

RX65N Group

Visualizing and Controlling Sensor Information Using Amazon Web Services with RX65N Cloud Kit and FreeRTOS

Introduction

This document describes a system that uses the RX65N Cloud Kit board from Renesas. This system incorporates the RX65N running Amazon FreeRTOS and via a Wi-Fi connection visualizes (light) sensor information on Amazon Web Services (AWS) and controls LEDs on the board using the AWS shadow service.

Amazon FreeRTOS is a realtime operating system that enhances the FreeRTOS kernel with functionality for connections, security, and over-the-air (OTA) updates. It includes demo applications for demonstrating the functionality of Amazon FreeRTOS.

e² studio is a development environment based on the open-source Eclipse CDT (C/C++ Development Tooling) project. In addition to a debugging interface, it provides support for building projects (editor, compiler, linker control). It also supports integration of Amazon FreeRTOS demo applications, enabling them to run on Renesas evaluation boards.

Note: The Amazon Elasticsearch service is scheduled to be renamed the Amazon OpenSearch service, but the name Amazon Elasticsearch service is used in the descriptions in this document.

Purpose of This Document

This document explains in an easy-to-understand manner the procedure for connecting and controlling AWS using an Amazon FreeRTOS demo application (from connecting to AWS to running the demo).

Operating Environment

Operation on the following environment has been confirmed.

Integrated development environment	e ² studio 2021-04
Board	RX65N Cloud Kit
Toolchain	CC-RX Compiler v3.03
	GCC for Renesas RX 8.3.0.202004
Emulator	E2 emulator Lite (on-board)

Visit the following webpage for information on boards, related programs, and development environments needed for development work using RX cloud solutions.

https://www.renesas.com/rx-cloud

Related Document

RX Family Troubleshooting when Using Amazon Web Services (R20AN0624)



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Notes:

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- FreeRTOS[™] is a trademark of Amazon Web Services, Inc. (<u>https://freertos.org/copyright.html</u>)
- GitHub[®] is a trademark of GitHub, Inc. (<u>https://github.com/logos</u>)
- Pmod is a trademark of Digilent Inc. (<u>https://store.digilentinc.com/</u>)



1. Terms

Terms used in this document are explained below.

Table 1.1 Terms

Term	Meaning
AWS	Amazon Web Service
shadow	Used to store and retrieve information on the current status of a device.
Amazon Elastic Service	A managed service for deploying, manipulating, and scaling AWS clusters in the Elasticsearch cloud.



2. Preparation

This document describes the process from importing the project to running the demo using RX65N Cloud Kit.

2.1 Hardware Configuration

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

Table 2.1 Hardware Configuration

Item	Content	Provider	Description
Board used (packaged with	Target board for RX65N	Renesas Electronics	Evaluation board mounted with RX65N MCU ^{*1}
RX65N Cloud Kit)	RX cloud option board	Corporation	Cloud communication evaluation board capable of connecting to AWS* ¹
	Silex Pmod module		Communication board mounted with wireless LAN module*1
Wi-Fi	Wireless router		Wireless LAN standard: IEEE 802.11b/g/n (2.4 GHz)
			Encryption method: ES
PC	Windows 10		Recommended OS
	Google Chrome		Web browser used

Note: 1. The target board for RX65N, RX65N cloud option board, and Silex Pmod module are included in RX65N Cloud Kit.

2.2 Software Configuration

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

Table 2.2 Software Configuration

Item	Content	Version
Integrated development environment	e ² studio	2021-04
Compiler	CC-RX	V3.03
	GCC for Renesas RX	8.3.0.202004
Communication software	Tera Term	Version 4.71
Emulator	E2 emulator Lite (on-board)	

To secure sufficient heap area for the application, change the value of the BSP_CFG_HEAP_BYTES macro in r_bsp_config.h from 0x400 to 0x1000.



2.3 Tera Term Settings

The Tera Term settings for the demo project are listed in the table below.

Table 2.3 Tera Term Settings

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



3. System Diagram

The system diagram below shows the steps from the acquisition of light sensor information to visualization, and the use of the shadow service to control RX65N Cloud Kit.



Figure 3.1 System Diagram of Steps from Acquisition of Sensor Information to Visualization



4. Connecting to AWS

The following preparation is necessary in order to connect RX65N Cloud Kit to AWS.

4.1 AWS Preparation

Refer to the tutorial below and make AWS settings.

Register device to AWS IoT

Link: https://github.com/renesas/amazon-freertos/wiki/Register-device-to-AWS-IoT

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



4.2 Hardware Preparation

Follow the steps below to prepare the hardware for the demo program.

