



# **GAP—Central Demo User's Guide**

# GAP\_Central\_Demo\_User's\_Guide

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## 1. Overview

This document explains how to setup an GAP-Central demo using SAML21 Xplained Pro, BM71-XPro. This document briefly talks about setting up hardware, building application, programming firmware and running a demo.

This demo application showcases a Proof-of-Concept example of using **ble\_host\_sdk** to setup BM71 as GAP-Central. This demo application scan for suitable GAP-Peripheral device and connects with it. Once connected it discovers device orientation service and characteristics in remote device and enable notifications to get accelerometer and gyroscope sensor data from remote device. Upon receiving data from remote GAP-Peripheral device, the Central demo prints them on serial console.

The following table provides the list of expected BLE services and Characteristics in this application.

Name	UUID	Properties	Size (bytes)
Device Orientation Service (Custom)	0xF05ABAC1393611E587A60002A5D5C51B	-	-
Accelerometer Position Characteristic	0x1BC5D5A50200A687E5113639D7BA5AF0	Notify, Read	6
Gyroscope Position Characteristic	0x1BC5D5A50200A687E5113639D4BA5AF0	Notify, Read	6

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## 1.1. Hardware Setup

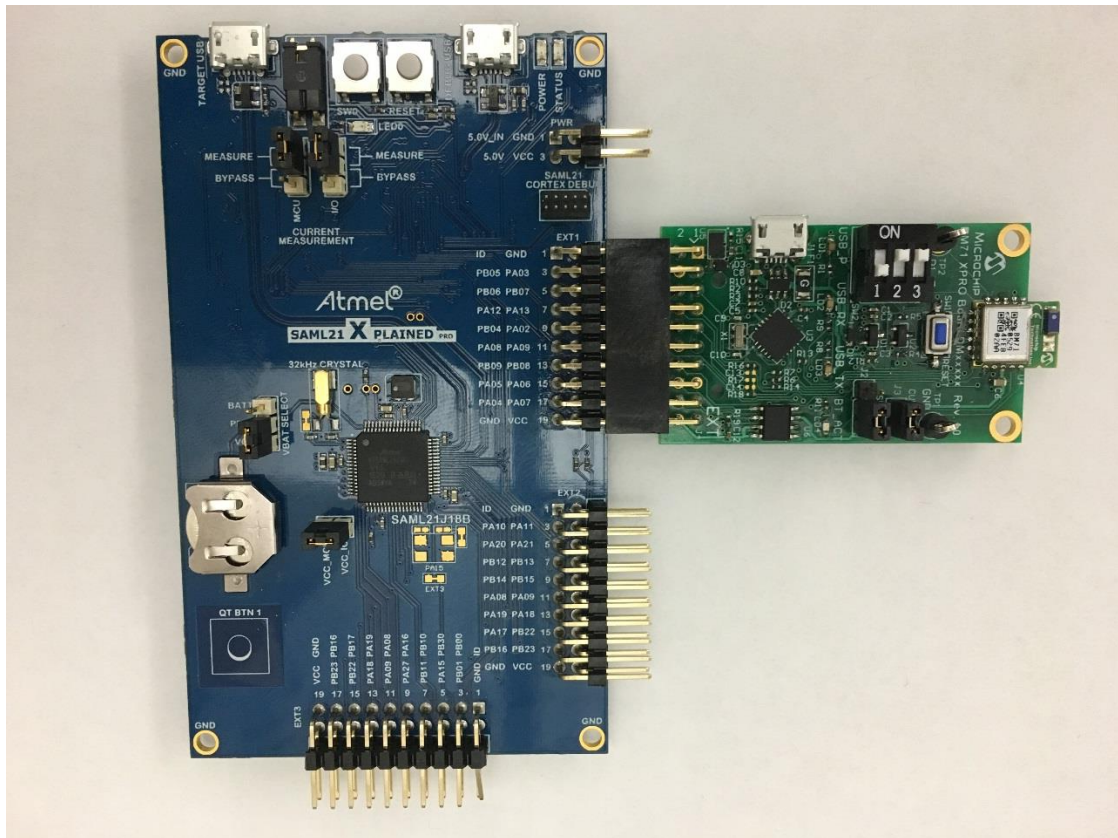


Figure 1: SAML21 Xplained Pro with BM71-XPro

1. Plug in the BM71-XPro board into EXT1 of SAML21 Xplained Pro board as shown in Figure 1.
2. Connect the SAML21 Xplained Pro board to the host PC using micro USB cable.

## 1.2. Console

The GAP-Central demo application uses the Universal Asynchronous Receiver/Transmitter (UART) interface on SAML21 Xplained Pro to send the status messages like Scanning, Connected, Disconnected and the sensor data from remote device. Any serial application (ex: TeraTerm) can be used to interact with SAML21 Xplained Pro.

Use the following serial port configuration to interact with BM70.

<b>Baud rate</b>	115200
<b>Data</b>	8 bits
<b>Parity</b>	none
<b>Stop</b>	1 bit
<b>Flow control</b>	none

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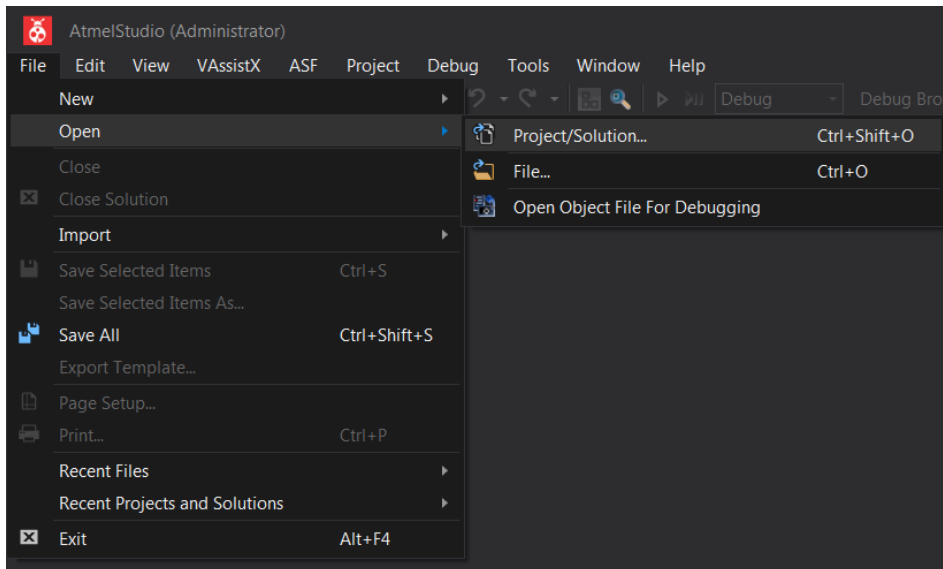
## 2. Build Procedure

This section describes the build procedure of GAP-Central demo application on Atmel Studio 7.

