

Li-Fi(Light Fidelity) Based on Illumination

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ABSTRACT: Li-Fi takes visible light communication (VLC) further by using light emitting diodes (LED's) it is an wireless technology that makes use of visible light in place of radio waves to transmit data at terabits per second it is more efficient and versatile can be used in sub sea level communication, hospitals, aircraft etc Li-Fi as reliable, affordable and more secure solutions. Li-Fi is based on the concept of illumination using this technique it transfer data and makes use of unused spectrum of visible light .this technology has a great potential impact on number of existing and emerging industries.

KEYWORDS: Li-Fi, Wi-Fi, illumination, RF power amplifier, spectrum.

I. INTRODUCTION

Li-Fi is the abbreviation of light fidelity and was expressed by Professor Herald Haar, the chair of mobile communications of the University of Edinburgh, is recognized as the founder of Li-Fi. He coined the term Li-Fi and is the co-founder of pureLi-Fi. He gave a demonstration of a Li-Fi prototype at the LED global conference in Edinburgh on 12th July 2011. He used a table lamp with a LED blub to transmit a video of blooming flower that was then projected onto a screen. During the talk, he periodically blocked the light from the lamp with his hand to show that the lamp was indeed the source video of data. Li-Fi can be regarded as light based Wi-Fi, i.e. instead of radio waves he used light to transmit the data in place of Wi-Fi modems Li-Fi would use transceivers filled with LED lamps that could light a room as well as transmit and receive information Li-Fi. It makes use of the visible position go the electromagnetic spectrum which is underutilized.

Transfer of data from one place to another place is one of the most important day to day activities. Li-Fi can be considered better than Wi-Fi because there are some limitations in Wi-Fi. Wi-Fi uses 2.4 to 5GHz radio frequencies to deliver wireless internet access and its bandwidth is limited to 50 to 100Mps. Wi-Fi communication is vulnerable to hackers as it penetrates easy through walls. As the number of devices that access the internet increases the fixed bandwidth available makes it more and more difficult to enjoy high data transfer rates and connect to a secure network but radio waves are just a small part of the spectrum available for transfer. A solution to this problem is by use of Li-Fi.



Fig1: Li-Fi system

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Li-Fi is transmission of data through illumination by taking the fiber optics by sending data through LED light bulb (fig.1) that varies in intensity faster than the human eye can follow. Li-Fi is the optical version of Wi-Fi. Li-Fi uses visible light instead of GHz radio waves for data transfer.

Li-Fi can play a major role in relieving the heavy loads which the current wireless systems face since it adds a new and unutilized band of visible light to the currently available radio waves for data transfer thus it offers much larger frequency band 300THz compared to the available radio frequency communications 300GHz. Also the data coming through the visible spectrum could help alleviate concerns that the electromagnetic waves that come with Wi-Fi could adversely effect the health.

Li-Fi can be the technology for the future where data for laptops, smart watches and tablets will be transmitted through the light in the room security would not be an issue because of you can't see the light you can't access the data. As a result it can be used in high security military access where RF communication is prone to eavesdropping.

Frank Deicke who leads Li-Fi development at Fraunhofer Institute for photonic Microsystems in Dreden, Germany has said that Li-Fi can achieve the same data rates as USB cables which is challenging for wireless technologies such as Bluetooth and Wi-Fi. He also cites another advantage of Li-Fi being that the latency of Li-Fi is in the order of microseconds where as that of Wi-Fi is in the order of milliseconds such increase in network traffic require significant changes in how we think of wireless communications and Li-Fi may be the change that we need.

