UM11798

Getting Started with Wireless on RW61x Evaluation Board Running FreeRTOS

Rev. 5.0 — 16 April 2025 User manual

Document information

Information	Content
Keywords	MCUXpresso SDK, RW61x evaluation board, FreeRTOS image
Abstract	Provides the step-by-step guidance to set up RW61x evaluation board, build the application image, and run Wi-Fi and Bluetooth LE demo applications.

1 About this document

1.1 Purpose and scope

This document describes RW61X-EVK board along with the overall architectures, platform interfacing, related configurations, and software package.

1.2 Considerations

The RW61x is powered by FreeRTOS™ and the FreeRTOS-based Wi-Fi drivers are added to support RW61x evaluation board. This document includes a brief description of RW61x evaluation kit (RW61X-EVK), while MCUXpresso SDK implementation and configuration are covered in RW61X-EVK documentation (ref.[4] and ref.[5]).

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2 Wireless MCU RW61x

RW61x Wireless MCUs feature NXP's advanced implementation of the Arm Cortex-M33 core with Wi-Fi 6 and Bluetooth Low Energy (LE) 5.4 / 802.15.4 radios designed for a broad array of applications, with support of FreeRTOS available within MCUXpresso SDK. Applications includes connected smart home devices, smart appliances, enterprise and industrial automation, smart accessories and smart energy. For more details on RW61x products, see ref.[10] and ref.[11].

The following products support NXP-based wireless features:

- RW610 (Wi-Fi +Bluetooth LE)
- RW612 (Wi-Fi + Bluetooth LE/ 802.15.4)

2.1 RW61x processor

The RW61x processor Arm Cortex-M33 offers high-performance processing optimized for the lowest power consumption and best real-time response. The RW61x products provide various memory interfaces and types including pSRAM, and NOR flash through Quad SPI (FlexSPI). The RW61x MCUs also feature a wide range of other interfaces for peripherals, such as Ethernet, USB, SDIO, USIM, and Flexcomm (SPI/I2C/USART/I2S). RW61x series supports rich audio and video features, including LCD display, DMIC, and I2S audio interface.

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2.2 RW61x architecture

Figure 1 shows RW610 block diagram. IMU interface is used for Wi-Fi/Bluetooth LE communication between the application CPU and Wi-Fi/Bluetooth LE MCU.

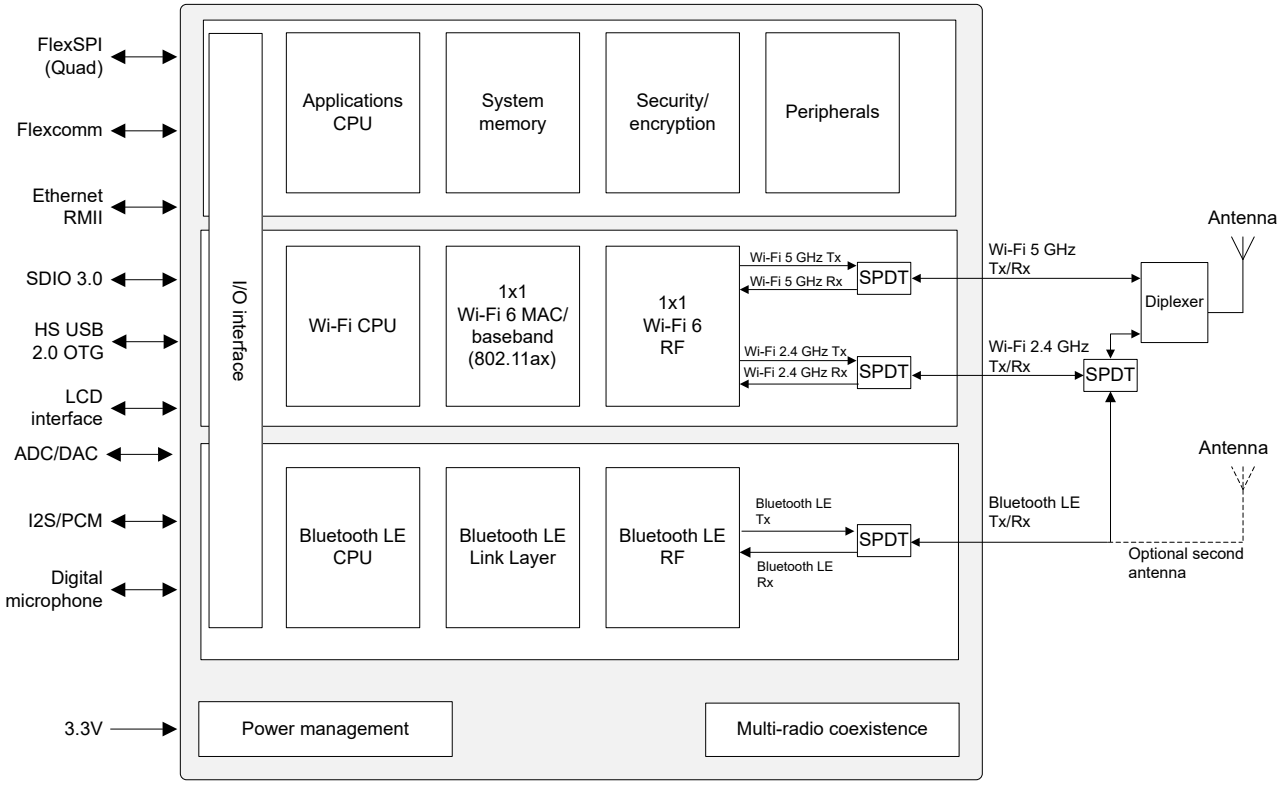

Figure 1. RW610 block diagram

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Figure 2 shows RW612 block diagram. IMU interface is used for the communication between the application CPU and Wi-Fi/Bluetooth LE/802.15.4 MCU.

