

INTRODUCTION OF IOT SOLUTIONS FOR RL78 FAMILY

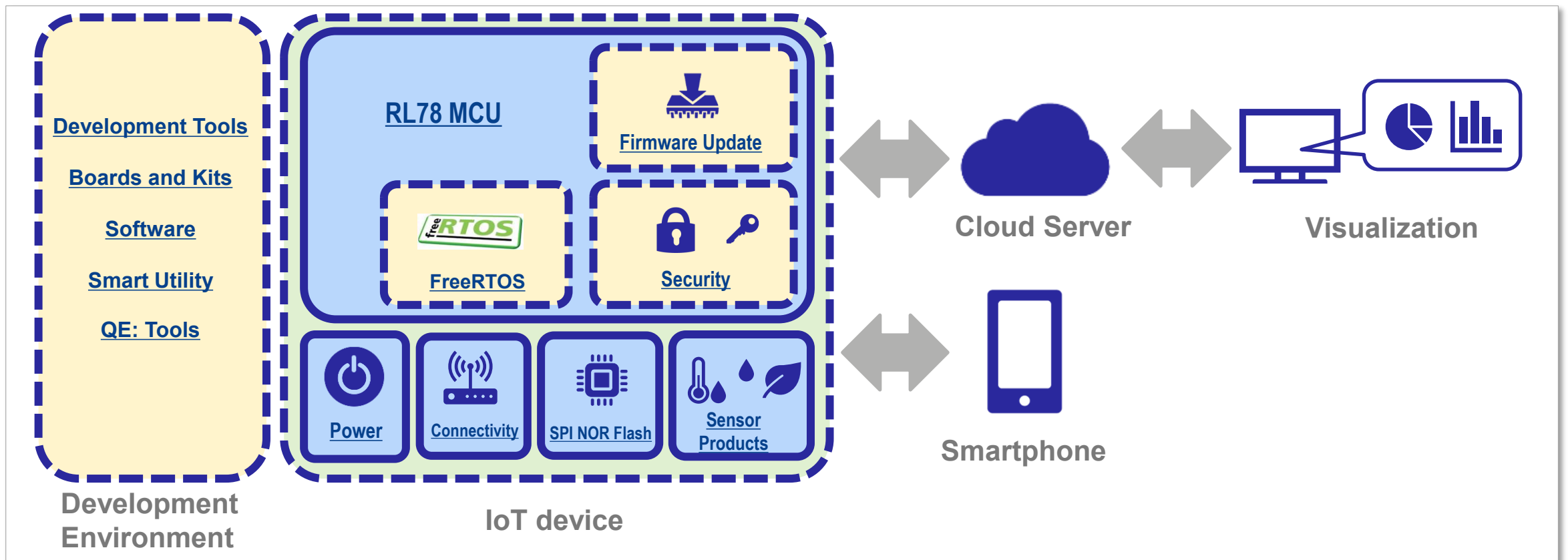
1ST, JUL. 2026

REV. 2.00

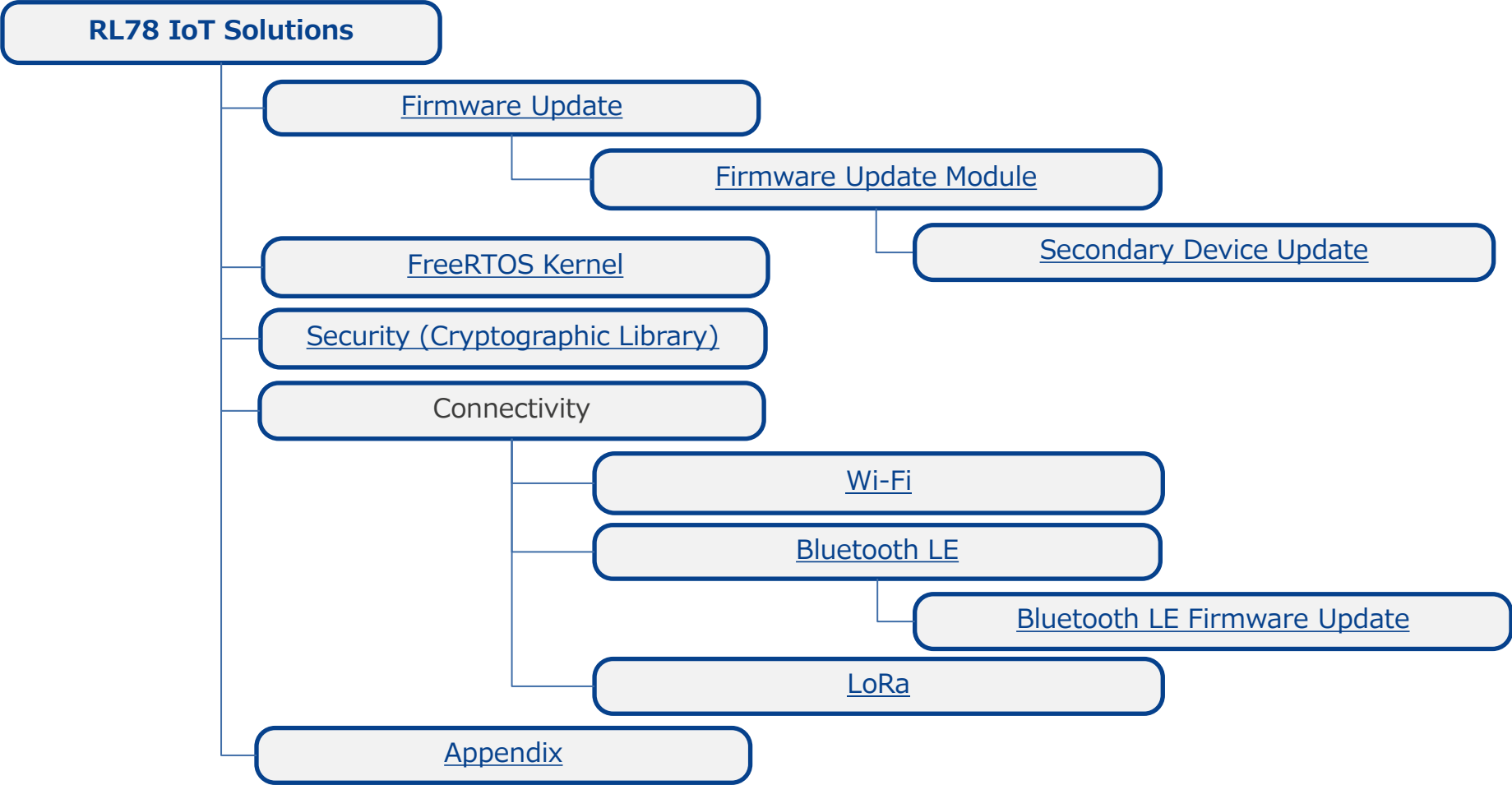
GENERAL-PURPOSE
EP MAINSTREAM MCU
EMBEDDED PROCESSING PRODUCT GROUP
RENESAS ELECTRONICS CORPORATION

RL78 FAMILY IOT SOLUTIONS

By using the RL78 family, it is possible to develop IoT device that take advantage of features such as the industry's highest level of low power consumption. We offer various evaluation kits, an easy-to-use development environment (e2 studio and so on), and **software solutions for connectivity, firmware updates, and security to enable IoT!**



