NXP Semiconductors
Application Notes

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MCU Alexa Voice Solution Support for AzureWave AW-NM372SM WiFi/BT

1. Introduction

NXPs MCU Alexa development kit is a comprehensive, secure, and cost optimized voice control solution with a widely adopted development environment that enables customers to quickly get to market with a production ready end-to-end software application.

MCU Alexa (p/n: SLN-ALEXA-IOT), embeds all the components required to produce a secure and connected end-product and is based on the i.MX RT106A microcontroller powered by an Arm® Cortex®-M7 core.

SLN-ALEXA-IOT reference design connects to Amazon services using a 2.4 GHz IEEE802.11b/g/n module. Modules from several providers can be supported, ranging from Murata (default selection) to AzureWave.

The present document details how a customer can modify the SLN-ALEXA-IOT hardware and software to support AzureWave AW-NM372SM IEEE802.11b/g/n W-LAN and Bluetooth module.

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2. MCU ALEXA Voice hardware update

The hardware architecture of the MCU ALEXA Voice Solution is detailed in the below figure.

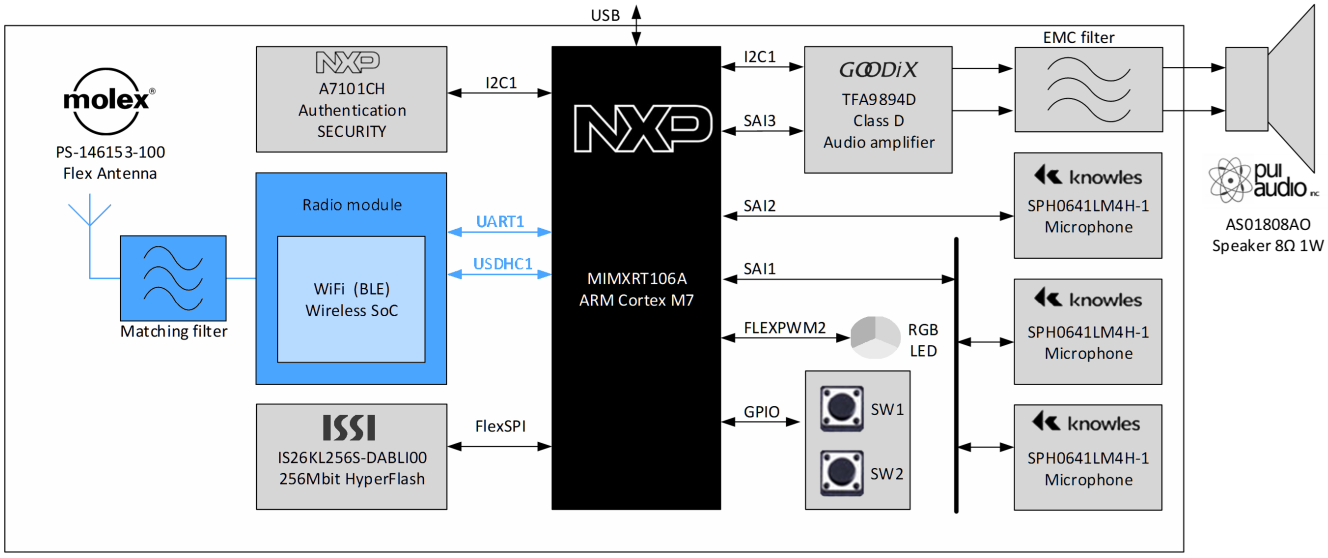

Figure 1. **MCU Alexa Voice hardware block diagram**

Two physical interfaces are required for the i.MX RT106A MCU to control and communicate with the Radio module:

- A SDIO 2.0 interface for Wi-Fi IEEE802.11 b/g/n, supported by RT106A USDHC1 peripheral.
- An UART interface for Bluetooth Low Energy (BLE), supported by RT106A UART1 module.

2.1 AzureWave AW-NM372SM module

The AzureWave AW-NM372SM module embeds a Cypress CYW43438_A1 combo Chipset supporting Wi-Fi IEEE802.11 b/g/n and Bluetooth 4.2. This module features a 12.0 mm x 12.0 mm LGA package and is compatible with hardware architecture described in the Figure 1.

The data sheet for the AzureWave AW-NM372SM module should be requested on www.azurewave.com.

NOTE

The module also supports an FM radio data receiver (RDS & RDBS). However, that functionality is not considered in this technical note.

2.2 Updated schematics

This section details the updated schematics for the i.MX RT106A SOM.

