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CE215120 - BLE Device Information Service with PSoC 6 MCU with BLE Connectivity

Objective

This example project demonstrates how to configure and use the Bluetooth Low Energy (BLE) Component APIs and an application layer callback.

Overview

This is a simple BLE example project that demonstrates how to configure and use the BLE Component APIs and an application layer callback. The Device Information Service is used as an example to demonstrate how to configure the BLE service characteristics in the BLE Component.

Requirements

Tool: PSoC Creator™ 4.2

Programming Language: C (Arm® GCC 5.4-2016-q2-update)

Associated Parts: All PSoC® 6 BLE parts

Related Hardware: CY8CKIT-062-BLE PSoC 6 BLE Pioneer Kit

Hardware Setup

This example uses the kit's default configuration. See the kit guide to ensure the kit is configured correctly.

1. Connect the BLE Pioneer Kit to the computer's USB port.
2. Connect the BLE Dongle to one of the USB ports on the computer.

LED Behavior for V_{DDD} Voltage < 2.7 V

If the V_{DDD} voltage is set to lesser than 2.7 V in the DWR settings **System** tab, only the red LED is used. The red LED blinks to indicate that the device is advertising. The red LED is OFF when the device is connected to a peer device. When the device is in Hibernate mode, the red LED stays ON.

Software Setup

BLE Host Emulation Tool

This example requires the CySmart application. Download and install either the CySmart Host Emulation Tool PC application or the CySmart app for iOS or Android. You can test behavior with any of the two options, but the CySmart app is simpler. Scan one of the following QR codes from your mobile phone to download the CySmart app.

iOS

Android

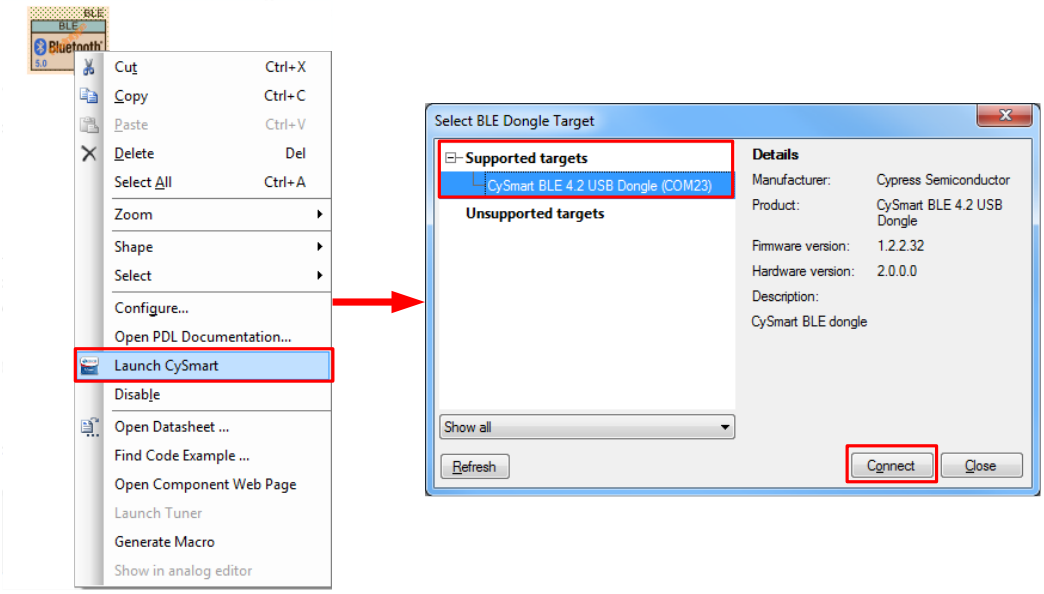
Operation

The green LED blinks to indicate that the device is advertising. The red LED turns ON to indicate that no client is connected to the device. When a client is connected successfully, the red and green LEDs are turned OFF.

Operation Steps

1. Plug the CY8CKIT-062-BLE kit board into your computer's USB port.
2. Build the project and program it into the PSoC 6 MCU device. Choose **Debug** > **Program**. For more information on device programming, see PSoC Creator Help. Flash for both CPUs is programmed in a single program operation.
3. Observe the green LED blinks while the device is advertising.
4. Do the following to the test example using the CySmart Host Emulation Tool application as a Device Information Service Client:
   a. Connect the BLE Dongle to your Windows PC. Wait for the driver installation to complete, if necessary.
   b. Right-click the BLE Component and select **Launch CySmart** to launch the CySmart Host Emulation Tool. Alternatively, you can navigate to **Start** > **Programs** > **Cypress** and click **CySmart** to launch the tool.
   c. CySmart automatically detects the BLE dongle connected to the PC. Click **Refresh** if the BLE dongle does not appear in the **Select BLE Dongle Target** pop-up window. Click **Connect**, as shown in Figure 1.