OVERVIEW OF RL78 FAMILY IOT SOLUTIONS

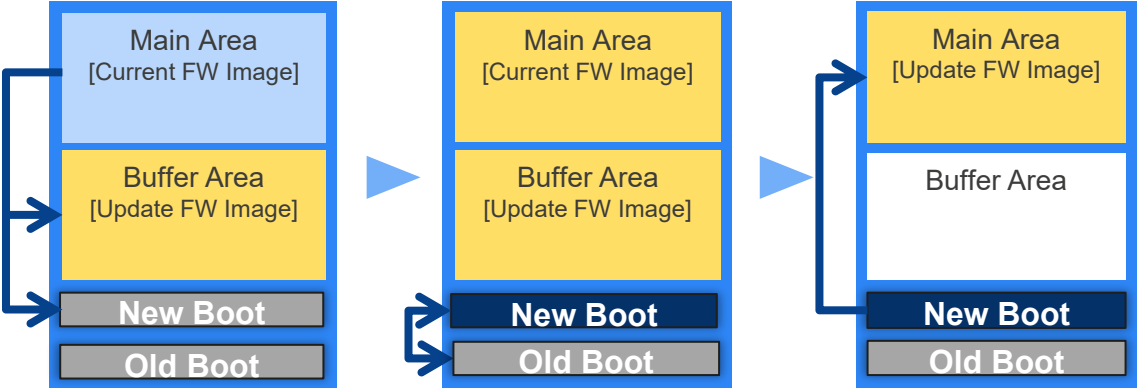


FIRMWARE UPDATE

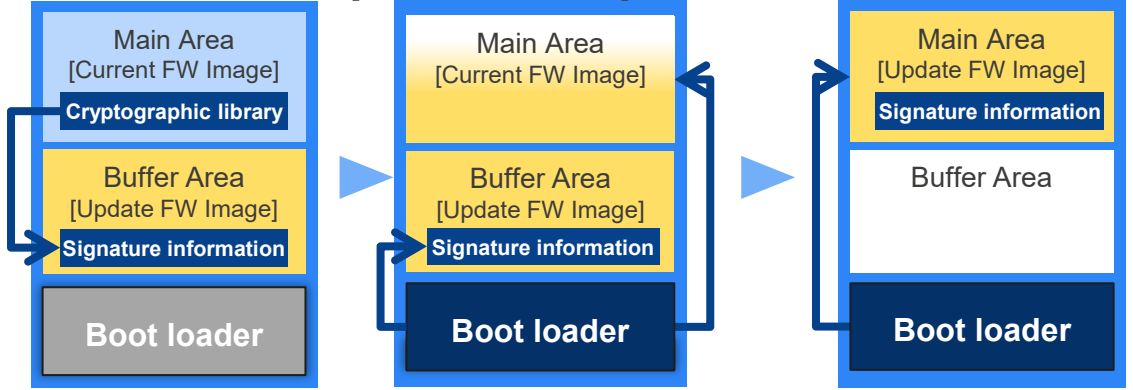
Sample code is available to help you implement firmware updates on RL78 Family MCUs.

Purpose	Solution	Content
Small code size	Firmware update using boot swap	Achieving Firmware Updates Using Boot Swap
Securely Update	Firmware Update Module	Realization of firmware update with built-in Secure Boot function

- Boot Swap Update Example



- Secure Boot Update Example



Example) [RL78/G23 Updating Firmware by Using UART Communication and Boot Swapping](#)

Example) [RL78/G22, RL78/G23, RL78/G24, RL78/L23 Firmware Update Module](#)



SAMPLE SYSTEM CONFIGURATION USING THE FW UP MODULE

The FW UP Module is ideal for realizing your firmware update over various “Primary Devices”

Compatible with various use cases

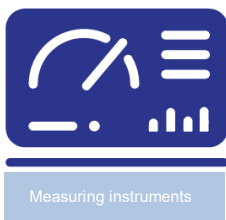
New Firmware Image

Stand-alone

(Products that run on a single device)



