

A Review Paper on Li-Fi Technology

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Abstract— If you are using wireless internet in a coffee shop, stealing it from the guy next door, or competing for bandwidth at a conference, you might get frustrated at the slow speeds you face when more than one device is connected to the network. To solve this issue, a German Physicist- Harald Haas has introduced a new technology known as “data through illumination” which means transmission of data through LED lights which vary in intensities faster than the human eye can follow. According to him, this technology is based on the intensity and potential of the light emitting diode. This paper draws its attention on construction and working of Li- Fi based system and compares its performance with the existing wireless network technologies.

Key words: Li-Fi, Wi- Fi, VLC (Visible light communication), LED (Light emitting diode), RF (Radio frequency)

I. INTRODUCTION

We all are dependent on internet directly or indirectly for the fulfillment of our daily requirements. It is impossible to think of a day in our lives, when we are not “connected” to the “net”. We use the web for an assortment of purposes, among them being sharing of data. In the today’s scenario we are sharing lots of data so the good data sharing capacity is required.

In 2011, Professor Harold Haas from the University of Edinburgh in the UK suggested an idea about the new form of wireless network technology which is named as “Data through illumination” [3]. And to implement this he used fiber optics to send data through LED light bulbs. Although light modulation is not so new concept, but Haas is looking to move things forward and enable connectivity through simple LED bulbs. In Li-Fi technology, we can connect the internet with the help of an LED beam in a finite range. With this technology we would be able to transmit data even using our car headlights. There are various network topologies but new ones are emerging, as the network spectrum is increasing.

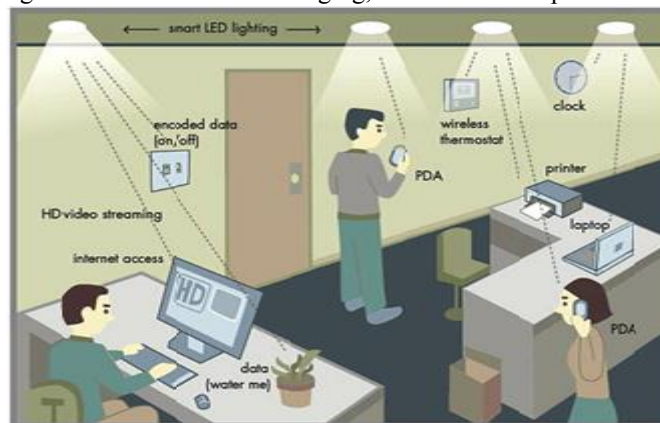


Fig. 1: Li- Fi environment

Li-Fi is a new technology uses visible light for communication rather than radio waves which is used in various conventional communication technologies; it refers to 5G Visible Light Communication systems. In Li-Fi technology, LED act as a medium to high-speed communication in a similar manner as Wi-Fi [5]. It can help to conserve a large amount of electricity by transmitting data through light bulbs and other such lighting equipment’s. Li-Fi uses visible light as a carrier at the place of radio waves as in Wi-Fi. As the visible light cannot be penetrating through the walls so it is (Li-Fi) considered as secure means of data transmission system. We fix LED bulbs at the downlink transmitter [1]. If the LED current is varied at a very high speed then we can vary the yield at high speeds. This is the guideline of the Li-Fi. The working of the Li-Fi is very simple-if the Driven is ON, the sign transmitted is a computerized 1 while if it is OFF, the signal transmitted is a digital 0. By changing the rate at which the LEDs flash, we can encode different data and transmit it.

II. WORKING TECHNOLOGY OF LI-FI

This brilliant idea was showcased by Harald Haas coming from University of Edinburgh, Great Britain, in his TED Worldwide talk on VLC. He or she explained, “Very simple that if the LED is on then a digital ‘1’ is transmitted in case the LED is off then a digital ‘0’ is transmitted. The LEDs can be switched on and off very quickly, which gives great open gateways for sending data”. So, a few LEDs furthermore to a controller that code info into those LEDs are essential. We have to just vary the rate of which the LED’s flicker based on the data to be encoded. Further enhancements may be made in this process, which involves the variety of LEDs for parallel info transmission, or using mixtures of red, green and blue LEDs to correct the light’s frequency with each frequency encodes the data of various channels. Such advancements promise any theoretical speed of 10 Gbps – which means that one can download an entire high-definition film in just 30 seconds. Simply

great! But blazingly fast info rates and depleting bandwidths worldwide usually are not the only reasons that offer this technology a higher hand. Since Li-Fi employs just the light, it is usually used safely in aircrafts and hospitals which are susceptible to interference from radio dunes. This can even operate underwater where Wi-Fi neglects completely, thereby throwing open up endless opportunities for army operations.

