Review Paper on Li-Fi (Light Fidelity)

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ABSTRACT

Li-Fi means Light-Fidelity. Li-Fi technology, proposed by the German Scientist — Harald Haas, Harald Haas proposed the technology that transmits the data through illumination by sending data through the LED light bulb. The main aim of this paper is to develop a Li-Fi based system and measure its performance with respect to existing technology. Now days the Wi-Fi is the more popular wireless technology that cover within buildings, whereas Li-Fi is ideal for high speed wireless data transmission in confined area. Li-Fi provides higher bandwidth, efficiency, availability and security than Wi-Fi and has already achieved high speed in the lab. By using the low-cost nature of LEDs we can implement this system public internet access through street lamps to auto-piloted cars that communicate through their headlights. As the speed of light is higher hence the data transmission speed is so much faster that the existing system. In the future we can implement this technology for fast data access for the laptops, smart phones, and tablets will be transmitted through the light in a room.

Keyword --*Wireless-Fidelity (Wi-Fi), Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Line of Sight (Los), Visible Light Communication (VLC).*

1.INTRODUCTION

Harald Haas was developed LI-FI and promoted LI-FI in his 2011 TED Global talk by giving Presentation of an LED light bulb to transmit a data with the speed 10 times more faster.As the speed of light is very high so the data transmission speed via the light is also high.

Transfer of data from one place to another is one of the most important day-to-day activities. When the multiple devices are connected to the current wireless networks that connect us to the internet are very slow. As the number of devices increasing the internet access, the fixed bandwidth which is available makes it more and more difficult to utilize high data transfer rates and connect to a network. But, radio waves are just a small part of the spectrum available for data transfer. A solution to this problem is by the use of the proposed system. Li-Fi stands for the Light-Fidelity. Li-Fi is transmission of data through light by sending data through an LED bulb that varies in intensity faster than the human eye can follow and the faster data transmission speed. Li-Fi is the new technology has used to label the fast and cheap wireless communication system, which is the next optical version of Wi-Fi. Li-Fi uses light spectrum that send via LED Bulb instead of Gigahertz radio waves for data transfer.

Fig 1.1: LI-FI LED Bulb

This technology communicate with the help of visible light communication spectrum and has no side effect as we know the light is very much part of our life and so much faster. In this spectrum 10,000 times more space is available and also more availability as a LED light bulb and street light are available already.There are some commonly used examples of wireless networks like- traffic control systems, Bluetooth, infrared and ultrasonic remote control devices, VHF radios, professional LMR, SMR, Two way radio including FRS, GPS, cordless telephone, satellite TV etc

Wi-Fi connection within the Building and around the 10-100 meter range to connect our Laptops, P.C., palmtops etc. The current paper deals with the visible light communication which may utilize a wide and fast data rate like 500MBPS. Study made comparison between WI-Fi, Wimax, LI-Fi and other important parameters of the communication process.

Li-Fi can be the future technology for where data for laptops, PC, smart phones, and tablets will be transmitted through the light in a room. It is more secure because if you can't see the light, you can't access the data. As a result, it can be implemented in high security areas like military where RF communication is prone to eavesdropping.

Fig 1.2: Li-Fi system connecting devices in a room

2.CONSTRUCTION OF LI-FI SYSTEM

Li-Fi is a next version of Wi-Fi that is fast and cheap. It is based on Visible Light Communication (VLC).VLC is a communication medium, which utilized visible light between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission. It uses faster pulses of light to transmit information wireless. The main components of Li-Fi systemare as follows:

a) A high brightness LED Bulb which acts as transmission (source).

b) A silicon photodiode react as receiver.

LEDs can be turned on and off to generate digital strings of different combination of 0s and 1s. The LEDs can be used as a source or sender, by modulating the light with the data signal. The LED output appears same to the human eye by virtue of the fast flickering rate of the Bulb. Data transmission rate greater than 100 Mbps can be possible by using high speed LEDs with the help of various multiplexing techniques. Visible Light Communication data rate can be increased by sending parallel data transmission using a multiple of LEDs where each LED sends a different data stream. The Li-Fi emitter system consists of 4 primary parts:

a) Bulb

b) RF power amplifier circuit (PA)

c) Printed circuit board (PCB)

d) Enclosure

The Printed circuit board controls the electrical inputs and outputs of the bulb and houses the microcontroller used to manage different bulb functions. A RF (radio-frequency) signal is created by the solid-state PA and is guided in the electric field about the bulb. The high concentration of energy in the electric field vaporizes the contents of the bulb to a plasma state at the bulb's center; this controlled plasma generates an source of light.