- 1. Remove the jumper from the EJ2 pins on the target board (bottom board).
- 2. Connect the ECN1 connector on the target board (bottom board) to the PC via a USB cable.
- 3. Connect the CN18 connector on the cloud option board (top board) to the PC via a USB cable.



Figure 4.1 RX65N Cloud Kit (Top)



Figure 4.2 RX65N Cloud Kit (Bottom)



4.3 Software Preparation

Follow the steps below to prepare the software for the demo program.

1. Extract the project files from the archive and copy them to a suitable location. (In the description below, the root folder containing the project files is designated as \${base_folder}.)

Note: After extracting the project files from the archive, copy them to a location with a short file path, such as the root folder on the C: drive. If the file path is too long, a build error may result.

2. Launch e² studio and specify a workspace directory.

e² studio Launcher
Select a directory as workspace e ² studio uses the workspace directory to store its preferences and development artifacts.
Workspace Browse
□ Use this as the default and do not ask again ▶ <u>R</u> ecent Workspaces
Launch Cancel

Figure 4.3 Workspace Selection Menu

3. Select File \rightarrow Import....

File	Edit Source Refactor Navigate S	earch Project Rer
	New	Alt+Shift+N > th Co
	Open File	
	Open Projects from File System	
	Recent Files	> <u></u>
	Close Editor	Ctrl+W
	Close Al Editors C	trl+Shift+W
	Save	Ctrl+S
<u> </u>	Save As	
	Save All 0	Ctrl+Shift+S
	Revert	
	Move	
	Rename	F2
8	Refresh	F5
	Convert Line Delimiters To	>
b	Print	Ctrl+P
2	Import	
<u></u>	Export	

Figure 4.4 File \rightarrow Import...



4. Click General \rightarrow Existing Projects into Workspace \rightarrow Next >.

Select Create new pro	jects from an archive file or directory.	_	Ľ	×	
Select an impo type filter text General Gener	ert wizard:	sh	Cance		

Figure 4.5 General \rightarrow Existing Projects into Workspace \rightarrow Next >



5. Click **Browse...**, then specify the root directory as follows.

- \${base_folder}\projects\renesas\rx65n-cloud-kit-uart-sx-ulpgn\e2studio\aws_demos
 (When using CC-RX as the compiler)
- \${base_folder}\projects\renesas\rx65n-cloud-kit-uart-sx-ulpgn\e2studio-gcc\aws_demos (When using GCC for Renesas RX as the compiler)

Finally, click Finish.

Note: Make sure **Copy projects into workspace** is unchecked.

	🕲 Import — 🗆 🗙	
_	Import Projects Select a directory to search for existing Eclipse projects.	7
	Select root directory: Browse Select archive file: Browse	
	<u>P</u> rojects:]
	Refresh	
	< >> Options	
	Search for nested projects Copy projects into workspace Cose newly imported projects upon completion Hide projects that already exist in the workspace	
	Working sets Add project to working sets	
	Working sets: Select	
_	② < <u>B</u> ack <u>N</u> ext > <u>F</u> inish Cancel]

Figure 4.6 General \rightarrow Existing Projects into Workspace \rightarrow Next >



- 6. Define the following four macros in \${base_folder}\demos\include\aws_clientcredential.h.
 - clientcredentialMQTT_BROKER_ENDPOINT
 - \rightarrow The name of the endpoint confirmed as described in 4.1, AWS Preparation.
 - clientcredentialIOT_THING_NAME
 - \rightarrow The name of the thing registered as described in 4.1, AWS Preparation.
 - clientcredentialWIFI_SSID (when using Wi-Fi)
 - \rightarrow The SSID of the access point to connect to.
 - clientcredentialWIFI_PASSWORD (when using Wi-Fi)
 - \rightarrow The password of the access point to connect to.

(Makes sure to enclose the above macro definitions in quotes (" ") as shown in the figure below.

Note: The Wi-Fi encryption standard listed in 2.1, Hardware Configuration, is the default. To use a different encryption standard you will need to define clientcredentialWIFI_SECURITY as well.