Home appliances



Measuring instruments

Air conditioners, etc.
such as “Paired” systems
Outdoor unit (ODU)



Indoor unit (IDU)

Industrial system

(System consisting of control devices and connected multiple secondary devices)

Control device
(primary device)



Secondary Device

Secondary Device

Secondary Device

MCUs supported by FW UP Module : **RX Family** - All RX Family,
RL78 Family - RL78/G22, RL78/G23, RL78/G24, RL78/L23

Get an updated FW via serial communication

“ Primary Device ”

Renesas MCUs

USB Memory Stick

Communication device

Other vendor MCUs

MPU, SoC etc....

Serial Communication I/F
(*1)



FW UP Module
For RX/RL78 Family

“ Secondary Device ”

FW UP Module

UART Driver

Cryptographic Library

Flash Driver

Bootloader

*1 : Firmware Updating Communications Module : ([RX](#), [RL78](#))

Application Notes



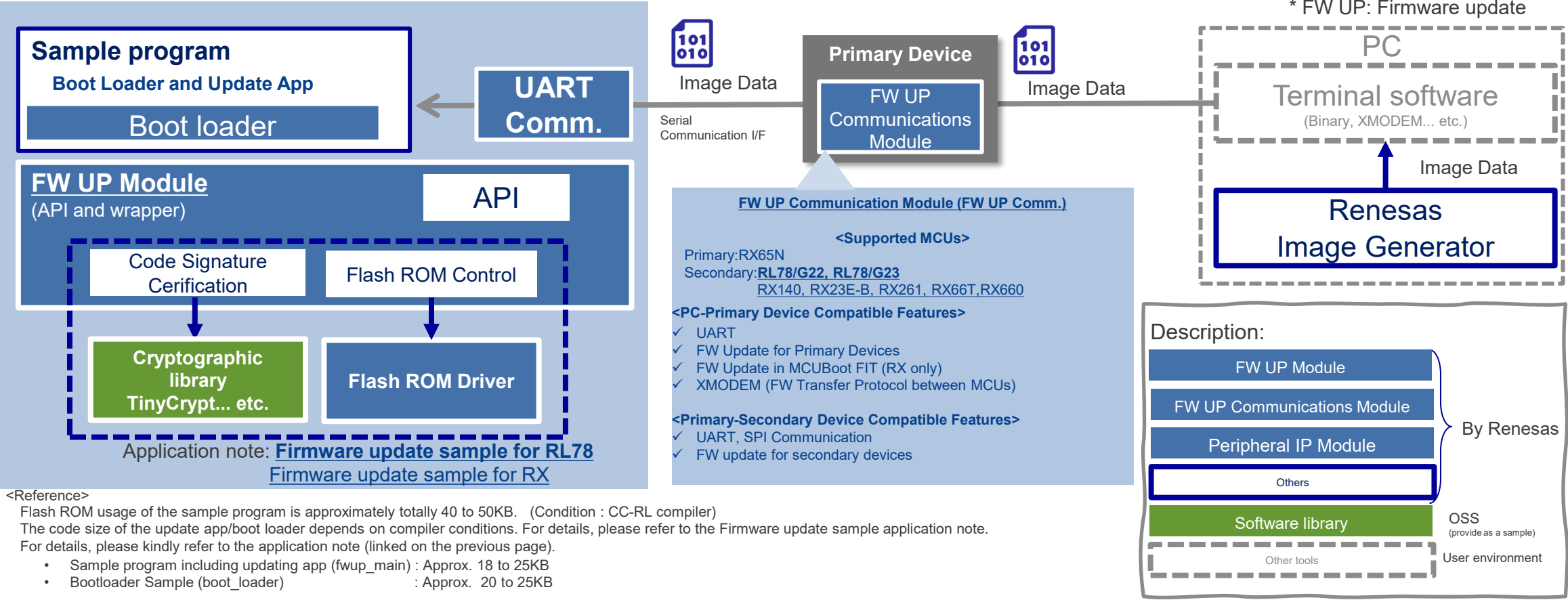
FW UP Module APN ([Link](#)) for RX Family
([Sample Code](#))



