UM11441

Getting Started with NXP-based Wireless Modules on i.MX RT Platforms Running RTOS

Rev. 8 — 6 July 2022 **User manual**

Document information

Information	Content
Keywords	i.MX RT crossover MCU, i.MX RT products, i.MX RT1050, i.MX RT1064, i.MX RT1064, i.MX RT1160, i.MX RT1170, i.MX RT500, i.MX RT600, i.MX RT595, i.MX RT1020, i.MX RT685, i.MX RT685S, i.MX RT1060 EVK board, MCUXpresso SDK, 88W8801-based wireless module, 88W8977-based wireless module, IW416-based wireless module, 88W8987-based wireless module, RTOS image
Abstract	Provides the step-by-step guidance to set up NXP-based wireless modules with i.MX RT products, build the firmware image and run Wi-Fi and Bluetooth demo applications.

1 Revision history

Revision history

Rev	Date	Description
v.1	20200717	Initial version
v.2	20210113	**Modifications**: • Extended the scope to IW416-based modules • Section 3 "i.MX RT products": reorganized the content • Section 4.3 "IW416-based wireless modules": added • Section 6 "i.MX RT product image setup": added • Section 7 "Run a Wi-Fi demo application": added • Section 8 "Run a Bluetooth/Bluetooth LE demo application": added
v.3	20210324	**Modifications**: • Section 3 "i.MX RT products": updated the list of i.MX RT products that support NXP-based wireless modules • Section 4 "NXP-based wireless modules": updated the section headings • Section 5.1 "MCUXpresso SDK download": updated • Section 8 "Run a Bluetooth/Bluetooth LE demo application": updated
v.4	20210612	**Modifications**: • Extended the scope to 88W8987, i.MX RT500, i.MX RT1070 and i.MX RT1160 • Section 2.3 "References": updated • Table 2 "Combinations of i.MX RT products and wireless modules": added • Table 4 "Boot mode selection": updated • Section 4.4 "88W8987-based wireless modules": added • Section 5 "Software download": updated to version 2.10.0 • Section 7 "Run a Wi-Fi demo application": updated • Section 8.1 "Demo start-up logs": updated
v.5	20210909	**Modifications**: • Extended the scope to IW416-based module (Embedded Artists), 88W8801-based module (Embedded Artists) and 88W8987-based module (Embedded Artists) • Section 2.3 "References": updated • Table 2 "Combinations of i.MX RT products and wireless modules": updated • Section 4.1.2 "Embedded Artists' (Murata) 2DS M.2 module": added • Section 4.1.2.2 "Murata's uSD-M.2 adapter": added • Section 4.3.1 "AzureWave AW-AM457 module" • Section 4.3.2 "Embedded Artists' (Murata) 1XK M.2 module ": added • Section 4.4.3 "Embedded Artists' (Murata) 1ZM M.2 module ": added • Section 7 "Run a Wi-Fi demo application": updated • Section 8.1 "Demo start-up logs" : updated

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Revision history...*continued*

Rev	Date	Description
v.6	20220110	**Modifications**: • Section 2.1 "Purpose and scope": updated • Section 2.2 "Considerations": updated • Section 3 "i.MX RT products": extended the list of i.MX RT products that support NXP-based wireless modules • Figure 1 "Interfaces between i.MX RT products and NXP-based wireless modules": updated • Figure 2 "i.MX RT evaluation board diagram": updated • Table 2 "Combinations of i.MX RT products and wireless modules": updated the content • Table 3 "Wireless modules configured by default on i.MX RT products": added • Table 4 "Boot mode selection": updated the content • Figure 3 "i.MX RT MCUXpresso SDK - Wi-Fi and Bluetooth layer interfaces": updated • Section 4.3.3 "AzureWave AW-AM510 module": added the section • Section 7 "Run a Wi-Fi demo application": updated the module reference in the note • Table 23 "List of macros": updated the table content • Section 8.1 "Demo start-up logs": updated the module reference in the note • Table 24 "List of macros": updated the table content
v.7	20220314	**Modifications**: • Section 2.1 "Purpose and scope": updated • Figure 3 "i.MX RT MCUXpresso SDK - Wi-Fi and Bluetooth layer interfaces": replaced *uHDHC* with *SDIO* • Section 3.4 "i.MX RT MCUXpresso SDK": updated the first sentence • Section 4 "NXP-based wireless modules": updated the first sentence • Section 4.1.1 "AzureWave AW-NM191NF-uSD adapter board": removed the section *About antenna diversity feature* • Section 4.3.1.4 "About Bluetooth host and audio interfaces": updated the path to *Hardware Rework Guide for EdgeFast BT PAL* • Section 4.3.3.4 "Bluetooth host and audio interfaces": updated the path to *Hardware Rework Guide for EdgeFast BT PAL* • Figure 21 "Embedded Artists' 1XK M.2 module": updated the module reference • Section 4.4.1.2 "Connecting AW-CM358-uSD adapter board to i.MX RT1060 EVK board": updated the path to *Hardware Rework Guide for EdgeFast BT PAL* • Figure 32 "Embedded Artists' 1ZM M.2 module": updated the module reference • Section 5 "Software download": updated the first paragraph and the path to *UM11442* • Section 5.1 "MCUXpresso SDK download": replaced some screen captures • Section 7 "Run a Wi-Fi demo application": updated the path to *app_config.h* file • Table 2, Table 23, and Table 24: updated the release process version in the table footnote • Section 8.2 "Establishing a Bluetooth LE connection": updated the path to *UM11442*

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Revision history...*continued*

Rev	Date	Description
v.8	20220706	**Modifications**: • Section 2.3 "References": added the references to u-blox modules (Maya, Lily, and Jody) • .Section 3.2 "i.MX RT products and NXP-based wireless modules": updated Table 2 with the references to u-blox modules • Section 4.1.1.1 "Jumper settings on AzureWave AW-NM191NF-uSD adapter board": renamed VIO as VIO_SD for the voltage level selection • Section 4.1.2.1 "Connecting Embedded Artists' (Murata) 2DS M.2 module to i.MX RT1050 EVK using Murata's uSD-M.2 adapter": highlighted the last paragraph as a note • Section 4.1.3 "u-blox LILY-W1 evaluation board": added the section • Section 4.3.1.1 "AzureWave AW-AM457-uSD evaluation board": replaced the paragraph introducing the figure • Section 4.3.1.2 "Jumper settings on AzureWave AW-AM457-uSD evaluation board": renamed VIO as VIO_SD for the voltage level selection • Section 4.3.1.3 "Connecting AzureWave AW-AM457-uSD to i.MX RT1060 EVK board": added the note and figure at the end of the section • Section 4.3.2.1 "Connecting Embedded Artists' (Murata) 1XK M.2 module to i.MX RT1050 EVK using Murata's uSD-M.2 adapter": highlighted the last paragraph as a note • Section 4.3.3.2 "Jumper settings on AzureWave AW-AM510-uSD evaluation board": renamed VIO as VIO_SD for the voltage level selection • Section 4.3.4 "u-blox MAYA-W1 module": added the section • Section 4.4.4 "u-blox JODY-W2 module": added the section • Table 23 "List of macros": added the macros for u-blox EVKs • Section 5.1 "MCUXpresso SDK download": updated the screen captures (Figure 39, Figure 40, Figure 41, Figure 42) • Section 8.1 "Demo start-up logs": updated the references to macros

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2 About this document

2.1 Purpose and scope

This document details the integration of modules based on NXP Wi-Fi and Bluetooth solutions with i.MX RT crossover MCUs. It describes the hardware setup to connect NXP-based wireless modules with i.MX RT EVK boards, the software download, and how to run Wi-Fi and Bluetooth demo applications.

The i.MX RT crossover MCUs are powered by FreeRTOS and the FreeRTOS-based Wi-Fi drivers are used for NXP-based wireless modules.

2.2 Considerations

This document does not include the detailed description of i.MX RT evaluation kits (EVKs) nor MCUXpresso SDK implementation and configuration as these are covered in i.MX documentation (see Section 2.3).

