Murata's RF Bundle

Linux Quick Start Guide - Rev. 1.0
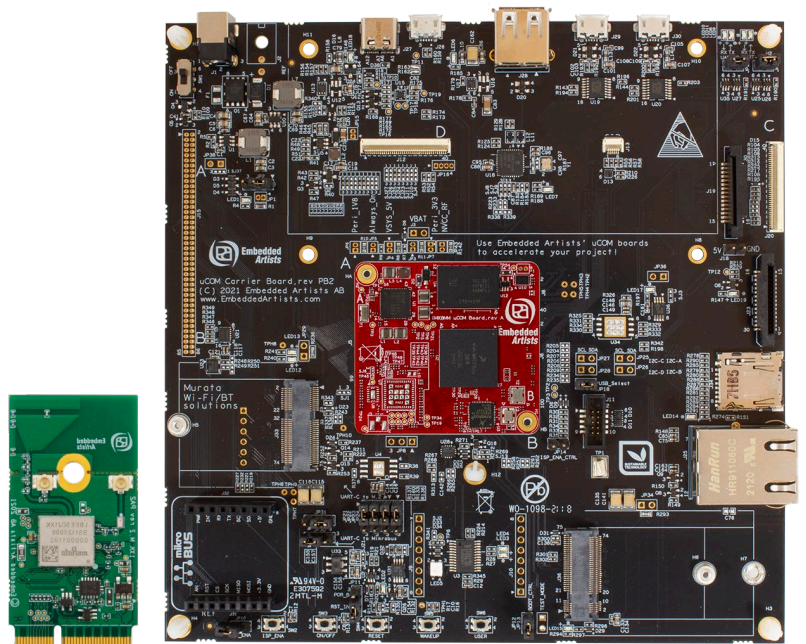
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About This Guide

This document guides the user on enabling a popular subset of Murata's Wi-Fi/Bluetooth modules (1XK, 1ZM, 1YM, 1YN, 1LV, and 2AE) on Embedded Artists' iMX8M Mini Developer's Kit V3. All Murata Wi-Fi/Bluetooth modules are designed into Embedded Artists' M.2 modules. As such, the exercise of enabling various Murata modules is a simple matter of plug 'n play.

Audience & Purpose

This document is intended as an introduction for end users to start evaluating Murata Wi-Fi/Bluetooth solutions for Linux on Embedded Artists' i.MX platforms. This document is expressly written for Future Electronics FAEs and their customers.

Document Conventions

Table 1 describes the document conventions used in this guide.

Table 1: Document Conventions

Conventions	Description
	Warning Note Indicates very important note. Users are strongly recommended to review.
	Info Note Intended for informational purposes. Users should review.
	Menu Reference Indicates menu navigation instructions. **Example**: Insert➜Tables➜Quick Tables➜Save Selection to Gallery
	External Hyperlink This symbol indicates a hyperlink to an external document or website. **Example**: Embedded Artists AB Click on the text to open the external link.
	Internal Hyperlink This symbol indicates a hyperlink within the document. **Example**: Introduction Click on the text to open the link.
`Console input/output or code snippet`	**Console I/O or Code Snippet** This text *Style* denotes console input/output or a code snippet.
`# Console I/O comment` `// Code snippet comment`	**Console I/O or Code Snippet Comment** This text *Style* denotes a console input/output or code snippet comment. • Console I/O comment (preceded by "#") is for informational purposes only and does not denote actual console input/output. • Code Snippet comment (preceded by "//") may exist in the original code.

1 Introduction

This Quick Start Guide details enabling a selection of both NXP and Infineon based Murata's Wi-Fi/Bluetooth modules ↗ specifically on the Embedded Artists' iMX8M Mini Developer's Kit V3 ↗ (running Linux 5.10.72). As already indicated, the Embedded Artists' M.2 modules in this RF Bundle include:

- **NXP**: Type 1XK (IW416), Type 1ZM (88W8987), and Type 1YM (88W8997).
- **Infineon**: Type 1YN (CYW43439), Type 1LV (CYW43012), and Type 2AE (CYW4373E).

