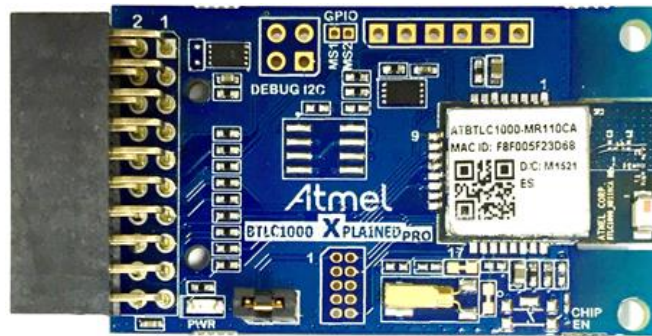

Blood Pressure Profile Example - Getting Started Guide

USER GUIDE

Introduction

This getting started guide describes the setup of the Atmel® ATBTLC1000 with a supported platform bringing-up an example profile supplied as part of the BluSDK release. The Bluetooth® Blood Pressure Profile is an example application that is embedded as part of the software release package.

The Blood Pressure Profile (BLP) enables a device to connect and interact with a Blood Pressure Sensor device for use in consumer and professional health care applications.

The Blood Pressure Profile is used to enable a device to obtain blood pressure measurement and other data from a non-invasive blood pressure sensor that exposes the Blood Pressure Service. For example, a nurse or doctor could use a non-invasive blood pressure sensor on a patient that sends blood pressure measurements to a laptop or other hand held device.

This example demonstrates a Blood Pressure Sensor application (GATT Server role).

This document explains the details about:

1. Getting started with the setup of a supported platform to be used as a Blood Pressure Sensor.
2. Getting the Blood Pressure Measurement application working on the above mentioned setup.

Features

- Device Discovery and Disconnection
- Pairing / Bonding
- Blood Pressure Measurements
- Console Display

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1 Demo Setup

Figure 1-1. Demo Setup for Blood Pressure Profile



2 Supported Hardware Platforms and IDEs

Table 2-1. BluSDK – Supported Hardware and IDEs

| Platform | MCU | Supported BLE Module | Supported evaluation kits | Supported IDEs |
|---------------|--------------|----------------------|---|-------------------|
| SAM L21 (MCU) | ATSAML21J18B | ATBTLC1000 | ATBTLC1000-XSTK (ATSAML21-XPRO-B + ATBTLC1000 XPRO) | Atmel Studio v7.0 |
| SAM L21 (MCU) | ATSAML21J18A | ATBTLC1000 | ATSAML21 XPRO + ATBTLC1000 XPRO | Atmel Studio v7.0 |
| SAM D21 (MCU) | ATSAMD21J18A | ATBTLC1000 | ATSAMD21-XPRO + ATBTLC1000 XPRO | Atmel Studio v7.0 |
| SAM G55 (MCU) | ATSAMG55J19 | ATBTLC1000 | ATSAMG55-XPRO + ATBTLC1000 XPRO | Atmel Studio v7.0 |
| SAM 4S (MCU) | ATSAM4SD32C | ATBTLC1000 | ATSAM4S-XPRO + ATBTLC1000 XPRO | Atmel Studio v7.0 |

3 Hardware Setup

3.1 SAM L21 Xplained Pro Blood Pressure Sensor Setup

Figure 3-1. ATBTLC1000 Xplained Pro Extension Connected to a SAM L21 Xplained Pro



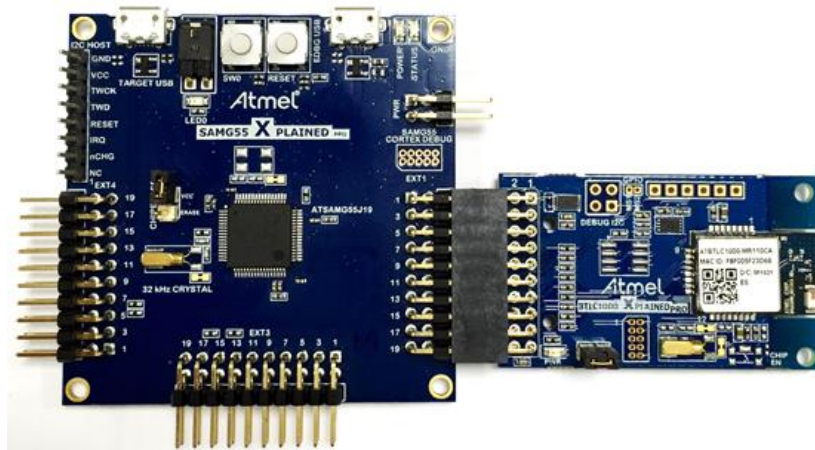
3.2 SAM D21 Xplained Pro Blood Pressure Sensor Setup

Figure 3-2. ATBTLC1000 Xplained Pro Extension Connected to a SAM D21 Xplained Pro