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2.3 References

Table 1. References

Reference type	Description
Data sheet	NXP - IW416 - Dual-band 1x1 Wi-Fi 4 and Bluetooth 5.2 Combo SoC - Data sheet (public) (link)
Data sheet	Saiko Systems Ltd. - ST-SD-uSD – ST Card to Micro-SD Card Converter (link)
Data sheet	DeLOCK - Delock Adapter Micro SD male > SD female (link)
Data sheet	AzureWave - AW-AM457 - IEEE 802.11 1X1 a/b/g/n Wireless LAN + Bluetooth 5.1 Combo LGA Module (link)
Data sheet	AzureWave – AW-CM358 - IEEE 802.11a/b/g/n/ac WLAN with Bluetooth 5 Combo Stamp Module With M.2 2230 adapter Board (link)
Data sheet	Murata – Type 2DS W-LAN Module Data Sheet (link)
Data sheet	Murata – Type 1XK W-LAN+Bluetooth Combo Module Data Sheet (link)
Data sheet	Murata – Type 1ZM W-LAN+Bluetooth Combo Module Data Sheet (link)
Data sheet	Murata – LBWA0ZZ2DS-688 – Type 2DS W-LAN Module Data Sheet NXP 88W8801 Chipset for 802.11b/g/n (link)
Data sheet	Murata – LBEE5CJ1XK-687 – Type 1XK W-LAN+Bluetooth Combo Module Data Sheet NXP IW416 Chipset for 802.11a/b/g/n + Bluetooth 5.2 (link)
Data sheet	Murata – LBEE5QD1ZM-572 – Type 1ZM W-LAN+Bluetooth Combo Module Data Sheet NXP 88W8987 Chipset for 802.11a/b/g/n/ac + Bluetooth 5.1 (link)
Data sheet	Murata – LBEE0ZZ1WE-uSD-M2 – Murata uSD-M.2 Adapter Datasheet (link)
Data sheet	u-blox - LILY-W1 series - Host-based Wi-Fi modules - Data sheet (link)
Data sheet	u-blox - MAYA-W1 series - Host-based Wi-Fi modules - Data sheet (link)
Data sheet	u-blox - JODY-W2 series - Host-based multiradio modules with Wi-Fi 5 and Bluetooth 5.2 - Data sheet (link)
Mobile application	NXP - IoT Toolbox Android (IoT Toolbox on Google Play) (IoT Toolbox on the APP Store)
Quick start guide	Murata – Murata Wi-Fi/BT (NXP) Solution for i.MX FreeRTOS Quick Start Guide (link)
Short data sheet	NXP - 88W8801 - 2.4 GHz Single-band 1x1 Wi-Fi 4 Solution - Short data sheet (public) ((link)
Short data sheet	NXP - 88W8977 - 2.4 GHz/5 GHz Dual-band 1x1 Wi-Fi 4 and Bluetooth 5.2 Combo SoC - Short data sheet (public)(link)
Short data sheet	NXP - 88W8987 - 2.4/5 GHz Dual-band 1x1 Wi-Fi 5 (802.11ac) and Bluetooth 5.2 Solution - Short data sheet (public) (link)
User guide	AzureWave - uSD-1216 Adapter Board for AW-NM191-uSD and AW-CM276-uSD (link)
User guide	AzureWave - uSD-15x15 Adapter for AW-AM457-uSD (link)
User guide	AzureWave - uSD-12x12 Adapter for for AW-AM281 uSD and AW-CM358-uSD (link)
User guide	Murata – Murata Wi-Fi/BT (NXP) Solution for i.MX FreeRTOS User Guide (link)
User guide	u-blox - EVK-LILY-W1 - Evaluation kit for the LILY-W1 host-based Wi-Fi modules - User guide (link)
User guide	u-blox - EVK-MAYA-W1 - Evaluation kit for MAYA-W1 host-based modules - User guide (link)

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Table 1. References...*continued*

Reference type	Description
User guide	u-blox - EVK-JODY-W2 - Evaluation kit for JODY-W2 host-based modules - User guide (link)
User manual	NXP - Getting Started with MCUXpresso SDK (link)
Web page	NXP - Getting Started with Wi-Fi on i.MX RT platforms (link)
Web page	NXP - MCUXpresso Integrated Development Environment (IDE) (link)
Web page	armkeil - MDK Microcontroller Development Kit (link)
Web page	IAR SYSTEMS - Arm Cortex-M edition (link)
Web page	AzureWave - Wi-Fi Evaluation Kit: AW-NM191-uSD - uSD adapter Board for AW-NM191 NF Evaluation (link)
Web page	Panasonic - Wi-Fi® & Bluetooth® Evaluation Kit: PAN9026 (link)
Web page	Murata – Wi-Fi/Bluetooth Modules for NXP i.MX (link)
Web page	Murata – NXP Based Modules (link)
Web page	Murata – LBWA0ZZ2DS-688 – Type 2DS Shielded Small Wi-Fi® 11b/g/n Module (link)
Web page	Embedded Artists – EAR00386 – 2DS M.2 module (link)
Web page	Murata – LBEE5CJ1XK-687 – Type 1XK Shielded Ultra Small Dual band Wi-Fi® 11a/b/g/n + Bluetooth® 5.2 Module (link)
Web page	Embedded Artists – EAR00385 – 1XK M.2 Module (link)
Web page	Murata – LBEE5QD1ZM-572 – Type 1ZM Shielded Ultra Small Dual Band Wi-Fi® 11a/b/g/n/ac + Bluetooth® 5.1 Module (link)
Web page	Embedded Artists – EAR00364 – 1ZM M.2 Module (link)
Web page	Murata – LBEE0ZZ1WE-uSD-M2 – uSD-M.2 Adapter (link)

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3 i.MX RT products

i.MX RT crossover MCUs feature NXP's advanced implementation of the ARM Cortex-M core and support the FreeRTOS available within the MCUXpresso SDK to help users reduce the overall time-to-market for their product. This section provides a brief description of i.MX RT EVK along with the jumpers or switch settings. Refer to i.MX RT Products for more details on i.MX RT Crossover MCUs.

The following i.MX RT products support NXP-based wireless modules:

- i.MX RT1020
- i.MX RT1050
- i.MX RT1060
- i.MX RT1064
- i.MX RT1160
- i.MX RT1170
- i.MX RT500
- i.MX RT600
- i.MX RT595
- i.MX RT685
- i.MX RT685S

3.1 i.MX RT processor family

The i.MX RT processor family offers high-performance processing optimized for the lowest power consumption and best real-time response. The i.MX RT products provide various memory interfaces and types including SDRAM, Raw NAND FLASH, NOR FLASH, SD/eMMC, and Quad SPI (FlexSPI). The i.MX RT crossover MCUs also feature a wide range of other interfaces for peripherals, such as SDIO, UART, displays, camera sensors, and GPS. i.MX RT series supports rich audio and video features, including LCD display, 2D graphics, camera interface, SPDIF and I2S audio interface.

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3.2 i.MX RT products and NXP-based wireless modules

Figure 1 shows the interfaces between i.MX RT products and NXP-based wireless modules. The SDIO interface is used for Wi-Fi communication and UART interface is used for Bluetooth communication.

Note: *Support for Bluetooth is available for the wireless modules based on IW416 and 8W8987.*

Figure 1. Interfaces between i.MX RT products and NXP-based wireless modules

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Table 2 shows the combinations of i.MX RT products and wireless modules.

