Chapter 2: Tour of Cypress Bluetooth

Objective: Understand the basics of Bluetooth.

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2.1 TOUR OF BLUETOOTH

Bluetooth is a short-range wireless standard that runs on the 2.4 GHz ISM (Industrial, Scientific, and Medical) band modulation. It is controlled by the Bluetooth Special Interest Group (SIG).

Discussions about Bluetooth are typically divided into *Classic Bluetooth* and *Bluetooth Low Energy*.

2.1-1 THE BLUETOOTH SPECIAL INTEREST GROUP (SIG)

The Bluetooth Special Interest Group is an industry consortium that owns the specifications for Bluetooth. All the Bluetooth documentation is available at www.bluetooth.org. You can register for an account on that website.

The current Bluetooth Specification is Version 5.1 is a ~3000 page long document that can be downloaded from the Bluetooth SIG website at https://www.bluetooth.com/specifications/bluetooth-core-specification

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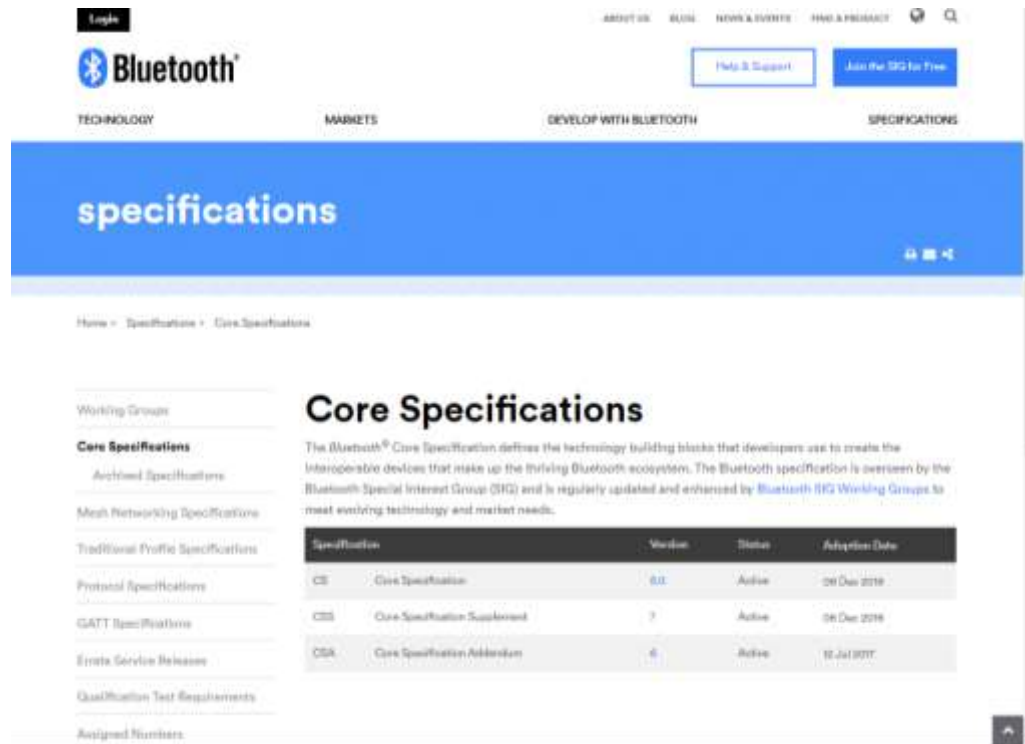
2.1-2 CLASSIC BLUETOOTH

Classic Bluetooth uses 79 channels with a channel spacing of 1 MHz. It has three main speeds – Basic Rate (BR) and two Extended Data Rates (EDR). Each of these uses a different modulation scheme.

Mode	Speed	Modulation
Basic Rate	1 Mbps	GFSK (Gaussian Frequency Shift Keying)
Extended Data Rate	2 Mbps	π/4 DQPSK (Differential Quadrature Phase Shift Keying)
Extended Data Rate	3 Mbps	8DPSK (Octal Differential Phase Shift Keying)

The range is dependent on the transmission power which is divided into four classes:

Class	Max Permitted Power		Typical Range
	(mW)	(dBm)	(m)
1	100	20	100
2	2.5	4	10
3	1	0	1
4	0.5	-3	0.5

2.1-3 BLUETOOTH LOW ENERGY

Bluetooth Low Energy (BLE) uses 40 channels with a channel spacing of 2 MHz (and so it shares the same range of frequencies with Bluetooth Classic). It provides much lower power consumption than Classic Bluetooth. Lower power is not achieved by reducing range (i.e. transmission power) but rather by staying actively connected for short bursts and being idle most of the time. This requires devices to agree on a connection interval. This connection interval can be varied to trade off the frequency of data transmitted vs. power. Therefore, BLE is excellent for data that can be sent in occasional bursts such as sensor states (i.e. temperature, state of a door, state of a light, etc.) but is not good for continuous streaming of data such as audio. BLE typically transmits data up to 1 Mbps, but 2 Mbps can be achieved in Bluetooth version 5 with shorter range.

