ATWILC/ATWINC Serial Bridge Application Note

Introduction

This application note describes the Host Serial Bridge application with its test setup information. The Serial Bridge application software, along with the MCHPRT2 tool, helps to place the ATWILC/ATWINC device in the test mode for RF validation, certification and production test without any other dedicated test interface or an external hardware tool.

The Serial Bridge application is designed to use with the RF test tool (MCHPRT2), which have both Graphical User Interface (GUI) and Command Line Interface (CLI). GUI is preferred for the design validation and certification activity and CLI is preferred for the production test which eases test script preparation.

The Serial Bridge application software runs on Host MCU/MPU which acts as a bridge between the test PC (MCHPRT2 tool) and Device Under Test (DUT) ATWILC/ATWINC by passing commands received from PC to DUT and by passing response received from DUT to PC (MCHPRT2 tool).

There are two variants of serial bridge application software available as follows:

1. RTOS based Serial Bridge application
2. Linux based Serial Bridge application

Note: MCHPRT2 GUI tool will be provided by request to the customer.

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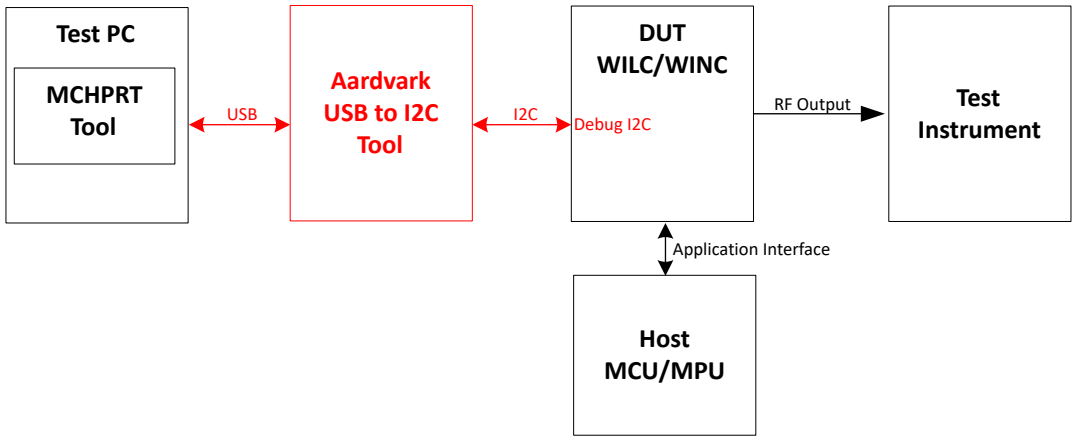
1. Existing Test Setup

To place the ATWILC/ATWINC devices in the RF test mode, a dedicated debug test I^2C interface is required. Also, to interface the I^2C to the test PC , an external hardware tool, Aardvark (USB to I^2C) is required.

The test setup connection using Aardvark Tool is shown in the following figure:

Figure 1-1. Test Setup using Aardvark Tool



Disadvantages

- Requires an additional external tool (Aardvark).
- End design must bring out the debug test I^2C pins to the test points. The debug test I^2C pins must be accessible (even if the end design board is placed inside the enclosure) in the production test setup.

2. Serial Bridge Test Setup

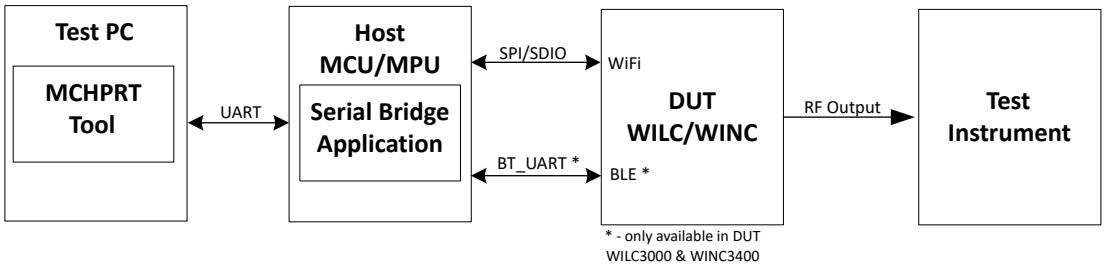
The Serial Bridge acts as a replacement for Aardvark (USB to I2C) Tool.

The Serial Bridge application software runs on Host MCU/MPU which acts as a simple bridge between the test PC (MCHPRT2 tool) and DUT (Device Under Test - ATWILC/ATWINC devices) by passing commands received from PC to DUT and by passing response received from DUT to PC (MCHPRT2 tool).

Using the serial bridge test setup, the application interface between the host MCU/MPU and DUT can be used for RF testing. Therefore, it does not require any dedicated test interface lines or an external Aardvark Tool.

The following is block overview of the serial bridge test setup:

Figure 2-1. Serial Bridge Block Overview



2.1 Test PC

The test PC has the MCHPRT2 tool in its local disk. This tool can be controlled through the GUI or command prompt. In the production setup, test script such as Python can be used to trigger the commands through MCHPRT2 CLI (Command Line Utility). This uses the `*.dll` files of MCHPRT2 in the background to control the DUT.

2.2 Host MCU/MPU

The Host MCU/MPU has the Serial Bridge application firmware which communicates the commands from MCHPRT2 tool (from test PC) to DUT and vice versa. There are two types of Serial Bridges based on the host device:

1. MCU – RTOS based serial bridge(1)
2. MPU – Linux based serial bridge(2)

Note:

1. Supports all the ATWILC/ATWINC devices.
2. Supports only the ATWILC1000 and ATWILC3000 devices.

2.3 DUT

The DUT, ATWILC/ATWINC is interfaced to the test PC (MCHPRT2 tool) through the Host Serial Bridge application software. The DUT device which has Wi-Fi is interfaced to the host controller through Serial Peripheral Interface (SPI) or Serial Data Input/Output (SDIO) and the DUT device which has BLE is interfaced to the host through BT_UART.

The following is the list of test interfaces:

Table 2-1. Test Interface

S. No.	DUT	Technology Support	Application and Test Interface	
			Wi-Fi	BLE
1	ATWILC1000	Wi-Fi only	SPI or SDIO	-

.....continued

S. No.	DUT	Technology Support	Application and Test Interface	
			Wi-Fi	BLE
2	ATWINC15x0	Wi-Fi only	SPI	-
3	ATWILC3000	Wi-Fi and BLE	SPI or SDIO	BT_UART
4	ATWINC3400	Wi-Fi and BLE	SPI *	BT_UART*

Note: In the ATWILC1000, ATWINC15x0, and ATWILC3000 devices, the application interface and test interface are the same. In the ATWINC3400, the application firmware uses the SPI interface for both Wi-Fi and BLE functional operation. Wi-Fi and BLE RF testing requires both SPI and BT_UART interface as follows:

- Wi-Fi test - SPI interface for both burst test firmware download and other test mode commands
- BLE test - SPI interface for BLE test firmware download and BT_UART interface for BLE HCI commands

2.4 RF Test Instrument

The RF test instrument is used for the RF measurement of the DUT output and sends the measured value as the feedback to the test PC based on the requirement. The following are some of the test instruments:

1. Frequency Counter – supports only frequency offset calibration measurement.
2. Basic Spectrum Analyzer – supports frequency offset calibration and TX power measurement.
3. Advanced Spectrum Analyzer with more features, which includes IEEE 802.11 compliance standard.
4. IQxel (LitePoint) – enables full test coverage of the Wi-Fi and Bluetooth enabled devices as follows:
   – Tx test coverage such as Error Vector Magnitude (EVM), frequency offset error, output power and spectral mask
   – Rx test coverage such as Packet Error Rate (PER)

3. Test Setup for ATWILC/ATWINC Devices

This section describes the interfaces and its block overview with its test setup information of the ATWILC and ATWINC devices.

3.1 MCU based Serial Bridge Test Setup

For MCU based Serial Bridge test setup, the SAM4S Xplained Pro Evaluation Kit is used as reference. However, other MCU based boards can also be used, such as SAMD21 Xplained Pro, or SAM L21 Xplained Pro Evaluation Kits.

3.1.1 Using ATWILC1000/ATWINC15x0 SPI Interface

This section provides the block overview, interface pinout, test setup block diagram for the ATWILC1000 and ATWINC15x0 module with SPI interface.

Figure 3-1. Block Overview of ATWILC1000/ATWINC15x0 using SPI Interface

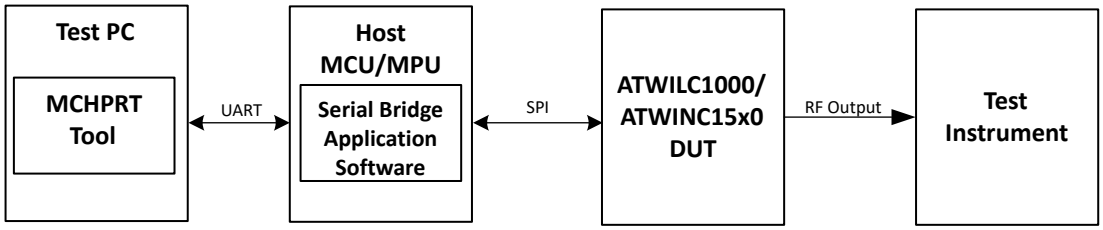
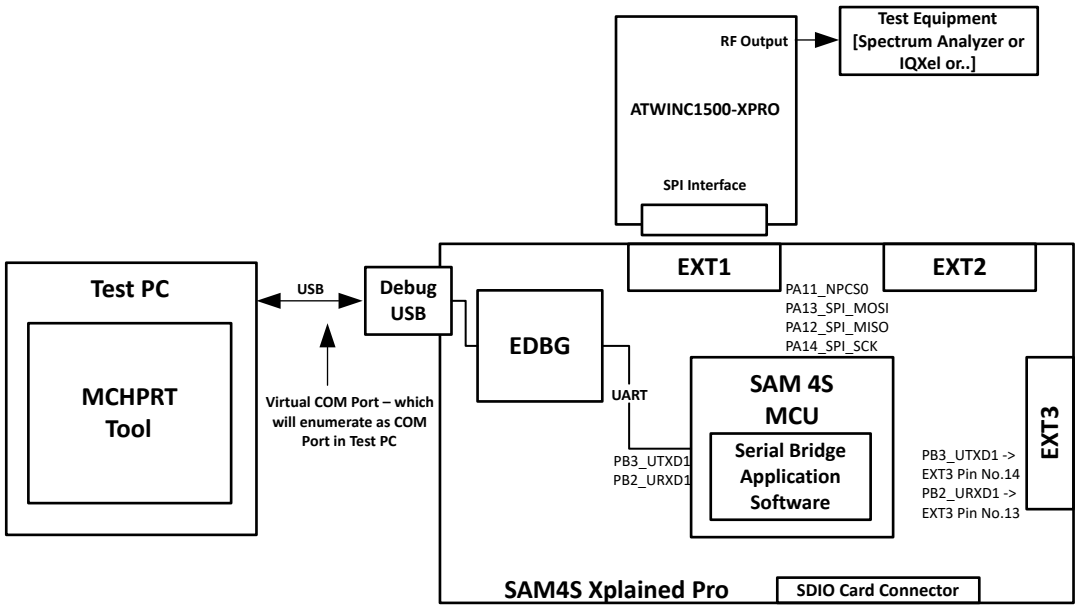


Table 3-1. Pinout of ATWILC1000/ATWINC15x0 SPI Interface

S. No.	SPI Interface	SPI Function	Pin No. of ATWILC1000-MR110xB and ATWINC15x0-MR210xB Module	Pin No. of ATWILC1000B and ATWIN15x0B IC
1	SPI_MOSI	Active low SPI Slave Select	15	13
2	SPI_SSN	Master Out Slave In	16	16
3	SPI_MISO	Master In Slave Out	17	17
4	SPI_SCK	SPI Clock	18	18