#de	ING CITEULCLEGEULIJIMÓLI RKOKFK FUDAOINI
∋/*	
* (brief Host name.
* (todo Set this to the unique name of your IoT Thing.
*/ #de	ine clientcredentialIOT THING NAME
)/* * (When the MOTT broken is using
*/	WITE FOLE HUNDER THE HUT DIOKEL TO ROTHER.
#de	ine clientcredentialMQTT_BROKER_PORT 8883
∋/*	
* (brief Port number the Green Grass Discovery use for JSON retrieval from cloud is using.
#de	ine clientcredentialGREENGRASS DISCOVERY PORT 8443
* (Worief Wi-Fi network to join.
*	
* (itodo If you are using Wi-Fi, set this to your network name.
	ine clientcredentialWIFI_SSID " " " " " " " " " " " " " " " " " " "
#de	
#de	
#de ∋ /* * (brief Password needed to join Wi-Fi network.
#de	brief Password needed to join Wi-Fi network. Hodo If you are using WPA, set this to your network password.
#de > /* * (* (* (#de	brief Password needed to join Wi-Fi network. Hodo If you are using WPA, set this to your network password. ine clientcredentialWIFI_PASSWORD "
#de * (* (* (#de	brief Password needed to join Wi-Fi network. <u>todo</u> If you are using WPA, set this to your network password. ine clientcredentialWIFI_PASSWORD "
#de /* * (* (*/ #de /* * (brief Password needed to join Wi-Fi network. <u>todo</u> If you are using WPA, set this to your network password. <u>'ine clientcredentialWIFI_PASSWORD</u> " brief Wi-Fi network security type.
#de > /* * (* (*/ #de > /* * (*/	brief Password needed to join Wi-Fi network. todo If you are using WPA, set this to your network password. ine clientcredentialWIFI_PASSWORD """"""""""""""""""""""""""""""""""""
#de * (* (* (#de * (* (* (* (* (* (* (* (brief Password needed to join Wi-Fi network. todo If you are using WPA, set this to your network password. ine clientcredentialWIFI_PASSWORD """"""""""""""""""""""""""""""""""""
#de /* * (* (* (* (* (* (* (*	brief Password needed to join Wi-Fi network. Hodo If you are using WPA, set this to your network password. ine clientcredentialWIFI_PASSWORD """"""""""""""""""""""""""""""""""""
#de- * (* (* (* (* (* (* (* (brief Password needed to join Wi-Fi network. <u>Itodo</u> If you are using WPA, set this to your network password. <u>Sine clientcredentialWIFI_PASSWORD</u> <u>Ubrief Wi-Fi network security type.</u> Usee WIFISecurity_t. Note Possible values are eWiFiSecurityOpen, eWiFiSecurityWEP, eWiFiSecurityWPA, WiFiSecurityWPA2 (depending on the support of your device Wi-Fi radio).

Figure 4.7 aws_clientcredential.h



7. Double-click \${base_folder}\tools\certificate_configuration\CertificateConfigurator.html.

js	2021/05/10 15:33	ファイル フォルダー	
CertificateConfigurator.html	2021/05/06 11:03	Chrome HTML Do	5 KB
PEMfileToCString.html	2021/05/06 11:02	Chrome HTML Do	4 KB

Figure 4.8 Opening CertificateConfigurator.html

- 8. Specify the thing certificate and private key files downloaded as described in 4.1, AWS Preparation, then click **Generate and save aws_clientcredential_key.h**.
 - xxxxxx-certificate.pem.crt (thing certificate)
 - xxxxxx-private.pem.key (private key)



Figure 4.9 Certificate Configuration Tool

9. Overwrite the file \${base_folder}\demos\common\include\aws_clientcredential_key.h with the newly generated aws_clientcredential_key.h file.

🔛 aws_application_version.h	2021/04/27 12:04	C言語ヘッダファイル	2 KB
🕍 aws_ble_gatt_server_demo.h	2021/04/08 10:17	C言語ヘッダファイル	5 KB
aws_clientcredential.h	2021/04/12 9:41	C言語ヘッダファイル	3 KB
aws_clientcredential_keys.h	2021/04/08 16:12	C言語ヘッダファイル	4 KB
aws_demo.h	2021/04/08 10:17	C言語ヘッダファイル	3 KB
aws_iot_demo_network.h	2021/04/08 10:17	C言語ヘッダファイル	3 KB
aws_ota_codesigner_certificate.h	2021/04/08 10:17	C言語ヘッダファイル	2 KB
aws_wifi_connect_task.h	2021/04/08 10:17	C言語ヘッダファイル	2 KB
■ iot_ble_numericComparison.h	2021/04/08 10:17	C言語ヘッダファイル	3 KB
■iot_config_common.h	2021/04/08 10:17	C言語ヘッダファイル	9 KB
■iot_demo_logging.h	2021/04/08 10:17	C言語ヘッダファイル	3 KB
🕍 iot_demo_runner.h	2021/04/19 17:23	C言語ヘッダファイル	6 KB

Figure 4.10 Overwriting aws_clientcredential_key.h



- 10. Select $Project \rightarrow Build All$ and confirm that 0 errors are reported.
 - Note: Make sure to clean the project before building it for the first time. If a demo build error occurs after the initial build, clean the project again and then build it.