FW UP Module APN ([Link](#)) for RL78 Family
([Sample Code](#))

System Configuration for Secondary Device Update with FW UP Module

Sample code is available to help you update the firmware of secondary devices in end products that consist of a primary device and one or more secondaries.



FreeRTOS KERNEL



Operation has been verified on an RL78 MCU running the FreeRTOS kernel.
FreeRTOS Blinky demo sample code is now available.

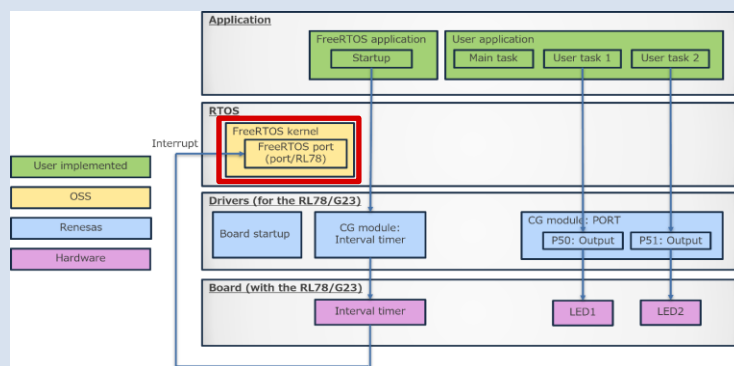
Sample Operation:

The FreeRTOS Blinky demo generates two user tasks on FreeRTOS and controls the flashing of LEDs on the board.

Operation Board: [FPB-RL78G14](#), [FPB-RL78G23-128p](#)

Supported compiler: [CC-RL](#)

Software Stack Diagram (RL78/G23)



Application Note

[RL78/G14, RL78/G23 FreeRTOS Blinky Demo Application Note \(Sample Code\)](#)

Software (Download from GitHub)

- [GitHub - renesas/FreeRTOS-Kernel · GitHub](#)
 - [FreeRTOS-Kernel: RL78 FreeRTOS 11.1.0 from original V11.1.0 · GitHub](#)

FreeRTOS documentation

- [FreeRTOS Documentation - FreeRTOS™](#)
- [FreeRTOS-Kernel-Book · GitHub](#)

Sample program for FreeRTOS with network connectivity provided.

FreeRTOS-LTS 202406 Software

- [GitHub - renesas/iot-reference-rl78 · GitHub](#)
 - [FreeRTOS IoT Reference: RL78 MCUs FreeRTOS IoT Reference from original 202406.04-LTS · GitHub](#)



SECURITY (CRYPTOGRAPHIC LIBRARY)

Cryptographic libraries are available to help you develop systems that meet your security requirements.

AES Encryption

Key generation, encryption, and decryption (AES 128-bit / 256-bit, ECB and CBC modes), plus a GCM library compatible with Galois/Counter Mode (GCM) for use with the AES libraries.

Using the RL78/G24 with the FAA improves processing speed.

Operation Verification Device: RL78/G14, RL78/G23

Supported compiler: CC-RL, IAR C/C++
Compiler for Renesas RL78, LLVM for Renesas RL78

Application Note

[RL78 Family AES Library: Introduction Guide Application Note](#) ([Sample code](#))

[RL78/G24 FAA AES Library Introduction Guide Application Note](#) ([Sample code](#))

SHA Hash

Supports hash calculation for SHA-1 and SHA-256, and specifies the build target file for each API. When used together with the FAA of the RL78/G24, only SHA-256 is supported, allowing for faster processing speed through FAA

Operation Verification Device: RL78/G14, RL78/G23, RL78/G24

Supported compiler: CC-RL, IAR C/C++
Compiler for Renesas RL78, LLVM for Renesas RL78

