S130 Sample Application

User Guide v *1.1*

1 Introduction

A sample S130 application, called *the application* in this document, illustrates the possibility of concurrent central and peripheral operations. The application can handle up to three connections acting as a central and one acting as a peripheral, for a total of 4 simultaneous active connections.

2 Prerequisites

- 1x PCA10028 (Evaluation Kit board) to run this sample application along with the S130 SoftDevice . This must have an IC with revision QFACAB.
- 0-3x PCA10028 (Evaluation Kit board) to run the SDK Heart Rate Service app along with the S110 SoftDevice.
- 0-1x PCA10031 (Evaluation Kit USB dongle) to run the MEFW firmware used by the Master Control Panel application.
- Keil toolchain and IDE. MDK-ARM can be downloaded from www.keil.com for free, and it is adequate for this sample application.
- Newest nRF51 SDK. The included sample application using the Heart Rate service for the nRF51422 evaluation board (PCA10028).
- Master Control Panel application, recommended v. >= 3.3.0.

3 Application description

The roles that take part in the topology defined by this sample application are shown in table 1.

Role	Description
The application	Runs on the S130 prototype SoftDevice. It can handle up to three connections with peer peripherals and one with a peer central.
Peer peripheral	A device running a sample application from SDK (Heart Rate service) on the S110 SoftDevice. Up to 3 of those peers can be connected to the sample application at the same time
Peer central	Master Control Panel application that connects to this sample application to retrieve HR data averages that have been collected from all the connected peer peripherals

Table 1. Description of roles

The application uses simple UART input and output to control its operation and to print out informational messages. When debug logging (UART_LOG_DEBUG) is enabled it provides additional information such as error codes and locations in source code. UART logging is disabled by commenting out the USE_UART_LOG_INFO and/or USE_UART_LOG_DEBUG flag.

If USE_UART_LOG_INFO is set, the application prints out the following welcome message while it starts (see fig. 1).

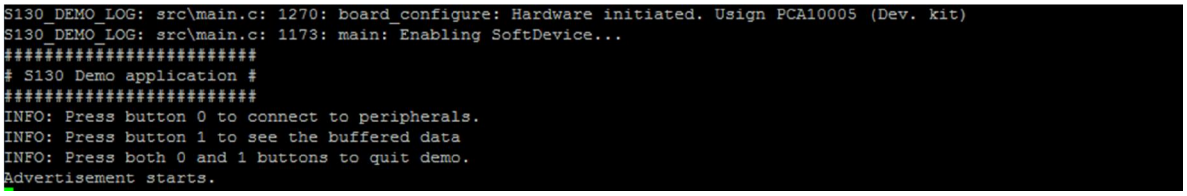

Figure 1.

UART settings:

- Speed: 19 200 bauds,
- Data bits: 8,
- Stop bits: 1,
- Parity: none,
- Flow control RTS/CTS.

3.1. Peer peripherals

The application can handle up to three connections with peer peripherals (itself acting as a central).

Configuration of the peer peripherals can be set by changing:

- NUMBER_OF_PERIPHERALS (initially set to 3),
- gs_hb_peripheral_address (initially set to the device addresses provided in the example described below Notice the reverse byte ordering).

Peripherals should run the SDK sample application that implements the Heart Rate service. Pressing button 0 on the sample application board starts the connection procedure with all the peer peripherals configured above.

The sample application checks the connection status of each peer peripheral and if the peer is disconnected it connects to it. This means that pressing button 0 restarts the procedure to allow reconnecting with one or more of disconnected peer peripherals. A sample run is shown in fig. 2.

```
Advertisement stopped.
S130_DEMO_LOG: src\main.c: 792: (Peripheral 0) Connecting.
S130_DEMO_LOG: src\main.c: 802: (Peripheral 0) Connection established.
(Peripheral 0) Connected.
S130_DEMO_LOG: src\main.c: 867: Service found UUID 0x180D
S130_DEMO_LOG: src\main.c: 912: Characteristic found UUID 0x2A37
S130_DEMO_LOG: src\main.c: 958: Descriptor found UUID 0x2902
S130_DEMO_LOG: src\main.c: 999: (Peripheral 0) Writing CCCD
S130_DEMO_LOG: src\main.c: 792: (Peripheral 1) Connecting.
S130_DEMO_LOG: src\main.c: 802: (Peripheral 1) Connection established.
(Peripheral 1) Connected.
S130_DEMO_LOG: src\main.c: 601: (Peripheral 0) Write confirmed
(Peripheral 0) CCCD update confirmed.
S130_DEMO_LOG: src\main.c: 867: Service found UUID 0x180D
S130_DEMO_LOG: src\main.c: 912: Characteristic found UUID 0x2A37
S130_DEMO_LOG: src\main.c: 958: Descriptor found UUID 0x2902
S130_DEMO_LOG: src\main.c: 999: (Peripheral 1) Writing CCCD
S130_DEMO_LOG: src\main.c: 792: (Peripheral 2) Connecting.
S130_DEMO_LOG: src\main.c: 802: (Peripheral 2) Connection established.
(Peripheral 2) Connected.
S130_DEMO_LOG: src\main.c: 601: (Peripheral 1) Write confirmed
(Peripheral 1) CCCD update confirmed.
S130_DEMO_LOG: src\main.c: 867: Service found UUID 0x180D
S130_DEMO_LOG: src\main.c: 912: Characteristic found UUID 0x2A37
S130_DEMO_LOG: src\main.c: 958: Descriptor found UUID 0x2902
S130_DEMO_LOG: src\main.c: 999: (Peripheral 2) Writing CCCD
Advertisement starts.
(Peripheral 0) Requests to change connection parameters (timeout = 0x190, min conn. interval = 0x190, max conn. int
erval = 0x320, latency = 0x0).
S130_DEMO_LOG: src\main.c: 601: (Peripheral 2) Write confirmed
(Peripheral 2) CCCD update confirmed.
(Peripheral 1) Requests to change connection parameters (timeout = 0x190, min conn. interval = 0x190, max conn. int
erval = 0x320, latency = 0x0).
(Peripheral 0) Connection parameters updated.
(Peripheral 2) Requests to change connection parameters (timeout = 0x190, min conn. interval = 0x190, max conn. int
erval = 0x320, latency = 0x0).
(Peripheral 1) Connection parameters updated.
(Peripheral 2) Connection parameters updated.
Central connected.
```