2.1-4 BLUETOOTH HISTORY

Bluetooth Spec	Year	Major Features
1.0	1999	Initial standard.
1.1	2002	Many bug fixes. Addition of RSSI and non-encrypted channels.
1.2	2003	Faster connection and discovery. Adaptive Frequency Hopping (AFH) Host Control Interface (HCI) Addition of flow control and retransmission.
2.0 + EDR	2004	Addition of EDR (up to 3 Mbps).
2.1 + EDR	2007	Addition of Secure Simple Pairing (SPP) and enhanced security. Extended Inquiry Response (EIR).
3.0 + HS	2009	Addition of HS which uses Bluetooth for negotiation and establishment, then uses an 802.11 link for up to 24 Mbps. This is called Alternative MAC/PHY (AMP). Addition of Enhanced Retransmission Mode (ERTM) and Streaming Mode (SM) for reliable and unreliable channels.
4.0 + LE	2010	Addition of BLE. Addition of Generic Attribute Profile (GATT). Addition of Security Manager (SM) with AES encryption.
4.1	2013	Incremental software update.
4.2	2014	LE secure connections with data packet length extension. Link Layer privacy. Internet Protocol Support Profile (SPP) version 6.

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Bluetooth Spec	Year	Major Features
5	2016	LE up to 2 Mbps for shorter range, or 4x range with lower data rate. LE increased packet lengths to achieve 8x data broadcasting capacity.
5.1	2019	Mesh-based model hierarchy Angle of Arrival (AoA) and Angle of Departure (AoD) fo rtracking Advertising Channel Index GATT Cacheing

2.2 TOUR OF CHIPS

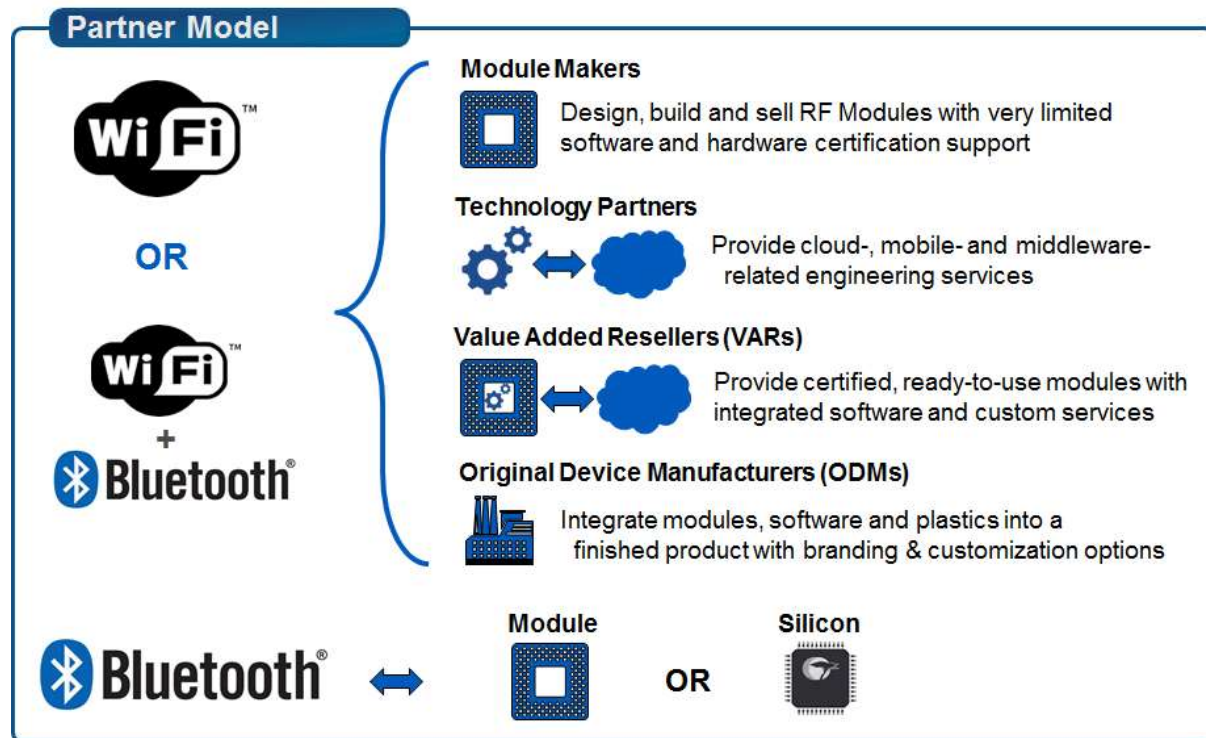| Device	Key Features	Notes
CYW20706	• Bluetooth BR, EDR and LE 5.x • ARM Cortex-M3 • 848 kB ROM • 352 kB RAM (data and patches) • 2 kB NVRAM	WICED Studio
CYW20719	• Bluetooth BR, EDR and LE 5.x • 2 Mbps LE v5 • 96 MHz ARM Cortex-M4 • Single Precision FPU • 2 MB ROM • 1 MB On-Chip Flash • 512 kB RAM	WICED Studio
CYW20819	• Bluetooth BR, EDR and LE 5.x • BR/EDR 2 Mbps and 3Mbps • LE 2Mbps • Ultra-low power • 96 MHz ARM Cortex-M4 • 1 MB ROM • 256 kB On-Chip Flash • 176 kB RAM	ModusToolbox
PSoC 4 BLE	• BLE 4.2 • 48 MHz ARM Cortex-M0	PSoC Creator