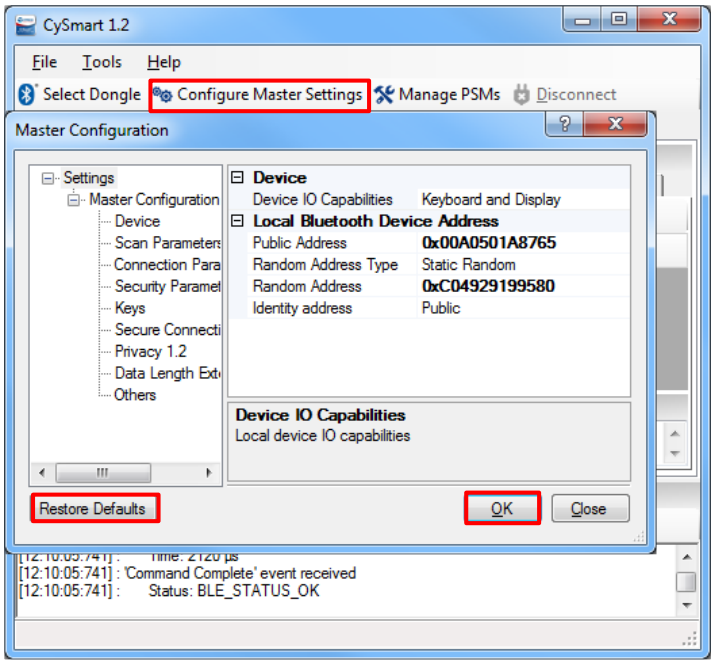
Figure 1. CySmart BLE Dongle Selection



Note: If the dongle firmware is outdated, you will be alerted with an appropriate message. You must upgrade the firmware before you can complete this step. Follow the instructions in the window to update the dongle firmware.

   d. Select **Configure Master Settings** and then click **Restore Defaults**, as Figure 2 shows. Then, click **OK**.

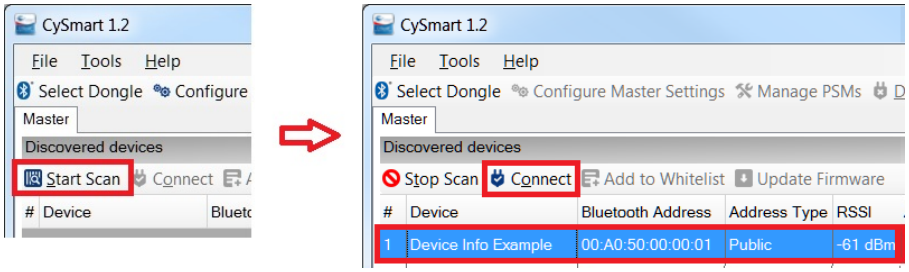
Figure 2. CySmart Master Settings Configuration



e. Press the reset switch on the Pioneer Kit to start BLE advertisement if no device is connected or the device is in the Hibernate mode (red LED is ON). Otherwise, skip this step.

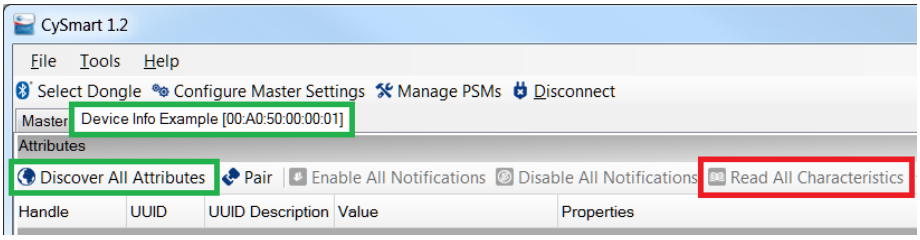
f. On the CySmart Host Emulation Tool, click **Start Scan**. Your device name (configured as **Device Info Example**) should appear in the **Discovered devices** list, as Figure 3 shows. Select the device and click **Connect** to establish a BLE connection between the CySmart Host Emulation Tool and your device.

