

Comparison and Research on Li-Fi Technology

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ABSTRACT

Li-Fi stands for Light-Fidelity, for the fast increasing gadgets and to improve more effective use of lights a new technology is developed which is called- LIFI. LIFI is a modern technology which is used in progression with WIFI technology. LIFI uses LED lights which helps in faster and flexible data transfer transmitted through Wi-Fi. As light is everywhere, using light as the transmission medium Li-Fi can provide wireless indoor communication. The data transfer through LIFI is in bits and is much faster than Wi-Fi. Dr. Herald Haas, the professor of mobile communications at the University of Edinburgh, UK, first time publically displayed the proof of Light Fidelity (Li-Fi), a method of Visible Light communication (VLC). Li-Fi is the transfer of data through light by taking fiber out of fiber optics and sending data through LED light.

Keywords— Li-Fi, Wi-Fi, LED Lights, Wireless, VLC, Bits and Fiber optics.

1. INTRODUCTION

1.1 Definition of Visible Light Communication

In actinic ray Communication project, the characteristic of short transient time in turning the sunshine on/off processes was any investigated. A high-speed wireless communication system that is embedded in our diode lighting system was built. The duplex communication system consists of each downlink and transmission media through totally different frequencies of lights. Many experiments were conducted within the visible radiation communication system. In this communication system, off-the-self components were taken part in building the driver circuit and the performance of the system was evaluated, such as, data transmission rate, data transmission distance and the field of view of the transmitter.

1.2 Introduction of Visible Light Communication

The **Visible Light Communications** Consortium (VLCC) that is principally comprised of Japanese technology firms was supported in November 2003. It promotes usage of actinic ray for information transmission through packaging and tries to ascertain consistent standards. A list of member companies can be found in the appendix. The work done by the VLCC is divided among 4 different committees:

- **Research Advancement and Planning Committee** this committee is concerned with all organizational and administrative tasks such as budget management and supervising different working groups. It conjointly researches queries like intellectual rights in regard to VLC.
- **Technical Committee** the Technical Committee is bothered with technological matters like knowledge transmission via LEDs and fluorescent lights.
- **Standardization Committee** the standardization committee is concerned with standardization efforts and proposing new suggestions and additions to existing standards.
- **Popularization Committee** the Popularization Committee aims to lift public awareness for VLC as a promising technology with widespread applications. It conjointly conducts marketing research for that purpose.

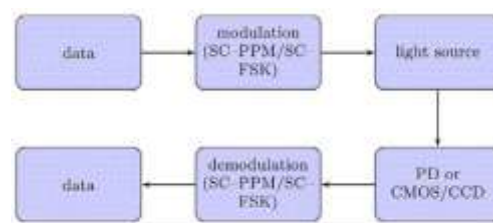


Fig-VLC TECHNIQUE

The most important day-to-day activities in this fast world are the transfer of data and information. As the world is becoming faster the need of fast data transmission is also increasing. As the numbers of devices that access to the internet are increasing, the limited bandwidth leads to decrease in the speed of the data transfer.



Fig 1: Li-Fi Bulb.

To give a solution to this problem Li-Fi technology is introduced. Li-Fi stands for Light Fidelity. Li-Fi provides better bandwidth, efficiency, availability and security than WiFi and thus increases the data transfer speed. Li-Fi technology provides transmission of data through illumination by taking the fibre out of fibre optics by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi is right for top density wireless information coverage in confined space and for relieving radio interference problems.

Lifi uses visible light instead of Gigahertz radio waves for data transfer which makes it fast and cheap mode of wireless communication. The idea of Li-Fi was introduced by a German physicist, Harald Hass, which he also referred to as data through illumination. The term Li-Fi was first used by Haas in his TED Global talk on Visible Light Communication. According to Hass, the light, which he referred to as D-Light, can be used to produce data rates higher than 10 megabits per second which is much faster than our average broadband connection.

2. CONSTRUCTIONS OF LI-FI SYSTEM

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 homes the microcontroller used to manage completely different lamp functions. An RF (radio-frequency) signal is generated by the solid-state PA and is guided into an electrical field concerning the bulb.

The high concentration of energy within the field vaporizes the contents of the bulb to a plasma state at the bulb's Centre; this controlled plasma generates associate degree intense supply of sunshine. All of these subassemblies are contained in an aluminum enclosure.

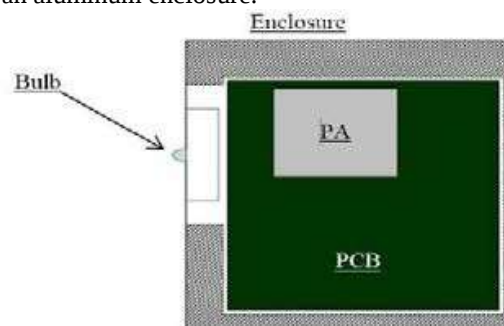


Fig 2: Block Diagram of Li-Fi sub-assemblies.