Examples of hardware/software configurations for both NXP and Infineon are illustrated to introduce users to the Murata wireless solution and demonstrate the ease of getting started with Embedded Artists' hardware/software. **Figure 1** shows the Embedded Artists' hardware platform with one of the bundled (1XK) M.2 modules. The Wi-Fi/Bluetooth M.2 interconnect on this Developer Kit is optimized to provide comprehensive signaling for all necessary bus interfaces (WLAN-SDIO, WLAN-PCIe, WLAN-USB, BT-UART, BT-PCM, WLAN and Bluetooth control signals). Embedded Artists document their platform extensively at this link ↗ – select "Resources" tab. In particular, users are encourage to reference Embedded Artists' Getting Started with M.2 modules and i.MX6/7/8 on Linux v5.10 ↗. In addition, Murata provides the following documents detailing both NXP and Infineon based solutions: Murata Wi-Fi/BT (NXP) Solution for i.MX Linux User Guide ↗, and Murata Wi-Fi/BT (CYW) Solution for i.MX Linux User Guide ↗.

Figure 1: Embedded Artists' iMX8M Mini Developer's Kit V3 with Type 1XK M.2 Module
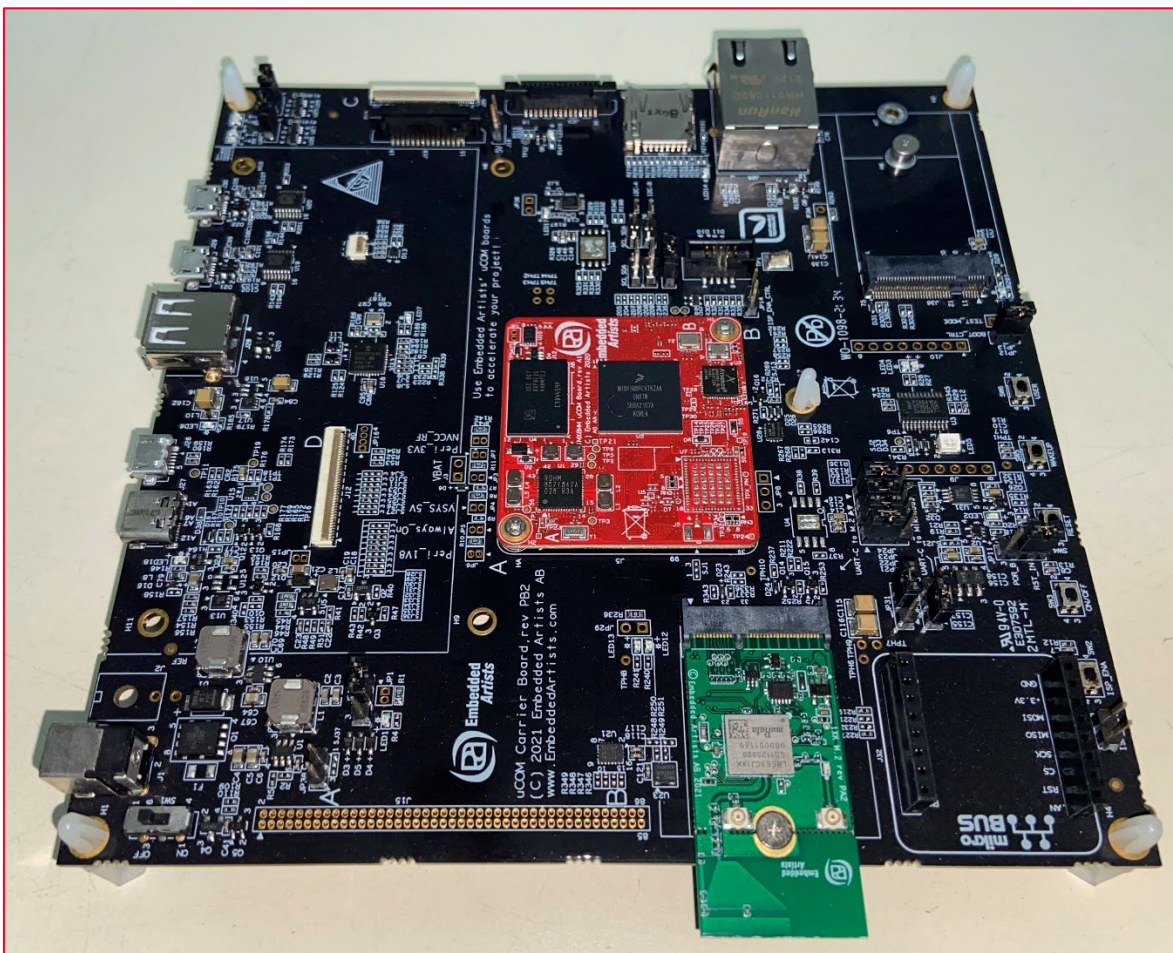
The following sections describe the process of getting Wi-Fi and Bluetooth up and running on Embedded Artists' iMX8M Mini Developer's Kit V3 ↗ with Embedded Artists' M.2 Module based on Murata Wi-Fi/Bluetooth ↗, running Embedded Artists' Linux 5.10.72 kernel release ↗. This document also describes the process of easily switching between Embedded Artists' M.2 modules without any need for complicated hardware changes or software builds.