Figure 3. CySmart Device Discovery and Connection



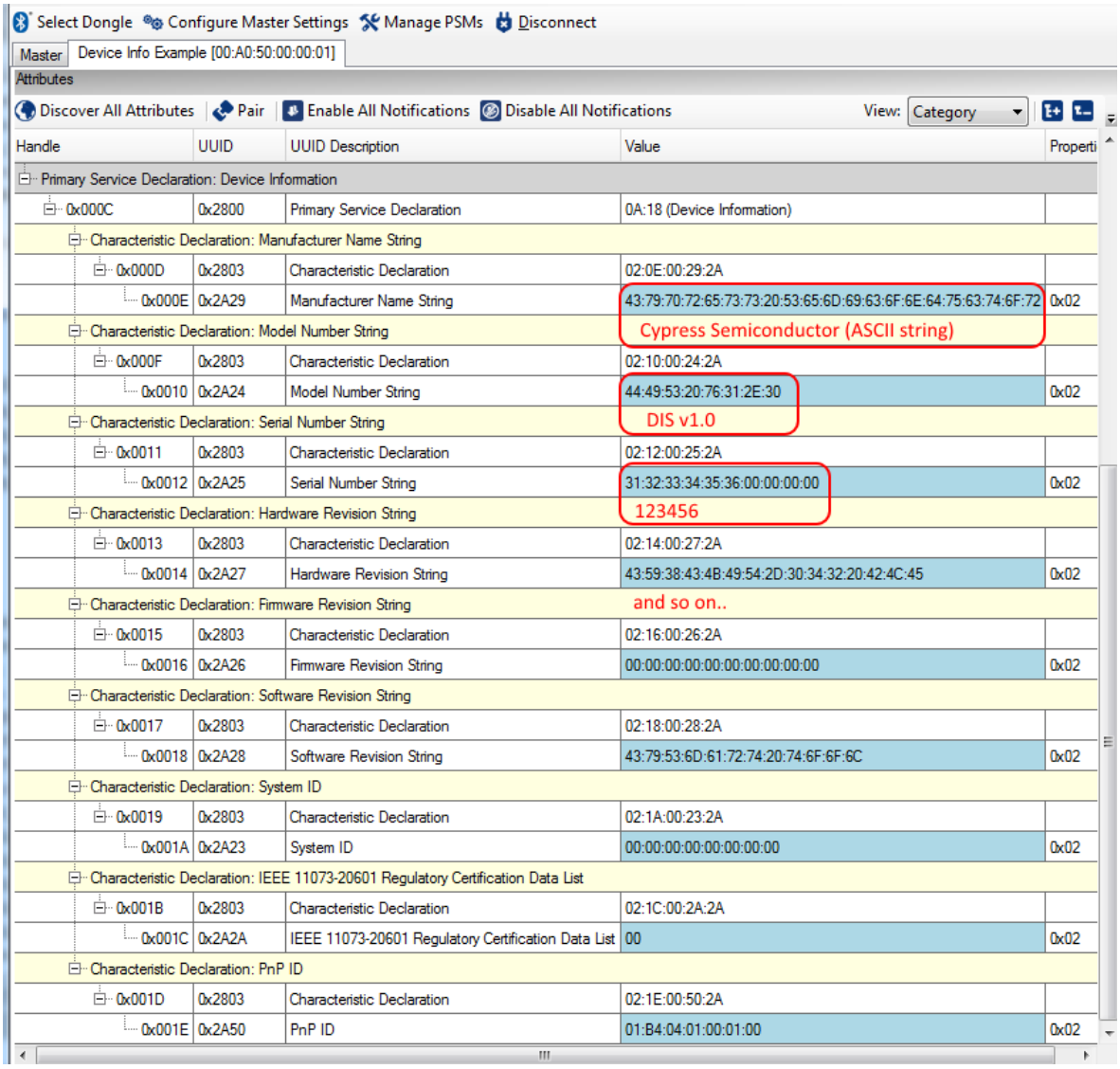
g. Once connected, switch to the **Device Info Example <device>** tab and click **Discover All Attributes** on your design from the CySmart Host Emulation Tool, as shown in Figure 4. Then, click **Read All Characteristics**.

Figure 4. CySmart Attribute Discovery and Characteristics Read



h. Observe the Device Information Service characteristics values read with example data, as shown in Figure 5.

Figure 5. CySmart Device Information Service Characteristics Values



5. Do the following to test the example using the CySmart mobile app as Running Speed and Cadence Service Client:
   a. Launch the CySmart mobile app and swipe down the screen to refresh the list of BLE devices available nearby. Make sure that the development kit is advertising (green LED is blinking): you may need to press the **SW1** button to wake up the device from the Hibernate mode. Once the **Device Info Example** device appears on the BLE devices list, connect to it and choose **Device Information Service** in the service selector.
   b. Explore information about the device.

Figure 6. CySmart Android App Recognized BLE Kit as Device Info Example

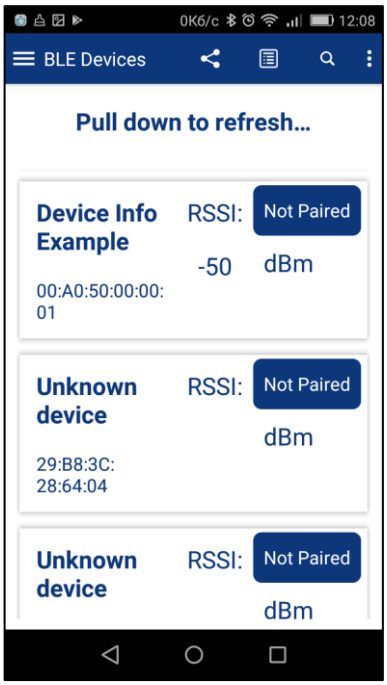
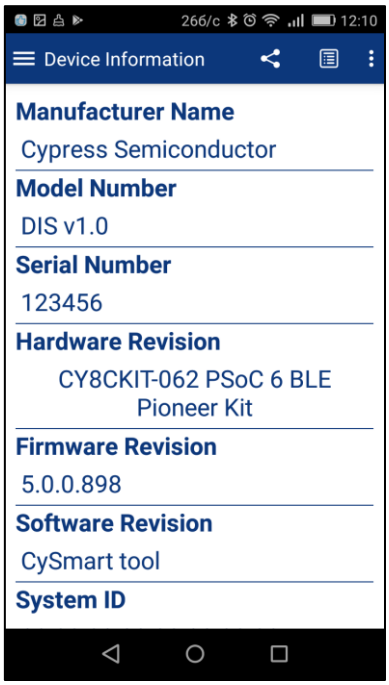


