

Bluetooth Lower Energy Technology

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Abstract

With the advent of the Bluetooth 4.0 specification, Bluetooth low energy technology (BLE) has been widely concerned. This paper first briefly introduces the history of the Bluetooth logo, then expounds the software overall architecture of Bluetooth 4.0, and finally compares Bluetooth low energy technology with the classic Bluetooth.

Keywords

Bluetooth 4.0 specification, Bluetooth low energy technology(BLE), software overall architecture.

1. Bluetooth profile

The design of Bluetooth logo is derived from the Danish king, Harald Blatand, took the two letters-H and B, expressed in the ancient northern letters, a combination of both that became the famous Bluetooth logo at present, as shown in Fig. 1.

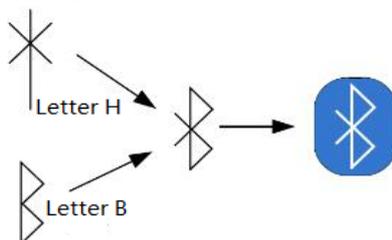


Fig. 1 The origin of the Bluetooth logo

Bluetooth is a kind of wireless communication technology that supports short distance among equipment. The communication distance of the traditional Bluetooth is about 10 meters, and while BLE4.0 version of Bluetooth communication distance can reach 100 meters. Bluetooth technology can connect all kinds of electronic devices using Bluetooth technology(including Bluetooth louder-speaker box, Bluetooth headset, Bluetooth laptops, etc.) with wireless communication, which does not need to deploy abundant cable, and thus can simplify the connection between the devices. Bluetooth uses the distributed network structure, supports point to point and point to multi-point communication, and works in universal 2.4 GHz ISM spectrum.

2. The software overall architecture of Bluetooth 4.0

The software system of the whole Bluetooth includes six parts: the application layer, layer configuration file, the protocol layer, the host /controller interface layer, logical link layer and physical layer, as shown in Fig. 2.

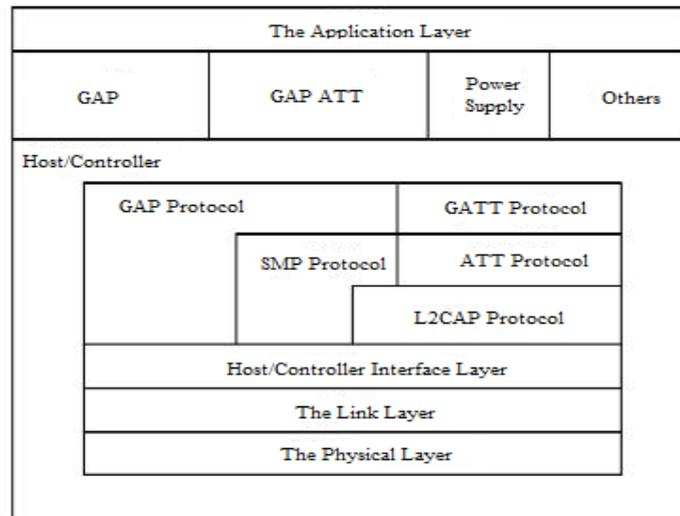


Fig. 2 The block diagram for Bluetooth system

Bluetooth technology is the bridge of connecting the electronic equipment through the wireless technologies, which has the characteristics of low power consumption, low cost, short distance communication, can replace the traditional cable, and simplify the connection between the equipment. Bluetooth supports point to point and point to multi-point communication, and can sustain a Bluetooth host connecting up to 7 slave devices to communicate it at the same time. From the above characteristic, we can form a Bluetooth piconet, connecting the communication between Bluetooth devices, and the form of piconet topology is for scattering network, as shown in Fig. 3.

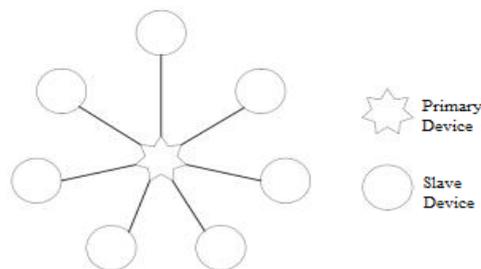


Fig. 3 Bluetooth Piconet

3. Bluetooth low energy technology compared with the classic Bluetooth

BLET is the code standard put forward by the Bluetooth 4. 0 version up to the minute, the integrated BLET consists of three parts: controller, the host and the part of application Profiles standard. BLET basically has the following three characteristics: long standby time, the fast speed of connection, lower power of the transmitting and receiving peak time, which decides the performance of its ultra-low power consumption, and using the standard button battery is enough to operate for several years. In addition, BLET has low cost, and the connected interoperability performance between multiple devices. Some of the specific characteristics are compared as follows.

