



Li-Fi TECHNOLOGY

Alfiya Sheikh¹, Avanti Walchale²

¹Student, Department of Electronics & Telecommunication, Government Polytechnic, Amravati, Maharashtra, India, alfiyasheikh254@gmail.com

²Student, Department of Electronics & Telecommunication, Government Polytechnic, Amravati, Maharashtra, India

Abstract

Li-Fi stands for light fidelity, light technology proposed by the German physician-Harald Hass provide transmission of data through illumination by sending an data through LED's. Light bulb that varies in intensity faster than the human eye can follow. It is a wireless technology that make use of visible light in place of radio waves to transmit data at Terabits per second speed- more than 100 times the speed of Wi-Fi. The term of Li-Fi refers to visible light communication technology that uses light as medium to deliver light speed communication. Li-Fi provide better bandwidth ,efficiency , connectivity and security . By leveraging the low cost nature of LED's , there are many opportunity to exploit this medium from public internet access through street lamp to auto-piloted cars that communicate through their headlight.

Keywords:Li-Fi(Light fidelity),Wi-Fi(wireless fidelity),VLC(Visible light communication),LED(Light emitting diode),RF(Radio frequency),Gbps(Gega bytes per second),Tbps(Tera bytes per second).

INTRODUCTION

As we know now a days internet has become major demand. People are roaming here and there for Wi-Fi hotspot. There are 1.4 million cellular mask radio waves base station deployed, with over 5billion mobile phone. Spectrum is one of the most essential requirement for wireless communication with the advance in technology and number of user, the existing radio wave spectrum fail to overcome this need to resolve the issues of scalability and availability and security, we have come up with the concept of transmitting the data wirelessly through light using LED's which is called as Li-Fi .Li-Fi is the latest technology which is used for transmission of data through illuminance by taking the fiber out off fiber optics by sending data through an LED light bulb as shown in fig (1).

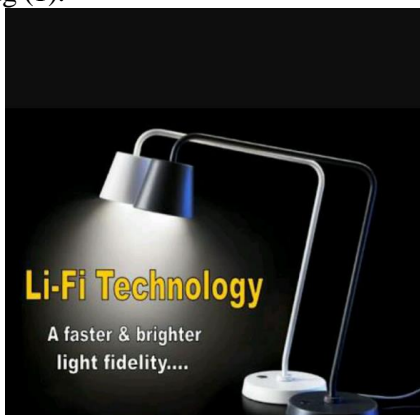


Fig.(1)

The term Li-Fi refers to visible light communication (VLC) technology that uses light as a medium to deliver high- speed communication in manner similar to Wi-Fi. Li-Fi provides better bandwidth, efficiency, connectivity and security than Wi-Fi and has already achieved high speed larger than 1Gbps under the laboratory conditions.

PRESENT SCENARIO

Expect to hear a whole lot more about Li-Fi a wireless technology that transmits high speed data using VLC- in the coming months. With scientists achieving speeds of 224 Gbps in the lab using Li-Fi earlier this year , the potential for this technology to change everything about the way we use the internet is huge. And now, scientists have taken Li-Fi out of the lab for the first time, trailing it in offices and industrial environments in Tallinn, Estonia, reporting that they can achieve data transmission at 1 GB per second – that's 100 times faster than current average Wi-Fi speeds. As an innovation in Li-Fi some companies like the Russian company stinsconam is selling its Li-Fi based solution(VLC technology that uses light from LED to developed internet) in the US, Israil, China,etc.The Li-Fi projected to have a compound annual growth rate of 825 from 2013 to 2018 and to be worth over 6 billion per year by 2018.

PRESENT SCENARIO



1.4 Million



5 Billion

Fig.(2)

WORKING PRINCIPLE OF Li-Fi:-

Important factor that should be considered while designing Li-Fi are as follow:

- (a) A high brightness white LED which act as a transmission source
- (b) Silicon photodiode with good response to visible light as receiving element

The working of Li-Fi is very simple. There is a light emitter on one end i.e. an LED transmitter, and a photodiode detector (light sensor) on the other. The data input to the LED transmitter is encoded into the light (technically refers to as VLC) by varying the flickering rate at which the LED's flicker "on" and "off" to generate different strings of 1s and 0s. The on- off activity of the LED transmitter seems to be invisible, enable data transmission in light from in accordance with the incoming binary code: switching on LED is a logical 1, switching it off is a logical 0 by varying the rate at which the LED is flicker on and off, information can be encoded in the light to different combinations of 1s and 0s.