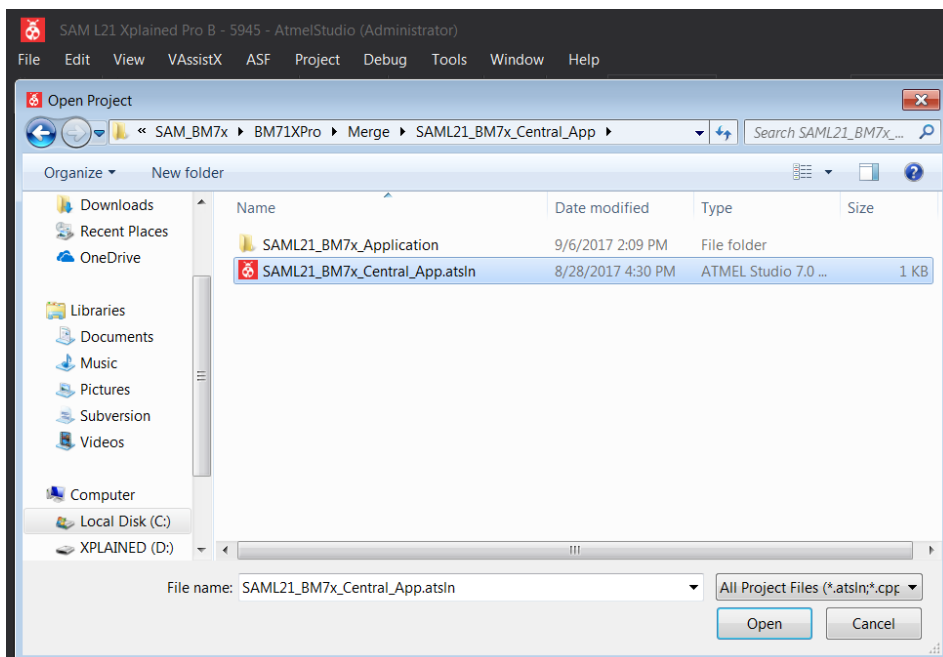
### 2.1. Open Atmel Studio 7

### 2.2. Open GAP-Central Demo Application

1. Go to menu **File** → **Open** → **Project/Solution**.



2. Select “SAML21\_BM7x\_Central\_App.atsln” and press **Open**.



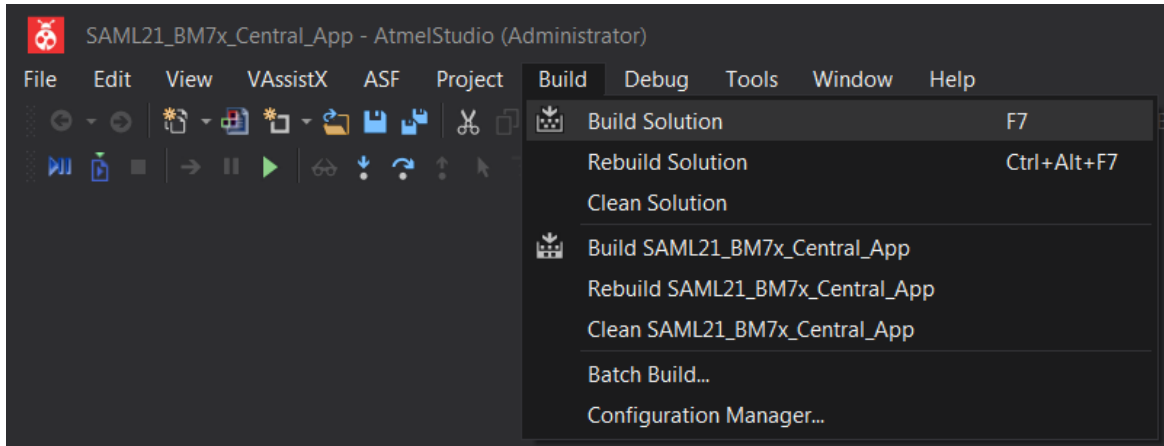
3. Once the project is opened, you can see the files attached to this project in Solution Explorer Window

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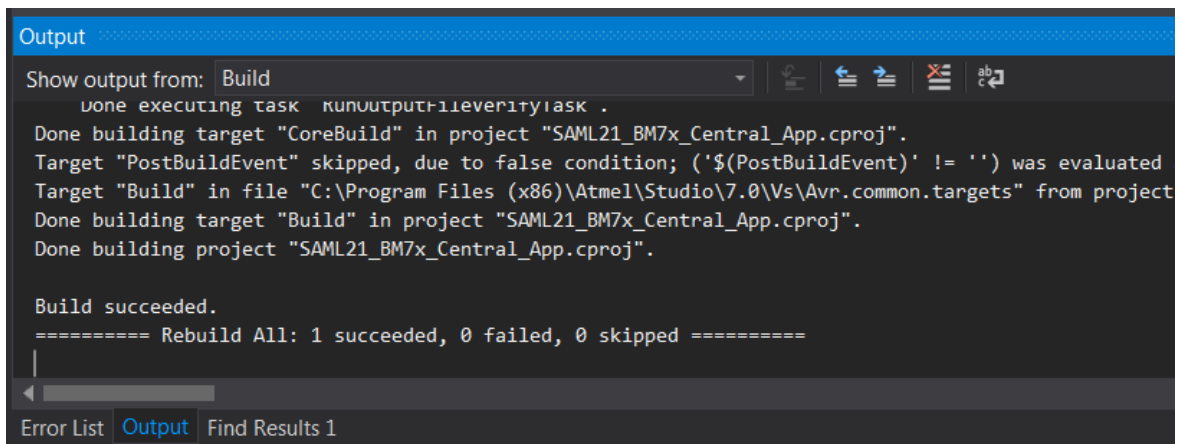
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## 2.3. Build GAP-Central Demo Application