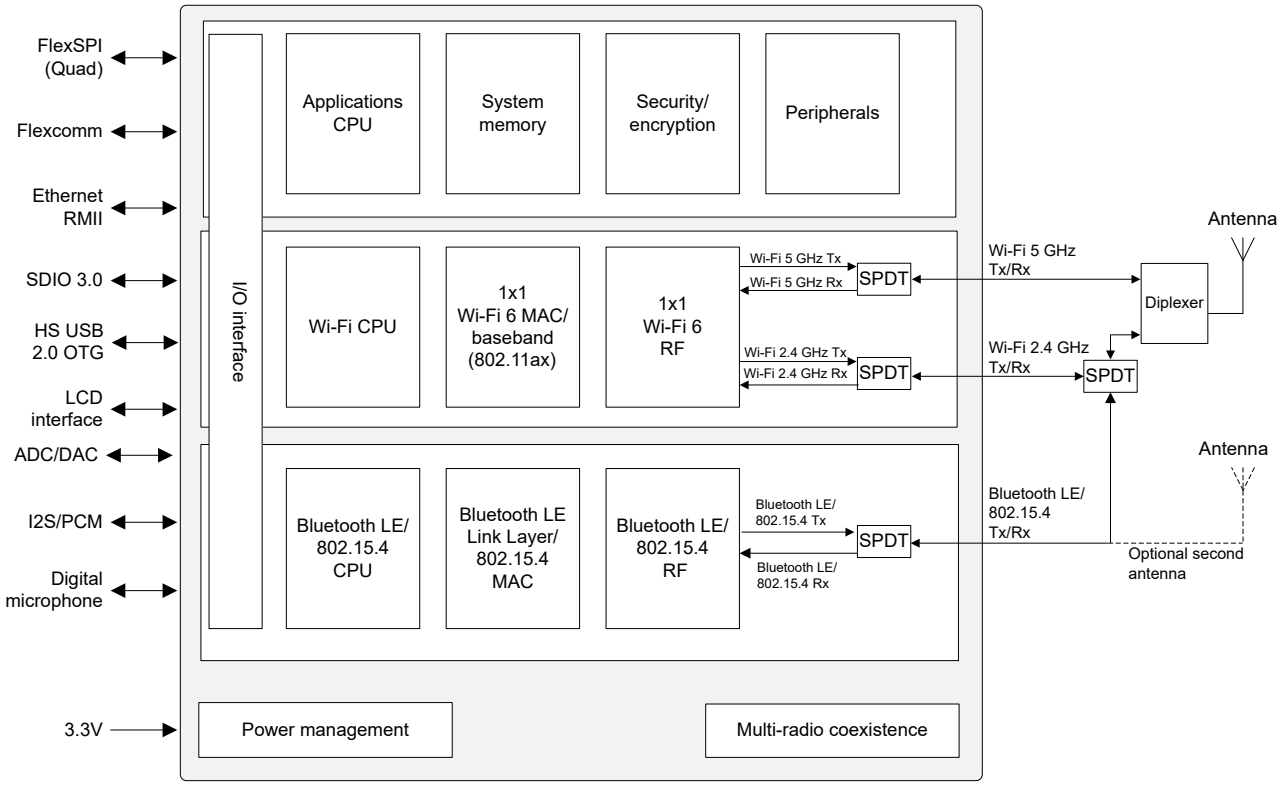

Figure 2. RW612 block diagram

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2.3 RW61x MCUXpresso SDK

This section describes the architectural overview for the MCUXpresso software development kit (SDK) including NXP-based wireless drivers and related dependencies. The MCUXpresso SDK architecture consists of the following key components:

- The Arm Cortex Microcontroller Software Interface Standard (CMSIS) CORE compliance device-specific header files, SOC Header, and CMSIS math/DSP libraries
- Cloud connectivity APIs for Amazon AWS
- Peripheral drivers such as SPI, I2C, ADC, uSDHC, UART
- Real-time Operating Systems (FreeRTOS and Zephyr)
- Stacks and Middleware that are part of MCUXpresso SDK and include:
  - Connectivity, Security, DMA, File System, MCU boot, and other software features
  - Specific features for Wi-Fi connectivity: lwIP stack, DHCP, Wireless connection manager, and Wi-Fi module driver
  - Specific features for Bluetooth connectivity: Bluetooth stack, Bluetooth module driver
- Demo Applications based on the MCUXpresso SDK

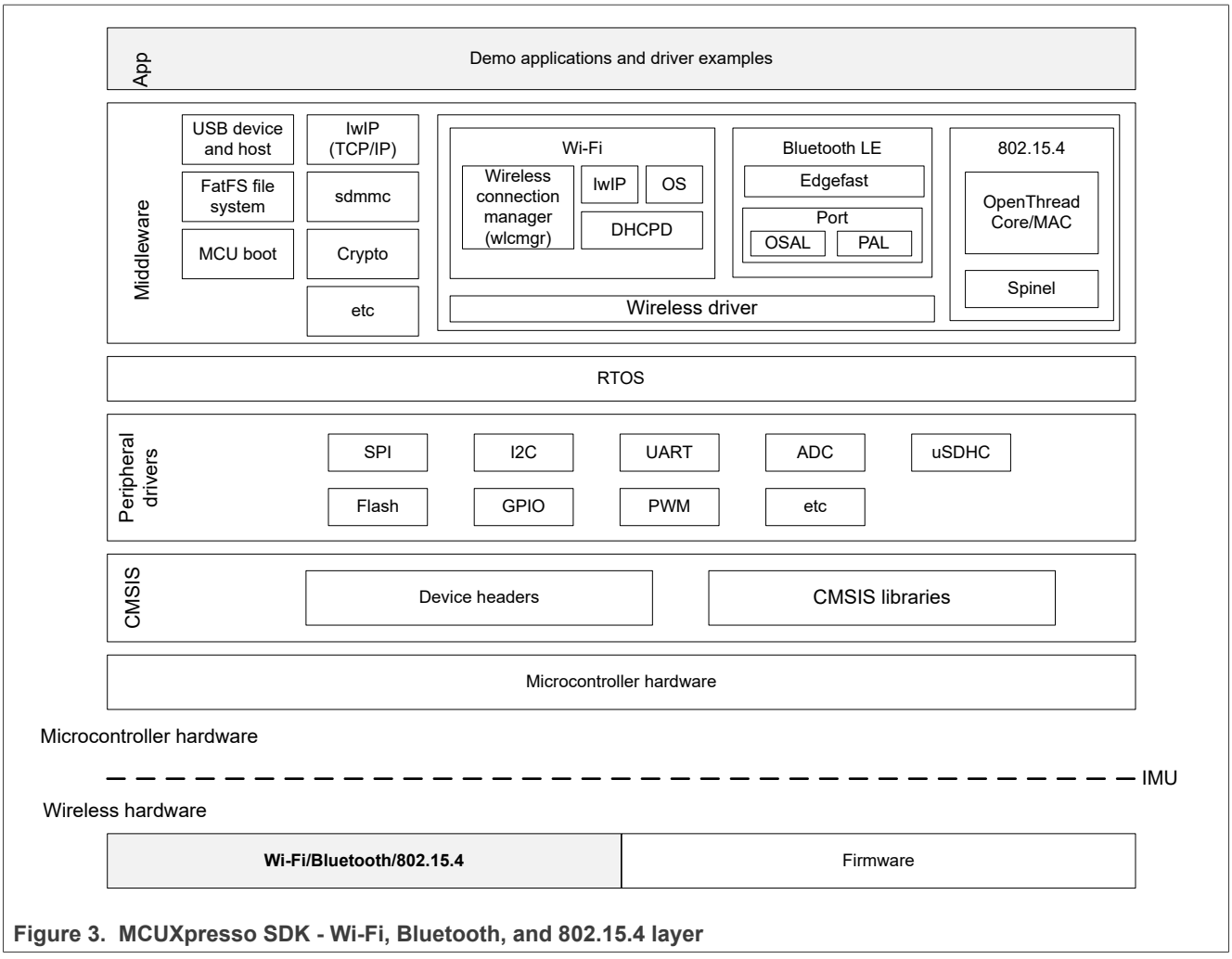

Figure 3. MCUXpresso SDK - Wi-Fi, Bluetooth, and 802.15.4 layer

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3 RW61x evaluation board

3.1 RW61x evaluation board overview

The RW61x EVK boards are USB powered printed circuit boards (PCB). At their heart lies the RW61x SoC, featuring highly integrated Arm Cortex-M33 core, Wi-Fi 6, Bluetooth LE and 802.15.4. Cortex-M33 core operates at sufficient speed to provide high CPU performance and excellent real-time response.

