

specifications

Bluetooth Core Specification

The building blocks of your Bluetooth device.

The *Bluetooth*® core specification defines the technology building blocks that developers use to create the interoperable devices that make up the thriving Bluetooth ecosystem. The Bluetooth specification is overseen by the Bluetooth Special Interest Group (SIG) and is regularly updated and enhanced by Bluetooth SIG Working Groups to meet evolving technology and market needs.

Two flavors of Bluetooth

The two most prevalent implementations of the specification are Bluetooth Basic Rate/Enhanced Data Rate (BR/EDR), which was adopted as version 2.0/2.1, and Bluetooth with low energy (LE), which was adopted as version 4.0/4.1/4.2. Each implementation has different use cases and each implementation uses a different chipset to meet essential hardware requirements. Dual-mode chipsets are also available for applications that include both use cases.

What's the difference?

- **Bluetooth BR/EDR**—establishes a relatively short-range, continuous wireless connection, which makes it ideal for use cases such as streaming audio
- **Bluetooth with low energy functionality (LE)**—allows for short bursts of long-range radio connection, making it ideal for Internet of Things (IoT) applications that don't require continuous connection but depend on long battery life
- **Dual-Mode**—dual-mode chipsets are available to support single devices such as smartphones or tablets that need to connect to both BR/EDR devices (such as audio headsets) and LE devices (such as wearables or retail beacons)

Core System Architecture

While each implementation has specific requirements that are detailed in the Bluetooth specification, the Bluetooth core system architecture has many consistent elements. The system includes an RF transceiver, baseband and protocol stacks that enable devices to connect and exchange a variety of classes of data.

Bluetooth devices exchange protocol signaling according to the Bluetooth specification. Core system protocols are the radio (RF) protocol, link control (LC) protocol, link manager (LM) protocol and logical link control and adaptation protocol (L2CAP), all of which are fully defined in the Bluetooth specification.

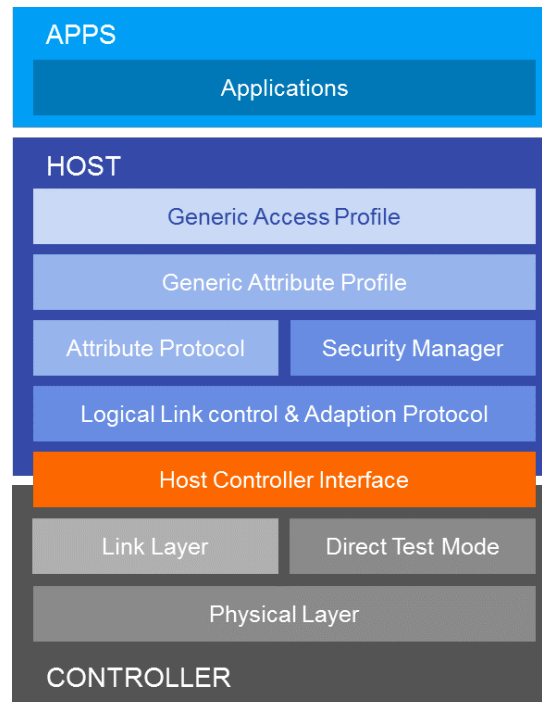
The lowest three system layers—the radio, link control and link manager protocols—are often grouped into a subsystem known as the Bluetooth controller.

This is a common implementation that uses an optional standard interface—the Host to Controller Interface (HCI)—that enables two-way communication with the remainder of the Bluetooth system, called the Bluetooth host.

The primary controller may be one of the following configurations, depending on use case:

- BR/EDR controller including the radio, baseband, Link Manager and optionally HCI
- LE controller including the LE PHY, Link Layer and optionally HCI
- Combined BR/EDR controller and LE controller, with one Bluetooth device address shared by the combined controller

The Bluetooth specification enables interoperability between systems by defining the protocol messages that are exchanged between equivalent layers. It also enables interoperability between independent Bluetooth sub-systems by defining the common interface between Bluetooth controllers and Bluetooth hosts.



Physical (PHY) Layer

Controls transmission/receiving of the 2.4Ghz radio with Bluetooth communication channels. BR/EDR provides more channels with narrower bandwidth, while LE uses fewer channels but broader bandwidth.

Link Layer

Defines packet structure/channels, discovery/connection procedure and sends/receives data.



Direct Test Mode

Allows testers to instruct the PHY layer to transmit or receive a given sequence of packets, submitting commands to it either via the HCI or via a 2-wire UART interface.

Host to Controller Interface (HCI)

Optional standard interface between the Bluetooth controller subsystem (bottom three layers) and the Bluetooth host.

Logical Link Control and Adaptation Protocol (L2CAP) Layer

A packet-based protocol that transmits packets to the HCI or directly to the Link Manager in a hostless system. Supports higher-level protocol multiplexing, packet segmentation and reassembly, and the conveying of quality of service information to higher layers.

Attribute Protocol (ATT)

Defines the client/server protocol for data exchange once a connection is established. Attributes are grouped together into meaningful services using the Generic Attribute Profile (GATT). ATT is used in LE implementations and occasionally in BR/EDR implementations.

Security Manager

Defines the protocol and behavior that manages pairing integrity, authentication and encryption between Bluetooth devices, and provides a toolbox of security functions that other components use to support almost any level of security needed by diverse applications.

Generic Attribute Profile (GATT)

Using the Attribute Protocol, GATT groups services that encapsulate the behavior of part of a device and describes a use case, roles and general behaviors based on the GATT functionality. Its service framework defines procedures and formats of services and their characteristics, including discovering, reading, writing, notifying and indicating characteristics, as well as configuring the broadcast of characteristics. GATT is used only in Bluetooth LE implementations. Get additional in-depth GATT information.

Generic Access Profile (GAP)

Works in conjunction with GATT in Bluetooth LE implementations to define the procedures and roles related to the discovery of Bluetooth devices and sharing information, and link management aspects of connecting to Bluetooth devices.