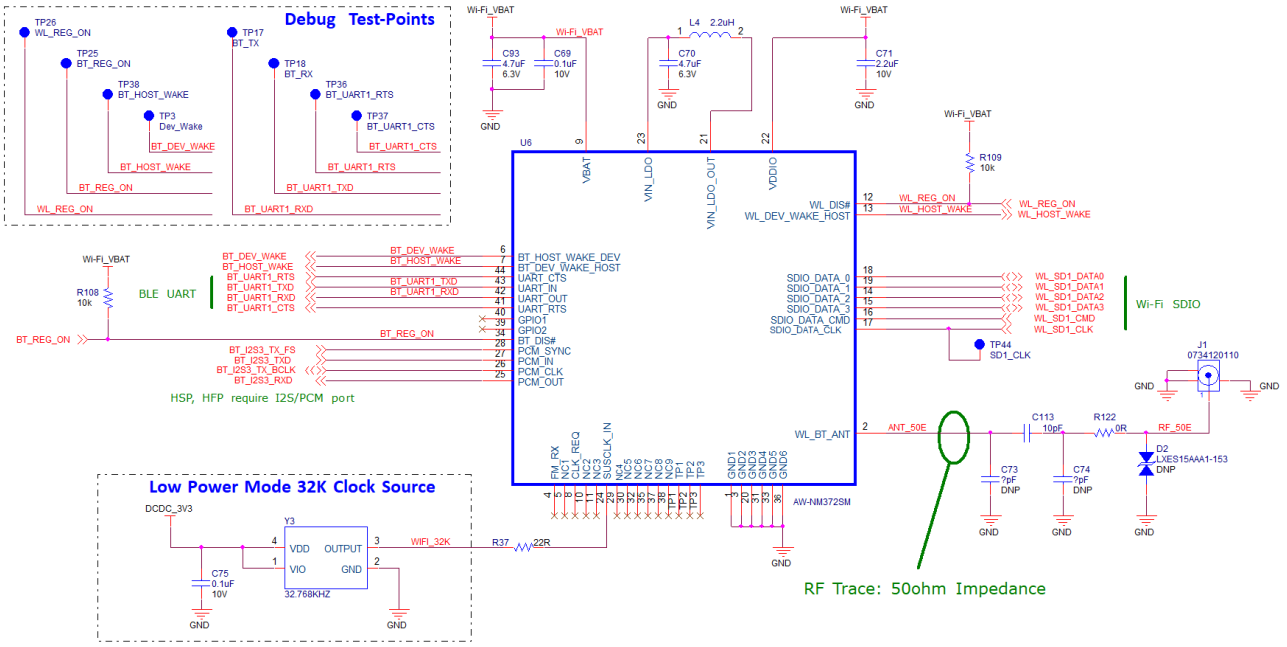

Figure 2. **Updated schematics with Azurewave AW-NM372SM module**

2.3 Antenna line implementation

The AzureWave AW-NM372SM module features a radio input/output pin (WL_BT_ANT), which shall be connected to a 2.4 GHz antenna. The design of this connection shall optimize the RF power transfer from the antenna to the module input pin. Failure to do so limits the receiver sensitivity and affects the transmitter effective output power, leading to a reduced connection range for both Wi-Fi and Bluetooth Low Energy.

Here are the key design considerations for any new development:

- PCB trace shall have a 50 Ω characteristic impedance in the range [2.4 GHz; 2.5 GHz]
- A pi-filter is required to adjust the impedance matching (and therefore optimize the RX/TX power transfer). (C73, C113, C74; R122). The component values are specific to each PCB layout implementation
- A 2.4 GHz RF connector is used to manage the connection to a distant antenna (J1).
- An optional ESD protection might be considered if it does not affect the line impedance (D2).

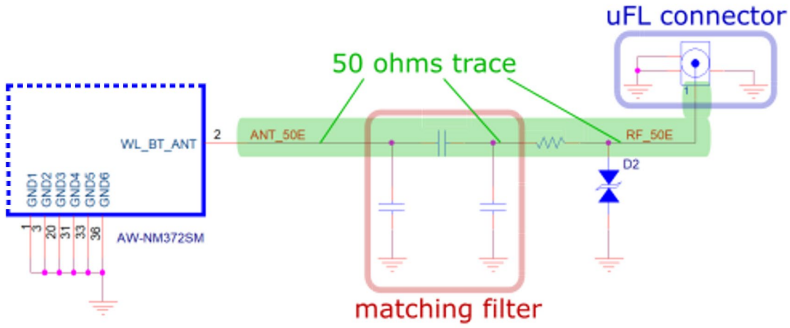

Figure 3. **Antenna line**

NOTE

The practical design of a 2.4 GHz antenna is beyond the scope of this document. Hardware developers can find a comprehensive application note AN91445 - Antenna Design and RF Layout Guidelines from Cypress website.