Figure 4.11 Project \rightarrow Build All \rightarrow 0 errors

To check the connection to AWS, perform the steps described in section 2, Confirming the Connection to AWS, in the reference document Troubleshooting when Using Amazon Web Services.



5. Shadow Service

This section describes how to use the AWS IoT Core shadow service to control an edge device (RX65N Cloud Kit) from the cloud.

The shadow service can be used not only to collect data from edge devices, but also to control edge devices from the cloud. By controlling the product remotely it is possible to realize a variety of application requests.

The sample code performs operations to switch LED control in response to data obtained about the LEDs and sensors.

5.1 **Device Properties**

The table below lists the device properties used by the demo.

Property	Status	Operation
"LEDControl"	"LED_ON"	LED1 (red) and LED2 (red) on the RX65N Cloud Kit top board
		are on.
	"LED_OFF"	LED1 (red) and LED2 (red) on the RX65N Cloud Kit top board
		are off.
	"LED_LIGHT"	The light sensor value is 500 or greater: LED1 (red) and LED2 (red) off.
		The light sensor value is 100 or greater but less than 500: LED1 (red) on, LED2 (red) off.
		The light sensor value is less than 100: LED1 (red) and LED2 (red) on.
	"LED_TEMP"	The temperature sensor value is 30 or less: LED1 (red) and LED2 (red) off.
		The temperature sensor value is greater than 30 but no more than 40: LED1 (red) on, LED2 (red) off.
		The temperature sensor value is greater than 40: LED1 (red) and LED2 (red) on.
"SWVersion"	"VER_x.y.z"	The software version is changed to x.y.z. (The value in
	(Note: X, y, and	aws_application_version.hts used initiality.)
	2 Tepresent	(red) flash for 10 seconds
	positive integer	
	values.)	
"IPAddress"	None	Indicates the IP address.
		(Uses the value of R_WIFI_SX_ULPGN_GetIpAddress.)
"sensorDataUpdateOn"	"UpdateOn"	The value obtained from the light sensor is uploaded.
	"UpdateOff"	A fixed value of 0 is uploaded.

Table 5.1Device Properties



5.2 Using the Shadow Service

The procedure for manipulating shadows is described below.

- 1. Perform all the steps listed in 4, Connecting to AWS.
- On the AWS Management Console select Services → All services → IoT → IoT Core, then click Test → Subscribe to a topic, enter # in the topic filter field, and click the Subscribe button.

aws Services ▼		Q Search for services, features, marketplace products, and docs [Alt+S]
AWS IoT	×	AWS IoT > MQTT test client
Monitor		MQTT test client info
Activity Onboard		You can use the MQTT test client to monitor the MQTT messages being passed in your AWS account. Devices publish MQTT messages that are identified by topics to communicate thei inform devices and apps of changes and events. You can subscribe to MQTT message topics and publish MQTT messages to topics by using the MQTT test client.
Manage		• Subscribe to a topic Publish to a topic
Greengrass		
Secure		Topic Fifter Info The Kopic filter describes the topic(s) to which you want to subscribe. The topic filter can include MQTT wildcard characters.
Defend		#
Act Test		Additional configuration Subscribe
Software		
Settings		Subscriptions Topic

Figure 5.1 Subscribing to a Topic

3. Click the Debug icon in the upper left corner of the e² studio window.

|--|

Figure 5.2 Debug

4. A message appears asking you to confirm that you wish to switch to the Debug perspective; click the **Switch** button.



Figure 5.3 Confirm Perspective Switch



5. Click the **Resume** icon. After a short time execution pauses at the main function; click the **Resume** icon again.



Figure 5.4 Running the Demo Program

6. Return to the AWS Management Console, click **Test** → **Publish to a topic**, and enter the following code as the topic name.

Note: In place of xxxx, enter the name of the thing registered as described in 4.1, AWS Preparation.

\$aws/things/xxxx/shadow/update

Figure 5.5 Topic Name

 Copy the following lines of code and paste them into the message payload field. (In this example the setting LED_ON is used, but you can make settings to tailor the operation to match the statuses listed in the Device Properties table.)



