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 CySmart

We will make extensive use of a tool called CySmart to act as a Bluetooth® LE central to connect to and test the peripherals that we will create. That tool is available for Android, iOS, and Windows. Instructions to install the appropriate program(s) will be provided in the exercises.

Recommended: if you want to use CySmart for Windows, you will need a CY5677 CySmart Bluetooth® Low Energy Dongle. This can be purchased from:

> https://www.cypress.com/documentation/development-kitsboards/cy5677-cysmart-bluetooth-low-energy-ble-42-usb-dongle

The Windows version of CySmart gives you much more control and ability to see what is going on so it is recommended to use it if possible.

1.3.3 LightBlue (Optional)

Another popular Bluetooth® development tool is called LightBlue. It is available on both Android and iOS and can perform similar functions as CySmart.

1.3.4 Beacon Scanner app

For the chapter on Bluetooth® beacons, a beacon scanner app for Android or iOS 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™ Wi-Fi and Bluetooth® Combo Devices (CYW4343x, CYW43012, CYW4373x)
  - The CYW43xxx device runs the lower levels of the stack in hosted mode while a host processor such as a PSoC™ 6 MCU runs the upper levels of the stack and the application.
  - This solution supports Bluetooth® LE and Wi-Fi
- AIROC™ Bluetooth® SoC (CYW20xxx)
  - The 20xxx device runs the entire Bluetooth® stack and the application.
  - This solution supports Bluetooth® BR, EDR, and LE.
  - The firmware architecture for this solution is almost identical to the 43xxx case.
- AIROC™ Bluetooth® Microcontroller (PSoC™ 63 MCU)
  - The PSoC™ 63 device runs the entire Bluetooth® stack and the application.
  - This solution supports Bluetooth® LE.
  - The stack for this solution is different from the prior two cases so the firmware architecture is considerably different.

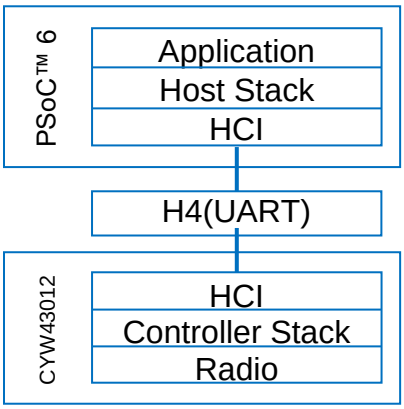
Note: *All examples and exercises in this class use the CYW43xxx hosted mode solution and firmware architecture. The kit used is the CY8CKIT-062S2-43012.*

Development kits are available for each of the three families described above. More kits are released all the time so when you read this, additional kits may be available. See the list of kits in the ModusToolbox™ Project Creator tool to see the most up-to date list.

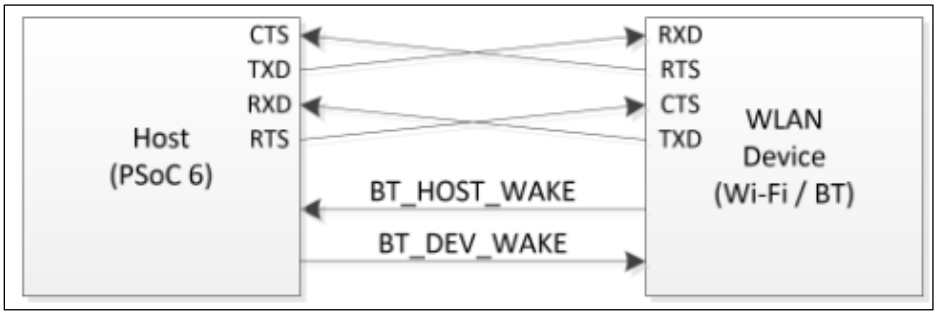
1.4.1 AIROC™ Wi-Fi and Bluetooth® Combo Devices

In the combo device solution, the interface between the host (e.g. PSoC™ 6) and the combo device (e.g. CYW43012) uses the Host Controller Interface (HCI). The lower level of the Bluetooth stack (the Controller Stack) will run on the CYW43012 while the higher level of the Bluetooth stack (the Host Stack) will run on the PSoC™ 6 along with the user application.