Figure 7. CySmart Android App Shows Device Information Service in Service Selector



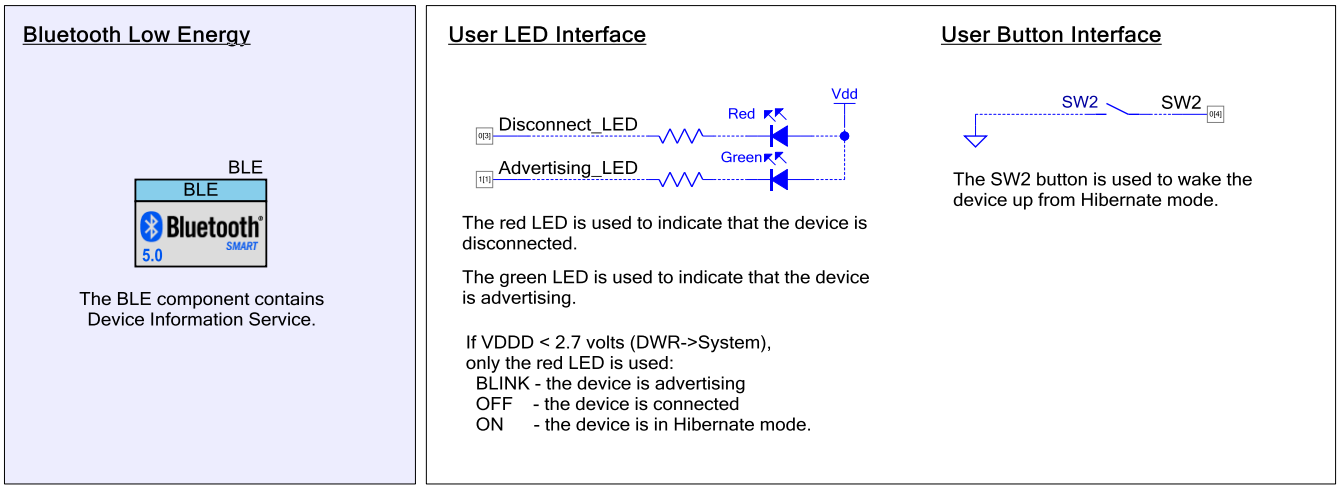
Figure 8. CySmart Android App Reads Device Information Service Characteristics



Design and Implementation

Figure 9 shows the top design schematic.

Figure 9. BLE Device Information Service Code Example Schematic



One callback function (`AppCallBack()`) is required to receive generic events from the BLE Stack.

The `Cy_BLE_GAPP_StartAdvertisement()` API is called after the `CY_BLE_EVT_STACK_ON` event to start advertising.

Pin assignments

The pin assignments and connections required on the development board for supported kits are in Table 1.

Table 1. Pin Assignment

Pin Name	Development Kit CY8CKIT-062	Comment
Disconnect_LED	P0[3]	The red color of the RGB LED
Advertising_LED	P1[1]	The green color of the RGB LED
SW2	P0[4]	

Components and Settings

Table 2 lists the PSoC Creator Components used in this example, how they are used in the design, and the non-default settings required so they function as intended.

Table 2. PSoC Creator Components

Component	Instance Name	Purpose	Non-default Settings
Bluetooth Low Energy (BLE)	BLE	The BLE component contains Device Information Service.	See the Parameter Settings section
Digital Input Pin	SW2	The **SW2** button is used to wake the device up from Hibernate mode.	**[General tab]** Uncheck HW connection Drive mode: Resistive Pull Up
Digital Output pin	Disconnect_LED Advertising_LED	These GPIOs are configured as firmware-controlled digital output pins that control LEDs.	**[General tab]** Uncheck HW connection Drive mode: Strong Drive

For information on the hardware resources used by a Component, see the Component datasheet.

Parameter Settings

The BLE component is configured as the custom profile in peripheral role. Device Information Service is added with all characteristics.

