UM11798

Getting Started with Wireless on RW61x Evaluation Board Running RTOS

Rev. 3 — 12 May 2023

User manual
CONFIDENTIAL

Document Information

Information	Content
Keywords	MCUXpresso SDK, RW61x evaluation board, RTOS 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 Revision history

Revision history

Rev	Date	Description
v.1	20220509	Initial version
v.2	20220810	**Modifications** • Section 3.2 "RW61x architecture": updated Figure 1 and Figure 2 • Section 3.3 "RW61x MCUXpresso SDK": updated Figure 3 • Section 4 "RW61x evaluation board": added Flexcomm in Figure 4 • Section 4.2 "Jumper configuration": . Replaced "Setting"with "Default setting" in Table 2 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 5.1 "MCUXpresso SDK download": updated • Section 5.3 "SDK development environment": added *MCUXpresso IDE* • Section 6 "RW61x product image setup": added *MCUXpresso IDE* in the introduction and removed the section *Program FCB to FlexSPI Flash* • Section 6.2 "RW61x application image setup": updated • Section 7 "Run a Wi-Fi demo application": updated • Section 8 "Run a Bluetooth LE demo application": updated • Section 9 "Acronyms and abbreviations": replaced FCP with FCB
v.3	20230512	**Modifications** • Section 4.2 "Jumper configuration": updated • Section 5.1 "MCUXpresso SDK download": updated

2 About this document

2.1 Purpose and scope

This document describes the wireless MCU RW61x evaluation board (EVB) along with the overall architectures, platform interfacing, related configurations, and software package.

2.2 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 (EVK), while MCUXpresso SDK implementation and configuration are covered in RW61x-EVK documentation (see Section 2.3).

2.3 References

Table 1. References

Reference type	Description
Data sheet	RW610 - Wireless MCU with Integrated 1x1 Wi-Fi 6, Bluetooth Low Energy - Data sheet (confidential) (link)
Data sheet	RW612 - Wireless MCU with Integrated 1x1 Wi-Fi 6, Bluetooth Low Energy / 802.15.4 - Data sheet (confidential) (link)
Design package	RW61x EVB (RD-RW61x-BGA-IPA-2A-V2) design package (link)
Mobile application	IoT Toolbox Android (IoT Toolbox on Google Play) (IoT Toolbox on the APP Store)
User manual	Getting Started with MCUXpresso SDK for RDRW610. SDK document available at: *SDK_<version>_RDRW610\docs*
User manual	UM11799 - Wi-Fi and Bluetooth Demo Applications for RW61x (UM11799). SDK document available at: *SDK_<version>_RDRW610\docs\wireless*
Web page	MCUXpresso Integrated Development Environment (IDE) (link)
Web page	IAR SYSTEMS - Arm Cortex-M edition (link)
Web page	RW610- Wireless MCU with Integrated 1x1 Wi-Fi® 6 + Bluetooth® Low Energy Radios (link)
Web page	RW612 - Wireless MCU with Integrated Tri-radio: 1x1 Wi-Fi® 6 + Bluetooth® Low Energy / 802.15.4 (link)

3 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) 5.2 / 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, gaming controllers, enterprise and industrial automation, smart accessories and smart energy. Refer to Wireless MCU RW610 and RW612 for more details on RW61x products.

The following products support NXP-based wireless functionalities:

- RW610 (Wi-Fi +Bluetooth LE 5.2)
- RW612 (Wi-Fi + Bluetooth LE 5.2 / 802.15.4)

3.1 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.