3. FUNCTIONS OF THE BULB SUB-ASSEMBLY

At the heart of LIFI™ is the bulb sub-assembly where a sealed bulb is embedded in a dielectric material. This style is a lot of reliable than standard light-weight 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 electrical field quickly heats the fabric within the bulb to a plasma state that emits lightweight of high intensity and full spectrum.

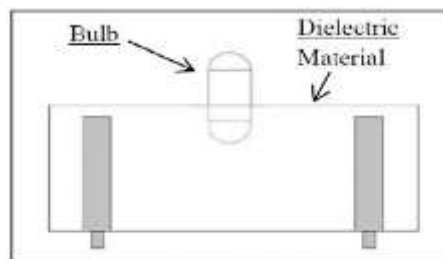


Fig 3: Bulb sub-assembly.

4. WORKING OF LI-FI

A new era of large brightness light-emitting diodes forms the core part of Li-Fi technology. The logic is thus straightforward as follows-If the crystal rectifier light-weight is on, a digital one is transmitted. If the LED light is off, a digital 0 is transmitted. These large brightness LEDs lights can be switched on and off very quickly which gives us a very nice chance for transmitting data through light.

The operating of Li-Fi is extremely straightforward as Wi-Fi. There is a light emitter on one corner, for example, an LED, and a photo detector (light sensor) on the other corner. The photo detector registers a binary one when the LED is on; and a binary zero if the LED is off same as microprocessor. To get any message, flash the diode various times or use associate array of LEDs of maybe a couple of totally different colors, to get knowledge rates within the vary of many megabits per second.

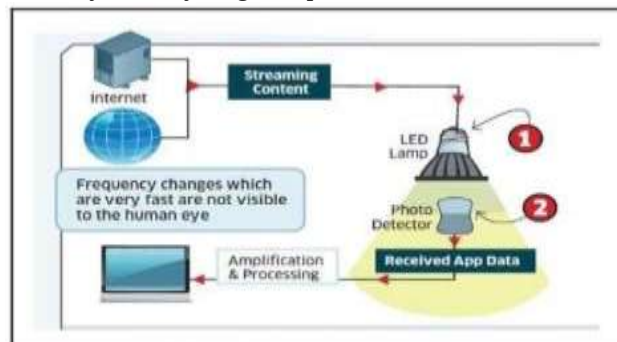


Fig 4: Block Diagram of Li-Fi system.

The data are often encoded within the light-weight by variable the a flicker rate at that the LEDs flicker on and off to get totally different strings of 1s and 0s. The LED intensity is modulated so rapidly that human eye cannot notice, so the light of the LED appears constant to humans. Light-emitting diodes can be switched on and off faster than the human eye will sight, inflicting the sunshine supply to seem to get on incessantly, albeit it's indeed 'flickering'.

The on-off activity of the bulb that looks to be invisible allows information transmission victimization binary codes: shift on AN diode may be a logical '1', shift it off may be a logical '0'. By varied the speed at that the LEDs flicker on and off, data may be encoded within the lightweight to completely different combos of 1s and 0s.

This technique of victimization speedy pulses of sunshine to transmit data wirelessly is technically mentioned as light Communication (VLC), though it's popularly referred to as as Li-Fi as a result of it will vie with its radio-based rival Wi- Fi.

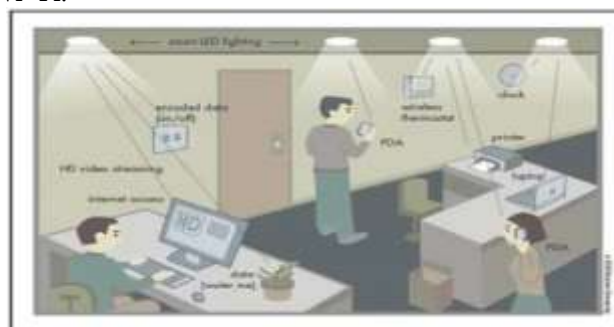


Fig 5: Li-Fi system connecting devices in a room.

5. RECENT ADVANCEMENT ON LI-FI TECHNOLOGY

Researchers at the Heinrich Hertz Institute in Berlin, Germany: have reached knowledge rates of over five hundred megabytes per second. A consortium called _Li-Fi Consortium 'was formed in October 2011 by a group of companies and industry groups to promote high speed optical wireless systems and overcome the limited amount of radio based wireless spectrum. According to the Li-Fi syndicate, it's attainable to realize quite ten Gbps of speed, on paper which might enable a high-definition film to be downloaded in only thirty seconds. Researchers at University of Strathclyde in Scotland, began the task of bringing high-speed, ubiquitous.

