

# Enhancing the Application of Visible Light Communication in Organization Using Li-Fi



## Computer Science

**KEYWORDS :** Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Visible Light Communication (VLC), Organization devices, Speed.

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### ABSTRACT

Nowadays high bandwidth network (WAN, MAN, and internet, etc.) is a very important need of many people to get their task completed using wired or wireless network. As the number of internet access devices have been increased tremendously, a high speed network is on demand. Dr. Harald Haas has introduced a technique called Li-Fi technology- Light Fidelity, which will provide a high speed internet like never before. This paper gives a large view on the use of light for organizational benefits. Using copper wire for connecting devices for network access will be replaced by an LED light bulb that is used to fluctuate the light faster. Embracing Li-Fi in the organization will culminate to a secure and cheaper infrastructure with the help of light as a wireless data transmission medium.

### 1. Introduction

This paper gives a comprehensive view on the use of light as a transmission medium for wireless communication. Nowadays Wi-Fi technology is rigorously used in organizations. Wi-Fi is based on radio frequencies for data transmission. But Wi-Fi is facing several challenges, namely capacity, availability, efficiency and security. The arrangement of Wi-Fi technology is costly with the implementing cost and maintenance cost. German Physicist Harald Haas introduced the term Li-Fi (Light-Fidelity). Li-Fi is based on VLC (Visible Light Communication) concept. A constant input power is given to LED (Light Emitting Diode) bulb and the produce output will also be constant. Faster the fluctuation in input power faster be the produced output power. Li-Fi is bidirectional technology.

Implementing Li-Fi in an organization will lead to access the high speed internet network for all the devices (example: Computer systems, router, employee’s mobile phone, etc.). Using LED bulbs for wireless data transmission will withdraw the harmful effect of radiation. Most importantly, as Li-Fi is visible light communication, the light signal will only reach till the nearest light source. This means it is highly secured [1].

### The rest of this paper is organized as follows:

Section2 covers possible applications. Section3 specifies the working of Li-Fi. Section4 illustrates the actual methodology used. Section5 illustrates the benefits of Li-Fi in the organization. Finally, Section6 ends with a conclusion.

### Literature Review

The Li-Fi system is the technology that transmits data through various intensities of light. On July 2011, Dr. Harald Haas demonstrated Light fidelity which is based on visible light communication. Li-Fi uses an LED light bulbs which are used currently in many organizations and homes. In this technique Li-Fi bulbs are outfitted with a chip that modulates the intensity of the light and then the signal is demodulated into electronic form for optical data transmission. The operational work of the LED is very simple. If the button of the LED light is on then it transmits a digital 1 and if the button of LED light is off then it transmits a digital 0. This operation occurs very quickly. Li-Fi provides a very high speed of internet access, up to 10 Gbps speed is tested. And its spectrum bandwidth is 10000 times greater than radio frequency. Li-Fi is very safe as it does not generate harmful radiation. It also provides mul-

tiple access at a time with the same high speed and data density [3].

### General Working Principle

As shown in the Figure 1. The Light emitting diodes (LEDs) gets switched on and off faster since the operating speed of the LED is less than 1 ms. Data transmission is done using binary codes. When LED is switched on, it transmits binary ‘1’ and when it is off, it transmits binary ‘0’. A light sensitive device (photo detector) receives the signal and convert it back into the original data.

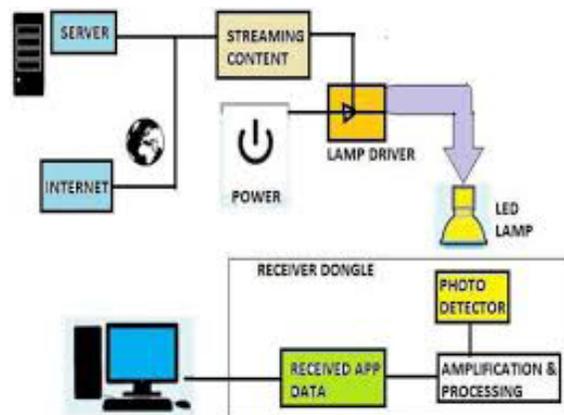


Fig 1. Li-Fi architecture [2]

Using rapid pulses of light to transmit information without using wire is called Visible Light Communication. Data which comes from the outer world (internet) or through LAN server is used to modulate the intensity of the LED light source. The photo detector picks up the signal and then converted into a data stream (original data) and sends to the client [2]-[5]-[6].

