BLE Proximity Profile

1.0

Features

- BLE IAS Service GATT Server role operation
- DeepSleep mode support
- Reporting the workflow status through UART
- LED status indication

General Description

This example project demonstrates the Proximity operation of the BLE PSoC Creator Component. The Proximity Reporter utilizes the BLE Proximity Profile with one instance of Link Loss Service and one instance of Tx Power Service to display alerts on the device if connection with Client has been lost. The Proximity Reporter operates with other devices which implement the Proximity Monitor Profile role. The device uses Limited Discovery mode during which it is visible for BLE Clients. The device remains in DeepSleep mode between BLE connection intervals.

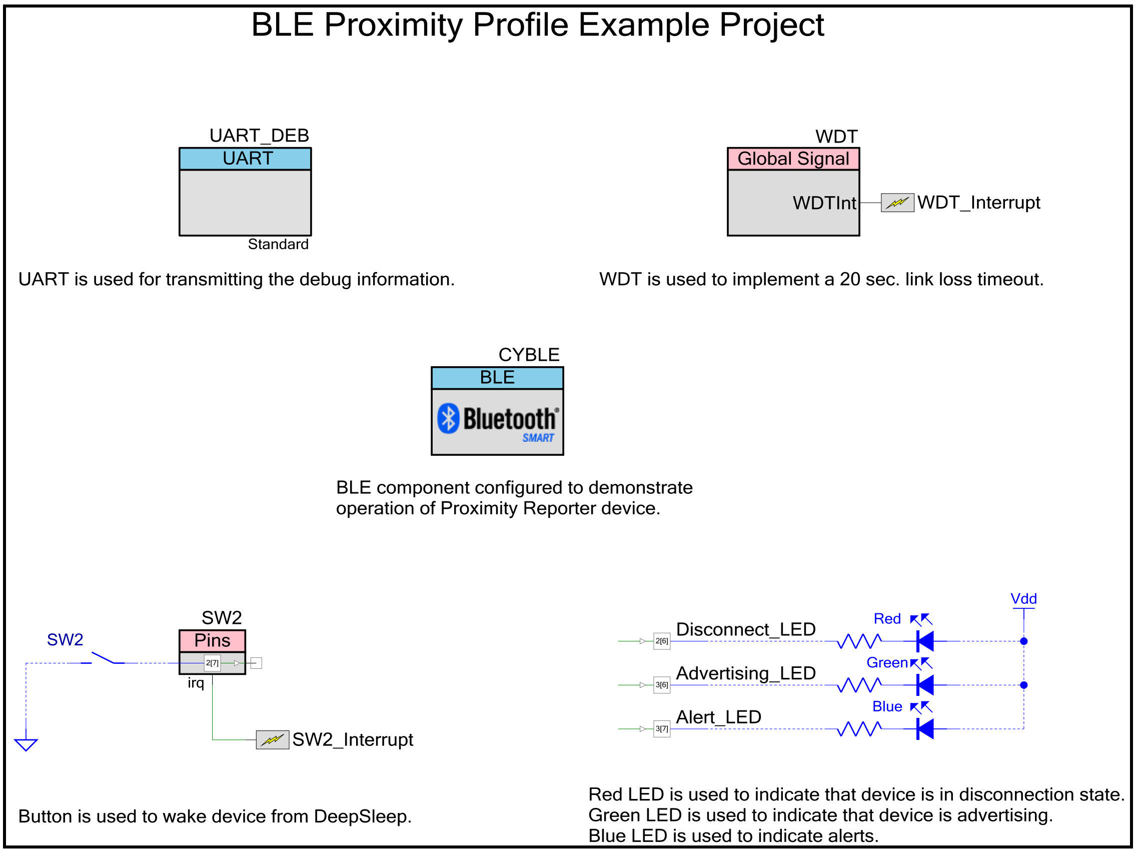
Development Kit Configuration

Configure your device as follows:

- The UART RX pin is connected to port 1 pin 4.
- The UART TX pin is connected to port 1 pin 5.
- A mechanical button (port 2 pin 7) is used to wake up the device and start re-advertising. It also allows decreasing the Tx power level of the device.
- The red LED (port 2 pin 6) is used to indicate the BLE disconnection state.
- The green LED (port 3 pin 6) is used to indicate the advertising state.
- The blue LED (port 3 pin 7) is used to indicate alerts.

Project Configuration

The top design schematic is shown in **Figure 1**.



UART is used for transmitting the debug information.

WDT is used to implement a 20 sec. link loss timeout.