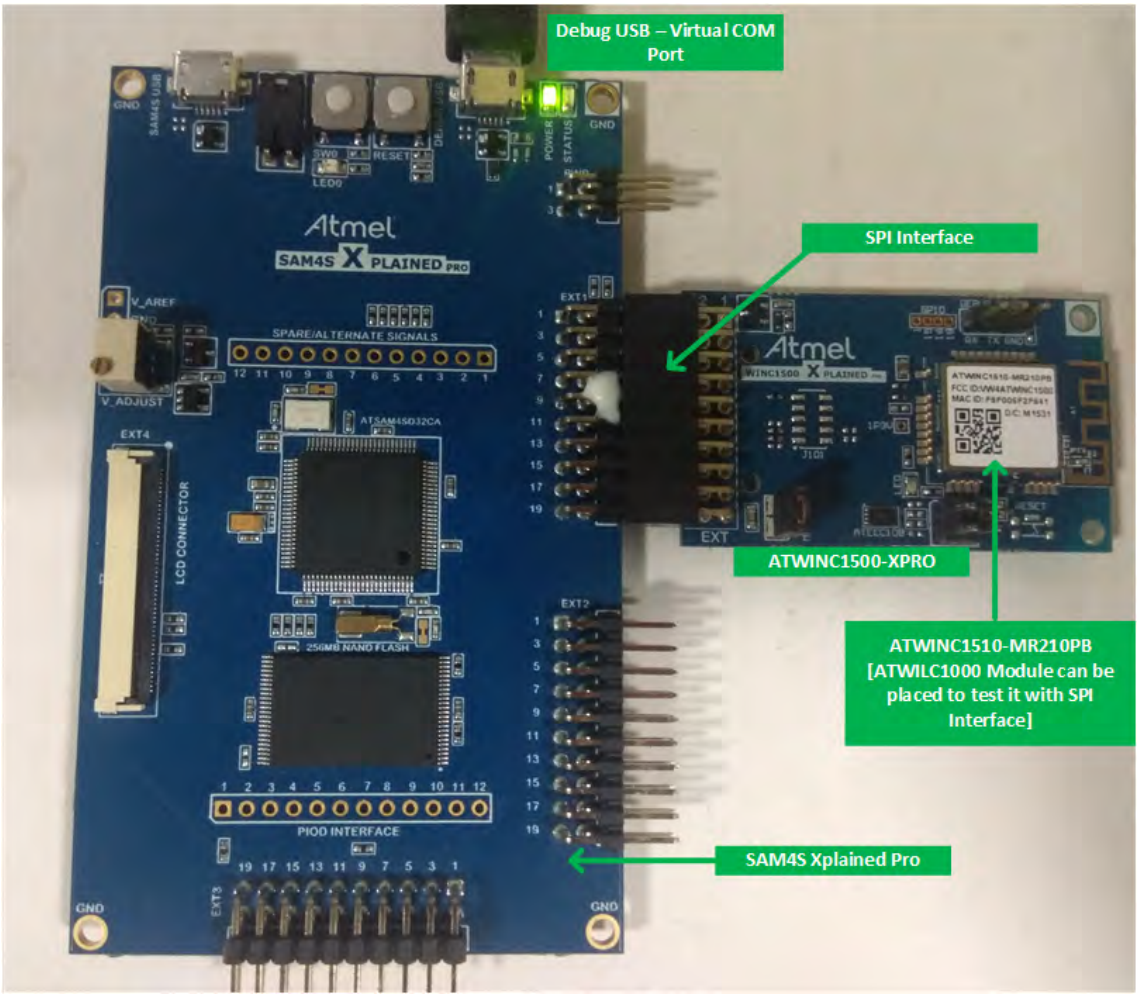
Figure 3-2. Block Diagram of Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC1000/ ATWINC15x0 with SPI Interface



Note:

- External UART to USB converter can also be used by plugging the connection into EXT3 pin 13 (RXD) and pin 14 (TXD) for connecting MCHPRT2 tool to the SAM4S UART instead of using virtual COM port.
- The ATWINC1500-XPRO board is used in this reference test setup. To test the ATWILC1000 module, solder the ATWILC1000 module in ATWINC1500-XPRO (ATWILC1000 and ATWINC1500 module pin out is same) in this SPI interface test setup and use the modified board.

Figure 3-3. Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC1000/ATWINC15x0 with SPI Interface



3.1.2 Using ATWILC1000 SDIO Interface

This section provides the block overview, interface pinout and test setup block diagram for the ATWILC1000 module with SDIO interface.

Figure 3-4. Block Overview of ATWILC1000 using SDIO Interface

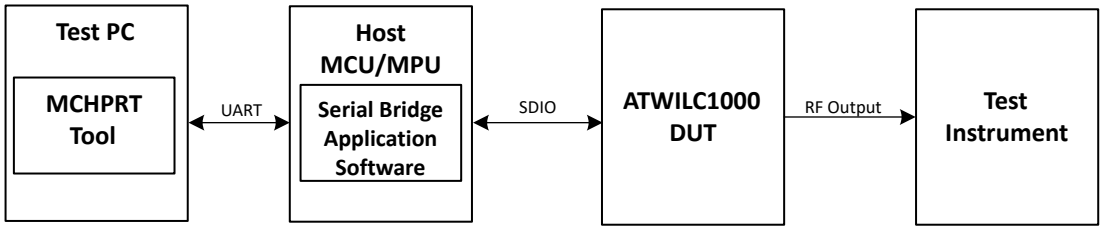


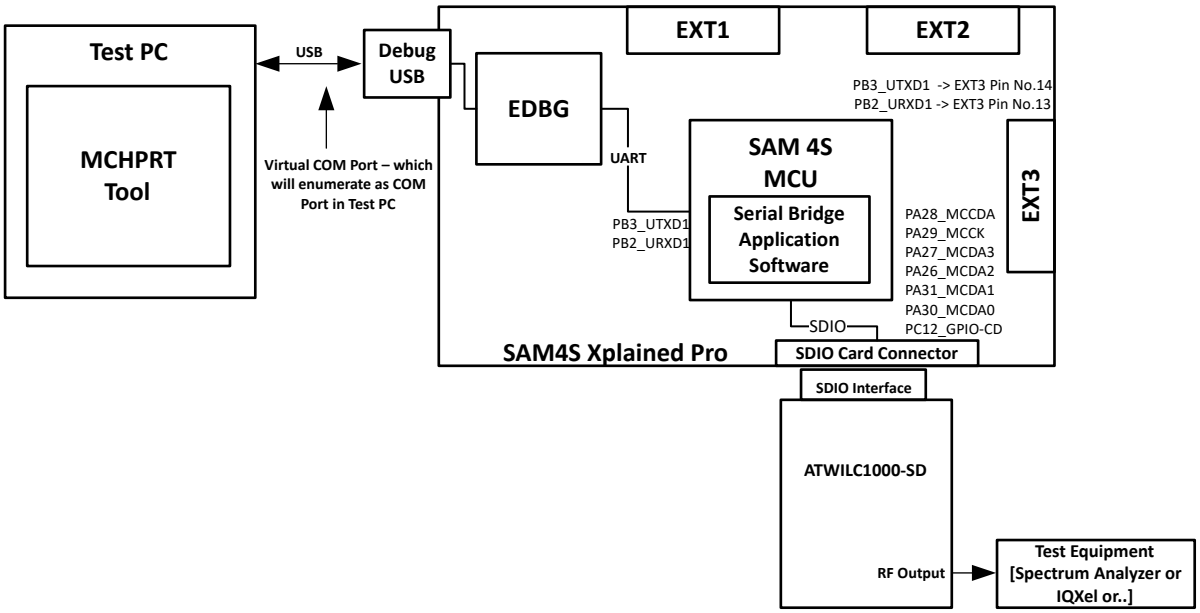
Table 3-2. Pinout of ATWILC1000 SDIO Interface

S. No.	SDIO Interface	Description	Pin No. of ATWILC1000-MR110xB Module	Pin No. of ATWILC1000B IC
1	SD_DATA3	SDIO Data3	14	12
2	SD_DATA2	SDIO Data2	15	13

.....continued

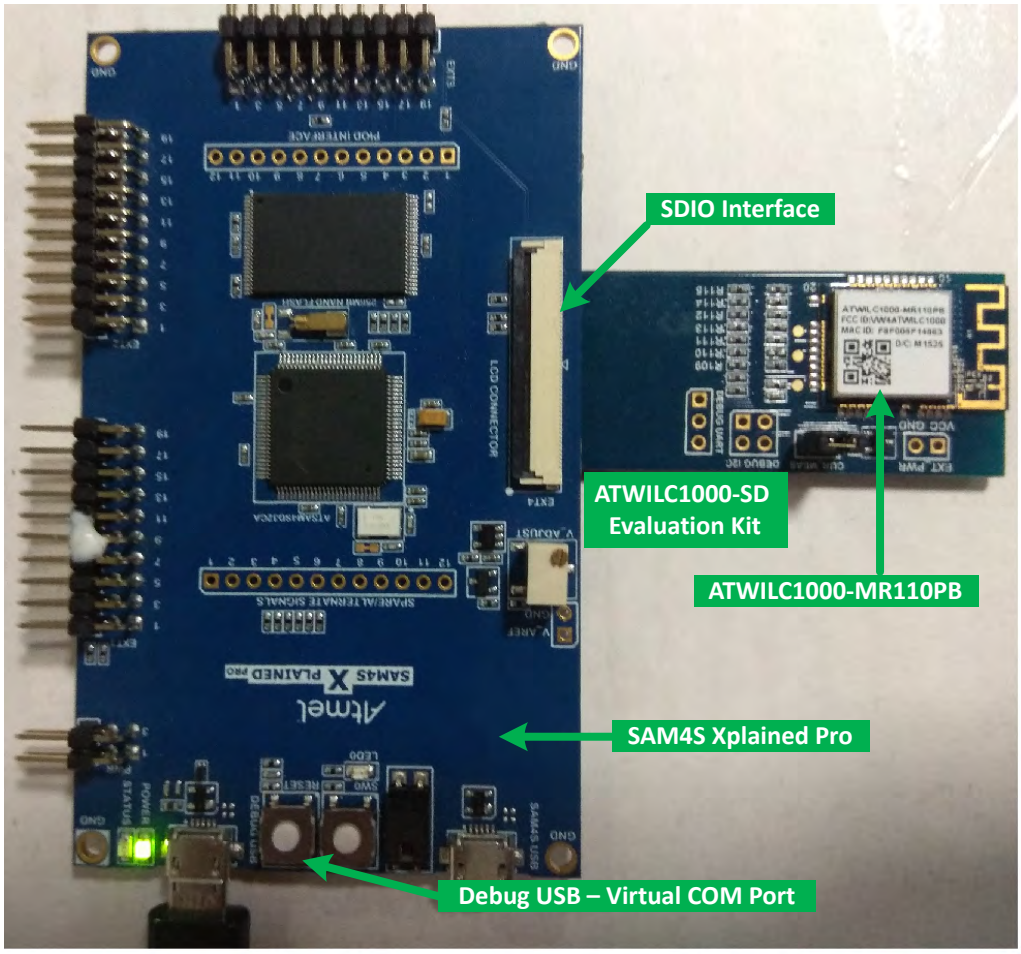
S. No.	SDIO Interface	Description	Pin No. of ATWILC1000-MR110xB Module	Pin No. of ATWILC1000B IC
3	SD_DATA1	SDIO Data1	16	16
4	SD_DATA0	SDIO Data0	17	17
5	SD_CMD	SDIO Command	18	18
6	SD_CLK	SDIO Clock	18	19

Figure 3-5. Block Diagram of Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC1000 with SDIO Interface



Note: External UART to USB converter can be plugged into EXT3 pin 13 (RXD) and pin 14 (TXD) for connecting MCHPRT2 tool to the SAM4S UART instead of using virtual COM port.

Figure 3-6. Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC1000 with SDIO Interface



3.1.3 Using ATWILC3000/ATWINC3400 SPI (Wi-Fi) and BT_UART (BLE) Interface

This section provides the block overview, interface pinout and test setup block diagram for the ATWILC3000 and ATWINC3400 with SPI interface for Wi-Fi and BT_UART interface for BLE.

