Technical Article

Back to Basics: Exploring the Benefits of Affordable Bluetooth® Low Energy

Nick Smith

Bluetooth® connects us to the world through our smartphone. We can interface with door locks, thermostats or even our cars. But is all Bluetooth the same? Do you unlock your car with the same Bluetooth that you used to stream music from your phone to a smart speaker?

The answer is yes – and no. Bluetooth Low Energy is a standards-based protocol that enables interoperability between different devices and products; however, there are also optional add-on features to expand the functionality of more complex solutions. There are three basic things that you should consider when picking the right Bluetooth solution for your application: software features, hardware and cost.

Software features

On the software side, there are two important technical details to consider:

- Which core specification can the device certify to?
- Which feature set does the device support?

The core specification defines the basic features of Bluetooth Low Energy that must run in order to create the interoperability consumers experience when their phone interfaces to products made by hundreds of different companies. These features are mandatory to release a product that is BTX.X certified (for example, BT5.0). Additional features associated with different Bluetooth Low Energy specification releases (outside of the core specification) are optional. For instance, BT5.0 added a high-speed mode, a long-range mode and extended advertising, but your application doesn't have to support these features to be BT5.0-certified. Along the same lines, BT5.1 added direction finding as a bonus feature.

Hardware

The hardware that runs the Bluetooth stack can also vary widely. There are basic devices that have a single core for both the application and radio-frequency functionality, versus integrated devices that offer both an application core and a microcontroller (MCU) core. There are also one-time programmable devices that are read-only memory-based and cannot be updated after programming, whereas flash-based devices can be upgraded thousands of times and even upgraded in the field over the air.

If your goal is to design a scalable and reliable application, it is important to evaluate affordable, high-quality devices with various hardware options including integrated application MCUs and flash memory architectures. Such evaluations enable you to select the right feature at the right price.

The table below shows some of the key features of Bluetooth Low Energy devices in the TI portfolio.

Table 1. SimpleLink™ Bluetooth Low Energy portfolio offering and specifications

	CC2640R2L	CC2640R2F (Q1)	CC2642R (Q1)	CC2652RB	CC2652P
	Most cost-effective	Smallest size, lowest power automotive option	Full BT5.1 feature set, automotive option	No need for external crystals – smallest system size	Longest range, highest output power, multiprotocol Bluetooth Low Energy
1 Ku price	$0.85	$1.44	$1.86	$3.00	$3.10
Bluetooth core specification | Bluetooth feature set	BT5.1 | BT4.2*	BT5.1 | BT4.2*	BT5.2 | Long Range, Advertising extension, 2Mbps, CSA#2, BLE Mesh, Direction Finding	BT5.2 | Long Range, Advertising extension, 2Mbps, CSA#2, BLE Mesh, Direction Finding	BT5.2 | Long Range, Advertising extension, 2Mbps, CSA#2, BLE Mesh, Direction Finding
Smallest package option	5-mm-x-5-mm quad flat no-lead (QFN)	2.7-mm-x-2.7-mm wafer chip-scale package (WCSP)	7-mm-x-7mm QFN	7-mm-x-7mm QFN	7-mm-x-7mm QFN
Application MCU core	M3	M3	M4F	M4F	M4F
Flash (KB)	128	128	352	352	352
Maximum output power	+5 dBm	+5 dBm	+5 dBm	+5 dBm	+20 dBm
Protocol support	Bluetooth Low Energy, Proprietary 2.4 GHz	Bluetooth Low Energy	Bluetooth Low Energy	Bluetooth Low Energy + 802.15.4 (Zigbee, Thread)	Bluetooth Low Energy + 802.15.4 (Zigbee, Thread)

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Some applications like wearable devices require the smallest size possible so that they aren't intrusive. Other applications require higher performance, such as longer ranges or multiprotocol operation, and are not size-sensitive. The TI portfolio offers hardware options that scale across memory footprints, performance, Bluetooth features and package. For instance, the smallest-size offering is the CC2640R2F in the 2.7-mm-by-2.7mm WCSP package. The most cost-effective offering is the CC2640R2L in the 5-mm-by-5-mm QFN package. For multiprotocol support and long ranges, the best option is the CC2652P with its integrated power amplifier.

Cost

When designing a Bluetooth Low Energy product, it is not only important to select the correct features, but also to consider the price. The SimpleLink portfolio has devices with various price, feature and performance options. The newest device in the TI Bluetooth platform, the CC2640R2L, is a flash-based, Bluetooth wireless system on chip with a starting price of $0.85. Additionally, the CC2652RB offers a path to system cost savings by removing the need for external crystals. It integrates this crucial system component into the package of the device, saving $0.10 to $0.20 on average for the total system compared to crystal-based solutions.

Remember – all Bluetooth is standard, but it's not all the same. When designing your application, it's critical to cover the Bluetooth basics (software features, hardware and cost) so that you can find the right solution whether you're unlocking a car or setting the temperature in your house. The TI portfolio is built to cover all bases by offering a variety of software options (BT5.0, locationing, co-existence) and hardware options (memory, package, performance).

Get started today: www.ti.com/BluetoothLowEnergy. Check out our Bluetooth Low Energy mesh network demo video.

* Some limited options available for BT5.0

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265