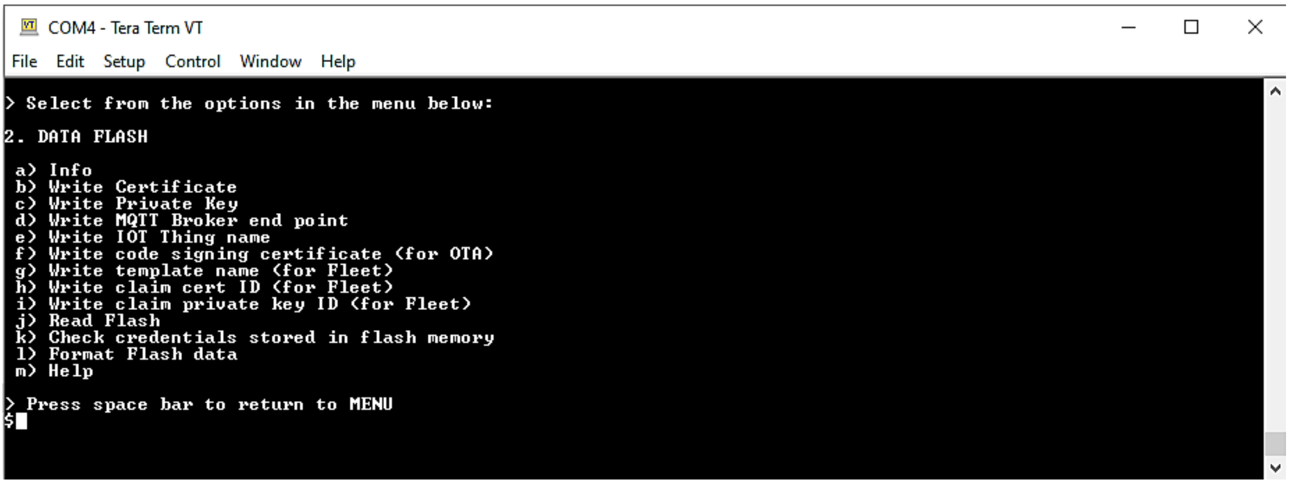
Figure 43. Dashboard for this Application

5.3 Software Preparation - Running Project from IDE

5.3.1 Storing the Device Certificate, Key, MQTT Broker Endpoint and IoT Thing Name

Device Certificate, Device Private Key, MQTT Broker Endpoint and IOT Thing name need to be stored in the data flash for the application to work. These are obtained after registering to the Cloud Dashboard.

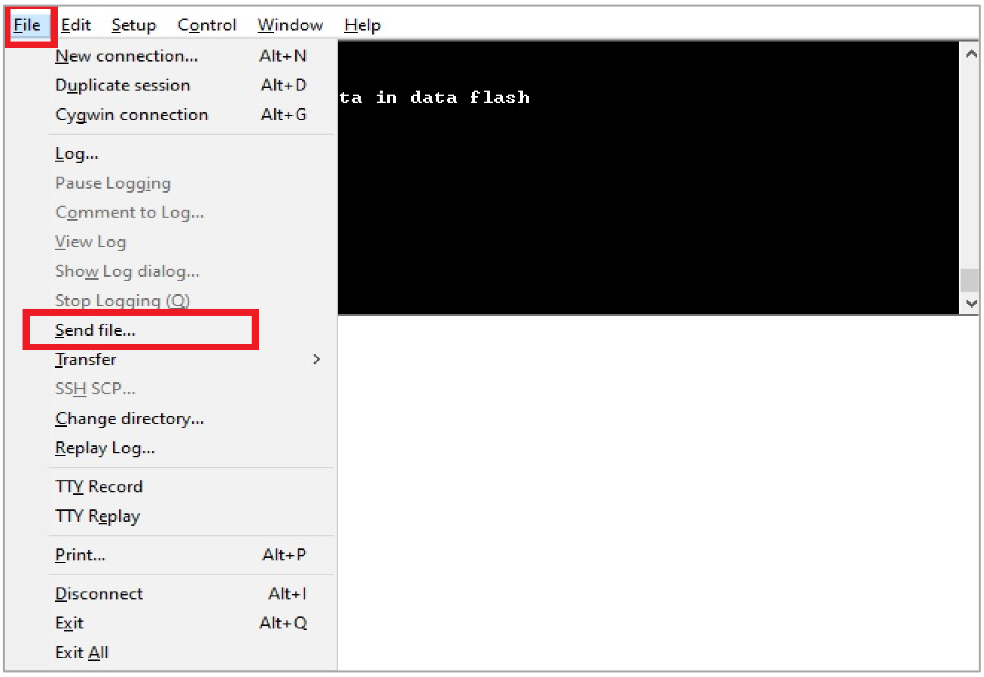
1. Press ‘**2’** on the **Main Menu** to display **Data Flash** related commands as shown in the following screenshot. This sub menu has commands to store, read, and validate the data.



```
> Select from the options in the menu below:

2. DATA FLASH

 a) Info
 b) Write Certificate
 c) Write Private Key
 d) Write MQTT Broker end point
 e) Write IOT Thing name
 f) Write code signing certificate (for OTA)
 g) Write template name (for Fleet)
 h) Write claim cert ID (for Fleet)
 i) Write claim private key ID (for Fleet)
 j) Read Flash
 k) Check credentials stored in flash memory
 l) Format Flash data
 m) Help

> Press space bar to return to MENU
$█
```

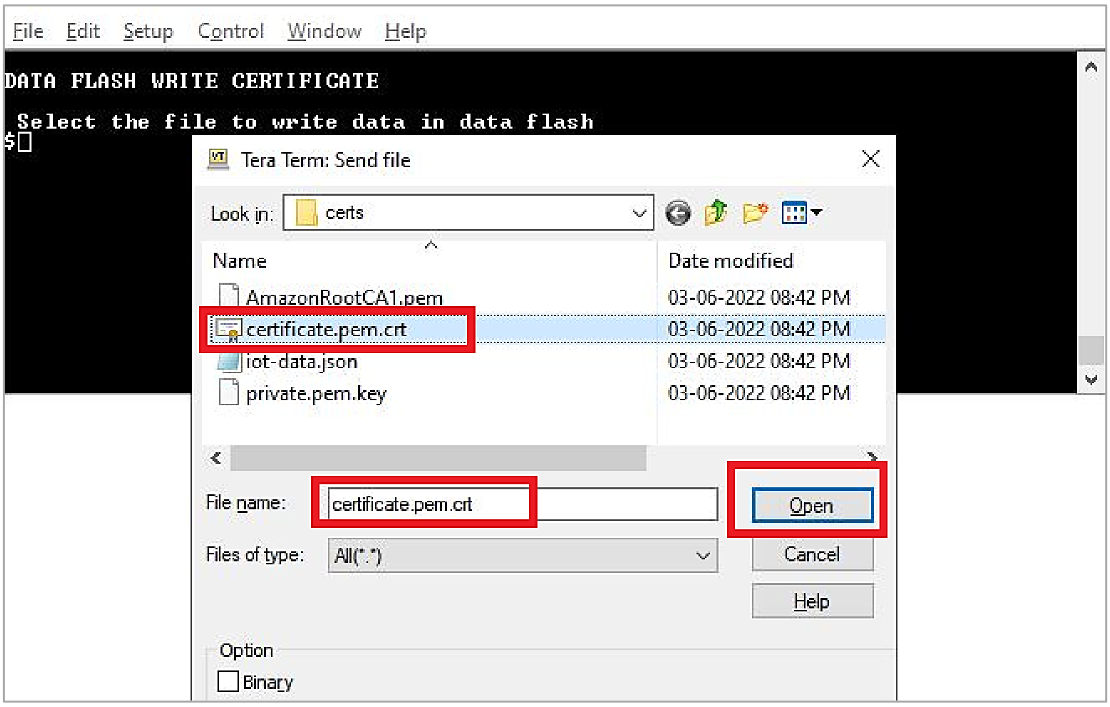
Figure 44. Data Flash related Menu and Commands

2. Unzip the `cert.zip` from the dashboard.
3. To store the **Device Certificate,** press the option ‘**b**’. Click the **File** tab of the Tera Term, select the **Send File** option, and choose the downloaded Device certificate file from the dashboard **“xxxxxcertificate.pem.crt”**. The details for downloading the certificates are provided in the Dashboard document linked as part of this Application Note.



```
ta in data flash
```

Figure 45. Accessing the Device Certificate



```
DATA FLASH WRITE CERTIFICATE

 Select the file to write data in data flash
$
```

Look in: certs

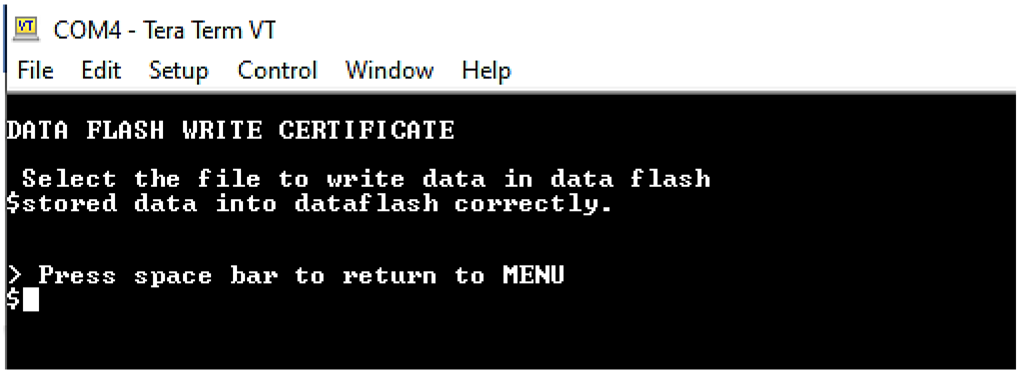
Name	Date modified
AmazonRootCA1.pem	03-06-2022 08:42 PM
certificate.pem.crt	03-06-2022 08:42 PM
iot-data.json	03-06-2022 08:42 PM
private.pem.key	03-06-2022 08:42 PM

File name: certificate.pem.crt

Files of type: All(*.*)

□ Binary

Figure 46. Downloading the Device Certificate into the Data Flash



```
DATA FLASH WRITE CERTIFICATE

 Select the file to write data in data flash
$stored data into dataflash correctly.


> Press space bar to return to MENU
$
```

Figure 47. Status of the Downloaded Device Certificate into the Data Flash

4. To store the **Device Private Key,** press the option ‘**c**’, click the **File** tab in the Tera Term and select the **Send File** option. Choose the downloaded Device Private Key **“xxxxxxxprivate.pem.key”** which is downloaded from the Dashboard download link.
5. **Open the “iot-data.json” file.**
   This file has information about IoT things name and IoT endpoint.

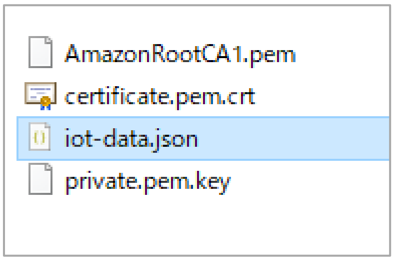
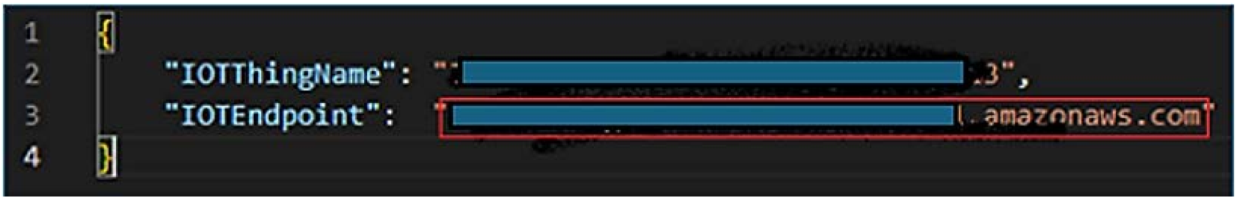


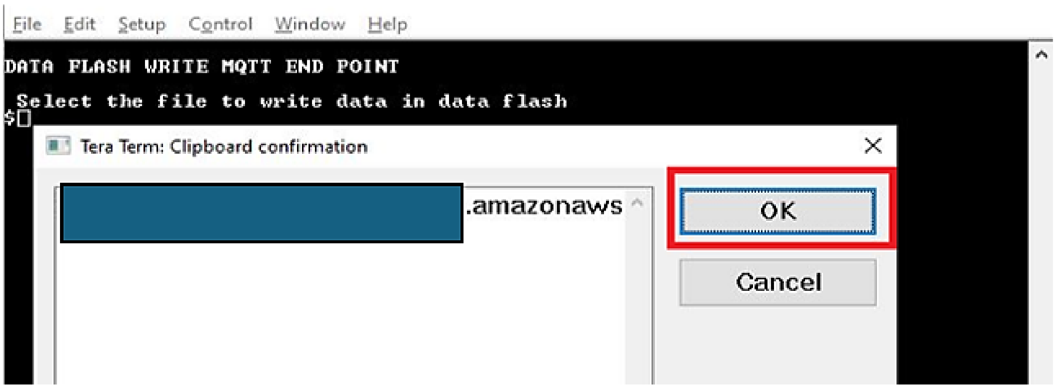
Figure 48. Getting the IoT Things Name and IoT Endpoint Information

6. To store the **MQTT Broker end point,** copy the end point string between the quotes **xxxxxxxxxx.iot.us-east-1.amazonaws.com** from the downloaded certificate link, press the option ‘**d**’ and click the **Edit** tab in the Tera Term and “**Paste<CR>**” and verify and confirm the valid string and press **OK**.
   Note: Please copy the IOTEndpoint without “”.



```
{
    "IOTThingName": "[redacted]3",
    "IOTEndpoint": "[redacted].amazonaws.com"
}
```

Figure 49. Copy the IOTEndpoint

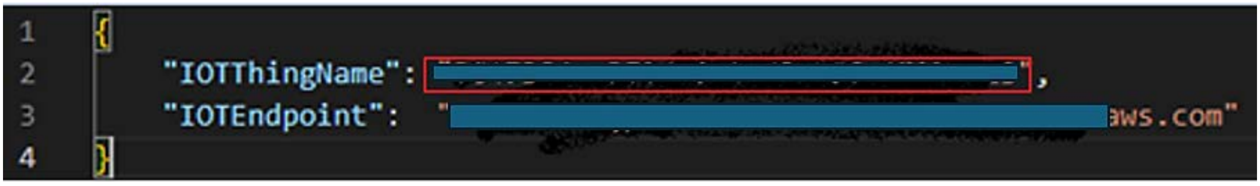

File Edit Setup Control Window Help

```
DATA FLASH WRITE MQTT END POINT
 Select the file to write data in data flash
$
```

Tera Term: Clipboard confirmation
[redacted].amazonaws
OK
Cancel

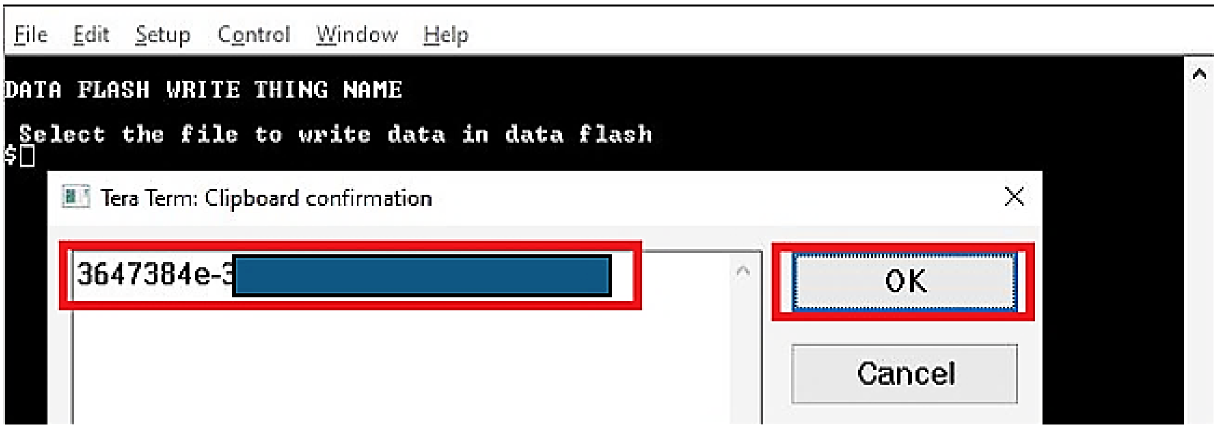
Figure 50. Storing the MQTT IoT endpoint into the Data Flash

7. To store the **IOT Thing Name,** copy the Thing Name string between the quotes **xxxxxxxx-xxxx-xxxxxxxx-xxxx** of IoT thing Name from the downloaded certificate link, press the option ‘**e**’, click the **Edit** tab in the Tera Term and “**Paste<CR>**”, verify and confirm the valid string, and press **OK**.
   Note: Please copy the IOTThingName without “”.



```
{
    "IOTThingName": "[redacted]",
    "IOTEndpoint": "[redacted]aws.com"
}
```

Figure 51. Copy the IOTThingName



```
DATA FLASH WRITE THING NAME
 Select the file to write data in data flash
$
```

Tera Term: Clipboard confirmation

3647384e-3[redacted]

Figure 52. Storing the Thing Name into the Data Flash

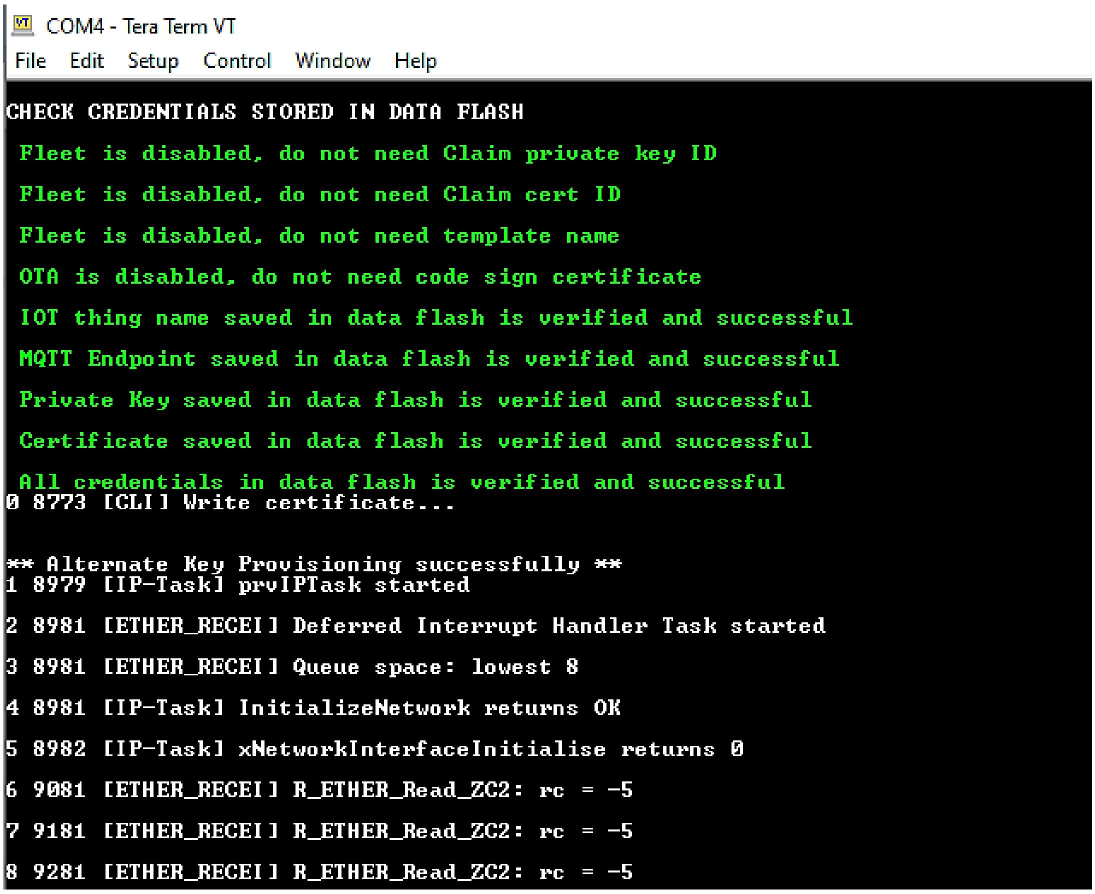
8. Press option **‘j’ and ‘k’** to read and validate the stored information in the data flash.

Note: Validation of the stored data is very limited and validates minimum set of data points. Users are required to input the valid data to the flash obtained from the Dashboard for the proper working of the application.

Note: Option **‘l) Format Flash data’** will erase all saved value in data flash. Please be careful when using this option in application.

5.3.2 Starting the Application

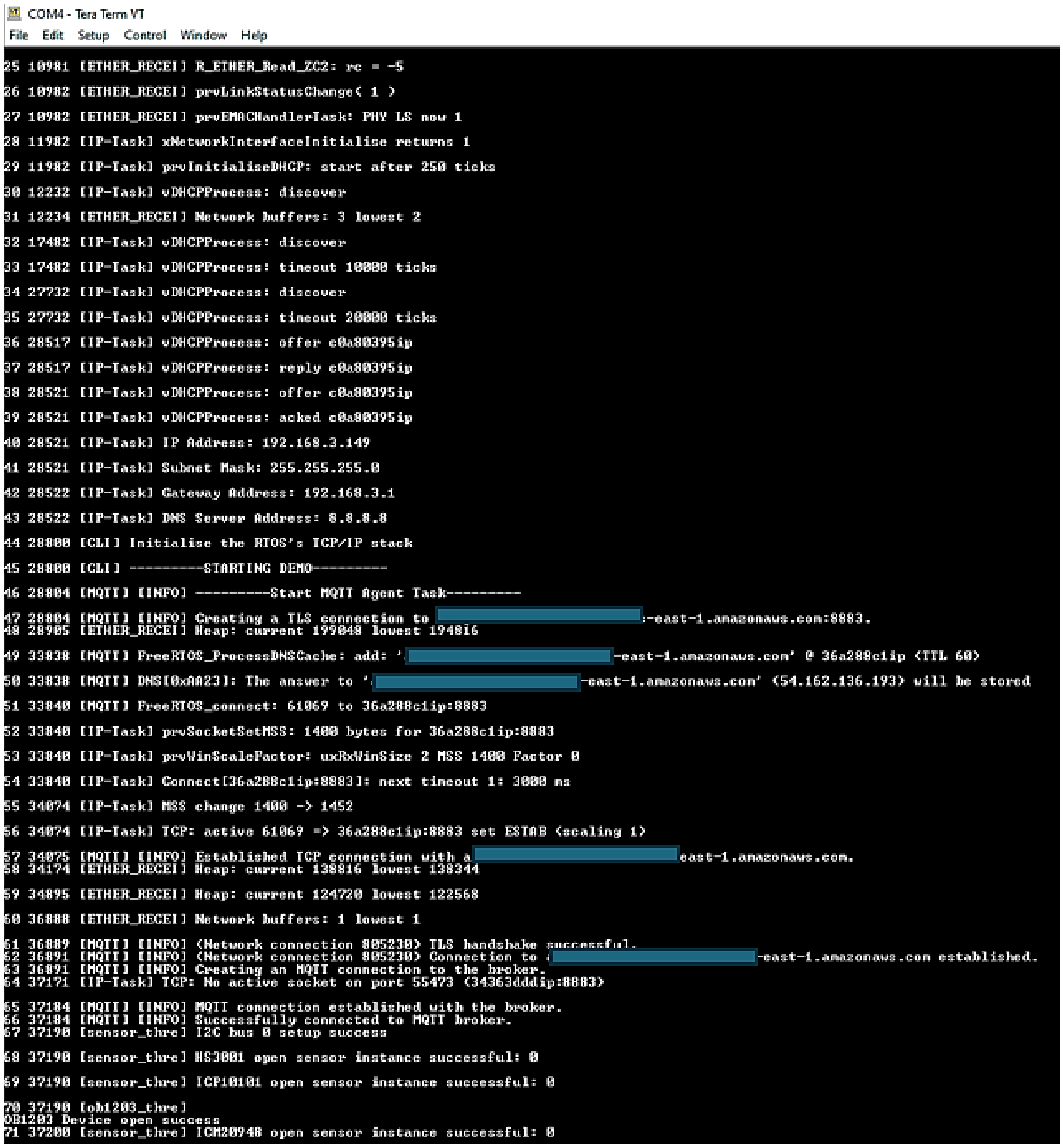
After activating the SIM card (if using Cellular project), registering to the Dashboard and configuring the required Cloud credentials via the CLI, the application is ready to run. Press option **'Run Sensor App with MQTT'** to start the application. The application prints a welcome screen along with the status of validating the Cloud credentials data present in the data flash as shown below.



```
CHECK CREDENTIALS STORED IN DATA FLASH
 Fleet is disabled, do not need Claim private key ID
 Fleet is disabled, do not need Claim cert ID
 Fleet is disabled, do not need template name
 OTA is disabled, do not need code sign certificate
 IOT thing name saved in data flash is verified and successful
 MQTT Endpoint saved in data flash is verified and successful
 Private Key saved in data flash is verified and successful
 Certificate saved in data flash is verified and successful
 All credentials in data flash is verified and successful
0 8773 [CLI] Write certificate...

** Alternate Key Provisioning successfully **
1 8979 [IP-Task] prvIPTask started
2 8981 [ETHER_RECEI] Deferred Interrupt Handler Task started
3 8981 [ETHER_RECEI] Queue space: lowest 8
4 8981 [IP-Task] InitializeNetwork returns OK
5 8982 [IP-Task] xNetworkInterfaceInitialise returns 0
6 9081 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
7 9181 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
8 9281 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
```

Figure 53. Welcome Screen on the Console

When the connection is successful, the data is shown.



```
25 10981 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
26 10982 [ETHER_RECEI] prvLinkStatusChange( 1 )
27 10982 [ETHER_RECEI] prvEMACHandlerTask: PHY LS now 1
28 11982 [IP-Task] xNetworkInterfaceInitialise returns 1
29 11982 [IP-Task] prvInitialiseDHCP: start after 250 ticks
30 12232 [IP-Task] vDHCPProcess: discover
31 12234 [ETHER_RECEI] Network buffers: 3 lowest 2
32 17482 [IP-Task] vDHCPProcess: discover
33 17482 [IP-Task] vDHCPProcess: timeout 10000 ticks
34 27732 [IP-Task] vDHCPProcess: discover
35 27732 [IP-Task] vDHCPProcess: timeout 20000 ticks
36 28517 [IP-Task] vDHCPProcess: offer c0a80395ip
37 28517 [IP-Task] vDHCPProcess: reply c0a80395ip
38 28521 [IP-Task] vDHCPProcess: offer c0a80395ip
39 28521 [IP-Task] vDHCPProcess: acked c0a80395ip
40 28521 [IP-Task] IP Address: 192.168.3.149
41 28521 [IP-Task] Subnet Mask: 255.255.255.0
42 28522 [IP-Task] Gateway Address: 192.168.3.1
43 28522 [IP-Task] DNS Server Address: 8.8.8.8
44 28800 [CLI] Initialise the RTOS's TCP/IP stack
45 28800 [CLI] ---------STARTING DEMO---------
46 28804 [MQTT] [INFO] ---------Start MQTT Agent Task---------
47 28804 [MQTT] [INFO] Creating a TLS connection to [redacted]-east-1.amazonaws.com:8883.
48 28905 [ETHER_RECEI] Heap: current 199048 lowest 194816
49 33838 [MQTT] FreeRTOS_ProcessDNSCache: add: '[redacted]-east-1.amazonaws.com' @ 36a288c1ip (TTL 60)
50 33838 [MQTT] DNS[0xAA23]: The answer to '[redacted]-east-1.amazonaws.com' (54.162.136.193) will be stored
51 33840 [MQTT] FreeRTOS_connect: 61069 to 36a288c1ip:8883
52 33840 [IP-Task] prvSocketSetMSS: 1400 bytes for 36a288c1ip:8883
53 33840 [IP-Task] prvWinScaleFactor: uxRxWinSize 2 MSS 1400 Factor 0
54 33840 [IP-Task] Connect[36a288c1ip:8883]: next timeout 1: 3000 ms
55 34074 [IP-Task] MSS change 1400 -> 1452
56 34074 [IP-Task] TCP: active 61069 => 36a288c1ip:8883 set ESTAB (scaling 1)
57 34075 [MQTT] [INFO] Established TCP connection with a[redacted]east-1.amazonaws.com.
58 34174 [ETHER_RECEI] Heap: current 138816 lowest 138344
59 34895 [ETHER_RECEI] Heap: current 124720 lowest 122568
60 36888 [ETHER_RECEI] Network buffers: 1 lowest 1
61 36889 [MQTT] [INFO] (Network connection 805230) TLS handshake successful.
62 36891 [MQTT] [INFO] (Network connection 805230) Connection to [redacted]-east-1.amazonaws.com established.
63 36891 [MQTT] [INFO] Creating an MQTT connection to the broker.
64 37171 [IP-Task] TCP: No active socket on port 55473 (34363dddip:8883)
65 37184 [MQTT] [INFO] MQTT connection established with the broker.
66 37184 [MQTT] [INFO] Successfully connected to MQTT broker.
67 37190 [sensor_thre] I2C bus 0 setup success
68 37190 [sensor_thre] HS3001 open sensor instance successful: 0
69 37190 [sensor_thre] ICP10101 open sensor instance successful: 0
70 37190 [ob1203_thre]
OB1203 Device open success
71 37200 [sensor_thre] ICM20948 open sensor instance successful: 0
```

Figure 54. Application with MQTT

Note: Above is the log of the Ethernet application running.

Note: Sensor's data will be able to read correctly after stabilization time. You can also check the sensor's operation by choosing the option **"Run Only Sensors App"**.

Note: With OB1203 sensor, besides the stabilization time, OB1203 sensor data which is sent to the MQTT (shown in the terminal) is affected by the "Data Publishing Interval Settings" (refer to **Data Publishing Interval Settings (Optional)** to set this value). So, please keep your finger on the sensor until the terminal displays the correct data. It can be slightly longer than the stabilization time.

Note: For Ethernet applications, firewalls in the network may prevent connectivity to AWS IoT. Configure the network to allow access to the MQTT Port 8883.

About the detail of stabilization time, please see **Table 12. Sensor Stabilization Time**

5.4 For Users Using Their Own AWS Account

Note: Complete the steps up to "Check AWS IoT endpoints."

5.4.1 Get an AWS Account

Get an AWS account > Click the "**Sign into the Console**" button.

When considering using AWS, you can use the AWS Free Tier.

5.4.2 Log in to the AWS Management Console

Amazon Web Services > My Account > AWS Management Console

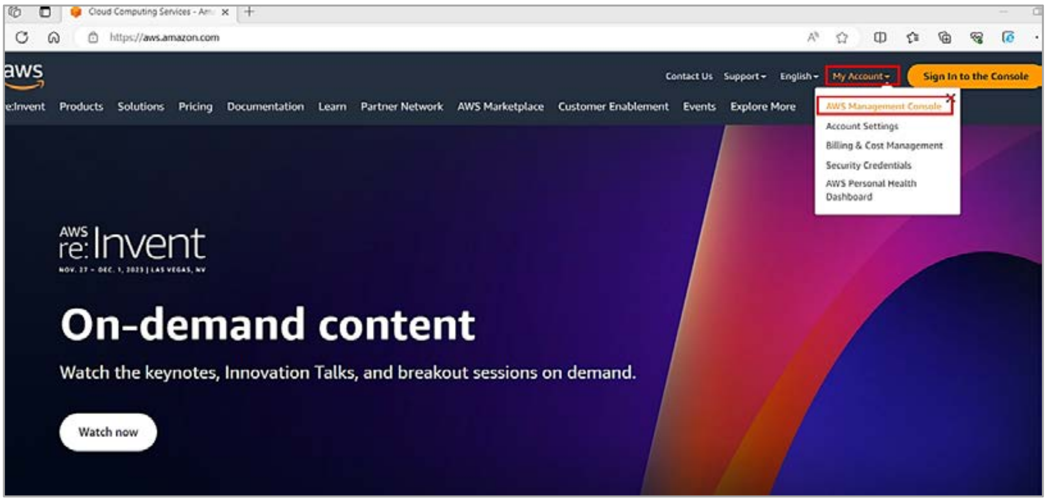


Figure 55. Login the AWS

5.4.3 Move to IoT Core Control Panel

AWS services > **All services** > **IoT Core**

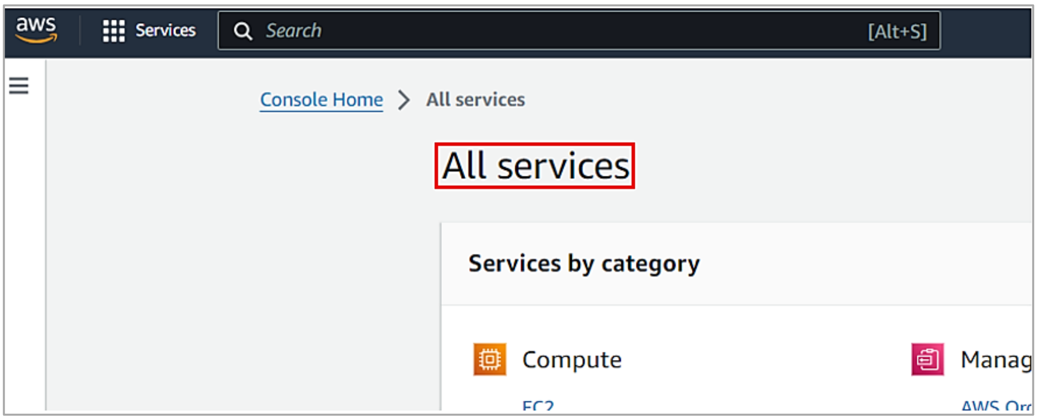


Figure 56. Search the IoT Core (1/2)

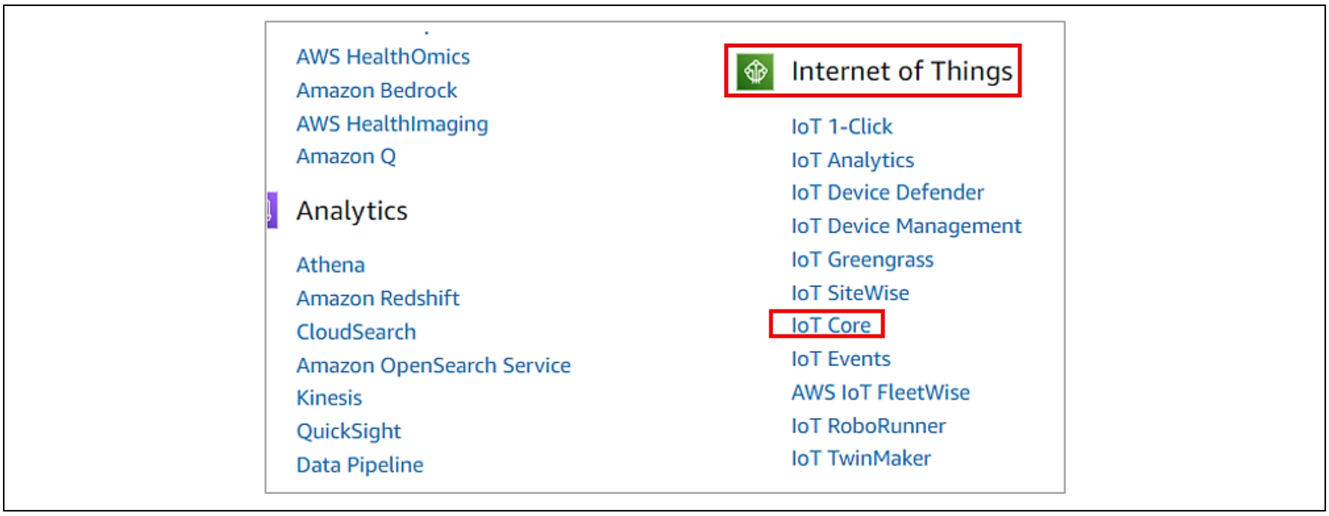
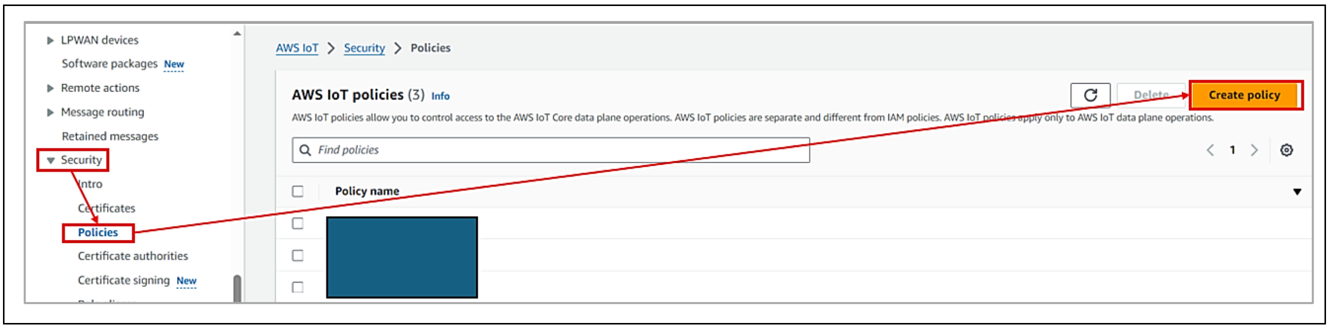


Figure 57. Search the IoT Core (2/2)

5.4.4 Create a Security Policy

Security > Policies > Create policy.



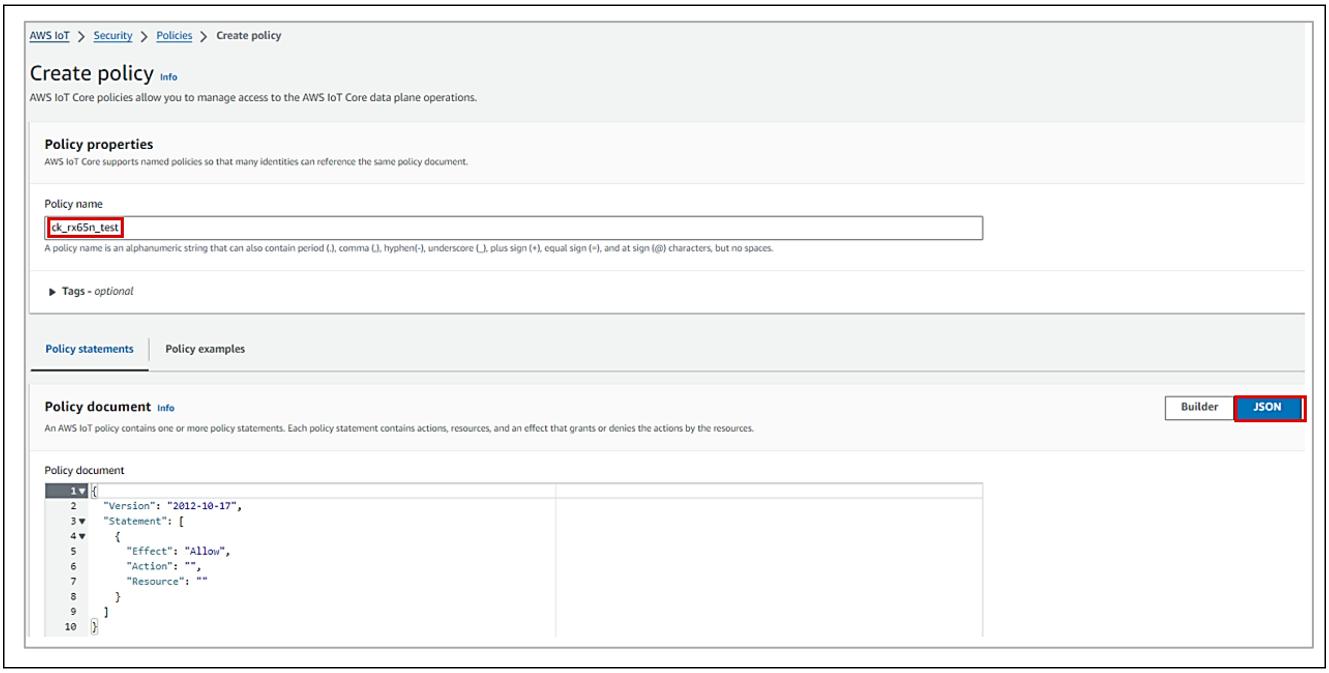
AWS IoT policies (3) Info

AWS IoT policies allow you to control access to the AWS IoT Core data plane operations. AWS IoT policies are separate and different from IAM policies. AWS IoT policies apply only to AWS IoT data plane operations.

Find policies

□	Policy name
□	[redacted]
□	
□	

Figure 58. Create the Policy (1/3)



Create policy

AWS IoT Core policies allow you to manage access to the AWS IoT Core data plane operations.

Policy properties

AWS IoT Core supports named policies so that many identities can reference the same policy document.

Policy name: ck_rx65n_test

A policy name is an alphanumeric string that can also contain period (.), comma (,), hyphen(-), underscore (_), plus sign (+), equal sign (=), and at sign (@) characters, but no spaces.

▶ Tags - *optional*

Policy document

An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.

Policy document

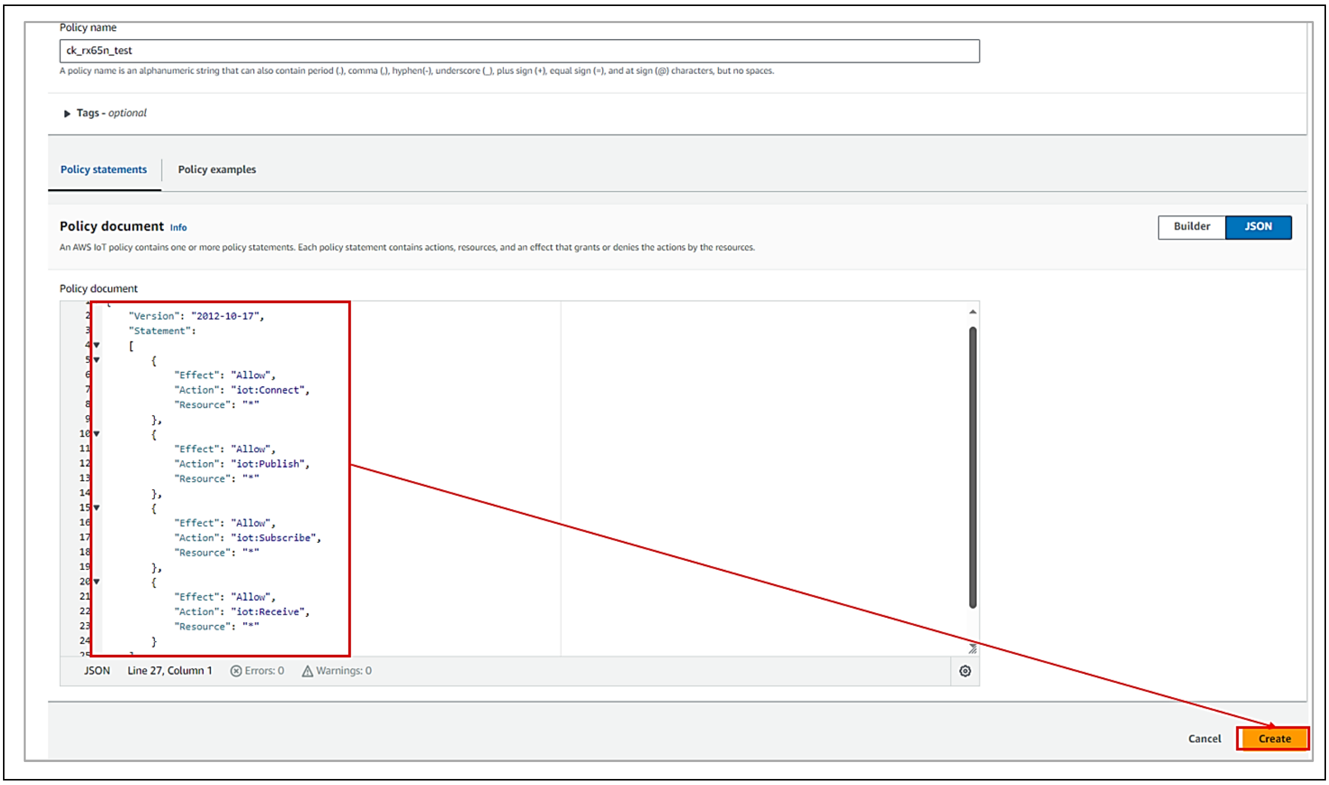
```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": "",
      "Resource": ""
    }
  ]
}
```

Figure 59. Create the Policy (2/3)

Copy the following code:

```
{
    "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": "*"
      }
    ]
}
```

Paste the copied code into the policy document > Create



Policy name

ck_rx65n_test

A policy name is an alphanumeric string that can also contain period (.), comma (,), hyphen(-), underscore (_), plus sign (+), equal sign (=), and at sign (@) characters, but no spaces.

▶ Tags - *optional*

Policy document Info

An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.

Policy document

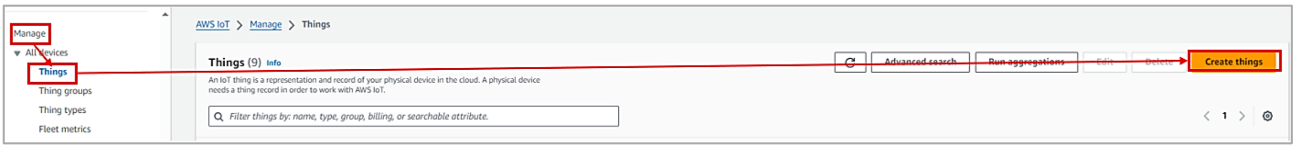
```
    "Version": "2012-10-17",
    "Statement":
    [
        {
            "Effect": "Allow",
            "Action": "iot:Connect",
            "Resource": "*"
        },
        {
            "Effect": "Allow",
            "Action": "iot:Publish",
            "Resource": "*"
        },
        {
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

JSON Line 27, Column 1 ⊗ Errors: 0 ⚠ Warnings: 0

Figure 60. Create the Policy (3/3)

5.4.5 Register your device (thing) with AWS IoT

Manage > **Things** > **Create things**

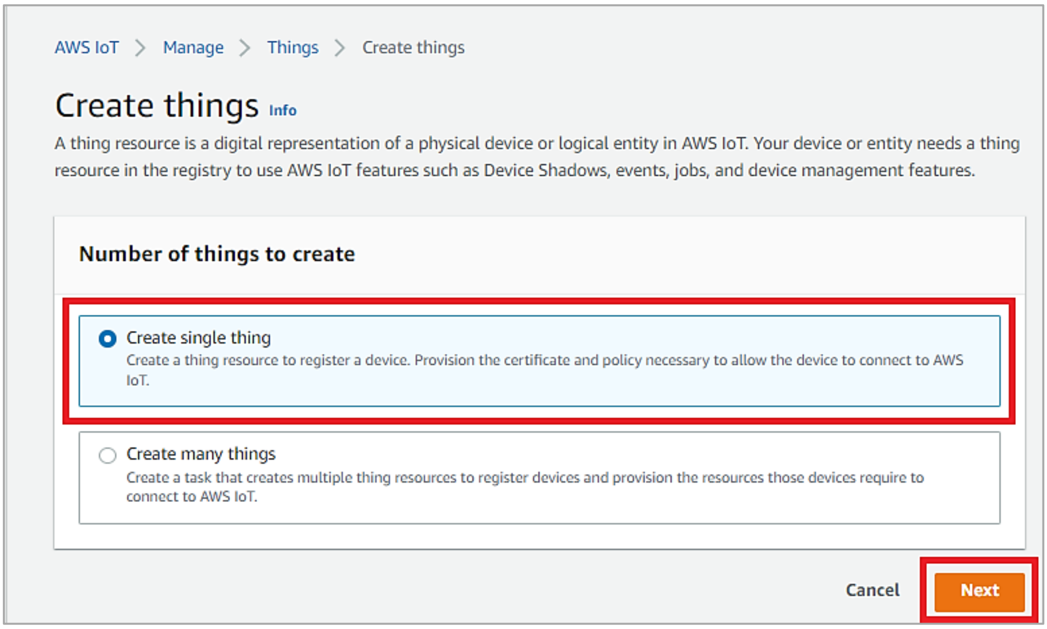


An IoT thing is a representation and record of your physical device in the cloud. A physical device needs a thing record in order to work with AWS IoT.

Filter things by: name, type, group, billing, or searchable attribute.

Figure 61. Creating the Things (1/5)

Creating **AWS IoT things > Create single thing**


AWS IoT > Manage > Things > Create things
Create things Info
Number of things to create
Cancel
Next

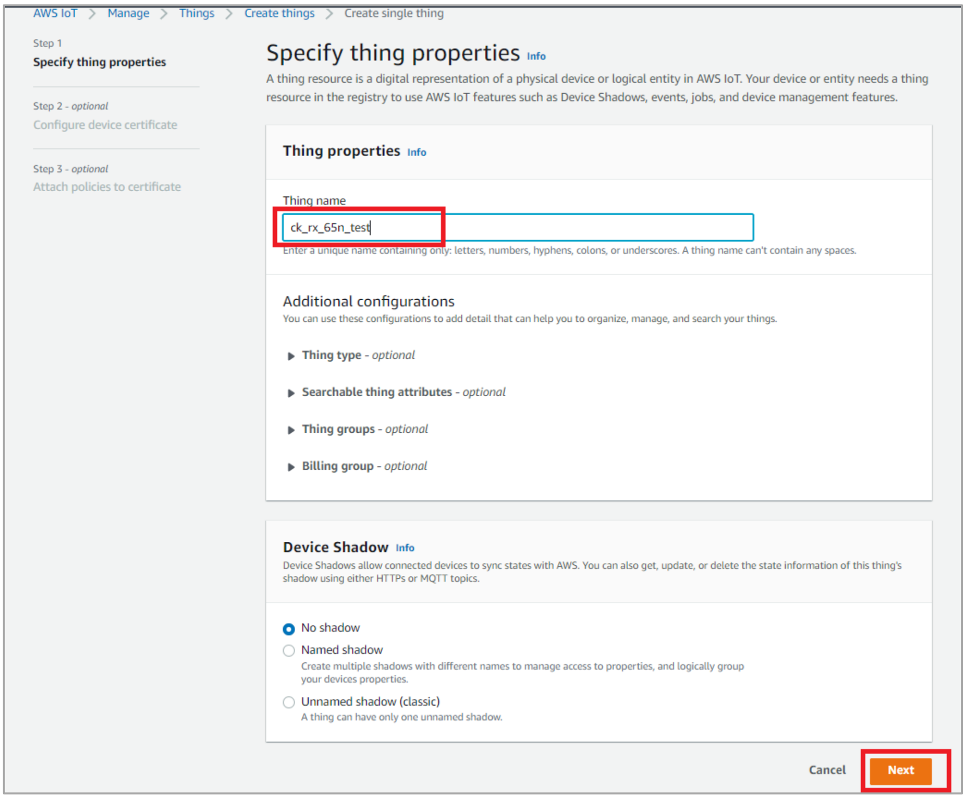
A thing resource is a digital representation of a physical device or logical entity in AWS IoT. Your device or entity needs a thing resource in the registry to use AWS IoT features such as Device Shadows, events, jobs, and device management features.

● Create single thing
Create a thing resource to register a device. Provision the certificate and policy necessary to allow the device to connect to AWS IoT.

○ Create many things
Create a task that creates multiple thing resources to register devices and provision the resources those devices require to connect to AWS IoT.

Figure 62. Creating the Things (2/5)

Add your device to the thing name > **Next**
Make a note of the name with a text editor (this will be used later)



AWS IoT > Manage > Things > Create things > Create single thing

Step 1
Specify thing properties

Step 2 - *optional*
Configure device certificate

Step 3 - *optional*
Attach policies to certificate

Specify thing properties Info

A thing resource is a digital representation of a physical device or logical entity in AWS IoT. Your device or entity needs a thing resource in the registry to use AWS IoT features such as Device Shadows, events, jobs, and device management features.

Thing properties Info

Thing name
ck_rx_65n_test
Enter a unique name containing only: letters, numbers, hyphens, colons, or underscores. A thing name can't contain any spaces.

Additional configurations
You can use these configurations to add detail that can help you to organize, manage, and search your things.

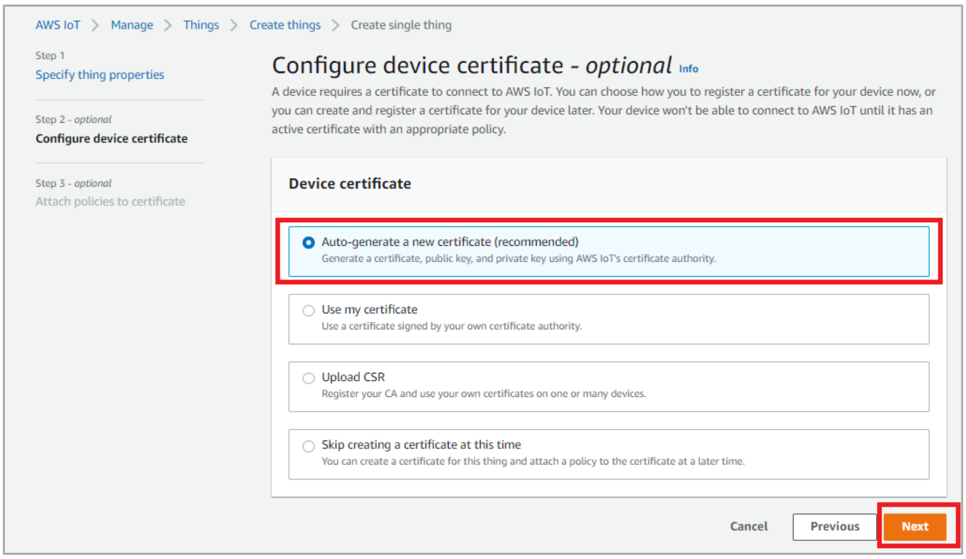
▶ Thing type - *optional*
▶ Searchable thing attributes - *optional*
▶ Thing groups - *optional*
▶ Billing group - *optional*

Device Shadow Info
Device Shadows allow connected devices to sync states with AWS. You can also get, update, or delete the state information of this thing's shadow using either HTTPs or MQTT topics.

● No shadow
○ Named shadow
Create multiple shadows with different names to manage access to properties, and logically group your devices properties.
○ Unnamed shadow (classic)
A thing can have only one unnamed shadow.

Figure 63. Creating the Things (3/5)

Auto-generate a new certificate.



AWS IoT > Manage > Things > Create things > Create single thing

Step 1
Specify thing properties

Step 2 - *optional*
Configure device certificate

Step 3 - *optional*
Attach policies to certificate

Configure device certificate - *optional* Info

A device requires a certificate to connect to AWS IoT. You can choose how you to register a certificate for your device now, or you can create and register a certificate for your device later. Your device won't be able to connect to AWS IoT until it has an active certificate with an appropriate policy.

Device certificate

● Auto-generate a new certificate (recommended)
Generate a certificate, public key, and private key using AWS IoT's certificate authority.

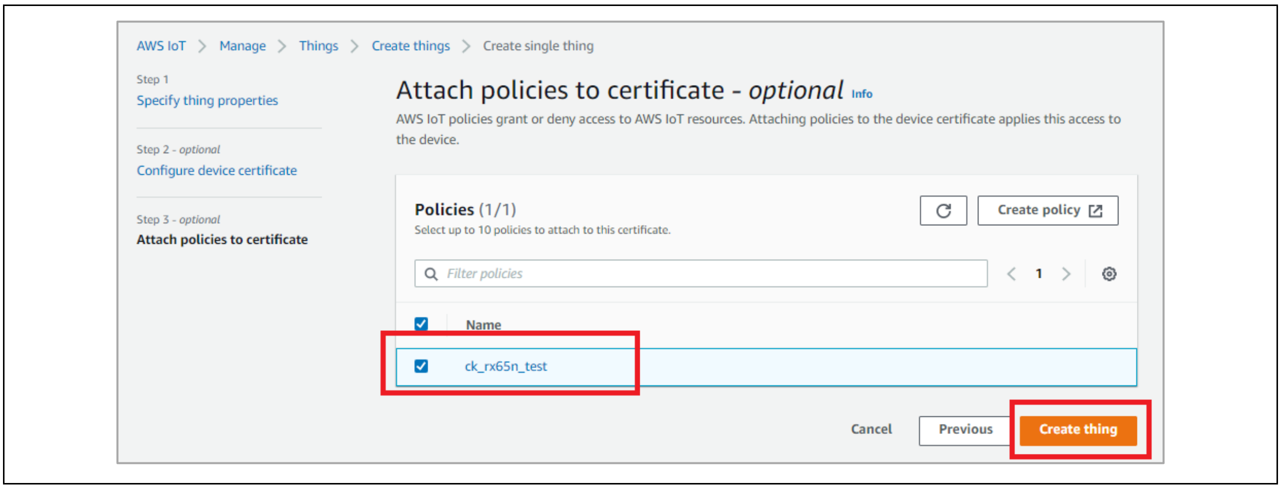
○ Use my certificate
Use a certificate signed by your own certificate authority.

○ Upload CSR
Register your CA and use your own certificates on one or many devices.

○ Skip creating a certificate at this time
You can create a certificate for this thing and attach a policy to the certificate at a later time.

Figure 64. Creating the Things (4/5)

Add a policy for your thing.



AWS IoT > Manage > Things > Create things > Create single thing

Step 1
Specify thing properties

Step 2 - *optional*
Configure device certificate

Step 3 - *optional*
Attach policies to certificate

Attach policies to certificate - *optional* Info

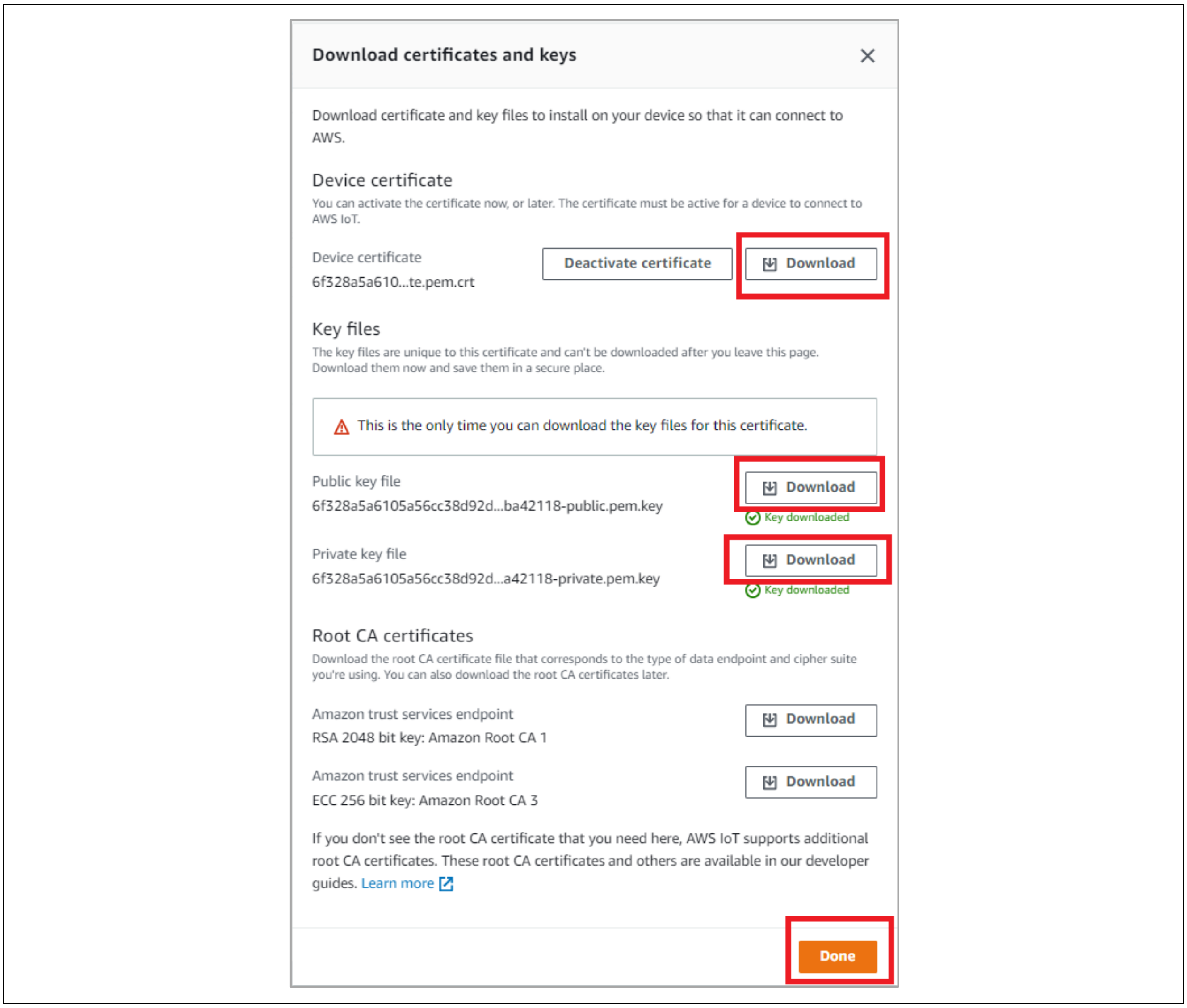
AWS IoT policies grant or deny access to AWS IoT resources. Attaching policies to the device certificate applies this access to the device.

Policies (1/1)
Select up to 10 policies to attach to this certificate.

☑	Name
☑	ck_rx65n_test

Figure 65. Creating the Things (5/5)

Download certificate, public key and private key for this thing.



Download certificates and keys

Download certificate and key files to install on your device so that it can connect to AWS.

Device certificate

You can activate the certificate now, or later. The certificate must be active for a device to connect to AWS IoT.

Device certificate
6f328a5a610...te.pem.crt

Key files

The key files are unique to this certificate and can't be downloaded after you leave this page. Download them now and save them in a secure place.

⚠ This is the only time you can download the key files for this certificate.

Public key file
6f328a5a6105a56cc38d92d...ba42118-public.pem.key

✓ Key downloaded

Private key file
6f328a5a6105a56cc38d92d...a42118-private.pem.key

✓ Key downloaded

Root CA certificates

Download the root CA certificate file that corresponds to the type of data endpoint and cipher suite you're using. You can also download the root CA certificates later.

Amazon trust services endpoint
RSA 2048 bit key: Amazon Root CA 1

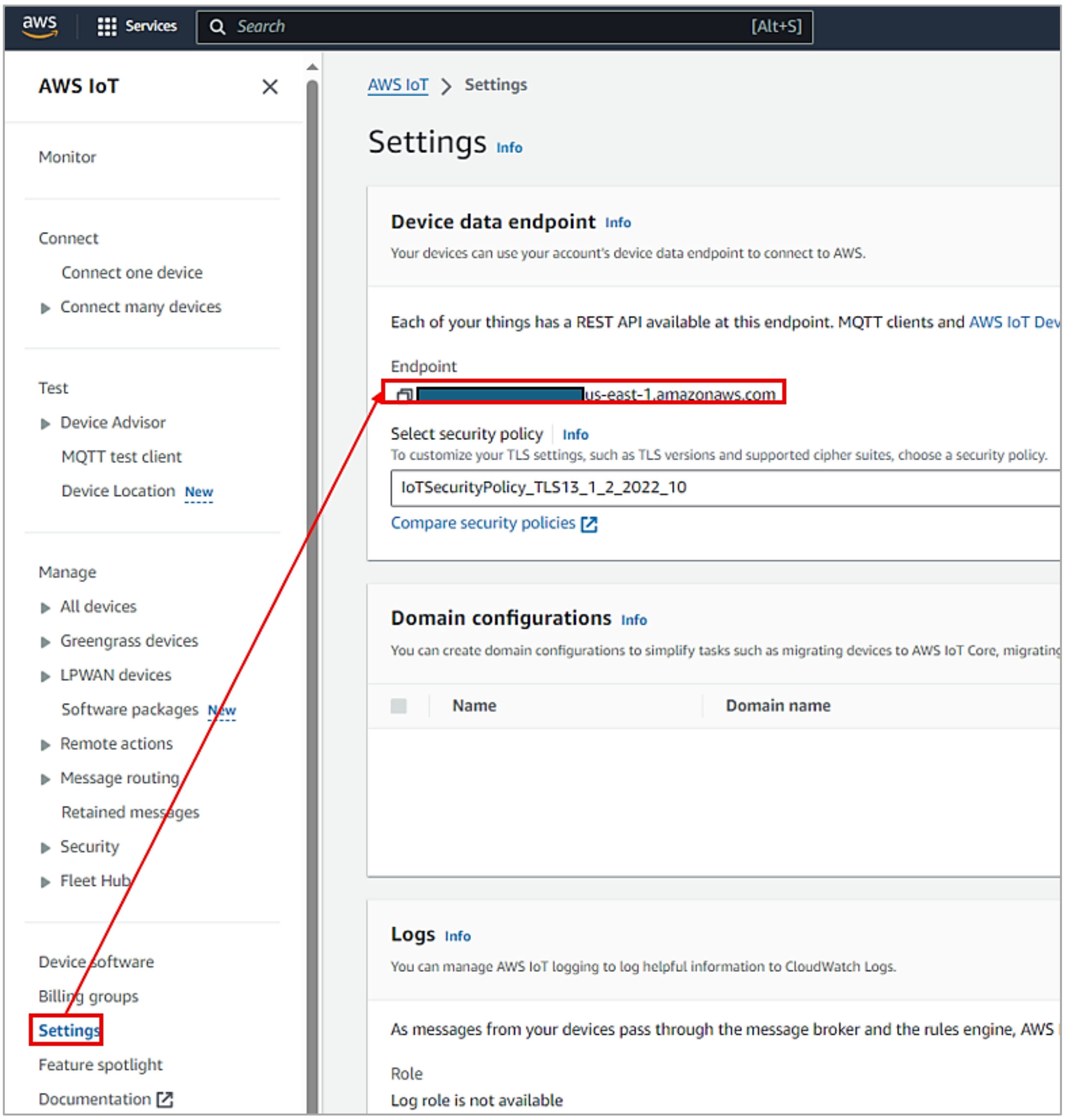
Amazon trust services endpoint
ECC 256 bit key: Amazon Root CA 3

If you don't see the root CA certificate that you need here, AWS IoT supports additional root CA certificates. These root CA certificates and others are available in our developer guides. Learn more

Figure 66. Download certificate, public key and private key

5.4.6 Check AWS IoT Endpoint

- Make a note of the Endpoint in a text editor and so forth (will be used later)



Settings Info

Device data endpoint Info

Your devices can use your account's device data endpoint to connect to AWS.

Each of your things has a REST API available at this endpoint. MQTT clients and AWS IoT Dev

Endpoint

[redacted]us-east-1.amazonaws.com

Select security policy Info

To customize your TLS settings, such as TLS versions and supported cipher suites, choose a security policy.

IoTSecurityPolicy_TLS13_1_2_2022_10

Compare security policies

Domain configurations Info

You can create domain configurations to simplify tasks such as migrating devices to AWS IoT Core, migrating

Name	Domain name

Logs Info

You can manage AWS IoT logging to log helpful information to CloudWatch Logs.

As messages from your devices pass through the message broker and the rules engine, AWS

Role

Log role is not available

Figure 67. Check AWS IoT Endpoints

You can also access the tutorial to register a device to AWS IoT tutorial on GitHub at https://github.com/renesas/amazon-freertos/wiki/Register-device-to-AWS-IoT

5.4.7 Running Application

After collecting Cloud Credentials, it includes:

- Device Certificate, Key, IoT Thing name: after registering device (see section **5.4.5**)
- MQTT Broker endpoint: (see section **5.4.6**)

Please refer to the section **5.3 Software Preparation - Running Project from IDE** for storing Cloud credentials and running application.

Note: Instead of getting cloud credentials from `cert.zip` file**,** users collected them directly from AWS cloud.

5.5 Verifying the Application Project using AWS Dashboard and Renesas Dashboard

5.5.1 Subscribe to a Topic Messages on the AWS IoT

This section describes the steps on how to verify this application example's functions.

Note: Wait for the board to get the IP address from the service provider upon successful cellular/ethernet initialization, and the board to resolve the DNS lookup for the endpoint. After the successful MQTT connection message on the Console, "***Successfully connected to MQTT broker***", the device is ready for Publishing and Subscribing of Messages.

Note: This Application involves AWS MQTT IOT Core, user has an option to use the AWS IOT Dashboard for the Validation purpose, in addition to using the Renesas GUI based Dashboard for customized view of all the Sensor Data.

For verification purposes, the user can use the AWS IoT core Dashboard for configuring and controlling the subscription and publishing of the topics as described in the following sections.

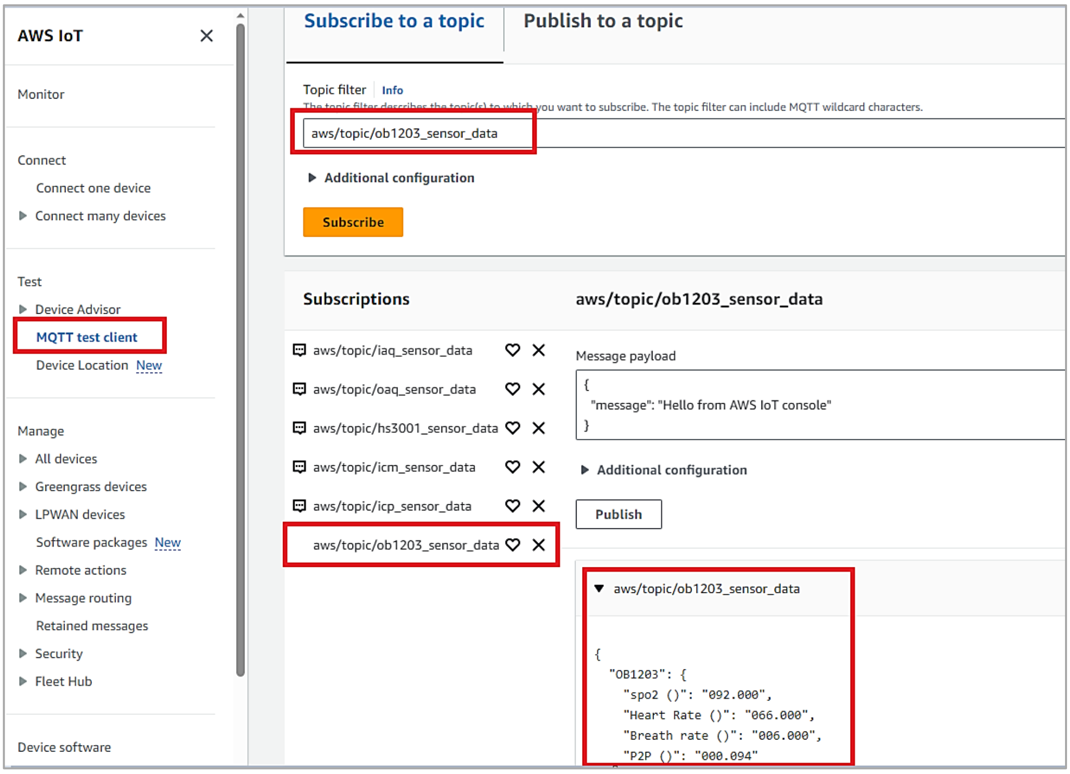
On the AWS cloud Dashboard, go to IoT Core and select **Test**, then choose **MQTT test client**. Subscribe to a topic listed below one at a time. The sample snapshot for subscribing to the topics is shown below.

Note: The messages shown below are **case-sensitive**; users need to take care of this when entering the publish or subscribe messages.

Only enter one message at a time. Copy the message 'as-is' between the quotes and do not include any extra spaces.