Table 2. Combinations of i.MX RT products and wireless modules

i.MX RT product	Wireless product	NXP-based wireless module
SDIO interface for Wi-Fi		
i.MX RT1060 EVK i.MX RT1060 EVKB i.MX RT1050 EVK i.MX RT1064 EVK i.MX RT600 EVK i.MX RT500 EVK	88W8801	AW-NM191NF-uSD[1] EAR00386 M.2 + LBEE0ZZ1WE-uSD-M2[1] EVK-LILY-W131
	88W8977	PAN9026-ETU AW-AM281-uSD
	IW416	AW-AM457-uSD AW-AM510-uSD[1] EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2 EVK-MAYA-W1
	88W8987	AW-CM358-uSD[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2 EVK-JODY-W2
i.MX RT595 EVK	88W8801	AW-NM191MA M.2[1] EAR00386 M.2[1]
	IW416	AW-AM457 M.2 AW-AM510 M.2[1] EAR00385 M.2[1]
	88W8987	AW-CM358MA M.2[1] EAR00364 M.2[1]
i.MX RT1020 EVK	88W8801	AW-NM191NF-uSD[1] EAR00386 M.2 + LBEE0ZZ1WE-uSD-M2[1]
i.MX RT685 EVK	88W8801	AW-NM191NF-uSD[1] EAR00386 M.2 + LBEE0ZZ1WE-uSD-M2[1]
	IW416	AW-AM510-uSD[1] EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2[1]
	88W8987	AW-CM358-uSD[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2[1]
i.MX RT685S EVK	88W8801	AW-NM191MA M.2[1] EAR00386 M.2[1]
	IW416	AW-AM510 M.2[1] EAR00385 M.2[1]
	88W8987	AW-CM358MA M.2[1] EAR00364 M.2[1]

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Table 2. Combinations of i.MX RT products and wireless modules...*continued*

i.MX RT product	Wireless product	NXP-based wireless module
SDIO interface for Wi-Fi... *continued*		
i.MX RT1170 EVK i.MX RT1160 EVK	88W8801	AW-NM191NF-uSD AW-NM191MA M.2[1] EAR00386 M.2 + LBEE0ZZ1WE-uSD-M2 EAR00386 M.2
	88W8977	PAN9026-ETU AW-AM281-uSD
	IW416	AW-AM457-uSD AW-AM510-uSD[1] EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2 EAR00385 M.2
	88W8987	AW-CM358-uSD[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2 EAR00364 M.2[1]
UART interface for Bluetooth/Bluetooth LE		
i.MX RT1060 EVK	IW416	AW-AM457-uSD AW-AM510-uSD[1] EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2[1]
	88W8987	AW-CM358-uSD[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2[1]
i.MX RT1060 EVKB	IW416	AW-AM457-uSD AW-AM510-uSD[1] EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2[1] AW-AM510 M.2[1] EAR00385 M.2[1]
	88W8987	AW-CM358-uSD[1] AW-CM358 M.2[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2[1] EAR00364 M.2[1]
i.MX RT1170 EVK	IW416	AW-AM457-uSD AW-AM510 M.2[1] EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2 EAR00385 M.2[1]
	88W8987	AW-CM358MA M.2[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2 EAR00364 M.2[1]
i.MX RT595 EVK	IW416	AW-AM510 M.2[1] EAR00385 M.2[1]
	88W8987	EAR00364 M.2[1] AW-CM358MA M.2[1]
i.MX RT685 EVK	IW416	AW-AM457-uSD EAR00385 M.2 + LBEE0ZZ1WE-uSD-M2[1] AW-AM510-uSD[1] EAR00364 M.2 + LBEE0ZZ1WE-uSD-M2[1]
	88W8987	AW-CM358-uSD[1]

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[1] The module operation was tested during 2.12.0 release process
uSD = microSD interface and M2 = M.2 interface

Table 3 shows NXP-based wireless modules which are configured by default for a list of i.MX RT products.

Table 3. Wireless modules configured by default on i.MX RT products

i.MX RT product	NXP-based wireless module
i.MX RT1060 EVK i.MX RT1060 EVKB i.MX RT1050 EVK i.MX RT1064 EVK i.MX RT685 EVK	AW-AM510-uSD
i.MX RT1020	AW-NM191NF-uSD
i.MX RT1160 EVK i.MX RT1170 EVK i.MX RT595 EVK i.MX RT685S EVK	AW-AM510 M.2

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3.3 i.MX RT EVK boards

The i.MX RT EVK boards are USB powered printed circuit boards (PCB). At their heart lies the i.MX RT crossover MCU, featuring NXP's advanced implementation of the Arm Cortex-M core. This core operates at sufficient speed to provide high CPU performance and excellent real-time response.

For more details on i.MX RT EVK, visit i.MX RT Products page, click the link to the product of interest, and look for the section under ***Development Boards and Designs***.

Figure 2. i.MX RT evaluation board diagram

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The i.MX RT EVK boards support different boot modes. Specific switch and/or jumper settings are used to configure the boot modes. Select the i.MX RT product of interest on i.MX RT Products web page and look for the *EVK User Manual* and *EVK Hardware User Guide* on the documentation tab of the product web page. The documents include the details on the jumpers, boot mode, and switch settings.

Table 4 shows the switch settings for the i.MX RT EVK boards that support NXP-based wireless modules.

Table 4. Boot mode selection

i.MX RT EVK board	Component	Configuration	Boot mode
i.MX RT1020	SW8	0010	Internal (QSPI flash)
i.MX RT106X	SW7	0010	Internal (QSPI flash)
i.MX RT1050	SW7	0110	Internal (Hyperflash)
i.MX RT1170	SW1	0010	Internal (QSPI flash)
i.MX RT1160	SW1	0010	Internal (QSPI flash)
i.MX RT500	SW7	001	Internal (OSPI flash)
i.MX RT600	SW5	101	Internal (OSPI flash)
i.MX RT685S	SW2	011	Internal (OSPI flash)

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3.4 i.MX RT MCUXpresso SDK

This section provides an overview of MCUXpresso Software Development Kit. 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
- 88W8801/88W8977/IW416/88W8987 Firmware with a support for SDIO and UART host interfaces
- 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. i.MX RT MCUXpresso SDK - Wi-Fi and Bluetooth layer interfaces

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4 NXP-based wireless modules

The wireless modules described in this section are based on the following NXP products:

- 88W8801
- 88W8977
- IW416
- 88W8987

4.1 88W8801-based wireless modules

4.1.1 AzureWave AW-NM191NF-uSD adapter board

AW-NM191NF module is a 2.4 GHz Wi-Fi radio module and a highly integrated Wi-Fi solution that enables a high performance, cost effective, low-power, compact solution with SDIO interface to the host processor. This module is based on the 88W8801 chipset that supports 1x1, 802.11 b/g/n station and access point operations. The high level of integration and full implementation of the power management functions specified in the IEEE 802.11 standard contribute to minimizing the system power requirements. For more details about module Wi-Fi features, refer to AW-NM191NF module datasheet.

The AW-NM191NF-uSD adapter board includes AW-NM191NF (88W8801-based Wi-Fi) module and the uSD-1216 adapter which enables the Micro SD interface for the module.

Table 5. AzureWave AW-NM191NF module features

Feature	Description
Wi-Fi chipset	88W8801
Module name	AW-NM191NF
Module adapter board	AW-NM191NF-uSD
Interface	Micro SD
Antenna	EVB kit includes Mag Layers MSA-4008-25GC1-A2_V01 PIFA antenna
Form factor	12 x 16 x 1.95 mm stamp module

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Figure 4 shows the interfaces and jumpers on AW-NM191NF-uSD adapter board.

Figure 4. AzureWave AW-NM191NF-uSD adapter board

4.1.1.1 Jumper settings on AzureWave AW-NM191NF-uSD adapter board

Table 6 shows the jumper settings for the power source and for VIO_SD voltage level options.