> ℹ️ Note that Wi-Fi/Bluetooth M.2 EVB (Evaluation Board) is equivalent to Wi-Fi/Bluetooth M.2 module. We use "EVB" sometimes to better distinguish the M.2 form factor from the actual Murata module.

2 Interfacing the Wi-Fi/Bluetooth M.2 Module (EVB)

Figure 2 and **Figure 3** illustrate how Embedded Artists' M.2 module is connected to their iMX8M Mini Developer's Kit V3 in the M.2 slot. No additional cabling is required.

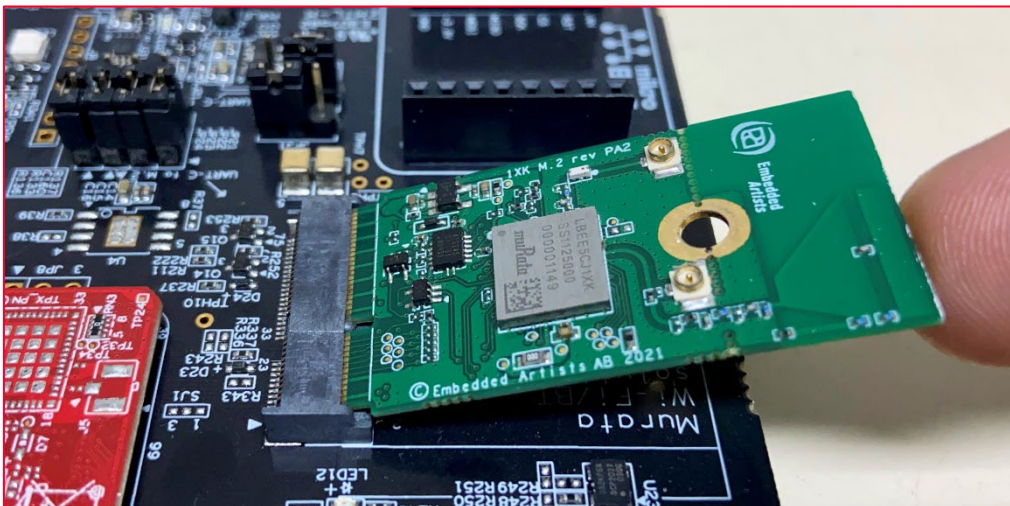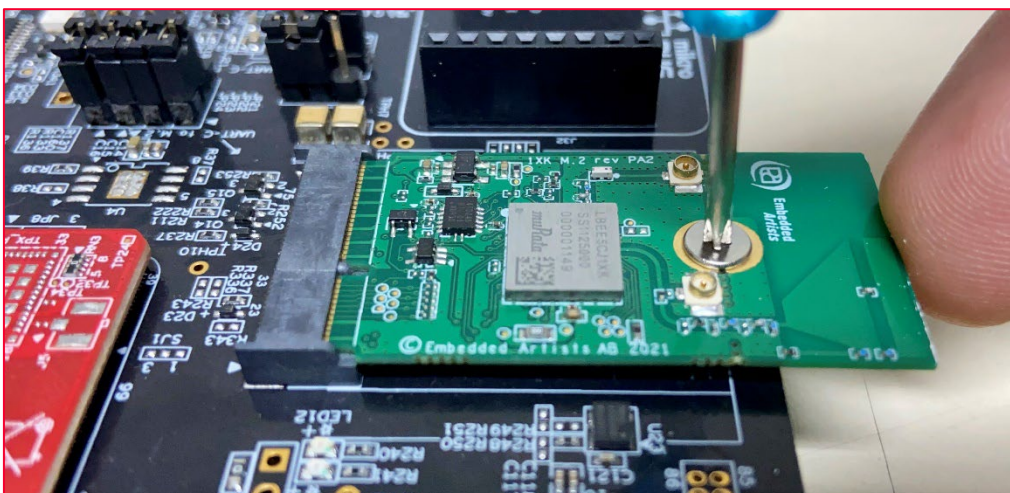**Figure 2: Plug in the M.2 module at a shallow angle, inserting it fully into M.2 Connector**