1. Go to menu **Build** → **Build Solution** or Press **F7**



2. Build status can be checked in **Output** window



3. You can find the Hex images in “..\SAML21\_BM7x\_Application\Debug”.

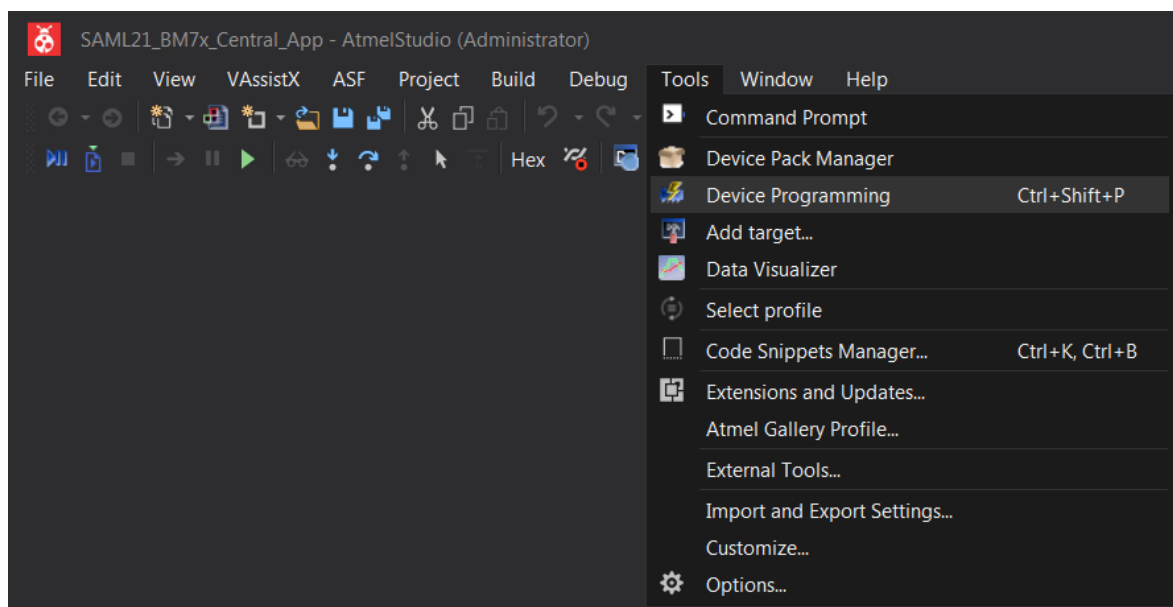
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## 3. Programming Firmware

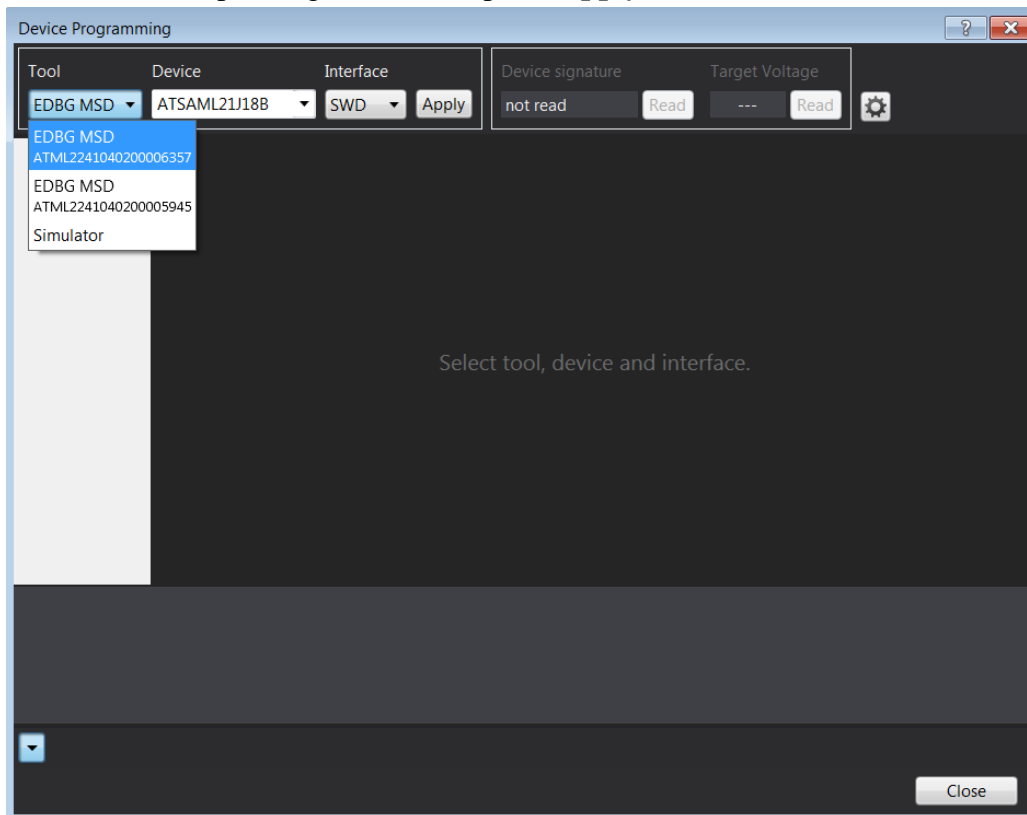
This section describes the procedure to program GAP-Central demo firmware on SAML21 Xplained Pro board.

1. Connect the SAML21 Xplained Pro board to the host PC using micro USB cable. Perform the following steps:
  - a. Verify that the virtual COM port is enumerated on the host PC.
  - b. Make sure that POWER LED (green) is solid ON.
2. To program the HEX files into the SAML21, go to menu **Tools → Device Programming** or Press **Ctrl + Shift + P**.

