

Survey on Wi-Fi vs. Li-Fi

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Abstract: One of the most important task/ activity in our day to day life in transferring of data from one place to another place. But when connected multiple devices to the internet, the current wireless networks are very slow. Wi-Fi based on radio waves technology. When there are lots of devices connected to the internet, the fixed bandwidth techniques used in the radio waves technology, which is a small part of spectrum for data transmission, makes it more difficult to transfer data easily. The cause for the security concern for Wi-Fi is that the radio waves can easily penetrate through the walls and one can misuse it. As the bandwidth is typically limited the Wi-Fi also has some limitations like other technologies. The radio waves are restricted in particular areas like hospitals, aeroplanes, petrochemicals plant and petrol pumps. In these places we cannot connect to the internet. The Wi-Fi technology provides us with the good data transmission but it does not allow us large data like HDTV, Movies, video games and music. So, Li-Fi technology is being developed to overcome this problem. The Li-Fi technology provides the transmission of data by sending the data through the LED Light Bulb. The performance of Li-Fi technology as compare to existing other technology is primarily focused in this paper. The Li-Fi is effective for relieving radio interference issue and in confined area. As compare to Wi-Fi the Li-Fi provides the efficiency availability, security and higher bandwidth.

Keywords: Li-Fi (Light Fidelity), Wi-Fi (Wireless Fidelity), LED (Light Emitting Diode)

1. INTRODUCTION:

LIFI stands for light fidelity. This technology is very new and it was proposed by the German physicist and scientist Prof. Harald Hass along with his team member's Dr. Gordon Povey, and Dr. Mustafa Afgani and the University of Edinburgh. Prof. Harald has proposed this technology in July 2011 (TED) (Technology, entertainment and design) and Global Talk On Visible Light Communication (VLC), By referring as "data through illumination". He use the table lamp with led bulb to transmit a video of blooming flower that was then projected on to a screen For the transmission of data the Li-Fi uses wireless optical networking that uses LED. The Li-Fi is a VLC technology (Visible light communication) which deals with the transfer of data through illumination by taking fibre out of fibre by sending data through LED Bulbs. The Li-Fi

technology provides higher data speed than 10mbps which is very much faster as compare to general broadband connections. The Li-Fi is as an OWC (Optical Wireless Communication) system which uses the light from led which acts as a medium to deliver high speed networks in mobile communication similar to Wi-Fi. Both the technology that Wi-Fi and Li-Fi transmits the data over the electromagnetic spectrum and the only difference is the Wi-Fi uses radio waves and Li-Fi uses visible light. As the velocity of light is very large, because due to this the rate of transmission is very more as compare to Wi-Fi technology that uses radio waves for the transmission of data.

As the lifi technology communicates through visible lights, it has the possibility to stream videos, receive emails, and change how we access the internet and much more. As the data can't be access in the absence of light security would not be an issue. So this technology can be used in very high security military areas where RF communication is likely to eavesdropping.

2. ARCHITECTURE OF LI-FI SYSTEM:

The Li-Fi technology can be the future of data communication which can be appeared to be cheap optical version of Wi-Fi and it will also be fast. The visible light of electromagnetic spectrum ranges between 400 THz to and 800 THz as an optical carrier for data illumination and transmission. The main components of Li-Fi system consists of the following:

- a) A silicon photo diode with a good response to the visible light as the receiver.
- b) A high brightness led light bulb which acts as transmission centre.

The different combination of 1's and 0's can generate digital strength by switching the led on and off. The data can be encrypted in the line by varying the flickering rate of led to generate the new data stream. By modulating the light with the data signal, the led's work as a sender in this way. The led light appears constant to the human eye because they tend to flicker at a phenomenon speed (million times per second) which is impossible to detect this frequency to human eyes. By using the high speed led with the help of different multiplexing techniques communication rate can be achieved for more than 100 Mbps. This data rate (VLC) can be increased further to be

as high as 10Gbps through the parallel data transmission by using arrays of led lights with each led transmitting a different data stream. The Li-Fi transmitter system consists of the following 4 primary sub-assemblies:

- a) RF Power Amplifier Circuit(PA)
- b) Bulb
- c) Enclosure
- d) Printed Circuit Board(PCB)