Figure 3-7. Block Overview of ATWILC3000/ATWINC3400 using SPI Interface

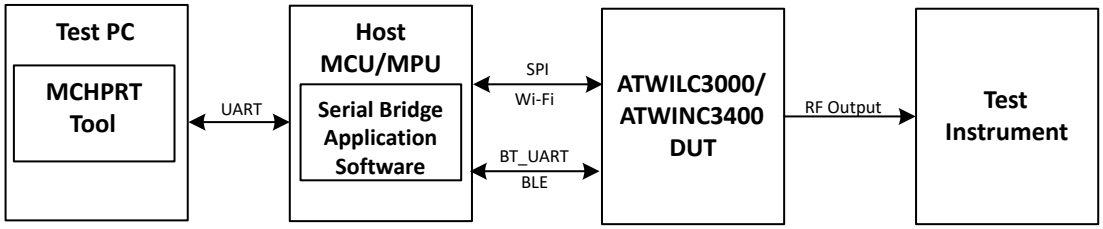


Table 3-3. Pinout of ATWILC3000/ATWINC3400 SPI Interface for Wi-Fi Test

S. No.	SPI Interface	SPI Function	Pin No. of ATWILC3000-MR110xA and ATWINC3400-MR210xA Module	Pin No. of ATWILC3000 and ATWINC3400 IC
1	SPI_CFG	Must be tied to VDDIO	23	12
2	SPI_SCK	Serial Clock	23	30

.....continued

S. No.	SPI Interface	SPI Function	Pin No. of ATWILC3000-MR110xA and ATWINC3400-MR210xA Module	Pin No. of ATWILC3000 and ATWINC3400 IC
3	SPI_MISO	Master In Slave Out (Serial Data Transmit)	24	31
4	SPI_SSN	Active Low SPI Slave Select	25	32
5	SPI_MOSI	Master Out Slave In (Serial Data Receive)	26	34

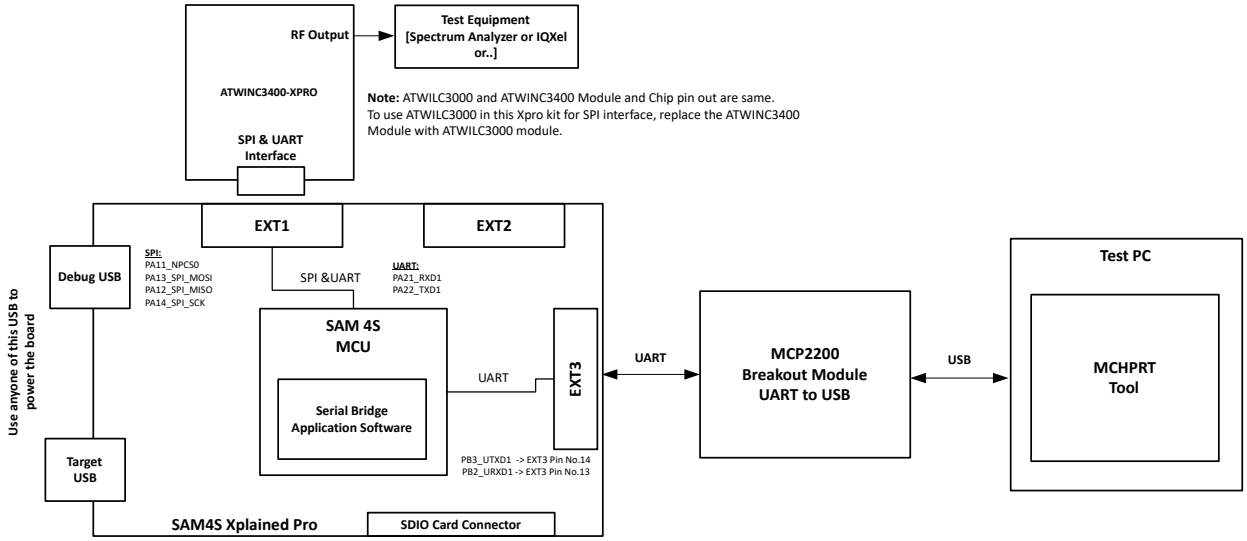
Table 3-4. ATWILC3000/ATWINC3400 - BT_UART Pin Out for BLE Test

S. No.	BT_UART Interface	UART Function	Pin No. of ATWILC3000-MR110xA and ATWINC3400-MR210xA Module	Pin No. of ATWILC3000 and ATWIN15x0B IC
1	BT_TXD	BLE UART transmit data output. Connect to UART_RXD of host	8	14
2	BT_RXD	BLE UART receive data input. Connect to UART_TXD of host	9	15

Note:

- To test using the MCHPRT2 tool, BT_UART does not operate in the flow control mode. Therefore, UART Flow Control pin information is not detailed in this section. For more details on detailed pin information, refer to the corresponding data sheet.
- In the ATWINC3400 application firmware, use SPI interface for both Wi-Fi and BLE functional operation. Wi-Fi and BLE RF testing requires both SPI and BT_UART interface as detailed in the block overview.

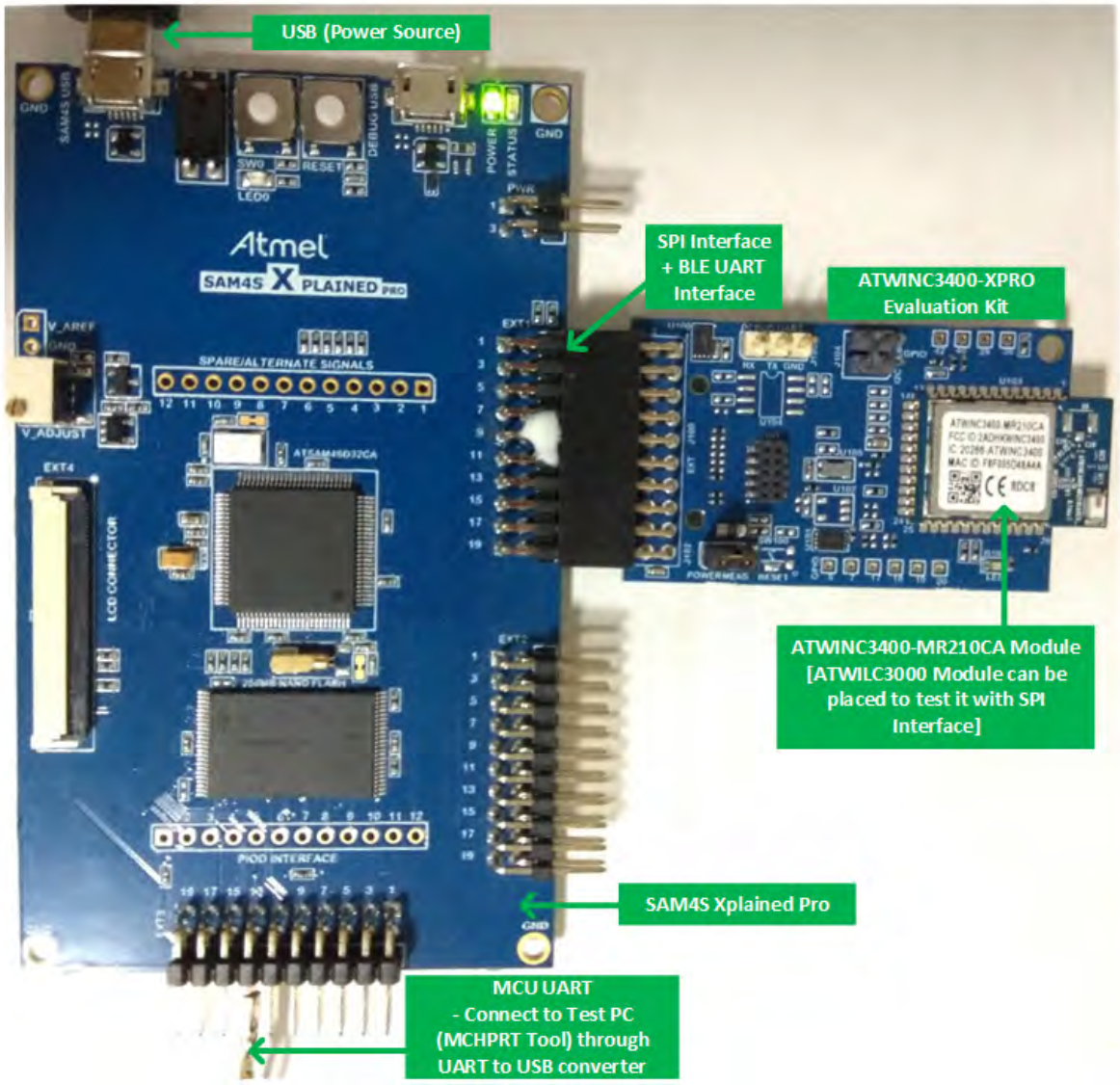
Figure 3-8. Block Diagram of Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC3000/ ATWINC3400 with SPI and BT_UART Interface



Note:

- External UART to USB converter can be plugged into EXT3 Pin 13 (RXD) and 14 (TXD) for connecting MCHPRT2 tool to the SAM4S UART instead of using virtual COM port.
- The ATWINC1500-XPRO board is used in this reference test setup. To test the ATWILC1000 module, solder the ATWILC1000 module in ATWINC1500-XPRO (ATWILC1000 and ATWINC1500 module pin out is same) in this SPI interface test setup and use the modified board.

Figure 3-9. Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC3000/ATWINC3400 with SPI and BT_UART Interface



Note: The test setup information is based on the ATWILC3000 module placed in the ATWINC3400-XPro board for use. However, the ATWILC3000-SHIELD board can also be used for the test setup.
Refer the MCU pin out for the SPI interface (for Wi-Fi test) and UART interface (for BLE test) and connect it to the ATWILC3000-SHIELD Arduino headers.

For more details on SPI and Bluetooth pin out, refer the ATWILC3000-SHIELD User Guide. By default, ATWILC3000-SHIELD board supports SDIO.

However, it can also be modified to support SPI by a resistor combination. Refer ATWILC3000 Shield Peripheral Configuration section of the ATWILC3000-SHIELD User Guide.

3.1.4 Using ATWILC3000 SDIO (Wi-Fi) and UART (BLE) Interface

This section provides the block overview, interface pin out and test setup block diagram for the ATWILC3000 with SDIO interface for Wi-Fi and BT_UART interface for BLE.

Figure 3-10. Block Overview of ATWILC3000 using SDIO and UART Interface

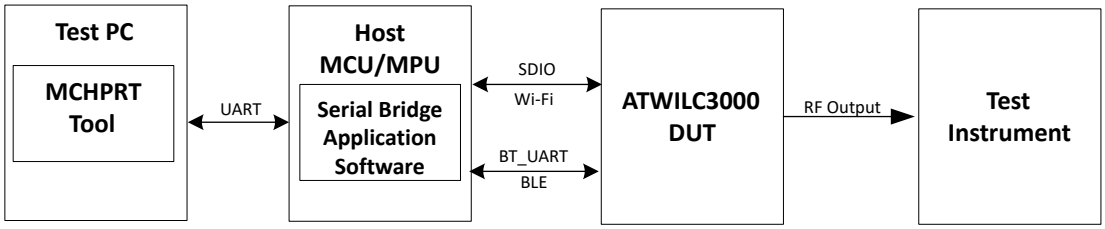


Table 3-5. Pinout of ATWILC3000 SDIO Interface for Wi-Fi Test

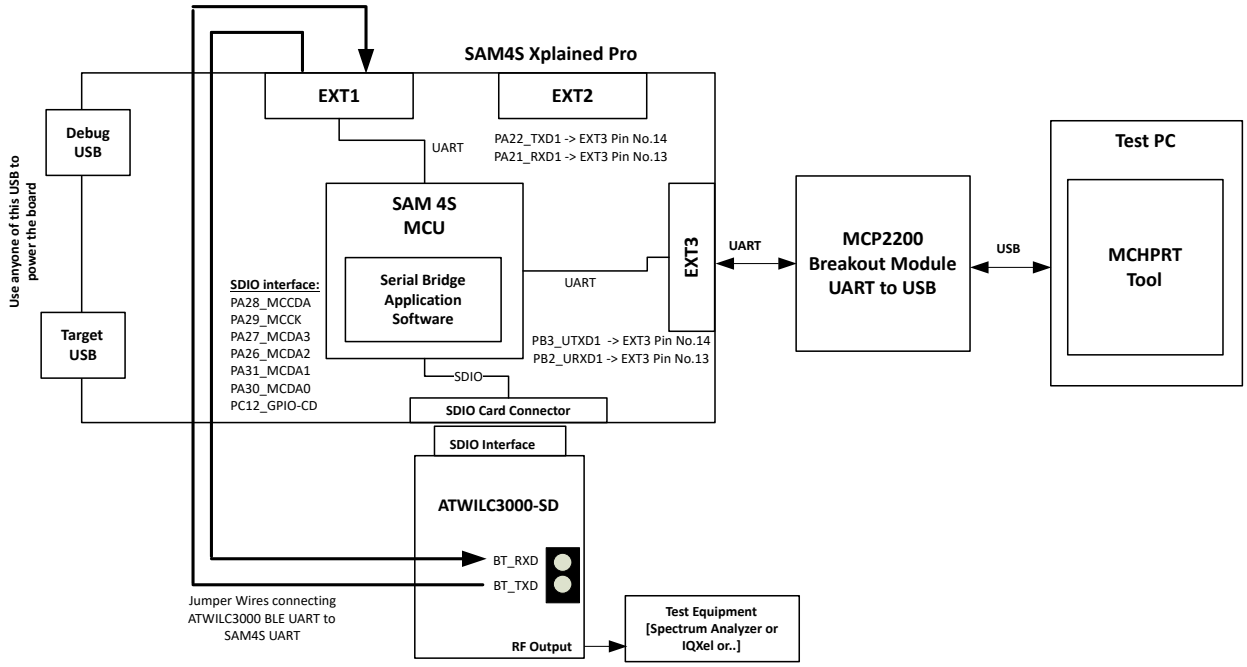
S. No.	SPI Interface	SPI Function	Pin No. of ATWILC3000-MR110xA Module	Pin No. of ATWILC3000 IC
1	SDIO/ SPI_CFG	Must be tied to GND	2	12
2	SD_CLK	SDIO Clock Line	22	29
3	SD_CMD	SDIO Command Line	23	30
4	SD_DAT0	SDIO Data Line 0	24	31
5	SD_DAT1	SDIO Data Line 1	25	32
6	SD_DAT2	SDIO Data Line 2	26	34
7	SD_DAT3	SDIO Data Line 3	27	35

