

Review of Light Fidelity

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Abstract— As we know Wi-Fi technology enables devices to be connected without having to constantly rewire a home whenever a device is moved around the house. However, Wi-Fi can only handle so much—and its maximum data capacity will soon be too low to connect all of these devices in the home at once. You may have already experienced this firsthand if your family likes to stream movies or television shown on more than one device at a time. To recover this problem-tested a possible solution, In 2011, Harald Hass, an engineering professor at the university of Edinburgh, invented a technology called light Fidelity or Li-fi. Instead of using Radio waves to communicate, Li-fi uses visible light. It means Li-Fi can use white light for data transmission by using LED bulbs which having high intensity and variations that human eye can't follow it.

Key words: Li-Fi, Wi-Fi, Visible Light Communication (VLC)

I. INTRODUCTION

Li-Fi is a light fidelity. There is various numbers of wireless technologies that can be used to transfer data from one place to another, there no need to wired architecture. The Bluetooth, infrared, Wi-Fi, IrDA Wi Gig Giga-IR are the existence of wireless technology which are previously most popular. Wi-Fi is now a day much more popular, Bulb Wi-Fi having many limitation for it used. It uses Radio wave as Electromagnetic waves to transfer data. This Radio waves having limited band frequency, Increasing used of this waves are harmful to human body. Wi-Fi work for short distance provides better performance, but if we connect more devices in Wi-Fi network, then quality of network is degraded. That means speed of network of transferring data is too low. [1],[4]

To overcome this problem, the Solution is Li-Fi. Li-Fi stands for Light fidelity technology.

The Basic ideology behind this technology is that data can be transfer through illumination.

Li-Fi is invented by German physicist prof. Harald Hass, from the university of Edinburgh "data through illumination" taking the fiber out of fiber optic by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. This idea same as infrared remote control too more powerful. This brilliant idea was first discover by Harald Hass, in his LED Global talk on VLC. The Li-Fi used visible light (Instead of Radio wave) as transmission medium. Li-Fi provide wireless indoor communication.

Hass Explained, "very Simple, if LED bulb is ON, then it Transmit digital '1' and if LED bulb is OFF, it transmit digital '0'. [1]



Fig.1: Li-Fi Bulb

This LED bulb is made up of using of semiconductor material or LED's having very cute & nice properties. It provides High intensity of light and it flickering very faster than human eye cannot follow. By using this property we can transmit data through LED High intensity bulbs. In Li-Fi architecture it means more LED's more data can be transferred, It transfer data in parallel. Li-Fi (Light Fidelity) is bidirectional, higher speed, cheaper, low cost and fully networked wireless communication technology. [8]

Wi-Fi IEEE 802.11n standard provide maximum 150Mbps speed. But Li-Fi provide than 1Gbps speed for data transmission. Li-Fi is 100 time faster than Wi-Fi we need to note that following points to designing of Li-Fi-

- 1) Presence of Light
- 2) Line of Sight
- 3) For better performance used high intensity LED. [4]

II. HISTORY

Harald Haas, an Engineering professor, who teaches at the University of Edinburgh in UK. He coined term "Li-Fi" Light Fidelity at his TED Global talks 2011, where he introduced idea of "wireless data from every light." He is chair of mobile communications at the University of Edinburgh and co-founder of Pure Li-Fi. [1] Li-Fi technology has a possibility to change how we access the internet, stream videos, receive mails and much more. The technology truly began during the 1990's in countries like Germany, Korea and Japan where they discovered LED could be retrofitted to send information. This type of light would come in familiar from such as infrared, Ultraviolet and visible light. Number of industries and companies formed Li-Fi Consortium in October 2011, to promote high-speed optical wireless system. They believe using this technology (Li-Fi) can achieve more than 10Gbps speed. [1]



Fig. 2: Prof. Harald Haas

III. CONSTRUCTION OF LI-FI SYSTEM

Li-Fi is fast, cheap, bidirectional, high speed, and fully network wireless communication technology. Li-Fi is optical version of Wi-Fi. It is the best one visible light communication (VLC). VLC is a data communication medium, VLC uses light frequency between 400 THz (780nm) and 800 THz (375nm) as an optical carrier for data.[10]

