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 additonal features such to increase throughput, support additional connection topologies, and improve latency. Each new feature broadens the scope of Bluetotoh 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.
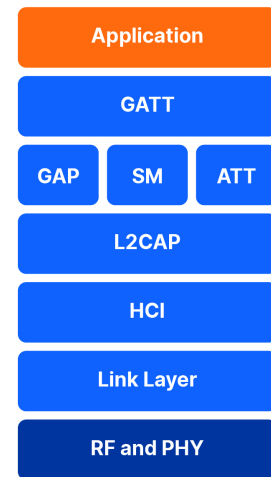
L2CAP: Logical Link Control and Adaptation Protocol acts as a protocol multiplexer and handles segmentation and reassembly of packets.

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
Core Features	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
Direction Finding with Angle of Arrival (AoA)	Scale to AoA to few hundred devices simultaneously
Certificate Based Authentication and Pairing (CBAP)	Use certificates to authenticate devices before provisioning, thus saving cost and time. Also, prevents counterfeit devices from being provisioned into the network
Channel Sounding	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

BG24	BG22	BG21	BG27	BG26	BG22E
High Performance device for Bluetooth LE, Bluetooth mesh, and Channel Sounding applications that require advance features and more Flash and RAM	Industry-leading, energy efficient device for Bluetooth LE applications	Optimized for line-powered devices including LED bulbs, and gateways for Bluetooth LE and Bluetooth mesh	Most Battery Versatile SoC for Connected Health, Smart Home, Portable Products	Most robust and feature-rich, multi-protocol SoC till date for more complex applications and ML capabilities	Most power-optimized, ultra-fast SoC till date for ultra-low power or extended storage applications
(AECQ-100 qualified packages available)	(AECQ-100 qualified packages available)				(AECQ-100 qualified packages available)
1536kB Flash	**512kB** Flash	**1024kB** Flash	**768kB** Flash	**3200kB** Flash	**512kB** Flash
256kB RAM	**32kB** RAM	**96kB** RAM	**64kB** RAM	**512kB** RAM	**32kB** RAM
TX power **19.5dBm**	TX power **6dBm**	TX power **20dBm**	TX power **8dBm**	TX power **19.5dBm**	TX Power **6dBm**
-105.7dBm @ 125kbps	**-106.7dBm** @ 125kbps	**-104.9dBm** @ 125kbps	**-106.9dBm** @ 125kbps	**-105.7 dBm** @ 125 Kbps	**-106.7 dBm** @ 125 Mbit/s
-97.6dBm @ 1Mbit/s	**-98.9dBm** @ 1Mbit/s	**-97.5dBm** @ 1Mbit/s	**-99.2dBm** @ 1Mbit/s	**-97.6 dBm** @ 1Mbit/s	**-98.9 dBm** @ 1Mbit/s
-94.8dBm @ 2Mbit/s	**-96.2dBm** @ 2Mbit/s	**-94.4dBm** @ 2Mbit/s	**-96.3dBm** @ 2Mbit/s	**-94.8 dBm** @ 2 Mbit/s	**-96.2dBm** @ 2Mbit/s
RX current **4.4mA @ 1Mbps**	RX current **3.6mA @ 1Mbps**	RX current **8.8mA @ 1Mbps**	RX current **3.6mA @ 1Mbps**	RX current **5.4mA @ 1Mbps**	RX current **3.6mA @ 1Mbps**
TX current **5.0mA @ 0dBm**	TX current **4.1mA @ 0dBm**	TX current **9.3mA @ 0dBm**	TX current **4.1mA @ 0dBm**	TX current **6mA @ 0dBm**	TX current **4.1mA @ 0dBm**
1.3 µA Sleep current (16kB)	**1.26µA** Sleep current (16**kB**)	+135 Junc. Temperature	1.26µA Sleep current (16kB)	**1.4µA** Sleep current	**1.2µA** Sleep current (8kB)
Robust peripheral set	Lowest Power Bluetooth LE	**Secure Vault High**	**Secure Vault Mid**	**Secure Vault Mid/High**	**Secure Vault Base**
AI/ML hardware accelerator	**Secure Vault Mid**	Line-Powered Bluetooth LE	QFN40 5x5 (26)	QFN 6x6 (48)	**Lowest power Bluetooth LE, optimized for energy harvesting applications**
Direction Finding	QFN40 5x5 (26) **(AEC-Q100)**	QFN32 4x4 (20)	QFN32 4x4 (18)	QFN 8x8 (68)	QFN 4x4 (32) (AEC-Q100)
Channel Sounding	QFN32 4x4 (18) **(AEC-Q100)**		TQFN32 4x4 (18)	7x7 BGA136	QFN 5x5 (40) (AEC-Q100)
Secure Vault High	TQFN32 4x4 (18)				
QFN40 5x5 (26)) (AEC-Q100)					
QFN48 6x6 (32)) (AEC-Q100)					

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

ESL	LED Lighting
Medical	HVAC
Asset Tracking	Building Automation
Smart Home	Switches
Smart Tags	Sensors

Smart. Connected.
Energy-Friendly.

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