Table 3-6. Pinout of ATWILC3000 BT_UART Interface for BLE Test

S. No.	BT_UART Interface	UART Function	Pin No. of ATWILC3000-MR110xA Module	Pin No. of ATWILC3000 IC
1	BT_TXD	BLE UART transmit data output. Connect to UART_RXD of host.	8	14
2	BT_RXD	BLE UART receive data input. Connect to UART_TXD of host.	9	15

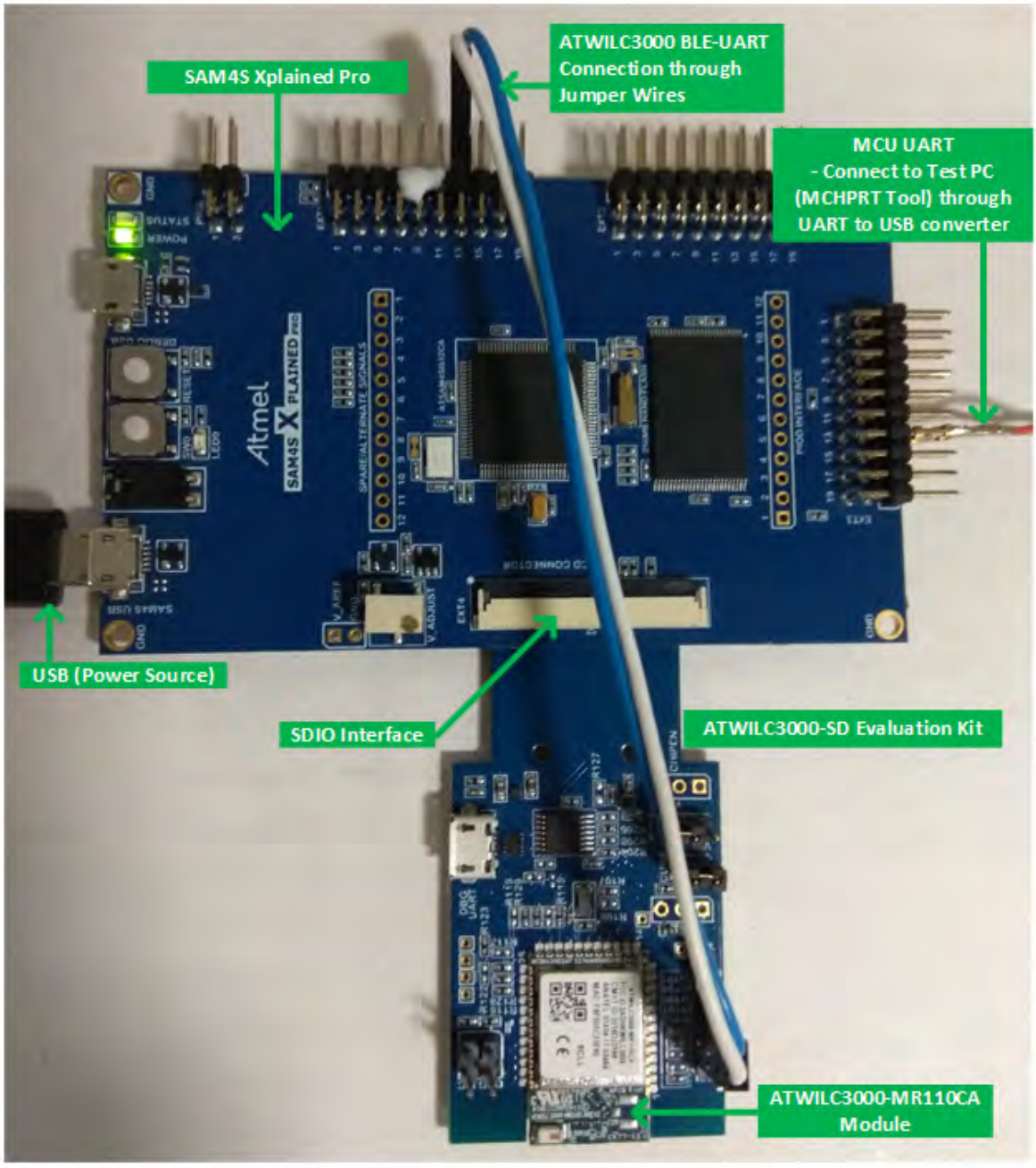
Note: To test using the MCHPRT2 tool, BT_UART does not operate in the flow control mode. Therefore, UART Flow Control pin information is not detailed in this section. For more details on detailed pin information, refer the corresponding data sheet.

Figure 3-11. Block Diagram of Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC3000 with SDIO and BT_UART Interface



Note: The SDIO interface is used for Wi-Fi testing and BLE_UART interface is used for BLE testing. In ATWILC3000-SD kit, the BLE_UART must be connected to MCU using jumper wires.

Figure 3-12. Serial Bridge Reference Test Setup for SAM 4S MCU and ATWILC3000 with SDIO and BT_UART Interface



Note: The test setup information is based on the ATWILC3000-SD Evaluation Kit. However, the ATWILC3000-SHIELD board can also be used for the test setup.
Refer the MCU pin out for the SDIO interface (for Wi-Fi test) and UART interface (for BLE test) and connect it to the ATWILC3000-SHIELD Arduino headers.

For more details on SPI and Bluetooth pin out, refer the ATWILC3000-SHIELD User Guide. By default, ATWILC3000-SHIELD board supports SDIO.

However, it can also be modified to support SPI by a resistor combination. Refer ATWILC3000 Shield Peripheral Configuration section of the ATWILC3000-SHIELD User Guide.

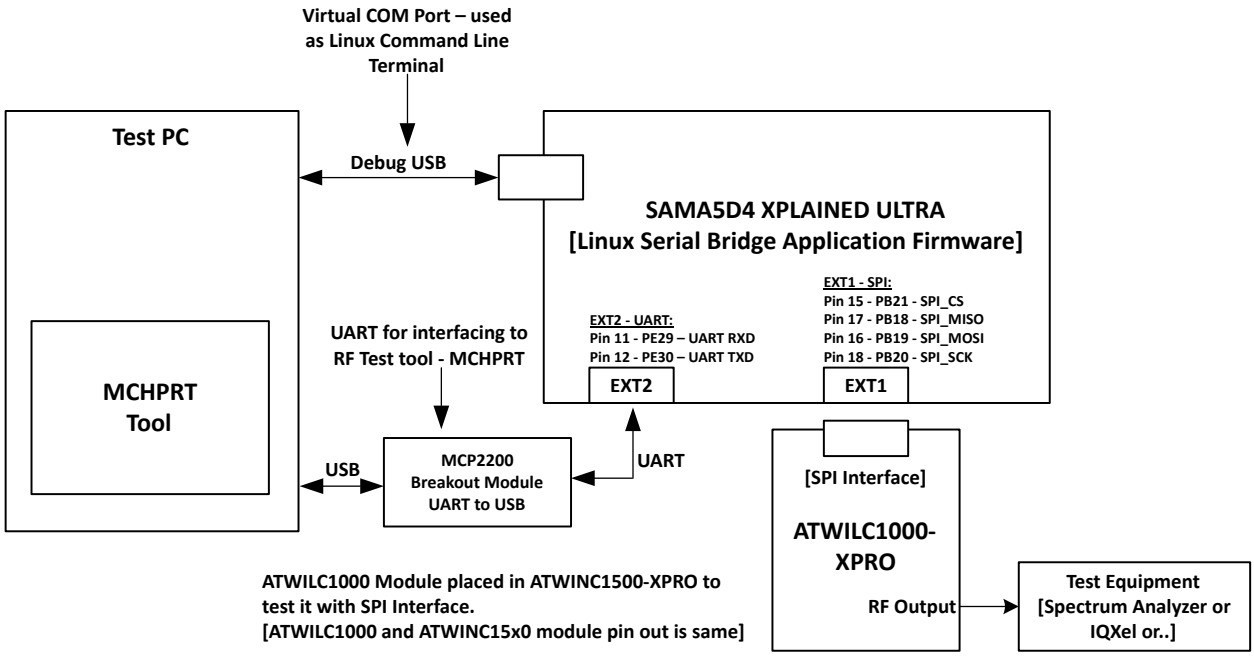
3.2 MPU based Serial Bridge Test Setup

For MPU based Serial Bridge test Setup, the SAMA5D4 Xplained Ultra Evaluation kit is used as reference. However, other MPU based kits can also be used.

3.2.1 Using ATWILC1000 SPI Interface

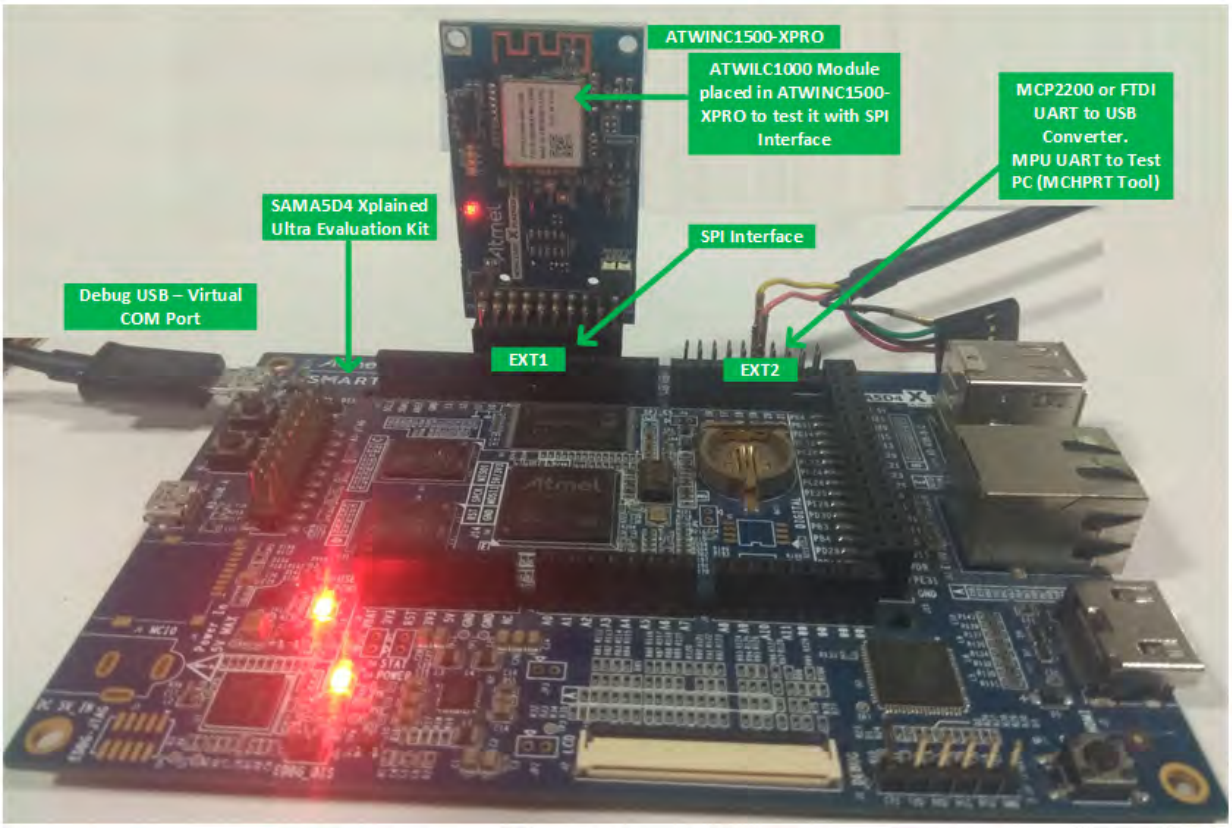
For block overview, and interface pinout see Figure 3-1 and Table 3-1.

