International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 07 | July -2020 ISSN: 2582-3930

LiFi - Applications and Challenges

Mr.Gaurang Tandon [1] - Student MCA

Dr.Devesh Katiyar[2] - Assistant Professor

Mr.Gaurav Goyal[3] - Assistant Professor

Dr.Shakuntala Misra National Rehabilitation University, Lucknow-226017

Abstract-In this modern age of high end devices and high bandwidth communication the issues such as spectral overloading are increasing. With the modernization in LED business, LiFi is primarily used for indoor networks and is a useful substitute for the prevailing radio RF based network setups. Due to its potential to perform functionality of both lighting and networking, LiFi is attracting industrial ad also educational researchers. LiFi networking provides with enhancements in performance which may build it as an attractive optional choice to be used on networking of IOT infrastructure and its indoor capabilities create it as a good alternative for big scale indoor communication in upcoming next generation wireless networking surroundings. In this paper we discusses basic applications of LiFi communication system and shows the challenges that it is.

I. INTRODUCTION

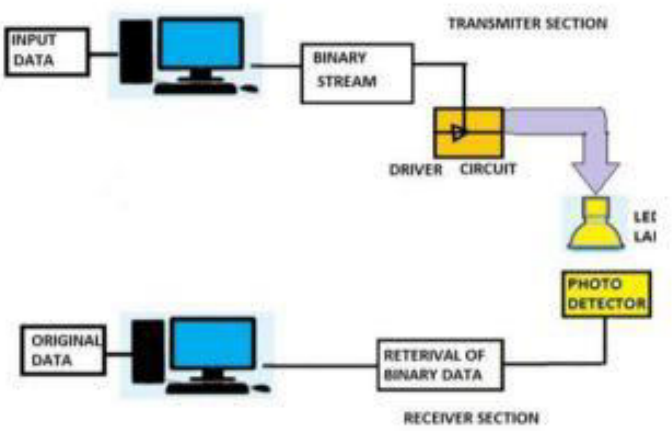
Light fidelity or LiFi is amongst the new and emerging field of optical wireless communication that gives a chance to push forward toward higher frequencies in EM spectrum by employing a visible light spectrum. The emerging usage of LEDs and its ability to perform dual functions of illumination and as communication has provided an opportunity for indoor lighting and wireless communication system to emerge. LEDs have a capability to change intensity of light at an extremely rapid rate, this capability is utilize for sending data across the visible light spectrum.

Apart from fast blinking rate at various intensity of light LEDs even have high life. They're energy economical and a decent choice to be used for indoor due to lower generation of warmth. These advantages let the LEDs to be an ideal selection for a replacement technology known as LiFi which may be helpful for indoor communication and might even give a backup for wireless fidelity technology. LiFi can also be categorized as nm-wave communication as it uses higher band of frequencies within the spectrum for prime speed digital communication. LiFi can also be used as a multi user wireless network as it can on operate user's wireless network than can operate simultaneously time along with WiFi and LTE. It's an eco-friendly communication methodology as it reuses the prevailing lightning infrastructure.