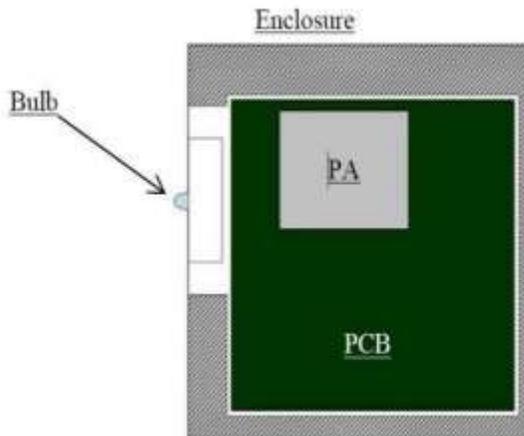


Figure 1: Block Diagram of Li-Fi sub-assemblies

The electrical inputs and outputs of the lamp houses are being controlled by printed control board (PCB). Radio frequency (RF) is being generated by the power amplifier and it is directed into electric field of bulb. The content of the bulb will get vaporized into a plasma state at bulb centre which, as result of high concentration of energy on the electric field. This vaporized plasma in return will produce an intense source of light. All the sub assembly are contained in an aluminium enclosed which shown in the figure above.

2.1 Sub Assemblies Of Li-Fi Bulb:

The main part of Li-Fi emitter is the bulb sub assembly, it consists of a sealed bulb which is embedded in a via electric material which has 2 purpose.

- a) It acts as a wave guide for the radio frequency energy transmitted by the power amplifier.
- b) It acts as an electric field concentrator that focuses energy into bulb.

The next figure shows the sub-assembly of bulb:

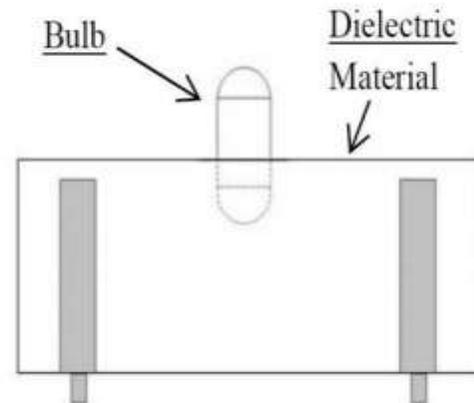


Figure 2: Bulb sub-assembly

There are some important factors that should be considered while designing the Li-Fi system. They are:

1. Line Of Side(LOS)
2. For better performance use led an fluorescent light
3. Presence of light

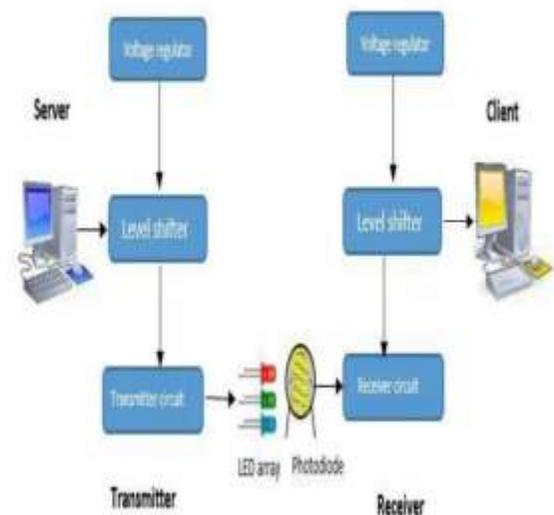


Figure 3: Construction of Li-Fi System

1. WORKING OF LI-FI SYSTEM:

The Li-Fi technology is based on the visible light communication system, which uses light for the data transmission process. The data transmission is done with high speed as the intensity of light and velocity is very high. The working of Li-Fi technology is very simple.

The Light emitting Diode (LED) which acts as a light emitter is fixed on one end and a photo sensor (Photo detector) on the other end the photo detector recognizes the binary 1 when the LED is on, and the photo detector recognizes the binary 0 when the LED is off. Flash the led multiple times to build up the message or one can use array of LED of different colour to obtain the data rate in the range of hundreds megabit per second. The data is encrypted and receive in the light by the difference of the flickering rate at which the led's flicker on and off to generate the different strings of 0's and 1's.

The led can be switch on and off quickly because light source appears constant even though it is a fact that the LED's are flickering, the intensity is modulated so rapidly that the human eye cannot detected. The on off activity of the bulb seems to be invisible, enables the data transmission using binary code:

- a) Switch ON LED: logical 1.
- b) Switch OFF LED: Logical 0.
- c) The method of using the rapid pulses of the light to transmit the information wirelessly is referred to as VLC visible light communication

The radio waves can penetrate through the walls in the Wi-Fi technology, which becomes the disadvantages in the security purpose. One can misuse this disadvantage. But in Li-Fi technology, the optical signals cannot penetrate through walls, which act as an advantage to the security purpose. The Li-Fi techniques contain 2 major components:

- a) Li-Fi router
- b) Li-Fi room connector

As we know that optical signals are unable to penetrate through walls, the rooms should be connected to one other to provide an optical WLAN (wireless local area network). This can be done using the Li-Fi room connector.

