Li-Fi Technology – A survey on Current IT Trends

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***Abstract* — Li-Fi (Light Fidelity) technology is a ground breaking light-based communication technology, which makes use of light waves instead of radio technology to deliver data. Li-Fi is a bidirectional, high speed and fully networked wireless communication technology similar to Wi-Fi. Li-Fi is a subset of optical wireless communications (OWC) and can be a complement to RF communication (Wi-Fi or Cellular network), or a replacement in contexts of data broadcasting. To write this survey paper, I have studied about wireless communication. After detailed study of wireless communication, I am presenting my work.**

***Keywords* — Wireless Communication, Wi-Fi, Internet of Things (IoT)**

I. INTRODUCTION

Li - Fi is wireless and uses visible light communication or infra-red and near ultraviolet (instead of radio frequency waves) spectrum, part of Optical wireless communications technology, which carries much more information, and has been proposed as a solution to the RF-bandwidth limitations [2]. A complete solution includes an industry led standardization process.

2013 highlights include:

- pureLiFi's first product, the Li-1st, went to Beta release in Q3 of 2013.
- Delivering the world's first commercially available bidirectional optical wireless communication system achieving high speed internet in both, downlink and uplink
- Demonstrating that Li – Fi technology can work with both direct as well as indirect or reflected light.
- Constructing world's first public LiFi demonstration at the Bexley Business Academy in London and increasing deployment of the technology.

II. TECHNOLOGICAL DETAILS

This OWC technology uses light from light-emitting diodes (LEDs) as a medium to deliver networked, mobile, high-speed communication in a similar manner to Wi-Fi.[3] Li-Fi could lead to the Internet of Things, which is everything electronic being connected to the internet, with the LED lights on the electronics being used as Li-Fi internet access points [4].

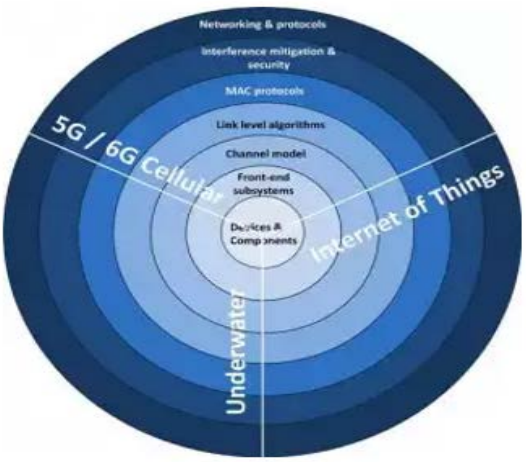
Visible light communications (VLC) works by switching bulbs on and off within nanoseconds,[6] which is too quick to be noticed by the human eye. Although Li-Fi bulbs would have to be kept on to transmit data, the bulbs could be dimmed to the point that they were not visible to humans and yet still functional [7].

The light waves cannot penetrate walls which makes a much shorter range, though more secure from hacking, relative to Wi-Fi.[8][9] Direct line of sight isn't necessary for Li-Fi to transmit a signal; light reflected off the walls can achieve 70 Mbit/s.[10][11]

Both Wi-Fi and Li-Fi transmit data over the electromagnetic spectrum, but whereas Wi-Fi utilizes radio waves, Li-Fi uses visible light. While the US Federal Communications Commission has warned of a potential spectrum crisis because Wi-Fi is close to full capacity, Li-Fi has almost no limitations on capacity.[12]

The visible light spectrum is 10,000 times larger than the entire radio frequency spectrum [13]. Researchers have reached data rates of over 10 Gbit/s, which is much faster than typical fast broadband in 2013.[14][15] Li-Fi is expected to be ten times cheaper than Wi-Fi.[7] Short range, low reliability and high installation costs are the potential downsides.[5][6]

Bg-Fi is a Li-Fi system consisting of an application for a mobile device, and a simple consumer product, like an IoT (Internet of Things) device, with color sensor, microcontroller, and embedded software.



III. History

Professor Harald Haas, from the University of Edinburgh in the UK, is widely recognised as the original founder of Li-Fi. He coined the term Li-Fi and is Chair of Mobile Communications at the University of Edinburgh and co-founder of pureLiFi.[12]

Haas promoted this technology in his 2011 TED Global talk and helped start a company to market it.[21] PureLiFi, formerly pureVLC, is an original equipment manufacturer (OEM) firm set up to commercialize Li-Fi products for integration with existing LED-lighting systems.[22][23]

In October 2011, companies and industry groups formed the Li-Fi Consortium, to promote high-speed optical wireless systems and to overcome the limited amount of radio-based wireless spectrum

VLC technology was exhibited in 2012 using Li-Fi.[25] By August 2013, data rates of over 1.6 Gbit/s were demonstrated over a single color LED.[26] In September 2013, a press release said that Li-Fi, or VLC systems in general, do not require line-of-sight conditions.[27]

In April 2014, the Russian company Stins Coman announced the development of a Li-Fi wireless local network called BeamCaster. Their current module transfers data at 1.25 gigabytes per second but foresee boosting speeds up to 5 GB/second in the near future.[29] In 2014 a new record was established by Sisoft (a Mexican company) that was able to transfer data at speeds of up to 10Gbps across a light spectrum emitted by LED lamps.[30]

IV. Standards

LiFi is wireless and uses similar 802.11 protocols; but it uses visible light communication. The IEEE 802.15.7 standard defines the physical layer (PHY) and media access control (MAC) layer. The standard is able to deliver enough data rates to transmit audio, video and multimedia services. It takes into account optical transmission mobility, its compatibility with artificial lighting present in infrastructures, and the interference which may be generated by ambient lighting.

The standard defines three PHY layers with different rates:

- The PHY I was established for outdoor application and works from 11.67 kbit/s to 267.6 kbit/s.
- The PHY II layer permits reaching data rates from 1.25 Mbit/s to 96 Mbit/s.
- The PHY III is used for many emissions sources with a particular modulation method called color shift keying (CSK). PHY III can deliver rates from 12 Mbit/s to 96 Mbit/s.[32]

V. Conclusion

Li – Fi technology can be used to enhanced wireless infrastructures, for the avoidance of the radio frequency spectrum crunch (10,000 times more capacity), for enabling very high peak data rates (10 Gbps) , for enabling of the Internet-of-Things (100 times more devices), for signicantly enhancing secure wireless communication (reduced interception of signals), for Enhancing energy-efficiency by combining data communication and illumination (100 times energy reduction).

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