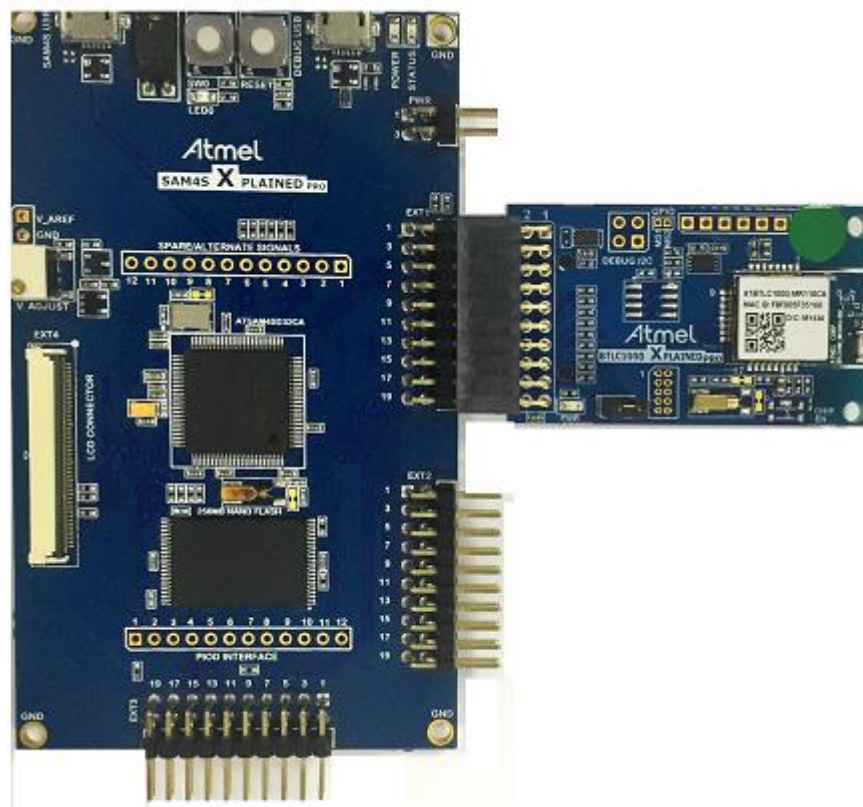
3.3 SAM G55 Xplained Pro Blood Pressure Sensor Setup

Figure 3-3. ATBTLC1000 Xplained Pro Extension Connected to a SAM G55 Xplained Pro



3.4 SAM 4S Xplained Pro Blood Pressure Sensor Setup

Figure 3-4. ATBTLC1000 Xplained Pro Extension Connected to a SAM 4S Xplained Pro



4 Blood Pressure Measurements

The Blood Pressure Measurement characteristic shall be used to send Blood Pressure measurements. Included in the characteristic are a Flags field (containing units of Blood Pressure and used to show presence of optional fields), the Blood Pressure Measurement Compound Value field and, depending upon the contents of the Flags field, Time Stamp (time of the measurement), Pulse Rate, User ID, and Measurement Status fields.

The Intermediate Cuff Pressure characteristic may be notified frequently during the course of a measurement so that a receiving device can effectively update the display on its user interface during the measurement process.

When the Client Characteristic Configuration descriptor is configured for indications and a Blood Pressure measurement is available, this characteristic shall be indicated while in a connection.

The Blood Pressure Measurement Application, which is the GATT server, will hold the characteristics and send the measurement values to the Blood Pressure Monitor.

- The Blood Pressure Measurement characteristic shall be used to send Blood Pressure measurements
- The Intermediate Cuff Pressure characteristic is used to send Current Cuff Pressure values to a device for display purposes while the measurement is in progress
- The Blood Pressure Feature characteristic shall be used to describe the supported features of the Blood Pressure Sensor

ATBTLC1000 together with the host MCU simulates a Blood Pressure Sensor (GATT Server Role) and sends simulated values to the Blood Pressure Monitor (Smart Connect mobile application).

5 Software Setup

5.1 Installation Steps

1. Atmel Studio installation [**Atmel Studio 7.0 (build 594) Installer – with .NET**]
<http://www.atmel.com/tools/atmelstudio.aspx>.
(Note: SAM L21 Rev B/SAM D21/SAM G55/SAM 4S part pack is built-in as part of Atmel Studio 7.0)
2. Atmel USB Driver Installer <http://www.atmel.com/tools/atmelstudio.aspx>.
3. Install the standalone ASF package from
<http://www.atmel.com/tools/AVRSOFTWAREFRAMEWORK.aspx> .

Note: Refer to the BluSDK release notes for updates to version numbers of the components mentioned above.

This package will install the following examples within the Atmel Studio environment.