Figure 10. General Settings

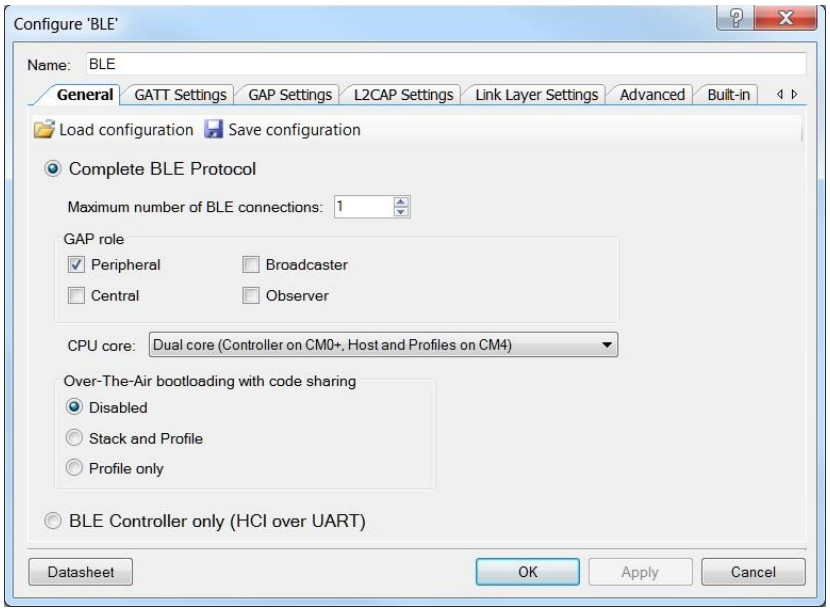


Figure 11. GATT Settings

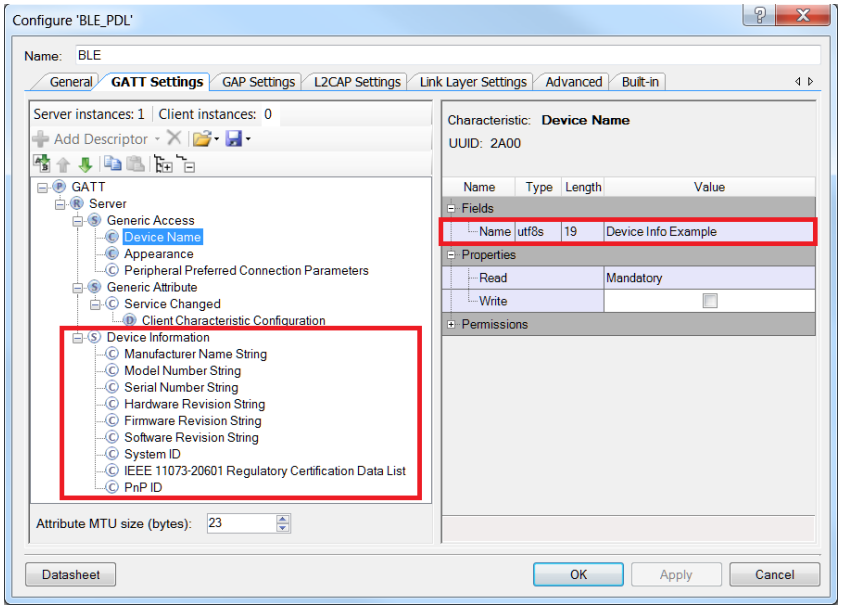


Figure 12. GAP Settings

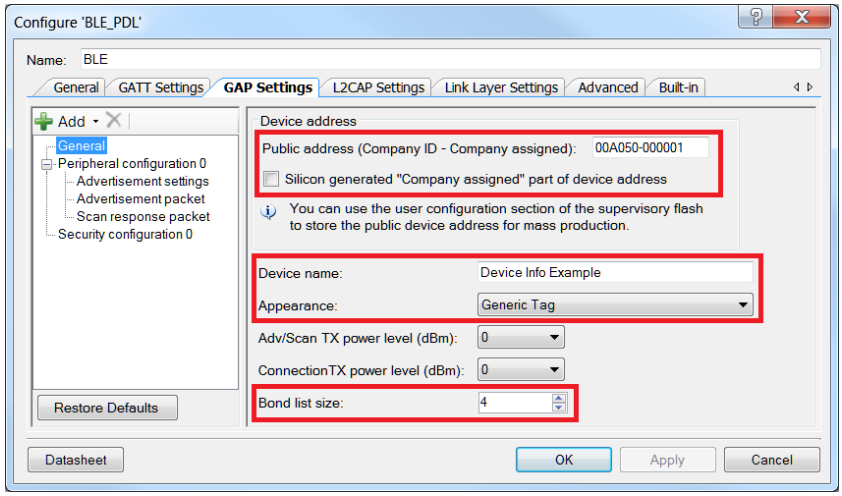


Figure 13. GAP Settings: Advertisement Settings

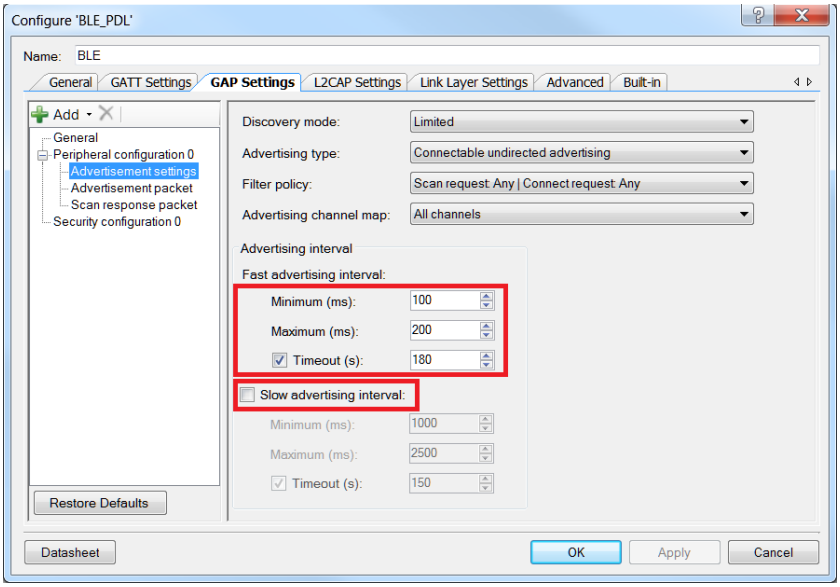