Figure 2.

When a connection is established the sample application searches for the HR service, its characteristics and descriptors and looks for the required ATT handle to write to the corresponding CCCD. If the search completes successfully it then writes to the peer CCCD to enable notifications coming from the peer peripheral, and otherwise it disconnects.

After enabling the CCCD, the peripheral will start to send notifications. The values of the Heart Rate measurement are kept in a buffer. Pressing button 1 triggers printing out to the terminal (USE_UART_LOG_INFO

must be set) the buffered values for each of the connected peer peripherals and the corresponding averages. Additionally it shows the current status of all connections (see fig. 3).

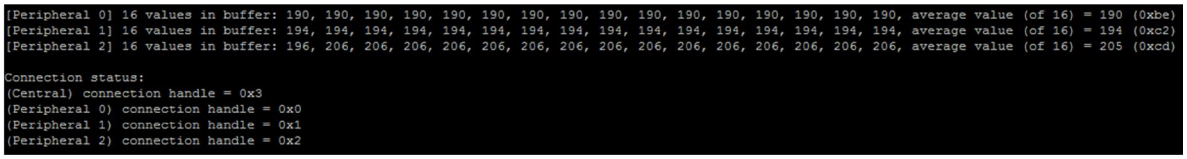

Figure 3.

Please note that the same averages are sent as notifications to the peer central if it has requested reception of notifications.

4 Peer central

Concurrently with operation in the central role, this sample application can also act as a peripheral on one single link. The usage of the Master Control Panel (MCP) as a central is described below.

To be discovered by the MCP, the sample application must set up a service with a vendor-specific UUID type. In this particular example we use the 128-bit UUID 310bfe40-ed6b-11e3-a1be-0002a5d5c51b, which is defined in SERVICE_UUID128 (see fig. 4.).

The Master Control Panel, acting as a central, discovers the sample application (S130demo) and, if they have not been connected to yet, also the peer peripherals (Nordic_HRM), all of which will be advertising at this point.

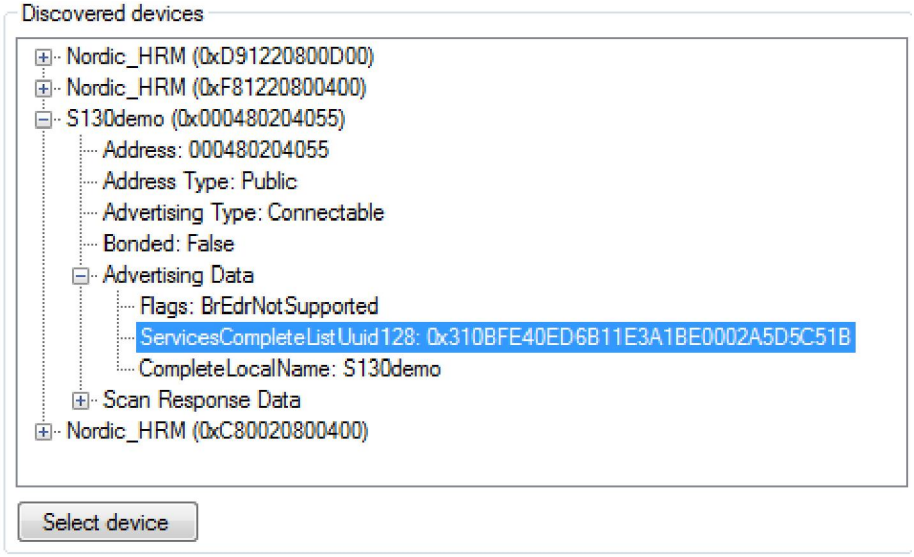

Figure 4.