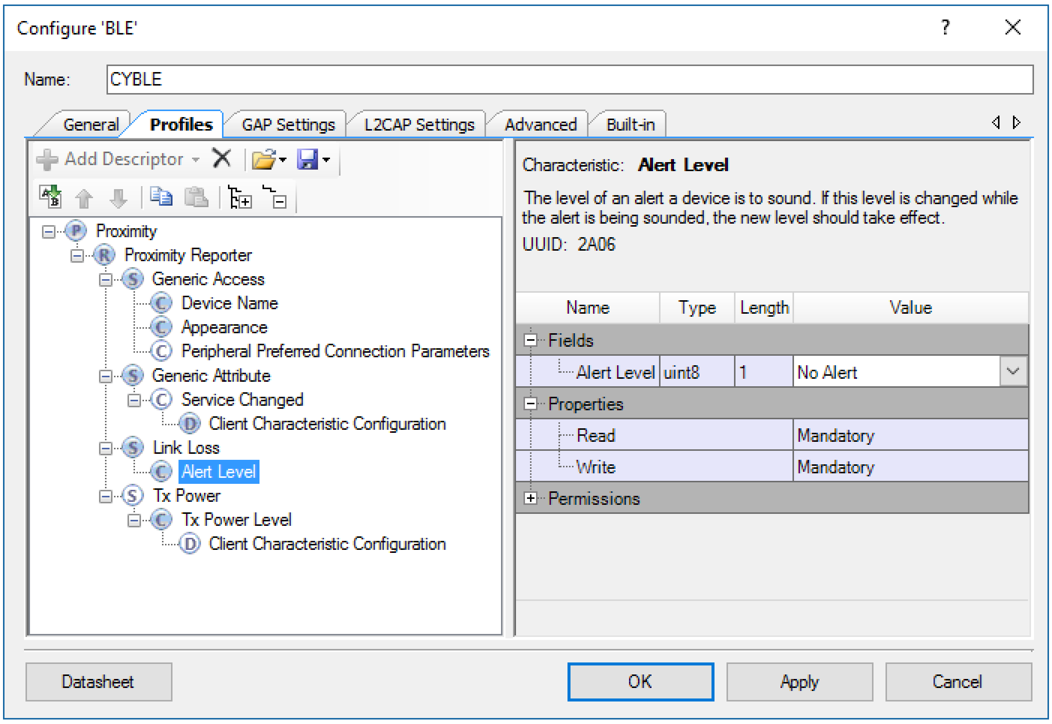
BLE component configured to demonstrate operation of Proximity Reporter device.

Button is used to wake device from DeepSleep.

Red LED is used to indicate that device is in disconnection state.
Green LED is used to indicate that device is advertising.
Blue LED is used to indicate alerts.

Figure 1. Top design schematic

The BLE component is configured as Proximity Reporter in the GAP Peripheral role.



Name: CYBLE

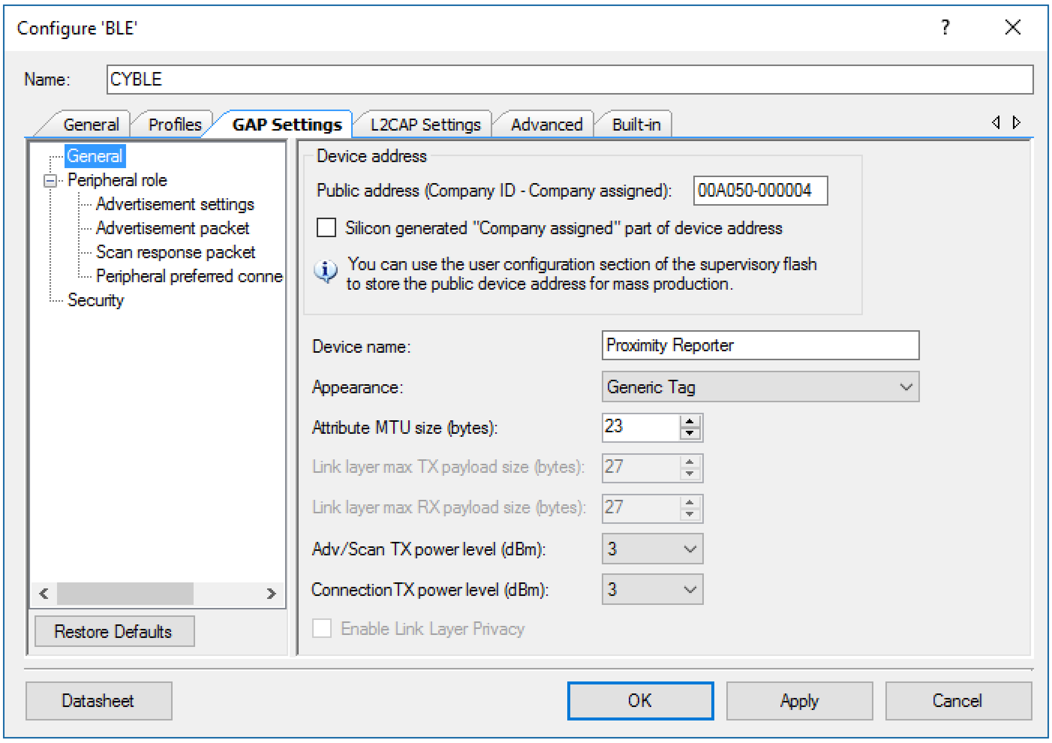
Characteristic: **Alert Level**

The level of an alert a device is to sound. If this level is changed while the alert is being sounded, the new level should take effect.