2.4 Power supply line

The AzureWave AW-NM372SM module is powered through VBAT pin with following specifications:

- To ensure compatibility with i.MX RT I/Os, VBAT must be supply with +3.3 V typical
- Moreover, the module guarantees optimal RF performances with VBAT superior to +3.2 V
- Consequently, VBAT supply should be designed to support +3.3 V +/- 3 %
- The design of the 3V3 power-supply should also tolerate 700 mA current peaks from the module

It is recommended to incorporate an LC filter on the 3V3 supply line for the radio module. Typically this filter helps rejecting the noise injected in the supply line by digital components (i.MX RT, flash memory).

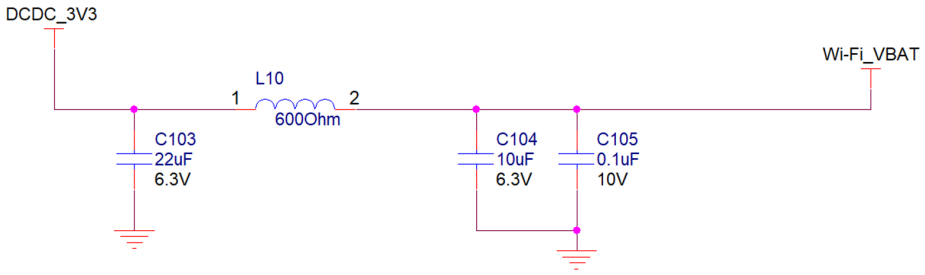

Figure 4. **Recommended VBAT LC filter**

2.5 Switching regulator filter

The Cypress CYW43438 chipset embeds a buck regulator. The regulator requires a LC filter (L4, C70) to operate properly. The loop VIN_LDO_OUT, LC filter, and VIN_LDO should be:

- Kept as short as possible to minimize its radiations
- Routed away from any other signal

The current rating of the inductance L4 is critical and it is recommended to use the Murata LQM18PN2R2MGHD for that filter.

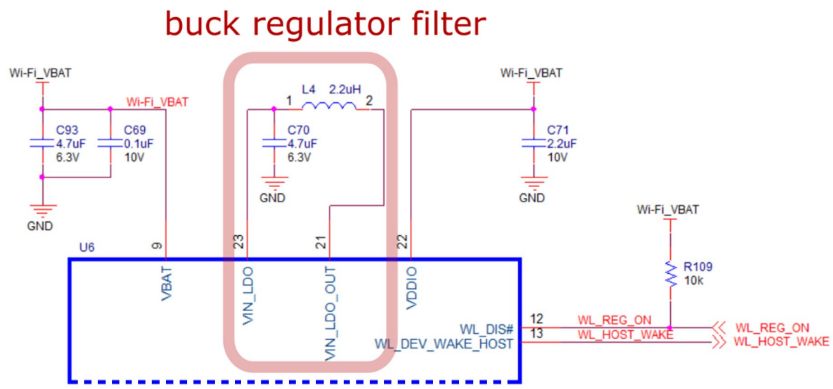

Figure 5. **Buck regulator filter**

2.6 UART interface

A four wires UART interface connects the AzureWave AW-NM372SM module to the i.MX RT106A UART1 peripheral.

Line	AW-NM372SM		i.MXRT106A		Description
	Pin	Type	Pin	Type	
BT_UART1_TXD	43. UART_IN	Input	K14. UART1_TXD	Output	AW-NM372SM UART Data in
BT_UART1_RXD	42. UART_OUT	Output	L14. UART1_RXD	Input	AW-NM372SM UART Data out
BT_UART1_RTS	44. UART_CTS	Input	L10. UART1_RTS	Output	AW-NM372SM UART Clear To Send
BT_UART1_CTS	41. UART_RTS	Output	H14. UART1_CTS	Input	AW-NM372SM UART Request To Send

Table 1. UART Interface for BT/BLE

This UART interface is dedicated to BT/BLE control/communication, it is 3V3 compliant and runs by default at 115200 bauds.

NOTE

It is recommended to add some serial resistors on each UART line to facilitate BT/BLE performance evaluation.

