

RL78/G22

OTA Firmware Update for a Secondary MCU

Introduction

This application note is for a system in which an RX65N microcontroller is used as a primary MCU that communicates with Amazon Web Services[™] (hereafter, referred to as "AWS") and an RL78 microcontroller is used as a secondary MCU that receives data measured by sensors. This application note describes a demonstration where AWS services are used to perform an over-the-air (OTA) firmware update of the secondary MCU (hereafter, referred to as "secondary OTA update").



Devices Used in Confirming Operation

- RX65N
- RL78/G22
- Sensors

HS3001 high-performance relative humidity and temperature sensor (HS3001 sensor) FS3000 air velocity sensor module (FS3000 sensor)

Boards Used in Confirming Operation

- Primary MCU: CK-RX65N (RTK5CK65N0S04000BE)
- Secondary MCU: RL78/G22 Fast Prototyping Board (RTK7RLG220C0000BJ)
- Sensors
 - Relative Humidity Sensor Pmod™ Board (US082-HS3001EVZ) FS3000 Pmod™ Board (US082-FS3000EVZ)



Related Documents

RL78/G22 User's Manual: Hardware (R01UH0978)

RL78 Family User's Manual: Software (R01US0015)

RL78/G22, RL78/G23, RL78/G24 Firmware Update Module (R01AN6374)

RL78/G22 Fast Prototyping Board User's Manual (R20UT5121)

RX65N Group CK-RX65N v1 User's Manual (R20UT5100)

RX65N Group Sample Code for OTA Update of Secondary Device with Amazon Web Services Using FreeRTOS (R01AN6220)

RX Family How to implement FreeRTOS OTA using Amazon Web Services in RX65N (for v202210.01-LTS-rx-1.1.0 or later)

(Download the latest versions from the Renesas Electronics Corp. website.)

Technical Updates and Technical News

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1. Overview

This demonstration involves using a secondary OTA update to add a working sensor and confirming addition of the working sensor by the display of sensor data in an AWS display in your browser.

IoT devices require the appropriate fixing of security vulnerabilities and updating of functions in response to customer requests. Implementing the secondary OTA update to supplement OTA updating of the primary MCU that has been provided in the past enables product development that supports measures against vulnerabilities in the secondary MCU and the updating of flexible services.

2. Conditions for Confirming Operation

The sample demonstration programs for this application note have been confirmed to operate correctly under the following conditions.

Item	Description
MCU	RL78/G22 (R7F102GGE2DFB)
Board	RL78/G22 Fast Prototyping Board (RTK7RLG220C00000BJ)
Operating frequency	High-speed on-chip oscillator clock: 32 MHz
Operating voltage	3.3 V
Integrated development environment (IDE)	e ² studio V2024-01 (24.1.0) made by Renesas Electronics Corporation
C compiler	CC-RL v1.13.00 made by Renesas Electronics Corporation
Firmware programming tool	Renesas Flash Programmer V3.14.00
Smart Configurator (SC)	Renesas Smart Configurator for RL78 23.4.0.v20230320-0633
Board Support Package (BSP)	v1.62 (r_bsp)

Table 2-1 Conditions for Confirming Demo Operation (RL78/G22)

Table 2-2 Conditions for Confirming Demo Operation (Sensors)

Item	Description
Relative humidity and temperature sensor board	US082-HS3001EVZ board
Air velocity sensor board	US082-FS3000EVZ board

Table 2-3 Conditions for Confirming Demo Operation (RX65N)

Item	Description	
MCU	RX65N (R5F565NEHDFB)	
Board	CK-RX65N (RTK5CK65N0S04000BE)	
IDE	e ² studio V2024-01 (24.1.0)	
C compiler	CC-RX v3.06.00	
RTOS	FreeRTOS v202210.01-LTS-1.1.3	

Table 2-4 Conditions for Confirming Demo Operation (Others)

Item	Description
QE for OTA	V2.00
Python	3.10.4

QE for OTA is available at https://www.renesas.com/qe-ota/.

Python is available at https://www.python.org/.



3. Description of Hardware

3.1 System Configuration

The system consists of an RX65N microcontroller (primary MCU) that provides functionality for controlling communications with AWS and an RL78 microcontroller (secondary MCU) connected to the HS3001 and FS3000 sensors. The two microcontrollers communicate with each other via UARTs.

Via UART communications, this demonstration can perform secondary OTA updating of the RL78 microcontroller connected to sensors, the uploading of sensor data acquired from sensor boards to the cloud, and the display of sensor data.

The system configuration is shown in Figure 3-1.

An RL78/G22 Fast Prototyping Board (hereafter referred to as "RL78/G22 FPB") equipped with an RL78/G22 microcontroller is used as the secondary MCU.

The CK-RX65N equipped with an RX65N microcontroller is used as the primary MCU.

Also, a UART connection is made between the CK-RX65N and RL78/G22 FPB.



Figure 3-1 System Configuration of This Demo

3.2 List of Pins Used

Table 3-1 lists the pins of the RL78/G22 microcontroller that are used and their functions.

 Table 3-1
 Pins Used and Their Functions

Pin Name	Input/Output	Description
P12/TxD0	Output	Log output to the PC
P00/TxD1	Output	UART communications with the RX65N (transmission)
P01/RxD1	Input	UART communications with the RX65N (reception)
P70/SCL21	Output	I ² C communications with sensors (clock)
P71/SDA21	Input/Output	I ² C communications with sensors (data)

Caution In this application note, only the pins that are used are handled correctly. When actually creating a circuit, handle all pins appropriately and be sure to design a circuit that satisfies the hardware's electrical characteristics.



4. Description of Software

"FreeRTOS[™] with IoT Library" is implemented in the RX65N firmware, which utilizes AWS-certified programs. This allows the use of AWS IoT Core and AWS IoT Device Management, which are managed services provided by AWS, to perform OTA firmware updating and data uploading to the cloud via MQTT communications.

The RX65N microcontroller on the primary MCU side uses the AWS IoT Over-the-air Update Library to control OTA updating of the secondary MCU. The update firmware for the RL78 microcontroller, which is received from AWS, is then transmitted to the secondary MCU, where the firmware update is applied.

The RL78 microcontroller on the secondary MCU side uses "<u>RL78/G22,RL78/G23,RL78/G24 Firmware</u> <u>Update Module Rev.2.01</u>" to control OTA updating of the secondary MCU.

4.1 Firmware Update Methods

This application note provides sample programs for two among the methods provided by the firmware update module. The two methods are "partial update method (buffer side is internal flash)" (hereafter referred to as "partial update method") and "full update method (without buffer side)" (hereafter referred to as "full update method"). For details on these methods, refer to "1.3 Firmware Update Operation" in "RL78/G22,RL78/G23,RL78/G24 Firmware Update Module Rev.2.01".

4.1.1 Partial Update Method

The memory map of the sample program for executing partial update is shown in the following.



Figure 4-1 Memory Map of the Sample Program for Executing Partial Update

Operations for the partial update method are summarized in Figure 4-2. The states of the ROM in each phase of the OTA update are shown in Figure 4-3. Note that the red frames in Figure 4-3 indicate the programs under execution at the given times.





Figure 4-2 Overview of Operations for the Partial Update Method



Figure 4-3 States of ROM in Each Phase of OTA Updating by the Partial Update Method



4.1.2 Full Update Method

The memory map of the sample program for executing full update is shown in the following.



Figure 4-4 Memory Map of the Sample Program for Executing Full Update

Operations for the full update method are summarized in Figure 4-5. The states of the ROM in each phase of the OTA update are shown in Figure 4-6.







Figure 4-5 Overview of Operations for the Full Update Method



Figure 4-6 States of ROM in Each Phase of OTA Updating by the Full Update Method



4.2 Settings of Option Bytes

The settings of option bytes are listed below.

Table 4-1	Settings	of Option	Bytes
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Address	Setting	Details
000C0H or 020C0H	01101110B	Stops operation of the watchdog timer (counting is stopped after the microcontroller is released from the reset state).
000C1H or 020C1H	11111110B	LVD detection voltage: Reset mode In the case of rising: Typ. 1.90 V (1.84 V to 1.95 V) In the case of falling: Typ. 1.86 V (1.80 V to 1.91 V)
000C2H or 020C2H	11101000B	High-speed main (HS) mode or high-speed on-chip oscillator clock (fill): 32 MHz
000C3H or 020C3H	00000100B	Disables on-chip debugging.

4.3 Folder and File Structure

Figure 4-7 shows the folder structure of the sample programs.

