

Getting Started with the Renesas GR-MANGO

Required Resources

To build and run the GR-MANGO example, you will need following resources:

Development tools & software

- e²studio IDE 2021-04 ([e²studio download](#))
- GNU ARM Embedded 6-2016q2-update (can be installed during installing e²studio 2021-04)

Hardware

- Renesas GR-MANGO, (<https://www.renesas.com/products/gadget-renesas/boards/gr-mango>)
- PC running Windows 10; the Tera Term console, or similar application; and an installed web browser (Google Chrome, Internet Explorer, Microsoft Edge, or Mozilla Firefox).
- Ethernet LAN internet access

Before you begin, see [Prerequisites](#).

If you do not have an GR-MANGO, you can order one from [some distributors](#).

Setting Up Your Environment

FreeRTOS for the GR-MANGO uses e²studio IDE and GNU ARM Embedded compiler.

Before you begin, install the IDE and compiler to your machine:

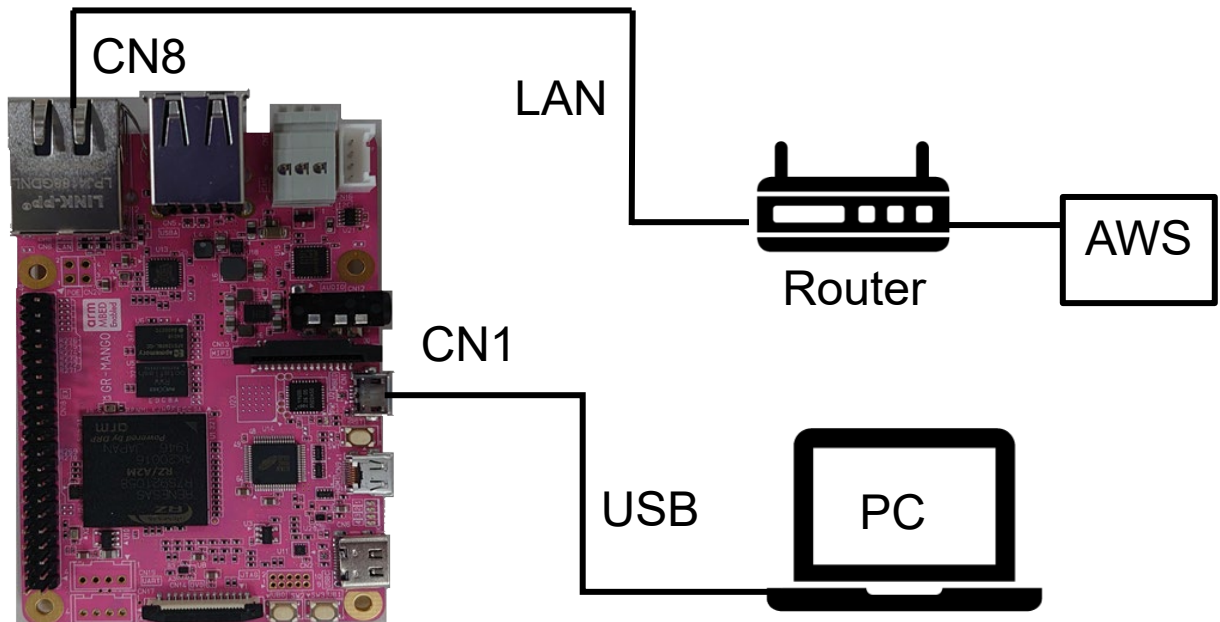
To install e²studio:

1. Browse to [e²studio](#) and choose **Download Software**. **Make sure to use** e²studio version 7.8.0 or later.
2. Unzip and run the installer. Follow the prompts for the section 2.1 and 2.2 of the [e²studio Getting Started Guide](#).

In this document, **Wired Ethernet** and **SX-SDMAC** are indicated to the part needed different settings.

Connecting a Debugger

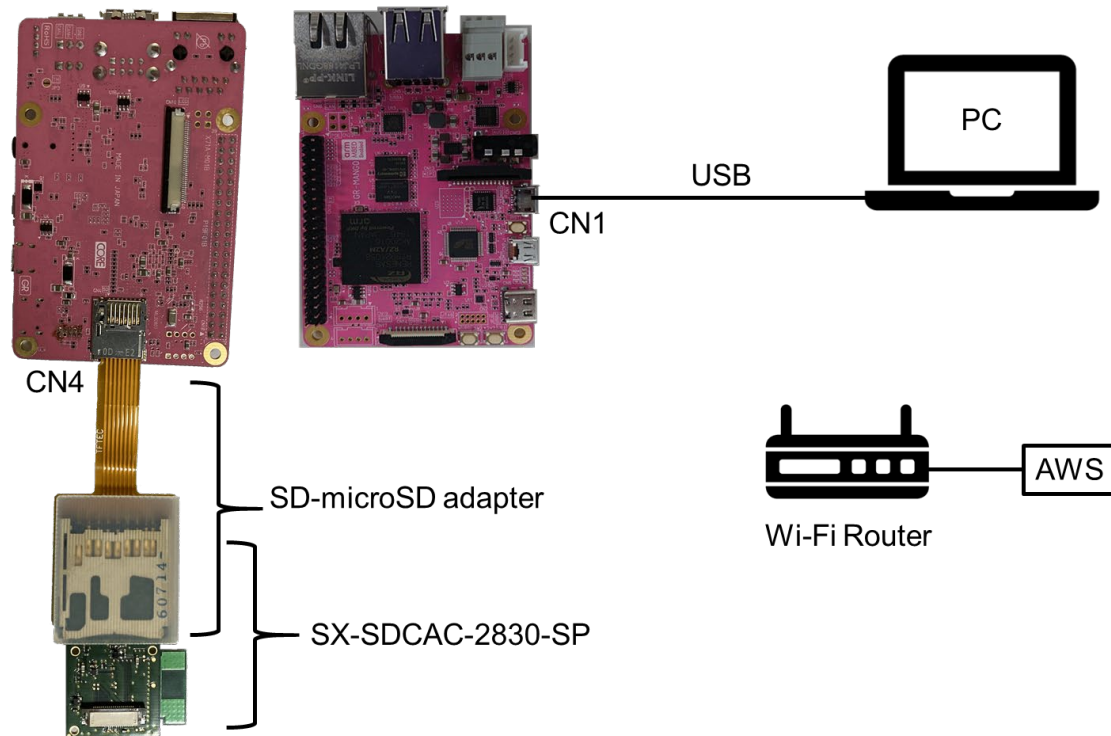
Wired Ethernet



1. Connect USB cable from CN1 to a spare USB port on your PC.
2. Connect LAN cable from CN8 to a router can access AWS.

SX-SDMAC

Solder side



1. Connect USB cable form CN1 to a spare USB port on your PC.
2. Insert SX-SDCAC to CN4.

Download and Build FreeRTOS

After your environment is set up, you can download 'Renesas GR-MANGO Application Example' and run the demo code.