For more details on RW61X-EVK, look for ***Design resources*** on RW610 and RW612 web pages (ref.[10] and ref.[11]).

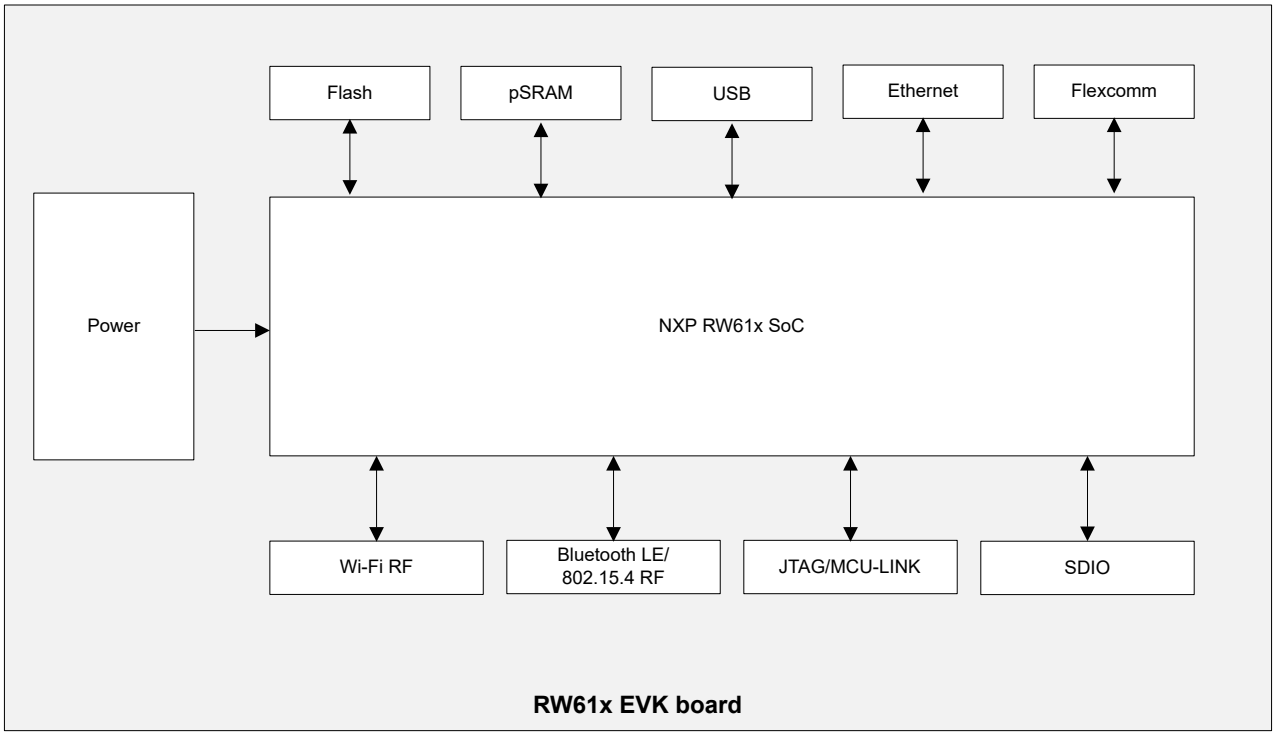

Figure 4. RW61x evaluation board diagram

Note: *RW61x EVB (RD-RW61x-xxx) is preconfigured for the dual-antenna configuration. The antennas used for Wi-Fi and Bluetooth/802.15.4 are on separate paths.*

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3.2 Jumper configuration

RW61x EVB (RD-RW61x-xxx) is preconfigured with the default jumper settings shown in Table 1. For more details, refer to the schematic included in the design package available in the design section of ref.[10] and ref.[11].

Table 1. Recommended jumper configuration

Jumper	Default setting	Description
U38 DIP-Switch CON[3:0]	1111: FlexSPI flash boot	Boot mode selection 0 - Switch ON position 1 - Switch OFF position Other available Boot modes: 1110: ISP boot (UART/I2C/SPI/USB) 1101: Serial boot (UART/I2C/SPI/USB) 1100: ISP boot (SDIO) 1011: Serial boot (SDIO)
JP31	(1-2): RW61x internal Buck	To select the source of VCORE supply.
JP34	(2-3): RW61x internal Buck	To select the source of 1.8 V voltage.

Note:

- *For details on the configuration options and configuration pins, see ref.[1] and ref.[2].*
- *Do not change the other jumper configurations*

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Figure 5 shows the top view of RW61x evaluation board.