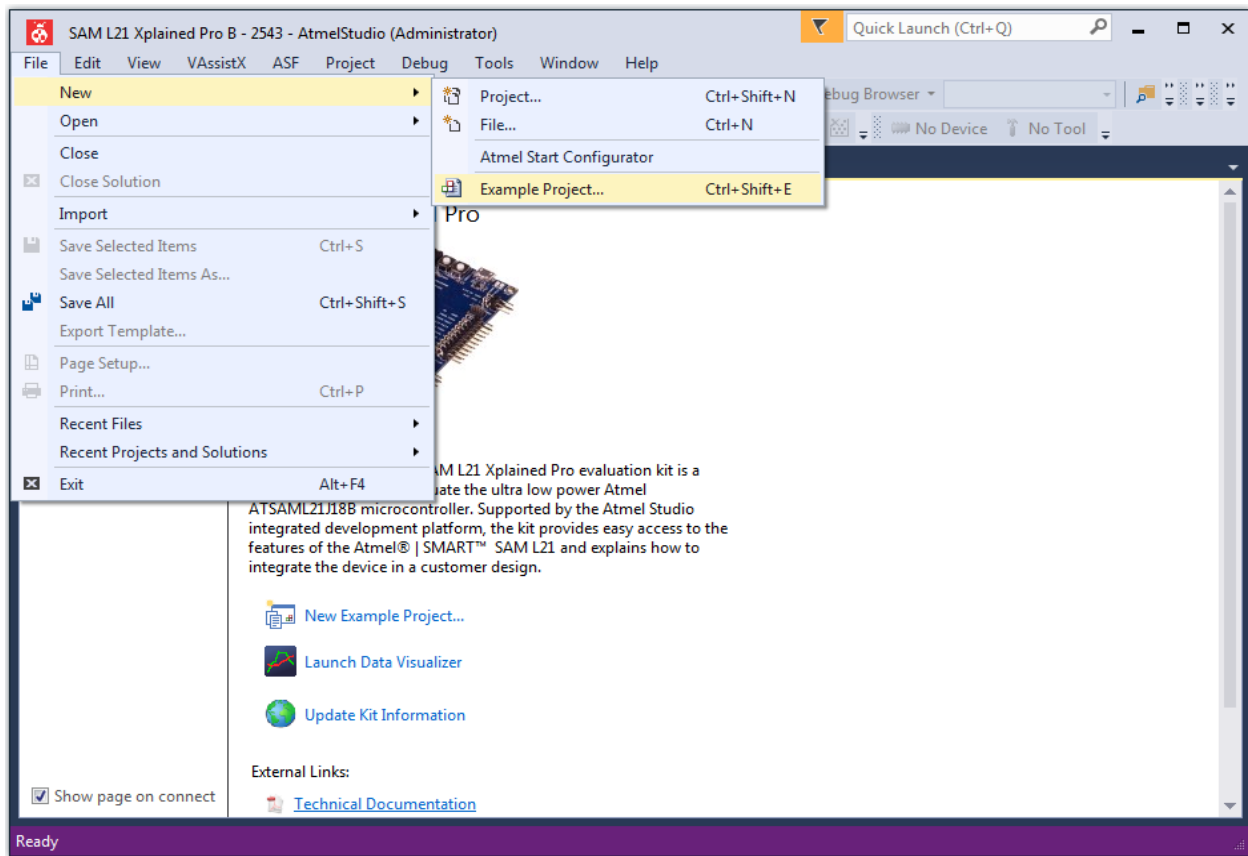
1. Blood Pressure Application for SAM L21.
2. Blood Pressure Application for SAM D21.
3. Blood Pressure Application for SAM G55.
4. Blood Pressure Application for SAM 4S.

5.2 Build Procedure

The following procedure is explained for SAM L21 application example. The same procedure is valid for the case of all the other supported platforms as well.

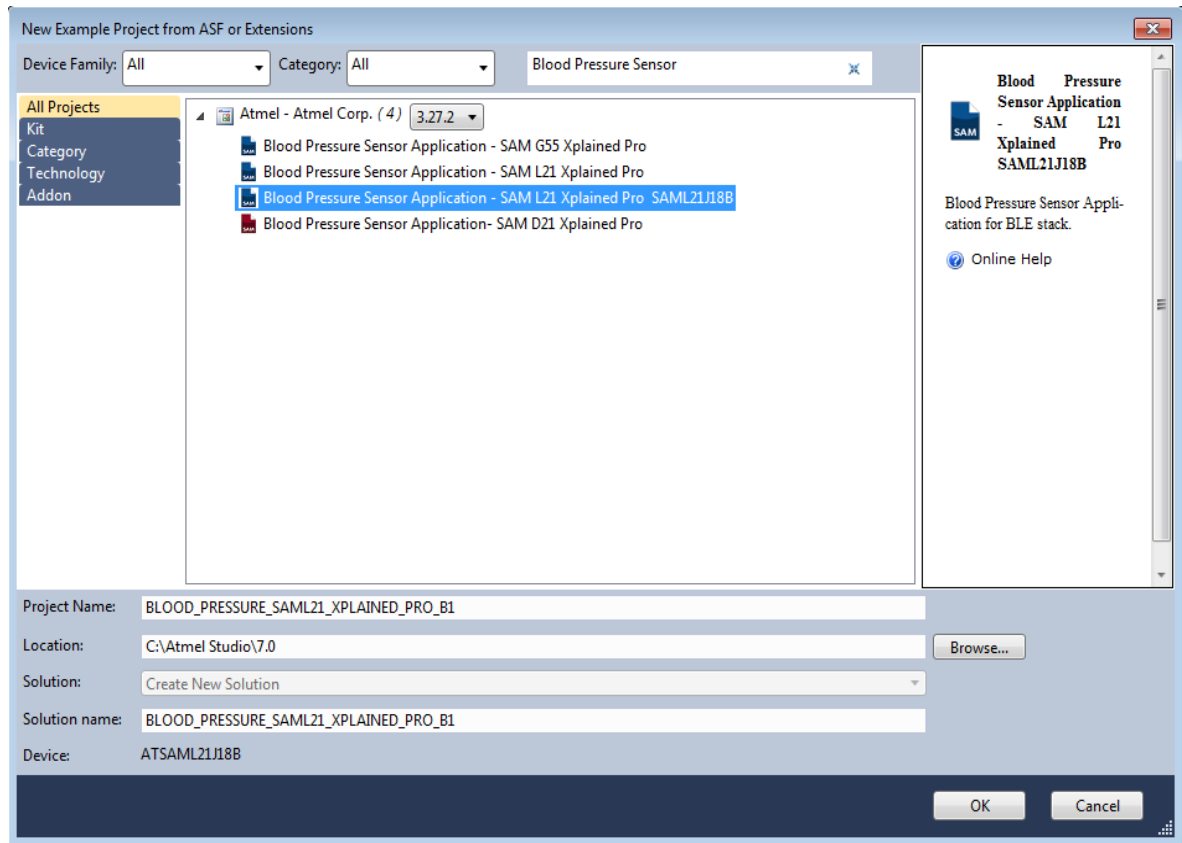
Select New Example Project.