Imagine only needing to hover under a street lamp for getting public internet access, or downloading a movie from your lamp on your workplace. A new technology is introduced in the area which could, quite literally along with metaphorically, 'throw light on' how to meet the ever-increasing require for high-speed wireless on the web connectivity. Radio waves are replaced by light waves in a very new method of data transmission which can be being called Li-Fi. The rate of switching of LED is faster than the rate which our eye can detect, causing the light source to seem to be on continuously. A flickering light may be incredibly annoying, but has ended up to have its upside, being precisely what enables us to use light for instant data transmission. Light-emitting diodes (commonly referred to as LEDs and found throughout traffic and street lighting, car brake lights, remote control units along with countless other applications) can be switched on and off greater than the eye can detect, causing the light source to seems to be on continuously, even though it is actually 'flashing'. This imperceptible on-off action empowers a kind of data transmission using binary unique codes. When the LED is started up then a logical '1' is indicated and when the LED is turned off then a logical '0' is indicated. Information can therefore be encoded inside light by varying the rate of which the LEDs flicker on and off to give different guitar series of 1s and 0s. This technique for utilizing quick heartbeats of gentle to transmit information wirelessly is technically termed as Visible Light Communication (VLC), even it's potential to tackle conventional Wi-Fi has inspired the widely used characterization Li-Fi[6].

A. Visible light communication (VLC)- "A potential solution to the global wireless spectrum shortage"

Li-Fi (Light Fidelity) is normally a fast and cheap optical edition of Wi-Fi and its technology will depend on Visible Light Communication (VLC). VLC is usually a data communication medium, which in turn uses visible light concerning 400 THz (780 nm) in addition to 800 THz (375 nm) as optical carrier for information transmission and illumination. It utilizes fastpulses of light for your communication and the transmission of data is performed wirelessly [7]. The fundamental components of this communication system are-

- 1) A top brightness white LED, Which acts as being a communication source and
- 2) A silicon photodiode which indicates great reaction to unmistakable wavelength regionplays the role of receiving element.

LED can be switched on and off to generate digital guitar strings of 1s and 0s.Data is usually encoded in the light to get a new data flow by varying the flickering rate from the LED.

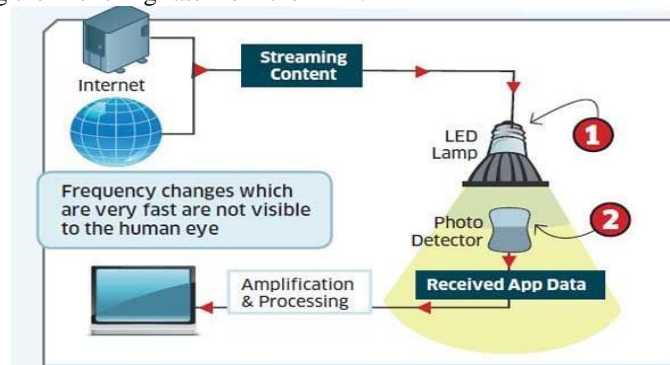


Fig. 2: Data transmission using LED

The LED illumination can be employed as a communication origin by modulating the LED light while using data signal more specifically.As the glimmering rate can be so quick, the LED output appears constant towards human eye. Data rate can even be increased by parallel information transmission using LED arrays wherever each LED transmits some other information stream.There are motivations to incline toward LED as the light source in VLC, though many other light gadgets like fluorescent light, radiant light etc. are available [8].

III. COMPARISION BETWEEN LI-FI & WI-FI

Li-Fi is needed to describe visible light communication technology put on high speed wireless transmission.The name is acquired due to the similarity to Wi-Fi.