	• 256 kB On-Chip Flash • 32 kB RAM	
PSoC 6 BLE	• BLE 5.x • 150 MHz ARM Cortex-M4 & M0+ • 1MB or 2 MB On-Chip Flash • 288 KB RAM	ModusToolbox PSoC Creator

This class covers only the WICED Bluetooth SoC devices, not the PSoC BLE devices.

The Cypress CYW20819 is an ultra-low power (ULP), highly integrated, and dual-mode Bluetooth wireless MCU. By leveraging the all-inclusive development platform ModusToolbox, it allows you to implement the industry's smallest-footprint, lowest-power Bluetooth Low Energy (BLE) and dual mode Bluetooth applications quickly. CYW20819 is a Bluetooth 5.x compliant SoC with support for Bluetooth Basic Rate (BR), Enhanced Data Rate (EDR), and BLE.

The CYW20819 employs the highest level of integration to eliminate all critical external components, thereby minimizing the device's footprint and the costs associated with implementing Bluetooth solutions. A 96 MHz CM4 CPU coupled with 256 kB on-chip flash and 1 MB ROM for stack and profiles offers significant processing power and flash space to customers for their applications. CYW20819 is the optimal solution for a range of battery-powered single/dual mode Bluetooth internet of things applications such as home automation, HID, wearables, audio, asset tracking, and so on.

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Partner Model

Module Makers
Design, build and sell RF Modules with very limited software and hardware certification support

Technology Partners
Provide cloud-, mobile- and middleware-related engineering services

Value Added Resellers (VARs)
Provide certified, ready-to-use modules with integrated software and custom services

Original Device Manufacturers (ODMs)
Integrate modules, software and plastics into a finished product with branding & customization options

Bluetooth ⟷ Module OR Silicon

A global partner ecosystem enables you to get the level of support you need for your IoT application

Module Makers	Technology Partners	Value-Added Resellers	ODMs
SPIL, muRata, AzureWave, USI, MITSUMI, CyberTAN	Ayla Networks, Google, NXP, Particle, Apple, IBM Bluemix, electric imp, amazon web services, adb, CIKLUM, ST	Anaren, Cyntec, Inventek Systems, LANTRONIX, Laird, ZG, MXCHIP, SAVITECH Corp.	CoAsia Microelectronics Corp., Honeywell, DEXATEK, JABIL, MAXWELL GUIDER, INGICS, Chicony, PRIMAX

An IoT Selector Guide including partner modules available can be found in the Community at:

https://community.cypress.com/docs/DOC-3021

2.4 TOUR OF DEVELOPMENT KITS

2.4-1 CYPRESS CYW920819EVB-02

- Bluetooth 5.x plus 2 Mbps LE from v5
- 96 MHz ARM Cortex-M4
- Integrated transceiver
- 1 MB ROM, 256 kB On-Chip Flash, 176 kB SRAM
- 1 User Button, 2 User LEDs
- USB JTAG Programmer/Debugger

2.4-2 CYPRESS CYBT-213043-MESH

- Bluetooth Mesh kit with 20819 module
- Each kit contains 4 boards to evaluate mesh networks
- 1 User Button, RGB LED, ambient light sensor, PIR motion sensor

2.4-3 CYPRESS CYW920706WCDEVAL

- Monolithic, Single-chip, Bluetooth 5.x + HS
- ARM Cortex-M3 processor
- Integrated transceiver
- 848 kB ROM, 352 kB SRAM (data and patches), 2 kB NVRAM, 512 kB External Serial Flash
- 1 User Button, 2 User LEDs
- USB JTAG Programmer/Debugger

2.4-4 CYPRESS CYW920719Q40EVB-01

- Bluetooth 5.x plus 2 Mbps LE from v5

- 96 MHz ARM Cortex-M4

- Integrated transceiver

- 2 MB ROM, 1 MB On-Chip Flash, 512 kB SRAM

- 1 User Button, 2 User LEDs
- USB JTAG Programmer/Debugger