Chapter 1: Introduction

After completing this chapter, you will understand what this class is, what topics are covered, and the overall class objectives.

Table of contents

Document conventions

Convention	Usage	Example
`Courier New`	Displays code and text commands	`CY_ISR_PROTO(MyISR);` `make build`
Italics	Displays file names and paths	*sourcefile.hex*
[**bracketed, bold**]	Displays keyboard commands in procedures	[**Enter**] or [**Ctrl**] [**C**]
Menu > Selection	Represents menu paths	**File > New Project > Clone**
Bold	Displays GUI commands, menu paths and selections, and icon names in procedures	Click the **Debugger** icon, and then click **Next**.

1.1 What is this Class

This is a class to teach how to use Bluetooth® Low Energy in ModusToolbox™ applications. The descriptions and exercises use a PSoC™ 6 MCU as a host to an AIROC™ CYW43012 Wi-Fi & Bluetooth® combo chip.

After completing this class, you should be able to create and debug full Bluetooth® applications using ModusToolbox™ tools including peripherals, centrals, and beacons.

1.2 Prerequisites

This class assumes that you know the basics of using the ModusToolbox™ ecosystem, how to interact with PSoC™ 6 MCUs including using peripherals, and how to program a PSoC™ 6 device. If you are unfamiliar with these topics, the following classes should be reviewed first:

- ModusToolbox™ Software Training Level 1 – Getting Started
- ModusToolbox™ Software Training Level 2 – PSoC™ MCUs

1.3 Required Software

The following software is required for completing the exercises in this class. Installation instructions will be provided in the exercises.

1.3.1 ModusToolbox™ tools

You should already have ModusToolbox™ tools installed on your system. If not, you will install it in the exercises.

1.3.2 AIROC™ Bluetooth® Connect App

We will make extensive use of a smart phone app called AIROC™ Bluetooth® Connect to act as a Bluetooth® LE central to connect to and test the peripherals that we will create. That tool is available for Android and iOS.

1.3.3 LightBlue

Another popular Bluetooth® development tool is called LightBlue. It is available on both Android and iOS and can perform similar functions as AIROC™ Bluetooth® Connect. It will be used in the scan response exercise and can be used in other exercises instead of AIROC™ Bluetooth® Connect.

1.3.4 Beacon Scanner app

For the chapter on Bluetooth® beacons, a beacon scanner app for Android or iOS was used to test the exercises. Many free beacon scanner apps are available.

1.4 Bluetooth® Families and Development Kits

Infineon supports Bluetooth® on multiple families of devices. A high-level summary of the different solutions is:

- AIROC™ Bluetooth® device paired with an external host (e.g., CYW43012 + PSoC™ 6)
  - The CYW43xxx device runs the Bluetooth® controller in hosted mode while a host processor such as a PSoC™ 6 MCU runs the upper levels of the stack and the user's application.
  - This is a 2-chip solution.
  - The connectivity device used in this solution often supports Bluetooth® LE, BR, EDR and Wi-Fi.
- AIROC™ Bluetooth® device with two CPUs (e.g., CYW20829 or PSoC™ 63 BLE)
  - This is a single chip solution with two CPU cores. One CPU runs the user's application and the Bluetooth® stack while the other CPU runs the Bluetooth® controller.
  - The CYW20829 additionally provides:
    - Bluetooth® LE long-range (https://www.youtube.com/watch?v=TYwwHk0my5E).
    - Periodic advertisements with responses which can be used for Electronic Shelf Labeling.
    - ISOC channels which can be used for ultra-low latency HID (ULL-HID) and Bluetooth® LE audio.
- AIROC™ Bluetooth® device with a single CPU (e.g., CYW20819 or CYW20835)
  - This is a single chip solution with a single CPU core.
  - The device runs the entire Bluetooth® stack and the application.
  - Some of these devices support Bluetooth® BR, EDR, and LE.

Note: *This class covers the first two solutions listed above. The third solution is covered in the Type2 class.*

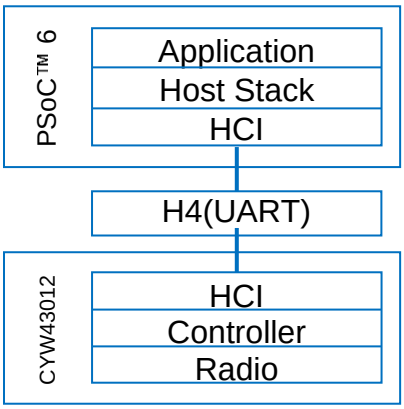
Note: *All examples and exercises in this class can be done using one of the following kits:*
CY8CKIT-062S2-43012
CYW920829M2EVK-02
CY8CPROTO-062-4343W
CY8CPROTO-062S2-4343

Development kits are available for each of the families described above. See the list of kits in the ModusToolbox™ Project Creator tool and the Infineon website for the most up-to date list.

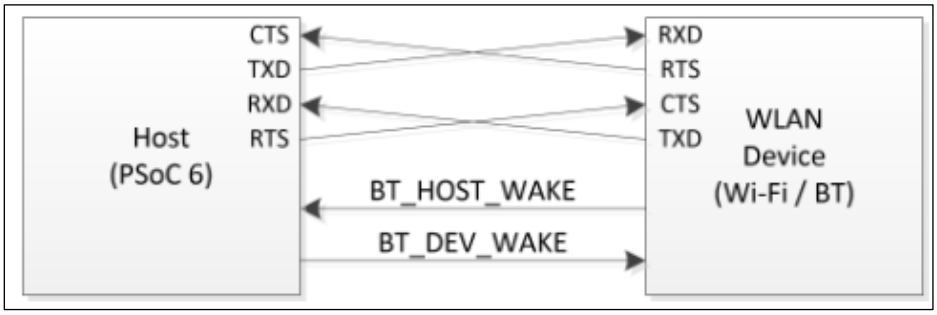
1.4.1 AIROC™ Bluetooth® device paired with an external host

In the 2-chip solution, the interface between the host (e.g., PSoC™ 6) and the radio device (e.g., CYW43012) uses the Host Controller Interface (HCI) to communicate between devices. The lower level of the Bluetooth® system (the Controller) runs on the CYW43012 while the higher level of the Bluetooth system (the Host Stack) runs on the PSoC™ 6 along with the user application.