3.2 RW61x architecture

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

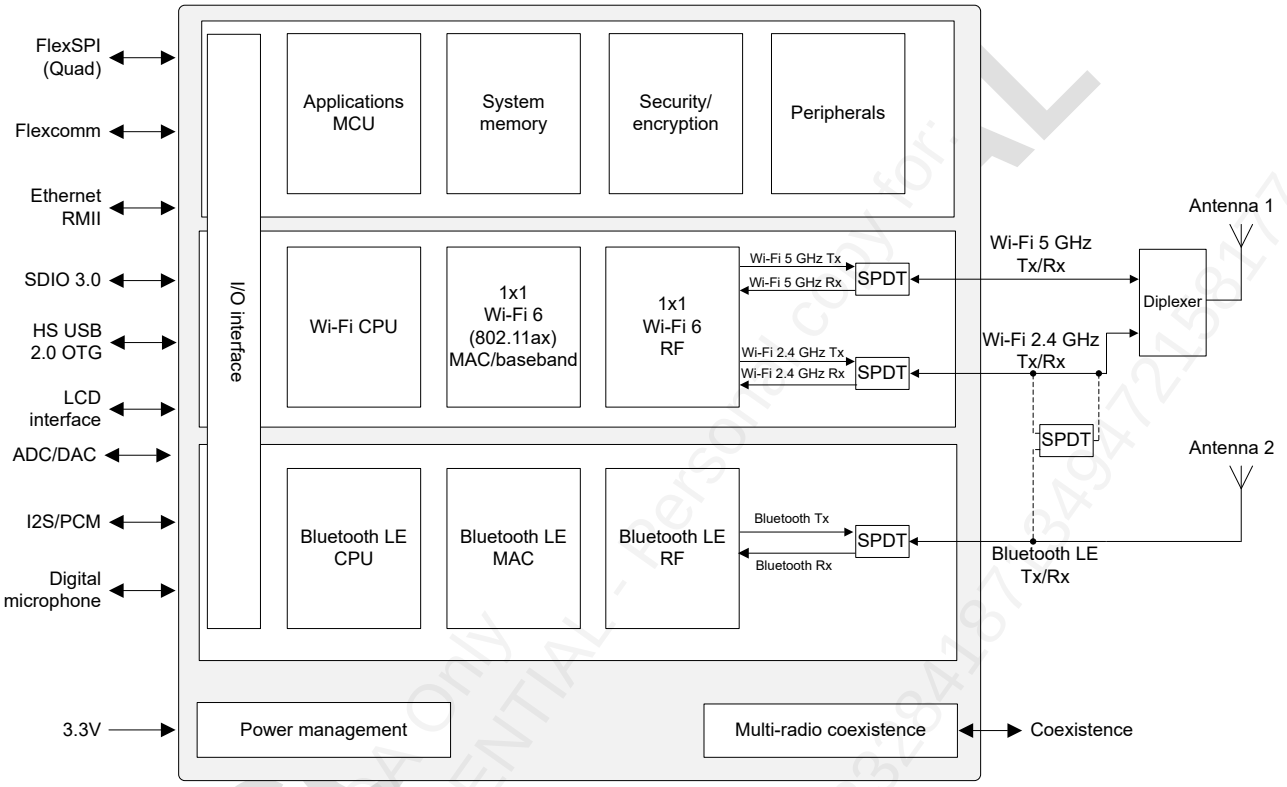


Figure 1. RW610 block diagram

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

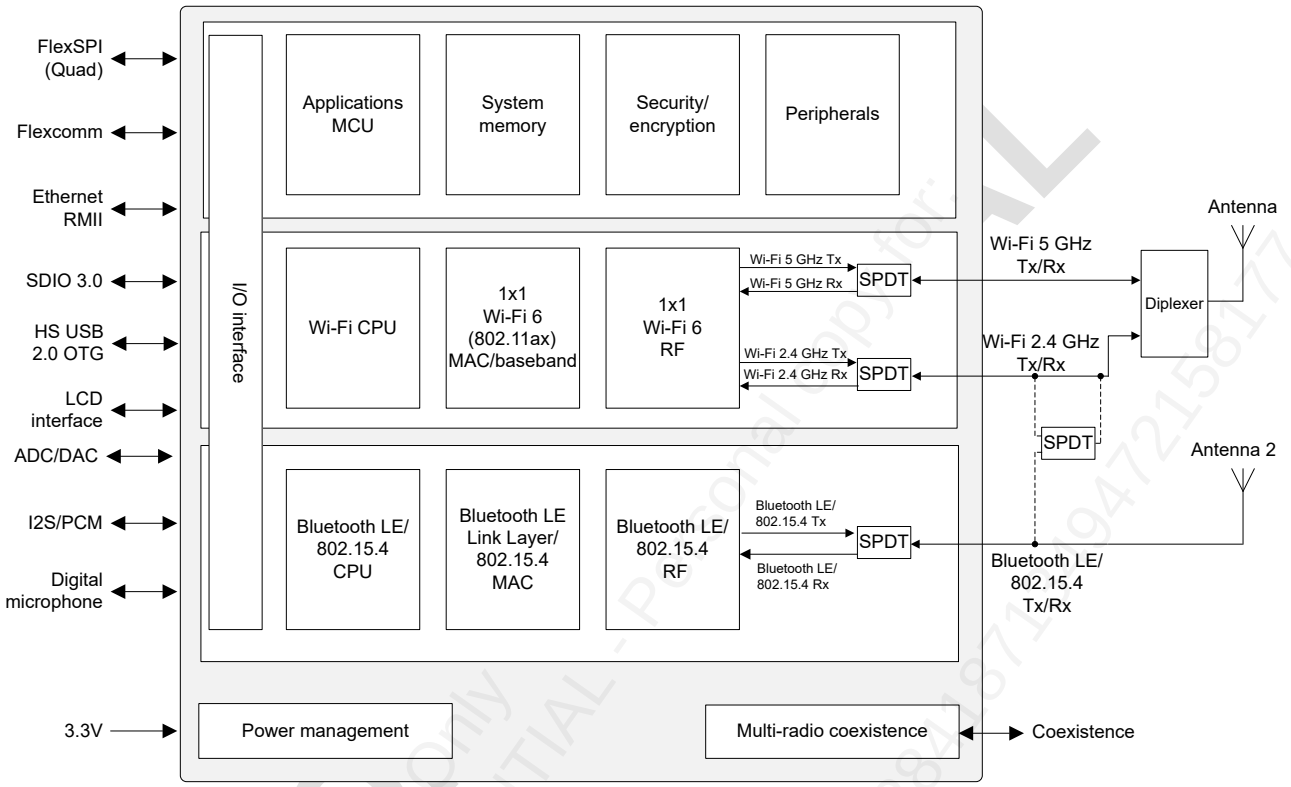


Figure 2. RW612 block diagram

3.3 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, and Microsoft Azure
- Peripheral drivers such as SPI, I2C, ADC, uSDHC, UART
- Real-time Operating Systems (FreeRTOS)
- 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 Daemon, 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