Download FreeRTOS

1. Browse to the [GitHub Page](#) and download the code.
2. Unzip the downloaded file to a folder and make a note of the folder path. In this tutorial, this folder is referred to as BASE_FOLDER.

Note: The e²studio doesn't support long path names. To accommodate the files in the FreeRTOS projects, make sure the path to the directory is less than 260 characters and does not contain spaces or special characters.

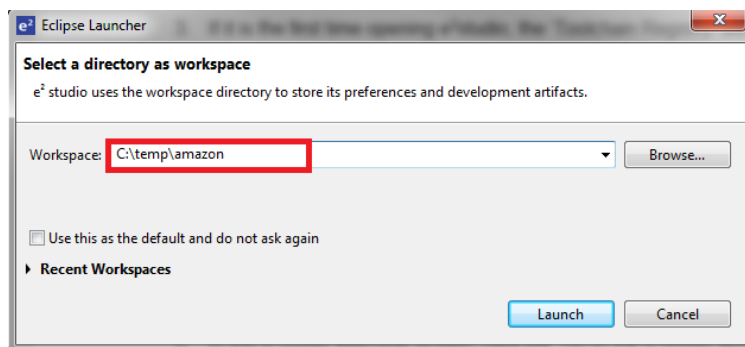
Import the FreeRTOS Demo Code into Your IDE

To import the FreeRTOS demo code into e²studio IDE

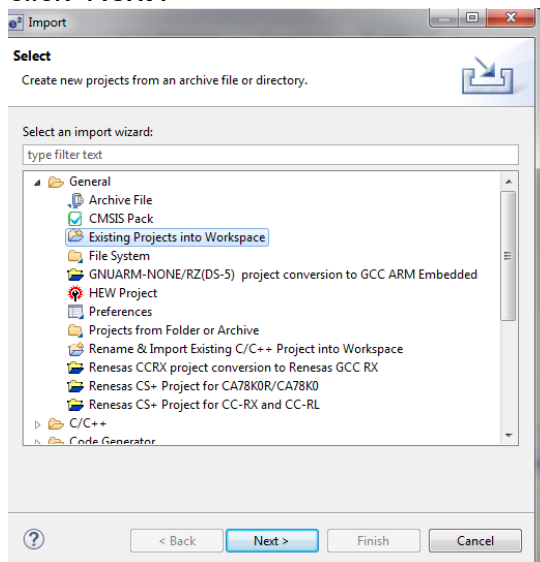
1. e²studio integrates various tools such as compiler, an assembler, debugger and an editor into a common graphical user interface. Start e²studio:

Windows™ 10: Start Menu>All Apps> Renesas Electronics e2studio>e2studio

2. In the 'Select a workspace' folder that appears, browse to the folder "...BASE_FOLDER\amazon". Click 'OK' to continue.



3. If it is the first time opening e²studio, the 'Toolchain Registry' window will open. In the 'Toolchain Registry' dialog select GCC ARM Embedded and ensure that '6.3.1.20170620' is selected. Click 'Register'. A dialog will appear "Selected Toolchains were successfully integrated with e²studio ". Click 'OK'.
4. In the 'Code Generator Registration' dialog click 'OK'. This window opens up first time only after installation.
5. A 'Code Generator COM component register' dialog will pop-up with the text "Please restart e²studio to use Code Generator". Click 'OK'.
6. In the 'Restart e²studio dialog, click 'OK'.
7. Once e²studio is restarted, then 'Select a workspace' window appears again with the folder path selected in step 2. Click 'OK'.
8. In the e²studio welcome screen, click 'Go to the e²studio workbench' arrow icon, on the far right.
9. Right click in the Project Explorer window, and select 'Import'.
10. In the import wizard, select General > Existing Projects into Workspace, and click 'Next'.



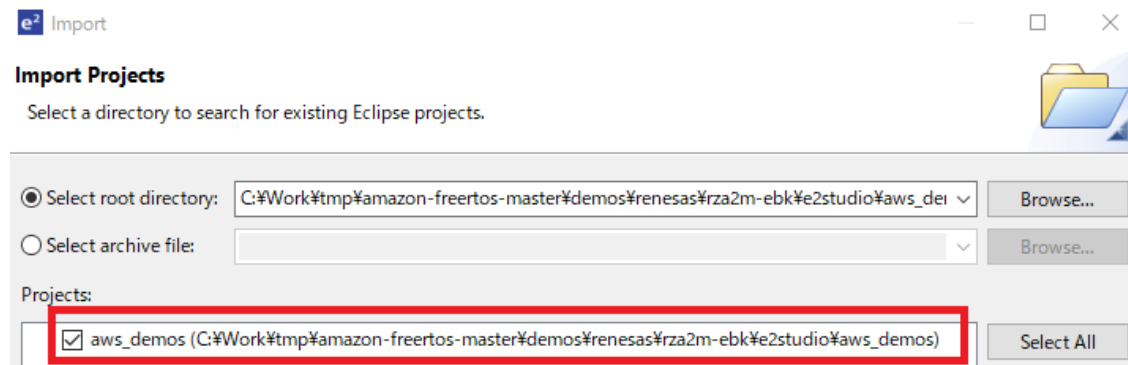
11. Click the 'Browse' button, and locate the following directory

Wired Ethernet

'<BASE_FOLDER>\projects\renesas\rza2m-gr-mango\e2studio\aws_demos'.

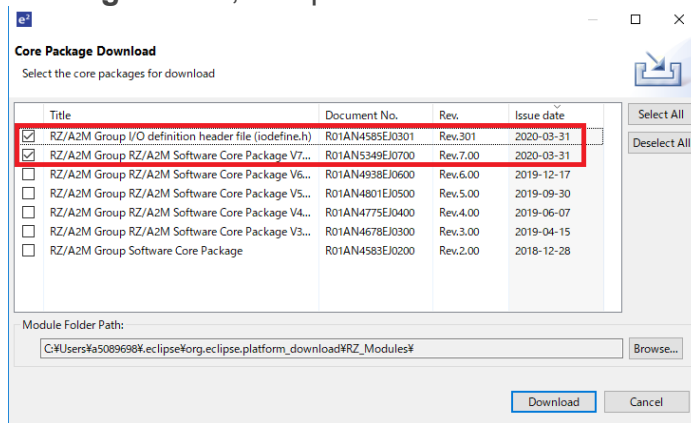
SX-SDMAC

'<BASE_FOLDER>\projects\renesas\rza2m-gr-mango-sdio-sx-sdmac\e2studio\aws_demos'.

