

LiFi: Introduction, Advantages, Drawbacks and Applications

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Abstract - In today's era where everything is connected to one another via the internet, the internet is the backbone of major industries, finance, healthcare, transportation etc. This calls for more reliable, efficient and faster connectivity solution. LIFI is a one-stop solution to these issues providing more bandwidth, more reliability, security and faster connectivity (up to 10 Gbps), wider accessibility. It also solves issues of RF Interference as it uses VLC (Visible Light Communication) over RF. This paper discusses the working, application of LIFI, its drawbacks & advantages.

Key Words: Light Fidelity (LiFi), telecommunication, wireless broadband, VLC technology

1. INTRODUCTION

The concept of using visible light as a communication medium is not a new one. In 1880, Alexander Graham Bell invented a device called Photo phone, which transmits signal through beam of light. In this device, he implemented sunlight and used a modulation mechanism of vibrating mirror on a parabolic mirror as a receiver.

Social media becomes a huge and an effective tool for any purpose to achieve a goal. Since now on, almost everyone has account to at least one of social media. Then it is used for any campaign, business, entertainment and also government uses it for official page to give information to all citizen. A survey result concludes that Facebook has been being a king of social media with 1.590 billion active users all around the world. On the other hand, another survey says that traffic for internet video has been increasing 48% per year which is supported with video services such as Netflix and YouTube, and now they share 50% of internet traffic. It shows that data traffic and video traffic will continue increasing in line with people lifestyle who spend their time to internet contents.

According to data, total number of internet users in world are 5.11 billion (as of 2019) In fact, survey conducted in 2019 also says 3.26 billion people use social media on mobile devices in January 2019, with a growth of 297 million new users representing a year-on-year increase of more than 10 percent. This is quite a huge number of internet users, unfortunately it is not in line with internet connectivity in some areas such as basement, lift or room and rural areas as well which still cannot be established. Global average internet speed is just 28 Mbps, but with growing demand of internet users and increase in online content and services we need to upgrade the infrastructure to accommodate new users and make more space and faster access for existing users to fulfill market demands.

Internet infrastructure is one of the main parts of whole system and is a backbone of modern economy and society making it essential to bring good internet connectivity, and it should be concerned along with the very fast growth of internet user's demand. Almost 60% internet users are using mobile access for their connection. It means that wherever they are, they need to be connected to the internet. That is why nowadays Wireless Fidelity (WIFI) is utilized in many, both paid and free, hot spot areas, whereas the number of internet users increases then it affects the traffic much heavier and consecutively reliability will be decreased.

Due to escalating and expanding wireless network traffic there is need for greater bandwidth and spectral relief. Some telecommunication industries have deployed fiber optic as backhaul and spreading Fiber to The Home (FTTH). Thus, in the near future, all of these can support the Visible Light Communication (VLC), which utilizes the advanced modulation bandwidth of Light Emitting Diodes (LEDs) to transmit data.

In this context, we can say Li-Fi can turn out to be a major implementation of VLC. In simple words, it can be said Li-Fi can be referred as optical version of Wi-Fi which will be faster, cheaper and more secured than existing wireless technologies. Data transmission through Li-Fi can actually meet up the exponentially increasing wireless traffic demand.

1.1 LiFi

WIFI and mobile communication operated on radio frequency which has limitation on capacity, in the near future will be burdened much heavier traffic density of data transmission then eventually going to be overwhelmed in providing it services. If no one concerns about this problem, spectrum crunch will happen in line with emerging Internet of Things (IoT) which needs big connection.

Dr. Harald Haas, who has idea of LIFI and “LED-based Li-Fi could reach data rates of 10 Gb/s”-said by Dr, Harald Haas. It uses light wave spectrum which not yet utilized, with narrow spectrum it has no limitation for bandwidth. The main reason to choose light is because of harmless biological and environmental effect and widely available as an infrastructure globally. If we compare to Wireless Fidelity which uses radio wave spectrum, Light Fidelity (LIFI) has much higher speed and broader spectrum. Beside it is more secure than WIFI because we can see the network territory and difficult for hijacking.

1.2 Functioning of Li-Fi

LED as light source has a very potential opportunity to be developed and will work as a hub for data transmission since it can be flickered faster than human eye can detect. All the data will be streamed to a lamb driver and flickering activity converts the data into binary codes. Led’s light received by the phototransistor and it will trigger the output depending on the received light. Furthermore, depending on the output voltage of photodetector micro-controllers gives the output by comparing the voltage. And then MATLAB is used on receiver side to get original final output image.