Figure 3-13. Block Diagram of Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC1000 with SPI Interface



Note: In this reference test setup, the ATWILC1000 module is placed in the ATWINC1500-XPRO to test the ATWILC1000 module in SPI interface test setup. The pin out and mechanical package is same for the ATWILC1000 and ATWINC15x0 module/device. Therefore, both the ATWILC1000 and ATWINC15x0 module can be placed in same footprint package (similar case for device also).

Figure 3-14. Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC1000 with SPI Interface



3.2.2 Using ATWILC1000 SDIO Interface

For block overview and interface pinout see Figure 3-4 and Table 3-2.

Figure 3-15. Block Diagram of Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC1000 with SDIO Interface

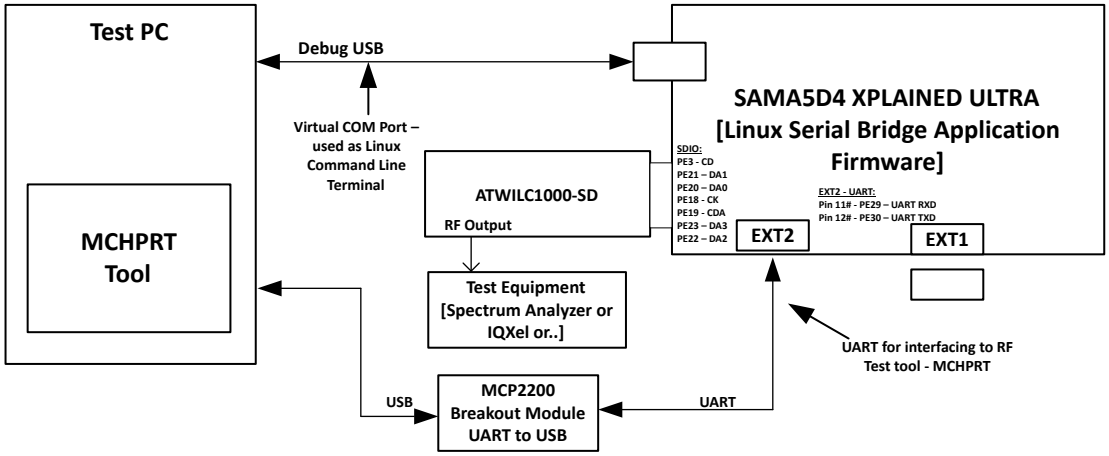
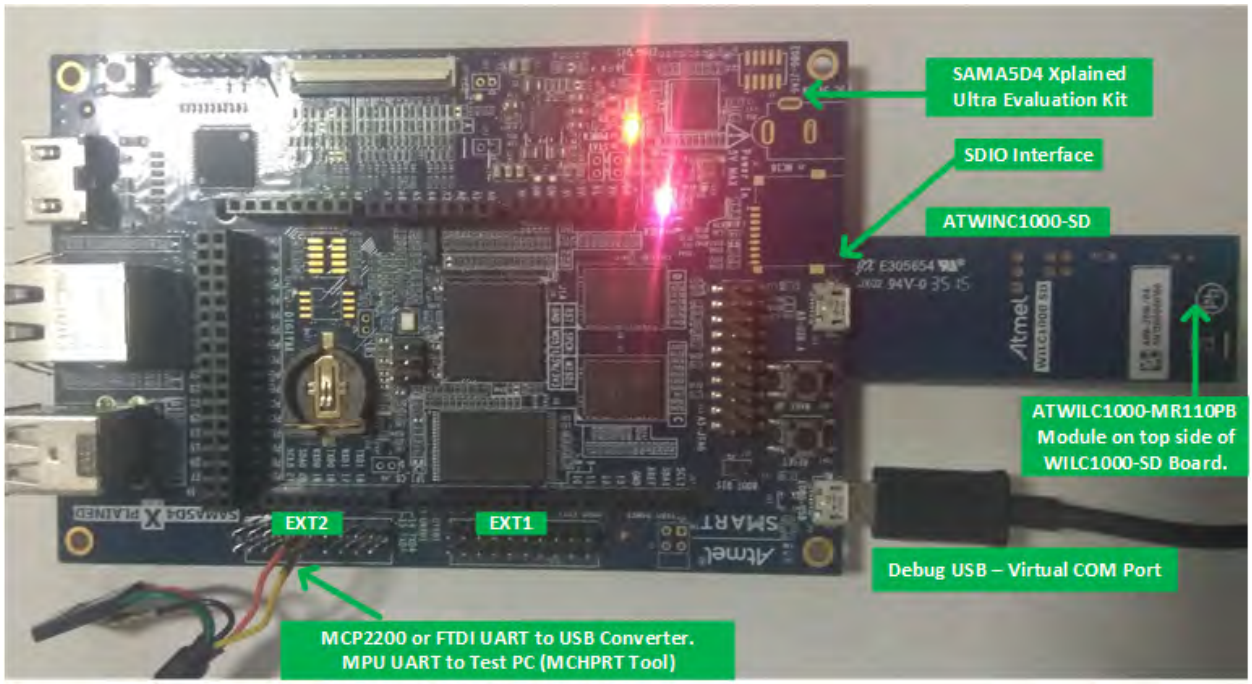


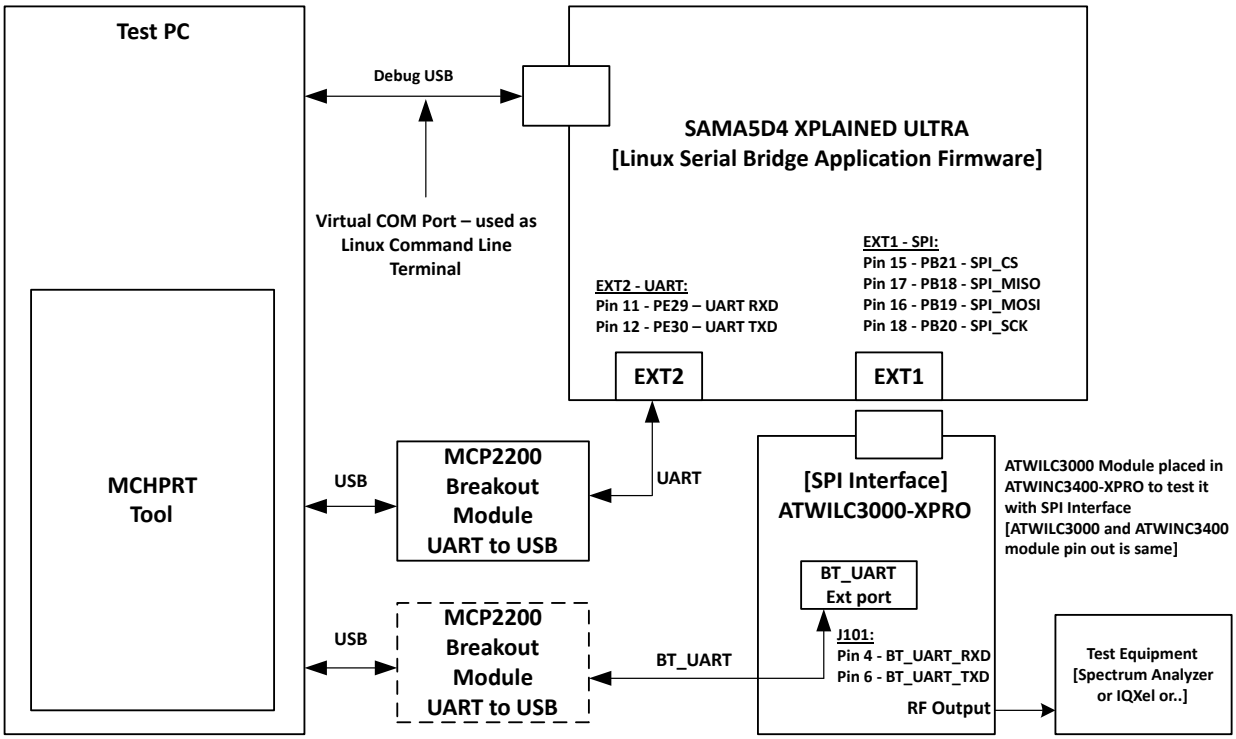
Figure 3-16. Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC1000 with SDIO Interface



3.2.3 Using ATWILC3000 SPI Interface

For block overview and interface pinout see Figure 3-7 and Table 3-3.

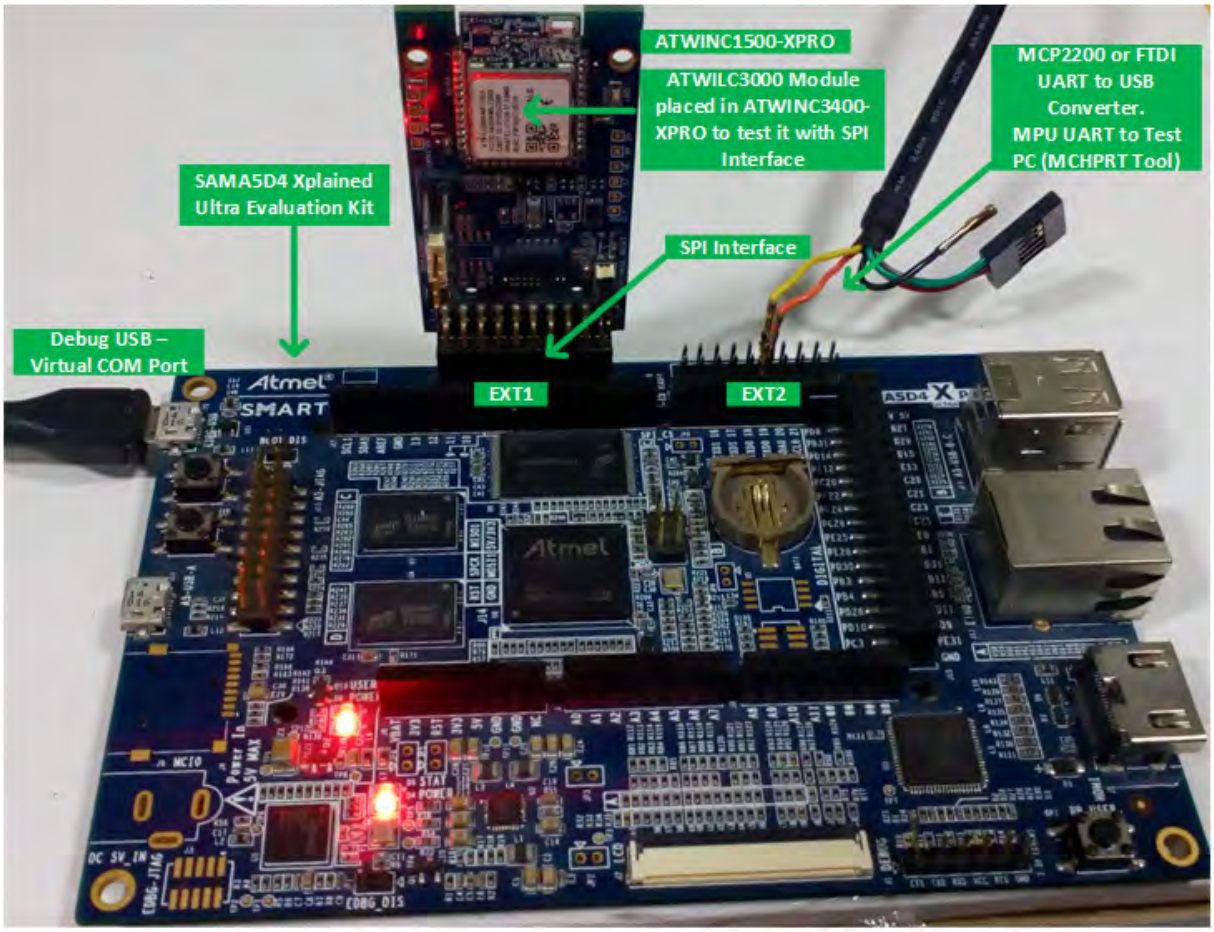
Figure 3-17. Block Diagram of Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC3000 with SPI Interface



Note:

1. In this reference test setup, the ATWILC3000 module is placed in the ATWINC3400-XPRO to test the ATWILC3000 module in SPI interface test setup. The pin out and mechanical package is same for the ATWILC3000 and ATWINC15x0 module/device. Therefore, both the ATWILC3000 and ATWINC15x0 module can be placed in same footprint package (similar case for device also).
2. The test setup information is based on ATWILC3000 module placed in ATWINC3400-XPro board for easy use. However, the ATWILC3000-SHIELD board can also be used for the test setup. Refer to the MPU pinout for the SPI interface (for Wi-Fi test) and UART interface (for BLE test) and connect it to the ARWILC3000-SHIELD Arduino headers. For more details on SPI and Bluetooth UART pinout, refer to pin out section in the ATWILC3000-SHIELD User Guide. By default, ATWILC3000-SHIELD board supports SDIO. A resistor combination must be modified to support the SPI interface. Refer ATWILC3000 Shield Peripheral Configuration section of the ATWILC3000-SHIELD User Guide.

