



Twist'N'Blue

Bluetooth Low Energy
solutions



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What is Bluetooth Low Energy?

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BLE and Classic Bluetooth characteristics

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BLE and Bluetooth Classic architectures

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What is Bluetooth Low Energy?

PART 1

What is Bluetooth Low Energy?

Description of the Bluetooth Low Energy (BLE) Technology

BLE is also known as Bluetooth Smart (introduced with Bluetooth 4.0).

A technology designed around low power consumption → Not adapted for large data transfers or streaming of data.

Devices can be designed on a single mode (only BLE) or a dual mode (BLE + Classic Bluetooth) basis.

Design goals:

- Worldwide operation
- Low cost
- Robust
- Short range
- Low power

What is Bluetooth Low Energy?

BLE and Classic Bluetooth characteristics

BLE addresses different design goals and market segments compared to Classic Bluetooth technology.

The Bluetooth 4.0 specification permits devices to implement either or both of the BLE and Classic systems.

Technical Specification	Classic Bluetooth technology	Bluetooth Smart technology
Distance/Range (theoretical max.)	100 m (330 ft)	>100 m (>330 ft)
Over the air data rate	1–3 Mbit/s	1 Mbit/s
Application throughput	0.7–2.1 Mbit/s	0.27 Mbit/s
Active slaves	7	Not defined; implementation dependent
Security	56/128-bit and application layer user defined	128-bit AES with Counter Mode CBC-MAC and application layer user defined
Robustness	Adaptive fast frequency hopping, FEC, fast ACK	Adaptive frequency hopping, Lazy Acknowledgement, 24-bit CRC, 32-bit Message Integrity Check
Latency (from a non-connected state)	Typically 100 ms	6 ms
Minimum total time to send data (det. battery life)	100 ms	3 ms ^[31]
Voice capable	Yes	No
Network topology	Scatternet	Scatternet
Power consumption	1 W as the reference	0.01 to 0.5 W (depending on use case)
Peak current consumption	<30 mA	<15 mA
Service discovery	Yes	Yes
Profile concept	Yes	Yes
Primary use cases	Mobile phones, gaming, headsets, stereo audio streaming, smart homes, wearables, automotive, PCs, security, proximity, healthcare, sports & fitness, etc.	Mobile phones, gaming, smart homes, wearables, automotive, PCs, security, proximity, healthcare, sports & fitness, Industrial, etc.

Source : <http://www.wikipedia.com>.

What is Bluetooth Low Energy?

BLE Architecture (1/3)

BLE Architecture is split into 3 parts:

- **The controller** is a physical device that can transmit and receive radio signals and understand how these can be interpreted
- **The host** is typically a software stack that manages how devices communicate together and how different services can be provided at the same time using the radios
- **The applications** use the software stack and so indirectly uses the controller to enable a use case

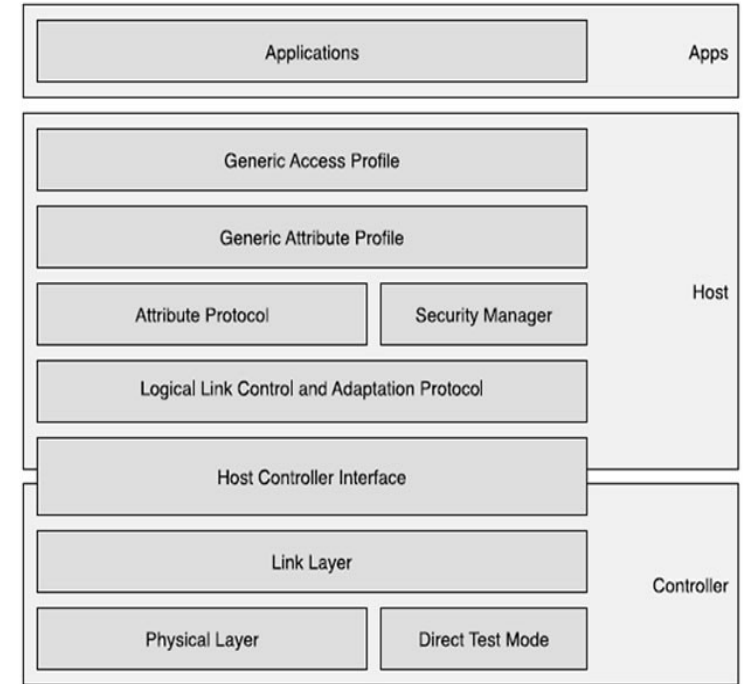


Figure 3-1 The Bluetooth Architecture

What is Bluetooth Low Energy?

BLE Architecture (2/3)

Physical Layer: Transmits and receives bits using the 2.4GHz radio.

Direct Test Mode: In charge of testing the Physical Layer. Can also measure various RF parameters to determine if the Physical Layer is compliant with the RF specs.

Link Layer: Responsible for advertising, scanning and creating and maintaining connections. It also ensures that packets are well structured with correct check values and encryption sequences.

Host/controller interface (HCI): Allows the host to send commands and data to the controller and the controller to send events and data to the host.

