Technical Issue of The IEEE 802.15.7r1 OWC Standardization

Chang-Hyun Hong*, M. A. Hossain*, T. Nguyen*, N. T. Le*, M. S. Ifthekhar*, Yeong Min Jang*©

*Dept. of Electronics Engineering, Kookmin University, Seoul, Korea
E-mail: {88changhyun, yjang}@kookmin.ac.kr, {dihan.kuet, nguyenvantrangbkhn, namtuan42th}@gmail.com, shareef_ifthekhar@yahoo.com

Summary

Lately, radical progress as well as prodigious rectification has been noticed the wireless technology in conjunction with devices. The existing wireless communications has been upgraded by these revolutions considerably. The Optical Wireless Communication (OWC) technology is one them because of its obvious advantages over Radio Frequency (RF) communication such as low interference, low cost, low electromagnetic radiation and so on. The massive unlicensed 10000nm (1mm-10nm) bandwidth in the optical domain, spectrally found between microwave and X-ray wavelengths can be used by the OWC technology [1]. For the sake of developing PHY and MAC layer protocols for OWC technology, the IEEE 802.15.7r1 (revision 1) OWC TG (Task Group) committee is working since 2011 which was started through the formation IEEE 802.15.7 committee. The Technical Considerations Document (TCD) of IEEE 802.15.7r1 is a reflection of the standardization procedure. This document has been prepared to assist the IEEE P802.15. However, The OWC technology was classified into three types such as Image Sensor Communications, Low Speed Photodiode Communications and High Speed Photodiode Communications according to the TCD of the IEEE 802.15 TG7r1 [3] In addition, three PHY data rates for the implementation using photodiode receiver was defined previously in the IEEE 802.15.7 TCD. PHY 1 specifies 11.67 kbps to 266.6 kbps, PHY 2 specifies 1.25 Mbps to 96 Mbps, and PHY 3 specifies 12 Mbps to 96 Mbps.

Later, the Low Speed Photodiode Communications and High Speed Photodiode Communications have been altered into the Low Rate Photodiode Communications and High Rate Photodiode Communications, respectively. Considering the low speed and high speed, the throughput threshold data rate has been changed to 1 Mbps as measured at the PHY SAP. The throughput less than 1 Mbps rate at the PHY SAP has been defined as low rate and higher than 1 Mbps at the PHY SAP has been considered as high rate [3].

According to the definition of the TCD, Image Sensor Communications (ISC) is one kind of OWC in which an image sensor acts as a receiver [2]-[3].The transfer modes for ISC are introduced, including ID broadcast mode, Unidirectional data transfer mode, and Bidirectional data transfer mode. The TCD states various filed of applications and scenarios which are also highlighted, including Offline to Online Marketing, Public Information System, IoT (M2M/D2D/ Internet of Light (IoL), LBS/Indoor Positioning, Vehicular Communication and positioning, Underwater Communication, Seaside Communication, LED based Tag application, Point-to-(multi)point / relay communication, and Digital Signage. The compatibility support for various image sensor types with different resolutions and frame rates (either varying or constant frame rate) is considered.

High Rate PD Communications is another form of OWC in which high-speed, bidirectional, networked and mobile wireless communications is established using light with a high speed photodiode receiver [3].The standard will support continuous data streaming for all applications with bidirectional functionality as well as short packet transmissions where low latency is required. The main application fields for the application

J.J. Kang et al. (Eds.): IICCC 2015, SCCTL 01, pp. 100~101, 2015

of High Rate PD Communications that are considered including Indoor Office/Home Applications such as Conference Rooms, General Offices, Shopping Centre etc., Data Center / Industrial Establishments, Vehicular Communications and Wireless Backhaul.

Low Rate PD Communications is wireless light ID system using various LEDs with a low speed photodiode receiver [3]. The decided transfer mode in the TCD of the IEEE 802.15.7r1 OWC TG are given as below. D2D/IoT data transmission and Relay mode and Unidirectional/Bi-directional data transfer mode. The fields of application for the Low Rate PD Communications are considered as: Underwater/Seaside Communication, Point-to-(multi)point communication, Digital signage, d) D2D/IoT, LOS Authentication, and Identification based service

The modulated light for communications, first of all, is illumination; therefore it can be seen by the human eyes. The safety for human eyes is also considered related to the frequency band in used and the intensity of light. Besides, it has be to ensure that the modulated light will not stimulate any kind of sickness such as photosensitive epilepsy [3]. A frequency greater than 200 Hz is generally considered safe. The lower frequency range can be used in display/digital signage with limited intensity [2]. The modulated light of the light source should not be in state of flickering [3].The standard will co-exist with ambient lights and may allow a receiver to communicate even in the presence of other modulated lights. Moreover, coexistence shall be investigated with the existing IEEE802.15.7-2011 operating modes [3].

In conclusion, the TCD of IEEE 802.15.7r1 Optical Wireless Communications Task Group can be summarized and classified into three communications including Image Sensor Communications, Low Rate PD Communications, and High Rate PD Communications. This TG is working to standardize a novel paradigm that will follow in the commercial as well as research field.

***Keywords**: IEEE 802.15.7r1; Optical Wireless Communication; Image Sensor Communication; Low Rate PD Communications; High Rate PD Communication;*

Acknowledgement

This work was partly supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (No. 2014-004-051-001, Development of visible light communication application system using smart phone image sensor) and Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP) (No. R0127-15-1025, Development of Optical Wireless Communications (OWC) Standardization).

References

[1] Nirzhar Saha, Md Shareef Ifthekhar, Nam Tuan Le, and Yeong Min Jang“Survey on optical camera communications: challenges and opportunities,” IET Optoelectronics, pp. 1-12, May, 2015.

[2] Flickering Consideration for OWC [Online].Available: https://mentor.ieee.org/802.15/dcn/15/15-15-0575-01-007a-kookmin-university-comments-to-tcd-15-492r2-flickering-consideration-for-owc.ppt

[3] The 3rd Revision of The IEEE P802.15.7r1 Short-Range Optical Wireless Communications Task Group Technical Considerations Document [Online]. Available: https://mentor.ieee.org/802.15/dcn/15/15-15-0492-03-007a-technical-considerations-document.docx