

## A survey on methodologies for LI-FI (Light Fidelity) technology

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### ABSTRACT

People often get frustrated when the internet speed becomes dead slow. When more than one person make access on an internet, the traffic becomes high and the speed gradually decreases, to overcome such difficulty a German physicist Herald Hass has come up with a solution called Data through illumination. 10 megabits per sec data rates will be produced by D-LIGHT which is comparatively faster than the average broadband connection. Hence a future can be envisioned having light as transmitting medium to our laptops, smart phones and tablets. And security would be a snap- if you away from the light source you can't access the data.

**Keywords:** Li- Fi, ICT, VLC, transmitter, photo detector, data utilization, lamp driver

### INTRODUCTION

A German physicist Herald Hass has invented the transfer of data through light which is known as Light Fidelity. The invention will be a supplant for Wi-Fi, the data are transmitted at the rate of 500Mbps. This technology uses all kind of light spectrum like white light, infrared, ultraviolet. The HD film can be downloaded within 30 sec. The data are transmitted when the light is in ON state i.e logic 1 is sent and the transmission of data is stopped when the light is in OFF state i.e logic 0. The LED light appears to glow continuously but flickering takes place within the bulb more than 100 times which can't be followed by the naked eyes. As the intensity of the light changes the output appears to be constant throughout the transmission. The researchers from the university of Edingburb and university of oxford worked upon the array of LED's by parallel transmission, here each LED's in the array of LED's have different data stream. Research is undergone with colored LEDs like red, blue, green to alter the light frequency encrypting different data channel. In 2011, companies gathered to promote the Li-Fi technology in order to overcome the limited availability of radio based wireless spectrum and believes that it is possible to achieve greater than 10Gbps

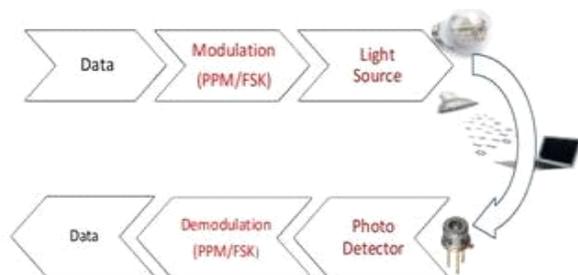


Figure.1. Block diagram of Li-Fi

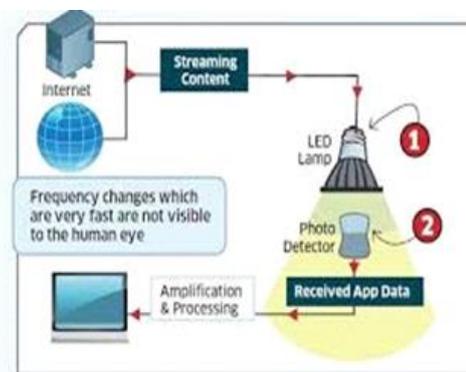


Figure.2. Working principle of Li-Fi

### MATERIALS AND METHODS

**Working principle:** The data are encrypted in the LEDs with the help of a controller and some LEDs. The logical 1 is transmitted when the LED is ON and logical 0 is transmitted when the LED is OFF. The LED flickers enormously so that the data are being transmitted at high speed over 10Gbps on theoretical basis. An array of LEDs is used for parallel data transmission and different colored LEDs to alter the LED frequency so that data are encrypted for different frequency. To encode the information in LED's, the flickering rate of the LED's is varied so that we can obtain different set of 0's and 1's

**A. Visible Light Communication:** This method of transmitting information through the pulses of light wirelessly is called Visible Light Communication (VLC). VLC is one of the high potential wireless spectrum storage. Li-fi is fast, cheap and highly secured wireless data transmission technology which is based on visible light communication and Li-fi is an optical version of Wi-Fi. VLC uses visible light between the range 400THz-800THz as an optical carrier for illumination and data transmission. The high intensity LED is used as a source, a silicon photodiode is used as a receiver which has good response for visible light. New stream of data can be encrypted by changing the flickering rate of the LED. As the flickering rate is to high the output appears to be constant. The data can be

transmitted more than 100Mbps through the fast illuminating LEDs with appropriate multiplexing technology. For more data transmission the parallel arrangement of LEDs are developed.

## RESULTS AND DISCUSSIONS

**Li-Fi vs Wi-Fi:** The Li-Fi is more advantageous than Wi-Fi technology, in case of Wi-Fi the user depends upon the source like routers but in case of Li-Fi it is not so. The Li-Fi technology uses light as a source for data transfer and the user can make use of any kind of light source for data transfer. Wi-Fi uses radio signals which can't be used underwater data transmission since the radio signals won't be able to pass through water but we know that the light can go through the water and Li-Fi is more helpful in underwater data transmission. The security concern in case of Wi-Fi is much compared to Li-Fi the radio waves can easily penetrate through the walls and the data can be easily hacked but the light can't penetrate through the walls therefore the data are more secured. The radio waves are more harmful which are not allowed in hospitals and in airlines but light is very much eco-friendly which can be used in hospitals and also in airlines. The data rate is greater than 1Gbps in case of Li-Fi but the data rate using Wi-Fi is 10Mbps, which finds the user more efficient to surf on the internet.

