

RX Family

Sample Code for Secondary OTA Update using Microsoft Azure ADU

Introduction

This application note uses an RX65N that communicates with Microsoft Azure (hereinafter, Azure) and an RX660 connected to the RX65N via UART as a secondary microcontroller.

This application note describes a demo that uses IoT services provided by Azure to perform an OTA firmware update of the secondary microcontroller.



Target Device

Host MCU: RX65NSecondary MCU: RX660Sensor: HS3001 Relative Humidity and Temperature Sensor (HS3001 sensor)

Target Board

Host MCU	: CK-RX65N (RTK5CK65N0S04000BE)
Secondary MCU	: Target Board for RX660 (RTK5RX6600C00000BJ)
Sensor	: Relative Humidity Sensor Pmod [™] Board (US082-HS3001EVZ)

Related Documents

RX Family How to implement OTA by using Microsoft Azure Services (R01AN6928) RX Family Firmware Update Module Using Firmware Integration Technology (R01AN6850) RX Family Firmware Update Software Development Guide using AWS/Azure QE for OTA (R20AN0712) RX65N Group CK-RX65N v1 User's Manual (R20UT5100) RX660 Group Target Board for RX660 User's Manual (R20UT5068)



RX Family Sample Code

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1. Overview

The demonstration shows the operation of the OTA update of the firmware of the RX65N microcontroller connected to the Azure IoT Hub via Ethernet and the secondary microcontroller connected to the RX65N microcontroller via UART (hereinafter, secondary OTA update) using Azure Device Update (ADU), an OTA update service for IoT devices provided by Microsoft.

In this application note, the microcontroller connected to the Azure IoT Hub via Internet is called "Host" and the second microcontroller connected to Host via UART is called "Leaf."

IoT devices are required to fix security vulnerabilities as appropriate and update their functions according to customer requests. By implementing the secondary OTA update in addition to the OTA update of the Host that has been provided in the past, it is possible to realize product development that can respond to vulnerabilities in the Leaf and update flexible services.

2. Operation Confirmation Condition

The sample application has been confirmed to operate correctly in the following environment.

ltem	Description
MCU	RX65N (R5F565NEHDFB)
MCU board	CK-RX65N (RTK5CK65N0S04000BE)
Operating voltage	3.3V
RTOS	Azure RTOS 6.2.1_rel-rx-1.2.0
IDE	<u>e² studio 2023-07</u>
	<u>QE for OTA v1.10</u>
C Compiler	C/C++ Compiler Package for RX Family [CC-RX] v3.05.00
	GCC for Renesas RX 8.3.0.202202
Firmware programming tool	Renesas Flash Programmer V3.12.00

Table 2-1 Demo Operation Confirmation Conditions (RX65N)

Table 2-2 Demo Operation Confirmation Conditions (RX660)

Item	Description
MCU	<u>RX660 (R5F56609BDFP)</u>
MCU board	Target Board for RX660 (RTK5RX6600C00000BJ)
Operating voltage	3.3V
IDE	<u>e² studio 2023-07</u>
C Compiler	C/C++ Compiler Package for RX Family [CC-RX] v3.05.00
	GCC for Renesas RX 8.3.0.202202
Firmware programming tool	Renesas Flash Programmer V3.12.00
MOT file converter	Renesas Image generator (Included in the RX660 project)
USB-UART converter	PmodUSBUART™

Table 2-3 Demo Operation Confirmation Conditions (Senor Board)

Item	Description
Humidity and temperature sensor board	US082-HS3001EVZ Board

Table 2-4 Demo Operation Confirmation Conditions (Others)

Item	Description
Python	3.10.4
Azure IoT Explorer (preview)	0.15.8



3. Hardware Description

This system uses CK-RX65N with RX65N as Host and Target Board for RX660 (hereinafter, TB-RX660) with RX660 as Leaf.

In this demonstration, secondary OTA update (proxy updates) of the Leaf to which the sensor is connected and sensor data acquired by the sensor board can be uploaded to the cloud via UART communication between the microcontrollers.

Figure 3-1 shows the system configuration.



Figure 3-1 System Configuration of Demo



4. Software Description

The firmware of the RX65N on the host side is implemented with Azure RTOS.

Therefore, it is possible to perform OTA firmware update and upload data to the cloud via MQTT communication using Azure IoT Hub and Device Update for IoT Hub, which are services for IoT provided in the Azure cloud.

To control the secondary OTA update, the RX65N microcontroller on the Host side uses the <u>Azure ADU's</u> <u>proxy updates function</u> to send the updated firmware for the RX660 received from Azure to the RX660 microcontroller on the Leaf to achieve the firmware update.

To control the firmware update of the RX660 microcontroller on the Leaf side, use the "<u>RX Family Firmware</u> <u>Update module Using Firmware Integration Technology Rev.2.00</u>". Note that the macro values in the source code have been changed to use the Firmware Update Module Rev.2.00 on the RX660, and the operation has been confirmed only with the Happy path in this demo. Please refer to Chapter 8.2 for details.

Regarding uploading sensor data acquired by the sensor board to the cloud and visualization of sensor data, this is achieved by referring to "<u>RX65N Group Visualization of Sensor Data using RX65N Cloud Kit and Azure RTOS</u>".

4.1 Sample Program Structure

The firmware update mechanism of Leaf in this sample program uses the "Linear Mode Partial Update Method" among the methods provided by the firmware update module. For details of this method, please refer to "Linear Mode Partial Update Method" in Chapter 1.3 "Firmware Update Operation" of "<u>RX Family</u> <u>Firmware Update module Using Firmware Integration Technology Rev.2.00</u>".

The memory map of this sample program is shown below.



Figure 4-1 The Memory Map of This Sample Program



4.2 Folder and File Structure

The following are the folder and file structure.

r01an6925xx0100-rx-communication
Demo
│ │ └─ck_rx65n_azure_2ndota_demo
│ │ ├─ck_rx65n_demo_bootloader
│ │ │ │ │ │ │ │ │ │ │ │ │ │ │ │ │ │ │
│ │ └─rx660_tb_demo_bootloader
└─gcc
└─ck_rx65n_azure_2ndota_demo
│ └─ck_rx65n_demo_bootloader
│
│ └─rx660_tb_demo_bootloader
⊣r01an6925ej0100-rx-communication.pdf
└r01an6925jj0100-rx-communication.pdf

The ck_rx65n_demo_bootloader folder and ck_rx65n_azure_2ndota_demo folder contains project files for CK-RX65N.

The rx660_tb_demo_bootloader folder and rx660_tb_2ndota_demo folder contains project files for TB-RX660.

The main file structure of the ck_rx65n_azure_2ndota_demo folder(CC-RX) is shown below.





The main file structure of the rx660_tb_2ndota_demo folder(CC-RX) is shown below.

rx660_tb_2ndota_demo ⊢.cproject ⊢.project -rx660_tb_2ndota_demo.rcpc -rx660_tb_2ndota_demo.scfg −rfp └─rx660_program.rpj -----Senerator -RenesasImageGenerator -keys image-gen.py ∟src base64 └─cmdresp └─key -sensor -smc_gen ⊣tinycrypt └─rx660_tb_2ndota_demo.c



4.3 Code Size

Code sizes for each project are shown below. The code sizes in the table below are confirmed under the following conditions.

CC-RX

Compiler

Optimization level (-optimize): Level 2: Performs whole module optimization Optimization type (-speed/-size): Optimizes with emphasis on code size

Linker

Optimization type (-nooptimize/-optimize): All

Library Generator

Optimization level (-optimize): Level 2: Performs whole module optimization Optimization type (-speed/-size): Optimizes with emphasis on code size

Table 4-1 Code Size Lists (CC-RX)

Project	ROM	RAM
ck_rx65n_demo_bootloader	35KB	45KB
ck_rx65n_azure_2ndota_demo	570KB	224KB
rx660_tb_demo_bootloader	27KB	13KB
rx660_tb_2ndota_demo	49KB	22KB

GCC

Optimization level: Optimize for debug (-Og)

Table 4-2 Code Size Lists (GCC)

Project	ROM	RAM
ck_rx65n_demo_bootloader	62KB	47KB
ck_rx65n_azure_2ndota_demo	652KB	234KB
rx660_tb_demo_bootloader	59KB	17KB
rx660_tb_2ndota_demo	91KB	37KB



5. Demo Operation Description

- (1) In the initial state of the demo, TB-RX660 only acquires humidity data using the connected HS3001 sensor.
- (2) Using the secondary OTA update mechanism, downloads the updated firmware of TB-RX660 of the Leaf via CK-RX65N from Azure and updates the firmware. At the same time, the firmware update of the CK-RX65N of the Host is also performed.
- (3) After the firmware update, TB-RX660 acquires temperature data in addition to humidity data from the HS3001 sensor.

