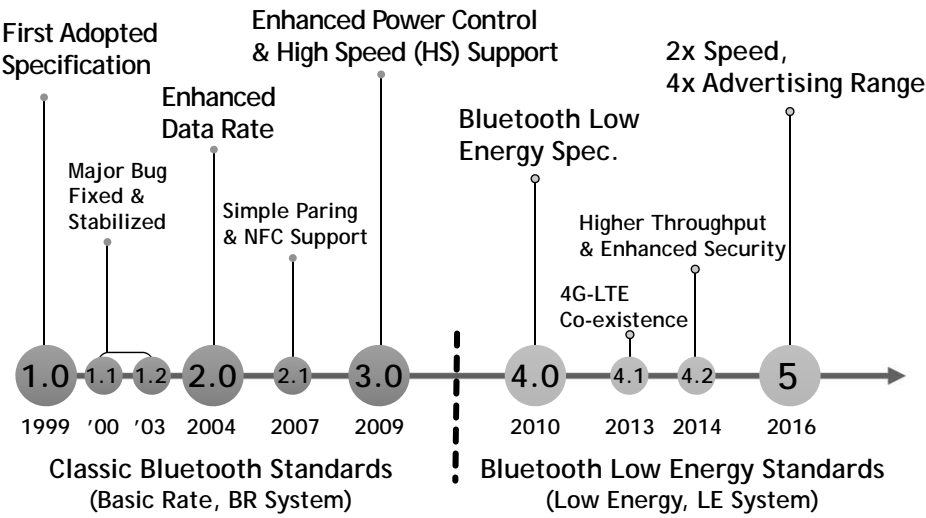


Wi-Fi & Bluetooth

Bluetooth Standards

Bluetooth Standards

❖ Bluetooth Evolution



## Bluetooth Standards

### ❖ EDR (Enhanced Data Rate)

- Introduced in Bluetooth v2.0 to enable faster data transfer
- Supports a data rate up to 3 Mbps
- EDR provides a lower power consumption using reduced duty cycle control

## Bluetooth Standards

### ❖ Bluetooth HS (High Speed)

- Bluetooth high speed technology was released in April 2009 (in Bluetooth version 3.0+HS)
- Bluetooth 3.0+HS provides data transfer speeds of up to 24 Mbps, though not over the Bluetooth link itself
- Bluetooth link is used for negotiation and establishment, and the high data rate traffic is carried over a collocated IEEE 802.11 Wi-Fi link

## Bluetooth Standards

### ❖ Bluetooth HS (High Speed)

- +HS part of the specification is not mandatory in Bluetooth version 3.0
- Only devices that display the "+HS" logo actually support Bluetooth over Wi-Fi high-speed data transfer

## Bluetooth Standards

### ❖ Bluetooth 4.0

- Bluetooth Specification 4.0 (called Bluetooth Smart) was adopted in June 2010
- Bluetooth 4.0 includes
  - Former Bluetooth standards (BR/EDR)
  - BLE (Bluetooth Low Energy)

## Bluetooth Standards

### ❖ BLE (Bluetooth Low Energy)

- Defines several profiles (specifications) on how a device can consume very low energy consumption while servicing a particular application
- Provides reduced power consumption and reduced cost while maintaining a similar communication range

## Bluetooth Standards

### ❖ BLE (Bluetooth Low Energy)

- A manufacturer can implement customized specifications for their product
- A device can have multiple BLE profiles
  - Health Care Profiles
  - Sports and fitness profiles
  - IPSP (Internet Protocol Support Profile)
  - ESP (Environmental Sensing Profile)
  - etc.

## Bluetooth Standards

### ❖ Bluetooth Beacons

- Bluetooth beacon devices transmit a unique ID number that can be read by a Bluetooth receiver, which can be used by an Application on a smartphone
- Bluetooth beacons are now commonly deployed as small devices (many are battery-powered) that broadcasts signals through BLE technology using a Bluetooth low energy antenna

## Bluetooth Standards

### ❖ Bluetooth Beacons

- Smartphone Apps identify the location of the Beacon device and activate location specific information on the smartphone
- Beacons are used in many location based applications
  - Advertisement & Coupon distribution
  - Home Automation Systems
  - Transportation Systems
  - Sport Stadiums, Stores, etc.

## Bluetooth Standards

### ❖ Bluetooth 4.1

- Bluetooth Specification 4.1 was adopted in December 2013
- Incremental software update to Bluetooth Specification v4.0 (no hardware updates)
  - Increased co-existence support for LTE
  - Bulk data exchange rate support
  - Device multiple role simultaneous support

## Bluetooth Standards

### ❖ Bluetooth 4.2

- Bluetooth Specification 4.2 was adopted in December 2014
- Preparing for emerging IoT devices
  - Low energy secure connection
  - Link layer privacy with extended scanner filter policies
  - 6<sup>th</sup> version of profile called IPSP (Internet Protocol Support Profile) is prepared to support connected home apps

## Bluetooth Standards

### ❖ Bluetooth 5

- Bluetooth Specification 5 was released in December 2016
- New features focusing on **IoT**
  - 2x transmission speed in LE system (2 Mbps)
  - 2x advertising message size extension
  - 4x advertising range (max. 240 meters)
    - ➔ Brings 8x advertising capacity
  - New coding scheme supporting error correction
  - Higher output power class added (up to 100 mW)

## Bluetooth Standards

### ❖ Bluetooth Spec. Evolution

Specifications	1.1	1.2	2.0 + EDR	2.1 + EDR	3.0 +HS	4.0	5
Adopted	2002	2005	2004	2007	2009	2010	2016
Max. Transmission Rate (↑ : BR, ↓ : LE)	723.1 kbps	723.1 kbps	2.1 Mbps	3 Mbps	25 Mbps	25 Mbps	25 Mbps
						1 Mbps	2 Mbps
Standard WPAN Range	10 m	10 m	10 m	10 m	10 m	50 m	50 m
Improved Pairing (without a PIN)				Yes	Yes	Yes	Yes
Improved Security		Yes	Yes	Yes	Yes	Yes	Yes
NFC Support			Yes	Yes	Yes	Yes	Yes

## Bluetooth Standards

### ❖ Bluetooth Feature Evolution

Specifications	1.1	1.2	2.0 + EDR	2.1 + EDR	3.0 +HS	4.0	5
Voice Dialing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Call Mute	Yes	Yes	Yes	Yes	Yes	Yes	Yes
802.11 Cooperated Transmission					Yes	Yes	Yes
Lower Power Consumption					Yes	Yes	Yes
Bluetooth Low Energy						Yes	Yes
Error Correction PHY Coding							Yes
Higher Output Power							Yes

## Wi-Fi & Bluetooth References



## References

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### Image sources

- Bluetooth Logo, By Bluetooth Special Interest Group. (SVG rendering drawn by me, =Nichalp «Talk»=) [Public domain], via Wikimedia Commons