Figure 3-18. Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC3000 with SPI Interface

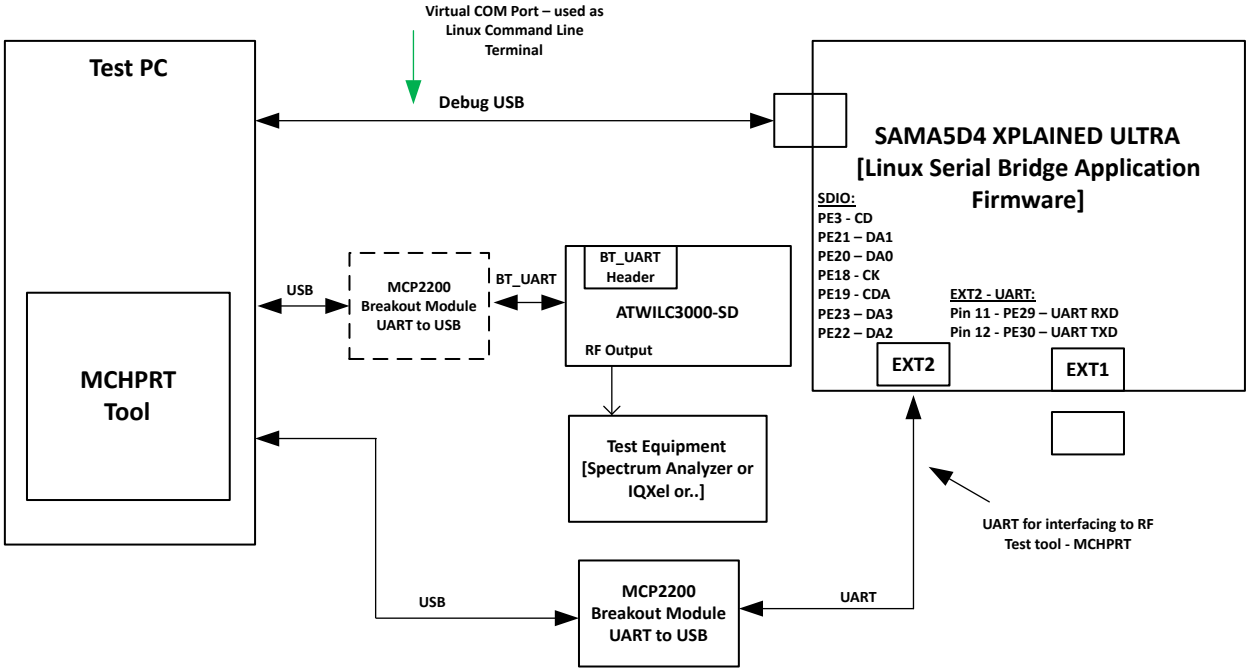


Note:
The MCU - RTOS Serial Bridge supports both Wi-Fi (SPI/SDIO) and BLE (BT_UART) interface, whereas Linux Serial Bridge does not support BLE (BT_UART) interface. Therefore, BT_UART of ATWILC3000 module must be connected to the test PC through a UART to USB converter for BLE test.

3.2.4 Using ATWILC3000 SDIO Interface

For block overview and interface pinout see Figure 3-10 and Table 3-5.

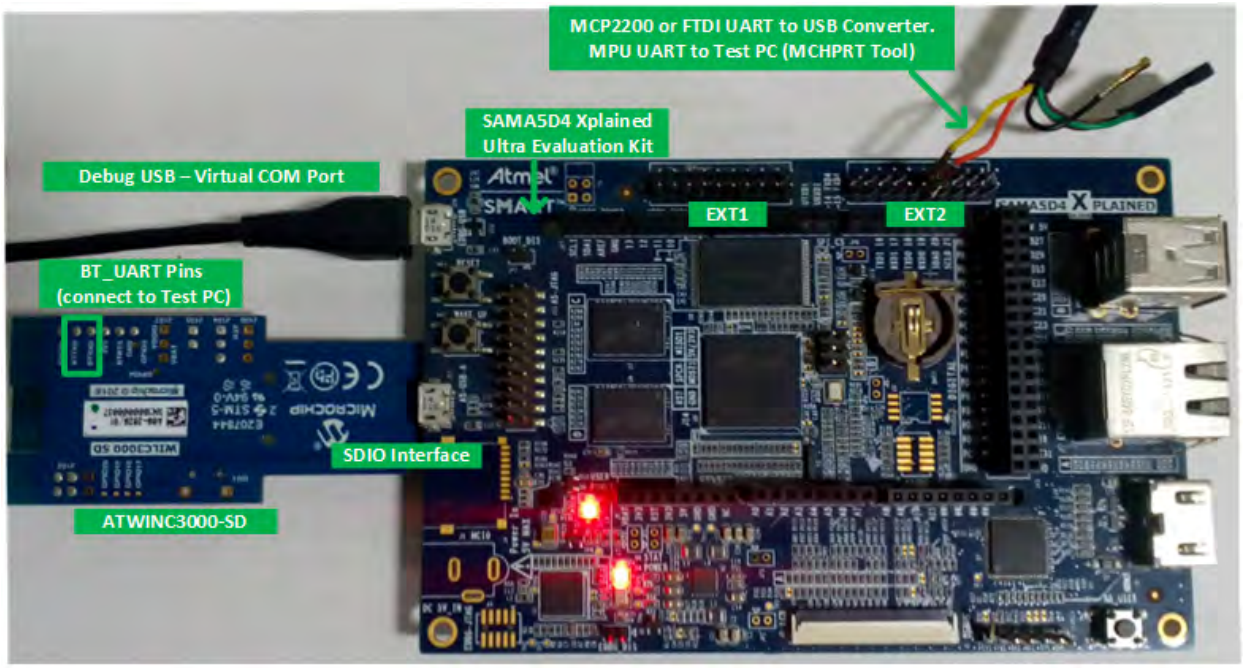
Figure 3-19. Block Diagram of Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC3000 with SDIO Interface



Note:

1. In this reference test setup, the ATWILC3000 module is placed in the ATWINC3400-XPRO to test the ATWILC3000 module in SPI interface test setup. The pin out and mechanical package is same for the ATWILC3000 and ATWINC15x0 module/device. Therefore, both the ATWILC3000 and ATWINC15x0 module can be placed in same footprint package (similar case for device also).
2. The test setup information is based on ATWILC3000 module placed in ATWINC3400-XPro board for easy use. However, the ATWILC3000-SHIELD board can also be used for the test setup. Refer to the MPU pinout for the SPI interface (for Wi-Fi test) and UART interface (for BLE test) and connect it to the ARWILC3000-SHIELD Arduino headers. For more details on SPI and Bluetooth UART pinout, refer to pin out section in the ATWILC3000-SHIELD User Guide. By default, ATWILC3000-SHIELD board supports SDIO. A resistor combination must be modified to support the SPI interface. Refer ATWILC3000 Shield Peripheral Configuration section of the ATWILC3000-SHIELD User Guide.

Figure 3-20. Serial Bridge Reference Test Setup for SAMA5D4 MPU and ATWILC3000 with SDIO Interface



3.3 Additional Information – Disabling MSD Mode

While using the Xplained Pro board for evaluating the Serial Bridge, ensure that the kit is not in the MSD (Mass Storage Device) mode. When the kit is in the MSD mode, virtual COM port does not enumerate or work properly.

To disable the MSD, Data Gateway Interface (DGI) must be enabled instead of MSD in the kit mode settings.

To disable the MSD mode in the kit, perform the following:

1. Open Atmel Studio.
2. Navigate to *View>Available Atmel Tools*.
3. Right click EDBG and choose kit mode settings.
4. Select DGI and check the Persist checkbox.
5. Click Set and click Close.

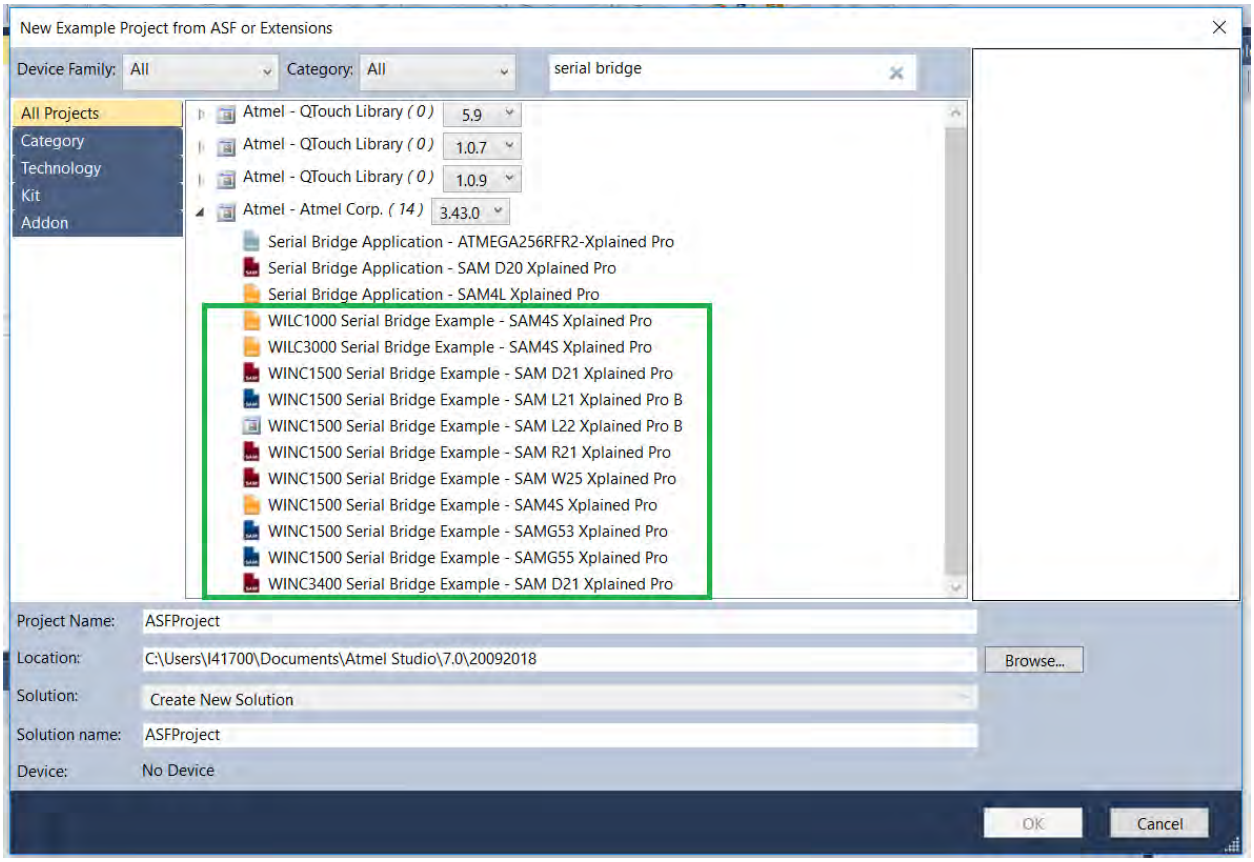
4. Serial Bridge Application Source Code

This section describes the two types of Serial Bridge applications.