Figure 5.6 Message Payload



8. Click **Publish** and confirm that LED1 and LED2 on the RX65N Cloud Kit top board turn on.

Topic name The topic name identifies the pe	essage. The message payload will be	e published to this topic with a Quality of Service (QoS) o
Q \$aws/things/rx65n_clo	oud_kit/shadow/update	
Message payload		
{		
"state": {		

Figure 5.7 Publishing a Topic



Figure 5.8 RX65N Cloud Kit LED1 and LED2 On



6. Elasticsearch

This section describes using the Elasticsearch service of AWS to visualize data obtained from the sensor module mounted on the RX65N Cloud Kit board.

Fees are incurred when using the Amazon Elasticsearch service. Make sure to delete your Elasticsearch domain after you finish using the demo program.



6.1 Elasticsearch Preparation

Follow the steps below to prepare Elasticsearch for the demo program.

Follow the steps below to set up Elasticsearch.

1. On the AWS Management Console, click **Elasticsearch Service** under **All services** \rightarrow **Analytics**.

	ElastiCache	~	Analytics
	Neptune		Athena
	Amazon QLDB		Amazon Redshift
	Amazon DocumentDB		EMR
	Amazon Keyspaces		CloudSearch
	Amazon Timestream		Elasticsearch Service
			Kinesis
ج	Migration & Transfer		QuickSight 🔼
	AWS Migration Hub		Data Pipeline
	AWS Application Migration Service		AWS Data Exchange
	Application Discovery Service		AWS Glue
	Database Migration Service		AWS Lake Formation
	Server Migration Service		MSK

Figure 6.1 Selecting Elasticsearch Service

2. Click Create a new domain.



Figure 6.2 Create a new domain



3. Select the radio button next to **Development and testing** and set **Elasticsearch version** to **7.1**. Then click **Next**.

Deployment types specify common settings for your us	e case. After creating the domain, you can change these settings at any time.	
Deployment ty	Production Multiple Availability Zones and dedicated master nodes for higher availability.	
	Development and testing One Availability Zone for when you just need an Elasticsearch endpoint.	
	Custom Choose settings from all available options.	
Version Select the version of Elasticsearch for your domain	•	
Elasticsearch versio	n 7.1 •	
Elasticsearch 7.1 does not support cold stor	age. Learn more	

Figure 6.3 Choose deployment type

4. Enter an **Elasticsearch domain name** and change the **Instance type** selection to **t2.small.elasticsearch**, then scroll down.

A domain is the collection of resources needed to run Elas	ticsearch. The domain name will be part of your domain endpoint.
Elasticsearch domain name	
	The name must start with a lowercase letter and must be between 3 and 28 characters. Valid characters are a-z (lowercase only), 0-9, and - (hyphen).
Data nodes	
elect an instance type that corresponds to the compute, r eplicas, type of queries, and volume of requests. Learn m	nemory, and storage needs of your application. Consider the size of your Elasticsearch indices, number of shards an ore 🕜
Instance type	t2.small.elasticsearch 🗸
	The AWS Free Tier includes usage of up to 750 hours per month of t2.micro or t2.small instance usage and up to 10 GiB of Magnetic or General Purpose EBS storage. Amazon Elasticsearch Service Free Tier t2 small elasticsearch instance type needs EBS storage.
The selected instance type (t2.small.elasticsea)	rch) does not support encrypton at rest.

Figure 6.4 Configure domain



5. Click Next.

hen trat	, Amazon Elasticsearch Service takes an automated snapshot of your cluster. You can set the start hour for the snapshot. We recommend that you choose a time on your cluster is low.
0	Snapshot time can't be configured. Elasticsearch version 5.3 and above only support hourly snapshots.

Figure 6.5 Configure domain, Next

6. Select Public access, then scroll down.

Configure access and security Amazon Elasticsearch Service offers numerous security features, including fine-grained access control, IAM, SAML, Cognito authentication for Kibana, encryption, and VPC access. Learn more Network configuration Choose internet or VPC access. To enable VPC access, we use private IP addresses from your VPC, which provides an inherent layer of security. You control network access within your VPC using security groups. Optionally, you can add an additional layer of security by applying a restrictive access policy. Internet endpoints are publicly accessible. If you select public access, you should secure your domain with an access policy that only allows specific users or IP addresses to access the domain. VPC access (Recommended) Public access

Figure 6.6 Network configuration

- 7. Set **Domain access policy** to **Custom access policy** and select **IPv4 address**. Enter the global IP address of your PC and select **Allow**.
 - Note: Search for "check global IP address" on the internet to find out how to determine the global IP address of your PC.