Application Note

[RL78 Family SHA Hash Function Library: Introduction Guide Application Note](#) ([Sample Code](#))

RSA Cipher

Supports major APIs such as signature generation and verification (RSASSA-PKCS1-V1_5) and exponentiation residue operations

Operation Verification Device: RL78/G14, RL78/G23

Supported compiler: CC-RL, IAR C/C++
Compiler for Renesas RL78, LLVM for Renesas RL78

Application Note

[RL78 Family RSA Library: Introduction Guide Application Note](#) ([Sample code](#))

Steps to migrate sample code projects for drivers and middleware to other RL78 family devices

Application Note

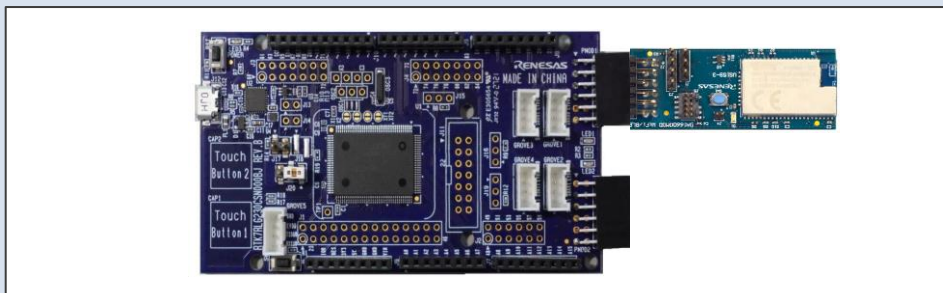
[RL78 Family How to change devices in the sample project for the DSP Library and the Security Library Application Note](#)

CONNECTIVITY (WI-FI)

Software Integration System (SIS) software for Wi-Fi applications
Sample code using the SIS utility is now available.

SIS provides a software API that simplifies the use of DA16XXX Wi-Fi modules.

- Supported compiler: [CC-RL](#)
- Operation Verification Board: [FPB-RL78G23-128p](#)



- **Application Note**

[RL78 Family US159-DA16XXXMEVZ Wi-Fi Control Module Using Software Integration System APN](#) ([Sample Code](#))

Main Features of DA16XXX Wi-Fi SIS Modules

- IEEE 802.11b/g/n (2.4 GHz) Wi-Fi connectivity (Open, WPA, WPA2)
- MAC address retrieval
- IP address retrieval
- Wi-Fi network scanning and ping testing
- DNS-based IPv4 address resolution
- SNTP client for time synchronization
- TCP client socket support
- On-chip TLS client
- On-chip MQTT client
- On-chip HTTP client
- On-chip OTA service for DA16xxx firmware updates

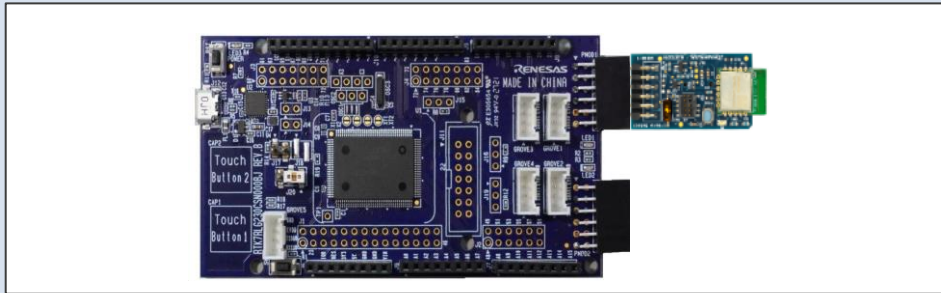
CONNECTIVITY (BLUETOOTH LE)

Configure Bluetooth LE functions efficiently with QE for BLE.

Build custom devices using External Processor Interface (GTL Interface) firmware for Bluetooth LE applications.

The SIS for Bluetooth LE applications provides a software API that simplifies the use of DA1453XMOD Bluetooth LE modules.

- Supported compiler: [CC-RL](#)
- Operation Verification Board: [FPB-RL78G23-128p](#)



- **Application Note**

[RL78 Family US159-DA1453xEVZ BLE Control Module Using Software Integration System](#) ([Sample Code](#))

Main Features of the DA1453X Bluetooth LE SIS Module

- DA1453x basic features
 - Host MCU boot and DA14531/DA14535 flash boot support
 - Bluetooth LE stack control (open/close)
 - Sleep mode support
- GAP features
- Common GATT features
- GATT client features
- Security features (peripheral role)