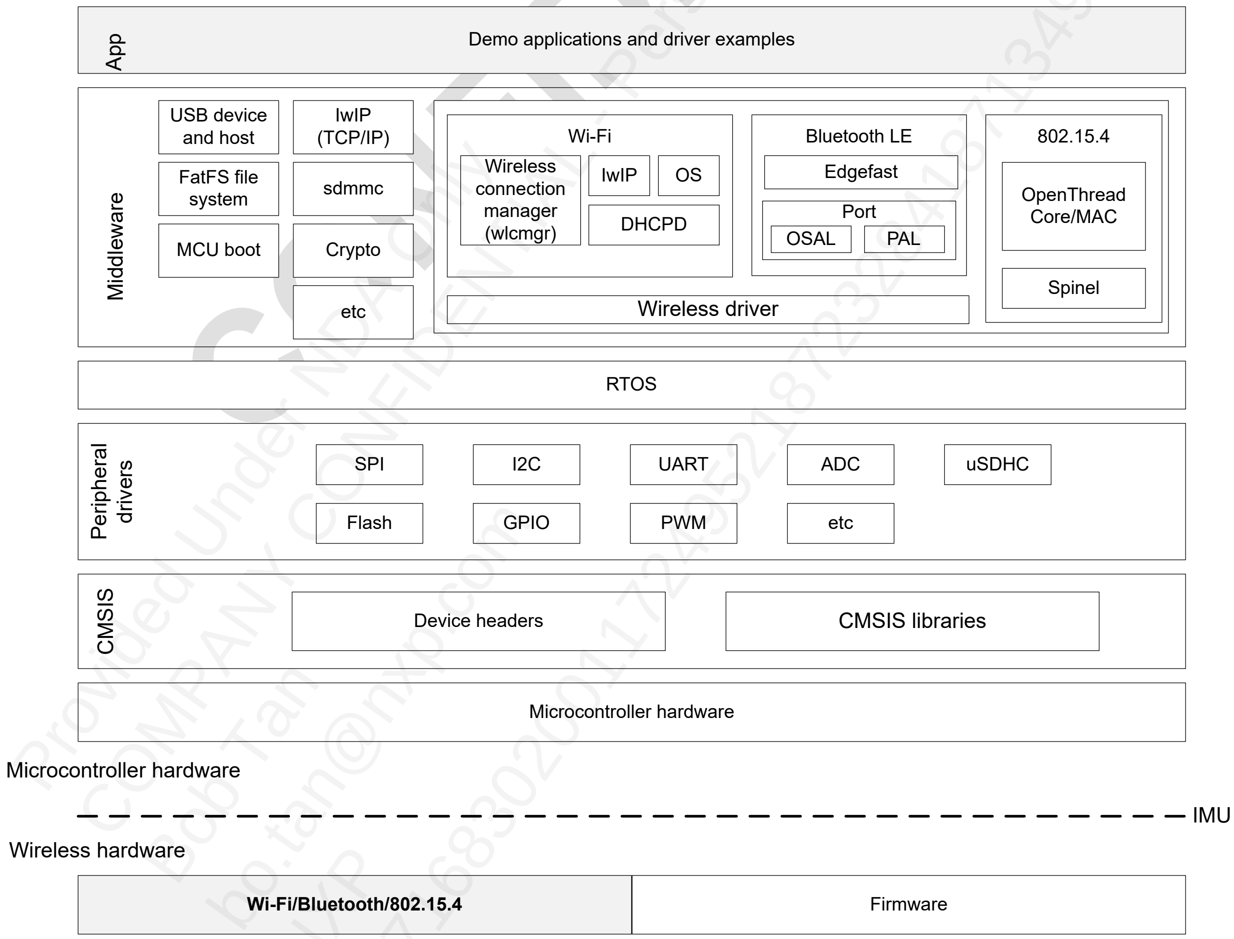


Figure 3. MCUXpresso SDK - Wi-Fi, Bluetooth, and 802.15.4 layer

4 RW61x evaluation board

4.1 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, visit RW610 and RW612 web pages and look for ***Design Resources***.

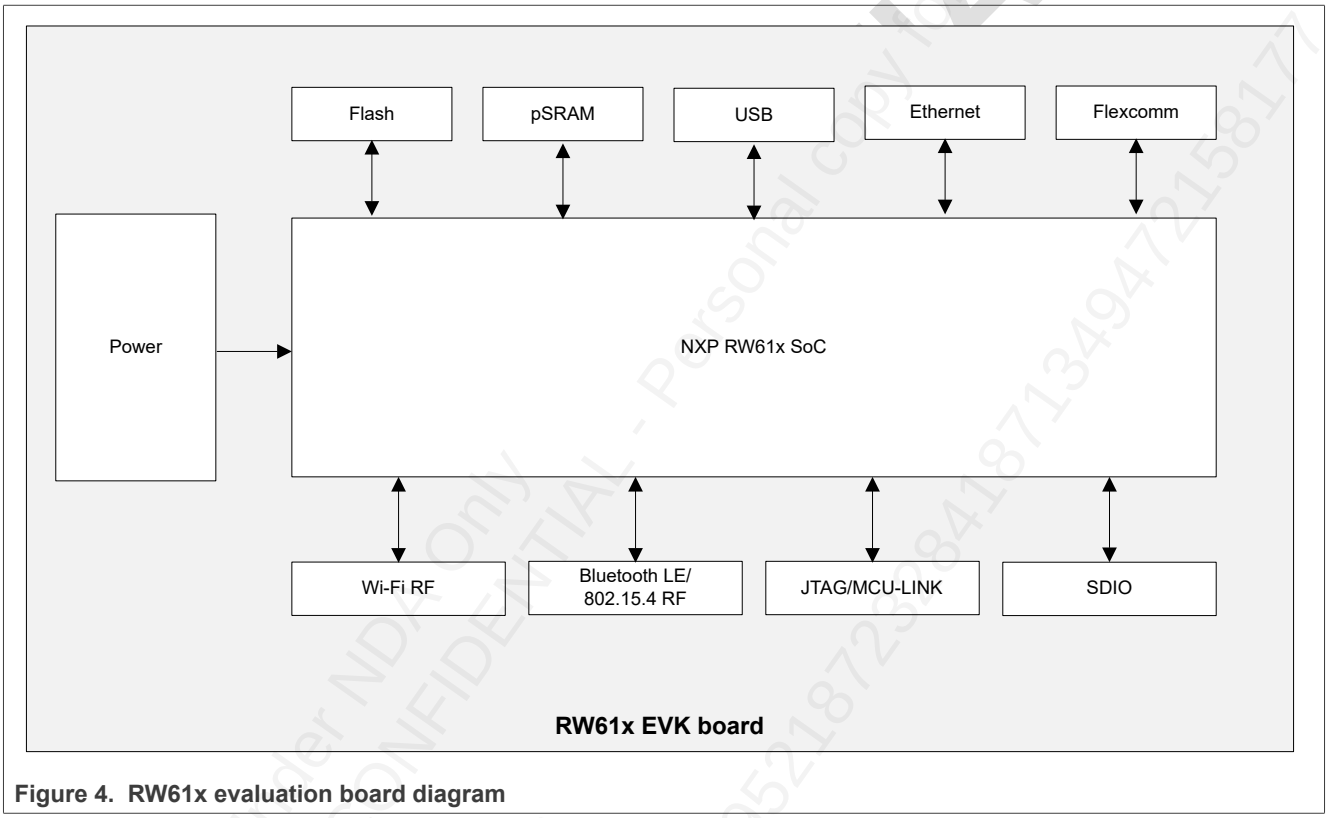


Figure 4. RW61x evaluation board diagram

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.*

4.2 Jumper configuration

RW61x EVB (RD-RW61x-xxx) is preconfigured with the default jumper settings shown in Table 2. Refer to the schematic included in RD-RW610-xxx design package for more details.

Table 2. 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:

- *Refer to RW610 data sheet and/or RW612 data sheet for details on the configuration options and configuration pins*
- *Do not change the other jumper configurations*

Figure 5 shows the top view of RW61x evaluation board.

