Fortification Learning of Li-Fi, A Stride In Wireless Dissemination

Shylaja P
Dept of Information Technology
Kannur University, Kerala, India

Abstract- *Every social being need communication for a better life. Exponential growth is taking place in Wi-Fi connections and data transfer now a days. The 5G technology for data transfer, Li-Fi(Light Fidelity) invented by Prof. Harald Haas in 2011 is a wireless networking technology by means of LED light using the principle of Visible Light Communication. Recent research shows that by 2022, 74zetta bytes of data will be generated. As data volume goes up exponentially and generating demand for electromagnetic spectrum, which will cause damage to human as well as animal health. In such situations, Li-Fi performs well to get data quickly and the applications of Li-Fi include hospitals, under water communication, Schools, Military operations, Business and many more. Also the situations where transmission of radio frequencies is hazardous such as chemical plants or petroleum plants, data transmission can be replaced by Li-Fi technology instead of using Wi-Fi. This paper reviews the Li-Fi technology and lists out the advantages and limitations which will help for further research.*

Keywords- Li-Fi, OFDM, Radio Frequency, Visible Spectrum, Wireless Communication

I. INTRODUCTION

People will get frustrated when they are in dense areas or congested with too many network connections and not able to get wi-fi signals properly. This situation made Prof. Harald Haas of Edinburg University, the UK to invent the idea of Li-Fi in 2011. Many research studies have been carried out after the introduction of Li-Fi (Light Fidelity), a wireless network technology. At present, radio waves have been used for the transmission of data in Wi-Fi technology. But visible light is more appropriate for data transmission than radio waves and so LED light is used for Li-Fi technology for data transmission. Light coming from LED light have different modulations upon varying frequencies and is imperceptible for the human eye. The method of encoding, OFDM (Orthogonal Frequency-Division Multiplexing) for multiple carrier frequencies is used for digital transmission [1-2]. Communication yields a crucial part in everyday social life as well as getting better opportunities in a carrier also. Wi-Fi places a major role in internet access in the present era. Electromagnetic waves have been used in Wi-Fi technology [3]. More IoT devices need high bandwidth connectivity in the present day and increasing the bandwidth will cause some health issues for people as well as animals. The new emerging Li-Fi technology is a remedy for this for which LED light is the main medium of communication [4-5]. Information can be transmitted at a very high speed than in the Wi-Fi since ON condition of a LED light transmit a digital one and the OFF condition transmit a digital zero. There are many applications of Li-Fi such as in Hospitals, Businesses, Schools, Diving, and many more where confidentiality has to be maintained within a smaller area of range [6].

II. VISIBLE SPECTRUM

The visible spectrum has 10,000 times broader frequency than radio waves [7].

To increase the bandwidth of Wi-Fi, the frequency of radio waves has to be increased, which will ultimately be dangerous for human health. Moreover, regular usage of Wi-Fi will affect human health [8-9].

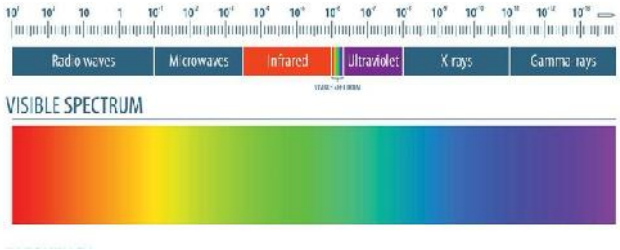

Figure1: Visible Spectrum

III. WORKING OF Li-Fi

For working with Li-Fi, two components required to drive the internet are: (a) an LED lamp and (b) a Li-Fi dongle. Using light intensity modulation, Li-Fi will transmit data. It will use LEDs and photo detectors at the transmission end and receiver end respectively. The lamp driver acts as the mediator to connect the Internet server and the chip-attached LED light. Light with wavelength ranging from 380nm to 780nm is used for data communication between LEDs and photo detectors

[10-12]. Li-Fi can support three different modes, namely peer to peer, broadcast, and star. It can be used for different applications like street lights and signboards.

When a LED light passes electrical current, photons (stream of light), as well as data, emits from the lamp which is of different rates of modularity. The detector receives those signals and interprets them.

The LED light bulb in Li-Fi flickers at a very low frequency of 1MHz, which is 10,000 times more than the screen refresh rate (100Hz) of a computer [16].

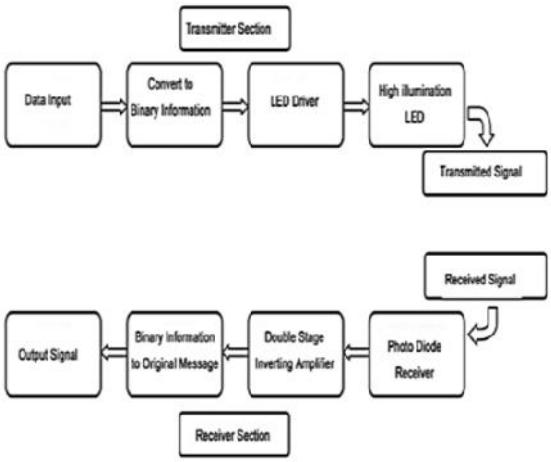

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Figure2: Proposed Methodology

IR remote can send a bit stream at a rate of 10,000-20,000 bits/second. By replacing the IR LED with a box of the large LED array, it is possible to transfer thousands of streams at a higher speed.