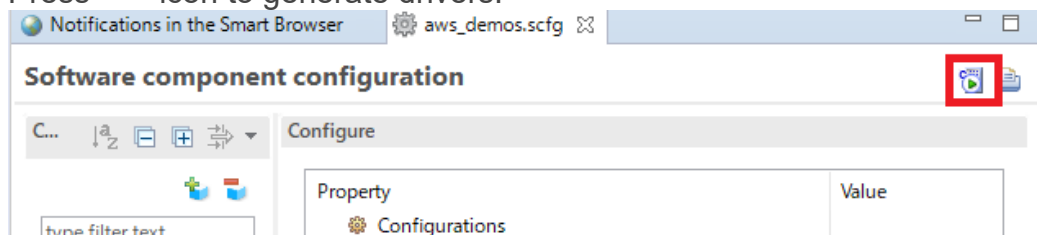


12. Click "Finish".

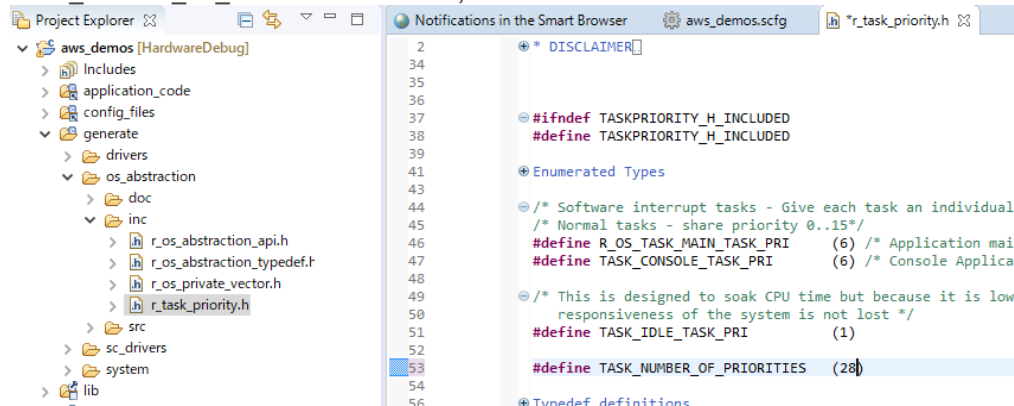
13. **SX-SDMAC** requires extra settings below. Steps a. to i. are required only once:
- Download [RZ/A2M SDIO Wi-Fi Package](#).
 - Add SILEX SX-SDMAC driver component to your PC by following the section 4 of [the release note of the package](#).
 - Doble click `aws_demos.scfg`.
 - Select **Components** tag.
 - Press  icon.
 - Software Component Selection dialog will be appeared. Click **Download more software components**.
 - Region Setting dialog will be appeared. Select your region and click OK.
 - Select **RZ/A2M I/O definition header file** and **RZ/A2M Software Core Package V8.10**, and press download.



- Close Software Component Selection dialog by pressing Cancel button.
- Press  icon to generate drivers.



- k. Open `generate\os_abstraction\inc\r_task_priority.h`, modify the value of `TASK_NUMBER_OF_PRIORITIES` to 28, and save the file.



The screenshot shows an IDE with the Project Explorer on the left and the source code editor on the right. The Project Explorer shows the file structure of the 'aws_demos' project, with the file `r_task_priority.h` selected under the path `generate > os_abstraction > inc`. The source code editor displays the contents of `r_task_priority.h`. The file includes a disclaimer, a check for `TASKPRIORITY_H_INCLUDED`, and several task priority definitions. The line `#define TASK_NUMBER_OF_PRIORITIES (28)` is highlighted in blue, indicating it has been modified.

```
2
34
35
36
37
38
39
41
43
44
45
46
47
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49
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51
52
53
54
55
56
```

```
/* DISCLAIMER */

#ifndef TASKPRIORITY_H_INCLUDED
#define TASKPRIORITY_H_INCLUDED

/* Enumerated Types */

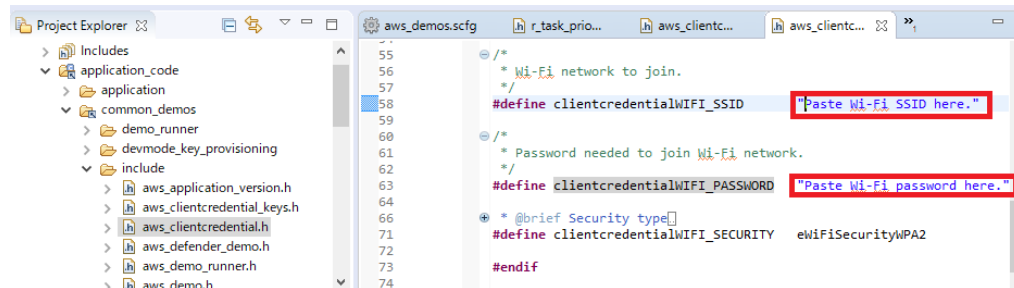
/* Software interrupt tasks - Give each task an individual
/* Normal tasks - share priority 0..15*/
#define R_OS_TASK_MAIN_TASK_PRI (6) /* Application mai
#define TASK_CONSOLE_TASK_PRI (6) /* Console Applica

/* This is designed to soak CPU time but because it is low
responsiveness of the system is not lost */
#define TASK_IDLE_TASK_PRI (1)

#define TASK_NUMBER_OF_PRIORITIES (28)

/* Tunedef definitions
```

- l. Open `application_code\common_demos\include\aws_clientcredential.h`, modify the value of `clientcredentialWIFI_SSID` and `clientcredentialWIFI_PASSWORD`, and save the file.