In the series of steps, the type of sensor data being acquired, and its value can be checked from the log output from both microcontrollers to the PC and Azure IoT Explorer.

6. Demo Setup

This section describes the setup required to run the demo in this application note.

Hardware setup such as wiring between CK-RX65N and TB-RX660 and connecting HS3001 sensor, software setup such as creating and writing initial firmware for each microcontroller board, and preparation on the Azure cloud side for executing OTA update and checking sensor data in Azure IoT Explorer are required.

6.1 Hardware Setup

6.1.1 Overall Structure

To begin, the overall hardware structure that comprises this demo is shown below. See Figure 6-12 for the actual image after setup. The following sections provide detailed instructions on how to setup each board.



Figure 6-1 Overall Hardware Structure of This Demo



6.1.2 Setup for CK-RX65N

The following shows how to setup the CK-RX65N.

(1) Cable Connection for UART Communication with TB-RX660

TXD, RXD and GND for UART communication with TB-RX660 are allocated to the following pins on the J8 and J3 connectors of CK-RX65N. Connect the pins on the TB-RX660 side as shown in 6.1.3(3), with the corresponding UART signals as shown in the table below.

Table 6-1 UART Connection between CK-RX65N and TB-RX660

CK-RX65N	(Note1)	HS3001 Pmod I/F		TB-RX660 Pmod I/F
J8 Pin 1: D0/RX (RXD7)	<>	Pin 9: TXD (Note1)	$\langle \rangle$	Pin 9: TXD9
J8 Pin 2: D1/TX (TXD7)	<>	Pin 10: RXD (Note1)	$\langle \rangle$	Pin 10: RXD9
J3 Pin 7: GND	<>	Pin 11: GND	$\langle \rangle$	Pin 11: GND

Note1: Since both pins of the HS3001 sensor board are directly connected, it can handle the input/output signals of the Pmod I/F of the TB-RX660.



Figure 6-2 Pin Positions in CK-RX65N Used for UART Communication between Microcontrollers



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(2) Cable Connection for Log Output to PC

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



Figure 6-3 Connection for Log Output to PC

(3) Power Supply and Connection with 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 for Power Supply and Debugger

(4) LAN Cable Connection for Internet

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



Figure 6-5 Wired Internet connection with Ethernet



(5) Short-circuit Jumper J16 to DEBUG Side

To set CK-RX65N to debug mode, short jumper J16 to the DEBUG side (pin 1-2).



Figure 6-6 Location of Jumper J16

6.1.3 Setup for TB-RX660

The following shows how to setup the CK-RX65N.

(1) Advance Preparation

Since the board in the shipped condition does not have headers attached to the through-holes, please make the following advance preparations.

- Refer to "5.13 Emulator Reset Header" in the <u>TB-RX660 User's Manual</u> and attach header pins.
- Refer to "5.14 Power-Supply Selection Header" in the TB-RX660 User's Manual to enable 3.3V voltage supply. In this demonstration, the RX660 is operated at 3.3V.
- Attach CN2 connector to TB-RX660.
- (2) Connection with HS3001 Board

Connect the HS3001 board to the Pmod connector on the TB-RX660.



Figure 6-7 Connection between Pmod Connector of TB-RX660 and Sensor Board



(3) Cable Connection for UART Communication with CK-RX65N

TXD, RXD and GND for UART communication with CK-RX65N are allocated to the following pins on the Pmod connector of TB-RX660. Connect the pins on the CK-RX65N side as shown in 6.1.2(1), with the corresponding UART signals as shown in the Table 6-1.



Figure 6-8 Pin Positions Used for UART Communication between Microcontrollers

(4) Cable Connection for Log Output to PC

TXD, RXD, and GND for log output to PC are allocated to the following pins on the MCU header CN2 of TB-RX660. Connect the pins of the PmodUSBUART converter with the corresponding UART signals as shown in the table and figure below.

Jumper JP1 on PmodUSBUART should be shorted on the VCC-LCL side. This will make the UART I/F voltage 3.3V with power from the micro USB side.

In addition, connect the micro USB Type-B connector of the PmodUSBUART converter to the PC with a USB cable.

Table 6-2 Connection of TB-RX660 and PmodUSBUART Converter

TB-RX660 MCU Header CN2		PmodUSBUART Pmod I/F
Pin 12: GND	\Leftrightarrow	Pin 5: GND
Pin 20: RXD1 (MCU P30)	⇔	Pin 3: TXD
Pin 22: TXD2 (MCU P26)	⇔	Pin 2: RXD



Figure 6-9 Cable Connection of Serial Communication for Log Output to PC for TB-RX660



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(5) Cable Connection for Power Supply

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



Figure 6-10 USB Connection for Power Supply and Emulator

(6) Open the Emulator Reset Header (J6)

Open the emulator reset header (J6) of TB-RX660.



Figure 6-11 Position of the Emulator Reset Header (J6)

That completes the hardware setup for the demonstration. Figure 6-12 shows an overall image of the demonstration configuration.





Figure 6-12 Overall Image of the Demo Configuration



6.2 Software Setup

The following procedure is performed with the sample project for the CC-RX compiler provided in this application note, but the procedure is the same for the project for GCC.

6.2.1 Advance Preparation

Install the software to be used in the demonstration. Please refer to Table 2-4 for the version of each software that has been confirmed to work.

(1) Install QE for OTA

Open [Renesas Views] \rightarrow [Renesas QE] from e² studio menu bar and check if QE for OTA is installed. If OTA Main (QE), OTA Manage IoT Device (QE) is available, it has already been installed.

If not, refer to chapter "2.1 Install QE for OTA" in "<u>RX Family Firmware Update Software Development Guide</u> using AWS/Azure QE for OTA" and install QE for OTA.



Figure 6-13 Check if QE for OTA is installed

(2) Install Python Runtime Environment

Python is available at <u>https://www.python.org/</u>.

In addition, we will use the pycryptodome library in Python. After installing Python, run the following pip command to install it.

> pip install pycryptodome

(3) Install Renesas Flash Programmer

Renesas Flash Programmer is available at Renesas Flash Programmer (Programming GUI) | Renesas.

6.2.2 Terminal Emulator Software Settings

Terminal emulator software (e.g., <u>Tera Term</u>) is required to generate log output using serial communication. The serial port settings are shown below.

Table 6-3 Serial Port Settings

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



6.2.3 Creating and Running Initial Firmware for CK-RX65N

Create initial firmware for CK-RX65N using QE for OTA and run debugging in e² studio. The procedure is shown below.

(1) Import Projects

Import the **ck_rx65n_demo_bootloader** project, a bootloader for the CK-RX65N, and the **ck_rx65n_azure_2ndota_demo** project, a user program for the CK-RX65N, provided as sample code in this application note, into e² studio.

When importing, please uncheck the option "Copy projects into workspace".

6	New Open File Open Projects from File System	Alt+Shift+N >	□ □ \$ 7	Select
	Recent Files	>		Create new projects from an archive file or directory.
	Close Editor Close All Editors	Ctrl+W Ctrl+Shift+W	ng existing code	Select an import wizard:
	Save Save As	Ctrl+S		type filter text
0	Save All Revert	Ctrl+Shift+S		Centeral Contention Con
	Move			File System
	Rename	F2		Preferences
<u>ه</u>	Convert Line Delimiters To			Projects from Folder or Archive
	Convert Line Deminiters to			Rename & Import Existing C/C++ Project into Workspace
-	Print	Ctri+P		Renesas CC-RX project conversion to Renesas GCC RX
2	Import			Renesas CS+ Project for CA/8K0R/CA/8K0
~1	Export			Renesas CS+ Project for CC-RA, CC-RL and CC-RH
	Properties	Alt+Enter		Sample Projects on Renesas Website
	Switch Workspace	>		> C/C++
_	Restart Exit			> Code Generator

Figure 6-14 Importing Projects (1)

Import – Import Projects Select a directory to search for existing Eclipse projects.	
Select root directory: C:\r01an6925xx0100-communication\Demo Select archive file: Projects: C:\r01an6925xx0100-communicatig C:\r01an6925xx0100-communicatig	Browse Browse
C k_rx65n_demo_bootloader (C:\r01an6925xx0100-communication) rx660_tb_2ndota_demo (C:\r01an6925xx0100-communication\Dem rx660_tb_demo_bootloader (C:\r01an6925xx0100-communication\	eselect All Refresh
Copy projects into workspace	
Hide projects that already exist in the workspace Working sets Add project to working sets Working sets Se	ew
? < Back Next > Finish	Cancel

Figure 6-15 Importing Projects (2)



(2) Open QE for OTA Screen

From the e² studio menu bar, select [Renesas Views] \rightarrow [Renesas QE] \rightarrow [OTA Main (QE)].



