



Review Analysis of Li-Fi (Light fidelity) Technology

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Abstract- Li fi is very rapidly emerging and bright wireless technology in field of data communication. It offers a genuine and very efficient alternative to radio-based wireless systems. This technology give better solution on problem such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn't allowed like aircraft. The wireless internet service is offered to the people through latest technologies in commercial and industries. Most of them are based on radio waves in the spectrum. These waves are very harmful to the diseased people and in signal sensitive areas. Hence it could not be utilized in such environments. To overcome these limitations, Li-Fi is the technology which is created to work in these environments. This technology provides transmission of data through illumination by sending data through LED. This paper deals with the overview of Li-Fi technology, its working principle, and applications of Li-Fi. The comparative study of the features of other technologies with Li-Fi is also taken into consideration.

Keywords - Wi-Fi, VLC, Radio Spectrum, Li-Fi, LED

I. INTRODUCTION

The idea of Light Fidelity Technology was proposed by Prof. Harald Hass, a German scientist, along with his team including Dr. Gordon Povey, Dr. Mostafa Afgani at the University of Edinburgh. It provides transmission of data through illumination by sending data through an LED light bulb. It is a VLC (Visible Light Communication) technology deals with the transfer of data through illumination by taking fiber out of fiber by sending data through LED light bulb. LED is a p-n junction diode which emits light when activated and helps in LiFi technique. The flow of Li-Fi is bidirectional which provides high speed and is cheap wireless communication via light. Li-Fi uses light instead of radio waves in Wi-Fi for the transfer of data[7]. The scientist Harald Hass referred this technology as "Data through illumination". As compared to general broadband connection, this technology provides higher data speed up to 1 Gbps which is much faster. This is an OWC (Optical Wireless Communication) system which uses light

from LED (light Emitting Diode), acts as a medium to deliver networked, and mobile, very high-speed communication similar to Wi-Fi.

Both Wi-Fi and Li-Fi transmit the data over the electromagnetic spectrum only difference is that Wi-Fi utilizes radio waves whereas Li-Fi utilizes visible light. As the velocity of light is much large, hence due to this the rate of data transmission is more as compared to Wi-Fi which uses radio waves for data transmission. Latest technologies and evolution of smart devices like phones, laptops, computers etc. are leading to increase the curiosity of common people in wireless communication. Most of these people are connected through network for data sharing, interaction, communication, knowledge updates, education and social activities. Hence, people are interested in low cost and high bandwidth data connections. Experts estimate that the Internet of Things will consist of almost 50 billion objects by 2020. Currently wireless Fidelity (Wi-Fi) is the most versatile, competent and effective technology that consist of Radio Frequency (RF) / microwave frequencies for rapid wireless data transmission. The high sensitivity receivers provide wide coverage at low frequencies and Line of Sight (LoS) communication at high frequencies. However, Wi-Fi is facing many challenges and issues in terms of capacity, efficiency, availability and security since hasty demand for wireless communications [1].

Li-Fi (Light Fidelity) is a high speed, wireless communication using visible light. It comes under the category of optical wireless communications. Data transmission takes place through LED bulbs whose intensity may going to vary. Based on this variation, communication occurs digitally. This technology has vast applications where the use of Wi-Fi is limited or banned. It also eliminates the adverse health effects of using electromagnetic waves.

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Unless light is seen, data can't be hacked and so data transmission is more safer and secure. Data transmission is typically in terms of Giga bytes per second.

II. WORKING PRINCIPLE

Wireless communication using light in Li-Fi technology requires the basic components such as LED as a source of data transmission and photodiode like silicon which is variable wavelength region friendly material act as receiver[8]. Li-Fi is a technology that uses visible light for communication

instead of existing Radio Frequency (RF) technology. It reduces a huge amount of electricity by transmitting data through LED bulbs and other such

lighting sources. The main reason to choose light because is because of harmless biological and environment effect and widely available as an

Infrastructure, globally [8]. This technique use conventional binary method of 0 and 1 of data transmission by manipulating light intensity that is beyond the human capability to see. It can be used in aircraft without causing any kind of interference. Li-Fi cannot go into or through the heavy objects such as walls, thick wooden pieces, steel, etc. since it uses Visible Light Communication (VLC) as a data carrier [6].

The transceiver is well equipped with LED bulbs and varying the current through these bulbs at a very high speed, the data is sent according to the on or off condition[1]. The data signal '1' is sent when LED is ON and data signal '0' is sent when LED is OFF. The data is encoded for transmission using LED flicker between 400 and 800 THz (780–375 nm) by varying the current rate.

The demonstration of this scheme has been proved that commercial normal fluorescent lamps, LEDs transmit the data up to 10 kbit/s and 500 Mbit/s respectively. It is also demonstrated for low rate data transmissions at 1 and 2 kilometers (0.6 and 1.2 mi) [7][8].