**Table.1.Comparison of Li-Fi& Wi-Fi**

PARAMETERS	Li-Fi	Wi-Fi
Operating band	Visible Light band	Radiofrequency band
Range	Short range (based on LED light intensity)	About 100m
Frequency	$4-8 \times 10^{14}$ Hz (Visible light)	2.4-5 GHz
Data transfer rate	>1Gbps	Downlink speed: 10.9 Mbps Uplink Speed: 2.8 Mbps
Power consumption	Medium	Medium
Standard	IEEE 802.15	IEEE 802.11b
Cost	Low	High
Security	Highly secured	Less secure

### Advantages:

- The Li-Fi has data connectivity over 500Mbps.
- As light is used for data transfer the data interpretation is much less.
- While travelling in planes the VLC can be used without affecting the airline signals.
- Like Bluetooth, wi-fi, infrared and internet the VLC can also be used all locations.
- The medical devices used in the hospitals are integrated using Li-Fi and the treatment becomes easier.
- The underwater analysis can be carried out using light communication.
- Since the Li-Fi is confined within a small range and doesn't penetrate through walls, the data are more secured.
- The street light becomes a public hotspot and the user can surf on internet at any place in presence of the light source.
- The HD film can be downloaded within 30 sec.

**Applications:** The steep increase in the use of LEDs for lighting gives us the opportunity to incorporate Li-Fi technology in to a large number of LED Environment, the Li-Fi technology will be more useful for "more content consumption" applications such as you tubes, Skype, & for audio, video downloads etc.

**A. Health technologies:** For no longer time now medical technology would lag behind the rest of the wireless world. Till now operating rooms did not allowed Wi-Fi over radiation concerns, and there was also a whole lack of dedicated spectrum. The Wi-Fi emits radio waves which are very harmful for the patients and the radio waves interpret the medical instruments. Thus we can use internet in operating rooms by Li-Fi technology. The light spectrum is 1000 times more than the electromagnetic spectrum and it doesn't interfered with MRI scanners also.

**B. Airlines:** In Airlines passengers want to pay some amount of money for the dial up service in the plane. And also they are very expensive. Soon Passengers in the plane will be offered a "high-speed like" connection on some airlines. Li-Fi could easily introduce that sort of speed to each passengers reading light. It would be interruption free to and from other wireless signals on the board.

**C. Power Plants:** Wi-Fi and many other radiation or radio waves are bad for sensitive areas like those of power plants especially the atomic power plants. Nuclear power plants need high speed data transfer systems to monitor the plant demand, grid integrity and core temperature. Proper monitoring can save huge benefits in terms of energy and economy obviously. Li-Fi will provide safe, high speed connectivity for all places of these sensitive areas where it gets easily affected by electromagnetic waves. This would be cost effective as well as would improve upon the current implementations solutions.

**D. Underwater:** Working Underwater Rovers, also called toys of treasure seekers. ROVs work efficiently until unless they got stuck somewhere or if the search area is huge. If made wireless and replaced with light — say from a submerged, high-powered lamp— then they would be free to explore more. They could also communicate with each other via headlamps, process intermediate data autonomously and periodically sends data back to the ground and waits for their next set of instructions from the source.

**E. Information Delegation:** Suppose your town is hit by earthquake and an average resident is not aware of such disastrous situations and precautions to be taken. Until he passes under a street light, he won't be aware of the emergency broadcasts. Remember, with Li-Fi, you're online only till its light. Li-Fi can be used in places like Subway stations and tunnels and places where communication is too difficult like under water pose no obstruction and Li-Fi will provide a high speed web access with low cost in every nook and corner of the city

**F. Other areas:** Li-Fi has its main advantages in places where it is difficult to use the optical fibre cable. Lamps present in the streets can be used as Li-Fi lamps to transfer data. In flights data transmission is possible by using Li-Fi which doesn't interpret any the airline signals. Li-Fi can be used in petroleum, chemical industry as well as in nuclear plants where electromagnetic waves will be hazardous.

## CONCLUSION

The applications of Li-Fi can be explored further, if we started to use LIFI practically then ,each and every LED bulbs that are available in streets, roads , public places like mall , etc. , can be used as hotspot to transmit data The concept of Li-Fi is most welcomed by many people, just because of its data transfer speed. We can observe the speed of Li-Fi in dense population areas like metropolitan cities since many people will access the internet. Radio waves can be eradicated by the Li-Fi so that they can be freely used in hospitals, aircraft, and underground water. If we use Li-Fi We don't want to worry about the bandwidth, channel width of Wi-Fi router. The major drawback of Li-Fi is it can be used only with in the small area as it can't penetrate through walls it can also be considered as an advantage in terms of security purposes, but on the whole it sounds good in the developing field of wireless communication technology.

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