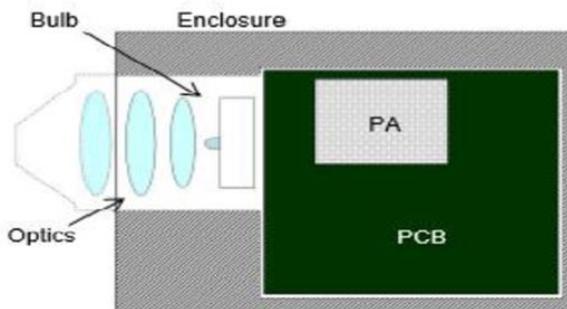


Fig. 3: Block diagram of Li-Fi.[10]

It uses a fast pulse of variation in amplitude of light to transmit information wirelessly.

The component of Li-Fi system is as follows:-

- 1) Transmission source- High intensity LED bulb
- 2) Receiving Element- Silicon Photodiode with better response to visible light.

To generate digital string of different combination of 1's & 0's by switching ON, OFF LED.

To generate the new data stream, data can be encoded in light by flickering rate of LED.

LED can be used as a sender or source, by modulating the LED light with data signal by using various multiplexing techniques with high speed LED.

It is possible to achieved communication rate greater than 100 Mbps due to parallel data transmission VLC data rate can be increased.

Li-Fi is emitter system having 4 Parts :

- 1) LED bulb
- 2) RFPA (Radio Frequency Power AmplifierCircuit)
- 3) PCB (Printed Circuit Board)
- 4) Enclosure.

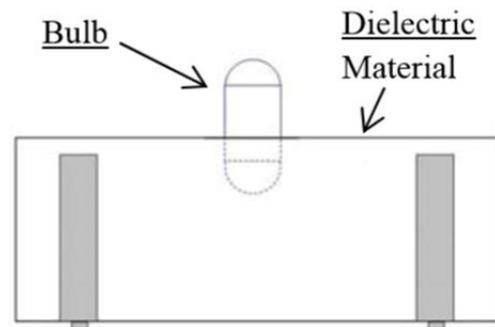


Fig. 4: LED Bulb sub-assembly.[10]

The PCB controls the input and output lamp. Microcontroller used to manage different lamp functions. Solid state amplifier circuit generate radio frequency (RF) signal. Is guided into an electric field about the bulb. The higher concentration of energy in electric field vaporizes the contents of the bulb to a plasma state at the bulb center; all of this sub-assemblies (shown in fig.4) are contained in an aluminum enclosure. [10]

IV. WORKING OF LI-FI SYSTEM

Now day to day life the wireless devices increasing rapidly, there is need to large or strong network to handle this number of wireless devices.

Li-Fi is high speed, large bandwidth, fully network technology which works on light to transfer data.

Prof. Harald Haas says " It's very simple, if LED bulb is ON ,we send digital '1', if LED bulb is OFF ,we send digital '0'.for sending of a data stream we used this technology. High intensity LED bulb is used controller is also connected at the backside of this LED bulbs to code data to this LED'S. Bulb can be switched ON and OFF very quickly that human eye can't notice. This LED is a flickering very fast than human eye, so it look appears like continuously.

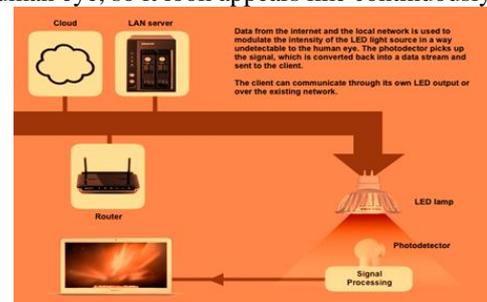


Fig. 5: Working of Li-Fi System.

