

# Bluetooth Low Energy

## Overview

Bluetooth version 4.0 introduced Bluetooth Low Energy technology. Bluetooth Low Energy optimized Bluetooth communication over 2.4 GHz for short bursts of long-range radio connections, making it ideal for applications that depend on long battery life and don't need high throughput streaming data. Since its introduction, numerous updates to the Bluetooth Low Energy specification have standardized additional features such to increase throughput, support additional connection topologies, and improve latency. Each new feature broadens the scope of Bluetooth Low Energy to include additional use cases and usage models. Silicon Labs offers a qualified Bluetooth® Core Specification, Bluetooth™ LE 6.0 protocol stack today.

## Bluetooth LE Architecture

The Bluetooth Low Energy architecture components are as follows:

**Physical Layer:** Controls radio transmission/receiving.

**Link Layer:** Defines packet structure, includes the state machine and radio control, and provides link layer-level encryption.

**HCI:** A Host-to-Controller interface (HCI) standardizes communication between the controller and the host.

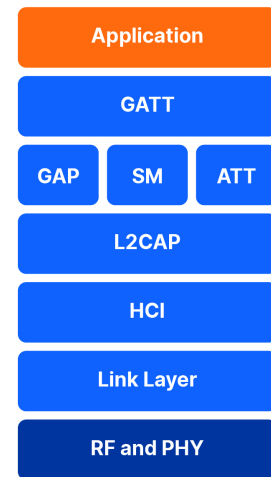
**L2CAP:** Logical Link Control and Adaptation Protocol acts as a protocol multiplexer and handles segmentation and reassembly of packets.

**ATT:** Attribute protocol provides means to transmit data between Bluetooth low energy devices.

**SM:** Security Manager provides means for bonding devices, encrypting and decrypting data, and enabling device privacy

**GAP:** Generic Access Profile layer provides means for Bluetooth low energy devices to advertise themselves or other devices, make device discovery, open and manage connections, and broadcast data.

**GATT:** GATT is used to group individual attributes into logical services. GATT also provides information about the attributes, that is, how they can be accessed and what security level is needed.



## Key Features of Silicon Labs Bluetooth Solution

Feature	Benefit
<b>Core Features</b>	Periodic Advertising with Responses (PAwR), Encrypted Advertising Data (EAD), Advertisement Extensions, Periodic Advertising, LE secure connections, 2M PHY, Long Range, AFH, LE Privacy 1.2 (peripheral), LE packet length extensions, Accept List (central side), GATT, & GATT Caching
<b>Direction Finding with Angle of Arrival (AoA)</b>	Scale to AoA to few hundred devices simultaneously
<b>Certificate Based Authentication and Pairing (CBAP)</b>	Use certificates to authenticate devices before provisioning, thus saving cost and time. Also, prevents counterfeit devices from being provisioned into the network
<b>Channel Sounding</b>	Utilizes 2-way connection-oriented ranging to precisely estimate the distance between 2 Bluetooth LE enabled devices

Silicon Labs Bluetooth stack supports three modes:

**Standalone mode:** Bluetooth stack and the application run in an EFR32SoC or module

**Network Co-Processor mode:** Bluetooth stack runs on the EFR32, and the application runs on a separate host MCU. API is exposed over a serial interface such as UART.

**Radio Co-Processor mode:** Link layer of the Bluetooth stack runs on the EFR32, and the Host Layer of the stack, as well as the application runs on a separate host MCU or PC. Link Layer and Host Layer communicate via HCI.