UUID: 2A06

Name	Type	Length	Value
Fields			
Alert Level	uint8	1	No Alert
Properties			
Read			Mandatory
Write			Mandatory
Permissions			

Figure 2. GATT settings



Name: CYBLE

Device address

Public address (Company ID - Company assigned): 00A050-000004

□ Silicon generated "Company assigned" part of device address

You can use the user configuration section of the supervisory flash to store the public device address for mass production.

Device name: Proximity Reporter

Appearance: Generic Tag

Attribute MTU size (bytes): 23

Link layer max TX payload size (bytes): 27

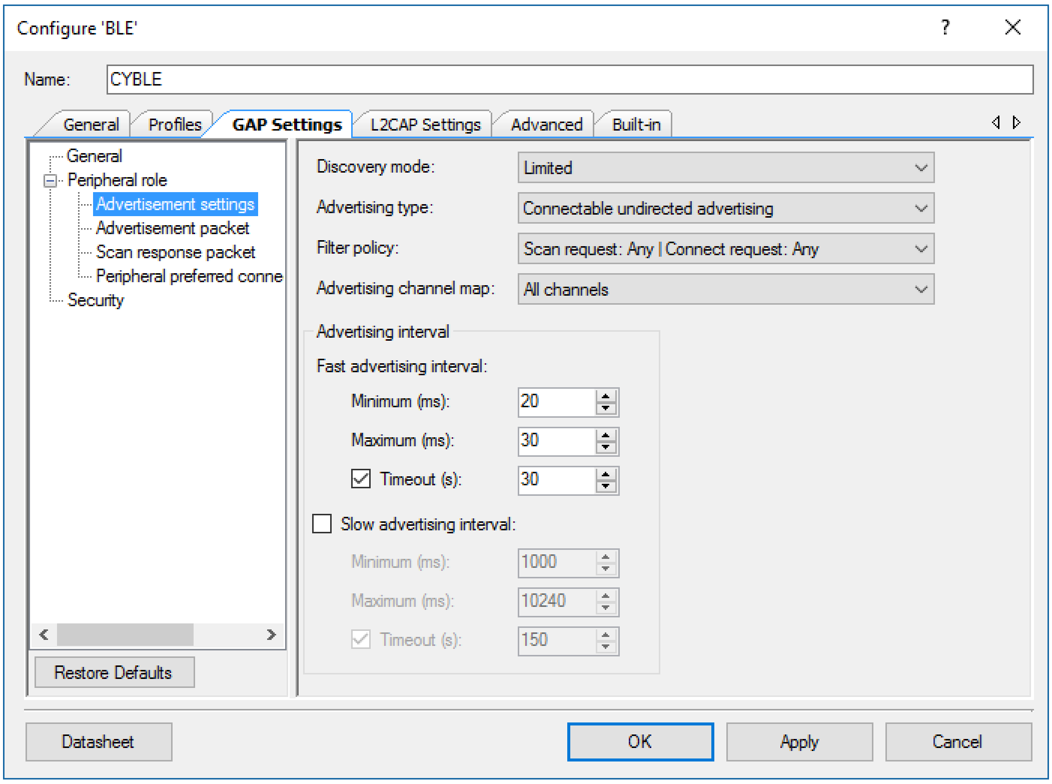
Link layer max RX payload size (bytes): 27

Adv/Scan TX power level (dBm): 3

Connection TX power level (dBm): 3

□ Enable Link Layer Privacy

Figure 3. GAP settings



Name: CYBLE

Discovery mode: Limited

Advertising type: Connectable undirected advertising

Filter policy: Scan request: Any | Connect request: Any

Advertising channel map: All channels

Advertising interval

Fast advertising interval:

Minimum (ms): 20

Maximum (ms): 30

☑ Timeout (s): 30

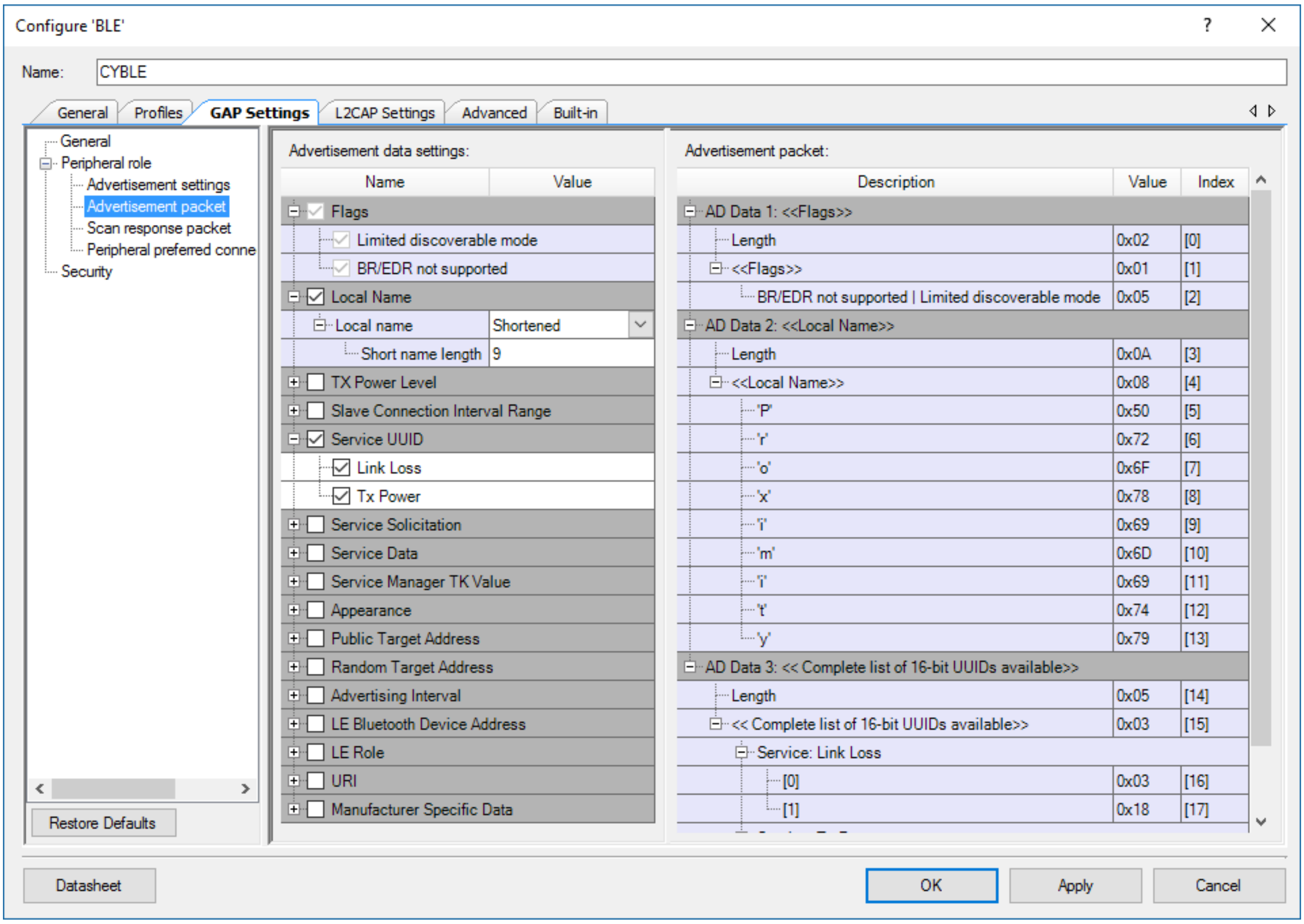
□ Slow advertising interval:

Minimum (ms): 1000

Maximum (ms): 10240

☑ Timeout (s): 150

Figure 4. GAP settings -> Advertisement settings



Name: CYBLE

- General
- Peripheral role
  - Advertisement settings
  - Advertisement packet
  - Scan response packet
  - Peripheral preferred conne
- Security

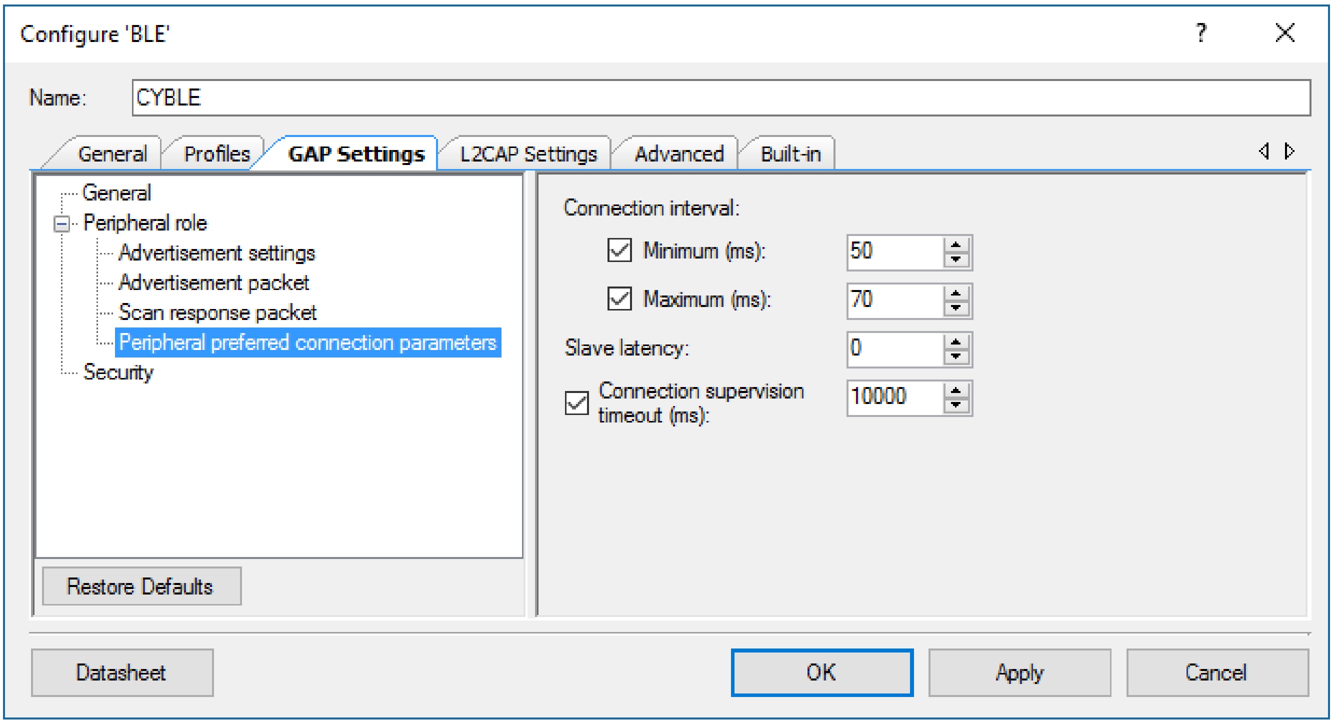
Advertisement data settings:

Name	Value
☑ Flags	
☑ Limited discoverable mode	
☑ BR/EDR not supported	
☑ Local Name	
Local name	Shortened
Short name length	9
☐ TX Power Level	
☐ Slave Connection Interval Range	
☑ Service UUID	
☑ Link Loss	
☑ Tx Power	
☐ Service Solicitation	
☐ Service Data	
☐ Service Manager TK Value	
☐ Appearance	
☐ Public Target Address	
☐ Random Target Address	
☐ Advertising Interval	
☐ LE Bluetooth Device Address	
☐ LE Role	
☐ URI	
☐ Manufacturer Specific Data	

Advertisement packet:

Description	Value	Index
AD Data 1: <<Flags>>		
Length	0x02	[0]
<<Flags>>	0x01	[1]
BR/EDR not supported | Limited discoverable mode	0x05	[2]
AD Data 2: <<Local Name>>		
Length	0x0A	[3]
<<Local Name>>	0x08	[4]
'P'	0x50	[5]
'r'	0x72	[6]
'o'	0x6F	[7]
'x'	0x78	[8]
'i'	0x69	[9]
'm'	0x6D	[10]
'i'	0x69	[11]
't'	0x74	[12]
'y'	0x79	[13]
AD Data 3: << Complete list of 16-bit UUIDs available>>		
Length	0x05	[14]
<< Complete list of 16-bit UUIDs available>>	0x03	[15]
Service: Link Loss		
[0]	0x03	[16]
[1]	0x18	[17]

Figure 5. GAP settings -> Advertisement packet



Name: CYBLE

- General
- Peripheral role
  - Advertisement settings
  - Advertisement packet
  - Scan response packet
  - Peripheral preferred connection parameters
- Security

Connection interval:

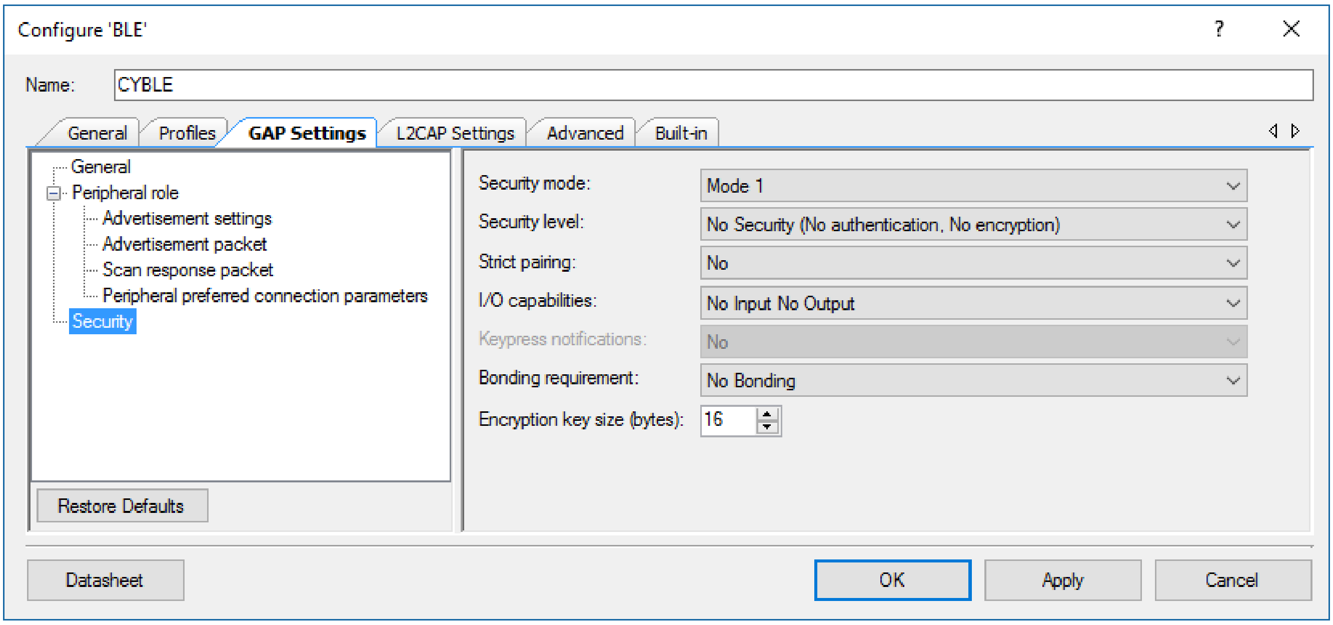
☑ Minimum (ms): 50

☑ Maximum (ms): 70

Slave latency: 0

☑ Connection supervision timeout (ms): 10000

Figure 6. GAP settings -> Peripheral preferred connection parameters



Security mode: Mode 1
Security level: No Security (No authentication, No encryption)
Strict pairing: No
I/O capabilities: No Input No Output
Keypress notifications: No
Bonding requirement: No Bonding
Encryption key size (bytes): 16

Figure 7. Security settings

Project Description

The example project demonstrates the core functionality of the BLE component configured as a Proximity Reporter.

To start the example project operation, build it and program onto CY8CKIT-042-BLE Pioneer Kit with PSoC 4100-BLE, PSoC 4200-BLE or PRoC BLE device. Right after the startup, the device performs BLE component initialization as well as initialization of UART and ISR components. In this project three callback functions are required for the BLE operation. One callback function (AppCallBack()) is required for receiving generic events from BLE Stack and the others (LlsServiceAppEventHandler(), TpsServiceAppEventHandler()) are required for receiving events from Link Loss and Tx Power Services. The CYBLE_EVT_STACK_ON event indicates a successful initialization of the BLE Stack. After this event is received, the component starts advertising using the advertisement packet configured in the BLE component customizer (see **Figure 5**). The advertising is stopped once the 30 seconds advertising period expires. To resume advertising, press the mechanical button: this will resume advertising for another 30 seconds. The blinking green LED indicates that the device is advertising. Glowing red LED indicates that no Client was connected to the device within of 30 seconds advertising period.

You can connect to the Proximity Reporter device with BLE 4.0 or BLE 4.1 compatible device configured in the GAP Central role and capable of discovering Link Loss Service with Alert Level Characteristic and Tx Power Service with Tx Power Level Characteristic. To connect to the Proximity Reporter device, send a connection request to the device while the device is advertising. When the Client connects successfully, all of the LEDs are turned off. If the Client is connected to Proximity Reporter, the Alert Level Characteristic can be written to configure alerts on the link loss. When the Alert Level is set to CYBLE_MILD_ALERT and the link loss is detected, the blue LED begins to blink, which demonstrates "Mild Alert". When Alert Level is set to CYBLE_HIGH_ALERT and the link loss is detected, the blue LED is turned on – that is “High Alert”. Once the device starts alerting, there are two options to disable alerts. The first option is to wait for a 20 seconds timeout to expire; the second option is when the Client reestablishes connection with Proximity Reporter before the alert timeout expires. Note in pair with alerting the device will be advertising and it will be available for a connection but the green LED will not be blinking during 20 seconds alerting timeout and will resume blinking after the timeout if no Client will connect to Proximity Reporter.

While connected to a Client and between connection intervals, the device is put into DeepSleep mode.

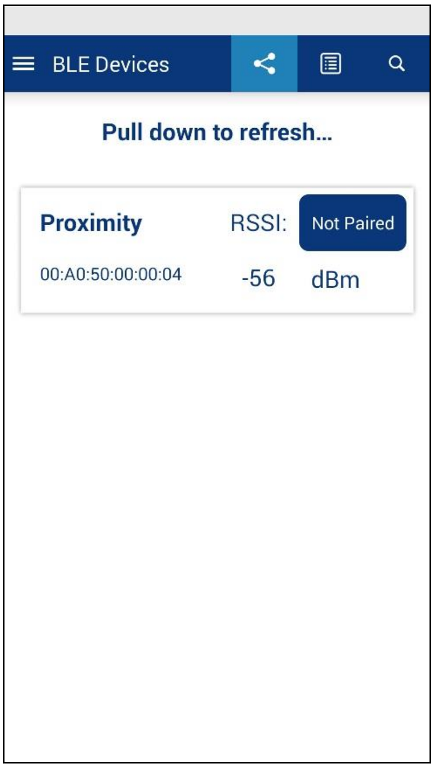
To simulate a link loss, decrease the Tx power level of the device to the lowest possible value using the mechanical button. With each button press the Tx power level will be decreased and the Client will receive the notification about the Tx Power Level Characteristic change. Note that when the Tx power level will reach -18 dBm the value will not be decreased anymore.

