

## Comparative Study on IEEE Standard of WPAN 802.15.1/ 3/ 4

### Abstract

A personal area network (PAN) is a computer network used for communication among computerized devices, including telephones and personal digital assistants. A wireless personal area network (WPAN) is a personal area network a network for interconnecting devices centered around an individual person's workspace in which the connections are wireless. Wireless PAN is based on the standard IEEE 802.15. In these papers we are concentrating on the different IEEE standard 802.15.1, 802.15.3, 802.15.4 of WPAN. We present the comparative study on this Standard. We hope which will help to WPN user, student and researchers for selection of better type of WPAN standard.

**Keyword:** WPAN, IEEE 802.15.1/ 3/ 4

### I. Introduction

Wireless Personal Area Network (WPAN) technologies have fueled the development as well as the wide proliferation of wireless personal devices (e.g. PDAs, Bluetooth headset, PSP, and etc). Yet, the popularity of these wireless devices has resulted in many forms of frequency spectrum clash amongst the different wireless technologies. To understand the performance of these wireless devices in different interference situations, it is increasingly important to study the coexistence issue amongst the existing wireless technologies. Various wireless technologies have been developed for WPAN purposes. A WPAN could serve to interconnect all the ordinary computing and communicating devices that many people have on their desk or carry with them today; or it could serve a more specialized purpose such as allowing the surgeon and other team members to communicate during an operation. The technology for WPANs is in its infancy and is undergoing rapid development. Proposed operating frequencies are around 2.4 GHz in digital modes. The objective is to facilitate seamless operation among home or business devices and systems. Wireless PAN is based on the standard IEEE 802.15. In this paper we concentrate on the three most famous IEEE standard 802.15.1, 802.15.3, and 802.15.4 we overview on these standard pad compare in table-1 on the basis of basic characteristic, application, limitation and there used.

### II. Overview on IEEE 802.15

**IEEE 802.15** is a working group of the Institute of Electrical and Electronics Engineers (IEEE) IEEE 802 standards committee which specifies Wireless

Personal Area Network (WPAN) standards. It includes seven task groups.

#### IEEE 802.15.1

IEEE 802.15.1 [9] is a WPAN standard based on the Bluetooth v1.1 Specification, which is a short-range radio technology operating in the unlicensed 2.4GHz ISM frequency band. The original goal of Bluetooth was to replace the numerous proprietary cables to provide a universal interface for devices to communicate with each other. However, it soon became to use Bluetooth technology to interconnect various Bluetooth devices to form so-called personal area networks, and facilitate more creative ways of exchanging data. Low cost and smaller footprint of Bluetooth chips consequently met with high demands.[2][6][7]

#### IEEE 802.15.3

IEEE 802.15.3 [10] is designed to facilitate High-Rate Wireless Personal Area Networks (HR-WPAN) for fixed, portable and moving devices within a personal operating space. The main purpose of IEEE 802.15.3 is to provide low cost, low complexity, low power consumption, and high data rate connectivity for wireless personal devices. Thus, it is designed to support at least 11Mbps data rate within at least 10 meters range. The IEEE 802.15.3 standard is operated in 2.4GHz ISM frequency band. Unlike IEEE 802.15.1, which employs FHSS on PHY layer, IEEE 802.15.3 uses Direct Sequence Spread Spectrum (DSSS), and it does not allow changes of operating channels once a connection is initiated. [2][6][7]

#### IEEE 802.15.4

IEEE 802.15.4 [11] addresses the needs of Low-Rate Wireless Personal Area Networks (LR-WPAN). While other WLAN (e.g. IEEE 802.11.a/b/g [5]) and WPAN (e.g. IEEE 802.15.1 and 802.15.3) technologies focus on providing high data throughput over wireless ad hoc networks, IEEE 802.15.4 is designed to facilitate those wireless networks, which are mostly static, large, and consuming small bandwidth and power. Therefore, the IEEE 802.15.4 technology is anticipated to enable various applications in the fields of home networking, automotive networks, industrial networks, interactive toys and remote metering [2] [6] [7].

**Comparative overview on 802.15.1, 802.15.3, 802.15.4**

In this paper we overview the comparison on different standard of WPAN on the basis of basic characteristic like Topic, Operational Spectrum, Physical Layer Detail, Channel Access, Maximum Data Rate, Modulation Technique, Coverage, Approximate Range, Power Level Issues, Interference, Price, Security, rcv Bandwidth, Number of Channels, Applications, Mode of operation(Ad hoc, Infrastructure, VANET ), License/Unlicensed, QoS needs.