```
"aws/topic/iaq_sensor_data"
"aws/topic/oaq_sensor_data"
"aws/topic/hs3001_sensor_data"
"aws/topic/icm_sensor_data"
"aws/topic/icp_sensor_data"
"aws/topic/ob1203_sensor_data"
```

Note: After the subscription to the Topics, the Dashboard is ready to receive the messages being published from the device.



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

aws/topic/ob1203_sensor_data

Subscriptions:
aws/topic/iaq_sensor_data
aws/topic/oaq_sensor_data
aws/topic/hs3001_sensor_data
aws/topic/icm_sensor_data
aws/topic/icp_sensor_data
aws/topic/ob1203_sensor_data

aws/topic/ob1203_sensor_data

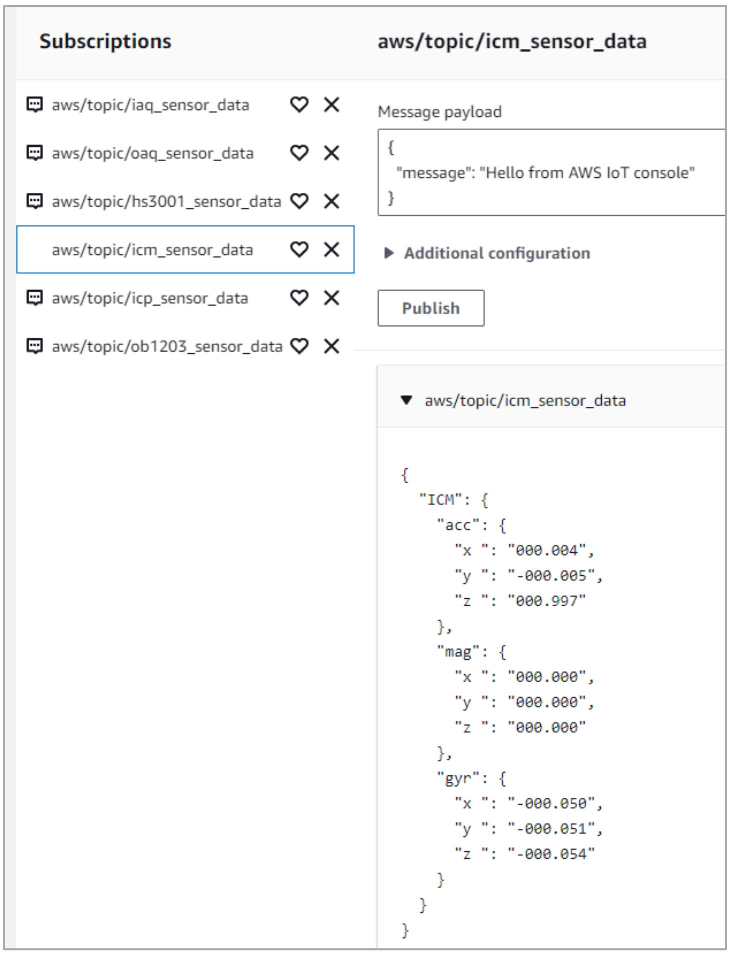
Message payload:

```
{
  "message": "Hello from AWS IoT console"
}
```

▼ aws/topic/ob1203_sensor_data

```
{
  "OB1203": {
    "spo2 ()": "092.000",
    "Heart Rate ()": "066.000",
    "Breath rate ()": "006.000",
    "P2P ()": "000.094"
```

Figure 68. Subscribe to a Topic Messages on the AWS IoT Screen



Subscriptions
aws/topic/iaq_sensor_data
aws/topic/oaq_sensor_data
aws/topic/hs3001_sensor_data
aws/topic/icm_sensor_data
aws/topic/icp_sensor_data
aws/topic/ob1203_sensor_data
aws/topic/icm_sensor_data
Message payload
Additional configuration
Publish
aws/topic/icm_sensor_data

```
{
  "message": "Hello from AWS IoT console"
}
```

```
{
  "ICM": {
    "acc": {
      "x ": "000.004",
      "y ": "-000.005",
      "z ": "000.997"
    },
    "mag": {
      "x ": "000.000",
      "y ": "000.000",
      "z ": "000.000"
    },
    "gyr": {
      "x ": "-000.050",
      "y ": "-000.051",
      "z ": "-000.054"
    }
  }
}
```

Figure 69. Subscribed Messages on the AWS IoT Screen

5.5.2 Publish a Topic Messages on the AWS Dashboard and Renesas Dashboard

5.5.2.1 With AWS Dashboard

The board subscribed to the topic: **aws/topic/<topicRx>**

If we publish the below data from AWS console

HS3001 temperature alerts:

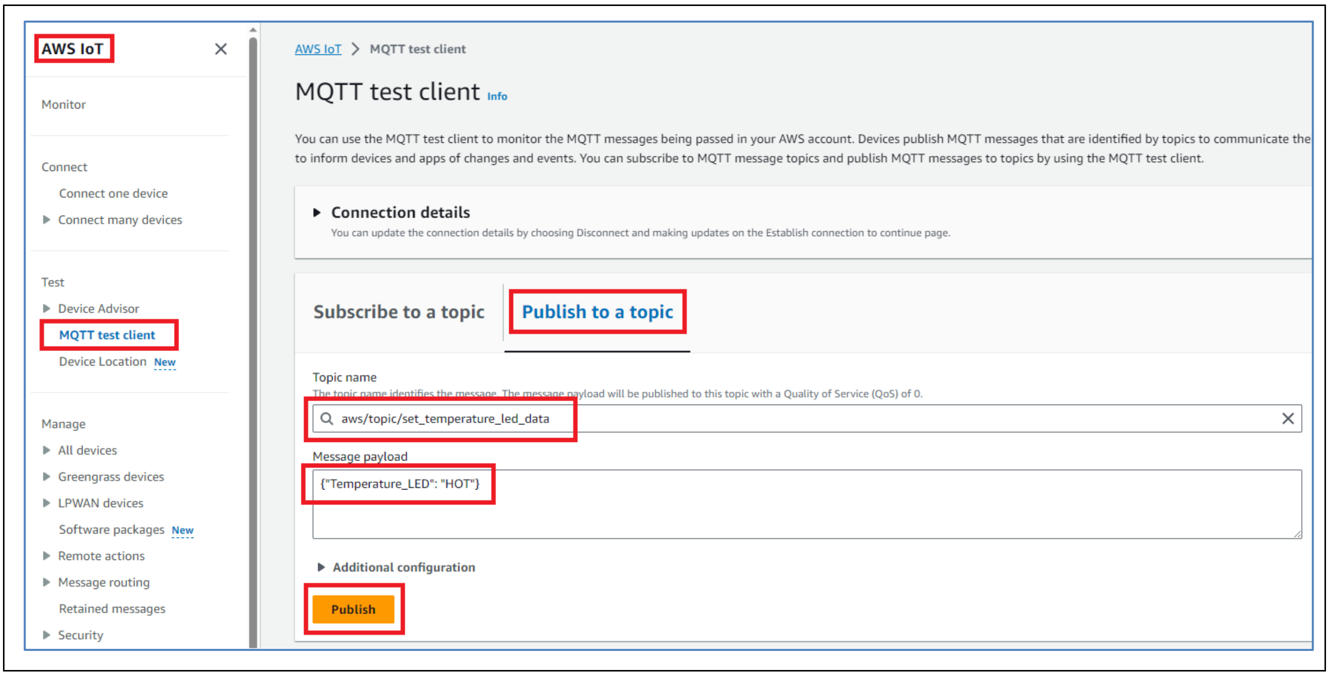
Based on temperature, dashboard will send the alert messages to CK-RX65N V1 kit via below topic

Topic: `aws/topic/set_temperature_led_data`

```
Message: {"Temperature_LED": "HOT"}    Will turn on RED in Tri-Color LED
Message: {"Temperature_LED": "WARM"}   Will turn on GREEN in Tri-Color LED
Message: {"Temperature_LED": "COLD"}   Will turn on BLUE in Tri-Color LED
```

Example:

Click **Test** > **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 the 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.

Connection details

You can update the connection details by choosing Disconnect and making updates on the Establish connection to continue page.

Topic name

The topic name identifies the message. The message payload will be published to this topic with a Quality of Service (QoS) of 0.

aws/topic/set_temperature_led_data

Message payload

{"Temperature_LED": "HOT"}

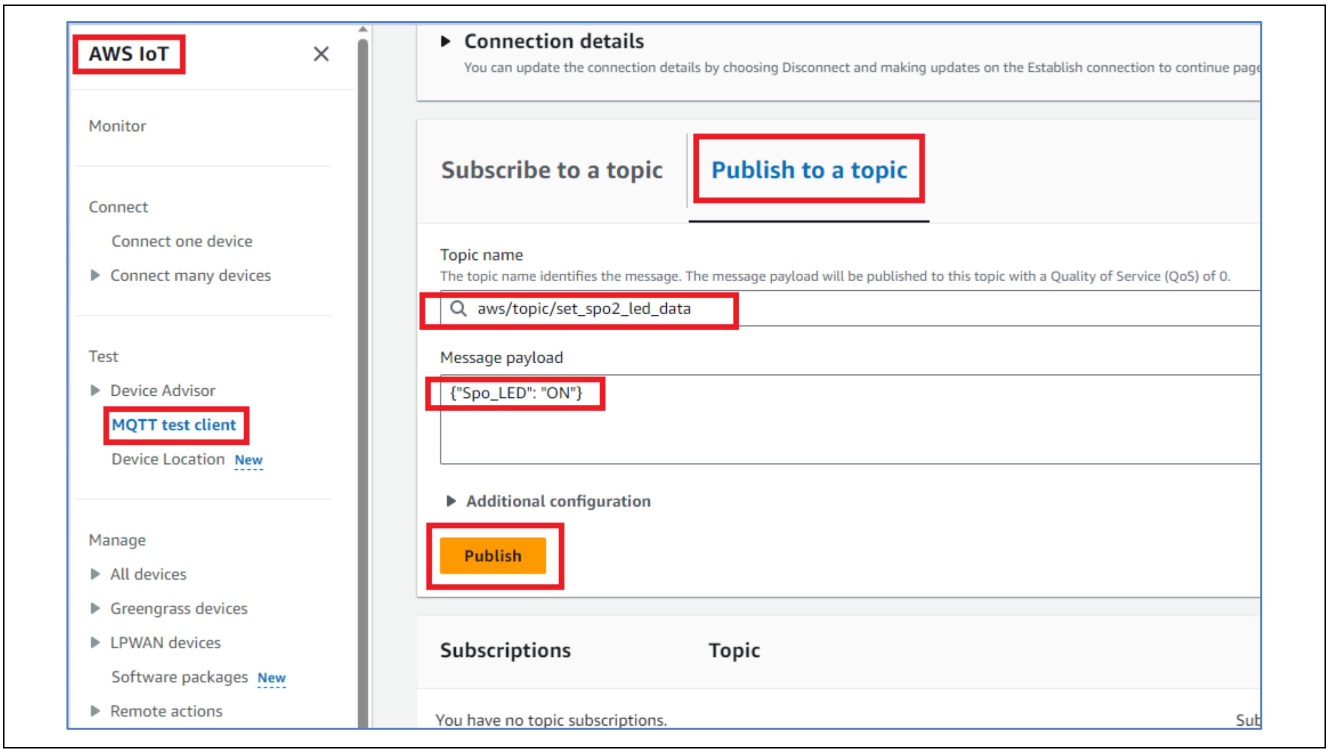
Figure 70. Publish the MQTT Message (1/2)

OB1203 SPO2 alerts:

Based on SPO2 value, dashboard will send the alert messages to CK-RX65N V1 kit via below topic

Topic: `aws/topic/set_spo2_led_data`

```
Message: {"Spo_LED": "ON"} Will turn on BLUE LED in CK-RX65N V1
Message: {"Spo_LED": "OFF"}Will turn off BLUE LED in CK-RX65N V1
```



Connection details

You can update the connection details by choosing Disconnect and making updates on the Establish connection to continue page

Topic name

The topic name identifies the message. The message payload will be published to this topic with a Quality of Service (QoS) of 0.

aws/topic/set_spo2_led_data

Message payload

{"Spo_LED": "ON"}

You have no topic subscriptions.

Figure 71. Publish the MQTT Message (2/2)

5.5.2.2 With Renesas Dashboard

(1) Dashboard Types

Depending on the sensors, you can choose one of the dashboard types: Renesas 9-Axis sensor or Renesas. Click on **Renesas** option.

Note: The 9-AXIS MEMS Motion Tracking Sensor TDK ICM-20948 is not fitted on this CK-RX65N board due to shortages in component availability (For more information: CK-RX65N v1 – Release Note (renesas.com))

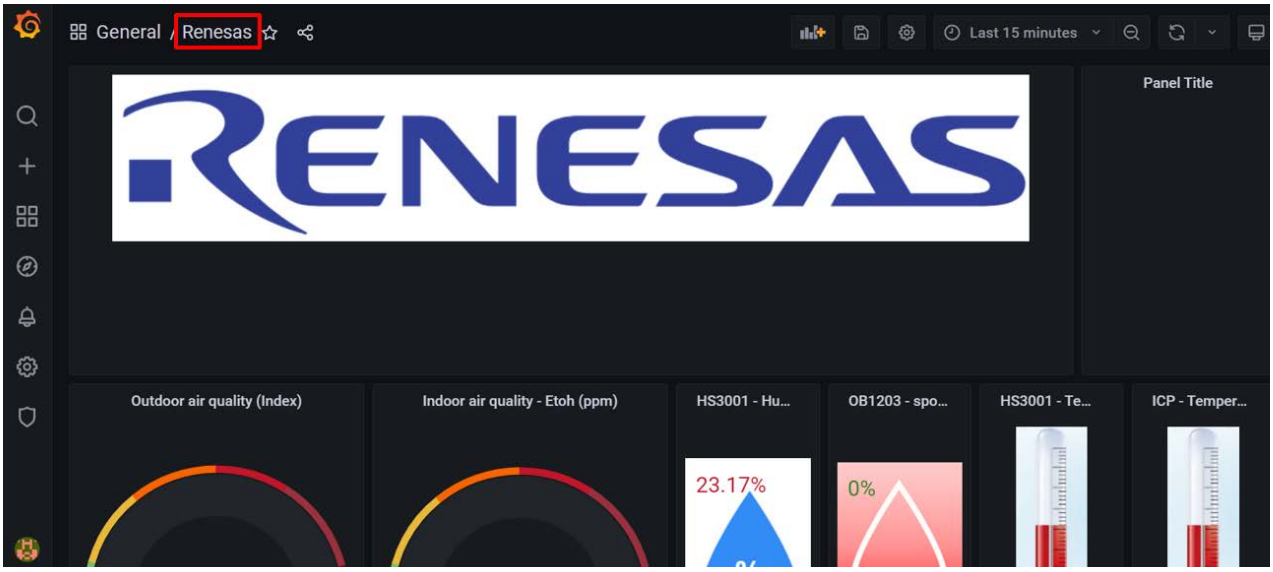


Figure 72. Renesas AWS Cloud Dashboard Types

Choose Renesas 9-Axis sensor.

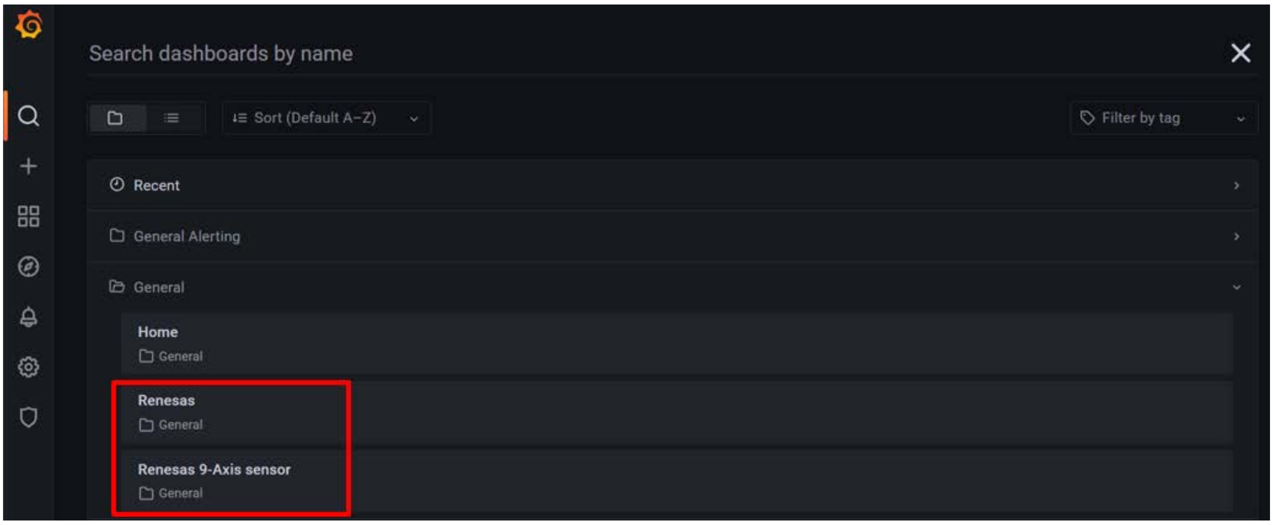


Figure 73. Choosing Renesas 9-Axis Sensor

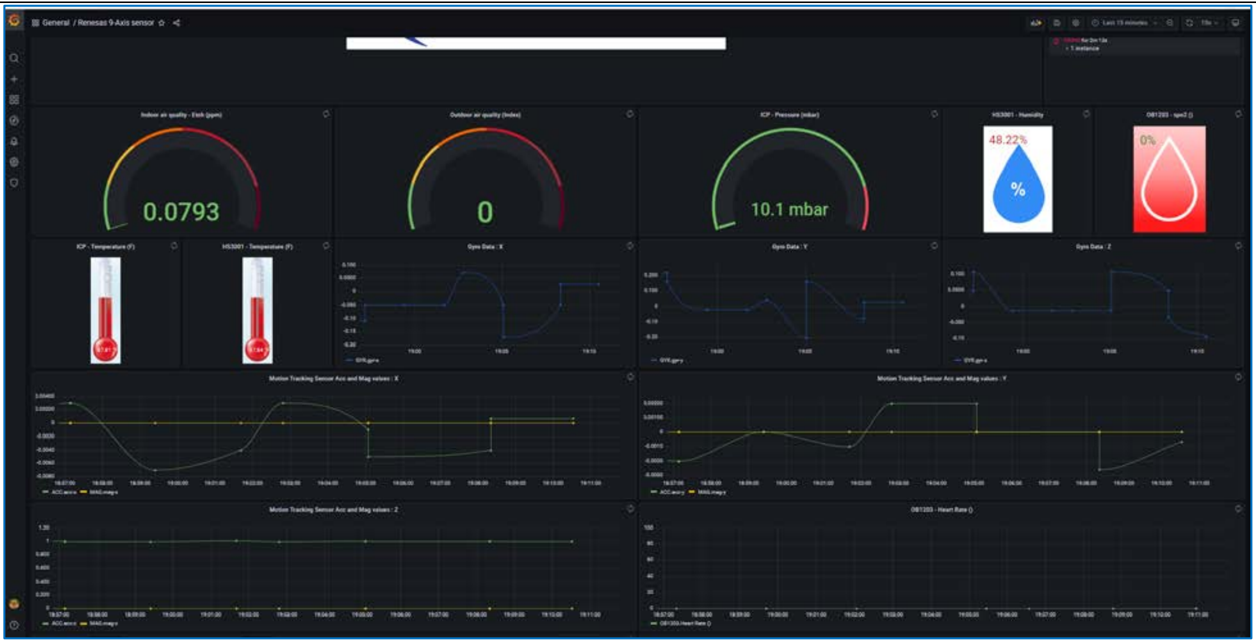

General / Renesas 9-Axis sensor
Indoor air quality - Etoh (ppm)
0.0793
Outdoor air quality (Index)
0
ICP - Pressure (mbar)
10.1 mbar
HS3001 - Humidity
48.22%
%
OB1203 - spo2 ()
0%
ICP - Temperature (F)
HS3001 - Temperature (F)
Gyro Data : X
Gyro Data : Y
Gyro Data : Z
Motion Tracking Sensor Acc and Mag values : X
Motion Tracking Sensor Acc and Mag values : Y
Motion Tracking Sensor Acc and Mag values : Z
OB1203 - Heart Rate ()

Figure 74. Renesas Dashboard displays 9-Axis Sensor

(2) Sensor Data for Cloud Kits

The Grafana dashboard displays the following Data from sensors.

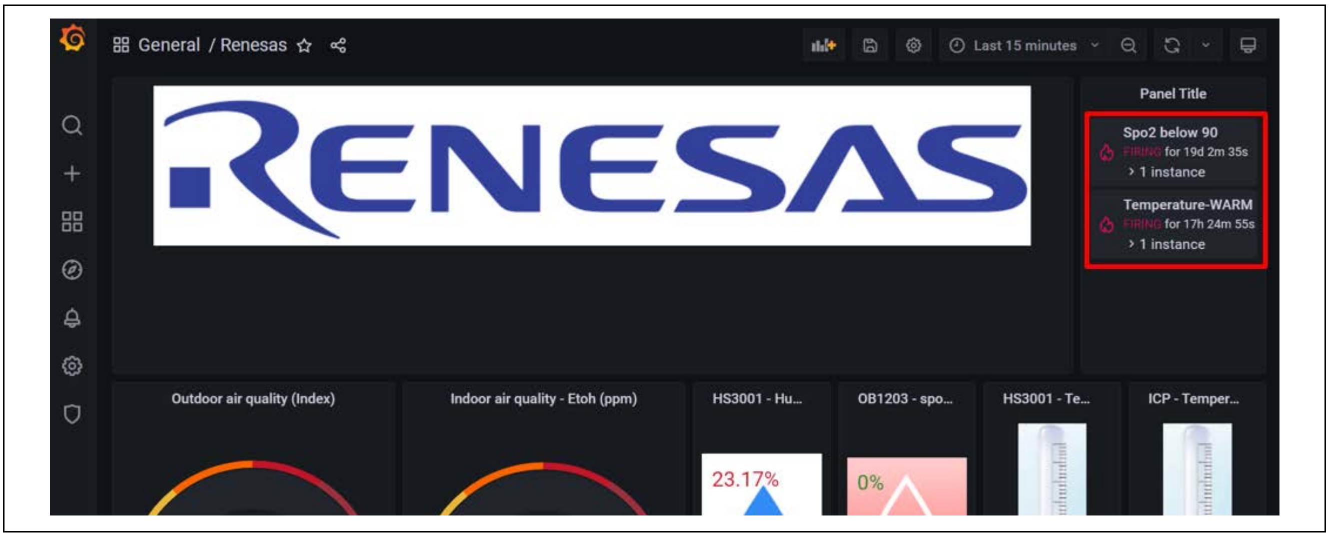
Table 9. Sensor Data from Grafana Dashboard

Sensor	Data
HS3001- Humidity and Temperature Sensor	Temperature, F
	Humidity, %
ZMOD4410- Indoor Air Quality Sensor	Etoh, ppm
	ECO2- Estimated Carbon dioxide, ppm
	TVOC - Total Organic Compounds, mg/m^3
OB1203 - Heart Rate, Blood Oxygen Concentration, Pulse Oximetry, Proximity, Light and Color Sensor	SPO2, %
	HR (Heart Rate), bpm (beats per minute)
	RR (Respiration Rate), breaths per minute
	P2P
ICP-10101 - Barometric Pressure and Temperature Sensor	Temperature, F
	Barometric Pressure, mbar
ICM-20948 Motion Tracking Sensor	Acc values, unit: g
	Gyro Data, unit: dps (degrees per sec)
	Mag Data, unit: mT
OAQ – Outdoor Air Quality	OAQ, ppm

(3) Alerting and Anomaly Detection

Grafana's alerts are ways to send notifications when a metric crosses a threshold that has been configured. By default, the dashboard has thresholds for the following sensors:

- OB1203-SPO2: SPO2 above 90, SPO2 below 90
- HS3001 – Temperature, F:
  - Temperature – Cold: below 65
  - Temperature – Warm: within range from 65 to 85
  - Temperature – Hot: above 85



Panel Title

Spo2 below 90
FIRING for 19d 2m 35s
› 1 instance

Temperature-WARM
FIRING for 17h 24m 55s
› 1 instance

Figure 75. Sensor Status Feedback

Sensor status feedback is sent to the device which is indicated by the LEDs.

6. OTA over MQTT

6.1 Overview OTA

This section describes the steps on using OTA in this application.

OTA (Over-The-Air) updates are crucial in maintaining the functionality, security, and performance of IoT devices. This feature allows the user to efficiently deploy updates, patches, or new versions of software to connected IoT devices without requiring physical access to each device.

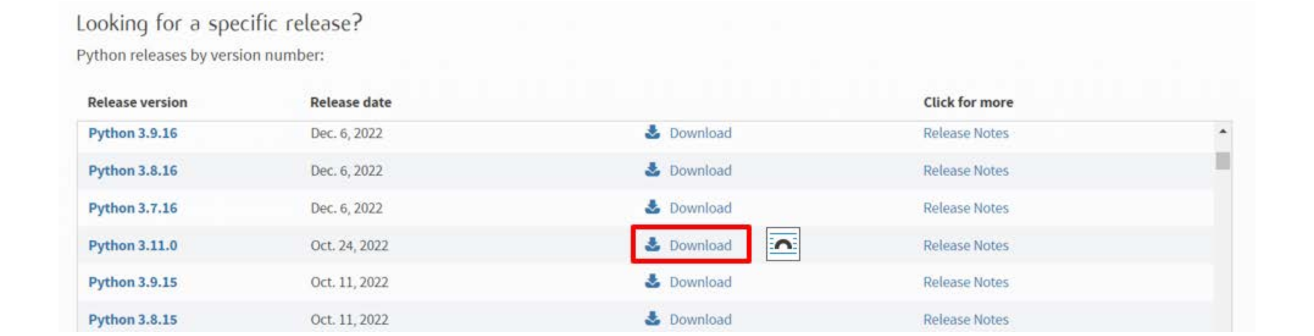
Please refer to the document about OTA: OTA-using-Amazon-Web-Services-in-RX65N-FreeRTOS-for-v202210.01-LTS-rx-1.1.0

Note: This OTA feature in the application is not available for users who use AWS account with free 10$ credit and dashboard that are provided by Renesas, because of some limitations with this account's permission.

6.2 Prerequisites

6.2.1 Installing Python

1. Access the Python download website: Python downloaded website and download the Python 3.11.0 installer: Click the **Download** link for Python 3.11.0



Looking for a specific release?

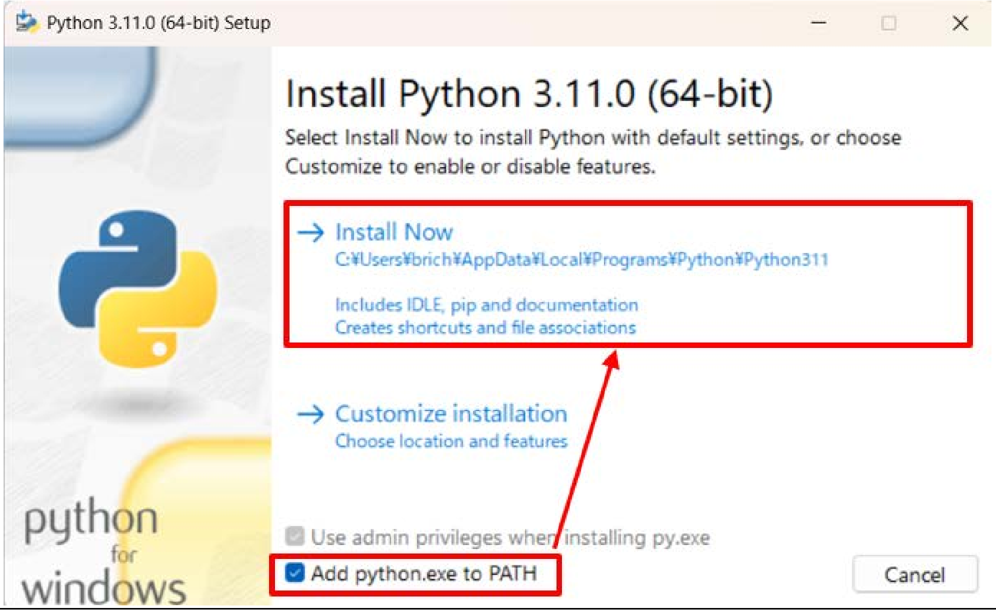
Python releases by version number:

Release version	Release date		Click for more
Python 3.9.16	Dec. 6, 2022	Download	Release Notes
Python 3.8.16	Dec. 6, 2022	Download	Release Notes
Python 3.7.16	Dec. 6, 2022	Download	Release Notes
Python 3.11.0	Oct. 24, 2022	Download	Release Notes
Python 3.9.15	Oct. 11, 2022	Download	Release Notes
Python 3.8.15	Oct. 11, 2022	Download	Release Notes

Figure 76. Python Download Website

2. Run the installer and follow the prompts to install Python

On the installation screen, select the **Add python.exe to PATH** check box.



Python 3.11.0 (64-bit) Setup

Install Python 3.11.0 (64-bit)

Select Install Now to install Python with default settings, or choose Customize to enable or disable features.

→ Install Now
C:¥Users¥brich¥AppData¥Local¥Programs¥Python¥Python311

Includes IDLE, pip and documentation
Creates shortcuts and file associations

→ Customize installation
Choose location and features

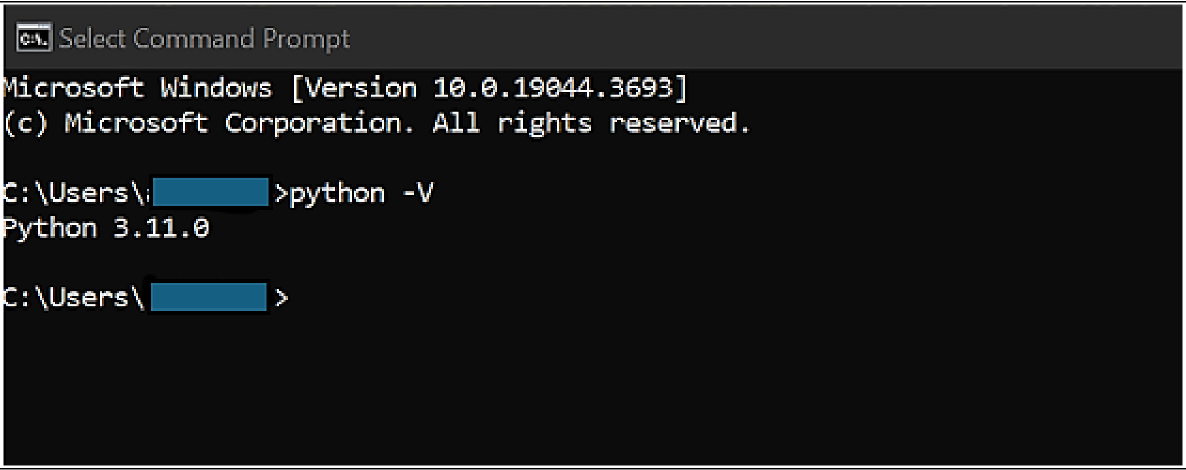
☑ Use admin privileges when installing py.exe

☑ Add python.exe to PATH

Figure 77. Python 3.11.0 installer

3. Open a command prompt and confirm that Python 3.11.0 is installed.

Execute the following command and confirm that information appears: *$python -V*



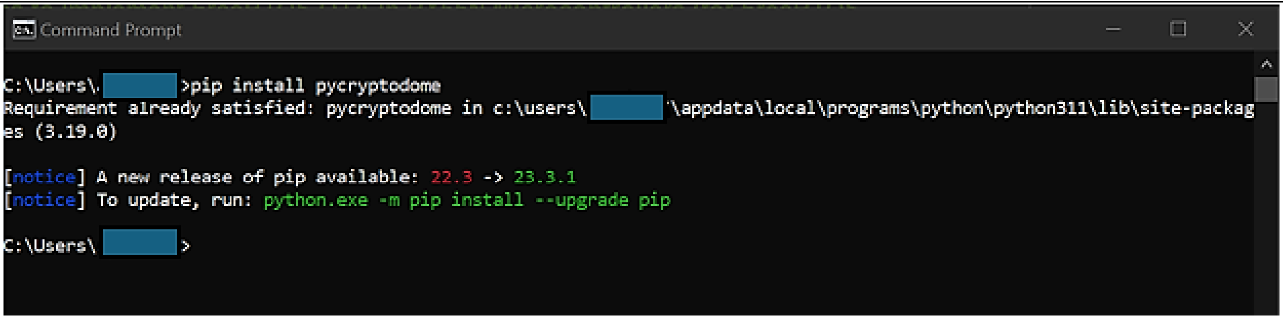
Select Command Prompt

```
Microsoft Windows [Version 10.0.19044.3693]
(c) Microsoft Corporation. All rights reserved.

C:\Users\[redacted]>python -V
Python 3.11.0

C:\Users\[redacted]>
```

Figure 78. Checking version of Python

4. Install the Python encryption library (pycryptodome)

Install the encryption library by executing the following command: *$ pip install pycryptodome*

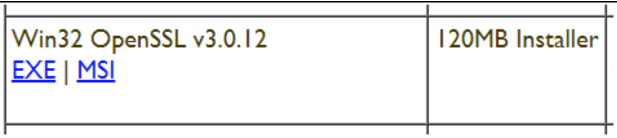


```
C:\Users\[redacted]>pip install pycryptodome
Requirement already satisfied: pycryptodome in c:\users\[redacted]\appdata\local\programs\python\python311\lib\site-packag
es (3.19.0)

[notice] A new release of pip available: 22.3 -> 23.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip

C:\Users\[redacted]>
```

Figure 79. Installing Python encryption library

6.2.2 Installing OpenSSL

1. Access the Win32/Win64 download website for OpenSSL: OpenSSL Download Website and download the installer for the operating system you are using.



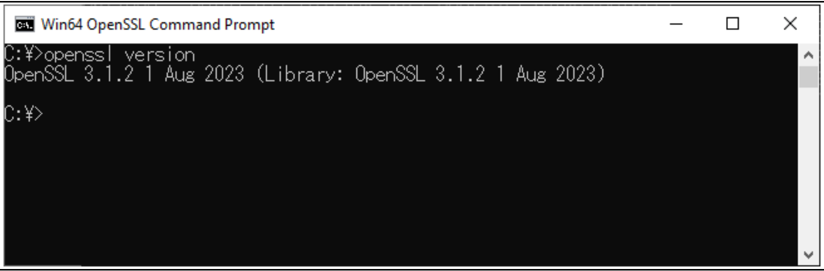
Win32 OpenSSL v3.0.12 EXE | MSI	120MB Installer

Figure 80. OpenSSL Download Website

2. Run the installer and follow the prompts to install OpenSSL.

3. Open the Win64 OpenSSL Command Prompt and confirm that OpenSSL is installed.

Execute the following command and confirm that information appears: *$openssl version*



```
C:¥>openssl version
OpenSSL 3.1.2 1 Aug 2023 (Library: OpenSSL 3.1.2 1 Aug 2023)