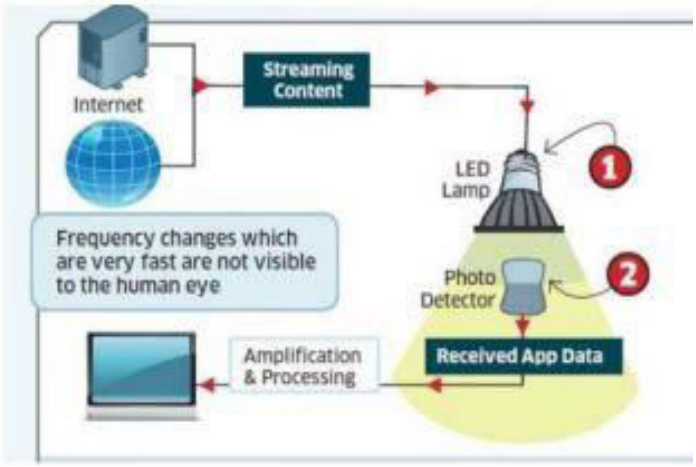
II. HISTORY

The technological set of ideas for LiFi was introduced at University of Edinburgh situated in UK by German Physicist named Harald Hass. Haas used the term LiFi in 2011 at the TED Conference presenting new technologies. Haas's research project prior known as D-light abbreviation for Data Light, is set to launch a prototype LiFi application under the name of VLC Ltd., setup to financially gain from the technology. LiFi can be used in multiple areas, it uses LEDs for data transmission, and thus any screens which uses LEDs to illuminate light can serve as a point for emission of data for communication. The screen of the mobile phone, television, bulbs can act as a source of light. The photo detector of any type such as camera setup in a mobile phone can be used for scanning and retrieving data and act as the receiving platform. Its other applications include use if LiFi in schools, hospitals, smartcards, desktops, LiFi in smart cities, museums, hotels, hostels, fairgrounds, indoor events, dangerous environments like thermal power plants, malls, airport, etc.

III. LiFiWORKING



The working of the LiFi technology is easy to understand. There is a light source at one point supposedly a LED and at the other end point a photo detector supposedly a Light Sensor or camera. A VLC light source might comprise of either a fluorescent bulb or a LED bulb. As a robust LiFi network system needs light output rates to be high, LED bulbs are considered as the most ideal one for implementation of LiFi. Also, LED blub is a semiconductor light source, meaning that LED bulbs can amplify the intensity of light and rapidly switch between. Thus modulating thousands of signals not visible to naked human eye. At the other receiving end, the fluctuations in the intensity of light from the source are interpreted and converted as electrical current by the light sensor or photodiode device. After the demodulation of electrical signal, the signal is converted into a stream of continuous data in binary form comprising of various information.



IV. LiFi APPLICATIONS

LiFi applications are limitless. It's a technology which extends the capabilities of a WiFi communication. Wherever there's a LED, there will be data. Various common applications of LiFi are as follows:

A. Applications in The Military:

Unlike wireless fidelity (WiFi), LiFi is confined to small space. As light waves do not penetrate walls, information transmitted over LiFi will be restricted to confined area space like a tent. This makes LiFi of great usefulness for even the remote military areas because data can't be intercepted by any outside hackers. Moreover, no complicated wiring infrastructure is required for LiFi, wherever there's light installed, there can be LiFi.

B. Applications throughTraffic Lights:

LiFi through traffic lights can provide drivers while they stop there with updates regarding traffic ahead and weather too. This conjointly eliminates the matter of obtaining crucial traffic updates to drivers who are already in traffic or travelling on the road.

C. Applications in Underwater Communication:

Conventional WiFi networks are not usable underwater as the radio waves get dull and disappear in the liquids mediums. Whereas in LiFi, data transmission is done by the use of lights. Light can travel deep through the water thus can be utilized for underwater communication by LiFi networking, changing the methods of communication between underwater vehicles and divers.

D. Applications in Dense Urban Environment:

Urban environments mostly use artificial lightning for complete illumination. This prevailing infrastructure of artificial lights can be utilized to provide high-speed data connections at all times. For example, people waiting in the corridor of hotel can have access to various downloads at high speed provided by LiFi. Not just that, but even the rooms and suits in the whole hotel can get localized LiFi access providing them with high-speed data access and no interruptions.

E. Applications in Safety Environments:

Environments having high risks of explosion prohibit mobile phone use. Data transmission in such environments can ease configuration and data

encryption using LiFi technology. New modes of making such environments secure from any such potential threats can also be developed using LiFi.

F. Applications in Augmented Reality:

Augmented reality is used for customer to enhance their experience in museums and many such institutions. Yet, they are dependent upon WiFi like many other services, therefore their experience depends on many factors which can be slow and sluggish as the number of people connected on the network increases. This problem can be solved easily by LiFi by providing all exhibits with its own personal data streaming point using a LED bulb. In Addition, LiFi lighting can even provide localized data transfer within its light. LiFi will allow people to enjoy AR experience at the museum uninterrupted, also it will also provide them with the facility to download information regarding that exhibit using the same light that illuminates that exhibit.