Figure 5-1. Creating a New Project



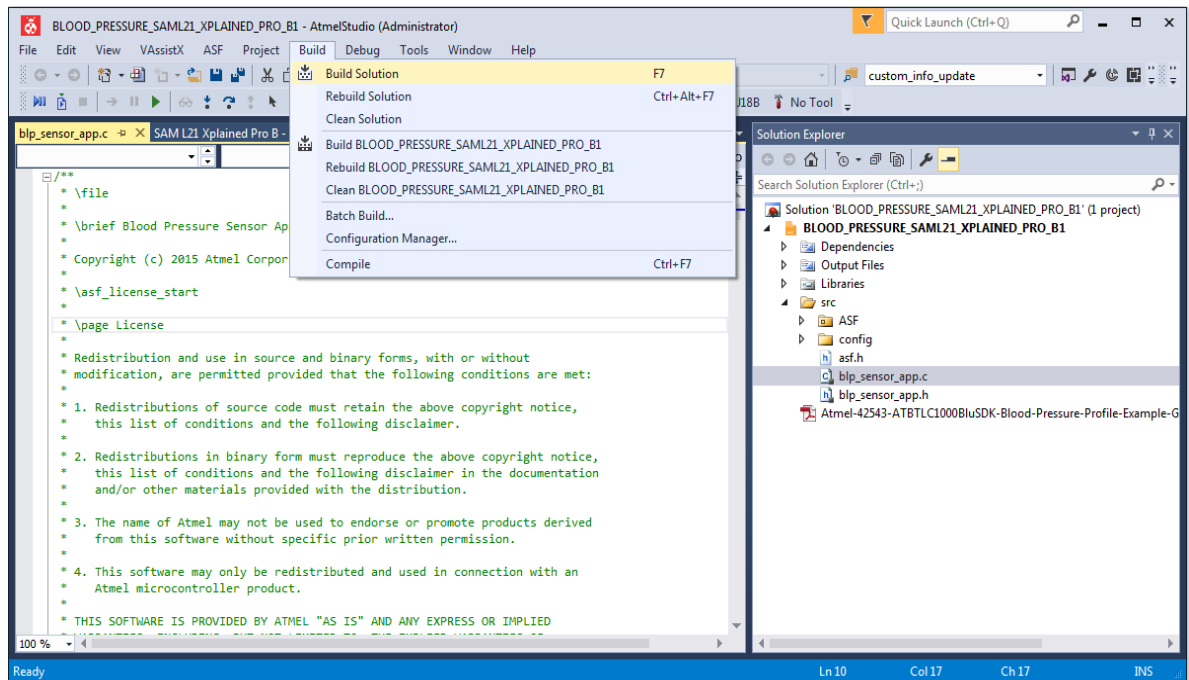
1. Select "SAML32-bit" in the device family, enter "Blood Pressure " in the search window, and expand Atmel Corp. Projects. The location and the name of the project can be selected in the respective fields. Click OK.

Figure 5-2. Selecting the Blood Pressure Application from Example Projects



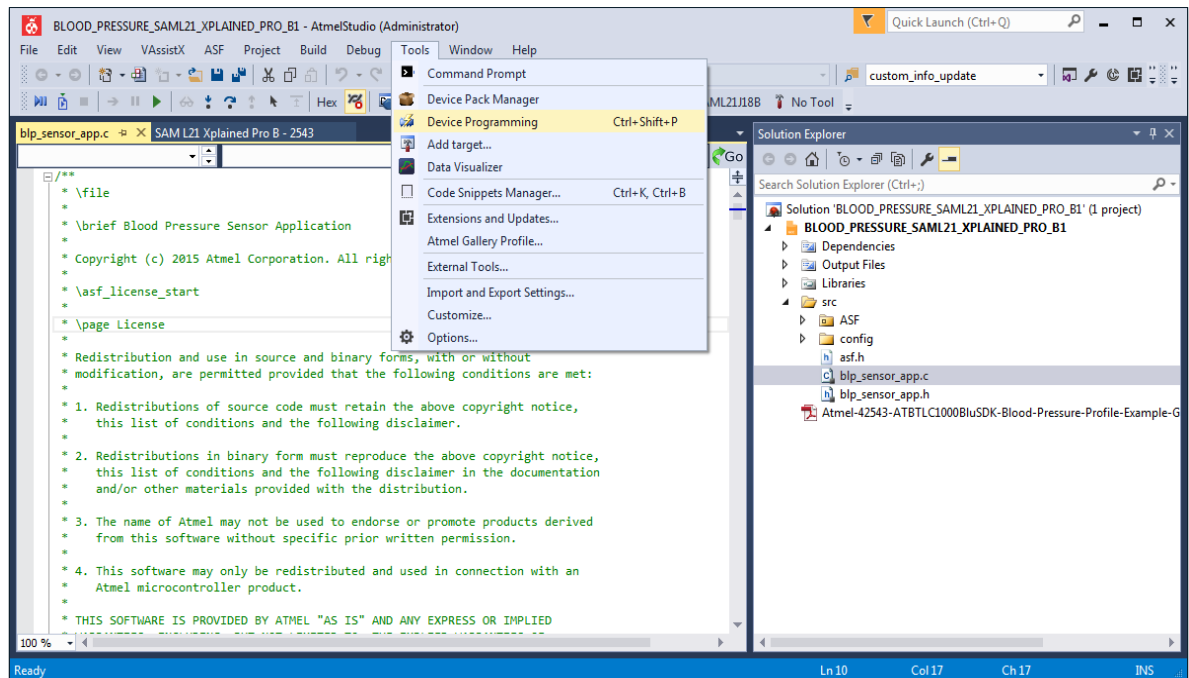
2. Accept the license Agreement. The studio will generate the Blood Pressure Profile project for SAM L21.
3. Build the solution.