C:¥>
```

Figure 81. Checking version of OpenSSL

6.2.3 Installing Renesas Image Generator

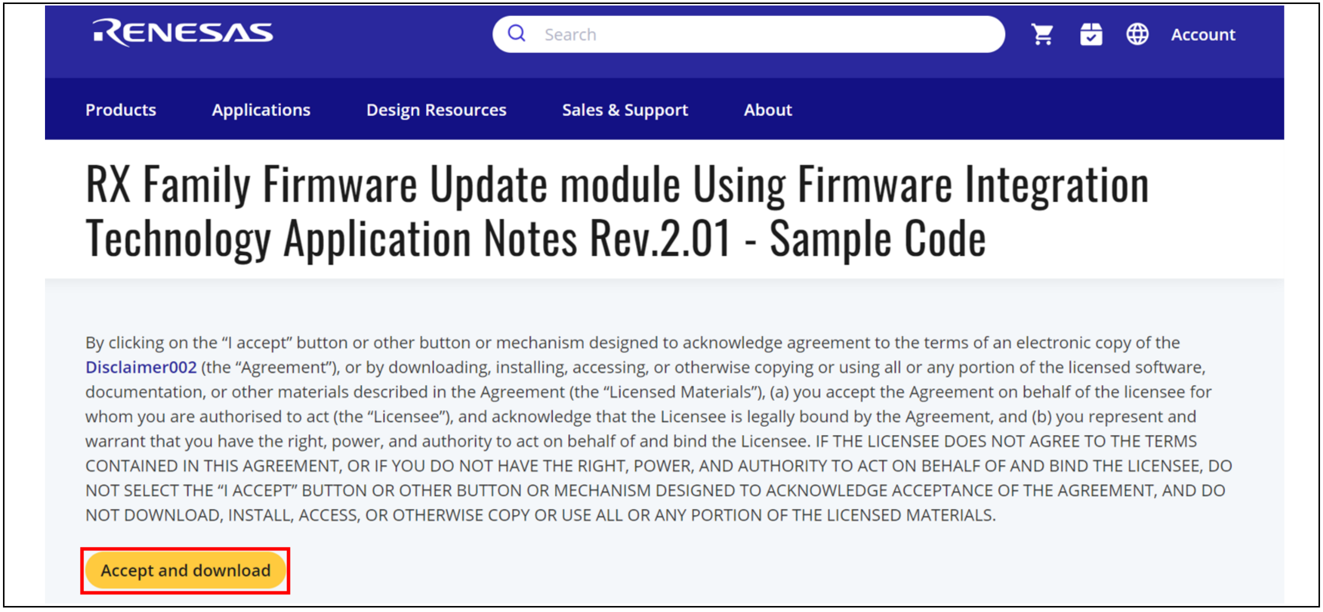
Renesas Image Generator is a tool that generates the firmware images used by the firmware update module. This tool can generate the following images for use by the firmware update module:

- **Initial image:** An image file containing the bootloader and application program written by flash writer during initial system configuration (extension: mot)
- **Update image:** An image file containing the updated firmware (extension: rsu)

Renesas Image Generator is provided as part of the Firmware Update FIT module.

Note: Version Rev.2.00 and later of the Firmware Update module only support firmware generation using Python scripts.

1. Access the link RX Family Firmware Update module Using Firmware Integration Technology Application Notes Rev.2.01 - Sample Code | Renesas and download the firmware update module.



RX Family Firmware Update module Using Firmware Integration Technology Application Notes Rev.2.01 - Sample Code

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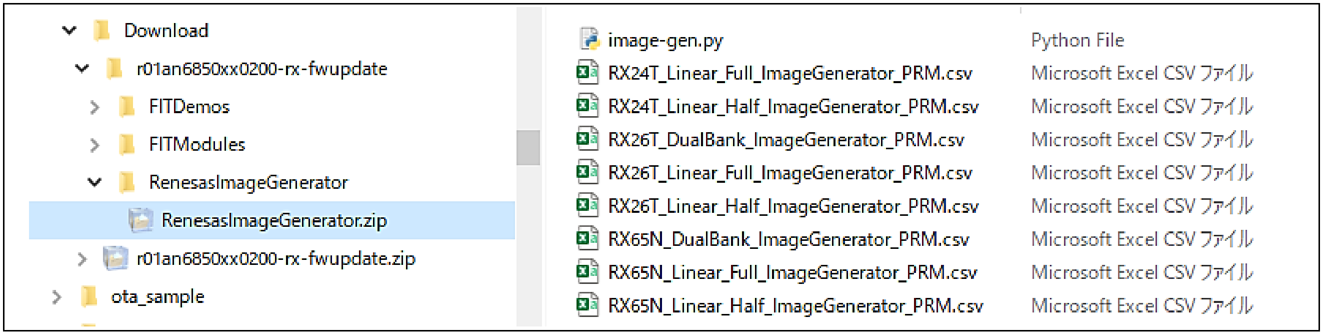
Figure 82. Renesas Image Generator Downloading

2. Extract the downloaded firmware update module.

Extract the file **RenesasImageGenerator.zip** in the firmware update module. The RenesasImageGenerator folder contains the Renesas Image Generator script file (image-gen.py) and the parameter files for various devices (*_ImageGenerator_PRM.csv).



Download
r01an6850xx0200-rx-fwupdate
FITDemos
FITModules
RenesasImageGenerator
RenesasImageGenerator.zip
r01an6850xx0200-rx-fwupdate.zip
ota_sample

image-gen.py	Python File
RX24T_Linear_Full_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX24T_Linear_Half_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX26T_DualBank_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX26T_Linear_Full_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX26T_Linear_Half_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX65N_DualBank_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX65N_Linear_Full_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル
RX65N_Linear_Half_ImageGenerator_PRM.csv	Microsoft Excel CSV ファイル

Figure 83. Renesas Image Generator package

6.3 Setting up AWS for OTA

6.3.1 Register your Device in AWS

See chapter **5.4** for details on how to sign up for an AWS account.

6.3.2 Creating an Amazon S3 bucket

Amazon S3 is an online storage web service used to store the firmware with the device will be updated.

1. From the **Services** menu, select **Storage** and then choose **S3.**

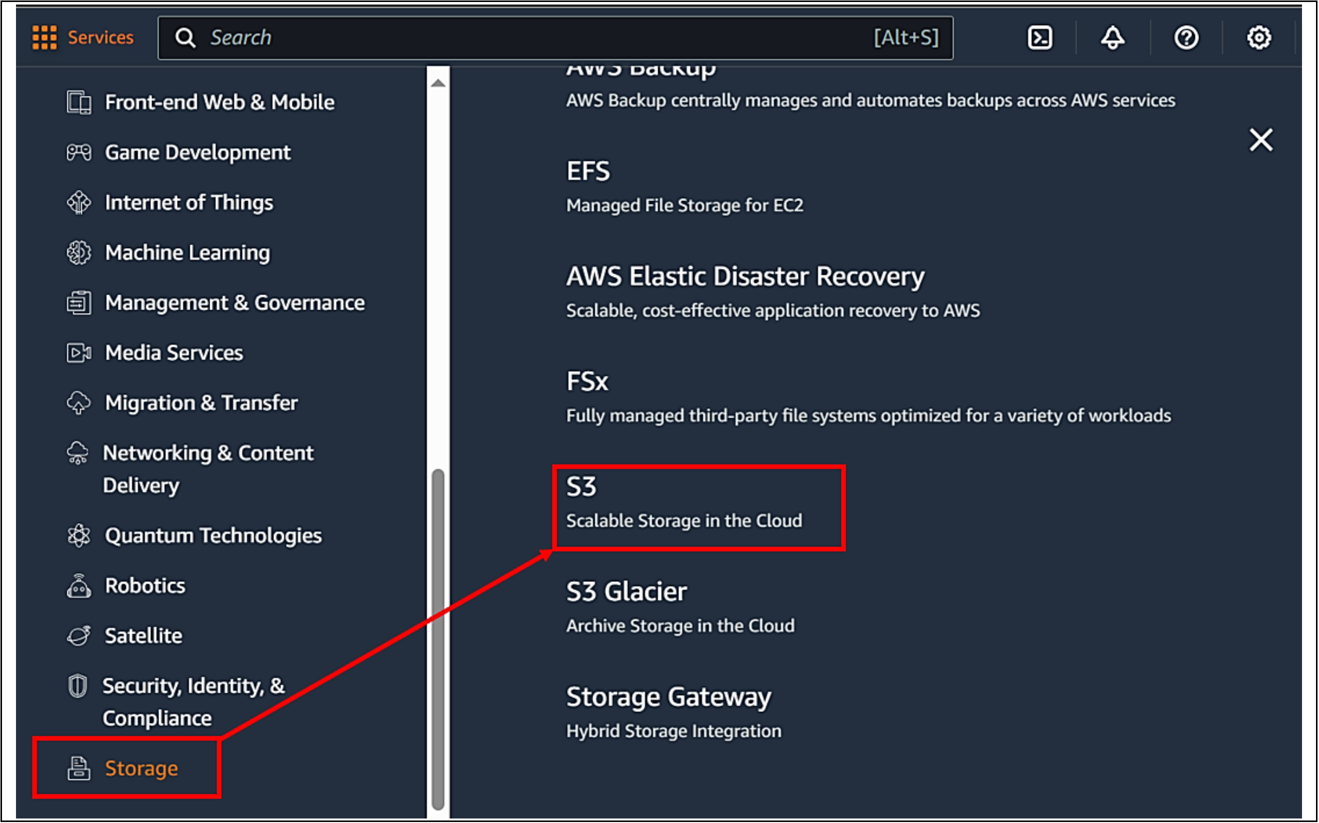

Services
Search
[Alt+S]
Front-end Web & Mobile
Game Development
Internet of Things
Machine Learning
Management & Governance
Media Services
Migration & Transfer
Networking & Content Delivery
Quantum Technologies
Robotics
Satellite
Security, Identity, & Compliance
Storage
AWS Backup
AWS Backup centrally manages and automates backups across AWS services
EFS
Managed File Storage for EC2
AWS Elastic Disaster Recovery
Scalable, cost-effective application recovery to AWS
FSx
Fully managed third-party file systems optimized for a variety of workloads
S3
Scalable Storage in the Cloud
S3 Glacier
Archive Storage in the Cloud
Storage Gateway
Hybrid Storage Integration

Figure 84. Create AWS S3 bucket (1/2)

2. On the **Buckets** page, click the **Create bucket** button.

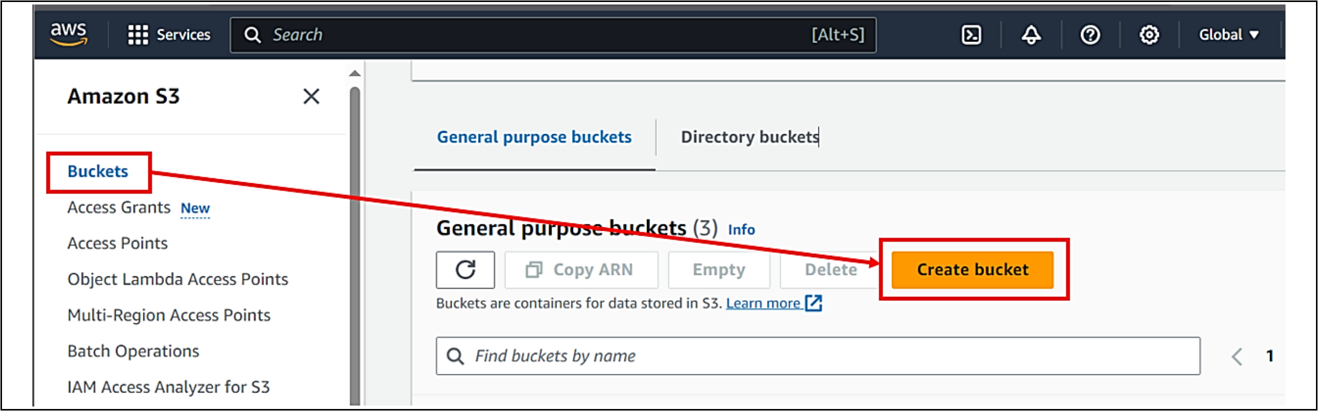
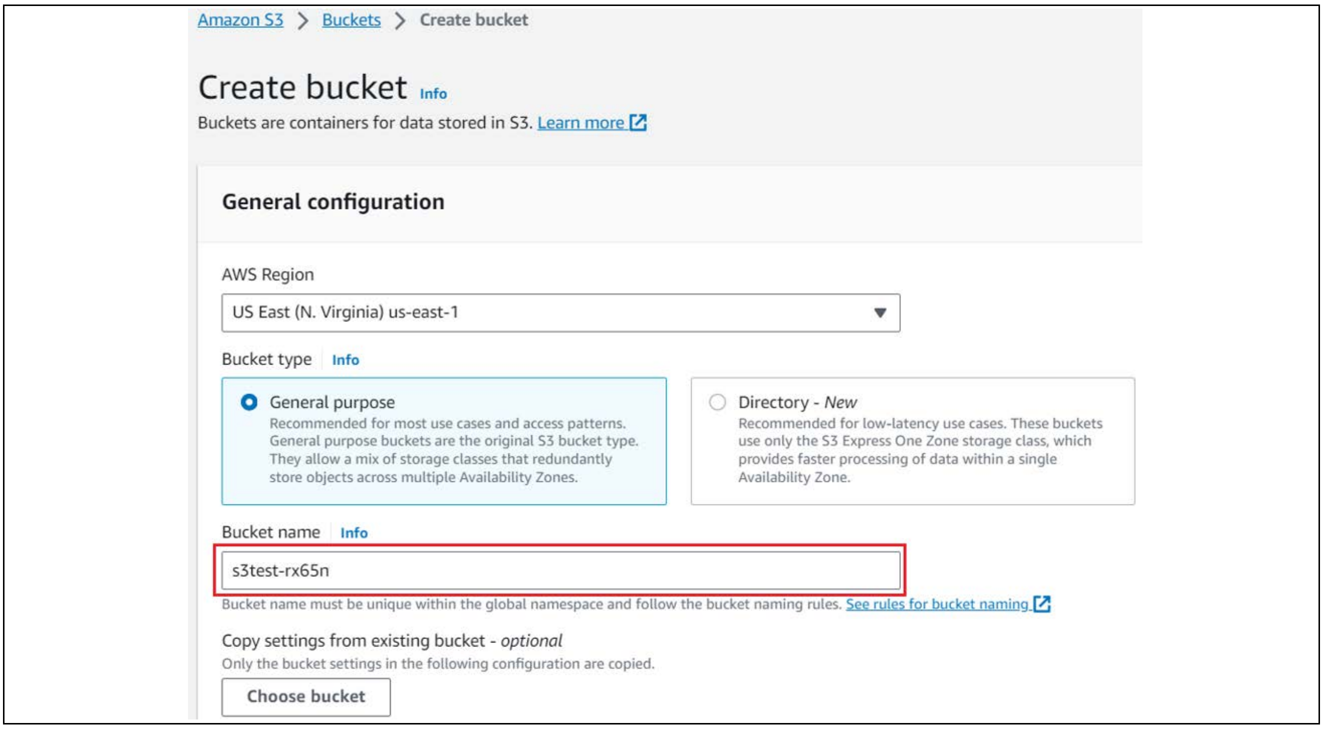


Figure 85. Create AWS S3 bucket (2/2)

3. Enter a bucket name (example: s3test-rx65n)



Amazon S3 > Buckets > Create bucket

Create bucket Info

Buckets are containers for data stored in S3. Learn more

General configuration

AWS Region

US East (N. Virginia) us-east-1

Bucket type Info

● General purpose
Recommended for most use cases and access patterns. General purpose buckets are the original S3 bucket type. They allow a mix of storage classes that redundantly store objects across multiple Availability Zones.

○ Directory - *New*
Recommended for low-latency use cases. These buckets use only the S3 Express One Zone storage class, which provides faster processing of data within a single Availability Zone.

Bucket name Info

s3test-rx65n

Bucket name must be unique within the global namespace and follow the bucket naming rules. See rules for bucket naming

Copy settings from existing bucket - *optional*
Only the bucket settings in the following configuration are copied.

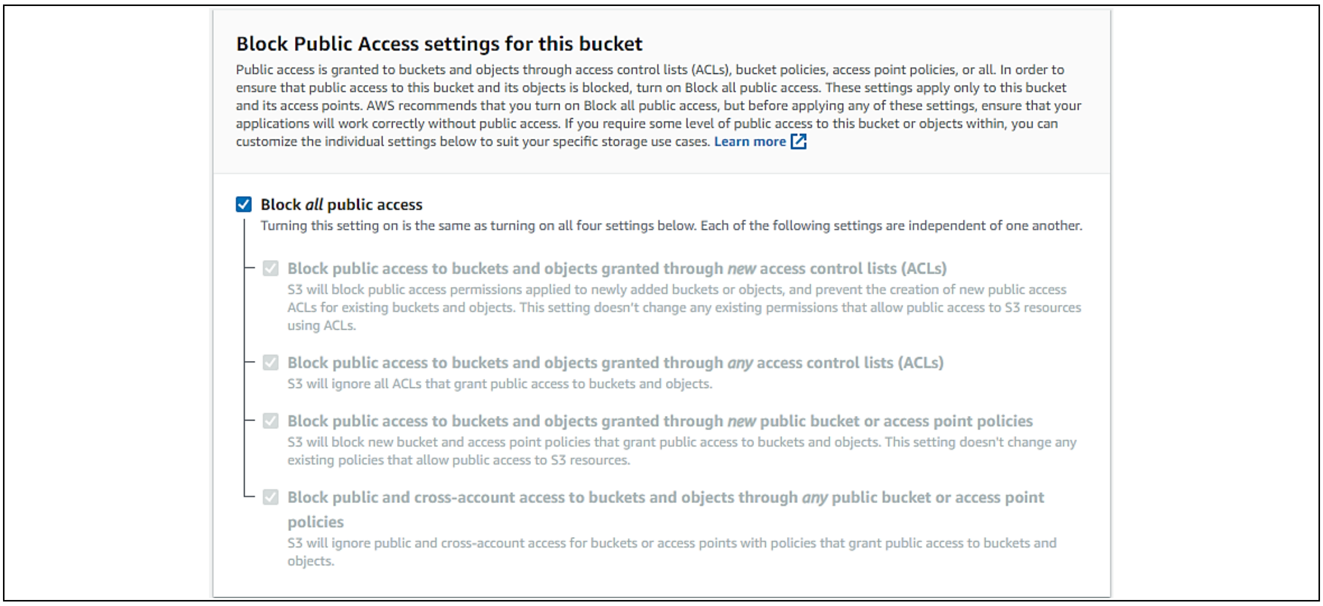
Figure 86. Naming for bucket

Note: The bucket name must be globally unique. And it follows the bucket naming rules.

4. Create the bucket.

Enter the settings as follows, and then click the **Create bucket** button.

Block Public Access setting for this bucket: **Block all public access.**
Bucket Versioning: **Enable**



Block Public Access settings for this bucket

Public access is granted to buckets and objects through access control lists (ACLs), bucket policies, access point policies, or all. In order to ensure that public access to this bucket and its objects is blocked, turn on Block all public access. These settings apply only to this bucket and its access points. AWS recommends that you turn on Block all public access, but before applying any of these settings, ensure that your applications will work correctly without public access. If you require some level of public access to this bucket or objects within, you can customize the individual settings below to suit your specific storage use cases. Learn more

☑ Block *all* public access
Turning this setting on is the same as turning on all four settings below. Each of the following settings are independent of one another.

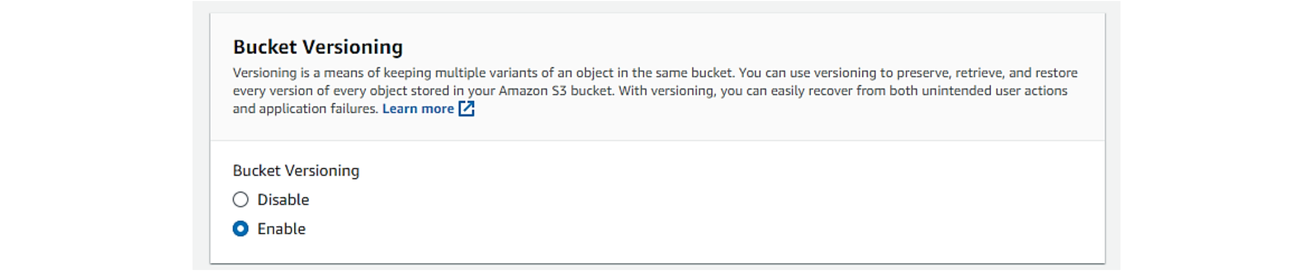
☑ Block public access to buckets and objects granted through *new* access control lists (ACLs)
S3 will block public access permissions applied to newly added buckets or objects, and prevent the creation of new public access ACLs for existing buckets and objects. This setting doesn't change any existing permissions that allow public access to S3 resources using ACLs.

☑ Block public access to buckets and objects granted through *any* access control lists (ACLs)
S3 will ignore all ACLs that grant public access to buckets and objects.

☑ Block public access to buckets and objects granted through *new* public bucket or access point policies
S3 will block new bucket and access point policies that grant public access to buckets and objects. This setting doesn't change any existing policies that allow public access to S3 resources.

☑ Block public and cross-account access to buckets and objects through *any* public bucket or access point policies
S3 will ignore public and cross-account access for buckets or access points with policies that grant public access to buckets and objects.

Figure 87. Bucket setting (1/2)



Bucket Versioning

Versioning is a means of keeping multiple variants of an object in the same bucket. You can use versioning to preserve, retrieve, and restore every version of every object stored in your Amazon S3 bucket. With versioning, you can easily recover from both unintended user actions and application failures. Learn more

Bucket Versioning

○ Disable

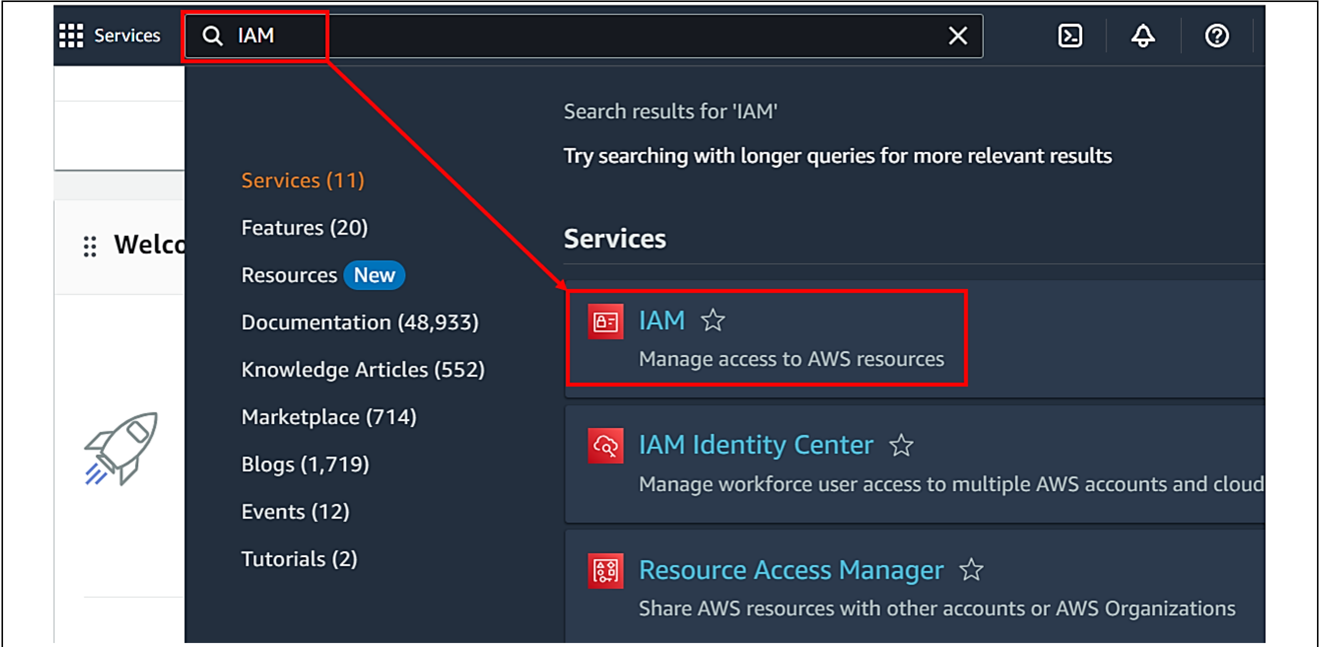
● Enable

Figure 88. Bucket setting (2/2)

6.3.3 Allocating OTA execution permission to IAM users

Create a role with the appropriate access permissions to create OTA update jobs.

1. Enter “IAM” in the search box at the top of the screen and click **IAM** in the search results.



Search results for 'IAM'

Try searching with longer queries for more relevant results

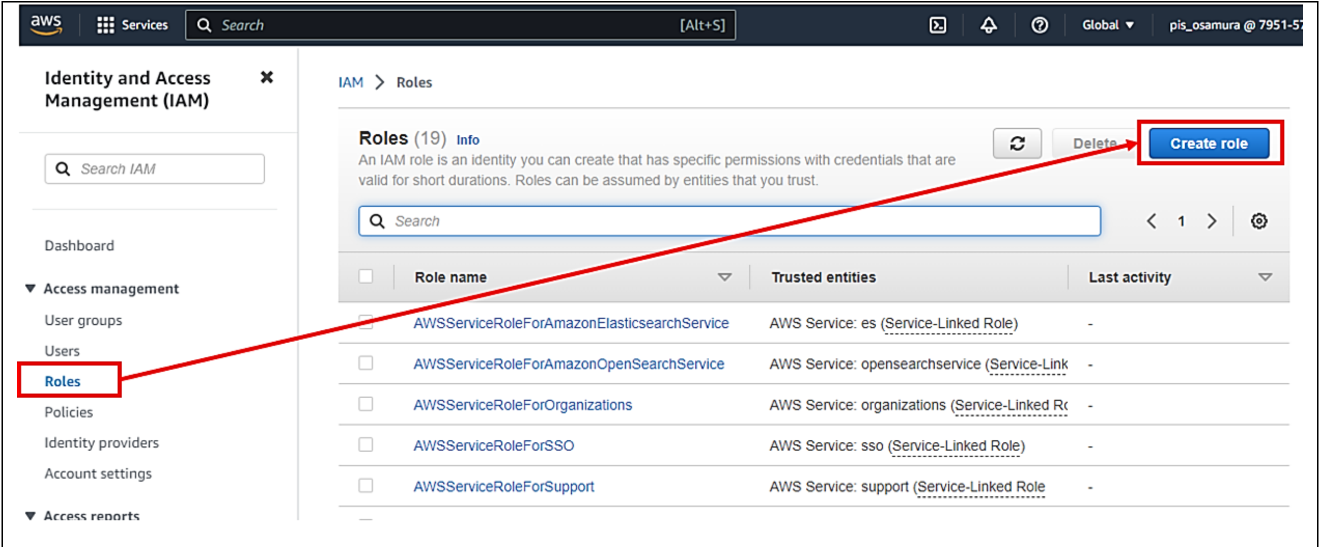
IAM ☆ Manage access to AWS resources

IAM Identity Center ☆ Manage workforce user access to multiple AWS accounts and cloud

Resource Access Manager ☆ Share AWS resources with other accounts or AWS Organizations

Figure 89. IAM search box

2. In the menu, click **Roles** and then click the **Create role** button.



Roles (19) Info

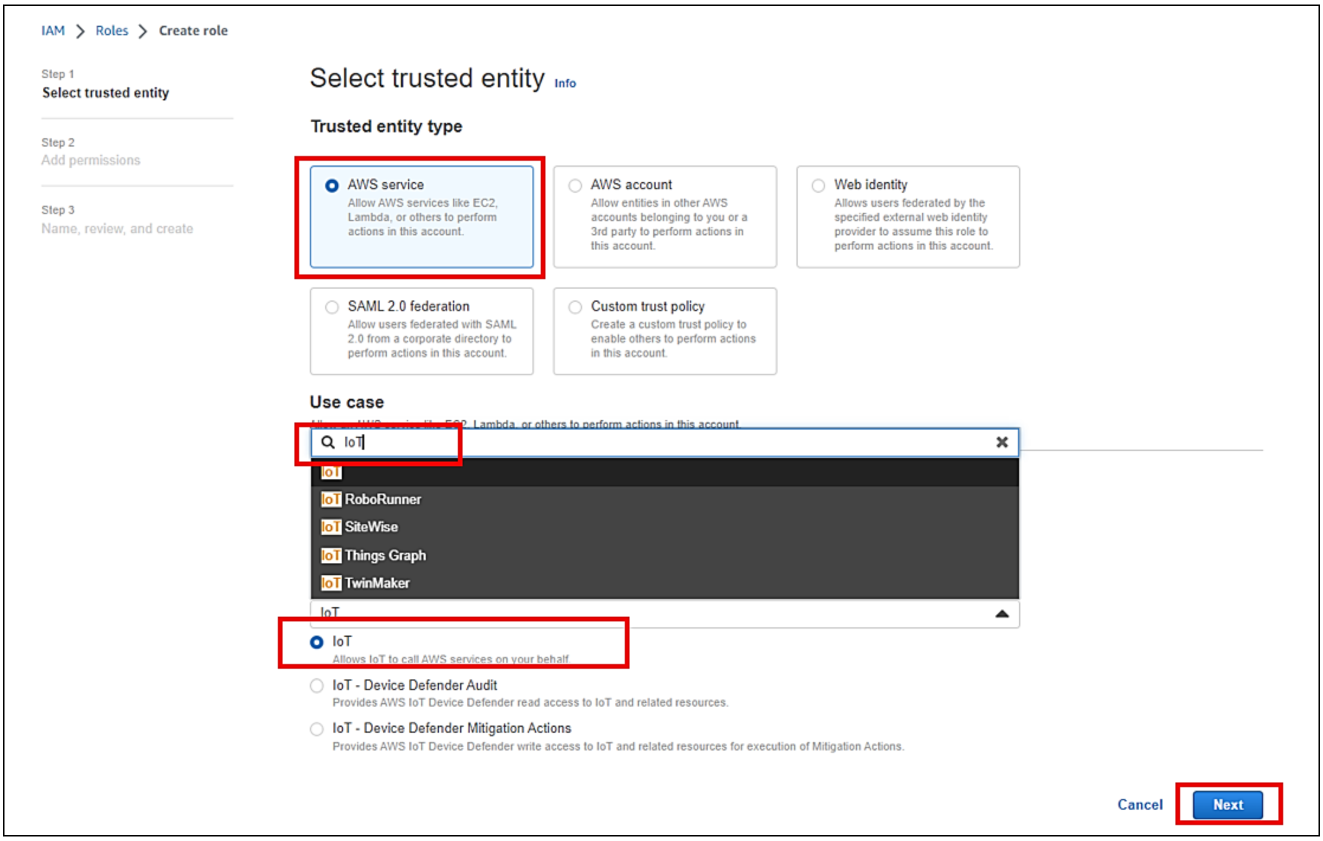
An IAM role is an identity you can create that has specific permissions with credentials that are valid for short durations. Roles can be assumed by entities that you trust.

□	Role name	Trusted entities	Last activity
□	AWSServiceRoleForAmazonElasticsearchService	AWS Service: es (Service-Linked Role)	-
□	AWSServiceRoleForAmazonOpenSearchService	AWS Service: opensearchservice (Service-Link	-
□	AWSServiceRoleForOrganizations	AWS Service: organizations (Service-Linked Ro	-
□	AWSServiceRoleForSSO	AWS Service: sso (Service-Linked Role)	-
□	AWSServiceRoleForSupport	AWS Service: support (Service-Linked Role	-

Figure 90. Creating a role

3. Under **Select trusted entity**, enter the following settings, and then click **Next**:

Under **Trusted entity type**, select **AWS service**
Under **Use cases for other AWS services**, select **IoT**
Select the **IoT** option button



IAM > Roles > Create role

Step 1
Select trusted entity

Step 2
Add permissions

Step 3
Name, review, and create

Select trusted entity Info

Trusted entity type

● AWS service
Allow AWS services like EC2, Lambda, or others to perform actions in this account.

○ AWS account
Allow entities in other AWS accounts belonging to you or a 3rd party to perform actions in this account.

○ Web identity
Allows users federated by the specified external web identity provider to assume this role to perform actions in this account.

○ SAML 2.0 federation
Allow users federated with SAML 2.0 from a corporate directory to perform actions in this account.

○ Custom trust policy
Create a custom trust policy to enable others to perform actions in this account.

Use case
Allow an AWS service like EC2, Lambda, or others to perform actions in this account.

IoT

IoT
IoT RoboRunner
IoT SiteWise
IoT Things Graph
IoT TwinMaker

IoT

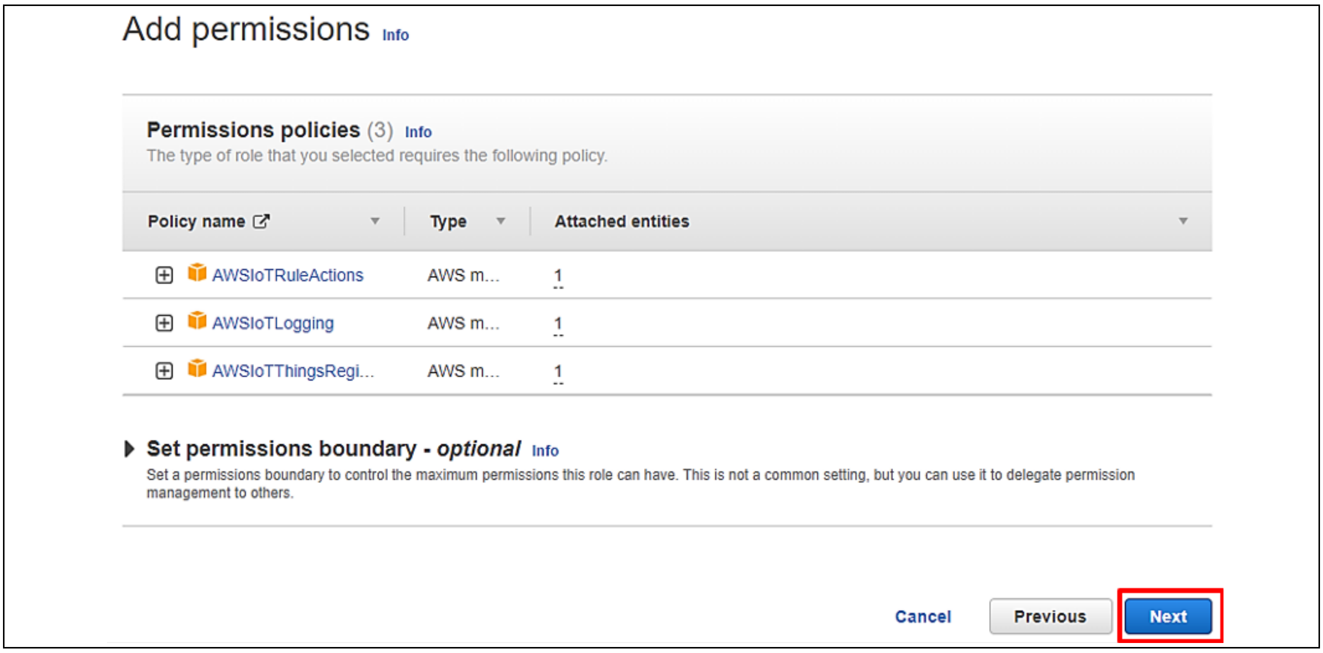
● IoT
Allows IoT to call AWS services on your behalf.

○ IoT - Device Defender Audit
Provides AWS IoT Device Defender read access to IoT and related resources.

○ IoT - Device Defender Mitigation Actions
Provides AWS IoT Device Defender write access to IoT and related resources for execution of Mitigation Actions.

Figure 91. Selecting trusted entity

4. Click **Next** on the **Add permissions** page without making any changes.



Add permissions Info

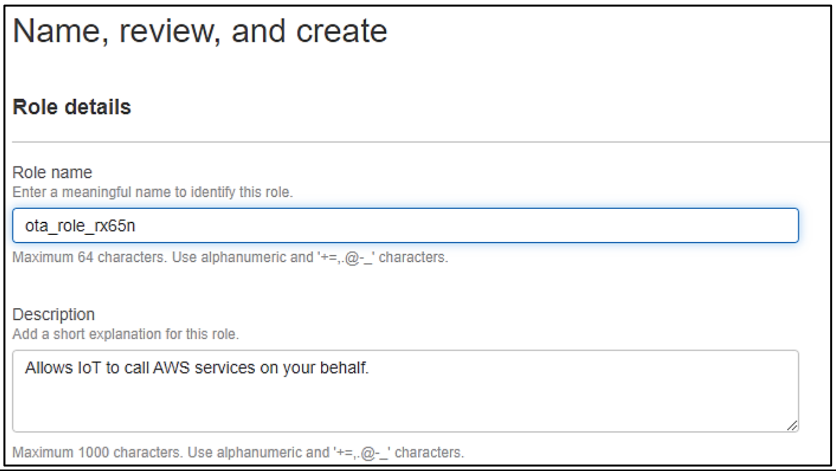
Permissions policies (3) Info
The type of role that you selected requires the following policy.

Policy name	Type	Attached entities
AWSIoTRuleActions	AWS m...	1
AWSIoTLogging	AWS m...	1
AWSIoTThingsRegi...	AWS m...	1

Set permissions boundary - *optional* Info
Set a permissions boundary to control the maximum permissions this role can have. This is not a common setting, but you can use it to delegate permission management to others.

Figure 92. Add Permissions for Role

5. Enter a role name (example: ota_role_rx65n), and then click the **Create role** button



Name, review, and create

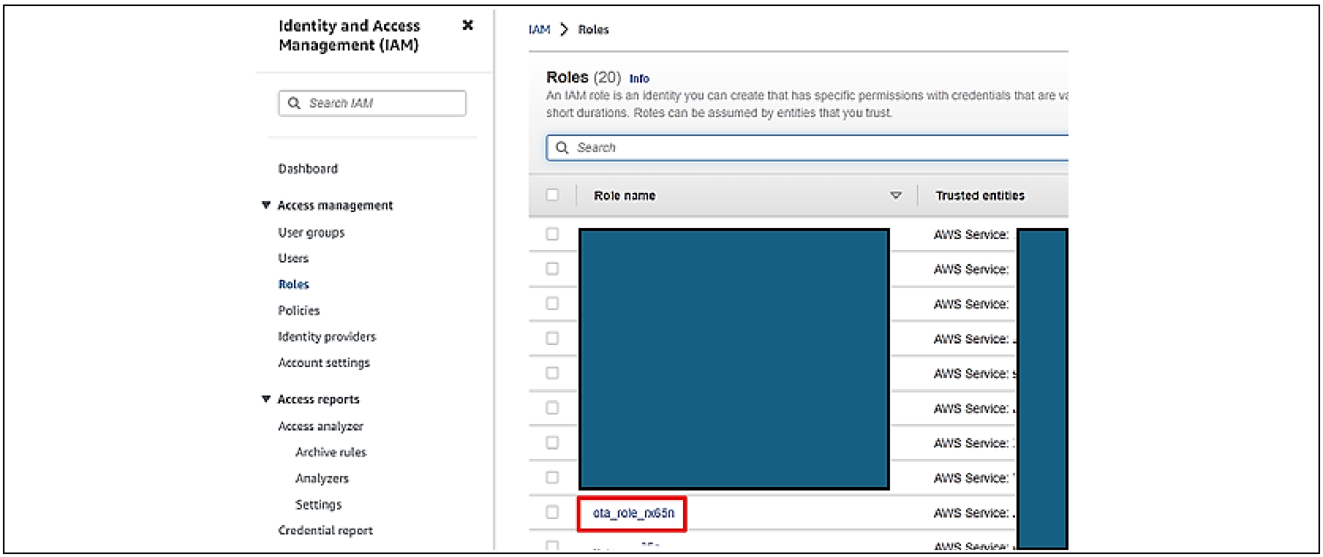
Role details

Role name
Enter a meaningful name to identify this role.
ota_role_rx65n
Maximum 64 characters. Use alphanumeric and '+=,.@-_' characters.

Description
Add a short explanation for this role.
Allows IoT to call AWS services on your behalf.
Maximum 1000 characters. Use alphanumeric and '+=,.@-_' characters.

Figure 93. Naming for Created Role

6. Click on the role you created.



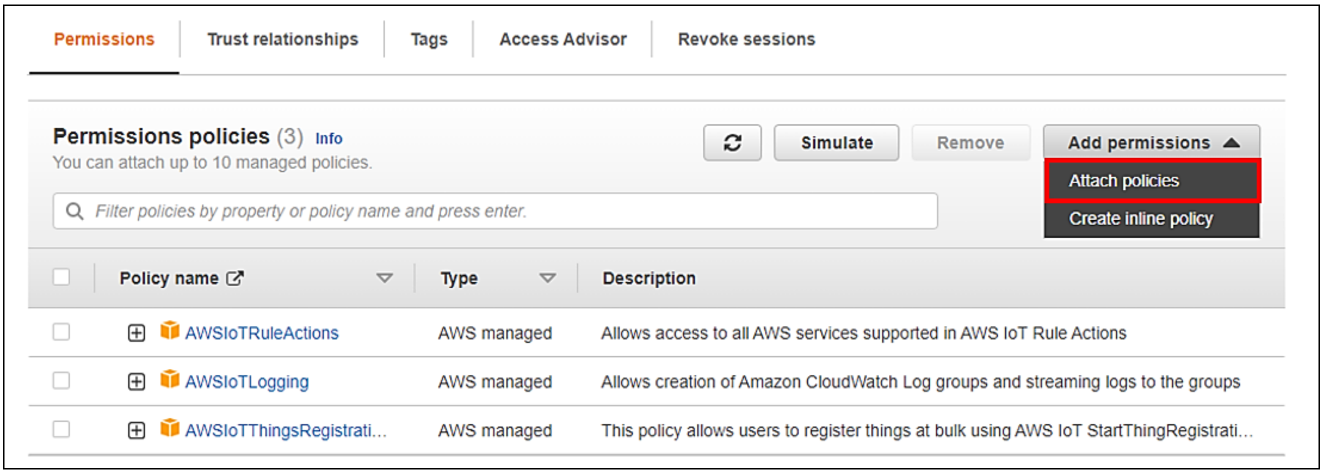
Roles (20) Info
An IAM role is an identity you can create that has specific permissions with credentials that are va short durations. Roles can be assumed by entities that you trust.
Search

□	Role name	Trusted entities
□	[redacted]	AWS Service:
□		AWS Service:
□		AWS Service:
□		AWS Service:
□		AWS Service:
□		AWS Service:
□		AWS Service:
□		AWS Service:
□	ota_role_rx65n	AWS Service:

[redacted]

Figure 94. Created Role

7. Select **Attach policies**.

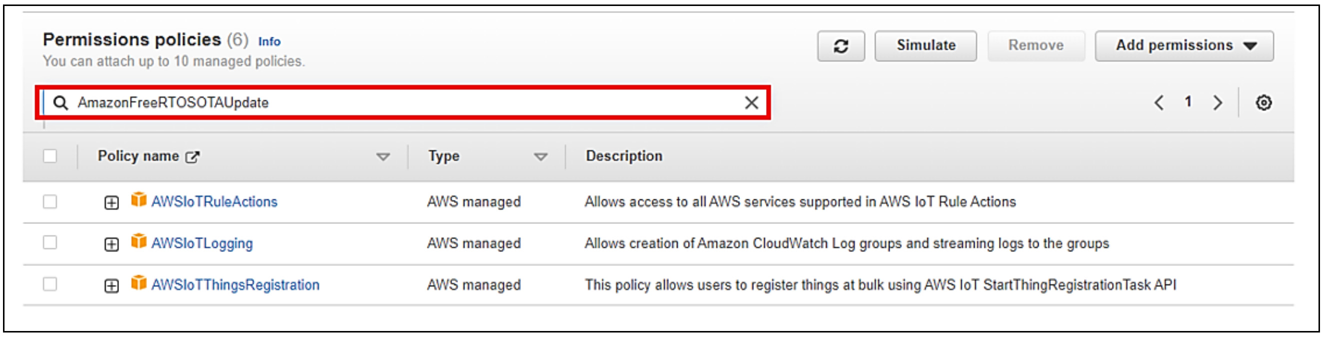


Permissions policies (3) Info
You can attach up to 10 managed policies.
Filter policies by property or policy name and press enter.

□	Policy name	Type	Description
□	AWSIoTRuleActions	AWS managed	Allows access to all AWS services supported in AWS IoT Rule Actions
□	AWSIoTLogging	AWS managed	Allows creation of Amazon CloudWatch Log groups and streaming logs to the groups
□	AWSIoTThingsRegistrati...	AWS managed	This policy allows users to register things at bulk using AWS IoT StartThingRegistrati...

Figure 95. Add permission (1/3)

8. Enter AmazonFreeRTOSOTAUpdate in the **Permissions policies** search box, and then press the **Enter** key.



Permissions policies (6) Info

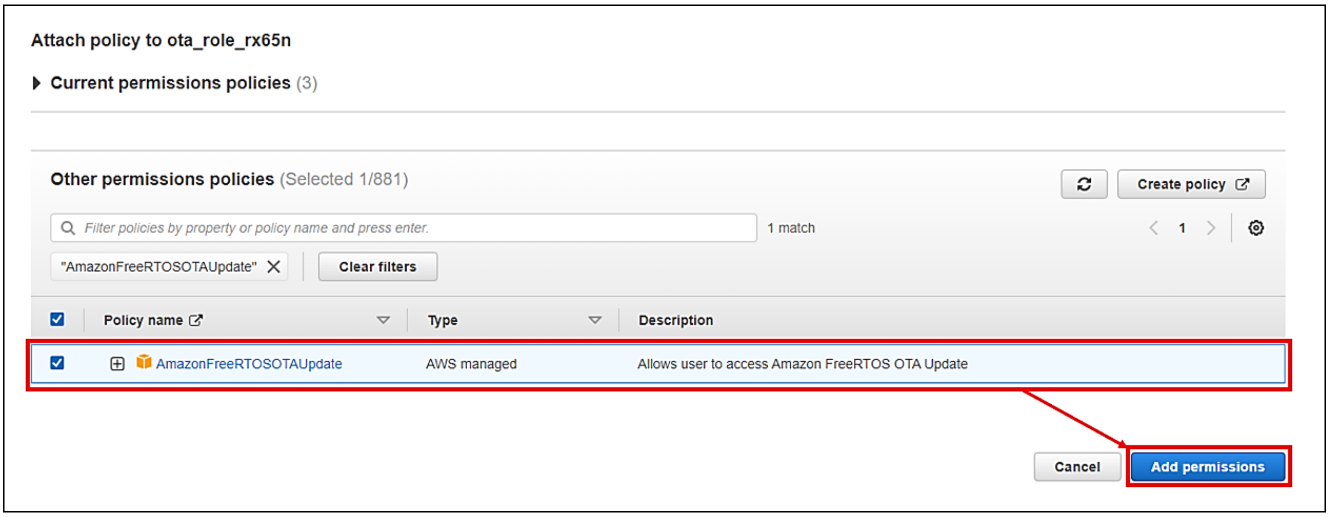
You can attach up to 10 managed policies.

AmazonFreeRTOSOTAUpdate

□	Policy name	Type	Description
□	AWSIoTRuleActions	AWS managed	Allows access to all AWS services supported in AWS IoT Rule Actions
□	AWSIoTLogging	AWS managed	Allows creation of Amazon CloudWatch Log groups and streaming logs to the groups
□	AWSIoTThingsRegistration	AWS managed	This policy allows users to register things at bulk using AWS IoT StartThingRegistrationTask API

Figure 96. Add permission (2/3)

9. Select the check box beside the AmazonFreeRTOSOTAUpdate policy, and then click the **Add permissions** button.



Attach policy to ota_role_rx65n

Current permissions policies (3)

Other permissions policies (Selected 1/881)

Filter policies by property or policy name and press enter.

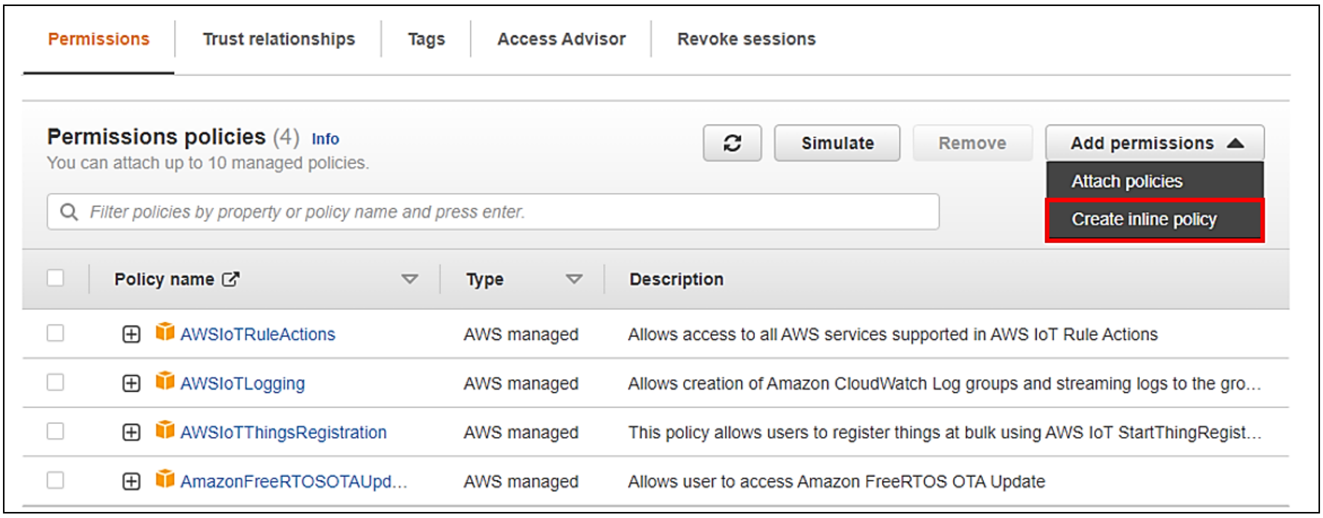
1 match

"AmazonFreeRTOSOTAUpdate"

☑	Policy name	Type	Description
☑	AmazonFreeRTOSOTAUpdate	AWS managed	Allows user to access Amazon FreeRTOS OTA Update

Figure 97. Add permission (3/3)

10. From the Add permissions drop-down list, select **Create inline policy**.



Permissions | Trust relationships | Tags | Access Advisor | Revoke sessions

Permissions policies (4) Info

You can attach up to 10 managed policies.

Filter policies by property or policy name and press enter.

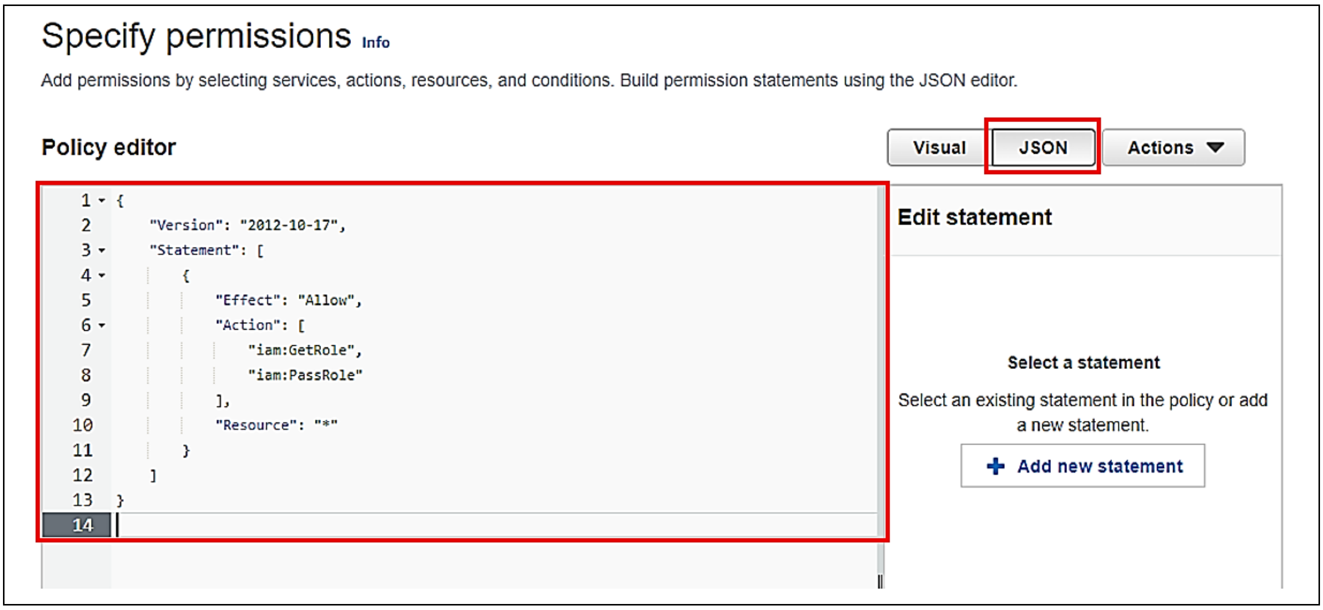
□	Policy name	Type	Description
□	AWSIoTRuleActions	AWS managed	Allows access to all AWS services supported in AWS IoT Rule Actions
□	AWSIoTLogging	AWS managed	Allows creation of Amazon CloudWatch Log groups and streaming logs to the gro...
□	AWSIoTThingsRegistration	AWS managed	This policy allows users to register things at bulk using AWS IoT StartThingRegist...
□	AmazonFreeRTOSOTAUpd...	AWS managed	Allows user to access Amazon FreeRTOS OTA Update

Figure 98. Create inline policy (1/3)

11. Click **JSON**, paste the following code, and then click **Next.**

This code grants permission to pass the IAM role to AWS services.

```
{
   “Version”: “2012-10-17”,
   “Statement”: [
    {
       “Effect”: “Allow”,
       “Action”: [
          “iam:GetRole”,
          “iam:PassRole”
       ],
       “Resource”: “*”
    }
   ]
}
```



Specify permissions Info

Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.

Policy editor

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "iam:GetRole",
                "iam:PassRole"
            ],
            "Resource": "*"
        }
    ]
}
```

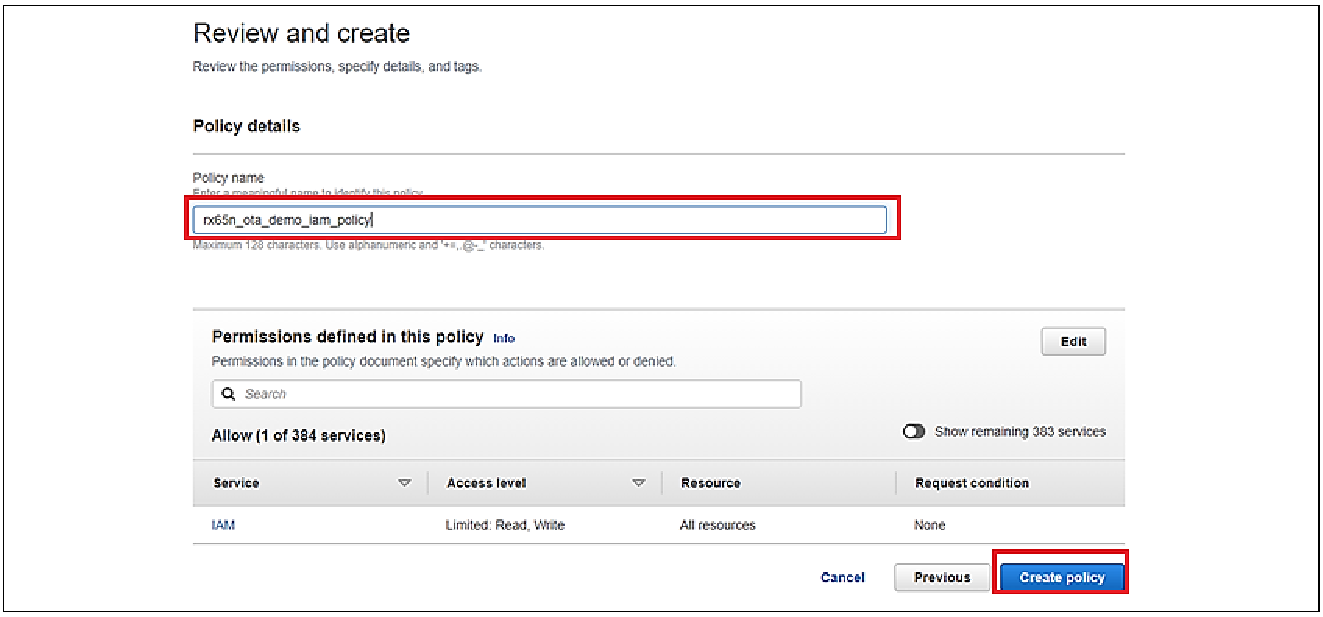
Edit statement

Select a statement

Select an existing statement in the policy or add a new statement.

Figure 99. Create inline policy (2/3)

12. Enter a policy name (example: rx65n_ota_demo_iam_policy), and then click the **Create policy** button.



Review and create

Review the permissions, specify details, and tags.

Policy details

Policy name
Enter a meaningful name to identify this policy.

rx65n_ota_demo_iam_policy

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

Permissions defined in this policy Info

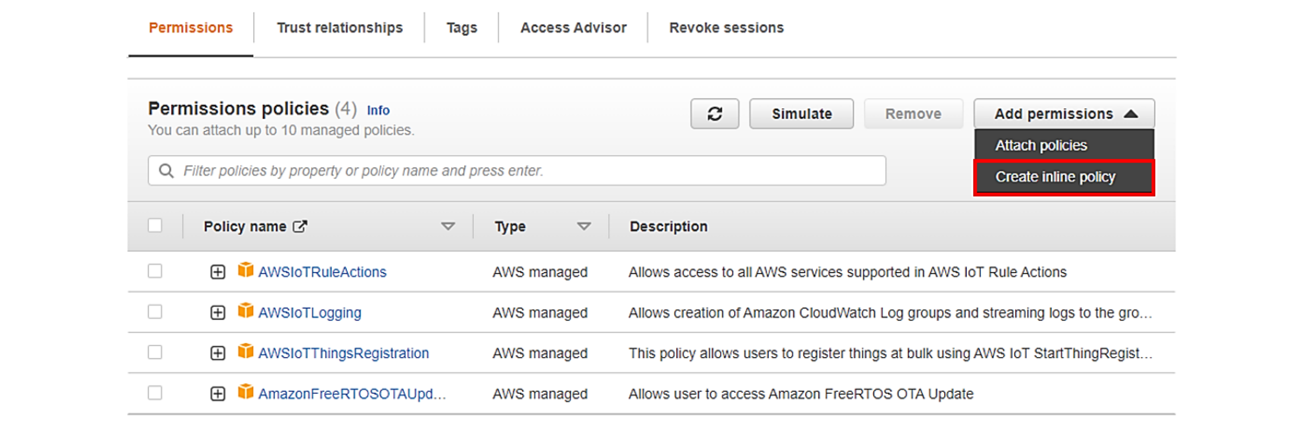
Permissions in the policy document specify which actions are allowed or denied.

Allow (1 of 384 services)

Service	Access level	Resource	Request condition
IAM	Limited: Read, Write	All resources	None

Figure 100. Create inline policy (3/3)

13. Again, from the **Add permissions** drop-down list, select **Create inline policy.**



Permissions policies (4) Info
You can attach up to 10 managed policies.

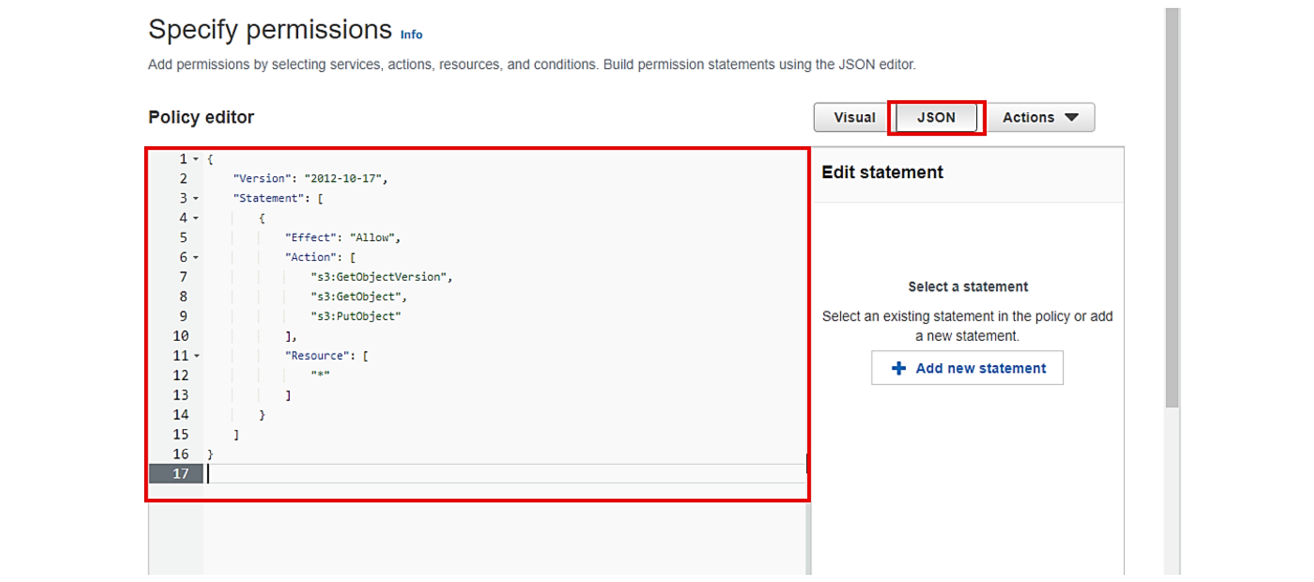
Policy name	Type	Description
AWSIoTRuleActions	AWS managed	Allows access to all AWS services supported in AWS IoT Rule Actions
AWSIoTLogging	AWS managed	Allows creation of Amazon CloudWatch Log groups and streaming logs to the gro...
AWSIoTThingsRegistration	AWS managed	This policy allows users to register things at bulk using AWS IoT StartThingRegist...
AmazonFreeRTOSOTAUpd...	AWS managed	Allows user to access Amazon FreeRTOS OTA Update

Figure 101. Create inline policy (1/3)

14. Click **JSON**, paste the following code, and then click **Next.**

This code allows access to Amazon S3 where the updated firmware is stored.

```
{
  “Version”: “2012-10-17”,
  “Statement”: [
   {
      “Effect”: “Allow”,
      “Action”: [
         “s3:GetObjectVersion”,
         “s3:GetObject”,
         “s3:PutObject”
      ],
      “Resource”: [
         “*”
      ]
   }
  ]
}
```


Specify permissions Info

Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.

Policy editor

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetObjectVersion",
                "s3:GetObject",
                "s3:PutObject"
            ],
            "Resource": [
                "*"
            ]
        }
    ]
}
```

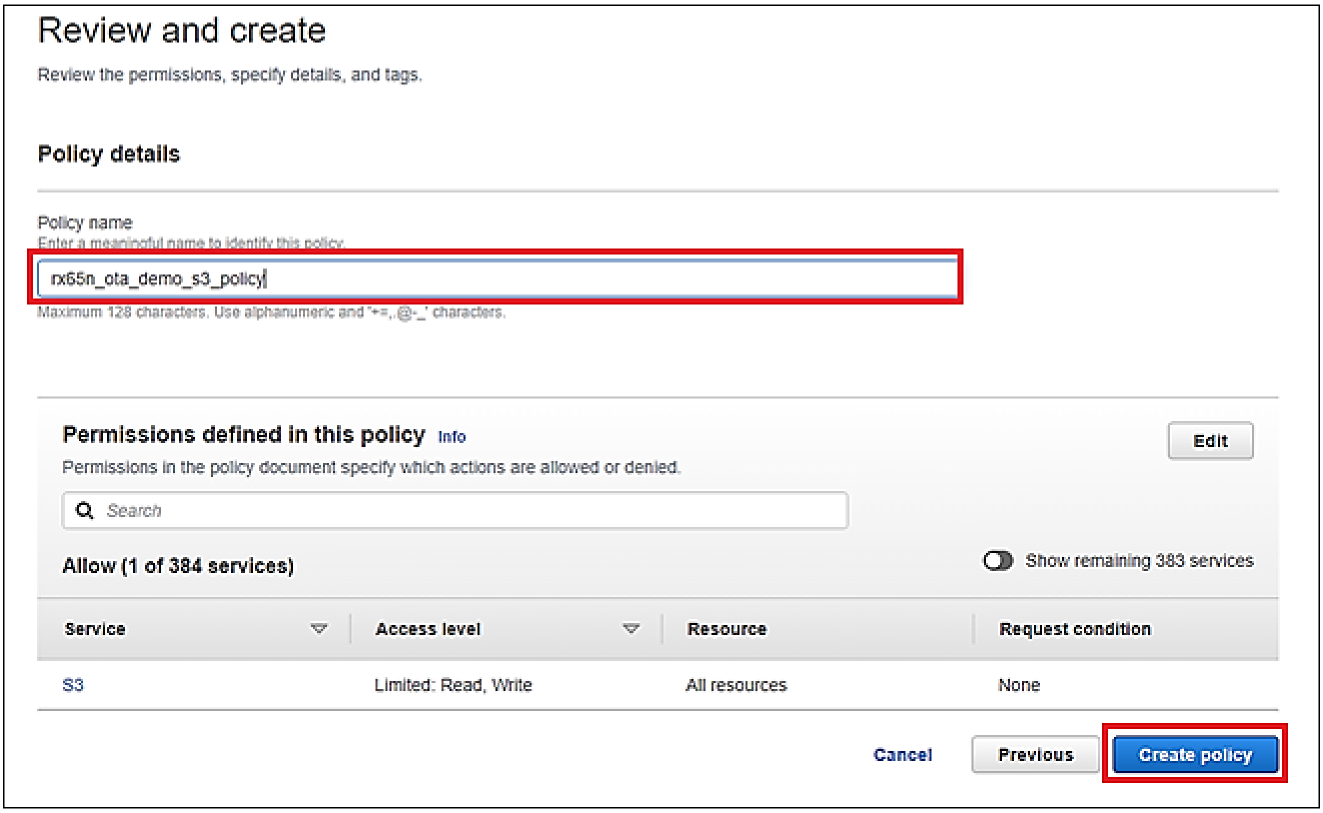
Edit statement

Select a statement

Select an existing statement in the policy or add a new statement.

Figure 102. Create inline policy (2/3)

15. Enter a policy name (example: rx65n_ota_demo_s3_policy), and then click the **Create policy** button.



Review and create

Review the permissions, specify details, and tags.

Policy details

Policy name
Enter a meaningful name to identify this policy.
rx65n_ota_demo_s3_policy
Maximum 128 characters. Use alphanumeric and '+=,.@-_' characters.

Permissions defined in this policy

Permissions in the policy document specify which actions are allowed or denied.

Allow (1 of 384 services)

Service	Access level	Resource	Request condition
S3	Limited: Read, Write	All resources	None

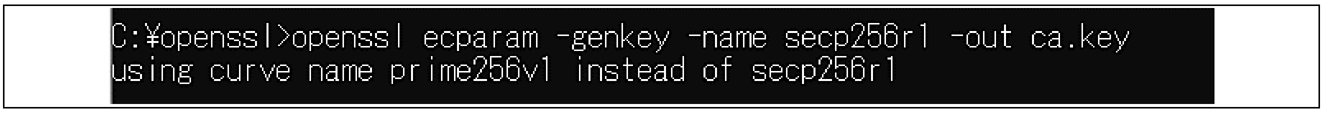
Figure 103. Create inline policy (3/3)

6.4 Setting up the Device

6.4.1 Generating Key Pairs and Certificates

1. Open the **Win64 OpenSSL Command Prompt** and create a CA private key using ECDSA.

Execute the following command: *$openssl ecparam -genkey -name secp256r1 -out ca.key*

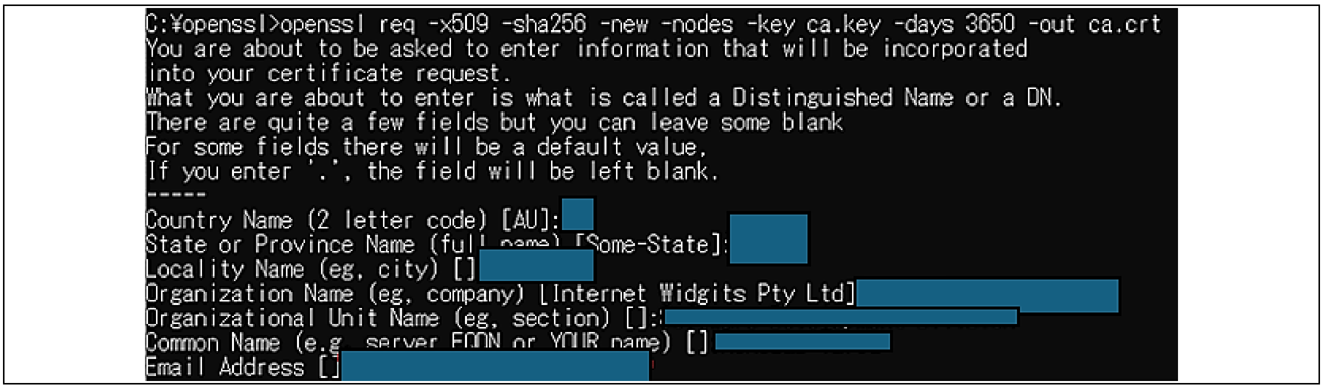


```
C:¥openssl>openssl ecparam -genkey -name secp256r1 -out ca.key
using curve name prime256v1 instead of secp256r1
```

Figure 104. Creating CA private key

2. Create a CA certificate from the created CA private key.

Execute the following command: *$openssl req -x509 -sha256 -new -nodes -key ca.key -days 3650 -out ca.crt*

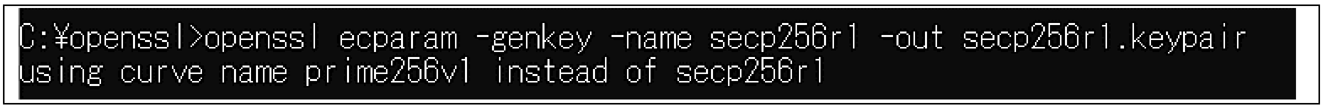


```
C:¥openssl>openssl req -x509 -sha256 -new -nodes -key ca.key -days 3650 -out ca.crt
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:[redacted]
State or Province Name (full name) [Some-State]:[redacted]
Locality Name (eg, city) []:[redacted]
Organization Name (eg, company) [Internet Widgits Pty Ltd]:[redacted]
Organizational Unit Name (eg, section) []:[redacted]
Common Name (e.g. server FQDN or YOUR name) []:[redacted]
Email Address []:[redacted]
```

Figure 105. Creating CA certificate

3. Create an ECDSA key pair.

Execute the following command: *$openssl ecparam -genkey -name secp256r1 -out secp256r1.keypair*

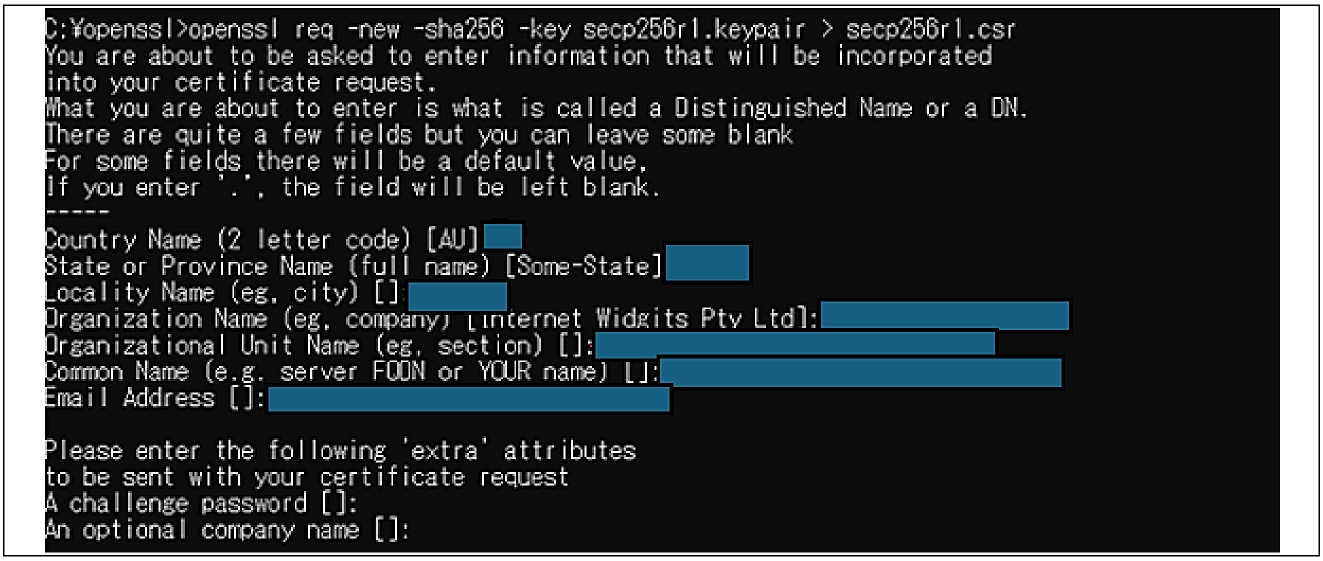