The screenshot shows an IDE with the Project Explorer on the left and the source code editor on the right. The Project Explorer shows the file structure of the 'aws_demos' project, with the file `aws_clientcredential.h` selected under the path `application_code > common_demos > include`. The source code editor displays the contents of `aws_clientcredential.h`. The file includes comments for Wi-Fi network joining and defines `clientcredentialWIFI_SSID` and `clientcredentialWIFI_PASSWORD`. The values `"Paste Wi-Fi SSID here."` and `"Paste Wi-Fi password here."` are highlighted in red boxes, indicating they have been modified.

```
55
56
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66
71
72
73
74
```

```
/*
 * Wi-Fi network to join.
 */
#define clientcredentialWIFI_SSID "Paste Wi-Fi SSID here."

/*
 * Password needed to join Wi-Fi network.
 */
#define clientcredentialWIFI_PASSWORD "Paste Wi-Fi password here."

/* @brief Security type */
#define clientcredentialWIFI_SECURITY eWiFiSecurityWPA2

#endif
```

14. In the **Project** menu, choose **Project->Build All**. The project should build with no errors.

Configure Your Project

To configure your project, you need to know your AWS IoT endpoint and Thing name that represents your board.

Configure AWS IoT endpoint

1. Login to aws account and Click on [IoT Core](#) services.
2. In the left navigation pane, choose **Settings**.
3. Copy your AWS IoT endpoint from the **Endpoint** text box. It should look like `<1234567890123>.iot.<us-east-1>.amazonaws.com`.
4. Open `aws_demos/application_code/common_demos/include/aws_clientcredential.h` and set `clientcredentialMQTT_BROKER_ENDPOINT` to your AWS IoT endpoint.

```
static const char clientcredentialMQTT_BROKER_ENDPOINT[] = "Paste AWS IoT Broker endpoint here.;"
```

5. In the left navigation pane, Click on Manage-> Things, and then Click on 'Create' to create a new Thing.
6. In the next window, click on "Create a single thing".

Creating AWS IoT things

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

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

Create a single thing

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

Create many things

7. Enter thing Name for your IoT board.

CREATE A THING

Add your device to the thing registry

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

Name

8. Open `aws_demos\application_code\common_demos\include\aws_clientcredential.h`. Specify AWS IoT thing for your board in the following `#define` constants from **Thing** pane in [AWS IoT console](#).

```
#define clientcredentialIOT_THING_NAME "Paste AWS IoT Thing name here."
```

9. Click next. In next window click on “Create Certificate”

CREATE A THING

Add a certificate for your thing

STEP 2/3

A certificate is used to authenticate your device's connection to AWS IoT.

One-click certificate creation (recommended)
This will generate a certificate, public key, and private key using AWS IoT's certificate authority.

Create certificate

10. Download the certificate.

Certificate created!

Download these files and save them in a safe place. Certificates can be retrieved at a after you close this page.

In order to connect a device, you need to download the following:

A certificate for this thing	f96334faa1.cert.pem	Download
A public key	f96334faa1.public.key	Download
A private key	f96334faa1.private.key	Download

You also need to download a root CA for AWS IoT:
A root CA for AWS IoT [Download](#)

Activate

11. Activate the certificate.

Certificate created!

Download these files and save them in a safe place. Certificates can be retrieved at a after you close this page.

In order to connect a device, you need to download the following:

A certificate for this thing	f96334faa1.cert.pem	Download
A public key	f96334faa1.public.key	Download
A private key	f96334faa1.private.key	Download

You also need to download a root CA for AWS IoT:
A root CA for AWS IoT [Download](#)

Activate

Create AWS IoT policy

1. In the left navigation pane, Click on **Secure-> Policies**, and then Click on "**Create a policy**" or "**Create**" to create a new policy.
2. Enter Policy name for your test.

Create a policy

Create a policy to define a set of authorized actions. You can learn more about IoT policies go to the [AWS IoT Policies document](#).

Name

test

3. Enter **iot:Connect** in Action box, replace `replaceWithAClientId` with **MQTTEcho** in Resource ARN box, check **Allow** in Effect, and click on **Add statement**.

Add statements

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

Action
iot:Connect
Resource ARN
arn:aws:iot:ap-northeast-1:123456789012:client/MQTTEcho
Effect
☒ Allow ☐ Deny

Add statement

4. Enter **iot:Publish** in Action box, replace `replaceWithATopic` with **freertos/demos/echo** in Resource ARN box, check **Allow** in Effect, and click on **Add statement**.

The screenshot shows the 'Add statement' form in the AWS IAM console. It is divided into three sections: 'Action', 'Resource ARN', and 'Effect'. In the 'Action' section, the text 'iot:Publish' is entered and highlighted with a red box. In the 'Resource ARN' section, the text 'arn:aws:iot:ap-northeast-1: [account ID]:topic/freertos/demos/echo' is entered, with 'freertos/demos/echo' highlighted by a red box. In the 'Effect' section, the 'Allow' checkbox is checked and highlighted with a red box, while the 'Deny' checkbox is unchecked.

Add statement

5. Enter **iot:Subscribe** in Action box, replace `replaceWithATopicFilter` with **freertos/demos/echo** in Resource ARN box, check **Allow** in Effect, and click on **Add statement**.

The screenshot shows the 'Add statement' form in the AWS IAM console. It is divided into three sections: 'Action', 'Resource ARN', and 'Effect'. In the 'Action' section, the text 'iot:Subscribe' is entered and highlighted with a red box. In the 'Resource ARN' section, the text 'arn:aws:iot:ap-northeast-1: [account ID]:topicfilter/freertos/demos/echo' is entered, with 'freertos/demos/echo' highlighted by a red box. In the 'Effect' section, the 'Allow' checkbox is checked and highlighted with a red box, while the 'Deny' checkbox is unchecked.

Add statement

6. Enter **iot:Receive** in Action box, replace **replaceWithATopic** with **freertos/demos/echo** in Resource ARN box, check **Allow** in Effect, and click on **Create**.

Action

iot:Receive

Resource ARN

arn:aws:iot:ap-northeast-1:123456789012:topic/freertos/demos/echo

Effect

☒ Allow ☐ Deny

Remove

Add statement

Create

7. In the left navigation pane, Click on **Secure-> Certificates**, and then Click on certificate created in the sequence 10 of **Configure AWS IoT endpoint** section above.
8. Click on Actions and select **Attach policy**.

Actions

- Activate
- Deactivate
- Revoke
- Accept transfer
- Reject transfer
- Revoke transfer
- Start transfer
- Attach policy
- Attach thing
- Download
- Delete

Certificate ARN

arn:aws:iot:ap-northeast-1:123456789012:cert/91fab...