Figure 4-7	Folder Structure of Sample Programs
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The ck_rx65n_2ndota_demo folder and ck_rx65n_demo_bootloader folder contain project files for the CK-RX65N.

The rl78g22_fpb_2ndota_demo folder and rl78g22_fpb_bootloader folder contain project files for the partial update method of the RL78/G22 FPB.

The rl78g22_fpb_2ndota_demo_full folder and rl78g22_fpb_bootloader_full folder contain project files for the full update method of the RL78/G22 FPB.

4.4 Code Size

Table 4-2 shows the code size for each project.

Table 4-2 Code Size

Project	ROM	RAM	
rl78g22_fpb_bootloader	11 Kbytes	0.8 Kbytes	
rl78g22_fpb_2ndota_demo	16 Kbytes	2 Kbytes	
rl78g22_fpb_bootloader_full	14 Kbytes	2 Kbytes	
rl78g22_fpb_2ndota_demo_full	18 Kbytes	2 Kbytes	



5. Operations of the Demonstration

The operations of the demonstration are common to the partial update method and full update method.

- (1) In the initial state of the demonstration, the RL78/G22 FPB only acquires temperature and humidity data by using the HS3001 sensor.
- (2) The secondary OTA update mechanism is used to download the update firmware for the RL78/G22 FPB from AWS via the CK-RX65N and then update the firmware.
- (3) After the firmware updating is complete, the RL78/G22 FPB acquires flow data from the FS3000 sensor as well as the data from the HS3001 sensor.

In this sequence, the type of sensor data from which data are being acquired and the values can be checked from the log output from both microcontrollers to your PC and from the dashboard on AWS.



6. Setting up the Demonstration

This section describes the setting up required to run the demonstration covered by this application note.

The necessary steps are setting up the hardware, such as the wiring of the CK-RX65N and RL78/G22 FPB and connection of the HS3001 and FS3000 sensors, setting up the software, such as creating and writing the initial firmware for each microcontroller board, and the preparation on the AWS cloud side for display of the sensor data from AWS.

6.1 Setting up the Hardware

6.1.1 Overall Structure

Firstly, the overall hardware structure for this demonstration is shown below. For an actual image after setup is complete, see Figure 6-12. The methods for setting up each of the boards are described in detail in the subsequent subsections.



Figure 6-1 Overall Hardware Structure for This Demo

6.1.2 Setting up the CK-RX65N

The procedure for setting up the CK-RX65N is described in the following passages.

(1) Connecting the cable for UART communications with the RL78/G22 FPB

TXD, RXD, and GND for UART communications with the RL78/G22 FPB are allocated to the following pins on the J8 and J3 connectors of the CK-RX65N. Connect the pins on the RL78/G22 FPB side as described in 6.1.3(2), with the corresponding UART signals listed in the table below.

Table 6-1	UART Connection between the CK-RX65N and RL78/G22 FPB
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CK-RX65N			RL78/G22 FPB	
UART Signal	Connector Pin Name		UART Signal	Connector Pin Name
TXD	J8-2 (TX►1)	\rightarrow	RXD	J7-1
RXD	J8-1 (RX ⋖ 0)	\leftarrow	TXD	J7-2
GND	J3-7 (GND)	_	GND	J8-7





Figure 6-2 Locations of Pins on the CK-RX65N Used for UART Communications between the Microcontrollers

(2) Connecting the cable for log output to the PC

Connect the PC to the USB serial connector (micro USB Type-B) on the CK-RX65N with a USB cable.







(3) Connecting the power supply and debugger

Connect the PC to the E2OB Debugger connector (micro USB Type-B) on the CK-RX65N with a USB cable.



Figure 6-4 Connection of the Power Supply and Debugger

(4) Connecting the LAN cable for Internet connection

Connect the LAN cable connected with the Internet to the Ethernet connector on the CK-RX65N.



Figure 6-5 Wired Internet Connection with the Ethernet

(5) Closing jumper block J16 on the DEBUG side

To set the CK-RX65N to debug mode, close jumper block J16 on the DEBUG side (pins 1-2).





Figure 6-6 Location of Jumper Block J16

6.1.3 Setting up the RL78/G22 FPB

The procedure for setting up the RL78/G22 FPB is described in the following passages.

(1) Setting the operating voltage to 3.3 V

To operate the RL78/G22 from a 3.3-V power supply, close the power selection header (J17) on the 2-3 side.



Figure 6-7 Location of the Power Selection Header (J17)

(2) Connecting the cable for UART communications with the CK-RX65N

TXD, RXD, and GND for UART communications with the CK-RX65N are allocated to the following pins on the J7 and J8 connectors of the RL78/G22 FPB. Connect the pins on the CK-RX65N side as described in 6.1.2(1), with the corresponding UART signals listed in Table 6-1.





Figure 6-8 Locations of Pins on the RL78/G22 FPB Used for UART Communications between the Microcontrollers

(3) Connecting the cable for log output to the PC and power supply

Connect the PC and the micro USB Type-B connector on the RL78/G22 FPB with a USB cable.



Figure 6-9 Connecting the PC and RL78/G22 FPB

(4) Connecting the HS3001 board and FS3000 board

Daisy-chain an HS3001 sensor board (hereafter referred to as "HS3001 board") and an FS3000 sensor board (hereafter referred to as "FS3000 board") to the Pmod2 connector on the RL78/G22 FPB. The order of connection of the sensor boards does not matter.

To pull up the I²C bus signal, close the two jumper block pins (J4 and J5) on the HS3001 board, and similarly close the two jumper block pins J4 and J5 on the FS3000 board. If the boards do not operate properly in this state, open the jumper block pins on one of the boards and adjust the resistance value.

Since the Pmod2 connector on the RL78/G22 FPB is Pmod Interface Type 2A/3A, so is not directly connectable to the HS3001 board and FS3000 board, which are Type 6A modules, they must be wired as shown in Figure 6-10.

Alternatively, the RL78/G22 FPB has a cut pattern that enables use of the Pmod2 connector as Type-6A, so this method can also be used. Refer to the "Pmod[™] Connectors" section in the <u>RL78/G22 Fast Prototyping</u> <u>Board User's Manual</u> for details.

Caution The US082-INTERPEVZ conversion board cannot be used with the RL78/G22 FPB.





Figure 6-10 Connecting the Pmod2 Connector on the RL78/G22 FPB to Sensor Boards

(5) Opening the USB-to-serial converter reset header (J15)

To use Micro USB as a COM port, open the USB-to-serial converter reset header (J15).



Figure 6-11 Location of the USB-to-Serial Converter Reset Header (J15)

The hardware setup for the demonstration is now completed. Figure 6-12 is an image of the overall configuration for the demonstration.





Figure 6-12 Image of the Overall Configuration for the Demo



6.2 Setting up the Software

6.2.1 Setting the Terminal Software

The terminal software (e.g., Tera Term) is required to generate log output using serial communication. The serial port settings are shown in the following.

Table 6-2 Serial Port Settings

Item	Setting
Baud rate	115,200 bps
Data	8 bits
Parity	None
Stop	1 bit
Flow control	None

6.2.2 Creating and Running the Initial Firmware for the CK-RX65N

Create initial firmware for the CK-RX65N by using QE for OTA and execute debugging in e² studio. The procedure is described below.

(1) Importing projects

Import the "ck_rx65n_demo_bootloader" project, a bootloader for the CK-RX65N, and the "ck_rx65n_2ndota_demo" project, a user program, into e² studio.

Click on [Import] from the [File] menu of e² studio. Select [Existing Projects into Workspace] and click on [Next].



Figure 6-13 Procedure for Importing e² studio Projects (1)

Select the folder of the sample program in [Select root directory] and tick the checkboxes of "ck_rx65n_2ndota_demo" and "ck_rx65n_demo_bootloader" among the displayed projects. After making sure that the [Copy projects into workspace] checkbox in the [Options] field is not ticked, click on [Finish].



		-
🔋 Import —		×
Import Projects		_
		7
Select a directory to search for existing Eclipse projects.	<u>/</u>	
Select root directory: C:\ws\r01an6935xx0110-rl78g22\Demo	Browse	
O Select archive file: ✓	Browse	
Projects:		
ck_rx65n_2ndota_demo (C:\ws\r01an6935xx0110-rl78g22\Demo\ck	Select All	
✓ ck_rx65n_demo_bootloader (C:\ws\r01an6935xx0110-rl78g22\Demo\ck	Select All	.11
rl78g22_fpb_2ndota_demo/full (C:\ws\r01an6935xx0110-rl78g22\D	Deselect A	All
rl78g22_fpb_2ndota_demo (C:\ws\r01an6935xx0110-rl78g22\Demo	Refresh	
rl78g22_fpb_bootloade_full (C:\ws\r01an6935xx0110-rl78g22\Den	nencan	<u> </u>
rl78g22_fpb_bootloager (C:\ws\r01an6935xx0110-rl78g22\Demo\rl		
Options		
Search for pes of 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	New	
Working sets:	Select	
Sack Next > Finish	Cancel	
Philsi	Cancel	

Figure 6-14 Procedure for Importing e² studio Projects (2)

(2) Opening the QE for OTA window

From the e^2 studio menu bar, select [Renesas Views] \rightarrow [Renesas QE] \rightarrow [OTA Main (QE)].