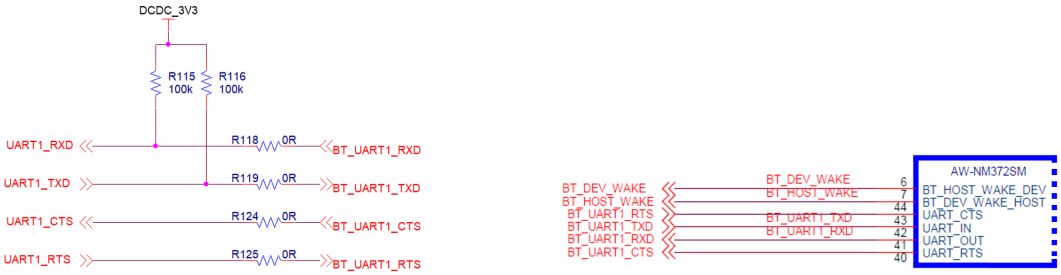

Figure 6. **UART interface**

Cypress is distributing via its Cypress Developer Community (https://community.cypress.com) a specific software utility called CyBlueTool to test the radio and measure the BT/BLE throughput.

2.7 SDIO interface

A six wires SDIO interface connects the AzureWave AW-NM372SM module to the i.MX RT106A SDHC1 peripheral.

Line	AW-NM372SM		i.MX RT		Description
	Pin	Type	Pin	Type	
WL_SD1_DATA0	18. SDIO_DATA_0	Input/Output	J1. SD1_DATA0	Input/Output	SDIO Data 0
WL_SD1_DATA1	19. SDIO_DATA_1	Input/Output	K1. SD1_DATA1	Input/Output	SDIO Data 1
WL_SD1_DATA2	14. SDIO_DATA_2	Input/Output	H2. SD1_DATA2	Input/Output	SDIO Data 2
WL_SD1_DATA3	15. SDIO_DATA_3	Input/Output	J2. SD1_DATA3	Input/Output	SDIO Data 3
WL_SD1_CMD	16. SDIO_DATA_CMD	Input	J4. SD1_CMD	Output	SDIO CMD
WL_SD1_CLK	17. SDIO_DATA_CLK	Input	J3. SD1_CLK	Output	SDIO CLK

Table 2. SDIO interface for WLAN

This SDIO interface is dedicated to Wi-Fi control/communication, it is 3V3 compliant and runs by default at 50 MHz.

NOTE

It is recommended to add some pull-up resistors, bypass capacitors, and serial resistors on each SDIO line to facilitate the SDIO line matching.

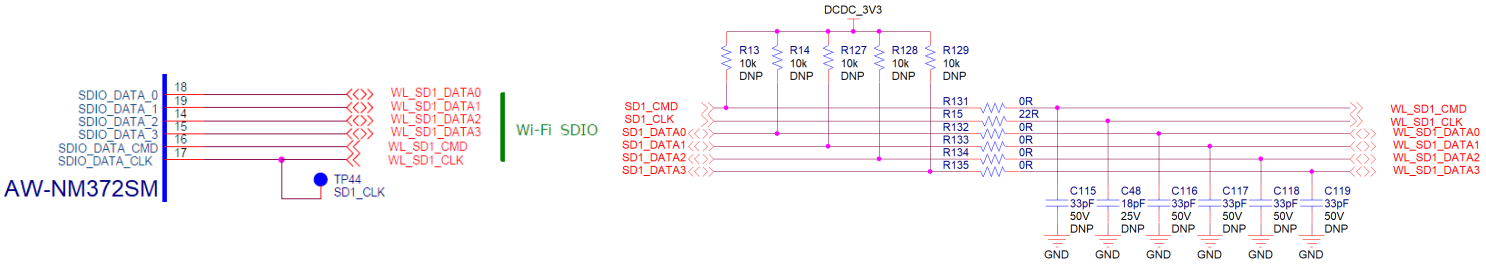

Figure 7. **SDIO interface**

2.8 Optional 32.768 kHz external oscillator

The proposed schematics include a 32.768 kHz external oscillator Y3 connected to the AzureWave AW-NM372SM module. This oscillator is only required for low-power modes.