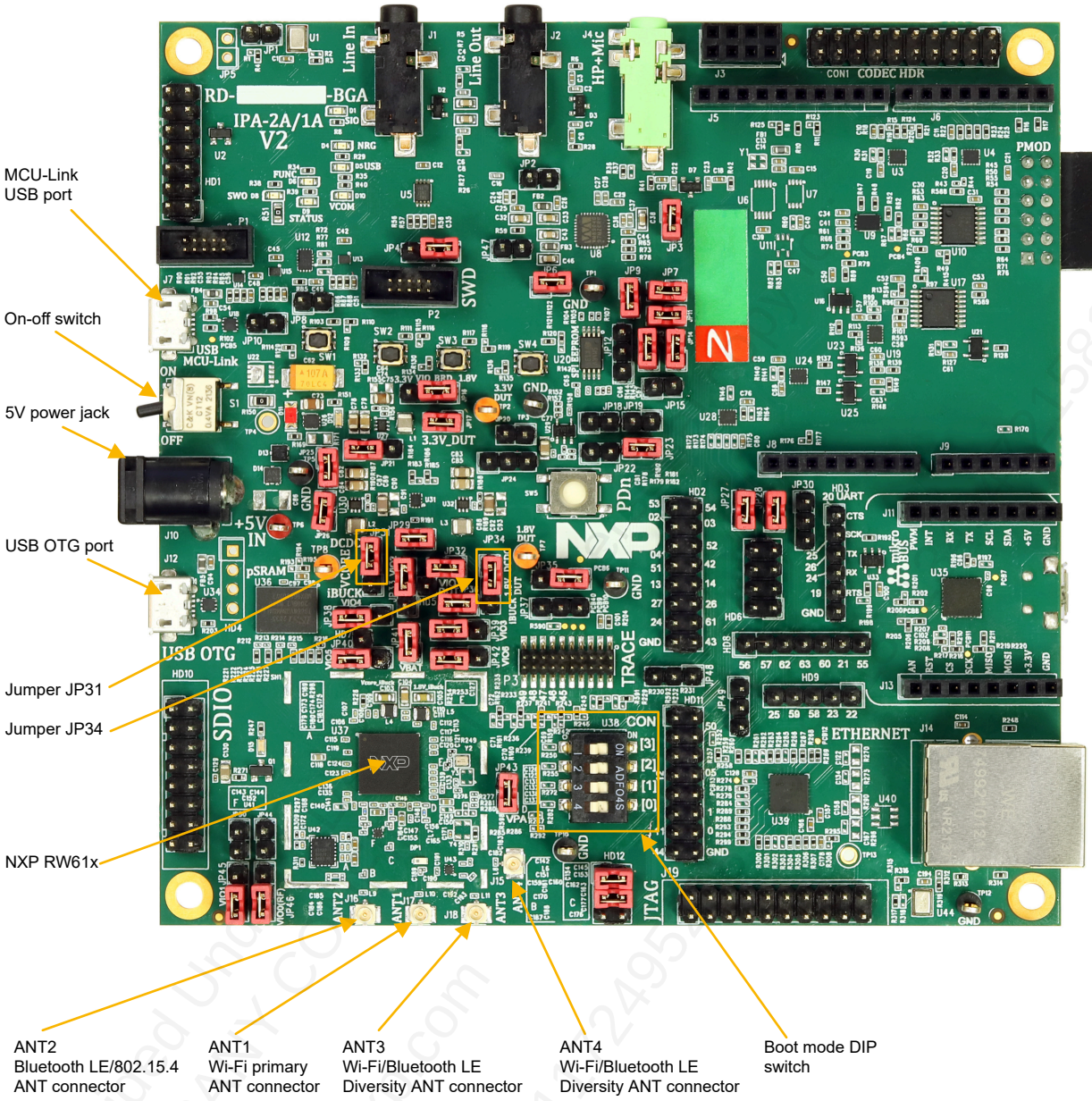


Figure 5. Top view of RW61x evaluation board

Figure 6 shows the bottom view of RW61x evaluation board.

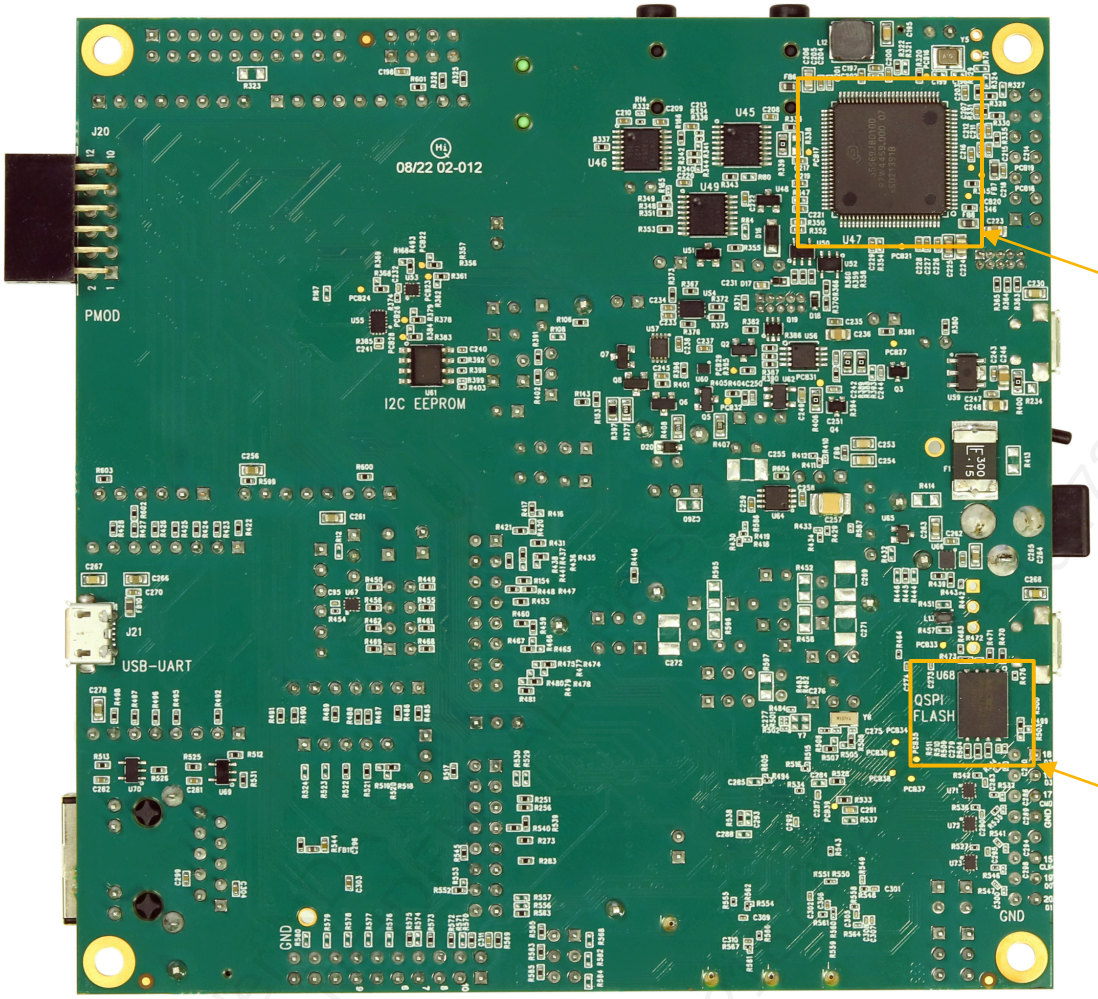


Figure 6. Bottom view of RW61x evaluation board

5 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.