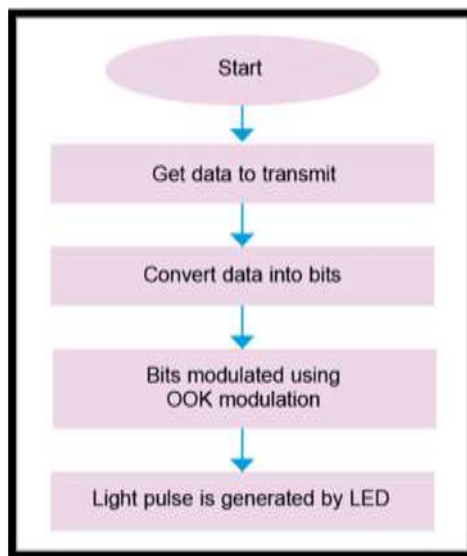


Fig-1: Trnasmission of data using LiFi

<https://electronicsforu.com/technology-trends/tech-focus/li-fi-data-transfer-applications>

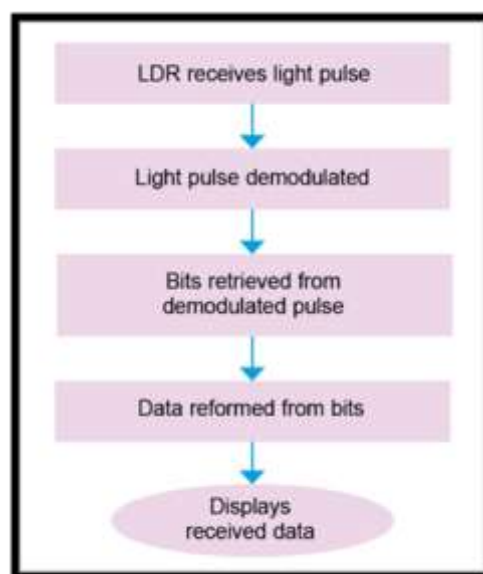


Fig-2: Reception of data using LiFi

<https://electronicsforu.com/technology-trends/tech-focus/li-fi-data-transfer-applications>

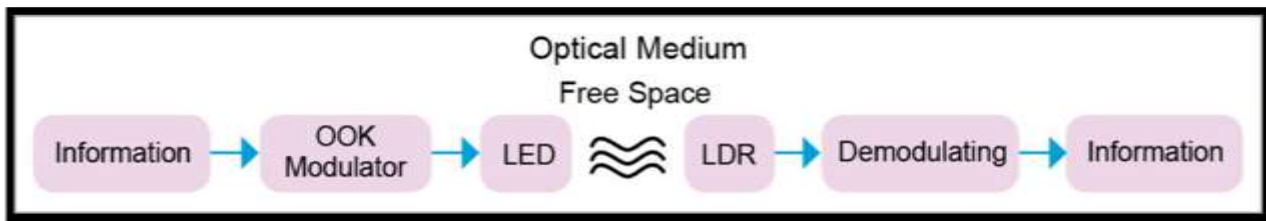


Fig-3: Data transfer process using LiFi

<https://electronicsforu.com/technology-trends/tech-focus/li-fi-data-transfer-applications>

2. Application of LiFi

- Healthcare Field:

Using radio waves for wireless technology in hospital can make harmful in operating rooms and interference with medical equipment in hospital. Thus, LiFi may become a solution because it harmless and larger spectrum.

- Aviation Industry:

When we use airplane, we must turn on flight mode to reduce interference of radio waves, but by utilizing lamp on airplane we can use LiFi for communication.

- Chemical Industry:

Chemical or petrochemical industries is sensitive to frequencies harmful. LiFi based on visible light communication can utilize lamp on industry for transmission.

- Office and Institute Use:

We are presently using Wi-Fi in office and education institute for data transmission and internet access, which is limited in bandwidth. Thus, we can adopt LiFi to existing lightening system to communicate at the speed of light without worrying about bandwidth.

2.1 Potential Applications

- Hospital

In hospitals, emergency situation occurs very frequently and this may threaten patient's life. It is very time-sensitive for responsible personnel to react to the emergency calls. Many hospitals are using WIFI to assist the activities of data transmission connections. WIFI which uses radio waves is actually contrary to the conditions in the hospitals filled with medical equipment which cause interference with radio waves. Using LiFi, wave interference and harmful body can be avoided, furthermore data transmission for the purpose of patient information as well as hospital management information sharing can be conducted with much higher speed than WIFI.

- Indoor Communication

Global 2014 Ericsson Consumer Lab study of 23 countries established that consumers spend 77 percent of their day indoors. It means that many people who connect to internet and enjoying internet activity mostly conducted indoor. For more, many hotspots are deployed in building area to cover internet connectivity and supporting fixed broadband which has not yet cover wider area. With many hot spots, wave interference is easy to happen, bandwidth limitation will also happen in line with heavy traffic. And all of this connectivity mostly is just supported by Base Transceiver System which means power loss to cover both indoor and outdoor communication will increase sharply.