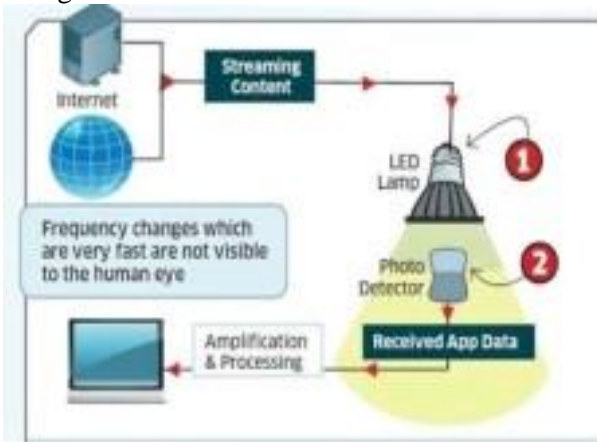


Fig. (3)

In a typical setup, the transmitter (LED) is connected to the data network (internet through the modem) and the receiver (photo detector/light sensor) on the receiving end receives the data as light signal and decode the information, which is then display on the device connected to the receiver. Thereceiver register a binary 1

when the transmitter is on and a binary 0 when the transmitter is off. Thus flashing the LED numerous times or using an array of LED's will eventually provide data rate in the range of 100's of Mbps. The LI-FI working is explained in the block diagram (Fig.3)

Hence all that is required, is some or an array of LED's and a controller that controls/encodes data into those LED's. All one has to do is to vary the rate at which the LED flicker depending upon data input to LED's. Further data rate enhancement can be made in this method, by using array of the LED's for parallel data transmission, or using mixture of red, green and blue LED's to alter the light frequency, with each frequency encoding a different data channel. Fig 3 shows working/development of a LI-FI system connecting devices in a room.

a. DATARATE VERSUS SIZE OF THE LED'S:

Different data rates can be achieved with different size of LED's .the size of normal LED's bulb can be reduced to micro-LED which handles millions alterations in light intensity. The tiny micro LED'S bulb allow the stream of light to be beam in parallel and transmitting huge amount of data interms of Gbps. Here it can be concluded that data rate (R) is inversely proportional to the size of LED.

b. DATA RATE VERSUS NUMBER OF LED'S:

The data rate can be increase with the increasing number of LED's. The number of LED's can be according to the available space inside the lamp. The number of LED's can be adjusted so that it can achieve the maximum bit rate (bps).

c. DATA RATE VERSUS ON-OFF SWITCHING OF LED'S:

The on-off switching of LED light bulb can be created binary in data of 1s and 0se.g. 1 for on and 0 for off . The micro -LED handles million of alternation in light intensity per second and faster the on-off switching, transmitting large amount of data at high speed.



Fig.(4)

Why Only VLC?

Electromagnetic Spectrum

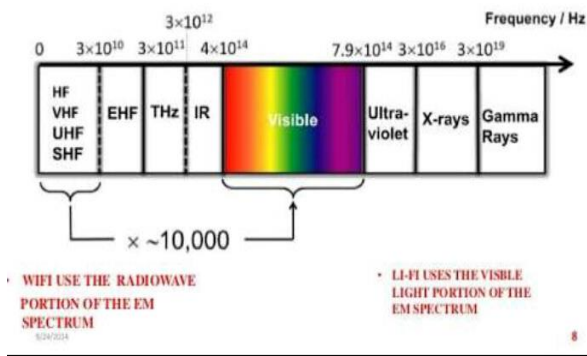


Fig.(5)

The radio waves are costly and very less safe the use of infrared can be done with power which is low for eye safety. Gamma rays cannot be used as they are dangerous. UV rays can be use at places where humans are not found otherwise they can be harmful. Now visible light is safe to use that is no harmful effect and it also have a large bandwidth. VLC uses the visible light between 400 THz (780nm) and 800 THz (375nm) as a medium which are less dangerous for high power application.

- Radio waves are expensive (due to spectrum charges) and less secure (due to interference and possible interception etc.)
- Gamma rays are harmful because it could be dangerous dealing with it, by the human being due to their proven adverse effects on human health.
- X-ray has health issues, similar to gamma rays.
- Ultraviolet light can be considered for communication technology purpose at place without people, otherwise they can also be dangerous for human body when exposed continuously.
- Infrared, due to high safety regulation, can also be used with low power.