Here is a picture that illustrates the connection:



The HCI interface physically runs using a 4-pin UART interface. The PSoC™ 6 that we are using has multiple UARTs on it so don't worry, you will still have a UART interface to print debug messages. There are also two wake pins that are used for low power which we will cover later.



Note: *The CYW43012 also supports Wi-Fi which uses a completely independent SDIO interface (not shown) for communication between the PSoC™ 6 host and the CYW43012.*

The controller (e.g., CYW43012) runs the radio physical layer (PHY) and link layer (LL). Everything above that runs on the PSoC™ 6.

1.4.2 AIROC™ Bluetooth® device with two CPUs

The CYW20829 and PSoC™ 63 devices each offer a single-chip Bluetooth® solution containing two CPU cores. For the PSoC™ 63, the upper-level Bluetooth® stack and user application runs on a CM4, while the lower-level Bluetooth® controller firmware runs on a CM0+. The CYW20829 contains two CM33 cores – the upper-level stack and user application runs on one CM33, while the controller runs on the other CM33.

The PSoC™ 63 also offers the benefit of CAPSENSE™ along with Bluetooth® LE in a single device.

1.4.3 AIROC™ Bluetooth® device with a single CPU

In the Bluetooth™ single CPU solution, the full stack and user application run on a single device. Many of the devices in this family are combo devices that support Bluetooth® BR/EDR and LE.

1.5 Bluetooth® Libraries

There is a single library that is included into the application to support the different requirements of the first two solutions. The library is called *btstack-integration.* It provides three different interfaces to the low-level hardware – one for each type of device. The *btstack-integration* library uses the `COMPONENT` mechanism to include the required interface layer. It also includes a dependency to the *btstack* library which contains the stack functions and API that is shared across all the solutions.

The three supported component values are:

Convention	Usage	Example
`COMPONENT_HCI-UART`	AIROC™ Wi-Fi and Bluetooth® Devices with Host MCU	PSoC™ 6 + CYW43012
`COMPONENT_BLESS-IPC`	PSoC™ 63 AIROC™ Bluetooth® Microcontroller	PSoC™ 63
`COMPONENT_BTSS-IPC`	CYW20829	CYW20829

Note: *For PSoC™ 63 AIROC™ Bluetooth® devices, the controller code that runs on the CM0+ is supplied from the cat1cm0p library using* *`COMPONENT_CM0P_BLESS`*.

Note: *The CYW20829 contains the Bluetooth® controller code in ROM.*

Note: *For single MCU devices such as the CYW20819 and CYW20835, the host stack and controller code are both contained in ROM. Therefore, the btstack and btstack-integration libraries are not used.*

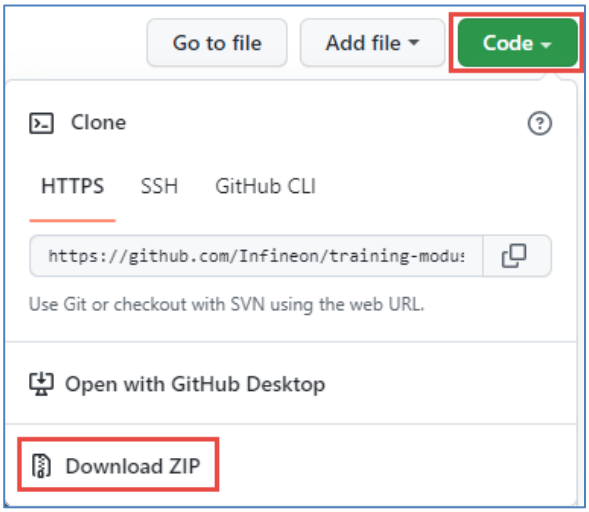
1.6 Exercises

Exercise 1: Download Class Material

In this exercise, you will download the class material from GitHub. This will give you local access to the manuals and projects.

1. Use a Web browser to go to the class GitHub site at: https://github.com/Infineon/training-modustoolbox-level3-bluetooth

2. Click the Code button.



3. Click the Download ZIP button to download the repo to your local disk to a convenient location and then unzip it.

Note: *If you are familiar with Git operations, you can clone the repository to your local disk using the URL instead of downloading a ZIP fie if you prefer.*

Exercise 2: Install Software

In this exercise, we will make sure you have all of the software needed for the class.

ModusToolbox™ tools

☐ 4. You should already have ModusToolbox™ tools installed on your system. If not, refer to the ModusToolbox™ Software Training Level 1 Getting Started class or visit https://www.infineon.com/cms/en/design-support/tools/sdk/modustoolbox-software for instructions.

Note: You must use ModusToolbox™ 2.3.1 or later. If you have ModusToolbox™ 2.3, you must install the 2.3.1 patch for the exercises in this class to work.

AIROC™ Bluetooth® Connect

☐ 1. Install AIROC™ Bluetooth® Connect onto your smartphone from the Android or iOS app store.

LightBlue

☐ 1. Install LightBlue onto your smartphone from the Android or iOS app store.

Beacon Scanner App

☐ 1. Install the beacon app of your choice onto your smartphone from the Android or iOS app store.

For Android, "Beacon Scanner" is a good choice.

For iOS, "BLE Scanner" is a good choice.

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