

## Study of Li-Fi Technology

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### ABSTRACT

*Nowadays many people are using internet to accomplish their task through wired or wireless network. As no of users get increased in wireless network speed decreases proportionally. Though Wi-Fi gives us speed up to 150mbps as per IEEE 802.11n, it is still insufficient to accommodate no of desired users. To remedy this limitation of Wi-Fi, we are introducing concept of Li-*

*Fila's per germen physics Herald Haas —data through illumination—taking the fibber out of fiber optic by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It's the same idea band behind infrared remote controls but far more powerful. Haas says his invention, which he calls DLIGHT, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection.*

### Keywords:

**LiFi (Light Fidelity), Wi-Fi (Wireless Fidelity), VLC (Visible Light Communication), LED (Light Emitting Diode), IEEE (Institute of Electrical and Electronics Engineers), RF (Radio F2).**

## II. INTRODUCTION

### Overview of Li-Fi

Li-Fi stands for 'LIGHT FIDELITY'. Li-Fi is transmission of data through illumination by taking the fibre out of fibre optics by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi is the term some have used to label the fast and cheap wireless-communication system, which is the optical version of Wi-Fi. Light reaches nearly everywhere so communication can also go along with light easily. Light Fidelity is a branch of optical wireless communication which is an emerging technology.

**Byfrequency), ALA  
(American Lighting Association )**

### 3. Design of Li-Fi

Li-Fi architecture consists numbers of Led bulbs or lamps, many wireless devices such as PDA, Mobile Phones, and laptops. Important factors we should consider while designing Li-Fi as following:

- Presence of Light
- Line of Sight (Los)
- For better performance use fluorescent light & LED As shown in figure streaming content must have proper integration with server & internet network, so that it is easily possible to work using visible light as transmission medium, Li-Fi provides wireless indoor communication. The bit rate achieved by Li-Fi cannot be achieved by

Wi-Fi. Prof. Herald Haas, human eye cannot detect it. If LED is on, then we transmit a digital signal 1, and if the LED is off, then we transmit a digital signal 0. A controller is connected at the back side of these LED bulbs to code data to these

LED's. Fig 2. Architect use of li-fi

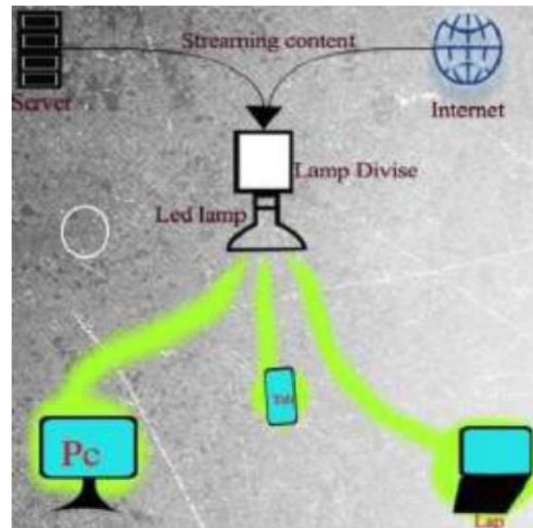


Fig 1:- Architecture of li-fi

#### 4 . Working of Li-Fi

□□ On one end all the data on the internet will be streamed to a lamp driver when the led is turned on the microchip converts the digital data in form of light.

□□ A light sensitive device (photo detector) receives the signal and converts it back into original data. This method

of using rapid pulses of light to

Transmit information wirelessly is technically

Referred as Visible Light Communication ubiquitous communication. Visible light communication (VLC) has following advantages over other competing radio communication technologies such as Wi-Fi and cellular phone wireless communication visible light spectrum is available for communication because the frequency above 3THz is not currently regulated by the Radio Regulation Law. What if, all lights in your rooms will communicate each other and creates a bridge of wireless networks to provide internet access? , Li-Fi Technology would be the best optimum solution over Wi-Fi technology. It can also be used to extend wireless networks at your home, office or university for data transfer at 10 Gbps, —on the move" data transfer rate at 100 Mbps, home wireless data network with local cloud & server.