Another option is to take away the device from the Client to the distance enough for the connection loss to occur.

Expected Results

The project is intended to work with any BLE-compatible device (e.g. phone, tablet). Appropriate software with Proximity Profile support should be installed on client OS. CySmart mobile app (available for Android and iOS) has support for this profile and can be used as a client for Proximity Reporter Service.

To use CySmart mobile app as a client for Proximity Reporter Service, launch it and swipe down the screen to refresh the list of BLE devices available nearby. Make sure that development kit is advertising (green LED is blinking): you may need to press SW2 button in order to wake up device from hibernate mode. Once “Proximity” device appears in BLE devices list, you can connect to it and choose “Proximity” in service selector.



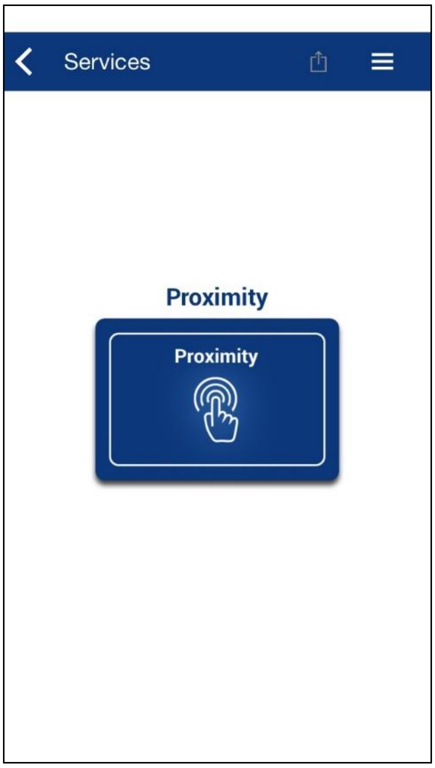


Figure 8. CySmart Android app connecting to Proximity Service

Figure 9. CySmart iOS app connected to Proximity Service and recognized Proximity Profile

Drop-down list is provided to control the Alert Level on link loss event.