There are various advantages of this system which includes more brightness, highest color quality and high luminous power of the emitter – in the range of 150 lumens per watt or more. The structure is mainly robust without typical degradation and failure mechanisms associated with tungsten electrodes and glass to metal seals, resulting in useful Bulb life of 30,000+ hours. In addition, the unique combination of high temperature plasma and digitally controlled solid state electronics results in an economically produced family of Bulb scalable in packages from 3,000 to over 100,000 lumens.

Important factors we should consider while designing Li-Fi as following:

1. Presence of Light
2. Line of Sight (Los)
3. For better performance use fluorescent light & LED

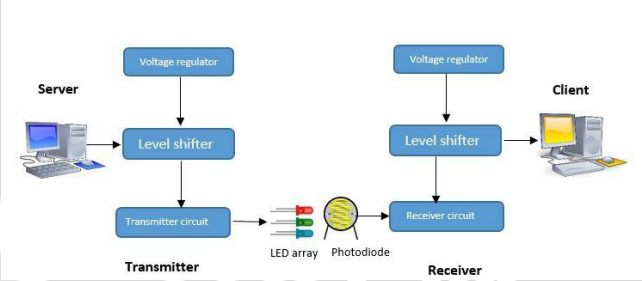

Fig 2.1: Construction of Li-Fi system

3. WORKING OF LI - FI

There may be also some improvement could be made, using LEDs for parallel transmission, or using amalgamation of basic three color's i.e., red, green and blue LEDs as a multiple frequency with each having a different data channel capacity. If the LED is on, a digital data 1 is transmitted. If the LED is off, a digital data 0 is transmitted via the LED. The photo detector registers a binary indication on the basic of LED ON and OFF

Transmission of data is done by single LED or multi LED through a visible light. On the receiver side there is a photo detector, which convert this light signal that emits electric signals to the connected device Voltage regulator and level shifter circuits are used on both the side to convert and maintain a voltage level between transmitter and receiver.

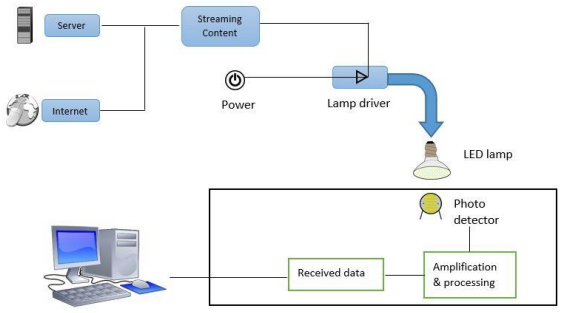

Fig 3.1: Actual working ofLi-Fi system

LiFi can be work underwater where Wi-Fi cannot use underwater, therefore we can implement this system in military operations. As per existing result been reported from the use of millimeter wave (mmWave) communication in the 28 GHz region along with visible light. Advancements promise a theoretical speed of LIFI 10Gbps – meaning one can download a full high-definition movie in only 30 seconds.

The concept of binding together the functions of illumination and communication gives the potential for tremendous cost savings. The deployment of VLC access points (APs) becomes straight forward as the existing lighting infrastructure can be reused, hence the cost required is less and there exist off-the-shelf technologies such as power-line communication (PLC) and power- over- Ethernet (PoE) for installations process, and new installations respectively. And because lighting is based on the time in indoor environments even in day time, the energy used for communication can practically zero as a result of the piggy-backing of data.

4. ADVANTAGES

Li-Fi is based on LEDs or other light source for the transformation of data. The transmission of the data can be with the all kinds of light, no matter the part of the light spectrum that they belong. That is, the light can belong to the ultraviolet, invisible or the visible part of the spectrum. Also, the speed of the communication channel is higher domain for downloading for downloading movies, music, and games all in very less time.

Also, Li-Fi overcomes the limitations that are put on the user by the Wi-Fi system.

a) ***Capacity***: Light has 10000 times faster bandwidth than radio waves. Also, light sources are already available. So, Li-Fi has got more capacity and also the equipment's are already available in the market.

b) ***Efficiency***: Data transmission using the Li-Fi is less costly. LED lights requires less energy and are highly efficient than the normal light.

c) ***Availability:*** As light sources are present everywhere hence the availability is not the issue. There are number of light bulbs worldwide; they just need to be replaced with LEDs for better transmission of data.

d) ***Security:*** Light is not visible hence it is more secure. Light waves do not penetrate through walls. So, they can't be intercepted and misused.