Figure 14. GAP Settings: Advertisement Packet

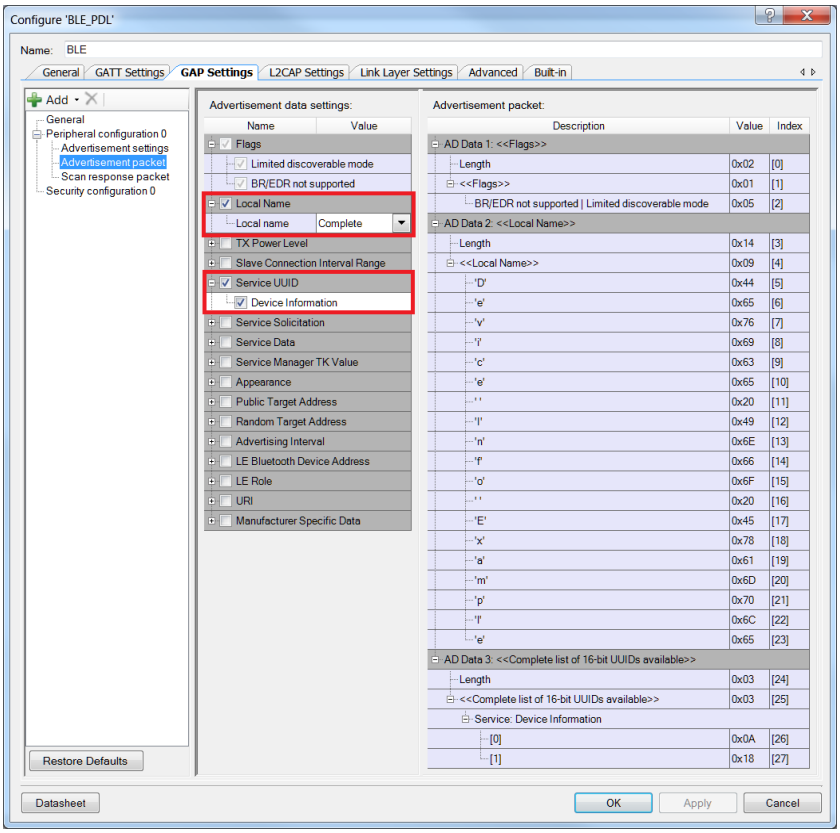
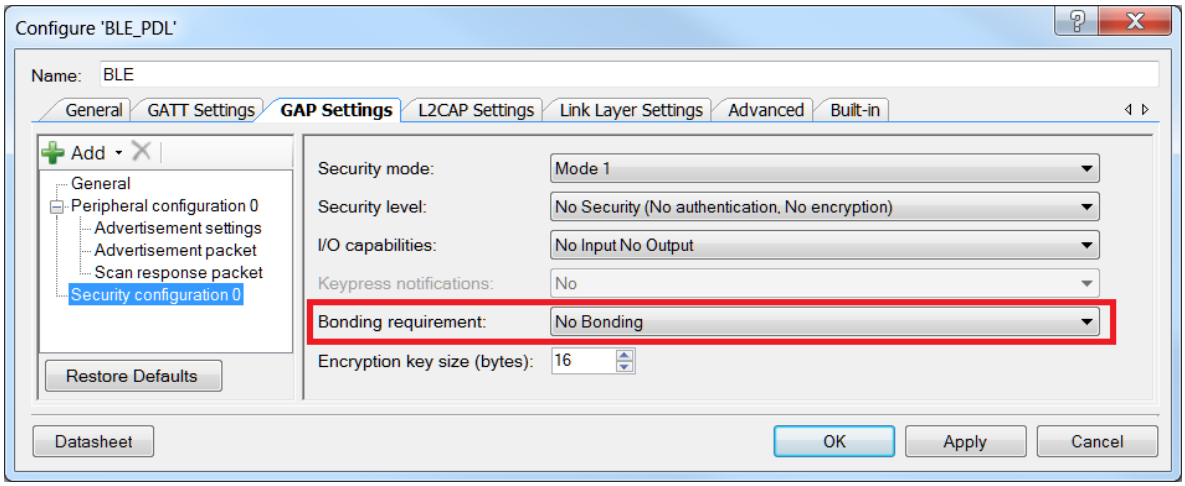


Figure 15. Security Settings



Switching the CPU Cores Usage

This section describes how to switch between different CPU cores usage (Single core and Dual core) in the BLE Peripheral Driver Library (PDL) examples.