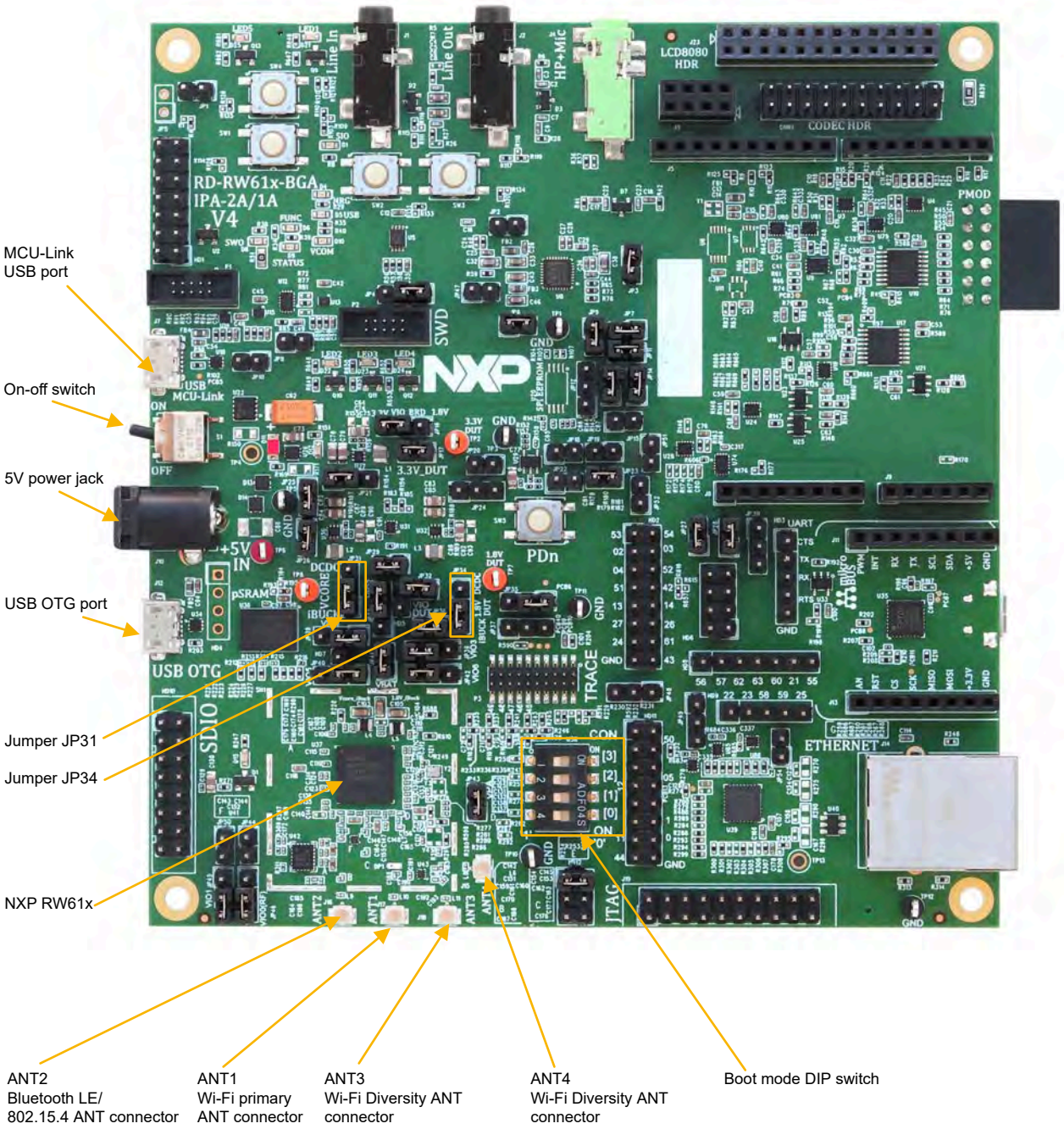

Figure 5. Top view of RW61x evaluation board

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Figure 6 shows the bottom view of RW61x evaluation board.

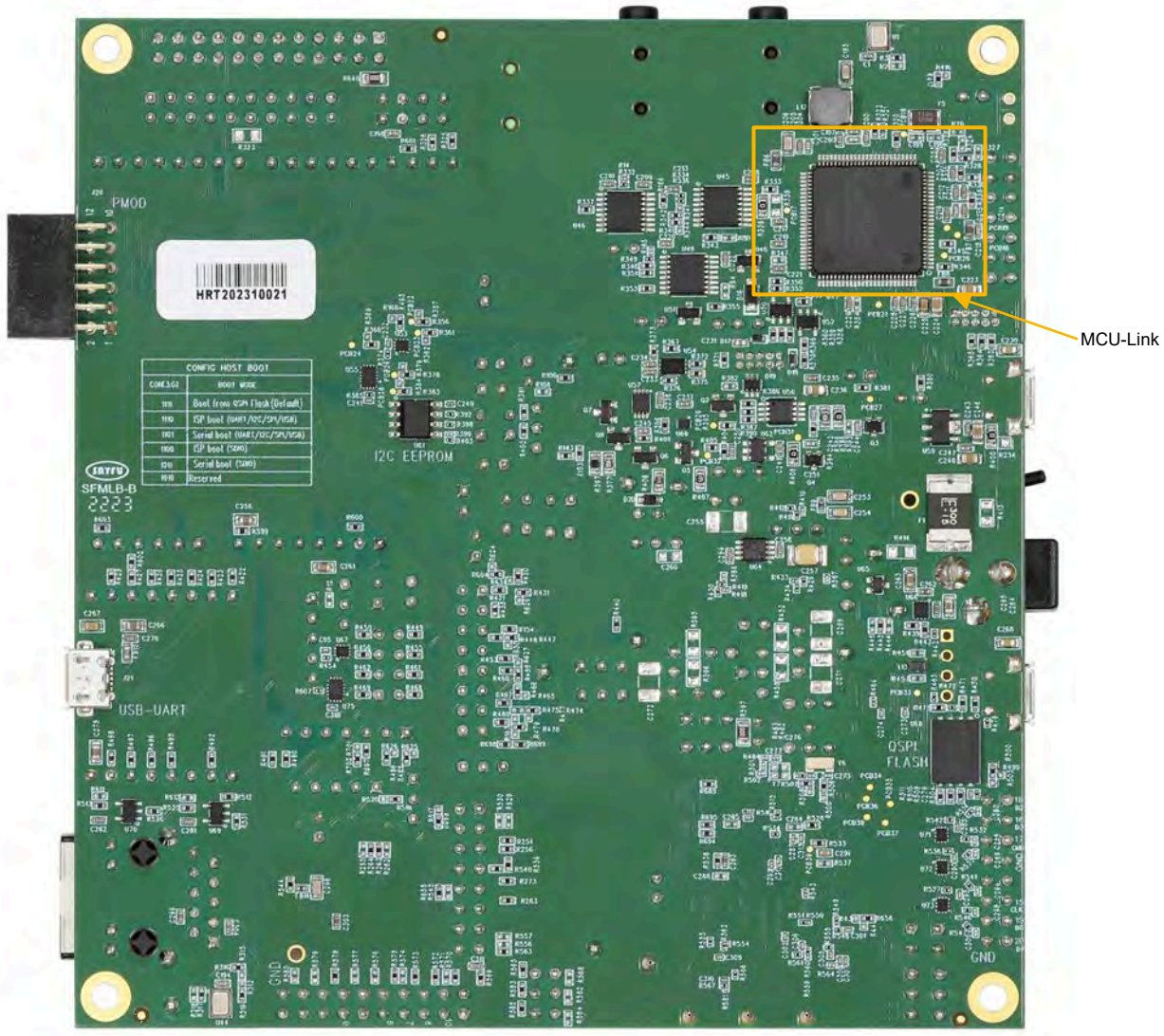

Figure 6. Bottom view of RW61x evaluation board

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4 Software download

This section provides the instructions on where and how to download the MCUXpresso SDK development environment for RW61x Wi-Fi and Bluetooth radios.

4.1 SDK download

4.1.1 MCUXpresso SDK download

- Go to MCUXpresso SDK Builder page on NXP website (ref.[9]).
- Click **Select Development Board**.

Figure 7. MCUXpresso SDK builder

- Select the development board and the latest SDK version.
  - RD-RW612-BGA: RW61x BGA board

Figure 8. Select the development board

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- The selection details are displayed on the right side. Use the arrow to select the SDK version.