Table 6. Jumper settings on AW-NM191NF-uSD adapter board

Jumper	Description
J2 (1-2)	Connect J2 on pins 1 and 2 to set the power source to VIO_uSD
J11 (1-2)	Connect J11 on pins 1 and 2 to set VIO_SD voltage level to 1.8 V supply

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4.1.1.2 Connecting AW-NM191NF-uSD adapter board to i.MX RT1060 EVK board

To connect AW-NM191NF-uSD adapter board to i.MX RT1060 EVK board:

- Plug AW-NM191NF-uSD adapter board into the Micro SD slot of i.MX RT1060 EVK board

Figure 5. AzureWave AW-NM191NF-uSD adapter board with i.MX RT1060

- Connect the antenna to Ant1 slot of the AW-NM191NF-uSD adapter board
- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 6. i.MX RT1060 EVK board connection to the host computer for power supply and console access

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4.1.2 Embedded Artists' (Murata) 2DS M.2 module

Murata's Type 2DS is a small high-performance module (integrated PCB antenna) based on NXP 88W8801 chipset which supports Wi-Fi 802.11b/g/n up to 72.2 Mbps PHY data rate. Type 2DS Wi-Fi module provides device manufacturers with an easy-to-design solution for data acquisition, device management, and industrial control applications. RF matching, Antenna design and Regulatory certification are already taken care of and tested. The versatile Type 2DS module is packaged in a small form factor that facilitates integration into size- and power-sensitive applications.

Embedded Artists collaborated closely with Murata on designing/validating their Type 2DS M.2 Module. For more details about the module, refer to Murata's Type 2DS web page. For details on the M.2 Module, refer to the Embedded Artists' 2DS M.2 product page.

Table 7. Embedded Artists' Type 2DS module features

Feature	Description
Wi-Fi chipset	88W8801
Module name	Murata Type 2DS M.2
Module interface	M.2 (Type 2230-S3-E) / microSD (via the Murata uSD-M.2 adapter)
Antenna	On-board
Wi-Fi standard	Wi-Fi 4, 802.11 b/g/n
Frequency	2.4 GHz
Network	STA and AP dual mode
Measurement	22x54 mm with antenna
Supply voltage	3.3 V (3.0 V-3.6 V)
Operating temperature range	-40°C to +85°C

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Figure 7 shows the various parts of the M.2 module.

Figure 7. Embedded Artists' Type 2DS module

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4.1.2.1 Connecting Embedded Artists' (Murata) 2DS M.2 module to i.MX RT1050 EVK using Murata's uSD-M.2 adapter

Embedded Artists' 2DS M.2 module can be connected to i.MX RT1050 EVK (or any other EVKs with a microSD or full-size SD slot) using Murata's uSD-M.2 adapter. Figure 8 shows the connection scheme.

Figure 8. Embedded Artists' 2DS M.2 module connected to i.MX RT1050 EVK

Note: *For EVKs with M.2 slots (for example NXP i.MX RT1160 and RT1170), Embedded Artists' M.2 module can be directly connected.*

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4.1.2.2 Murata's uSD-M.2 adapter

Murata uSD-M.2 adapter provides the following interfaces to host MCU/MPU:

- microSD (uSD) interface for Wi-Fi-SDIO (SD is an option with microSD-SD adapter)
- Arduino headers for Bluetooth UART, Bluetooth PCM and Wi-Fi/Bluetooth control signals
- Optional power, debug, and clocking signals connect through Arduino Header or Micro-AB USB Connector.

Figure 9 and Table 8 describe the various components of the uSD-M.2 interface.

Figure 9. Murata uSD M.2 adapter top and bottom views

Table 8. Description of Murata uSD M.2 adapter components

Letter on figure	Description
A	microSD connector for power (VBAT, GND) and Wi-Fi SDIO interface
B	SDIO bus test points (CLK, CMD, DAT0, DAT1, DAT2, DAT3)
C	Power LED indicator (green): if not illuminated, no power is applied to M.2 EVB
D	J11 = Optional Bluetooth disable jumper for Wi-Fi-only mode (currently no effect on Embedded Artists' 2DS, 1XK, or 1ZM M.2 modules)
E	J9 = Bluetooth UART Tx/Rx and Wi-Fi/Bluetooth control signals (8-pin header)
F	J5 = Optional Bluetooth PCM and Wi-Fi/Bluetooth debug signals (2x 8-pin header)
G	Threaded mount for M.2 screw - 30 mm distance from M.2 connector
H	Regulator to step down optional 5 V VBAT from USB or Arduino header to 3.3 V
I	External sleep clock input (32.768 kHz)

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Table 8. Description of Murata uSD M.2 adapter components...*continued*

Letter on figure	Description
J	J7 = Optional Arduino header power supply (8-pin header; 5 V or 3.3 V VBAT)
K	J8 = Bluetooth UART RTS/CTS signals (6-pin header)
L	J13 = Host IO voltage: J13 in 1-2 position for 3.3 V VDDIO (default); J13 in 2-3 position for 1.8 V
	J12 = M.2 IO voltage: J12 in 1-2 position for 1.8 V VDDIO (default); J12 in 2-3 position for 3.3 V
N	J2 = Optional 5 V USB power supply via micro-AB USB connector
O	LED2 = 3.3 V M.2 IO voltage indicator (blue) – not illuminated in default configuration
P	Regulator to provide optional 1.8 V VIO to M.2 interface (M.2 EVBs have their own 1.8 V on-board)
Q	J1 = Power supply selector. The jumper must be installed to power adapter (unless J5 Arduino header pins #15/16 are connected to external GND/3.3 V VBAT). Position **1-2**: 5 V/3.3 V VBAT supply from micro-USB (J2) or from Arduino (J7) Position **2-3**: VBAT supply (typical 3.1~3.3 V) from microSD connector
R	M.2 connector type 2230-xx-E
S	microSD connector pins for power supply (VBAT, GND) and Wi-Fi SDIO interface
T	Wi-Fi JTAG header (header pins not populated)
U	20 pin FFC connector (Bluetooth UART, Bluetooth PCM, Wi-Fi/Bluetooth control signals)
V	Additional test points from 20-pin flat/flex connector

For further details on Murata's uSD-M.2 adapter, refer to Murata's uSD-M.2 web page.

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4.1.3 u-blox LILY-W1 evaluation board

The LILY-W1 series ultra-compact Wi-Fi front end modules include an integrated MAC/baseband processor and RF front end components. The modules based on 88W8801 chipset support 1x1, 802.11 b/g/n station and access point operations. 88W8801 is developed for reliable, high-demand industrial devices, and LTE radio applications. The modules connect to a host via SDIO or USB interface. They provide simultaneous operation as a station and a micro access point for up to 8 clients. The LILY-W132 variant further includes an internal antenna and LTE filter to enable in-device co-existence without compromising Wi-Fi performance. The LILY-W1 is approved for use in the United States, Europe, Canada, Taiwan, and Japan. For more details about the module Wi-Fi features, refer to LILY-W1 series module data sheet.

The EVK-LILY-W1 evaluation board includes the LILY-W1 (NXP 88W8801-based Wi-Fi) module. The evaluation board offers a standard full-size SD card connector and a micro-USB receptacle for host communication.

Table 9. u-blox LILY-W1 module features

Feature	Description
Wi-Fi chipset	NXP 88W8801
Wi-Fi standard	Wi-Fi 4, 802.11 b/g/n
Antenna	Antenna pin (LILY-W131) Internal with LTE filter (LILY-W132) Internal (LILY-W133)
Host interfaces	Wi-Fi: SDIO, USB 2.0
Output RF power	LILY-W131: 19 dBm including 3 dBi antenna gain LILY-W132 and LILY-W133: 15 dBm including antenna gain
Operating temperature range	-40°C to +85°C

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Figure 10 shows the main components on LILY-W1 evaluation board.

Figure 10. u-blox LILY-W1 evaluation board

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4.1.3.1 Jumper settings for SDIO on LILY-W1 evaluation board

Figure 11 shows the jumper settings for SDIO on LILY-W1 evaluation board.

Figure 11. Jumper settings for SDIO on LILY-W1 evaluation board

Table 10. Jumper settings on LILY-W1 evaluation board

Jumper	Description
J2: 7-8 bridged	SDIO interface selection
J3: 5-6 bridged	Selects 3.3 V SD card as main power supply
J3: 3-4 bridged	Selects 3.3 V I/O voltage

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4.1.3.2 Connecting u-blox EVK-LILY-W1 to i.MX RT1060 EVK board

To connect u-blox EVK-LILY-W1 to I.MX RT1060 board:

- Use an SD-to-Micro-SD adapter to connect u-blox EVK-LILY-W1 evaluation board to i.MX RT1060 EVK board. Refer to Delock.

