IEEE 802 Standards for Supporting Everyday Healthcare

Shinsuke HARA
Graduate School of Engineering, Osaka City University

Abstract: Nowadays, a variety of vital sensing devices have been able to be easily and inexpensively connected to any smart phones by means of wireless technologies. Typical examples of such wireless tools are Bluetooth, Zigbee, WiFi and WiSUN, which are all based on the IEEE 802 standard families. This paper shows the current status of the IEEE 802 standardization activities related to the support of everyday healthcare and medicine, such as the working groups of the IEEE 802.15.1, 802.11, and 802.15.4g. In addition, it introduces the IEEE 802.15.6 standards for supporting highly reliable wireless communications, which is required for providing medical and healthcare services.

Keywords: IEEE 802 standards, everyday healthcare, frequency band, data transmission rate

1. Introduction
When we want to construct a system or implement a device for the purpose of medicine and healthcare, we suffer from how to select a wireless communication technique (ICT) suitable for it; nowadays, there have been a variety of wireless communication tools applicable for the medical and healthcare purposes, such as Bluetooth [1], Zigbee [2], WiFi [3], WiSUN [4]. Each of them has its own features, so we need to carefully select the best one out of them.

This paper presents the features of popular wireless communication tools and their pros and cons.

2. IEEE 802 Wireless Standard Families

The Institute of Electrical and Electronics Engineers (IEEE) 802 is a family of IEEE standards related to wired and wireless communications. Among them, IEEE 802.11 [5] and 802.15 [6] are standards for wireless local area networks (WLANs) and wireless personal area networks (WPANs), respectively. They have been bases of de facto standards for license-exempted wireless communication tools, WiFi and Zigbee, which are the names of alliances for WLAN and WPAN, were formed on the bases of the IEEE 802.11 and 802.15.4 standards [7], respectively. In addition, Bluetooth is the name of special interest group (SIG) for WPANs, which was standardized as 802.15.1 in the IEEE. Furthermore, WiSUN is the name of alliance, was formed on the basis of the IEEE 802.15.4g standard [7].

3. Frequency Bands and Transmittable Ranges

WLANs and WPANS have been provided in license-exempted frequency bands such as the 2.4 GHz and 5GHz Industry Science Medical (ISM) bands. The transmittable ranges are around 10-100 meters in the frequency bands and the signals are likely to be subject to fading, shadowing and blocking. Furthermore, there is much interference in the popular 2.4 GHz ISM band. The medium access schemes of WiFi and Zigbee are best-effort type, in other words, connection-less, which cannot guarantee a high reliability of wireless transmission, whereas the access scheme of Bluetooth is connection-oriented. This may be one of the reasons why medical and healthcare applications have adopted Bluetooth.

On the other hand, lower frequency bands are more advantageous in terms of transmittable range, although their antenna sizes become larger. WiSUN mainly uses the 900 MHz frequency band. WiFi supports the data transmission rate of over Gbps, whereas Bluetooth, Zigbee and WiSUN support the typical data transmission rate of less several Mbps. However, vital information from human body has a narrow frequency bandwidth of less than kило Hz, so vital information can be wirelessly transmitted by Bluetooth, Zigbee and WiSUN. For example, we are trying to collect vital information from several tens of persons during exercises reliably and in real-time using the 900 MHz frequency band [8].

4. IEEE Standards for Medical Purposes

The IEEE 802.15.6 is the standard on Body Area Network (BAN) [7], one of whose killer applications is provision of medical and healthcare services. In addition, the IEEE 802.15.4j is the standard for medical BAN usable only in USA [7], which is available in 2.36-2.4 GHz band. Furthermore, the IEEE 802.15.4n is the standard for Chinese medical BAN in 174-216 MHz, 407-425 MHz and 608-630 MHz bands. As compared to around 53 MHz bandwidth in USA and around 80 MHz bandwidth in China, only around 6 MHz bandwidth in the 430 MHz band is allocated for medical purposes in Japan [9].

4. Conclusions
This paper has summarized several wireless communication tools applicable for medical and healthcare purposes. It has also shown that only a narrow frequency band is allocated for medical devices in Japan, which has become a severe problem.

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References