M ≥ C/C++ A Mai Code Generator Debug > Partner OS > Smart Configurator > Solution Toolkit > Renesas Software Installer OTA Main (QE) Cota Generator > Image: Configurator > Solution Toolkit > Image: Configurator >	oject	Renesas Views Run Window	Hel	р	
A Mai Code Generator Debug Partner OS Renesas QE Solution Toolkit Renesas Software Installer Code Generator Cod	5 2	C/C++	>	10	🖢 🛷 🕶 🗾 🔛 🗐 👖 😓 🖛 🏹 🕶 🏷 🗆
Debug > Partner OS > Renesas QE > Smart Configurator > Solution Toolkit > Configurater > OTA Main (QE) Solution Toolkit > Renesas Software Installer	A Mai		>		
Renesas QE Measuring Current Consumption (QE) Smart Configurator OTA Main (QE) Solution Toolkit OTA Manage IoT Device (QE) Renesas Software Installer OTA Manage IoT Device (QE)	A Mai	Debug	>	-n 2	^
Smart Configurator > Image: Configurator Solution Toolkit > Image: Configurator Renesas Software Installer OTA Manage IoT Device (QE)		Partner OS	>		
Solution Toolkit > OTA Manage IoT Device (QE)		Renesas QE	>	<u>/v</u> /	Measuring Current Consumption (QE)
Renesas Software Installer		Smart Configurator	>	•	OTA Main (QE)
		Solution Toolkit	>		OTA Manage IoT Device (QE)
				ian	on public kov

Figure 6-15 Opening the QE for OTA Window

(3) <QE for OTA> [1. Cloud Settings] \rightarrow [Sign-in to Cloud]

From here, follow the steps displayed in the GUI window of QE for OTA.

Start by selecting "AWS" for [Cloud] and sign in. An AWS resource is generated in the region selected at the time of login.



1.Cloud Settings Sign-in to Cloud 9.Sign-in to Cloud Setup to sign-in to Cloud 2.Prepare projects Cloud • Select provisioning Setup to sign-in to Cloud 3.Manage 10T device Sign-in to AWS • Create initial firmware Sign-in to AWS • Or Create update firmware · Create new LAM user account • Or to ate update firmware · Drue QE for OTA, you need an AWS IAM user account. If you do not have an LAM user account, please create a new one. Please refer to the following ULE in carwa count creation. Please count AWS for more information about AWS.	Cloud	Prepare	\rangle	IoT	\rangle \odot	OTA	
2. Prepare projects Setup to sign-in to Cloud 1. Seter provisioning Seture to sign-in to Cloud 3. Manage IoT device Sign-in to AWS Image IoT device Create new IAM user account Image IoT device Sign-in to AWS Image IoT device Create new IAM user account Image IoT device Sign-in to AWS Image IoT device Create new IAM user account Image IoT device Sign-in to AWS Image IoT device Create new IAM user account Image IoT device Sign-in to AWS	1.Cloud Settings	<u></u>		Sign-in to Clou	d		
2. Prepare projects Select projects Select provisioning Select provisioning Select provisioning Sumanage 10 T device Manage 10 T device Sign-in to AWS Create initial firmware Orrest update firmware Create update firmware Create update firmware To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	Sign-in to Cloud			Ū			
Select provisioning Sign-in Settings 3.Manage IoT device Sign-in to AWS O Create initial firmware Sign-in to AWS O Write program to IoT devices Sign-in to AWS Corrate update firmware Sign-in to AWS O Create update firmware Create new IAM user account O Create update firmware I. To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, II you do not have an IAM user account, II you do not have an IAM user account, II you do not have an IAM user account, II you do not have an IAM user account, II you do not have an IAM user account, II you do not have an IAM user account, II you do not have an IAM user account, II you do not have an I			ſ	Cloud		AWS	~
⊘ Manage IoT device Sign-In to AWS ⊘ Create initial firmware • Create new IAM user account ⊘ Write program to IoT devices • Sign_in to AWS 4.0TA ✓ ⊘ Create update firmware • Create new IAM user account ○ Create update firmware • I. To use QE for OTA, you used an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	• • •					Sign-in	Settings
Image: Create initial firmware Sign-in to AWS Write program to IoT devices • Create new IAM user account JOTA • Create new IAM user account Create update firmware • Create new IAM user account To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	3.Manage IoT device						
^o Create new IAM user account ^o Write program to IOT devices ^o Create new IAM user account ^o Traine not the order terms ^o I. To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	 Manage IoT device 	Share in the AWIS					
Write program to 10 1 overces Sign_in to AWS Create update firmware I. To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	 Create initial firmware 	Ŭ					
Create update firmware I. To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please I. To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	⊘ Write program to IoT devices						
Create update firmware I. To use QE for OTA, you need an AWS IAM user account. If you do not have an IAM user account, please create a new one. Please	4.0TA -	Create new IAM user account					
	 Create update firmware 						
 Telet to the following CKL for new account creation. Frease contact Aw 5 for more minimation about Aw 5. 	 Execute OTA and check status 						ne. Please

Figure 6-16 Signing in to AWS with QE for OTA

(4) <QE for OTA> [2. Prepare projects] \rightarrow [Select projects]

Select the ck_rx65n_demo_bootloader project and the ck_rx65n_2ndota_demo project that were imported into e^2 studio earlier.

Cloud	Prepare	⊘ loI	r >	0	ΟΤΑ
1.Cloud Settings	▲	Select pr	rojects		
Sign-in to Cloud					
2.Prepare projects				OTA project Cr	reate New Import
Select projects					
Select provisioning	Select created projects				
3.Manage IoT device 👻	1	Boot Loader	ck_n	x65n_demo_bootloader	r ~
Manage IoT device		Firmware	ck	_rx65n_2ndota_demo	~
⊘ Create initial firmware					
✓ Write program to IoT devices	Information of firmware project				
4.0TA -	internation of minimate project	Device: R5F565N	EHxFB_DUAL		
 	1	Evaluation Boar	d: CK-RX05N		

Figure 6-17 Selecting Projects

(5) <QE for OTA> [2. Prepare projects] \rightarrow [Select provisioning]

Select "Source code includes credentials (asymmetric keys)" as the provisioning method.

Cloud	⊘ Prepare	⊘ IoT	\rangle o	OTA	
1.Cloud Settings -	~	Select provision	ing		
⊘ Sign-in to Cloud	Select a provisioning.				
2.Prepare projects 👻	Select a provisioning.				_
 Select projects 		Provisioning	Source code includes	credentials (asymmetric keys)	;) v
 Select provisioning 					
3.Manage IoT device -					
 Manage IoT device 	Select provisioning(AWS)				
⊘ Create initial firmware	QE for V1.1.0 supports only 1 proviso	ning.			
⊘ Write program to IoT devices	OE Series How to install/uninstall	How to update FAO License			
4.0TA 👻					
⊘ Create update firmware					
 Execute OTA and check status 					

Figure 6-18 Selecting the Provisioning Method



(6) <QE for OTA> [3. Manage IoT device] \rightarrow [Manage IoT device]

Create an IoT device following the procedure of QE for OTA.



Figure 6-19 Creating an IoT Device

(7) <QE for OTA> [3. Manage IoT device] \rightarrow [Create initial firmware]

Create initial firmware following the procedure of QE for OTA.