Figure 12. u-blox EVK-LILY-W1 with i.MX RT1060 EVK board

- Use a Micro USB-to-USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 13. i.MX RT1060 EVK board connection to the host computer for power supply and console access

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4.2 88W8977-based wireless module

NXP performs SDK integration and validation testing for the 88W8977 using the Panasonic PAN9026 module.

PAN9026 is a 2.4 GHz and 5 GHz dual band Wi-Fi and Bluetooth radio module, specifically designed for highly integrated and cost-effective applications. This module is based on the 88W8977 chipset supporting 802.11a/b/g/n simultaneous station and access point. The integrated power management, the fast dual-core CPU, 802.11i security standard support, and high-speed data interfaces deliver the performance for the speed, reliability, and quality requirements of products. For more details about the module Wi-Fi features, refer to PAN9026 module datasheet .

4.2.1 Panasonic PAN9026-ETU (Easy To Use) SDIO Adapter

Panasonic PAN9026-ETU SDIO adapter includes PAN9026 (88W8977-based Wi-Fi) module and the adapter which enables the SDIO interface for the module.

Table 11. Panasonic PAN9026 module features

Feature	Description
Wi-Fi chipset	88W8977
Module name	PAN9026
Module SDIO adapter	PAN9026-ETU
Interface	3.3 V SDIO 2.0 interface
Antenna	On-board chip antenna Optional external antenna through U.FL connector
Form factor	17.5 x 10 x 2.6 mm stamp module

Figure 14 shows the interfaces of Panasonic PAN9026-ETU SDIO adapter and the jumper (JP1) used for the selection of the on-board antenna (default recommended setting) or the U.FL connector.

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Figure 14. Panasonic PAN9026-ETU SDIO adapter

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4.2.2 Connecting PAN9026-ETU SDIO adapter to i.MX RT1060 EVK board

An SD to Micro SD converter is required to connect PAN9026-ETU SDIO adapter to i.MX RT1060 EVK board.

- Use an SD to Micro SD adapter to connect PAN9026-ETU SDIO adapter to i.MX RT1060 EVK board. Refer to Saiko_Systems and Delock.
- Check that jumper JP1 on PAN9026-ETU SDIO adapter is set to the default configuration for on-board antenna

Figure 15. Panasonic PAN9026-ETU SDIO adapter connection to i.MX RT1060 EVK board using an SD-to-uSD adapter

- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 16. i.MX RT1060 EVK connection to the host computer for power supply and console access

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4.3 IW416-based wireless modules

4.3.1 AzureWave AW-AM457 module

The AW-AM457 is a 2.4 GHz and 5 GHz dual band Wi-Fi and Bluetooth radio module, specifically designed for highly integrated and cost-effective applications. This module is based on the IW416 chipset supporting 802.11a/b/g/n simultaneous station and access point. The integrated power management, the fast dual-core CPU, 802.11i security standard support, and high-speed data interfaces deliver the performance for the speed, reliability, and quality requirements of products. For more details about module Wi-Fi and Bluetooth features, refer to AW-AM457 module datasheet.

4.3.1.1 AzureWave AW-AM457-uSD evaluation board

The AW-AM457-uSD evaluation board comprises AW-AM457 wireless module and the uSD-15x15 adapter board. The adapter board enables the Micro SD interface for the module.

Table 12. AzureWave AW-AM457 module features

Feature	Description
Wi-Fi chipset	IW416
Module name	AW-AM457
Module evaluation board	AW-AM457-uSD EVB
Host interface	Wi-Fi: SDIO 3.0 Bluetooth: UART
Antenna	AW-AM457-uSD EVB kit includes Mag Layers MSA-4008-25GC1-A2_V01 PIFA antenna
Form factor	15 x 15 x 2.5 mm stamp module

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Figure 17 shows the interfaces and jumpers on the AW-AM457-uSD adapter board.

Figure 17. AzureWave AW-AM457-uSD evaluation board

4.3.1.2 Jumper settings on AzureWave AW-AM457-uSD evaluation board

Table 13 shows the jumper settings for the power source and for VIO_SD voltage level selection.

Table 13. Jumper settings on AzureWave AW-AM457-uSD evaluation board

Jumper	Description
J2 (1-2)	Connect J2 on pins 1 and 2 to set the power source to VIO_uSD
J11 (1-2)	Connect J11 on pins 1 and 2 to set VIO_SD voltage level to 1.8 V supply

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4.3.1.3 Connecting AzureWave AW-AM457-uSD to i.MX RT1060 EVK board

To connect AzureWave AW-AM457-uSD to i.MX RT1060 EVK board

- Plug AzureWave AW-AM457-uSD evaluation board into the Micro SD slot of i.MX RT1060 EVK board

Figure 18. AzureWave AW-AM457-uSD connection to i.MX RT1060 EVK board

- Connect the antenna to AzureWave AW-AM457-uSD evaluation board
- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 19. i.MX RT1060 EVK connection to the host computer for power supply and console access

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Note: *In case the initialization of the Wi-Fi driver fails with the setup described in Figure 19, it is recommended to use an external power supply for RT1060 instead of a USB connector to power up RT1060 EVK board. Connect the 5V 3A adapter over the J2 connector of RT1060 as shown in Figure 20. Set the J1 jumper to position 1-2 instead of 5-6 to power up RT1060 EVK board.*

Figure 20. External power supply for i.MX RT1060 EVK board and connection to the host computer for console access

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4.3.1.4 About Bluetooth host and audio interfaces

For Bluetooth, the communication between the Host stack and the Link Layer (LL) is implemented via the standard HCI UART host interface and PCM interface for voice.

To enable the Bluetooth UART and PCM interfaces, some rework is required. Refer to the SDK document *Hardware Rework Guide for EdgeFast BT PAL* available at*SDK_<version>_EVK-<RT-Platform>\docs\wireless\Bluetooth\Edgefast_bluetooth*.

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4.3.2 Embedded Artists' (Murata) 1XK M.2 module

Type 1XK is a small module with high-performance based on NXP IW416 combo chipset which supports Wi-Fi 802.11a/b/g/n and Bluetooth 5.2 BR/EDR/LE up to 150 Mbps PHY data rate on Wi-Fi and 3 Mbps PHY data rate on Bluetooth. The Wi-Fi section supports SDIO 3.0 interface. The Bluetooth section supports high-speed 4-wire UART interface (optional support for SDIO) and PCM for audio data. The IW416 implements sophisticated enhanced collaborative coexistence hardware mechanisms and algorithms, which ensure that Wi-Fi and Bluetooth collaboration is optimized for maximum performance. In IEEE 802.11n mode, the Wi-Fi operation supports rates of MCS0 – MCS7 in 20 MHz and 40 MHz channels for data rate up to 150 Mbps. Type 1XK module is packaged in an impressively small form factor that facilitates integration into size- and power-sensitive applications such as IoT applications, hand-held wireless system, gateway and more.

Embedded Artists collaborated with Murata on designing/validating their type 1XK M.2 module. For more details about the module, refer to Murata's Type 1XK web page. And for details on the M.2 module, refer to Embedded Artists' 1XK M.2 product page.

Table 14. Embedded Artists' 1XK M.2 module features

Feature	Description
Wi-Fi and Bluetooth chipset	NXP IW416
Module name	Murata Type 1XK M.2
Module interface	M.2 (Type 2230-S3-E) / microSD (via the Murata uSD-M.2 adapter)
Antenna	PCB trace antenna or U.FL connected patch antenna
Wi-Fi standard	Wi-Fi 4, 802.11 b/g/n
Frequency	2.4 GHz and 5 GHz
Network	uAP and STA dual mode
Measurement	22x30 mm without trace antenna, 22x44 mm with trace antenna
Supply voltage	3.3 V (3.0 V-3.6 V)
Operating temperature range	-40°C to +85°C

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Figure 21 shows the main components on Embedded Artists' 1XK M.2 module.