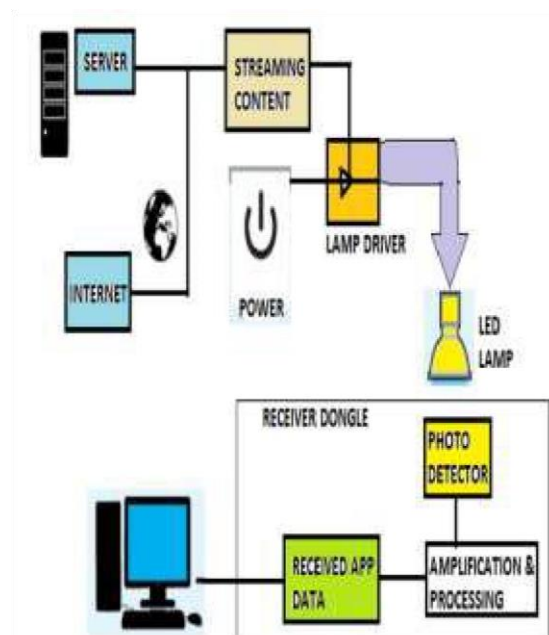
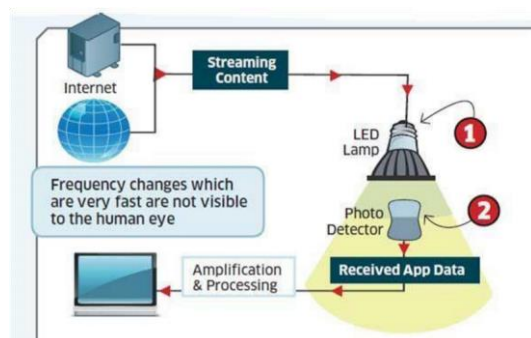


Fig 2:- Working of li-fi

**5. Comparison between Li-Fi & Wi-Fi** Li-Fi is the name given to describe visible light communication technology applied to obtain high speed wireless communication. It derived this name by virtue of the similarity to Wi-Fi. Wi-Fi works well for general 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 interference issues. It shows a comparison of transfer speed of various wireless technologies and comparison of various technologies that are used for connecting to the end user. Wi-Fi currently capable to transmit data 1000 times faster than normal LED with faster ON-OFF switching, transmitting large amount of data at high speed.

### BLOCK DIAGRAM OF LI-FI

The data can be encoded in the light by varying the flickering rate at which the LEDs flicker on and off to generate different strings of 1s and 0s. The LED intensity is modulated so rapidly that human eye cannot notice, so the light of the LED appears constant to humans. Light-emitting diodes (commonly referred to as LEDs and found in traffic and street lights, car brake lights, remote control units and countless other applications) can be switched on and off faster than the human eye can detect, causing the light source to appear to be on continuously, even though it is in fact 'flickering'. The on-off activity of the bulb which seems to be invisible enables data transmission using binary codes: switching on an LED is a logical '1', switching it off is a logical '0'. By varying the rate at which the LEDs flicker on and off, information can be encoded in the light to different combinations of 1s and 0s. This method of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication (VLC), though it is popularly called as Li-Fi because it can compete with its radio-based rival Wi-Fi. Figure 5 shows a Li-Fi system connecting devices in a room.



### 6. Problems in Wi-Fi

The following are the basic issues with radio waves:

- a) **Capacity:** Wireless data is transmitted through radio waves which are limited and expensive. It has a limited bandwidth. With the rapidly growing world and development of technologies like 3G, 4G and so on we are running out of spectrum.
- b) **Efficiency:** There are 1.4 million cellular radio base stations that consume massive amount of energy. Most of the energy is used for cooling down the base station instead of transmission. Therefore efficiency of such base stations is only 5%.
- c) **Availability:** Availability of radio waves is a big Concern. It is not advisable to use mobile phones in aero planes and at places like petrochemical plants and petrol pumps.
- d) **Security:** Radio waves can penetrate through walls. They can be intercepted. If someone has knowledge and bad intentions, they may misuse it. This causes a major security concern for Wi-Fi

## 6 .How it is different?

Li-Fi technology is based on LEDs for the transfer of data. The transfer of the data can be with the help of all kinds of light, no matter the part of the spectrum that they belong.