Cloud	Ø Prepare	e 🖉	IoT	\rangle	OTA	
1.Cloud Settings	▼		Create initia	l firmware		
😔 Sign-in to Cloud						
2.Prepare projects	▼ Build Boot	t loader and Firmware	o create program fo	or IoT devices.		
Select projects				Crea	te initial firmware	Open view
Select provisioning						
3.Manage IoT device	- Create	initial firmware(A	WS)			
🔗 Manage IoT device			<i>.</i>			
⊘ Create initial firmware		epare creating initial fir • <u>Install OpenSSL</u>	mware			
⊘ Write program to IoT devices	• <u>Bu</u>	uild initial firmware				
4.OTA	🚽 Install O	OpenSSL				
⊘ Create update firmware		nSSL to create a code s				
 Execute OTA and check status 	If you ha	we not installed OpenS	SL, install it as follo	ows:		
	Wi	ben the following URL in32/Win64 OpenSSL I ownload and install Wir	nstaller for Windov	vs - Shining Ligh	tt Productions (slpro	<u>web.com)</u>
	Push [Og	oen View] button				
	Build ini	itial firmware				
	Pu: To 2. Spi 3. Pu:	• • 🗶 • 🔹 Sync Cloud (1	te the initial firmwa , push [Add all] bu ial firmware.	are in list of [all I tton.	×	

Figure 6-20 Creating the Initial Firmware



(8) <QE for OTA> [3. Manage IoT device] \rightarrow [Write program to IoT devices]

Write the initial firmware to the CK-RX65N following the procedure of QE for OTA.



Figure 6-21 Writing the Initial Firmware

(9) Checking operation

Close jumper block J16 in Figure 6-6 on the RUN side (pins 2-3).

Launch the terminal software, and if the log is output as shown in Figure 6-22, the CK-RX65N is ready to run.

If the terminal software fails to connect to the COM port, open the "Firmware Log" view of QE for OTA and check if QE for OTA is not connected to the COM port.

Figure 6-22 Log Screen of the CK-RX65N



6.2.3 Creating and Running the Initial Firmware for the RL78/G22 FPB

Create initial firmware for the RL78/G22 FPB and write it to the microcontroller by using the Renesas Flash Programmer. The procedure to be used in the case of the partial update method is described below. For the full update method, replace the names of the projects to be used, that is, replace the rl78g22_fpb_2ndota_demo project with the rl78g22_fpb_2ndota_demo_full project and the rl78g22_fpb_bootloader project with the rl78g22_fpb_bootloader_full project.

(1) Advance preparation

Execute the procedure in 5.2.2 in "5.2 Operating environment preparation" of "<u>RL78/G22,RL78/G23,RL78/G24 Firmware Update Module Rev.2.01</u>" to build the execution environment of the Renesas Image Generator.

(2) Importing projects

Import the "rI78g22_fpb_bootloader" project, which is a bootloader for the RL78/G22 FPB, and the "rI78g22_fpb_2ndota_demo" project, which is a user program, into e² studio.

Click on [Import] from the [File] menu of e² studio.



Figure 6-23 Procedure for Importing e² studio Projects (1)

Select [Existing Projects into Workspace] and click on [Next].

🕲 Import	
Select Create new projects from an archive file or directory.	Ľ
Select an import wizard: type filter text	
	Cancel

Figure 6-24 Procedure for Importing e² studio Projects (2)



Select the folder of the sample program in [Select root directory] and tick the checkboxes of "rl78g22_fpb_2ndota_demo" and "rl78g22_fpb_bootloader" among the displayed projects. After making sure that the [Copy projects into workspace] checkbox in the [Options] field is not ticked, click on [Finish].

👩 Import — 🗆 🗙
Import Projects
Select a directory to search for existing Eclipse projects.
Select root directory: C\ws\rl-ota-2nd-mcu-demo\full-update Browse
○ Select archive file: ✓ Browse
Projects:
rl78g22_fpb_2ndota_demo_full (C:\ws\rl-ota-2nd-mcu-demo\full-
☐ rl78g22_fpb_bootloader_full (C:\ws\rl-ota-2nd-mcu-demo\full-ug
Refresh
Options
Copy projects into workspace
Close newly imported projects upon completion Hide projects that already exist in the workspace
Working sets New
Working sets: V Select
(?) < Back Next > Finish Cancel

Figure 6-25 Procedure for Importing e² studio Projects (3)

(3) Building projects

Build the rl78g22_fpb_bootloader project and the rl78g22_fpb_2ndota_demo project and create a MOT file for each. The MOT files are created in the HardwareDebug folder directly under the project folder.

(4) Creating the initial firmware

The initial firmware for the RL78/G22 FPB is created by combining the created MOT files of the rl78g22_fpb_bootloader and rl78g22_fpb_2ndota_demo projects. The Renesas Image Generator is a tool for use in combining MOT files and is included with the "<u>RL78/G22,RL78/G23,RL78/G24 Firmware Update</u> <u>Module Rev.2.01</u>". For details, refer to the "Renesas Image Generator" section in the application note at the link above.

Execute the following command in the r01an6935jj0100-rl78g22/RenesasImageGenerator folder to create the initial firmware "initial_firm.mot".

> python image-gen.py -ip .\RL78_G22_ImageGenerator_PRM.csv ibp ..\rl78g22_fpb_bootloader\HardwareDebug\rl78g22_fpb_bootloader.mot iup ..\rl78g22_fpb_2ndota_demo\HardwareDebug\rl78g22_fpb_2ndota_demo.mot -o initial_firm

The command to be used in the case of the full update method is as follows:

```
> python image-gen.py -ip .\RL78_G22_FullUpdate_ImageGenerator_PRM.csv -
ibp ..\rl78g22_fpb_bootloader_full\HardwareDebug\rl78g22_fpb_bootloader_full.mot -
iup ..\rl78g22_fpb_2ndota_demo_full\HardwareDebug\rl78g22_fpb_2ndota_demo_full.mot -o
initial_firm
```



(5) Writing the initial firmware

Using the Renesas Flash Programmer, write the initial firmware "initial_firm.mot" that was created in the previous step to the RL78/G22 FPB.

Launch the Renesas Flash Programmer and click on [New Project] from the [File] menu.

Renesas Flash Programme		- 🗆 X	
New Project Open Project Save Project Save Image File File Checksum Set File Password 1 rl78g22_write.rpj 2 flash_project.rpj	lock Settings Flash Options Connect Settings 2.writerpj 2.gGE no¥full-update¥RenesasImageGenerator¥initial_firr CRC-82 :	n.mot Browse	
3 erase.rpj 4 erase.rpj 5 flash_project.rpj 6 rx65n3.rpj 7 rx65n.2rpj 8 rx65n.rpj Exit	, Start		
	2 000, Size : 64 K, Erase Size : 2 K) 000, Size : 2 K, Erase Size : 256)		
	[Clear status and message	·

Figure 6-26 Procedure for Writing the MOT File (1)

Select "RL78/G2x" for [Microcontroller] and enter a project name in [Project Name]. Next, select "COM port" for [Tool] and "2 wire UART" for [Interface] in the [Communication] field. Click on [Tool Details], then select the virtual COM port of the RL78/G22 FPB and click on [OK]. Finally, click on [Connect] and confirm that "Operation completed." will be displayed.



File Target Device Help Operation Operation Settings Block Settings Unique Code Project Information Internet Project Flain Little Wicrocontroller: RX Group Endian: Little Project Information Internet Project Project Information Wicrocontroller: RL78/G2x Project Information Flast Project Folder: CV#Users¥a5125794¥OneDrive - Renesas Elec Browse_ Communication Tool: COM port Interface: 2 wire UART Wide Voltage Renesas F Tool Details
Project Information Current Project flash projectrpj Microcontroller: RX Group Endian: Little Prog Project Information Microcontroller: RL78/G2x Project Information Microcontroller: RL78/G2x Project Name: rl78/g22_write Project Folder: C#Users¥a5125794#OneDrive - Renesas Elex Erx Project Folder: C#Users¥a5125794#OneDrive - Renesas Elex Communication Tool: COM port v Interface: 2 wire UART v Wide Voltage Tool Details_ Num: COM29
Loading Pr Connect Cancel ectrpi)

Figure 6-27 Procedure for Writing the MOT File (2)

Loadine Pr Programme OK Cancel Jash	File T. Operation Projec Curr Micr Progr Flast Era Era	Creats Select Tool Reset Settings Project IP Micro Projec Projec Projec Projec Tool	x x se	
--	--	---	-----------	--

Figure 6-28 Procedure for Writing the MOT File (3)



Renesas Flash Programmer V3.12.00	- 🗆 🗙	<
File Target Device Help		
Operation Operation Settings Block Settings Flash Options Connect Settings	Unique Code	
Project Information Current Project: r178g22_writerpj Microcontroller: R7F102GGE Program File	Browse	
Flash Operation Erase >> Program >> Verify Start		
Signature: Device: R7F102GGE Boot Firmware Version: V1.02 Device Code: 10 00 0A Code Flash (Address: 0x00000000, Size: 64 K, Erase Size: 2 K) Data Flash (Address: 0x000F1000, Size: 2 K, Erase Size: 256) Disconnection: the tool Operation completed.		~
	Clear status and message	

Figure 6-29 Procedure for Writing the MOT File (4)

Click on [Browse...] in the [Program File] field and select "initial_firm.mot" that was created by the Renesas Image Generator.