6. APPLICATIONS OF LI-FI

Some of the future applications of Lifi are as follows:

- **Education System:** Lifi is the latest technology that can provide fastest speed internet access. So it can replace the Wi-Fi at Educational Institution and at companies so that they can use the same internet with more fast speed.
- **Medical applications:** As Wi-Fi uses radiations waves which can cause hazardous to the patients in OT (Operation Theatres) while radioactive operations. So Wifi is not allowed there as it can block the signals.
- **Internet in Aircrafts:** In Aircrafts Wi-Fi cannot be used as it can interfere with the navigational systems of the pilots. Thus Lifi Can be used for data transmission. Lifi can provide high speed internet using the every light source such as overhead reading bulbs.
- **Underwater Applications:** Lifi can work underwater where Wifi fails completely, thereby providing open endless opportunities for military operations.
- **Disaster Management:** Lifi can be powerful means of communication in times of earthquakes or hurricanes. Lifi bulbs could provide cheap high speed Web access to every street corner.
- **Applications in Sensitive Areas:** Wi-Fi area unit dangerous for sensitive areas like power plants. Lifi will give a lot of safer property in such sensitive areas. Additionally Lifi is employed in fossil oil or chemical plants wherever alternative transmission medium is risky.
- **Traffic management:** In traffic signals Lifi can be used which will communicate with the Led lights of the car which can help in traffic management. Also LED car lights can alert drivers when other vehicles are too close thus reducing the chances of accidents.
- **Replacement for other Technologies:** Lifi can be used in the areas where radio waves technologies such as Wi-Fi are banned.

7. ADVANTAGES OF LI-FI

Lifi technology relies upon lights could be any style 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 Li-fi has better capacity.
- **Efficiency:** LED lights consume less energy and really economical. Because it uses less energy it's low-cost and straight forward to use.
- **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.
- **Security:** Light waves cannot penetrate through walls. So they cannot be misused.
- **Bandwidth:** The actinic ray is unaccredited and liberal to use and provides a awfully massive information measure.
- **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.
- **Low Cost:** As it requires very few components the cost of it is comparatively low.

8. LIMITATION OF LI-FI

- As Lifi technology uses light as transmission medium, so if the receiver is somehow blocked in a way then the signal will immediately will be cut out.
- While information transfers interference from external lightweight sources like daylight, traditional bulbs, and opaque materials will cause loss of responsibility and network.
- As Lifi works in direct line of sight. Slight disturbance can cause to interruption.

9. DESIGN OF LI-FI

Important factors we should consider while designing Li-Fi as following:

- Presence of Light must be line-of-sight.
- Lamp driver wherever web association, switch and semiconductor diode lamp connected.
- For better performance use LED bulbs.
- A photo detector received data.

10. COMPARISON BETWEEN LI-FI/WI-FI

Li-Fi / Wi-Fi comparison

Parameter	Li-Fi	Wi-Fi
Speed	***	***
Range	*	**
Data density	***	*
Security	***	**
Reliability	**	**
Power available	***	*
Transmit/receive power	***	**
Ecological impact	*	**
Device-to-device connectivity	***	***
Obstacle interference	***	*
Bill of materials	***	**
Market maturity	*	***

* low ** medium *** high

Fig 6: Table of Comparison between Li-Fi /Wi-Fi

SR. NO	Li-Fi	Wi-Fi
1	Data transmission takes place using bits.	Data transmission takes place using radio waves.
2	Fast speed internet (1-3.5Gbps)	Comparatively slow speed (54-250 Mbps)
3	Range is limited (10 Meters)	Extended range (20-100 meters)
4	The Spectrum range is 1000times than Wi-Fi	It has radio spectrum range.
5	It uses Point-To-Point network topology.	It uses Point-To-Multi network topology.
6	It uses light as its data transfer medium	It uses radio spectrum as data transfer medium.
7	The frequency band is 100 times of Tera HZ.	The frequency band is 2.4GHz.
8	It is cheaper because free band doesn't need license and it uses light	Expensive because it uses radio spectrum.
9	Data density is high	Data Density is comparatively low
10	Lifi is more secured	Comparatively less secured.
11	Market Maturity is low	Market Maturity is high.

11. 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 Lifi bulb will be used as Wi-Fi hotspot to transmit wireless data. As the Lifi technology will be used which will lead to a cleaner, greener, safer and bright future and environment The concept of Lifi is attracting many people as it is free to use without any license and faster data transfer. If it develops faster people will more and more use this technology instead of Wi-Fi.

12. CONCLUSION

With the growing technology and increasing use of the internet services, possibilities are very high that use of Lifi technology will be soon in practice. Every bulb will be replaced by Lifi bulbs and might be used like a Wi-Fi hotspot for the transmission of data. Using Lifi 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 Lifi 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 Wi-Fi 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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