

LI-FI (Light Fidelity) Future of Wireless Communication

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Abstract—Li-Fi is a bidirectional, high speed and fully networked wireless communication technology similar to Wi-Fi. Coined by Prof. Haral Haas, Li-Fi is a subset of optical wireless communications (OWC) and can be a complement to RF communication (Wi-Fi or Cellular network), or a replacement in contexts of data broadcasting. Li-Fi technology provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. This paper focuses on developing a Li-Fi based system and analyzes its performance with respect to existing technology. Li-Fi provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved blisteringly high speed in the lab. He envisions a future where data for laptops, smart phones, and tablets is transmitted through the light in a room. And security would be snap – if you can't see the light, you can't access the data.[1]

“Li-Fi technology” which he calls “Data through illumination” or “D-Light”. Li-Fi is a new approach of VLC which has much more similar working of a OFC communication system providing data rates of ten's of Gbps. In this technology data is interpreted by the LED's ON/OFF concepts.[2]

Keywords— Li-Fi, Wi-Fi, high-brightness LED, photodiode, wireless communication. LED (Light emitted diode), Wi-Fi, VLC.

I. INTRODUCTION

LiFi is a wireless optical networking technology that uses light-emitting diodes (LEDs) for data transmission. LiFi is designed to use LED light bulbs similar to those currently in use in many energy-conscious homes and offices. Li-Fi having a various range of frequencies and wavelengths, from the infrared through visible and down to the ultraviolet

spectrum. Transfer of data from one place to another is one of the most important day-to-day activities.[1]



Figure-1.1 Light Fidelity [1]

Li-Fi basically known as “**LIGHT FIDELITY**” is an outcome of twenty first century. The basic idea behind this technology is that the data can be transmitted through LED light whose intensity varies even faster than the human eye. As the transmission of the data takes place through the light emitting diodes (LED's) the amount is comparatively small .In modern times, it is called as the optimized version of WI-FI .The advantageous thing is the wireless communication which decreases the cost enormously.[1]

II. WORKING PRINCIPLE

When a constant current is applied to an LED light bulb a constant stream of photons are emitted from the bulb which is observed as visible light. If the current is varied slowly the output intensity of the light dims up and down.

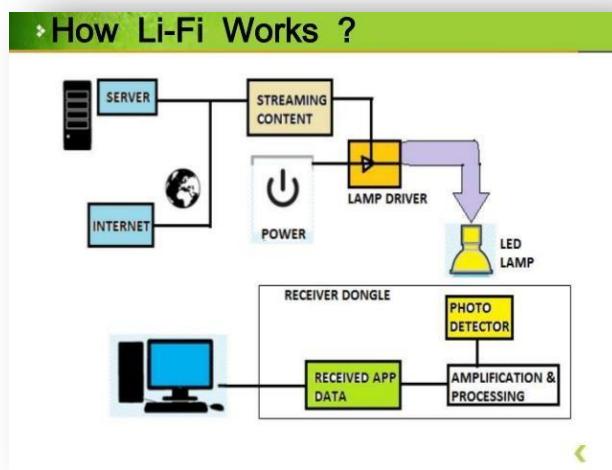


Figure 1.2 Working diagram [1]

If the current is varied slowly the output intensity of the light dims up and down. Because LED bulbs are semi-conductor devices, the current, and hence the optical output, can be modulated at extremely high speeds which can be detected by a photo-detector device and converted back to electrical current. The intensity modulation is imperceptible to the human eye, and thus communication is just as seamless as RF. Using this technique, high speed information can be transmitted from an LED light bulb. Radio frequency communication requires radio circuits, antennas and complex receivers, whereas Li-Fi is much simpler and uses direct modulation methods similar to those used in low-cost infra-red communications devices such as remote control units. Infra-red communication is limited in power due to eye safety requirements, whereas LED light bulbs have high intensities and can achieve very large data rates. [1]

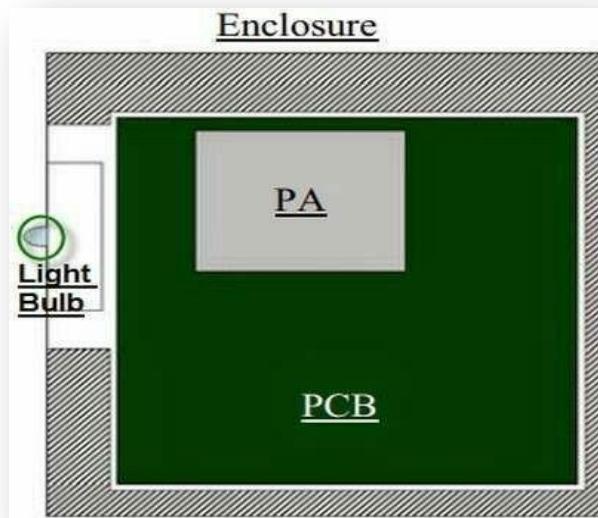


Figure1.3LIFIBlockDiagram[4]

III. CONSTRUCTION

The LIFI™ product consists of 4 primary sub-assemblies:

- Bulb
- RF power amplifier circuit (PA)
- Printed circuit board (PCB)
- Enclosure

The PCB controls the electrical inputs and outputs of the lamp and houses the microcontroller used to manage different lamp functions. An RF (radio-frequency) signal is generated by the solid-state PA and is guided into an electric field about the bulb. The high concentration of energy in the electric field vaporizes the contents of the bulb to a plasma state at the bulb's center; this controlled plasma generates an intense source of light. All of these subassemblies are contained in an aluminum enclosure.

