



Li-Fi the Most Recent Innovation in Wireless Communication

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Abstract: A new era in wireless communication is soon going to hit the word. In 21 century Morden human advancement is massively subordinate upon electronic and correspondence framework. In this electronic world, web is utilized for downloading computer games, programming likewise concentrates on material, and etc. These present tasks through wired or remote system. However, remote is best method, by expanding remote systems administration relatively diminishes the pace. So that as of late speed issue has been an ascent in Wi-Fi innovation. To conquer this issue Li-Fi innovation is proposed by German physicist Herald Hass and the idea in view of the "Information through enlightenment"- exchange of information through the light by taking fiber out of fiber optics and closure information through LED light that differs in power quicker than the human eye can take after. The creation of Prof. Hass the D-light is only the to deliver information rates higher than 10 megabits every second, this rate speedier than the normal broadband association. For information transmission utilizes light-radiating diodes (LEDs) in Li-Fi which is a remote optical systems administration innovation. In this paper concentrates on Li-Fi innovation is the best of the current innovation furthermore break down the execution of the innovation.

Keywords- Wireless-Fidelity (Wi-Fi), Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Line of Sight (Los) Visible Light Communication (VLC).

I. INTRODUCTION

Communication is one of the integral parts of anybody’s life for exchanging information on devices in wired or wireless networks. With the introduction of new mobile devices, wireless communications have become the basic necessity of our lives. Commercially, we have Wi-Fi as the wireless communication standard. Similarly, Li-Fi (Light-fidelity) is also wireless communication system based upon Visible Light Communication with higher data rate than Wireless Fidelity (Wi-Fi). Due to increasing demand for wireless communications, Wi-Fi is facing many challenges namely- capacity, availability, efficiency and security. So, the term “Li-Fi” was introduced by Harald Hass in 2011 in TED Global talk on visible light communication, to limit these challenges faced by Wi-Fi. Li-Fi uses visible light region of the electromagnetic spectrum, transmitting data through high brightness LED bulbs. Li-Fi is a framework for all of these providing new capabilities to current and future services, applications and end users. This brilliant idea works 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.

In order to handle more users and more data traffic, several solutions have been proposed. They can be classified into three groups:-

- (1) Improve spectrum utilization.
- (2) Establishing heterogeneous networks (Het Net) with small cells to reuse bandwidth.
- (3) Identify new spectrum with larger band. Basically the goal of Li-Fi is not to replace radio frequency, but rather to complement it.

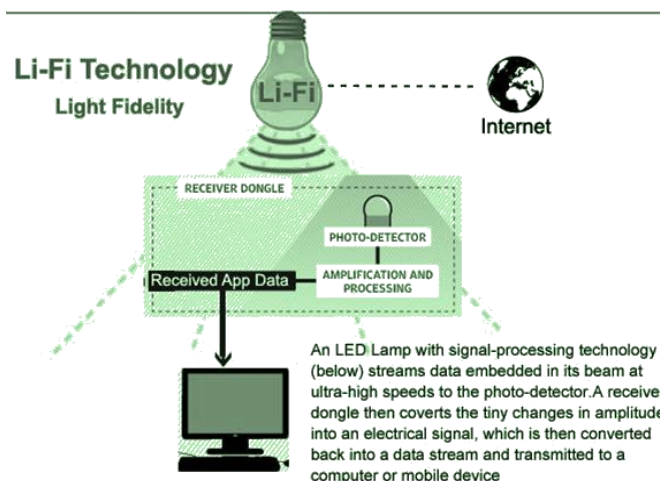


Fig 1: Overview of Li-Fi technology

II. VISIBLE LIGHT COMMUNICATION

This VLC data communication medium uses light between 400THz (780nm) and 800THz (375nm) as optical carrier or data transmission and illumination. The pulses are rapidly changes to transmit the light information wirelessly. Visible light fluorescent lamp is a beginning to be used in every home and office, which makes visible light ideal for ubiquitous data transmitter.