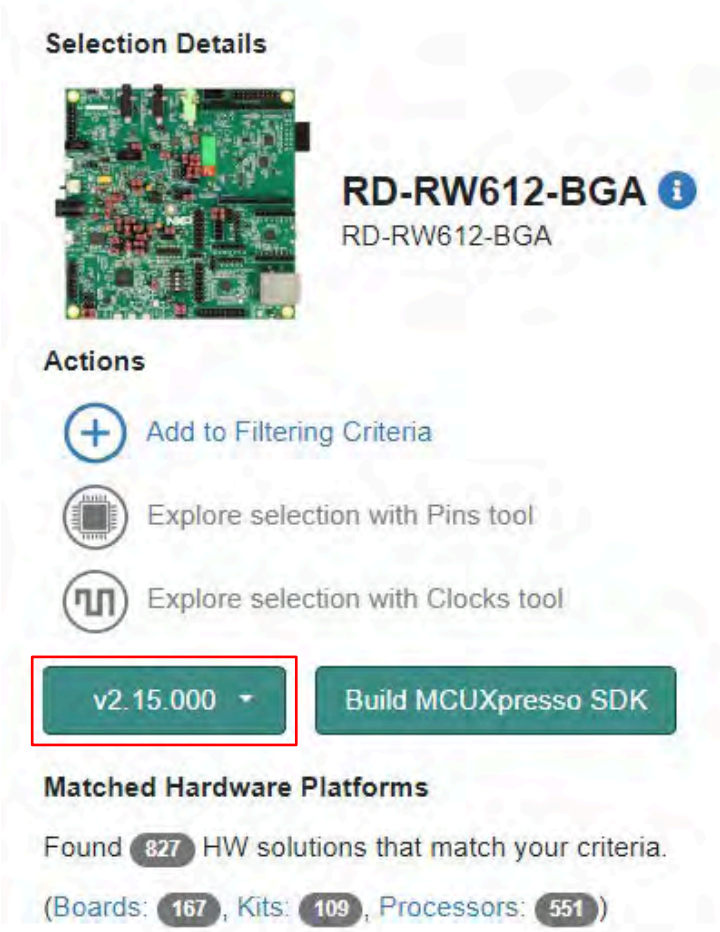

Figure 9. Selection details

- Click **Build MCUXpresso SDK**.
- Define the **Developer Environment Settings**.
  - Host OS: Windows, MacOS, Linux
  - Toolchain/IDE: MCUXpresso IDE, ARM-GCC, IAR (ref.[6]), Arm GCC, IAR (ref.[8]), Keil

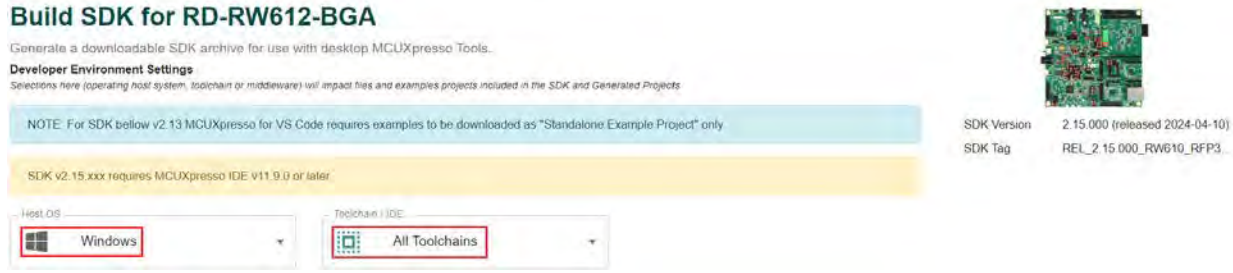

Figure 10. Developer environment settings

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- Click **SELECT ALL** or select the SDK components to download.

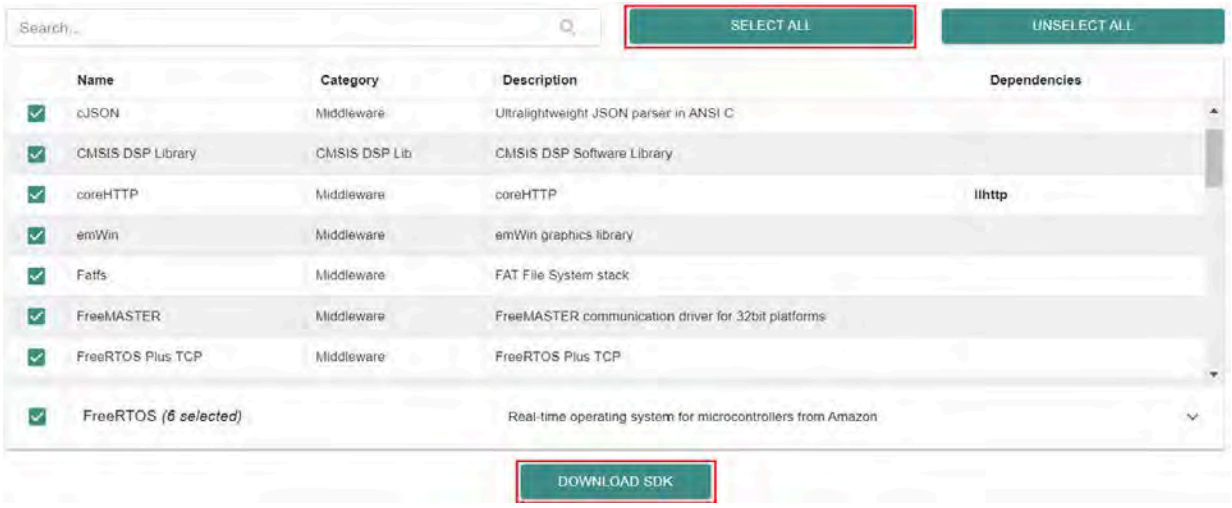

Figure 11. Select RW61x SDK components

- Scroll down and click **DOWNLOAD SDK**.
- Click **Download SDK** on MCUXpresso SDK Dashboard.

Figure 12. Download RW61x SDK

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- Select the items to download, for example SDK Archive (includes documentation).