```
C:¥openssl>openssl ecparam -genkey -name secp256r1 -out secp256r1.keypair
using curve name prime256v1 instead of secp256r1
```

Figure 106. Creating ECDSA key pairs

4. Create a certificate signing request from the created ECDSA key pair.

Execute the following command: *$openssl req -new -sha256 -key secp256r1.keypair > secp256r1.csr*

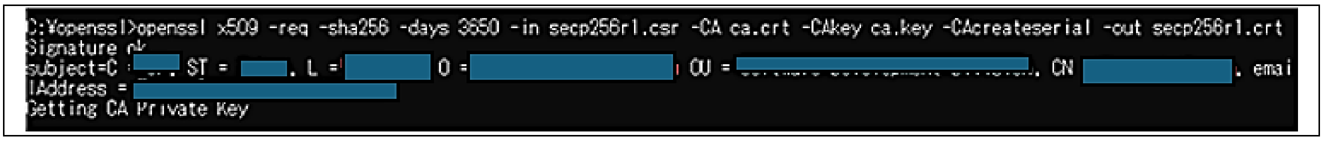


```
C:¥openssl>openssl req -new -sha256 -key secp256r1.keypair > secp256r1.csr
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU][redacted]
State or Province Name (full name) [Some-State][redacted]
Locality Name (eg, city) [][redacted]
Organization Name (eg, company) [Internet Widgits Pty Ltd]:[redacted]
Organizational Unit Name (eg, section) []:[redacted]
Common Name (e.g. server FQDN or YOUR name) []:[redacted]
Email Address []:[redacted]

Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:
An optional company name []:
```

Figure 107. Creating certificate signing request

5. Create a certificate from the certificate signing request, CA certificate, and CA private key.

Execute the following command: *$openssl x509 -req -sha256 -days 3650 -in secp256r1.csr -CA ca.crt -Cakey ca.key -Cacreateserial -out secp256r1.crt*



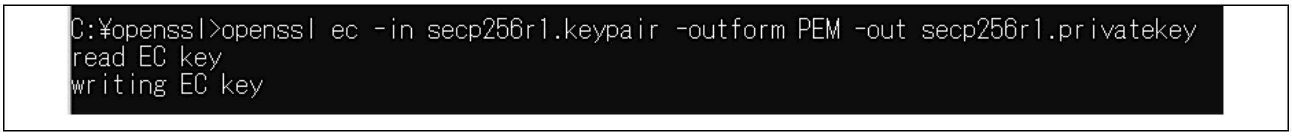
```
C:¥openssl>openssl x509 -req -sha256 -days 3650 -in secp256r1.csr -CA ca.crt -CAkey ca.key -CAcreateserial -out secp256r1.crt
Signature ok
subject=C = [redacted], ST = [redacted], L = [redacted], O = [redacted], OU = [redacted], CN [redacted], emai
lAddress = [redacted]
Getting CA Private Key
```

Figure 108. Creating code signing certificate

6. Extract the private key from the ECDSA key pair.

Execute the following command:

$openssl ec -in secp256r1.keypair -outform PEM -out secp256r1.privatekey



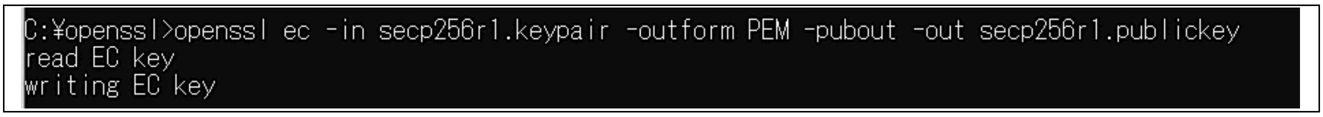
```
C:¥openssl>openssl ec -in secp256r1.keypair -outform PEM -out secp256r1.privatekey
read EC key
writing EC key
```

Figure 109. Create private key (secp256r1.privatekey)

7. Extract the public key from the ECDSA key pair.

Execute the following command:

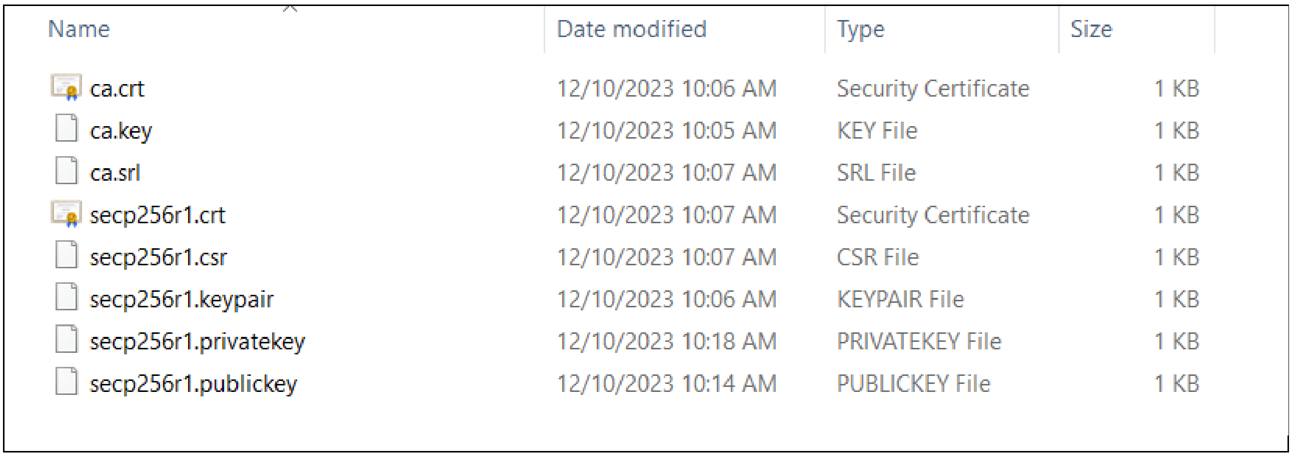
$openssl ec -in secp256r1.keypair -outform PEM -pubout -out secp256r1.publickey



```
C:¥openssl>openssl ec -in secp256r1.keypair -outform PEM -pubout -out secp256r1.publickey
read EC key
writing EC key
```

Figure 110. Create public key (secp256r1.publickey)

8. After creating, please check the result:



Name	Date modified	Type	Size
ca.crt	12/10/2023 10:06 AM	Security Certificate	1 KB
ca.key	12/10/2023 10:05 AM	KEY File	1 KB
ca.srl	12/10/2023 10:07 AM	SRL File	1 KB
secp256r1.crt	12/10/2023 10:07 AM	Security Certificate	1 KB
secp256r1.csr	12/10/2023 10:07 AM	CSR File	1 KB
secp256r1.keypair	12/10/2023 10:06 AM	KEYPAIR File	1 KB
secp256r1.privatekey	12/10/2023 10:18 AM	PRIVATEKEY File	1 KB
secp256r1.publickey	12/10/2023 10:14 AM	PUBLICKEY File	1 KB

Figure 111. Total created files

6.4.2 Setting up the project

6.4.2.1 Creating initial firmware

The following steps explain how to create the initial firmware that combines the boot loader (boot_loader_ck_rx65n) and the firmware (aws_ryz014a_ck_rx65n (when using Cellular project), or aws_ether_ck_rx65n (when using Ethernet project).

1. Additional import **boot_loader_ck_rx65n** project:

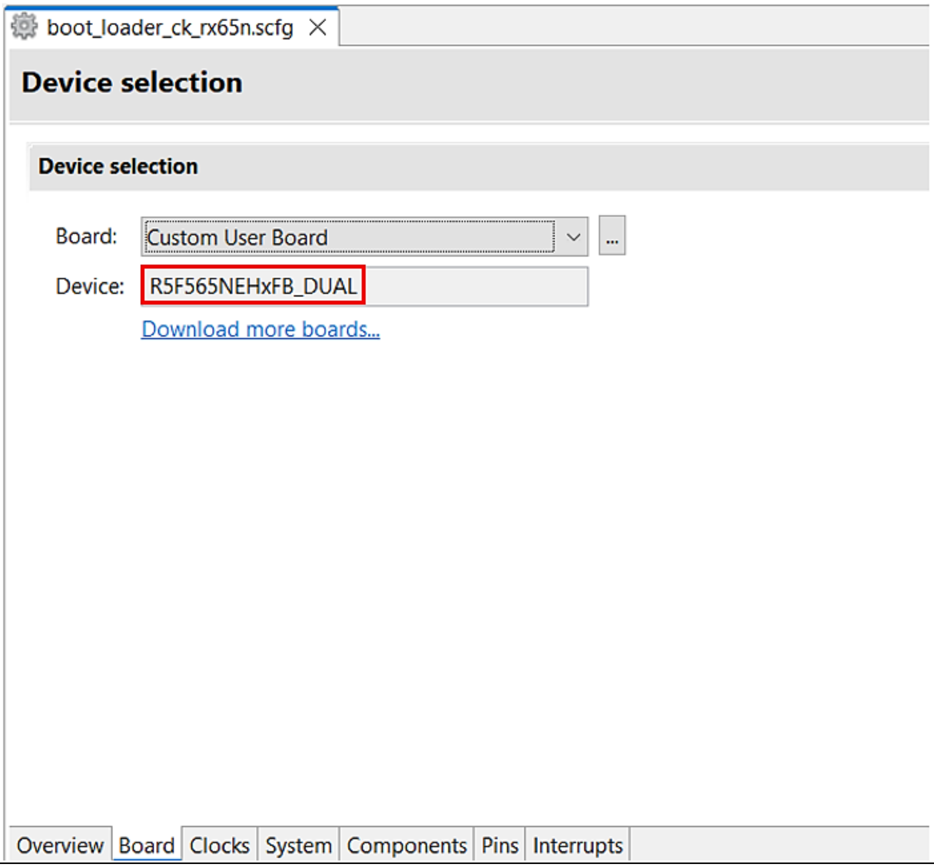
Make sure that the configuration in **boot_loader_ck_rx65n.scfg** file of boot_loader_ck_rx65n project is as below:

Table 10. Components Configuration of boot loader project

No	Component	Configuration
1	**Startup→Generic→r_bsp (v7.20)**	Enable user stdio charput function: **Use user charput() function**
2	**Drivers→Memory→r_flash_rx (v5.00)**	Enable code flash programming: **Includes code to program ROM area**
		Enable code flash self-programming: **Programming code flash while executing from another segment in ROM**
3	**Drivers→Communications→r_sci_rx (v4.40)**	Include software support for channel 5: **Include**
4	**Middleware→Generic→r_byteq (v2.00)**	Memory allocation for queue control blocks: **Static memory allocation**
		Number of static queue control blocks: **32**
5	**Middleware→Generic→r_fwup (v2.01)**	Select the function mode: **user for Boot Loader**
		Main area start address: **0xFFF00000**
		Buffer area start address: **0xFFE00000**
		Install area size: **0xF0000**

Check the boot loader device.

And also, in the **boot_loader_ck_rx65n.scfg** file, click the **Board** tab. Confirm that R5F565NEHxFB_DUAL appears in the **Board** field.



boot_loader_ck_rx65n.scfg

Device selection

Device selection

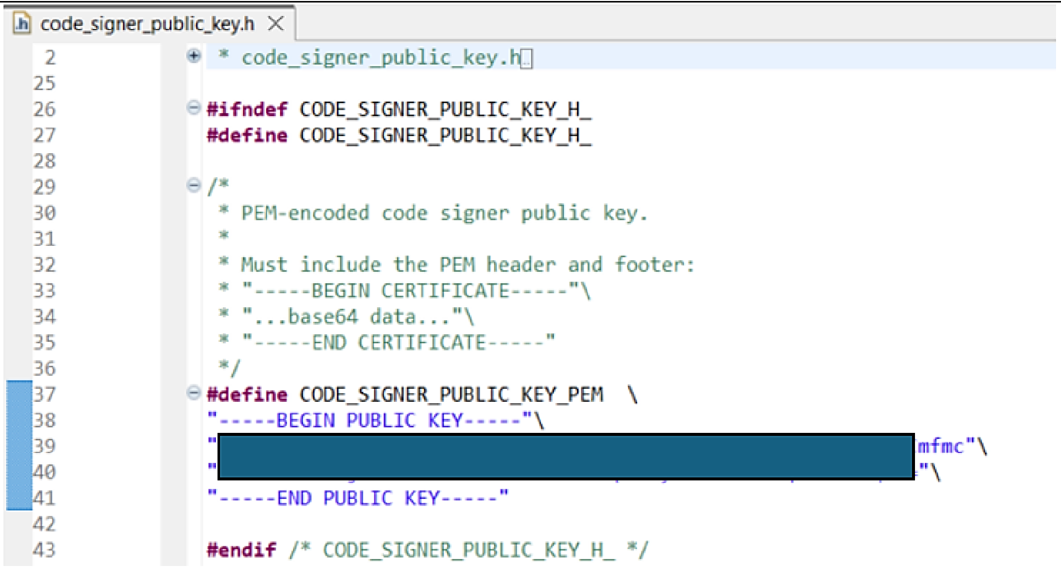
Board: Custom User Board

Device: R5F565NEHxFB_DUAL

Download more boards...

Figure 112. bootloader's device selection

Assign public key: Copy the contents of the secp256r1.publickey file you created in **"Extract the public key from the ECDSA key pair."**, and paste the contents into **CODE_SIGNER_PUBLIC_KEY_PEM** defined in the following files: boot_loader_ck_rx65n\src\key\code_signer_public_key.h

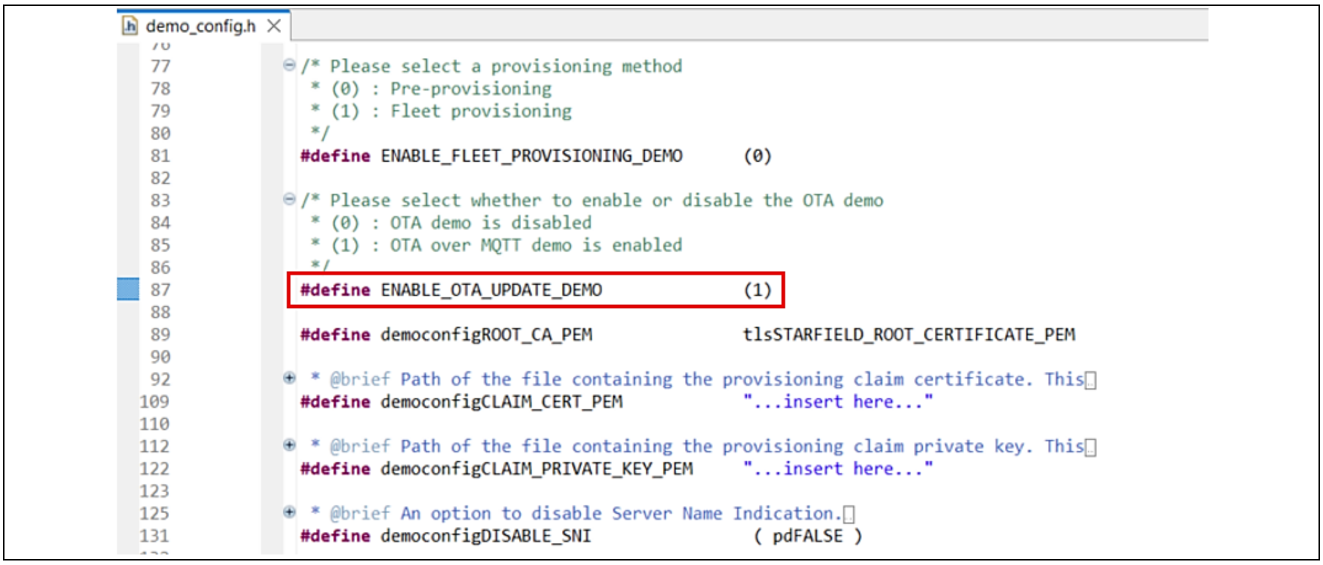


code_signer_public_key.h

```
 * code_signer_public_key.h

#ifndef CODE_SIGNER_PUBLIC_KEY_H_
#define CODE_SIGNER_PUBLIC_KEY_H_

/*
 * PEM-encoded code signer public key.
 *
 * Must include the PEM header and footer:
 * "-----BEGIN CERTIFICATE-----"\
 * "...base64 data..."\
 * "-----END CERTIFICATE-----"
 */
#define CODE_SIGNER_PUBLIC_KEY_PEM  \
"-----BEGIN PUBLIC KEY-----"\
[redacted]
"-----END PUBLIC KEY-----"

#endif /* CODE_SIGNER_PUBLIC_KEY_H_ */
```

Figure 113. Add Code Signing Public Key to Boot Loader Project

2. Set **ENABLE_OTA_UPDATE_DEMO** to 1 (Enable) in [Project_Loc]\e2studio_ccrx\src\frtos_config\demo_config.h. (The default is 0)



```
/* Please select a provisioning method
 * (0) : Pre-provisioning
 * (1) : Fleet provisioning
 */
#define ENABLE_FLEET_PROVISIONING_DEMO      (0)

/* Please select whether to enable or disable the OTA demo
 * (0) : OTA demo is disabled
 * (1) : OTA over MQTT demo is enabled
 */
#define ENABLE_OTA_UPDATE_DEMO              (1)

#define democonfigROOT_CA_PEM               tlsSTARFIELD_ROOT_CERTIFICATE_PEM

 * @brief Path of the file containing the provisioning claim certificate. This
#define democonfigCLAIM_CERT_PEM            "...insert here..."

 * @brief Path of the file containing the provisioning claim private key. This
#define democonfigCLAIM_PRIVATE_KEY_PEM     "...insert here..."

 * @brief An option to disable Server Name Indication.
#define democonfigDISABLE_SNI                ( pdFALSE )
```

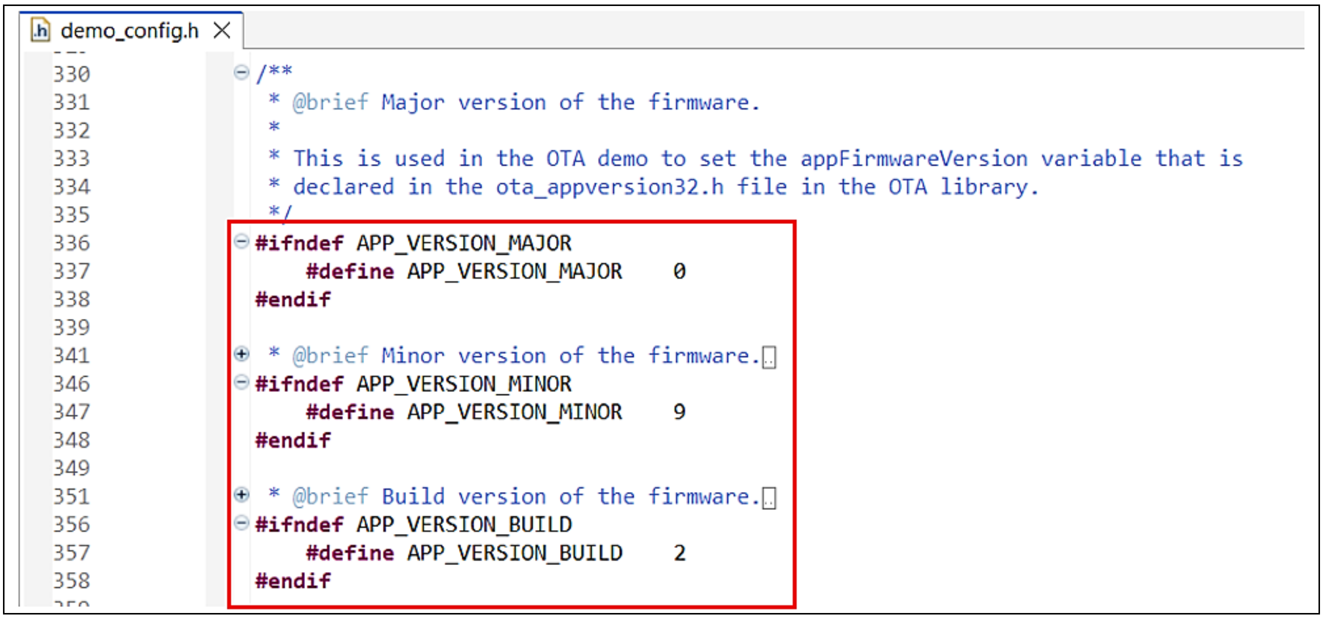
Figure 114. Enable OTA Demo

3. Confirm the initial project version:

   Confirm the version definitions in [Project_Loc]\src\frtos_config\demo_config.h:

- APP_VERSION_MAJOR
- APP_VERSION_MINOR
- APP_VERSION_BUILD

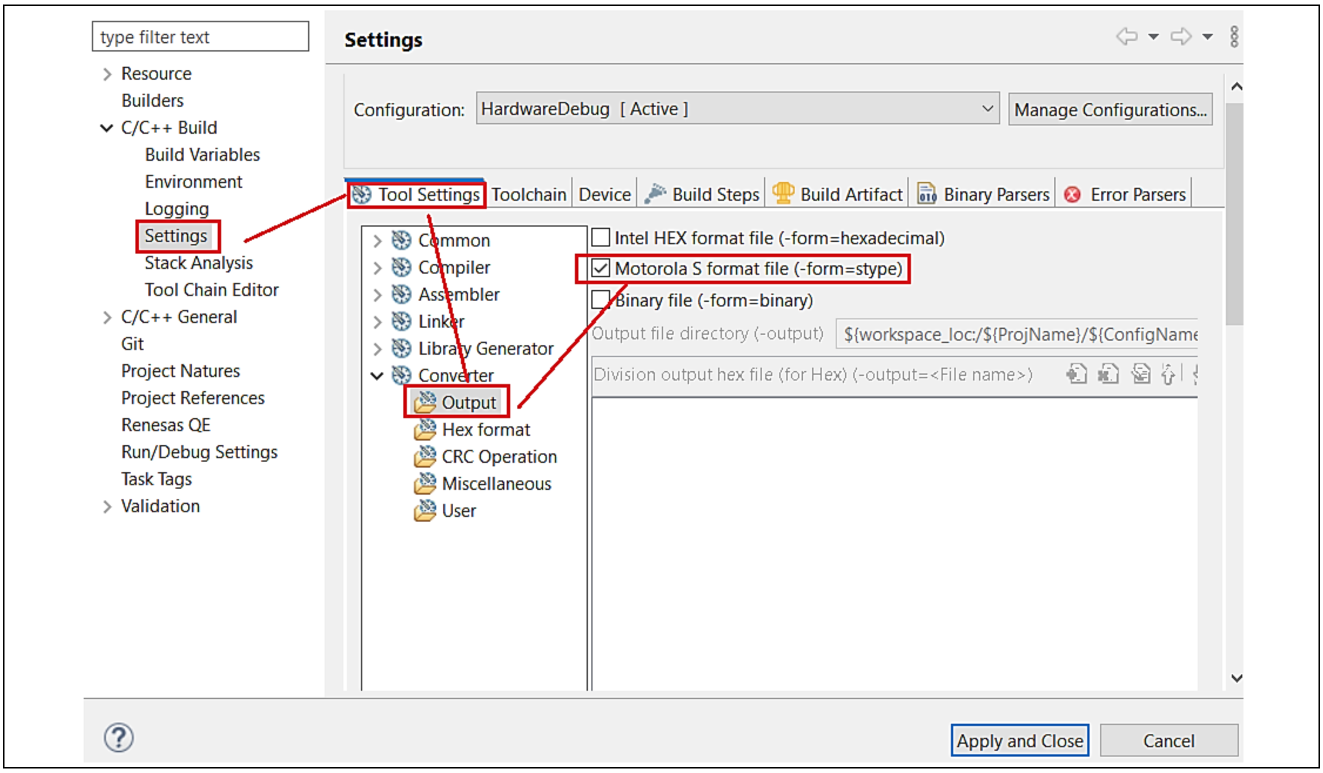
Example: The initial project version is 0.9.2



```
/**
 * @brief Major version of the firmware.
 *
 * This is used in the OTA demo to set the appFirmwareVersion variable that is
 * declared in the ota_appversion32.h file in the OTA library.
 */
#ifndef APP_VERSION_MAJOR
    #define APP_VERSION_MAJOR    0
#endif

 * @brief Minor version of the firmware.
#ifndef APP_VERSION_MINOR
    #define APP_VERSION_MINOR    9
#endif

 * @brief Build version of the firmware.
#ifndef APP_VERSION_BUILD
    #define APP_VERSION_BUILD    2
#endif
```

Figure 115. The initial project version 0.9.2

On the **Tool Settings** tab, expand the **Converter** menu and select **Output**. Confirm that the **Motorola S format file** check box is selected.



Settings

Configuration: HardwareDebug [Active]

□ Intel HEX format file (-form=hexadecimal)

☑ Motorola S format file (-form=stype)

□ Binary file (-form=binary)

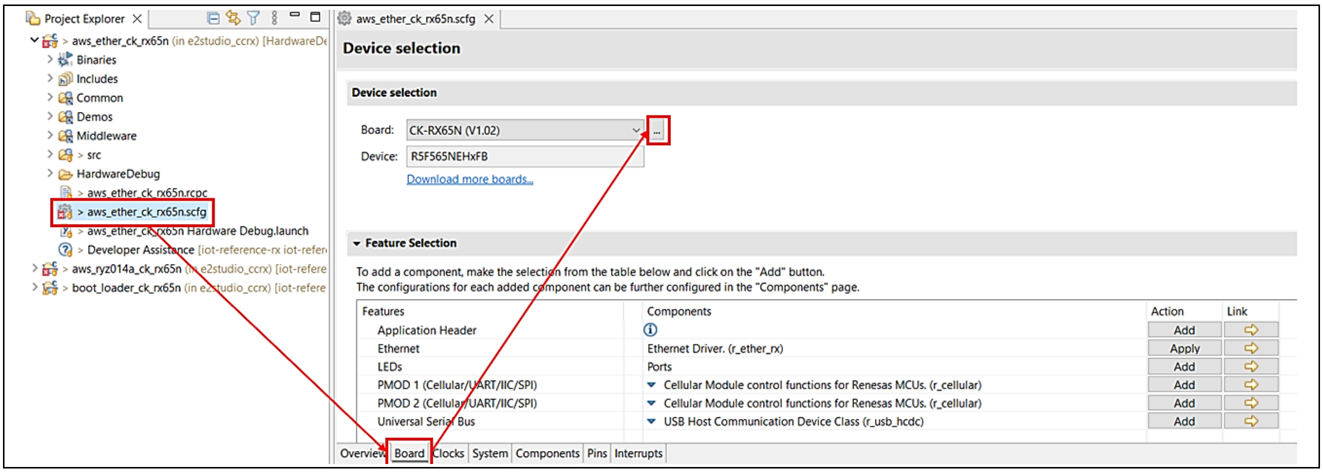
Output file directory (-output) ${workspace_loc:/${ProjName}/${ConfigName

Division output hex file (for Hex) (-output=<File name>)

Figure 116. Project setting

4. Device selection setting

   Open the file aws_ether_ck_rx65n.scfg and click the **Board** tab. Click the ellipsis (**…**) beside the **Board** field in the **Device selection** area.



Device selection

Board: CK-RX65N (V1.02)

Device: R5F565NEHxFB

Feature Selection

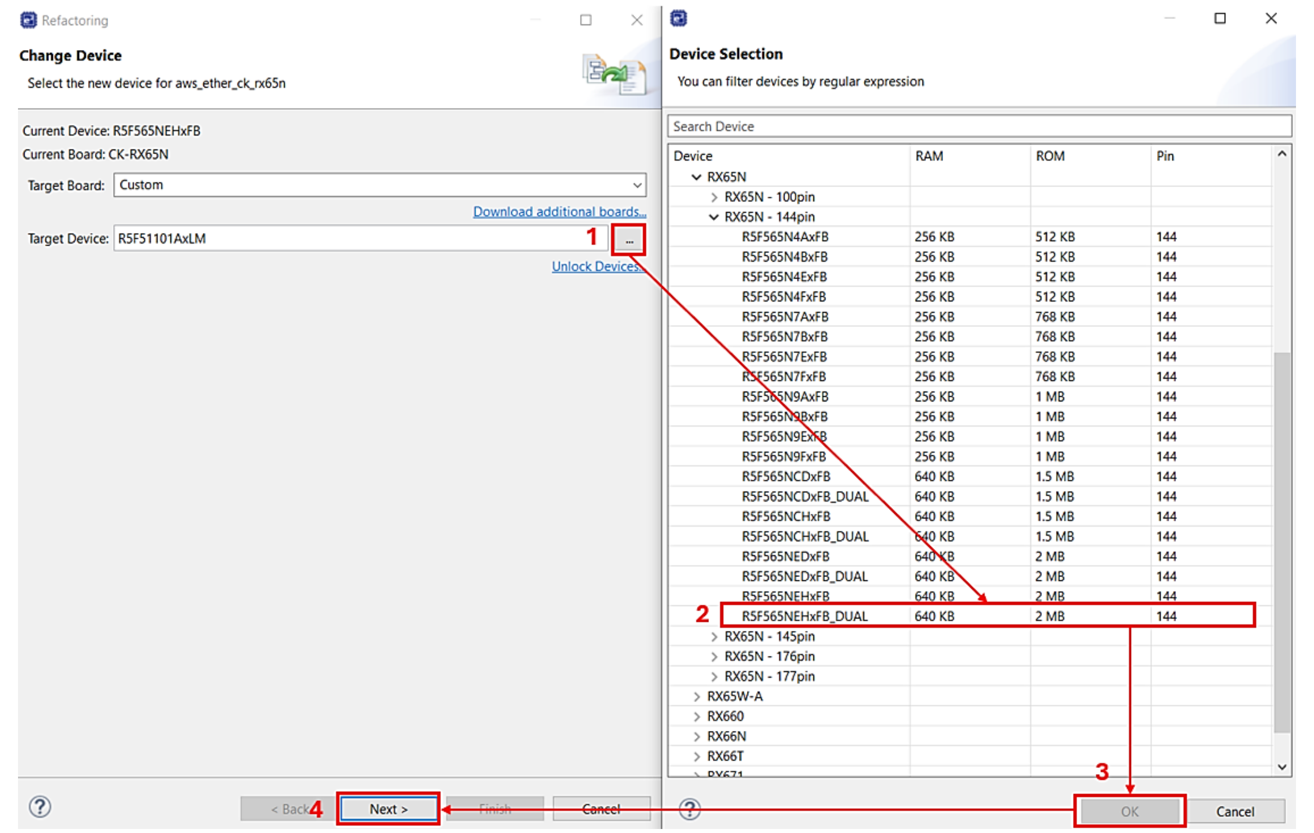
To add a component, make the selection from the table below and click on the "Add" button.
The configurations for each added component can be further configured in the "Components" page.

Features	Components	Action	Link
Application Header	ⓘ	Add	⇨
Ethernet	Ethernet Driver. (r_ether_rx)	Apply	⇨
LEDs	Ports	Add	⇨
PMOD 1 (Cellular/UART/IIC/SPI)	Cellular Module control functions for Renesas MCUs. (r_cellular)	Add	⇨
PMOD 2 (Cellular/UART/IIC/SPI)	Cellular Module control functions for Renesas MCUs. (r_cellular)	Add	⇨
Universal Serial Bus	USB Host Communication Device Class (r_usb_hcdc)	Add	⇨

Project Explorer
aws_ether_ck_rx65n (in e2studio_ccrx) [HardwareDe
Binaries
Includes
Common
Demos
Middleware
src
HardwareDebug
aws_ether_ck_rx65n.rcpc
aws_ether_ck_rx65n.scfg
aws_ether_ck_rx65n Hardware Debug.launch
Developer Assistance [iot-reference-rx iot-refer
aws_ryz014a_ck_rx65n (in e2studio_ccrx) [iot-refere
boot_loader_ck_rx65n (in e2studio_ccrx) [iot-refere
aws_ether_ck_rx65n.scfg
...
Download more boards...
Overview
Board
Clocks
System
Components
Pins
Interrupts

Figure 117. Device selection (1/3)

Click the ellipsis (**...**) beside the **Target Device** field and select R5F565NEHxFB_DUAL. The value in the **Target Board** drop-down list changes to **Custom**.



Refactoring

Change Device

Select the new device for aws_ether_ck_rx65n

Current Device: R5F565NEHxFB

Current Board: CK-RX65N

Target Board: Custom

Target Device: R5F51101AxLM

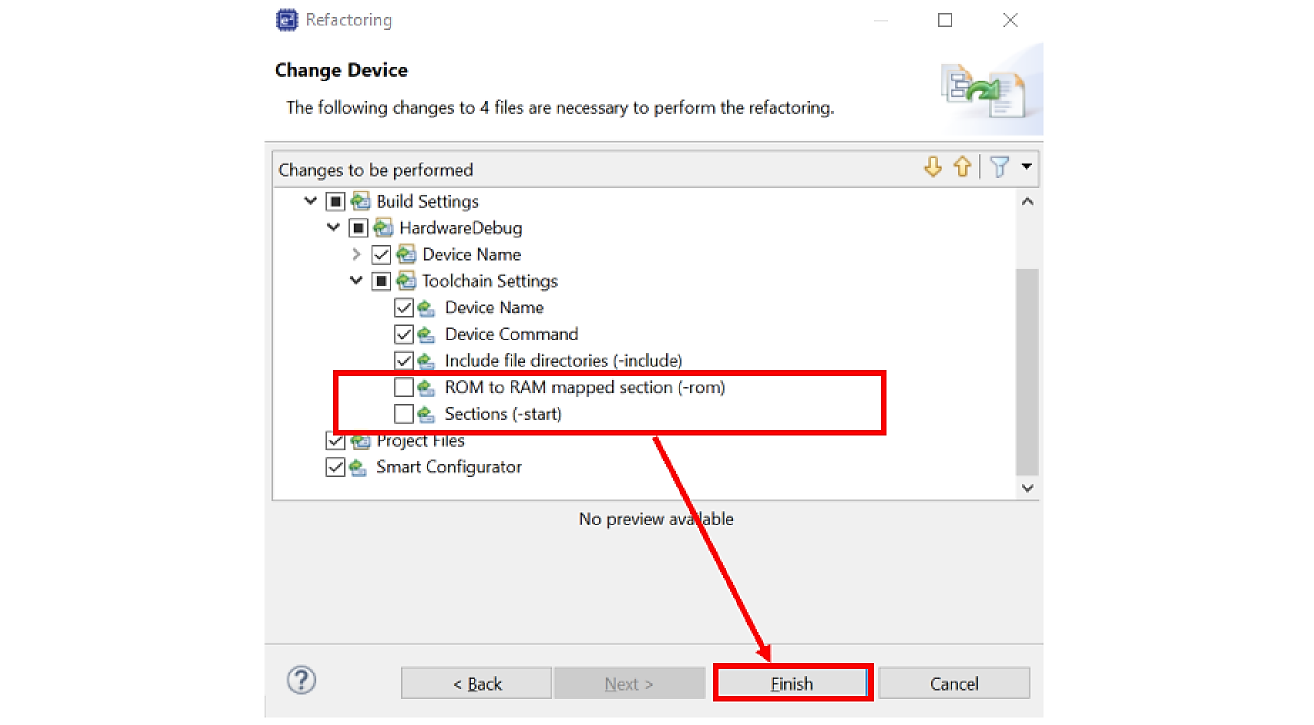
Device Selection

You can filter devices by regular expression

Device	RAM	ROM	Pin
RX65N			
RX65N - 100pin			
RX65N - 144pin			
R5F565N4AxFB	256 KB	512 KB	144
R5F565N4BxFB	256 KB	512 KB	144
R5F565N4ExFB	256 KB	512 KB	144
R5F565N4FxFB	256 KB	512 KB	144
R5F565N7AxFB	256 KB	768 KB	144
R5F565N7BxFB	256 KB	768 KB	144
R5F565N7ExFB	256 KB	768 KB	144
R5F565N7FxFB	256 KB	768 KB	144
R5F565N9AxFB	256 KB	1 MB	144
R5F565N9BxFB	256 KB	1 MB	144
R5F565N9ExFB	256 KB	1 MB	144
R5F565N9FxFB	256 KB	1 MB	144
R5F565NCDxFB	640 KB	1.5 MB	144
R5F565NCDxFB_DUAL	640 KB	1.5 MB	144
R5F565NCHxFB	640 KB	1.5 MB	144
R5F565NCHxFB_DUAL	640 KB	1.5 MB	144
R5F565NEDxFB	640 KB	2 MB	144
R5F565NEDxFB_DUAL	640 KB	2 MB	144
R5F565NEHxFB	640 KB	2 MB	144
R5F565NEHxFB_DUAL	640 KB	2 MB	144
RX65N - 145pin			
RX65N - 176pin			
RX65N - 177pin			
RX65W-A			
RX660			
RX66N			
RX66T			
RX671			

Figure 118. Device selection (2/3)

Under **Build Settings** > **HardwareDebug** > **Toolchain Settings**, clear the **ROM to RAM mapped section (-rom)** and **Sections (-start)** check boxes and then click **Finish**.



Refactoring

Change Device

The following changes to 4 files are necessary to perform the refactoring.

Changes to be performed

- ■ Build Settings
  - ■ HardwareDebug
    - ☑ Device Name
    - ■ Toolchain Settings
      - ☑ Device Name
      - ☑ Device Command
      - ☑ Include file directories (-include)
      - □ ROM to RAM mapped section (-rom)
      - □ Sections (-start)
- ☑ Project Files
- ☑ Smart Configurator

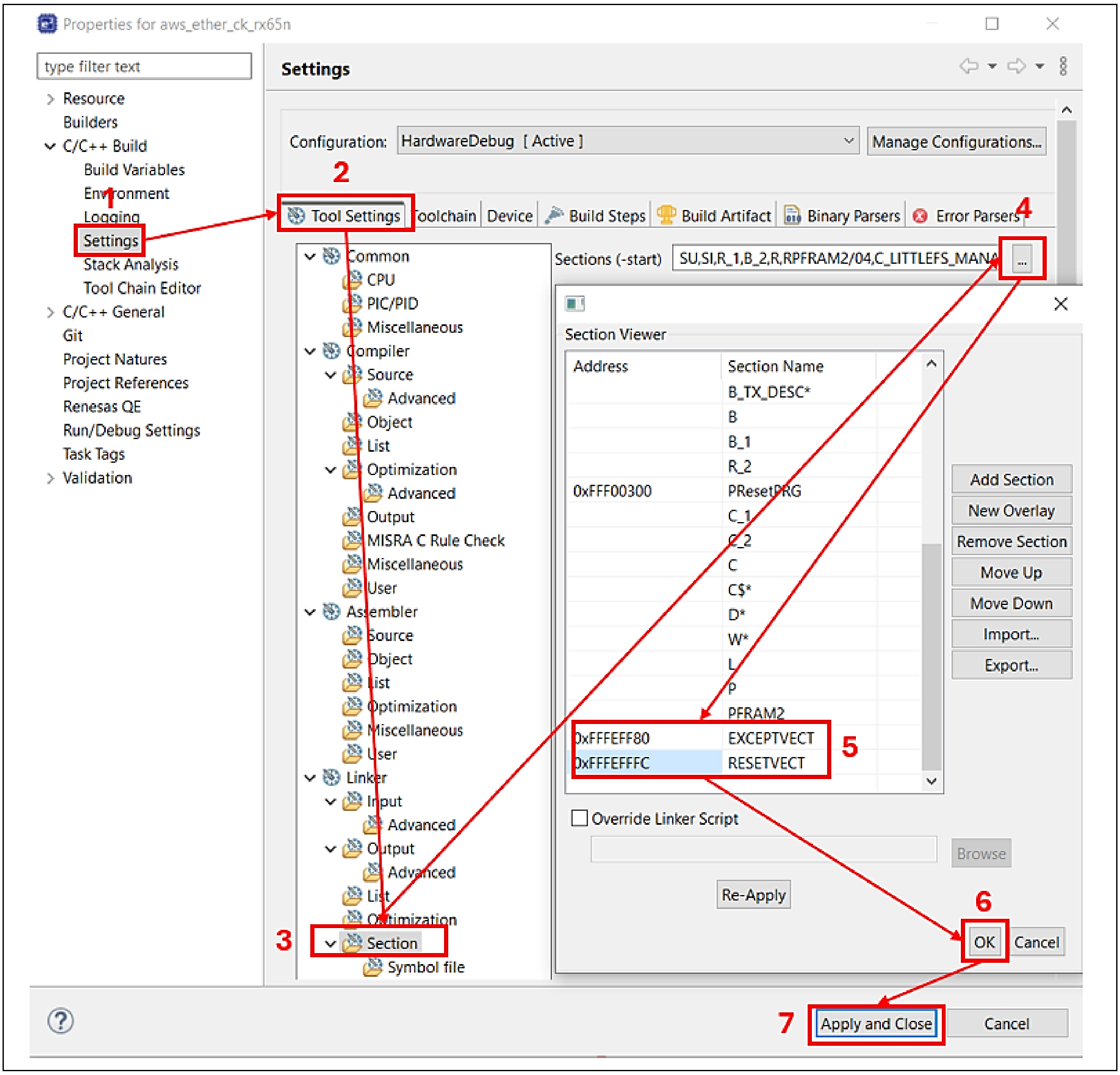
No preview available

Figure 119. Device selection (3/3)

5. Change the firmware (**aws_ether_ck_rx65n** (or **aws_ryz014a_ck_rx65n**)) vector.

Open the **aws_ether_ck_rx65n** (or **aws_ryz014a_ck_rx65n)** project, select **Project** and then **Properties**.

Expand the **C/C++ Build** menu and click **Settings**. In the menu tree on the **Tool Settings** tab, expand the **Linker** menu and click **Section**, and open the Section Viewer. **Allocate EXCEPTVECT to 0xFFFEFF80 and RESETVECT to 0xFFFEFFFC.**



Address	Section Name
	B_TX_DESC*
	B
	B_1
	R_2
0xFFF00300	PResetPRG
	C_1
	C_2
	C
	C$*
	D*
	W*
	L
	P
	PFRAM2
0xFFFEFF80	EXCEPTVECT
0xFFFEFFFC	RESETVECT

Figure 120. Vector setting

Build the project as described in Topic: **5.1.3 Importing the Project**

6. Generate the initial firmware.

Place the following files in the Renesas Image Generator folder:

The results of building the firmware: **aws_ether_ck_rx65n.mot (or aws_ryz014a_ck_rx65n.mot)**
The results of building the boot loader: **boot_loader_ck_rx65n.mot**
The private key created in **"Extract the private key from the ECDSA key pair."**: **secp256r1.privatekey**

Open a command prompt, navigate to the Renesas Image Generator folder, and execute the following command to generate the file **userprog.mot.**

```
$ python image-gen.py -iup aws_ether_ck_rx65n.mot -ip RX65N_DualBank_ImageGenerator_PRM.csv -o
userprog -ibp boot_loader_ck_rx65n.mot -key secp256r1.privatekey -vt ecdsa -ff RTOS
```

6.4.2.2 Running OTA project

1. Start Renesas Flash Programmer and create new project:

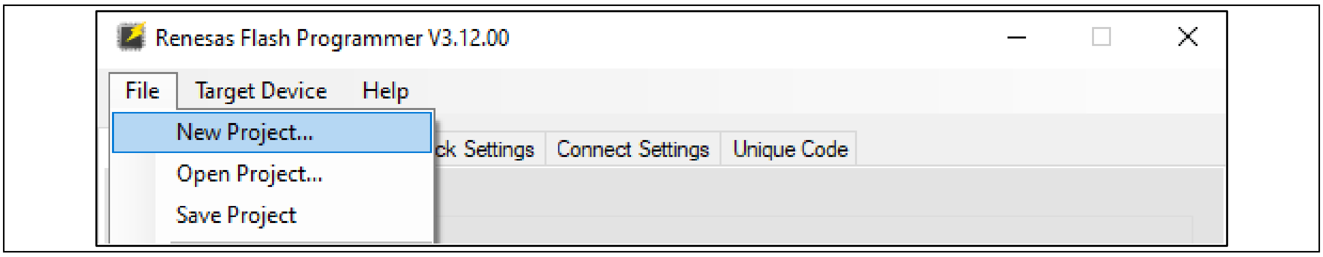
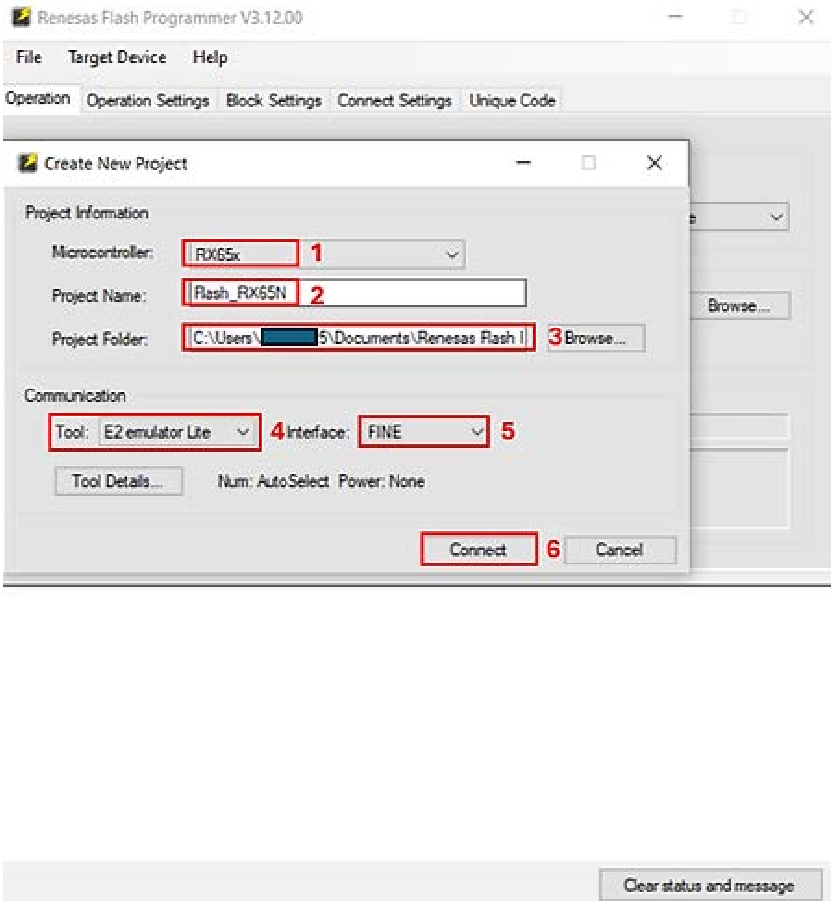


Figure 121. Create New Flash Project (1/4)

After that:

- Choose Microcontroller: **RX65x**
- Input project name.
- Browse "Project Folder"
- Communication: Tool: **E2 emulator Lite**
- Communication: Interface: **FINE**
- Choose "Connect"

Note**:** Jumper of J16 is "Debug" mode.



Microcontroller: RX65x

Project Name: Flash_RX65N

Project Folder: C:\Users\[redacted]5\Documents\Renesas Flash I

Tool: E2 emulator Lite

Interface: FINE

Num: AutoSelect Power: None

Figure 122. Create New Flash Project (2/4)

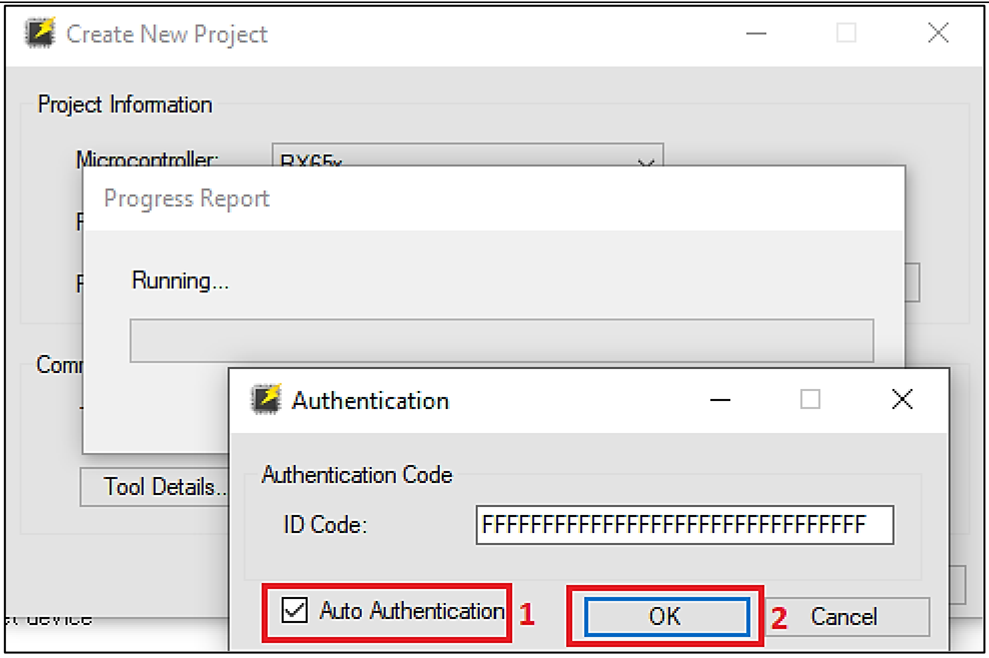
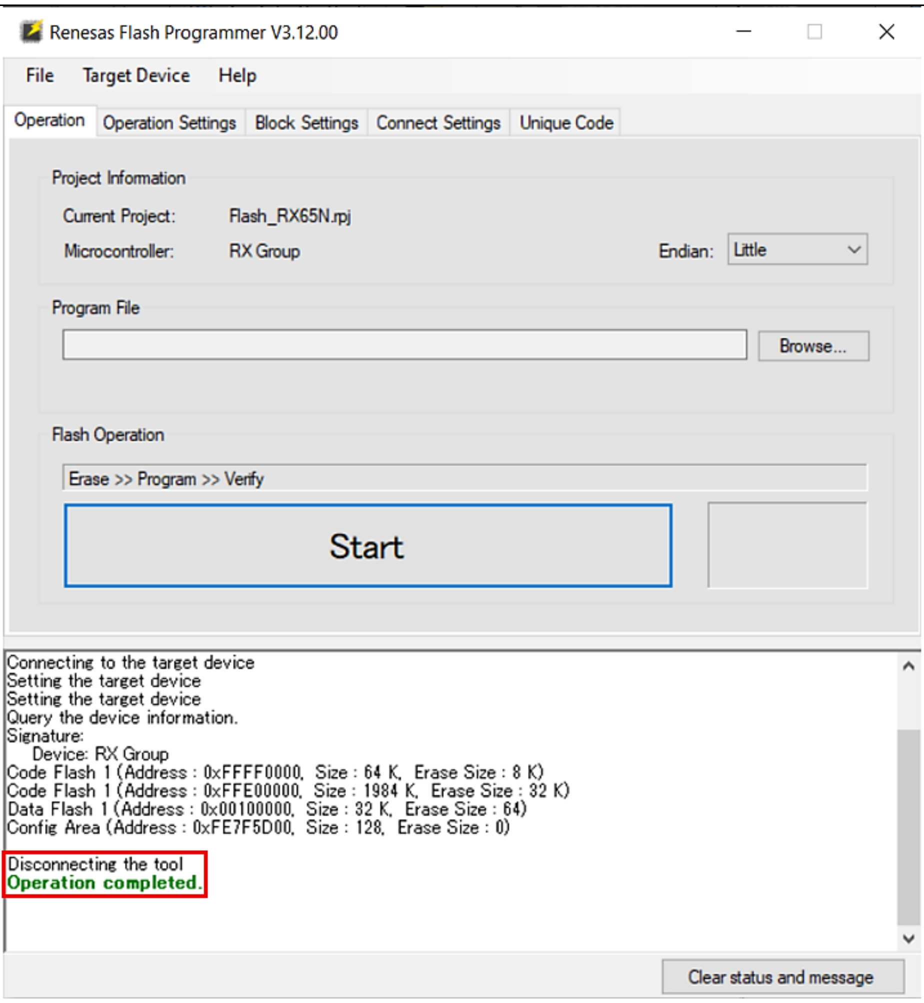


Figure 123. Create New Flash Project (3/4)



Project Information

Current Project: Flash_RX65N.rpj

Microcontroller: RX Group

Endian: Little

Program File

Flash Operation

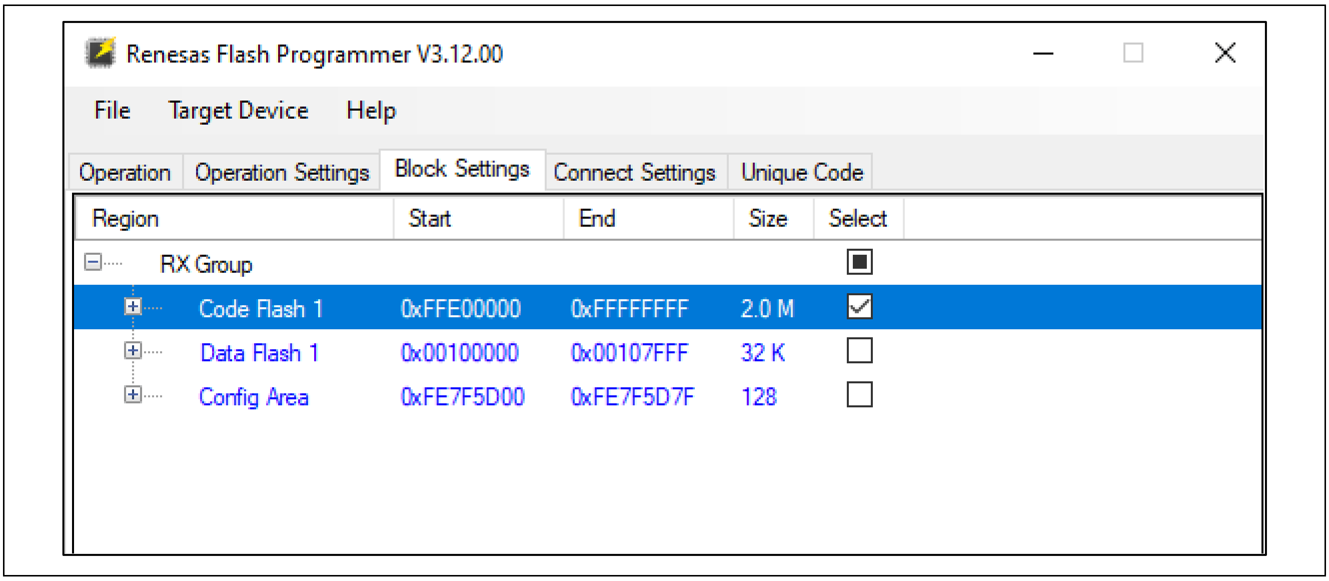
Erase >> Program >> Verify

```
Connecting to the target device
Setting the target device
Setting the target device
Query the device information.
Signature:
    Device: RX Group
Code Flash 1 (Address : 0xFFFF0000, Size : 64 K, Erase Size : 8 K)
Code Flash 1 (Address : 0xFFE00000, Size : 1984 K, Erase Size : 32 K)
Data Flash 1 (Address : 0x00100000, Size : 32 K, Erase Size : 64)
Config Area (Address : 0xFE7F5D00, Size : 128, Erase Size : 0)

Disconnecting the tool
Operation completed.
```

Figure 124. Create New Flash Project (4/4)

2. Choose code flash area in configuration:

   Only tick option **“Select”** for **“Code Flash 1”.**

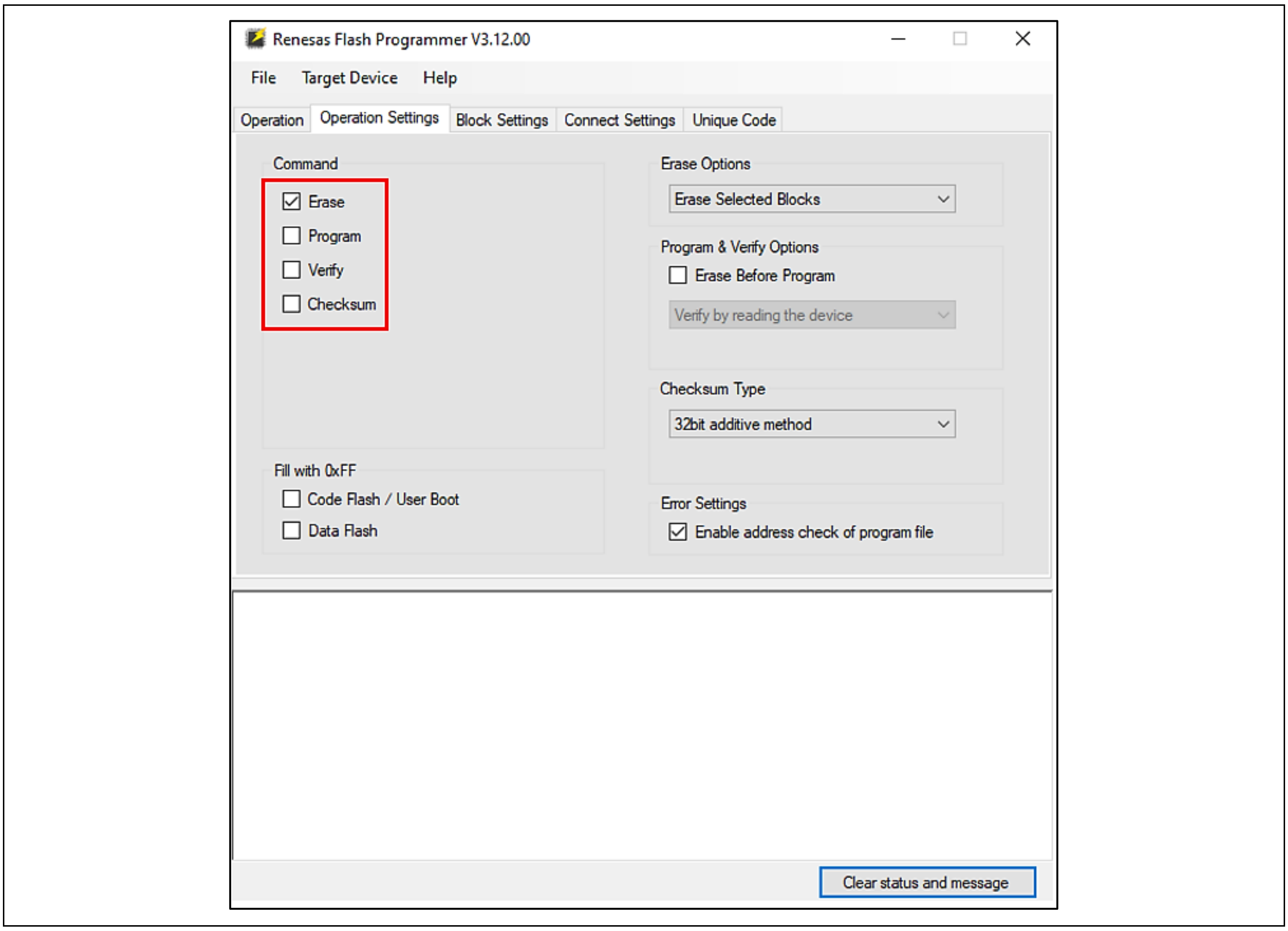


Region	Start	End	Size	Select
RX Group				■
Code Flash 1	0xFFE00000	0xFFFFFFFF	2.0 M	☑
Data Flash 1	0x00100000	0x00107FFF	32 K	□
Config Area	0xFE7F5D00	0xFE7F5D7F	128	□

Figure 125. Choose Code Flash Area

3. Erase “Code Flash” before loading new image:

   Choose “**Operation Settings**” > “**Erase**”.



Command
☑ Erase
□ Program
□ Verify
□ Checksum

Fill with 0xFF
□ Code Flash / User Boot
□ Data Flash

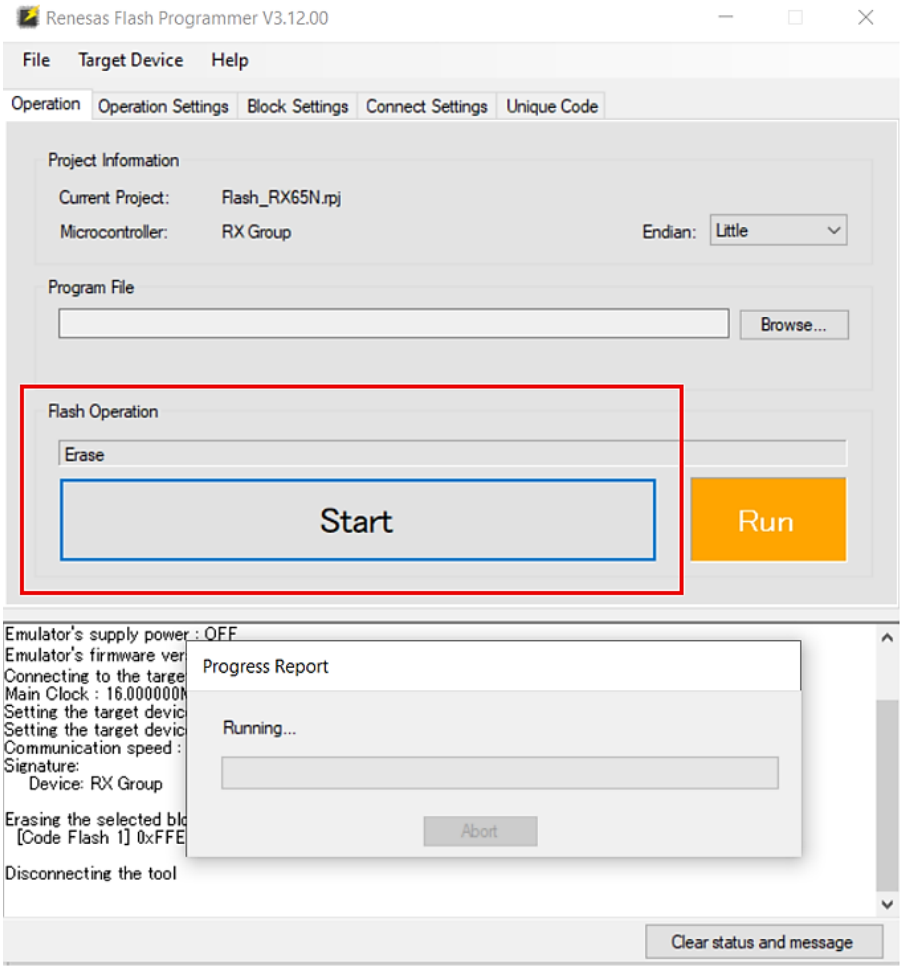
Erase Options
Erase Selected Blocks

Program & Verify Options
□ Erase Before Program
Verify by reading the device

Checksum Type
32bit additive method

Error Settings
☑ Enable address check of program file

Figure 126. Erase Code Flash (1/2)



Project Information

Current Project: Flash_RX65N.rpj

Microcontroller: RX Group

Endian: Little

Program File

Flash Operation

Erase

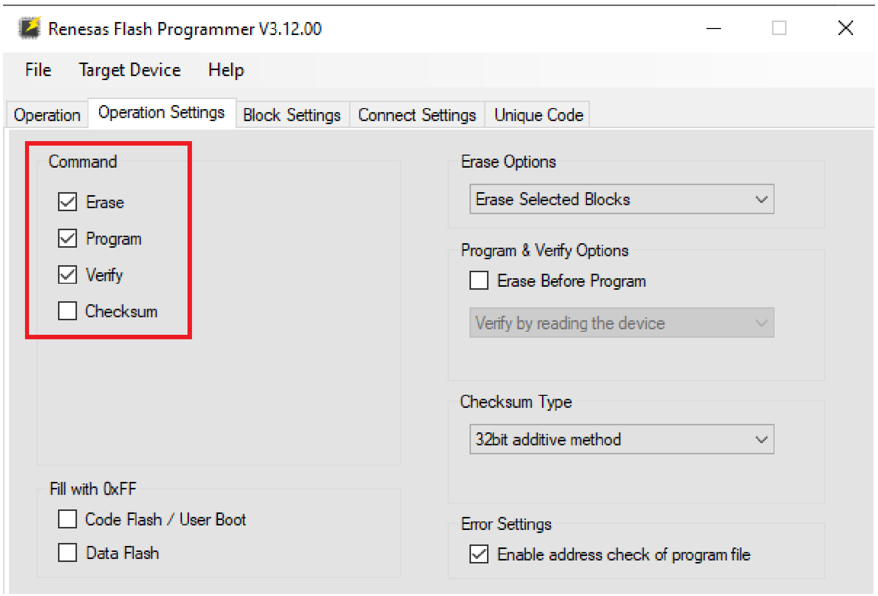
Running...