Click on [Start] to start the write operation.

Renesas Flash Programmer V3.12.00	- 🗆 X
File Target Device Help	
Operation Operation Settings Block Settings Flash Options	Connect Settings Unique Code
Project Information Current Project r178g22_write.rpj Microcontroller: R7F102GGE	
Program File	
C#ws¥rl-ota-2nd-mcu-demo¥full-update¥RenesasImage	Generator¥initial_firm.mot Browse CRC-32:0B91F1B5
Flash Operation Erase >> Program >> Verify Start	
Signature: Device: R7F102GGE Boot Firmware Version: V1.02 Device Code: 10 00 0A Code Flash (Address : 0x.00000000, Size : 64 K, Erase Size : 2 fo Data Flash (Address : 0x.000F1000, Size : 2 K, Erase Size : 256)	
Disconnecting the tool Operation completed.	,

Figure 6-30 Procedure for Writing the MOT File (5)



(6) Checking operation

Launch the terminal software, and if the values for temperature and humidity are output in the log as shown in Figure 6-31, the RL78/G22 FPB is ready to run.



Figure 6-31 Log Screen of the RL78/G22 FPB



6.3 Preparations for Using the AWS Cloud

Start by logging in to the AWS Management Console.

Manage AWS Resources - AWS Management Console - AWS (amazon.com)

Confirm the region displayed in the upper-right corner of the management console screen and select the same region as that set at the time of logging in to QE for OTA.



Figure 6-32 Confirming the Region

6.3.1 Settings for the OTA Update

Refer to the "<u>RX Family How to implement FreeRTOS OTA using Amazon Web Services in RX65N (for v202210.01-LTS-rx-1.1.0 or later)</u>" Application Note and make the necessary settings.

- (1) Create an Amazon S3 bucket according to the procedure described in "3.4 Creating an Amazon S3 bucket" in the above application note. The bucket name set here will be used when running the demonstration.
- (2) Create a service role according to the procedure described in "3.5 Allocating OTA execution permission to IAM users" in the above application note. The service role name set here will be used when running the demonstration.
- (3) Register a code signing certificate according to the procedure described in (5) to (9) in "5.2 Updating the firmware" in the above application note. The code signing certificate to be registered here is the certificate created when the initial firmware for the CK-RX65N was created by using QE for OTA in 6.2.2(7).

The certificate is created in "ck_rx65n_demo_bootloader/QE-OTA/codesigning". Specify secp256r1.crt for the certificate, secp256r1.privateKey for the private key, and ca.crt for the certificate chain.

✓ Fractional State - Ck_rx65n_demo_bootloader [ota-2nd-mcu-demo master]
> 🐙 Binaries
> 🔊 Includes
> 🗁 HardwareDebug
V 🕞 > QE-OTA
> 🔄 > bootloader
Codesigning
a.crt
📑 ca.key
secp256r1.crt
secp256r1.csr
📑 secp256r1.keypair
secp256r1.privateKey
secp256r1.publicKey
> 🔐 > src
ck_rx65n_demo_bootloader.rcpc
🆏 ck_rx65n_demo_bootloader.scfg
🕞 ck_rx65n_demo_bootloader HardwareDebug.launch
README.md
Peveloper Assistance [ota-2nd-mcu-demo master]

Figure 6-33 Location Where the Code Signing Certificate is Created



6.3.2 Settings for Displaying the Sensor Data

To display the received sensor data in a graphical format, set up Amazon CloudWatch and AWS IoT Core through the following steps.

Note: If you do not need to display the data in a graphical format, but only need to confirm in your browser that the data have been received by AWS, you can omit the entire procedure in 0. In this case, as shown in Figure 6-34, you can subscribe to "iotdemo/topic/sensor" in [MQTT test client] of AWS IoT to confirm in a text format that the sensor data are being received as expected.

aws Services Q Search	[Alt+S]
AWS IoT ×	AWS IoT > MQTT test client
Monitor	MQTT test client Info
Connect Connect one device	You can use the MQTT test client to monitor the MQTT messages being passed in your AWS account. Devices publish MQTT m AWS IoT. AWS IoT also publishes MQTT messages to inform devices and apps of changes and events. You can subscribe to MQ the MQTT test client.
Connect many devices	 Connection details You can update the connection details by choosing Disconnect and making updates on the Establish connection to continue page.
Test	
Device Advisor MQTT test client	Subscribe to a topic Publish to a topic
Device Location New	Topic filter info The topic filter describes the topic(s) to which you want to subscribe. The topic filter can include MQTT wildcard characters.
Manage	Enter the topic filter
All devices	Additional configuration
 Greengrass devices 	
LPWAN devices Software packages New	Subscribe

Figure 6-34 Confirming Data Reception by the MQTT Test Client



6.3.2.1 Setting up Amazon CloudWatch

(1) Creating rules in AWS IoT

Click on [AWS IoT] \rightarrow [Rules] \rightarrow [Create rule].



(2) Specifying the rule properties

Enter a rule name in [Rule name] and click on [Next].

=	AWS IoT > Message routing >	Rules > Create rule	6
	Step 1	Specify rule properties Info	
	Specify rule properties	A rule resource contains a list of actions based on the MQTT topic stream.	
	Step 2		
	Configure SQL statement	Rule properties	
	Step 3		
	Attach rule actions	Rule name	
	Step 4	cloudwatch_visualize_rule Enter an alphanumen-string that can also contain underscore () characters, but no spaces.	
	Review and create	Rule description - optional	
		Enter a description to provide additional densits about the rule to others.	
		A description of your new rule	
		▼ Tags - optional	
		No tags associated with the resource.	
		Add new tag	
		You can add up to 50 tags.	
		Cancel Next	
https://ap	-northeast-1.console.aws.amazon.com/console	e/home?region=ap-northeast-1 © 2024, Amazon Web Services, Inc. or its affiliates. Privacy Terms	Cookie preferences



(3) Setting the SQL statement

Enter the SQL statement by entering code like the following in the text editor field for [SQL statement]. Be sure to add a new line character at the end.

SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'

(A new line has to be entered at the end of the line above.)

AWS IoT > Message routing > R Step 1	
Specify rule properties	Configure SQL statement Info
Step 2	Add a simplified SQL syntax to filter messages received on an MQTT topic and push the data elsewhere.
Configure SQL statement	SQL statement
Step 3 Attach rule actions	SQL version The version of the SQL rules engine to use when evaluating the rule.
Step 4	2016-03-23
Review and create	SQL statement Enter a SQL statement using the following: SELECT «Attribute» FROM «Topic Filter» WHERE «Condition», For example: SELECT
	1 SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'
	SQL Ln 2, Col 1 I
	SQL DIZ, CHI
	Cancel Previous Next
dShell Feedback	© 2024, Amazon Web Services, Inc. or its affiliates. Privacy Terms Cookie prefer

(4) Selecting rule actions in the [Attach rule actions] step

Select "CloudWatch logs" for [Action 1] and click on [Create CloudWatch Log group].

Step 1 Specify rule properties	Attach rule actions Info An action routes data to a specific AWS service.	
Step 2 Configure SQL statement	SQL statement Back	
Step 3 Attach rule actions	<pre>SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'</pre>	
Step 4 Review and create	Rule actions Select one or more actions to happen when the above rule is matched by an inbound message. Actions define additional activities that occur when messages arrive, like storing them in a database, invoking cloud functions, or sending notifications. You can add up to 10 actions.	
	Action 1 CloudWatch logs Fend message data to CloudWatch logs Log group name Info	
	Choose a CloudWatch Log group C View C View C	
	Batch mode The payload that contains a JSON array of records will be sent to Cloud watch via a batch call. Use batch mode	
	IAM role	



(5) Creating a log group

Enter a log group name and click on [Create].

CloudWatch ×	CloudWatch > Log groups > Create log group	0
Favorites and recents	Create log group	0
Dashboards	create tog group	
Alarms ▲ 0 🕢 1 🖂 0	Log group details Info	
In alarm		
All alarms	CloudWatch Logs offers two log classes: Standard and Infrequent Access. Learn more about the features	
Logs	offered by each log class.	
Log groups	Log group name	
Log Anomalies	sensor-visualize	
live Tail		
ogs Insights	Retention setting	
Netrics		
Il metrics	Log class Infe	
xplorer	Standard	
treams	KMS key ARN - optional	
C-Ray traces		
Traces		
Trace Map	Tags	
Events	A tag is a label that you assign to an Amazon Web Services resource. Each tag consists of a rev and an optional value. You can use tags to search and filter your resources or track your Amazon Web Services costs.	
Rules		
Event Buses	No tags are associated with this log group.	
Application Signals	Add new tag	
Network monitoring	You can add up to 50 more tag(s).	
Insights		
Container Insights	Cancel	
ambda Insinhts		

(6) Creating a new role

Select the created log group in [Log group name] and click on [Create new role].