Figure 5-3. Building Blood Pressure Application



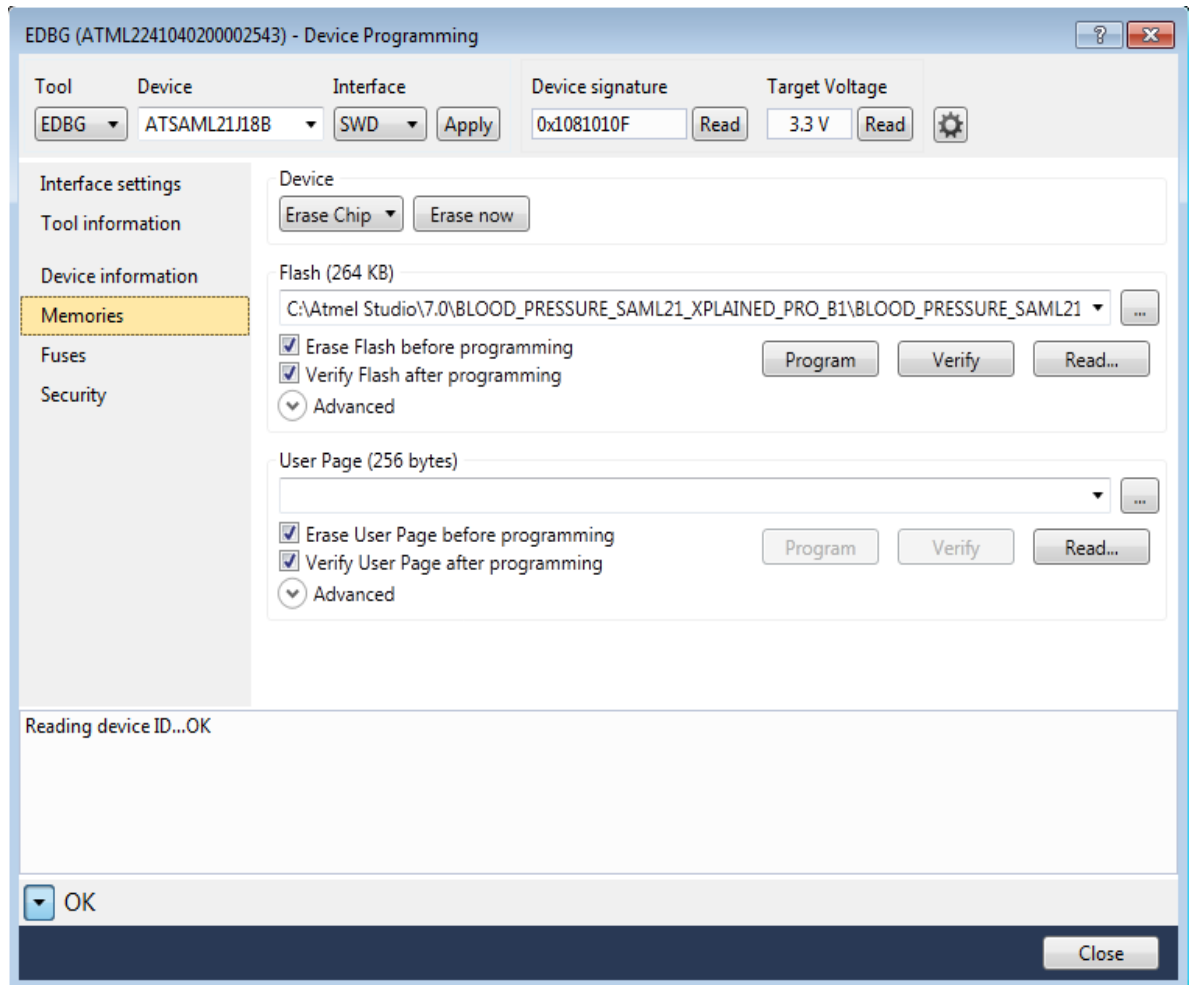
4. Download the application via the USB to the SAM L21 board by using the Device Programming option available in Tools as mentioned below.

Figure 5-4. Programming the Blood Pressure Application to SAM L21



5. Inside device programming the user has to select the correct configuration for the device and finally program the device by using the program button.

