Bluetooth report

Zehao Ba (B00732676)

The cable and wire are variable along with the development of transmission, there is numerous wire or cable no matter at office or home. These cable and wire give convenience and trouble simultaneously. The convenience is it makes our life easier, however, if there is any problem of cable or wire, it is difficult for transmission. Therefore, people came up with a wireless transmission method with less expense, Bluetooth.

Five companies created Bluetooth Special Interest Group(BSIG) and made the standard for Bluetooth technology. The Bluetooth technology indicates a machinery which allows different devices to communicate to each other wirelessly within a region. Bluetooth makes transmission between devices and devices, devices and internet possible so that the transmission can be efficient. Besides, it is wireless, openness and lower power consuming, which made it popular and worldwide.

The band of Bluetooth is 2.4GHz, therefore, user can use Bluetooth at 2400~2500MHz band without applying. 23 and 79 channels are employed, which the band internal is 1MHz. It uses time-division duplexing(TDD) to transmit information with GFSK modulation while BT=0.5, the modulate exponent is 0.28~0.35. Bluetooth wireless transmission device works under frequency modulation(FM) to reduce the complexity. There are three maximum emission power of Bluetooth devices, 100mW(20dBm), 2.5mW(4dBm) and 1mW(0dBm). There is power control between 4~20dBm, so the work distance of Bluetooth is 10~100m.

The data transmission velocity of Bluetooth is 1Mb/s, the data is transmitted as packet every 0.625μs. The Bluetooth system supports the directly synchronous connection and indirectly asynchronous connection. For each asynchronous data channel, it allows three concurrencies synchronous voice channel or one simultaneous transmit asynchronous data and synchronous voice channel. For each voice channel, Bluetooth can transmit 64KB/s synchronous voice or asynchronous voice with 721KB/s. For back response, Bluetooth can transmit the asymmetric connection with 57.6KB/s or 432.6KB/s for symmetric connection.

One of the most important technique of Bluetooth is frequency hopping. For single time slot packet, the velocity of frequency hopping is 600 per second, while for multiple time slot packet, the frequency hopping velocity is slower. The more the velocity it has, the better ability of anti-jamming. Besides, frequency hopping technology is easy to implement with better ability.

Bluetooth networking is convenience. According to the concept of internet, the wireless connection can be point to point or point to multi-point, Bluetooth also builds a connection like that. In Bluetooth network, all devices are equivalent within an effective communication area, they have same work approach. Any Bluetooth device can be master or slaver no matter it is included in piconet or scatternet. Therefore, there is no slave in Bluetooth system. Besides, all devices are mobile so that makes networking easier.

Like other communication system, the architecture of Bluetooth is hierarchical. The Bluetooth programming is writing into microchip. The bottom of programming is usable for various

applications, at the same time, the higher layers have different functions, which are basically divided into computer based or not. The computer based method control the connection between higher and lower layer by control the host control interface; while the non-computer based method do not need the host control interface. The hierarchical architecture makes the devices flexible and universal. According to the communication protocol, people can search the other Bluetooth devices manually or automatically no matter where they are, or use any Bluetooth device.

The components of Bluetooth system are combined by antenna unit, link control unit, link management unit and the protocol stack unit. The antenna unit has small volume and light weight. The air interface of Bluetooth is constructed on 0dbm of FCC, the maximum is 20dbm. The link control unit including three integrated devices, connection controller, baseband processor and radio frequency transfer/reception. What is more, there are three to five tuning components. Baseband link controller is response to dealing baseband protocol and other bottom protocols. Bluetooth baseband protocol is the combination of circuit switching and packet switching. The link management unit has the link data setting, authentication, and link hardware configuration protocols. Link management can aware the other long distance link managements and communicate with it by link management protocol. The protocol stack unit is an independent operating system. A standard Bluetooth interface can be integrated on laptop, USB interface, cellular phone or other optional devices. The protocol stack does not bind with another operating system and must work along the defined Bluetooth standard.

There are four states for Bluetooth connection, active, hold, sniff and park. When the Bluetooth is active, the main unit and slave unit involve the channel operation by detection, sending or receiving packet. The main and slave unit are operating at the same time. Under the sniff state, slave unit is detecting at predefined time slot so that it can receive the data which is sent by main unit. therefore, slave unit can have a rest when there is no detection during some time slot to save power. At the hold state, the device can refuse the ACL packet and stay with low power so that calling or scanning can use the channel. When the Bluetooth is park, it means there is an operation which is not using piconet channel but want to keeping the pace with the channel.

For Bluetooth security, we need to add identification and encryption at the link layer. Besides, we need to make sure every device has their own public address, an identification key and an encryption key, and a random number generator. For example, there is an inquiry sent from a device, other device must send a response based on the inquiry, public address and shared link key. After the identification, the communication can be encrypted.

The advantages of Bluetooth are obvious. First, the Bluetooth has extensive use. It has universal standard, therefore, no matter mobile phone, PDA, wireless earphone, laptop etc. can connect by Bluetooth and communicate. Second, Bluetooth is easy to use. It is easy to install and setting, wireless connection makes the transmit convenient. Once the devices are paired successfully, they can do the transmission. Third, Bluetooth has faster transmission speed. Comparing with infrared transmission, Bluetooth is much more fast because of its transmission protocol.

However, the Bluetooth also has disadvantages. Such as it easy to hack into, if the Bluetooth install on the mobile phone, the hacker can send cellphone viruses to you. Besides, it can only use within small area. Sometimes, it may lose connection under extreme environment.

Since the Bluetooth is created, it developed fast. There are much more future applications it can apply. For example, medical area. It can use on providing electronic curing, improve the transfer efficiency from one device to another. The biometric data collection can describe next by Bluetooth links. Medical testing can also use Bluetooth which can do detail measurement. Besides, it can also apply on travel. It allows passengers to check-in by themselves do other self-services.

Reference:

1. Miller, B. A., & Bisdikian, C. (2001). Bluetooth revealed: the insider's guide to an open specification for global wireless communication. Prentice Hall PTR.
2. Haartsen, J. C. (2000). The Bluetooth radio system. IEEE personal communications, 7(1), 28-36.
3. Lee, J. S., Su, Y. W., & Shen, C. C. (2007, November). A comparative study of wireless protocols: Bluetooth, UWB, ZigBee, and Wi-Fi. In Industrial Electronics Society, 2007. IECON 2007. 33rd Annual Conference of the IEEE(pp. 46-51). IEEE.
4. Bray, J., & Sturman, C. F. (2001). Bluetooth 1.1: connect without cables. pearson Education.
5. Baker, N. (2005). ZigBee and Bluetooth strengths and weaknesses for industrial applications. Computing & Control Engineering Journal, 16(2), 20-25.
6. Bisdikian, C. (2001). An overview of the Bluetooth wireless technology. IEEE Commun Mag, 39(12), 86-94.
7. Haartsen, J., Naghshineh, M., Inouye, J., Joeressen, O. J., & Allen, W. (1998). Bluetooth: Vision, goals, and architecture. ACM SIGMOBILE Mobile Computing and Communications Review, 2(4), 38-45.