Li-Fi Technology : Data Transmission Through Visible Light

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Abstract- *The new member of wireless data transmission family is Li-Fi which uses the concept of flickering light than human's eye ability for data transmission.*

As we know speed of light is much more than existing wireless data transmission technique Li-Fi stands for Light-Fidelity. The technology is very new and was proposed by the German physicist Harald Haasin 2011.Li-Fi provides better bandwidth, efficiency, availability and security. In our day-to-day routine , one of the most important activities is transfer of data from one place to another. But, the current wireless networks are very slow when multiple devices are connected to the internet. Wi-Fi based on radio waves. When the number of devices connected to the internet increases, the fixed bandwidth makes it more difficult to transfer data easily, as the radio waves are small part of spectrum for data transmission.

As radio waves can penetrate through the walls, one can misuse it and this can cause security concern for Wi-Fi. Li-Fi provides transmission of data through illumination by sending data through an LED light bulb. This paper focuses to analyze the performance of Li-Fi as compared to existing technologies.

Keywords- Li-Fi, Wi-Fi, VLC (Visible light communication), LED (Light emitting diode), RF (Radio frequency, pure Li-Fi

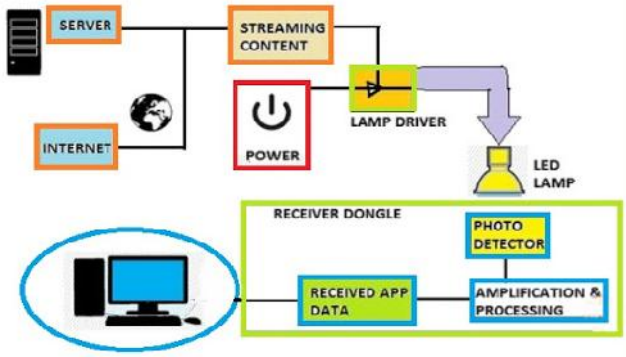
I. INTRODUCTION

Li-Fi means Light Fidelity. This technology was proposed by Prof. Harald Hass, a German scientist, along with his team including Dr. Gorden Povey, Dr. Mostafa Afgani at the University of Edinburgh. Li-Fi provides transmission of data through illumination by sending data through an LED light bulb. It is a VLC (Visible Light Communication) technology deals with the transfer of data through illumination by taking fiber out of fiber by sending data through LED light bulb. LED is a p-n junction diode which emits light when activated and helps in LiFi technique. The flow of Li-Fi is bidirectional. It provides high speed and is cheap wireless communication via light. Li-Fi uses light instead of radio waves in Wi-Fi for the transfer of data.

Li-Fi is an OWC (Optical Wireless Communication) system which uses light from LED (light Emitting Diode), acts as a medium to deliver networked, and mobile, high-speed communication similar to Wi-Fi. Both Wi-Fi and Li-Fi transmit the data over the electromagnetic spectrum only difference is that Wi-Fi utilizes radio waves whereas Li-Fi utilizes visible light. As the velocity of light is much large, hence due to this the rate of data transmission is more as compared to Wi-Fi which uses radio waves for data transmission.

WORKING OF LI-FI

The Li-Fi technology is based on the VLC system which uses light for the data transmission. As the velocity as well as the intensity of the light is very high, hence the data transmit with high speed. The working of this technology is very simple. The LED which acts as light emitter is fitted on one end and the photo detector (photo sensor) on another end. When the LED is ON, the photo detector recognizes the binary 1 and if the LED is OFF, the photo detector recognizes the binary 0. To build up a message, flash the LED numerous times or use an array of LED of perhaps a few different colors to obtain data rules in the range of hundreds of megabits per seconds . The data is received and encoded in the light by varying the flickering rate at which the LED's flicker ON and OFF to generate different strings of 1s or 0s. The light source appears constant because the LED's can be switched ON and OFF quickly and the intensity is modulated so rapidly that human eye cannot detect, 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 LED is a logical '1', switching it OFF is a logical '0'. This method of using rapid pulses of light to transmit information wirelessly is technically referred to as visible light communication (VLC).



II. 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 thescarft. 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.

G.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.

