New wireless technology not covered by the existing IEEE standards of 2017
Andrei I. Bodrenko

http://bodrenko.com
bodrenko@bodrenko.com

Bodrenko A.I.
ORCID: 0000-0002-4618-3784, PhD in Physics and Mathematics,
Associate Professor,
Volgograd, Russia

NEW WIRELESS TECHNOLOGY NOT COVERED BY THE EXISTING IEEE STANDARDS OF 2017

Abstract

A new type of wireless computer network is presented in this article. This wireless network, for data transmission, uses visible light, and does not use intensity modulation of optical sources, such as light-emitting diodes and etc. Thus represented wireless network differs substantially from wireless networks covered by the existing IEEE standards of 2017, and its ongoing revisions, for visible-light communication (VLC) technologies, Li-Fi technology and optical camera communication (OCC) technologies. This new wireless technology can be used for the next generation of wireless communication networks such as 5G networks.

Keywords: wireless network, optical communications, IEEE 802.15.7, VLC, OCC.

Бодренко А.И.
ORCID: 0000-0002-4618-3784, Кандидат физико-математических наук,
Доцент,
Волгоград, Россия

НОВАЯ БЕСПРОВОДНАЯ ТЕХНОЛОГИЯ, НЕ ОХВАЧЕННАЯ СУЩЕСТВУЮЩИМИ IEEE СТАНДАРТАМИ 2017 ГОДА

Аннотация

Беспроводная компьютерная сеть нового типа представлена в этой статье. Эта беспроводная сеть для передачи данных использует видимый свет и не использует модуляцию оптических источников света, таких как светодиоды и т.д. Таким образом, представленная беспроводная сеть существенно отличается от беспроводных сетей, охваченных существующими IEEE стандартами 2017 года и их новыми редакциями, разрабатывающи-

ся в настоящее время, для технологий передачи данных посредством видимого света (VLC), технологии Li-Fi и технологий передачи данных посредством оптических видео камер (OCC). Эта новая беспроводная технология может быть использована для беспроводных коммуникационных сетей следующего поколения, таких как 5G сети.

Ключевые слова: беспроводная сеть, оптические коммуникации, IEEE 802.15.7, VLC, OCC.

Introduction

The definition of "wireless" introduced by the Alliance for Telecommunications Industry Solutions (ATIS). This definition specifies that wireless is "descriptive of a network or terminal that uses electromagnetic waves (including RF, infrared, laser, visible light and acoustic energy) rather than wire conductors for telecommunications" [1].

VLC, Li-Fi and OCC technologies, for data transmission, use visible light, and transmit data by intensity modulating optical sources, and, at the receiver, the signal is detected by a photodiode or video camera. Standard IEEE 802.15.7-2011 [2] establishes VLC technology, and specifies the use of VLC technology for wireless personal area networks (WPAN). The ongoing IEEE 802.15.7 revisions, including VLC, Li-Fi and OCC technologies, are considered in [3, P. 4574–4594].

One of the main demerits of VLC, Li-Fi and OCC technologies, is that sometimes these technologies do not to produce reliable signal detection because of the presence of external light sources such as sunlight. This demerit can be reduced by using special equipment such as optical and color filters.

A new type of wireless computer network is established in [4]. This wireless network, for data transmission, uses visible light, and does not use intensity modulation of optical sources, and, at the receiver, the signal is detected by a video camera. Therefore this new wireless technology is not covered by the existing IEEE standards of 2017, and its ongoing revisions, for VLC, Li-Fi and OCC technologies. At the same time this new technology is wireless according to the ATIS's definition of "wireless", because video camera, used to receive signal, is capable of receiving only visible light.

Features of new wireless technology

Consider the main principles of this wireless technology including simplex wireless data communications as well as duplex wireless data communications. Proposed technology uses visible light to carry information, and can be used for free-space optical communications.

The idea is to use vibration generator instead of optical sources for data transmission. The definition of "vibration generator" is formulated in [5], and it specifies that: "vibration generator is any device for applying a controlled motion to the mounting surface of a transducer". Vibration generator has a contact surface, and creates controlled mechanical motions of this contact surface. There is a great variety of vibration generators used as a vibrating alert in communications devices,

and usually almost every mobile phone includes a vibration generator and a video camera. Usually, a vibration generator built-in a mobile phone can generate a vibration with frequency of about 180 Hz. Vibration generators used in medical ultrasonography can generate a vibration with frequency of about 18 MHz. Vibration generators used in acoustic microscopy can generate a vibration with frequency of up to 4 GHz.

Network node equipment of each node of this network comprises a computer with connected video camera and vibration generator. The video camera is used as a receiver, and the vibration generator is used as a transmitter. The computer confers the ability to control the operations of the connected vibration generator via the transmission of vibration generator's operating modes to this vibration generator. Each vibration generator confers the ability to create controlled mechanical motions of its contact surface, in accordance with the received set of vibration generator's operating modes. Proposed wireless technology, as well as OCC, uses a video camera that comprises a two-dimensional array of photodiodes (PD) to detect visible light. And PD communications support the required 5G data rate level using the advanced techniques [3, P. 4574–4594].

