

LIFI Communication Technology (VLC): An Innovative Technique Leading the Adaptation for Self Dependent Nation

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ABSTRACT

LIFI is the latest and emerging techniques for developing the communication system based on the VLC (visible light communication) which is totally harmless, clean and green communication system. With the advancement and adaptation of the techniques, a developing country like India may be benefitted in multifold with this. On one way it is totally harmless for living beings as based on light, on the other hand it will save light (Power) in multifold. As power saving is the national asset and lead to the development and self dependent of Nation.

Keywords

Li-Fi, VLC, LED, Photo Detector, Wi-Fi, Hard Wired

1. INTRODUCTION

Li-Fi (Light Fidelity): Li-Fi works on the principle of VLC (Visible Light Communication). The communication use in VLC utilizes 400 THz to 800 THz (780 nm to 375 nm) as optical carrier to broadcast the data. LED is the finest light source because of its structure LED light is modulated with data signal to achieve the target. LEDs have very high operating speed and it is feasible to switch ON and OFF invisibly so as to transmit data at much higher rate.

The transmitter has LED and a systemler, which encrypts data into LEDs flicker, varies as per the data to transmit. The more the LEDs more will be the data rate. Fiber optic cables are the medium to let the data from source to destination according to Harald Hass, which he calls – “data through illumination” – taking the fiber out of fiber optic by sending data through a LED bulb that varies in intensity faster than the human eye can follow.

Image sensors act as receivers, which detect the precise direction of incoming data and detect the minute variations in light and translate into electrical terms. Moreover, to achieve very high data rate, architecture of LEDs plays a vital role. The regular size of LED can be trimmed down

to micro, proficient in handling in millions of alterations in high intensity. The size of LEDs is reduced up to nano (n) and pico (p). The data rate 3.5 Gbps has being achieved and it is possible to achieve 10 Gbps data in near future. Micro LED is capable to transmit data 1000 times faster than normal LED.

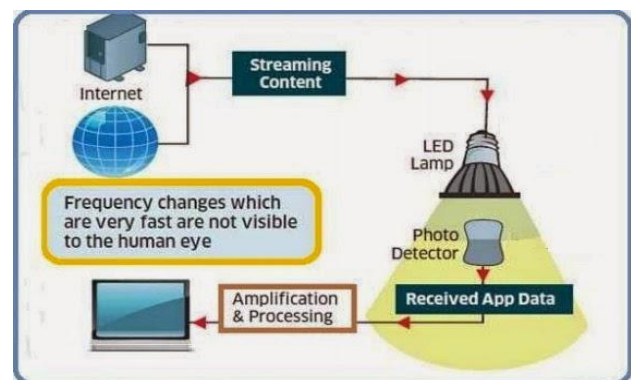


Figure 1: Working of Li Fi

Data rate varies according to various parameters. Data rate is directly proportional to number of LEDs and ON-OFF switching and inversely proportional to Size of LEDs.



Figure 2: LED with round tip

Data rate also depends on the dimension of LED bulb whether it is Placement and Positioning (PP) dimension or Internal Structure Design (ISD) dimension. The PP dimension can again be movable type or fixed position type. The areas covered by these dimensions are different and as a result have various applications in various fields.

ISD dimension has various parameters like diameter and position of LED bulb. LED bulbs with round tip have applications where target required is fixed and chip LEDs have applications where wide area is required to be covered.

Wireless communication becomes the backbone of life existence today. Wireless Technology has made the great revolution in the world. Now a day, Wireless technology has become the backbone of communication and information technology. Today, Research and Development has unturned astonishing mysteries of the entire universe. Tremendous researches in all spheres of science have undoubtedly made man his own boss. The surprising Wireless technology that has transformed our lives in many ways is one of such inventions. Until very recently, we needed a computer wired to a port, to get online. Surprisingly, wired telephones are becoming a thing of past. Our mobile phones have bagged places in our lives for a wide variety of services ranging from banking, to all service sectors like even to check ticket availability at a Cinema Hall, and many more. Wireless networking refers to any kind of networking that does not involve cables as a result, a lot of saving of manpower, material and revenue.

Several other methods have been proposed to overcome TCP-over-wireless faults including split-TCP connection, triple-acknowledgements and acknowledgment caching. Each of these methods improves the efficiency of TCP by improving a single fault aspect, while our proposal combines compatible improvements into an efficient and reliable protocol. In earlier days, mobiles were used for voice calls mainly. But now mobile phones have become smart and millions of people are using Internet through their smart phones. In different countries, the quality and

speed of mobile Internet differs depending on the progress of telecom industry.