Figure 21. Embedded Artists' 1XK M.2 module

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4.3.2.1 Connecting Embedded Artists' (Murata) 1XK M.2 module to i.MX RT1050 EVK using Murata's uSD-M.2 adapter

Embedded Artists' 1XK M.2 module can be connected to i.MX RT1050 EVK (or any other EVK with a microSD or full-size SD slot) using Murata's uSD-M.2 adapter. Figure 22 shows the connection scheme.

Figure 22. Connecting Embedded Artists' 1XK M.2 module to i.MX RT1050 EVK

The Murata uSD-M.2 adapter provides the following interfaces to host MCU/MPU:

- microSD (uSD) interface for Wi-Fi-SDIO (SD is an option with microSD-SD adapter)
- Arduino Headers for Bluetooth UART, Bluetooth PCM and Wi-Fi/Bluetooth control signals
- Optional power, debug, and clocking signals connect through Arduino header or Micro-AB USB connector

For details of the uSD-M.2 adapter, see Section 4.1.2.2 or refer to Murata's uSD-M.2 web page.

Note: *For EVKs with M.2 slots (e.g., NXP i.MX RT1160, RT1170), Embedded Artists' M.2 module can be directly connected.*

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4.3.3 AzureWave AW-AM510 module

The AW-AM510 is a 2.4 GHz and 5 GHz dual-band single-antenna Wi-Fi and Bluetooth radio module. The module includes IW416 wireless device that supports 802.11a/b/g/n simultaneous station and access point. For more details about the module Wi-Fi and Bluetooth features, refer to AW-AM510 module data sheet.

4.3.3.1 AzureWave AW-510-uSD evaluation board

The AW-AM510-uSD evaluation board comprises AW-AM510 wireless module and the uSD-12x12 adapter board. The adapter board enables the Micro SD interface for the module.

Table 15. AzureWave AW-AM510 module features

Feature	Description
Wi-Fi chipset	IW416
Module name	AW-AM510
Module evaluation board	AW-AM510-uSD EVB
Host interface	Wi-Fi: SDIO 3.0 Bluetooth: UART
Antenna	AW-AM510-uSD EVB kit includes Mag Layers MSA-4008-25GC1-A2_V01 PIFA antenna
Form factor	12 x 12 x 2 mm stamp module

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Figure 23 shows the interfaces of AzureWave AW-AM510-uSD evaluation board and the jumpers used for VIO_SD and VIO voltage level options.

Figure 23. AzureWave AW-AM510-uSD evaluation board

4.3.3.2 Jumper settings on AzureWave AW-AM510-uSD evaluation board

Table 16 shows the jumper settings for the power source and for VIO_SD voltage level selection.

Table 16. Jumper settings on AzureWave AW-AM510-uSD evaluation board

Jumper	Description
J2 (1-2)	Connect J2 on pins 1 and 2 to set the power source to VIO_uSD
J4 (1-2)	Connect J4 on pins 1 and 2 to set VIO_SD voltage level to 1.8 V supply

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4.3.3.3 Connecting AzureWave AW-AM510-uSD to i.MX RT1060 EVK board

To connect AzureWave AW-AM510-uSD to i.MX RT1060 EVK board:

- Plug AzureWave AW-AM510-uSD evaluation board into the Micro SD slot of i.MX RT1060 EVK board

Figure 24. Connecting AzureWave AW-AM510-uSD to i.MX RT1060 EVK board

- Connect the antenna to AzureWave AW-AM510-uSD evaluation board
- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 25. i.MX RT1060 EVK board connection to host computer for power supply and console access

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4.3.3.4 Bluetooth host and audio interfaces

For Bluetooth, the communication between the Host stack and the Link Layer (LL) is implemented via the standard HCI UART host interface and PCM interface for voice.

To enable the Bluetooth UART and PCM interfaces, some rework is required. Refer to the SDK document *Hardware Rework Guide for EdgeFast BT PAL* available at the following location:

SDK_<version>_EVK-<RTPlatform>\docs\wireless\Bluetooth\Edgefast_bluetooth.

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4.3.4 u-blox MAYA-W1 module

The MAYA-W1 series are host-based Wi-Fi 4 and Bluetooth 5 multi-radio modules based on IW416 device. MAYA-W1 modules support the Wi-Fi 4 (802.11a/b/g/n) standard, Bluetooth classic and the full-feature set of Bluetooth Low Energy 5.

Table 17. u-blox MAYA-W1 module features

Feature	Description
Wi-Fi chipset	NXP IW416
Wi-Fi standard	Wi-Fi 4, IEEE 802.11 a/b/g/n (2.4 GHz and 5 GHz) Bluetooth 5.2
Antenna	MAYA-W160: 2 U.FL connectors MAYA-W161: 2 antenna pins MAYA-W166: 1 embedded PCB antenna
Host interfaces	Wi-Fi: SDIO Bluetooth: UART
Output RF power	LILY-W131: 19 dBm including 3 dBi antenna gain LILY-W132 and LILY-W133: 15 dBm including antenna gain
Operating temperature range	-40°C to +85°C

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4.3.4.1 u-blox EVK-MAYA-W1 evaluation board

EVK-MAYA-W1 features:

- External connectors to all host interfaces through SD card and M.2 key E adapters
- USB interface to easily access the Bluetooth UART interface via a USB-to-UART bridge
- Digital and analog audio interfaces for Bluetooth
- SMA connectors for external antennas (EVK-MAYA-W161)
- Multiple power supply options

Figure 26. u-blox EVK-MAYA-W1 evaluation board

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4.3.4.2 Jumper settings on u-blox EVK-MAYA-W1 evaluation board for uSD

Figure 27 shows the jumper settings on u-blox EVK-MAYA-W1 evaluation board.

Figure 27. u-blox EVK-MAYA-W1 jumper settings for uSD connection

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4.3.4.3 Connecting u-blox EVK-MAYA-W1 to i.MX RT1060 EVK board using uSD

To connect u-blox EVK-MAYA-W1 to i.MX RT1060 EVK board:

- Use a Micro SD/SDIO adaptor to connect EVK-MAYA-W1 evaluation board to i.MXRT1060 EVK board

Figure 28. : u-blox EVK-MAYA-W1 connected to i.MX RT1060 EVK using uSD interface

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- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 29. i.MX RT1060 EVK board connection to the host computer for power supply and console access

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4.4 88W8987-based wireless modules

4.4.1 AzureWave AW-CM358-uSD adapter board

The AW-CM358 is a 2.4 GHz and 5 GHz dual band Wi-Fi and Bluetooth radio module, specifically designed for highly integrated and cost-effective applications. This module is based on the 88W8987 chipset supporting 802.11a/b/g/n/ac simultaneous station and access point. The integrated power management, the fast dual-core CPU, 802.11i security standard support, and high-speed data interfaces deliver the performance for the speed, reliability, and quality requirements of products. For more details about module Wi-Fi and Bluetooth features, refer to AW-CM358 module datasheet.

The AW-CM358-uSD adapter board includes AW-CM358 (88W8987-based Wi-Fi) module and the uSD-1212 adapter which enables the Micro SD interface for the module.

Table 18. AzureWave AW-CM358 module features

Feature	Description
Wi-Fi chipset	88W8987
Module name	AW-CM358
Module evaluation board	AW-CM358-uSD EVB
Host interface	Wi-Fi: SDIO 3.0 Bluetooth: UART
Antenna	AW-CM358-uSD EVB kit includes Mag Layers MSA-4008-25GC1-A2_ V01 PIFA antenna
Form factor	12 x 12 x 1.65 mm stamp module

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Figure 30 shows the interfaces and jumpers on AW-CM358-uSD adapter board

Figure 30. AzureWave AW-CM358-uSD adapter board

4.4.1.1 Jumper settings on AzureWave AW-CM358-uSD evaluation board

Table 19 shows the jumper settings for the power source and for VIO_SD voltage level selection.