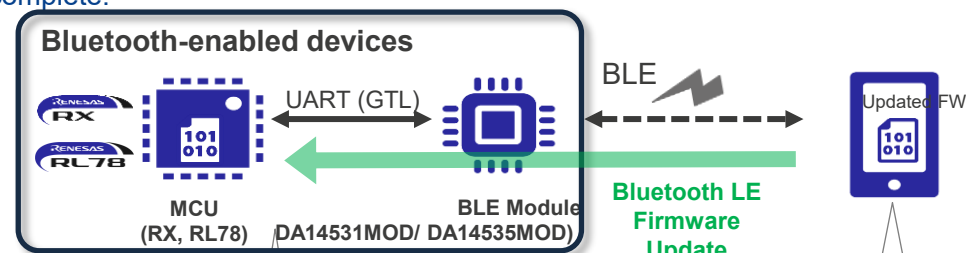
BLUETOOTH LE OTA FIRMWARE UPDATE



A Bluetooth LE OTA sample program is available for easy and secure firmware updates from a smartphone via Bluetooth LE

■ Composition

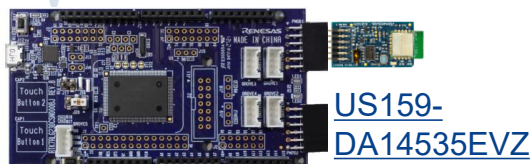
A sample program where the LED on the board blinks after the firmware update is complete.



Evaluation board

[OTA Operation]

Initial Image: LED Lights Out
Update Image: LED flashing

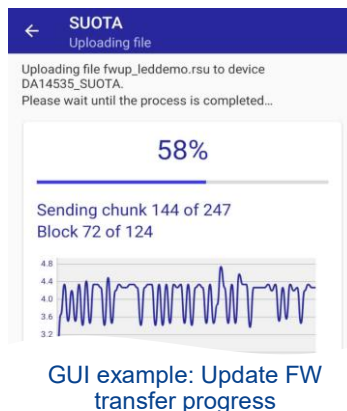


US159-
DA14535EVZ

[FPB-RL78G23-128p](#)

* Supports configurations using [FPB-RX261](#).
The Bluetooth LE module includes [US159-DA14531EVZ](#) is also available.

Smartphone (SUOTA App)



■ Features

- ✓ Provided **Sample software** and **smartphone app** (free of charge)
- ✓ You can check **firmware version** information and **update status** on your smartphone
- ✓ In addition to signature **verification** during firmware downloads, it also supports **secure boot** (signature verification method: ECDSA-SHA256)

■ Product Examples

Bluetooth LE-equipped appliances, beauty appliances, healthcare, and more



Air purifier



Electric toothbrush



Refrigerator



Scale



Smart Lock

[RX family Sample Code](#)

[RX Family Documentation](#)

[RL78 Family Sample Code](#)

[RL78 Family Documentation](#)

[Renesas SUOTA - Google Play Application](#)

LORA®-BASED SOLUTIONS

COVER A WIDE AREA WITH LOW POWER CONSUMPTION

LoRa® is a spread spectrum modulation technique derived from chirp spread spectrum (CSS) technology developed by Semtech Corporation.

Renesas LoRa®-based solutions use the sub-GHz frequency band of frequencies below 1 GHz and can cover a wide area with low power consumption.

Development Environment (MCU Evaluation Board + RF Transceiver)

RL78 MCU:

FPB-RL78G23-64p, FPB-RL78G23-128p,
FPB-RL78G22, FPB-RL78L23, FPB-RL78G14

* FPB is Fast Prototyping Board

RF Transceiver:

Semtech SX1261/1262 Shield



Software for Ease of Design

- Providing **LoRaWAN® protocol stack** compliant with the LoRaWAN® specification (Class A/B/C)
- Providing Private LoRa®-based network sample and the **radio driver** for custom protocol.
- The **firmware update sample** utilizing LoRaWAN® is available.

LoRaWAN®
Sample Apps

LoRaWAN®
MAC Stack

LoRa®-based
Sample Apps

LoRa®-based Radio Driver

* Please refer to the web-page for the MCU's supported functions.

Power LoRa® -based Solutions

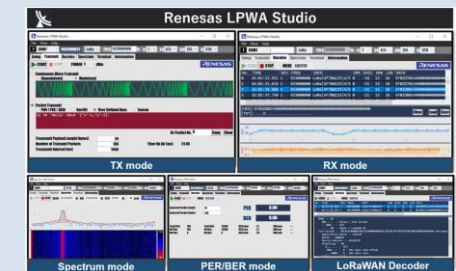
- The combination of a low-power microcontroller (**RL78/G23, RL78/G22, RL78/L23, RL78/G14**) and a LoRa® transceiver (Semtech SX1261/SX1262)
- The designed communication software for low power consumption achieves a current consumption of less than 1μA

* Please refer to the web page for current consumption

	RL78/G23 SX1261
Sleep	0.55 μA
RX / TX	4.6 / 25.5 mA

Tools for Ease of RF Characteristics Evaluation

“Renesas LPWA Studio” tool that makes RF characteristics evaluation easy



APPENDIX



SOFTWARE SOLUTIONS TO REALIZE IOT (1)

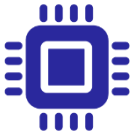
Renesas provides various software solutions for IoT development using RL78!