Figure 3: Continue pushing with finger (for snug fit) while securing M.2 module with screw

3 Download Prebuilt Linux Image and Flash Platform

Embedded Artists provide prebuilt Linux images for users to quickly download and flash the i.MX platforms. These are available at Embedded Artists i.MX Related Resources Page ⬀. The following steps showcase the process of downloading and flashing the image for the Linux kernel 5.10.72. The host system being used is running Windows® 10. For detailed information from Embedded Artists, please refer to Embedded Artists' Getting Started with M.2 modules and i.MX6/7/8 on Linux v5.10 ⬀.

- Download and extract the 5.10.72 Linux image for Embedded Artists' iMX8M Mini Developer's Kit V3 from Embedded Artists i.MX Related Resources Page ⬀ as shown in **Figure 4**. The correct title of the download is "uuu_imx8mm_ucom_5.10.72.zip (release notes)".

Figure 4: Embedded Artists i.MX Related Resources page

i.MX8M Mini uCOM Board / Kit			
Resource	Description	Updated	Size (MB)
uuu_imx8mm_ucom_5.10.72.zip (release notes)	UUU tool including bootloader, kernel (**5.10.72**) and file system images	2022-03-08	148.2
uuu_imx8mm_ucom_5.10.35.zip (release notes)	UUU tool including bootloader, kernel (**5.10.35**) and file system images	2022-01-12	183.0

- Extract the downloaded archive. This will extract both the image as well as the UUU application that can be used to flash the board.

- Set up the Developer's Kit and the console by following the online Getting Started ⬀.

- Put the Developer's Kit into OTG mode to download the image, by closing the JP10 jumper as shown in **Figure 5**.

Figure 5: JP10 jumper (closed for flashing mode) on Developer's Kit
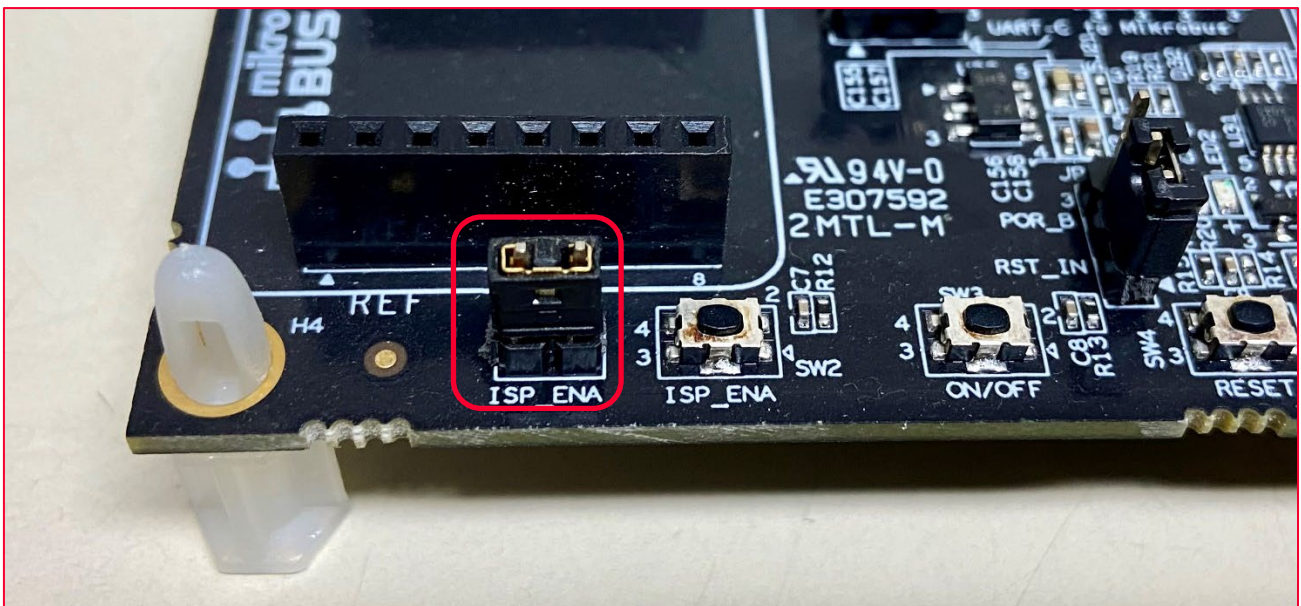
> ⛔ Ensure that no Windows application (such as VmWare Workstation) which may interfere with the USB device instantiation is running. The Embedded Artists' Dev Kit's onboard eMMC flash is configured as a USB interface during this step.

