User Guide

SaBLE-x Simple Advertiser

Version 1.0

LSR
a Laird Business

REVISION HISTORY

Version	Date	Notes	Approver
1.0	5/15/16	Initial Release	Chris Hofmeister

CONTENTS

1 PREFACE

For the user to get the most out of the SimpleAdvertiser, the user should be familiar with the different advertisement types. Please see the Appendix for more information.

The Simple Advertiser firmware is designed so you can easily configure the SaBLE-x to be any one of the following types of beacons: iBeacon, Eddystone URL, Eddystone UID, or Custom.

There are only five IO used for the Simple Advertiser: Beacon Enable, UART Enable, Bootloader Enable, UART RX, and UART TX.

The Beacon Enable is an input with no pullup. It must be driven. It is active low.

The UART Enable is an input with a pullup. It is active low. Note: once configured, and not intending to use UART any more, this line can be left as a no connect.

The bootloader enable is active low. It is used to bootload the module via UART. If not intending to use this functionality place a pullup on this line.

UART RX and TX are internally idle high. If configured, and not intending to use UART anymore, these lines can be left as no connects.

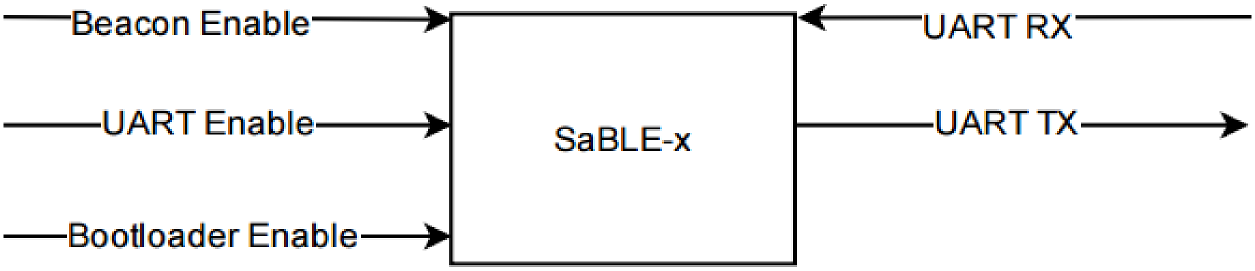
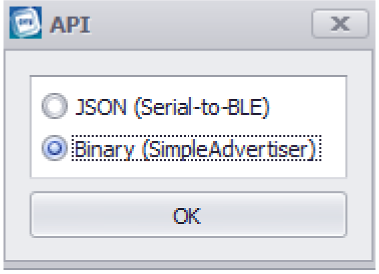


Figure 1: Simple Advertiser Block Diagram

Configuring the SaBLE-x as any one of these beacons can be done via the Developer Tool Suite. Simply choose the “Binary” API mode when starting the application:



○ JSON (Serial-to-BLE)
● Binary (SimpleAdvertiser)

Figure 2: Selection of Binary (SimpleAdvertiser) protocol in the Developer Tool Suite

Next select the “Beacon Configuration Tool” tile.

Figure 3: Selection of the Beacon Configuration Tool in the Developer Tool Suite

2 Hardware Setup on the SaBLE-x Development Board

S1 (DIO7) has be repurposed as the beacon enable. It is configured as an input no pull, it must be driven either high or low. It is active low. The pin is read during boot and run time.

If you would like to use S1 as the beacon enable that is fine, but it is likely not practical. If you would like beaconing enabled you should create a break on this line by disabling it on the dip switch, take the corresponding header pin, and tie it to ground.

SPI_CS (DIO10) has been repurposed as the UART enable. It is configured as an input pulled up. It is active low. The pin is read during boot and run time. If you configure a module and place it on a board and do not intend on ever using UART it is safe to leave this line as a no connect.

If using UART, you should create a break on this line by disabling it on the dip switch, take the corresponding header pin, and tie it to ground.

3 UART Protocol

The Simple Advertiser uses a binary protocol:

Table 1 - Host to Device

	Start Byte (0x01)	Length (Entire Message)	Setting Index	Get Set Byte (0=Get, 1=Set)	Setting Value	CRC-CCITT16	End Byte (0x04)
Number of bytes	1	1	2 - LSB	1	n	2 – LSB	1

When getting a value the Setting Value field is omitted.