V. LiFi over WiFi

A. LiFi vs. WiFi

	LI-FI	WI-FI
SPEED	1-3.5 Gbps	54-250 Mbps
RANGE	10 meters	20-100 meters
IEEE STANDARD	802.15.7	802.11b
SPECTRUM RANGE	10000 times than WI-FI	Radio spectrum range
NETWORK TOPOLOGY	Point-to-Point	Point-to-Multi Point
DATA TRANSFER MEDIUM	Use light as a carrier	Use radio spectrum
FREQUENCY BAND	100 times of THz	2.4 GHz

B. LiFi vs. WiMax

	LI-FI	WI-MAX
IEEE STANDARD	802.15.7	802.16a
SPEED	100 times faster than Wi-Max	100 times faster than WI-FI
RANGE	10 meters	30-100 meters
FREQUENCY BAND	100 times of THz	2-11 GHz
TECHNOLOGY USED	Light Fidelity	Microwave
NETWORK TOPOLOGY	Point-to-Point	Point-to-Multi Point
SPECTRUM RANGE	10000 times than WI-FI	10-66 GHz

VI. LiFi CHALLENGES

A. *LED ON-OFF mode:*

Indoor LiFi based communication system aims to provide illumination with communication, so ON-OFF speed of a LED plays a vital role. For a LiFi based system it is always compulsory to have a Light source in ON condition but it initiates main problem of how data transmission will occur when the LEDs are turned OFF. A data transmission can still be possible if brightness level of a LED transmitter is very low. The dimming level of LED bulb can be organized in such a way that a desired data rate can be achieved using light intensity. In hybrid setup, RF or infrared can be useful to provide communication in LED OFF mode but in LiFi based communication it is still a challenge to find a suitable solution of how communication will be possible in any undesirable situation when LEDs are in its OFF mode.

B. *LED Junction Temperature:*

The management of thermal temperature is a critical design issue of high power LEDs. High junction temperature can affects spectral efficiency. Junction temperature of LED can be increase due to variation in drive current, self-heating and ambient temperature. This high junction temperature could cause degradation in power of a single with respect to time which reduces the signal to noise ratio (SNR) and degrades the lifespan of LEDs. The effect could cause serious problems if array of hundreds of LEDs are connected closer to each other in a lighting system at large scale.

C. *FOV (Field Of View) Alignment:*

In LiFi network an assumption is consider before communication that transmitter and receiver have a LOS (Line Of Sight) connection. The LOS connection can provide high data rates because the transmitter and receiver are aligned their FOV to maximize the channel response. Nevertheless, in real life practical scenarios, a receiver FOV can be changed and it can also move from one place to another. The change in orientation of a receiver and its mobility suggest that receiver's FOV cannot always be aligned with the transmitter. Therefore it is essential to design such techniques which can handle the scenario of FOV misalignment and provides desirable data rates. This needs modification in schemes and development of new approaches to handle this problem but designing such schemes and methods is extremely challenging and it is an important direction of future research.

D. *Shadowing:*

The data rate in LiFi network will decline if an obstacle blocks the LOS channel as a result overall performance of the network will degrades. Not enough research is done until now to understand the indoor model and effect of shadowing on LiFi. Shadowing could be one of the reasons of LOS channel blockage and it can produce variations in received signals therefore it is necessary to have a mechanism to provide an alternative wireless connection in a typical blockage event. It is also possible that the blockage event is of very short duration caused by the passing of obstacles or humans so it necessary to propose such a schemes and mechanisms that can provide a solution of problems such as FOV misalignment and shadowing.

E. *Interference:*

In LiFi system light from any other energy source except of LED such as sun light or free ordinary electric light source can cause interference because it can interrupt the LOS channel between transmitter and receiver. The interruption in path of transmission will affect the data communication therefore for indoor communication new techniques are required to find solutions regarding this condition.

F. Security threats:

In recent research it is proposed by the researchers that LiFi network can also suffer from security threats. An attacker may be present inside or outside a room can perform eavesdropping using the light signals. These signals can be obtained from gap between floor and door, cracks inside flooring or from partially shielded windows. This threat indicates that more research is required to understand and resolve the security issues and privacy concerns of LiFi network.

VII. FUTURE SCOPE

LiFi will help in making our lives more technologically driven in the future. With this technology of light our world can be made into a cleaner, safer and greener world, in addition a brighter place. Data can be transferred wirelessly using any bulb to provide functionality of something like a WiFi. LiFi technology is presently attracting great deal of internet, notably because it offers an efficient and genuine substitute to radio waves based wireless networks. It can provide a solution to problems of radio frequency bandwidth shortage. LiFi also allow internet in airplanes and hospitals and other places where radio based wireless network usage are not allowed. With the increasing growth in population, users of radio frequency based networks and their wireless internet devices, with this the air waves traffic is increasing, therefore making it difficult to get high speed and reliable signals. LiFi seems to have a bright future because it can solve these issues.