- Power on the Developer's Kit.

- Open a command prompt, navigate to the folder where the downloaded zip file was extracted and run the UUU tool.

```
C:\> cd c:\temp\uuu_imx8mm_ucom_5.10.72
C:\temp\uuu_imx8mm_ucom_5.10.72> uuu.exe full_tar.uuu
```

- The terminal will show the download progress as shown in **Figure 6**.

Figure 6: Image downloading

```
C:\temp\uuu_imx8mm_ucom_5.10.72>uuu.exe full_tar.uuu
uuu (Universal Update Utility) for nxp imx chips -- libuuu_1.3.191-0-g4fe24b9

Success 0    Failure 0


1:1    32/35 [=========>       28%              ] FBK: ucp  files/ea-image-base-imx8mmea-ucom.tar.bz2 t:-
```

- Wait till the download is complete as shown in **Figure 7**.

Figure 7: Image Download Complete

```
C:\temp\uuu_imx8mm_ucom_5.10.72>uuu.exe full_tar.uuu
uuu (Universal Update Utility) for nxp imx chips -- libuuu_1.3.191-0-g4fe24b9

Success 1    Failure 0


1:1    35/35 [Done                              ] FBK: DONE
```

- Power off the Developer's Kit.
- Put the Developer's Kit into eMMC boot mode, by opening the JP10 jumper.
- Power on and boot the Developer's Kit.
  - Username: root
  - Password: pass

4 Connectivity Options

The modular design of Embedded Artists' Developer's Kits and the industry standard M.2 interface of the Murata Wi-Fi/BT modules allow users to quickly switch wireless solutions offered by both NXP and Infineon. Specifically, the Embedded Artists' solution makes switching wireless solutions quite simple by merely running the "switch_module.sh" script. This feature is consistent with Embedded Artists' overall approach to their hardware/software solutions: lowering the bar for customers so they can quickly get their desired software applications up and running. If you are using NXP modules, please refer to Section 4.1 ⌐. If you are using IFX modules, please refer to Section 4.2 ⌐.

4.1 NXP-based Murata Wi-Fi/Bluetooth Modules

Supported NXP-based Wi-Fi/Bluetooth modules bundled with the kit include Type 1XK, Type 1ZM and Type 1YM.

- Ensure the Developer's Kit is powered off and connect the Type 1XK M.2 module.

- Power on and boot the Developer's Kit. After logging in (username: "root"; password: "pass"), Issue the following commands to enable the Type 1XK module and reboot the platform.

```
$ switch_module.sh 1xk
$ switch_module.sh off
$ reboot
```

- The Developer's Kit should boot with the Wi-Fi driver loaded automatically.

The steps below describe the process of switching out the Type 1XK module used in the previous steps with the Type 1YM module. Note that Type 1YM is a WLAN-PCIe/BT-UART (default configuration) whereas Type 1XK is WLAN-SDIO/BT-UART. The Embedded Artists' M.2 interface provides these interconnect options, making it very customer friendly.

- Issue the "halt" command, power off the Developer's Kit

```
$ halt
```

- Unscrew and disconnect the Type 1XK M.2 module from the Developer's Kit and connect the Type 1YM M.2 module.

- Power on and boot the Developer's Kit. Issue the following commands to enable the Type 1YM M.2 module and reboot the platform.

```
switch_module.sh 1ym-pcie
switch_module.sh off
reboot
```

- The Developer's Kit should boot with and bring up Type 1YM's WLAN interface automatically.