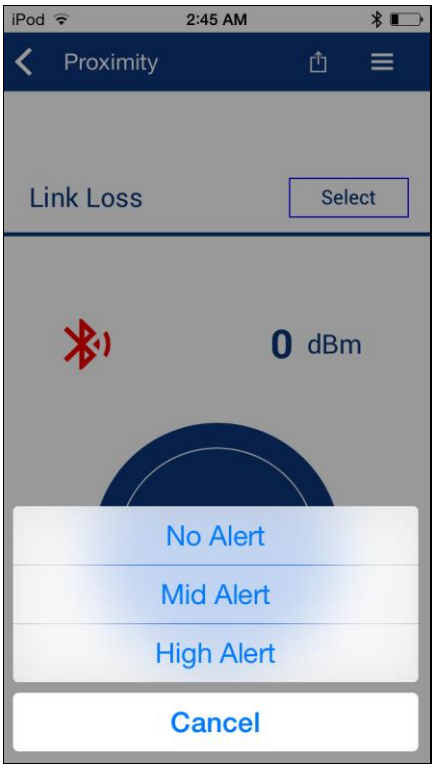


Figure 10. Alert Level selector on CySmart iOS app

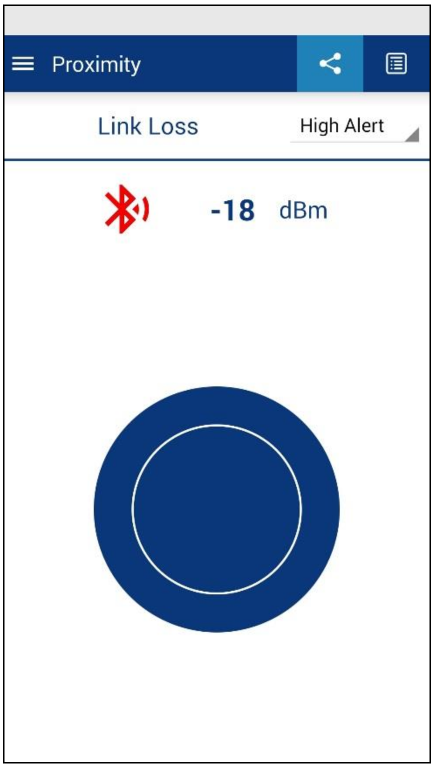


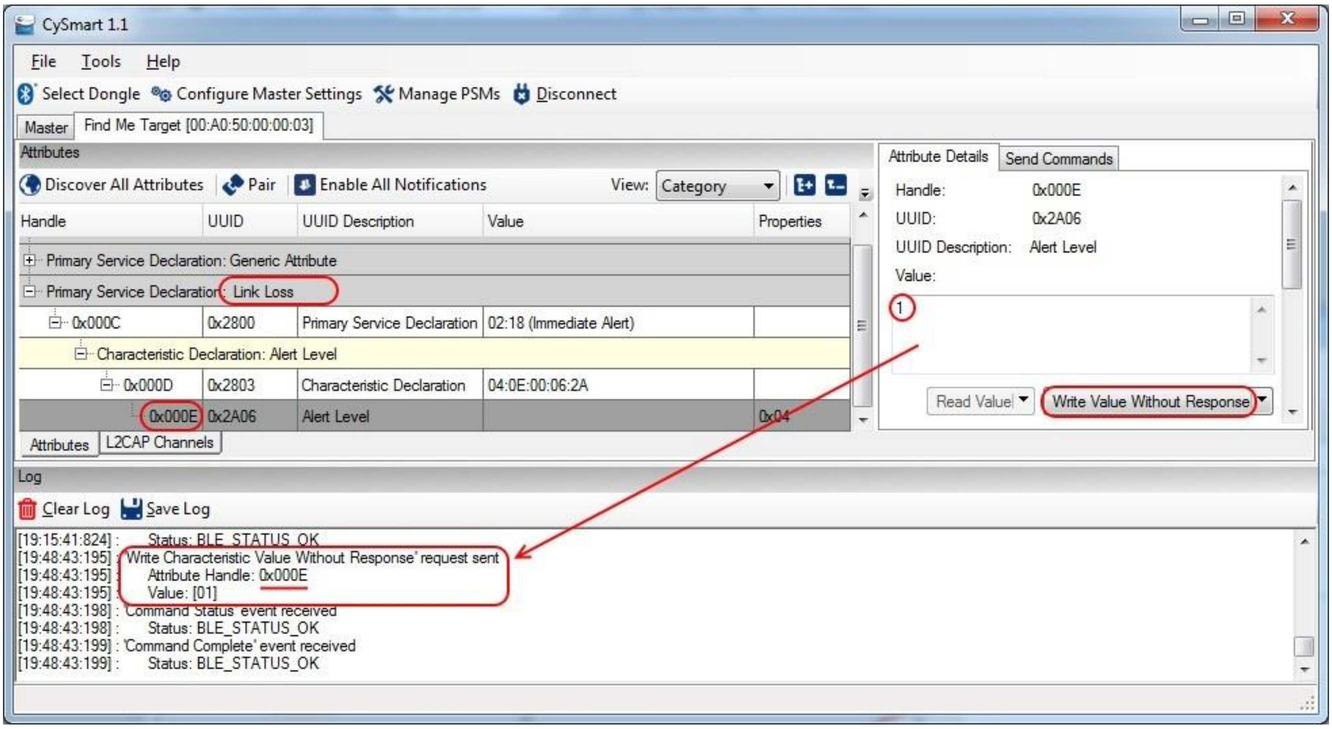
Figure 11. CySmart Android app shows actual values of Alert level and Tx power level

To trigger link loss event, terminate connection with development kit from within CySmart app: move two screens backwards and return to device selection list. Notice blue LED blinking according to value set from drop-down list.

Also, the Proximity Reporter can be used together with CySmart app for Windows. To connect to Proximity Reporter Service, this application requires USB Bluetooth Low Energy dongle installed (included with CY8CKIT-042-BLE Pioneer Kit). For further instructions on how to use CySmart application, see CySmart User Guide.

The simple example how to use CySmart Windows application as Proximity profile client is the next:

- Connect the CySmart BLE dongle to a USB port on the PC.
- Launch CySmart app and select connected dongle in the dialog window.
- Reset the development kit to start advertising by pressing SW1 button.
- Click **Start Scan** button to discover available devices.
- Select **Proximity** in the list of available devices and connect to it.
- Click **Discover All Attributes**, select the **Alert Level** characteristic value and write the number “1” there (mild alert, for example):



Handle	UUID	UUID Description	Value	Properties
Primary Service Declaration: Generic Attribute				
Primary Service Declaration: Link Loss				
0x000C	0x2800	Primary Service Declaration	02:18 (Immediate Alert)	
Characteristic Declaration: Alert Level				
0x000D	0x2803	Characteristic Declaration	04:0E:00:06:2A	
0x000E	0x2A06	Alert Level		0x04

Handle: 0x000E
UUID: 0x2A06
UUID Description: Alert Level
Value:

```
[19:15:41:824] :     Status: BLE_STATUS_OK
[19:48:43:195] : 'Write Characteristic Value Without Response' request sent
[19:48:43:195] :     Attribute Handle: 0x000E
[19:48:43:195] :     Value: [01]
[19:48:43:198] : 'Command Status' event received
[19:48:43:198] :     Status: BLE_STATUS_OK
[19:48:43:199] : 'Command Complete' event received
[19:48:43:199] :     Status: BLE_STATUS_OK
```

- Observe the blue LED is blinking when link is lost (it is explained in the Project Description section how to reproduce a link loss event).

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