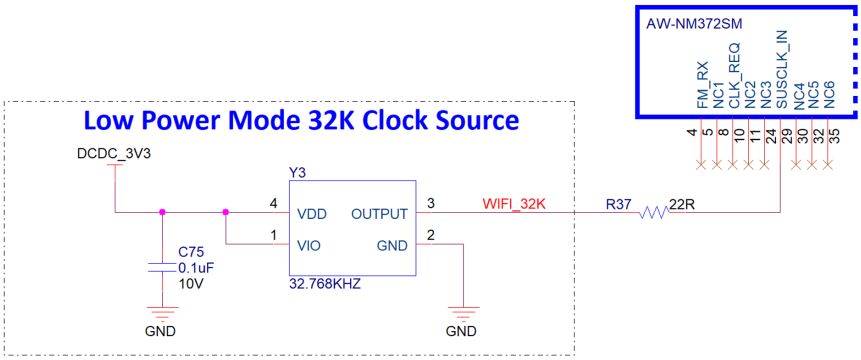

Figure 8. **Optional 32.768 KHz External Oscillator**

2.9 GPIO controls

A set of standard GPIOs controls the AzureWave AW-NM372SM module operation and power modes. The following allocation is used and should be copied as much as possible to ensure compatibility with our solution software.

Line	AW-NM372SM		i.MX RT		Description
	Pin	Type	Pin	Type	
WL_REG_ON	12. WL_DIS#	Input	K7. PMIC_ON_REQ	Output	Power up / down the WLAN regulator
WL_HOST_WAKE	13. WL_DEV_WAKE_HOST	Output	L6. WAKEUP	Input	i.MXRT Wake-up signal
BT_REG_ON	34. BT_DIS#	Input	C14. GPIO_B1_14	Output	Power up / down the BT/BLE regulator
BT_HOST_WAKE	7. BT_DEV_WAKE_HOST	Output	B14. GPIO_B1_15	Input	i.MXRT Wake-up signal
BT_DEV_WAKE	6. BT_HOST_WAKE_DEV	Input	H1. GPIO_EMC_12	Output	BT wake-up signal

Table 3. GPIO control signals

3. MCU ALEXA Voice software update

3.1 SDK package installation

The MCU Alexa Voice kit is currently supported by the SLN ALEXA IOT SDK package version 2.8.0, which can be downloaded from: https://mcuxpresso.nxp.com/en/select

This SDK package contains multiple projects to help evaluate the key Alexa Voice components including specific versions for each connectivity option supported: Ethernet and Wi-Fi Cypress 4343W or 43438.

The SDK project structure can be observed in the figure below:

