
Li-Fi Technology: A Review on Future Technology in Wireless Communication

V. S. Sardar, P. G. Dhokane

Department of Information Technology,
Anuradha Engineering College, Chikhali, India

E-mail: Sardarvaishaliengg4455@gmail.com,
pgdhokane@gmail.com

Abstract

Whether you are victimization wireless net in an exceedingly cafe, stealing it from the guy round the corner, or competitive for information measure at a conference, you have got most likely gotten annoyed at the slow speeds you face once quite one device is broach into the network. As a lot of and a lot of individuals and their several devices access wireless net, clogged airwaves area unit planning to create it. One German physicist Harald Haas has return up with associate degreeswer he calls “data through illumination”—taking the fiber out of fiber optic by causation knowledge through a diode lightweight bulb that varies in intensity quicker than the human eye will follow. It is an equivalent plan band behind infrared remote controls, however, much more powerful. Haas says his invention, that he calls D-LIGHT, will manufacture knowledge rates quicker than ten megabits per second that is speedier than your average broadband affiliation. He envisions a future wherever information for laptops, good phones, and tablets is transmitted through the sunshine in an exceedingly area. And security would be snap-if you cannot see the sunshine, you cannot access the info. Researchers at the Heinrich Rudolph Hertz Institute in Berlin, Germany, has reached information rates of over five hundred megabytes per second employing a normal white-light diode. The technology was incontestable at the 2012 client physics Show in metropolis employing a try of Casio good phones to exchange information victimisation lightweight of variable intensity given aloof from their screens, detectable at a distance of up to 10 metres.

Keywords: Bandwidth, Li-Fi, smart phones, tablets, data

INTRODUCTION

Li-Fi is transmission of through illumination by taking the fiber out of fiber optics by causation data through a diode lightweight bulb that varies in intensity quicker than the human eye will follow. Li-Fi is that the term some have accustomed label the quick and low cost wireless communication system, that is that the optical version of Wi-Fi. The term was initial utilized in this context by Harald Haas in his Ted international speak on actinic radiation Communication. "At the guts of this technology could be a new generation of high brightness light-emitting diodes", says Harald Haas from the University of capital, UK, "very merely, if the diode is on, you transmit a digital one, if it is off you transmit a zero," Haas says, "They is switched on and off terribly quickly, which supplies nice opportunities for transmitted knowledge [1, 2]. "It is feasible to cypher knowledge within the lightweight by variable the speed at that the LEDs flicker on and off to convey completely different strings of 1s and 0s. The LED intensity is modulated thus apace that human eye cannot notice, that the output seems constant. Additional subtle techniques may dramatically increase VLC rate. Terms at the University of Oxford and, therefore, the University of Edinburgh square measure

specializing in parallel information transmission victimization array of LEDs, wherever, every diode transmits a unique information stream. Alternative cluster square measure victimization mixtures of red, inexperienced and blue LEDs to change the sunshine frequency secret writing unique information channel. Li-Fi, because it has been dubbed, has already achieved blisteringly high speed Researchers at the physicist Institute in Berlin, FRG have reached information rates of over five hundred megabytes per second employing a normal white-light semiconductor diode [3–5]. The technology was incontestable at the 2012 client physics Show in metropolis employing a combine of Casio good phones to exchange information victimisation lightweight of variable intensity given far from their screens, detectable at a distance of up to 10 metres. In Oct 2011 variety of corporations and business teams fashioned the Li-Fi syndicate, to push high-speed optical wireless systems and to beat the restricted quantity of radio based mostly wireless spectrum out there by exploiting a very totally different a part of the spectrum. The syndicate believes it is potential to attain over ten Gaps, on paper permitting a high-definition film.



Fig. 1: Environment of Li-Fi.

