An Analysis of Bluetooth Technology

Huajun Chen

Institute of Information Engineering, Tongren University, Guizhou 554300, China

390832683@qq.com

Abstract

Bluetooth technology is an open short-range wireless voice and data communication technology, and obtains the large-scale application in the whole world, widely used in various fields such as wireless headset, tablet personal computer, smart phones, laptops, and so on. This paper mainly expounds the generation, characteristics, application and development prospects of Bluetooth technology.

Keywords

Bluetooth technology, short-range, large-scale, communication.

1. Introduction

1.1 The generation of Bluetooth technology

The name "Bluetooth"[1-2] is derived from the nickname of a Danish king-Harald Gormsson who was a Denmark of the king century at the 10th century. Harald was born a pirate family, unified the disintegrated countries of Nordic, and became the king of the Vikingdom. While the king Harald Blatand liked eating blueberries, every day his teeth was blue, so he got the nickname of "Bluetooth". In the run-up to industry association, it needed a very expressive to name after the high and new technology. After the personnel of industry organization discussed the development of the future wireless technology and European history, they thought the king name of Blatand was very suitable for the new technology. Because the king-Blatand unified Norway, Sweden and Denmark. He was articulate and sociable, like the forthcoming new technology maintaining good communication among each system field.

Bluetooth is the radio technology(generally within 10 meters) with supporting the equipment to process a short-distance communication. Using Bluetooth technology can exchange wireless information among several devices, and effectively simplify communication among the mobile communication terminals and also successfully between the equipment and Internet, which makes data transmission become more quickly and efficiently, in order to widen the road for wireless communication.

1.2 The generation of Bluetooth technology

Bluetooth technology realizes the duplex transmission with time-division duplex transmission scheme, and implements voice, data and video transmission with low-power wireless radio communication technology. Its maximum transmission rate is 1 Mb/s, and proceeds to full duplex communication with the way of time-division that the distance of communication is approximate 10 meters, and which is further increased by the configuration of power amplifier. The product of Bluetooth adopts the technology of frequency-hopping spread spectrum(FHSS) that can be able to resist signal fading. Using the technology of fast FHSS and short grouping can effectively reduce co-channel interference, and improve the security of communication. Using the technology of forward error correction coding can reduce the interference of random noise in the long distance communication. Using the frequency band-2.4 GHz of ISM(namely, industry, science and medicine) frequencies can save the trouble with applying special license. Using the mode of Frequency Modulation(FM) can make the devices become more simple and reliable. The product of Bluetooth is that a frequency-hopping frequency sends a synchronous grouping that each group takes up a time slot and also adds to 5 time slot. The technology of Bluetooth supports a asynchronous data channel,

or three concurrent synchronous voice channels, or a channel with sending asynchronous data and synchronous voice at the same time. Each voice channel of Bluetooth supports synchronous voice with 64 Kbps, its asynchronous channel supports the maximum rate with 721 Kbps, and its inverse response rate is 57.6 Kbps of asymmetric connection, or even 432.6 Kbps of symmetry connection.

Bluetooth device should have inter-operability, and some devices, from Radio compatible module and the air interface to the application layer protocol and the object exchange format, all realize inter-operability. While the demand of other devices (such as a head-mounted device, etc.) is much looser. The goal of Bluetooth plan is to make sure that any device with Bluetooth tag can proceed interchangeability operation. The inter-operability of software began in the discovery of multiplex transmission, equipment and service in the link level protocol , as well as grouping with segmenting and restructuring. Bluetooth device must be able to recognize each other, and through installing appropriate software identify the top function of supporting each other. Inter-operability demands to adapt the same application layer of protocol stack. Different types of Bluetooth devices have different request for compatibility, and the users can't expect head-mounted devices containing an address book. The compatibility of Bluetooth refers to having the compatibility of radio, possessing voice transceiver ability and finding other Bluetooth devices. And more function are completed by mobile phones, the hand-held devices, and notebook computer. To implement these function, the software architecture of Bluetooth will use the existing specifications, such as the OBEX, HID (human interface device), VCard/vCalendar and TCP/IP, etc., rather than develop new specifications[3] again. The compatibility of the equipment is required for accommodating the specifications of Bluetooth and the existing protocols.

1.3 The characteristics of Bluetooth technology

Bluetooth is a technical specification with short-range wireless communication, whose initial goal is to replace the cable connection of various digital equipment such as the existing PDA, mobile phones, etc. In the beginning of formulating the Bluetooth specification, the unified global goal is established, to declare the whole world in public, and work frequency range for 2.4 GHz ISM (Industrial, Scientific and Medical) with the global unified open. Communication between the product of Bluetooth technology and the Internet makes the equipment of family and office realize inter-flow and inter-connection without cable, which greatly improves the efficiency of office and communication. Therefore, Bluetooth will be new favorite in the field of wireless communication, for providing great convenience for the majority of users. Judging from the current application, because of the smaller volume and lower power of Bluetooth, its application is not limited to computer peripherals, and almost can be integrated into any digital device, especially the mobile and portable devices with the undemanding data transmission rate.

The characteristics[4-6] of Bluetooth technology can be summarized as follows.

Fisrtly, the application in the global scope:Working the frequency band of 2.4GHz ISM, the ISM frequency range of most countries is from 2.4GHz to 2.4835GHz in the worldwide.