## Silicon Labs' Bluetooth Low Energy HW support

<p>High Performance device for Bluetooth LE, Bluetooth mesh, and Channel Sounding applications that require advance features and more Flash and RAM</p> <p>(AECQ-100 qualified packages available)</p>	<p>Industry-leading, energy efficient device for Bluetooth LE applications</p> <p>(AECQ-100 qualified packages available)</p>	<p>Optimized for line-powered devices including LED bulbs, and gateways for Bluetooth LE and Bluetooth mesh</p>	<p>Most Battery Versatile SoC for Connected Health, Smart Home, Portable Products</p>	<p>Most robust and feature-rich, multi-protocol SoC till date for more complex applications and ML capabilities</p>	<p>Most power-optimized, ultra-fast SoC till date for ultra-low power or extended storage applications</p> <p>(AECQ-100 qualified packages available)</p>
<ul style="list-style-type: none"> <li>1536kB Flash</li> <li>256kB RAM</li> <li>TX power 19.5dBm</li> <li>-105.7dBm @ 125kbps</li> <li>-97.6dBm @ 1Mbit/s</li> <li>-94.8dBm @ 2Mbit/s</li> <li>RX current 4.4mA @ 1Mbps</li> <li>TX current 5.0mA @ 0dBm</li> <li>1.3 μA Sleep current (16kB)</li> <li>Robust peripheral set</li> <li>AI/ML hardware accelerator</li> <li>Direction Finding</li> <li>Channel Sounding</li> <li>Secure Vault High</li> <li>QFN40 5x5 (26) (AEC-Q100)</li> <li>QFN48 6x6 (32) (AEC-Q100)</li> </ul>	<ul style="list-style-type: none"> <li>512kB Flash</li> <li>32kB RAM</li> <li>TX power 6dBm</li> <li>-106.7dBm @ 125kbps</li> <li>-98.9dBm @ 1Mbit/s</li> <li>-96.2dBm @ 2Mbit/s</li> <li>RX current 3.6mA @ 1Mbps</li> <li>TX current 4.1mA @ 0dBm</li> <li>1.26μA Sleep current (16kB)</li> <li>Lowest Power Bluetooth LE</li> <li>Secure Vault Mid</li> <li>QFN40 5x5 (26) (AEC-Q100)</li> <li>QFN32 4x4 (18) (AEC-Q100)</li> <li>TQFN32 4x4 (18)</li> </ul>	<ul style="list-style-type: none"> <li>1024kB Flash</li> <li>96kB RAM</li> <li>TX power 20dBm</li> <li>-104.9dBm @ 125kbps</li> <li>-97.5dBm @ 1Mbit/s</li> <li>-94.4dBm @ 2Mbit/s</li> <li>RX current 8.8mA @ 1Mbps</li> <li>TX current 9.3mA @ 0dBm</li> <li>+135 Junc. Temperature (16kB)</li> <li>Secure Vault High</li> <li>Line-Powered Bluetooth LE</li> <li>QFN32 4x4 (20)</li> </ul>	<ul style="list-style-type: none"> <li>768kB Flash</li> <li>64kB RAM</li> <li>TX power 8dBm</li> <li>-106.9dBm @ 125kbps</li> <li>-99.2dBm @ 1Mbit/s</li> <li>-96.3dBm @ 2Mbit/s</li> <li>RX current 3.6mA @ 1Mbps</li> <li>TX current 4.1mA @ 0dBm</li> <li>1.26μA Sleep current (16kB)</li> <li>Secure Vault Mid</li> <li>QFN40 5x5 (26)</li> <li>QFN32 4x4 (18)</li> <li>TQFN32 4x4 (18)</li> </ul>	<ul style="list-style-type: none"> <li>3200kB Flash</li> <li>512kB RAM</li> <li>TX power 19.5dBm</li> <li>-105.7 dBm @ 125 Kbps</li> <li>-97.6 dBm @ 1Mbit/s</li> <li>-94.8 dBm @ 2 Mbit/s</li> <li>RX current 5.4mA @ 1Mbps</li> <li>TX current 6mA @ 0dBm</li> <li>1.4μA Sleep current</li> <li>Secure Vault Mid/High</li> <li>QFN 6x6 (48)</li> <li>QFN 8x8 (68)</li> <li>7x7 BGA136</li> </ul>	<ul style="list-style-type: none"> <li>512kB Flash</li> <li>32kB RAM</li> <li>TX Power 6dBm</li> <li>-106.7 dBm @ 125 Mbit/s</li> <li>-98.9 dBm @ 1Mbit/s</li> <li>-96.2dBm @ 2Mbit/s</li> <li>RX current 3.6mA @ 1Mbps</li> <li>TX current 4.1mA @ 0dBm</li> <li>1.2μA Sleep current (8kB)</li> <li>Secure Vault Base</li> <li>Lowest power Bluetooth LE, optimized for energy harvesting applications</li> <li>QFN 4x4 (32) (AEC-Q100)</li> <li>QFN 5x5 (40) (AEC-Q100)</li> </ul>