3.1 The aspect of standby power

The consumed power to find other radio frequency devices by BLET is from tenth to twentieth of the traditional Bluetooth technology.

3.2 The connection process

According to the traditional Bluetooth protocol’s specification, if a Bluetooth device is broadcasting, it will not respond to the current ongoing scanning equipment, while the protocol specification of BLET allows the broadcasting equipment to connect the scanning device, which is effective to avoid the

repeated scanning, through the improvement of connection mechanism, to connect and establish process about the devices of BLET can be controlled to be finished within 3ms, and meanwhile can make the application program quickly start the linker, and the transmission speed of milliseconds to complete, after the approved data transfers, the link is immediately be closed. However just to establish the connection of the link layer under the traditional Bluetooth protocol takes 100 ms, and it needs more time to establish the connection of L2CAP layer (logical link control and adaptation protocol).

3.3 Peak power

BLET has the more strict definition of packet length, supports ultra-short (8-27 Byte) data packet; Compared to the traditional Bluetooth technology, it uses the more "loose" radio frequency (RF) parameters. BLET, also by increasing the modulation index, adopts 24 bits of CRC (cyclic redundancy check) to ensure that the packet has more stability when disturbance, and the range of BLET increases to more than 100 m. The above measures combined with the traditional principle of frequency hopping with Bluetooth, which effectively reduces the peak power.

3.4 The comparison between BLET and the classic Bluetooth

Table 1 describes the protocols of Bluetooth lower energy compared with that of classic Bluetooth.

Table 1 The protocols of Bluetooth lower energy compared with that of classic Bluetooth

Technical Specification	Classic Bluetooth technique	Lower energy Bluetooth technique
Wireless Frequency	2.4GHz	2.4GHz
Distance/Scope	10-100 meters	50 meters
(air data)Transmit rate	1-3Mbps	1Mbps
Throughput rate of application data	0.7-2.1Mbps	0.2Mbps
The number of nodes	7	An infinite number
Security	56-128 bit	128 bit AES
Robustness	FHSS(frequency-hopping spread spectrum)	FHSS
Delay(from not connect to send data)	100 ms	<3ms
Serviceable range	Global	Global
Certification authority	Bluetooth SIG	Bluetooth SIG
Speech support	Yes	No
Network topology	Point to point, decentralized network	Point to point, star
Power consumption	As the reference value 1	From 0.01 to 0.5(according to the different use case)
Service discovery	Yes	Yes
Profile definition	Have	Have
Main application fields	Mobile phone, headset, phonotape and videotape, car, PC, etc.	Mobile phone, PC, Exercise equipment, medical equipment, automotive, industrial, household electronics, etc

The features of Bluetooth lower energy compared with that of classic Bluetooth is as shown in Table 2.

Table 2 The features of Bluetooth lower energy compared with that of classic Bluetooth

Characteristics	Classic Bluetooth(BR/EDR)	Bluetooth lower energy
Packet types	5 kinds of must packet types 13 kinds of BR packet types 10 kinds of EDR packet types	1 kind of packet structure 2 kinds of packet format (Broadcast packet and data packet)
LM/LL Control Information	75 link management protocol information	8 kinds of link layer control information
Protocols	9(RFCOMM, BNEP, AVCTP, AVDTP, HCRP, TCSBIN, MCAP, OBEX, HID, SDP)	1(ATT attribute protocol)

4. Conclusion

Bluetooth low energy technology(BLET) will make a great contribution for the entire wireless sensor market, which can be for a specific application to develop very specific configuration files, can let the manufacturers develop the most innovation, has the function of a remarkable power, and is easy to make the consumers use the products. In the future BLET will have a wide range of applications in sports equipment, medical monitoring, Internet of things, smart phones, personal computers, automatic control, auto application and consumer electronics, etc.

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