Here is a picture that illustrates the connection.:

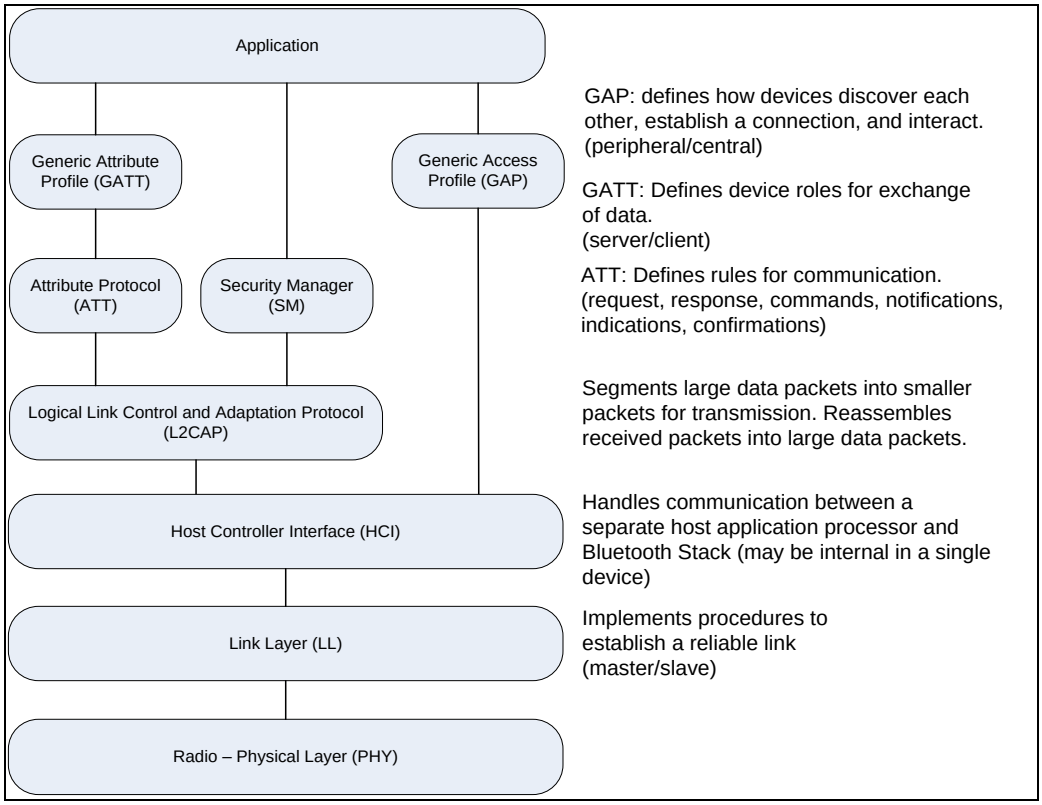


The HCI interface physically runs using a 4 pin UART interface. The PSoC™ 6 that we are using has multiple UARTs on it so don't worry – you will still have a UART interface to print debug messages. There are also two wake pins that are used for low power which we will cover later.



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 division of layers in the stack can be seen in the following picture. Everything below HCI runs on the CYW43012 and everything above HCI runs on the PSoC™ 6.



1.4.1.1 Development Kits

CY8CKIT-062S2-43012

- Wi-Fi + Bluetooth® Combo kit (CYW43012)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 2 MB on-chip flash, 1 MB SRAM
- 4 Mbit 108 MHz F-RAM
- 512 Mbit serial NOR flash memory
- CAPSENSE™ Slider, 2 Buttons
- 2 user mechanical buttons, 1 potentiometer
- 2 LEDs, 1 RGB LED
- microSD Card holder
- Mbed OS support

CY8CKIT-062-WiFi-BT

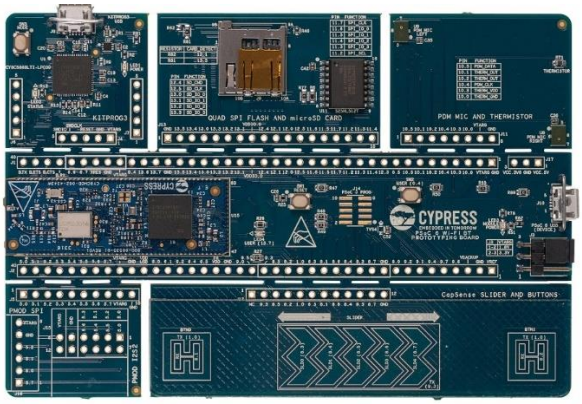
- Wi-Fi + Bluetooth® combo kit (CYW4343W)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 1 MB on-chip flash, 288 KB SRAM
- 512 Mbit serial NOR flash memory
- CCG3 USB Type-C Power Delivery
- CAPSENSE™ Slider, 2 Buttons, and Proximity
- 1 user mechanical button
- 2 LEDs, 1 RGB LED
- Mbed OS support
- Includes a CY8CKIT-028-TFT Display Shield

CY8CKIT-064B0S2-4343W

- Wi-Fi + Bluetooth® combo kit (CYW4343W)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 2 MB on-chip flash, 1 MB SRAM
- 4 Mbit 108 MHz F-RAM
- 512 Mbit serial NOR flash memory
- CAPSENSE™ Slider, 2 Buttons
- 2 user mechanical buttons, 1 potentiometer
- 2 LEDs, 1 RGB LED
- microSD Card holder
- Mbed OS support