Access policy				
Access policies control whether a request is accepted or re policy, you must sign your requests. Learn more 🗗	jected when it reaches	the Amazon Elasticsearch	Service domain. If you s	pecify an account, user, or role in this
Custom policy builder allows at most 10 elements. Use a J	SON-defined access po	licy to define a policy with	more than 10 elements.	
Domain access policy	Custom access polic	у	•	
	Allow or deny access by A	WS account ID, account ARN, I	AM user ARN, IAM role ARN	N, IPv4 address, or CIDR block.
	IPv4 address 🔹	Enter Principal	Allow	▼ Remove element
	Add element			

Figure 6.7 Access policy



8. Click Next.

Optional Elasticsearch cluster settings	
	Cancel Previous Next

Figure 6.8 Access policy, Next

9. On the Add tags page, click Next without doing anything.

u can add tags to describe velopment. You can creat	your domain. A tag consists of a case-s ie up to 50 tags for each domain. Learn	isitive key-value pair. For example, you can define a tag with a key-value pair of Env	vironment Nar
Key	Value	Remove	
Add unique kev	Add value		

Figure 6.9 Do Nothing and Click Next

10. On the **Review** page, double-check your configuration and choose **Confirm**.

Cancel	Previous	Confirm

Figure 6.10 After Clicking Next, Confirm



11. Your Elasticsearch domain is created. Stand by until **Domain status** changes to **Active**.

Note: It may take one to two hours before **Domain status** changes to **Active**.

Edit domain	Actions ~				
Your domain is Active as soon	being initialized, whic as your domain is rea	ch takes about 10 min ady to use.	utes. You can	not load data or r	un querie
Overview	Cluster health	Instance health	Indices	Auto-Tune	Logs
Notification	s				
	Domain status	Loading			
Ela	asticsearch version	7.1			
	Endpoint	-			
	Custom endpoint	-			
	Domain ARN				
	Kibana	-			

Figure 6.11 Stand by Until Domain status Changes to Active

12. Once **Domain status** changes to **Active**, access the **Kibana** URL.

Edit domain	Actions Y						
Overview	Cluster health	Instance health	Indices	Auto-Tune	Logs	Upgrade history	Packages
Notifications							
Elas	Domain status sticsearch version Endpoint	Active 7.1					
	Custom endpoint	-					
	Domain ARN						
	Kibana						
	Custom Kibana	-					

Figure 6.12 Domain status: Active



6.2 Kibana Preparation

Follow the steps below to prepare Kibana for the demo program.

1. Click Explore on my own.



Figure 6.13 Explore on my own



2. On the menu bar on the left, click the **Dev Tools** icon.



Figure 6.14 Dev Tools

3. Click Get to work.

While typing a request, Console will make suggestions which you can then accept by hitting En structure *as well as* your indices and types.

A few quick tips, while I have your attention

- Submit requests to ES using the green triangle button.
- Use the wrench menu for other useful things.
- You can paste requests in cURL format and they will be translated to the Console syntax.
- You can resize the editor and output panes by dragging the separator between them.
- Study the keyboard shortcuts under the Help button. Good stuff in there!

Get to work

Figure 6.15 Get to work



4. In the console window on the left, enter the following code.

```
PUT /sensor?include type name=true
{
  "mappings": {
    "sensor": {
      "properties": {
        "timestamp": {
          "type": "long",
          "copy_to": "datetime"
        },
        "datetime": {
          "type": "date",
          "store": true
        },
        "temperature": {
          "type": "long"
        },
        "humidity": {
          "type": "long"
        }
      }
    }
  }
}
```

Figure 6.16 Code Entered in Console Window



5. Click the click to send request icon in the upper right corner of the console.

Console			
1 PUT 2 ~ { 3 ~ "n 4 ~ 5 ~ 6 ~ 7 8 9 ~ 10 ~ 11 12 13 ~ 14 ~ 15 16 ~ 17 ~ 18 19 ~	<pre>/sensor?include_type_name=true mappings": { "sensor": { "properties": { "timestamp": { "type": "long", "copy_to": "datetime" }, "datetime": { "type": "date", "store": true }, "temperature": { "type": "long" },</pre>	▶ ↓	<pre>1* { 2 "acknowledged" : true, 3 "shards_acknowledged" : true, 4 "index" : "sensor" 5* }</pre>
20 21 • 22 • } 23 • }	}		:

Figure 6.17 click to send request

6. Confirm that the following response is returned.

```
{
  "acknowledged" : true,
  "shards_acknowledged" : true,
  "index" : "sensor"
}
```

Figure 6.18 Confirming Response



6.3 IoT Rule Preparation

Follow the steps below to prepare an IoT rule for the demo program.