The subsequent connection establishment and service discovery allows the MCP to find the handle that is used to enable the sending of notifications by the sample application, simply by writing value 0x0001 on the corresponding CCCD. Notifications can be stopped by writing 0x0000 to the same handle.

Once notifications are activated the sample application provides averages collected from the buffers mentioned above. The window below shows notifications being sent by the sample application peripheral to the MCP central with three average values calculated. In this particular case all averages are equal to 180 (0xB4), see fig. 5.

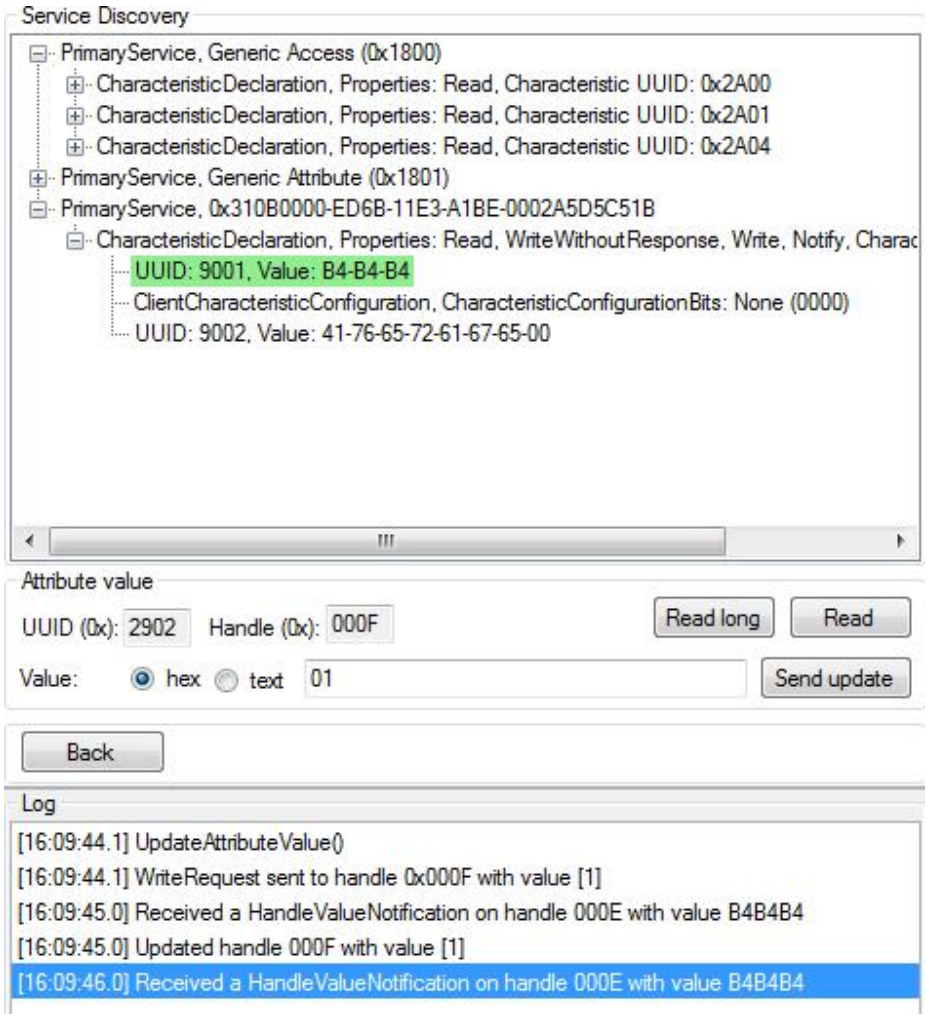
Service Discovery
PrimaryService, Generic Access (0x1800)
CharacteristicDeclaration, Properties: Read, Characteristic UUID: 0x2A00
CharacteristicDeclaration, Properties: Read, Characteristic UUID: 0x2A01
CharacteristicDeclaration, Properties: Read, Characteristic UUID: 0x2A04
PrimaryService, Generic Attribute (0x1801)
PrimaryService, 0x310B0000-ED6B-11E3-A1BE-0002A5D5C51B
CharacteristicDeclaration, Properties: Read, WriteWithoutResponse, Write, Notify, Charac
UUID: 9001, Value: B4-B4-B4
ClientCharacteristicConfiguration, CharacteristicConfigurationBits: None (0000)
UUID: 9002, Value: 41-76-65-72-61-67-65-00
Attribute value
UUID (0x): 2902
Handle (0x): 000F
Read long
Read
Value:
hex
text
01
Send update
Back
Log
[16:09:44.1] UpdateAttributeValue()
[16:09:44.1] WriteRequest sent to handle 0x000F with value [1]
[16:09:45.0] Received a HandleValueNotification on handle 000E with value B4B4B4
[16:09:45.0] Updated handle 000F with value [1]
[16:09:46.0] Received a HandleValueNotification on handle 000E with value B4B4B4

Figure 5.

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Revision History

Date	Version	Description
25.06.2014	1.0	Initial version of document