Logical Link Control & Adaptation Protocol (L2CAP): is the multiplexing layer for BLE and defines channel signaling commands.

What is Bluetooth Low Energy?

BLE Architecture (3/3)

Security Manager Protocol: Defines a simple protocol for pairing and key distribution.

Attribute Protocol: Defines a set of rules for accessing data on a peer device. Each attribute has a unique handle that identifies that attribute, a type that identifies the data stored in the attribute and a value.

Generic Attribute Profile: Defines the types of attributes and how they are used as well as procedures to discover the services, characteristics and relationships between services. It also reads and writes characteristic values.

Generic Access Profile: Defines how devices discover, connect and present useful information to the users and can also create a permanent relationship (bonding). It also describes procedures to discover other devices, connect to other devices, read their device name and bond with them. For private devices, it defines how to resolve private addresses and how to connect to them.

What is Bluetooth Low Energy?

BLE and Bluetooth Classic Architectures



(classic or BR/EDR)

SPP

RFCOMM

L2CAP

Link Manager

BR/EDR PHY



(dual mode or BR/EDR/LE)

SPP

GAP

GATT

RFCOMM

SMP

ATT

L2CAP

Link Manager

Link Layer

BR/EDR + LE PHY



(single mode or BLE)

GAP

GATT

SMP

ATT

L2CAP

Link Layer

LE PHY

SpringBlue and its 5 modes

PART 2

SpringBlue and its 5 modes

Introduction to SpringBlue

Springblue is a new family of solutions designed by Springcard from Bluetooth Low Energy.

Smartphones that don't feature an NFC interface can also be used for contactless identification.

SpringCard's BLE expertise is based on Twist'N'Blue, a ready-to-use module enabling any software development.

Twist'N'Blue is available with RS232, RS485 and USB interfaces

The Springblue approach opens the door to a wide range of applications. The following slides describe the 5 modes that we have developed and that can be adapted to your special use case. We are here to help you find out which mode suits you the best.

SpringBlue and its 5 modes

1- The Beacon Mode

You will find 'iBeacons' which are beacons provided by Apple and 'Eddystones' which are beacons provided by Google.

Specificity of the mode: The BLE device only broadcasts messages by emulating an iBeacon or an Eddystone.

The length of this message is limited and depends on the beacon (ex 18 bytes for Eddystone URL)

It is a one way communication mode.

SpringBlue and its 5 modes

2- The Spy Mode

The Twist'N'Blue listens to beacons present around a certain perimeter (which depends on the environment).

Each beacon by definition regularly signals its presents by emitting some of its basic information (MAC address, advertised data and RSSI (Received Signal Strength Indication)).

In other words, the Twist'N'Blue scans beacons around and is able to get their MAC address, the advertised data and the RSSI of each beacon.

SpringBlue and its 5 modes

3- The Access Control Mode

Allows to replace or add BLE to a classical RFID access control system.

Typically, you can open a door using the BLE function in your smartphone.

To do so, a dedicated application in the smartphone allows card emulation (i.e. Host Card Emulation mode).

A BLE module set in parallel with an existing RFID reader works the same. When the BLE signal sent by the smartphone is detected, the BLE host checks if the Emulated Card contained in the phone are allowed. If so, the door opens.

Two modes are available in the app in the smartphone, the « Automatic Mode » and the « Manual Mode ».

SpringBlue and its 5 modes

4- The RFID scanner + BLE Mode

Objective of this mode: Using RFID and BLE technology for a full contactless user/object identification.

It consists in reading an RFID tag/badge (ex: a UID) with an RFID reader.

The UID retrieved by the RFID reader can be sent over to a BLE host (ex: a tablet). The BLE interface is called « cable replacement ».

The BLE host is required to work with a dedicated app, to pair with the BLE device and be able to match the UID with a user or an object.

SpringBlue and its 5 modes

5- The HID Mode

HID: Human Interface Device

This mode simulates a keyboard entry through BLE (using HID over Gatt Profiles I.e HOGP instead of its dedicated Attribute Protocol).

This mode allows and defines the communication from a BLE device (ex: watch, beacon, heart rate monitor,...) to a BLE host (ex: smartphone, laptop,...). It's a one way communication mode.

#Use case example: the UID of an NFC card is retrieved from an NFC reader and received on a smartphone through BLE as if the user were typing it on the phone, it can be on a dedicated app or an existing one supporting text editing entries.

Resources and sources

Resources

You will find our products on our website <http://www.springcard.com>

Sources

www.wikipedia.com

“Bluetooth Low Energy: The developer's handbook” by Robin Heydon Prentice Hall edition

“Getting Started with Bluetooth Low Energy” by Kevin Townsend; Robert Davidson; Akiba; Carles Cufí, Published by O'Reilly Media, Inc., 2014

Any questions?

Please feel free to come back to us
if you need any additional information!



SpringCard offers a wide range of products to meet
as many as possible of needs and use cases.

With a 15-year experience in contactless smartcards,
communication technologies and development on embedded or mobile systems,
SpringCard R&D Team is also a valuable partner to design your own solution or product.

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