Figure 6-16 Open QE for OTA Screen

(3) [QE for OTA] 1. Cloud Settings

Execute the steps for Azure in chapter "4.3 Cloud Settings" of the "<u>RX Family Firmware Update Software</u> <u>Development Guide using AWS/Azure QE for OTA</u>". This will complete the configuration on the Azure Cloud side.

(4) [QE for OTA] 2. Prepare projects – Select projects

Select the ck_rx65n_demo_bootloader project and ck_rx65n_azure_2ndota_demo project that you just imported into e² studio. There is no need to import a new OTA project.

4 01	TA Main (QE) $ imes $									8 🗖 🗖
	\odot	Cloud	\rangle	Prepare	$\supset \odot$	IoT		\odot	ΟΤΑ	
1.0	loud Setting	gs	•	<u>^</u>		Select p	rojects			^
\odot) Sign-in to C	loud						G		(C
\odot	Cloud resou	rce setting		Select created projects				Crea	te new OTA project(refer guide)
2.P	repare proj	ects	•	Sciect created projects						
\odot) Select proje	cts				Boot Loader		ck_rx65n	_demo_bootloader	~
\odot) Select provi	sioning				Firmware		ck_rx65	5n_2ndota_demo	~
3.N	Ianage IoT (device	•	Information of firmware pro	ject					
\odot	Manage IoT	device				Devi	ce:			
\odot	Create initia	l firmware								
\odot) Write progra	am to IoT devices		Prepare OTA projec	t(Azure)					
4.0	OTA		•	OTA project (firmv	vare)					
\odot	Create upda	te firmware		 <u>Create new p</u> <u>Change settin</u> 	<u>project</u> ngs					
\odot	Execute OT	A and check status		 <u>Build project</u> OTA project (boot 	loader)					
				• <u>Create new p</u> • <u>Change setti</u>	<u>project</u>					
				<u>Build project</u>	<u>uga</u> t					
				Iroubleshooting Not install co	omponent in	Smart Configura	tor			•
				1						•

Figure 6-17 Selecting Projects



(5) [QE for OTA] 2. Prepare projects – Select provisioning

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

	Cloud	\rangle	Prepare	\bigcirc	IoT	\geqslant	OTA
1.Cloud Set	tings	•	~		Select prov	visioning	
🕢 Sign-in t	to Cloud						
✓ Cloud re	source setting		Select a provisioning.				
2.Prepare p	rojects	•			Provisioning	Source code include	es credentials (symmetric keys)
🕢 Select pr	rojects						
Select pr	rovisioning						

Figure 6-18 Selecting a Provisioning Method

(6) [QE for OTA] 3. Manage IoT device

Execute steps for Azure in chapter "4.5 Manage IoT Device" of the "<u>RX Family Firmware Update Software</u> <u>Development Guide using AWS/Azure QE for OTA</u>". This will complete the registration of the device to the Azure cloud and the writing of the initial firmware for the CK-RX65N.

(7) Operation Check

Short-circuit jumper J16 in Figure 6-6 to the RUN side (pin 2-3).

Launch the terminal emulator software, and if the log is output as shown in Figure 6-19, the CK-RX65N is ready.



Figure 6-19 CK-RX65N Log Output Window



6.2.4 Creating and Running Initial Firmware for TB-RX660

Create the initial firmware for the TB-RX660 and write it with the Renesas Flash Programmer. The procedure is shown below.

(1) Import Projects

As we did earlier with the project for the CK-RX65N, import the **rx660_tb_demo_bootloader** project, a bootloader for the TB-RX660, and the **rx660_tb_2ndota_demo** project, a user program for the TB-RX660, provided as sample code in this application note into e² studio.

(2) Build Projects

Build the rx660_tb_demo_bootloader project and the rx660_tb_2ndota_demo project, and create a MOT file. The MOT file is created in the HardwareDebug folder directly under the project folder.

(3) Create Initial Firmware

The initial firmware for TB-RX660 is created by combining the created MOT files of rx660_tb_demo_bootloader and rx660_tb_2ndota_demo. To combine MOT files, use the Renesas Image Generator. Renesas Image Generator is a tool included in the "<u>RX Family Firmware Update module Using Firmware Integration Technology Rev.2.00</u>". For details, please refer to the "Renesas Image Generator" chapter in the application note linked above.

Execute the following command in the rx660_tb_2ndota_demo\RenesasImageGenerator folder to create the initial firmware **initial_firm.mot**.

```
> python .\image-gen.py -iup ..\HardwareDebug\rx660_tb_2ndota_demo.mot -
ibp ..\.\rx660_tb_demo_bootloader\HardwareDebug\rx660_tb_demo_bootloader.mot -
o .\initial_firm -key .\keys\secp256r1.privatekey -
ip .\RX660_Linear_Half_ImageGenerator_PRM_2ndota_demo.csv -vt ecdsa
```



(4) Write Initial Firmware

Using Renesas Flash Programmer, write the initial firmware **initial_firm.mot** created above to the TB-RX660.

Open the Renesas Flash Programmer project **rx660_program.rpj** in the rx660_tb_2ndota_demo/rfp folder, specify the initial firmware **initial_firm.mot** and click Start.

Renesas Flash Programmer V3.12.00	\times
File Target Device Help	
Operation Operation Settings Block Settings Flash Options Connect Settings Unique Code	
Project Information Current Project: rx660_program.rpj Microcontroller: RX Group Endian: Little ~ Program File szure-proxy-adu-demo¥rx660_tb_2ndota_demo¥RenesasImageGenerator¥initial_firm[mot] Browse CRC-32 : 14B6CC4F Flash Operation [Erase >> Program >> Verify Start	
Renesas Flash Programmer V3.12.00 [3 July 2023] Loading Project (C:\ws\azure-proxy-adu-demo\rx660_tb_2ndota_demo\rfp\rx660_program.rpj)	
Clear status and messa	ge

Figure 6-20 Writing Initial Firmware with Renesas Flash Programmer

(5) Operation Check

Short-circuit the emulator reset header (J6) of the TB-RX660.

Launch the terminal emulator software, and if the log is output as shown in Figure 6-21, the TB-RX660 is ready.

COM9 - Tera Term VT	-	×	
rme can setup Control Window Hep ==== RX660 : BootLoader [with buffer] ==== verify install area 0 [sig-sha256-ecdsa]0K execute new image		^	
==== RX660 : Update from User [with buffer] ver 1.0.0 [HS3001]HUMI:58.06[RH] [HS3001]HUMI:58.77[RH] [HS3001]HUMI:58.6[RH] [HS3001]HUMI:58.12[RH] [HS3001]HUMI:58.16[RH] [HS3001]HUMI:58.00[RH] [HS3001]HUMI:57.81[RH]			
		~	

Figure 6-21 TB-RX660 Log Output Window



6.3 Setup for Data Visualization

6.3.1 Install Azure IoT Explorer

See the link below for instructions on how to install and use Azure IoT Explorer.

Install and use Azure IoT explorer - Azure IoT | Microsoft Learn

This application note only describes how to check sensor data sent by Host.

Please refer to the following link to obtain Azure IoT Explorer.

Releases · Azure/azure-iot-explorer (github.com)

6.3.2 Configure IoT Plug and Play Settings

Launch Azure IoT Explorer.

Select "IoT Plug and Play Settings" from the left menu, then select Add -> Local folder from the top menu.

Click "Pick a folder" and select the ck_rx65n_azure_2ndota_demo/model folder.

Click "Save" to save the settings.



Figure 6-22 Configure IoT Plug and Play Settings



6.3.3 Configure IoT Hub

Open the Azure portal in a browser and obtain the primary connection string from the IoT Hub you created.

In the Azure portal, select in the following order.