The visible light portion (from red to blue) of the electromagnetic spectrum does not cause any harm to the people as visible rays are safe to use, provide large bandwidth and also have a promising future in communication field.

ADVANTAGES OF LI-FI

- Capacity:**-Light has 1000 times wider bandwidth than radio waves. Also, light sources are already installed. So, Li-Fi has got better capacity and also the equipment is already available.
- Efficiency:**-Data transmission using Li-Fi is very cheap. LED lights consume less energy and are highly efficient.
- Availability:**-Availability is not an issue as light sources are present everywhere. There are billions of light bulb worldwide; they just need to be replaced with LED'S for proper transmission of data.

- Security:**-Light waves do not penetrated through walls. So they can't be intercepted misused.

LIMITATIONS OF LI-FI

Some of the major limitation of Li-Fi are:

- Internet cannot be accessed without a light source. This could limit the location and situation in which Li-Fi could be used.
- It requires a near or perfect line – of –sight to transmit data
- Opaque obstacles on pathway can affect data transmission.
- Natural light, sunlight and normal electric light can affect the data transmission speed.
- Light waves do not penetrated through wall and so Li-Fi has a much shorter range than Wi-Fi.
- High initial installation cost, if used to set up a full-fledged data network.
- Yet to be developed for mass scale adoption.

APPLICATION OF LI-FI

Li-Fi technology is based on LED's or other light source for the transfer of data. The light can be belongs to the invisible ultraviolet or the visible part of the spectrum. Some of the future application of Li-Fi areas follows:-

- Education system
- Medical application
- Cheaper internet in aircraft
- Underwater application

FUTURE SCOPE

A consortium called Li-Fi consortium was formed in October 2011 by a group of companies and industry group promote high-speed optical wireless system and overcome the limited amount of radio based wireless spectrum occurring to the Li-Fi consortium, it is possible to achieve more than 10 Gbps.

- Researchers at the university of Strathclyde in Scotland have begun the task of bringing high speed, ubiquitous, Li-Fi technology to market.
- Further enhancement are possible like using an array of LED's for parallel data transmission or using mixture of red, green and blue LED's to alter the lights frequency with each frequency encoding a different data channel. Such advancement promises a theoretical speed of 10 Gbps.

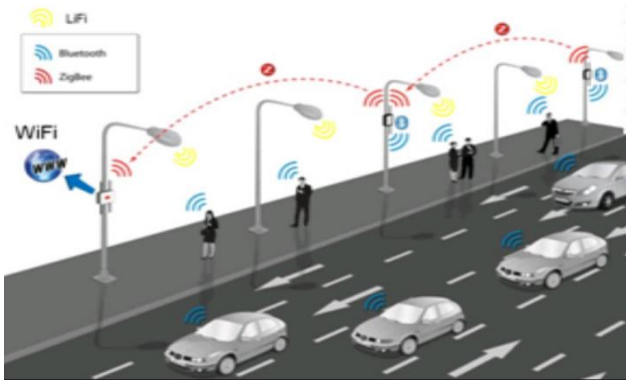


Fig.(6)

CONCLUSION

As a number of internet user are increasing per day, this concept is very much efficient and reliable alternative to RF communication. The visible spectrum of light is used that is better than the radio frequency, also prone to interference. By using this technology information can be transmitted and received at very high rates with simply turning on and off of the LED'S. This technology is much secured compared to Wi-Fi. By development of this technology, we can migrate to greener, cleaner, safer communication network. The various concept of Li-Fi promises to solve issues such as, shortage of radio-frequency bandwidth and eliminates the disadvantages of radio communication technology.

ACKNOWLEDGEMENT

We are thankful to our beloved Principal Dr. D. N. Shingade sir. We are also thankful to our beloved H.O.D Dr. V. R. Mankar sir.

REFERENCES

- [1]. Mr.AshishParnami "A review paper on light fidelity", National conference on innovation in microelectronics, signal processing and communication technology.
- [2]. Pro R. Karthika "wireless communication using LI-FI technology",SSRG international journal of electronics and communication engineering.]
- [3]. www.internationaljournalssrg.org
- [4]. <http://en.wikipedia.org/wiki/Li-Fi>