

Li-Fi Technology Light Fidelity Technology

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Abstract - Li-Fi means Light Fidelity. This technology is new to the world and it was developed by Harald Haas in the year 2011. It was mainly advanced for the wireless broadcast of data. Li-Fi is a wireless photosensitive networking technology that uses light emitting diodes (LED) for transmission of data. Though the technology was developed by German's it is most popularly used by Chinese. In India Li-Fi is not popularly used as much as Wi-Fi. Wi-Fi is of main use for wide-ranging wireless coverage within buildings, whereas Li-Fi is perfect for high density wireless data coverage in limited area and it is useful for applications in radio interference issues. Li-Fi is developed to overcome the hurdles faced by Wi-Fi such as speed limit and limited area coverage. Li-Fi delivers better bandwidth, proficiency, connectivity and security than Wi-Fi and it has achieved high speeds larger than 1 Gbps. This paper emphases on Li-Fi, its applications, features and contrast with existing technologies like Wi-Fi.

Keywords: Li-Fi, Wireless broadcast of data, Coverage.

I. Introduction

The technologies are developing so the transmission of data is very necessary. Wi Fi provides only limited speed of transmission of data and limited area coverage. One of the popular problems faced by current technology is slow network access when multiple devices are connected. In order to overcome the limits of Wi-Fi, Li-Fi is developed. It was developed in 2011 by Harald Hass for wireless speed transmission of data. The unique features of Li-Fi are data can be transferred through LED light by varying light strengths faster than the human eyes can observe. This technology uses the part of the electromagnetic spectrum that is still not greatly exploited- The Visible Spectrum, in its place of Gigahertz radio waves for data transfer. This technology was first used by Russian company Stins Coman. It was acknowledged for the advance of a Li-Fi wireless local network called Beam Caster. By Communication through visible light, Li-Fi technology has the possibility to change how we access the Internet, stream videos, receive emails, transfer data, and receive data and much more. Security would not be a problem as data cannot be accessed in the lack of light.

II. Comparison between Li-Fi and Wi-Fi

Li-Fi and Wi-Fi can afford wireless Internet access to operators. These technologies transmit data over electromagnetic spectrum. Li-Fi is a visible light or optical technology useful to attain high speed wireless communication. The main variance between Wi-Fi and Li-Fi is the Wi-Fi utilizes radio waves for data transmission and whereas the Li-Fi technology uses light waves for data transmission. Wi-Fi works fine for common wireless coverage within a building or area and Li-Fi is best for high density wireless data coverage inside a confined zone or scope. Wireless data is transmitted through radio waves which are limited and expensive. It has a restricted bandwidth, with the rapidly growing world and development of technologies like 3G, 4G and so on we are running out of radio spectrum. Accessibility of radio waves is a vast distress. Further, Radio waves are not advisable to be used in aeroplanes and at places where radio interference may cause undesirable/catastrophic result.

III. Construction of Li-Fi

Li-Fi mainly services rapid light pulses to wirelessly transfer information, also known as visible light communication (VLC). VLC is a subcategory of Optical Technology, where the visible light is in the range of 390THz (750 nm) and 780THz (384nm). The Li-Fi system uses an optical medium for the transmission of data through light.

Li-Fi system includes:

- a) Transmission source that primarily comprises bright LEDs.
- b) Receiving element having noble response to detectable light like silicon photodiode.

The emitter block of a Li-Fi system consists of following components:

1. Bulb or light source
2. Radio Frequency power amplifier circuit (PA)
3. Printed circuit board (PCB)
4. Enclosure

The electrical light source inputs and outputs are controlled by the printed circuit board (PCB). The microcontroller systematizes various functions of the LEDs in terms of brightness and intensity variations by executing the code that is dumped in it. A Radio Frequency signal is generated by the solid state Power Amplifier and then fed along with the electric field of the spotlight. The electric field's high energy vaporizes the contents to a state of plasma and this in fact is a source of intense light. This sub-assembly are kept in the enclosure of aluminium. The central core of the light fidelity technology is bright LED's. The sub-assembly consisting of the spotlight (bulb) forms the core of the Li-Fi emitter where the bulb is vacuum-packed and embedded in a dielectric material. This design theme of using the dielectric gives an advantage as the Radio Frequency waves transmitted by the power amplifier acts as a waveguide and the electric field's energy quickly take to up the inside material in the spotlight to a state of plasma which in-turn becomes the source of full spectrum and high intensity of light. The approach helps in achieving high brightness, luminous intensity and excellent colour quality of emitter with an approximate value of 160 lumens per watt or sometimes may be more. On using a robust structure that typically doesn't degrade in comparison to usual tungsten electrodes and thereby giving a lamp life of above 50,000 hours.

