**International Journal of Scientific Research and Management Studies (IJSRMS)**
**ISSN: 2349-3771** **Volume 2 Issue 12, pg: 493-499**

# OPTICAL WIRELESS TECHNOLOGY: LIGHT FIDELITY (LI-FI)

Saurav Rathore[1], Pradeepkumar Gupta[2], Vibhu Bindal[1],
Puneet Agarwal[1], Veerendra Singh[1]
[1]UG. Scholars, [2]Assistant Professor,
Electronics & Communication Department, MIT Moradabad, U.P., India

## *ABSTRACT*

*Now days 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-Fi. As per germen physicist Harald 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 D-LIGHT, can produce data rates faster than 10 megabits per second, which is faster than your average broadband connection. [1], [3]*

***KEYWORDS-*** Wireless-*Fidelity (Wi-Fi), Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Line of Side (LOS), Visible Light Communication (VLC).*

## I. INTRODUCTION

Li-Fi comprises a wide range of frequencies and wavelengths, from the infrared through visible and down to the ultraviolet spectrum. It includes sub-gigabit and gigabit-class communication speeds for short, medium and long ranges, and unidirectional and bidirectional data transfer using line-of-sight or diffuse links, reflections and much more. It is not limited to LED or laser technologies or to a particular receiving technique. Li-Fi is a framework for all of these providing new capabilities to current and future services, applications and end users. This brilliant idea was first showcased by Harald Haas from University of Edinburgh, UK, in his TED Global talk on VLC. He explained very simple, if the LED is on, you transmit digital 1; if it's off you transmit a 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data.

**Fig.1.**Overview of Li-Fi

## II. 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 2 streaming content must have proper integration with server & internet network, so that it is easily possible to work efficiently. [3]