1. Go to the IoT Core control panel, select $Act \rightarrow Rules$, and click Create a rule.

AWS IoT	×	AWS IoT > Rules
Monitor Activity Doboard Manage Greengrass Secure		
Act Rules Destinations Test	_	You don't have any rules yet Rules give your things the ability to interact with AWS and other web services. Rules are analyzed and actions are performed based on the messages sent by your things.
Software Settinos		Learn more Create a rule

Figure 6.19 Create a rule

2. Enter a name for the rule, then enter the following code under Rule query statement. SELECT *, timestamp() as timestamp FROM 'iotdemo/topic/sensor'

Description	
.	
Rule query statement	
Rule query statement Indicate the source of the messag	les you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version	jes you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version	jes you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version 2016-03-23	Jes you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version 2016-03-23 Rule query statement	Jes you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version 2016-03-23 Rule query statement SELECT <attribute> FROM <topic< td=""><td>Jes you want to process with this rule.</td></topic<></attribute>	Jes you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version 2016-03-23 Rule query statement SELECT <attribute> FROM <topic learn more, see AWS IoT SQL Refe</topic </attribute>	jes you want to process with this rule.
Rule query statement Indicate the source of the messag Using SQL version 2016-03-23 Rule query statement SELECT <attribute> FROM <topic learn more, see AWS IoT SQL Refe</topic </attribute>	Jes you want to process with this rule. Filter> WHERE <condition>. For example: SELECT temperature FROM 'iot/topic' WHERE temperature > Serence. Simestamp FROM 'iotdemo/topic/sensor'</condition>

Figure 6.20 Entering Code



3. Click Add action.

Set one or more Select one or more when messages are	e actions actions to happen when the above rule is matched by an inbound message. Actions define additional activities that occ ive, like storing them in a database, invoking cloud functions, or sending notifications. (*.required)
Add action	
Error action Optionally set an a	ction that will be executed when something goes wrong with processing your rule.
Add action	

Figure 6.21 Add action

4. Select Send a message to the Amazon Elasticsearch Service and click Configure action.

○ 🌷	Send message data to CloudWatch logs
•	Send a message to the Amazon Elasticsearch Service
salesforce	Send a message to a Salesforce IoT Input Stream
0 🍥	Send a message to IoT Analytics
0 * Č	Send a message to an IoT Events Input IOT EVENTS
0	Start a Step Functions state machine execution
	Send a message to a downstream HTTPS endpoint
	Write a message into a Timestream table
Cancel	Configure action

Figure 6.22 Configure action



5. For **Domain name** enter the domain name created as described in 6.1, Elasticsearch Preparation, for **ID** enter **\${newuuid()}**, for **Index** enter **sensor**, and for **Type** enter **sensor**.

	•	с	Create a new resource		
*Endpoint					
				-	
		-			
D (?)		-		•	
D ⑦				•	
D ⑦ \${newuuid()} ndex ⑦]		•	
D (?) \${newuuid()} ndex (?) sensor]		•	

Figure 6.23 Domain name, ID, Index, and Type Settings

6. Click **Create a new role**, then enter the name of the role and click **Create role**.

Create a new role	
A new IAM role will be created in your account. An inlir scoped-down permissions allowing AWS IoT to access r Name Give your role a name	ne policy will be attached to the role providing resources on your behalf.
	Cancel Create role

Figure 6.24 Create role



7. Confirm that the role you created is selected, then click Add action.

Cancel	Add action

Figure 6.25 Add action

8. Confirm that the action was added, then click Create rule.

	Provide a tag value, e.g. Acme-Corporation	Value	le a tag name, e.g. Manufacturer	ag name
Clea				
L				
				Add anoth

Figure 6.26 Create rule



6.4 Running the Demo Program

Follow the steps below to run the demo program.

1. Click the **Debug** button to connect to RX65N Cloud Kit.

🐔 🐞 🔳 🔅 Debug 🗸 🗸 💽 aws_demos HardwareDebug 🗸 🄅

Figure 6.27 Debug

2. Click the **Resume** button. After a short time execution pauses at the main function; click the **Resume** button again.



Figure 6.28 Running the Demo Program



6.5 Visualizing Sensor Information with Kibana

Follow the steps below to use Kibana to visualize sensor information.