That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum. Also, the speed of the internet is incredibly high and you can download movies, games, music etc. in just a few minutes with the help of this technology. Also, the technology removes limitations that have been put on the user by the Wi-Fi. You no more need to be in a region that is Wi-Fi enabled to have access to the internet. You can simply stand under any form of light and surf the internet as the connection is made in case of any light presence. There cannot be anything better than this technology.

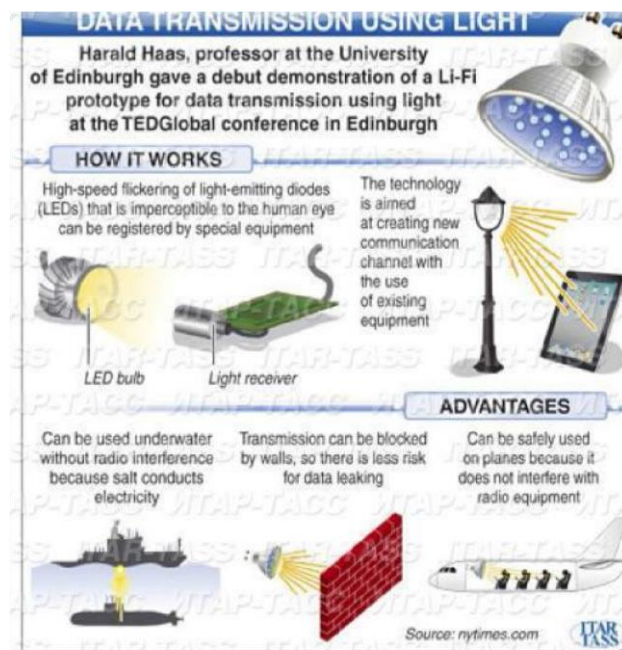


FIG 3 :- . Working and advantage

## Advantages of Li-fi

Li-Fi technology is based on LEDs or other light source for the transfer of data. The transfer of the data can be with the help of all kinds of light, no matter the part of the spectrum that they belong. That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum. Also, the speed of the communication is more than sufficient for downloading movies, games, music and all in very less time. Also, Li-Fi removes the limitations that have been put on the user by the Wi-Fi.

- a) **Capacity:** Light has 10000 times wider bandwidth than radio waves . Also, light sources are already installed. So, Li-Fi has got better capacity and also the equipments are already available.
- b) **Efficiency:** Data transmission using Li-Fi is very cheap. LED lights consume less energy and are highly efficient.
- c) **Availability:** Availability is not an issue as light sources are present everywhere. There are billions of light bulbs worldwide; they just need to be replaced with LEDs for proper transmission of data.
- d) **Security:** Light waves do not penetrate through walls. So, they can't be intercepted and misused

### Disadvantages of LiFi

One of the major demerits of this technology is that the artificial light cannot penetrate into walls and other opaque materials which radio waves can do. So a Li-Fi enabled end Device (through its inbuilt photo-receiver) will never be as fast and handy as a Wi-Fi enabled device in the open air. Also, another shortcoming is that it only works in direct line of sight. Still, Li-Fi could emerge as a boon to the rapidly depleting bandwidth of radio waves. And it will certainly be the first choice for accessing internet in a confined room at cheaper.

### Uses in various areas

Can be used in the places where it is difficult to lay the optical fibre like hospitals. In operation theatre Li-fi can be used for modern medical instruments. In traffic signals Li-fi can be used which will communicate with the LED lights of the cars and accident numbers can be decreased. Thousand and millions of street lamps can be transferred to LiFi lamps to transfer data. In aircraft LiFi can be used for data transmission. It can be used in petroleum or chemical plants where other transmission or frequencies could be hazardous.

## 7. APPLICATION OF LI-FI

**You Might Just Live Longer** For a long time, medical technology has lagged behind the rest of the wireless world. Operating rooms do not allow Wi-Fi over radiation concerns, and there is also that whole lack of dedicated spectrum. While Wi-Fi is in place in many hospitals, interference from cell phones and computers can block signals from monitoring equipment. Li-Fi solves both problems: lights are not only allowed in operating rooms, but tend to be the most glaring (pun intended) fixtures in the room. And, as Haas mentions in his TED Talk, Li-Fi has 10,000 times the spectrum of Wi-Fi, so maybe we can, I dunno, delegate red light to priority medical data. Code Red

### 7.1 Airlines

Airline Wi-Fi Ugh. Nothing says captive audience like having to pay for the "service" of dial-up speed Wi-Fi on the plane. And don't get me started on the pricing. The best I've heard so far is that passengers will "soon" be offered a "high-speed like" connection on some airlines. United is planning on speeds as high as 9.8 Mbps spar plane. Uh, I have twice that capacity in my living room. And at the same price as checking a bag, I expect it. Li-Fi could easily introduce that sort of speed to each seat's reading light. I'll be the guy Wowing next to you. Its better than listening to you tell me about your wildly successful son, ma'am.