The BLE Component has the CPU Core parameter that defines the cores usage. It can take the following values:

- **Single core (Complete Component on CM0+)** – only CM0+ will be used.
- **Single core (Complete Component on CM4)** – only CM4 will be used.
- **Dual core (Controller on CM0+, Host and Profiles on CM4)** – CM0+ and CM4 will be used: CM0+ for the Controller and CM4 for the Host and Profiles.

The BLE example structure allows easy switching between different CPU cores options.

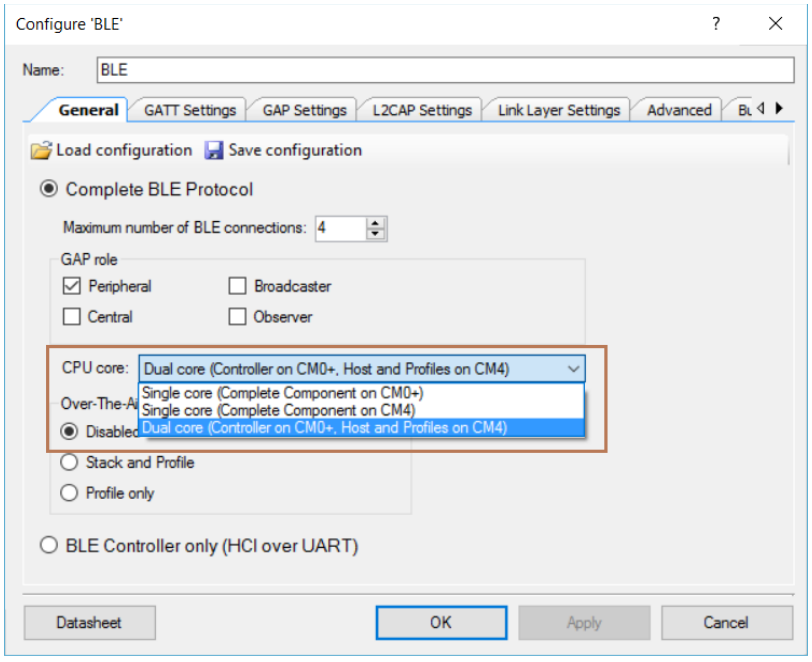
Important to remember:

- All application host-files must be run on the host core.
- The BLE Subsystem (BLESS) interrupt must be assigned to the core where the controller runs.

Do the following to switch the CPU cores usage:

1. In the BLE Component Customizer **General** tab, select the appropriate CPU core option.

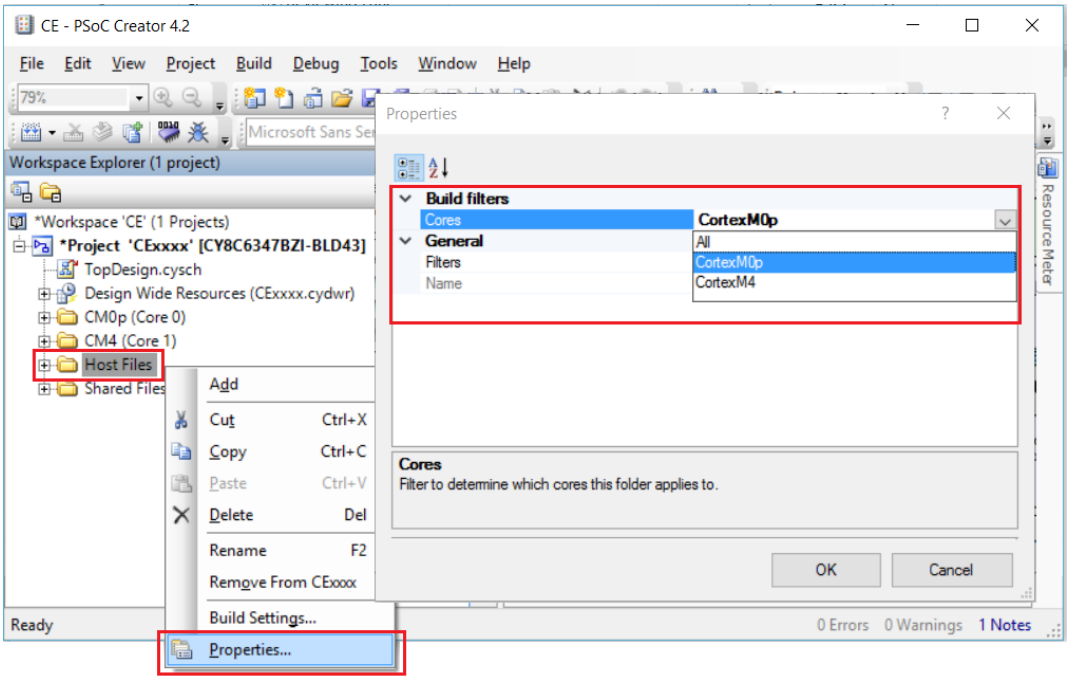
Figure 16. Select CPU Core



2. Identify the core on which host files will run. In the workspace explorer panel, right-click **Host Files**, choose **Properties**. Set the **Cores** property corresponding to the CPU core chosen in step 1, as shown in Figure 17.

   - For **Single core (Complete Component on CM0+)** option – CM0+
   - For **Single core (Complete Component on CM4)** option – CM4
   - For **Dual core (Controller on CM0+, Host and Profiles on CM4)** option – CM4

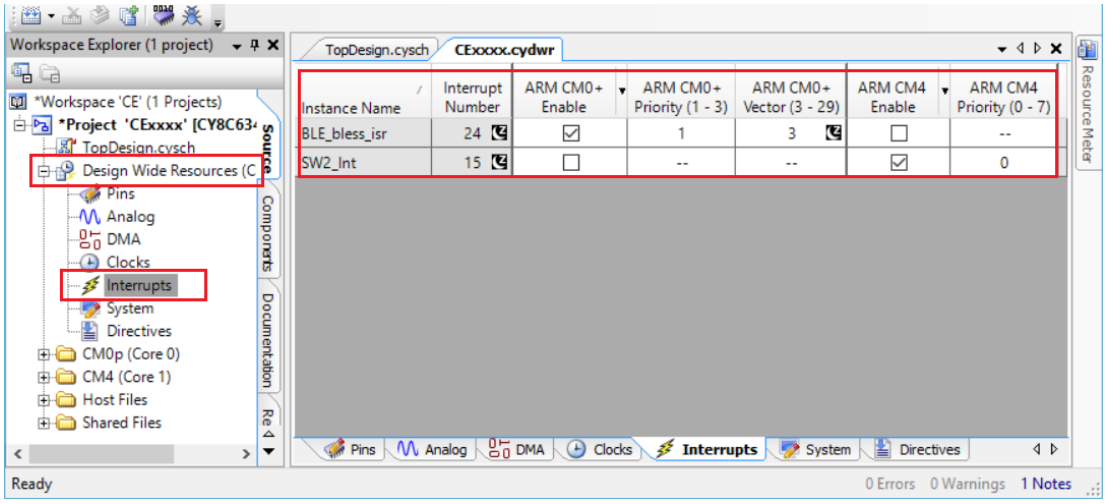
Figure 17. Change Core Properties



3. Assign the BLE_bless_isr and other peripheral (button – SW2, timer(s), and so on) interrupts to the appropriate core in **DWR** > **Interrupts** tab:

   - For **Single core (Complete Component on CM0+)** option: BLE_bless_isr and peripheral interrupts on **CM0+**
   - For **Single core (Complete Component on CM4)** option: BLE_bless_isr and peripheral interrupts on **CM4**
   - For **Dual core (Controller on CM0+, Host and Profiles on CM4)** option: BLE_bless_isr interrupt on **CM0+,** other peripheral interrupts on **CM4**

Figure 18. Assign Interrupts



Reusing This Example

This example is designed for the CY8CKIT-062-BLE pioneer kit. To port the design to a different PSoC 6 MCU device, kit, or both, change the target device using the Device Selector and update the pin assignments in the Design Wide Resources Pins settings as needed.

Related Documents

Application Notes		
AN210781	Getting Started with PSoC 6 MCU with Bluetooth Low Energy (BLE) Connectivity	Describes PSoC 6 BLE, and how to build a basic code example.
AN215656	PSoC 6 MCU Dual-CPU System Design	Presents the theory and design considerations related to this code example.
Software and Drivers		
CySmart – Bluetooth® LE Test and Debug Tool		CySmart is a Bluetooth® LE host emulation tool for Windows PCs. The tool provides an easy-to-use Graphical User Interface (GUI) to enable the user to test and debug their Bluetooth LE peripheral applications.
PSoC Creator Component Datasheets		
Bluetooth Low Energy (BLE_PDL) Component		The Bluetooth Low Energy (BLE_PDL) Component provides a comprehensive GUI-based configuration window to facilitate designing applications requiring BLE connectivity.
Device Documentation		
PSoC® 6 MCU: PSoC 63 with BLE. Datasheet.		PSoC® 6 MCU: PSoC 63 with BLE Architecture Technical Reference Manual
Development Kit (DVK) Documentation		
CY8CKIT-062-BLE PSoC 6 BLE Pioneer Kit		

Document History

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