By the fact of indoor activity, all buildings and offices have well equipped with lighting system and it always on even in daylight. With the incoming of LiFi technology, the light does not just have a function as lighting but can also be functioned as a data transmission. With this technology, we can create indoor optical wireless network by using existing lighting system which already set up on buildings. Bring LiFi for indoor communication, not only reducing waves interference in a room but also reducing power loss of BTS (Base Transceiver Station). So, BTS can be focused to cover outdoor communication for power

efficiency. Besides it can be an opportunity to make new business for Power Line Communication Hybrid with Fiber Optic Communication, Electricity Company has possibility to be a telecommunication provider as LiFi using light electricity in buildings.

- Transportation

Traffic congestion problem is a phenomenon which contributed huge impact to the transportation system in a country. This causes many problems especially when there are emergency cases at traffic light intersections which are always busy with many vehicles. The traffic control system in most countries has not been equipped with appropriate method when emergency case occurs. Most traffic lights in big city of world have used LED lamp. This can be used for vehicle-to-vehicle and vehicle-to-roadside communications. This can be applied for road safety and traffic management purposes.

Public transportation in most countries somehow has no stability of internet connectivity. Communication on public transportation such as train or bus come from handover processed by nearest Base Transceiver Station (BTS) while moving. The unstable of handover process causes latency and/or missing signal in some area or sometimes blank spot. On the other hand, this process needs high power to back up transmission data inside the vehicle. So, LiFi can be one of solution for transmission inside the vehicle by using lamp and radio waves covered transmission outside the vehicle. By balancing several technologies, it can reduce power consumption for BTS and make better connection to achieve customer satisfaction for internet connection service.

- Airplanes

Whenever we travel through airways, we face the problem in communication media, because the whole airways communication is performed on the basis of radio waves. To overcome this drawback on radio waves, Li-Fi can be used.

3. ADVANTAGES

LiFi is 100 times faster than WIFI.

It has wavelength ranges from 780nm to 375nm.

It is bi-directional.

It has a speed of up to 224 Gbps (in laboratory) using suitable modulation techniques.

3.1 DRAWBACKS

Range of communication is limited as light cannot pass through opaque object or obstacles.

It can't cover a large area as that of radio waves.

It can get affected by external light interference like sun, normal bulbs.

The implementation cost of VLC system is high.

4. FUTURE SCOPE

As light is everywhere and loose to use, there's a remarkable scope for the use and evolution of LiFi generation. If this technology becomes mature, each bulb can be used to transmit data. As the Li-Fi era will become famous, it will result in a cleaner, greener, more secure communications and feature vibrant destiny and surroundings. The idea of Li-Fi is deriving many humans as it's far free (require no license) and faster means of information transfer.

CONCLUSION

We have chance to develop LiFi as this technology brings much wider spectrum and bandwidth, more secure, more cost efficient, more environmentally friendly. Hospital, indoor communication and transportation sectors can become the right fields for the development of LiFi system, as hospital is critical place which needs more secure condition to avoid harmful and medical equipment interference. Building, where lighting system is utilized, can reduce wave interference and spectral relief. Furthermore, in the transportation field, the LiFi implementation may be developed as vehicle to road side communication or communication inside the public transportations by utilizing the lighting system inside.

All sectors have their own impact to each field. But the most important thing is, visible light wave spectrum is much wider than radio wave, it offers much more bandwidth capacity and it is not yet utilized as a communication media. This excess can answer a variety of problems that arise about the spectrum crunch, wave interference, etc. The emerging technology LiFi which uses VLC utilizing LED lamp as media transmission becomes an opportunity for human history to create many innovations on several sectors. LiFi is one of the best solution candidates which brings green technology even green networking.

REFERENCES

1. Harald Haas, 'Wireless data from every light bulb', TED Global, Edinburgh, July 2011.
2. S. Rajagopal, R. Roberts, Lim S.-K., "IEEE 802.15.7 visible light communication: Modulation schemes and dimming support" IEEE Communication Magazine, vol. 50, no. 3, pp. 72-82, Mar. 2012.
3. H. Haas, L. Yin, Y. Wang, C. Chen, "What is LiFi?" Journal of Light Wave Technology 2015.
4. D. Tsonev, S. Videv, H. Haas "Light Fidelity (Li-Fi): Towards AllOptical Networking", SPIE 9007, Broadband Access Communication Technologies VIII, 900702 2014.
5. N. Sklavos, M. Hübner, D Goehringer, P. Kitsos "System-Level Design Methodologies for Telecommunication", Springer International Publishing Switzerland, pp. 28, 2014
6. T. Koonen, J. Oh, K. Mekonnen, Z. Cao, E. Tangdionga "Indoor Optical Wireless Communication using Steered Pencil Beams" Journal of Lightwave Technology, Vol. 34, Issue 20, pp. 4802-4809, 2016