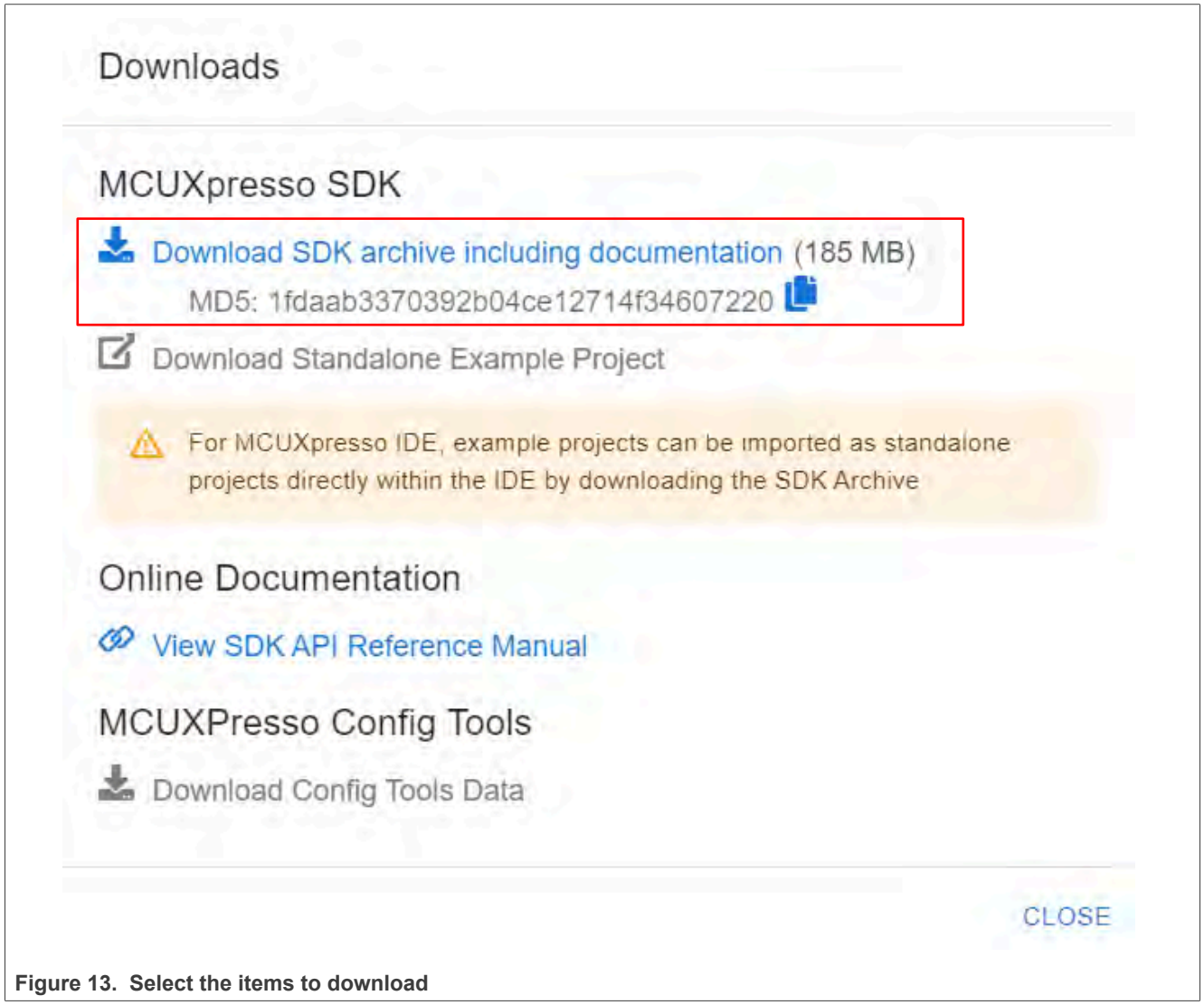

Figure 13. Select the items to download

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- Accept the terms and conditions.

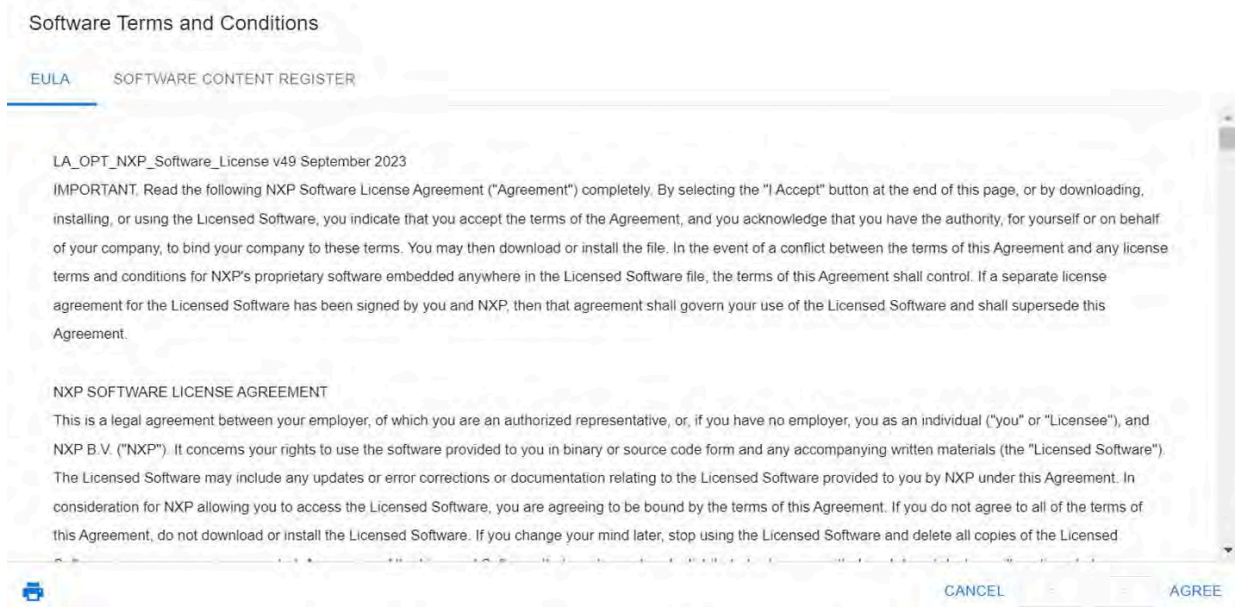

Figure 14. Accept the terms and conditions

The SDK starts to download automatically.

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4.1.2 GitHub download

- Go to GitHub *nxp-mcuxpresso/mcux-sdk* web page ref.[7].

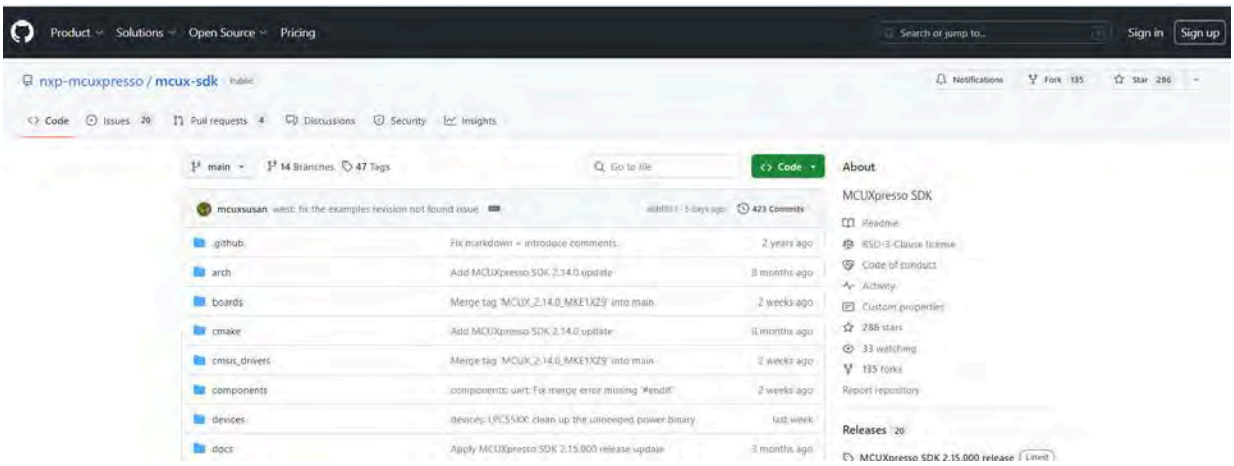

Figure 15. GitHub SDK web page

- Scroll down to the *README.md* file.
- Click *README.md* to open the overview.