Step 1 Specify rule properties	Attach rule actions Info An action routes data to a specific AWS service.	
Step 2 Configure SQL statement	SQL statement Back	
Step 3 Attach rule actions	SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'	
Step 4 Review and create	Rule actions Select one or more actions to happen when the above rule is matched by an inbound message. Actions define additional activities that occur when messages arrive, like storing them in a database, invoking cloud functions, or sending notifications. You can add up to 10 actions.	
	Action 1	
	Batch mode The payload that contains a JSON array of records will be sent to Canad works via a batch call. Use batch mode	
	IAM role Choose an IAM role Choose an IAM role AVYS for access to your endpoint. Choose an IAM role AVYS for will automatically create a policy with a prefix of "aws-iot-rule" under your IAM role selected.	
	Add rule action	



(7) Selecting the created IAM role

Select the created role in [IAM role].

Step 1 Specify rule properties	Attach rule actions Info	
Step 2	An action routes data to a specific AWS service.	
Configure SQL statement	SQL statement Back	
Step 3 Attach rule actions	SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'	
Step 4 Review and create	Rule actions Select one or more actions to happen when the above rule is matched by an inhound message. Actions define additional activities that occur when messages arrive, like storing them in a database, liveking cloud functions, or sending notifications. You can add up to 10 actions.	
	Action 1 * CloudWatch logs Send message data to CloudWatch logs Log group name infe sensor-sisualize (Create CloudWatch Log group [2])	
	Batch mode The payload that contains a JSON array of records will be sent to Cloud watch via a batch call. Use batch mode IAM role	
	Ocose and the grant MPS for access to your endpoint. sensor-visualize-cloudwatch-role V AVPS for will accessful accessful a profix of "ave-stor-rule" under your LMA role selected.	
	Add rule action	

(8) Confirming successful creation of the rule

Click on [Next] and then click on [Create] on the subsequent page. Finally, confirm that the created rule is displayed in the list of rules.

Attach rule actions	SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'	0
Step 4 Review and create	Rule actions Select one or more actions to happen when the above rule is matched by an inbound message. Actions define additional activities that occur when messages arrive, like storing them in a database, invoking doud functions, or sending notifications. You can add up to 10 actions.	
	Action 1 V CloudWatch logs V Remove Log group name Info	
	sensor-visualize View [2] Create CloudWatch Log group [2] Batch mode that contains a JSON array of records will be sent to Cloud watch via a batch call.	
	Use batch mode HAff role Choice a net to grant AVS for access to your endpoint. Sensor-visualize-cloudwatch-trole View Create new role Create new role	
	AMS for will automatically create a policy with a prefix of "ave-i-to-rule" under your IAM role selected. Add rule action	
	Error action - optional "You can aptionally set an action that will be executed when something goes wrong with processing your rule. If two rule actions in the same rule fail, the error action reviews one message that contains both errors.	
	Add error action Cancel Previous Next	
CloudShell Feedback	© 2024, Amazon Web Services, Inc. or its affiliates. Privacy Terms Cookie prefe	rences


E Step 4 Review and create	Cloudwatch_visualize_nule Description
	·
	Step 2: SQL statement Edit
	SQL statement SQL version
	2016-03-23 SQL query
	SELECT *, timestamp() as timestamp FRON 'iotdemo/topic/sensor'
	Step 3: Rule actions Edit
	Actions
	CloudWatch logs Send message data to CloudWatch logs
	Log group name IAM role Batch mode sensor-visualize i armaevs.am:088695088161:role/s False ervice-role/sensor-visualize- cloudwatch-role i
	Error action
	No error action
	Cancel Previous Create
CloudShell Feedback	© 2024, Amazon Web Services, Inc. or its affiliates. Privacy Terms Cookie pr

AWS IoT \times	Successfully created rule cloudwatch_visualize_rule.	View rule 🗙
lonitor	AWS IOT > Message routing > Rules	
	Rules (1) Info C Activate Deactivate Edit Delete	Create rule
onnect	Rules allow your things to interact with other services. Rules are analyzed and perform specific actions based on messages published by your devices.	
Connect one device	Q. Find rules	< 1 > ©
Connect many devices	Q Find rules	< 1 > ③
	□ Name ▲ Status ♥ Rule topic ♥ Created date	~
ist	□ cloudwatch_visualize_rule ② Active iotdemo/topic/sensor February 19, 2024, 15:52:11 (UTC+09:00)	
Device Advisor	consumeror_resonance_nee Oucline indegination/person resonanting/consumeror_resonating/consumeror_resonanting/consumeror	
MQTT test client		
Device Location New		
anage		
All devices		
Greengrass devices		
LPWAN devices		
Software packages New		
Remote actions		
Message routing		
Rules		
Destinations		
Retained messages		
Security		
Fleet Hub		
evice software		
illing groups		
ettings		
	v	



(9) Checking the graphical display in Amazon CloudWatch

Display the screen of Amazon CloudWatch and click on [Logs Insights] on the menu at left.

Select the group that was created in 6.3.2.1(5) as the log group, enter the following query, and click on [Run query].

stats avg(hs300x_humidity), avg(hs300x_temperature), avg(fs3000_flow) by bin(1m)

A graph is displayed on the [Visualization] tabbed page.

loudWatch	×Î	Logs Insights Info	(Off) - new Local timezone ▼	^ =
		Select log groups, and then run a query or <u>choose a sample query</u> .		Discov
avorites and recents	•	Select up to 50 log groups.	Browse log groups	field
Dashboards				6
Alarms 🛕 0 ⊘ 1 💬 0		sensor-visualize X Clear all		Que
n alarm		<pre>stats-avg(hs300x_humidity), avg(hs300x_temperature), avg(fs3000_flow) by bin(1m)</pre>		
ll alarms				Ġ
ogs				He
og groups		🔀 Query generator	5 C @	
.og Anomalies		Run query Cancel Save History		
ive Tail		Logs Insights query on run for maximum of 60 minutes.		
ogs Insights		Ogs insignis query an on normalitation of on minutes.		
ogs msignts				
letrics		Logs (3) Patterns (-) Visualization		
ll metrics		Visualization	Add to dashboard	
xplorer				
treams		Graph type: Line 🔻		
-Ray traces			1. avg(hs300x_humidity)	
races		40	 2. avg(hs300x_humber) 	
ace Map		35	3. avg(fs3000_flow)	
are may		70		
vents		30		
ules		25		-



7. Procedure for Running the Demonstration

The procedure for running the demonstration is described in detail below.

7.1 Checking the Initial State of Operation

With the setup for the demonstration described in section 0 completed, press the reset switch (RST) on the RL78/G22 FPB to apply a hardware reset. Similarly, press the reset switch (S1) on the CK-RX65N to apply a hardware reset.

Check the logs from each of the microcontrollers by using terminal software.

Figure 7-1 shows the log screen of the CK-RX65N. Confirm that data from the HS3001 sensor are being output. Since the FS3000 sensor is not acquiring data, the value for that is 0.00. Below that, you can also see the log of sensor data being sent to AWS via MQTT communications.



Figure 7-1 Log Screen of the CK-RX65N



Next, Figure 7-2 shows the log screen of the RL78/G22 FPB. Confirm that only data from the HS3001 sensor are displayed.

🔟 COM29 - Tera Term VT		_	×
File Edit Setup Control Window	Help		
[HS3001]TEMP:27.97[°C], HU	MI:48.16[RH]		~
[HS3001]TEMP:27.97[°C], HU	MI:48.11[RH]		
[HS3001]TEMP:27.97[°C], HU	MI:48.11[RH]		
[HS3001]TEMP:27.98[° C], HU	MI:48.14[RH]		
[HS3001]TEMP:27.98[°C], HU	MI:48.12[RH]		
[HS3001]TEMP:27.98[°C], HU	MI:48.09[RH]		
	MI:48.08[RH]		
[HS3001]TEMP:27.97[°C], HU			
[HS3001]TEMP:27.98[°C], HU			
	MI:48.08[RH]		
[HS3001]TEMP:27.98[° C], HU	MI:48.02[RH]		
[HS3001]TEMP:27.95[° C], HU			
[HS3001]TEMP:27.97[°C], HU	MI:4/.9/LRHJ		

Figure 7-2 Log Screen of the RL78/G22 FPB

Finally, Figure 7-3 shows the display for Amazon CloudWatch. Confirm that the temperature and humidity data acquired from the HS3001 sensor are displayed as a graph.