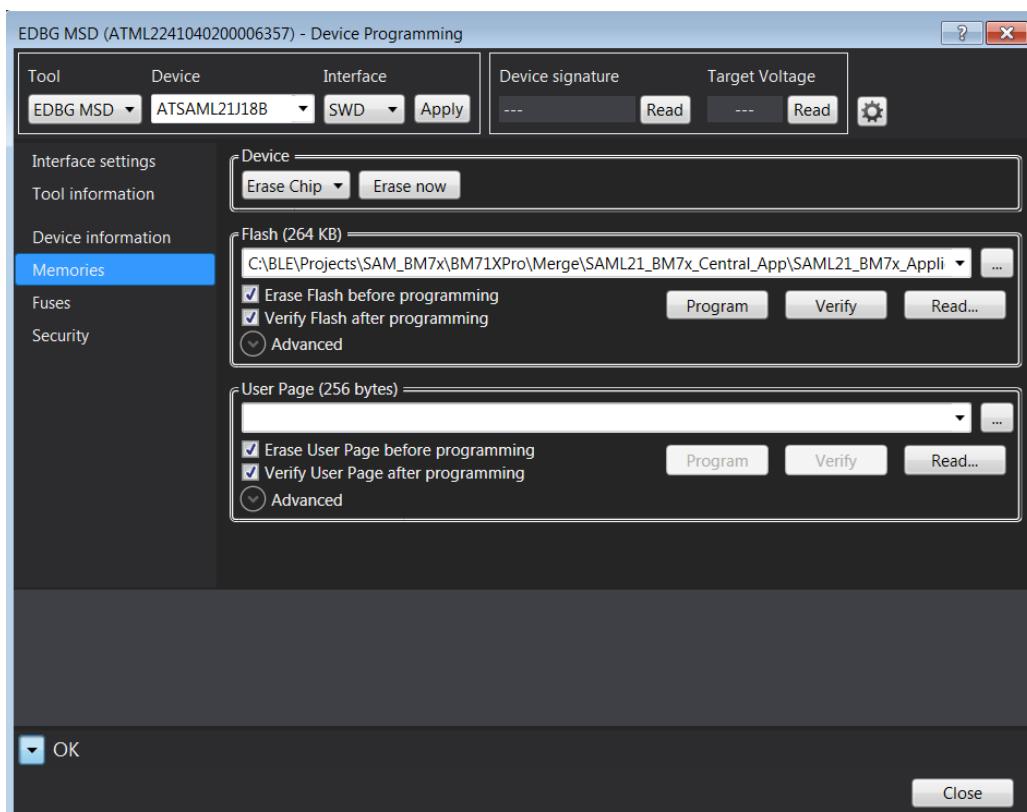


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3. Select the corresponding **EDBG** and press **Apply**.



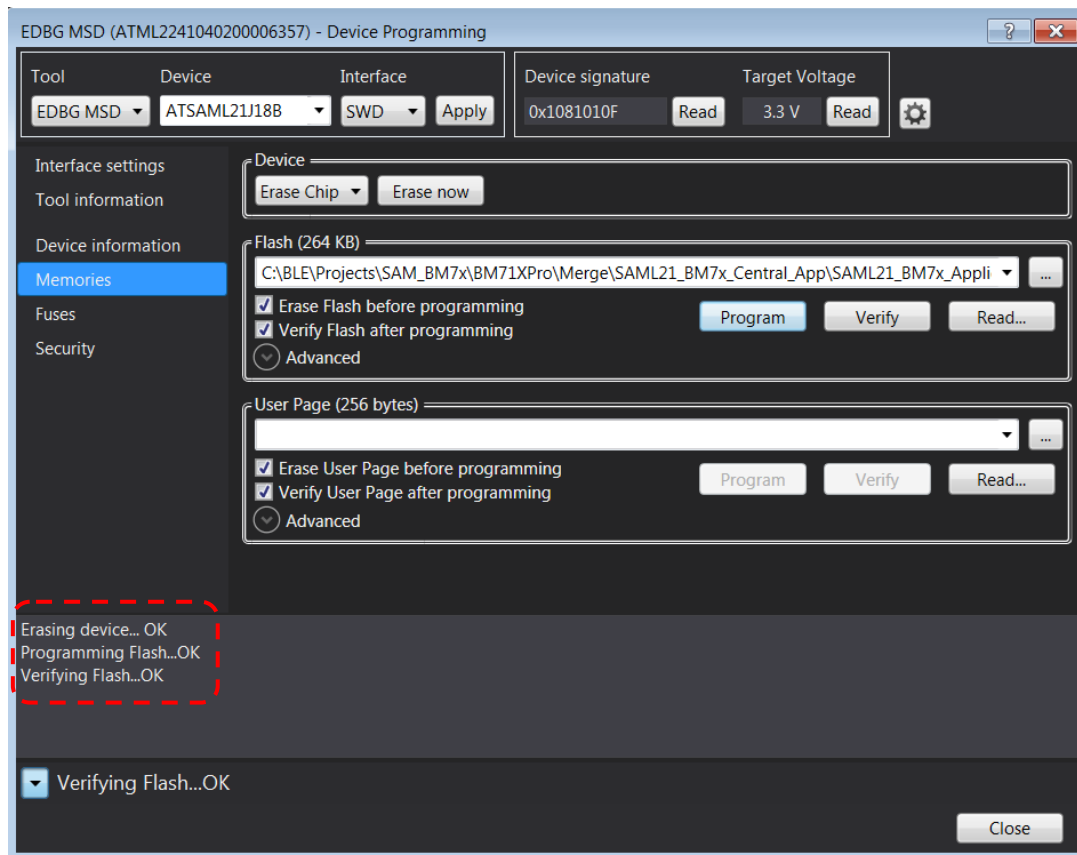
4. Go to **Memories** Tab and select Hex file.





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5. Press **Program**, the tool will program SAML21. You can check the status of programming.



6. Once programming is done, close the Device Programming window.

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## 4. Running GAP-Central Demo with GAP-Peripheral Device

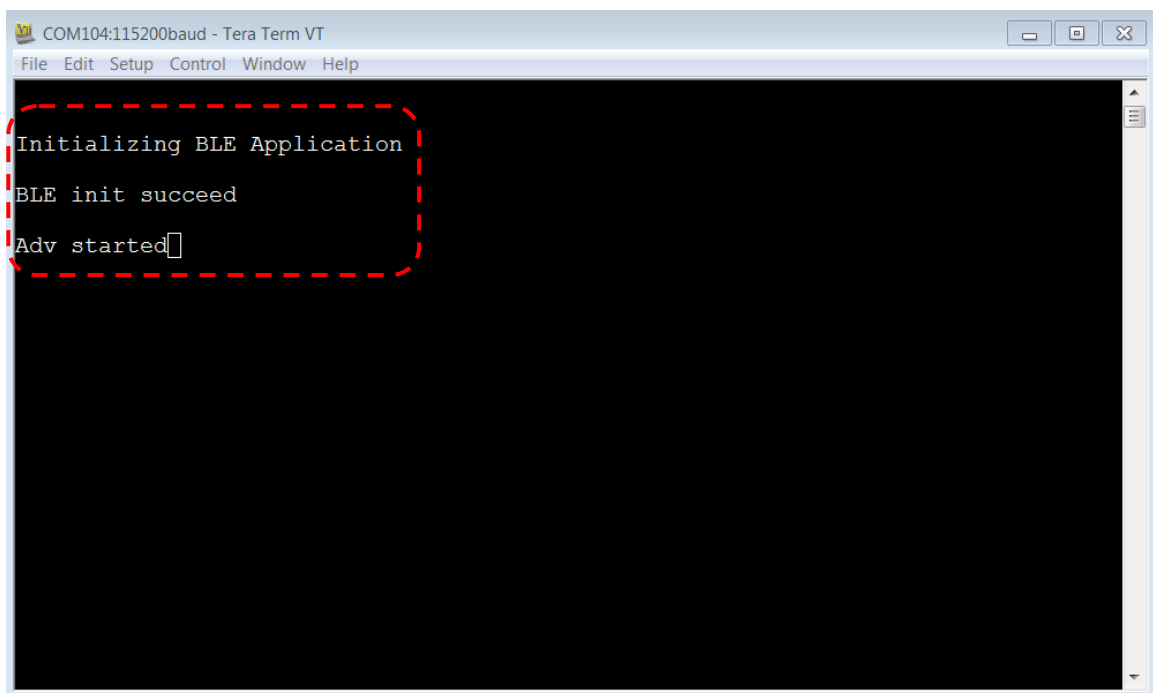
This section describes the GAP-Central Demo procedures to work with GAP-Peripheral device.