IEEE Standard	802.15.1	802.15.3	802.15.4
<b>Topic</b>	Bluetooth	High rate WPAN	Low rate WPAN
<b>Operational Spectrum</b>	2.4 GHz ISM band	2.402-2.480 GHz ISM band	2.4 GHz and 868/915Mhz
<b>Physical Layer Detail</b>	FHSS 1600 hops per second	Uncoded QPSK, Trellis Coded QPSK or 16/32/64-QAM scheme	DSSS with BPSK or MSK (O-QPSK)
<b>Channel Access</b>	Master-Slave Polling, Time Division Duplex(TDD)	CSMA-CA and Guaranteed Time Slot(GTS) in a Super frame Structure	CSMA-CA and Guaranteed Time Slot(GTS) in a Super frame Structure
<b>Maximum Data Rate</b>	Up to 1 Mbps(0.72) / 3Mbps	11-55 Mbps/ 110Mbits	868 MHz -20,915 MHz- 40 MHz, 2.4 GHz-250 Kbps, 40 kbps
<b>Modulation Technique</b>	8DPSK, DQPSK, _/4-DQPSK, GFSK, AFH	QPSK, DQPSK, 16/32/64QAM	BPSK, OQPSK, ASK, DSSS, PSSS
<b>Coverage</b>	<10 m	<10m	<20m
<b>Approximate Range</b>	100m	10m	75m
<b>Power Level Issues</b>	1mA-60mA	<80mA	Very low current drain(20- 50 $\mu$ A)
<b>Interference</b>	Present	Present	Present
<b>Price</b>	Low(<\$10)	Medium	Very low
<b>Security</b>	Less Secure. User the SAFER + encryption at baseband layer. Relies on higher layer security	Very high level of security including, piracy, encryption and digital service certificate	Security feature in development
<b>rcv Bandwidth</b>	1MHz	15MHz	2MHz
<b>Number of Channels</b>	79	5	16
<b>Applications</b>	WPAN	HR-WPAN	LR-WPAN
<b>Ad hoc</b>	Yes	Yes	Yes
<b>Infrastructure</b>	No	No	No
<b>VANET</b>	Yes	Yes	Yes
<b>License/Unlicensed</b>	Unlicensed	Unlicensed	Unlicensed
<b>QoS needs</b>	QoS suitable for voice application	Very high QoS	Relaxed needs for data rate and QoS

Table -1: comparison of IEEE standard of WPAN [1][2][4][5][6][8]

### III. Conclusion

In this paper, we study the different issue of Wireless Personal Area Network technologies and compare different IEEE 802.15 standard and studied their differences on the basis of their basic characteristic, application, limitation and use.

### IV. References

- [1] IEEE 802.15 Working Group for WPAN, <http://ieee802.org/15/index.html>
- [2] Ling-Jyh Chen, Tony Sun, Mario Gerla, "Modeling Channel Conflict Probabilities between IEEE 802.15 based Wireless Personal Area Networks"
- [3][https://en.wikipedia.org/wiki/IEEE\\_802.15](https://en.wikipedia.org/wiki/IEEE_802.15)
- [4] Jan Magne Tjensvold, "Comparison of the IEEE 802.11, 802.15.1, 802.15.4 and 802.15.6 wireless standards", September 18, 2007
- [5] Amit R. Welekar, Prashant Borkar, S. S. Dorle, "Comparative Study of IEEE 802.11, 802.15,802.16, 802.20 Standards for Distributed VANET" International Journal of Electrical and Electronics Engineering(IJEEE) Vol-1,Iss-3,2012
- [6] Carlo de Morais Cordeiro, Dharma Prakash Agrawal, "ADHOC &SENSOR NETWORKS Theory and Application", World Scientific Publishing Co.Pvt.Ltd, 2010
- [7]D. P. Agrawal, Q A Zeng, "Introduction to Wireless and Mobile System", Cengage, 2/e
- [8]Upen Dalal, "Wireless Communication", Oxford
- [9] "Ieee 802.15 wpan task group 1 (tg1)," <http://www.ieee802.org/15/pub/TG1.html>.
- [10] "Ieee 802.15 wpan task group 3 (tg3)," <http://www.ieee802.org/15/pub/TG3.html>.
- [11] "Ieee 802.15.4 wpan-lr task group," <http://www.ieee802.org/15/pub/TG4.html>.