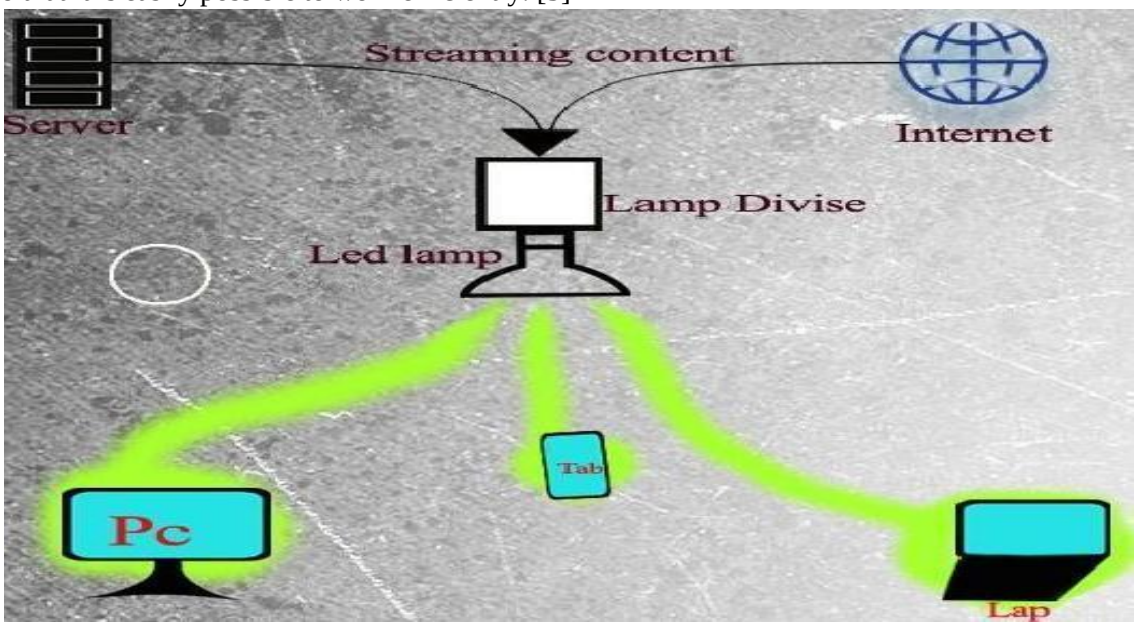


**Fig.2.**Architcture of LI-FI

## III. IMPLEMENTATION: LI-FI

Li-Fi is typically implemented using white LED light bulbs at the downlink transmitter. These devices are normally used for illumination only by applying a constant current. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. This very property of optical current is used in Li-Fi setup. The operational procedure is very simple-, if the LED is on, you transmit a digital 1, if it's off you transmit a 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data. Hence all that is required is some LEDs and a controller that code data into those LEDs. All one has to do is to vary the rate at which the LED's flicker depending upon the data we want to encode. Further enhancements can be made in this method, like using an array of LEDs for parallel data transmission, or using mixtures of red, green and blue LEDs to alter the light's frequency with each frequency encoding a different data channel. Such advancements promise a theoretical speed of 10Gbps – meaning one can download a full high-definition film in just 30 seconds. [2], [3], [4].

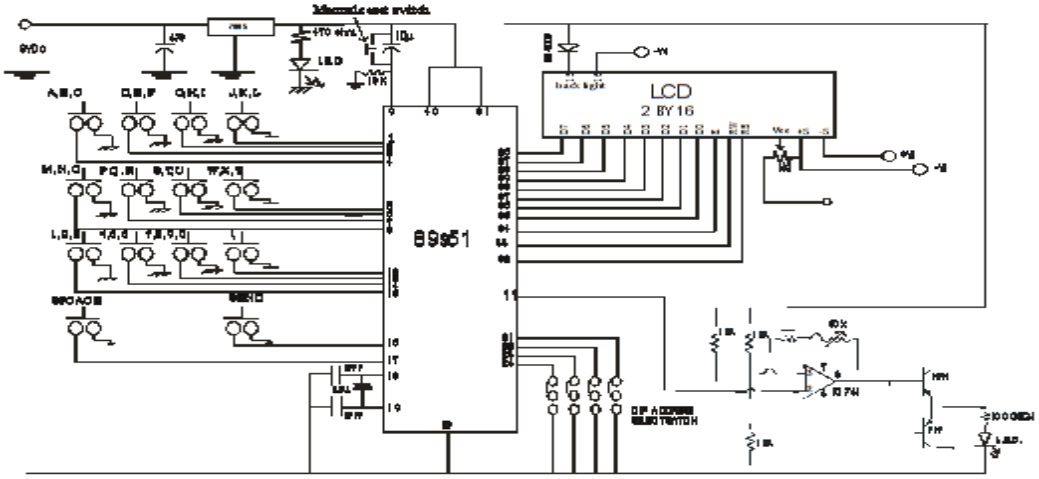


**Fig.3**.Implementation of Li-Fi

## IV. VALUES OF LI-FI

- A free band that does not need license.
- High installment 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.
- Lower electricity costs.
- Longevity of LED bulb: saves money.
- Light doesn't penetrate through walls: secured access. [1]

## V. LIMITATIONS OF LI-FI

- The main problem is that light can't pass through objects, so if the receiver is inadvertently blocked in any way, then the signal will immediately cut out. If the light signal is blocked, or when you need to use your device to send information — you can seamlessly switch back over to radio waves.
- Reliability and network coverage are the major issues to be considered by the companies while providing VLC services. Interference from external light sources like sun light, normal bulbs; and opaque materials in the path of transmission will cause interruption in the communication.
- High installation cost of the VLC systems can be complemented by large-scale implementation of VLC though Adopting VLC technology will reduce further operating costs like electricity charges, maintenance charges etc.
- This research report categorizes the global VLC technology market; based on component, applications, and geography. Li-Fi uses light-emitting diodes (LEDs) which are rapidly gaining in popularity for standard light bulbs and other domestic and commercial purposes. They are expected to be ubiquitous in 20 years. VLC is not in competition with Wi-Fi, Prof. Haas says, it is a complimentary technology that should eventually help free up much needed space within the radio wave spectrum.
- We still need Wi-Fi we still need radio frequency cellular systems. You can't have a light bulb that provides data to a high-speed moving object or to provide data in a remote area where there are trees and walls and obstacles behind.
- **Best hotspots are :**

✓ The remote control devices under the ocean: radio wave doesn't work there.