	LI- FI	WI- FI
SPEED	1-3.5 Gbps	54-250 Mbps
RANGE	10 meters	20-100 meters
IEEE STANDARD	802.15.7	802.11b
SPECTRUM RANGE	10000 times than WI-FI	Radio spectrum range
NETWORK TOPOLOGY	Point-to-Point	Point-to-Multi Point
DATA TRANSFER MEDIUM	Use light as a carrier	Use radio spectrum
FREQUENCY BAND	100 times of THz	2.4 GHz

Table 1: Comparison between Li-Fi and Wi-Fi

IV. APPLICATIONS OF LI-FI

A. Health Technologies:

Your Wi-Fi emits radio waves which are very harmful for the patients and the radio waves interpreting the actual medical instruments. Thus you can use internet in running rooms by Li-Fi technology. For no longer time period now medical technology would lag behind those other entire wireless world. Till now operating rooms did not facilitate Wi-Fi over radiation concerns, and there was also a complete lack of dedicated selection.

B. Airlines:

In Airlines passengers concur to pay additional quantity of cash for the dial up service within the scarf. Li-Fi might simply introduce "high-speed" transmission service which might be interruption free and differs from alternative wireless signals on the board.

C. Li-Fi uses light rather than radio frequency signals.

D. Under water in sea Wi-Fi does not work at where Li-Fi will work.

E. There are around 19 billion bulbs worldwide, they simply should be supplanted with LED ones that transmit data, we reckon VLC is at a factor of ten, cheaper than Wi-Fi.

F. Security is another benefit, since light does not penetrate through walls.

C. Street Light:

Cars have semiconductor diode primarily based headlights, semiconductor diode primarily based backlights, and automobile will communicate one another and stop accidents within the method that they exchange data. Traffic signal will communicate to the automobile then on.

H. Li-Fi may solve issues such as the shortage of radio frequency bandwidth.

V. ADVANTAGES OF LI-FI

A. Capacity:

As we know that light is a voluntarily accessible form of energy so most of the portion of EM spectrum can be covered by it. Spectrum of visible light is 10000 times more than the spectrum of radio wave.

B. Efficiency:

Li-Fi data bits can be transmitted parallelly which brings about the expanding efficiency.

C. Availability:

Light is available in every part of the world which makes each individual to work on the internet in airplanes.

D. Data rate:

It is possible to get more than 10Gbps, theoretically permit a top quality motion picture to be downloaded in 30sec. This leads to the fast and easy communication.

E. Cost:

Due to the use of LEDs in Li-Fi its cost is well-organized.

F. Bandwidth:

The principle point of interest of Li-Fi is that its data transfer capacity is 10,000 more than the Wi-Fi.

VI. RECENT ADVANCEMENT

A. Li-Fi for smart cities:

The simplicity on the li-fi technology using LED lamps to transmit data, including high speed data connections that could be served from street lights could boost emergence of smart locations.

B. In the future, topology matters the most:

Researchers published worldwide indicate that a future network is going to be faster but capacity complications could still remain. It further reveals of which topology – the cosmetics of transmitters providing the network signal is going to be increasingly important for conference demand in densely-populated places.

C. Reliable communication and improved networking in a Li-Fi network:

Li-Fi is a high-speed, bi-directional and fully networked broadband wireless technology that's aimed at offloading the present Wi-Fi technology. A Li-Fi access level can serve multiple users simultaneously inside the area of it's insurance coverage, and this is called as optical at to cell.

D. Light brings users super-fast wireless internet:

Lighting in shop windows, cars and classrooms can often access the wireless web. Li-Fi could prove to get seven times faster than Wi-Fi as well as enable to download a complete HD movie in several seconds.

VII. CONCLUSION

The probabilities are numerous and therefore for the exploration can be done. If his technology might be put into practical utilize, every bulb can supply something like a Wi-Fi hotspot to help transmit wireless data and we will precede toward the solution, greener, safer and better future. The concept of Li-Fi is currently attracting lots of interest, not least because it may offer a genuine and also efficient alternative to radio-based Wi-Fi. As a growing number of individuals and their many device access wireless internet, the airwaves have grown to be increasingly clogged, making it increasingly more difficult to get an honest, high-speed signal. This may solve issues like the shortage of radio-frequency bandwidth furthermore permit web where conventional radio based remote isn't allowed for example aircraft or hospitals. Among the shortcomings however is whose only work in direct distinct sight?

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