Table 19. Jumper settings on AzureWave AW-CM358-uSD evaluation board

Jumper	Description
J2 (1-2)	Connect J2 on pins 1 and 2 to set the power source to VIO_uSD
J4 (1-2)	Connect J4 on pins 1 and 2 to set VIO_SD voltage level to 1.8 V supply

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4.4.1.2 Connecting AW-CM358-uSD adapter board to i.MX RT1060 EVK board

- Plug AW-CM358-uSD adapter board into the Micro SD slot of i.MX RT1060 EVK board

- Connect the antenna to Antenna slot of the AW-CM358-uSD adapter board
- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

About Bluetooth host and audio interfaces

For Bluetooth, the communication between the Host stack and the Link Layer (LL) is implemented via the standard HCI UART host interface and PCM interface for voice.

To enable the Bluetooth UART and PCM interfaces, some rework is required. Refer to the SDK document Hardware Rework Guide for EdgeFast BT PAL available at *SDK_<version>_EVK-<RT-Platform>\docs\wireless\Bluetooth\Edgefast_bluetooth*.

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4.4.2 AzureWave AW-CM358MA M.2 adapter board

The AW-CM358MA M.2 adapter board includes AW-CM358 (88W8987-based Wi-Fi and Bluetooth) module with M.2 adapter which enables the SDIO interface for the module.

Note: *Only i.MX RT1170 EVK board require AW-CM358MA M.2 adapter board as it does not has support for the Bluetooth on AW-CM358-uSD adapter board.*

Table 20. AzureWave AW-CM358MA module features

Feature	Description
Wi-Fi chipset	88W8987
Module name	AW-CM358
Module evaluation board	AW-CM358MA M.2
Host interface	Wi-Fi: SDIO 3.0 Bluetooth: UART
Antenna	AW-CM358MA M.2 adapter board includes Mag Layers MSA-4008 -25GC1-A2_ V01 PIFA antenna
Form factor	22 x 30 x 2.45 mm stamp module

Figure 31. AzureWave AW-CM358MA M.2 adapter board

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4.4.2.1 Connecting AW-CM358MA adapter board to i.MX RT1170 EVK board

- Plug AW-CM358MA adapter board into the M.2 slot of i.MX RT1170 EVK board screw

- Connect the antenna to the antenna slot of the AW-CM358MA adapter board
- Use a Micro USB to USB cable to connect i.MX RT1170 EVK board to the host computer

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4.4.3 Embedded Artists' (Murata) 1ZM M.2 module

Type 1ZM is a small module with and very high performance based on NXP 88W8987 combo chipset which supports Wi-Fi 802.11a/b/g/n/ac + Bluetooth 5.1 BR/EDR/LE up to 433 Mbps PHY data rate on Wi-Fi and 3 Mbps PHY data rate on Bluetooth. The Wi-Fi section supports SDIO 3.0 interface, and the Bluetooth section supports high-speed 4-wire UART interface and PCM for audio data. The 88W8987 implements highly sophisticated enhanced collaborative coexistence hardware mechanisms and algorithms, which ensure that Wi-Fi and Bluetooth collaboration is optimized for maximum performance. In IEEE 802.11ac mode, the Wi-Fi operation supports rates of MCS0 - MCS9 (up to 256 QAM) in 20 MHz, 40 MHz and 80 MHz channels for data rate up to 433 Mbps. Type 1ZM module is packaged in an impressively small form factor that facilitates integration into size- and power-sensitive applications such as IoT applications, hand-held wireless system, gateway and more.

Embedded Artists collaborated with Murata on designing/validating their Type 1ZM M.2 Module. For more details about the module, refer to Murata's Type 1ZM web page. And for details on the M.2 module, refer to Embedded Artists' 1ZM M.2 product page.

Table 21. Embedded Artists' 1ZM M.2 module features

Feature	Description
Wi-Fi chipset	NXP 88W8987
Module name	Murata Type 1ZM M.2
Module interface	M.2 (Type 2230-S3-E) / microSD (via the Murata uSD-M.2 adapter)
Antenna	PCB trace antenna or U.FL connected patch antenna
Wi-Fi standard	Wi-Fi 5, 802.11a/b/g/n/ac
Frequency	2.4 GHz and 5 GHz
Network	uAP and STA dual mode
Measurement	22x30 mm without trace antenna, 22x44 mm with trace antenna
Supply voltage	3.3 V (3.2 V-3.6 V)
Operating temperature range	-30°C to +85°C

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Figure 32 shows the main components on Embedded Artists' 1ZM M.2 module.

Figure 32. Embedded Artists' 1ZM M.2 module

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4.4.3.1 Connecting Embedded Artists' (Murata) 1ZM M.2 module to i.MX RT1050 EVK using Murata's uSD-M.2 adapter

Embedded Artists' M.2 module can be connected to i.MX RT1050 EVK (or any other EVK with a microSD or full-size SD slot) using Murata's uSD-M.2 adapter. Figure 33 shows the connection scheme.

Figure 33. Connecting Embedded Artists' 1ZM M.2 module to i.MX RT1050 EVK

The Murata uSD-M.2 adapter provides the following interfaces to host MCU/MPU:

- microSD (uSD) interface for Wi-Fi-SDIO (SD is an option with microSD-SD adapter)
- Arduino headers for Bluetooth UART, Bluetooth PCM and Wi-Fi/Bluetooth control signals
- Optional power, debug, and clocking signals connect through Arduino header or Micro-AB USB connector

For details of the uSD-M.2 adapter, see Section 4.1.2.2 or refer to Murata's uSD-M.2 web page.

For EVKs with M.2 slots like NXP i.MX RT1160 or RT1170, the Murata M.2 EVB can be directly connected.

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4.4.4 u-blox JODY-W2 module

The JODY-W2 series are compact modules based on NXP 88W8987 wireless device for automotive. The JODY-W2 modules comply with AEC-Q100 automotive grade, and enable Wi-Fi, Bluetooth, and Bluetooth Low Energy (LE) communication. These modules are ideal for automotive and industrial applications. For more details, refer to JODY-W2 datasheet.

Table 22. u-blox JODY-W2 module features

Feature	Description
Wi-Fi chipset	NXP 88W8987
Wi-Fi standard	Wi-Fi 5, IEEE 802.11 a/b/g/n/ac (2.4 GHz and 5 GHz) Bluetooth 5.2
Antenna	Antenna pin 1: 2.4 GHz and 5 GHz Wi-Fi Antenna pin 2: 2.4 GHz Bluetooth
Host interfaces	Wi-Fi: SDIO Bluetooth: UART
Operating temperature range	-40°C to +105°C (JODY-W263-01A)

4.4.4.1 u-blox EVK-JODY-W2 evaluation board

The EVK-JODY-W2 evaluation board includes NXP 88W8987-based JODY-W2 module. An external host processor can access the module via SDIO and UART communication. The EVK provides internal antennas and SMA connectors for external antennas. All the module interfaces are externally available via connectors or pin headers.

Figure 34. u-blox EVK-JODY-W2 evaluation board

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4.4.4.2 Connecting u-blox EVK-JODY-W2 to i.MX RT1060 EVK board using uSD

To connect u-blox EVK-JODY-W2 to i.MX RT1060 EVK board:

- Use the included SD card adapter to connect EVK-JODY-W2 to i.MX RT1060 EVK board

Figure 35. u-blox EVK-JODY-W2 connected to i.MX RT1060 EVK using uSD interface

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- Use a Micro USB to USB cable to connect i.MX RT1060 EVK board to a host computer running Windows, Linux or Mac OS

Figure 36. i.MX RT1060 EVK board connection to the host computer for power supply and console access

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5 Software download

This section provides guidance for MCUXpresso SDK download and for the serial console setup.