Details

Issuer

OU=Amazon Web Services O=Amazon.com Inc. I=Seattle ST=Washi

9. Check the policy you created, then click on **Attach**.

Attach policies to certificate(s)

Policies will be attached to the following certificate(s):

[87156b4e41153a822c084c328f8b1d35483543cf15b47b1120e0d934d6a0f8d6d102ea](#)

Choose one or more policies

☐ rz_echo_test	View
☒ test	View

1 policy selected

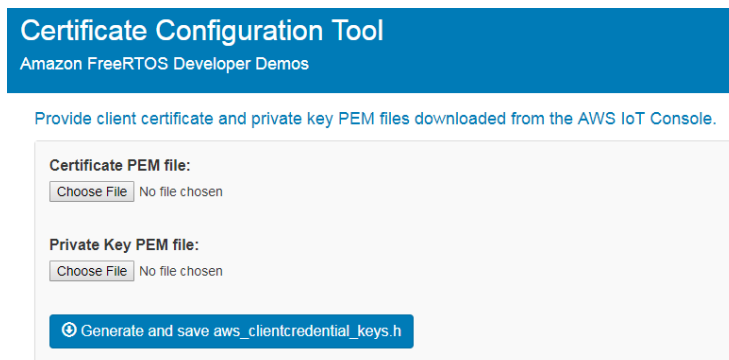
CancelAttach

Configure certificate and private key

The certificate and private key must be hard-coded into the FreeRTOS demo code. This is for demo purposes only. Production level applications should store these files in a secure location. FreeRTOS is a C language project, and the certificate and private key must be specially formatted to be added to the project.

To format your certificate and private key

1. In a browser window, open certificate configuration tool from project
`<BASE_FOLDER>\tools\certificate_configuration\CertificateConfigurator.html`.



The screenshot shows the 'Certificate Configuration Tool' interface. At the top, there is a blue header with the text 'Certificate Configuration Tool' and 'Amazon FreeRTOS Developer Demos'. Below the header, a blue instruction bar says 'Provide client certificate and private key PEM files downloaded from the AWS IoT Console.' The main area is a light gray box containing two sections: 'Certificate PEM file:' and 'Private Key PEM file:'. Each section has a 'Choose File' button and the text 'No file chosen'. At the bottom of the gray box is a blue button with a circular arrow icon and the text 'Generate and save aws_clientcredential_keys.h'.

2. Under **Certificate PEM file**, choose `certificate.pem.crt` you downloaded from the AWS IoT console in previous step.
3. Under **Private Key PEM file**, choose `private.pem.key` you downloaded from the AWS IoT console in previous step.
4. Choose **Generate and save aws_clientcredential_keys.h**, and then save the file in `<BASE_FOLDER>\demos\common\include`. This overwrites the file `aws_clientcredential_keys.h` in the directory.

Configure MAC address

Wired Ethernet

MAC address is NOT stored in the storage memory on the board. Therefore, you need to set MAC address to your project.

1. Get your MAC address.

GR-MANGO does not include MAC address. Please get MAC address.

2. Set MAC address in your code.

Edit **configMAC_ADDRN** (N=0, 1, ... ,5) macros defined in **FreeRTOSConfig.h** to the MAC address printed on CN9. Ethernet driver is configured to use CN9.

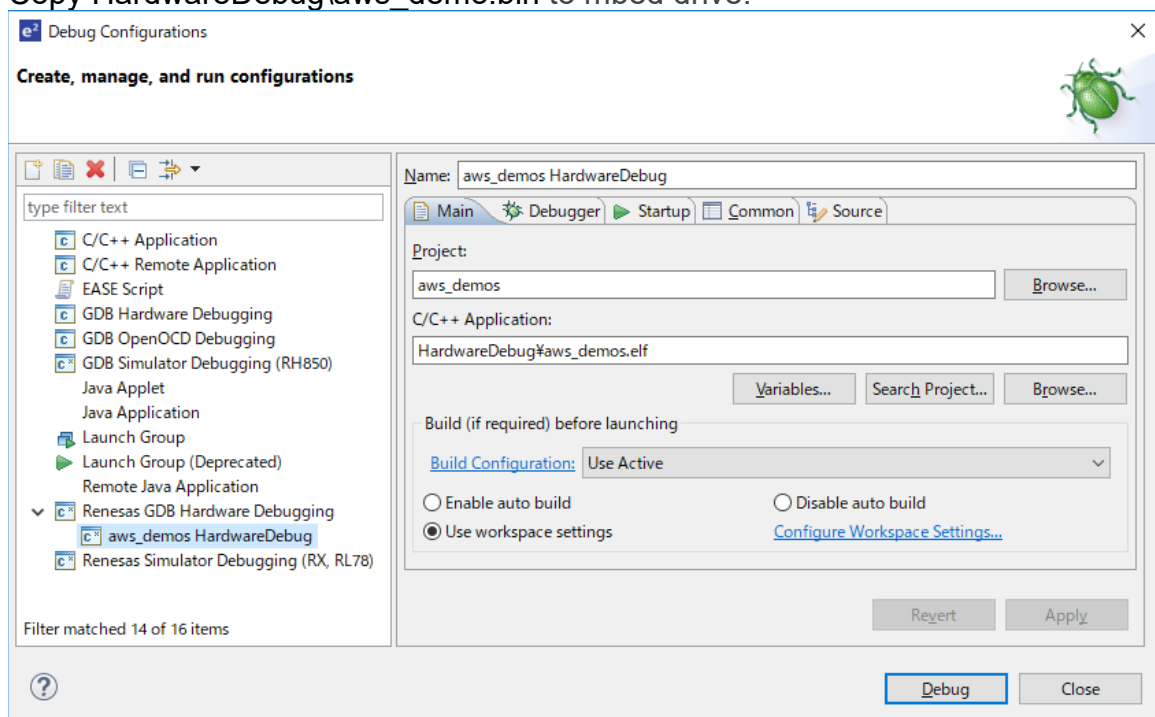
In the case your MAC address is 01:23:45:67:89:AB, set macros as follows:

```
#define configMAC_ADDR0          0x01
#define configMAC_ADDR1          0x23
#define configMAC_ADDR2          0x45
#define configMAC_ADDR3          0x67
#define configMAC_ADDR4          0x89
#define configMAC_ADDR5          0xAB
```

Run the FreeRTOS Demo

To run the FreeRTOS demos on the GR-MANGO:

1. Sign in to the [AWS IoT console](#).
2. In the left navigation pane, choose **Test** to open the MQTT client.
3. In the **Subscription topic** text box, type '**freertos/demos/echo**', and then choose **Subscribe to topic**.
4. Rebuild the project, "**Project->Build All**".
5. Connect USB cable from CN1. MBED drive will be mounted.
6. Copy HardwareDebug\aws_demo.bin to mbed drive.