```
Emulator's supply power : OFF
Emulator's firmware ver
Connecting to the targe
Main Clock : 16.000000
Setting the target devic
Setting the target devic
Communication speed :
Signature:
    Device: RX Group

Erasing the selected bl
  [Code Flash 1] 0xFFE

Disconnecting the tool
```

Figure 127. Erase Code Flash (2/2)

4. Write the initial firmware (userprog.mot)

   This flash project will use commands: Erase, Program and Verify.



Command

☑ Erase

☑ Program

☑ Verify

□ Checksum

Erase Options

Erase Selected Blocks

Program & Verify Options

□ Erase Before Program

Verify by reading the device

Checksum Type

32bit additive method

Fill with 0xFF

□ Code Flash / User Boot

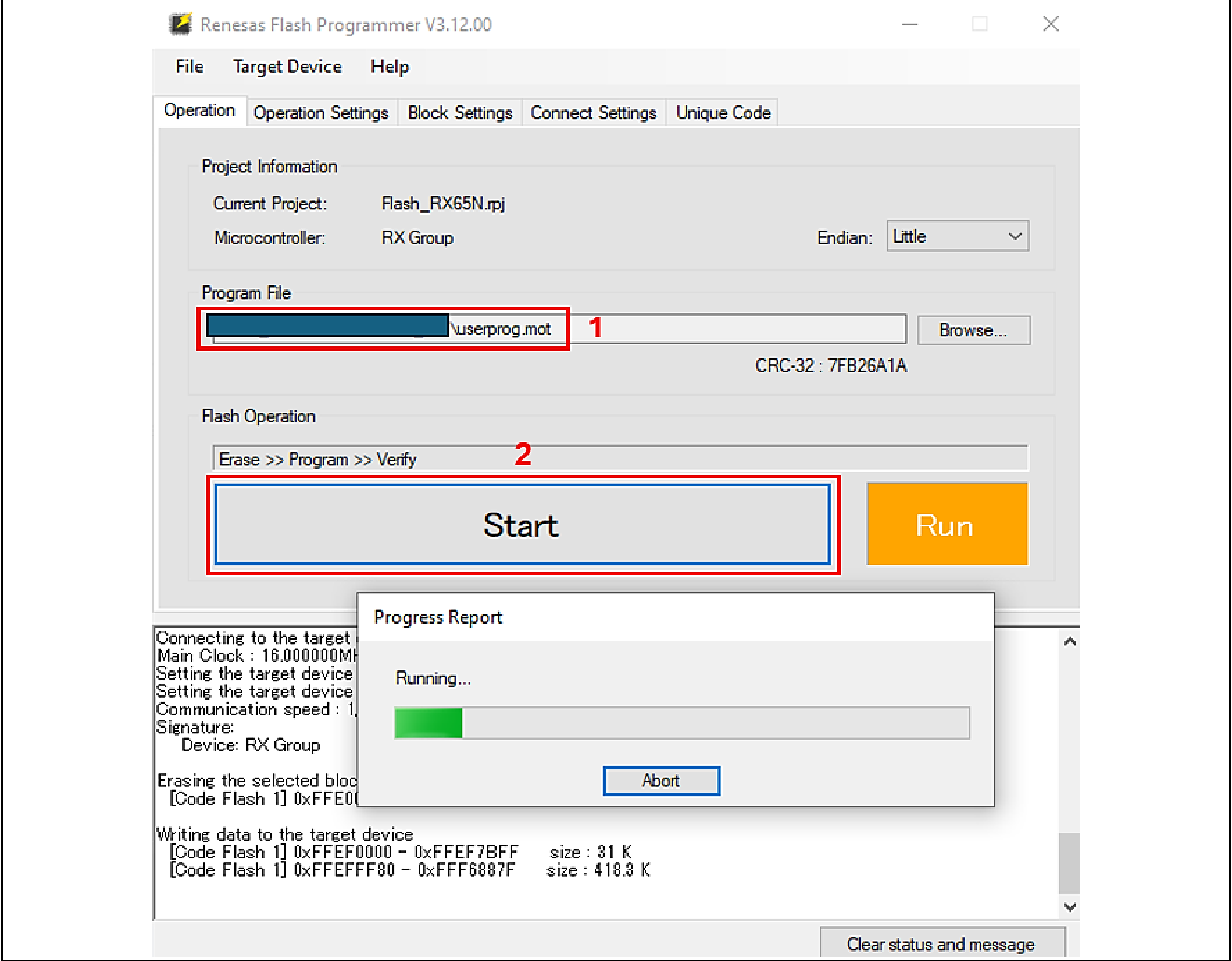
□ Data Flash

Error Settings

☑ Enable address check of program file

Figure 128. Flash the Firmware (1/3)

Add firmware’s path (users have created in **6.4.2.1**) to “Program File” and click “Start”:



Project Information

Current Project: Flash_RX65N.rpj

Microcontroller: RX Group

Endian: Little

Program File

[redacted]\userprog.mot

CRC-32 : 7FB26A1A

Flash Operation

Erase >> Program >> Verify

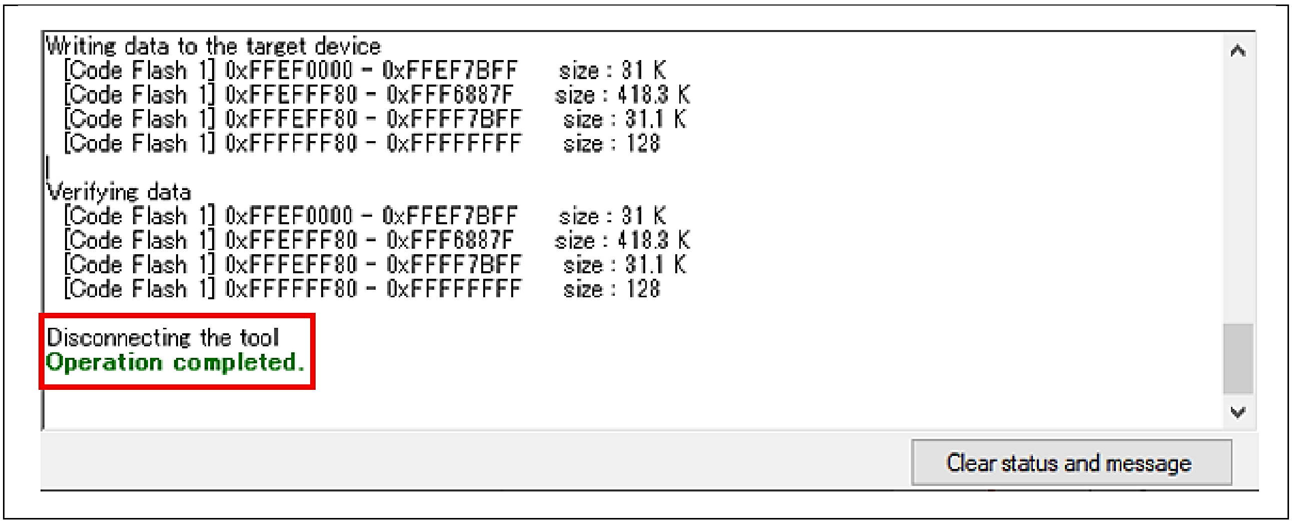
Progress Report

Running...

```
Connecting to the target
Main Clock : 16.000000MH
Setting the target device
Setting the target device
Communication speed : 1.
Signature:
    Device: RX Group

Erasing the selected bloc
  [Code Flash 1] 0xFFE0

Writing data to the target device
  [Code Flash 1] 0xFFEF0000 - 0xFFEF7BFF    size : 31 K
  [Code Flash 1] 0xFFEFFF80 - 0xFFF6887F    size : 418.3 K
```

Figure 129. Flash the Firmware (2/3)

If it is successful, it will display “Operation completed”:

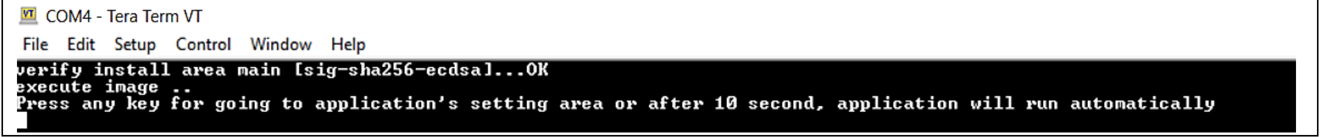


```
Writing data to the target device
  [Code Flash 1] 0xFFEF0000 - 0xFFEF7BFF    size : 31 K
  [Code Flash 1] 0xFFEFFF80 - 0xFFF6887F    size : 418.3 K
  [Code Flash 1] 0xFFFEFF80 - 0xFFFF7BFF    size : 31.1 K
  [Code Flash 1] 0xFFFFFF80 - 0xFFFFFFFF    size : 128

Verifying data
  [Code Flash 1] 0xFFEF0000 - 0xFFEF7BFF    size : 31 K
  [Code Flash 1] 0xFFEFFF80 - 0xFFF6887F    size : 418.3 K
  [Code Flash 1] 0xFFFEFF80 - 0xFFFF7BFF    size : 31.1 K
  [Code Flash 1] 0xFFFFFF80 - 0xFFFFFFFF    size : 128

Disconnecting the tool
Operation completed.
```

Figure 130. Flash the Firmware (3/3)

5. Running the application:

Set jumper J16 to “Run” mode. The application will run as below:



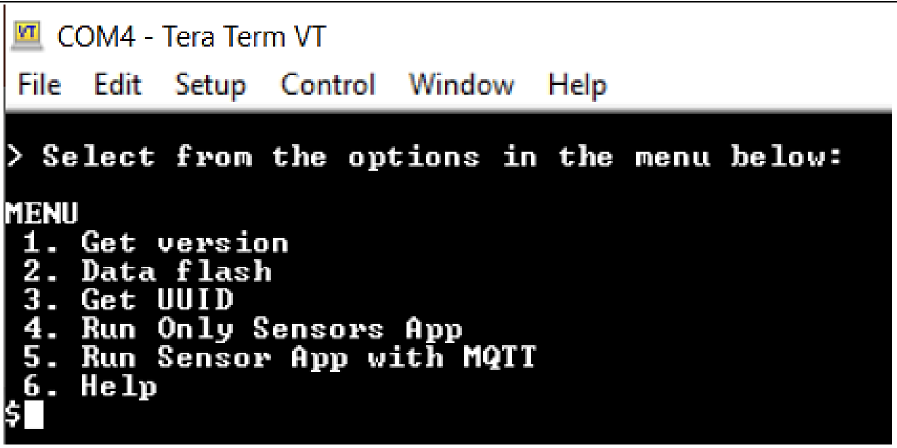
```
verify install area main [sig-sha256-ecdsa]...OK
execute image ..
Press any key for going to application's setting area or after 10 second, application will run automatically
```

Figure 131. Start Application with OTA

Press any key to configure the application. For setting Cloud’s credentials for IoT Device, please refer to the **“0 ”** section.

Besides that, for OTA, please store the code signing certificate (user created **“secp256r1.crt”** file at step: ***Create a certificate from the certificate signing request, CA certificate, and CA private key***).

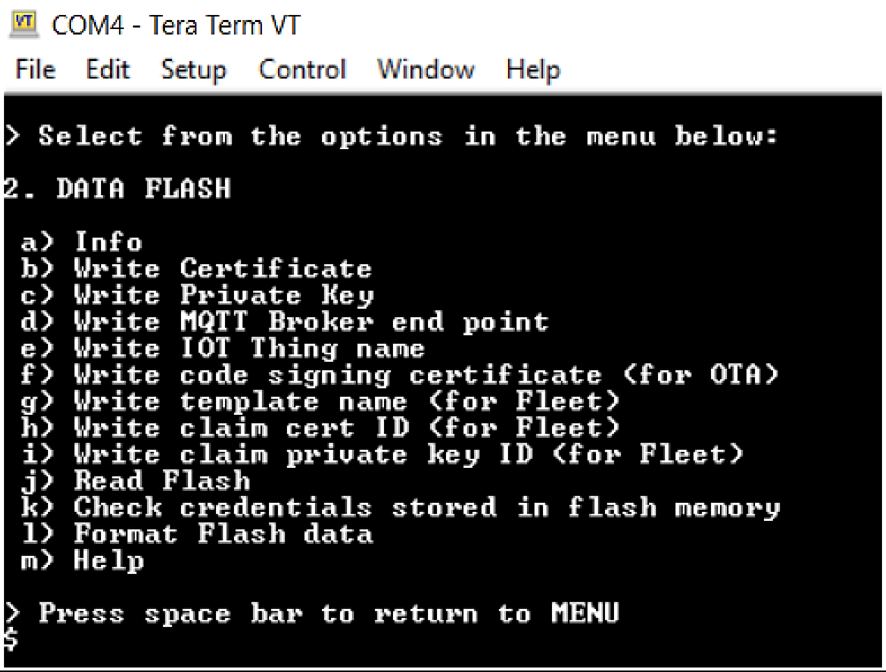
Press **‘2’** on the Main Menu to display Data Flash.



```
> Select from the options in the menu below:

MENU
 1. Get version
 2. Data flash
 3. Get UUID
 4. Run Only Sensors App
 5. Run Sensor App with MQTT
 6. Help
$
```

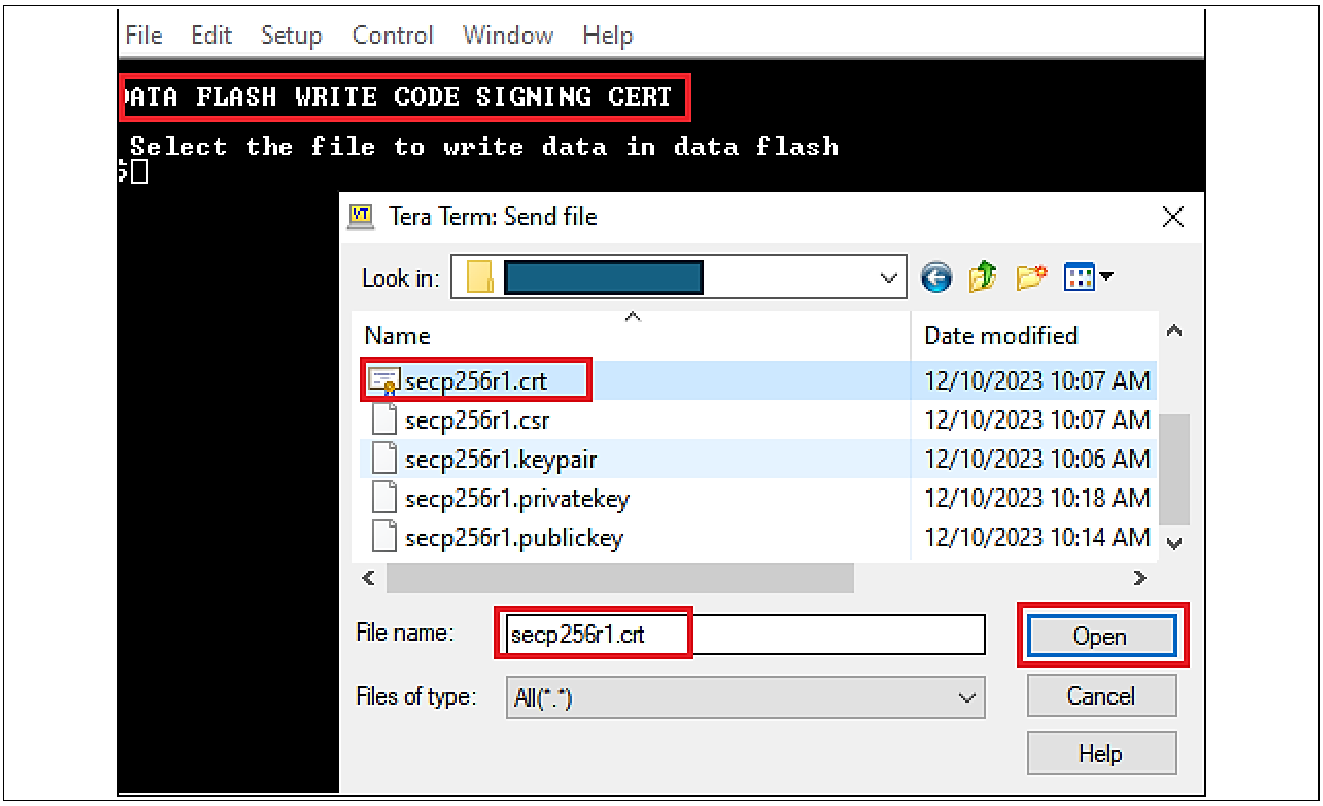
Figure 132. Main Menu

Press **‘f’** for storing code signing certificate:



```
> Select from the options in the menu below:

2. DATA FLASH

 a) Info
 b) Write Certificate
 c) Write Private Key
 d) Write MQTT Broker end point
 e) Write IOT Thing name
 f) Write code signing certificate (for OTA)
 g) Write template name (for Fleet)
 h) Write claim cert ID (for Fleet)
 i) Write claim private key ID (for Fleet)
 j) Read Flash
 k) Check credentials stored in flash memory
 l) Format Flash data
 m) Help

> Press space bar to return to MENU
$
```

Figure 133. Data Flash Menu

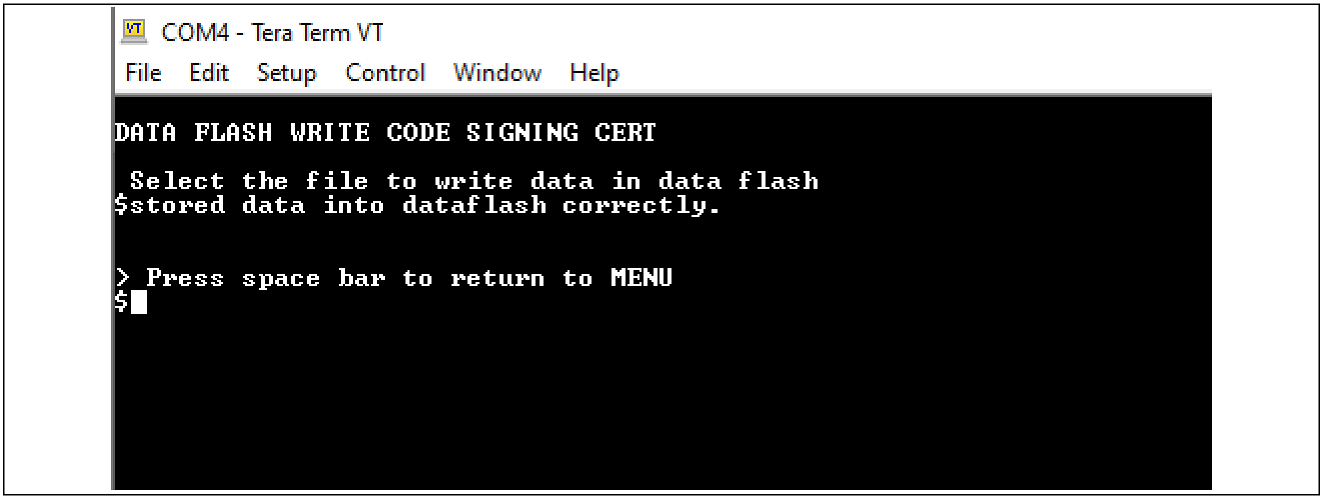


```
DATA FLASH WRITE CODE SIGNING CERT

 Select the file to write data in data flash
$
```

File Edit Setup Control Window Help
Tera Term: Send file
Look in:
Name
Date modified
secp256r1.crt 12/10/2023 10:07 AM
secp256r1.csr 12/10/2023 10:07 AM
secp256r1.keypair 12/10/2023 10:06 AM
secp256r1.privatekey 12/10/2023 10:18 AM
secp256r1.publickey 12/10/2023 10:14 AM
File name: secp256r1.crt
Files of type: All(*.*)
Open
Cancel
Help

Figure 134. Store code signing certificate into flash (1/2)

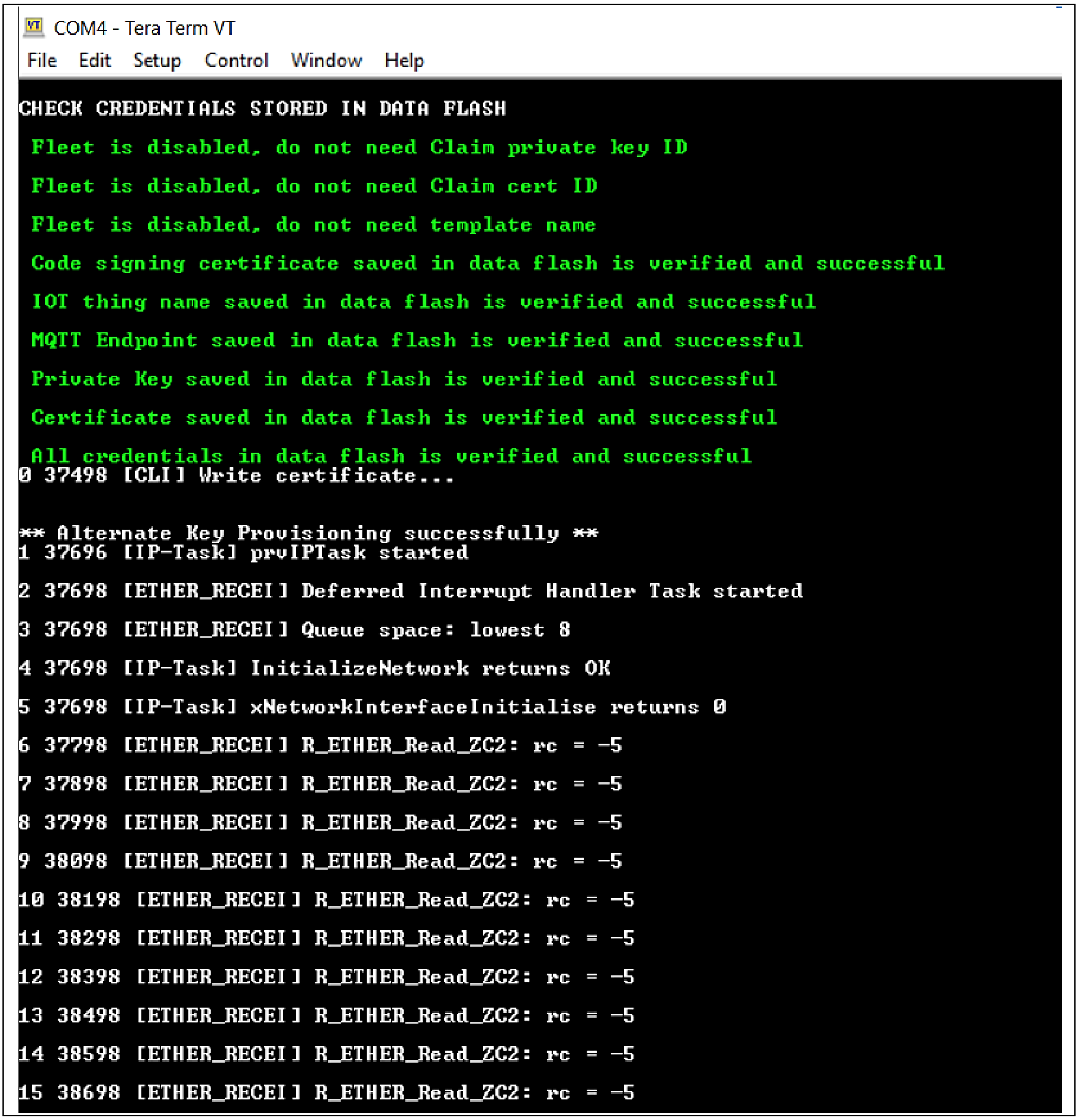
Note**:** please check the EOL of **secp256r1.crt** and **convert it to LF** before saving it into data flash.



```
DATA FLASH WRITE CODE SIGNING CERT

 Select the file to write data in data flash
$stored data into dataflash correctly.


> Press space bar to return to MENU
$
```

Figure 135. Store code signing certificate into flash (2/2)

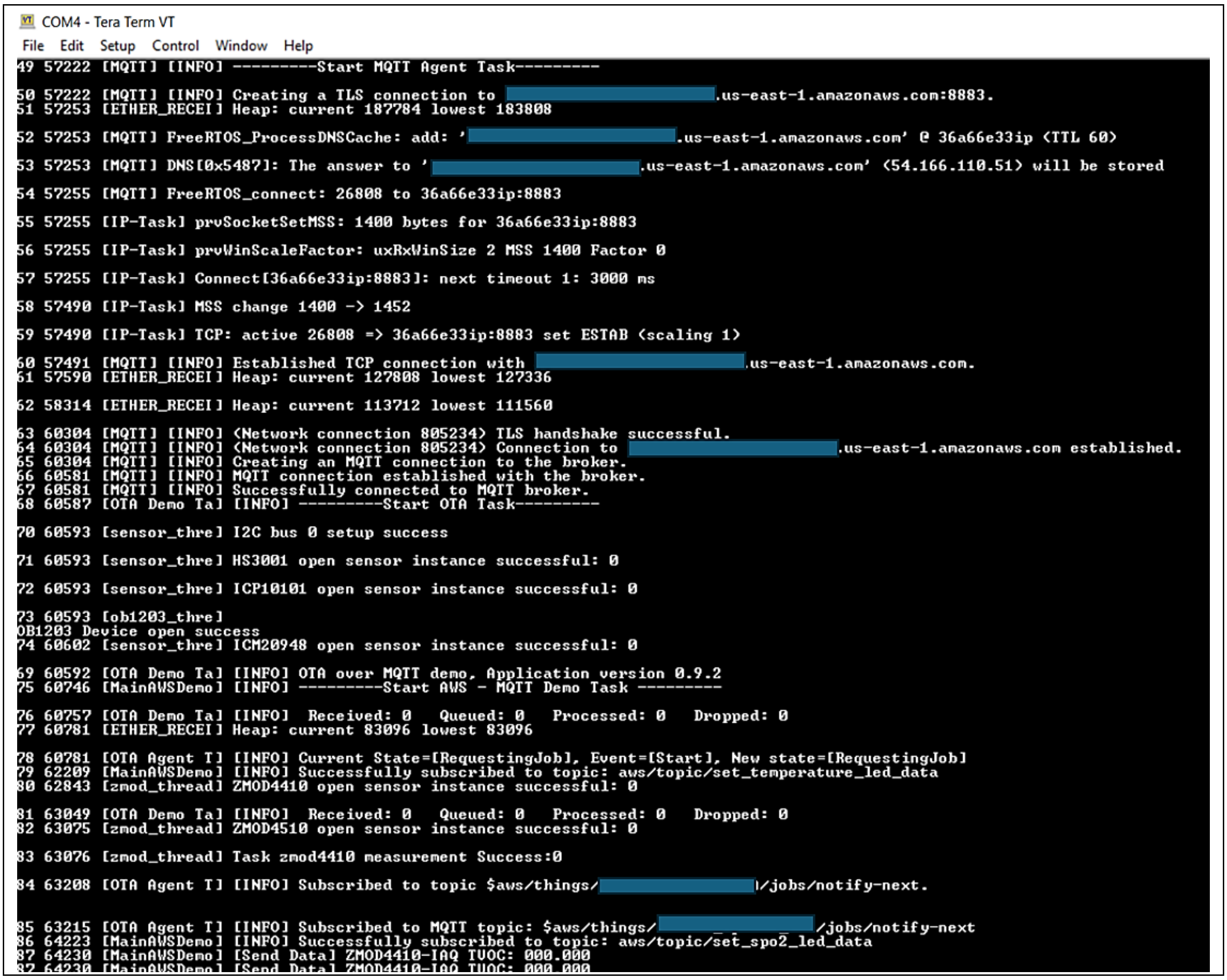
After saving all Cloud credentials, user starts the application by choosing option **“Run Sensor App with MQTT”** on Main Menu:



```
CHECK CREDENTIALS STORED IN DATA FLASH
 Fleet is disabled, do not need Claim private key ID
 Fleet is disabled, do not need Claim cert ID
 Fleet is disabled, do not need template name
 Code signing certificate saved in data flash is verified and successful
 IOT thing name saved in data flash is verified and successful
 MQTT Endpoint saved in data flash is verified and successful
 Private Key saved in data flash is verified and successful
 Certificate saved in data flash is verified and successful
 All credentials in data flash is verified and successful
0 37498 [CLI] Write certificate...

** Alternate Key Provisioning successfully **
1 37696 [IP-Task] prvIPTask started

2 37698 [ETHER_RECEI] Deferred Interrupt Handler Task started

3 37698 [ETHER_RECEI] Queue space: lowest 8

4 37698 [IP-Task] InitializeNetwork returns OK

5 37698 [IP-Task] xNetworkInterfaceInitialise returns 0

6 37798 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

7 37898 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

8 37998 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

9 38098 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

10 38198 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

11 38298 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

12 38398 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

13 38498 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

14 38598 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5

15 38698 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
```

Figure 136. Application with OTA (1/2)

While subscribing/publishing messages to MQTT (sensor's data, control LEDs and so forth), application will also check the event of OTA from Cloud.



```
49 57222 [MQTT] [INFO] ---------Start MQTT Agent Task---------

50 57222 [MQTT] [INFO] Creating a TLS connection to [redacted].us-east-1.amazonaws.com:8883.
51 57253 [ETHER_RECEI] Heap: current 187784 lowest 183808

52 57253 [MQTT] FreeRTOS_ProcessDNSCache: add: '[redacted].us-east-1.amazonaws.com' @ 36a66e33ip (TTL 60)

53 57253 [MQTT] DNS[0x5487]: The answer to '[redacted].us-east-1.amazonaws.com' (54.166.110.51) will be stored

54 57255 [MQTT] FreeRTOS_connect: 26808 to 36a66e33ip:8883

55 57255 [IP-Task] prvSocketSetMSS: 1400 bytes for 36a66e33ip:8883

56 57255 [IP-Task] prvWinScaleFactor: uxRxWinSize 2 MSS 1400 Factor 0

57 57255 [IP-Task] Connect[36a66e33ip:8883]: next timeout 1: 3000 ms

58 57490 [IP-Task] MSS change 1400 -> 1452

59 57490 [IP-Task] TCP: active 26808 => 36a66e33ip:8883 set ESTAB (scaling 1)

60 57491 [MQTT] [INFO] Established TCP connection with [redacted].us-east-1.amazonaws.com.
61 57590 [ETHER_RECEI] Heap: current 127808 lowest 127336

62 58314 [ETHER_RECEI] Heap: current 113712 lowest 111560

63 60304 [MQTT] [INFO] (Network connection 805234) TLS handshake successful.
64 60304 [MQTT] [INFO] (Network connection 805234) Connection to [redacted].us-east-1.amazonaws.com established.
65 60304 [MQTT] [INFO] Creating an MQTT connection to the broker.
66 60581 [MQTT] [INFO] MQTT connection established with the broker.
67 60581 [MQTT] [INFO] Successfully connected to MQTT broker.
68 60587 [OTA Demo Ta] [INFO] ---------Start OTA Task---------

70 60593 [sensor_thre] I2C bus 0 setup success

71 60593 [sensor_thre] HS3001 open sensor instance successful: 0

72 60593 [sensor_thre] ICP10101 open sensor instance successful: 0

73 60593 [ob1203_thre]
OB1203 Device open success
74 60602 [sensor_thre] ICM20948 open sensor instance successful: 0

69 60592 [OTA Demo Ta] [INFO] OTA over MQTT demo, Application version 0.9.2
75 60746 [MainAWSDemo] [INFO] ---------Start AWS - MQTT Demo Task ---------

76 60757 [OTA Demo Ta] [INFO]  Received: 0   Queued: 0   Processed: 0   Dropped: 0
77 60781 [ETHER_RECEI] Heap: current 83096 lowest 83096

78 60781 [OTA Agent T] [INFO] Current State=[RequestingJob], Event=[Start], New state=[RequestingJob]
79 62209 [MainAWSDemo] [INFO] Successfully subscribed to topic: aws/topic/set_temperature_led_data
80 62843 [zmod_thread] ZMOD4410 open sensor instance successful: 0

81 63049 [OTA Demo Ta] [INFO]  Received: 0   Queued: 0   Processed: 0   Dropped: 0
82 63075 [zmod_thread] ZMOD4510 open sensor instance successful: 0

83 63076 [zmod_thread] Task zmod4410 measurement Success:0

84 63208 [OTA Agent T] [INFO] Subscribed to topic $aws/things/[redacted]/jobs/notify-next.


85 63215 [OTA Agent T] [INFO] Subscribed to MQTT topic: $aws/things/[redacted]/jobs/notify-next
86 64223 [MainAWSDemo] [INFO] Successfully subscribed to topic: aws/topic/set_spo2_led_data
87 64230 [MainAWSDemo] [Send Data] ZMOD4410-IAQ TVOC: 000.000
87 64230 [MainAWSDemo] [Send Data] ZMOD4410-IAQ TVOC: 000.000
```

Figure 137. Application with OTA (2/2)

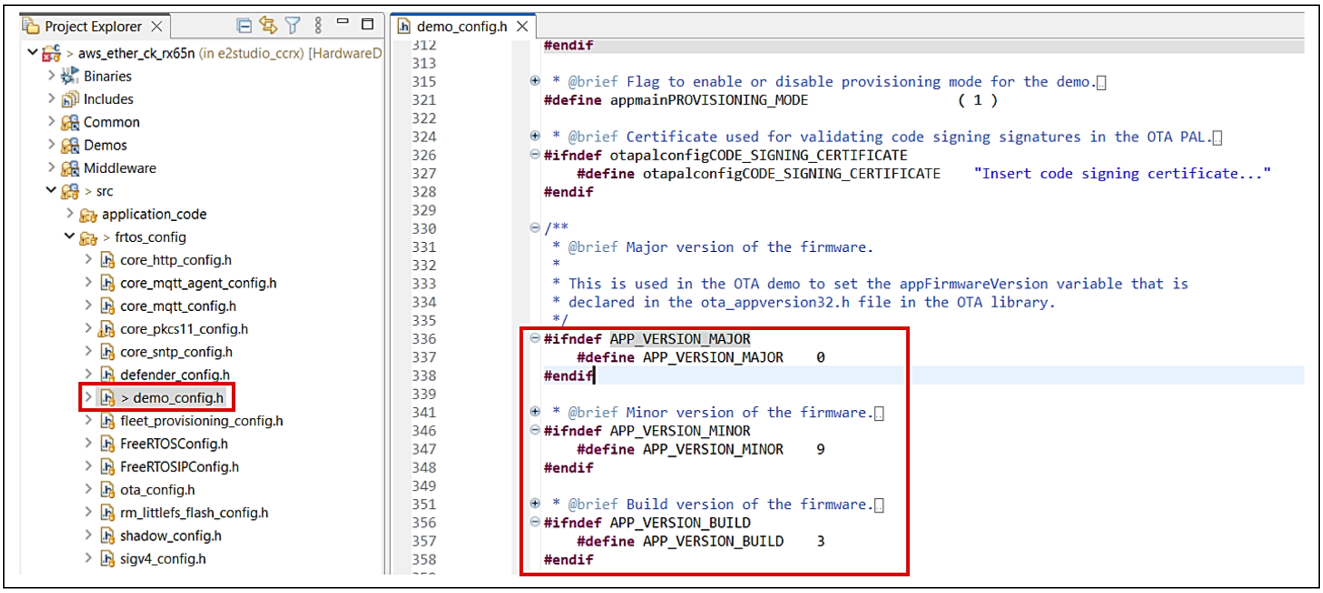
6.5 Updating the Firmware

6.5.1 Creating the updated firmware

6.5.1.1 Changing the firmware version

Change the firmware version to a higher version. (Example: The previous version is 0.9.2, so the new version we can choose is 0.9.3)

Repeat the build process, this time with 3 specified for the APP_VERSION_BUILD definition in `[Project_Loc]\e2studio_ccrx\src\frtos_config\demo_config.h`.



```
#endif

 * @brief Flag to enable or disable provisioning mode for the demo.
#define appmainPROVISIONING_MODE                    ( 1 )

 * @brief Certificate used for validating code signing signatures in the OTA PAL.
#ifndef otapalconfigCODE_SIGNING_CERTIFICATE
    #define otapalconfigCODE_SIGNING_CERTIFICATE    "Insert code signing certificate..."
#endif

/**
 * @brief Major version of the firmware.
 *
 * This is used in the OTA demo to set the appFirmwareVersion variable that is
 * declared in the ota_appversion32.h file in the OTA library.
 */
#ifndef APP_VERSION_MAJOR
    #define APP_VERSION_MAJOR    0
#endif

 * @brief Minor version of the firmware.
#ifndef APP_VERSION_MINOR
    #define APP_VERSION_MINOR    9
#endif