### 7.2 Smarter Power Plants

Wi-Fi and many other radiation types are bad for sensitive areas. Like those surrounding power plants. But power plants need fast, inter-connected data systems to monitor things like demand, grid integrity and (in nuclear plants) core temperature. The savings from proper monitoring at a single power plant can add up to hundreds of thousands of dollars. Li-Fi could offer safe, abundant connectivity for all areas of these sensitive locations. Not only would this save money related to currently implemented solutions, but the draw on a power plant's own reserves could be lessened if they haven't yet converted to LED lighting.

### 7.3 Undersea Awesomeness

Underwater ROVs, those favourite toys of treasure seekers and James Cameron, operate from large cables that supply their power and allow them to receive signals from their pilots above. ROVs work great, except when the tether isn't long enough to explore an area, or when it gets stuck on something.

If their wires were cut and replaced with light —say from a submerged, high-powered lamp—then they would be much freer to explore. They could also use their headlamps to communicate with each other, processing data autonomously and referring findings periodically back to the surface, all the while obtaining their next batch of orders. 7.4 It Could Keep You Informed and Save Lives Say there's an earthquake in New York .Or a hurricane. Take your pick—it's a wacky city. The average New Yorker may not know what the protocols are for those kinds of disasters. Until they pass under a street light, that is. Remember, with

Li-Fi, if there's light, you're online. Subway stations and tunnels, common dead zones for most emergency communications, pose no obstruction. Plus, in times less stress sing cities could opt to provide cheap high speed Web access to every street corner.

## 8. VALUES OF LI-FI

- ☐ A free band that does not need license.
- ☐ High instalment cost but very low maintenance cost.
- ☐ Cheaper than Wi-Fi.
- ☐ Theoretical speed up to 1 GB per second: Less time & energy consumption.
- ☐ No more monthly broadband bills.

## 9. RECENT ADVANCEMENT IN LI-FI

Using standard with-light LED , research at the Heimlich hertz institute in berlin , Germany, have reached data rate of over 500 megabytes per second [1]. Using a pair of Casio smart phones, the technology Was demonstrated at the2012 Consumer Electronics Show in Las Vegas to exchange data using light of varying intensity given off from their screens, detectable at a distance of up to ten meters [1]. A consortium called Li-Fi Consortium 'was formed in October 2011 by a group of companies and industry groups to promote high-speed optical wireless systems and overcome the limited amount of radio based wireless spectrum. According to the Li-Fi Consortium, it is possible to achieve more than 10 Gbps of speed, theoretically which would allow a high-definition film to be downloaded in just 30 seconds [1]. Researchers at the University of Strathclyde in Scotland have begun the task of bringing high-speed, ubiquitous, Li-Fi technology to market.

## III. CONCLUSION

There are a plethora of possibilities to be gouged upon in this field of technology. If this technology becomes justifiably marketed then every bulb can be used analogous to a Wi-Fi hotspot to transmit data wirelessly. By virtue of this we can ameliorate to a greener, cleaner, safer and a resplendent future. The concept of Li-Fi is attracting a lot of eye-balls because it offers a genuine and very efficient alternative to radio based wireless. It has a bright chance to replace the traditional Wi-Fib cause as an ever increasing population is using wireless internet, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. This concept promises to solve issues such as the shortage of radiofrequency bandwidth and boot out the disadvantages of WiFi. Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Hence the future applications of the Li-Fi can be predicted and extended to different platforms and various walks of human life.

## ACKNOWLEDGEMENT

We would like to acknowledge the contribution of all the people who have helped in reviewing this paper. We would Like to give sincere thanks to my Guide Mr **Prateek Kumar Singh** for his guidance and support throughout this paper. We would also like to thank our families and friends who supported us in the course of writing this paper.



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