Azure IoT Hub -> Shared access policies -> iothubowner -> Primary connection string

Home > Resource groups > q	e_ota_resource_group > qe-iot-hub-20230731 230731144749726 Shared	iothubowner qe-iot-hub-20230731144749726	2			
IoT Hub Search	Shared access policies may be used to	generate security tokens to consume IoT hub functionality. Learn more	Regenerate primary key Regenerate secondary key Swap keys			
File upload	 Connect using shared access policies 		Primary key	٩	0	
Failover	Save 'Discard change		Secondary key	-	1.0	
Pricing and scale	Allow		Primer exception thing	•] 10	
Properties	Obeny		Primary connection string	•		
Locks	Manage shared access policies		Secondary connection string		-	
ecurity settings	+ Add shared access policy 🖒 R	efresh 🔟 Delete		•	0	
Shared access policies	Policy Name	Permissions	Permissions Registry Read			
 Networking 	iothubowner	Registry Read, Registry Write, Service Connect, Device Connect	Registry Write			
Certificates	service	Service Connect	Service Connect Device Connect			
efender for IoT	device	Device Connect				
Overview	registryRead	Registry Read				
Security Alerts	registryReadWrite	Registry Read, Registry Write				
Settings	deviceupdateservice	Registry Read, Service Connect. Device Connect				
lonitoring		registi redu, scrice connect, scrice connect				
Alerts						
Metrics						
	•		Update Permissions Cancel			

Figure 6-23 Obtaining the Primary Connection String

Select "IoT hubs" from the left side menu of Azure IoT Explorer.

Click "Connect via IoT Hub connection string".

File Eait View Window Help Azure IoT Explorer (preview)	i Settings
Image: Second	Welcome to Azure IoT Explorer, a cross-platform UI for interacting with devices attached to Azure IoT Hub Choose an authentication method and connect to an Azure IoT hub. IoT Hub uses permissions to grant access to each IoT hub endpoint. Permissions limit the access to an IoT hub based on functionality. Learn more Image: Connect via IoT Hub Connect via IoT Hub

Figure 6-24 Selecting a Connection Method with the IoT Hub



Click "Add connection".



Figure 6-25 Connection settings with IoT Hub

Enter the primary connection string you obtained in "Connection string".

Click "Save".

Azure IoT Explorer (preview) File Edit View Window Help Azure IoT Explorer (preview)		- □ × Add connection string
Home > IoT hubs		Connection string *
	+ Add connection 🔄	
윰 IoT hubs	No connections to di	
\mathcal{S}° IoT Plug and Play Settings	You will need to add an Ic	
Notification Center	storage and can be edited	Where do I get an IoT hub connection string? Please do not save your hub connection string to any unsafe locations
	Where do I get an IoT hui	Host name Shared access policy name Shared access policy key Comparison Co

Figure 6-26 Enter Primary Connection String



A list of devices registered in Azure IoT hub will be displayed.

Click the link of the Device ID.

Azure IoT Explorer (preview)					-	_		×
File Edit View Window Help								
Azure IoT Explorer (preview)						Ę	🔅 Set	tings
Home > qe-iot-hub-202307	31144749726	5 > Devices						
🛨 New 🖒 Refresh 🗎 Delete								
Query by device ID	$\rho \rightarrow (\gamma$	⁷ Add query parame	ter					
Device ID \checkmark	Status $^{\smallsetminus}$	Connectio \vee	Authentica \vee	Last status $ \smallsetminus $	IoT Plug and $ \smallsetminus $	Edge	devic	e 🗸
ck_rx65n_2ndota_demo	Enabled	Disconnected	Sas		dtmi:com:example :Thermostat;4			

Figure 6-27 IoT Hub Setup Complete.

6.3.4 Start Receiving Telemetry Data

Select "Telemetry" from the left menu.

Click "Start" to start displaying the Telemetry data sent from the Host.

Azure IoT Explorer (preview) File Edit View Window Help	- D X
Azure IoT Explorer (preview)	🔅 Setting
Home > qe-iot-hub-2023	0731144749726 > Devices > ck_rx65n_2ndota_demo > Telemetry
=	▷ Start 🗌 Show system properties 📋 Clear events {} Simulate a device 🕂 Customize Content Type
Device identity	
🔁 Device twin	Telemetry You can monitor telemetry that the device sends to the IoT hub
🖵 Telemetry	Consumer group ① \$Default
≫ Direct method	Specify enqueue 🕕
🖾 Cloud-to-device message	No No
8 Module identities	Use built-in event hub Yes
$\mathcal{S}^{\mathcal{T}}$ IoT Plug and Play components	

Figure 6-28 Start Receiving Telemetry Data



7. Procedure for Running the Demo

The detailed procedure for running the demo is described below.

7.1 Checking the Initial State of Operation

With the setup for the demo in chapter 6 completed, press the reset switch (RESET) on the TB-RX660 to execute a hardware reset. Similarly, press the reset switch (S1) on the CK-RX65N to execute a hardware reset.

Check the logs from each microcontroller using terminal emulator software.

Figure 7-1 shows the log window of the CK-RX65N, confirming that the humidity data from the HS3001 sensor is displayed.



Figure 7-1 CK-RX65N Log Output Window

Next, Figure 7-2 shows the log window of TB-RX660, confirming that only the humidity data from the HS3001 sensor is displayed.

In addition, LED0 of TB-RX660 blinks in the initial state.



Figure 7-2 TB-RX660 Log Output Window



Finally, Figure 7-3 shows the Azure IoT Explorer window, confirming that the humidity data from the HS3001 sensor is displayed.



Figure 7-3 Azure IoT Explorer Telemetry Display before Secondary OTA Update

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



7.2 Run OTA Update

7.2.1 Create Update Firmware

7.2.1.1 Create Update Firmware for CK-RX65N

Execute the Azure procedure in chapter "4.6.1 Create Update Firmware" of the "<u>RX Family Firmware Update</u> <u>Software Development Guide using AWS/Azure QE for OTA</u>". The version of the update firmware should be "2.0.0".

(2) Specify version of firmware
V 2 🔹 0 🔹 0 🖨

Figure 7-4 Update Firmware Version Settings

This will create update firmware for the CK-RX65N.

Copy the "**<loT device name>.rsu**" file in the "ck_rx65n_azure_2ndota_demo/QE-OTA/apl/v2.0.0/<loT device name>" folder to the "ck_rx65n_azure_2ndota_demo_tools/AzureDeviceUpdateScripts" folder and rename the file to "host_update_firm_2.0.0.rsu".

7.2.1.2 Create Update Firmware for TB-RX660

(1) Changes in the Source Code of the ck_rx65n_azure_2ndota_demo Project

Change the definition of the "MEASURE_TEMPERATURE" macro from **0** to **1** of "rx660_tb_2ndota_demo/src/rx660_tb_2ndota_demo.c".

You can also change the firmware version displayed in the log output by setting DEMO_VER_MAJOR, MINOR, and BUILD to any value.

#define MEASURE_HUMIDITY #define MEASURE_TEMPERATURE	(1) (1)
#define DEMO_VER_MAJOR	(2)
<pre>#define DEMO_VER_MINOR</pre>	(0)
#define DEMO VER BUILD	(0)

(2) Create Update Firmware (MOT file format)

Build the rx660_tb_2ndota_demo project and create the MOT file.



(3) Create Update Firmware (RSU file format)

Convert the created rx660_tb_2ndota_demo MOT file to update firmware in RSU format using Renesas Image Generator.

Run the following command in the "rx660_tb_2ndota_demo/RenesasImageGenerator" folder to create the update firmware **leaf_update_firm_2.0.0.rsu**.

```
> python .\image-gen.py -iup ..\HardwareDebug\rx660_tb_2ndota_demo.mot -
```

```
o ..\..\ck_rx65n_azure_2ndota_demo\tools\AzureDeviceUpdateScripts\leaf_update_firm_2.0.
```

```
0 -key .\keys\secp256r1.privatekey -
```

```
ip .\RX660_Linear_Half_ImageGenerator_PRM_2ndota_demo.csv -vt ecdsa
```

7.2.2 Create a Manifest File

Launch Windows PowerShell and run the following command in the "ck_rx65n_azure_2ndota_demo_tools\AzureDeviceUpdateScripts" folder to create the manifest file.