4.1 MCU – RTOS based Serial Bridge Application Source Code

The RTOS based Serial Bridge application code for different MCU base is available in Studio 7 - ASF(Advanced Software Framework) as follows:

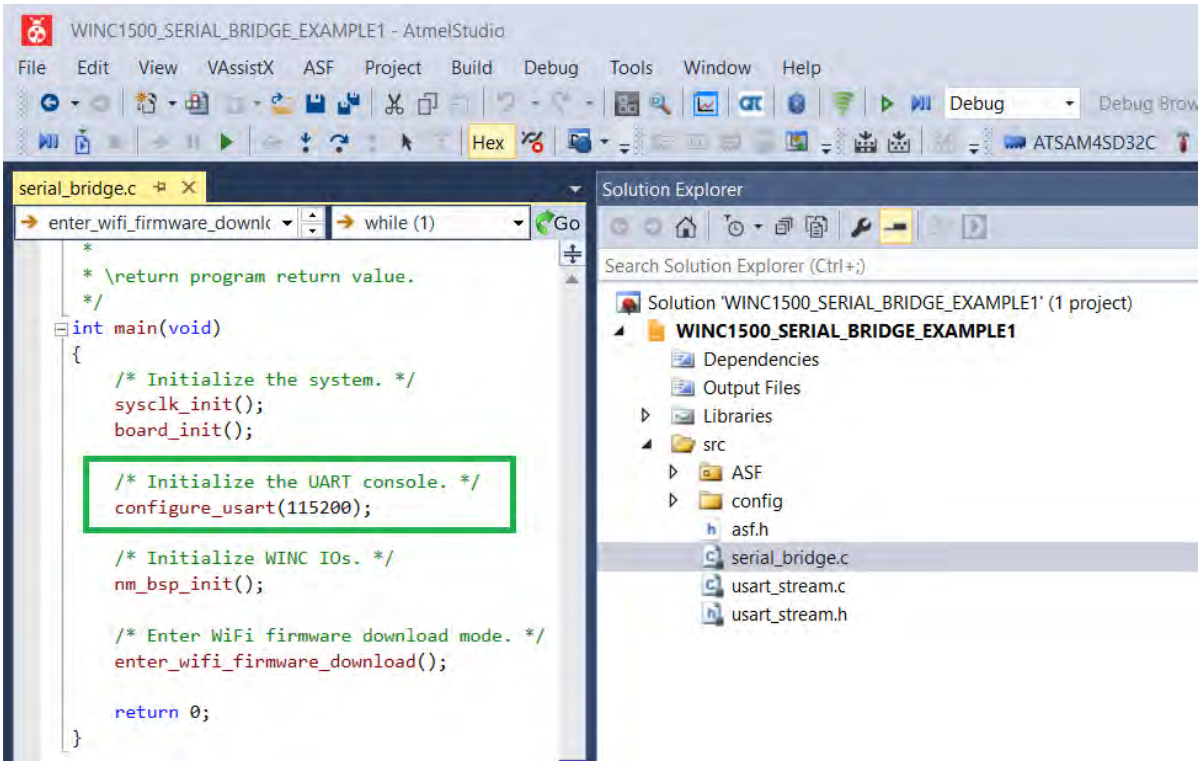
Figure 4-1. Serial Bridge Application Source Code - For MCU in ASF



Serial Bridge UART Baud Rate Configuration in ASF Source Code

- The default UART baud rate configuration in the ASF Serial Bridge application is 115200 bits/sec, whereas it can support for a maximum baud rate of 921600 bits/sec.
- In the Serial Bridge source code, the baud rate is configured as a function argument which can be changed in the `configure_usart()` function call as shown in the following screenshot:

Figure 4-2. Serial Bridge Application Source Code - Baud Rate Configuration



4.2 MPU – Linux based Serial Bridge Application Source Code

The Linux based Serial Bridge application code for the SAMA5D4 MPU is available in the *Linux Serial Bridge GitHub*.

4.3 Serial Bridge for other MCU/MPU

The user must port the Serial Bridge application source code on the following cases by using the available code as a base reference:

1. To other Microchip MCU, for which the Serial Bridge ASF example projects are not available.
2. When the user uses other vendor MCU/MPU in the end design, it is the user's responsibility to port the Serial Bridge application code to the MCU/MPU. This is used in the end design by utilizing existing source code as reference.

5. MCHPRT2 (RF Test Tool)

The MCHPRT2 is an RF test tool that helps to use the ATWILC/ATWINC devices in the Test mode, such as continuous Tx in modulation mode and continuous wave mode with a single channel and Rx test.

This application note describes the interface selection to choose Serial Bridge instead of Aardvark Tool for testing. For more details on the selection of each settings, refer the MCHPRT2 Application Note.

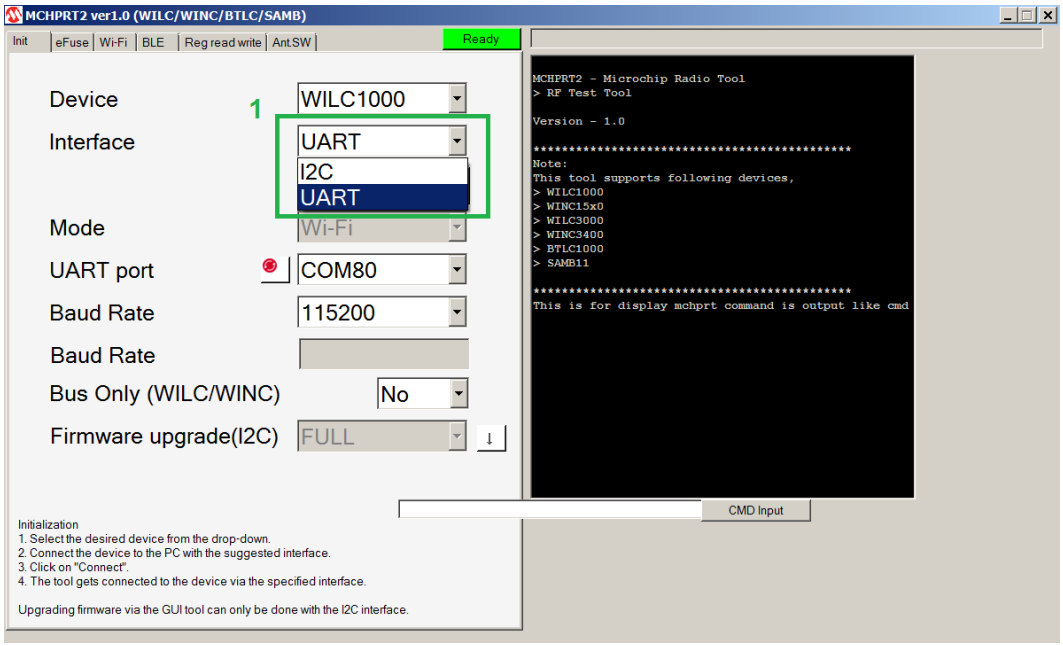
5.1 Wi-Fi Test using MCHPRT2 Tool and Serial Bridge

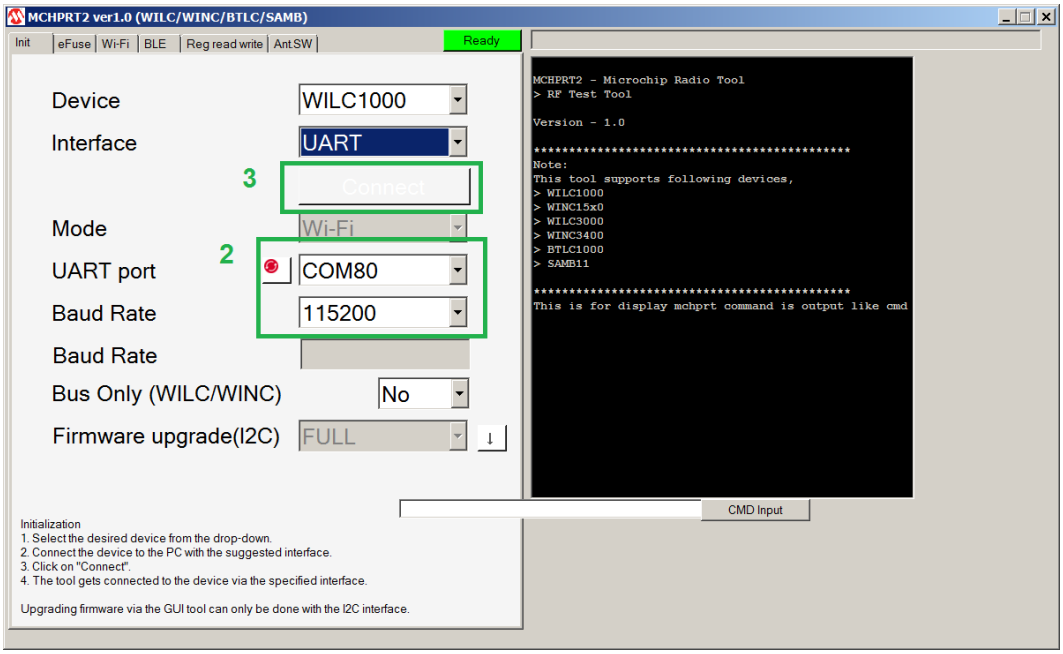
5.1.1 Using MCHPRT2 GUI

Perform the following steps to select Serial Bridge (UART) in the MCHPRT2 tool GUI for the Wi-Fi test:

1. Open the MCHRT2 tool.
2. From the drop-down list, choose **UART**. The UART is the interface selection for serial bridge.
3. Enter the Serial Bridge (MCU/MPU) COM Port number and Baud Rate Configuration details. The Serial Bridge supports for a maximum baud rate of 921600 bits/sec.
   Note:
   - COM Port number ‘0’ indicates auto-detect. The tool automatically detects the Serial Bridge. When more than one serial bridge is connected to the Test PC, the proper COM Port must be entered.
   - Baud Rate as ‘0’ makes the tool to operate with a baud rate of 115200 bits/sec.
   - Ensure that the baud rate is entered in the same manner as the serial bridge application software code.
4. Click **Init** to start initialization and enter selections in the same manner as entered for Aardvark Tool. For more details, refer the MCHPRT Application Note.

Figure 5-1. MCHPRT2 Tool - GUI : Serial Bridge (UART) Configuration





5.1.2 Using MCHPRT2 CLI

Perform the following steps for the Wi-Fi initialization through the Serial Bridge application software running on the host MCU/MPU:

- From the MCHPRT2 folder, open command prompt.
- Enter the Wi-Fi Initialization command syntax `MCHPRT X`. See the following table for the command value to be entered.
- Other commands remain the same. For more details, refer to command line chapter in MCHPRT2 Tool Application Note.

Table 5-1. Wi-Fi Initialization Command Syntax

Command Syntax	MCHPRT X
X	X refers to interface and chip selection. **Auto Chip Selection:** • 0_UART - Auto detect chip through UART (Serial Bridge). **Fast connection:** • 1000_UART - ATWILC1000 series with UART. • 1500_UART - ATWINC15x0 series with UART. • 3000_UART - ATWILC3000 series with UART. • 3400_UART - ATWILC3400 series with UART.
Example	**MCHPRT 0_UART** Auto detect chip through Serial Bridge UART and then start initialization process. **MCHPRT 1000_UART** The ATWILC1000 initialization process starts though Serial Bridge UART.

5.2 Bluetooth Low Energy Test using MCHPRT2 Tool and Serial Bridge

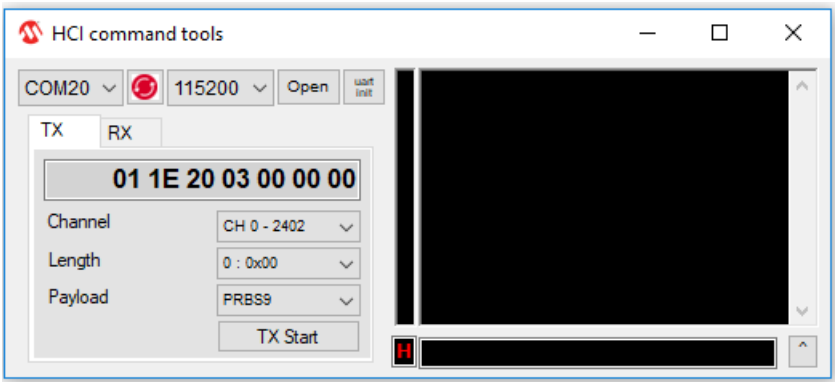
5.2.1 Using HCI Command Tools GUI

The HCI command tool is a part of MCHPRT2 tool and the `.exe` is available in the MCHPRT folder.

Perform the following steps to select the Serial Bridge (UART) in HCI command tool GUI for the Bluetooth low energy test:

1. Open HCI Command Tools.
2. From the drop-down list, choose **UART**. The UART is the interface selection for Serial Bridge.
3. Set the Baud Rate to 115200 bits/sec.
4. Click **Open** to open and lock the COM port.
5. Click **UART Init**. The Serial Bridge application code loads the Bluetooth low energy test firmware into the DUT (ATWILC/ATWINC) device. Wait for few seconds and click the **UART Init** again. Ensure to see the response `04 0E 04 0F 03 0C 00` (in green).
6. When the intialization is complete, perform the Tx and Rx test. For more details, refer MCHPRT Application Note.