5.1 MCUXpresso SDK download

- Go to MCUXpresso SDK Builder page on NXP website
- Click **Select Development Board**

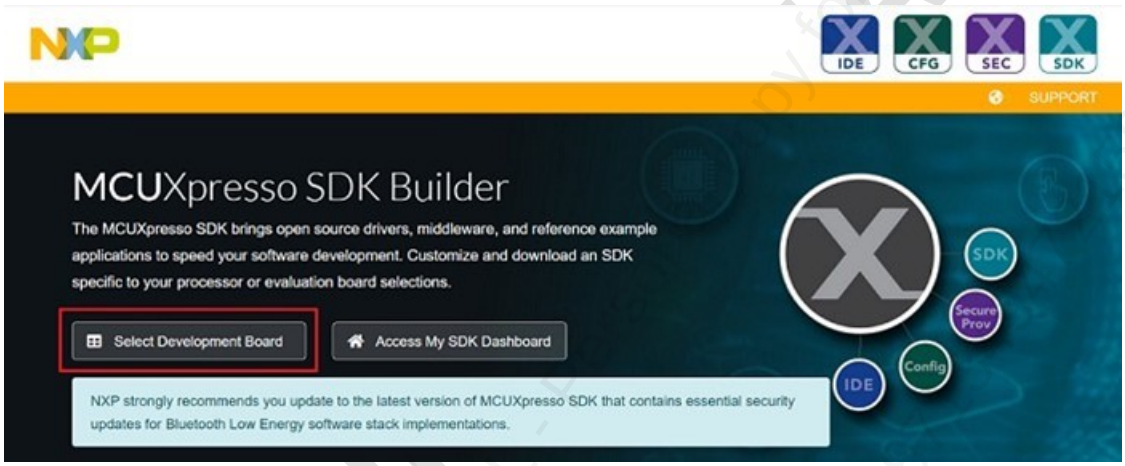


Figure 7. MCUXpresso SDK builder

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

Figure 8. Select the development board

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

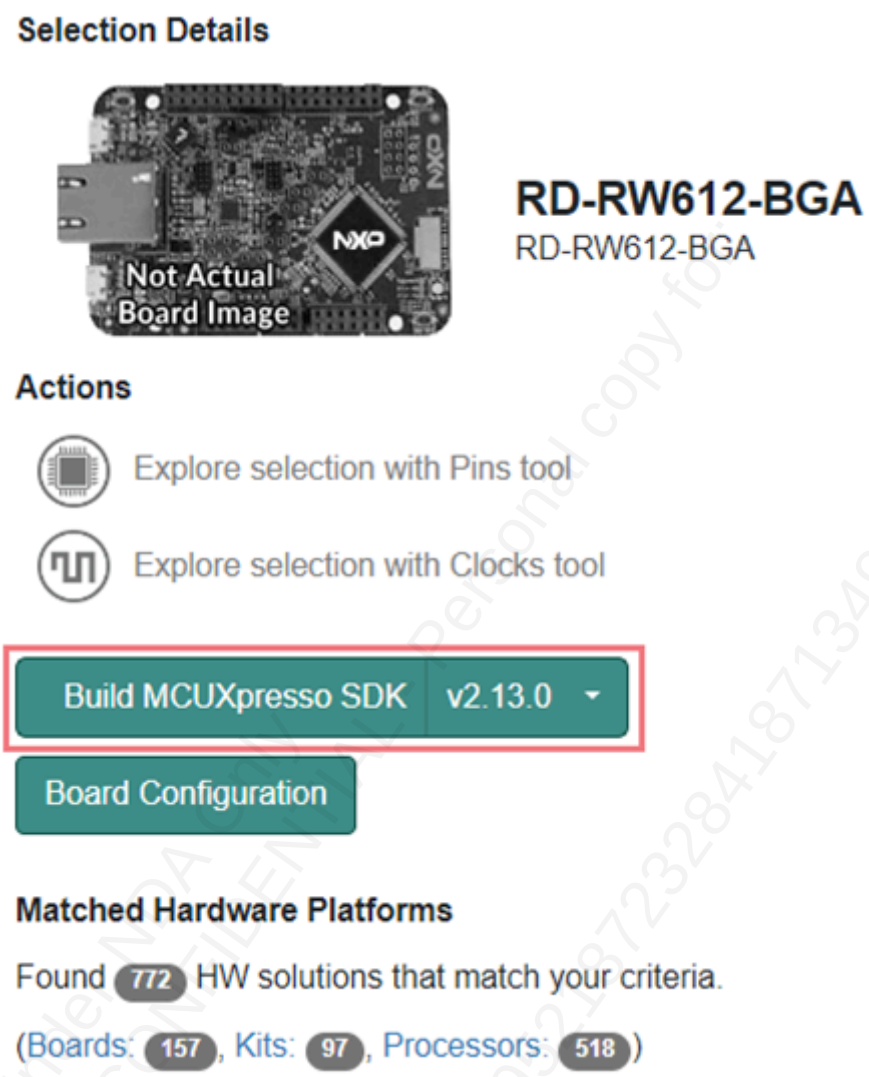


Figure 9. Selection details

- Click **Build MCUXpresso SDK**
- Define the **Developer Environment Settings**
  - Host OS: Windows, MacOS, Linux
  - Toolchain/IDE: MCUXpresso IDE, Arm GCC, IAR