The Fig.1 shows the data transmission using Li-Fi. Initially data is originated from the light source for transmission over the network. The originated data is modulated using pulse position modulation (PPM) and then directed towards LED lamp. The LED lamp is illuminating the light to forward data using VLC technology. The photo detector used is captures light, also receives the signal from LED lamp. The received data is send to the demodulator for isolating

S. N.	Features	Li-Fi	Wi-Fi	Bluetooth
1	IEEE Standard	802.15.7	802.11a/b/g	802.15.1
2	Data Transfer Speed	Faster transfer speed>1 Gbps	54 Mbps	24 Mbps
3	Frequency Bandwidth	No frequency is defined	2.4-5 GHz	2.4GHz
4	Network Topology	Point to point	Point to point	Point to point
5	Normal Range	Shorter range	10-100 m	10-80m
6	Power Consumption	Low	Medium	Medium
7	Cost	Low	Expensive	Moderate
8	Year	2001	1990	1993
9	Security	High	Less	Less

the carrier and data signals. Finally data is received at destination in sender's format [4][10][11].

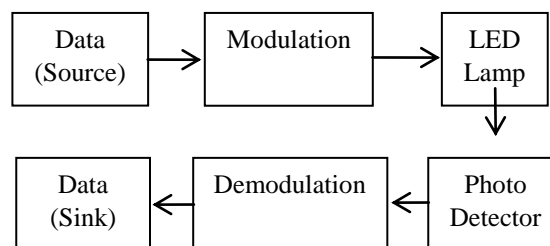


Fig. 1

III. COMPARATIVE STUDY

Table: 1 Comparisons of Wireless protocols

Table 1 summarizes the different various types of wireless protocols based on IEEE standards, data transmission speed, frequency bandwidth, network topology, range, power consumption, cost, year and security.

IV. ADVANTAGES

The Li-Fi technology contains the following advantages:

1. High data rate transmission more than 1 Gbps.



2. It can be used in place of infrared, Bluetooth, Wi-Fi and internet services.
3. It provides more privacy and security in transmission.
4. Enables the internet of things.
5. Li-Fi node is built for communication and networking interconnects of things at anytime, anywhere.
6. LED bulb in store/market windows, walls, vehicles and classrooms could be used to access the internet.
7. Li-Fi is harmless to living organism where as radio waves give harmful effects.
8. It also used in air traffic control, petrochemical plants, power plants etc

V. DISADVANTAGES

The various challenges of Li-Fi technology is facing availability, capacity, efficiency, coverage, interruption and security. One of the major disadvantages is that the artificial light cannot penetrate into the wall and other opaque materials which radio waves can do. Hence, we cannot transfer the data from one enclosed room to another one. Li-Fi is not able in the works in direct line of sight

VI. APPLICATIONS

1. It can be used in places such as underwater, nuclear power plants, hospitals especially inside the Operation Theater (OT) because radio signals are not permitted at such places which are used by Wi-Fi.
2. Freeing up spectrum as data transfer heaving depends upon radio spectrum which will help remove burden of clogged cellular networks.
3. Smart Traffic Management: Led lights of the car and from signals can be utilized for transmitting traffic related data to the cars by installing receptors in the cars.
4. Government and other agencies sharing critical information can use the technology against breaching of network which is possible through Wi-Fi but Li-Fi uses Visible light(VL) so this will take care of the above situation.
5. Also, it presents another unique possibility:- wireless power transmission, wherein the smart-phone will not only receive data

through Li-Fi, but will also receive power to charge itself.

6. For a long time, healthcare technology has lagged behind the rest of the wireless world because radio waves are harmful in operating rooms and also can make interference with medical and other important equipment in hospitals. One solution is Li-Fi Technology which has larger spectrum than Wi-Fi and also harmless and can use existing Light infrastructure.
7. Li-Fi is more reliable and faster than Wi-Fi used in Aeronautical and Aerospace Industry by using reading lamps.
8. Radio frequencies can be harmful in chemical or petrochemical industries but Li-Fi is transmission technique based on visible light which is used in every industry.
9. Invisibility of Radio waves are is not secure, whereas in Li-Fi, if light is visible then you are online. So Li-Fi is more secure than any other Wireless technology because we know the territory of our network.
10. Wi-Fi used for data communication in office, education systems and internet access which is very limited in terms of bandwidth. We can replace it with Li-Fi without worrying about bandwidth.

VII. CONCLUSION

Li-Fi technology is more advanced as compare to Wi-Fi and other techniques used for data communication in terms of data transmission speed, frequency bandwidth, range, power consumption, security. LED light which is used as a photo detector in this technology which gives cost effective, safer and cleaner solution. Li-Fi is a great revolution in the field of data Communication.

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