1. Connect BM71-XPro on EXT1 of SAML21 Xplained Pro board (GAP-Peripheral device).
2. Connect the GAP-Peripheral device to the host PC using micro USB cable. Perform the following steps:

- a. Verify that the virtual COM port is enumerated on the host PC.
- b. Open the enumerated COM port on a serial console application like TeraTerm with the following settings:

<b>Baudrate</b>	115200
<b>Data</b>	8 bits
<b>Parity</b>	none
<b>Stop</b>	1 bit
<b>Flow control</b>	none

- c. Make sure that POWER LED (green) on SAML21 Xplained Pro board is solid ON.
  - d. Press Reset button on SAML21 Xplained Pro board and verify that LD4 (blue) on BM71-XPro is blinking at a regular interval.
3. Ensure that the GAP-Peripheral device is up and running and start advertising. Check status on a serial console application.



4. Connect BM71-XPro on EXT1 of SAML21 Xplained Pro board (GAP-Central device).
5. Connect the GAP-Central device to the host PC using micro USB cable. Perform the following steps:

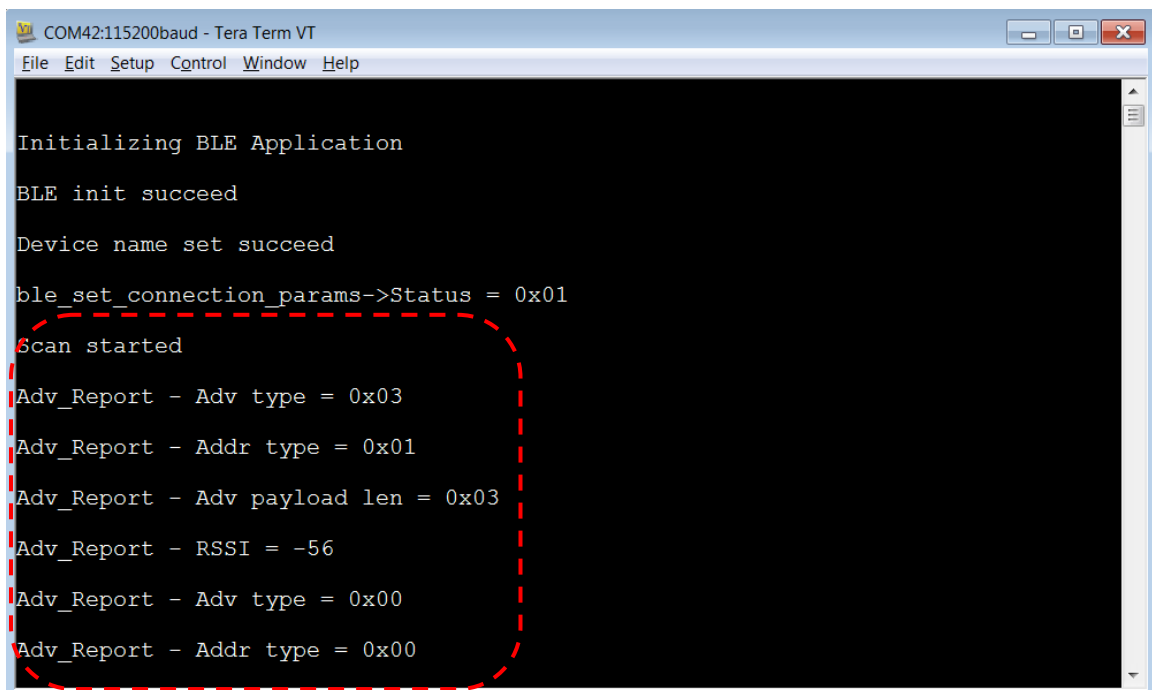
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- a. Verify that the virtual COM port is enumerated on the host PC.
- b. Open the enumerated COM port on a serial console application like TeraTerm with the following settings:

<b>Baudrate</b>	115200
<b>Data</b>	8 bits
<b>Parity</b>	none
<b>Stop</b>	1 bit
<b>Flow control</b>	none

- c. Make sure that POWER LED (green) on SAML21 Xplained Pro board is solid ON.
  - d. Press Reset button on SAML21 Xplained Pro board and verify that LD4 (blue) on BM71-XPro is blinking at a regular interval.
6. Ensure GAP-Central device is up and running and start scanning. Check status on a serial console application.



The screenshot shows a TeraTerm window titled 'COM42:115200baud - Tera Term VT'. The menu bar includes File, Edit, Setup, Control, Window, and Help. The terminal output is as follows:

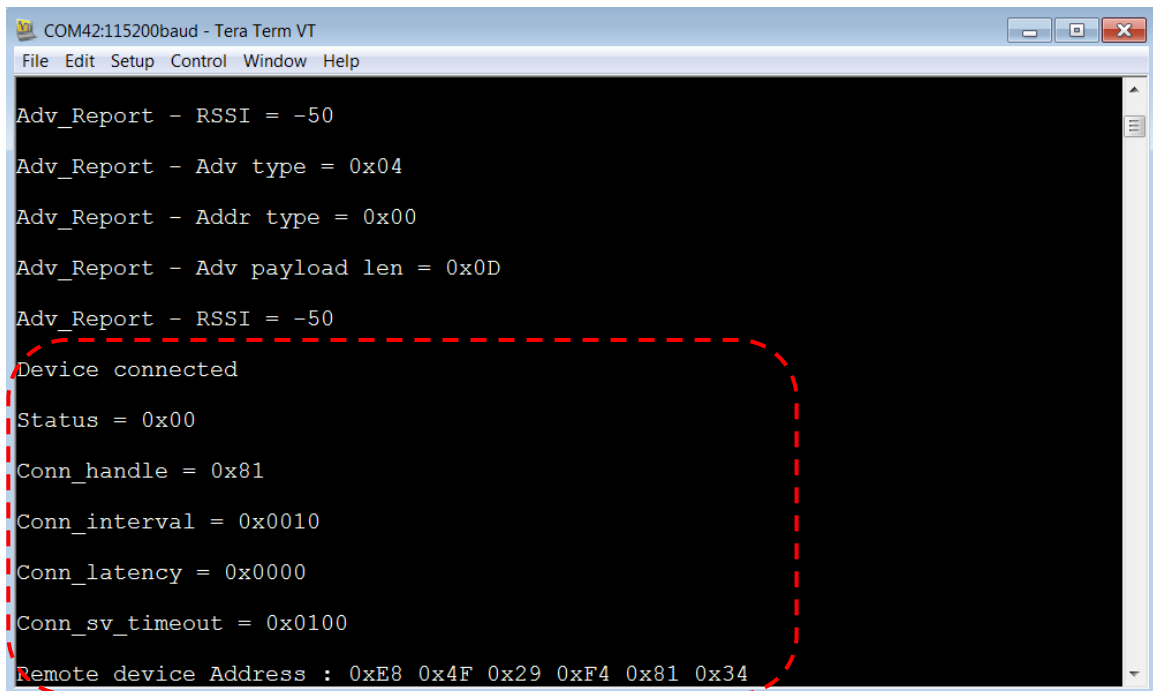
```
Initializing BLE Application
BLE init succeed
Device name set succeed
ble_set_connection_params->Status = 0x01
Scan started
Adv_Report - Adv type = 0x03
Adv_Report - Addr type = 0x01
Adv_Report - Adv payload len = 0x03
Adv_Report - RSSI = -56
Adv_Report - Adv type = 0x00
Adv_Report - Addr type = 0x00
```

A red dashed rectangle highlights the scanning output, starting from 'Scan started' and ending with the last 'Adv\_Report' line.

7. As GAP-Central device receives advertisements from devices in vicinity, it prints the advertisement report in serial console.
8. GAP-Central device finds the suitable GAP-Peripheral device based on the advertisement payload and initiates a connection.
9. Once connected the GAP-Central device prints the GAP-Peripheral device address and connection parameters in serial console.

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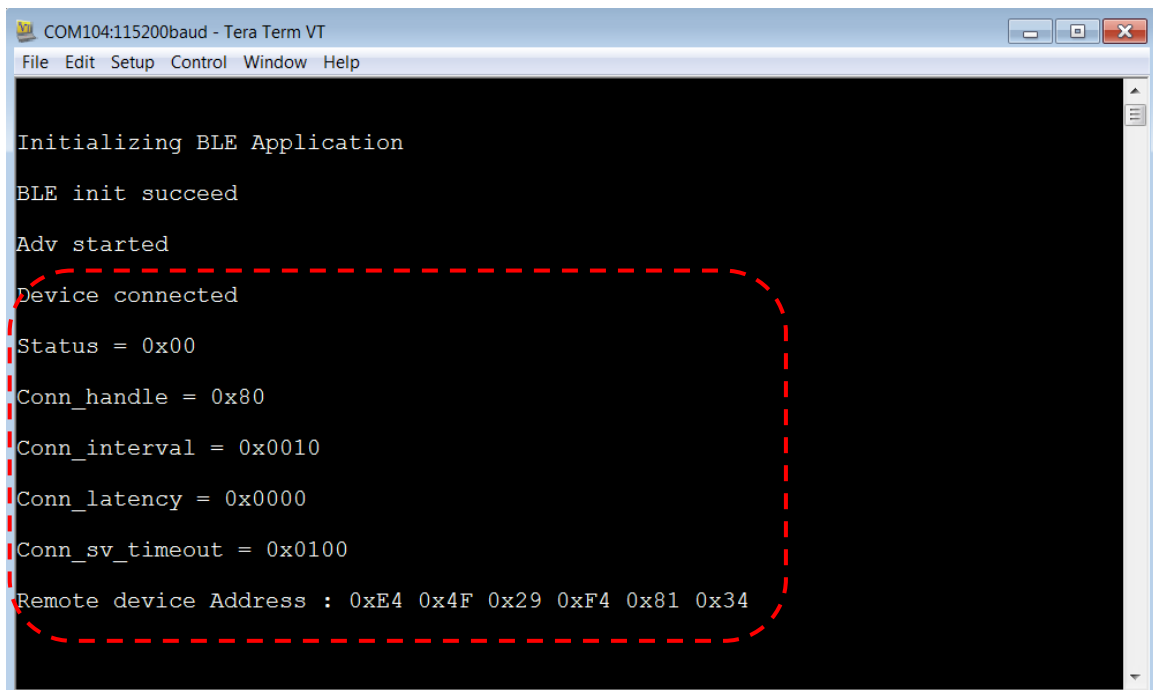
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```
COM42:115200baud - Tera Term VT
File Edit Setup Control Window Help