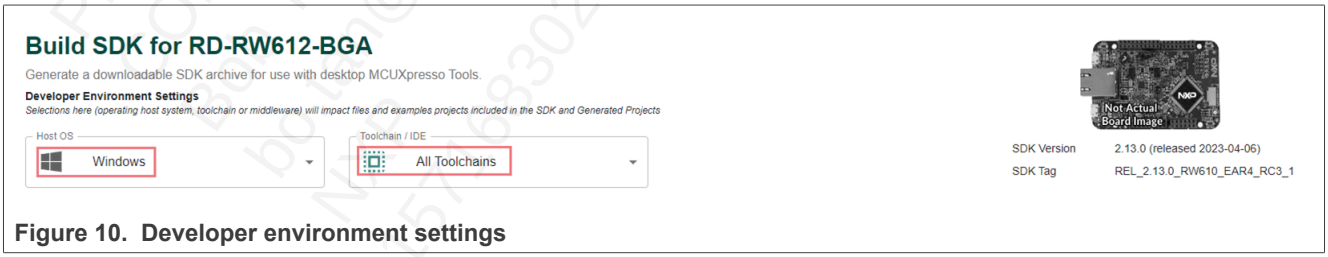


Figure 10. Developer environment settings

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

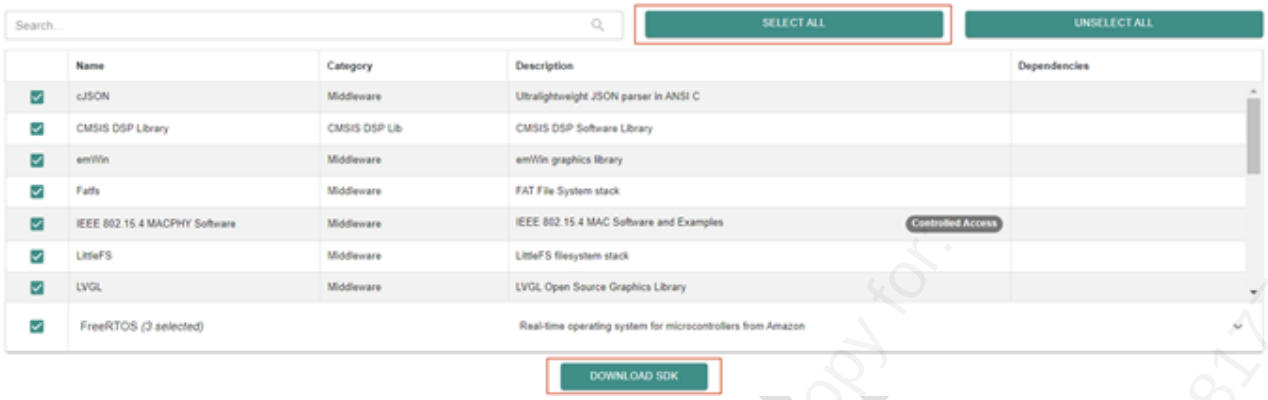


Figure 11. Select RW61x SDK components

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

Figure 12. Download RW61x SDK

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

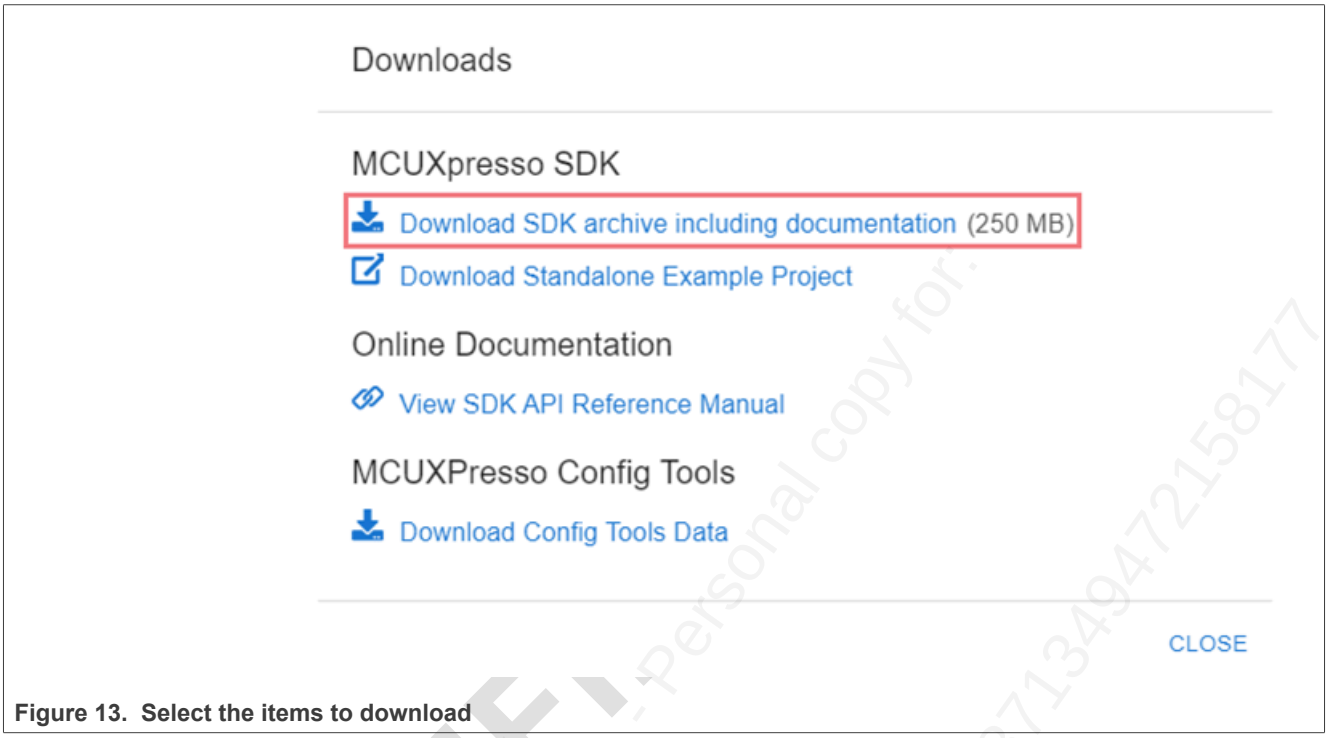


Figure 13. Select the items to download

- Accept the terms and conditions

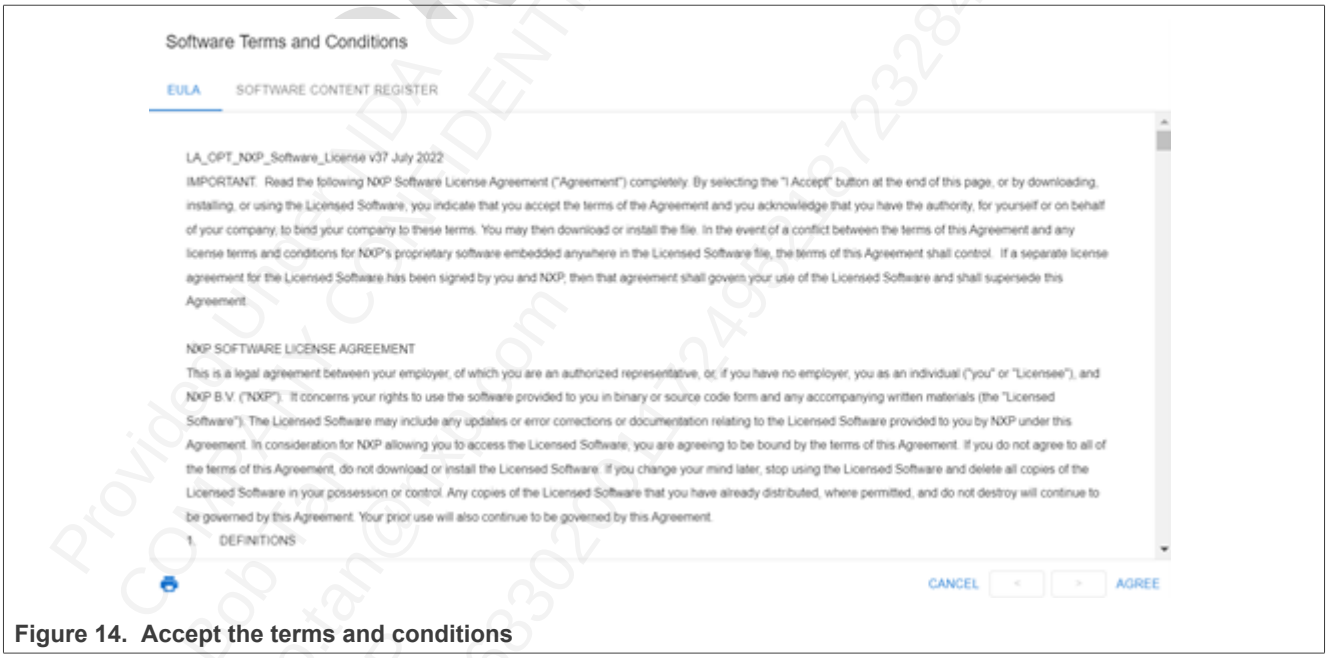


Figure 14. Accept the terms and conditions

The SDK starts to download automatically.

5.2 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.

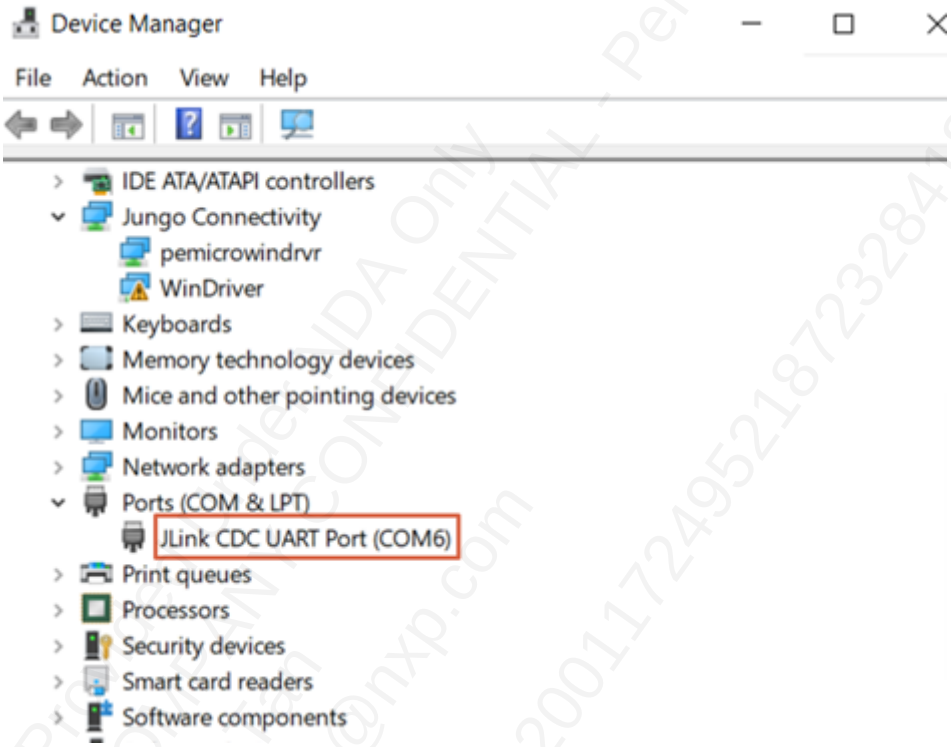
- Download and install the terminal emulator software such as Tera Term (Windows) or Minicom (Linux or Mac OS)
- To connect RW61x EVK board to the host computer running Windows, Linux, or Mac OS, use a micro USB to USB cable
- Open a terminal emulator program like Minicom or Tera Term, and configure the settings for serial console access

Determine COM port.

- Linux: Run below command after 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.



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

5.3 SDK development environment

RW61x MCUXpresso SDK currently supports the following development environments:

- MCUXpresso IDE