### 2. Application of Li-Fi

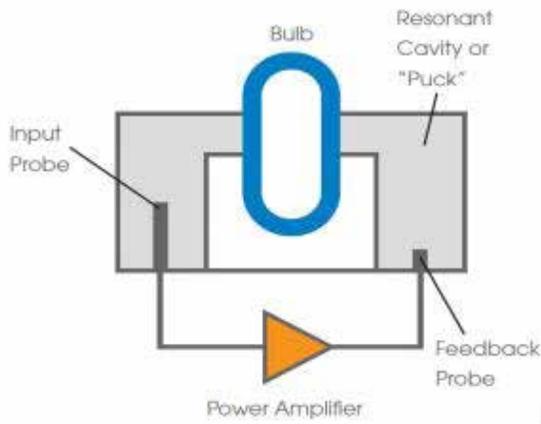
**a) Medical Application:** Use of Wi-Fi in hospitals is not allowed. Wi-Fi produces harmful radiations. It is unhealthy for the patient’s health. Li-Fi emits electromagnetic interference and it does not interfere with medical instruments available in the hospitals nor it interferes with by MRI scanners [4].

**b) Internet in the Airways:** While traveling in the airways, passengers gets low speed internet access at very high cost. Wi-Fi, Bluetooth, infrared can not be used in airways be-

cause it may interfere with the navigation systems of the pilots. Use of Li-Fi in airways will provide high speed internet via LED light source which is available in the aircraft at low cost [6].

**c) Vehicle communication and Traffic management:** vehicle headlights and tail lights can be replaced with LED lights. Street lamps and traffic signal also can be replaced by LED lights. This will be used to communicate one vehicle to another. So that when any vehicle comes too close, LED lights can alert the drivers which will help to reduce the accident numbers and manage traffic as well [7].

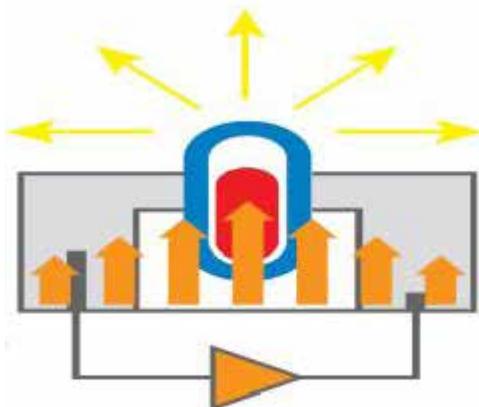
**3. How Li-Fi Works**



**Fig. 2. Assembled RF circuit [8]**

As shown in Fig.2, process of light generation in all Li-Fi systems can be understood in following steps:

1) First of all, RF circuit is formed by connecting the RF power source across cavity known as “puck”. When power source is connected to the RF driver then it generates electron assembly, which further leads to give high electric field.



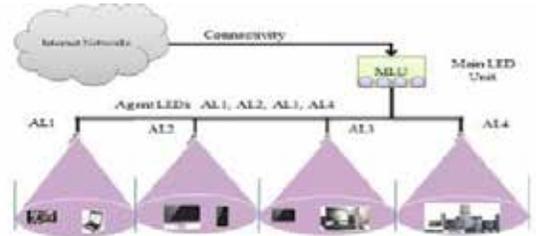
**Fig. 3. Emitting plasma column [8]**

2) This electric field ionizes the gases present inside the puck which in turn heats up and evaporates the metal-halide materials which form a bright plasma column within the bulb as illustrated in Fig.3

Process: The lamp driver i.e. power source is connected to LAN data. Accordingly, based on variation in the data, the source will generate digital signal and so as the corresponding intensity of light. In this way Li-Fi works [8].