Proposed wireless technology [4], for detecting signals, can use the same equipment as uses OCC technology, including a rolling shutter camera based OCC systems. Therefore the network architecture of this new wireless technology is very similar to the network architectures of VLC, Li-Fi and OCC networks. Thus, proposed wireless technology supporting the required 5G data rate level, can be used for 5G wireless networks.

Simplex wireless data communications within new wireless technology

At fist, consider simplex wireless communication with a point-to-point data communication technique. Transmission of electronic messages from one node to another node of this computer network is produced over the wireless communication channel (through simplex wireless communication), designed for the transmission of electronic messages from the source computer to the receiving computer.

Each wireless communication channel of this computer network transmits data as follows. Initially, the video camera, connected to the receiving computer, is set up to receive images of the contact surface of the vibration generator, connected to the source computer. Then an electronic message, which is transmitted, is encoded in the form of a finite sequence of vibration generator's operating modes, using a code satisfying the unique decoding condition. Then, controlled mechanical motions of the contact surface of the vibration generator are created, in accordance with the finite sequence of vibration generator's operating modes, representing transmitting electronic message.

Then the receiving computer gets the images of the contact surface of the vibration generator, receiving by the video camera. Then, from these images, using computer vision algorithms (such as algorithms of motion analysis and object

tracking) implemented in software such as the Open Source Computer Vision Library (OpenCV) [6], the receiving computer obtains the finite sequence of vibration generator's operating modes. Then this finite sequence is decoded, and the transmitted electronic message is obtained.

Duplex wireless data communications within new wireless technology

Since video camera and vibration generator work independently then duplex wireless communication with point-to-point data communication technique, works by using two simplex wireless communications. Initially, the video camera, connected to the first computer, is set up to receive images of the contact surface of the vibration generator, connected to the second computer. And the video camera, connected to the second computer, is set up to receive images of the contact surface of the vibration generator, connected to the first computer. Then data transmission from the first computer to the second computer, and from the second computer to the first computer can be implemented independently by using two different simplex wireless communications. Thus, duplex wireless communication, with bi-directional point-to-point communication, is implemented.

Conclusion

Proposed wireless technology can also implement a bi-directional multiuser communication, such as point-to-multipoint communication, and can be used for communications devices [7], UAVs [8], though there exist alternative approaches [9], [10]. New wireless technology provides full user mobility, and, like OCC technology can be used for 5G wireless networks. There is the great potential of proposed wireless technology in implementing the next generation of wireless communication networks such as 5G networks.

Список литературы / References

[1] ATIS Telecom Glossary [Electronic resource]. – URL: http://www.atis.org/glossary/definition.aspx?id=231 (accessed: 04.03.2018).

[2] IEEE Standard for Local and Metropolitan Area Networks — Part 15.7: Short-Range Wireless Optical Communication Using Visible Light, IEEE Standard 802.15.7-2011 [Electronic resource]. – URL: http://standards.ieee.org/findstds/standard/802.15.7-2011.html (accessed: 04.03.2018).

[3] Nguyen T. Current status and performance analysis of Optical Camera Communication technologies for 5G networks / T. Nguyen, A. Islam, T. Hossan, Y. M. Jang // IEEE Access. – 2017. – Vol. 5. – P. 4574–4594. doi: 10.1109/ACCESS.2017.2681110

[4] Bodrenko A.I. Way of organizing wireless network [Electronic resource] / A.I. Bodrenko // Patent application RU2016123581A. – 2017. – URL: https://patents.google.com/patent/RU2016123581A/en (accessed: 04.03.2018).

[5] ISO 16063-1:1998, Methods for the calibration of vibration and shock transducers – Part 1: Basic concepts [Electronic resource]. – URL: https://www.iso.org/standard/25043.html (accessed: 04.03.2018).

[6] Open Source Computer Vision Library [Electronic resource]. – URL: http://opencv.org (accessed: 04.03.2018).

[7] Bodrenko A.I. An apparatus for receiving a warning signal marksman using their individual small arms fire, and comprising a control handle butt [Electronic resource] / A.I. Bodrenko // Patent RU165421U1. – 2016. – URL: https://patents.google.com/patent/RU165421U1/en (accessed: 04.03.2018).

[8] Bodrenko A.I. Device intended for landing an unmanned helicopter type aircraft on a flat vertical surface [Electronic resource] / A.I. Bodrenko // Patent RU160508U1. – 2016. – URL: https://patents.google.com/patent/RU160508U1/en (accessed: 04.03.2018).

[9] Bodrenko A.I. A method of establishing a wireless network in a biological tissue [Electronic resource] / A.I. Bodrenko // Patent application RU2015108012A. – 2016. – URL: https://patents.google.com/patent/RU2015108012A/en (accessed: 04.03.2018).

[10] Bodrenko A.I. A method of establishing a wireless network in a chemical system [Electronic resource] / A.I. Bodrenko // Patent application RU2015113357A. – 2016. – URL: https://patents.google.com/patent/RU2015113357A/en (accessed: 04.03.2018).