5.COMPARISION BETWEEN WI-FI AND LI-FI

Li-Fi is the name given to describe visible light communication technology applied to access high speed wireless data communication. It derived this name by similarity to Wi-Fi. Wi-Fi works radio frequency and generally wireless coverage within buildings, and Li-Fi is ideal for high density wireless data coverage inside a confined area or room and for relieving radio signal interference issues.

Table 5.1: Comparison between WI-FI and LI-FI

Parameter	***Li-Fi***	***Wi-Fi***
speed	1-3.5 Gbps	54-250 Mbps
range	10 meters	20-100 meters
IEEE	802.15.7	802.11b
Spectrum range	10000 times than WiFi	Radio spectrum range
Network	Point-to-point	Point-to-Multi
Data Transfer	Used light as a	Use radio
Frequency	100 times of	2.4 GHz

Table shows a comparison of various technologies that used for connecting to the various user. Wi- Fi currently offers moderate data rates. The IEEE 802.11.n in most implementations provides up to 150Mbit/s although practically, very less speed is received.

6.COMPARISION BETWEEN WI-MAX AND LI-FI

Wi-MAX is one of the hottest wireless technologies around now a day. Wi-MAX systems are expected to deliver broadband access services to residential people and enterprise customers in the economical way.Loosely, Wi-Max is a standardized wireless technology to wire technologies (such as Cable Modems, DSL and T1/E1 links) to provide broadband access to customer premises

Table 6.1: Comparison between WI-MAX and LI-FI

Parameter	***Wi-Max***	***Li-Fi***
IEEE Standard	802.16a	802.15.7
Speed	100 times faster than Wi-Fi	100 times faster than Wi-Max

Range	30-100 meters	10 meters
Frequency Band	2-11 GHz	100 times of Tera Hz
Technology Used	Microwave	Light fidelity
Network Topology	Point-to-Multi point	Point-to-Point
Spectrum Range	10-66 GHz	1000 times than Wi-Fi

Li-Fi, an alternative solution for Wi-Fi that handled data using the spectrum of visible light, has achieved a new multiple researchers reporting transmission speeds of 10Gbit/s – more than 250 times faster.

The fastest speed WI-MAX previously mentions was 3Gbit/s, attempted earlier this year by the Fraunhofer Heinrich Hertz Institute in Germany. Asian scientist also declare this month to have produced a 150Mbp/s connection, but some experts were doubtful without seeing further proof.

7.APPLICATIONS OF LI-FI

1. High speed Data Transmission.
2. Li- Fi uses light rather than radio frequency signals
3. In the Aircraft VLC is use for safty.
4. In the medical devices and in hospitals Bluetooth, infrared, Wi-Fi and internet are banned. As this technology does not deal with radio waves, so it can easily be used in such places.
5. We can use the LI-FI Under water in sea Where Wi-Fi does not work.
6. Security is another benefit to handle the penetrate through walls.
7. In streets for traffic control. Cars have LED based headlights, LED based backlights, and Car can sending information to overcome accidents in the way that they exchange Information. Traffic light can communicate to the car and so on.
8. By implementing the Technology worldwide every street lamp would be a free access point.
9. Li-Fi may solve issues such as the shortage of radio frequency bandwidth.

8. CONCLUSION AND FUTURE SCOPE

There are numerous possibilities that can be explored as we advance. This technology if brought into practical implementation, every single bulb can be used somewhat like a Wi-Fi hotspot to transmit wireless data and we will advance towards the cleaner, greener, safer and brighter future. The concept of Li-Fi offers a genuine and very efficient substitute to radio-based wireless.

As increasing number of people and their numerous devices access wireless internet, the airwaves are becoming more and more clogged, making it further difficult to get a reliable, high-speed signal. The proposed system may fix problems such as the insufficient radio-frequency bandwidth and also permit internet where traditional radio based wireless isn't permitted as in aircraft or hospitals. Li-Fi could emerge bandwidth of radio waves. And it will certainly be the first choice for accessing internet in a confined room at cheaper cost.In future the limitations of artificial light will be overcome for faster transmission. Also, the direct line of sight will be overcome.

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