7. **SX-SDMAC** Remove SX-SDMAC module and re-insert it to the board.
This procedure is specific to GR-MANGO which can't stop power supply to SDIO.
8. Press RST button on the board.

In the AWS IOT console MQTT client, you should see the MQTT messages sent by your device.

Note:

Refer to the following website for debugging:

<https://os.mbed.com/teams/Renesas/wiki/How-to-debug-with-e2-studio>

Note:

Please visit the following GitHub repository to get the latest projects (prototype), but not yet certified for other Renesas devices, compilers, and target boards.

<https://github.com/renesas-rz/amazon-freertos>

Troubleshooting

If no messages appear in the AWS IoT console, try the following:

1. Check that your network credentials are valid.
2. Verify the switch settings on your board.

Test OTA demonstration

Before testing OTA demonstration, it is recommended to test FreeRTOS Demo.

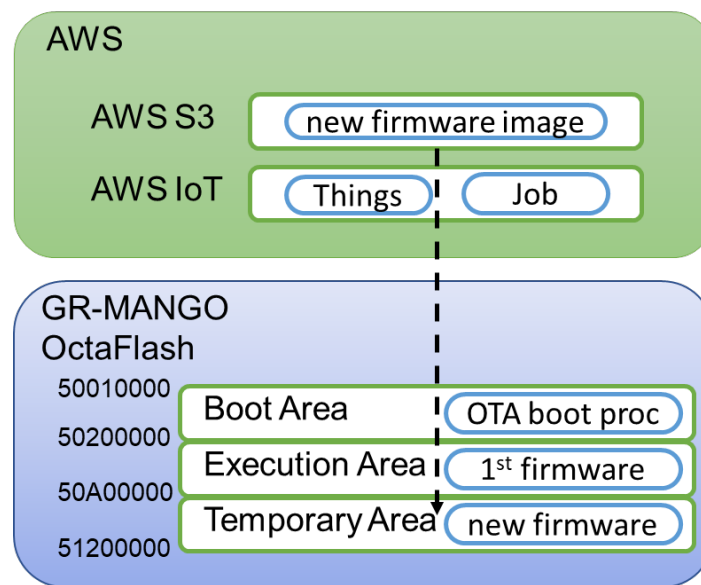
To realize OTA function, Octa Flash on the GR-MANGO Board is treated to split to 3 area stated below:

Boot Area – OTA boot proc is stored. OTA boot proc decides the firmware to execute.

Execution Area – Firmware to execute.

Temporary Area – Downloaded new firmware. If firmware exists in this area, OTA boot proc checks the firmware and copy it to Execution Area.

New firmware image is stored in AWS S3 Services, and is downloaded via AWS IoT Services.



In this section following steps are described:

1. Install needed software into PC.
2. Prepare settings by AWS console.
3. Generate the certificate used in OTA update.
4. Create firmware.
5. Create OTA job.
6. Execute OTA.

Install needed software into PC

Following software are needed to test OTA demonstration.

- OpenSSL
 - [Windows Download site](#)
Light version is OK.
 - Add path to openssl.exe.
- Python3.7
 - [Download site](#)
 - ECDSA is needed to install by following command:
\$ pip install ecdsa

▪

Prepare settings by AWS console

This section shows how to create S3 bucket to store the new firmware image, and create a role and policies required for OTA update.

This section is based on the following document:

<https://docs.aws.amazon.com/freertos/latest/userguide/ota-prereqs.html>

Create S3 bucket to store the new firmware image by following steps:

1. Launch web browser, and sign in to [AWS console](#).
2. Go to S3 console by inputting **S3** in **Find Services** in **AWS Management Console**.
3. Press **Create bucket** button.
4. Input **Bucket name** (in this document *rz-ota* is named as an example), and press **Create bucket** button.
5. Click created bucket.
6. Select **properties** tag.
7. Enable **Versioning**.

Create a role and policies required for OTA update by following steps:

8. Go to IAM console by pressing **Services** at the top of the screen, and inputting **IAM**.
9. Click Roles in the navigation pain at the left of the screen.
10. Press **Create role** button.
11. Choose **IoT** in the service list, select **IoT** in the use case list, and press **Next:Permissions** button.
12. Confirm 3 policies are displayed, and press **Next:Tags** button.
13. Input any keys if needed, and press **Next:Review** button.
14. Input Role name (in this document *role_rz-ota* is named as an example), and press **Create role** button.
15. Click created role in the role list.
16. Press **Attach policies** button.
17. Check the box at the left of **AmazonFreeRTOSOTAUpdate**, and press **Attach policy**.

18. Press **Add inline policy** at the right of Attach policies button.

19. Select **JSON** tab, copy following text to the text box, and press **Review policy** button:

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "iam:GetRole",
        "iam:PassRole"
      ],
      "Resource": "arn:aws:iam::nnnnnnnnnnnn:role/role_rz-ota"
    }
  ]
}
```

Replace **nnnnnnnnnnnn** to your AWS account ID composed of 12 numbers.

Replace **role_rz-ota** to the name you named at step 14.

20. Input Name (in this document *policy_rz-ota* is named as an example), and press **Create policy** button.

21. Press **Add inline policy** at the right of Attach policies button.

22. Select **JSON** tab, copy following text to the text box, and press **Review policy** button:

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

Replace **rz-ota** to the name you named at step 4.

23. Input Name (in this document *policy_rz-ota-S3* is named as an example), and press **Create policy** button.

Modify policy

24. Go to **IoT Core** console by pressing **Services** at the top of the screen, and inputting **IoT Core**.
25. In the left navigation pane, Click on **Secure-> Policies**, and then Click on the policy you created.
26. Click Edit policy document. And overwrite by following text:
Then press **Save as new version**.

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

Generate the certificate used in OTA update

This section shows how to generate certificate required for OTA update using OpenSSL.

Launch command prompt, go to your work folder, and enter following commands:

```
$ openssl ecparam genkey name secp256r1 out ca.key
$ openssl req x509 sha256 new nodes key ca.key days 3650 out ca.crt
    Input Country Name, State or Province Name, and other required information.
$ openssl ecparam genkey name secp256r1 out secp256r1.keypair
$ openssl req new sha256 key secp256r1.keypair > secp256r1.csr
    Input Country Name, State or Province Name, and other required information.
$ openssl x509 req sha256 days 3650 in secp256r1.csr CA ca.crt CAkey ca.key CACreateserial out secp256r1.crt
$ openssl ec in secp256r1.keypair outform PEM out secp256r1.privatekey
$ openssl ec in secp256r1.keypair outform PEM pubout out secp256r1.publickey
```

Create firmware

This section shows how to create ota_boot_proc, initial firmware, and new firmware.

Create ota_boot_proc by following steps:

1. Launch e² studio. If aws_demos project already exists, delete it. Import following 2 projects.

Wired Ethernet

- aws_demos (<BASE_FOLDER>\projects\renesas\rza2m-gr-mango\e2studio\aws_demos)
- ota_boot_proc (<BASE_FOLDER>\projects\renesas\rza2m-gr-mango\e2studio\ota_boot)

SX-SDMAC

- aws_demos (<BASE_FOLDER>\projects\renesas\rza2m-gr-mango-sdio-sx-sdmac\e2studio\aws_demos)
 - ota_boot_proc (<BASE_FOLDER>\projects\renesas\rza2m-gr-mango-sdio-sx-sdmac\e2studio\ota_boot)
2. Open secp256r1.publickey generated at the last section by text editor.
 3. Open ota_boot_proc\src\key\code_signer_public_key.h.
 4. Copy public key described in secp256r1.publickey to CODE_SIGNENR_PUBLIC_KEY_PEM in code_signer_public_key.h like below:

```
#define CODE_SIGNENR_PUBLIC_KEY_PEM "-----BEGIN PUBLIC KEY-----\"
"ABCDEFGHIJKLMN0PQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012345678901\"
"ABCDEFGHIJKLMN0PQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012345678901\"
"-----END PUBLIC KEY-----"
```

Note that red character is needed to add.

5. Build ota_boot_proc project.

Create initial firmware by following steps:

6. Copy your AWS IoT endpoint from the Endpoint text box. It should look like
`<1234567890123>.iot.<us-east-1>.amazonaws.com.`
7. Open `aws_demos/application_code/common_demos/include/aws_clientcredential.h` and set `clientcredentialMQTT_BROKER_ENDPOINT` to your AWS IoT endpoint.

```
static const char clientcredentialMQTT_BROKER_ENDPOINT[] = "Paste AWS IoT Broker endpoint here.";
```

8. Open `aws_demos\application_code\common_demos\include\aws_clientcredential.h`. Specify AWS IoT thing for your board in the following `#define` constants from **Thing** pane in [AWS IoT console](#).

```
#define clientcredentialIOT_THING_NAME "Paste AWS IoT Thing name here."
```

9. Format your certificate and private key following the way described in *To format your certificate and private key*.
10. Open
`<BASE_FOLDER>\lib\third_party\mcu_vendor\renesas\rz_mcu_boards\core_package\generate\linker_script_gr_mango.ld` by a text editor.
11. Modify ROM (rx):ORIGIN to **0x50200300** from **0x50010000**, erase following section, and save the file, and close. `0x50010000` is the start address for the environment in which `ota_boot_proc` is not used, or for debugging. `0x50200300` is the start address for the environment using `ota_boot_proc`.

```
.boot 0x50000000 :  
{  
    KEEP(*(.boot_loader))  
} > BOOT_LOADER
```

12. Open
`<BASE_FOLDER>\lib\third_party\mcu_vendor\renesas\rz_mcu_boards\core_package\generate\sc_drivers\r_octabus\inc\r_octabus_drv_sc_cfg.h` by a text editor.
13. Modify the second value of `OCTABUS_SC_TABLE` to **OCTABUS_INIT_AT_LOADER** from **OCTABUS_INIT_AT_APP**, save the file, and close. `ota_boot_proc` initializes OctaBus. To avoid initialize OctaBus twice, this modification is needed.
14. Open
`aws_demos/application_code/common_demos/include/aws_ota_codesigner_certificate.h` and copy the content of `secp256r1.crt` like below:

```
static const char signingcredentialSIGNING_CERTIFICATE_PEM[] = "-----BEGIN CERTIFICATE-----\n"  
"ABCDEFHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012345678901\n"  
"ABCDEFHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz012345678901\n"  
"-----END CERTIFICATE-----";
```

15. Open

aws_demos/application_code/common_demos/include/demo_runner/aws_demo_runner.c.
And modify the file to disable vStartMQTTEchoDemo() and enable
vStartOTAUpdateDemoTask() like below:

```
/* Demo declarations. */  
/* extern void vStartMQTTEchoDemo( void ); */  
extern void vStartOTAUpdateDemoTask( void );  
  
void DEMO_RUNNER_RunDemos( void )  
{  
    /*vStartMQTTEchoDemo();*/  
    vStartOTAUpdateDemoTask();  
}
```

16. **SX-SDMAC** requires extra settings described in step13 of *Import the FreeRTOS Demo Code into Your IDE*.

17. In the Project menu, choose Project->Build All. The project should build with no errors.

18. Confirm HardwareDebug\aws_demos.bin is generated.

19. Copy following 3 files to your work folder.

- a. HardwareDebug\aws_demos.bin
- b. **<BASE_FOLDER>**\lib\third_party\mcu_vendor\renesas\rz_mcu_boards\tools\initial-image-gen-gr-mango.py
- c. secp256r1.privatekey generated at the last section.
- d. ota_boot_proc\HardwareDebug\ota_boot_proc.bin

20. Launch command prompt and go to your work folder.

21. Open initial-image-gen-gr-mango.py by a text editor, and confirm filename:

```
# Input Filename  
input_file          = 'aws_demos.bin'  
# boot Filename  
boot_file           = 'ota_boot_proc.bin'  
# Output Filename  
output_file         = 'userprog.bin'  
# Input Key  
input_key_file      = 'secp256r1.privatekey'
```

22. Enter following command to generate initial firmware named userprog.bin:

```
$ python initial-image-gen-gr-mango.py
```

Create new firmware by following steps:

23. Open

aws_demos/application_code/common_demos/include/aws_application_version.h and modify the value of APP_VERSION_BUILD macro to 3 from 2.

24. In the Project menu, choose Project->Build All. The project should build with no errors.

25. Confirm **HardwareDebug\aws_demos.bin** is generated.

26. Copy following 3 files to your work folder.

e. HardwareDebug\aws_demos.bin

f. **<BASE_FOLDER>**\lib\third_party\mcu_vendor\renesas\rz_mcu_boards\tools\update-image-gen.py

g. secp256r1.privatekey generated at the last section.

27. Launch command prompt and go to your work folder.

28. Enter following command to generate new firmware named userprog.rsu:

```
$ python update-image-gen.py
```

Note that the name of the generated file is the same as initial firmware and the old file will be overwritten.

You can change the file name and sequence number by modifying update-image-gen.py.