For communication it uses VLC.The light source is LED lamp which emits light. In another end there is a receiver that contain photo detector which detects light source and decode the data signal. In Li-Fi system transceiver-fitted LED lamps used. It can glow in room as well as send s and receives information.[9]

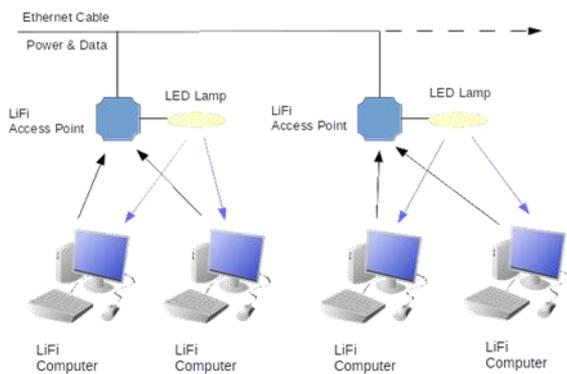


Fig. 6: Li-Fi Architecture

V. PROBLEMS IN WI-FI

1) Capacity:

Radio frequency having limited band and expensive band .as technology developing fastly like 2G, 3G, 4G, 5G so on. So capacity of RF is one of the major issues for data transmission

2) Efficiency:-

Efficiency is only 4-5% only because most of energy wastes for cooling down base station.

3) Availability:

High security and sensitive zone we cannot able to used radio waves like aero planes, petrol pumps or petrochemical plants.

4) Security:-

Radio wave can pass through all so any area can access network they may misuse it. This caused major security concern for Wi-Fi.

VI. ADVANTAGES OF LI-FI

Li-Fi used LED or light source for the transfer of data. It can be done by all kind of lights, that is light can belong to the invisible ultraviolet or the visible part of spectrum.

Also Li-Fi removes limitation by the Wi-Fi.

1) Capacity

light have to large band limit i.e. 10,000 times larger than radio waves.

2) Efficiency:

LED consumes less energy & highly efficient no need to any cooling system.

3) Availability:

Light is present everywhere & light used in aero plane also no interface occurred.

4) Security:

Light cannot pass through wall so, if we see light then we can access network that means no light, no network access so it is more secure.

Some of the other advantages:-

- 1) Light source is freely available No need to purchase it.
- 2) Low maintance cost.
- 3) Li-Fi is cheaper than Wi-Fi.
- 4) d)Li-Fi provides higher speed greater than 1Gbps, so communication of data is fast and easy.
- 5) It cannot passed through wall: secured network.
- 6) Work underwater: military purpose.

VII. DISADVANTAGES OF LI-FI

- 1) Light can't passed through object if you see light then and then only we can access.

- 2) It need to line of sight
- 3) It provides only Indoor Communication.
- 4) Reliability & network coverage are major issues.
- 5) Wi-Fi enable devices in open air but Li-Fi in open door Interference from external light source like sum light or Normal bulbs.

VIII. APPLICATION OF LI-FI

There is numerous application of this technology from public Internet Access through street lamps to auto-piloted cars that communicate through their headlights. This technology can be applicable for medical technology, power plants and various other areas.[2]

Future applies of Li-Fi are as follows:

1) Education Systems:

In advancement of science & Technology Li-Fi provide high speed or fast communication with multiple devices, so this will leads to the replacement of Wi-Fi of Institution & companies so all will can enjoy same speed of Internet.

2) Health care Centre & Hospitals –

In operation theatres do not allow Wi-Fi due to radiation concern. Other Wi-Fi wireless devices Interferes and block the monitoring equipment health to overcome this problem we can use Li-Fi.

3) Easy available in Aircrafts:

In aircrafts get low speed Internet at very high rate and also much time Wi-Fi is restricted, because it may interfere with the navigational system of the Pilot.[8] Li-Fi can easily provide high speed Internet via Every light Source present inside the internet.

4) Undersea application :

Li-Fi can even work under water where Wi-Fi completely fails.[8] There by throwing open endless opportunities for military operations.

5) Traffic Management

In Traffic signals & street LED lights of the cars which can help to manage traffic & also useful for reducing number. Of accident, Also LED car lights alert to drivers when vehicles are too close.[8]

IX. CONCLUSION

These technology having many grateful and future application which are applicable in future implementation.by comparing this technology with other technology there are far difference between us. Li-Fi is high speed, cheap, fully and bidirectional fulfilled technology. If this technology can be put into practical use , every bulb can be used something like a Wi-Fi hotspots to transmit wireless data.[3]

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