VIII. CONCLUSION

The vision behind LiFi technology is to produce a high speed digital communication using light spectrum and its future looks bright for indoor implementation due to rapid increase of LEDs for indoor lighting. With LEDs expected to slowly replace the conventional lighting system, LiFi is anticipated to be step by step enforced into general lighting infrastructures which can bring about many useful applications. Broadband net can even be accessible using same LED lighting system that will provides us illumination in our everyday life.

LiFi has a capability of large scale application and it can attract many companies, designers and researchers to keep working for practical application of LiFi networks for indoor communication as improvements are possible in the technology with time. Hybrid network systems comprising of both LiFi and WiFi can help in achieving system load balancing.

Each and every LED bulb can act as a network hotspot to transmit data wirelessly with the use of this modern technology and the world will be able to move forward towards a cleaner, safer, greener and brighter future.

IX. REFRENCES

1) Scope and Challenges in Light Fidelity(LiFi) Technology in Wireless Data Communication - Shubham Chatterjee, Shalabh Agarwal, AsokeNath - Department of Computer Science, St. Xavier's College, Kolkata, India.

2) Ravi Prakash, Prachi Agarwal "The New Era of Transmission and Communication Technology : Li-Fi (Light Fidelity) LED & TED Based Approach", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 3, Issue 2, February 2014.

3) A Study on Li-Fi Technology and Challenges in Connecting Devices - R.Sanam - B.E Student, Dept. of CSE, Saranathan college of Engineering, Trichy, India, J.Srikanth - B.E Student, Dept. of CSE, Saranathan college of Engineering, Trichy, India, T. Sathiskumar - Assistant Professor, Dept. of CSE, Saranathan college of Engineering, Trichy, India.

4) Dinesh Khandal, SakshiJain ,"Li-Fi (Light Fidelity): The Future Technology in Wireless Communication", International Journal of Information & Computation Technology. ISSN 0974-2239 Volume 4, Number 16 (2014).

5) Li-Fi Security Issues and Challenges - AlifAsyraaf, Hafiz Helmi, AininSofiya, Muhammad Akram, AlyaSahira, Zubir- Student, Information Technology Security -Faculty of Information and Communication Technology - University Teknikal Malaysia Melaka.

6) I. Meena and D. Kumar, "A Review Paper on Li - Fi," in National Conference on Innovations in Microelectronics, Signal Processing and Communication Technologies, 2016.

7) P. Mishra, J. Poddar, and S. Priya, "A Review On LiFi : The Green WiFi," Int. Res. J. Eng. Technol., vol. 3, no. 3, pp. 99–103, 2016.

8) S. Vinay Kumar, K. Sudhakar, L. Sudha Rani, ―Emerging Technology Li-Fi over Wi-Fi‖, International Journal of Inventive Engineering and Sciences, Vol 2, Issue 3, February 2014.

9) Rahul R. Sharma, Raunak and AkshaySanganal, "Li-Fi technology", Int.J. Computer Technology & Application, Vol 5.

10) Shubham Chatterjee, Shalabh Agarwal, AsokeNath, (Jun 2015) ―Scope and Challenges in Light Fidelity(Li-Fi) Technology in Wireless Data Communication‖ International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Issue 6, Volume 2.

11) Bhavya, R. and M.R. Lokesh, 2016. A survey on Li-Fi technology. ABHIYANTRIKI: Int. J. Eng. Technol.

12) Chatterjee, S., S. Agarwal and A. Nath, 2015. Scope and challenges in Light Fidelity (LiFi) technology in wireless data communication. Int. J. - Innov. Res. Adv. Eng.

13) N. Kumar and N. Lourenco, "LED based visible light communication: A brief survey and investigation", J. Eng. Appl. Sci., vol. 5, no. 4, pp. 296–307, 2010.

14) Harald Haas, Member, IEEE, Liang Yin, Student Member, IEEE, Yunlu Wang, Student Member, and Cheng Chen, Student Member, IEEE, "what is LiFi? ",Journal of Light wave, vol. 34, no. 6, MARCH 15, 2016.

15) Gagandeep Kaur Virk "Li-Fi: A New Communication Mechanism" International Journal of Computer Applications, Volume 118 – No.15, May 2015.