```
# Input Filename
input_file           = 'aws_demos.bin'
# Output Filename
output_file          = 'userprog.rsu'
# Input Key
input_key_file        = 'secp256r1.privatekey'
# Firmware version (sequence number)
sequence_number       = 1
```

Create OTA job

In this section, upload the new firmware, and create AWS IoT job by AWS console.

Upload the new firmware to Amazon S3 by following steps:

1. Launch web browser, and sign in to AWS console.
2. Go to Amazon **S3** console.
3. Click **buckets** at the left of the screen.
4. Click the created bucket (*rz-ota* is named in this document).
5. Press **Upload**.
6. Drag and drop the generated new firmware (*useprog.rsu* is named in this document), and press **Next** button.
7. Manage users is displayed. Press **Next** button.
8. Storage class is displayed. Press **Next** button.
9. Press **Upload** button.

Create AWS IoT job by following steps. They are based on the document below:

<https://docs.aws.amazon.com/freertos/latest/userguide/ota-console-workflow.html>

10. Go to AWS **IoT** console by searching **iot core**.
11. Select **Manage** at the left of screen.
12. Select **Jobs** at the left of screen.
13. Press **Create** button.
14. Press **Create OTA update job** button.
15. Click **Select**, check the generated thing, and press **Next** button.
16. Click **Create** in the Code signing profile box.
17. **Create a code signing profile** dialog will be appeared.
18. Enter **Profile name**.
19. Click **Select** in Device hardware platform box, click **Select** at the right of **Windows Simulator**.
20. Click **Import** in Code signing certificate, select following files generated at *Generate the certificate used in OTA update* section:
 - a. Select Certificate - secp256r1.crt
 - b. Select Certificate private key - secp256r1.privatekey
 - c. Select Certificate chain (optional) - ca.crt
21. Press **Import** button, enter **Pathname of code signing certificate on device**, and click **Create** button.
22. Click **Select** in Select your firmware image in S3 or upload it, click S3 bucket (*rz-ota* is named in this document), and click **Select** at the right of uploaded new firmware.
23. Enter **Pathname of firmware image on device**.
24. Click **Select** in the Role (requires S3 access), click **Select** at the right of the created role (*role_rz-ota* is named in this document), and press **Next** button.
25. Enter a job name in the box under the **ID**, and press **Create** button. It is recommended to name with unique number.

Execute OTA

In this section, download the firmware in which ota_boot_proc and download initial firmware are combined, and update to the new firmware.

Download ota_boot_proc by the following steps:

1. Copy userprog.bin to mbed drive.
2. **SX-SDMAC** Remove SX-SDMAC module and re-insert it to the board. Then press RST button.

This procedure is specific to GR-MANGO which can't stop power supply to SDIO.

3. Confirm **OTA demo version 0.9.2** is displayed.

```
0 1 [IP-task] prvIPTask started
1 513 [Tmr Svc] recover retry count = 4.
2 513 [Tmr Svc] EEPROM(main) hash check...
3 515 [Tmr Svc] NG
4 515 [Tmr Svc] EEPROM(mirror) hash check...
5 517 [Tmr Svc] NG
6 517 [Tmr Svc] write EEPROM(main)...
7 1502 [Tmr Svc] OK
8 1503 [Tmr Svc] write EEPROM(mirror)...
9 2488 [Tmr Svc] OK
10 2488 [Tmr Svc] EEPROM setting OK.
11 2488 [Tmr Svc] EEPROM(main) hash check...
12 2490 [Tmr Svc] OK
13 2490 [Tmr Svc] EEPROM(mirror) hash check...
14 2492 [Tmr Svc] OK
15 2501 [Tmr Svc] Write certificate...
45 8864 [OTA] OTA demo version 0.9.2
```

4. Confirm starting OTA update automatically.

5. Confirm ota_boot_proc is executed after downloading the new firmware image.

```
2076 51267 [OTA Task] [prvPAL_ActivateNewImage] Changing the Startup Bank
2082 56267 [OTA Task] [prvPAL_ResetDevice] Resetting the device.
-----
RZ/A2M secure boot program
-----
Checking flash ROM status.
bank 0 status = 0xfc [LIFECYCLE_STATE_VALID]
bank 1 status = 0xfe [LIFECYCLE_STATE_TESTING]
integrity check scheme = sig-sha256-ecdsa
bank1(temporary area) on code flash integrity check...OK
update LIFECYCLE_STATE from [LIFECYCLE_STATE_TESTING] to [LIFECYCLE_STATE_VALID]
bank1(temporary area) block0 erase (to update LIFECYCLE_STATE)...bank1(temporary area) block0
write (to update LIFECYCLE_STATE)...swap bank...
-----
RZ/A2M secure boot program
-----
Checking flash ROM status.
bank 0 status = 0xfc [LIFECYCLE_STATE_VALID]
bank 1 status = 0xff [LIFECYCLE_STATE_BLANK]
integrity check scheme = sig-sha256-ecdsa
bank0(execute area) on code flash integrity check...OK
jump to user program
```

6. Confirm OTA demo version is changed. Confirm the version number is changed to 0.9.3 from 0.9.2. This indicates firmware has been updated.

```
0 1 [IP-task] prvIPTask started
1 513 [Tmr Svc] recover retry count = 4.
2 513 [Tmr Svc] EEPROM(main) hash check...
3 515 [Tmr Svc] OK
4 515 [Tmr Svc] EEPROM(mirror) hash check...
5 517 [Tmr Svc] OK
6 517 [Tmr Svc] EEPROM(main) hash check...
7 519 [Tmr Svc] OK
8 519 [Tmr Svc] EEPROM(mirror) hash check...
9 521 [Tmr Svc] OK
10 530 [Tmr Svc] Write certificate...
11 943 [Tmr Svc] recover retry count = 4.
12 943 [Tmr Svc] EEPROM(main) hash check...
13 945 [Tmr Svc] OK
14 945 [Tmr Svc] EEPROM(mirror) hash check...
15 947 [Tmr Svc] OK
40 6920 [OTA] OTA demo version 0.9.3
```