

LIGHT FIDELITY (LI-FI): A WIRELESS TECHNOLOGY

Siddhant Meshram¹ and Sangita Meshram²

¹T.E Electronics & Telecommunication Engineering
SIES Graduate School of Technology, Nerul, India
siddhantmeshram149@gmail.com

²VPM's B.N.Bandodkar College of Science Thane, India
sangita.meshram@rediffmail.com

ABSTRACT

Wireless technology has bloomed to a great extent. Nowadays, internet and digital communication has been in major demand, with a greater speed, safer and secure data transmission Li-Fi comes into picture. Li-Fi, a fast, upcoming and growing technology, is a better alternative to Wi-Fi in wireless communication. To overcome complexity in network traffic and shortage of bandwidth, superfast wireless communication, Li-Fi (Light fidelity) is a better option. In the present paper the authors have focused on the advantages, applications and limitations of using Li-Fi in transferring data. This wireless technology is not only greener but safer and cheaper in the future of communication.

Keywords: Li-Fi, VLC (Visible Light Communication), LED, RF (Radio Frequency)

INTRODUCTION

Exchange of information in digital form and the speed of transmission of data has its own significance in wireless communication. The currently existing data transmission system has become old and slow. The new wireless communication technology Li-Fi (Light Fidelity), transmits data between devices using light at higher speed.

In 2011 TED Global Talk held in Edinburgh, this term was first introduced by Harald Hass (Prakash and Agarwal, 2014; Khandal and Jain, 2014).

LED's are used to transmit multimedia data using Li-Fi between two terminals. Transmission through illumination is achieved by Li-Fi, LED light bulbs are used to transmit data and it varies in intensity, that a human eye cannot follow. In our daily life the light we use is also used to provide communication by illumination (Mahendran, 2016).

Transmission of data at high speeds over the visible light, ultraviolet and infrared spectrums is possible through Li-Fi (Chakraborty *et al.*, 2017).

Light emitting diodes are used to transmit data wirelessly through this technology. Rapid pulses of light are used by visible light communication (VLC) to transmit information wirelessly (Ekta and Kaur, 2014).

This technology is similar to Wi-Fi, the only difference is that radio frequency is used by Wi-Fi to transmit data. Li-Fi has several advantages, as it uses light to transmit the data. Wider bandwidth channel, security and high data speed are some of its notable advantages. Several organizations are actively developing this technology across the globe.

LI-FI TECHNOLOGY WORKING

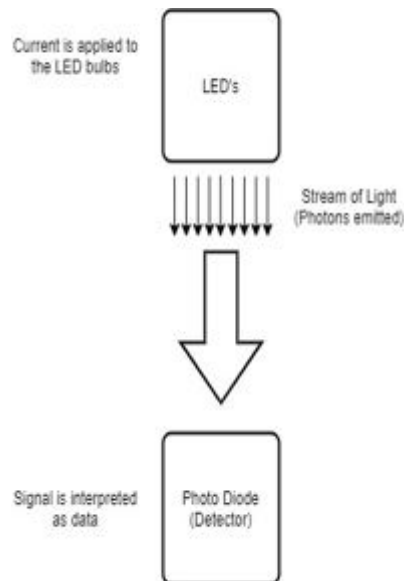


Figure 1: Block Diagram

Li-Fi is high speed bidirectional networked and mobile communication of data using light. Li-Fi comprises multiple light bulbs that form a wireless network.

A stream of light (photons) are emitted from the LED light bulb, when an electrical current is applied to it. Since these LED bulbs are semiconductor devices, brightness of the light flowing through them can be changed at extremely high speeds. This property of LED bulbs can be used to modulate the light at different rates before sending the signal. A detector is used to receive the signal and it also interprets the variation in light intensity (received signal) as data.

This communication is seamless as the other radio systems, since the intensity modulation cannot be seen by the human eye, allowing the individuals to be connected to the internet through Li-Fi enabled light.

ADVANTAGES AND DISADVANTAGES

ADVANTAGES OF LI-FI TECHNOLOGY:

- **Efficiency:**

Transmission of data requires negligible additional power due to availability of LED in the home, offices and malls which makes LiFi efficient in terms of cost as well as energy.

- **Availability:**
Light bulbs are available in abundance; therefore, availability is not a concern at all.
- **Security:**
Light cannot pass through opaque structures. Users outside the stipulated area cannot access and misuse the data.
- **High Speed:**
Lifi provides high data rates of about 1 Gbps due to combination of low interference, high bandwidth and high intensity output.

DISADVANTAGES OF LI-FI TECHNOLOGY:

- **Limited Usage:**
The usage of Li-Fi is limited, as without a light source the internet cannot be used.
- **Range of Signal:**
The range of the signal is limited by the physical barriers as Li-Fi uses visible light.
- **Interception of the signal:**
Interception of the signal outdoors is the biggest potential drawback of this technology. The interference of the sunlight will also result in interrupted internet.
- **Cost:**
In order to implement Li-Fi a whole new infrastructure will be required and this won't be cheap.