.\CreateRX65NRSKUpdate.ps1

You will be asked to enter Version, HostPath, and LeafPath, each of which should be entered as follows:

- Version: 2.0.0
 - Manifest file version. It is independent of each firmware version.
- HostPath: host_update_firm_2.0.0.rsu The RSU file created in 7.2.1.1.
- LeafPath: leaf_update_firm_2.0.0.rsu The RSU file created in 7.2.1.2(3)

.\CreateCKRX65NUpdate.ps1

```
cmdlet CreateCKRX65NUpdate.ps1 at command pipeline position 1
Supply values for the following parameters:
(Type !? for Help.)
Version: 2.0.0
HostPath: host_update_firm_2.0.0.rsu
LeafPath: leaf_update_firm_2.0.0.rsu
Preparing update RENESAS.CK-RX65N.2.0.0 ...
Preparing child update RENESAS.CK-RX65N-Leaf.2.0.0 ...
Preparing child update RENESAS.CK-RX65N-Leaf.2.0.0 ...
Saving child update manifest RENESAS.CK-RX65N-Leaf.2.0.0 ...
Preparing parent update RENESAS.CK-RX65N.2.0.0 ...
Preparing parent update RENESAS.CK-RX65N.2.0.0 ...
Saving parent update RENESAS.CK-RX65N.2.0.0 ...
Saving parent manifest RENESAS.CK-RX65N.2.0.0 ...
Saving parent manifest RENESAS.CK-RX65N.2.0.0 ...
```

Figure 7-5 Create a Manifest File

When execution is complete, a folder "RENESAS.CK-RX65N.2.0.0" will be created and a manifest file and updated firmware will be generated in the folder.



7.2.3 Deploying an Update

(1) Add ADUGroup Tag to the Device

Open the Azure portal in a browser and select "Devices" from the left menu of the IoT Hub.

Check the Device ID created with QE for OTA in 6.2.3(6) and click "Assign tags".

Home > qe-iot-hub-20230731144 equation equation (equation of the second	⁷⁴⁹⁷²⁶ 10731144749726 Device	S ☆ ☆ …					×
🔎 Search	« View, create, delete, and update device	es in your IoT Hub. <u>Learn more</u>					
🕺 Overview	▲ Add Device == Edit columns	🖒 Refresh 🖉 Assign tags 📋 De	elete				Find devices using a query
Activity log		Types: All + Add filter					
Access control (IAM)		Types. All					
Tags	Device ID	Type Status	Last status update	Authentication type	C2D messag	Tags	
Diagnose and solve problems		.ype sures	autoratus apaare	, and the second s	- LD message		
🗲 Events	ck_rx65n_2ndota_demo	IoT De Enabled		Shared Access Signature	0		
Device management Devices Interview Interview Configurations + Deployments	-						

Figure 7-6 Select Device and Add Tags

Enter "ADUGroup" for Name and "OTADemoGroup" for Value and click "Save".

Tags are name/value pairs that enable you to categorize devices by applying the same tag to multiple devices. Device tag names and values are case sensitive. Learn more Tags Basic Advanced Name Value ADUGroup : ortADemoGroup : e.g. environment : icit e.g. production	Assign tags Assign tags to 1 device		×
Tags Basic Advanced Name Value ADUGroup : OTADemoGroup e.g. environment : e.g. production Device : e.g. production iiii ck_rx65n_2ndota_demo : to be added ()	Tags are name/value pairs that enable you to categorize devices by case sensitive. <u>Learn more</u>	applying the same tag to multiple devices. Device tag names and val	ues are
Basic Advanced Name Value ADUGroup : OTADemoGroup e.g. environment : e.g. production Device ig ck_rx65n_2ndota_demo 1 to be added ①	Tags		
Name Value ADUGroup : OTADemoGroup e.g. environment : e.g. production	Basic Advanced		
ADUGroup : OTADemoGroup e.g. environment : e.g. production Device Image: ck_rx65n_2ndota_demo 1 to be added ①	Name	Value	
e.g. environment : e.g. production Device : : ck_rx65n_2ndota_demo 1 to be added ① : : :	ADUGroup	: OTADemoGroup	1 I
Device i ck_rx65n_2ndota_demo 1 to be added ①	e.g. environment	: e.g. production	
iiii ck_rx65n_2ndota_demo 1 to be added ⊙	Device		
1 to be added ①	ck_rx65n_2ndota_demo		
	1 to be added 🕕		

Figure 7-7 Add ADUGroup Tag



(2) Add Permission to Update

Return to the IoT Hub page and select "Updates" from the left side menu.

Click the gear icon in the upper right corner and click "View account details".

Home > qe-iot-hub-2023073114474972	²⁶ 31144749726	Updates ጵ ☆ …			×
Search «	Please ensure the Ai Device Sync operation	ture Device Update service principal ha on from the Diagnostics tab to register	s <u>required permission</u> . Key management ac any devices provisioned before permission	tions like deployment creation and new device registration wil was granted.	l otherwise be blocked. After granting permission, initiate a
Overview Activity log	Updates Groups ar	nd Deployments Diagnostics	Get started		©
Access control (IAM)	Import, view, and delete	updates. View 'Groups and Deploym	ents' to deploy.		This IoT hub is currently connected to Device Update instance: qe-
 Diagnose and solve problems 	+ Import a new upda	te 🖔 Refresh 🗎 Remove 🕄) View import history		adu-instance. View account details
🗲 Events	Provider	Name	Version	Descriptive label	
Device management					
Devices	(i) You do not have per	mission to view updates.			
IoT Edge					
🕺 Configurations + Deployments					
Updates					
🔎 Queries					
Hub settings					
e- Built-in endpoints					

Figure 7-8 Go to the Device Update Account Page from the Updates Page

The Device update account page will open, click "Access control(IAM)" from the left menu, and select "Add role assignment" from the "Add" tab.

Device optiate for for Hub			
	+ Add \downarrow Download role assignments \equiv E	idit columns Refresh 🛛 🗙 Remove 🖉 F	eedback
Overview	Add role assignment	Demonstration (least adaptivity)	
Activity log	Add co-administrator	Deny assignments Classic administrators	
R Access control (IAM)	My access		
🎙 Tags	View my level of access to this resource.		
Diagnose and solve problems	View my access		
	Check access		
ettings			
Settings	Review the level of access a user, group, service prin	cipal, or managed identity has to this resource. Learn n	iore C
ettings	Review the level of access a user, group, service prin Check access	cipal, or managed identity has to this resource. Learn n	nore d'
identity	Review the level of access a user, group, service prin	cipal, or managed identity has to this resource. Learn n	iore G [*]
ettings I dentity Networking Properties	Review the level of access a user, group, service prin Check access Grant access to this resource	cipal, or managed identity has to this resource. Learn n	view deny assignments
identity → Networking Properties Locks	Review the level of access a user, group, service prin Check access Grant access to this resource	cipal, or managed identity has to this resource. Learn n View access to this resource	vore d
identity Networking Properties Locks Instance Management	Review the level of access a user, group, service prin Check access Grant access to this resource Grant access to resources by assigning a role. Learn more [7]	cipal, or managed identity has to this resource. Learn n View access to this resource View the role assignments that grant access to this and other resources.	view deny assignments View the role assignments that have been denied access to specific actions at this
identity i> Networking IProperties Locks nstance Management Instances	Review the level of access a user, group, service prin Check access Grant access to this resource Grant access to resources by assigning a role. Learn more [것]	cipal, or managed identity has to this resource. Learn n View access to this resource View the role assignments that grant access to this and other resources. Learn more c3	View deny assignments View the role assignments that have been denied access to specific actions at this scope. Learn more ♂
identity Vetworking Properties Locks Instance Management Instances Annitoring	Review the level of access a user, group, service prin Check access Grant access to this resource Grant access to resources by assigning a role. Learn more c ³	cipal, or managed identity has to this resource. Learn n View access to this resource View the role assignments that grant access to this and other resources. Learn more	View deny assignments View the role assignments that have been denied access to specific actions at this scope. Learn more ♂

Figure 7-9 Add Roles from the IAM Page



Select "Device Update Administrator" from the list of roles and click "Next".