- IAR Embedded Workbench
- Arm® GCC

6 RW61x product image setup

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

6.1 Pre-requisites for RW61x image setup

Currently IAR IDE and SEGGER J-Link do not support RW61x officially, so additional patches for these two tools are needed to work with RW61x. To get the patches, reach out to your NXP support representative.

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*

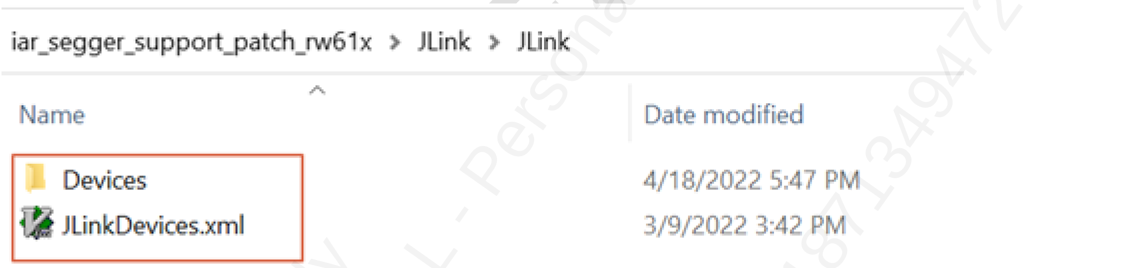


Figure 15. JLink install directory

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 16. IAR install directory

6.2 RW61x application image setup

The detailed steps for RW61x application image setup are introduced in Getting Started with MCUXpresso SDK for RDRW610. Refer to:

- Section 3: Run a demo application using MCUXpresso IDE
- Section 4: Run a demo application using IAR
- Section 5: Run a demo application using Arm GCC

7 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
  Refer to Section 6.2 for guidance on how to build a demo application
- Program Wi-Fi firmware for RW61x EVK board
- Program *wifi_cli* image for RW61x EVK board
  Refer to UM11799 for the detailed steps to program the Wi-Fi firmware and application image
- Apply a power reset on RW61x EVK board
- Check the console on the connected computer screen to see the application start-up log