The Li-Fi room connector acts as a duplicator/replicator which sends the data from one side of the wall to another side of the wall using the fibre optic code...

The Wi-Fi router is useful, to connect to the external link. It connects the entertainment equipment and /or office & it waves a radius of 20 meters with 100 mbps of transmission speed.

The data sent in the Li-Fi system is sent using the light rather than radio waves with the 'light flame' prototype that knows which light is supposed to the receiving data frame. As we know that the LED's are the most common source used for the lighting of rooms, giving the pathway

for connecting the devices to the internet with higher speed & it also has quicker response time than Wi-Fi.

"All the component, all the mechanism exists already," Hass says. "You just have to put them together & make them work"

The fall fig. shows the block diag. of the Li-Fi system.

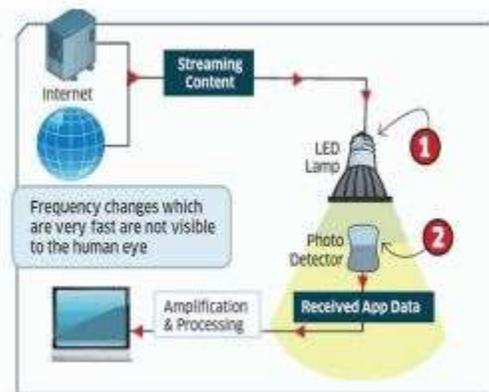


Figure 4: Block diagram of Li-Fi System

The following table shows the comparison of various wireless technologies:

Technology	Speed	Data density
Wireless(current)		
Wi-Fi-IEEE 802.11n	150 Mbps	*
Bluetooth	3 Mbps	*
IRDA	4 Mbps	***
Wireless(future)		
WiGig	2Gbps	**
Giga-IR	1Gbps	***
Li-Fi	>1Gbps	****

3.1 Comparison between Wi-Fi, Li-Fi & other radio communication technologies:

Both the Wi-Fi as well as Li-Fi technologies transmit data over electromagnetic spectrum & both can provide wireless internet access to the users. To obtain a high speed wireless communication Li-Fi is used which is a visible light communication (VLC) technology.

The difference is: Li-Fi uses the light waves the light waves whereas Wi-Fi technology uses the radio waves for the data transmission.

Wi-Fi works well with general wireless usage within campus/building/compound & Li-Fi is ideal for higher

density wireless data coverage inside an enclosed/ confined area a room and it is free from interference issues like the Wi-Fi.

The following table shows the comparison of transfer of spread of various wireless technologies:

Technology	Speed
Li-Fi	~1 Gbps
Wi-Fi – IEEE 802.11n	~150 Mbps
IrDA	~4 Mbps
Bluetooth	~3 Mbps
NFC	~424 Kbps

The following table shows the comparison of Wi-Fi & Li-Fi:

Parameter	Li-Fi	Wi-Fi
Spectrum Used	Visible Light	RF
Standard	IEEE 802.15.7	IEEE 802.11
Range	Based on Light Intensity (< 10m)	Based on Radio propagation & interference (< 300 m)
Data Transfer Rate*	Very high (~1 Gbps)	Low (100 Mbps-1 Gbps)
Power consumption	Low	High
Cost	Low	High
Bandwidth	Unlimited	Limited

4. ADVANTAGE OF LI-FI:

- a) The Li-Fi technology is based on all the kinds of light. The light can belong to ultraviolet, invisible or visible part of the spectrum, hence it does not matter in which spectrum they belong, which gives high speed for the communication purpose, games, music, downloading movies and all application more than efficient.
- b) Every street light would be free data hotspot by using the Li-Fi technology.
- c) The light bulbs need to be replaced by the led bulbs, for the proper data transmission.
- d) The Li-Fi technology is very cheap for transmission purpose, since LED consume less energy & are more efficient.

- e) The light waves cannot be penetrated through the walls which makes it highly secure from the hacking.
- f) The light has 10000 times wider bandwidth than the radio waves; hence Li-Fi gives better capacity as compared to Wi-Fi technology.

5. CONCLUSION:

The Li-Fi technology is way more advanced to the Wi-Fi as the potential for bandwidth is very high & quick response time. Every light bulb present can be replaced by LED light bulb which acts as a photo detector for the transmission of data. As it is a very cheap & faster technology, everyone can access it easily. It will be easier to transfer the data within a second, if this technology is developed. We could proceed to a cleaner, greener, safer & brighter future, if all the light bulbs are replaced by LED bulbs. It will be a great revolution in the field of technology, if this technology is been developed. The platform of shortage of radio frequency bandwidth can be reduced by using this technology. Li-Fi can offer a genuine & very efficient alternative to the airways which are getting clogged day by day. Li-Fi is enabled by digital transmission technologies

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