### Silicon Labs' Bluetooth LE Development Kits

Silicon Labs' Bluetooth development kits are divided into three categories based on your development need:

- Rapid Prototyping
- Proof of Concept
- Advanced RF Development

For more information on the portfolio, check the link:

### Technical Resource

(scan the QR code and search for keywords)

- EFR32xG27
- EFR32xG26
- EFR32xG24
- EFR32xG21
- EFR32xG22
- API Documentation



Bluetooth LE Product Portfolio



Bluetooth Low Energy Selector Guide

### Software and Tools features

- Channel Sounding
- Supports Bluetooth™ LE 6.0
- Wi-Fi Coexistence
- Simplicity Studio IDE
- GATT Configurator
- Network Analyzer
- Direction Finding Tool suite
- Bluetooth NCP Commander
- Proprietary Radio Configurator
- Energy Profiler
- Tool Chain – GCC and IAR

Links: [Bluetooth Low Energy SDK](#), [Bluetooth Channel Sounding](#)

### Bluetooth LE Software / Tools

Silicon Labs Bluetooth Low Energy SDK helps you build smooth, reliable, and secure wireless connectivity for your IoT applications.

### Bluetooth LE Target Applications

- |                                |                                     |
|--------------------------------|-------------------------------------|
| <a href="#">ESL</a>            | <a href="#">LED Lighting</a>        |
| <a href="#">Medical</a>        | <a href="#">HVAC</a>                |
| <a href="#">Asset Tracking</a> | <a href="#">Building Automation</a> |
| <a href="#">Smart Home</a>     | <a href="#">Switches</a>            |
| <a href="#">Smart Tags</a>     | <a href="#">Sensors</a>             |



**IoT Portfolio**  
[www.silabs.com/products](http://www.silabs.com/products)



**Quality**  
[www.silabs.com/quality](http://www.silabs.com/quality)



**Support & Community**  
[www.silabs.com/community](http://www.silabs.com/community)

**Disclaimer:** Silicon Labs intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Labs products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications. Application examples described herein are for illustrative purposes only. Silicon Labs reserves the right to make changes without further notice to the product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Without prior notification, Silicon Labs may update product firmware during the manufacturing process for security or reliability reasons. Such changes will not alter the specifications or the performance of the product. Silicon Labs shall have no liability for the consequences of use of the information supplied in this document. This document does not imply or expressly grant any license to design or fabricate any integrated circuits. The products are not designed or authorized to be used within any FDA Class III devices, applications for which FDA premarket approval is required or Life Support Systems without the specific written consent of Silicon Labs. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Labs products are not designed or authorized for military applications. Silicon Labs products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons. Silicon Labs disclaims all express and implied warranties and shall not be responsible or liable for any injuries or damages related to use of a Silicon Labs product in such unauthorized applications. **Note: This content may contain offensive terminology that is now obsolete. Silicon Labs is replacing these terms with inclusive language wherever possible.** For more information, visit [www.silabs.com/about-us/inclusive-lexicon-project](http://www.silabs.com/about-us/inclusive-lexicon-project)

**Trademark Information**

SiliconLabs, Silicon Laboratories, Silicon Labs, SiLabs and the Silicon Labs logo, Bluegiga, Bluegiga Logo, EFM, EFM32, EFR, Ember, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Redpine Signals, WiSeConnect, n-Link, ThreadArch, EZLink, EZRadio, EZRadioPRO, Gecko, Gecko OS, Gecko OS Studio, Precision32, Simplicity Studio, Telegesis, the Telegesis Logo, USBXpress, Zentri, the Zentri logo and ZentriDMS, Z-Wave, and others are trademarks or registered trademarks of Silicon Labs. ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings. Keil is a registered trademark of ARM Limited. Wi-Fi is a registered trademark of the Wi-Fi Alliance. All other products or brand names mentioned herein are trademarks of their respective holders.



Silicon Laboratories Inc. 400 West Cesar Chavez Austin, TX 78701

[www.silabs.com](http://www.silabs.com)