Secondly, the establishment of temporary and peer connection:Master device is the Bluetooth equipment with a network connection to actively initiate the request for connection. Several Bluetooth devices are connected into a piconet, which exists only a master device, and the rest are all slave units.

Thirdly, the strong anti-interference ability:Bluetooth adopts the way of frequency-hopping to spread spectrum to resist interference from these equipment.

Fourthly, the security: Bluetooth provides the function of authentication and encryption to ensure the safety of the link level.

Fifthly, the simultaneous transmission of voice and data: Bluetooth uses the technology of circuit switching and packet switching, to support a channel with asynchronous data, three channels with voice and synchronous and a channel with asynchronous data and simultaneous transmission.

Sixth, the short distance communication: The communication distance of Bluetooth technology is 10 meters, and according to the requirement expands to 100 meters to satisfy the deeds of various devices.

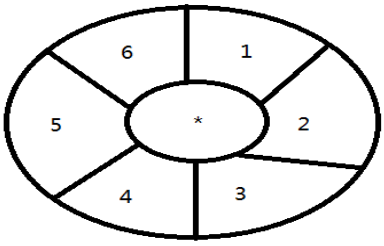
Seventh, the lower power and smaller volume: Bluetooth devices have four work modes under the state of communication: the activate mode, the respiratory mode, the hold model, and the sleep mode. The first mode is normal, and the other three modes are stipulated to the low power mode to save energy. In addition, the volume of a Bluetooth device is small and which is convenient to carry.

Eighth, the open interface standard: In order to generalize the use of Bluetooth technology, SIG opens all the standards of Bluetooth technology, any units and individuals around the world can all develop the products of Bluetooth. Only the product Bluetooth is ultimately through the compatibility tests by SIG, it can push to the market.

Ninth, the low cost: With the expanding demand of market, various suppliers have launched their own Bluetooth chip and module, the price of the product Bluetooth also declines, and the Bluetooth equipment is slowly gained popularity.

2. The application of Bluetooth technology

Today the electronic equipment and network is very popular, because the Bluetooth technique has the incomparable superiority to other technologies, its range of application[7] is greatly wide, and it can play its unique advantage in many fields, as shown in Fig. 1.



* the application of Bluetooth technology
1 the system of telephone
2 wireless cable
3 wireless office package
4 electronic commerce
5 the digital electronic devices
6 office automation and home entertainment

Fig. 1 The application figure of Bluetooth technology

3. The development prospects of Bluetooth technology

As a kind of short-range wireless communication technology, Bluetooth can connect communication, personal computer, network, industry, automation and home appliances etc, together through voice or data, and the distance can reach 10 meters, or even 100 meters. The advantage of Bluetooth technology is that it makes the users emancipate from the complex connection, merchants and customers can be more simple flexible to implement synchronous communication, and at the same time also more conducive to establish the more rapid and convenient contact among colleagues, friends or office network.

Bluetooth technology has been developing rapidly in recent years, and its superiority makes a variety of Bluetooth devices be popular in the market and good prospects. But it is not enough mature for the Bluetooth technology to research and apply in these field such as medical electronics, industrial control and home appliances automation, and which is still to be further developed . A new technology emerges, whose expected value is often very high, but the development of any new technology requires a procedure, and Bluetooth technology is no exception. However it is believed that software developers make ongoing efforts, the future development of Bluetooth technology[7-10] is inestimable.

References

[1] Bluetooth.org. http://www.bluetooth.org.

[2] Bluetooth.com. Bluetooth. http://www.bluetooth.com.

[3] Bluetooth Special Interest Group, Bluetooth Specification Version4.0, URL: https://www. bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=229737(accessed December 2014).

[4] M.Ryan, Bluetooth: with low energy comes low security, in:*Proceedings of the Presented as part of the Seventh USENIX Workshop on Offensive Technologies*(Berkeley,2013). URL: https: // www.usenix.org/conference/woot13/workshop-program/presentation/Ryan.

[5] Wikipedia, Bluetooth Low Energy, URL: http://en.wikipedia.org/wiki/Bluetooth_low_energy (accessed November 2014).

[6] R.Frank, W. Bronzi, G.Castignani,T. Engel, Bluetooth low energy: an alternative technology for vanet applications,in:*Pro-ceedings of the 11th Annual Conference on Wireless On-demand Network Systems and Services(*2014,*)* p.104-107, doi: 10.1109/ WONS. 2014. 6814729.

[7] J.-R.Lin, T. Talty, O. Tonguz,An empirical performance study of intra-vehicular wireless sensor networks under wifi and bluetooth interference, in:*Proceedings of the Global Communications Conference (GLOBECOM)*, 2013IEEE, p.581–586, doi: 10.1109/ GLOCOM. 2013. 6831134.

[8] M.Kracheel, W.Bronzi, A wearable revolution: is the smart watch the next small big thing? ITONEMag. Vol. 52 (2014) No.7.

[9] SueWhite,Wi-Fiand. Bluetooth coexistence, URL:http://www.ecnmag.com/articles/2012/03/ wifi-and-bluetooth-coexistence (accessed February 2015).

[10] PhilSmith. Comparing Low-Power Wireless Technologies, URL:http://www.digikey.com/en /articles/techzone/2011/ aug/comparing-low-power-wireless- technologies (accessed February 2015).