III. COMPARISION BETWEEN LI-FI & WI-FI

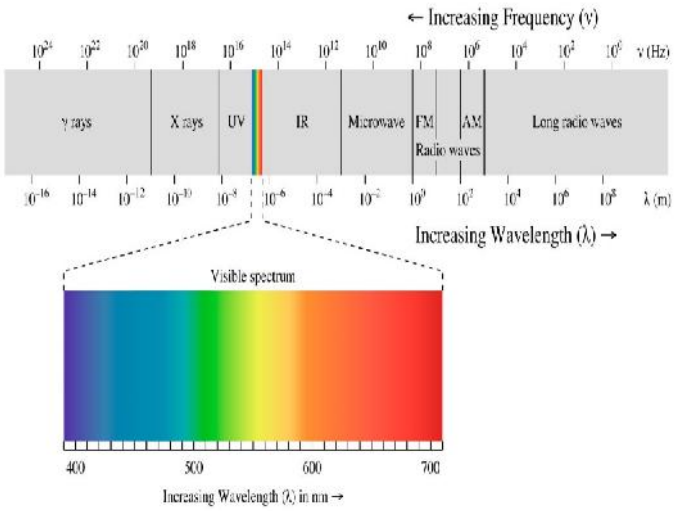
Li-Fi is needed to describe visible light communication technology put on high speed wireless transmission.

The name is acquired due to the similarity to Wi-Fi.

Parameter	***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	Used light as a carrier	Use radio spectrum
Frequency Band	100 times of Tera HZ	2.4 GHz

Visible Light Communication

Visible Light Communication, also known as VLC, can be defined as the transmission of data through the use of light sources emitting at visible wavelengths between 400 and 800 THz (780–375 nm). It is a subset of optical wireless communications technologies.



The VLC market is in its infant stage. There is a growing demand for an alternative wireless communication technology due to the crowding of the Radio Frequency (RF) bandwidth. This will result in the adoption of VLC technology on a global scale. As the VLC technology is based on LEDs, it does not face distortions or spectrum deficits and can transfer data at tremendous speeds.

Cost of Li Fi

Getting Li-Fi products from different Li-Fi companies can be very expensive for consumers. According to pureLi-Fi, they are currently working towards miniaturisation of Li-Fi technology as well as making affordable for consumers in the long run. Ultimately the end goal is to have Li-Fi in every mobile device. This means that the technology will be affordable for integration into handsets, tablets and laptops.

Ultimately the end consumer will see minimal or no cost associated with Li-Fi as the goal is to have Li-Fi embedded in every wireless mobile device. Today companies can speak to pureLi-Fiabout working with us on proof of concept projects and other types of installations. These installations arepriced baseindividual requirements. PureLi-Fi only offers B2B services.

PureLi-Fi has just recently started to offer a Li-Fi starter kit for small businesses and institutions at the cost of £2500 excluding delivery and duties. The Li-Fi starter kit includes the followings:

LI FI STATIONS

USB (2.0) dongle that fits into device to send and receive data, to and from Access Point.

LI FI ACCESS POINTS AND TX DRIVERS

This help connecting to the Li-Fi-enabled lights to send and receive data.

LUCICUP II LUMINAIRES

ADVANTAGES OF LI-FI

a) The Li-Fi technology is based on all kinds of light. The light belongs to the invisible, ultraviolet or visible part of spectrum, hence no matters the part of the spectrum they belong. This gives the high speed for the communication purpose, downloading movies, games, music and all applications more than sufficient.

b) The light is present everywhere. There are many light bulbs worldwide, only they need to be replaced by LED's for proper transmission of data.
c) Light has 10000 times wider bandwidth than radio waves. Hence, Li-Fi proves better capacity compared to Wi-Fi.
d) The light waves cannot penetrate through walls which makes more security from hacking.
e) Li-Fi is very cheap for transmission purpose. LED light consume less energy and are highly efficient.
f) Li-Fi can be used in such area where radio waves are problematic. Li-Fi is useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power plant without causing electromagnetic interference.
g) The Wi-Fi does not work under water in sea and hence, light can be used undersea explorations are good to go. h) Using this technology, every street light would be free data hotspot.

Challenges for Li-Fi

Apart from many advantages over Wi -Fi, Li-Fi technology is experiencing some challenges. One of these shortcomings is that it works in direct line of sight. Another challenge is how the receiving device will transmit to the transmitting device. One cannot shift the receiving device in case of indoor arrangement of the apparatus as light cannot penetrate through walls and is easily blocked by somebody simply walking in front of LED source.

IV. CONCLUSION

The concept of Li-Fi is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing number of people and their many devices access wireless internet, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, highspeed signal. The unique physical properties of light promise to deliver very densely-packed high-speed network connections resulting in orders of magnitude improved user data rates. Based on these very promising results, it seems that Li-Fi is rapidly emerging as a powerful wireless networking solution to the looming RF spectrum crisis, and an enabling technology for the future Internet-of-Everything. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn't allowed such as aircraft or hospitals.

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