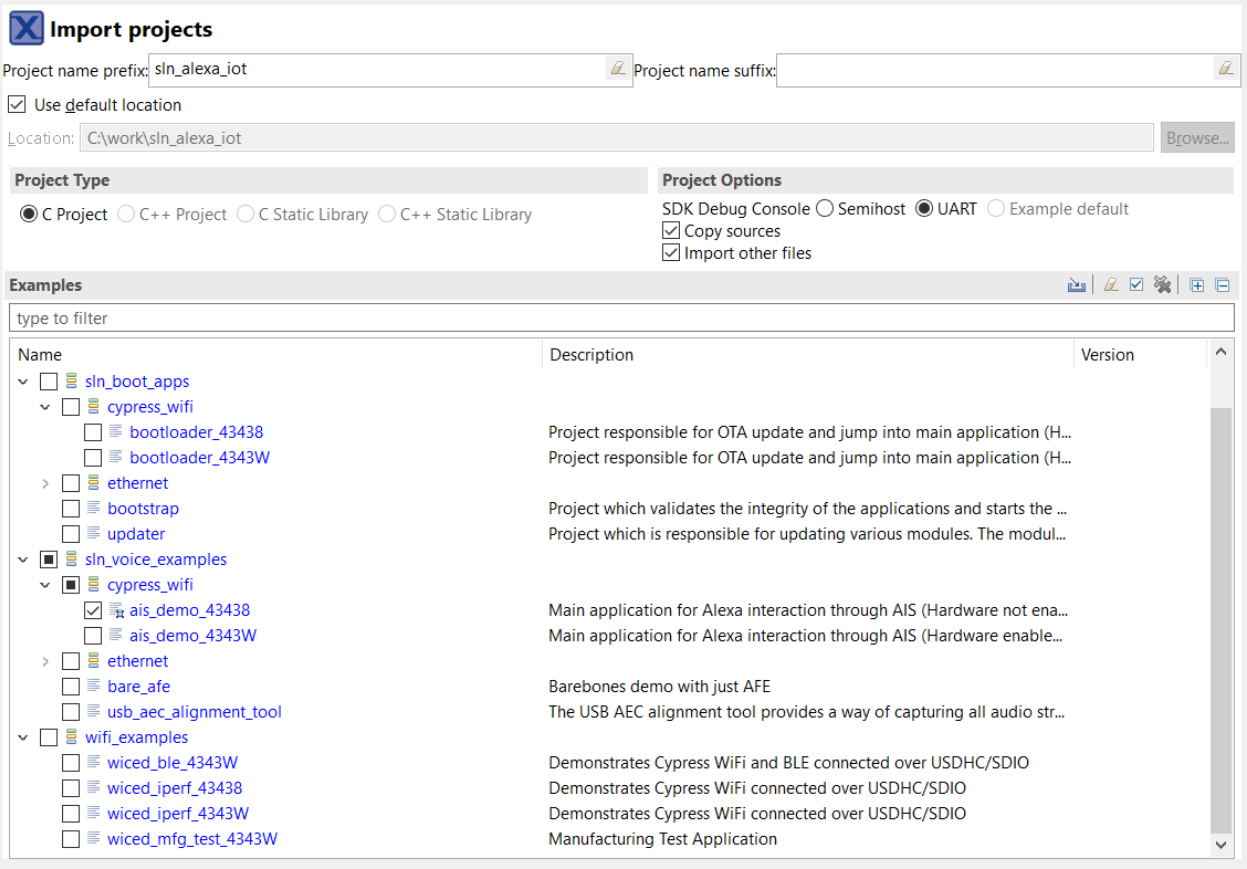

Figure 9. **Project examples for Wi-Fi versions**

For this Software Patch to be applicable, the SDK source must be unzipped. If the SDK Package was previously imported in MCUXpresso IDE directly as an archive (ZIP file), its source must be extracted before applying this Patch.

To make sure the SDK source is in the right format, open MCUXpresso IDE and select the view "Installed SDKs" then check if the SLN-ALEXA-IOT SDK is linked to an archive (ZIP file) as shown in the picture below, or a folder (skip the next step).

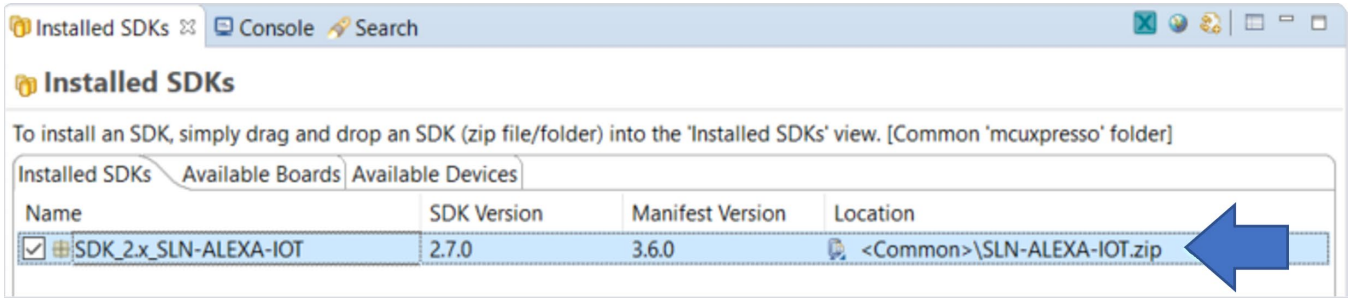

Figure 10. **SDK installation format**

If it is linked to an archive (ZIP file), right-click on the SDK entry and select "Unzip archive" as shown in the picture below.

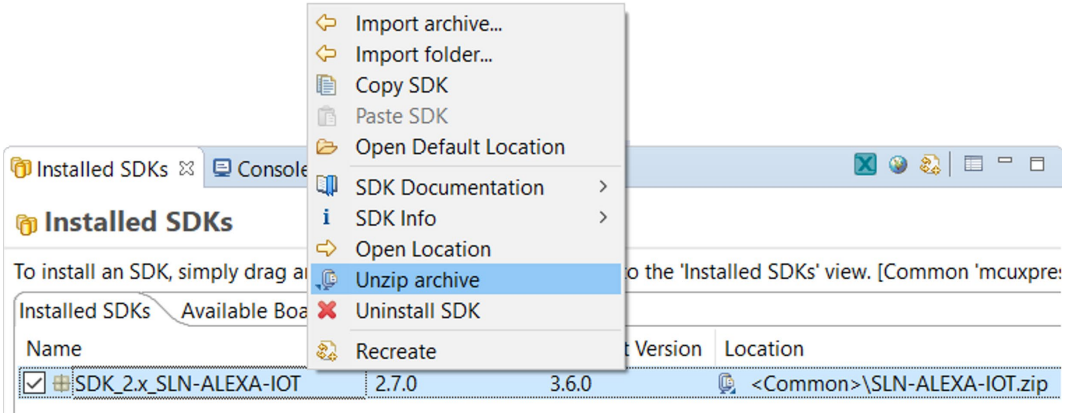

Figure 11. **Unzip installed SDK package**

Finally, right-click again on the SDK entry and select "Open location" to access from the file explorer the SDK folder where the patch must be applied.