ad role assignment					
ole Members Review + assign					
role definition is a collection of permissions. You signment type	u can use the built-in roles or you can create your own custom roles. Learn more $\sigma^{\rm e}$				
lob function roles Privileged administrat	or roles				
Grant access to Azure resources based on job fu	inction, such as the ability to create virtual machines.				
Search by role name, description, or ID	Type : All Category : All				
Name ↑↓	Description 14	Туре ↑↓	Category ↑↓	Details	
Reader	View all resources, but does not allow you to make any changes.	BuiltInRole	General	View	
App Compliance Automation Administrator	Create, read, download, modify and delete reports objects and related other resource objects.	BuiltInRole	None	View	
App Compliance Automation Administrator Vevice Update Administrator	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations	BuiltInRole BuiltInRole	None Internet of things	View View	
App Compliance Automation Administrator Device Update Administrator Device Update Content Administrator	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations	BuiltInRole BuiltInRole BuiltInRole	None Internet of things Internet of things	View View View	
App Compliance Automation Administrator Vevice Update Administrator Vevice Update Content Administrator Vevice Update Content Reader	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations Gives you read access to content operations, but does not allow making changes	BuiltInRole BuiltInRole BuiltInRole BuiltInRole	None Internet of things Internet of things Internet of things	View View View	
App Compliance Automation Administrator Nevice Update Administrator Nevice Update Content Administrator Nevice Update Content Reader Nevice Update Deployments Administrator	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations Gives you read access to content operations, but does not allow making changes Gives you full access to management operations	BuiltInRole BuiltInRole BuiltInRole BuiltInRole BuiltInRole BuiltInRole	None Internet of things	View View View View View	
App Compliance Automation Administrator Nevice Update Administrator Device Update Content Administrator Device Update Content Reader Device Update Deployments Administrator Device Update Deployments Reader	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations, but does not allow making changes Gives you full access to management operations Gives you full access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes	BuiltInRole BuiltInRole BuiltInRole BuiltInRole BuiltInRole BuiltInRole	None Internet of things	View View View View View	
App Compliance Automation Administrator Device Update Administrator Device Update Content Administrator Device Update Content Reader Device Update Deployments Administrator Device Update Deployments Reader Device Update Reader	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations, but does not allow making changes Gives you full access to management operations Gives you full access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes	BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole	None Internet of things	View View View View View View View	
App Compliance Automation Administrator Device Update Administrator Device Update Content Administrator Device Update Content Reader Device Update Deployments Administrator Device Update Deployments Reader Device Update Reader og Analytics Contributor	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations, but does not allow making changes Gives you full access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives	BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole	None Internet of things Analytics	View View View View View View View View	
App Compliance Automation Administrator Device Update Administrator Device Update Content Administrator Device Update Content Reader Device Update Deployments Administrator Device Update Deployments Reader Device Update Reader og Analytics Contributor og Analytics Reader	Create, read, download, modify and delete reports objects and related other resource objects. Gives you full access to management and content operations Gives you full access to content operations, but does not allow making changes Gives you full access to management operations, but does not allow making changes Gives you full access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Gives you read access to management and content operations, but does not allow making changes Log Analytics Reader can view and search all monitoring data as well as and view monitoring settings, including viewing th	BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole BuiltinRole . BuiltinRole . BuiltinRole	None Internet of things Analytics Analytics	View View View View View View View View	

Figure 7-10 Select the Device Update Administrator Role from the List of Roles

Click "Select members," search for your account name and click on it.

Home > qe-adu-20230 Add role assig	731144749726 Access control (IAM) > gnment ···			Select members ×
Role Members	Review + assign			
Selected role	Device Update Administrator			
Assign access to	 User, group, or service principal Managed identity 			
Members	+ Select members			
	Name	Object ID	Туре	
	No members selected			
Description	Optional			Selected members: No members selected. Search for and add one or more members you want to assign to the role for this resource.
				Learn more about RBAC
Review + assign	Previous Next			Select Close

Figure 7-11 Select the Member to Assign the Role (1)



Confirm that your account is selected and click "Select".

Home > qe-adu-20230 Add role assig	0731144749726 Access control (IAN gnment	A) >		Select members ×
Role Members	Review + assign			No users, groups, or service principals found.
Selected role	Device Update Administrator			
Assign access to	 User, group, or service principal Managed identity 			
Members	+ Select members			
	Name	Object ID	Туре	
	No members selected			
Description	Optional			Selected members:
				Remove

Figure 7-12 Select the Member to Assign the Role (2)

Confirm that your account is listed in "Members" and click "Review + assign".

Home > qe-adu-2023 Add role ass	30731144749726 Access control (IAM)) >			×
Role Members	Review + assign				
Selected role	Device Update Administrator				
Assign access to	 User, group, or service principal Managed identity 				
Members	+ Select members				
	Name	Object ID	Туре		
			User	Î	
Description	Optional				

Figure 7-13 Assign the Device Update Administrator Role



(3) Import a New Update

Return to the IoT Hub page and select "Updates" from the left menu.

Click "Import a new update".

\equiv Microsoft Azure	$\mathcal P$ Search resources, services, and do	ocs (G+/)			D 🛱	Д,	ŝ
Home > qe-iot-hub-2023073114474	9726						
ot Hub	731144749726 Upda	tes 🖈 🛧 …					
ρ βearch «	Please ensure the Azure Device Device Sync operation from the	Update service principal has <u>required</u> Diagnostics tab to register any device	<u>permission</u> . Key management actions like es provisioned before permission was grar	deployment creation and new onted.	device registra	ion will othe	erwis
🔀 Overview	Updates Groups and Deploy	ments Diagnostics Get s	started				
Access control (IAM)	Import, view, and delete updates. V	iew 'Groups and Deployments' to c	leploy.				
Tags	+ Import a new update 💍 Re	efresh 📋 Remove 🕚 View in	nport history				
 Events 	Provider	Name	Version	Descriptive	label		
Device management							
Devices	There are no updates to display.						
💁 IoT Edge							
😤 Configurations + Deployments							
🧼 Updates							
🔎 Queries							
Hub settings							
 Built-in endpoints 							
🔀 Message routing							
🕒 File upload							
🐣 Failover							



Click "Select from storage container".

\equiv Microsoft Azure	𝒫 Search resources, services, and docs (G+/)
Home > qe-iot-hub-2023073114	4749726 Updates >
Import updatege-iot-hub-20230731144749726	
Import an update by selecting upd	ate files and import manifests.
Descriptive label	
enter a descriptive label	<i>h</i>
+ Select from storage container	

Figure 7-15 Select from Storage Container



Select the storage account created with QE for OTA in 6.2.3(3) and select the container on the Containers page that appears.

orage accounts «	qestor20230731144749726			
Storage account 💍 Refresh 🛛 \cdots	🕂 Container 🕐 Refresh 🛛 🗖 Give feedback			
arch storage accounts	Search containers by prefix			
Show classic storage accounts	Name	Last modified	Public access level	Lease state
ame	qestor-blob-container	7/31/2023, 3:01:32 PM	Private	Available
1100320011c906090				
estor20230731144749726				
65nstrage01				

Figure 7-16 Select the Container

Click "Upload" on the Container page that appears, and upload the set of files in the "RENESAS.CK-RX65N.2.0.0" folder created in section 7.2.2.

ne > Import update > storage accounts > Containers >				Upload blob	>
astor-blob-container					
Upload 🕐 Refresh 🕴 🖗 Give feedback					
thentication method: Access key (Switch to Azure AD User Account) cation: qestor-blob-container					10
earch blobs by prefix (case-sensitive)					
⁺ç Add filter				browse for files	
Name	Modified	Access tier	Archive :	Overwrite if files already exist	
lo results				\checkmark Advanced	
				Upload	R Give feedba

Figure 7-17 Upload Manifest File and Update Firmware



Sample Code for Secondary OTA Update using Microsoft Azure ADU

					_
				Drag and drop files here	
		_		or Browso for files	
				browse for mes	
			Overwrite if files already ex	kist	
/1/2023. 2:25:09 AM	Access tier	Archive :	✓ Advanced		
/1/2023, 2:25:08 AM	Hot (Inferred)				-
/1/2023, 2:25:08 AM	Hot (Inferred)		Upload		À ^J Give feedbac
(1/2023, 2:25:08 AM	Hot (Inferred)		Current uploads		Dismiss: Completed
			host_update_firm_2.0.0.rsu	🔮 960 KiB / 960 KiB	
			leaf_update_firm_2.0.0.rsu	🥝 60.25 KiB / 60.25 KiB	
			RENESAS.CK-RX65N.2.0.0	🕑 2.3 KiB / 2.3 KiB	
			RENESAS.CK-RX65N-Leaf	1.72 KiB / 1.72 KiB	
	odified 1/2023, 2:25:09 AM 1/2023, 2:25:08 AM 1/2023, 2:25:08 AM 1/2023, 2:25:08 AM	odified Access tier 1/2023, 2:25:09 AM Hot (Inferred) 1/2023, 2:25:08 AM Hot (Inferred) 1/2023, 2:25:08 AM Hot (Inferred) 1/2023, 2:25:08 AM Hot (Inferred)	odified Access tier Archive : 1/2023, 2:25:09 AM Hot (inferred) 1/2023, 2:25:08 AM Hot (inferred) 1/2023, 2:25:08 AM Hot (inferred) 1/2023, 2:25:08 AM Hot (inferred)	odified Access tier Archive 1/2023, 2:25:09 AM Hot (Inferred) 1/2023, 2:25:08 AM Hot (Inferred)	odified Access tier Archivet 1/2023, 2:25:09 AM Hot (Inferred) 1/2023, 2:25:08 AM Hot (Inferred) 1/2024, 2:25:08 AM Hot (Inferred) 1/2025, 2:25:08 AM Hot (Inferred) 1/2024, 2:25:08 AM Hot (Inferred) 1/2025, 2:25:08 AM Hot (Inferred) 1/2026, 2:25:08 AM Hot (Inferred) 1/2027, 2:25:08 AM Hot (Inferred) 1/2028, 2:25:

Figure 7-18 Manifest File and Update Firmware Successfully Uploaded

Check all uploaded files and click "Select".