Figure 5-5. Flashing the Blood Pressure Sensor Application



6. Once the application is flashed the BLOOD PRESSURE application is ready for usage.

6 Console Logging

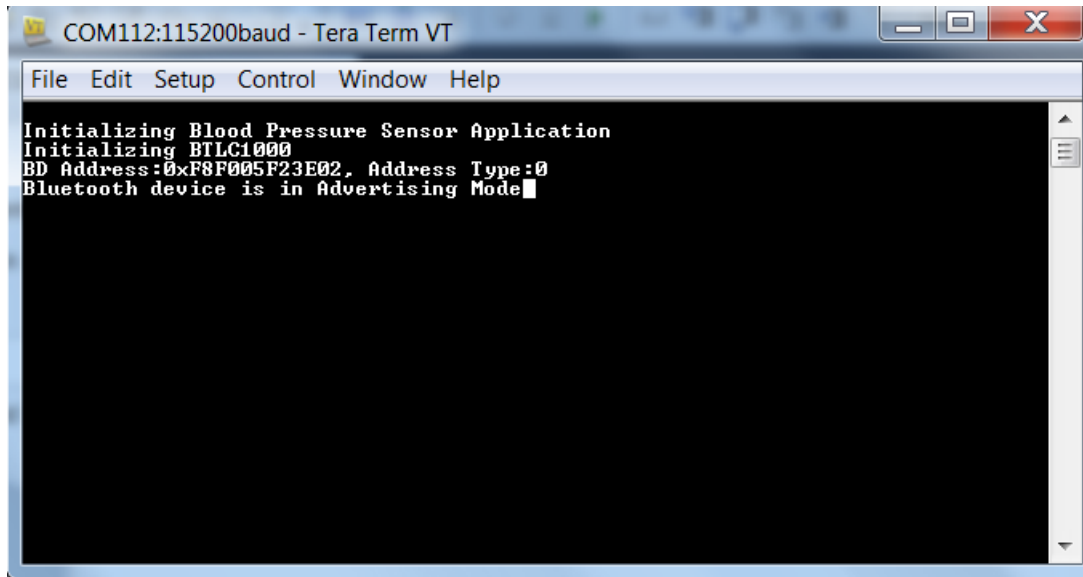
For the purpose of debugging, a logging interface has been implemented in the BLOOD PRESSURE application.

The logging interface utilizes the same EDBG port that connects to the supported platform. A serial port monitor application (for example TeraTerm) shall be opened and attached to the corresponding COM port enumerated on the PC by the device. Baud rate should be set to 115200.

7 Running the Demo

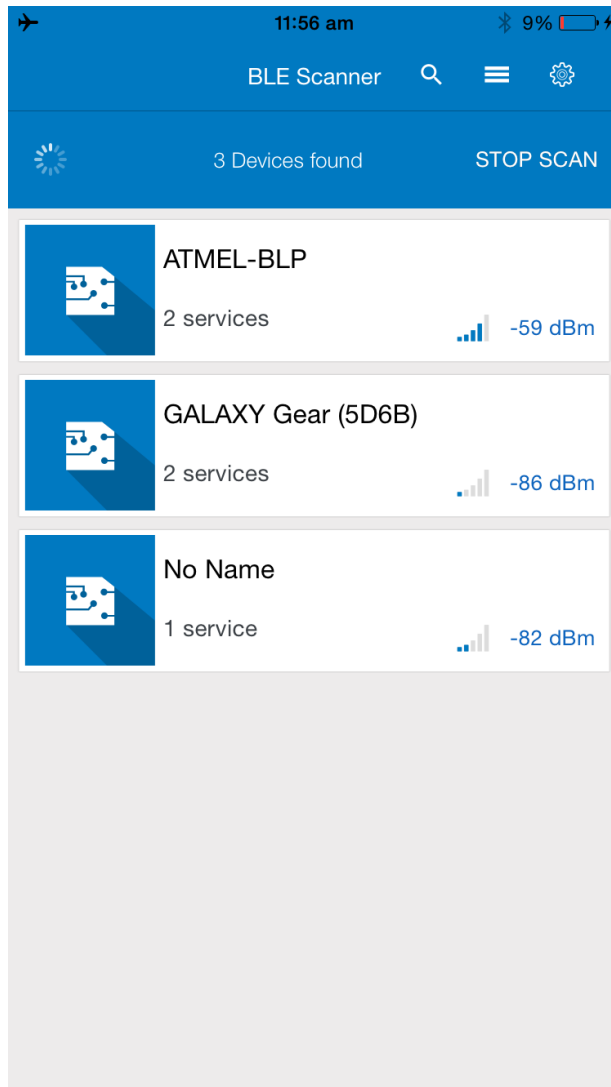
1. Power on the SAM L21 + ATBTLC1000 setup by connecting the USB cable as indicated in [Figure 3-1](#).
2. Open a console window by using TeraTerm or any equivalent serial port monitor application and connect to the corresponding COM port enumerated on the PC. (Settings: Baudrate 115200, None Parity, one Stop bit, one Start bit, no Hardware Handshake.)
3. Press the Reset button on the SAM L21 or supported platform board.
4. The device is now in advertising mode.

Figure 7-1. Console Display for Advertising Mode



5. On a BLE compatible Android phone or on an iPhone, enable Bluetooth in the Settings page. Use the Atmel Smart Connect mobile app and scan for devices. ATMEL-BLP will appear among the devices scanned. Click on ATMEL-BLP to connect to the SAM L21 or supported platform + ATBTLC1000 device.

Figure 7-2. Atmel BLP Device Discovery on iPhone



6. Once connected, the client side will request for the pairing procedure with the phone. The console log provides a guidance for the user to enter the pass-key on the phone.