APPLICATIONS

- **UNDERWATER APPLICATION:**
The vehicles used underwater are mostly wired and use large cables, these cables are fragile and may be destroyed by the underwater animals. Therefore, Lifi is a better solution, since light can easily travel through water up to 1000 meters (Khare *et al.*, 2016; Chakraborty *et al.*, 2017).
- **AVIATION:**
Li-Fi can be utilized to provide efficient communication of data in airborne environments. Aircraft equipment such as radar uses radio waves, so the transmission using Li-Fi will not interfere with it (Ayara, Usikalu, Akinyemi and Adagunodo, 2016) (www.purevlc.net).
- **HOSPITAL:**
Information of patients can be communicated at a higher speed using Li Fi as light waves are less harmful for humans. Thus, increases the efficiency of the task (Ayara *et al.*, 2016).

- **SMART TRANSPORT:**

India has recorded many road fatalities over many years, with UP recording maximum fatalities in the year 2018 followed by Maharashtra & Tamil Nadu. In order to ensure safety of pedestrians and drivers, LiFi technology can be used. Vehicles can communicate with each other via back and the front lights ensuring the safety on roads (Ekta and Kaur, 2014).

- **ADVERTISING:**

The street lamps or the lights of any store can be used to display advertisements of new products, job openings and so on, on the smartphones of the people passing by (Swami, Vijaykumar *et al.*, 2017).

- **EDUCATION:**

Today's generation is more techno savvy, therefore to create a more efficient learning environment along with active participation of students in learning Li-Fi enabled smartphones/laptops can be used for better understanding of academics (Vijaykumar *et al.*, 2017).

- **RAILWAY TRANSPORT NETWORK:**

Ever increasing demands of the customers using mobile communication & internet in the rail transport can be more intelligently met by visible light communication (VLC) by providing seamless connectivity (Ahamed, 2016).

ISSUES WITH LI-FI

Lifi is a pretty good unguided technology, because of the speeds it can offer. But every technology has its pros & cons. Here are some issues with LiFi:

- **COST:**

A lot of instruments are required for this technology. We require at least one receiver for each device (PCs, TV, Laptop, Smart Phones and so on). Nowadays the emitter and receiver are bundled into a single device, but still there will be a need of separate Li-Fi routers for each device we want to connect. Since we don't use devices in the same place, we will require multiple Li-Fi routers in each place, this increases the cost.

- **LINE OF SIGHT:**

Light is a transverse, electromagnetic wave. Since the light follows the principle of rectilinear propagation, it travels in a straight path. Therefore, line of sight is an issue. The LED with Li-Fi system embedded in it should be in the line of sight with the

receiving device. More the device is closer to the LED, the more the speed will be. This issue also restricts the usage of this technology (Ali, 2018).

- **HEALTH:**

Some people may experience seizures due to gazing at the light emitted by the LiFi embedded LED tube lights (Ali, 2018).

- **WASTAGE OF POWER:**

Smart generation needs the internet 24x7, therefore even during the day, light source is needed, which is a wastage of power (Sonnad *et al.*, 2013).

- **RESTRICTED USAGE:**

Since the Li-Fi technology uses light waves, it cannot penetrate through thick walls, which easily stops data transmission (Chatterjee *et al.*, 2015; Navalakha and Maheshwari, 2012).

FUTURE SCOPE

Lifi Technology has a great scope for the use as it may lead to a cleaner, greener, safer communication and have a bright future and environment. If the technology becomes mature and popular, people will use it more and more and it may become an important tool for faster communication of the mob. In the long run, Li-Fi could be an alternative solution for unguided speedy and secure data transmission technology. “Li-Fi could be used in India's upcoming Smart Cities - where IT will be the primary infrastructure”, according to Neena Pahuja, director general of the Education and Research Network (ERNET), an autonomous scientific society under the IT ministry. In traffic systems, Li-Fi could serve as an internet hotspot. In some military operations where RF communication is not allowed Li-Fi could be used to transmit data keeping it integrity. (<https://www.vccircle.com/will-lifi-replace-wifi-it-ministry-finds-out-if-light-can-power-the-internet/>) (Tharunn *et al.*, 2015).

CONCLUSION

Due to increased demands for high speed data, many wireless technologies are evolving and emerging, LiFi promises great potential in the wireless domain. It is an efficient, fast and cost-effective technology. Even India's IT ministry has successfully tested lifi in a pilot jointly conducted with IIT Madras and Lighting company Philips. A great change in daily life will happen if Li-Fi technology replaces Wi-Fi and other broadband networks. Though this technology's biggest challenge is high speed data upload, upcoming and growing technology is gaining pace in recent times which will potentially resolve the many unsolved mysteries of the world.

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