Table 2 - Device to Host

	Start Byte (0x01)	Length (Entire Message)	Setting Index	Error Code	Setting Value	CRC-CCITT16	End Byte (0x04)
Number of bytes	1	1	2 - LSB	2 - LSB	n	2 – LSB	1

1) When the host is *getting* a value it omits the Setting Value Field. For example, this is the sequence of bytes for the host to get the firmware version:

    0x01, Start Byte
    0x08, Length Byte
    0x00, Setting Index LSB
    0x00, Setting Index MSB
    0x00, Get/Set Byte
    0x9E, CRC LSB
    0x3E, CRC MSB
    0x04, End Byte

2) When the host is *setting* a value, the module's response omits the Setting Value Field. For example, this is the sequence of bytes in hex the module sends in response to a "Set Beacon Type" message:

    0x01, Start Byte
    0x09, Length Byte
    0x03, Setting Index LSB
    0x00, Setting Index MSB
    0x00, Error Code LSB
    0x00, Error Code MSB
    0x10, CRC LSB
    0x78, CRC MSB
    0x04, End Byte

3) When the host is *getting* a value, and the module's response has a **non-zero Error Code** the response omits the Setting Value Field. For example, this is the sequence of bytes in hex the module sends in response to a "Set Beacon Payload" message when the payload is too large:

    0x01, Start Byte
    0x09, Length Byte
    0x04, Setting Index LSB
    0x00, Setting Index MSB
    0x04, Error Code LSB
    0x10, Error Code MSB
    0xC8, CRC LSB
    0xF7, CRC MSB
    0x04, End Byte

The CRC-CCITT16 is calculated using a seed of 0xFFFF. The calculation is provided in source code.

4 Error Codes

INVALID_CRC: 0x1000

GET_SET_OR_SETTING_INDEX_OUT_OF_BOUNDS: 0x1001

INVALID_MESSAGE_LEN: 0x1002

MESSAGE_TIMEOUT: 0x1003

INVALID_SETTING_VALUE: 0x1004

INVALID_OPERATION: 0x1005

If the integrity of the message is unknown the setting index in the response will be 0xFFFF. This will occur for an invalid CRC, invalid message length, and message timeout.

Any error returned in the range of 0x01 – 0xFF is a TI BLE stack related error.

5 Setting Indices

For more information click this tile in the binary mode of the Developer Tool Suite:

Figure 4: Selection of API viewer in the Developer Tool Suite

Table 3 - A brief overview of the setting indices:

Setting Index	Associated Setting	Description
0x0000	Firmware Version	Read Only
0x0001	Beacon Interval	The interval at which the device beacons. In units of 625us. Example: 0x00A0 = 160. 160x625us = 100ms.
0x0002	Beacon Led Interval	Values of 0x0000-0x0064 mean that the LED will not blink. Only active when beaconing. Max value of 0xFFFF.
0x0003	Beacon Type	0x00 = Custom 0x01 = iBeacon 0x02 = Eddystone

0x0004	Beacon Payload	3-28 bytes of beaconing (advertising) data. Pre-appended with a length byte. Do not include the AD Flags from the spec. This is done for you in the firmware and is the reason 3 of the 31 bytes are not usable.
0x0005	Scan Response Payload	3-31 bytes of scan response data. Pre-appended with a length byte. If not using, set it to 0x00,0x00,0x00.
0x0006	Power Level	0x00 = -21dBm 0x01 = -18dBm 0x02 = -15dBm 0x03 = -12dBm 0x04 = -9dBm 0x05 = -6dBm 0x06 = -3dBm 0x07 = 0dBm 0x08 = 1dBm 0x09 = 2dBm 0x0A = 3dBm 0x0B = 4dBm 0x0C = 5dBm
0xFFFF	Global Error	Used to return an error code when the integrity of the message received is unknown, thus the setting index is unknown.

6 LOADING THE FIRMWARE

The complete hex is provided in the zip file. To load the hex file select the “Wired Bootloader” in the Developer Tool Suite:

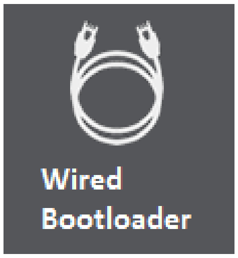
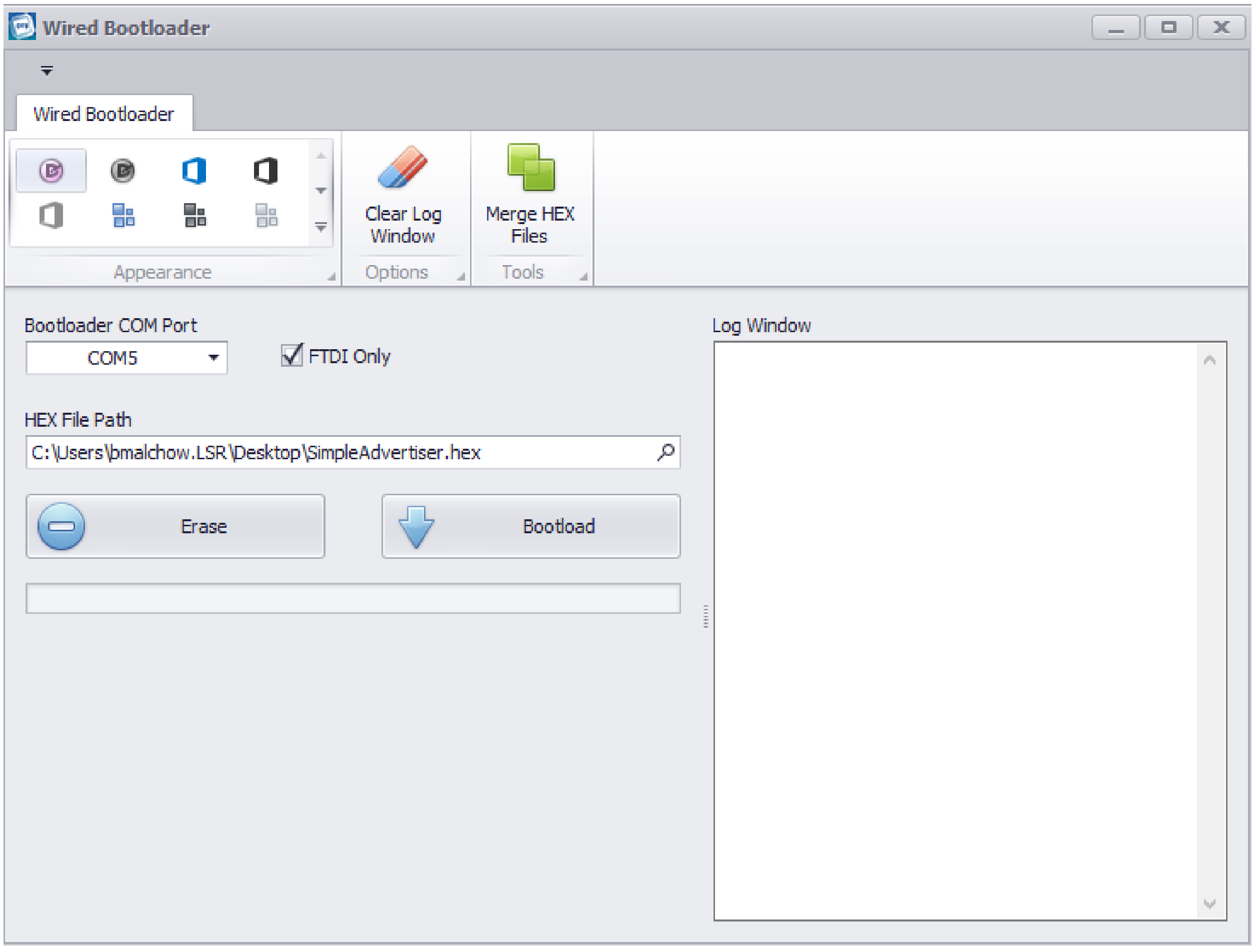


Figure 5: Selection of the Wired Bootloader in the Developer Tool Suite

Next select the COM port connected to the SaBLE-x development board and select the SimpleAdvertiser.hex. Please ensure that DIO9, DIO1, DIO0, and Reset are connected to the module via the dip switches before attempting to bootload.



Bootloader COM Port
COM5
☑ FTDI Only

HEX File Path
C:\Users\bmalchow.LSR\Desktop\SimpleAdvertiser.hex

Figure 6: Criteria for loading the firmware in the Wired Bootloader

7 BUILDING THE PROJECT FROM SOURCE CODE

The complete IAR project is provided in the zip file. It requires TI BLE Stack 2.1.1, and that it be installed in the default install directory:

C:\ti\simplelink\ble_cc26xx_2_01_01_44627

Take the SimpleAdvertiser folder in the zip file and copy/extract it to the following directory:

C:\ti\simplelink\ble_cc26xx_2_01_01_44627\Projects\ble

Next copy the OSAL_ICallBle.c file from the directory:

C:\ti\simplelink\ble_cc26xx_2_01_01_44627\Projects\ble\SimpleBLEBroadcaster\CC26xx\Source\Stack

And paste it into the new SimpleAdvertiser project here:

C:\ti\simplelink\ble_cc26xx_2_01_01_44627\Projects\ble\SimpleAdvertiser\CC26xx\Source\Stack

The project can now be opened with IAR.

8 APPENDIX

8.1. SIG AD Types

SIG AD Types Hyperlink

https://www.bluetooth.org/en-us/specification/assigned-numbers/generic-access-profile

8.2. iBeacon Overview

Apple iBeacon Hyperlink

https://developer.apple.com/ibeacon/Getting-Started-with-iBeacon.pdf

8.3. Eddystone Overview

Google Eddystone Hyperlink

https://github.com/google/eddystone

9 CONTACTING LSR/LAIRD

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