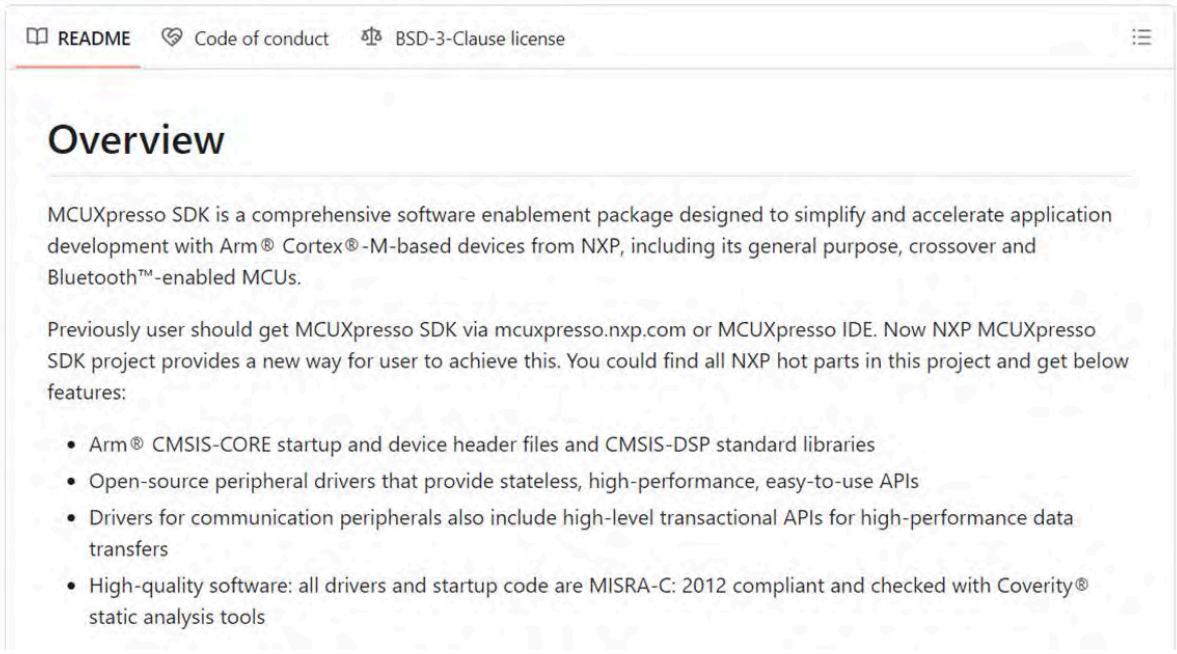

Figure 16. README overview on GitHub

- Follow the instructions in the README to "Clone/check-out a new delivery of whole SDK" or "Update existing west cloned SDK whole delivery".

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4.2 Serial console tool setup

The serial console tool is used to read out the demo application logs on the computer connected to RW61X-EVK board.

- Download and install the terminal emulator software such as Tera Term (Windows) or Minicom (Linux or Mac OS)
- To connect RW61X-EVK board to the host computer running Windows, Linux, or Mac OS, use a micro USB to USB cable
- Open a terminal emulator program like Minicom or Tera Term, and configure the settings for serial console access

Determine COM port.

- Linux: issue the following command once the USB Serial is connected to host.

```
# dmesg | grep "ttyACM"
[503175.307873] cdc_acm 1-1.2:1.0: ttyACM0: USB ACM device
```

- Windows: click the Start menu and type Device Manager in the search bar. In the Device Manager, expand the Ports (COM and LPT) section to view the available ports.

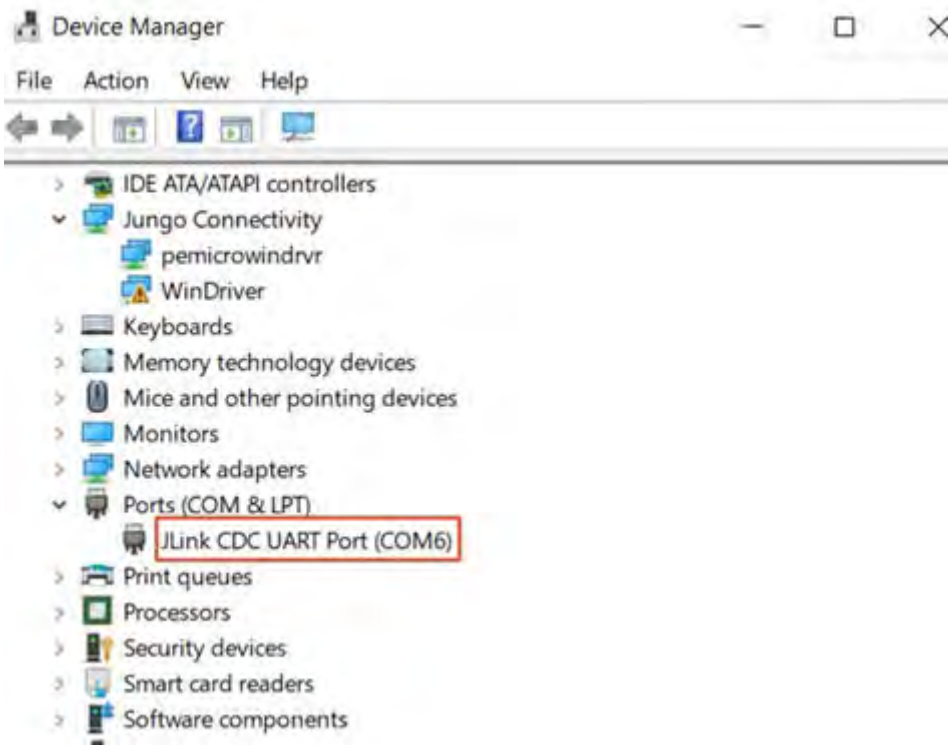

Figure 17. Device manager application

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Settings for serial console access with the COM port:

```
115200 baud rate
8 data bits
No parity
One stop bit
No flow control
```

Before starting the demo application, update the serial console configuration to avoid extra spacing.

For Tera Term:

- Go to **Setup > Terminal**
- Look for the **New line** section
- Set the **Receive** to **Auto**

For Minicom:

- To open the *Help* menu, press the **Ctrl** + **A** keys and then press the **Z** key
- To add a carriage return, press the **U** key

4.3 SDK development environment

RW61x MCUXpresso SDK currently supports the following development environments:

- MCUXpresso IDE
- IAR Embedded Workbench
- Arm® GCC
- Keil MDK/µVision

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5 RW61x product image setup

This section introduces the pre-requisites and instructions to build and download application image to RW61x board. RW61x supports image building with MCUXpresso IDE, IAR Embedded Workbench, Arm GCC, and Keil MDK/µVision.

5.1 Pre-requisites for RW61x image setup

IAR IDE and SEGGER J-Link version older than v7.92c[1] do not support RW61x. Additional patches for IAR IDE and J-Link are required. To download the patch files from NXP website, see ref.[3].

SEGGAR J-Link

- Unzip *iar_segger_support_patch_rw610_flash.zip*
- Copy *Devices* directory folder and *JLinkDeivces.xml* files to J-Link install directory at the following location *C:\Program Files\SEGGER\JLink*

Figure 18. JLink install directory

IAR

- Unzip *iar_segger_support_patch_rw610_flash.zip*
- Copy *debugger*, *devices*, *flashloader* to IAR install directory at the following location *C:\Program Files\IAR Systems\Embedded Workbench 9.0\arm/config*

Figure 19. IAR install directory

1 J-Link supports RW61x from version v7.92c.

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5.2 RW61x application image setup

The detailed steps for RW61x application image setup are introduced in ref.[4]. Refer to the sections:

- Run a demo application using MCUXpresso IDE.
- Run a demo application using IAR.
- Run a demo application using Arm GCC.
- Run a demo application using Keil MDK/µVision.