IV. DIFFERENCES BETWEEN Wi-Fi and Li-Fi[8-10]

Sl No	Key Concept	Wi-Fi Technology	Li-Fi Technology
1	Definition	Wireless Fidelity	Light Fidelity
2	Inventor	NCR Corporation invented Wi-Fi in 1991	Prof. Harald Haas invented Li-Fi in 2011
3	Medium of Data Transmission	Radio frequency	Light
3	Hardware Components	Major Hardware Components adapters, routers, antennas, repeaters and access points	Major components are LEDs, LED driver, photodetector and image sensor
4	Device compliance policy	WLAN 802.11/b/g/n/ac/d standard compliant devices	IrDA compliant devices
5	Frequency Rate	2.4GHz, 4.9GHz & 5GHz	10,000times Radio Frequency
6	Coverage Area	32 meters on an avereage	10 meters on an average
7	Passage of Signals	Radio frequency signals can pass through walls and people outside the room can access data which may cause insecurity	Li-Fi can offer secured data transfer as light does not pass through the walls
8	Working Environment	Works well in less dense situation due to the frequency interference issues	Works very well even in high dense environment

V. APPLICATIONS OF Li-Fi

There are various applications of Li-Fi where Wi-Fi lacks its performance [13-18]. Some of them are:

1) In Confidential Meetings

Li-Fi technology enables more confidential conference meetings or business meetings as high-intensity internet is available within a room. All users in a room will get a higher volume of data rates within the width of the light pool. Security is better than Wi-Fi as light cannot pass through the walls.

2) In Hospitals

Li-Fi technology is more suitable in a health care environment where patient data need to be maintained secretly and data need to be accessed fast during an emergency. Also, there are certain limitations of radio signals in Hospitals as a collision of radio signals makes errors in electric devices installed, making it dangerous for patient safety. So Li-Fi replaces these and is more suitable in the dense area of a multi-specialty modern health care environment.

3) Highly populated areas

Modern urban areas have been filled with equipment functioning under Artificial Intelligence System. Li-Fi with interference-free wireless communication empowers the working of the devices.

4) Electromagnetic Interference Areas

Li-Fi allows better connectivity for each traveler in an aircraft. Additionally, it reduces cabling requirements in the plane which would reduce the overall installation and maintenance cost.

5) In Cellular Communications

Li-Fi access points can be made in street lights, in-home, in malls, and everywhere instead of deploying new radio stations as in the Wi-Fi connectivity. Moreover, the cost of installing a new Wi-Fi base station is high and that would be eliminated in Li-Fi.

6) In Underwater Communication

Radio waves have to be quickly absorbed in water, especially in saltwater and the signals will be lost before reaching its targeted area. Whereas light can penetrate greater distances in water and this would allow divers communicate with each other and ultimately will benefit to the tourism department.

7) Transportation Systems

Li-Fi opens a way to vehicle-to-vehicle communication if headlights and tail lights are replaced by LED lights. A city-wide traffic management system can be controlled and operated through Li-Fi-enabled traffic.

8) In Live streaming

According to the report by Go-Globe, 82% of consumers prefer to see live videos than recorded videos. Using Li-Fi high-speed transformation technology, you can download massive files in a blink of an eye.

9) In high-risk areas

Interruption of Radio Frequency is banned in places such as petrochemical plants and oil and gas producing platforms. Li-Fi technology can be used in these high-risk areas.

VI. PRESENT STATUS

The world's initial commercially offered Li-Fi technology was released by pureLiFi, by the company developed by Harald Haas. Li-Frame, the first Li-Fi product was released for mobile wireless communication in February 2015. pureLiFi and Lucibel, a French lighting company deployed the world's first industrialized Li-Fi in 2016[19].

LiFi-XC system was on the rampage in October 2017. This is a plug-and-play certified system that works on USB devices as well. Li-Fi starter kits to researchers were released by pureLiFi in June 2018.

A Li-Fi operated light bulb produced by the company named 'velmenni' on a small scale. The demonstration shows the data transfer of 1Gbps speed, which is 100 times quicker than Wi-Fi in the USA. Chinese Scientist at Fudan University says that Li-Fi successfully tested at 150Mbps [20].

Indonesia tested Li-Fi in an education center in Merch6, 2019. Incubex, Bangalore started a Li-Fi meeting room to explore the technology. A company named Orange piloting the technology at the office of Paris and the France Republic Polytechnic of Singapore is going to install Li-Fi on their Smart Devices Lab [20].

Many more countries have put forward ideas for Li-Fi technology and it's been predicted that Li-Fi accession will be available to the public in early 2022. The LED bulbs are appropriated through a chip that inflicts the light for visual data broadcast which is accepted by photoreceptors.
here are various applications [21-23].

VII. ADVANTAGES OF Li-Fi

- A data transmission rate of a maximum of 10 Gbps can be obtained by using Li-Fi. Compared to Wi-Fi, light is 10,000 times higher than radio waves.
- Because LED bulbs are the transmission media in Li-Fi and the elimination of modem and router, it is cheaper to construct.
- Use of light as a medium makes it a safe environment as there is no health hazard due to electromagnetic radiation.
- A white LED and RGB LED can convey data at a speed of 1Gbps and 3.4 Gbps respectively, which is far higher than the existing speed.
- It is a free band and does not require any license
- As lights are present everywhere including the street, availability of light sources is not an issue and common people can use it at a low cost by creating each light source as a channel [7,9,24-26].

VIII. LIMITATIONS OF Li-Fi

- It can be used only for point-to-point communication

- Data transmission can be obstructed by opaque objects
- Limit to very short distances only
- Line of sight should be needed for data transmission [7,20,21,24-26]

IX. CONCLUSION

LiFi cannot be a complete solution for existing Wi-Fi technology. Their unique roles play a different role and making a hybrid of both makes the world a much better place to live in.

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