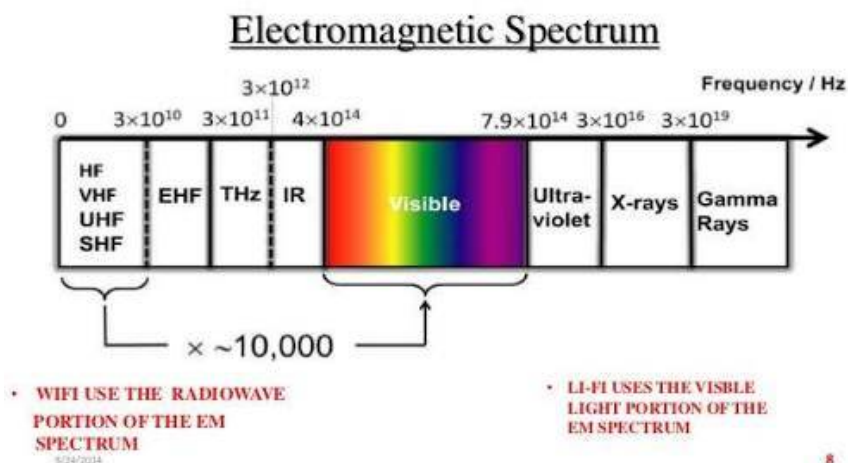


Fig2: .Li-Fi and Wi-Fi spectrum usage

II. COMPARISON BETWEEN LI-FI AND WI-FI

SI No	Basis of comparison	Wi-Fi	Li-Fi
1	Security	Not secured(can be hacked)	Secured (cannot be hacked)
2	Data Transmission Rate	Slower (uses radio waves)	Much faster (uses visible light)
3	Range	Small	Large
4	Traffic control	Less (signal become weaker as Traffic increases)	More (due to high Speed and easy Availability)
5	Where can be used	Within a range of WLAN infrastructure Usually inside a building	Anywhere Where light Source is present
6	Cost	Costly	Cheap

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7	Working concept	Various topologies	Direct Binary Data serving
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III. CONSTRUCTION OF LI-FI SYSTEM

The main components of Wi-Fi system are as follows:

- A high brightness white LED which acts as transmission source.
 - A silicon photo diode with good response to visible light as the receiving element.
- LED's can be switched on and off to generate digital strings of different combination of 0's and 1's. Data can be in coded in the light by varying the flickering rate of the light LED, to generate a new data stream. The LED can be used as sender or source, by modulating the LED light with the data signal communication rate is greater than 100Mps is possible by using high speed LED's. VLC data rate can be increased by parallel data transmission using an array of LED's.

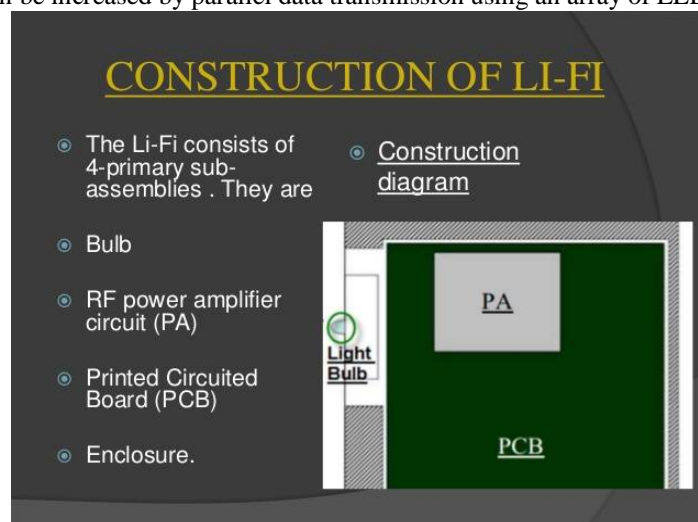


Fig 3: Block diagram of Li-Fi sub-assemblies

The PCB controls the inputs and outputs of the lamp and houses. The micro controller 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 centre, this controls plasma generates an intense source of light all of this sub as semblies are contained in a aluminum enclosure

Function of bulb assembly:

At the heart of LI-FI is the bulb subassembly where a sealed bulb is embedded in dielectric material. This design is more reliable than conventional light source that insert degradable electrodes into the bulb. The dielectric material serves two purposes first as a wave guide for radio frequency energy transmitted by 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 bulb to a plasma state that emits light of high intensity and full spectrum.

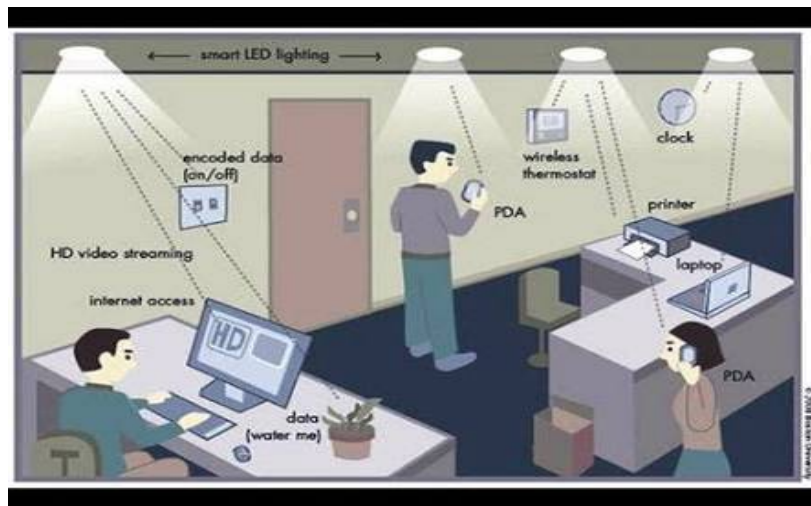
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IV. APPLICATION