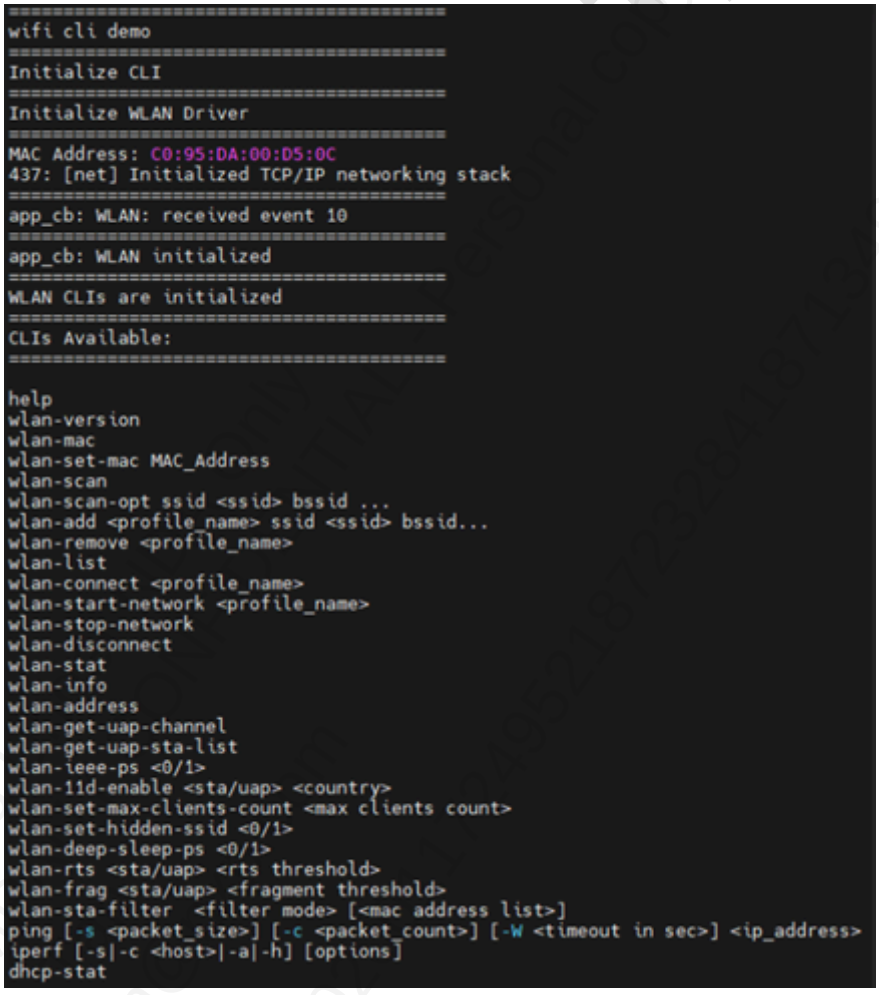


Figure 17. Example of console output for *wifi_cli* application

Note: *Refer to UM11799 for wifi_cli commands.*

8 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.

8.1 Starting the demo

- Build *peripheral_ht* application.
  Refer to Section 6.2 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
  Refer to UM11799 for the detailed steps to program Bluetooth LE firmware and application image
- 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.

8.2 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 18. Select Health Thermometer Service

- 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

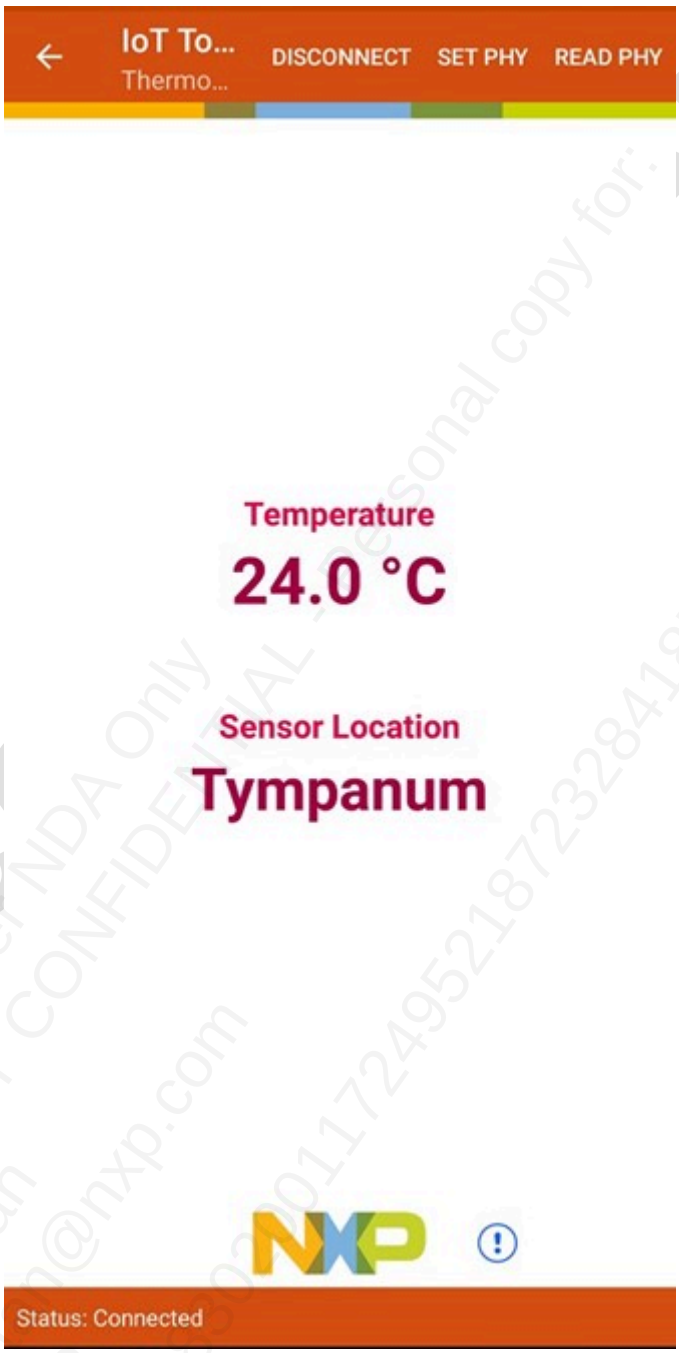


Figure 19. Temperature display on smartphone screen

Note: *The SDK package includes other Bluetooth LE demo applications. Refer to UM11799 for the detailed steps to build and run those applications. UM11799 is at SDK_<version>>_RDRW610\docs\wireless.*

9 Acronyms and abbreviations

Table 3. Acronyms and abbreviations

Terms	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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