- ✓ Petrochemical plants: radio wave data transmission is not secured there.
- ✓ Hospitals: for medical purpose.
- ✓ Street lights, traffic signals: for traffic update.
- ✓ Aircraft cabins: for emergency conversations. [1]

## VI. COMPARISON BETWEEN WI-FI &LI-FI

The main difference between Wi-Fi and Li-Fi is, Wi-Fi uses radio waves in order to transmit data at a slower data rate whereas Li-Fi uses visible light in order to transmit data at a much faster rate. Li-Fi is a groundbreaking technology which has been introduced recently in wireless communication. Through this technology, the bulbs at homes, offices and streets will not only be able to light and illuminate the environment but will also be able to transmit data wirelessly at high speed. Let us take a closer look at Wi-Fi and Li-Fi and see what both of these technologies have to offer.

| Parameter | Li-Fi | Wi-Fi |
|---|---|---|
| Speed | *** | *** |
| Range | * | ** |
| Data density | *** | * |
| Security | *** | ** |
| Reliability | ** | ** |
| Power available | *** | * |
| Transmit/receive power | *** | ** |
| Ecological impact | * | ** |
| Device-to-device connectivity | *** | *** |
| Obstacle interference | *** | * |
| Bill of materials | *** | ** |
| Market maturity | * | *** |

* low ** medium *** high

## VII. CONCLUSION

Li-Fi is certainly not useless, but it has certain inherent limits for the technology.LI-FI may not be able to replace conventional radios altogether, but it could turbo charge the development of wireless television and make it easier to throw a wireless signal across an entire house. At present, finding the ideal position for a wireless router is something of a divine art. If the signal could be passed via VLC from Point A to Point B inside a home, small local routers at both points could create local fields with less chance of overlapping and interfering with each other. Large scale areas that are saturated with radio signals or that doesn't permit them for security reasons could use LI-FI as an alternate high-speed wireless network solution.

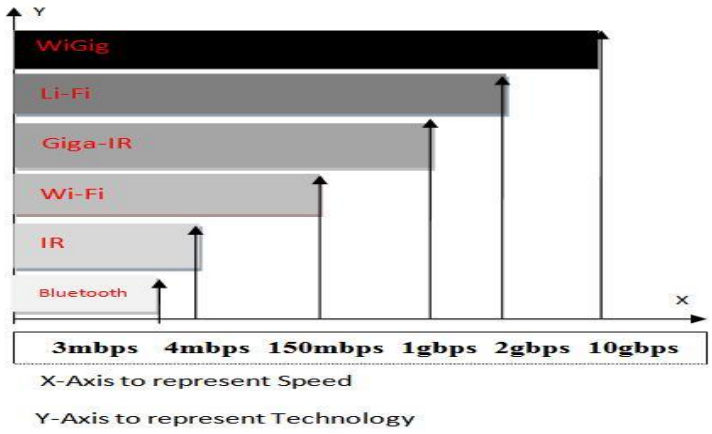


**Fig.4.** Spectrum of Wireless Network

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## AUTHOR BIOGRAPHY:

**Saurav Rathore**: He was born in Ghaziabad, India in 1995. He is pursuing the B.tech degree in electronics and communication from the University of Uttar Pradesh Technical University, India in current year. He was attending the four weeks workshop of Embedded System from Hewlett Packard (H.P) in Dehradun.

**Vibhu Bindal:** He was born in Moradabad, India in 1995. He is pursuing the B.tech degree in electronics and communication from the University of Uttar Pradesh Technical University, India in current year. He was attending the four weeks workshop of Very Large Scale Integrated (VLSI) Technology from Hindustan Computer Limited (HCL) in Noida.

**Veerendra Singh:** He was born in Amroha, India in 1995. He is pursuing the B.tech degree in electronics and communication from the University of Uttar Pradesh Technical University, India in current year. He was attending the four weeks training of JAVA language from Cetpa in Noida.

**Puneet Agrawal:** He was born in Ghaziabad, India in 1995. He is pursuing the B.tech degree in electronics and communication from the University of Uttar Pradesh Technical University, India in current year. He was attending the four weeks workshop of Telecom Technologies in ALTTC Ghaziabad.