Sections 4.1.1 ⌐ and 4.1.2 ⌐ provide more details on configuring and exercising Wi-Fi and Bluetooth, including console log output. Similarly, "switch_module.sh" script can be used to enable any of the bundled M.2 modules (see Section 6 ⌐).

4.1.1 Enable Wi-Fi for NXP-based Wi-Fi/Bluetooth modules

This section details steps for bringing up Wi-Fi on NXP-based Wi-Fi/Bluetooth M.2 modules. For NXP-based devices, the WLAN device name is **mlan0**. The logs shown below are for Type 1XK module.

- Enable 1XK module with the following two "switch_module.sh" commands.

```
root@imx8mmea-ucom:~# switch_module.sh 1xk
DTB_VER is v3

Setting up for 1XK (NXP - SDIO)
Please wait for 15 seconds (one-time only)...
Enabling mlan0
Created symlink /etc/systemd/system/multi-
user.target.wants/wpa_supplicant@mlan0.service
-> /lib/systemd/system/wpa_supplicant@mlan0.service.
Disabling wlan0
Setup complete.

root@imx8mmea-ucom:~# switch_module.sh off
DTB_VER is v3
Disabling mlan0
Removed /etc/systemd/system/multi-
user.target.wants/wpa_supplicant@mlan0.service.
Disabling wlan0
```

- Issue the "reboot" command.

```
$ reboot
```

- After rebooting and logging in (username: "root"; password: "pass"), check to see if the interface is up.

```
# WLAN MAC address can be seen as Hwaddr
# The UP flag indicates the mlan0 interface is up
root@imx8mmea-ucom:~# ifconfig mlan0
mlan0     Link encap:Ethernet  HWaddr 9C:50:D1:44:F3:05
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

- Scan for available Wi-Fi networks.

```
$iw dev mlan0 scan
```

- Connect to an unsecured Access Point (AP) "Murata_5G".

```
root@imx8mmea-ucom:~#  iw dev mlan0 connect Murata_5G
[ 5383.671368] wlan: mlan0 START SCAN
root@imx8mmea-ucom:~# [ 5387.779929] wlan: SCAN COMPLETED: scanned AP
count=12
[ 5387.792618] mlan0:
[ 5387.792628] wlan: HostMlme Auth received from 60:XX:XX:XX:21:0d
```

```
[ 5387.809291] wlan: HostMlme mlan0 Connected to bssid 60:XX:XX:XX:21:0d
successfully
[ 5387.817158] IPv6: ADDRCONF(NETDEV_CHANGE): mlan0: link becomes ready

$ iw dev mlan0 link
Connected to 84:1b:5e:f6:a7:60 (on wlan0)
        SSID: Murata_5G
        freq: 5180
        RX: 1944 bytes (8 packets)
        TX: 0 bytes (0 packets)
        signal: -44 dBm
        tx bitrate: 24.0 MBit/s
        bss flags:
        dtim period:    1
        beacon int:     100
```

- Run DHCP client to get IP address.

```
root@imx8mmea-ucom:~# udhcpc -i mlan0
udhcpc: started, v1.33.1
udhcpc: sending discover
udhcpc: sending discover
udhcpc: sending select for 192.168.1.24
udhcpc: lease of 192.168.1.24 obtained, lease time 86400
/etc/udhcpc.d/50default: Adding DNS 192.168.1.1
```

- Ping AP (IP address 192.168.10.1) to check connectivity.

```
$ ping 192.168.10.1
```

4.1.2 Enable Bluetooth for NXP-based Wi-Fi/Bluetooth modules

This section details steps for bringing up Bluetooth (and performing an initial scan) on NXP-based Wi-Fi/Bluetooth M.2 modules. The logs shown below are for Type 1XK module. Embedded Artists' "bluetooth_up.sh" script both brings up the Bluetooth interface and scans for devices.

- Load the Bluetooth driver by issuing the following command. The Linux BlueZ stack is used for Bluetooth operations.

> ℹ️ There might be couple of error or warning messages, but these can be safely ignored.

