

Future of Visible Light Communication with Li-Fi Technology: A Review

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Abstract- Light Fidelity (Li-Fi) refers to the 5G Visible Light Communication systems using light-emitting diodes as a medium for high-speed communication in a similar manner as Wi-Fi.^[5] As now a days where internet has become a major demand, people are in a search for Wi-Fi hotspots for their activities. Li-Fi is a better alternative to Wi-Fi in wireless communication as it is^[1] bidirectional, high speed and fully networked wireless communications similar to Wi-Fi. It is a subset of visible light communication(VLC) and can be a complement to RF communication, or a replacement in contexts of data broadcasting. This paper proposes a survey on Li-Fi Technology. Li-Fi has more capacity in terms of bandwidth in visible region therefore it does not interfere in other communications which uses radio frequency range, without taking its frequency bands. It has thousand times greater speed than Wi-Fi. Such technology has brought not only greener but safer and cheaper future of communication.

Index Terms- Li-Fi Technology, Radio Frequency(RF), Wi-Fi Technology, Visible Light Communication, Wireless Communication

I. INTRODUCTION

The concept of Li-fi is currently enticing a great deal of interest, not least because it offers a unpretentious and very efficient alternative to RF. As a growing number of people and their recent device access wireless internet, the airwaves are becoming increasingly clogged and unavailability of free bandwidths to every device, making it more and more difficult to get a reliable, high speed signal. The opportunity to exploit a completely different part of the electromagnetic spectrum is very alluring. As Li-fi is the transmission of data through illumination by taking the fibre optics by sending data through a LED light bulb. Li-Fi has other advantages over Wi-Fi, such as safe to use at nuclear power plants, thermal

power stations where Wi-Fi cannot be used.^[5] In such stations RF waves can be harmful and can cause accident, to communicate in such regions only visible light spectrum can be safe. Apart from adverse regions Li-fi can also be used in all places where Wi-Fi can be used. Li-fi is present wherever there is availability of light, in turn eradicating the necessity of having hot-spots only at selected places. There are four criterions to judge on the working of Li-Fi and Wi-Fi that is, capacity, efficiency, availability and security. Both Li-fi and Wi-Fi uses electromagnetic spectrum for data transmission, but whereas Wi-Fi utilizes radio waves, Li-Fi uses visible light communication in the range of 100Mbps. The present paper deals with the Li-Fi (part of VLC), which provide a wide and fast data rate like 500Mbps^[5]. In this paper, the comparison is made between Wi-Fi, Li-Fi technology and Bluetooth. This paper also discusses the working, future scope, real time usage, Limitations and Advantages in Li-fi technology.

II. HISTORY OF LI-FI

The technology supporting Li-Fi was initiated by German Physicist Harald Hass, currently based at University of Edinburgh in UK. Hass coined the term Li-Fi(Light Fidelity) in 2011 in the context of a talk presenting the new technology at the TED (Technology Entertainment and Design) Global conference.^[1] The word quickly entered common dialect as an instantly recognizable alternative to Wi-Fi. Both terms are examples of abbreviations polyglots sometimes describe as clipped forms(i.e. Wi-Fi=wireless fidelity, Li-Fi= light fidelity).^[1] Haas's research project, originally known as D-light(short for Data Light project at Edinburgh's Institute for Digital Communications was funded from

January 2010 to January 2012)is now set to launch a prototype Li-Fi application under the name of newly-formed company VLC(Visible Light Communication) Ltd., which was setup to commercialize the technology.^[2] VLC technology was exhibited in 2012 using Li-Fi.^[7] By August 2013, data rates of over 1.6 Gbit/s were demonstrated over a single color LED.In September 2013, a press release said that Li-Fi, or VLC systems in general, do not require line-of-sight conditions.In October 2013, it was reported Chinese manufacturers were working on Li-Fi development kits.^[5]

In April 2014, the Russian company Stins Coman announced the development of a Li-Fi wireless local network called BeamCaster. Their current module transfers data at 1.25 gigabytes per second but foresee boosting speeds up to 5 GB/second in the near future.^[5]

III. FUTURE SCOPE OF LI-FI

The Li-Fi technology can be used for various purposes, it matters the data transmission through LEDs thus all the screens which illuminate light can be served as a platform for data communication. The screen of the mobile phone, television, bulbs can act as a source of light. On the other hand, the receiving platform, the photo detector can be replaced by a camera in mobile phone for scanning and retrieving data. Its other applications are Li-fi for desktops, smartcard Li-fi, Li-fi for schools, hospitals, Li-fi in cities, smart guides, museums, hotels, fairgrounds, events indoor and LBS(Location-based Services), access control and identification crisis, malls, airport and dangerous environments like thermal power plants^[7]It also has the advantage of being useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power plants without causing electromagnetic interference.

IV. REAL TIME USAGE OF LI-FI

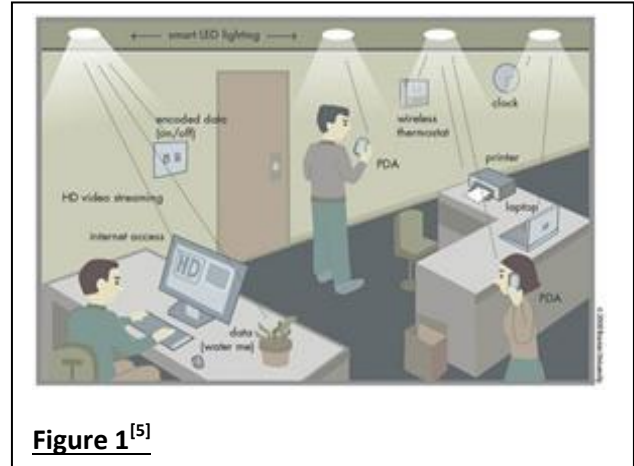


Figure 1^[5]

Fig. 1 shows the real time use of Li-Fi Technology. Li-Fi can be used at the place of Wi-Fi for internet connection to all devices. It is also very useful for communication between two devices for data transfer and other type of connections.It's provides the very fast speed for internet access and streaming purpose and also very fast and secure data transfer between the devices.So the Li-Fi Technology is very useful for general use like at the place of Wi-Fi and Other wireless technologies for data transmission or internet access.