 * @brief Build version of the firmware.
#ifndef APP_VERSION_BUILD
    #define APP_VERSION_BUILD    3
#endif
```

Figure 138. Setting New Version for Firmware

6.5.1.2 Use Renesas Image Generator to Generate the Updated Firmware

Overwrite the file in the Renesas Image Generator folder with the firmware you rebuilt in **6.5.1.1** (aws_ether_ck_rx65n.mot), and then execute the following command at the command prompt:

$ python image-gen.py -iup *aws_ether_ck_rx65n.mot* -ip *RX65N_DualBank_ImageGenerator_PRM.csv* -o *user_093* -key *secp256r1.privatekey* -vt ecdsa -ff RTOS

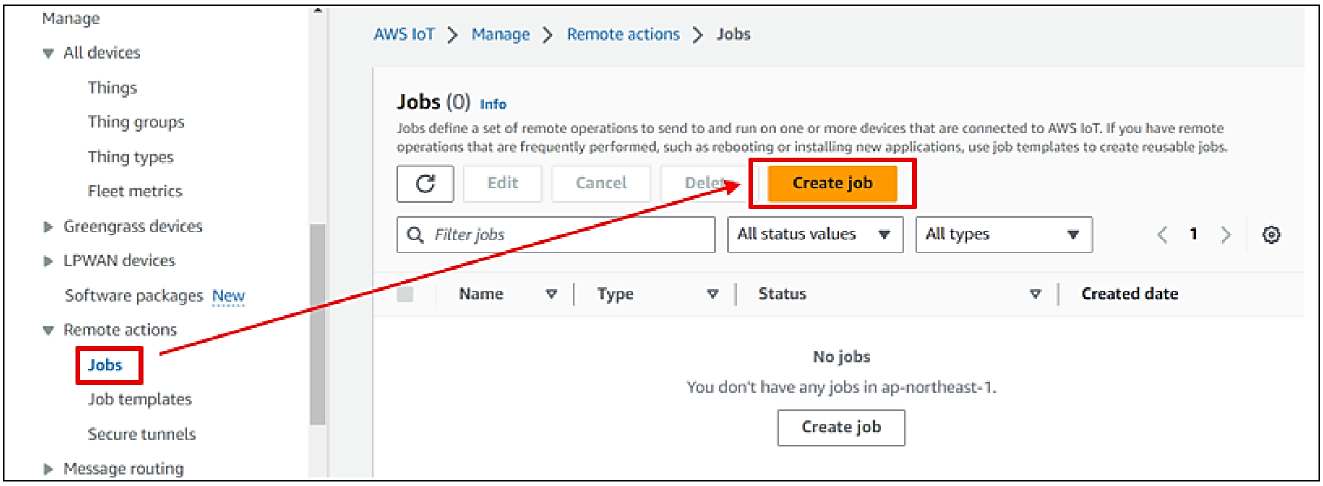
This command generates a file named user_093.rsu.

6.5.2 Updating the firmware

In AWS, create an OTA update job that will update the firmware.

6.5.2.1 Creating New Job

In the IoT Core menu, select **Manage** > **Remote actions** > **Jobs**, and then click the **Create job** button.



Jobs (0) Info

Jobs define a set of remote operations to send to and run on one or more devices that are connected to AWS IoT. If you have remote operations that are frequently performed, such as rebooting or installing new applications, use job templates to create reusable jobs.

Filter jobs

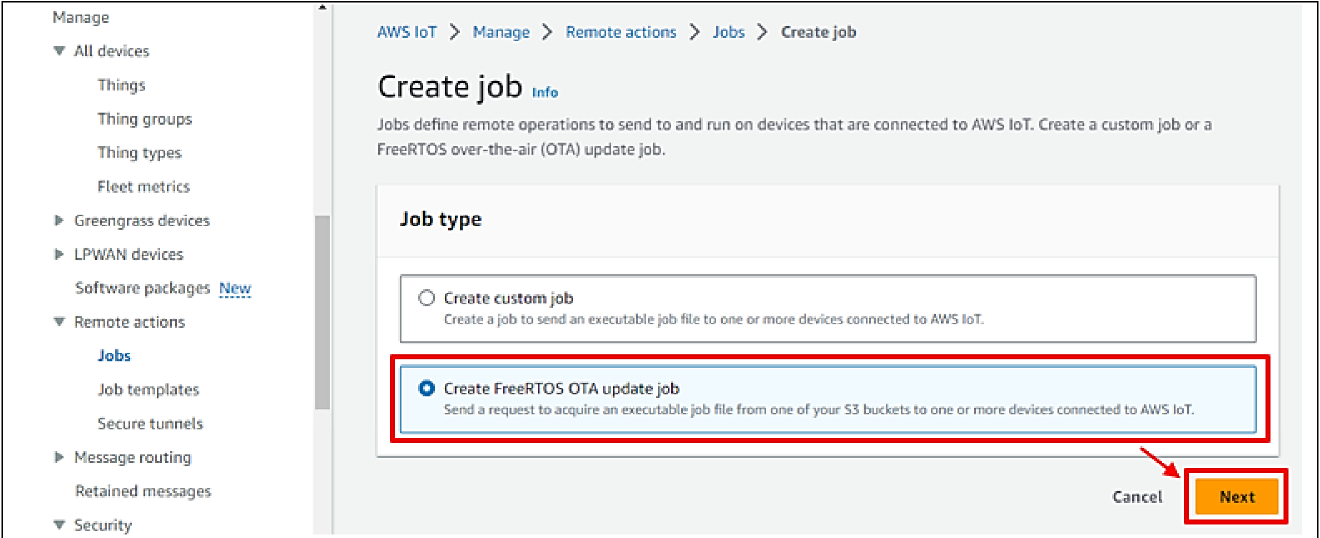
No jobs

You don't have any jobs in ap-northeast-1.

Figure 139. Create New Job for OTA (1/2)

6.5.2.2 Creating FreeRTOS OTA Job Update

Select **Create FreeRTOS OTA update job** and then click **Next**.



AWS IoT > Manage > Remote actions > Jobs > Create job

Create job Info

Jobs define remote operations to send to and run on devices that are connected to AWS IoT. Create a custom job or a FreeRTOS over-the-air (OTA) update job.

Job type

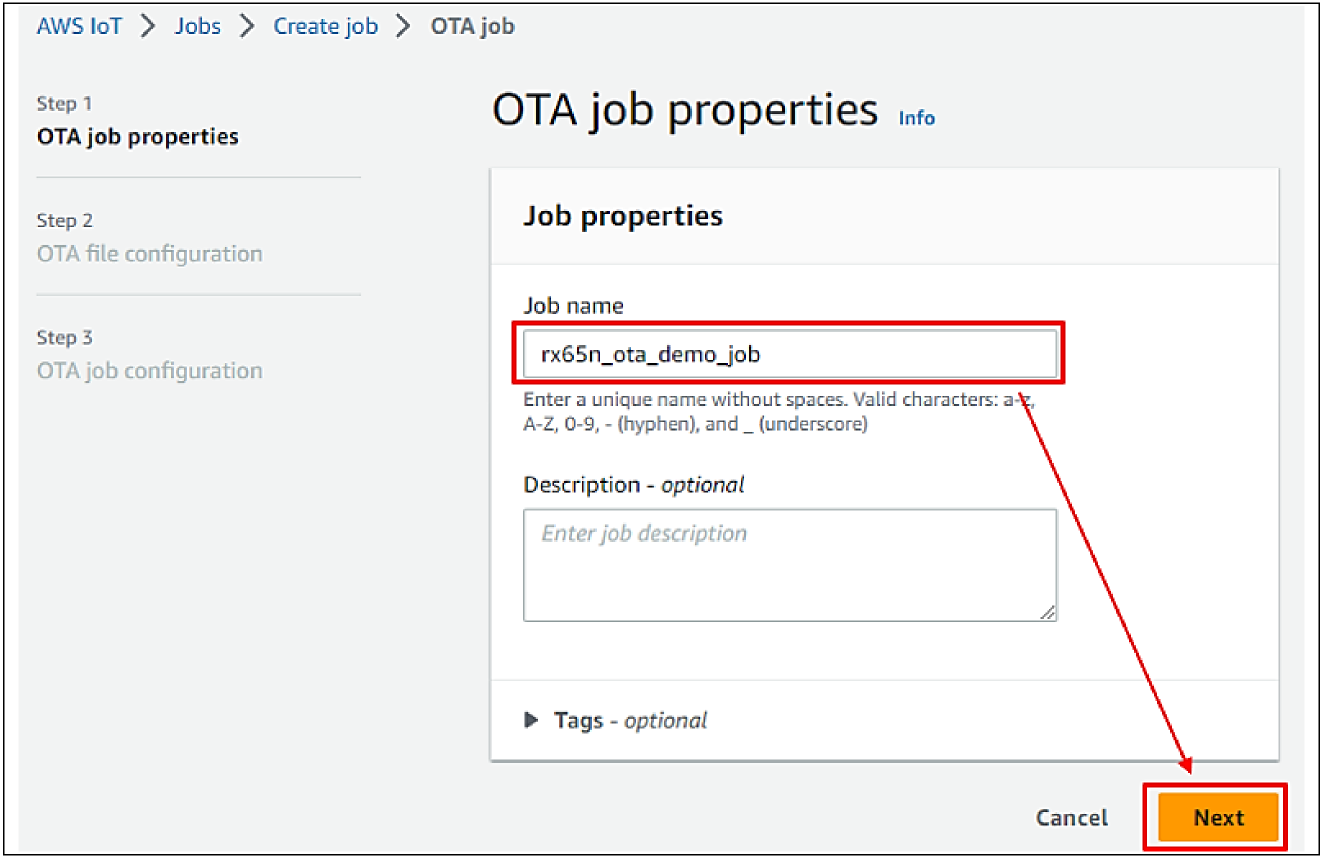
○ Create custom job
Create a job to send an executable job file to one or more devices connected to AWS IoT.

● Create FreeRTOS OTA update job
Send a request to acquire an executable job file from one of your S3 buckets to one or more devices connected to AWS IoT.

Figure 140. Create New Job for OTA (2/2)

6.5.2.3 Entering a Job Name

Enter a job name (example: rx65n_ota_demo_job) and then click **Next**.



AWS IoT > Jobs > Create job > OTA job

OTA job properties Info

Job properties

Job name: rx65n_ota_demo_job

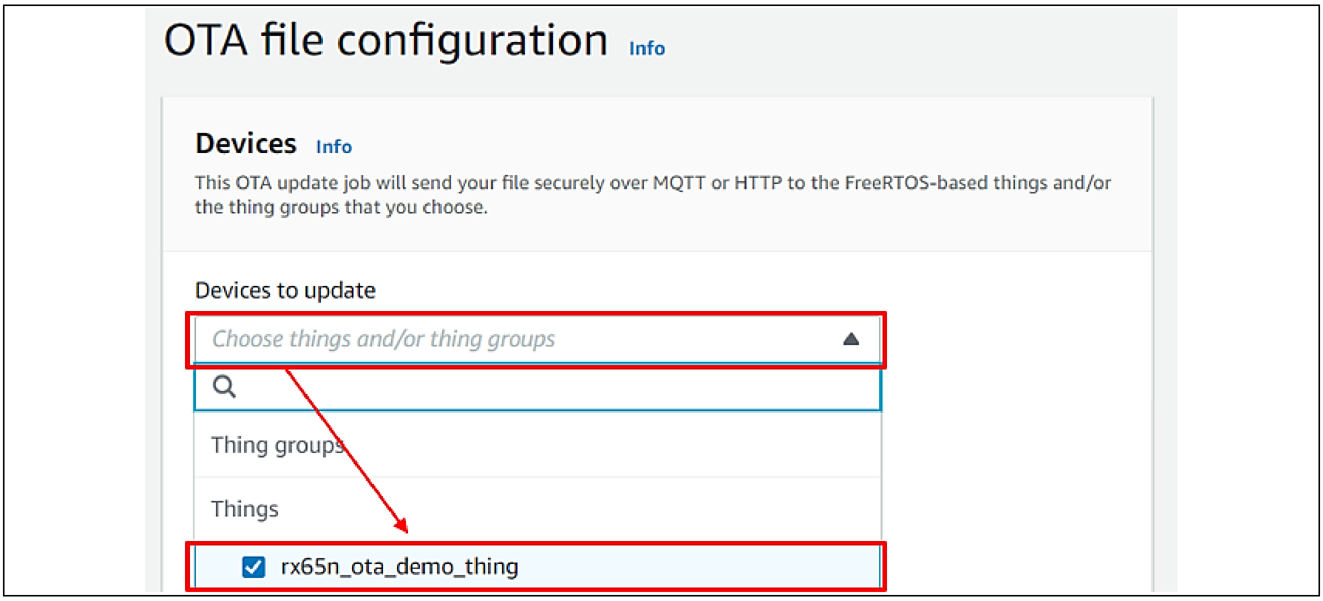
Enter a unique name without spaces. Valid characters: a-z, A-Z, 0-9, - (hyphen), and _ (underscore)

Description - *optional*: Enter job description

Figure 141. Enter OTA Job Name

6.5.2.4 Updating Devices

Click the Devices to update drop-down list and select the device to update.



OTA file configuration Info

Devices Info

This OTA update job will send your file securely over MQTT or HTTP to the FreeRTOS-based things and/or the thing groups that you choose.

Devices to update

Choose things and/or thing groups

Thing groups

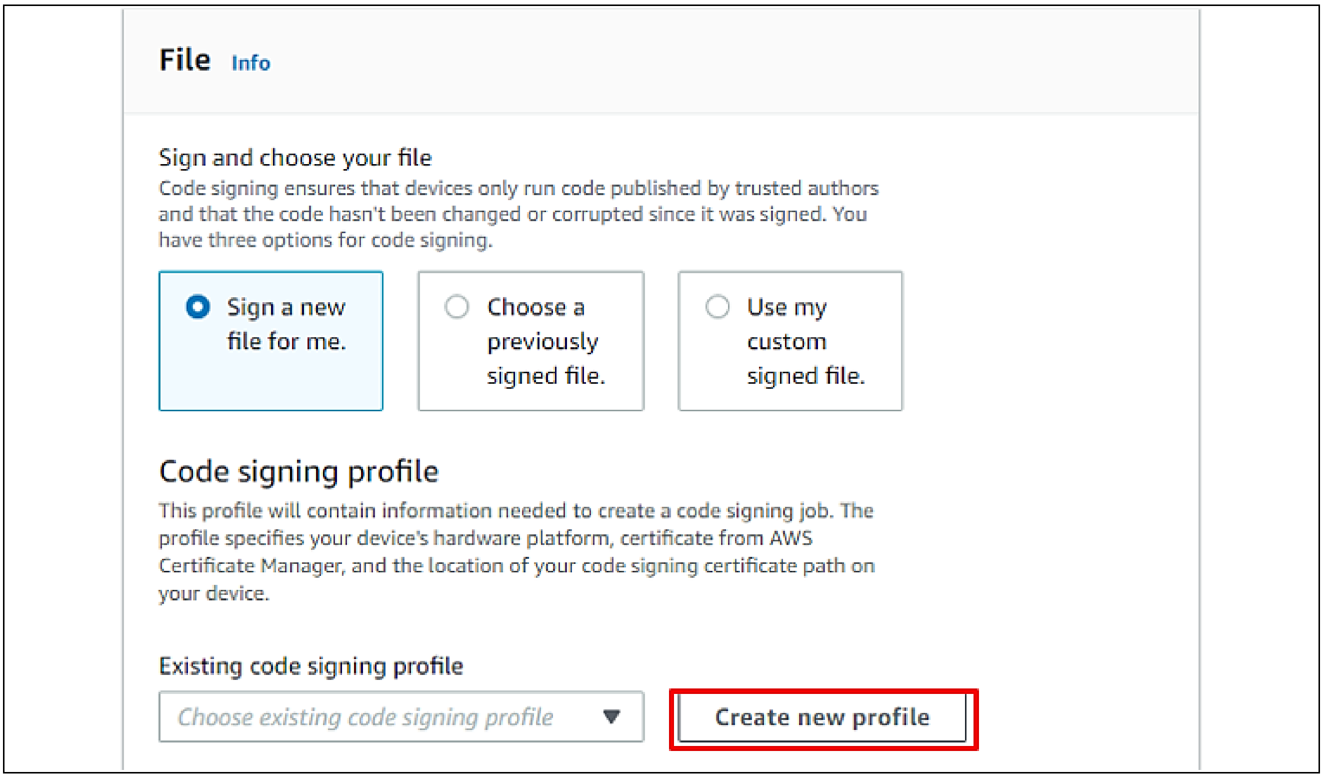
Things

☑ rx65n_ota_demo_thing

Figure 142. Choose Device to Update

6.5.2.5 Creating New Profile

Click **Create new profile**.



File Info

Sign and choose your file

Code signing ensures that devices only run code published by trusted authors and that the code hasn't been changed or corrupted since it was signed. You have three options for code signing.

● Sign a new file for me.

○ Choose a previously signed file.

○ Use my custom signed file.

Code signing profile

This profile will contain information needed to create a code signing job. The profile specifies your device's hardware platform, certificate from AWS Certificate Manager, and the location of your code signing certificate path on your device.

Existing code signing profile

Choose existing code signing profile

Create new profile

Figure 143. Create New Code Signing Profile

You can skip steps **6.5.2.5** to **6.5.2.9** if you have already created a profile. Click **Choose existing code signing profile** and select the profile you created from the drop-down list.

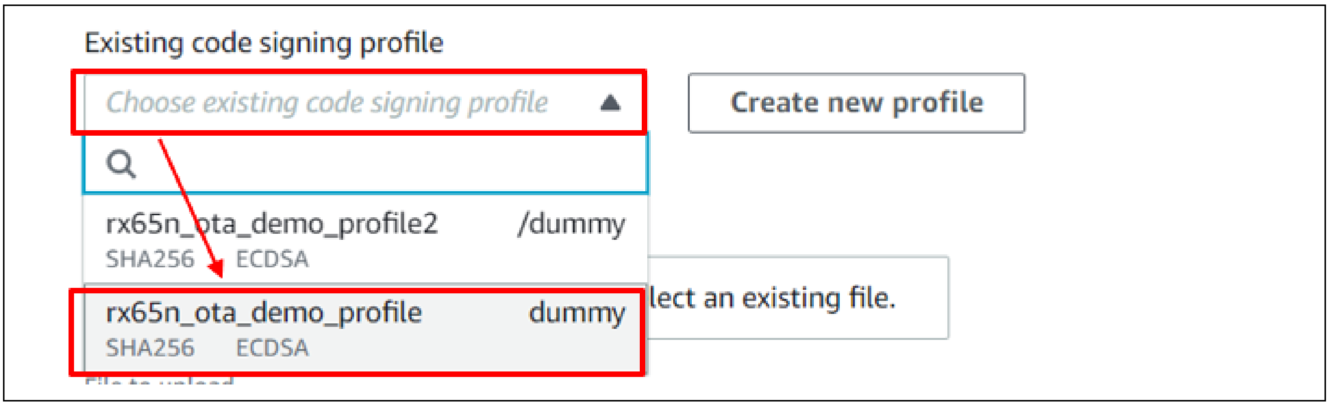
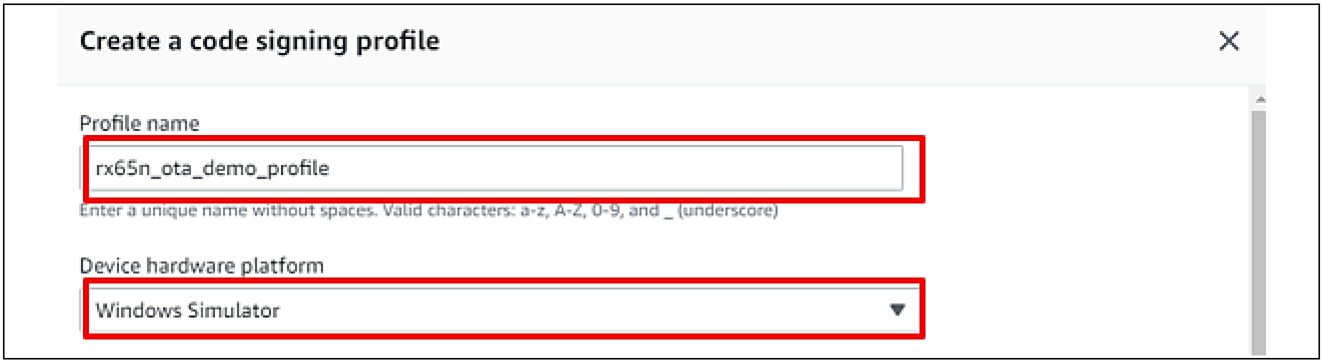

Existing code signing profile
Choose existing code signing profile
Create new profile
rx65n_ota_demo_profile2 /dummy
SHA256 ECDSA
rx65n_ota_demo_profile dummy
SHA256 ECDSA
lect an existing file.

Figure 144. Choose Existing Code Signing Profile

6.5.2.6 Creating a Profile Naming

Create a profile (1): Profile name and device hardware platform:

Enter the profile name (example: rx65n_ota_demo_profile)
Select **Windows Simulator** as the device hardware platform.


Create a code signing profile

Profile name: rx65n_ota_demo_profile

Enter a unique name without spaces. Valid characters: a-z, A-Z, 0-9, and _ (underscore)

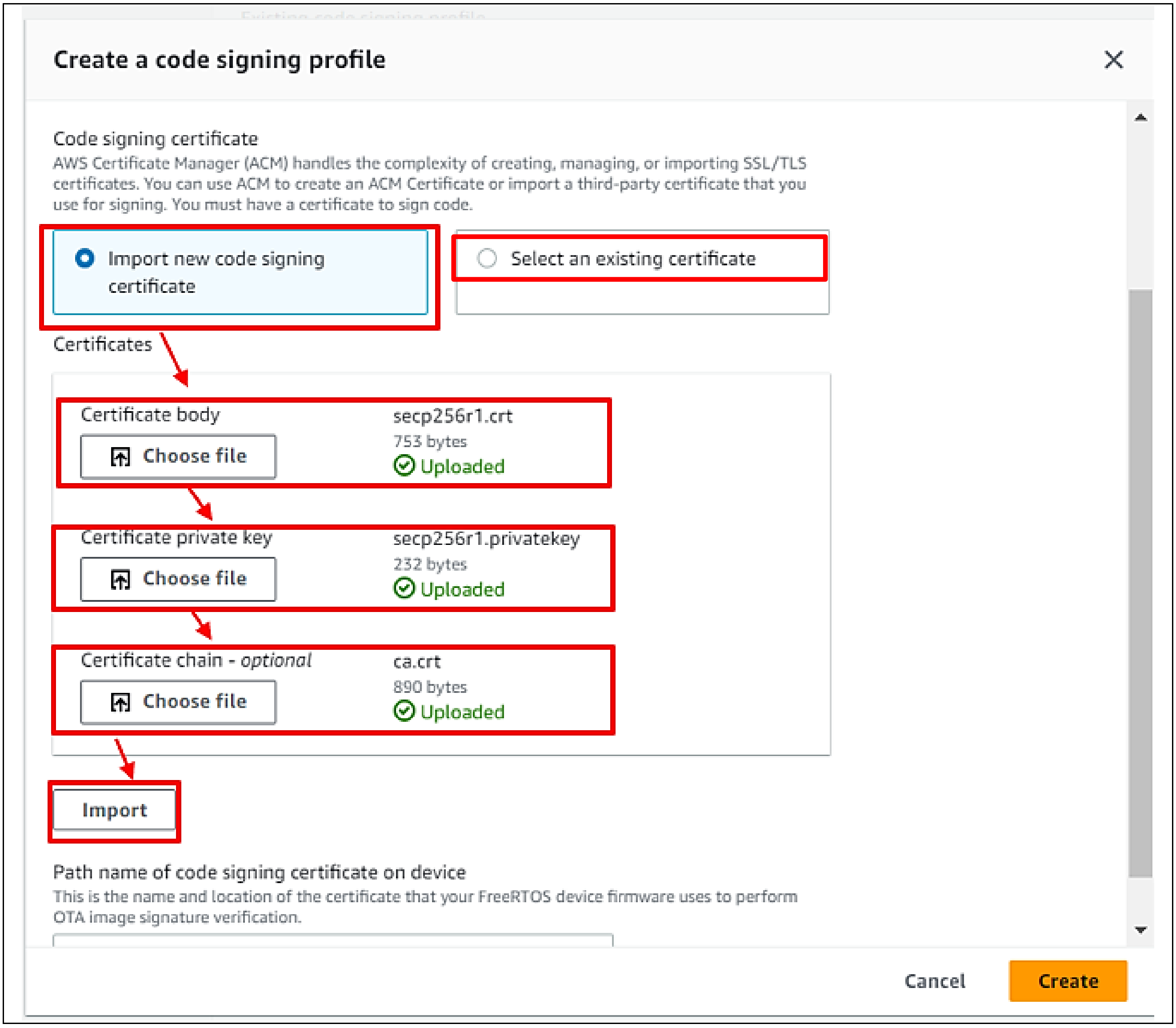
Device hardware platform: Windows Simulator

Figure 145. Create New Code Signing (1/2)

6.5.2.7 Creating a Profile: Importing Certificate

Create a profile (2): Import a certificate.

In the **Code signing certificate** area, click **Import new code signing certificate.**
In **Certificate body**, select the file secp256r1.crt.
In **Certificate private key**, select the file secp256r1.privatekey
In **Certificate chain**, select the file ca.crt.
Note: You have created above files in **6.4**.
> Click **Import**



Create a code signing profile

Code signing certificate
AWS Certificate Manager (ACM) handles the complexity of creating, managing, or importing SSL/TLS certificates. You can use ACM to create an ACM Certificate or import a third-party certificate that you use for signing. You must have a certificate to sign code.

● Import new code signing certificate
○ Select an existing certificate

Certificates

Certificate body: secp256r1.crt, 753 bytes, Uploaded
Certificate private key: secp256r1.privatekey, 232 bytes, Uploaded
Certificate chain - *optional*: ca.crt, 890 bytes, Uploaded

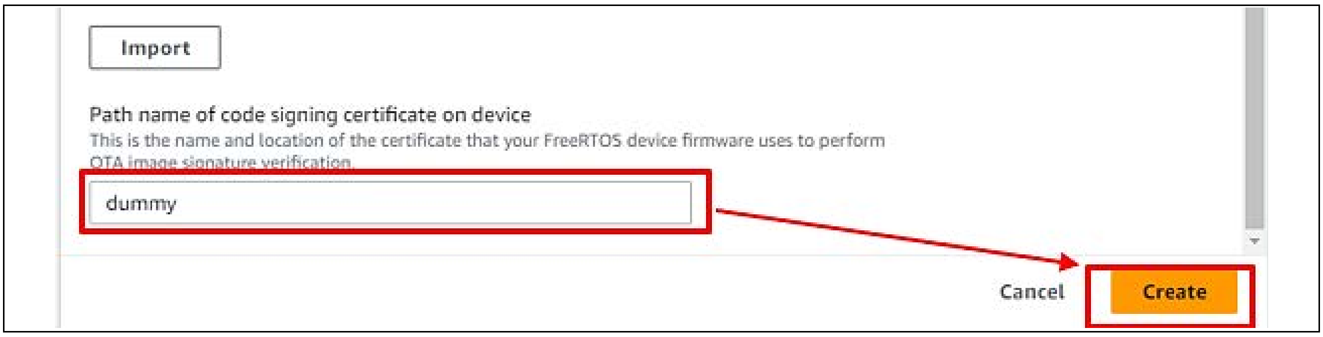
Path name of code signing certificate on device
This is the name and location of the certificate that your FreeRTOS device firmware uses to perform OTA image signature verification.

Figure 146. Create New Code Signing (2/2)

6.5.2.8 Creating a Profile: Entering Path

Create a profile (3): Enter the path of the code signing certificate of the device and then click **Create.**

You can enter any path. (Example: dummy)



Import

Path name of code signing certificate on device

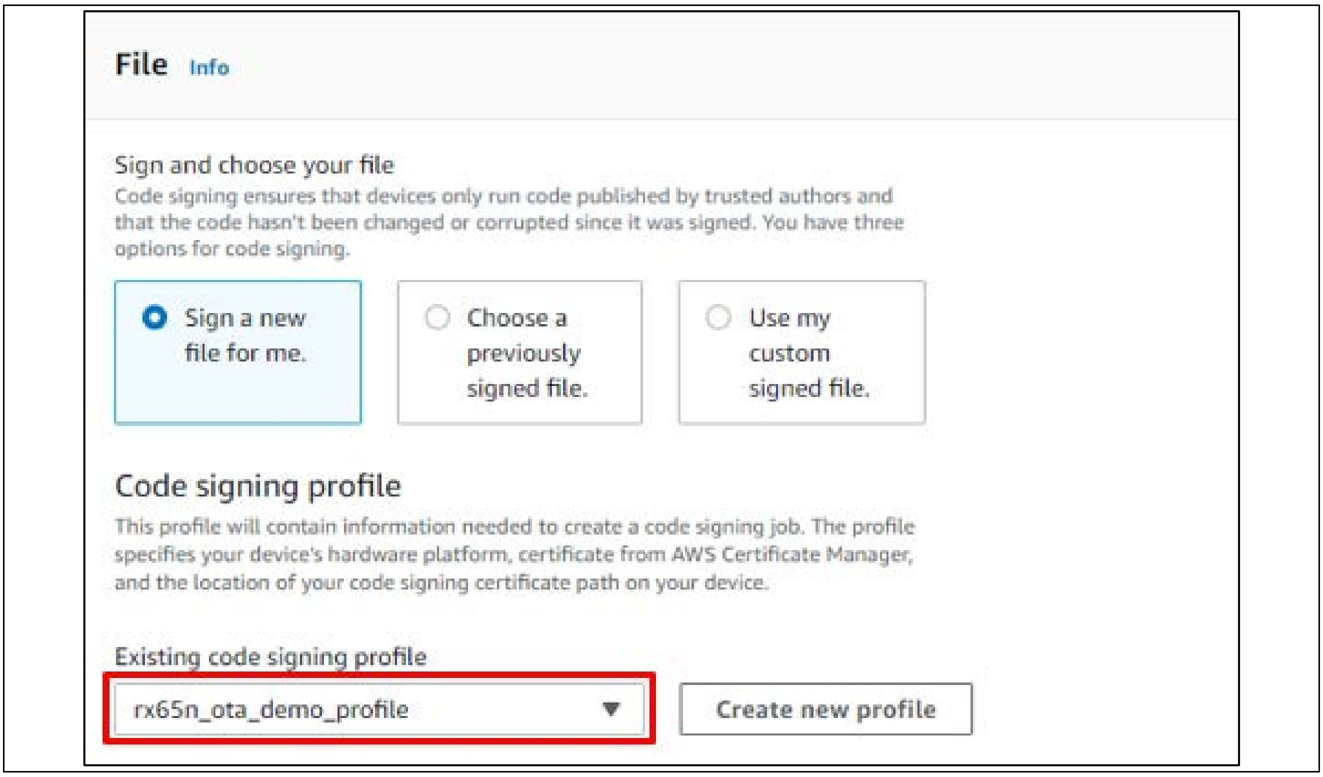
This is the name and location of the certificate that your FreeRTOS device firmware uses to perform OTA image signature verification.

dummy

Figure 147. Enter the Path of the Code Signing Certificate of the Device

6.5.2.9 Confirming Profile Name

Confirm that the name of the profile you created earlier is selected in the Existing code signing profile drop-down list.



File Info

Sign and choose your file

Code signing ensures that devices only run code published by trusted authors and that the code hasn't been changed or corrupted since it was signed. You have three options for code signing.

● Sign a new file for me.

○ Choose a previously signed file.

○ Use my custom signed file.

Code signing profile

This profile will contain information needed to create a code signing job. The profile specifies your device's hardware platform, certificate from AWS Certificate Manager, and the location of your code signing certificate path on your device.

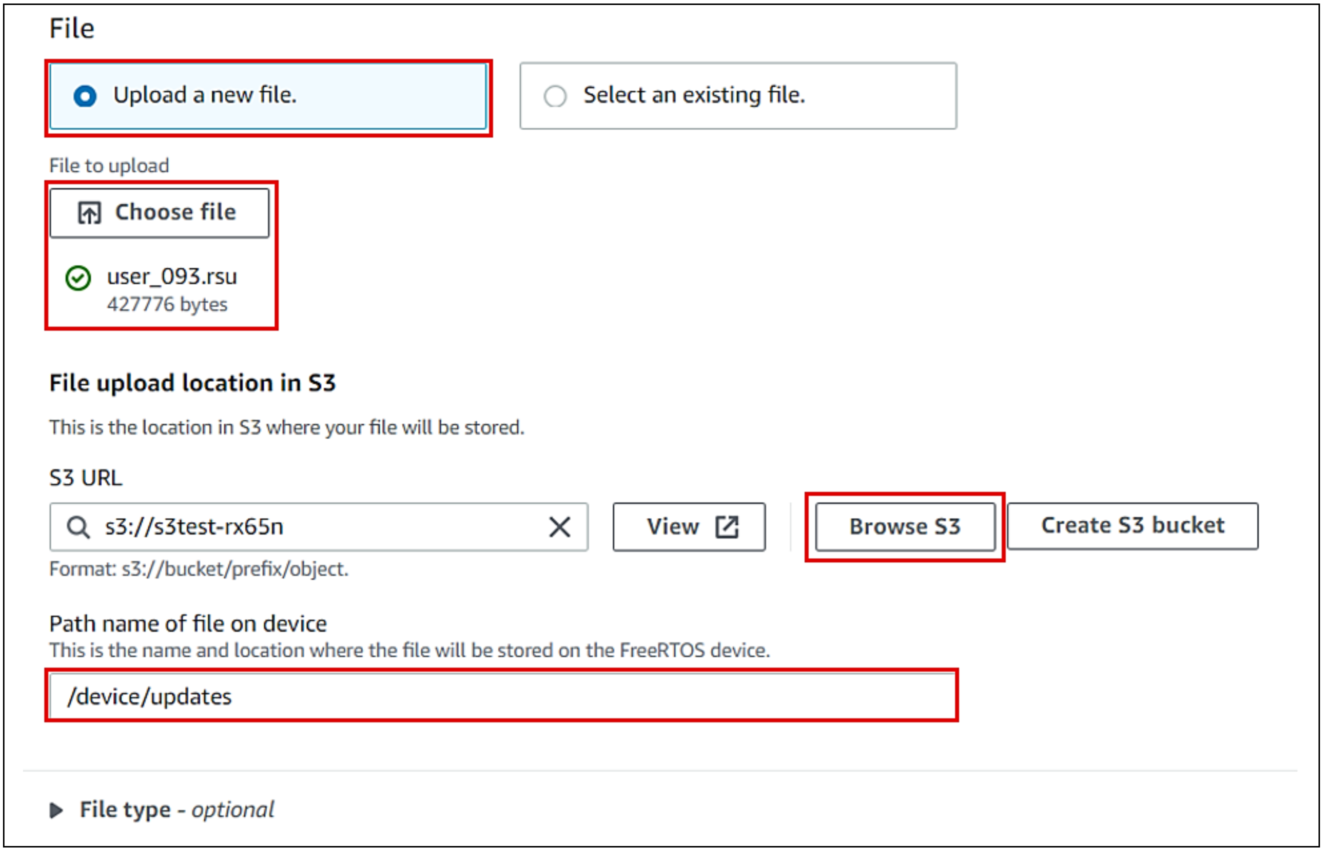
Existing code signing profile

rx65n_ota_demo_profile ▼

Figure 148. Choose Existing Code Signing Profile

6.5.2.10 Updating the Firmware

Select **Upload a new file.**
In **File to upload**, select the file user_093.rsu you created in **6.5.1.2.**
Click **Browse S3** and select the S3 bucket you created in **6.3.**
Enter a path name in **Path name of file on device** (You can enter any path name. Example: /device/updates).



File

● Upload a new file. ○ Select an existing file.

File to upload

Choose file

user_093.rsu
427776 bytes

File upload location in S3

This is the location in S3 where your file will be stored.

S3 URL

s3://s3test-rx65n

View | Browse S3 | Create S3 bucket

Format: s3://bucket/prefix/object.

Path name of file on device
This is the name and location where the file will be stored on the FreeRTOS device.

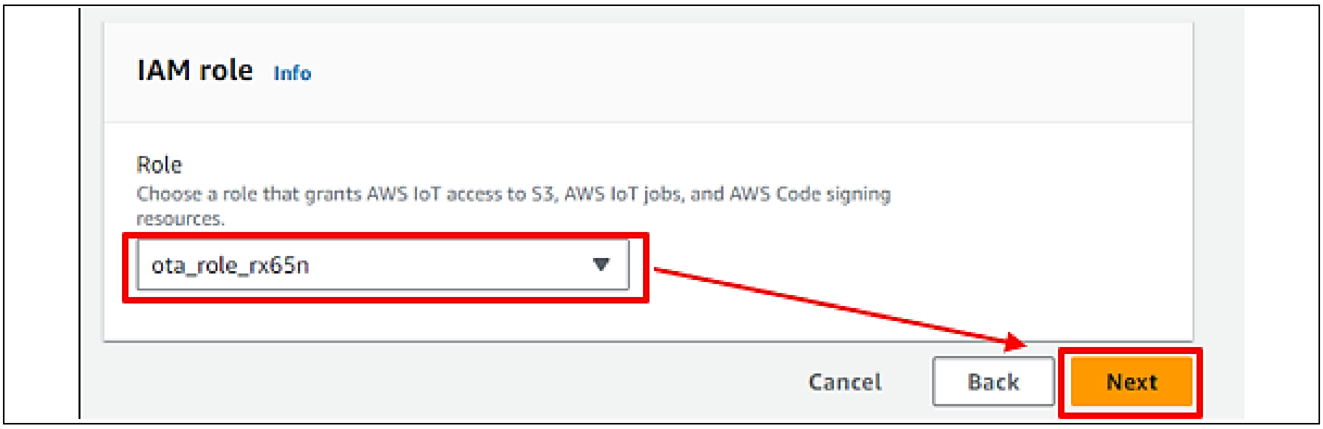
/device/updates

File type - *optional*

Figure 149. Choose Firmware to Update

6.5.2.11 Choosing the Role for the Job

In the Role drop-down list, select the role you created in **6.3** and then click **Next**.



IAM role Info

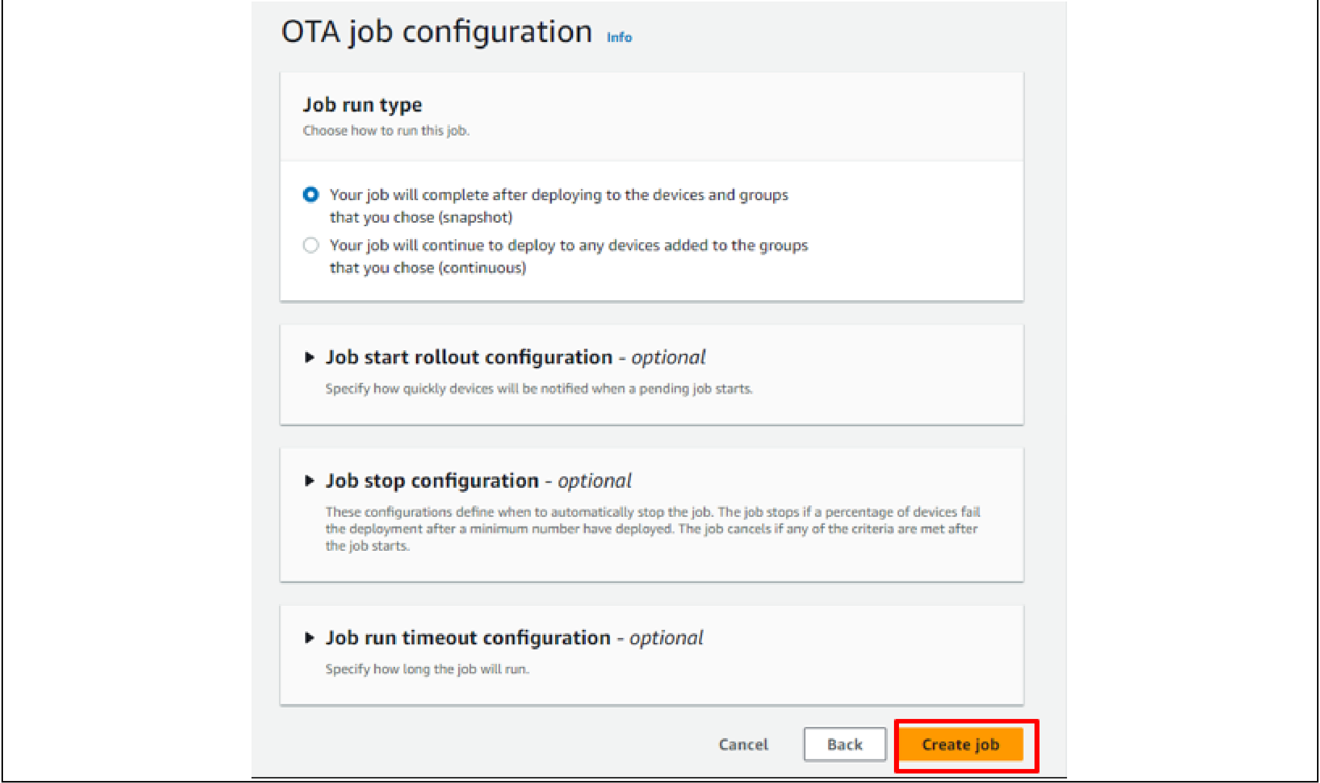
Role
Choose a role that grants AWS IoT access to S3, AWS IoT jobs, and AWS Code signing resources.

ota_role_rx65n

Cancel | Back | Next

Figure 150. Choose Role for Creating Job

Click **Create job**.



OTA job configuration Info

Job run type

Choose how to run this job.

● Your job will complete after deploying to the devices and groups that you chose (snapshot)

○ Your job will continue to deploy to any devices added to the groups that you chose (continuous)

▸ **Job start rollout configuration** - *optional*

Specify how quickly devices will be notified when a pending job starts.

▸ **Job stop configuration** - *optional*

These configurations define when to automatically stop the job. The job stops if a percentage of devices fail the deployment after a minimum number have deployed. The job cancels if any of the criteria are met after the job starts.

▸ **Job run timeout configuration** - *optional*

Specify how long the job will run.

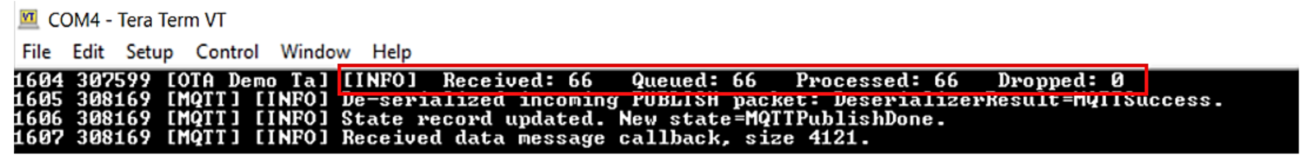
Figure 151. Create Job

6.5.2.12 Waiting until Firmware Reception is Complete

Wait until firmware reception is complete.

When the job starts, the job receives and writes the firmware.

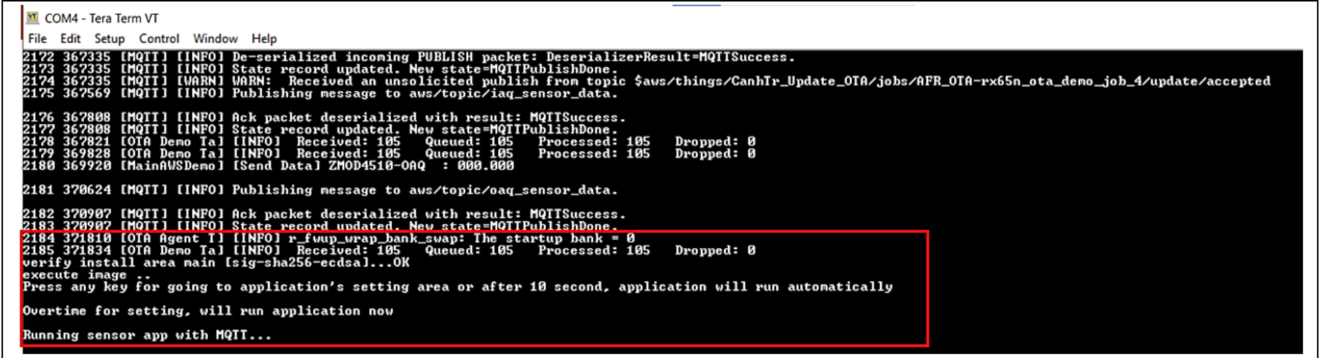
The Received counter is incremented when reception starts.



```
1604 307599 [OTA Demo Ta] [INFO]  Received: 66   Queued: 66   Processed: 66   Dropped: 0
1605 308169 [MQTT] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
1606 308169 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
1607 308169 [MQTT] [INFO] Received data message callback, size 4121.
```

Figure 152. OTA Job is Processed

When the update process is complete, the device resets and the initial menu appears.

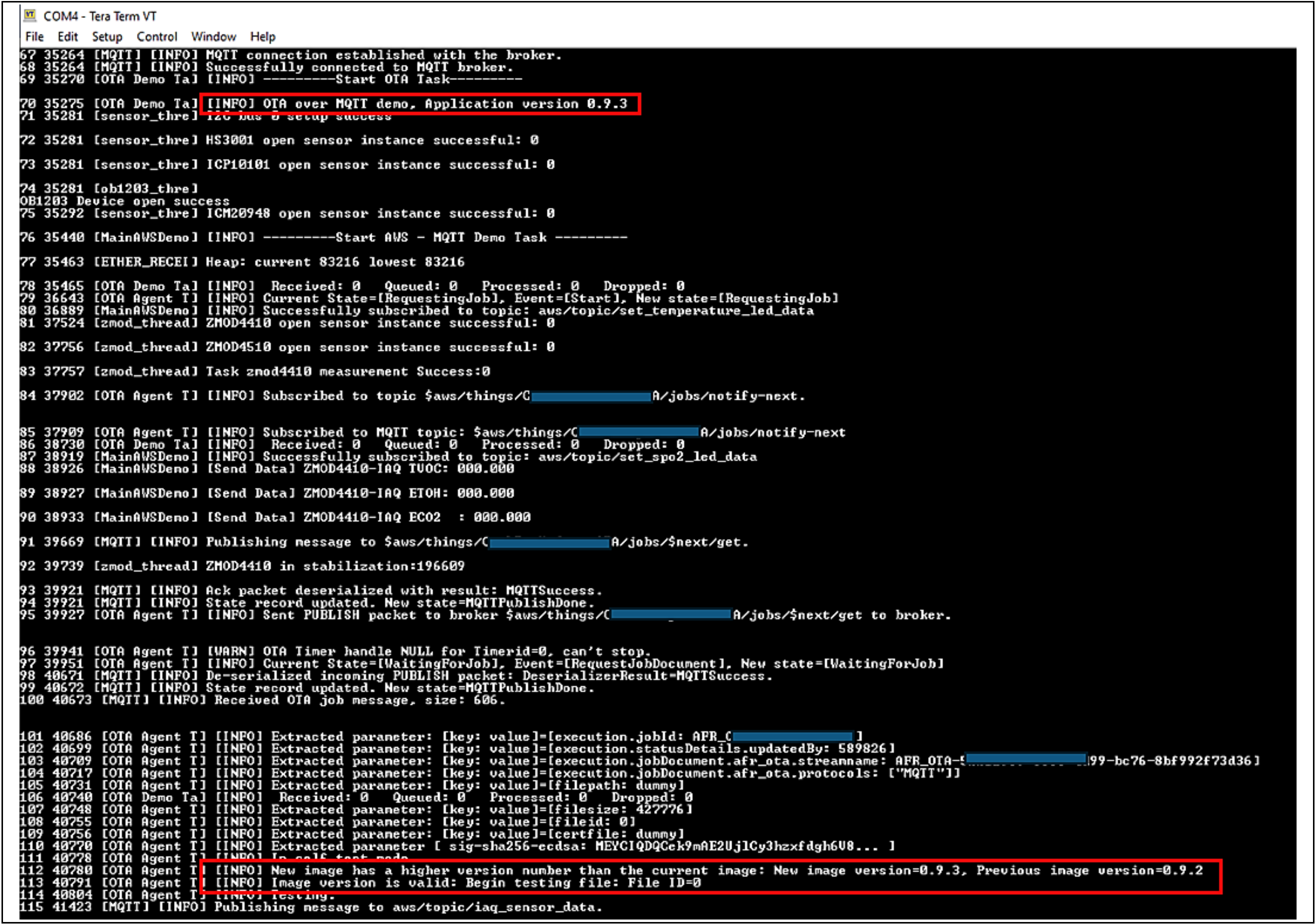


```
2172 367335 [MQTT] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
2173 367335 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
2174 367335 [MQTT] [WARN] WARN:  Received an unsolicited publish from topic $aws/things/CanhTr_Update_OTA/jobs/AFR_OTA-rx65n_ota_demo_job_4/update/accepted
2175 367569 [MQTT] [INFO] Publishing message to aws/topic/iaq_sensor_data.

2176 367808 [MQTT] [INFO] Ack packet deserialized with result: MQTTSuccess.
2177 367808 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
2178 367821 [OTA Demo Ta] [INFO]  Received: 105   Queued: 105   Processed: 105   Dropped: 0
2179 369828 [OTA Demo Ta] [INFO]  Received: 105   Queued: 105   Processed: 105   Dropped: 0
2180 369920 [MainAWSDemo] [Send Data] ZMOD4510-OAQ  : 000.000

2181 370624 [MQTT] [INFO] Publishing message to aws/topic/oaq_sensor_data.

2182 370907 [MQTT] [INFO] Ack packet deserialized with result: MQTTSuccess.
2183 370907 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
2184 371810 [OTA Agent T] [INFO] r_fwup_wrap_bank_swap: The startup bank = 0
2185 371834 [OTA Demo Ta] [INFO]  Received: 105   Queued: 105   Processed: 105   Dropped: 0
verify install area main [sig-sha256-ecdsa]...OK
execute image ..
Press any key for going to application's setting area or after 10 second, application will run automatically

Overtime for setting, will run application now

Running sensor app with MQTT...
```

Figure 153. Device Reset and Update New Firmware

6.5.2.13 Confirming that the Firmware Version is a New Version

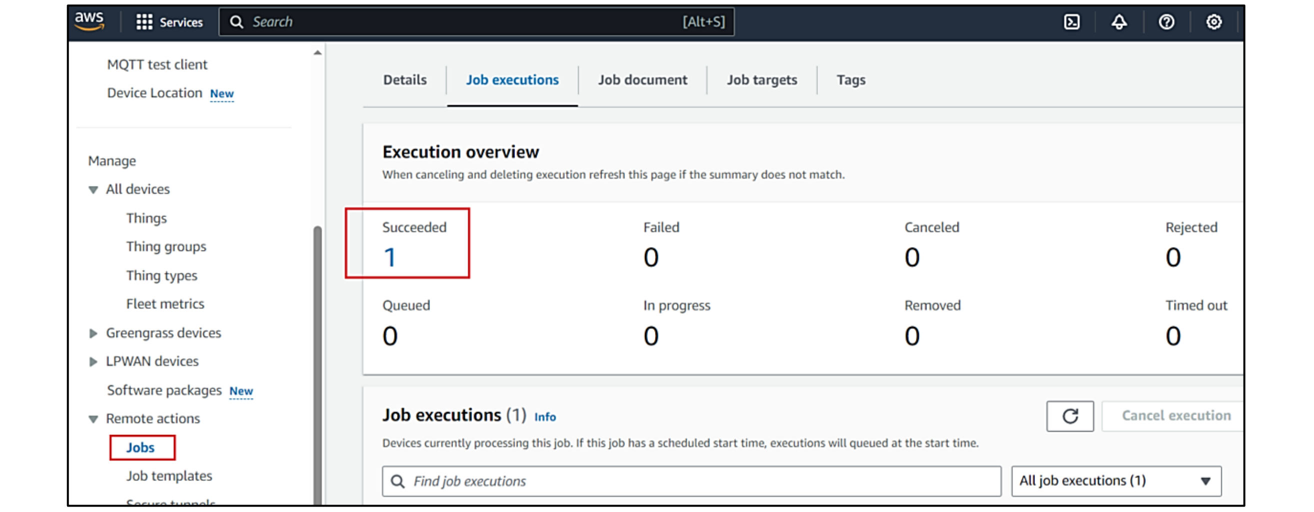
Example: 0.9.3 (updated at **6.5.1.1**)



```
67 35264 [MQTT] [INFO] MQTT connection established with the broker.
68 35264 [MQTT] [INFO] Successfully connected to MQTT broker.
69 35270 [OTA Demo Ta] [INFO] ---------Start OTA Task---------

70 35275 [OTA Demo Ta] [INFO] OTA over MQTT demo, Application version 0.9.3
71 35281 [sensor_thre] I2C bus 0 setup success

72 35281 [sensor_thre] HS3001 open sensor instance successful: 0

73 35281 [sensor_thre] ICP10101 open sensor instance successful: 0

74 35281 [ob1203_thre]
OB1203 Device open success
75 35292 [sensor_thre] ICM20948 open sensor instance successful: 0

76 35440 [MainAWSDemo] [INFO] ---------Start AWS - MQTT Demo Task ---------

77 35463 [ETHER_RECEI] Heap: current 83216 lowest 83216

78 35465 [OTA Demo Ta] [INFO]  Received: 0   Queued: 0   Processed: 0   Dropped: 0
79 36643 [OTA Agent T] [INFO] Current State=[RequestingJob], Event=[Start], New state=[RequestingJob]
80 36889 [MainAWSDemo] [INFO] Successfully subscribed to topic: aws/topic/set_temperature_led_data
81 37524 [zmod_thread] ZMOD4410 open sensor instance successful: 0

82 37756 [zmod_thread] ZMOD4510 open sensor instance successful: 0

83 37757 [zmod_thread] Task zmod4410 measurement Success:0

84 37902 [OTA Agent T] [INFO] Subscribed to topic $aws/things/C[redacted]A/jobs/notify-next.


85 37909 [OTA Agent T] [INFO] Subscribed to MQTT topic: $aws/things/C[redacted]A/jobs/notify-next
86 38730 [OTA Demo Ta] [INFO]  Received: 0   Queued: 0   Processed: 0   Dropped: 0
87 38919 [MainAWSDemo] [INFO] Successfully subscribed to topic: aws/topic/set_spo2_led_data
88 38926 [MainAWSDemo] [Send Data] ZMOD4410-IAQ TVOC: 000.000

89 38927 [MainAWSDemo] [Send Data] ZMOD4410-IAQ ETOH: 000.000

90 38933 [MainAWSDemo] [Send Data] ZMOD4410-IAQ ECO2  : 000.000

91 39669 [MQTT] [INFO] Publishing message to $aws/things/C[redacted]A/jobs/$next/get.

92 39739 [zmod_thread] ZMOD4410 in stabilization:196609

93 39921 [MQTT] [INFO] Ack packet deserialized with result: MQTTSuccess.
94 39921 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
95 39927 [OTA Agent T] [INFO] Sent PUBLISH packet to broker $aws/things/C[redacted]A/jobs/$next/get to broker.


96 39941 [OTA Agent T] [WARN] OTA Timer handle NULL for Timerid=0, can't stop.
97 39951 [OTA Agent T] [INFO] Current State=[WaitingForJob], Event=[RequestJobDocument], New state=[WaitingForJob]
98 40671 [MQTT] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
99 40672 [MQTT] [INFO] State record updated. New state=MQTTPublishDone.
100 40673 [MQTT] [INFO] Received OTA job message, size: 606.


101 40686 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[execution.jobId: AFR_C[redacted]]
102 40699 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[execution.statusDetails.updatedBy: 589826]
103 40709 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[execution.jobDocument.afr_ota.streamname: AFR_OTA-[redacted]99-bc76-8bf992f73d36]
104 40717 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[execution.jobDocument.afr_ota.protocols: ["MQTT"]]
105 40731 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[filepath: dummy]
106 40740 [OTA Demo Ta] [INFO]  Received: 0   Queued: 0   Processed: 0   Dropped: 0
107 40748 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[filesize: 427776]
108 40755 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[fileid: 0]
109 40756 [OTA Agent T] [INFO] Extracted parameter: [key: value]=[certfile: dummy]
110 40770 [OTA Agent T] [INFO] Extracted parameter [ sig-sha256-ecdsa: MEYCIQDQCek9mAE2UjlCy3hzxfdgh6V8... ]
111 40778 [OTA Agent T] [INFO] In self test mode.
112 40780 [OTA Agent T] [INFO] New image has a higher version number than the current image: New image version=0.9.3, Previous image version=0.9.2
113 40791 [OTA Agent T] [INFO] Image version is valid: Begin testing file: File ID=0
114 40804 [OTA Agent T] [INFO] Testing.
115 41423 [MQTT] [INFO] Publishing message to aws/topic/iaq_sensor_data.
```

Figure 154. Firmware with New Version is Updated

When OTA updated firmware successfully, status will be “Succeeded” like below:



Execution overview

When canceling and deleting execution refresh this page if the summary does not match.

Succeeded	Failed	Canceled	Rejected
1	0	0	0
Queued	In progress	Removed	Timed out
0	0	0	0

Job executions (1)

Devices currently processing this job. If this job has a scheduled start time, executions will queued at the start time.

Figure 155. Job’s Status in AWS Portal

7. Fleet Provisioning

7.1 Overview Fleet Provisioning

This section describes the steps on using Fleet Provisioning in these applications.

Fleet provisioning is a procedure in which provisioning takes place when each IoT device is started for the first time.

Generally speaking, it can be implemented in either of the following two ways.

1. Provisioning by claim (approach using provisioning claim certificates)

2. Provisioning by trusted user (mobile or web app user, etc.)

In addition, either of the following two procedures can be used to obtain the individual certificates and private keys used for fleet provisioning.

A) Having the AWS certification authority generate a new individual certificate and private key and send it to the device (CreateKeysAndCertificate).

B) Generating a key pair on the device internally and sending a certificate signature request (CSR) to AWS to have them generate only an individual certificate and send it to the device (CreateCertificateFromCsr).

This document describes the implementation of a fleet provisioning that combines 1. and B).

Advantages

- The device's private key never leaves the device.
- There is no need to establish a connection between the manufacturing plant and AWS IoT.
- There is no need to put in place a structure for issuing individual certificates or registering devices.

On the other hand, it also has the following disadvantages. It is necessary to be aware of both the advantages and the disadvantages when using this provisioning method.

Disadvantages

- It is necessary to take into account the possibility that the provisioning claim certificate could leak to an unauthorized party.
- It is necessary to implement functionality on the device to issue a provisioning request and receive a response.

For details about Fleet Provisioning, please refer to chapters 3 and 4 of the AN: RX Family Provisioning Procedure for IoT Devices Rev.1.00 (renesas.com) (Demo application for Cellular + Ethernet).

7.2 Setting up AWS for Fleet Provisioning

It is necessary to configure AWS settings in order to run the fleet provisioning demo.

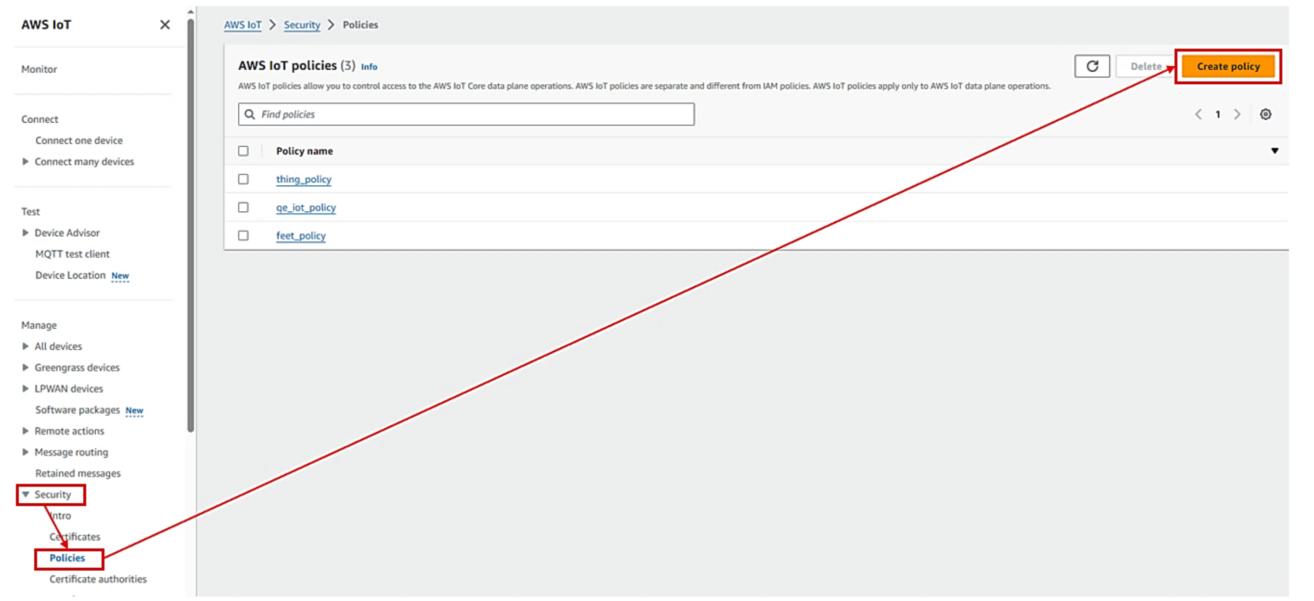
1. Policy settings

2. Generating a claim certificate and claim key pair

3. Creating a fleet provisioning template

7.2.1 Policy Settings

Follow the steps below to create AWS IoT Core policies. The first policy you create will be used when fleet provisioning is run.



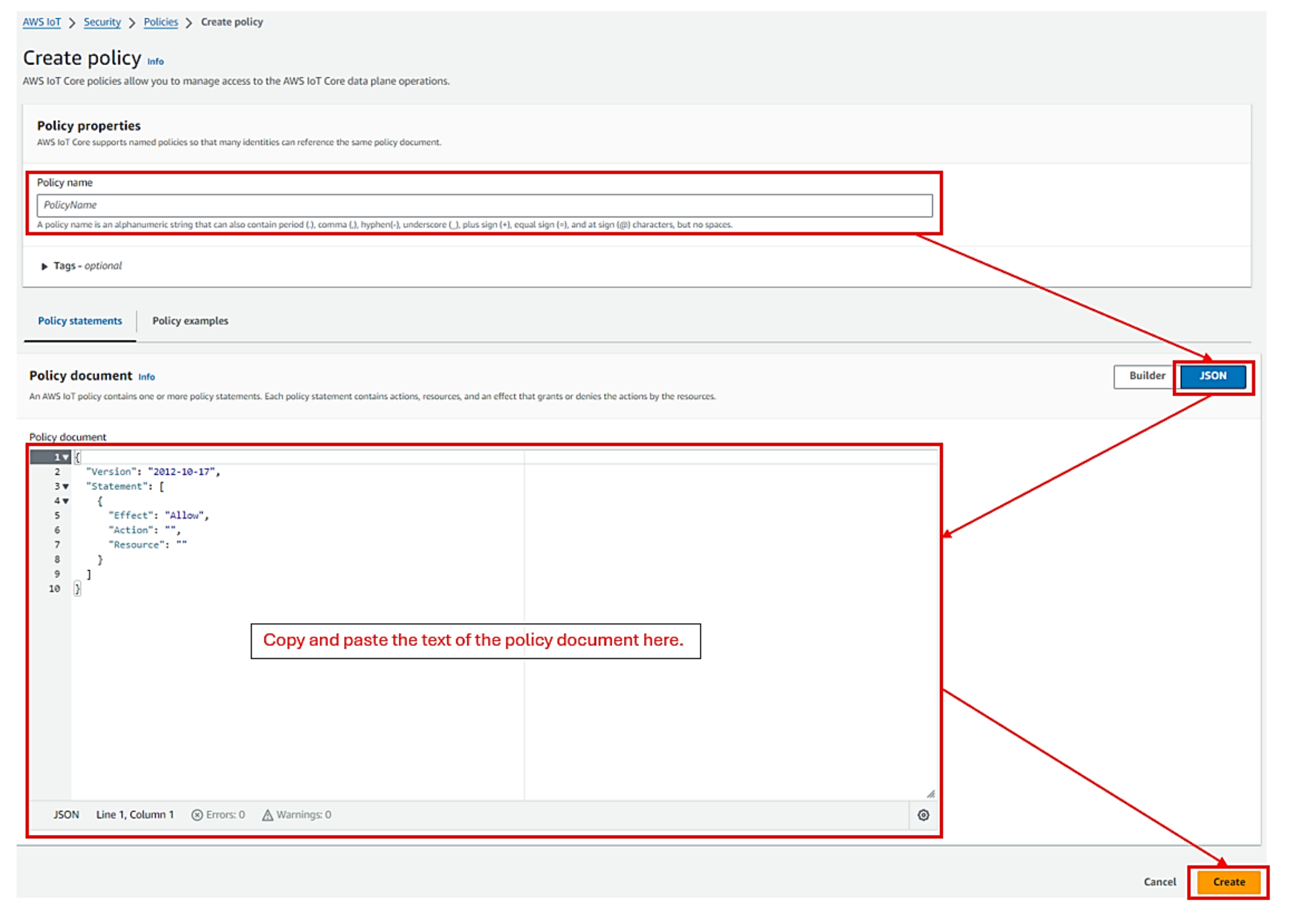
AWS IoT policies (3)

AWS IoT policies allow you to control access to the AWS IoT Core data plane operations. AWS IoT policies are separate and different from IAM policies. AWS IoT policies apply only to AWS IoT data plane operations.

Policy name
thing_policy
qe_iot_policy
feet_policy

Figure 156. Creating an AWS IoT Policy (1/2)

In the Policy name field, enter the policy name of your choice.



Create policy

AWS IoT Core policies allow you to manage access to the AWS IoT Core data plane operations.

Policy properties

AWS IoT Core supports named policies so that many identities can reference the same policy document.

Policy name: PolicyName

A policy name is an alphanumeric string that can also contain period (.), comma (,), hyphen(-), underscore (_), plus sign (+), equal sign (=), and at sign (@) characters, but no spaces.

Policy document

An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.

Policy document

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

Copy and paste the text of the policy document here.

Figure 157. Creating an AWS IoT Policy (2/2)

Click the JSON button to display the policy document input field, then copy and paste the policy document shown in **Table 11. Policy Document** into the input field. When copying and pasting the policy document in **Table 11. Policy Document**, make the following changes:

・Change “us-east-1” to match the region used.

・Change <account id> to your own account ID (account ID is the 12-digit number after @ that is displayed by clicking on the account name in the upper right corner, excluding the hyphen)

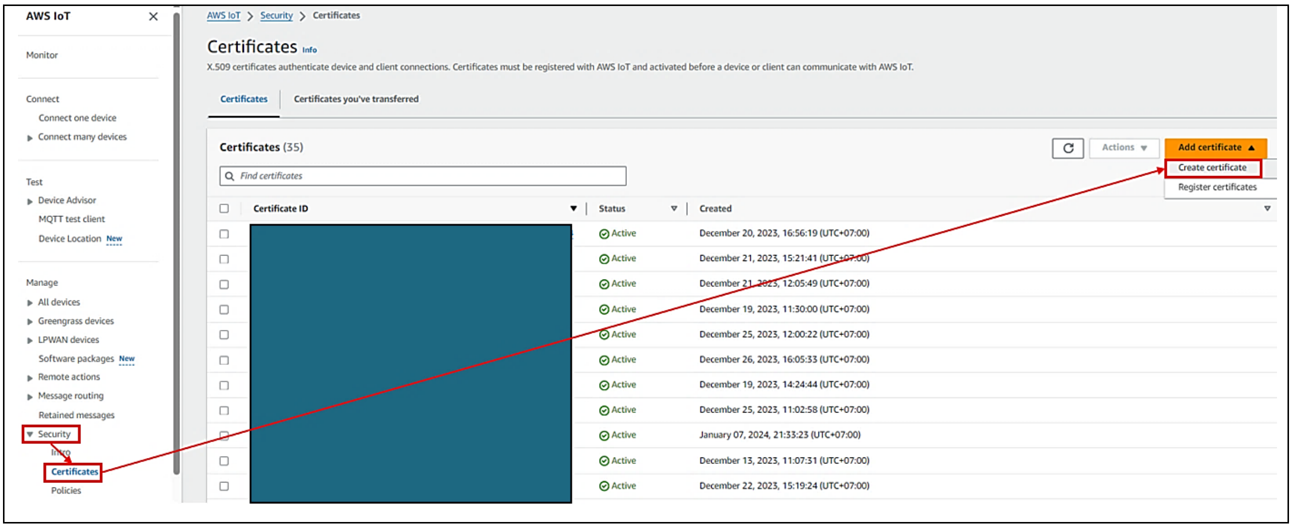
Table 11. Policy Document