Figure 7-3. Console Log for Pairing Procedure

```
COM129:115200baud - Tera Term VT
File Edit Setup Control Window Help

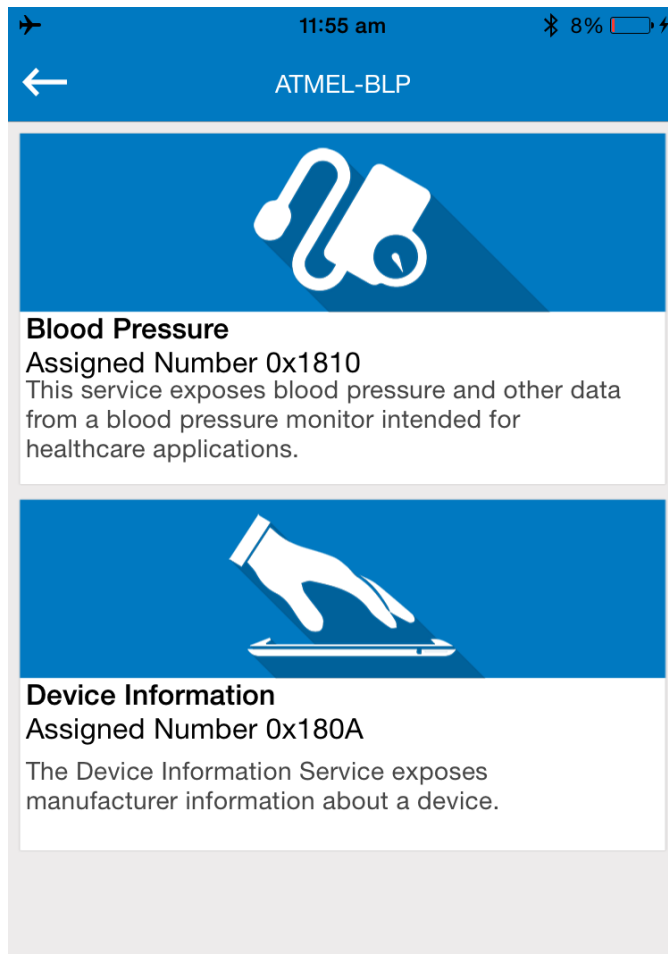
Initializing Blood Pressure Sensor Application
Initializing BTLC1000
BD Address:0xF8F005F35254, Address Type:0
Bluetooth device is in Advertising Mode
Connected to peer device with address 0x585e3bb3e08a
Connection Handle 0
Please Enter the following Pass-code(on other Device):123456
Pairing procedure completed successfully
Indications enabled by the remote device for blood pressure

Systolic      10 kpa
Diastolic     07 kpa
Map           08 kpa
Pulse rate    60 bpm

Press the button to receive the blood pressure parameters
Notifications enabled by the remote device for interim cuff pressure
```

7. Once the device is connected, the following services shall be displayed on the mobile app.

Figure 7-4. Discovery of Services for BLP Application



8. On entering the Blood Pressure service page, the mobile application will enable the notifications and indications for interim cuff pressure and blood pressure characteristics respectively. The blood

pressure sensor device simulated by ATBTLC1000 + SAML21 will send the current blood pressure values after receiving the indications enabling request. The corresponding console logs and mobile application screen are shown below

Figure 7-5. Console Log for Blood Pressure Measurements

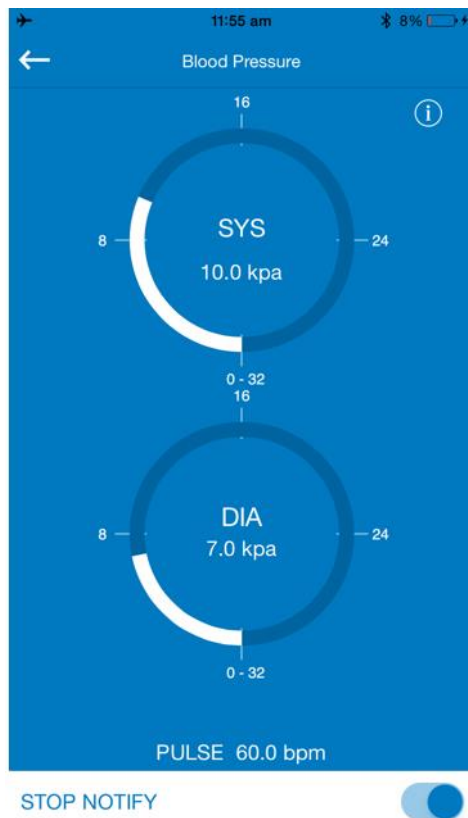
```
COM129:115200baud - Tera Term VT
File Edit Setup Control Window Help

Initializing Blood Pressure Sensor Application
Initializing BTLC1000
BD Address:0xF8F005F35254, Address Type:0
Bluetooth device is in Advertising Mode
Connected to peer device with address 0x585e3bb3e08a
Connection Handle 0
Please Enter the following Pass-code(on other Device):123456
Pairing procedure completed successfully
Indications enabled by the remote device for blood pressure

Systolic      10 kpa
Diastolic     07 kpa
Map           08 kpa
Pulse rate    60 bpm

Press the button to receive the blood pressure parameters
Notifications enabled by the remote device for interim cuff pressure
```

Figure 7-6. Mobile app Blood Pressure Service Page after Receiving BP Indications



9. The SW0 button can be used on SAML21 to receive updated blood pressure measurements. The blood pressure sensor will first send the interim cuff pressure values as notifications and then send the final blood pressure measurements as indication. The blood pressure measurements

sent by blood pressure sensor are simulated values. The following pictures demonstrates the scenario after SW0 button press