V. WORKING OF LI-FI

The functioning of new Li-Fi technology is just simple. You will have a light source at one end like a LED and a photo detector (Light Sensor) on the other end. In figure 2, procedure of Li-fi technology is shown.

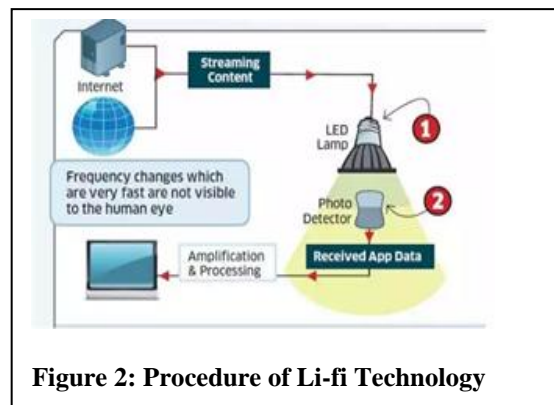


Figure 2: Procedure of Li-fi Technology

As soon as, LED starts glowing, photo detector or light sensor on other end will detect light and get a binary 1 otherwise binary 0.

As we know that any data can be transmit or received in terms of digital signal (0 or 1).Then we can convert the data into 0 and 1 after that it can be transmitted received by the Li-Fi Technology easily.Data transmission rate can be depends upon the intensity of the light of the LED used in the system or intensity of light depends upon the power of the electric voltage. It also depends upon the frequency of the input or output signal.



Figure 3: Model of LED

Figure 3 is the model of li-fi led lights, on a more general level; Li-Fi might be used to extend wireless networks throughout the home, workplace, and in commercial areas. Li-Fi is restricted by line of sight, so it won't ever replace Wi-Fi, but it could augment it nicely. Instead of trying to find the perfect sweet spot for your home's Wi-Fi router, it would be much simpler if every light in your house simply acted as a wireless network bridge. [16]While Li-Fi is still in its early stages, the technology could provide an alternative to using radio waves for wireless Internet access. Currently, household Wi-Fi routers and mobile telecommunication towers depend on radio signals to send data wirelessly. But the amount of radio spectrum is limited.^[7]

VI. HOW LI-FI IS DIFFERENT FROM OTHERS

Li-Fi technology is based on LEDs for the transfer of data.The transfer of the data can be with the help of all kinds of light, no matter the part of the spectrum that they belong.That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum.^[5]And also Li-Fi not uses the the RF

bandwidth then problems related to bandwidth are not present.

As we know that the VLC has a great advantage as compare to other technologies for communication like in terms of speed and security.Then Li -Fi is also differ from other technologies .Noise and interference of other radio waves are also not present then it's provides better quality .

VII. COMPARISON BETWEEN LI-FI,WI-FI AND BLUETOOTH

Table 1: Comparison Table

| <u>CHARACTERISTICS</u> | <u>Wi-Fi</u> | <u>Li-Fi</u> | <u>Bluetooth</u> |
|-------------------------------|----------------------|-----------------------------|--|
| Speed | High | Very high | Low (in comparison) |
| Range | 100metres | Based on light fittings | 10metres |
| Power consumption rate | moderate | moderate | low |
| Data transfer rate | 11Mbps | >1Gbps | 1 Mbps |
| Security | Not properly secured | Highly secured | It lies in the hand of the user.So it's quite unsecured. |
| Cost | Medium | Low | Medium |
| Primary application | WLAN | Wherever light is available | Between devices |
| Frequency | 2+5G | NO | |

| | | | |
|------------------------------|---------------|---------------------|---------------|
| | Hz | frequency for light | |
| Operating band | RF Band | Visible light band | ISM Band |
| Standard | IEEE S02.1 1b | IEEE SO2.1 5 | IEEE 802.15.1 |
| Development started | 1990 | 2011 | 1994 |
| Ecological impact | high | Low | low |
| Obstacle interference | Low | high | high |
| Market maturity | High | low | moderate |

VIII. LIMITATIONS

- Wherever there is unavailability of light, li-fi cannot work. Also, it cannot work if it's raining.
- Visible light waves cannot penetrate walls.
- It can not be used for long distance transmission.
- Due to sunlight and other sources of light, there can be variation in the desired results.

IX. CONCLUSION

In this paper, we have given a review on Li-Fi technology. With this Li-Fi technology, we can see that Li-Fi is an advanced approach on design, having the best design of internet by largely reducing the size of device which transfers data implementation- by means of having more than 1.4 million light bulbs all over the world if replaced by such LEDs can provide feasible access, and last but not the least enormous applications compared to any other networks in various fields which cannot be concocted by on use networks. Although there are some shortcomings, but can be eliminated by careful further research. Li-Fi has provided a step forward development in the world of growing hunger

communication, this is safe to all biodiversity including humans and progressing towards a greener, cheaper and brighter future of technologies.^[6] And also with the advance upgradation it's also helpful in 4G & 5G technologies and broadband technologies. In future it's a most demanding and valuable technology for the VLC communication and also helpful for Optical Fiber Communication.

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