Note: *This section covers the download of MCUXpresso SDK and IDE. Refer to UM11442 for the other IDEs and toolchains such as uVision Keil, Arm GNU toolchain, and IAR. UM11442 is located at SDK_<version>_EVK-<RT-Platform>\docs\wireless.*

5.1 MCUXpresso SDK download

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

- Select the board and the latest SDK version

Figure 37. Select the development board

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- Click on **Build MCUXpresso SDK**
- Define the **Developer Environment Settings**
- Click on **Select All**
- Click on **Download SDK**

Figure 38. Download the SDK

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- Read the terms and conditions on page 1
- Click the icon to open the second page

Figure 39. Page 1 of the terms and conditions

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- Click **AGREE**

Figure 40. Accept the terms and conditions (page 2)

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- Select the items to download, for example SDK Archive

Figure 41. Download page

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- Read the SDK archive details and click **Download**

Figure 42. SDK build details

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5.2 Serial console tool setup

The serial console tool is used to read out the demo application logs on the computer connected to i.MX RT EVK board.

- Download and install the terminal emulator software such as Tera Term (Windows) or Minicom (Linux or Mac OS)
- Use a micro USB to USB cable to connect i.MX RT1060 EVK board to the host computer running Windows, Linux, or Mac OS
- Open a terminal emulator program like Minicom or Tera Term, and configure the settings for serial console access

Command to access Minicom configuration menu:

```
# minicom -s
```

Settings for serial console access:

```
- /dev/ttyACMX serial port
- 115200 baud rate
- 8 data bits
- No parity
- One stop bit
- No flow control
```

Prior to running the Bluetooth demo application, update the serial console configuration so there is no extra spacing.

For Tera Term:

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

For Minicom:

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

5.3 IDE setup

- Go to MCUXpresso IDE page on NXP website
- Download MCUXpresso IDE
- Install MCUXpresso IDE on the host computer

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6 i.MX RT product image setup

The detailed steps for the image setup are published on the Getting Started with NXP Wi-Fi modules using i.MX RT platforms page on NXP website.

- Open the Getting started page
- Select the section **2.Build and Run Wi-Fi demo from the SDK** in the left navigation pane

- Click on the icon to play the video (*the screenshot below has no active link to play the video*)

- Follow the instructions to install the SDK, import a project, build an image, and run an application in debug mode

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7 Run a Wi-Fi demo application

Use the Wi-Fi example application available in the SDK to bring up the Wi-Fi interface.

- Open the Getting started page
- Select the section **2.Build and Run Wi-Fi demo from the SDK** in the left navigation pane

- Scroll down the page and click on the **BUILD AND RUN WIFI EXAMPLE** button to access the step-by-step procedure to build and run a Wi-Fi demo application

Note: *The default application works on AW-AM510-uSD module using the macro* `WIFI_IW416_BOARD_AW_AM510_USD`*. To enable support for other modules, define the respective macro and disable other macros in evk<RT-Platform>_wifi_cli\source\app_config.h file as per the list provided in Table 23.*

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Table 23. List of macros

Module	Wireless product	Macro
Panasonic PAN9026	88W8977	WIFI_88W8977_BOARD_PAN9026_SDIO
AzureWave AW-AM281	88W8977	WIFI_88W8977_BOARD_AW_AM281_USD
AzureWave AW-NM191NF	88W8801	WIFI_88W8801_BOARD_AW_NM191_USD[1] WIFI_88W8801_BOARD_AW_NM191MA
AzureWave AW-AM457	IW416	WIFI_IW416_BOARD_AW_AM457_USD WIFI_IW416_BOARD_AW_AM457MA
AzureWave AW-CM358	88W8987	WIFI_88W8987_BOARD_AW_CM358_USD[1] WIFI_88W8987_BOARD_AW_CM358MA[1]
Murata Type 2DS	88W8801	WIFI_88W8801_BOARD_MURATA_2DS_USD[1] WIFI_88W8801_BOARD_MURATA_2DS_M2
Murata Type 1XK	IW416	WIFI_IW416_BOARD_MURATA_1XK_USD[1] WIFI_IW416_BOARD_MURATA_1XK_M2
Murata Type 1ZM	88W8987	WIFI_88W8987_BOARD_MURATA_1ZM_USD[1] WIFI_88W8987_BOARD_MURATA_1ZM_M2
EVK-LILY-W131	88W8801	WIFI_88W8801_BOARD_UBX_LILY_W1_USD
EVK-MAYA-W1	IW416	WIFI_IW416_BOARD_UBX_MAYA_W1_USD
EVK-JODY-W2	88W8987	WIFI_88W8987_BOARD_UBX_JODY_W2_USD

[1] The module operation was tested during 2.12.0 release process
USD = microSD interface
M2 = M.2 interface

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8 Run a Bluetooth/Bluetooth LE demo application

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 Demo start-up logs

- Build and run *peripheral_ht* application.
- Flash the image on i.MX RT EVK board
  Refer to Section 6 "i.MX RT product image setup" for guidance on how to build and run a demo application. Follow the steps with *peripheral_ht* application instead of *iperf* application.

Note: *The default application works on AW-AM510-uSD module using the macro* `WIFI_IW416_BOARD_AW_AM510_USD` *or* `WIFI_IW416_BOARD_AW_AM510MA`*. To enable support for other modules, define the respective macro and disable other macros in evk<RT-Platform>_peripheral_ht\sources\app_config.h file. See Table 24 for the list of macros.*

- Apply a power reset on i.MX RT EVK board
- Check the console on the connected computer screen to see the application start-up logs

The demo application first loads the Wi-Fi and Bluetooth module firmware through the SDIO interface. 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 i.MX RT EVK board and NXP-based wireless module are up and running.

```
Bluetooth initialized
Advertising successfully started
```

At this point, the stack is ready to accept incoming connections from any peer device.

Table 24. List of macros

Module	Wireless product	Macro
AzureWave AW-AM457	IW416	WIFI_IW416_BOARD_AW_AM457_USD
AzureWave AW-AM510	IW416	WIFI_IW416_BOARD_AW_AM510_USD[1] WIFI_IW416_BOARD_AW_AM510MA[1]
AzureWave AW-CM358	88W8987	WIFI_88W8987_BOARD_AW_CM358_USD
Murata Type 1XK	IW416	WIFI_IW416_BOARD_MURATA_1XK_USD[1] WIFI_IW416_BOARD_MURATA_1XK_M2[1]
Murata Type 1ZM	88W8987	WIFI_88W8987_BOARD_MURATA_1ZM_USD[1] WIFI_88W8987_BOARD_MURATA_1ZM_M2[1]

[1] The module operation was tested during 2.12.0 release process.
USD = microSD interface
M2 = M.2 interface

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8.2 Establishing a Bluetooth LE connection

This section describes the steps to establish a Bluetooth LE connection between a smartphone and NXP-based wireless module.

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

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

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Note: *The SDK package includes other Bluetooth demo applications. Refer to UM11442 for the detailed steps to build and run those applications. UM11442 is located at SDK_<<version>>_EVK-<RT-Platform>\docs\wireless.*

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9 Acronyms and abbreviations

Table 25. Acronyms and Abbreviations

Terms	Definition
AP	Access point
DHCP	Dynamic host configuration protocol
DHCPD	DHCP daemon
EVB	Evaluation board
EVK	Evaluation kit
FW	Firmware
HCI	Host controller interface
HTS	Health thermometer service
I/O	Input/output
IDE	Integrated development environment
IP	Internet protocol
LE	Low energy
lwIP	Light weight IP
PCM	Pulse code modulation
SD	Secure digital
SDK	Software development kit
STA	Station/client
SW	Software
UART	Universal asynchronous receiver-transmitter
uSD	Micro SD
uSDHC	ultra-secured digital host controller
WLAN	Wireless local area network

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10 Contact information

Refer to the following links for more details on the products, and for queries or support.

- Home Page: nxp.com
- Web Support: nxp.com/support
- NXP Community: https://community.nxp.com/

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