```
{
  “Version”: “2012-10-17”,
  “Statement”: [
    {
      “Effect”: “Allow”,
      “Action”: “iot:Connect”,
      “Resource”: “*”
    },
    {
      “Effect”: “Allow”,
      “Action”: [
        “iot:Publish”,
        “iot:Receive”,
        “iot:RetainPublish”
      ],
      “Resource”: [
        “arn:aws:iot:us-east-1:<account id>:topic/$aws/certificates/create-from-csr/*”,
        “arn:aws:iot:us-east-1:<account id>:*”
      ]
    },
    {
      “Effect”: “Allow”,
      “Action”: “iot:Subscribe”,
      “Resource”: [
        “arn:aws:iot:us-east-1:<account id>:topicfilter/$aws/certificates/create-from-csr/*”,
        “arn:aws:iot:us-east-1:<account id>:*”
      ]
    }
  ]
}
```

7.2.2 Generating a Claim Certificate and Claim Key Pair

Generate a provisioning claim certificate and provisioning claim key pair for use in fleet provisioning.

Select **Security** → **Certificates** and then click **Add certificate** → **Create certificate**.



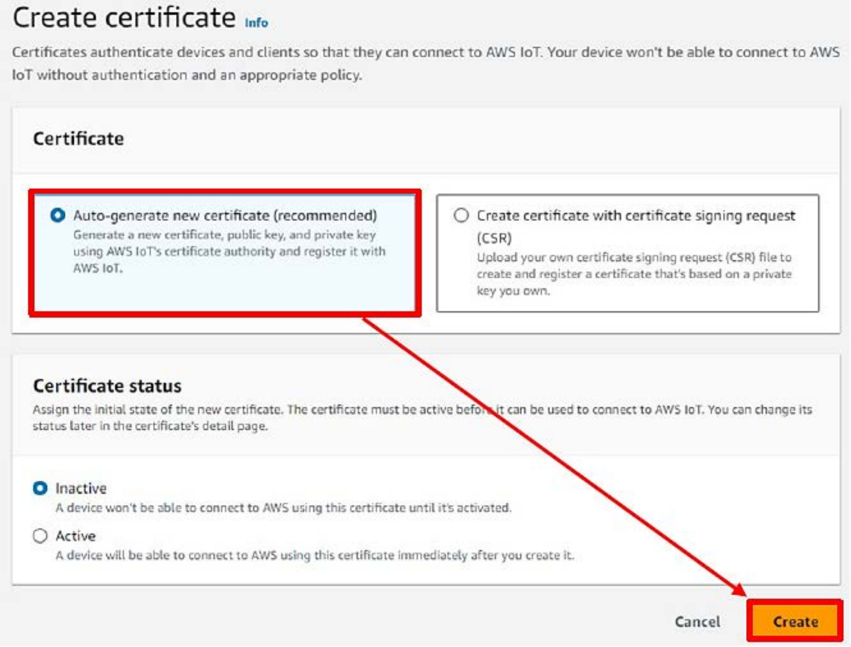
Certificates

X.509 certificates authenticate device and client connections. Certificates must be registered with AWS IoT and activated before a device or client can communicate with AWS IoT.

Certificates (35)

□	Certificate ID	Status	Created
□	[redacted]	Active	December 20, 2023, 16:56:19 (UTC+07:00)
□	[redacted]	Active	December 21, 2023, 15:21:41 (UTC+07:00)
□	[redacted]	Active	December 21, 2023, 12:05:49 (UTC+07:00)
□	[redacted]	Active	December 19, 2023, 11:30:00 (UTC+07:00)
□	[redacted]	Active	December 25, 2023, 12:00:22 (UTC+07:00)
□	[redacted]	Active	December 26, 2023, 16:05:33 (UTC+07:00)
□	[redacted]	Active	December 19, 2023, 14:24:44 (UTC+07:00)
□	[redacted]	Active	December 25, 2023, 11:02:58 (UTC+07:00)
□	[redacted]	Active	January 07, 2024, 21:33:23 (UTC+07:00)
□	[redacted]	Active	December 13, 2023, 11:07:31 (UTC+07:00)
□	[redacted]	Active	December 22, 2023, 15:19:24 (UTC+07:00)

Figure 158. Create a Certificate



Create certificate Info

Certificates authenticate devices and clients so that they can connect to AWS IoT. Your device won't be able to connect to AWS IoT without authentication and an appropriate policy.

Certificate

● Auto-generate new certificate (recommended)
Generate a new certificate, public key, and private key using AWS IoT's certificate authority and register it with AWS IoT.

○ Create certificate with certificate signing request (CSR)
Upload your own certificate signing request (CSR) file to create and register a certificate that's based on a private key you own.

Certificate status

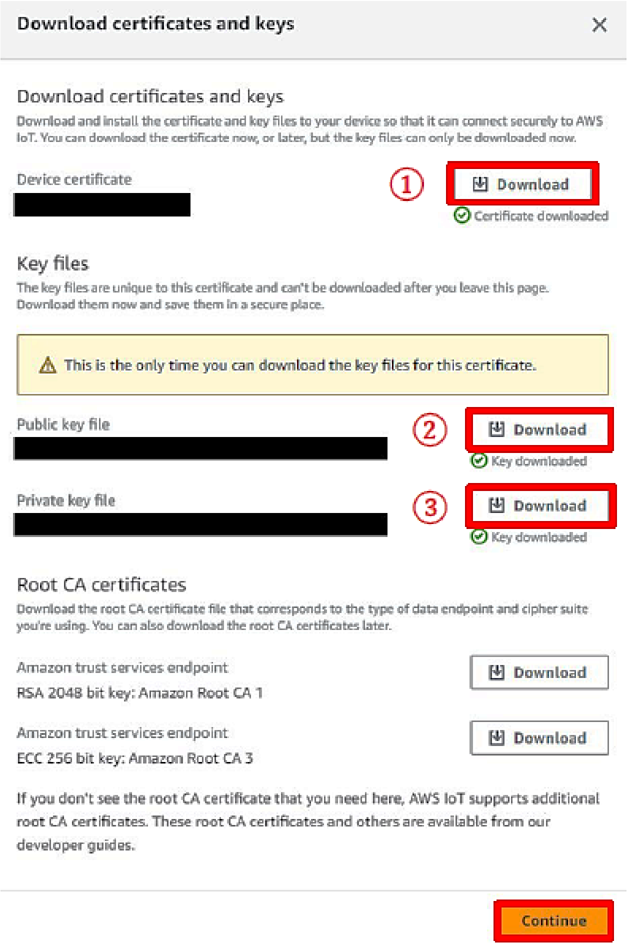
Assign the initial state of the new certificate. The certificate must be active before it can be used to connect to AWS IoT. You can change its status later in the certificate's detail page.

● Inactive
A device won't be able to connect to AWS using this certificate until it's activated.

○ Active
A device will be able to connect to AWS using this certificate immediately after you create it.

Figure 159. Creating a Certificate Automatically

Download the newly created certificate ① and key pair ②③, then click the **Continue** button.



Download certificates and keys

Download certificates and keys

Download and install the certificate and key files to your device so that it can connect securely to AWS IoT. You can download the certificate now, or later, but the key files can only be downloaded now.

Device certificate
[redacted]

Key files

The key files are unique to this certificate and can't be downloaded after you leave this page. Download them now and save them in a secure place.

⚠ This is the only time you can download the key files for this certificate.

Public key file
[redacted]

Private key file
[redacted]

Root CA certificates

Download the root CA certificate file that corresponds to the type of data endpoint and cipher suite you're using. You can also download the root CA certificates later.

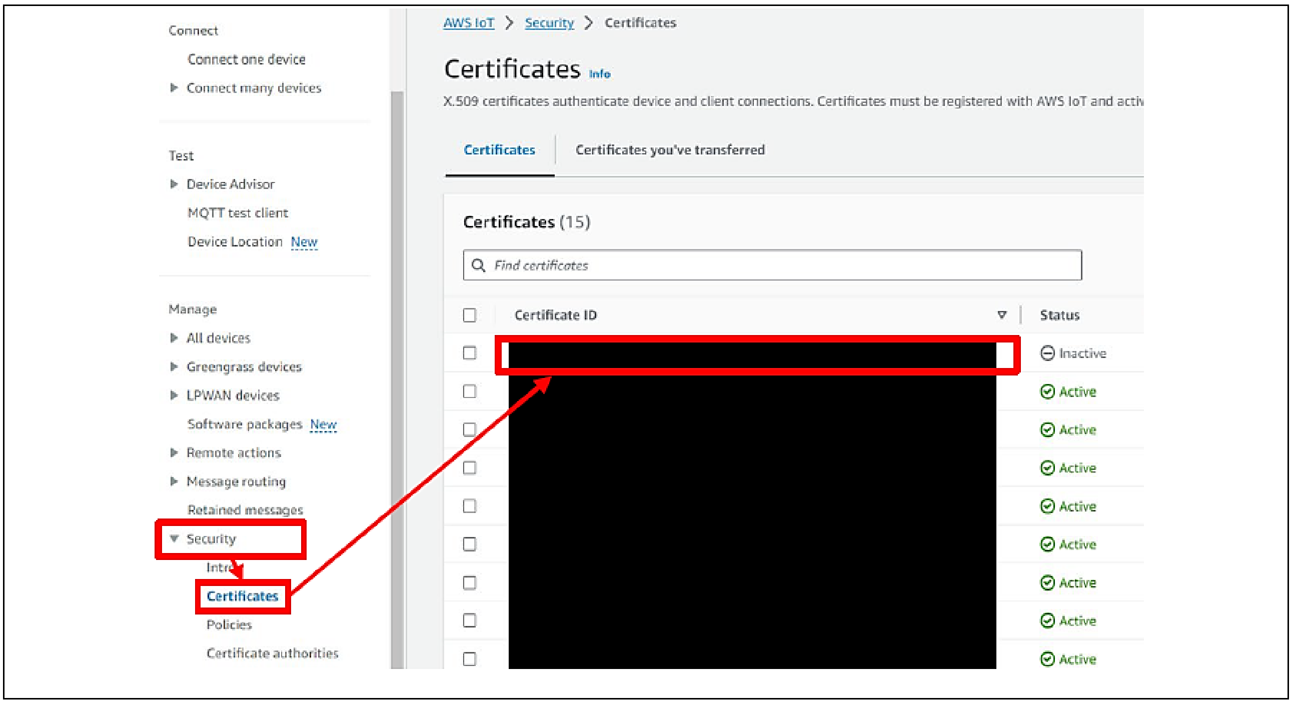
Amazon trust services endpoint
RSA 2048 bit key: Amazon Root CA 1

Amazon trust services endpoint
ECC 256 bit key: Amazon Root CA 3

If you don't see the root CA certificate that you need here, AWS IoT supports additional root CA certificates. These root CA certificates and others are available from our developer guides.

Figure 160. Downloading the Certificate and Key Pair

On the AWS console, select **Security** → **Certificates** and select the newly generated certificate ID.



Certificates Info

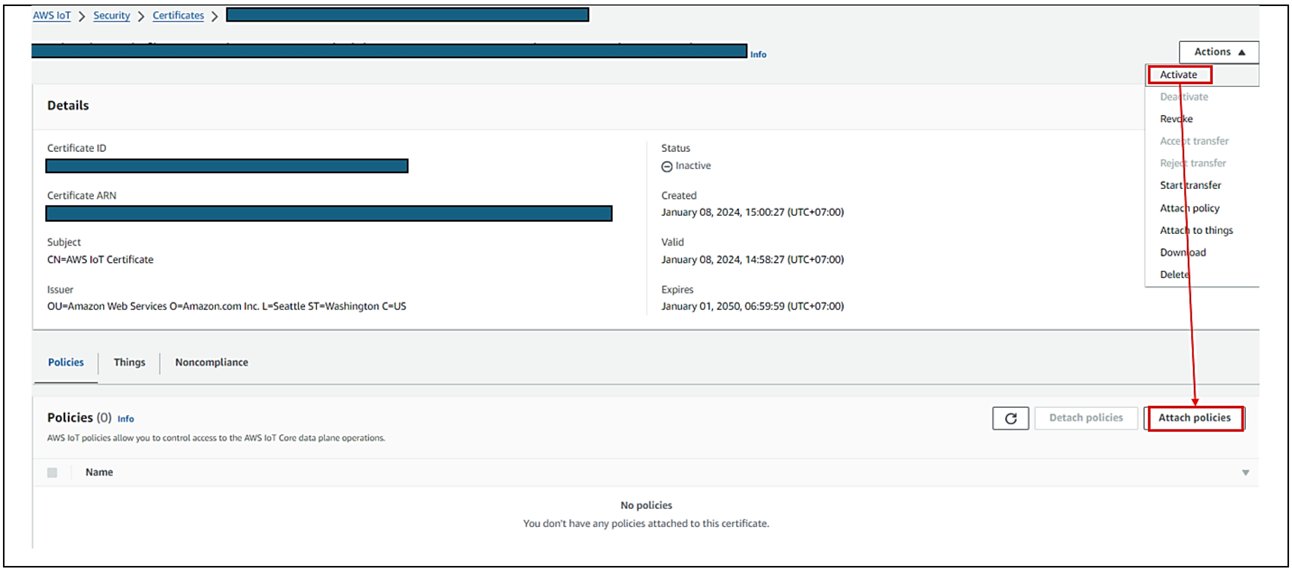
X.509 certificates authenticate device and client connections. Certificates must be registered with AWS IoT and activ

Certificates (15)

☐	Certificate ID	Status
☐	[redacted]	Inactive
☐	[redacted]	Active
☐	[redacted]	Active
☐	[redacted]	Active
☐	[redacted]	Active
☐	[redacted]	Active
☐	[redacted]	Active
☐	[redacted]	Active
☐	[redacted]	Active

Figure 161. Certificate Settings

Click **Actions** → **Activate** to activate the certificate. Also click the **Attach policies** button.



[redacted]

Details

Certificate ID
[redacted]

Certificate ARN
[redacted]

Subject
CN=AWS IoT Certificate

Issuer
OU=Amazon Web Services O=Amazon.com Inc. L=Seattle ST=Washington C=US

Status
Inactive

Created
January 08, 2024, 15:00:27 (UTC+07:00)

Valid
January 08, 2024, 14:58:27 (UTC+07:00)

Expires
January 01, 2050, 06:59:59 (UTC+07:00)

Policies (0) Info

AWS IoT policies allow you to control access to the AWS IoT Core data plane operations.

No policies

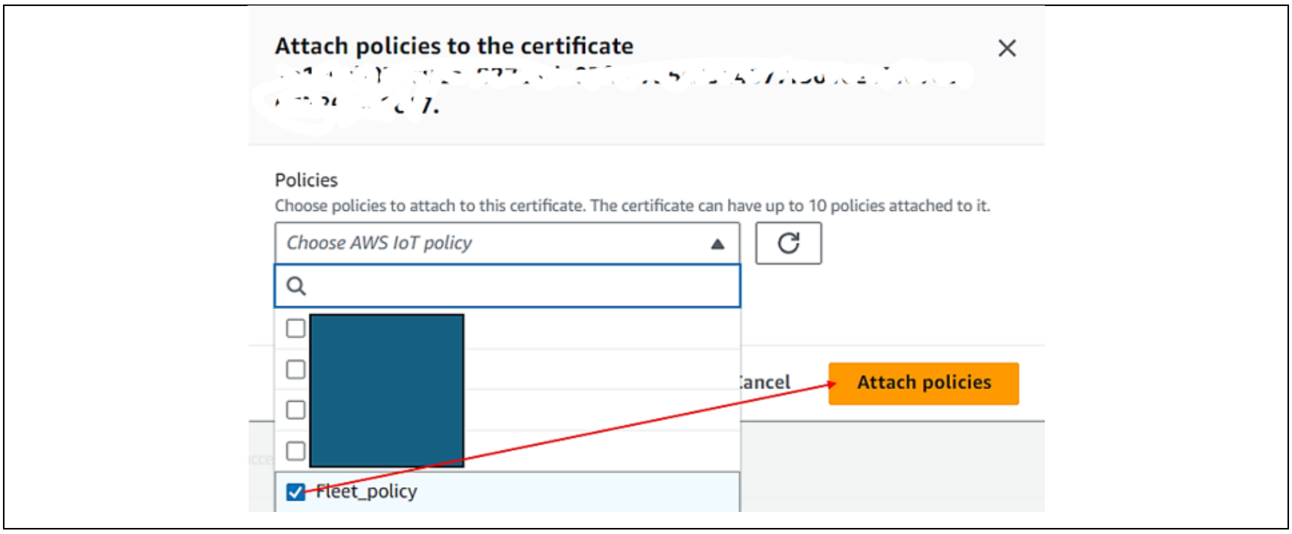
You don't have any policies attached to this certificate.

Figure 162. Certificate Settings: Attach Policies (1/2)

Clicking the Attach policies button opens the dialog box shown in **Figure 163**.

Select the policy to be used when fleet provisioning is run, created in **7.2.1**, Policy Settings, and then click the **Attach policies** button to attach it to the certificate. Example, the name of policy, which is created for Fleet demo, is **“Fleet_policy”**.

This completes the settings related to generation of the claim certificate and claim key pair.



Attach policies to the certificate

[redacted]

Policies

Choose policies to attach to this certificate. The certificate can have up to 10 policies attached to it.

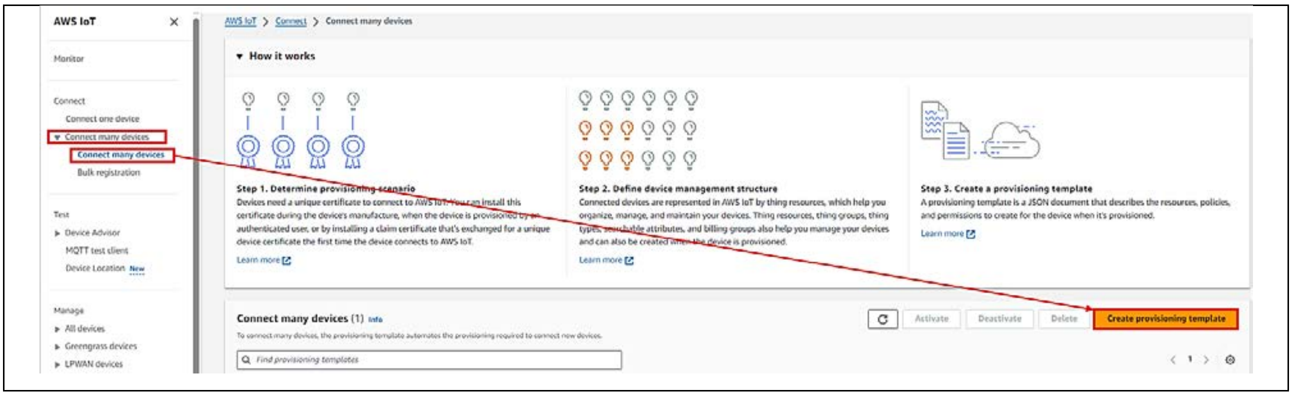
Choose AWS IoT policy

□ [redacted]
□
□
□
☑ Fleet_policy

Figure 163. Certificate Settings: Attach Policies (2/2)

7.2.3 Creating a Fleet Provisioning Template

Select **Connect many devices** → **Connect many devices**, then click the **Create provisioning template** button.



Step 1. Determine provisioning scenario
Devices need a unique certificate to connect to AWS IoT. You can install this certificate during the device's manufacture, when the device is provisioned by an authenticated user, or by installing a claim certificate that's exchanged for a unique device certificate the first time the device connects to AWS IoT.
Learn more

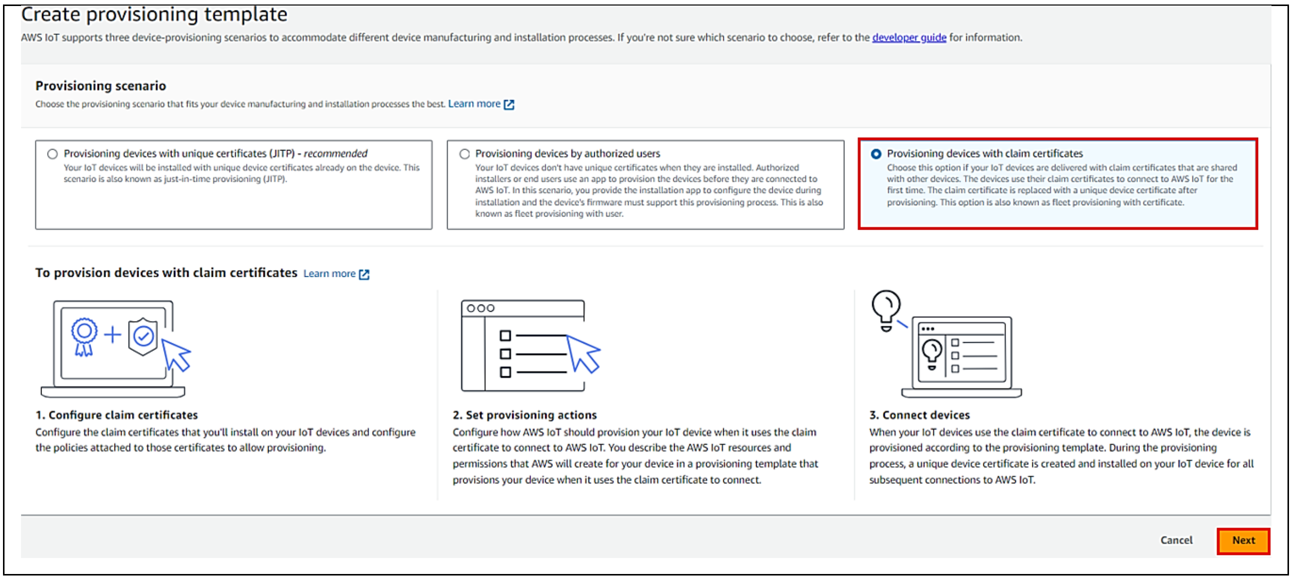
Step 2. Define device management structure
Connected devices are represented in AWS IoT by thing resources, which help you organize, manage, and maintain your devices. Thing resources, thing groups, thing types, searchable attributes, and billing groups also help you manage your devices and can also be created when the device is provisioned.
Learn more

Step 3. Create a provisioning template
A provisioning template is a JSON document that describes the resources, policies, and permissions to create for the device when it's provisioned.
Learn more

Connect many devices (1) Info
To connect many devices, the provisioning template automates the provisioning required to connect new devices.

Figure 164. Creating a Provisioning Template (1/7)

Select **Provisioning devices with claim certificates**, then click the **Next** button.



Create provisioning template

AWS IoT supports three device-provisioning scenarios to accommodate different device manufacturing and installation processes. If you're not sure which scenario to choose, refer to the developer guide for information.

Provisioning scenario
Choose the provisioning scenario that fits your device manufacturing and installation processes the best. Learn more

○ Provisioning devices with unique certificates (JITP) - *recommended*
Your IoT devices will be installed with unique device certificates already on the device. This scenario is also known as just-in-time provisioning (JITP).

○ Provisioning devices by authorized users
Your IoT devices don't have unique certificates when they are installed. Authorized installers or end users use an app to provision the devices before they are connected to AWS IoT. In this scenario, you provide the installation app to configure the device during installation and the device's firmware must support this provisioning process. This is also known as fleet provisioning with user.

● Provisioning devices with claim certificates
Choose this option if your IoT devices are delivered with claim certificates that are shared with other devices. The devices use their claim certificates to connect to AWS IoT for the first time. The claim certificate is replaced with a unique device certificate after provisioning. This option is also known as fleet provisioning with certificate.

To provision devices with claim certificates Learn more

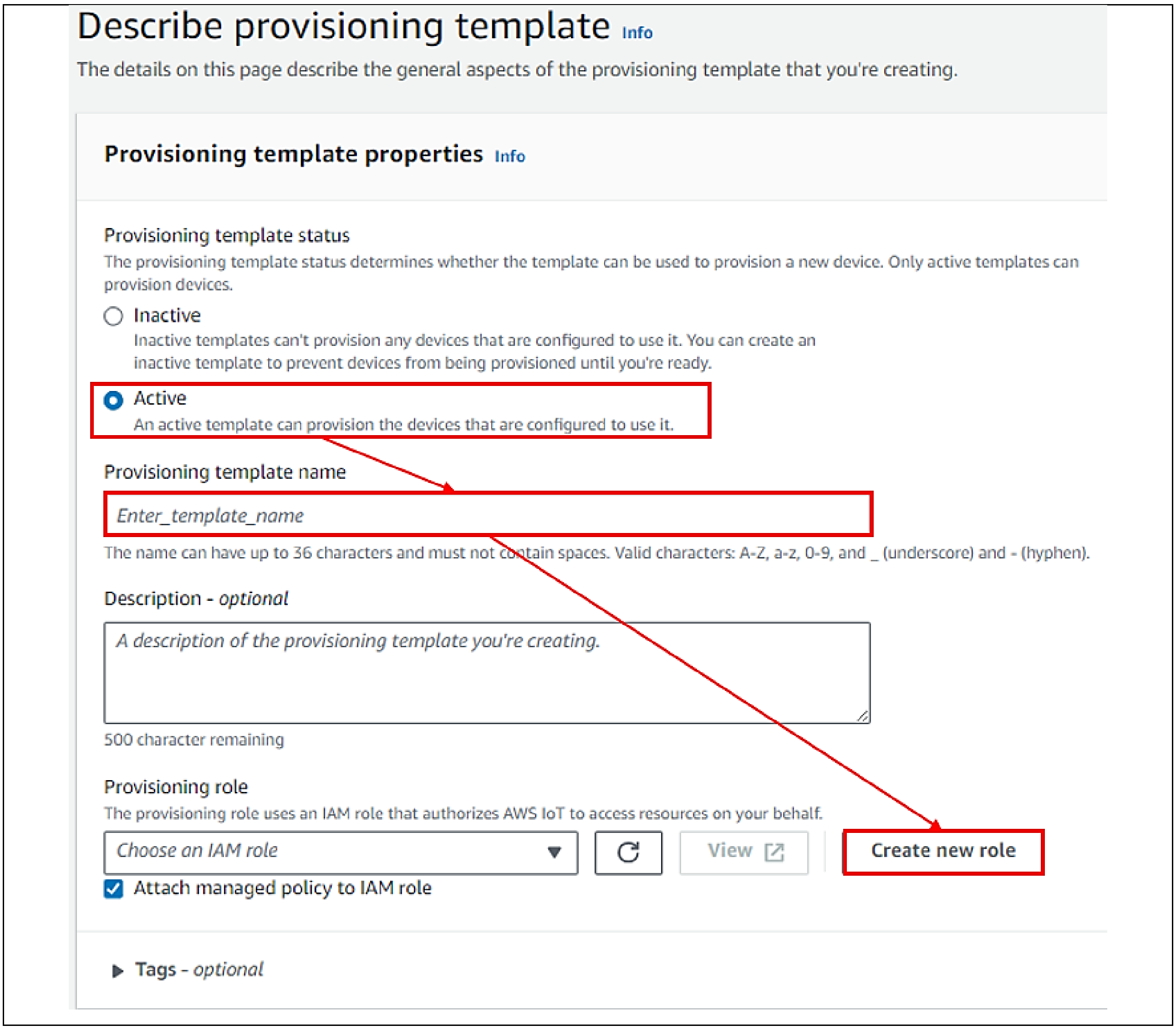
1. Configure claim certificates
Configure the claim certificates that you'll install on your IoT devices and configure the policies attached to those certificates to allow provisioning.

2. Set provisioning actions
Configure how AWS IoT should provision your IoT device when it uses the claim certificate to connect to AWS IoT. You describe the AWS IoT resources and permissions that AWS will create for your device in a provisioning template that provisions your device when it uses the claim certificate to connect.

3. Connect devices
When your IoT devices use the claim certificate to connect to AWS IoT, the device is provisioned according to the provisioning template. During the provisioning process, a unique device certificate is created and installed on your IoT device for all subsequent connections to AWS IoT.

Figure 165. Creating a Provisioning Template (2/7)

On the template creation screen, specify the provisioning template status, template name, and provisioning role. For **Provisioning template status** select **Active** and enter the name of the provisioning template. Then click the **Create new role** button and enter the role name.



Describe provisioning template Info

The details on this page describe the general aspects of the provisioning template that you're creating.

Provisioning template properties Info

Provisioning template status

The provisioning template status determines whether the template can be used to provision a new device. Only active templates can provision devices.

○ Inactive

Inactive templates can't provision any devices that are configured to use it. You can create an inactive template to prevent devices from being provisioned until you're ready.

● Active

An active template can provision the devices that are configured to use it.

Provisioning template name

Enter_template_name

The name can have up to 36 characters and must not contain spaces. Valid characters: A-Z, a-z, 0-9, and _ (underscore) and - (hyphen).

Description - *optional*

A description of the provisioning template you're creating.

500 character remaining

Provisioning role

The provisioning role uses an IAM role that authorizes AWS IoT to access resources on your behalf.

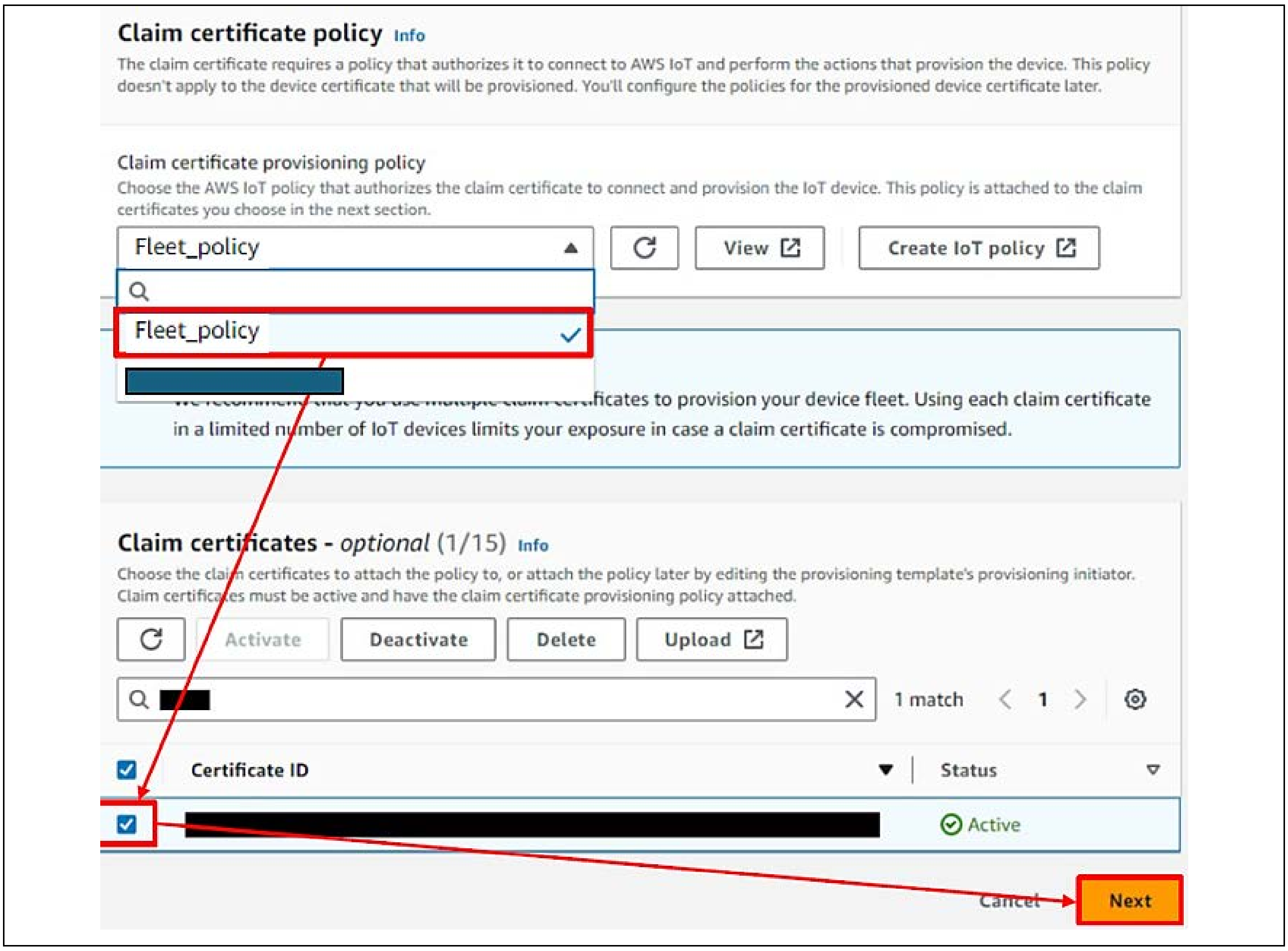
Choose an IAM role ▼

☑ Attach managed policy to IAM role

▶ Tags - *optional*

Figure 166. Creating a Provisioning Template (3/7)

For **Claim certificate policy**, select the policy to be used when fleet provisioning is run, created in **7.2.1**. For **Claim certificate**, select the certificate created in **7.2.3**, and click the **Next** button.



Claim certificate policy Info

The claim certificate requires a policy that authorizes it to connect to AWS IoT and perform the actions that provision the device. This policy doesn't apply to the device certificate that will be provisioned. You'll configure the policies for the provisioned device certificate later.

Claim certificate provisioning policy

Choose the AWS IoT policy that authorizes the claim certificate to connect and provision the IoT device. This policy is attached to the claim certificates you choose in the next section.

Fleet_policy ▲

Fleet_policy ✓

[redacted]

We recommend that you use multiple claim certificates to provision your device fleet. Using each claim certificate in a limited number of IoT devices limits your exposure in case a claim certificate is compromised.

Claim certificates - *optional* (1/15) Info

Choose the claim certificates to attach the policy to, or attach the policy later by editing the provisioning template's provisioning initiator. Claim certificates must be active and have the claim certificate provisioning policy attached.

[redacted]

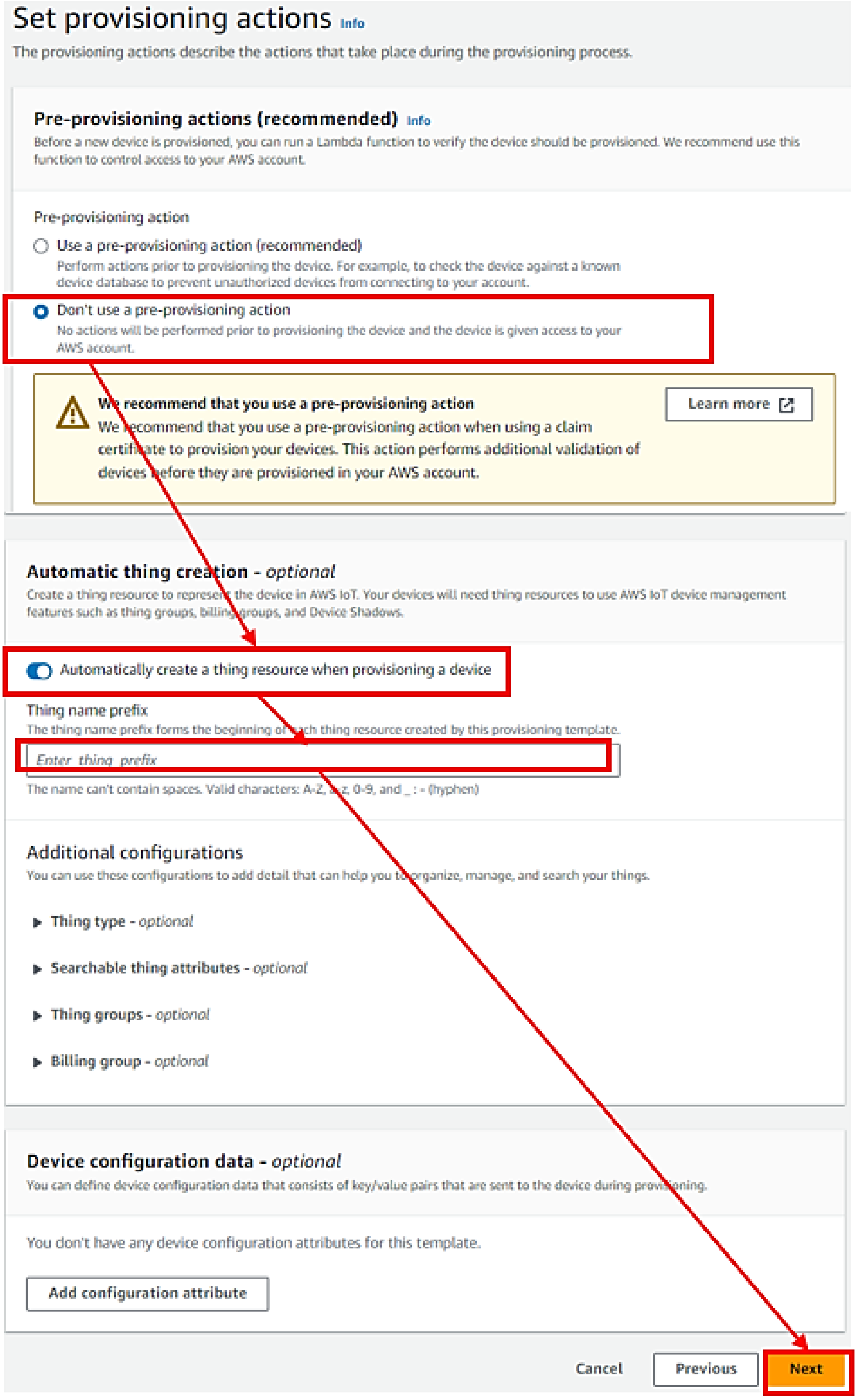
1 match

☑	Certificate ID	Status
☑	[redacted]	Active

Figure 167. Creating a Provisioning Template (4/7)

For **Pre-provisioning actions**, select **Don't use a pre-provisioning action**. Also, under **Automatic thing creation**, turn on **Automatically create a thing resource when provisioning a device**, and if necessary, enter a character string of your choice as the thing name prefix. The thing name registered with AWS will be generated from this character string and the serial number set by the program. After entering the prefix, click the **Next** button.

Note: The demo does not use pre-provisioning actions. Refer to the page linked to below for information on using pre-provisioning actions: Using pre-provisioning hooks with the AWS CLI



Set provisioning actions Info

The provisioning actions describe the actions that take place during the provisioning process.

Pre-provisioning actions (recommended) Info

Before a new device is provisioned, you can run a Lambda function to verify the device should be provisioned. We recommend use this function to control access to your AWS account.

Pre-provisioning action

○ Use a pre-provisioning action (recommended)
Perform actions prior to provisioning the device. For example, to check the device against a known device database to prevent unauthorized devices from connecting to your account.

● Don't use a pre-provisioning action
No actions will be performed prior to provisioning the device and the device is given access to your AWS account.

We recommend that you use a pre-provisioning action
We recommend that you use a pre-provisioning action when using a claim certificate to provision your devices. This action performs additional validation of devices before they are provisioned in your AWS account.

Automatic thing creation - *optional*

Create a thing resource to represent the device in AWS IoT. Your devices will need thing resources to use AWS IoT device management features such as thing groups, billing groups, and Device Shadows.

Automatically create a thing resource when provisioning a device

Thing name prefix
The thing name prefix forms the beginning of each thing resource created by this provisioning template.

Enter thing prefix

The name can't contain spaces. Valid characters: A-Z, a-z, 0-9, and _ : - (hyphen)

Additional configurations

You can use these configurations to add detail that can help you to organize, manage, and search your things.

- Thing type - *optional*
- Searchable thing attributes - *optional*
- Thing groups - *optional*
- Billing group - *optional*

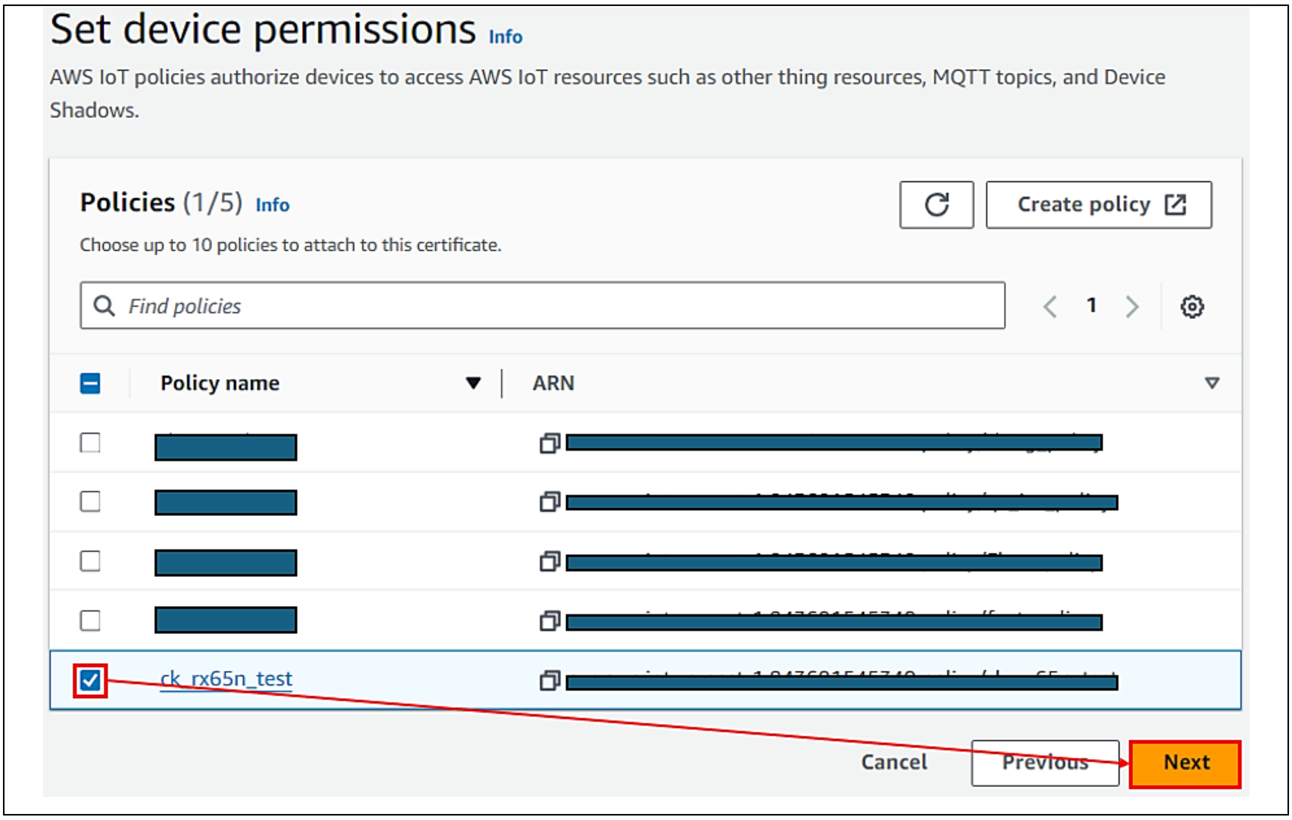
Device configuration data - *optional*

You can define device configuration data that consists of key/value pairs that are sent to the device during provisioning.

You don't have any device configuration attributes for this template.

Figure 168. Creating a Provisioning Template (5/7)

For **Set device permissions**, check the box next to the policy attached to newly created things, which was created in **5.4.4**, then click the **Next** button.



Set device permissions Info

AWS IoT policies authorize devices to access AWS IoT resources such as other thing resources, MQTT topics, and Device Shadows.

Policies (1/5) Info

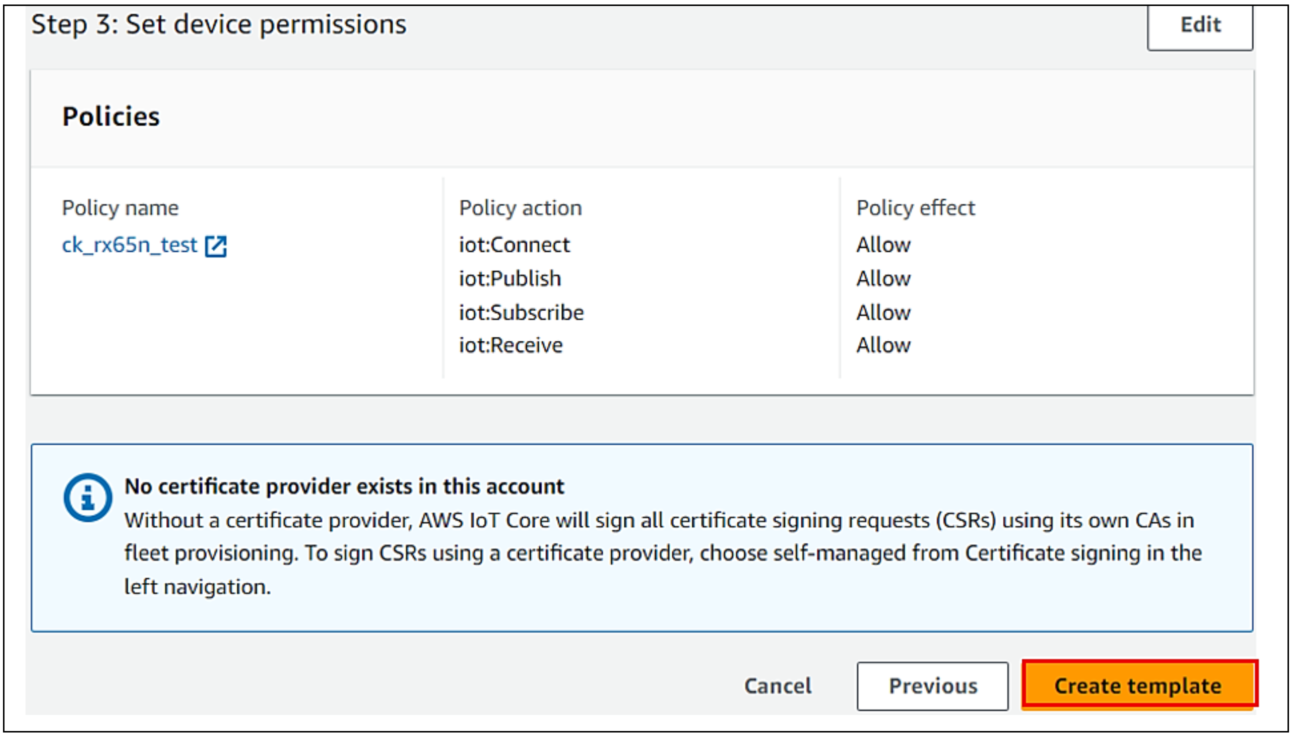
Choose up to 10 policies to attach to this certificate.

Find policies

▬	Policy name	ARN
□	[redacted]	[redacted]
□	[redacted]	[redacted]
□	[redacted]	[redacted]
□	[redacted]	[redacted]
☑	ck_rx65n_test	[redacted]

Figure 169. Creating a Provisioning Template (6/7)

Click the **Create template** button to complete the process of creating a fleet provisioning template.



Step 3: Set device permissions

Policies

Policy name	Policy action	Policy effect
ck_rx65n_test	iot:Connect iot:Publish iot:Subscribe iot:Receive	Allow Allow Allow Allow

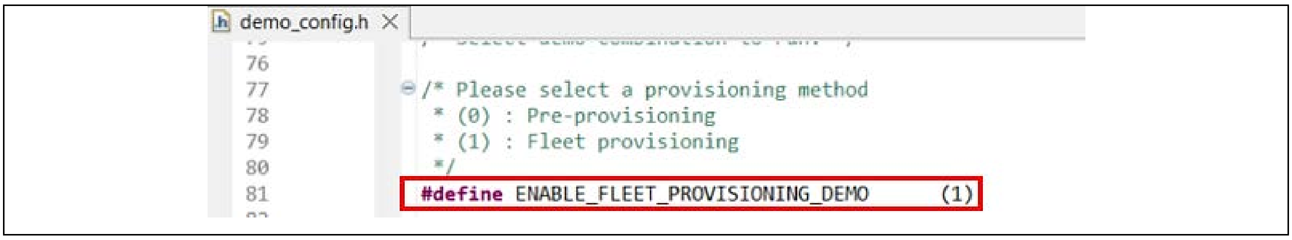
No certificate provider exists in this account

Without a certificate provider, AWS IoT Core will sign all certificate signing requests (CSRs) using its own CAs in fleet provisioning. To sign CSRs using a certificate provider, choose self-managed from Certificate signing in the left navigation.

Figure 170. Creating a Provisioning Template (7/7)

7.3 Setting up the Project

Change the value of **ENABLE_FLEET_PROVISIONING_DEMO** to **1** in **aws_ether_ck_rx65n/src/frtos_config/demo_config.h:**



```
/* Please select a provisioning method
 * (0) : Pre-provisioning
 * (1) : Fleet provisioning
 */
#define ENABLE_FLEET_PROVISIONING_DEMO      (1)
```

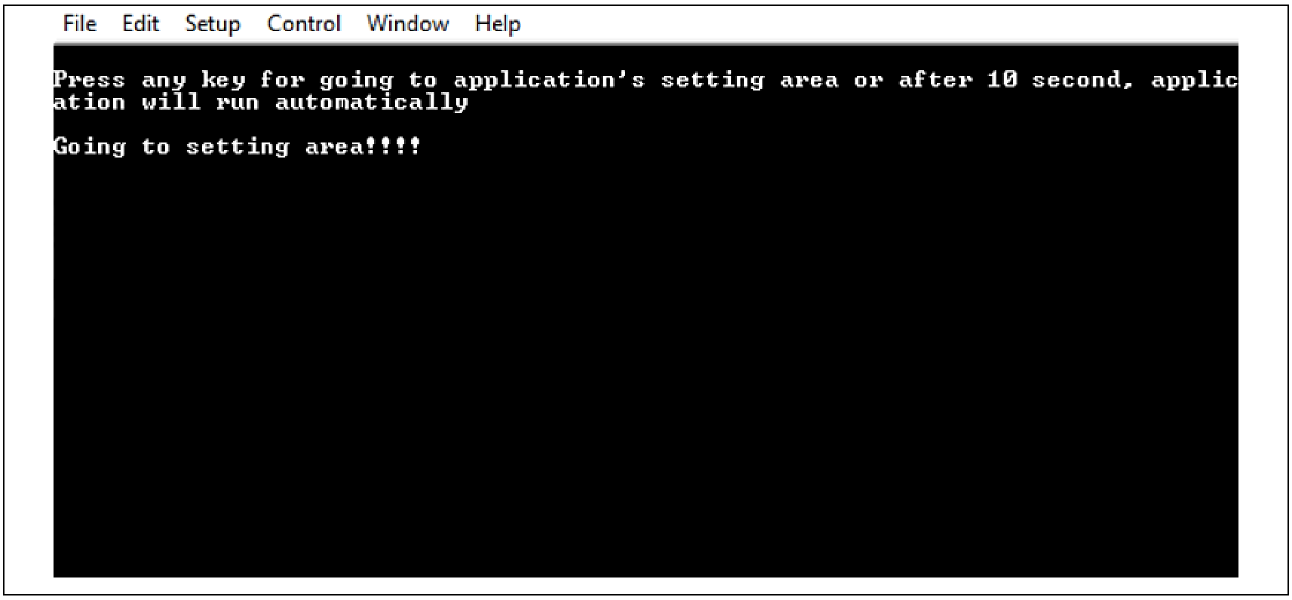
Figure 171. Enable Fleet Provisioning macro

Build and Debug the project as described in Topic: **5.1.3 Importing the Project** (number **9, 10**)

7.4 Running Fleet Provisioning

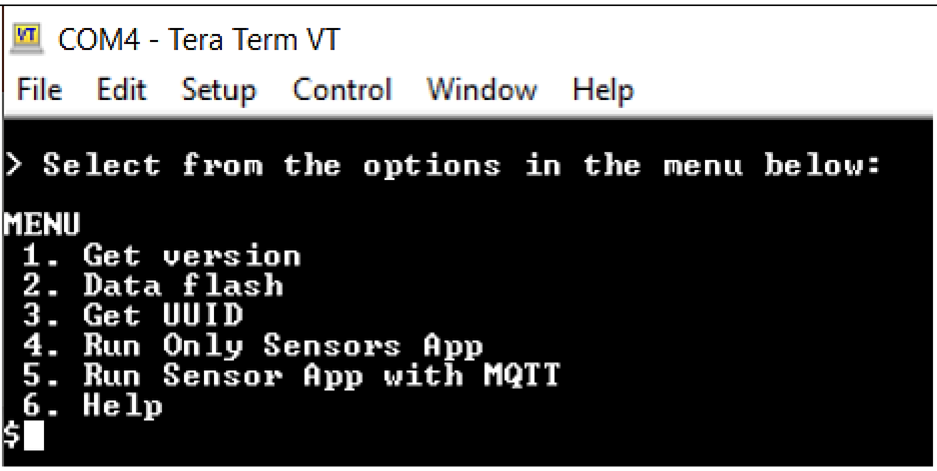
Note**:** User can run both Fleet Provisioning and OTA (**Section 6**) in this application. This section only describes Fleet Provisioning feature.

1. After loading debugging to board, press any key to configure the application. (in case users have not config Cloud's credential for Fleet Provisioning before, or users want to save another value for Cloud's credential)



```
Press any key for going to application's setting area or after 10 second, applic
ation will run automatically

Going to setting area!!!!
```

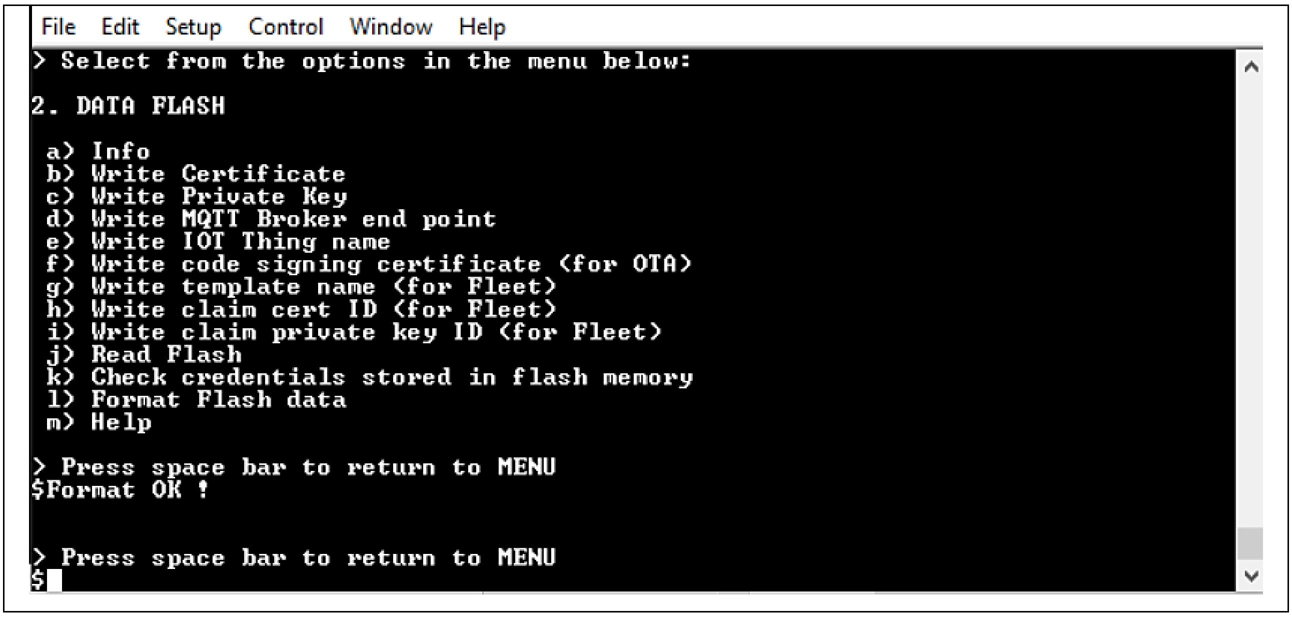
Figure 172. Save credentials for Fleet Provisioning (1/8)



```
> Select from the options in the menu below:

MENU
 1. Get version
 2. Data flash
 3. Get UUID
 4. Run Only Sensors App
 5. Run Sensor App with MQTT
 6. Help
$
```

Figure 173. Save credentials for Fleet Provisioning (2/8)

2. Press **‘2’** to choose **“2. Data flash” >** press **‘l’** to choose **“l) Format Flash data”** to erase all stored information in flash (if application was run previously) **(optional)**

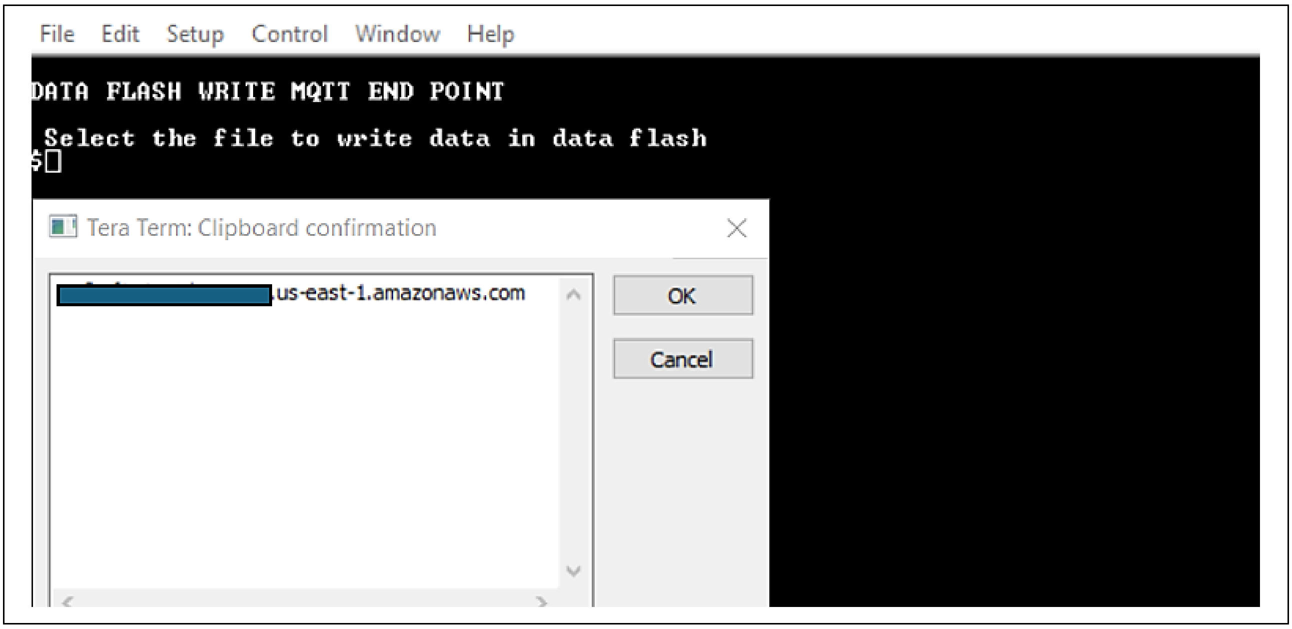


```
> Select from the options in the menu below:

2. DATA FLASH

 a) Info
 b) Write Certificate
 c) Write Private Key
 d) Write MQTT Broker end point
 e) Write IOT Thing name
 f) Write code signing certificate (for OTA)
 g) Write template name (for Fleet)
 h) Write claim cert ID (for Fleet)
 i) Write claim private key ID (for Fleet)
 j) Read Flash
 k) Check credentials stored in flash memory
 l) Format Flash data
 m) Help

> Press space bar to return to MENU
$Format OK !


> Press space bar to return to MENU
$
```

Figure 174. Save credentials for Fleet Provisioning (3/8)

Different from normal provisioning, Fleet Provisioning requires credentials: MQTT broker endpoint, fleet template name, claim cert ID, claim private key ID.

3. Get MQTT endpoint and save to flash like topic **5.4.6** and **5.3.1**:

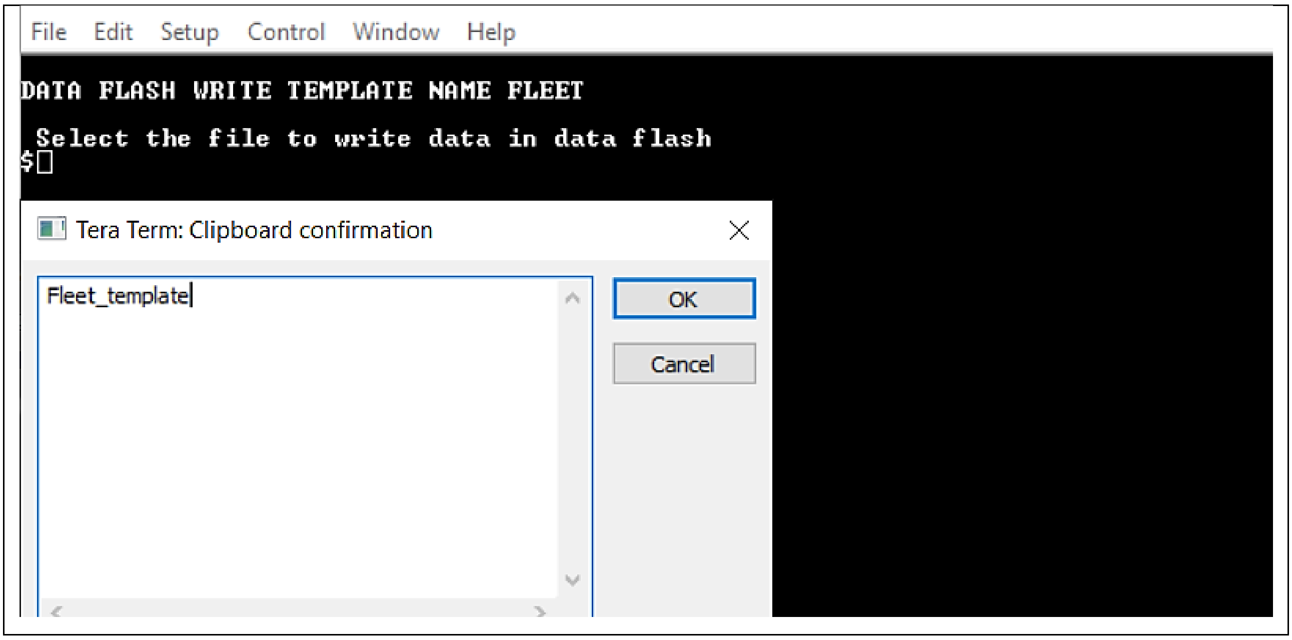


```
DATA FLASH WRITE MQTT END POINT

 Select the file to write data in data flash
$
```

[redacted].us-east-1.amazonaws.com

Figure 175. Save credentials for Fleet Provisioning (4/8)

4. Next, storing fleet template name that user created at **7.2.3,** copy this value**,** press the option ‘**g**’ and click the **Edit** tab of the Tera Term, choose “**Paste<CR>**”, verify and confirm the valid string then press **OK**.



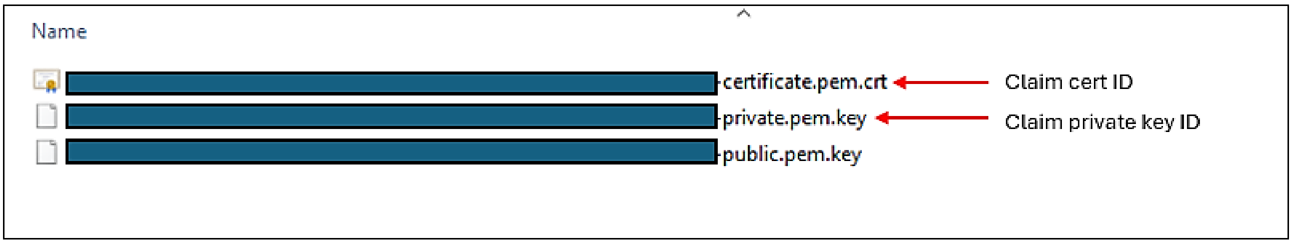
```
DATA FLASH WRITE TEMPLATE NAME FLEET

 Select the file to write data in data flash
$
```

Tera Term: Clipboard confirmation

Fleet_template

Figure 176. Save credentials for Fleet Provisioning (5/8)

5. Next, storing fleet claim cert ID, claim private key ID that users created at **0,** users downloaded (**Figure 160. Downloading the Certificate and Key Pair**):



Name

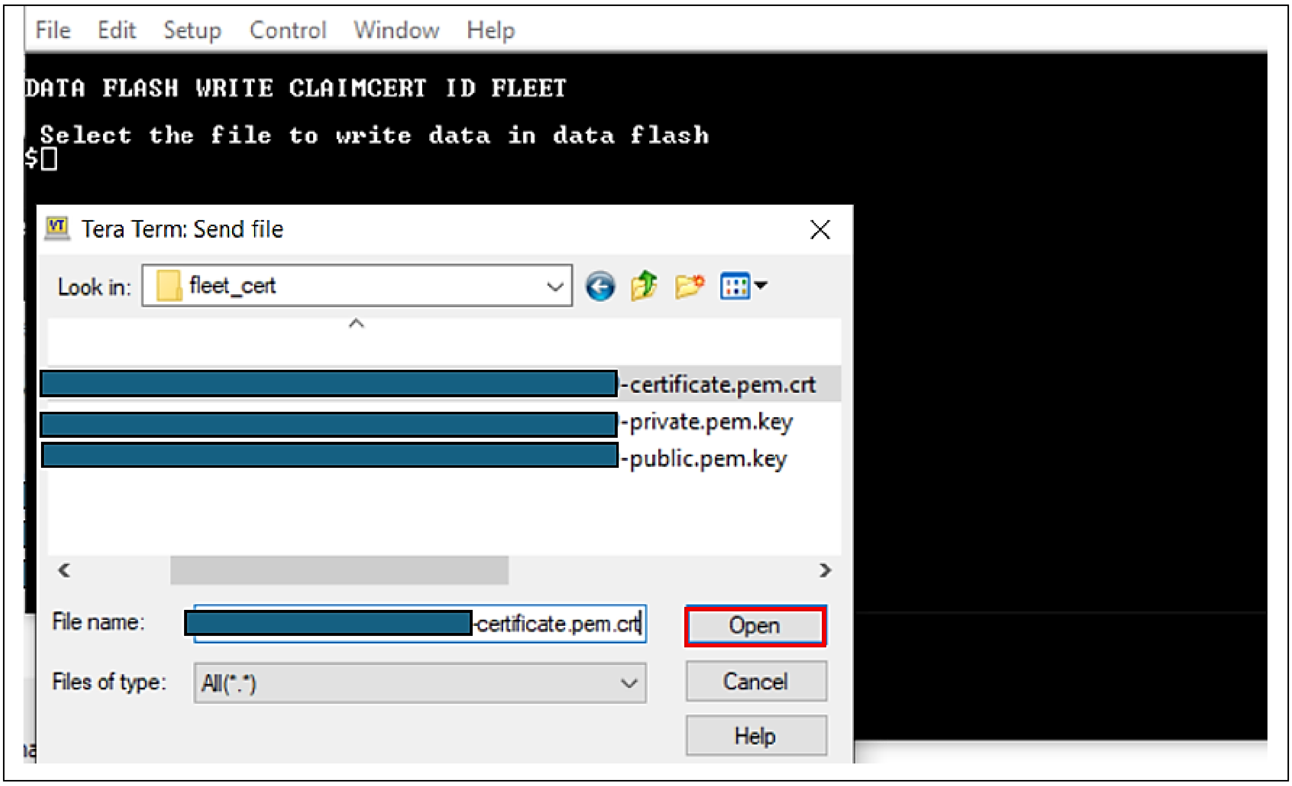
[redacted]certificate.pem.crt ← Claim cert ID

[redacted]private.pem.key ← Claim private key ID

[redacted]public.pem.key

Figure 177. Save credentials for Fleet Provisioning (6/8)

From **“2. DATA FLASH”** menu, press **‘h’** to save **Claim cert ID**. Then click the **File** tab of the Tera Term and **Send File** option and choose the downloaded Device certificate file “**xxxxxcertificate.pem.crt**”.