1. Go to Kibana, and click the **Management** icon in the menu at left.





2. Click Index Patterns and for Index pattern enter sensor, then click > Next step.

Saved Objects Advanced Settings	You must select or create one to continue.	Kibana uses index patterns to retrieve data from Elasticsearch indices for things like visualizations.	X Include system
		Step 1 of 2: Define index pattern	
		sensor ×	
		You can use a * as a wildcard in your index pattern. You can't use spaces or the characters /, ?, *, <, >, .	> Next step
		Success! Your index pattern matches 1 index.	
		sensor	
		Rows per page: 10 \checkmark	

Figure 6.30 Define index pattern



3. For Time Filter field name select datetime, then click Create index pattern.

You've defined sensor* as you before we create it.	r index pattern. Now you can specify some settings
Time Filter field name	Refresh
datetime	\sim
The Time Filter will use this field to filter y You can choose not to have a time field, k narrow down your data by a time range.	your data by time. but you will not be able to
> Show advanced options	

Figure 6.31 Configure settings

4. Click the Visualize icon in the menu at left.

٢	📕 Kibana	Create index p			
Ø	Index Patterns Saved Objects Visualize ed Settings	★ sensor	 Sensor Time Filter field name: datetime This page lists every field in the recorded by Elasticsearch. To c 		
5					
A			Fields (17)	Scripted	
3			Q Filter		
٢					
		<u> </u>			

Figure 6.32 Visualize



٦

5. Click Create a visualization.

Q Search	Looks like you don't have any visualizations. Let's create some! Create a visualization
) items selected	

Figure 6.33 Create a visualization

6. Click the Line icon.

Filter				Line
	E			Emphasize trends
Area	Controls	O Coordinate Map	Data Table	
(A)	ଜ	°0 00	E	
Gauge	Goal	Heat Map	Horizontal Bar	
M	(Ŧ)	8	œ	
Line	Markdown	Metric	Pie	
		۲		
gion Map	Tag Cloud	Timelion	Vega	
	ſŀn	品		
	Vertical Bar	Visual Builder		

Figure 6.34 Line



7.Click sensor.

ſ

New Line / Choose a × source
Index pattern Saved search
Q Search
Title
sensor

Figure 6.35 New Line / Choose a source



٦

8. Click the calendar icon at the upper right, set **Refresh every** to **5 seconds**, and click **Start**.

Last \checkmark 15	minute: ~	Apply	 Count
Commonly used			
Today	This week		
This month	This year		
Today so far	Week to date		
Month to date	Year to date		
Refresh every			

Figure 6.36 Refresh every Setting

9. For Metrics, under Y-Axis set Aggregation to Average and Field to light.

Metrics			
~ Y-Axis			
Aggregation		Average help	
Average		\sim	
Field			
light		\sim	
Custom Label			
		> Advanced	
	Add metrics		

Figure 6.37 Metrics Settings



10. For Buckets, under X-Axis set Aggregation to Date Histogram, Field to datetime, and Interval to Second.

Buckets	
✓ X-Axis	© ×
Aggregation	Date Histogram help
Date Histogram	\sim
Field	
datetime	\sim
Interval	
Second	\sim
Drop partial bucke	ets ⑦
Custom Label	
	> Advanced
Add sul	b-buckets

Figure 6.38 X-Axis Settings

11. Click the Apply changes icon.

sensor				
Data	Metrics & Axes	Panel Settings	⊳	×
Me	trics		Apply char	nges
~	Y-Axis			
Ag	gregation	Av	verage help	
A	verage		\sim	

Figure 6.39 Apply changes



12. On the graph of sensor data, confirm that the values change when the brightness changes. (The line on the graph should move downward when you cover the board with your hand and move upward when more light strikes the board.)





Figure 6.40 Visualization of Light Sensor Information



6.6 Important Note after Running Demo Program

Fees are incurred when are using the Amazon Elasticsearch Service.

Make sure to delete your Elasticsearch domain after you finish using the demo program.



Figure 6.41 Don't Forget to Delete Your Elasticsearch Domain!



7. Websites and Support

AWS Amazon FreeRTOS forum: <u>http://forums.aws.amazon.com</u> Renesas Amazon FreeRTOS GitHub: <u>https://github.com/renesas/amazon-freertos</u>



Revision History

		Description		
Rev.	Date	Page	Summary	
1.00	Jun. 23, 2021	—	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 is supplied until the power reaches the level at which reseting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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