IV. Working of Li-Fi Technology

The design of Li-Fi has LED bulbs and wireless device such as mobile phones, personal digital assistance (PDA), laptops, personal computers. The data that is being streamed needs to be perfectly assimilated between client and server through an internet network so as to achieve a perfect working efficiency. Continuous switching on-off of the LEDs forms the basic binary logic. If digital '1' is transmitted the LED needs to be turned on and for digital '0' transmission the LED is turned off. To increase the longevity of the electronic system the LEDs are brought down to a lower intensity brightness for '0' transmission. A light source on one end forms the basic transmitter of the data that is to be transferred and on the other hand we have a photo detector (Light Sensor) that behaves as the receiver of the transferred data. To register a binary '1' in the photo detector the LED needs to be turned on and for binary '0' the LED needs to be turned off. The streams of encoded data are obtained on the basis of the flickering rate of the LED.

V. Advantages of Li-Fi Technology

The technology uses visible light that is present in abundant quantities in nature or in-fact something which is all around. The Communication speed not only profits the random browsing of pages in the internet but an ever-long desire to reach intense downloading rates.

1. **Capacity:** The visible spectrum finds an edge over the normally uses electromagnetic spectrum of the radio waves and has a greater bandwidth potential (approx. 11,000 times). Theoretically or under laboratory test conditions it has shown fruitful results. The overloaded radio frequency spectrum thus can be avoided.
2. **Efficiency:** The transfer of data from the source to the recipient is achieved at an almost zero collision free, distortion less and almost negligible bit loss per frame. The consumption of negligible energy has increased the importance. It reduces energy consumption up to 100 times by combining the data communication and illumination.
3. **Availability:** Internet connection can be made possible wherever there is a light source. Light is already available in huge amount thus can help this technology to be available to a great extent. Homes, offices have LED bulbs for lighting purposes which can further be used for data transmission.
4. **Security:** Li-Fi helps to develop the security of wireless communication significantly. Light cannot pass through opaque or dense materials and walls so data cannot be breached by a person in other room or buildings. Data theft becomes negligible as the working is completely based on direct line of sight and so it has achieved an addition of encryption layer.

VI. Applications of Li-Fi Technology

There are enormous applications and if implemented practically, every source of light can be used as a Li-Fi hotspot thereby having hotspot almost everywhere.

1. Spectrum Allocations & 5G: Increasing strains of cellular networks can be met with the adoption to Li-Fi networks. It carries the advantage of the both the purposes of high speed wireless data transfer and lighting, Li-Fi is a perfect and an efficient technology for 5G generation and beyond next generation of networks. The visible light range which is in the spectrum of electromagnetic waves is more than 300 THz; a astonishing unregulated resource of bandwidth can potentially be exploited in Li-Fi systems.

2. Education: Li-Fi is the foremost technology that improves the internet accessibility speed with high bandwidth. Hence educational institutes and organizations can use this technology for high speed internet accessibility, video conference, digital tutorial downloads and online learning.

3. Medical: Radio waves from Wi-Fi turn out to be harmful in hospitals and other various health care sectors. Robotic surgeries, seamless consultation and interaction between doctors will benefit as exchange of ideas and new methods can be discussed over a seamless network.

4. Under Sea Communications: Li-Fi finds a power as light is very less absorbed than radio waves in water. Military advantage as under water communication of submarines can be efficiently done with fewer delays. This technology can be extremely used by deep sea divers for both lightning and data transfer applications simultaneously.

5. Hotspot Everywhere: The light sources are being abundant like street lamps, vehicle lights; the setting up of high speed smart hotspots would be very easy. This can also turn out to be a handful mode in emerging smart cities for high speed data transmission.

6. Smart Vehicular Communication: Li-Fi can be used for controlling of traffic, prevention of collisions and an Internet on the Go almost everywhere there by coming closer for the execution of IOT (Internet of Things). Vehicular headlights having LEDs will act as the transmitter to communicate with photo sensors receiver of nearby vehicles and alert the driver in case of a probable collision.

VII. Conclusion

The attainable performances in terms of user data rates, number of users served and increase in total traffic are well aligned with 5G key performance indicators. A key factor permitting this is the radical decrease of cell sizes, and this is possible by using the existing infrastructures through the grouping of LED lighting and wireless data networking. Although there's still a long way to go to make this technology a commercial success, it promises a great potential in the field of wireless internet. An important number of researchers and companies are currently working on this notion, which promises to solve the problem of lack of radio spectrum, space and low internet connection speed. By organization of this technology, we can migrate to greener, cleaner, safer communication networks and harmless networks. The very concept of Li-Fi promises to solve issues such as, absence of radio-frequency bandwidth and brings down the disadvantages of Radio communication technologies. Li-Fi is the growing technology acting as reagent for various other new technologies. Therefore, there is conviction of development of future applications of the Li-Fi which can be prolonged to different platforms and various walks of human life.

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