```
DATA FLASH WRITE CLAIMCERT ID FLEET

 Select the file to write data in data flash
$
```

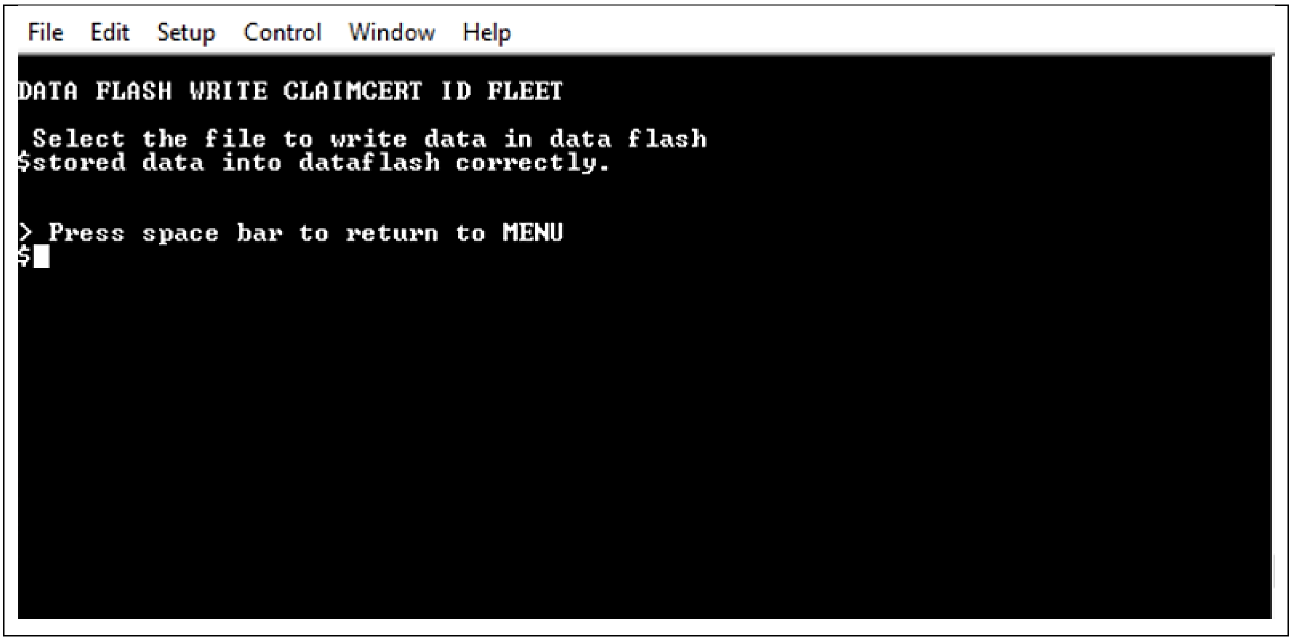
Look in: fleet_cert

[redacted]-certificate.pem.crt
[redacted]-private.pem.key
[redacted]-public.pem.key

File name: [redacted]-certificate.pem.crt

Files of type: All(*.*)

Figure 178. Save Credentials for Fleet Provisioning (7/8)



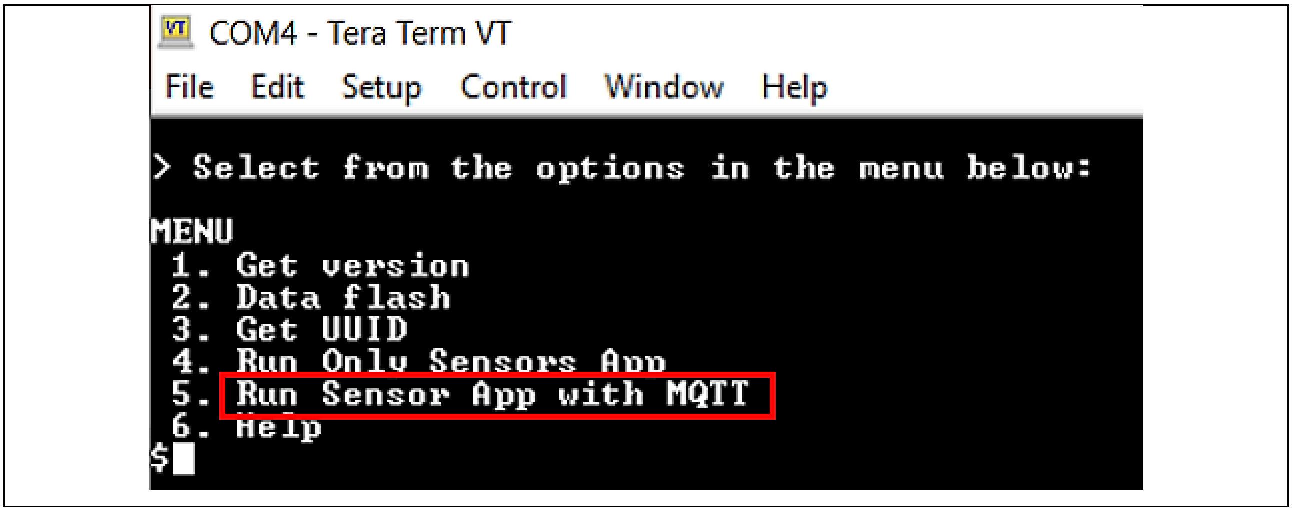
```
DATA FLASH WRITE CLAIMCERT ID FLEET

 Select the file to write data in data flash
$stored data into dataflash correctly.


> Press space bar to return to MENU
$
```

Figure 179. Save Credentials for Fleet Provisioning (8/8)

To store the **Claim private key ID,** press the option ‘**i**’ and click the **File** tab of the Tera Term and **Send File** option, choose “**xxxxxprivate.pem.key**”.

6. Start application with Fleet Provisioning:

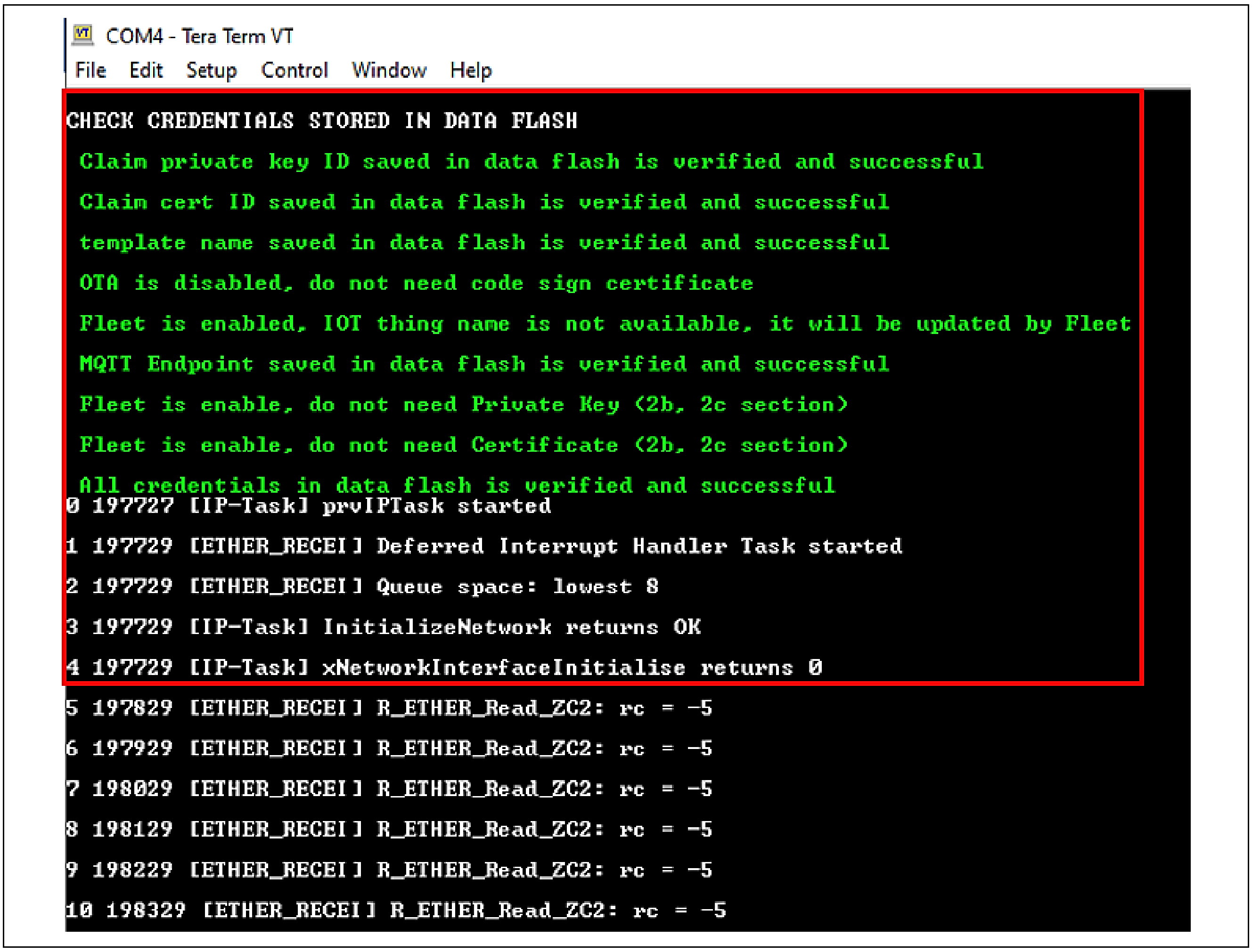
Back to the Application Menu and press **‘Run Sensor App with MQTT’** to run application:



```
> Select from the options in the menu below:

MENU
 1. Get version
 2. Data flash
 3. Get UUID
 4. Run Only Sensors App
 5. Run Sensor App with MQTT
 6. Help
$
```

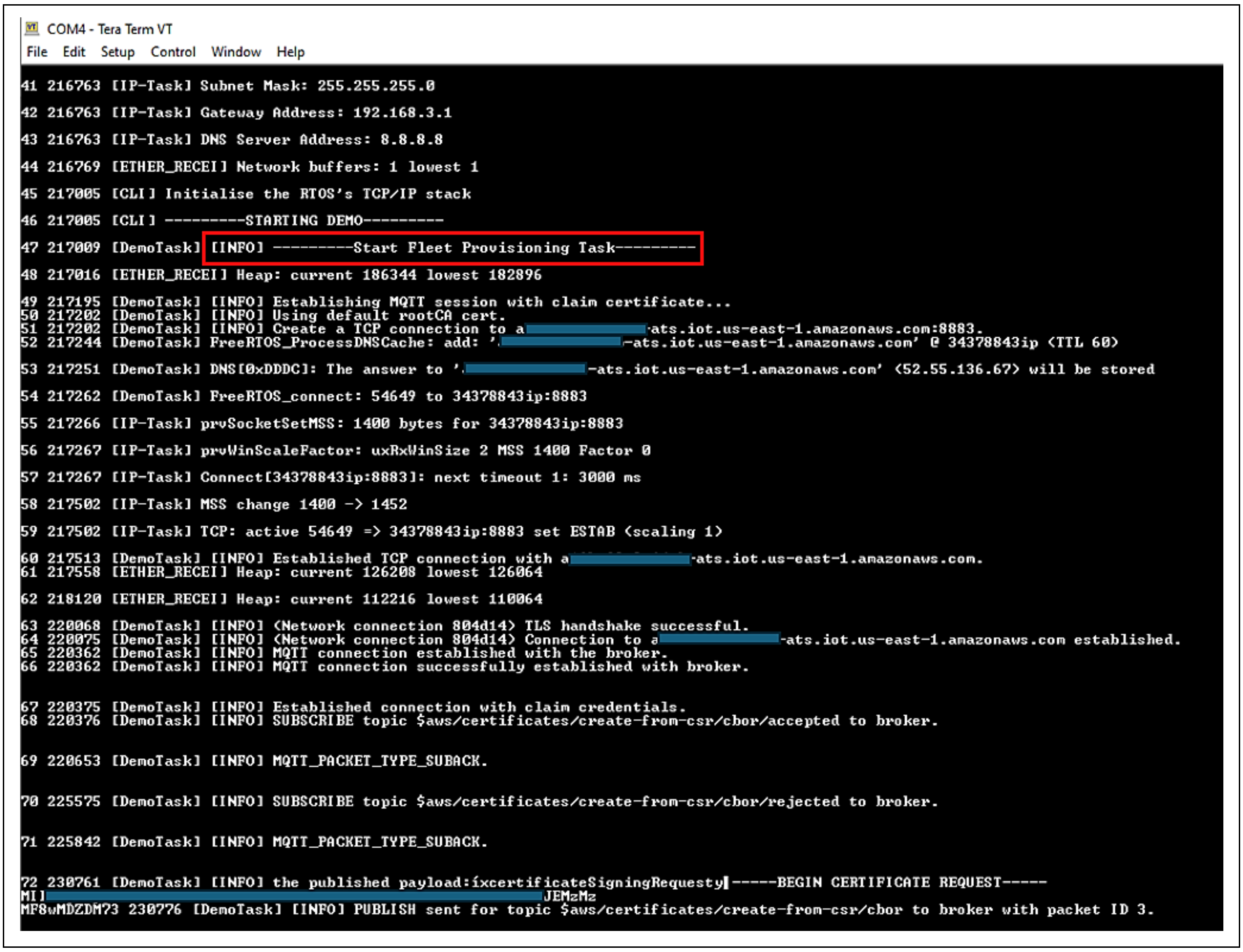
Figure 180. Running Application with Fleet (1/8)

Application will check stored data flash. When it has enough necessary credentials, application will start. Otherwise, the application will send a notice to the user and the user has to save the lacking credentials for running application.



```
CHECK CREDENTIALS STORED IN DATA FLASH
 Claim private key ID saved in data flash is verified and successful
 Claim cert ID saved in data flash is verified and successful
 template name saved in data flash is verified and successful
 OTA is disabled, do not need code sign certificate
 Fleet is enabled, IOT thing name is not available, it will be updated by Fleet
 MQTT Endpoint saved in data flash is verified and successful
 Fleet is enable, do not need Private Key (2b, 2c section)
 Fleet is enable, do not need Certificate (2b, 2c section)
 All credentials in data flash is verified and successful
0 197727 [IP-Task] prvIPTask started
1 197729 [ETHER_RECEI] Deferred Interrupt Handler Task started
2 197729 [ETHER_RECEI] Queue space: lowest 8
3 197729 [IP-Task] InitializeNetwork returns OK
4 197729 [IP-Task] xNetworkInterfaceInitialise returns 0
5 197829 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
6 197929 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
7 198029 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
8 198129 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
9 198229 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
10 198329 [ETHER_RECEI] R_ETHER_Read_ZC2: rc = -5
```

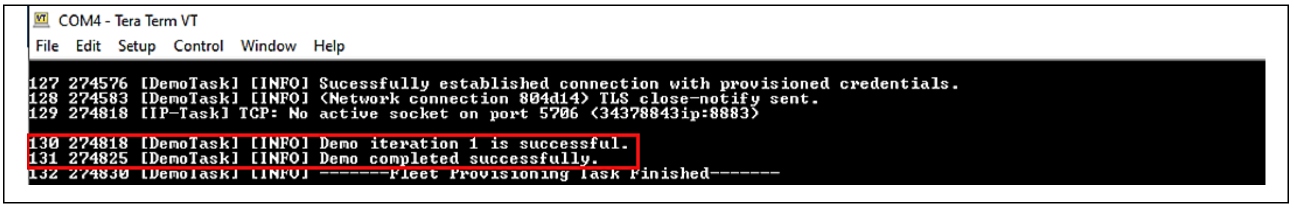
Figure 181. Running Application with Fleet (2/8)



```
41 216763 [IP-Task] Subnet Mask: 255.255.255.0

42 216763 [IP-Task] Gateway Address: 192.168.3.1

43 216763 [IP-Task] DNS Server Address: 8.8.8.8

44 216769 [ETHER_RECEI] Network buffers: 1 lowest 1

45 217005 [CLI] Initialise the RTOS's TCP/IP stack

46 217005 [CLI] ---------STARTING DEMO---------

47 217009 [DemoTask] [INFO] ---------Start Fleet Provisioning Task---------

48 217016 [ETHER_RECEI] Heap: current 186344 lowest 182896

49 217195 [DemoTask] [INFO] Establishing MQTT session with claim certificate...
50 217202 [DemoTask] [INFO] Using default rootCA cert.
51 217202 [DemoTask] [INFO] Create a TCP connection to a[redacted]-ats.iot.us-east-1.amazonaws.com:8883.
52 217244 [DemoTask] FreeRTOS_ProcessDNSCache: add: '[redacted]-ats.iot.us-east-1.amazonaws.com' @ 34378843ip (TTL 60)

53 217251 [DemoTask] DNS[0xDDDC]: The answer to '[redacted]-ats.iot.us-east-1.amazonaws.com' (52.55.136.67) will be stored

54 217262 [DemoTask] FreeRTOS_connect: 54649 to 34378843ip:8883

55 217266 [IP-Task] prvSocketSetMSS: 1400 bytes for 34378843ip:8883

56 217267 [IP-Task] prvWinScaleFactor: uxRxWinSize 2 MSS 1400 Factor 0

57 217267 [IP-Task] Connect[34378843ip:8883]: next timeout 1: 3000 ms

58 217502 [IP-Task] MSS change 1400 -> 1452

59 217502 [IP-Task] TCP: active 54649 => 34378843ip:8883 set ESTAB (scaling 1)

60 217513 [DemoTask] [INFO] Established TCP connection with a[redacted]-ats.iot.us-east-1.amazonaws.com.
61 217558 [ETHER_RECEI] Heap: current 126208 lowest 126064

62 218120 [ETHER_RECEI] Heap: current 112216 lowest 110064

63 220068 [DemoTask] [INFO] (Network connection 804d14) TLS handshake successful.
64 220075 [DemoTask] [INFO] (Network connection 804d14) Connection to a[redacted]-ats.iot.us-east-1.amazonaws.com established.
65 220362 [DemoTask] [INFO] MQTT connection established with the broker.
66 220362 [DemoTask] [INFO] MQTT connection successfully established with broker.


67 220375 [DemoTask] [INFO] Established connection with claim credentials.
68 220376 [DemoTask] [INFO] SUBSCRIBE topic $aws/certificates/create-from-csr/cbor/accepted to broker.


69 220653 [DemoTask] [INFO] MQTT_PACKET_TYPE_SUBACK.


70 225575 [DemoTask] [INFO] SUBSCRIBE topic $aws/certificates/create-from-csr/cbor/rejected to broker.


71 225842 [DemoTask] [INFO] MQTT_PACKET_TYPE_SUBACK.


72 230761 [DemoTask] [INFO] the published payload:íxcertificateSigningRequesty▌-----BEGIN CERTIFICATE REQUEST-----
MI][redacted]JEMzMz
MF8wMDZDM73 230776 [DemoTask] [INFO] PUBLISH sent for topic $aws/certificates/create-from-csr/cbor to broker with packet ID 3.
```

Figure 182. Running Application with Fleet (2/8)

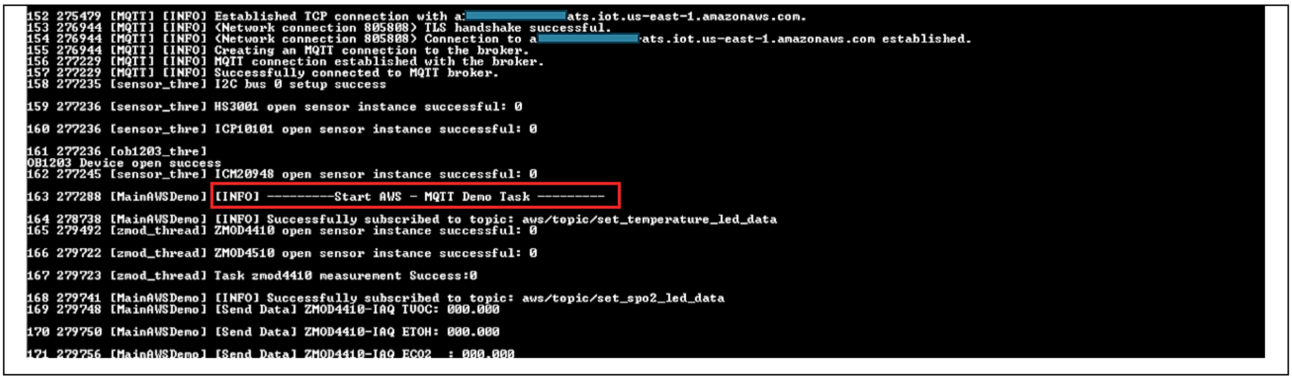
If the text string **"Demo completed successfully."** appears at the end of the log, the fleet provisioning demo completed successfully. Successful completion of the demo means that a new thing has been registered on AWS IoT Core and an individual device certificate assigned to it.



```
127 274576 [DemoTask] [INFO] Sucessfully established connection with provisioned credentials.
128 274583 [DemoTask] [INFO] (Network connection 804d14) TLS close-notify sent.
129 274818 [IP-Task] TCP: No active socket on port 5706 (34378843ip:8883)

130 274818 [DemoTask] [INFO] Demo iteration 1 is successful.
131 274825 [DemoTask] [INFO] Demo completed successfully.
132 274830 [DemoTask] [INFO] -------Fleet Provisioning Task Finished-------
```

Figure 183. Running Application with Fleet (3/8)

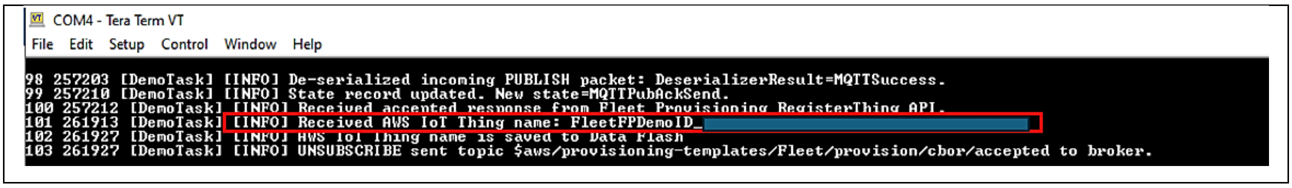
After running the fleet provisioning demo, users can use the individual device certificate and private key obtained from AWS to run the MQTT with sensors demo:



```
152 275479 [MQTT] [INFO] Established TCP connection with a[redacted]ats.iot.us-east-1.amazonaws.com.
153 276944 [MQTT] [INFO] <Network connection 805808> TLS handshake successful.
154 276944 [MQTT] [INFO] <Network connection 805808> Connection to a[redacted]-ats.iot.us-east-1.amazonaws.com established.
155 276944 [MQTT] [INFO] Creating an MQTT connection to the broker.
156 277229 [MQTT] [INFO] MQTT connection established with the broker.
157 277229 [MQTT] [INFO] Successfully connected to MQTT broker.
158 277235 [sensor_thre] I2C bus 0 setup success

159 277236 [sensor_thre] HS3001 open sensor instance successful: 0

160 277236 [sensor_thre] ICP10101 open sensor instance successful: 0

161 277236 [ob1203_thre]
OB1203 Device open success
162 277245 [sensor_thre] ICM20948 open sensor instance successful: 0

163 277288 [MainAWSDemo] [INFO] ---------Start AWS - MQTT Demo Task ---------

164 278738 [MainAWSDemo] [INFO] Successfully subscribed to topic: aws/topic/set_temperature_led_data
165 279492 [zmod_thread] ZMOD4410 open sensor instance successful: 0

166 279722 [zmod_thread] ZMOD4510 open sensor instance successful: 0

167 279723 [zmod_thread] Task zmod4410 measurement Success:0

168 279741 [MainAWSDemo] [INFO] Successfully subscribed to topic: aws/topic/set_spo2_led_data
169 279748 [MainAWSDemo] [Send Data] ZMOD4410-IAQ TVOC: 000.000

170 279750 [MainAWSDemo] [Send Data] ZMOD4410-IAQ ETOH: 000.000

171 279756 [MainAWSDemo] [Send Data] ZMOD4410-IAQ ECO2  : 000.000
```

Figure 184. Running Application with Fleet (4/8)

Users can check on the thing registered by the fleet provisioning demo from AWS IoT console. When running fleet provisioning successfully, please check the log in Tera Term with line: "**Received AWS IoT Thing name: FleetFPDemoID_xxxxxxxxxxx**"

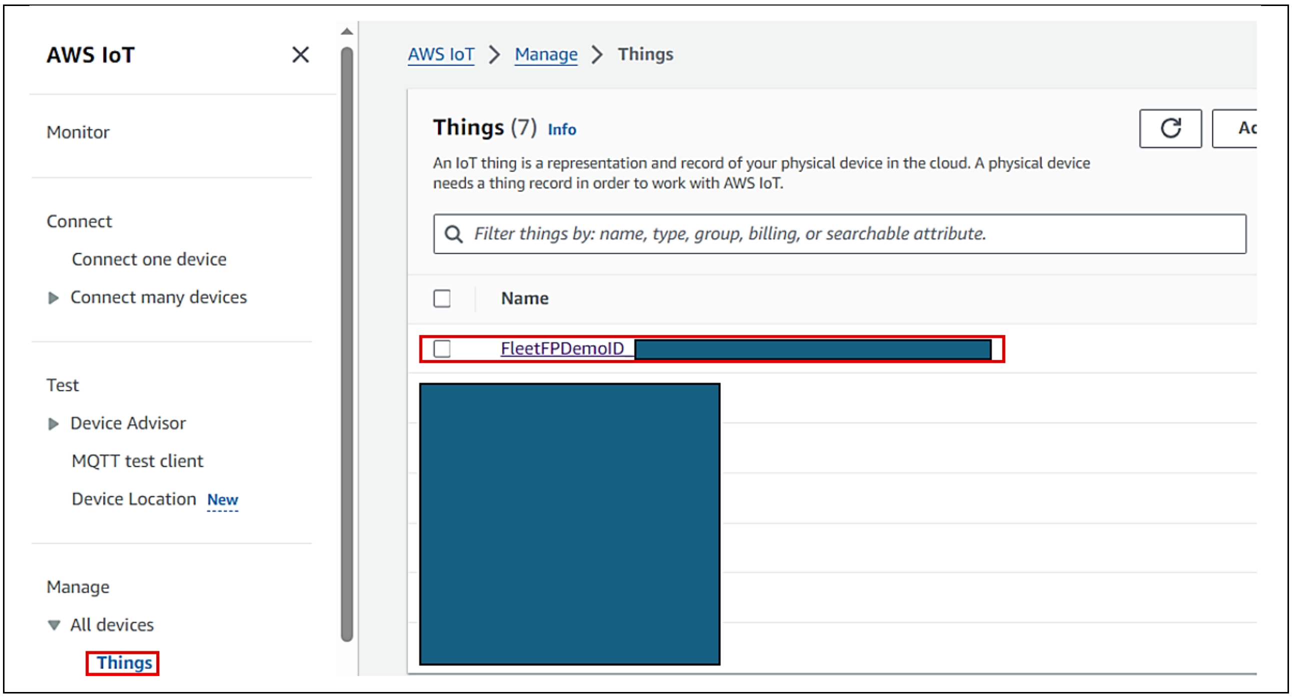


```
98 257203 [DemoTask] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
99 257210 [DemoTask] [INFO] State record updated. New state=MQTTPubAckSend.
100 257212 [DemoTask] [INFO] Received accepted response from Fleet Provisioning RegisterThing API.
101 261913 [DemoTask] [INFO] Received AWS IoT Thing name: FleetFPDemoID_[redacted]
102 261927 [DemoTask] [INFO] AWS IoT Thing name is saved to Data Flash
103 261927 [DemoTask] [INFO] UNSUBSCRIBE sent topic $aws/provisioning-templates/Fleet/provision/cbor/accepted to broker.
```

Figure 185. Running Application with Fleet (5/8)

Note**:** Prefix **Fleet** is the name that is set by user when creating Fleet template.

Under **All devices**, select **Things**. The registered thing is shown below (It will have a name that matches the "Received AWS IoT Thing name" shown in **Figure 185**):



Things (7) Info

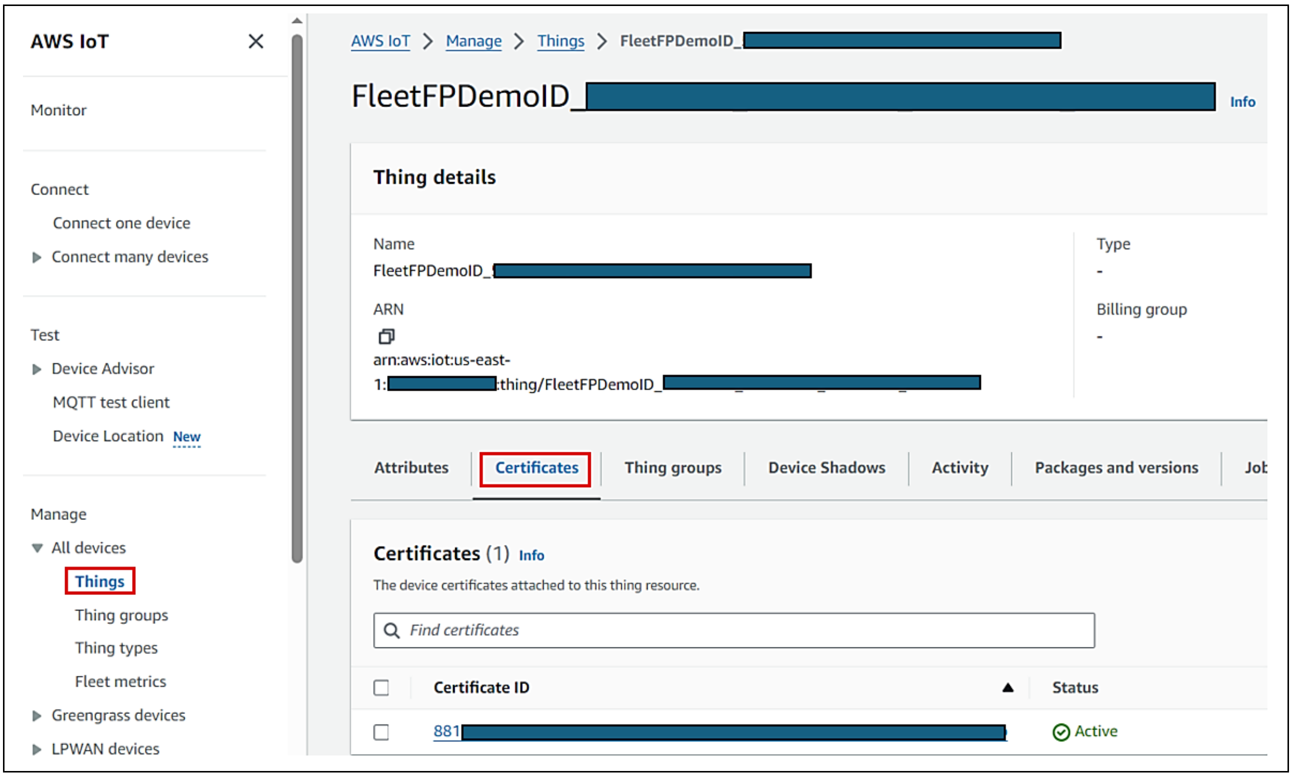
An IoT thing is a representation and record of your physical device in the cloud. A physical device needs a thing record in order to work with AWS IoT.

Filter things by: name, type, group, billing, or searchable attribute.

□	Name
□	FleetFPDemoID_[redacted]
	[redacted]

Figure 186. Running Application with Fleet (6/8)

By checking the registered things, user can confirm that the individual device certificate generated and assigned by fleet provisioning has been attached and activated:



FleetFPDemoID_[redacted]

Thing details

Name: FleetFPDemoID_[redacted]

ARN: arn:aws:iot:us-east-1:[redacted]:thing/FleetFPDemoID_[redacted]

Type: -

Billing group: -

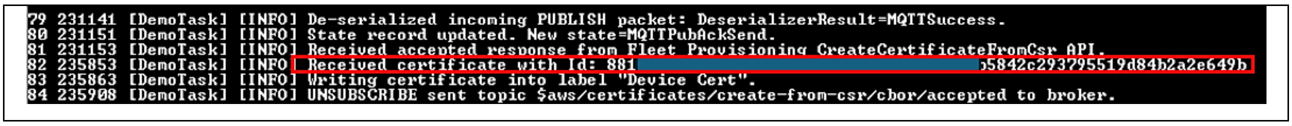
Certificates (1)

The device certificates attached to this thing resource.

□	Certificate ID	Status
□	881[redacted]	Active

Figure 187. Running Application with Fleet (7/8)

This Certificate ID will be shown in Tera Term with line “Received certificate with Id: **xxxxxxxxxxxxxxxxxx**”.



```
79 231141 [DemoTask] [INFO] De-serialized incoming PUBLISH packet: DeserializerResult=MQTTSuccess.
80 231151 [DemoTask] [INFO] State record updated. New state=MQTTPubAckSend.
81 231153 [DemoTask] [INFO] Received accepted response from Fleet Provisioning CreateCertificateFromCsr API.
82 235853 [DemoTask] [INFO] Received certificate with Id: 881[redacted]5842c293795519d84b2a2e649b
83 235863 [DemoTask] [INFO] Writing certificate into label "Device Cert".
84 235908 [DemoTask] [INFO] UNSUBSCRIBE sent topic $aws/certificates/create-from-csr/cbor/accepted to broker.
```

Figure 188. Running Application with Fleet (8/8)

8. Note and Troubleshooting

8.1 Sensor Stabilization Time

Each sensor has a stabilization time during which correct values cannot be read.

The following table shows the details of sensor stabilization times.

Table 12. Sensor Stabilization Time

Sensor Name	When power up first time	After soft or hard reset
ZMOD4410 IAQ	Up to 1 minutes	Up to 1 minute
ZMOD4510 OAQ	Up to 1.5 hours	Up to 1 hour
OB1203	Up to 20 minutes (After putting finger on sensor, it may take up to 60 seconds to sense data)	Up to 20 seconds (After putting finger on sensor, it may take up to 60 seconds to sense data)
HS3001	Up to 30 seconds	Up to 10 seconds
ICP	Up to 30 seconds	Up to 10 seconds
ICM	Up to 30 seconds	Up to 10 seconds

8.2 Connection Issue When Using Ethernet (Wired cable)

The Ether PHY only supports full-duplex communication. If your router or Ethernet hub only supports half duplex, it cannot connect to the internet. Please use full duplex devices.

8.3 Current Supply Short Issue When Using RYZ014A

If the CK-RX65N V1 board is not powered through the Debug port (J14), the current available to the board may be limited to 100mA. When using the supplied RYZ014A Pmod module with other code (found here: RYZ014A - LTE Cat-M1 Cellular IoT Module | Renesas) be aware that this Pmod has a maximum operating current of **480 mA** dependent upon the LTE band, Tx/Rx settings, and network coverage. Please ensure that the host board can supply sufficient power or provide supplemental USB power via CN4 on the Pmod to avoid RF instability.

8.4 When Build Errors Occur

If a 'No such file or directory' error occurs, the project path may be too long. When the path is longer than 256 characters, e^2 studio outputs errors at build time.
When this error occurs, move the project to a shorter path location (such as, under C:\).

8.5 When Unable to Log in to the Dashboard (Grafana Account)

If you cannot log in to the Dashboard with the password you changed in step 6 of section **5.2.2 Getting the Account 10 USD for Trial of AWS**, try the following:

Set “admin” in the Email or username field and set the changed password in the password field.

When changing the password for the initial session, the username is not changed from admin. Therefore, admin must be entered in the username field. To enable users to log in with their own username and email address, please change the user information in the Server Admin menu after logging in.

8.6 Notes on Performing Firmware Update Over-The-Air on AWS FreeRTOS

The following symptoms occur when performing Firmware Update Over-The-Air (FOTA) on AWS FreeRTOS.

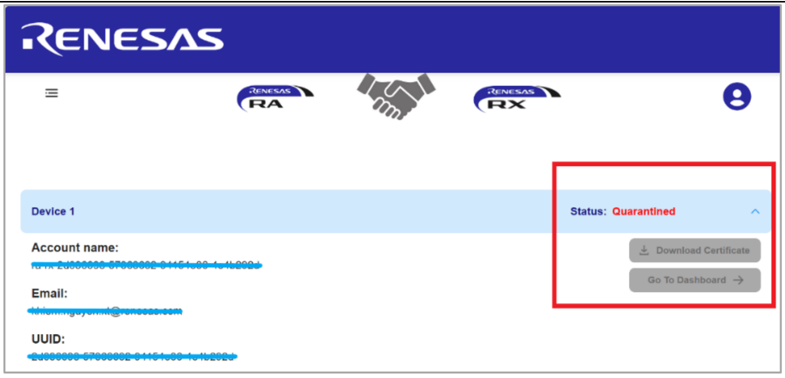
1. Device (thing) names and credential information are overwritten.
2. Processing of OTA fails after recovering from low power consumption mode.

For more information, refer to the Tool News at:

[Notes] RX Family Notes on Performing Firmware Update Over-The-Air on AWS FreeRTOS (renesas.com)

8.7 When the Trial 10 USD is Used Up

When the trial 10 USD is used up, status will change to “Quarantined”. At this time, the user cannot download the certificate or go to Dashboard.



Device 1

Status: Quarantined

Account name:
[redacted]

Email:
[redacted]

UUID:
[redacted]

Figure 189. Account Used Up Trial 10 USD

Note: Please add payment options before the account is quarantined and enable the option on the dashboard. If the account is quarantined, please contact Renesas Customer Support.

To enable option on the dashboard, go to the user profile.

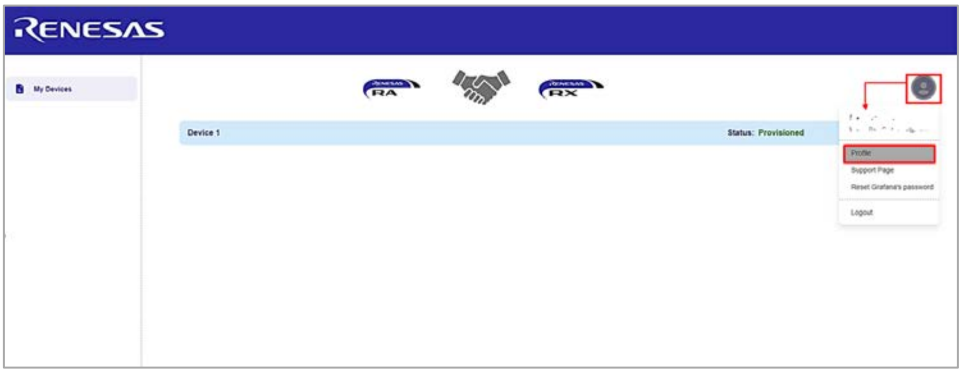
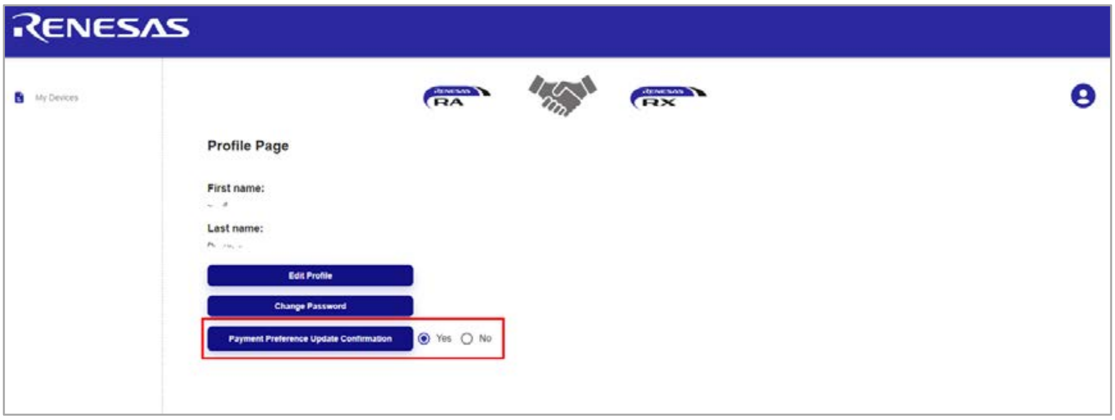


Figure 190. Choose Profile

Choose “**Yes**” for the **Payment Preference Update Confirmation**.



Profile Page

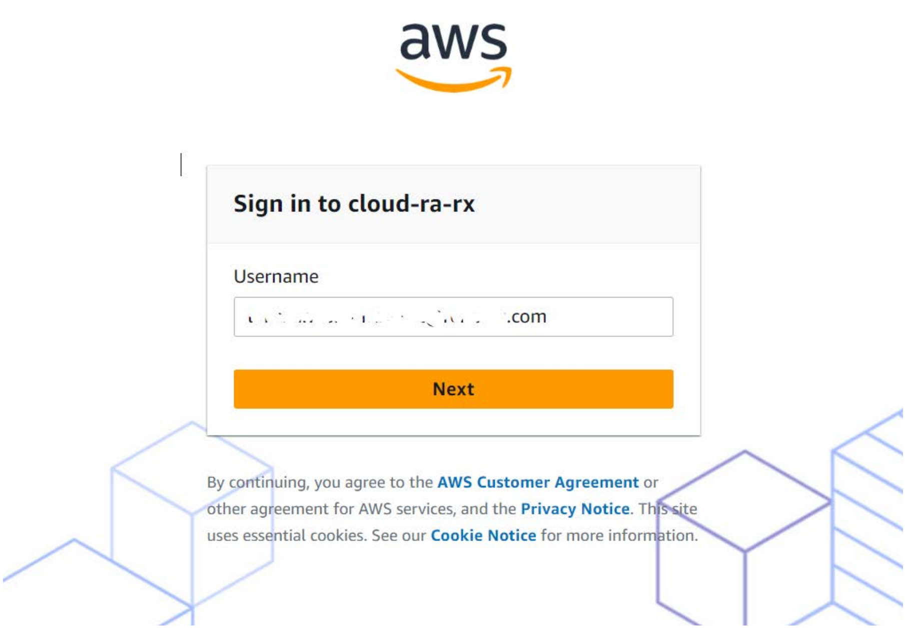
First name:

Last name:

● Yes ○ No

Figure 191. Payment Confirmation

To add a credit card to continue using this account or using another AWS account, go to https://cloud-ra-rx.awsapps.com/start#/, sign up with AWS account.



Sign in to cloud-ra-rx

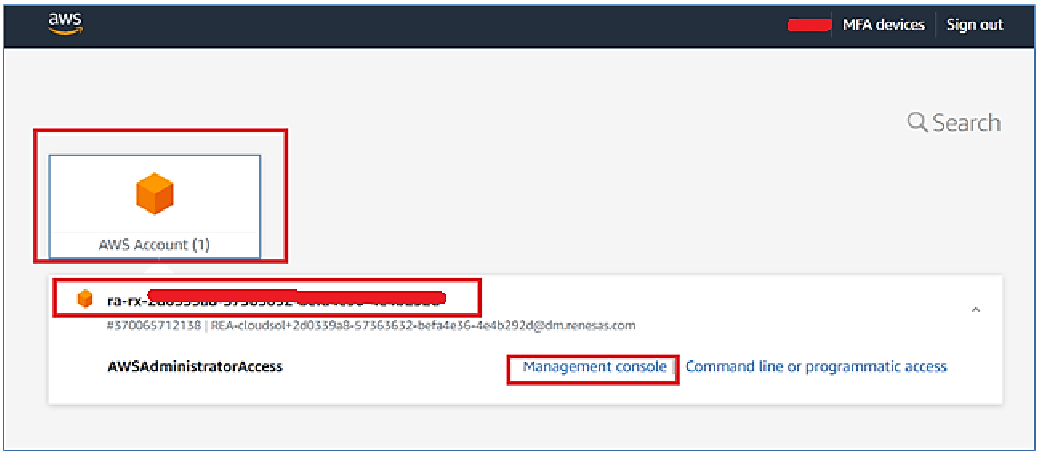
Username

.com

By continuing, you agree to the AWS Customer Agreement or other agreement for AWS services, and the Privacy Notice. This site uses essential cookies. See our Cookie Notice for more information.

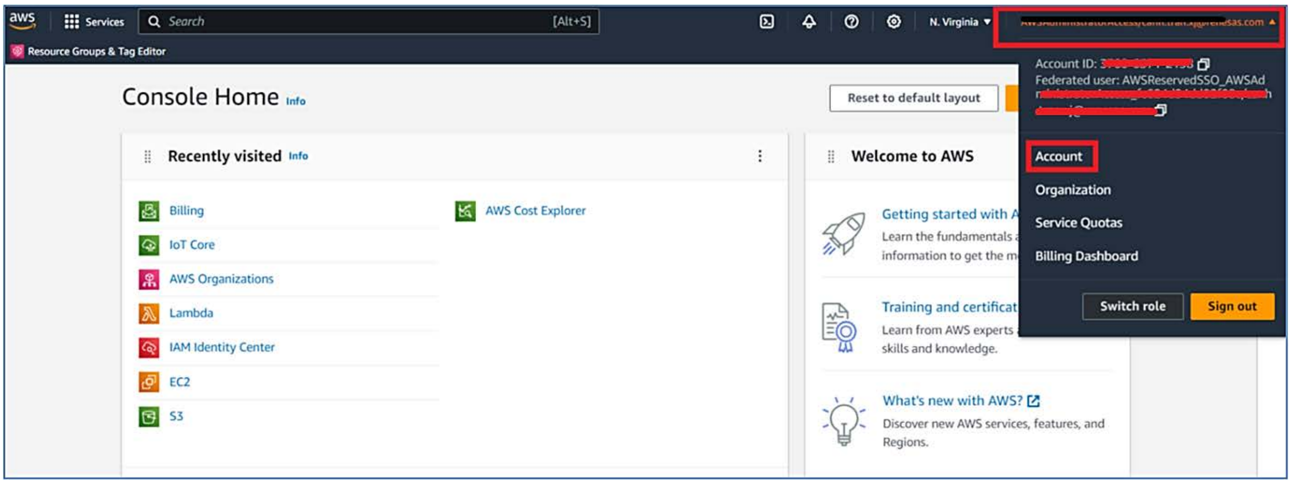
Figure 192. Sign up to AWS Account

Go to **Manage Console > Account > AWS Billing > Payment preferences > Add payment method.**



#370065712138 | REA-cloudsol+2d0339a8-57363632-befa4e36-4e4b292d@dm.renesas.com

Figure 193. Add Credit Card for Trial Account (1/4)

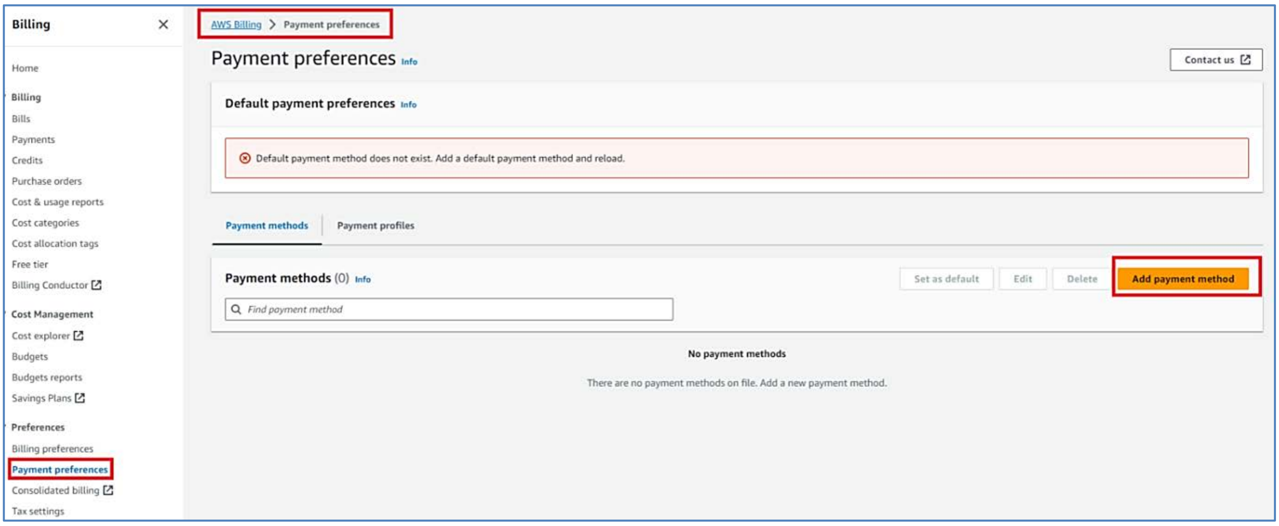


Learn the fundamentals a information to get the m

Learn from AWS experts skills and knowledge.

Discover new AWS services, features, and Regions.

Figure 194. Add Credit Card for Trial Account (2/4)

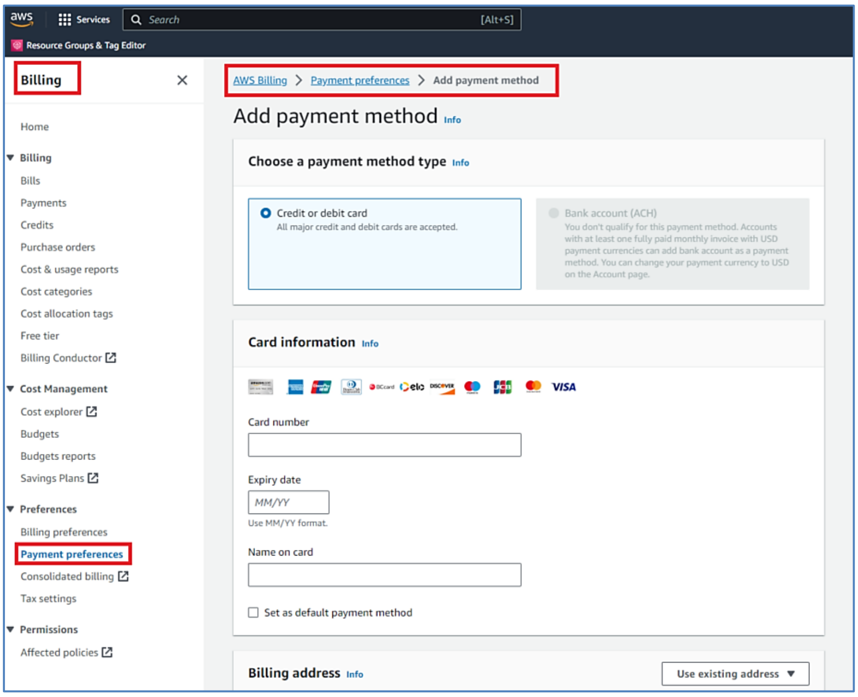


Default payment method does not exist. Add a default payment method and reload.

No payment methods

There are no payment methods on file. Add a new payment method.

Figure 195. Add Credit Card for Trial Account (3/4)



Add payment method Info

Choose a payment method type Info

● Credit or debit card
All major credit and debit cards are accepted.

○ Bank account (ACH)
You don't qualify for this payment method. Accounts with at least one fully paid monthly invoice with USD payment currencies can add bank account as a payment method. You can change your payment currency to USD on the Account page.

Card information Info

Card number

Expiry date
MM/YY
Use MM/YY format.

Name on card

□ Set as default payment method

Billing address Info

Figure 196. Add Credit Card for Trial Account (4/4)

8.8 How to Enable/Disable EC2 Instance

AWS trial accounts start billing immediately after device registration. The following steps will disable the EC2 instance, saving the user's credits.

Access AWS account from https://cloud-ra-rx.awsapps.com/start#/ using the dashboard credentials. (Refer to **Figure 192** to log in).

To disable the EC2 instance, use the following steps:

1. From the **Services** menu, select **Compute** and then choose **EC2.**

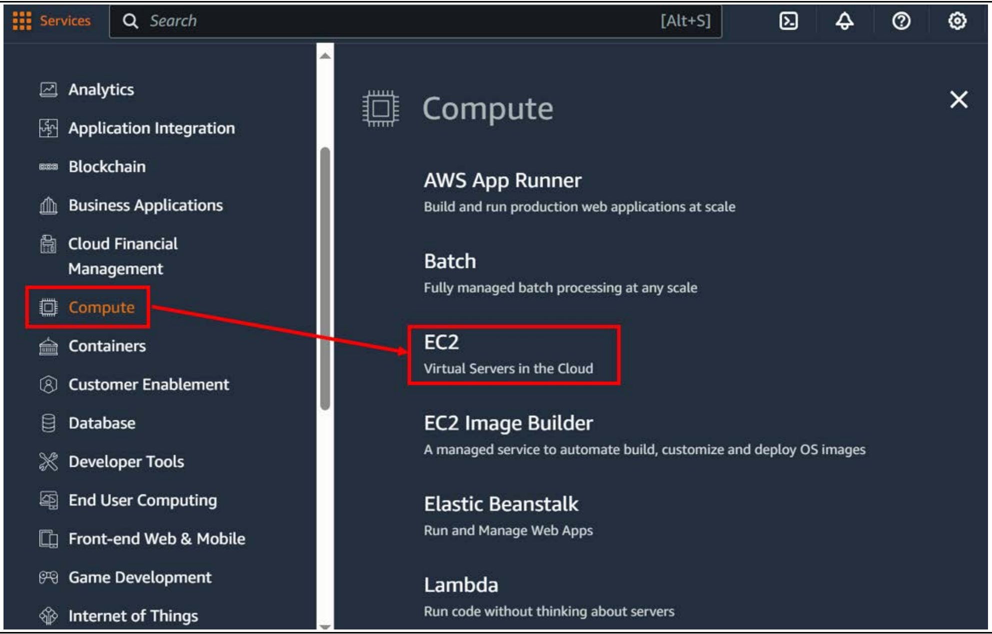


Figure 197. EC2 AWS Service

2. Choose the instance, then change the **Instance state** to **Stop instance**

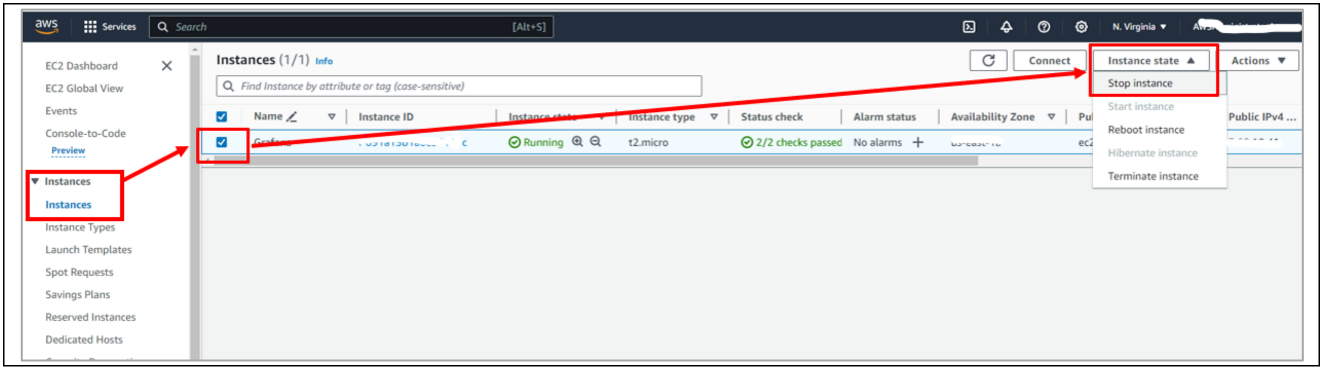


Figure 198. Disable Instance

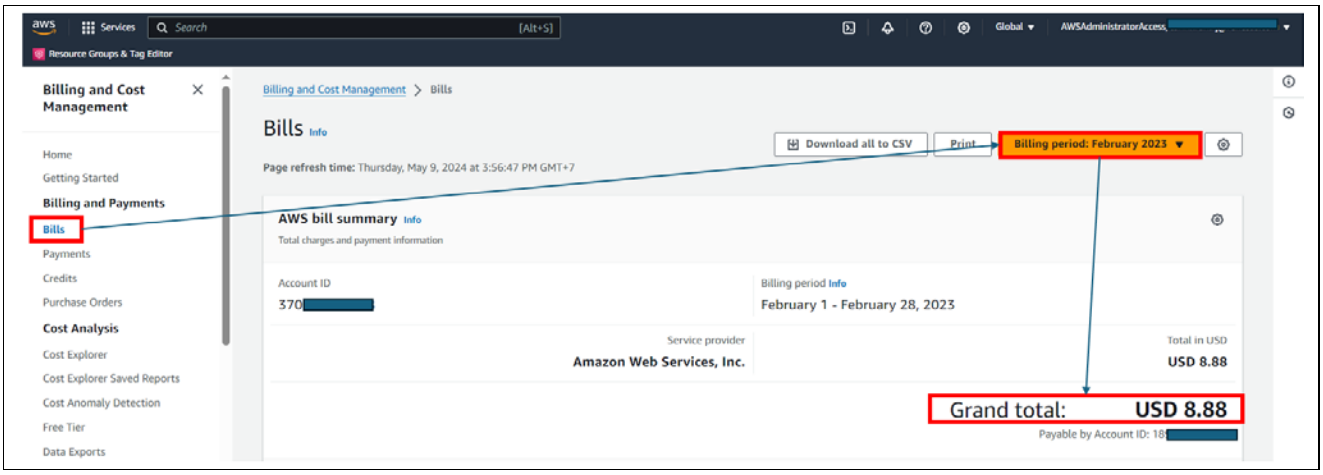
Note**:** If you wish to use the dashboard again, please enable the EC2 instance before using it.

8.9 How to check the total amount spent in AWS account

Access AWS account from https://cloud-ra-rx.awsapps.com/start#/ using the dashboard credentials. (Refer to the **Figure 192** to login).

Go to **Account > Bills.**

User can choose the **"Billing period"** to see the amount spent during that period:



Page refresh time: Thursday, May 9, 2024 at 3:56:47 PM GMT+7

Account ID: 370[redacted]

Billing period Info: February 1 - February 28, 2023

Service provider: Amazon Web Services, Inc.

Total in USD: USD 8.88

Grand total: USD 8.88

Payable by Account ID: 18[redacted]

Figure 199. Check the amount spent in AWS Account

8.10 An error occurs when connecting to AWS

The AWS IoT information is not set yet or is set incorrectly. Please check and set AWS IoT information again. **(5.3.1)**

8.11 Command to create the initial firmware fails (OTA)

The cause of this issue is the Python installation folder is not set correctly in the Path variable or the encryption library is not installed.

Users have to re-install Python. Also, make sure that the Add python.exe to PATH check box is selected when you perform the step in **6.2.1 Installing Python** and install the encryption library.

8.12 Initial firmware cannot be written/ does not start. (OTA)

Make sure that the jumper on J16 of CK-RX65N board is on pins 1-2 (debug mode) when writing initial firmware and on pins 2-3 (run mode) when starting the initial firmware.

8.13 Firmware does not start after starting the boot loader (OTA)

Please review the public key setting in the bootloader because it is not correctly set in the boot loader.

8.14 Firmware does not start after an OTA update (OTA)

Users can review the public key setting in the firmware because the public key is not set correctly in the firmware. If not, please review the device setting in the firmware and the boot loader.

9. Website and Support

Visit the following vanity URLs to learn about key elements of the RX family, download components and related documentation, and get support.

CK-RX65N V1 Kit Information	renesas.com/rx/ck-rx65n
RX&RA Cloud Solutions	renesas.com/cloudsolutions
RX Cloud solution web	renesas.com/rx-cloud
RX Product Information	renesas.com/rx
RX Product Support Forum	renesas.com/rx/forum
RX Driver Package	renesas.com/RDP
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jun.14.22		First version
1.10	Jun.29.22	15	Improved 5.1.4 Activating a SIM card on MicroAI Launchpad of activation way of SIM
		49	Added the restrictions section
		Program	Fixed the program about getting the issue of UUID lacking parts of the number.
1.20	Jul.06.22	10-11	Added 8. Apply Patch files
		50	Removed “SpO2 sensor of OB1203 (Cellular version of Project)” from the restriction section. Updated 5.1 Communication time (Cellular version of Project).
		Program	Updated Cellular version of Project - Supported SpO2 sensor of OB1203. - Added patch file to project.
1.30	Jun.02.23	11	Added the settings for Truphone SIM
		26	Added 4.1.6 about the activation procedure for Truphone SIM
		50	Added 6.4 about when build errors occur.
			Added 6.5 about when unable to log in to the Dashboard (Grafana account)
			Added 6.6 Notes on Performing Firmware Update Over-The-Air on AWS FreeRTOS
1.31	Jan.19.24	—	Fix typo mistake
		5	Updated Figure 2
		5	Updated description for 4. Connection to AWS section
		11, 19	Removed information of MicroAI Sim card, added note about SIM Card’s information
		—	Removed 4.1.5.2 Activate a SIM card on MicroAI Launchpad Section due to the MicroAI SIM card is discontinued to support CK-RX65N.
		44	Correct description for “LED Alerts” Section
		45	Added “Automatic alert from Renesas Dashboard feature” into Restrictions section
		23-26, 33-40, 46-50	Updated information about latest Renesas Dashboard (add payment, enable/disable EC2 instance, …), AWS
1.40	Jun.24.24	49-106	Added OTA feature (section 6), Fleet Provisioning feature (section 7)
		6-8	Add section “4. Cloud Connectivity Application Example”: Add application overview.
		9-48	Re-arrange section “5. Connection to AWS”
		110	Add restrictions (8.9 → 8.14) in “Note and Troubleshooting”

General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.
2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.
3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.
4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.
5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.
6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).
7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.
8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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TOYOSU FORESIA, 3-2-24 Toyosu,
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