1. LI-FI wireless optical communication: Visible light communication (VLC) technology, one of the advanced optical wireless communication technologies, in which light in the visible region (375nm-780nm) is used as a medium for data transmission is more secure and achieves high data rate as compared to conventional wireless technologies like Wi-Fi ,Bluetooth, wi-max etc., to overcome the shortage of bandwidth we can use light to transfer the data which can be known as “DATA THROUGH ILLUMINATION”. The idea behind is that, infra-red remote is slightly modified i.e., LED light bulb that varies in intensity which cannot be followed by human eye. if you can’t see the light then you can’t access the data so the security would be snapped.



2. Aircraft: Airlines can be deployed VLC and LI-FI technology for delivery of board band and media content on aircraft to increase data rates, eliminate wiring reduce weight and eliminate the risk of RF interfaces with avionics. Also Wi-Fi is not used because it may interfere with the navigational systems of the pilots. In aircrafts Li-Fi can be used for data transmission. Li-Fi can easily provide high speed internet via every light source such as overhead reading bulb, etc. present inside the airplane.



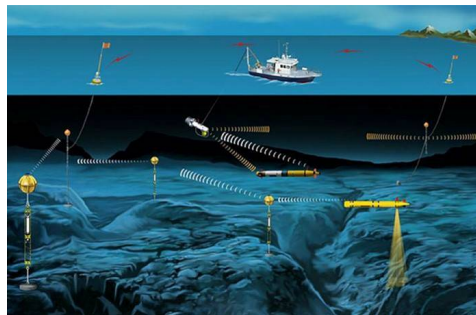
3. Integrated, under water optical/acoustic communication system: In case of WI-FI ,it is not possible to communicate through water as radio waves are quickly absorbed in water prevents underwater radio communications

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but light can penetrate for larger distances. Therefore, LI-FI can enable underwater communication. Consequently, acoustic techniques have been developed for underwater communication system and now represent a relatively mature and robust technology.



4. Traffic light: Traffic light can communication to the car and with each other. Cars have LED-based headlights, LED-based cack lights, and cars can communicate with each other and prevent accidents in by exchanging information. Using Li-Fi street lights can be used to send information about the road condition of the car.



5. Security: In a conference room the access area of each channel depends on the width of the light pool, and at the same time can be accessed by multiple users present within that environment. when we using Li-Fi, each user present in the application environment can receive higher data rate than would be the case with an equivalent Wi-Fi channel. Therefore, with minimal precautions to avoid leakage from windows, doors, etc., security is fundamentally enhanced as compared with Wi-Fi.

6. Medical Applications: Operation theatres (OTs) do not allow Wi-Fi due to radiation concerns. Usage of Wi-Fi at hospitals with the mobile and pc which blocks the signals for monitoring equipments. So, it may be hazardous to the patient's health. To overcome this and to make OT tech savvy Li-Fi can be used to accessing internet and control medical equipments. This can even be beneficial for robotic surgeries and other automated procedures.

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V.LIMITATIONS

1. It cannot penetrate through walls, which is main drawback.
2. Whenever you want to transmit for longer distance then it's power has to be increased, which will enhance the light source intensity. It may harm human eyes, skin, etc..
3. Interference with the other lights in the environment.
4. Additional hardware requirement.
5. It is not like broadcasting when the light source is laser.
6. At very high frequencies, it is difficult to get APDs.

VI. CONCLUSION

Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Since light is a major source for transmission in this technology it is very advantageous and implementable in various fields that can't be done with the Wi-Fi and other technologies. Hence the future applications of the Li-Fi can be predicted and extended to different platforms like education fields, medical field, industrial areas and many other fields. The possibilities are numerous and can be explored further. If this technology can be put into practical use, every bulb can be used something like a Wi-Fi hotspot to transmit wireless data and we will proceed towards the cleaner, Greener, Safer and Brighter future.

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