Connectivity 	• [Wi-Fi] US159-DA16XXXMEVZ Wi-Fi Control Module Using SIS (Sample Code) • [Wi-Fi] Wi-Fi Communication (Soft AP mode) with DA16200/DA16600(Sample Code) • [Bluetooth LE] US159-DA1453xEVZ BLE Control Module Using SIS (Sample Code) • [LoRa] LoRa®-based Solutions for RL78 Family • [Cellular] LTE RYZ024A MQTT Communication (Sample Code)
FreeRTOS Kernel 	• FreeRTOS Blinky Demo (Sample Code)
Cloud connection 	• IoT Cloud Solutions

Blue: Application notes, web page links

SOFTWARE SOLUTIONS TO REALIZE IOT (2)

Renesas provides various software solutions for IoT development using RL78!

Firmware update 	• Firmware Update Module (Sample Code) • Updating Firmware by Using UART Communication and Boot Swapping (Sample Code) • Firmware Upgrade Using External Flash Memory via Simplified SPI (CSI) Communication (Sample Code) → Firmware Update
SPI NOR Flash 	• SPI Serial Flash Memory Driver Serial Memory
Security 	• Crypto Library AES Library, RSA Library, SHA Hash Function Library

Blue: Application notes, web page links, Black: Page links within the document

BOARDS & KITS

Main boards & kits related to RL78 IoT solutions

	<u>FPB-RL78G23-128p - RL78/G23-128p Fast Prototyping Board</u>
	<u>FPB-RL78G22 - RL78/G22 Fast Prototyping Board</u>
	<u>US159-DA16600EVZ - Ultra-Low-Power Wi-Fi + Bluetooth Low Energy Combo Pmod Board</u>
	<u>US159-DA14531EVZ - Low-Power Bluetooth Pmod Board</u>
	<u>US159-DA14535EVZ - Bluetooth Low Energy Pmod Board</u>



PARTNER ECOSYSTEM

Renesas is enabling a comprehensive partner ecosystem to deliver an array of software and hardware building blocks that will work out-of-the-box with **Renesas RL78 Family MCUs**.

Renesas RL78 Partner Ecosystem Solutions for IoT

- Security
- Safety
- Connectivity
- Cloud

DOCUMENTATION (CONNECTIVITY)

Application Note

[RL78/G22 Wi-Fi Communication \(Soft AP mode\) with DA16200/DA16600](#) [日本語](#) Related Files: [Sample Code](#)

[RL78 Family US159-DA14531EVZ BLE Control Module Using Software Integration System](#) Related Files: [Sample Code](#)

[RL78 Family US159-DA16XXXMEVZ Wi-Fi Control Module Using Software Integration System](#) Related Files: [Sample Code](#)

[RL78/G23 AWS Cloud Connectivity for MCU Firmware Update Over-the-Air on RL78/G23-128p Fast Prototyping Board with Wi-Fi DA16600](#)
Related Files: [Sample Code](#)

[RL78 Family Renesas Firmware Update Over the Air \(FOTA\) Sample Program With Bluetooth Low Energy DA14535/DA14531](#) Related Files: [Sample Code](#)

[RL78/G22 LTE MQTT Communication Application Note](#) [日本語](#) Related Files: [Sample Code](#)

[LoRaWAN® Stack Reference Guide](#)

[LoRaWAN® Stack Sample Application](#)

[RL78/G23, RL78/G22, RL78/L23, RL78/G14 LoRaWAN® Sensor Demo](#) Related Files: [Sample Code](#)

[RL78/G23, RL78/G22, RL78/L23, RL78/G14 LoRa®-based Wireless Software Package](#) Related Files: [Sample Code](#)



DOCUMENTATION (SPI SERIAL FLASH MEMORY DRIVER)

Application Note

[RL78 Family Serial NOR Flash Memory Control Module Software Integration System](#) [日本語](#) Related Files: [Sample Code](#)

[RL78/G14, RL78/G1C, RL78/L12, RL78/L13, RL78/L1C, RL78/G23 Group Clock Synchronous Single Master Control Software Using CSI Mode of Serial Array Unit](#) [日本語](#) Related Files: [Sample Code](#)

[RX Family, RL78 Family, 78K0R/Kx3-L Macronix International MX25/66L Family Serial NOR Flash Memory Control Software](#) [日本語](#) Related Files: [Sample Code](#)

[RX Family, RL78 Family, 78K0R/Kx3-L Micron Technology M25P Series Serial Flash memory Control Software](#) [日本語](#) Related Files: [Sample Code](#)