RX Family

estor-blob-container …						
Upload 🕐 Refresh 🕴 🞘 Give feedback						
thentication method: Access key (Switch to Azure AD User Account) ation: qestor-blob-container						
earch blobs by prefix (case-sensitive)				Show delete	ed blobs	
try Add filter						
Name	Medified	Access tion	Archivo status	Plob type	Size	Leare state
host_update_firm_2.0.0.rsu	8/1/2023, 2:25:09 AM	Hot (Inferred)	Archive status	Block blob	960 KiB	Available
leaf_update_firm_2.0.0.rsu	8/1/2023, 2:25:08 AM	Hot (Inferred)		Block blob	60.25 KiB	Available
RENESAS.CK-RX65N-Leaf.2.0.0.importmanifest.json	8/1/2023, 2:25:08 AM	Hot (Inferred)		Block blob	1.72 KiB	Available
RENESAS.CK-RX65N.2.0.0.importmanifest.json	8/1/2023, 2:25:08 AM	Hot (Inferred)		Block blob	2.3 KiB	Available
RENESASCK-RADINE2.0.0.Importmanifestjson	6/1/2023, 2:25:08 AM	Hot (interred)		BIOCK DIOD	2.3 NID	Available

Figure 7-19 Select Manifest File and Update Firmware



Click "Import update".

Home > Import update > Import update	×
qe-iot-hub-20230731144749726	
Import an update by selecting update files and import manifests.	
Descriptive label	
enter a descriptive label	
+ Select from storage container	
V RENESAS CK-RX65N 20.0	
RENESAS.CK-RX65N.2.0.0.importmanifest.json	
host_update_firm_20.0.rsu	
V RENESAS CK-RX65N-Leaf 2.0.0	
RENESAS.CK-RX65N-Leaf.2.0.0importmanifest.json	
leaf_update_firm_2.0.0.rsu	
Import update Cancel	

Figure 7-20 Import Update Firmware

Once the import is complete, you will see the update information. It may take several minutes for the process to complete.

Home > qe-iot-hub-2023073114474	9726				
or Hub IoT Hub	731144749726 Upc	lates 🖈 ☆ …			
₽ Search	Please ensure the Azure Device Sync operation from	vice Update service principal has <u>required pe</u> the Diagnostics tab to register any devices p	rmission. Key management actions like o provisioned before permission was grant	leployment creation and new device registrationed.	on will otherwise be blocked. After gra
🕂 Overview 📔 Activity log	Updates Groups and Dep	loyments Diagnostics Get sta	ted		
Access control (IAM)	Import, view, and delete update	s. View 'Groups and Deployments' to dep	loy.		
🗳 Tags	L Incord a numerica da la	Defeate 💼 Demons 🏟 Minuteres			
Diagnose and solve problems		Refresh im Remove 🕔 view impo	on history		
🗲 Events	Provider	Name	Version	Descriptive label	
Device management	RENESAS	CK-RX65N	2.0.0		Details
Devices					
IoT Edge					
Configurations + Deployments					
> Updates					

Figure 7-21 Successful Import of the Update



(4) Deploy an Update

Select the "Groups and Deployments" tab and click on the "OTADemoGroup" group created in 7.2.3(1). If the group does not appear, press the RESET button on the CK-RX65N, reconnect the device to the IoT Hub, and then click "Refresh" on the page.

D Search	Please ensure the Azure Device Update service princip Device Sync operation from the Diagnostics tab to reg	al has required permission. Key management actions like deploy ister any devices provisioned before permission was granted.	ment creation and new device regis	tration will otherwise be blocked. After granting permission, initiate
 Tags Diagnose and solve problems 	Updates Groups and Deployments Diagnos	tics Get started		
Events evice management	View compliance information for devices connected to D New updates <i>i</i> Updates in pro	evice Update for IoT Hub. vailable: 1 gress: 0		
Devices IoT Edge Configurations + Deployments	On latest upda Total: 1	te: 0		
Updates Queries				
b settings	View device groups and deploy updates to member devi	ces. Device groups are automatically created based on devi	ce tags. <u>Learn more</u>	
Duilt in andersists				
Built-in endpoints Message routing	🕐 Refresh 🗊 Remove			
Built-in endpoints Message routing File upload	C Refresh Remove	Created	Device count Status	
Built-in endpoints Message routing File upload Failover	C Refresh Remove Group name 1 OTADemoGroup	Created 8/1/2023. 5:10:38 PM GMT+9	Device count Status	more new updates are available for this group. Deploy
Built-in endpoints Message routing File upload Failover Pricing and scale	C Refresh Remove C Group name 1 OTADemoGroup	Created 8/1/2023, 5:10:38 PM GMT+9	Device count Status	more new updates are available for this group. Deploy
Built-in endpoints Message routing File upload Failover Pricing and scale Properties	Refresh Remove Group name 1 OTADemoGroup	Created 8/1/2023; 5:10:38 PM GMT+9	Device count Status 1 One or	more new updates are available for this group. Deploy

Figure 7-22 Select a Group on the Groups and Deployments Page

Click "Deploy".

Group details: O	qe_ota_resource_group > qe-iot-hu TADemoGroup ····	ıb-20230731144749726 Updates >		1 90	New updates e-lot-hub-20230731144749726	×
Sroup basics Current upd Group details Name OTADemoGrou ype IoT Hub tag ba reated 8/1/2023, 5:10: One or more new updates a Device list Cevice list	dates Deployment history ip sed group 38 PM GMT+9 ire available for this group.	C Ne Up On Total	w updates available: 1 dates in progress: 0 latest update: 0 : 1	Vi	ew best available updates for devices in the group. Provider RENESAS Name CK-RX65N Version 2.0.0 More update details > Target devices	🕒 Deploy
C Refresh						
Refresh search entries by device ID or de Name	evice ID followed by a 'space' and module Deployment status	Deployment status: All	Last attempted update	On late:		
Refresh search entries by device ID or di Name ck_rx65n_2ndota_demo	evice ID followed by a 'space' and module Deployment status NA	P.D. Deployment status: All Installed update	Last attempted update	On late: No		

Figure 7-23 Deploy the Update



Click "Create" to deploy the update.

(Create deployment e-iot-hub-20230731144749726	×
	Create a new deployment targeting devices in this group.	
	Update properties Provider RENESAS Name CK-RX65N Version 2.0.0	
	Group name DTADemoGroup	
	 Specify when this deployment should start. * Start immediately. Start at a scheduled date and time. 	
	Rollback all applicable devices in the group to a different update if rollback criteria	is met
[Create	

Figure 7-24 Create Deployment



7.3 Check Operation during OTA Update Running

The OTA update starts within a few seconds after the deployment is created. Both CK-RX65N and TB-RX660 will output logs of the progress of the secondary OTA update.