```
root@imx8mmea-ucom:~# /opt/ea/bluetooth_up.sh
Setting TTY to N_HCI line discipline
Device setup complete
< HCI Command: ogf 0x3f, ocf 0x0009, plen 4
  C0 C6 2D 00
> HCI Event: 0x0e plen 4
  01 56 0C 00
[   22.787996] Bluetooth: hci0: sending frame failed (-49)
Setting TTY to N_HCI line discipline
Device setup complete
Scanning ...
[   33.763864] VSD_3V3: disabling
[   33.766932] usbotg_vbus: disabling
        50:14:79:B8:2D:09        j755020
        28:39:5E:24:FE:95        [AV] Samsung Soundbar K450 K-Series
```

4.2 Infineon-based Murata Wi-Fi/Bluetooth Modules

Supported Infineon-based Wi-Fi/Bluetooth modules bundled with the kit include Type 1YN, Type 1LV and Type 2AE.

- Ensure the Developer's Kit is powered off and connect the Type 1YN M.2 module.

- Power on and boot the Developer's Kit. Issue the following commands to enable the Type 1YN module and reboot the platform.

```
$ switch_module.sh 1yn
$ switch_module.sh off
$ reboot
```

- The Developer's Kit should boot with and bring up Type 1YN's WLAN interface automatically.

To setup the Developer's Kit for working with the Type 2AE module, follow the same procedure outlined above.

- If powered, issue the "halt" command, and power off the Developer's Kit

```
$ halt
```

- Unscrew and disconnect the Type 1YN M.2 module from the Developer's Kit and connect the Type 2AE M.2 module.

- Set up the Developer's Kit for working with the Type 2AE module, by invoking the "switch_module.sh script" and rebooting the platform as shown below.

```
switch_module.sh 2ae
switch_module.sh off
reboot
```

- The Developer's Kit should boot with and bring up Type 2AE's WLAN interface automatically.

Sections 4.2.1 ⧉ and 4.2.2 ⧉ provide more details on configuring and exercising Wi-Fi and Bluetooth, including console log output. Similarly, "switch_module.sh" script can be used to enable any of the bundled M.2 modules (see Section 6 ⧉).

4.2.1 Enable Wi-Fi for Infineon-based Wi-Fi/Bluetooth modules

This section includes the steps for bringing up Wi-Fi for IFX modules. For Infineon-based devices, the WLAN device name is **wlan0**. The logs shown below are for Type 2AE module.

- Enable 2AE module with the following two "switch_module.sh" commands.

```
root@imx8mmea-ucom:~# switch_module.sh 2ae
DTB_VER is v3

Setting up for 1DX, 1LV, 1MW, 1WZ, 1YN, 2AE (Cypress - SDIO)
Please wait for 15 seconds (one-time only)...
Disabling mlan0
Enabling wlan0
Created symlink /etc/systemd/system/multi-
user.target.wants/wpa_supplicant@wlan0.service ->
/lib/systemd/system/wpa_supplicant@wlan0.service.
```

```
Setup complete.

root@imx8mmea-ucom:~# switch_module.sh off
DTB_VER is v3
Disabling mlan0
Disabling wlan0
Removed /etc/systemd/system/multi-
user.target.wants/wpa_supplicant@wlan0.service.
```

- Issue the "reboot" command.

```
$ reboot
```

- After rebooting and logging in (username: "root"; password: "pass"), check to see if the interface is up.

```
# WLAN MAC address can be seen as Hwaddr
# The UP flag indicates the mlan0 interface is up
root@imx8mmea-ucom:~# ifconfig wlan0
wlan0     Link encap:Ethernet  HWaddr 10:A5:D0:99:27:3B
          UP BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
```

- Scan for available Wi-Fi networks.

```
$iw dev wlan0 scan
```

- Connect to an unsecured Access Point (AP) "Murata_5G".

```
root@imx8mmea-ucom:~# iw dev wlan0 connect Murata_5G
root@imx8mmea-ucom:~# [   45.537898] IPv6: ADDRCONF(NETDEV_CHANGE):
wlan0: link becomes ready
$ iw dev mlan0 link
Connected to 84:1b:5e:f6:a7:60 (on wlan0)
        SSID: Murata_5G
        freq: 5180
        RX: 1944 bytes (8 packets)
        TX: 0 bytes (0 packets)
        signal: -44 dBm
        tx bitrate: 24.0 MBit/s
        bss flags:
        dtim period:    1
        beacon int:     100
```

- Run DHCP client to get IP address.

```
root@imx8mmea-ucom:~# udhcpc -i wlan0
udhcpc: started, v1.33.1
udhcpc: sending discover
udhcpc: sending select for 192.168.1.16
udhcpc: lease of 192.168.1.16 obtained, lease time 86400
/etc/udhcpc.d/50default: Adding DNS 192.168.1.1
```

- Ping AP (IP address 192.168.10.1) to check connectivity.