3.2 Software patch for AzureWave AW-NM372SM support

Software support for the AzureWave AW-NM372SM module is distributed as a software patch that must be installed on top of the original SLN-ALEXA-IOT SDK Source by following the instructions below.

The AzureWave AW-NM372SM Software Patch can be downloaded from the Design Resources section of the SLN-ALEXA-IOT product page located at: https://www.nxp.com/mcu-avs

Once downloaded, copy the SLN_ALEXA_IOT_AW_CYW.ZIP archive inside the SDK folder previously opened. Make sure that the destination path is …\SDK_2.8.0_SLN-ALEXA-IOT\ (you may have to remove \SLN_ALEXA_IOT_AW_CYW). Extract/Unzip the archive from the SDK folder and ACCEPT to overwrite/replace existing files by the new ones from the patch.

When the operation is completed, return to the view “Installed SDKs” in MCUXpresso IDE, right-click on the SLN-ALEXA-IOT SDK entry and select the option “Recreate”. This action ensures that your SDK materials are updated together with all the relevant projects it contains.

Finally, user can verify that the Software Patch was successfully applied to the SDK Source by selecting “Import SDK example(s)” from MCUXpresso IDE Quick Start panel and review the available projects.

The figure below shows the different folder/file for the WICED iPerf project with support for the original Murata 1DX (Cypress CYW4343W) or the AzureWave NM372SM (Cypress CYW43438) Wi-Fi module.