Figure 5-2. Using HCI Command Tools GUI for Serial Bridge (UART) Configuration



5.2.2 Using HCI Command Tools and CLI

Perform the following steps for the Bluetooth low energy initialization through the Serial Bridge application software running on the host MCU/MPU:

- From the MCHPRT2 folder, open Command Prompt.
- Enter the BLE Initialization command syntax `MCHPRT HCI XX. XX`. Refer to Serial Bridge UART COM Port number.
- Other commands remain the same. For more details, refer HCI command line chapter in MCHPRT2 Tool Application Note.

6. Reference Documentation

The following list provides the links of relevant documents and Evaluation Kits detailed in this application note:

Table 6-1. Reference Documentation

Document	Description
ATWILC1000	ATWILC1000 module product page lists the ATWILC1000 module datasheet, ATWILC1000 SoC datasheet.
ATWILC1000-SD	ATWILC1000-SD Evaluation Kit
ATWINC1500	ATWINC1500 module product page lists the ATWINC15x0 module datasheet, ATWINC1500 SoC datasheet.
ATWINC1500-XPRO	ATWINC1500-XPRO Evaluation Kit
ATWILC3000	ATWILC3000 module product page lists the ATWILC3000 module datasheet, ATWILC3000 SoC datasheet.
ATWILC3000-SHLD	ATWILC3000 Shield Evaluation Kit
AC164158	ATWILC3000-SD Evaluation Kit
ATWINC3400	ATWINC3400 module product page lists the ATWINC3400 module datasheet, ATWINC3400 SoC datasheet
ATWINC3400-XPRO	ATWINC3400 Xplained PRO Evaluation Kit
ATSAM4S-XPRO (MCU/MPU Evaluation Kit)	SAM4S Xplained Pro Evaluation Kit
ATSAMD21-XPRO (MCU/MPU Evaluation Kit)	SAM D21 Xplained Pro Evaluation Kit
ATSAMA5D4-XULT (MCU/MPU Evaluation Kit)	SAMA5D4 Xplained Ultra Evaluation Kit
ADM00393 (UART to USB Converter)	MCP2200 (USB 2.0 to UART Protocol Converter) Breakout module
TTL-232R-3V3 (UART to USB Converter)	FTDI TTL to USB Serial Converter Cable datasheet

7. Linux Serial Bridge

The Linux Serial Bridge includes the following deliverables:

1. wilcsbridge_sdio.c
2. wilcsbridge_spi.c
3. wilc_sbridge.h
4. wilc3000_ble_burst_firmware.h
5. sbridge_app.c
6. Demo binaries for SAMA5D4 Xplained Pro board

7.1 Kernel Compilation with Serial Bridge Driver

Perform the following to compile the kernel with Serial Bridge driver.

1. Get the kernel source from Linux4wilc GitHub repository using the following command:

```
$ git clone https://github.com/linux4wilc/linux-at91.git
$ cd linux-at91
```

2. Create the kernel using sama5_defconfig defconfig file, using the following command:

```
$ make ARCH=arm sama5_defconfig
```

3. Add the wilcsbridge driver in kernel's directory "/drivers/staging/" as provided in the release package "src" folder, using the following command:

```
$ cp -rf ../src/wilcsbridge ../linux-at91/drivers/staging/
```

4. To include the wilcsbridge driver in the kernel build, relevant Kconfig and Makefile must be changed as following:

```
$ vi linux-at91/drivers/staging/Kconfig
```

   Add the following:

```
source "drivers/staging/wilcsbridge/Kconfig"
$ vi linux-at91/drivers/staging/Makefile
```

   Add the following:

```
obj-$(CONFIG_WILCSBRIDGE) += wilcsbridge/
```

5. To include the wilcsbridge driver in the kernel build, modify the default configuration using the “menuconfig” parameter in "Device Drivers > staging Driver > Select wilcsbridge SPI/SDIO" and select as modules.

```
$ make ARCH=arm menuconfig
```

6. Save and exit from the menuconfig configuration page.
7. Modify the Device Tree files for SDIO or SPI for ATWILC1000/ATWILC3000. Modify the files for UART interface for ATWILC3000 only. Sample Device Tree is based on the SAMA5D4_Xplained Pro board. User must modify the Device Tree node based on the used MPU. Mainly, the GPIO changes for CHIP_EN and RESETN pin detials must be added for SPI interface on wilc_sdio node of mmc1 and UART for BLE interface. For SD/MMC node:

```
mmc1: mmc@fc000000 {
pinctrl-names = "default";
pinctrl-0 = <&pinctrl_mmc1_clk_cmd_dat0 &pinctrl_mmc1_dat1_3>;
vmmc-supply = <&vcc_mmc1_reg>;
vqmmc-supply = <&vcc_3v3_reg>;
non-removable;
status = "okay";
wilc_sdio@0{
compatible = "microchip,wilc1000", "microchip,wilc3000";
irq-gpios = <&pioC 27 0>;
```

```
reset-gpios = <&pioB 28 0>;
chip_en-gpios = <&pioC 30 0>;
status = "okay";
reg = <0>;
bus-width = <4>;
};
};
```

For SPI interface:

```
spi1: spi@fc018000 {
cs-gpios = <&pioB 21 0>;
status = "okay";
wilc_spi@0 {
compatible = "microchip,wilc1000", "microchip,wilc3000";
spi-max-frequency = <48000000>;
irq-gpios = <&pioB 26 0>;
reset-gpios = <&pioE 21 0>;
chip_en-gpios = <&pioB 27 0>;
reg = <0>;
status = "okay";
};
};
```

For ATWILC3000 BLE UART interface:

```
usart4: serial@fc010000 {
atmel,use-dma-rx;
atmel,use-dma-tx;
status = "okay";
};
```

8. To build the kernel image and Device Tree binary file .dtb, generate the build using the following commands:

```
$ make ARCH=arm CROSS_COMPILE=...../arm-linux-gnueabihf- zImage modules dtbs
```

Kernel build generates the zImage, at91-sama5d4_xplained.dtb, wilcsridge-sdio.ko, and wilcsbridge-spi.ko files.

7.2 Flashing Binaries in SAMA5D4 Xplained Pro Board

Perform the following steps to flash binaries in the SAMA5D4 Xplained Pro board:

1. Download the demo binary package from linux4wilc GitHub repository, using the following commands:

```
$ git clone https://github.com/linux4wilc/wilc_demo.git
$ tar -xvf wilc_sama5d4_linux_demo_4.9_kernel.zip
$ cd wilc_sama5d4_linux_demo_4.9_kernel
```

2. Copy the Linux kernel "arch/arm/boot/zImage" and "arch/arm/boot/dts/at91-sama5d4_xplained.dtb" files to demo binary.
3. Install the sam-ba 2.18 or 3.2.x version in Windows or Linux platform.
4. For Linux sam-ba and 32 bit or sam-ba_64 and 64 bit, add the path in the shell script file "demo_linux_nandflash.sh".
5. Add the jumper at JP7 and connect to the PC via the USB port at J11.
6. Reset the board to enter in to "ROMboot" and remove the jumper JP7.
7. Execute demo_linux_nandflash.bat (for Windows®) or demo_linux_nandflash.sh (for Linux).
8. After successful flashing, copy the modules "drivers/staging/wilcsbridge/wilcsbridge-sdio.ko" and "drivers/staging/wilcsbridge/wilcsbridge-spi.ko" based on the used interface.
   For more details, refer the ATWILC Linux User Guide.

7.3 Compiling the Sbridge Application

Perform the following steps to compile the Sbridge Application:

1. Serial Bridge application must be cross compiled against the target device, using the following command:

```
...../arm-linux-gnueabihf-gcc -o sbridge_app sbridge_app.c
```

   Note: ARM GCC compiler must be same as the compiler which is used for Linux kernel compilation.
2. Export the ARM GCC compiler path or provide the absolute path

7.4 Output Modules

The following are the list of output modules:

1. wilcsbridge-spi.ko, for SPI interface.
2. wilcsbridge-sdio.ko, for SDIO interface.
3. sbridge_app, for serial bridge application with MAC address read/write feature.

7.5 Steps to Run Serial Bridge Application to Connect with MCHPRT2 Tool using SPI Interface

The following are the list of steps to run Serial Bridge application to connect with MCHPRT2 tool using SPI interface:

1. Enter `insmod wilcsbridge-spi.ko`
2. Navigate to `./sbridge_app spi 230400 ttyS5`
3. Connect the FTDI cable with SAMA5D4 EXT2 pin 11 (Tx) and pin 12 (Rx).
4. Run the MCHPRT2 tool and follow the user guide to run the tool.

7.6 Steps to Run Serial Bridge Application to Connect with MCHPRT2 Tool using SDIO Interface

The following are the list of steps to run Serial Bridge application to connect with MCHPRT2 tool using SDIO interface:

1. Enter `insmod wilcsbridge-sdio.ko`
2. Navigate to `./sbridge_app sdio 230400 ttyS5` > `interface` and set the sdio, buadrate - 230400, usrt console - ttyS5 with RECORDER_MODE macro enabled.
3. Connect the FTDI cable with SAMA5D4 EXT2 pin 11 (Tx) and pin 12 (Rx).
4. Run the MCHPRT2 tool and follow the user guide to run the tool.

7.7 Steps to Run Serial Bridge Application to Connect with HCI Tool for ATWILC3000 BLE UART Interface

The following are the list of steps to run Serial Bridge application to connect with HCI tool for ATWILC3000 BLE UART interface:

1. Enter `insmod wilcsbridge-sdio.ko / insmod wilcsbridge-spi.ko`
2. Navigate to `./sbridge_app uart 230400 ttyS5 ttyS2` > `interface` and set the sdio, buadrate - 230400, usrt console - ttyS5 with RECORDER_MODE macro enabled.
3. Connect the FTDI cable with SAMA5D4 EXT2 pin 11 (Tx) and pin 12 (Rx) for Sbridge connection.
4. Connect the ATWILC3000 BLE TX pin to SAMA5D4 UART4 Rx pin (SAMA5D4 Xplained Pro board J19 pin 1 - PE27).
5. Connect the ATWILC3000 BLE RX pin to SAMA5D4 UART4 Tx pin (SAMA5D4 Xplained Pro board J19 pin 2 - PE26).
6. Run the HCI_COMMAND tool and follow the user guide to run the tool.

7.8 Steps to Run MAC Read/Write using Sbridge Application

The following are the list of steps to run MAC Read/Write using Sbridge application:

1. Load the provided driver module in the package (wilcsbridge-spi.ko) using the following command:

```
insmod wilcsbridge-spi.ko
```

2. To run the application file, the following four parameters are required:
   – Protocol (valid argument:spi)
   – Serial console baud rate (valid argument:115200)
   – ttyS5

   Note: This parameter does not have impact on this application. This is used for compatibility with Serial Bridge application, which can be merged with this application in the future.

   To enter the MAC address write mode followed by hex value MAC address "mac" string is used (valid argument:6 bytes of hexadecimal number) as following:

```
./sbridge_app spi 230400 ttyS5 mac f8f005f431f2
```

7.9 UART Configuration for Serial Bridge Application

In SAMA5D4 Xplained Pro board, UART0 is used for Serial Bridge communication. By default UART0 is disabled. Enable the UART0 in Device Tree .dtsi file.

For the UART0 "/dev/ttyS5" device is created in the Serial Bridge application. This is also used to transmit and receive the data from the GUI tool.
Note: For other MPU's use any available UART and respective "/dev/ttyxx" device.

7.10 Pin Configuration for SAMA5D4 with ATWILC1000 SPI Interface

The Linux Serial Bridge driver acts as a reference to the SAMA5D4 Xplained pro board. EXT1 header pin configuration is used for SPI interface, Rest, Chip_En, and IRQ.

Table 7-1. Pin Configuration for SAMA5D4 with ATWILC1000 SPI Interface

Description	EXT1 of SAMA5D4 Xplained Pro Board
SPI MISO	17 pin
SPI MOSI	16 pin
SPI SCK	18 pin
SPI SS	15 pin
RESET	5 pin
CHIP_EN	10 pin
IRQ	9 pin (optional for Serial bridge application)

Note: The SPI interface pins are configured using Device Tree of the Linux kernel. The RESET and CHIP_EN pins are configured in the "wilc_spi.c" driver itself using GPIO numbers.

7.11 Test Procedure

1. Flash the Linux kernel image in to the SAMA5D4 MPU. For more details, refer ATWILC Linux User Guide.

2. Connect the ATWILC1000 SPI interface board to EXT1 or SD board to SDIO interface connector.
3. Connect the FTDI cable Rx - Yellow (ET2 header - pin 12) and Tx - Orange (ET2 header - pin 11) and Windows PC for GUI tool communication.
4. Follow the MCHPRT2 user guide for production and validation.

8. Document Revision History

Revision	Date	Section	Description
A	04/2020	Document	Initial release

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