VLC communication used because

- ✓ Compared to other spectrum visible light spectrum not used so far and it is safe to use and having larger bandwidth.
- ✓ X-rays have similar health issues as Gamma rays.
- ✓ Infrared, due to eye safety regulation, can only be used with low power.
- ✓ Gamma rays cannot be used as they could be dangerous.
- ✓ Ultraviolet light is good for place without people; otherwise it is dangerous for the human body.
- ✓ It is possible to encode data in the light by varying the rate at which the LEDs flicker on and off to give different strings of 1s and 0s. The LED intensity is modulated so rapidly that human eyes cannot notice, so the output appears constant.
- ✓ More sophisticated techniques could dramatically increase VLC data rates. Teams at the University of Oxford and the University of Edinburgh are focusing on parallel data transmission using arrays of LEDs, where each LED transmits a different data stream. Other groups are using mixtures of red, green and blue LEDs to alter the light's frequency, with each frequency encoding a different data channel.
- ✓ A potential solution to the global wireless spectrum shortage" Li-Fi (Light Fidelity) is a fast and cheap optical version of Wi-Fi, the technology of which is based on Visible Light Communication (VLC).VLC is a data communication medium, which uses visible light between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission and illumination. It uses fast pulses of light to transmit information wirelessly. The main components of this communication system are 1) a high brightness white LED, Which acts as a communication source and 2) a silicon photodiode which shows good response to visible wavelength region serving as the receiving element. The LED can be switched on and off to generate digital strings of 1s and 0s. Data can be encoded in the light to generate a new data stream by varying the flickering rate of the LED. To be clearer, by modulating the LED light with the data signal, the LED illumination can be used as a communication source. As the flickering rate is so fast, the LED output appears constant to the human eye. A data rate of greater than 100 Mbps is possible by using high speed LEDs with appropriate multiplexing techniques. VLC data rate can be increased by parallel data transmission using LED arrays where each LED transmits a different data stream. There are reasons to prefer LED as the light source in VLC. While a lot of other illumination devices like fluorescent lamp, incandescent bulb etc. are available.
- ✓ This technology uses a part of the electromagnetic spectrum that is still not greatly utilized- The Visible Spectrum. Light is in fact very much part of our lives for millions and millions of years and does not have any major ill effect. Moreover there is 10,000 times more space available in this spectrum and just counting on the bulbs in use, it also multiplies to 10,000 times more availability as an infrastructure, globally.

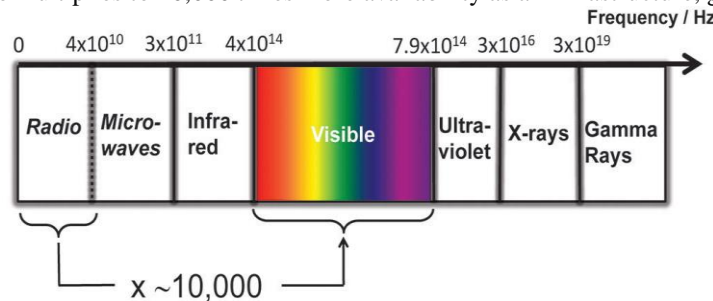


Fig 2:Electromagnetic band

III. CONSTRUCTIONS OF LI-FI SYSTEM

Main component of the Li-Fi technology: LED: At the sending side controller that code the data into LEDs, all the one has to do is to vary the rate at which LED is flicker depending on the data wants to encode. The rate of flickering is very high so that cannot distinguish light for the human eye. In this using array of LED for parallel data transmission or using mixtures of the red, green, blue LED"s to alter the light"s frequency with each frequency encoding of different data channel. Silicon Photodiode: At the receiver side photodiode is used, it shows good response to the visible wavelength region. For accepting the fluctuating light nothing but different string of coded data, LED on means binary „1" and LED off means binary „0".The Li-Fi emitter system consists of 4 primary sub assemblies:

- a) Bulb
- b) RF power amplifier circuit (PA)
- c) Printed circuit board (PCB)
- d) Enclosure.

IV. PRINCIPAL AND WORKING TECHNOLOGIES

We can imagine ourselves walking into a complex where GPS Signals are unavailable but the complex is equipped with ceiling bulbs that create their own ' constellation ' of navigation becomes.[8]As the concern of our cell phone automatically receives these signals, it switches our navigation software to use this information to guide us to the ATM machine we are looking for we conclude our ATM transaction and notice the Giga spot sign for instant digital movie download within a few seconds, or AD movie into Gign link flash desire plugged into the USB port of our smart phone. As we walk away, out phone notifies us that the leather jacket featured in the character of movie is ON sale nearby. We walk over there towards the slow window and own image comes up on the screen, wearing the jackets. We can turn and pause while the image matches our orientation and body gestures for a digital filtering. When we walk into the store, the clerk handover us the actual jacket into exactly size tilting.

How it is different from current technologies?