CloudWatch ×	<pre>stats-avg(hs300x_humidity), avg(hs300x_temperature), avg(fs3000_flow) by bin(im)</pre>		=
Favorites and recents			overed elds
Dashboards	🔀 Query generator	500	~
 ▼ Alarms ▲ 0 ⊘ 1 ⊖ 0 In alarm All alarms 	Run query Cancel Save History Logs Insights query can run for maximum of 60 minutes. Image: Complete Image: Complete	Qui	eries
▼ Logs	Logs (14) Patterns (-) Visualization	H	elp
Log Anomalies	Visualization	Add to dashboard	
Live Tail	Graph type: Line 🔻		
▼ Metrics	40	 1. avg(hs300x_humidity) 2. avg(hs300x_temperature) 	
All metrics	35	3. avg(fs3000_flow)	
Streams			
 X-Ray traces Traces 	25		
Trace Map	15		
▼ Events Rules	10		
CloudShell Feedback	© 2024, Amazon Web Services	s, Inc. or its affiliates. Privacy Terms Cookie prefere	ences

Figure 7-3 Graphical Display of Amazon CloudWatch before the Secondary OTA Update

This is the initial state before the secondary OTA update is run.



7.2 Executing the OTA Update of the RL78/G22 FPB

7.2.1 Creating the Update Firmware

7.2.1.1 Partial Update Method

(1) Changing the source code of the rl78g22_fpb_2ndota_demo project

Change the definition of the "USE_SENSOR_FS3000" macro at line 53 of rl78g22_fpb_2ndota_demo/src/rl78g22_fpb_2ndota_demo.c from 0 to 1.

You can also change the firmware version displayed in the log output by setting FWUP_DEMO_VER_MAJOR, MINOR, and BUILD to desired values.

50	Macro definitions.	
52	#define USE_SENSOR_HS3001	(1)
53	#define USE_SENSOR_FS3000	(0)
54		
55	#define FWUP_DEMO_VER_MAJOR	(1)
56	#define FWUP_DEMO_VER_MINOR	(0)
57	#define FWUP_DEMO_VER_BUILD	(0)
50		

(2) Creating the update firmware (MOT file format)

Build the rl78g22_fpb_2ndota_demo project and create a MOT file.

(3) Creating the update firmware (RSU file format)

Convert the created rl78g22_fpb_2ndota_demo MOT file into update firmware in the RSU format by using the Renesas Image Generator.

Run the following command in the r01an6935jj0100-rl78g22/RenesasImageGenerator folder to create the RSU-format update firmware "update_firm.rsu".

```
> python .\image-gen.py -ip .\RL78_G22_ImageGenerator_PRM.csv -
iup ..\rl78g22_fpb_2ndota_demo\HardwareDebug\rl78g22_fpb_2ndota_demo.mot -o update_firm
```

7.2.1.2 Full Update Method

Create the update firmware by following a procedure similar to that in "7.2.1.1 Partial Update Method". Replace the project to be used, that is, the rl78g22_fpb_2ndota_demo project, with the rl78g22_fpb_2ndota_demo_full project.

The command for creating an RSU file is as follows:

```
> python .\image-gen.py -ip .\RL78_G22_FullUpdate_ImageGenerator_PRM.csv -
iup ..\rl78g22_fpb_2ndota_demo_full\HardwareDebug\rl78g22_fpb_2ndota_demo_full.mot -o
update_firm
```



7.2.2 Creating an OTA Job in AWS

(1) Sign in to the AWS Management Console and select [Services] in the upper-left corner, then select [Internet of Things] → [IoT Core].



Figure 7-4 Window of Services of AWS



(2) Select [Remote action] \rightarrow [Jobs] from the menu at left in AWS IoT Core and click on [Create job].

aws Services Q Search		[Alt+S]
AWS IoT ×	AWS IoT > Manage > Remote actions	> Jobs
Monitor	Jobs (200+) Info Jobs define a set of remote operations to send	
Connect	C Edit Cancel E	Delete Create job
Connect one device	C Pritter Jobs	
Connect many devices	Name	Type Statu
Test	AFR_OTA-rx660-2nd r6	Snapshot 📀 Co
 Device Advisor 	AFR_OTA-rx6-d-2nd-15	Snapshot 📀 Co
MQTT test client	AFR_2.A-rx660-2nd-14	Snapshot 📀 Co
Device Location New	AFR_OTA-rx660-2nd-13	Snapshot 🛛 📿 Co
Manage	AFR_OTA-rx660-2nd-12	Snapshot 📀 Co
Manage All devices 	AFR_OTA-rx660-2nd-11	Snapshot 📀 Co
Greengrass devices	AFR_OTA-rx660-2nd-10	Snapshot 📀 Co
LPWAN devices Software packages new	AFR_OTA-rx660-2nd-09	Snapshot 📀 Co
Software packages <u>new</u> Remote action	AFR_OTA-rx660-2nd-08	Snapshot 📀 Co
Jobs	AFR_OTA-rx660-2nd-07	Snapshot 📀 Co
Job templates	AFR_OTA-rx660-2nd-06	Snapshot 📀 Co
Secure tunnels Message routing	AFR_OTA-rx660-2nd-05	Snapshot 📀 Co

Figure 7-5 Window of AWS IoT Core



(3) On the [Create job] page, select "Create FreeRTOS OTA update job" and click on [Next].

aws	Services Q Search [Alt+S]
=	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, a FreeRTOS over-the-air (OTA) update job, or a Greengrass V1 Core 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.
	Create Greengrass V1 Core update job Create a snapshot job to update one or more Greengrass V1 Core devices with the latest Greengrass V1 Core or OTA agent version.
	Cancel

Figure 7-6 Page for Creating a Job

(4) On the [OTA job properties] page, enter a job name in [Job name] and click on [Next].

aws Services Q Search	[Alt+5]
■ AWS IoT > Jobs > Create job	> OTA job
Step 1 OTA job properties	OTA job properties Info
Step 2 OTA file configuration	Job properties
Step 3 OTA job configuration	Job name 2nd_mcu_ota_update_dermo-01 Enter a unique name without spaces. Valid characters: a-z, A-Z, 0-9, - (hyphen), and _ (underscore) Description - optional Enter job description
	Tags - optional
	Cancel

Figure 7-7 Page for Entering the Properties of the OTA Job



- (5) Enter the various items indicated below on the [OTA file configuration] page.
 - 1. In [Devices to update], select the IoT device name that was set in QE for OTA in 0.
 - 2. In [Select the protocol for file transfer], select "MQTT".
 - 3. In [Sign and choose your file], select "Sign a new file for me".
 - 4. In [Code signing profile], select the code signing profile that was created in 6.3.1(3).
 - **Note:** The code signing certificate profile specified here is not used for code signing verification of the firmware of the secondary MCU, so any profile can be specified. The code signing will be written in the RSU file of the update firmware when it is created by the Renesas Image Generator.
 - 5. In [File], select "Upload a new file.".
 - 6. In [File to upload], click on [Choose file] and select the firmware (.rsu format) that was created in 7.2.1 for use in updating the RL78/G22 FPB.
 - 7. In [S3 URL], click on [Browse S3] and select the Amazon S3 bucket that was set in 6.3.1(1).
 - 8. In [Path name of file on device], enter a desired string of characters.
 - 9. In [File type], enter "1" for the partial update method and "2" for the full update method.
 - 10. In [Role], select the service role for the OTA update that was set in 6.3.1(2).

After entering the above, click on [Next].





Figure 7-8 Page for Setting up the OTA File



(6) Just click on [Create job] on the [OTA job configuration] page as it is not necessary to make any changes.

aws	Services Q Search for services, f	features, blogs, docs, and more [Alt+S]
=	AWS IoT > Jobs > Create job >	OTA job
	Step 1 OTA job properties	OTA job configuration Info
	Step 2 OTA file configuration	Job run type Choose how to run this job.
	Step 3 OTA job configuration	 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.
		Cancel Back Create job

Figure 7-9 Page for Setting up the OTA Job

An OTA job for the secondary OTA update is created by following the above steps, and the OTA job is delivered to the specified device.