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6 Run a Wi-Fi demo application

RW610x MCUXpresso SDK offers a series of Wi-Fi application examples. Use *wifi_cli* example in the SDK to demonstrate Wi-Fi functionality.

- Build *wifi_cli* application
  For guidance on how to build a demo application, see Section 5.2.
- Program Wi-Fi firmware for RW61X-EVK
- Program *wifi_cli* image for RW61X-EVK
  For the detailed steps to program the Wi-Fi firmware and application image, see ref.[5].
- Apply a power reset on RW61X-EVK
- Check the console on the connected computer screen to see the application start-up log

Figure 20. Example of console output for *wifi_cli* application

Note: *For wifi_cli commands, see ref.[5].*

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7 Run a Bluetooth LE demo application

RW61x MCUXpresso SDK offers a series of Bluetooth LE application examples. This section describes the steps to run *peripheral_ht* demo application. The application demonstrates the Bluetooth LE peripheral role, more specifically, it exposes the health thermometer (HT) GATT Service. Peer devices that subscribe to receive temperature indications get temperature readings every second. The temperature readings show values between 20°C and 25°C.

7.1 Starting the demo

- Build *peripheral_ht* application.
  Refer to Section 5.2 for guidance on how to build a demo application.
- Program Bluetooth LE firmware for RW61X-EVK board
- Program *peripheral_ht* image for RW61X-EVK board
  For the detailed steps to program Bluetooth LE firmware and application image, see ref.[5].
- Apply a power reset on RW61X-EVK board
- Check the console on the connected computer screen to see the application start-up logs

The demo application first loads the Bluetooth LE firmware. Next, the application automatically sets the Bluetooth LE advertisement parameters and enables the advertisements for a sample Bluetooth LE service. The following logs can be observed once the RW61X-EVK board and NXP-based wireless module are up and running.

```
Bluetooth initialized
Advertising successfully started
```

The stack is ready to accept incoming connections from any peer device.

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7.2 Establishing a Bluetooth LE connection

This section describes the steps to establish a Bluetooth LE connection between a smartphone and RW61X-EVK board.

- **Install** and **launch** the *IoT Toolbox* application on the smartphone
- **Enable** the *Bluetooth and Location service* of the smartphone
- To scan the available devices using the *Health Thermometer service*, **select** *Thermometer*

Figure 21. Select Health Thermometer Service

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- Look for *peripheral_ht* in *IoT Toolbox* application. From the application, it is now possible to connect to the device.
- Upon successful connection, temperature readings show on the smartphone

Figure 22. Temperature display on smartphone screen

Note: *The SDK package includes other Bluetooth LE demo applications. For the detailed steps to build and run those applications, see ref.[5].*

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8 Abbreviations

Table 2. Abbreviations

Abbreviation	Definition
Bluetooth LE	Bluetooth low energy
EVB	Evaluation board
EVK	Evaluation kit
FCB	FlexSPI configuration block
FW	Firmware
I/O	Input/output
IDE	Integrated development environment
IMU	Inter-CPU message unit
MCU	Microcontroller unit
SDIO	Secure digital I/O
SDK	Software development kit
SPI	Serial peripheral interface
SPSDK	Secure provisioning software development kit
SWD	ARM Serial Wire Debug
UART	Universal asynchronous receiver-transmitter

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9 References

[1] Data sheet – RW610: Wireless MCU with Integrated 1x1 Wi-Fi 6, Bluetooth Low Energy (link)
[2] Data sheet – RW612: Wireless MCU with Integrated 1x1 Wi-Fi 6, Bluetooth Low Energy / 802.15.4 (link)
[3] Software – Patch files for IAR IDE and J-Link (link)
[4] User manual – Getting Started with MCUXpresso SDK for RDRW610. SDK document available at: *SDK_<version>_RDRW610\docs*
[5] User manual – UM11799: Wi-Fi and Bluetooth Demo Applications for RW61x (link)
[6] Webpage – MCUXpresso Integrated Development Environment (IDE) (link)
[7] Webpage – GitHub NXP MCUXpresso/MCU SDK (link)
[8] Webpage – IAR embedded development tools (link)
[9] Webpage – MCUXpresso SDK Builder (link)
[10] Webpage – RW610: Wireless MCU with Integrated 1x1 Wi-Fi® 6 + Bluetooth® Low Energy Radios (link)
[11] Webpage – RW612: Wireless MCU with Integrated Tri-radio: 1x1 Wi-Fi® 6 + Bluetooth® Low Energy / 802.15.4 (link)

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11 Revision history

Table 3. Revision history

Document ID	Release date	Description
UM11798 v.5.0	16 April 2025	• Changed the document access to public. No other change in the document.
UM11798 v.4	22 April 2024	• Section 2 "Wireless MCU RW61x": updated RW61x description. • Section 2.2 "RW61x architecture": updated the block diagrams. • Section 2.3 "RW61x MCUXpresso SDK": updated the list of key components. • Section 3.2 "Jumper configuration": updated the figures. • Section 4.1.1 "MCUXpresso SDK download": updated the figures and added Keil to the list of toolchain/IDE. • Section 4.1.2 "GitHub download": added. • Section 4.3 "SDK development environment": added Keil MDK/µVision. • Section 5 "RW61x product image setup": added Keil MDK/µVision. • Section 5.1 "Pre-requisites for RW61x image setup": updated the introduction. • Section 5.2 "RW61x application image setup": added Keil MDK/µVision. • Section 9 "References": updated. • Section 10 "Note about the source code in the document": added.
UM11798 v.3	12 May 2023	• Section 3.2 "Jumper configuration": updated • Section 4.1.1 "MCUXpresso SDK download": updated
UM11798 v.2	10 August 2022	• Section 2.2 "RW61x architecture": updated Figure 1 and Figure 2 • Section 2.3 "RW61x MCUXpresso SDK": updated Figure 3 • Section 3 "RW61x evaluation board": added Flexcomm in Figure 4 • Section 3.2 "Jumper configuration": . Replaced "Setting"with "Default setting" in Table 1 header . Added the note about not changing the other jumpers . Updated ANT3 and ANT4 descriptions in Figure 5 . Added the indication for QSPI Flash in Figure 6 • Section 4.1.1 "MCUXpresso SDK download": updated • Section 4.3 "SDK development environment": added *MCUXpresso IDE* • Section 5 "RW61x product image setup": added *MCUXpresso IDE* in the introduction and removed the section *Program FCB to FlexSPI Flash* • Section 5.2 "RW61x application image setup": updated • Section 6 "Run a Wi-Fi demo application": updated • Section 7 "Run a Bluetooth LE demo application": updated • Section 8 "Abbreviations": replaced FCP with FCB
UM11798 v.1.0	09 May 2022	• Initial version

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