At the heart of LIFI™ is the bulb sub-assembly

where a sealed bulb is embedded in a dielectric material. This design is more reliable than conventional light sources that insert degradable electrodes into the bulb. The dielectric material serves two purposes; first as a waveguide for the RF energy transmitted by the PA and second as an electric field concentrator that focuses energy in the bulb. The energy from the electric field rapidly heats the material in the bulb to a plasma state that emits light of high intensity and full spectrum. [4]

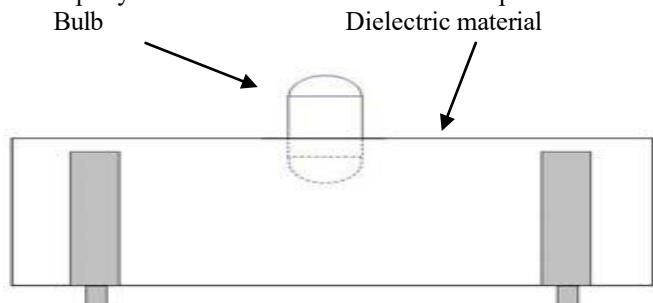


Figure 1.4 LIFI Bulb Sub-assemblies [4]

IV. ADVANTAGES

Li-Fi technology is based on LEDs or other light source for the transfer of data. The transfer of the data can be with the Help of all kinds of light, no matter the part of the spectrum That they belong. That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum. Also, the speed of the communication is more than sufficient for downloading Movies, games, music and all in very less time.

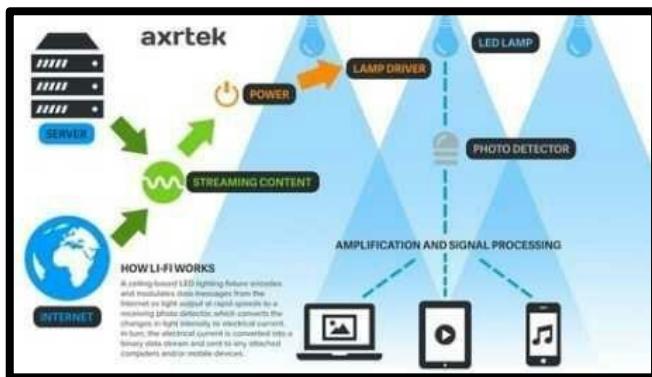


Figure 1.5 Working process [1]

Also, Li-Fi removes the limitations that have been put on the user by the Wi-Fi.

- a) **Capacity:** Light has 10000 times wider bandwidth than radio waves. Also, light sources are already installed. So, Li-Fi has got better capacity and also the equipments are already available.
- b) **Efficiency:** Data transmission using Li-Fi is very cheap. LED lights consume less energy and are highly efficient.
- c) **Availability:** Availability is not an issue as light sources are present everywhere. There are billions of light bulbs worldwide; they just need to be replaced with LEDs for proper transmission of data.
- d) **Security:** Light waves do not penetrate through walls. So, they can't be intercepted and misused.

With the advent of Li-Fi, now it is not mandatory to be in a region that is Wi-Fi enabled to have access to the internet. One can simply stand under any form of light and surf the internet as the connection is made if light is present.[4]

V. DISADVANTAGES OF LiFi

One of the major demerits of this technology is that the artificial light cannot penetrate into walls and other opaque materials which radio waves can do. So a Li-Fi enabled end device (through its inbuilt photo-receiver) will never be as fast and handy as a Wi-Fi enabled device in the open air. Also, another shortcoming is that it only works in direct line of sight. Still, Li-Fi could emerge as a boon to the rapidly depleting bandwidth of radio waves. And it will certainly be the first choice for accessing internet in a confined room at cheaper cost. [4]

VI. APPLICATION

There is a wide necessity for data transfer and by the end of the day every field involves the use of technologies. One such technology is Li-Fi which can have its applications extended in areas where the Wi-Fi technology lack its presence like medical technology, power plants and various other areas where Li-Fi proved its excellence of the undersea

awesomeness. At present its applications are beyond imagination but still if we think about few then they are :

- Can be used in the places where it is difficult to lay the optical fiber like hospitals. In operation theatre LiFi can be used for modern medical instruments.
- In traffic signals LiFi can be used which will communicate with the LED lights of the cars and accident numbers can be decreased.
- Thousand and millions of street lamps can be transferred to LiFi lamps to transfer data.
- In aircraft LiFi can be used for data transmission.
- It can be used in petroleum or chemical plants where other transmission or frequencies could be hazardous.[3]

VII. CONCLUSION

As the electromagnetic spectrum shrinking continuously the Li-Fi system will going to provide a greener, safer, better and healthier future for communication system. When this system will be developed each light source can be used as a Li-Fi AP means where is a light there is a Internet. Also it will shapes the better future for human kind by reducing the energy consumption, data as well as light at low cost, minimal cellular infrastructure and creating the employments opportunities at large scale. In short the Li-Fi system will be going to change the scenario of wireless communications in many greener ways.

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