Table: 1 Comparisons Wi-Fi and Li-Fi technologies

Parameter	Li-Fi	Wi-Fi
IEEE Standard	802.15.7	802.11b [20]
Development Year	2011	1999 [20]
Range of Spectrum	10000 Times than Wi-Fi	Radio spectrum Range
Network Topology	Point to Point	Point to Multipoint [12]
Data density	High	Low
Speed	1-3.5 Gbps	54-250Mbps
Security	High	Low
Cost	Less	High
Communication	Based on Visible Light Communication	Based on Radio Frequency Communication
Licenses	Not Required	Required
Data Transfer Medium	Used light as carrier	Use Radio Spectrum
Range	10 meters	20-100 meters
Frequency Band	100 Times of Tera Hz	2.4 GHz
Routing Device	LEDs	Access Points
Environmental impact	low	Medium
Usage Location	Anywhere, where LED light is available like roads, homes, offices etc.	Within the WLAN range and infrastructure used.
Carrier	Information carried over Optical intensities	Information carried over electric field

V. ADVANTAGES OF LI-FI TECHNOLOGY

Lifi technology is based upon lights might be any sort of lights. The transfer of data takes place in presence of any kinds of light whatever may be the band width. Due to which the depend of transmitting the data or information will be great and also sufficient information, music, movies, games anything can be downloaded using very less time.

- Capacity:** Light itself has 10000 times wider bandwidth than radio waves. Due to which the transfer of data is more effectively possible. So lifi has better capacity.
- Efficiency:** LED lights consume less energy and very efficient. As it uses less energy it is cheap and easy to use.

3. **Availability:** As light is present everywhere, Lifi is available everywhere. But for more efficient use of lifi technology LED bulbs must be placed for proper transmission on data for proper transmission on data.
4. **Security:** Light waves cannot penetrate through walls. So they cannot be misused.
5. **Bandwidth:** The visible light is unlicensed and free to use and gives a very large bandwidth.
6. **Data Density:** Li-Fi can achieve about 1000 times the data density of Wi-Fi because visible light can be well contained in the tight illumination area.
7. **Low Cost:** As it requires very few components the cost of it is comparatively low.

VI. APPLICATIONS OF Li-Fi TECHNOLOGY

- ✓ Education System
- ✓ Medical applications
- ✓ Internet in Aircrafts
- ✓ Underwater Applications
- ✓ Disaster Management
- ✓ Applications in Sensitive Areas
- ✓ Traffic management
- ✓ substitute for other Technologies

VII. SCOPE AND CHALLENGES OF Wi-Fi TECHNOLOGY

Although there are a lot of advantages of LI-FI, there are still certain challenges which need to be overcome. LI-FI requires Line of Sight.

- ✓ If the apparatus is set up outdoors, it would need to deal with changing weather conditions.
- ✓ If the apparatus is set up indoors, one would not be able to shift the receiver.
- ✓ The problem of how the receiver will transmit back to the transmitter still persists. Light waves can easily be blocked and cannot penetrate thick walls like the radio waves can.
- ✓ We become dependent on the light source for internet access. If the light source malfunctions, we lose
- ✓ Access to the internet.

VIII. FUTURE SCOPE

As light is everywhere and free to use possibilities increases to a great extent of the use of Li-Fi technology. If this technology comes to practice each Li-Fi bulb will be used as Wi-Fi hotspot to transmit wireless data. As the Li-Fi technology will be used which will lead to a cleaner, greener, safer and bright future and environment? The concept of Li-Fi is attracting many people as it is free to use without any license and faster means of data transfer. If it develops faster people will more and more use this technology instead of Wi-Fi.

IX. CONCLUSION

With the growing technology and increasing use of the internet services, possibilities are very high that use of Li-fi technology will be soon in practice. Every bulb will be replaced by Li-fi bulbs and might be used like a wi-fi hotspot for the transmission of data. Using Li-fi technology will grant a cleaner, greener and brighter future and environment. The concept of lifi is spreading so fast as it is easy to use; it is attracting interest of people. The use of li-fi technology gives a very golden opportunity to replace or to give alternative to the radio based wireless technologies. As the number of people and the access of internet is increasing on such a large scale, accessing internet through wifi will soon be insufficient as the usage is increasing but the bandwidth remains the same. As network traffic will increase it will result in lowering the speed of accessing the internet thus more increasing prices. The airways become clogged making it more difficult to use. Thus the use of Lifi will increase the speed of data transfer and also it is accessible in many banned places thus it will be available for all.

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