2. DEVELOPMENT OF TECHNOLOGY

The purpose of this study to propose a new transport layer protocol for 4G Wireless Systems, compatible with the existing TCP/ IP implementations that combine the best of the currently proposed algorithms and our own new congestion system algorithm. We designed an optimized congestion system algorithm for the wireless link that provides connection oriented, reliable data service with graceful handovers and ability to recover from frequent disconnections, the protocol deals with high bit error rate by implementing split connections with local fast retransmissions. It uses Zero Window Advertisement to accomplish smooth handover under inter-wireless cell mobility.

3. WORKING OF LI-FI (VLC)

A new generation of high brightness light-emitting diodes forms the core part of light fidelity technology. The logic is very simple. If the LED is on, a digital 1 is transmitted. If the LED is off, a digital 0 is transmitted. These high brightness LEDs can be switched on and off very quickly which gives us a very nice opportunity for transmitting data through light [3].

The working of Li-Fi is very simple. There is a light emitter on one end, for example, an LED, and a photo detector (light sensor) on the other. The photo detector registers a binary one when the LED is on; and a binary zero if the LED is off. To build up a message, flash the LED numerous times or use an array of LEDs of perhaps a few different colors, to obtain data rates in the range of hundreds of megabits per second.

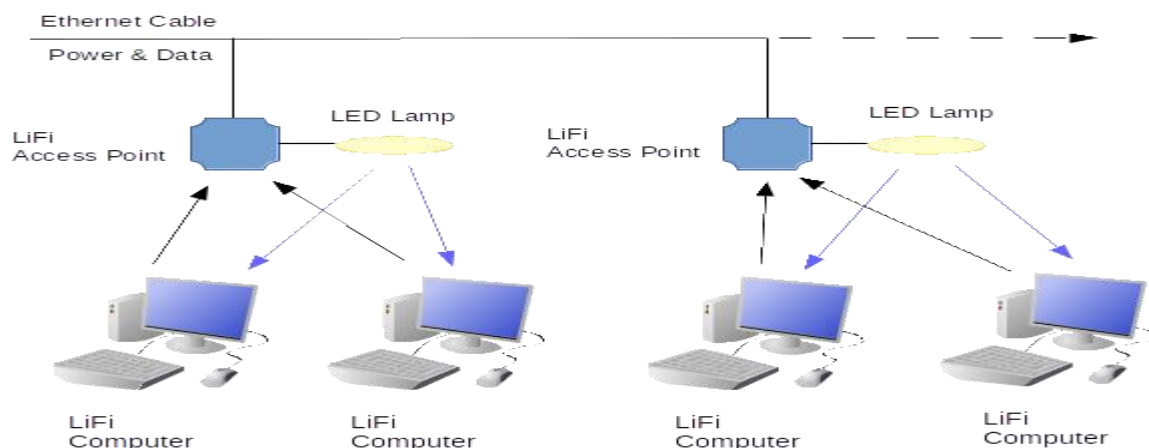


Figure 3: Block diagram of Li-Fi system

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.

4. COMPARATIVE STUDY BETWEEN LI-FI AND WI-FI AND HARD WIRED COMMUNICATION

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. Table I shows a comparison of various technologies that are used for connecting to the end user. Wi-Fi currently offers high data rates. The IEEE 802.11.n in most implementations provides up to 150Mbit/s although practically, very less speed is received.

Table 3: Comparison of technologies used for connecting to the end user

Technology	Connection	Security	Reach	Impact	Cost	Bandwidth Expansion
Wi-Fi	Wireless- EMF	Good	Excellent	unknown	Good	Limited
Hardwired	Cables	Excellent	Fair	None	Good	Limited
Li-Fi	Wireless- Light	Excellent	Excellent	None	Low	Exceptional

5. VARIOUS FAITHFUL AND DEDICATED APPLICATIONS OF LI-FI

Though the Li-Fi technology is in emerging and development phase. It has shows the innovative and wonderful application and its supremacy on the Wi-Fi technology . It has made the revolution in almost all the fields in the life of human being and living being also. The some of them has been listed as.

5.1 Security

In contrast to radio frequency waves used by Wi-Fi, lights cannot penetrate through walls and doors. In a meeting or living room condition, with some prevention on transparent materials, like curtains on window, the access of a Li-Fi channel is constrained in that room.

5.2 Underwater Application

Most remotely underwater operated vehicles (ROVs) use cables to transmit command, but the length of cables then limits the area ROVs can detect. However, as light wave

could travel through water, Li-Fi could be implemented on vehicles to receive and send back signals.

5.3 Hospital

Many treatments now involve multiple individuals, Li-Fi system could be a better system to transmit communication about the information of patients. Besides providing a higher speed, light waves also have little effect on medical instruments and human bodies.

5.4 Vehicles

Vehicles could commute with one another via front and back lights to increase road safety. Also, street lamps and traffic signals could also provide information about current road situations.