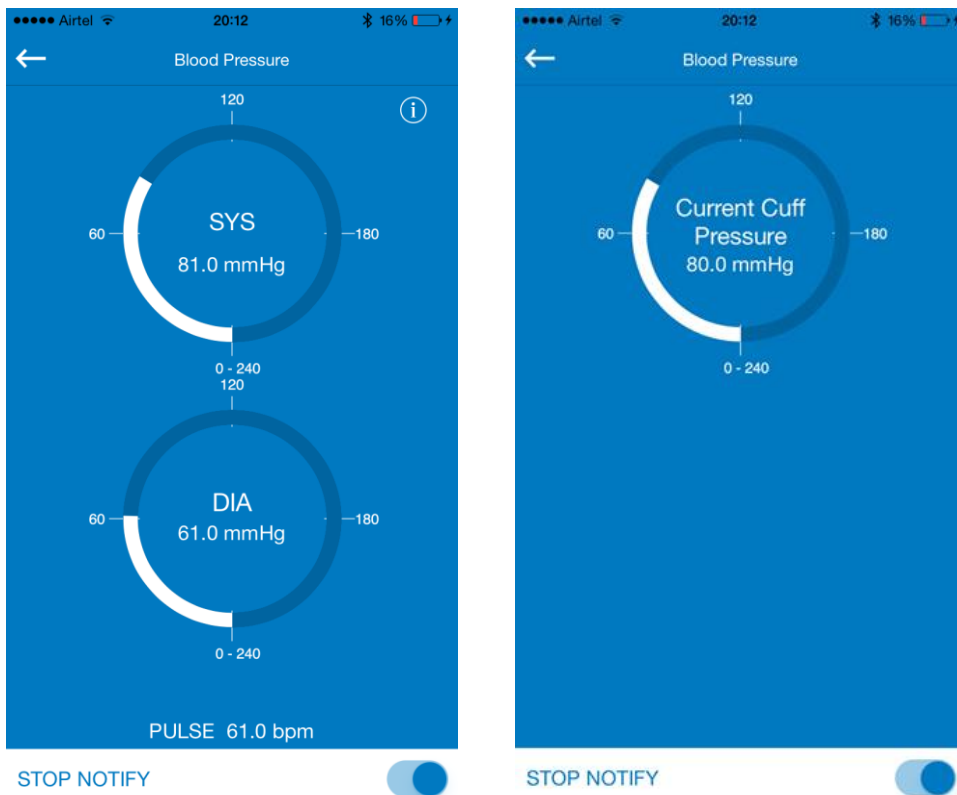
Figure 7-7. Console Log for Blood Pressure Values after Button Press

```
Started sending Interim Cuff Pressure Values
Cuff pressure 80 mmhg
Cuff pressure 81 mmhg
Cuff pressure 82 mmhg
Cuff pressure 83 mmhg
Cuff pressure 84 mmhg
Cuff pressure 85 mmhg
Cuff pressure 86 mmhg
Cuff pressure 87 mmhg
Cuff pressure 88 mmhg

The Blood Pressure Values are:
Systolic      81 mmhg
Diastolic     61 mmhg
Map           71 mmhg
Pulserate     61 bpm

Press the button to receive the blood pressure parameters
```

Figure 7-8. Mobile App Blood Pressure Service Pages after Receiving Measurement Data on Button Press

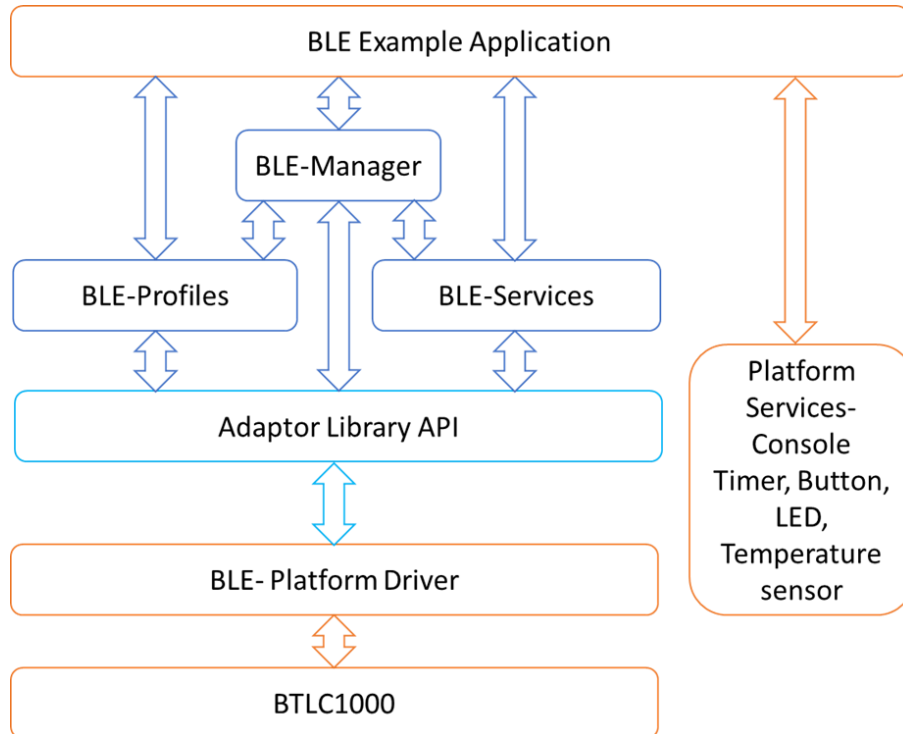


Note: The Atmel Smart Connect mobile App for Android also implements the same features and provides the same look and feel. Henceforth incase a BLE compatible Android phone is used, the demo instructions from the mobile app perspective remain the same as above.

8 BluSDK Software Architecture

Figure 8-1 illustrates the various layers in the BLE subsystem for the ATBTLC1000 configuration. The External host can be the supported platform. The application in this example is Blood Pressure Profile.

Figure 8-1. BluSDK Software Architecture



9 ATMEL EVALUATION BOARD/KIT IMPORTANT NOTICE AND DISCLAIMER

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10 Revision History

| Doc Rev. | Date | Comments |
|----------|---------|--|
| 42543C | 02/2016 | Table 2.1 is updated with SAM4S Hardware Support. Figure 3.4 is updated with SAM4S Xplained Pro Image. Section 5.1 Installation Steps are updated. |
| 42543B | 11/2015 | Figure 3-1 is updated. The screenshots in Chapter 5 are updated. |
| 42543A | 09/2015 | Initial document release. |



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