Adv_Report - RSSI = -50
Adv_Report - Adv type = 0x04
Adv_Report - Addr type = 0x00
Adv_Report - Adv payload len = 0x0D
Adv_Report - RSSI = -50
Device connected
Status = 0x00
Conn_handle = 0x81
Conn_interval = 0x0010
Conn_latency = 0x0000
Conn_sv_timeout = 0x0100
Remote device Address : 0xE8 0x4F 0x29 0xF4 0x81 0x34
```

10. Similarly, once connected GAP-Peripheral device prints the GAP-Central device address and connection parameters in serial console.



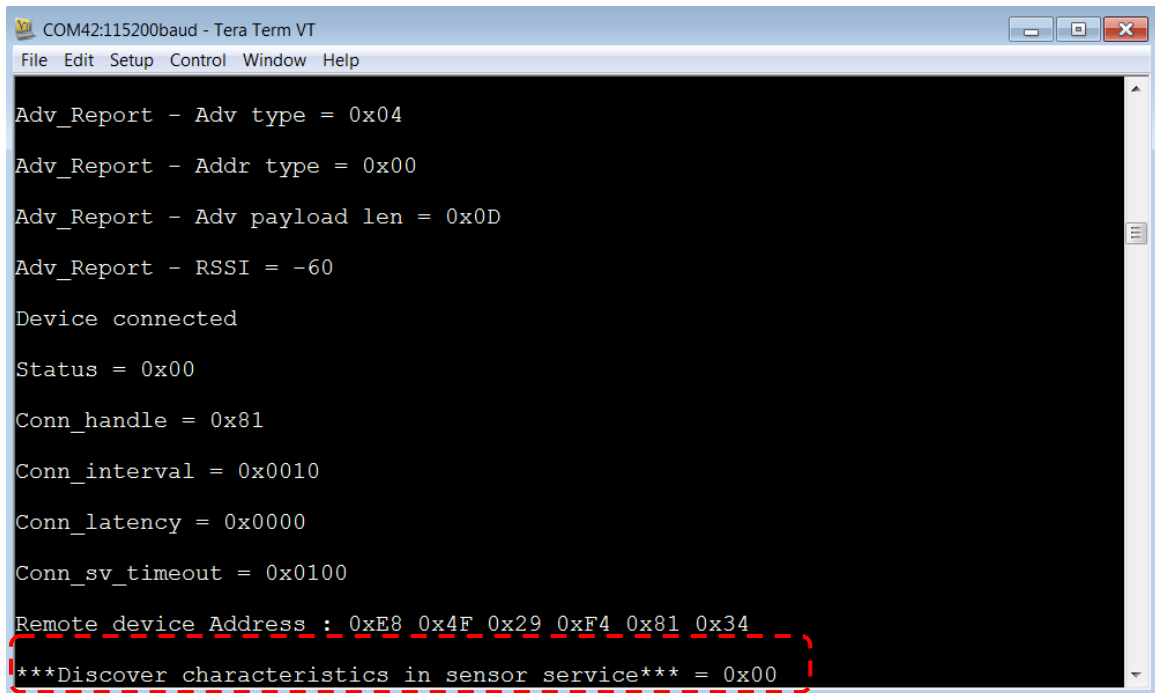
```
COM104:115200baud - Tera Term VT
File Edit Setup Control Window Help

Initializing BLE Application
BLE init succeed
Adv started
Device connected
Status = 0x00
Conn_handle = 0x80
Conn_interval = 0x0010
Conn_latency = 0x0000
Conn_sv_timeout = 0x0100
Remote device Address : 0xE4 0x4F 0x29 0xF4 0x81 0x34
```

11. Once connected, Multilink-Central discovers the device orientation service and characteristics in remote device based on the UUID.

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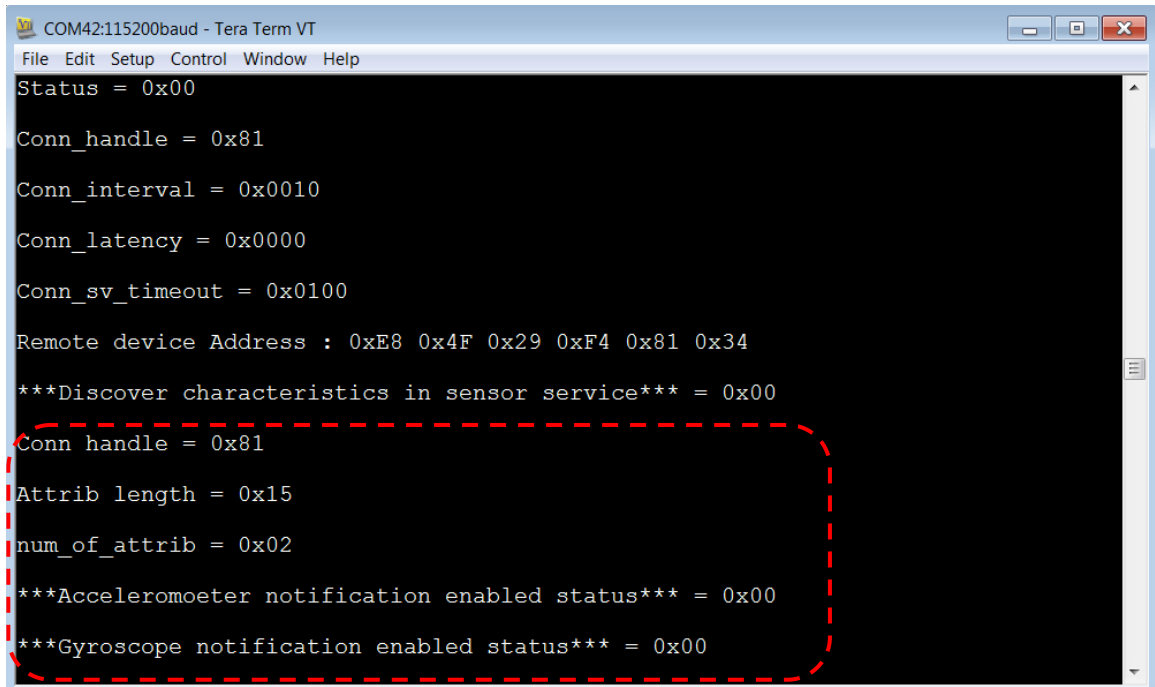
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```
COM42:115200baud - Tera Term VT
File Edit Setup Control Window Help

Adv_Report - Adv type = 0x04
Adv_Report - Addr type = 0x00
Adv_Report - Adv payload len = 0x0D
Adv_Report - RSSI = -60
Device connected
Status = 0x00
Conn_handle = 0x81
Conn_interval = 0x0010
Conn_latency = 0x0000
Conn_sv_timeout = 0x0100
Remote device Address : 0xE8 0x4F 0x29 0xF4 0x81 0x34
***Discover characteristics in sensor service*** = 0x00
```

12. It also discovers the Client Characteristic Configuration Descriptors (CCCD) of accelerometer and gyroscope sensor characteristics and enabled them to receive notifications.