```
$ ping 192.168.10.1
```

4.2.2 Enable Bluetooth for Infineon-based Wi-Fi/Bluetooth modules

This section includes the steps to bring up Bluetooth and scan for Bluetooth devices for IFX modules. The logs shown below are for Type 2AE module.

- Load the Bluetooth driver by issuing the following command. The Linux BlueZ stack is used for Bluetooth operations.

```
root@imx8mmea-ucom:~# /opt/ea/bluetooth_up.sh
bcm43xx_init
Set Controller UART speed to 3000000 bit/s
Flash firmware /etc/firmware/BCM4373A0.2AE.hcd
Set Controller UART speed to 3000000 bit/s
Setting TTY to N_HCI line discipline
Device setup complete
Scanning ...
        28:39:5E:24:FE:95       [AV] Samsung Soundbar K450 K-Series
        50:14:79:B8:2D:09       j755020
```

5 References

Links	Description
Forum Pages	
Murata Community Forum Landing Page ⤢	Main Forum landing page.
Registration Page for new users ⤢	Future FAE's and other Future employees need to use their Future corporate email address to register. Once they have registered and been approved, we will add them to Future's private group on the Forum which is used to exchange sensitive IP – board schematics, etc.
Community Forum Help ⤢	Landing page providing help to users. Links to necessary documents.
Troubleshooting Login and Registration ⤢	Specific post which details how to troubleshoot any login or registration issues. Normally we don't see any registration issues.
Wi-Fi/Bluetooth section ⤢	Starting point for any questions on Wi-Fi/Bluetooth module documents.
Embedded Artists' Platform section ⤢	Starting point for any question on Embedded Artists' iMX8M Mini Developer's Kit V3.
NXP-based Module section ⤢	NXP-based modules: 1XK, 1ZM, and 1YM. Also included are ABR, and 2DS.
IFX-based Module section ⤢	Infineon-based modules: 1YN, 1LV, and 2AE. Also included are 1DX, 1MW, and 1XA.
Website Pages	
Murata's Wi-Fi/BT Module Landing Page ⤢	Lists all of Murata Wi-Fi/Bluetooth modules. Provides quick links to each module webpage.
Murata's NXP-based Modules ⤢	Lists all NXP-based Murata Wi-Fi/Bluetooth modules. Provides quick links to each module webpage.
Murata's IFX-based Modules ⤢	Lists all Infineon-based Murata Wi-Fi/Bluetooth modules. Provides quick links to each module webpage.
Murata's i.MX Solution Landing Page ⤢	Murata's i.MX solution landing page. Details Murata Wi-Fi/Bluetooth module solutions for various i.MX processor platforms. Comprehensive documentation posted here.
Embedded Artists' M.2 Landing Page ⤢	Embedded Artists' landing page for Murata-based Wi-Fi/Bluetooth M.2 modules.
Embedded Artists' COM Boards ⤢	Embedded Artists' landing page for Embedded Artists' i.MX application processor-based COM boards.
Embedded Artists' i.MX 8M Mini Dev Kit V3 Resource Page ⤢	Comprehensive documentation from Embedded Artists on their Developer's Kit. Select "Resource" tab on this webpage.

6 Embedded Artists Wi-Fi/Bluetooth M.2 Modules

The following table lists the bundled Embedded Artists' Wi-Fi/Bluetooth modules.

Table 2: Embedded Artists' Wi-Fi/Bluetooth M.2 modules

Interface	Embedded Artists M.2 EVB	Murata Module
WLAN-SDIO	Type 1XK M.2 ⬀	Type 1XK ⬀
WLAN-SDIO	Type 1ZM M.2 ⬀	Type 1ZM ⬀
WLAN-PCIe	Type 1YM M.2 ⬀	Type 1YM ⬀
WLAN-SDIO	Type 1YN M.2 ⬀	Type 1YN ⬀
WLAN-SDIO	Type 1LV M.2 ⬀	Type 1LV ⬀
WLAN-SDIO	Type 2AE M.2 ⬀	Type 2AE ⬀

Revision History

Revision	Date	Author	Change Description
1.0	Apr 28, 2022	TF	Initial Release