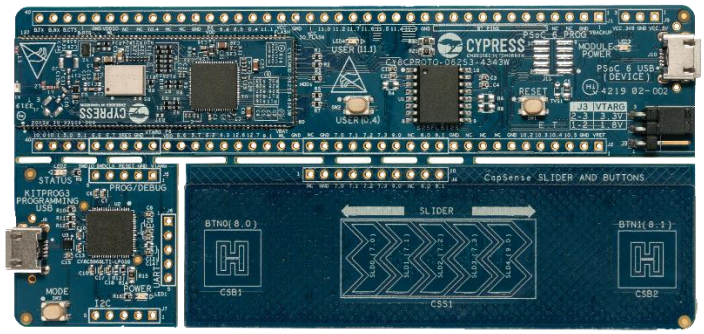
CY8CPROTO-062-4343W

- Wi-Fi + Bluetooth® combo kit (CYW4343W)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 2 MB on-chip flash, 1 MB SRAM
- 512 Mbit serial NOR flash memory
- CAPSENSE™ Slider, 2 Buttons
- 1 user mechanical button
- 1 thermistor, 2 PDM microphones
- 1 LED
- microSD Card holder
- Mbed OS support



CY8CPROTO-062S3-4343W

- Wi-Fi + Bluetooth® combo kit (CYW4343W)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 512 KB on-chip flash, 256 KB SRAM
- 512 Mbit serial NOR flash memory
- CAPSENSE™ Slider, 2 Buttons
- 1 user mechanical button
- 1 LED
- Mbed OS support



CYW9P62S1-43438EVB-01

- Wi-Fi + Bluetooth® Combo kit (CYW43438)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 1 MB on-chip flash, 288 KB SRAM
- 4 Mbit 108 MHz F-RAM
- 512 Mbit serial NOR flash memory
- CAPSENSE™ Slider, 2 Buttons
- 2 user mechanical buttons, 1 potentiometer
- 2 LEDs, 1 RGB LED

1.4.2 AROC™ Bluetooth® SOC

In the Bluetooth™ SOC solution, the stack and user application run on a single device. The advantage is a single chip solution at the expense of Wi-Fi support. The Bluetooth® API is almost identical to the Wi-Fi and Bluetooth® Combo Devices.

1.4.2.1 Development Kits

CYW920706WCDEVAL

- Bluetooth® BR, EDR, LE kit (CYW20706)
- Cortex M3
- 848 kB ROM, 352 kB SRAM
- 8 Mbit serial flash memory
- 1 user button
- 2 user LEDs

CYW920719B2Q40EVB-01

- Bluetooth® BR, EDR, LE kit (CYW20719)
- 96 MHz Cortex M4
- 2 MB ROM, 1 MB on-chip flash, 512 kB SRAM
- Thermistor
- Motion sensor
- 1 user button
- 2 user LEDs

CYW920735Q60EVB-01

- Bluetooth® BR, EDR, LE kit (CYW20719)
- 96 MHz Cortex M4
- 2 MB ROM, 384 kB SRAM
- 8 Mbit serial flash memory
- Thermistor
- Motion sensor
- 1 user button
- 2 user LEDs

1.4.3 AIROC™ Bluetooth® Microcontroller

PSoC™ 63 offer the benefit of a powerful PSoC™ MCU including CAPSENSE™ along with Bluetooth® LE in a single device.

1.4.3.1 Development Kits

CY8CKIT-062-BLE

- Bluetooth® LE kit (CY8C6347BZI-BLD53)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 1 MB on-chip flash, 288 KB SRAM
- 4 Mbit 108 MHz F-RAM
- 512 Mbit serial NOR flash memory
- CAPSENSE™ Slider, 2 Buttons, and Proximity
- 1 user mechanical button
- 2 LEDs, 1 RGB LED
- Mbed OS support
- Includes a CY8CKIT-028-EPD E-INK Display Shield
- Includes a CY5677 CySmart BLE 4.2 USB Dongle

CY8CPROTO-063-BLE

- Bluetooth® LE kit (CYBLE-416045-02)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 1 MB on-chip flash, 288 KB SRAM
- 1 user mechanical button
- 2 LEDs

CYBLE-416045-EVAL

- Bluetooth® LE kit (CYBLE-416045-02)
- PSoC™ 6 MCU with 150 MHz M4 and 100 MHz M0+
- 1 MB on-chip flash, 288 KB SRAM
- 1 user mechanical button
- 1 RGB LED

1.5 Exercises

Exercise 1: Install Software

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

ModusToolbox™ tools

☐ 1. 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.cypress.com/products/modustoolbox-software-environment 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.

CySmart

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

☐ 2. Recommended: Install CySmart for Windows if you have a Windows computer or a Windows virtual machine and you have a CY5677 CySmart Bluetooth® Low Energy USB Dongle.

You can find the installer at https://www.cypress.com/documentation/software-and-drivers/cysmart-bluetooth-le-test-and-debug-tool

LightBlue (optional)

☐ 1. Install LightBlue onto your smartphone from the Android or iOS app store if you want to try it in addition to CySmart.

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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