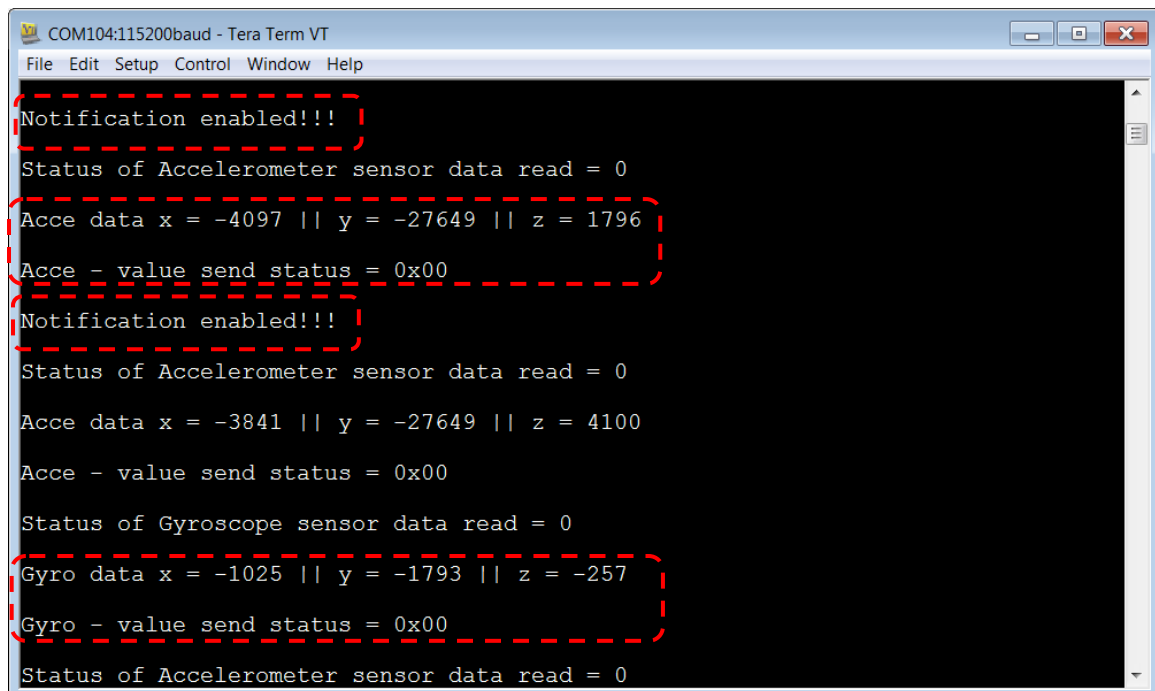
```
COM42:115200baud - Tera Term VT
File Edit Setup Control Window Help

Status = 0x00
Conn_handle = 0x81
Conn_interval = 0x0010
Conn_latency = 0x0000
Conn_sv_timeout = 0x0100
Remote device Address : 0xE8 0x4F 0x29 0xF4 0x81 0x34
***Discover characteristics in sensor service*** = 0x00
Conn handle = 0x81
Attrib length = 0x15
num_of_attrib = 0x02
***Acceleromoeter notification enabled status*** = 0x00
***Gyroscope notification enabled status*** = 0x00
```

13. Upon notification enabled by GAP-Central device, GAP-Peripheral device start notifies the accelerometer and gyroscope sensor data to GAP-Central device.
14. GAP-Peripheral prints the accelerometer and gyroscope sensor data on serial console. It also prints notification status on serial console.

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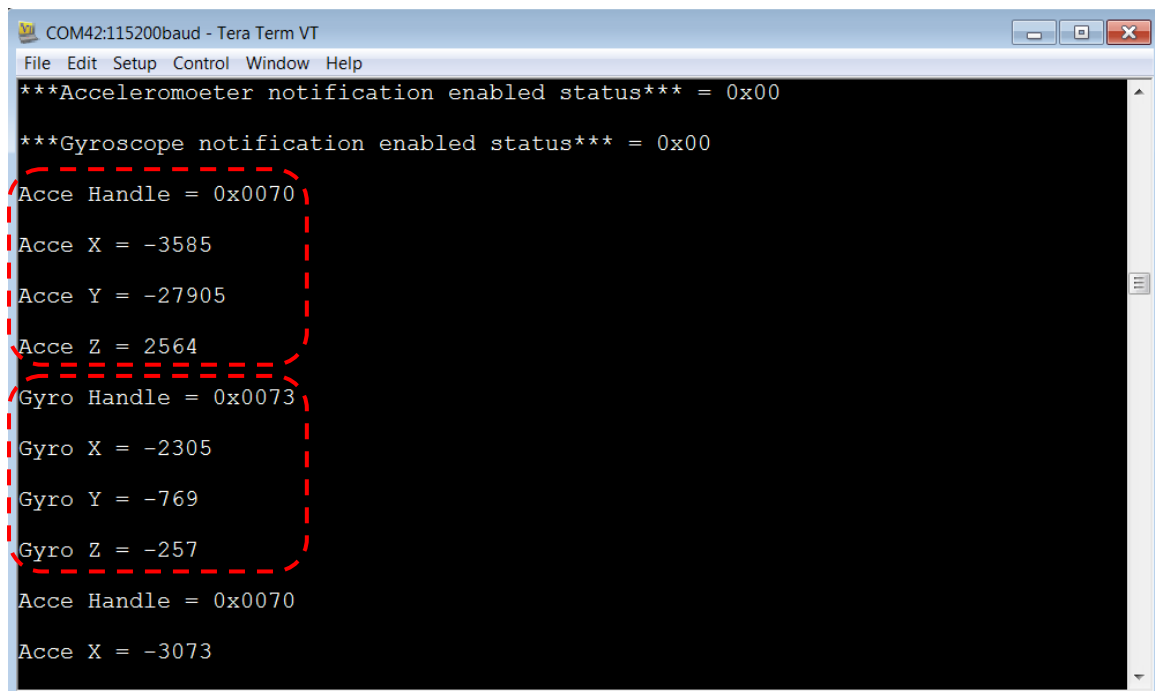
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```
COM104:115200baud - Tera Term VT
File Edit Setup Control Window Help

Notification enabled!!!
Status of Accelerometer sensor data read = 0
Acce data x = -4097 || y = -27649 || z = 1796
Acce - value send status = 0x00
Notification enabled!!!
Status of Accelerometer sensor data read = 0
Acce data x = -3841 || y = -27649 || z = 4100
Acce - value send status = 0x00
Status of Gyroscope sensor data read = 0
Gyro data x = -1025 || y = -1793 || z = -257
Gyro - value send status = 0x00
Status of Accelerometer sensor data read = 0
```

15. GAP-Central devices receive sensor data notifications and print them on serial console.



```
COM42:115200baud - Tera Term VT
File Edit Setup Control Window Help

***Accelerometer notification enabled status*** = 0x00
***Gyroscope notification enabled status*** = 0x00
Acce Handle = 0x0070
Acce X = -3585
Acce Y = -27905
Acce Z = 2564
Gyro Handle = 0x0073
Gyro X = -2305
Gyro Y = -769
Gyro Z = -257
Acce Handle = 0x0070
Acce X = -3073
```

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