7.2.3 Checking Operation during Execution of the Secondary OTA Update

The OTA update starts within a few seconds after creation of the job. Both the CK-RX65N and RL78/G22 FPB will output logs of the progress of the secondary OTA update.



7.3 Checking Operation after the OTA Update

Figure 7-10 shows the log screen of the CK-RX65N after the update.

You can see that data from the FS3000 sensor are displayed in addition to those from the HS3001 sensor.

COM5 - Tera Term VT	_	×
File Edit Setup Control Window Help 2967 2235853 [Sensor Task] [INFO] Sent PUBLISH packet to broker iotdemo/topic/sensor to broker 2968 2237162 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2970 2240437 [Sensor Task] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2971 2240440 [Sensor Task] [INFO] [F33000 SENSOR] FLOM: 0.17 [m/sec] 2971 2240440 [Sensor Task] [INFO] [HS300X SENSOR] TEMPERATURE: 24.91 [deg C], HUMIDITY: 41.66 [%RH] 2972 2240760 [MQTT] [INFO] Publishing message to iotdemo/topic/sensor.		^
2973 2240760 [Sensor Task] [INFO] Sent PUBLISH packet to broker iotdemo/topic/sensor to broker 2974 2241174 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2975 2243180 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2976 2245186 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2977 2245437 [Sensor Task] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2978 2245440 [Sensor Task] [INFO] [FS3000 SENSOR] FLOW: 0.16 [m/sec] 2978 2245440 [Sensor Task] [INFO] [HS300X SENSOR] TEMPERATURE: 24.93 [deg C], HUMIDITY: 41.68 [%RH] 2979 2249067 [MUHIT] [INFO] Publishing message to iotdemo/topic/sensor.		
2980 2245667 [Sensor Task] [INFO] Sent PUBLISH packet to broker iotdemo/topic/sensor to broker 2981 2247192 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2982 2249198 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2983 2250437 [Sensor Task] [INFO] [FS3000 SENSOR] FLOW: 0.17 [m/sec] 2984 2250440 [Sensor Task] [INFO] [HS300X SENSOR] TEMPERATURE: 24.93 [deg C], HUMIDITY: 41.66 [%RH] 2985 2250574 [MQTT] [INFO] Publishing message to iotdemo/topic/sensor.		
2986 2250574 [Sensor Task] [INFO] Sent PUBLISH packet to broker iotdemo/topic/sensor to broker 2987 2251204 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2988 2253210 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2989 2255216 [S_OTA Demo] [INFO] Received: 0 Queued: 0 Processed: 0 Dropped: 0 2990 2255437 [Sensor Task] [INFO] [FS3000 SENSOR] FLOM: 0.17 [m/sec] 2991 2255440 [Sensor Task] [INFO] [HS300X SENSOR] TEMPERATURE: 24.93 [deg C], HUMIDITY: 41.79 [%RH] 2992 2255481 [MQTT] [INFO] Publishing message to iotdemo/topic/sensor.		
2993 2255481 [Sensor Task] [INFO] Sent PUBLISH packet to broker iotdemo/topic/sensor to broker		~

Figure 7-10 Log Screen of the CK-RX65N after the Firmware Update

Next, Figure 7-11 shows the log output for the RL78/G22 FPB after the update.

If the firmware update of the RL78/G22 FPB was successful, measured data are acquired from both the HS3001 and FS3000 sensors.



🚾 COM29 - Tera Term VT		— [⊐ ×
File Edit Setup Control W [FS3000]FLOW:0.18[m/sec [HS3001]TEMP:27.18[° C] [FS3000]FLOW:0.13[m/sec [HS3001]TEMP:27.18[° C] [FS3000]FLOW:0.08[m/sec [HS3001]TEMP:27.12[° C] [FS3000]FLOW:0.08[m/sec [HS3001]TEMP:27.10[° C] [FS3000]FLOW:15.00[m/sec [HS3001]TEMP:27.04[° C] [FS3000]FLOW:11.10[m/sec	c]], HUMI:57.42[RH] c]], HUMI:55.53[RH] c]], HUMI:51.95[RH] c]], HUMI:60.73[RH] ec]], HUMI:57.36[RH]		^
[HS3001]TEMP:27.06[° C] [FS3000]FLOW:0.06[m/sec [HS3001]TEMP:27.12[° C] [FS3000]FLOW:13.22[m/sec [HS3001]TEMP:27.07[° C] [FS3000]FLOW:2.17[m/sec [HS3001]TEMP:27.08[° C] [FS3000]FLOW:0.10[m/sec [HS3001]TEMP:27.15[° C] [FS3000]FLOW:9.32[m/sec [HS3001]TEMP:27.18[° C] [FS3000]FLOW:9.66[m/sec], HUMI:61.02[RH] c]], HUMI:60.73[RH] ec]], HUMI:58.95[RH] c]], HUMI:60.95[RH] c]], HUMI:60.78[RH] c]], HUMI:62.31[RH]	e was success ata are acquire 3001 sensor a sor.	ed

Figure 7-11 Log Screen of the RL78/G22 FPB after the Firmware Update

Finally, Figure 7-12 shows the display for Amazon CloudWatch. Confirm that the flow data acquired from the FS3000 sensor as well as the temperature and humidity data acquired from the HS3001 sensor are displayed as a graph.

CloudWatch	×			<i>"</i> =
Favorites and recents	Þ	🔀 Query generator	5 C ()	Discovered
Dashboards ▼ Alarms <u>A</u> 0 ⊘ 1 ⊙ 0 In alarm		Run query Cancel Save History Logs Insights query can run for maximum of 60 minutes. Somplete		fields D Queries
All alarms		Logs (31) Patterns (-) Visualization		٩
▼ Logs Log groups Log Anomalies		Visualization Graph type: Line 🔻	Add to dashboard	Help
Live Tail Logs Insights		45	1. avg(hs300x_humidity) 2. avg(hs300x_temperatu 3. avg(fs300x_ftemperatu 3. avg(fs300x_ftem)	
Metrics		35		
All metrics Explorer Streams		30		
 X-Ray traces 		20		
Traces Trace Map		15	/	
♥ Events Rules		5		
CloudShell Feedback			© 2024, Amazon Web Services, Inc. or its affiliates. Privacy Ter	rms Cookie preferences

Figure 7-12 Graphical Display of Amazon CloudWatch after the Secondary OTA Update

Operations for the demonstration are completed at this point.



8. Precautions

8.1 License Information on the Open-Source Software in Use

The following open-source software is used.

- TinyCrypt Cryptographic Library
 - URL: <u>https://01.org/tinycrypt</u>
 - --- License: <u>https://github.com/intel/tinycrypt/blob/master/LICENSE</u>
- FreeRTOS
 - URL: <u>https://www.freertos.org/</u>
 - License: <u>FreeRTOS open source licensing</u>, FreeRTOS license description, FreeRTOS license terms and OpenRTOS commercial licensing options.

8.2 Region and User Privileges of AWS for the Demonstration

Regarding the setup of AWS for running the demonstration, notes on the region of use and user privileges are given below.

<Region of use>

This demonstration is provided in the ap-northeast-1 (Asia Pacific (Tokyo)) region of AWS.

If you want to run this demonstration in another region, confirm that the services used in the demonstration are available in that region beforehand.

<User privileges>

This demonstration is to be run by a user with Administrator Access permission in the AWS Identity and Access Management (IAM) system. Therefore, there is no particular description regarding the granting of necessary permissions in IAM when using various services.

8.3 Fees for Using AWS

A charge may apply to the cloud resources created and used in the demonstration depending on how AWS is used. To avoid inadvertently incurring charges, deleting the resources created in the cloud after running the demonstration is recommended.



Revision History

		Description		
Rev.	Date	Page	Summary	
1.00	Jun 30, 2023		First edition issued.	
1.10	Mar 29, 2024	_	The full update method was added to the firmware update methods.	
		_	The term of 1 st MCU was changed to primary MCU and the term of 2 nd MCU was changed to secondary MCU.	
		5	The version of each software in the environment for confirming operation was updated.	
		17	A description on the operating voltage was added.	
		20	An image of the overall configuration for the demonstration was added.	
		25-26	Descriptions on how to import projects were added.	
		27-29	Descriptions on how to write firmware using the Renesas Flash Programmer were added.	
		31	The application note to be referenced when preparing to use the AWS cloud was modified.	
		32	A description on the procedure for confirming the AWS region was added.	
		33-38	The method for displaying sensor data on the screen of AWS was modified from OpenSearch to CloudWatch.	
		50	A description on the fees for using AWS was added to "8. Precautions".	



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 is supplied until the 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 systemevaluation test for the given product.

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