**4. Methodology Used in Organization**

The LED bulb is fixed in the organization as per the requirement and structure of the organization. The employee can access the network from any location where the nearest light source is available.



**Fig. 4. The LED design for organization [10]**

The basic architecture of Li-Fi technology is based on Main LED Unit (MLU), Agent LED’s (AL) and Li-Fi cloud. The main line is connected to MLU and further it extends to smaller nodes, which are LED bulbs (example: AL1, AL2, AL3, etc.). The LED lamp is fixed to the walls and ceiling of the organization room. The position of the LED lamp is adjusted in such a way that it can cover the maximum area with high intensity of light [10]-[11]-[12]. Overall methodology will be illustrated in two parts. The first part covers the communication from the internet to the client, while the second part includes the client-internet communication.

**4.1 Internet-client communication:**

In recent years, the demand of IoT phenomena is increasing rapidly, but at the same time it also encounters with speed, security terms in large extent. Li-Fi has ability to overcome these aspects. For example, when any organization needs data from server with maximum speed and stringent security, it will employ following steps:

- i) First of all, information will be fetched from the internet. Further through ADSL router with dedicated IP address the information will pass on to LAN connectivity of the organization.
- ii) The flow of data coming from the LAN is fed to AL via MLU. According to the binary data, the chip inside the light unit will modulate the intensity of light.
- iii) The receiver section of client, i.e. photo detector will convert the light energy into electrical energy in analog form.
- iv) With the help of analog to digital converter (ADC), we can reconstruct the data sent by LAN.

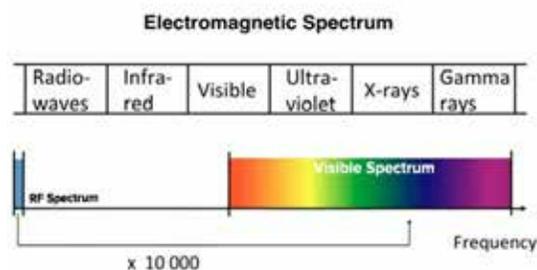
**4.2 Client-Internet communication:**

Now the data traveling from the client end to the internet follows the steps shown below:

- i) Along with photo detector, client unit also possesses LED unit, which is activated when data coming from the client end. Where at this end the binary data coming will convert into the light energy.
- ii) The detector unit located on the floor of the organization will transform the light energy into electrical form, further via ADC the binary data will get fed to the ADSL router.
- iii) Finally via router the data are transferred to the internet [9].

**5. Benefits of Li-Fi in organization**

- 1) Multiple Access a fixed LED lights can allow different people to browse the internet and use the network at the same time.
- 2) Speed - Li-Fi has produced a speed of over 10 gbps. As Li-Fi gives a high bandwidth which 1000 times greater than the radio frequency. Thus speed can be achieved.



**Fig. 4. The Light Spectrum [9]**

- 3) **Instant start-time-** The LED bulb can be switched ON/OFF instantly.
- 4) **Energy Efficiency-** LED bulbs consume low electrical power. Usage of Li-Fi in the organization will save the electricity consumption as well as will give high brightness.
- 5) **Cost-** Deploying LED infrastructure of the organization, does not require huge investments.
- 6) **Security-** Light signal can not travel through the wall, and also it allows roaming access between lights.
- 7) **safety-** light emissions are not harmful to the human body.

**VI. CONCLUSION**

Li-Fi is such technology, where the speed and security aspect makes it exceptional. Light is part of day to day life activities leads to easy access of the network. From the organization point of view, it is helpful in different aspects like easy availability of light source, safer, healthier, greener, etc. Henceforth Li-Fi plays an important role in providing massive speed with stringent security of information.

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