💆 COM5 - Tera Term VT		_	- 🗆	\times
File Edit Setup Control Wind	ow Help			
2nd_01 Test driver calle	d.			^
Leaf_01 Test NX_AZURE_I0 Proxy driver firmware wr Receive data size 140 Remaining data size 1420 Proxy driver firmware 1K Proxy driver firmware 1K	[_ADU_AGENT_DRIVER_WRITE call iting send Receive + Remaining sta send Receive + Remaining end	led. art d		
Remmaining data set [INFO] Getting download o	data 49688			
Receive data driver_comm Receive data driver_firm Receive data driver_firm Receive data driver_firm 2nd_01 Test driver called	and 3 vare_size 0 vare_data_offset 49688 vare_data_size 656 d.			
Leaf_01 Test NX_AZURE_I0 Proxy driver firmware wr Receive data size 536 Remaining data size 656 Proxy driver firmware 1K П	f_ADU_AGENT_DRIVER_WRITE call ting send Receive + Remaining sta	led. art		~

Figure 7-25 CK-RX65N Log during Update Running



Figure 7-26 TB-RX660 Log during Update Running



7.4 Check Operation after OTA Update

Figure 7-27 shows the log window of the CK-RX65N after the update.

In addition to the humidity data acquired by the HS3001 sensor, temperature data can be seen on the log window.

💆 COM5 - Tera Term VT		_	\times
File Edit Setup Control	Window Help		
Telemetry message ser	d: {"temperature":29.73,"humidity":61.83}.		^
[HS3001]HUMI:61.81[RH	l], TEMP: 29.73[deg C]		
Telemetry message ser	nd: {"temperature":29.72,"humidity":61.81}.		
[HS3001]HUMI:61.79[RH	l], TEMP: 29.73[deg C]		
Telemetry message ser	nd: {"temperature":29.72,"humidity":61.79}.		
[HS3001]HUMI:61.81[RH	l], TEMP: 29.70[deg C]		
Telemetry message ser	d: {"temperature":29.7,"humidity":61.81}.		
[HS3001]HUMI:61.84[RH	l], TEMP: 29.70[deg C]		
Telemetry message ser	d: {"temperature":29.7,"humidity":61.84}.		
[HS3001]HUMI:61.80[RH	l], TEMP: 29.69[deg C]		
Telemetry message ser	nd: {"temperature":29.69,"humidity":61.79}.		
[HS3001]HUMI:61.82[RH	l], TEMP: 29.69[deg C]		
Telemetry message ser	nd: {"temperature":29.69,"humidity":61.81}.		
[HS3001]HUMI:61.81[RH	l], TEMP: 29.70[deg C]		
Telemetry message ser	nd: {"temperature":29.7,"humidity":61.81}.		
[HS3001]HUMI:61.77[RH	l], TEMP: 29.69[deg C]		
Telemetry message ser	nd: {"temperature":29.69,"humidity":61.77}.		
[HS3001]HUMI:61.75[RH	l], TEMP: 29.67[deg C]		
Telemetry message ser	nd: {"temperature":29.67,"humidity":61.75}.		
[HS3001]HUMI:61.77[RH	l], TEMP: 29.67[deg C]		
Telemetry message ser	nd: {"temperature":29.67,"humidity":61.77}.		
[HS3001]HUMI:61.75[RH], TEMP: 29.67[deg C]		
Telemetry message ser	nd: {"temperature":29.67,"humidity":61.75}.		
			\sim
1			

Figure 7-27 CK-RX65N Log Window after Firmware Update

Next, Figure 7-28 shows the log window of the TB-RX660 after the update. After a successful TB-RX660 firmware update, the HS3001 sensor will acquire humidity and temperature measurement data.

Also, LED1 will blink in addition to LED0, which blinks initially.

Figure 7-28 TB-RX660 Log Window after Firmware Update



Finally, Figure 7-29 shows the Azure IoT Explorer window, where you can see the humidity and temperature measurement data acquired from the HS3001 sensor.

Azure IoT Explorer (preview)	Setting
Home > qe-iot-hub-2023	0731144749726 > Devices > ck_rx65n_2ndota_demo > Telemetry
	Stop 🗌 Show system properties 📋 Clear events - {} Simulate a device - T Customize Content Type
Device identity Device twin	Telemetry You can monitor telemetry that the device sends to the IoT hub
🖵 Telemetry	Consumer group O \$Default
 ✓ Direct method ☑ Cloud-to-device message ✗ Module identities ∞ IoT Plug and Play components 	<pre>Specify enqueue time ③ No Use built-in event hub Yes Ves Wed Aug 02 2023 02:56:39 GMT+0900 (Japan Standard Time): { "body": { "temperature": 28.25, "humidity": 56.86 }, "enqueuedTime": "Wed Aug 02 2023 02:56:39 GMT+0900 (Japan Standard Time)" }</pre>
	<pre>Wed Aug 02 2023 02:56:33 GMT+0900 (Japan Standard Time): { "body": { "temperature": 28.25, "humidity": 56.81 }, "enqueuedTime": "Wed Aug 02 2023 02:56:33 GMT+0900 (Japan Standard Time)" }</pre>

Figure 7-29 Telemetry Display in Azure IoT Explorer after Secondary OTA Update

That is all for the demo operation.

7.5 Cleanup of Azure Cloud Resources

Delete the Azure cloud resource created by the above demo operation.

Open the Resource groups service page from the Azure portal. Click the resource group created in the demo and click "Delete resource group" on the screen that appears.

Depending on your usage of Microsoft Azure, you may be charged by the cloud resources created in the demo. To avoid unintended charges, we recommend that you delete the resources on the cloud you created after the demo is done.



RX Family	Sample Code	e for Secondary OTA Updat	e using Micro	osoft Azure /	٩DU
Home > Resource groups > Resource groups (Reneas Bectronics Corporation (renesasgroupon + Create () Manage view $\vee \cdots$ Filter for any field Name †. () cloud-shell-storage-southeastasia () () clargesGroup-n () () TestResourceGroup ()	Contraction of the second of		sh ∳ Export to CSV ♥ Open q Deployments 1.Succeeded Location Japan East II × ↑ Add filter No grouping Type ↑↓	ueny ⊘ Assign tags ··· JSOI ↓ Location ↑↓ Location ↑↓	X N View
	A Locks		Device Update for IoT Hub	Southeast Asia	
	Cost Management \$ Cost analysis Cost alerts (preview)	storagenak	Storage account	Japan East	
< Page 1 v of 1 >	 Budgets Advisor recommendations Monitoring 	< Previous Page 1 v of 1 Next >		R Give feer	dback

Figure 7-30 Delete Azure Cloud Resources



RX Family

8. Note

8.1 Software License Information to Use

The software license information to use is shown below.

- TinyCrypt Cryptographic Library
 License <u>https://github.com/intel/tinycrypt/blob/master/LICENSE</u>
- Azure RTOS
 - -- License https://github.com/azure-rtos/threadx/blob/master/LICENSED-HARDWARE.txt

8.2 Firmware Update Module Modified Location

In r_fwup.c of the firmware update module used in the rx660_tb_demo_bootloader project, change FWUP_COPY_BUF_SIZE at line 37 to 256U to match the RX660 flash write unit.

32		
34	Macro definitions	
36	<pre>#define FWUP_READ_BUF_SIZE</pre>	(1280)
37	<pre>#define FWUP_COPY_BUF_SIZE</pre>	(256U) // modified for RX660
38	<pre>#define FWUP_VERI_BUF_SIZE</pre>	(1280)
39	<pre>#define FWUP_WRITE_HEADER_BUF_SIZE</pre>	(128U)
40	<pre>#define FWUP_IMAGE_FLAG</pre>	(0xFEU)
41	#define FWUP_HASH_BYTES	(32U)

Figure 8-1 Firmware Update Module Modified Location

8.3 Limitations/Restrictions of Leaf Version Information

The RSU file name generated in 7.2.1.2(3) has the following limitations:

File name: "2.0.0" in leaf_update_firm_2.0.0.rsu indicates the Leaf firmware version, and each digit has an input limit of 0~9.

Do not enter more than two digits.

Incorrect use case:

leaf_update_firm_10.0.0.rsu / leaf_update_firm_1.10.0.rsu / leaf_update_firm_1.0.10.rsu

The output file name can be handled by changing the following command.

> python .\image-gen.py -iup ..\HardwareDebug\rx660_tb_2ndota_demo.mot o ..\..\ck_rx65n_azure_2ndota_demo\tools\AzureDeviceUpdateScripts\leaf_update_firm_2.0.0key .\keys\secp256r1.privatekey -ip .\RX660_Linear_Half_ImageGenerator_PRM_2ndota_demo.csv -vt
ecdsa

Figure 8-2 Renesas Image Generator Command Changes



RX Family

Sample Code for Secondary OTA Update using Microsoft Azure ADU

Revision History

		Description	
Rev.	Date	Page	Summary
1.00	Aug. 31, 2023	—	First edition issued.



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 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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