5.5 Importance of White LED'S (VLC)

The breathtaking development of white light LEDs in recent years has led to significant market potential for a range of brand new applications. The high efficiency of these LEDs now means that solutions for room lighting,

automotive headlights and backlighting for LCD displays can be realized. The advantages of their reduced energy requirements are apparent – for example, the running time of battery operated devices such as mobile phones and notebook computers can be extended considerably. For general room lighting, the ability to vary the color temperature of a LED lamp allows new lighting designs.

In automotive applications, the reduced energy requirement helps to reduce petrol consumption and CO₂ emissions. Moreover, their long lifetime minimizes service requirements for headlights, the LEDs will in all probability outlive the lifetime of the car itself. And lastly, the technical characteristics of LEDs also bring significant advantages for adaptable headlight technology when compared to conventional forms of lighting.

All of these aspects additionally mean that these developments in automotive safety may also find application in a wider market. Attaining and maintaining the necessary regulatory lighting standards still represents challenges for LED manufacturers, and much research is currently being made into methods to reduce and control the varying quality inherent in the production process. Indeed, the proper characterization of the light emission parameters forms an important aspect of the quality control process. However, this characterization, in particular for white light LEDs, is as a consequence of their optical properties somewhat complicated [11].

6. CONCLUSION

Li-Fi is still in its developing stages and thus offers remarkable scope for future research and revolution. It has massive potential. A large number of research projects have focused on this new technology to support the higher data transmission. This study presents a summarized overview of the recent research works being conducted in this technology. Li-Fi provides promising features to improve the data communication. As the amount of available bandwidth is limited, the airwaves are becoming gradually blocked, difficult to used wire-less technology with accurate.

The LI-FI technology can give solution to this problem. Also it will shape the better future for next generation and can offer candid and very effective alterations to radio waves communications. This technology will be going to change the scenario of wireless communication in many harmless ways near in future.

This is the most recent technology in present day communication framework which makes the utilization of LEDs, Light Emitting Diodes that aides in the transmission of information a great deal more speedier and adaptable than the information that can be transmitted through Wi-Fi. It is essentially a 5G technology of noticeable light communication framework which uses light discharging diodes as a medium of rapid communication in comparable way as Wi-Fi.

"Immaculate LiFi looks to determine the worldwide battle for decreasing wireless limit by creating and conveying technology for secure, solid, rapid communication arranges that consistently incorporate information and lighting utility foundations and essentially diminish vitality utilization." This study examines and exhibits a novel Light Fidelity framework which utilizes obvious light for the transmission procedure .Simple minimal effort segments like LED, photograph finder are utilized as a part of the plan of the framework. Distinctive adjustment plans are utilized for long transmission of

information. This ease framework uses exceptionally basic development which can be utilized anyplace.

7. LIMITATIONS AND FUTURE SCOPE

There are many areas where we can't use microwave enabled wireless communication techniques. In all such areas lights, can be present as it is not dangerous to mankind. These places involve defense areas where it is highly dangerous to use microwaves or in hospitals where such waves will harm the patient. Vehicle to vehicle communication can be performed which can be used to reduce traffic congestion and vehicle collision. There are a lot of studies going on in such area and with not much time, such technologies will come into existence to help the mankind.

There is ship to ship communication possible now using light. But more sophisticated components have to be found out to reduce the cost of the devices used for the purpose. It will be of big help if the normal light can be converted to internet access points. So this is near future and some are already present in the context. So it will be always good to hope for the new things to come in the field of visible communication and light fidelity as these techniques are inviting every one's attention.As the data transfer using LASER light is possible without any kind of modulation, this idea can be used in the development of Li-Fi technology by proper design changes in circuits.

This method of data transmission can be applied where optic fiber and radiation prohibited areas such as chemical plants. This method can be used for wireless communication such as communication between space shuttles etc. This analytic study can be used for the future development of visible light communication systems. This can be applied at the chemical plants where the RF waves and OFC cannot be used

The data transfer is only possible if the transmitter and the receiver is in line of sight. The interference such as striking of objects between the transmitter and receiver will causes the data loss.

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Ravleen Singh, is pursuing the M.Phil degree from the OPJS university, Churu. He is working as Assistant Professor in J&K State. His research interest is Wireless Communication System Services and has attended some conferences on this technology.

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His Research work has been adjudged as outstanding work. He has submitted his 2 patents and are in process. He has also has been awarded as “Star of Asia Award” an international award, by Global achievers foundation. He has been awarded the Best Technical Director (Research) in Haryana in 2014, and Best Technical Director (Research) in Delhi 2015. He is also an expert and Master Trainer for the Teachers, empanelled by SCERT/NCERT. He is also the guide of research scholar for almost dozen of Universities. Besides these, he is the foundation member of LI-Fi consortium in India.