[RX Family, RL78 Family, 78K0R/Kx3-L Micron Technology M45PE Series Serial Flash memory Control Software](#) [日本語](#) Related Files: [Sample Code](#)

[RX Family, RL78 Family, 78K0R/Kx3-L Micron Technology N25Q Serial NOR Flash Memory Control Software](#) [日本語](#) Related Files: [Sample Code](#)

[RX Family, RL78 Family, 78K0R/Kx3-L Micron Technology P5Q Serial Phase Change Memory Control Software](#) [日本語](#) Related Files: [Sample Code](#)



DOCUMENTATION (SECURITY)

Application Note

[RL78/G24 FAA AES Library Introduction Guide](#) [日本語](#) Related Files: [Sample Code](#)

[RL78 Family How to change devices in the sample project for the DSP Library and the Security Library](#) [日本語](#)

[RL78 Family SHA Hash Function Library: Introduction Guide](#) [日本語](#) Related Files: [Sample Code](#)

[RL78 Family AES Library: Introduction Guide](#) [日本語](#) Related Files: [Sample Code](#)

[RL78 Family RSA Library: Introduction Guide](#) [日本語](#) Related Files: [Sample Code](#)

DOCUMENTATION (CLOUD CONNECTION)

Application Note

[RL78/G23 Getting Started Guide for Connecting Amazon Web Services \(202406-LTS Version\) in Wi-Fi Communication: RL78/G23-128p FPB + FreeRTOS](#) Related Files: [Sample Code](#)

[Getting Started Guide for Connecting Amazon Web Services in Wi-Fi Communication: RL78/G23-128p Fast Prototyping Board + FreeRTOS](#) Related Files: [Sample Code](#)

[RL78/G23 Getting Started Guide for Connecting Amazon Web Services in LTE Communication: RL78/G23-128p Fast Prototyping Board + FreeRTOS Rev.1.00](#) [日本語](#) Related Files: [Sample Code](#)

DOCUMENTATION (FIRMWARE UPDATE)

Application Note

[RL78/G22, RL78/G23, RL78/G24, RL78/L23 Firmware Update Module](#) [日本語](#) related files: [sample code](#)

[RL78/G22, RL78/G23 Firmware Updating Communications Module](#) [日本語](#) Related Files: [sample code](#)

[RL78/G23 Sample Code for OTA Update of a Secondary Device by Amazon Web Services with the Use of FreeRTOS](#) [日本語](#) Related Files: [Sample Code](#)

[RL78/G22 OTA Firmware Update for a Secondary MCU](#) [日本語](#) related files: [sample code](#)

[RL78/G23 updating firmware by using uart communication and boot swapping](#) [日本語](#) related files: [sample code](#)

[RL78/G23 firmware upgrade using external flash memory via simplified spi \(csi\) communication rev.1.00 \(renesas.com\)](#) [日本語](#) related files: [sample code](#)

DOCUMENTATION (SELF PROGRAMMING)

Communication method	APPLICABLE DEVICES	APPLICATION NOTE
UART	G12,G1G,G1P,L12	RL78/G12 Self-Programming (Received Data via UART) CC-RL 日本語 Related Files: Sample Code
	X1x *	RL78/G13 Self-Programming (Received Data via UART) CC-RL 日本語 Related Files: Sample Code
		RL78/G13 Flash Self Programming: Execution: Application Note 日本語 Related Files: Sample Code
	G2x	RL78/G23 Self-Programming Using Boot Swapping via UART communications 日本語 Related Files: Sample Code
		RL78/G23 Updating Firmware by Using UART Communication and Boot Swapping 日本語 Related Files: Sample Code
SPI(CSI)	G12,G1G,G1P,L12	RL78/G12 Self-Programming (Received Data via CSI) CC-RL 日本語 Related Files: Sample Code
	x1x *	RL78/G13 Self-Programming (Received Data via CSI) CC-RL 日本語 Related Files: Sample Code
	G2x	RL78/G23 Firmware Upgrade Using External Flash Memory via Simplified SPI (CSI) Communication 日本語 Related Files: Sample Code
IIC	G12,G1G,G1P,L12	RL78/G12 Self-Programming (Received Data via IIC) CC-RL 日本語 Related Files: Sample Code
	x1x *	RL78/G13 Self-Programming (Received Data via IIC) CC-RL 日本語 Related Files: Sample Code

* RL78/G10, G1M, G1N, excluding the above devices (applicable to **devices with boot swap function**)
 For details, refer to [RL78 Family Self RAM list of Flash Self Programming Library](#)

REVISION HISTORY

Rev.	Date	Description
1.00	7 th , May, 2024	1st edition
2.00	1 st , Jul, 2026	Completely Updated Version as 2 nd edition

[Renesas.com](https://www.renesas.com)