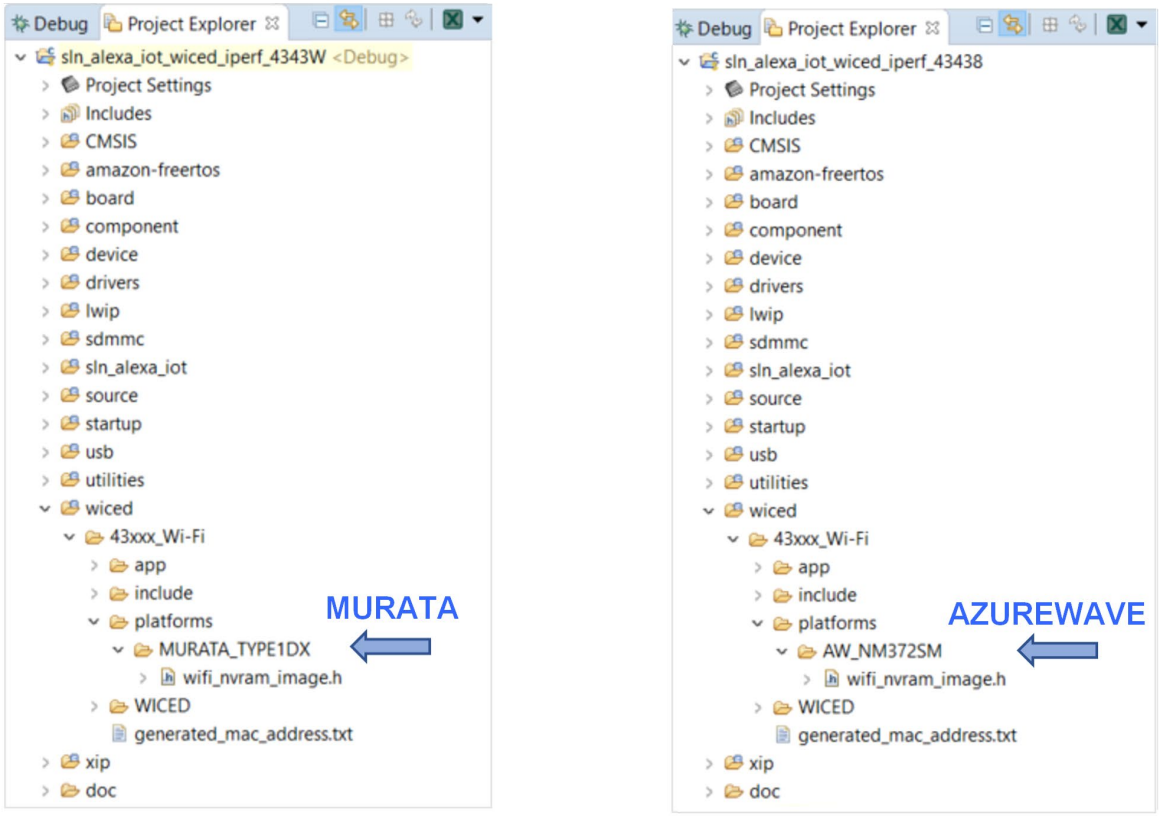

Figure 12. **Project structure for each Wi-Fi version**

3.3 Software patch content description

This software patch updates the project and the folder name featuring Wi-Fi connectivity as well as the the configuration file for the RF parameters loaded in NVRAM. Those RF parameters are specific for each Wi-Fi module and they are provided by the corresponding module supplier for best performance and FCC standard compliance.

After successfully installing the Software Patch, the “Import projects” view should look like as below:

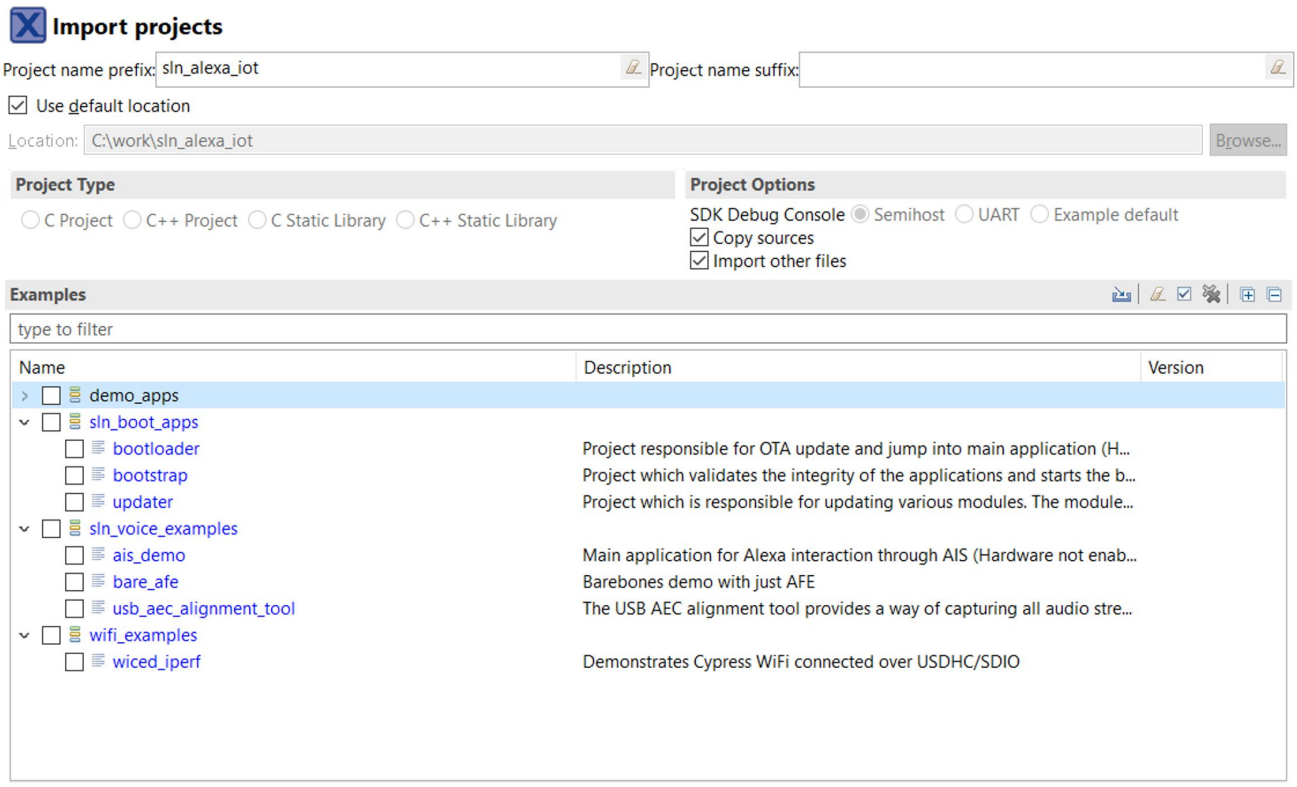

Figure 13. **Updated SDK project examples**

4. Revision history

Revision number	Date	Substantive changes
0	08/2020	Initial release

Table 4. Revision History

5. References

1. Cypress application note for optimized antenna design (AN91445 – Antenna Design and RF Layout Guidelines)

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