HISTORY

The history of actinic radiation Communications (VLC) dates back to 1880 in Washington, D.C. once the Scottish-born human Alexander Graham Bell unreal the image phone, that transmitted speech on modulated daylight over many hundred meters. It is attention-grabbing to notice that this really pre-dates the transmission of speech via radio. More recently the Nakagawa Laboratory, in Keio University, Japan began add 2003 mistreatment LEDs to transmit knowledge by actinic radiation. Since then there are various analysis activities focused on VLC [6, 7]. The notable analysis activities being sensible Lighting Engineering Centre, Omega Project, COWA, Inc., UC-

Light Centre and work on University. In 2006, researchers from CICTR at Penn State proposed a combination of power line communication (PLC) and white light LED to provide broadband access for indoor applications. This research suggested that VLC could be deployed as a perfect last-mile solution in future. IN January 2010 a team of researchers from Siemens and Fraunhofer Institute for Telecommunications (Heinrich Hertz Institute in Berlin) demonstrated transmission at 500 Mbit/s with a white LED over a distance of 5 metres (16 ft), and 100 Mbit/s over longer distance using five LEDs. The VLC standardization method is conducted inside IEEE Wireless Personal space Networks working party (802.15). In Gregorian calendar month 2010 St. Cloud, MN was the primary to commercially deploy this technology. In Gregorian calendar month 2011 a live demonstration of high definition video being transmitted from a regular semiconductor diode lamp was shown at TED Global. Recently, VLC-based indoor positioning system has become a horny topic. Publications are coming back from Nakagawa Laboratory, COWA at Penn State and different researchers round the world.

WHAT IS LI-FI

Li-Fi Technology has higher potential, it is pretty much potential to transmit the information via lightweight by dynamical the sparkle rate that offer totally different strings of one and zero, and its intensity is modulated thus quickly that the human eyes cannot notice. There are around nineteen billion lightweight emits worldwide. That in turns is also replaced by junction rectifier, i.e., potential supply of transmission data? “At the guts of this technology could be a new generation of high brightness (LED) lightweight emitting diodes,” says Herald Hass, from the University of Edinburg, U.K. terribly merely, if the junction rectifier is on, you transmit a digital one if it is off, you transmit a zero, “They may be switched on and off terribly quickly, which provides nice opportunities for property and transfer the information terribly quickly, with efficiency and correct with none external hindrances [8, 9]. LiFi is transmission of data through illumination by taking the fiber out of fiber optics by sending data through a LED light bulb that varies in intensity faster than the human eye can follow.

Li-Fi is the term some have used to label the fast and cheap wireless-communication system, which is the

optical version of Wi-Fi. The term was first used in this context by Harald Haas in his TED Global talk on Visible Light Communication. “At the heart of this technology is a new generation of high brightness light-emitting diodes”, says Harald Haas from the University of Edinburgh, UK, “Very simply, if the LED is on, you transmit a digital 1, if it is off you transmit a 0,” Haas says, “They can be switched on and off very quickly, which gives nice opportunities for transmitted data”. It is doable to write information within the light-weight by varied the speed at that the LEDs flicker on and off to relinquish totally different strings of 1s and 0s. The junction rectifier intensity is modulated thus apace that human eye cannot notice, that the output seems constant. Additional refined techniques may dramatically increase VLC rate. Terms at the University of Oxford and also the University of Edinburgh are specializing in parallel information transmission victimisation array of LEDs, wherever every junction rectifier transmits a unique information stream. Alternative cluster is victimisation mixtures of red, inexperienced and blue LEDs to change the sunshine frequency secret writing a unique information channel [10–12].

WORKING OF LI-FI

Li-Fi is usually enforced mistreatment white crystal rectifier light-weight bulbs at the downlink transmitter. These devices are usually used for illumination solely by applying a relentless current. However, by quick and refined variations of the present, the optical output is often created to vary at very high speeds. This terribly property of optical current is employed in Li-Fi setup. The operational procedure is incredibly simple, if the crystal rectifier is on, you transmit a digital one, if it is off you transmit a zero. The LEDs are often switched on and off terribly quickly, which supplies nice opportunities for transmission knowledge. Therefore, all that is needed is a few LEDs and a controller that code knowledge into those LEDs. All one should do is to vary the speed at that the LED's flicker relying upon the info we wish to write in code. Any enhancements are often created during this technique, like mistreatment associate degree array of LEDs for parallel knowledge transmission, or mistreatment mixtures of red, inexperienced and blue LEDs to change the light's frequency with every frequency encryption a special knowledge channel. Such advancements promise a theoretical speed of ten Gbps-that means one will transfer a full high-definition film in precisely thirty seconds.

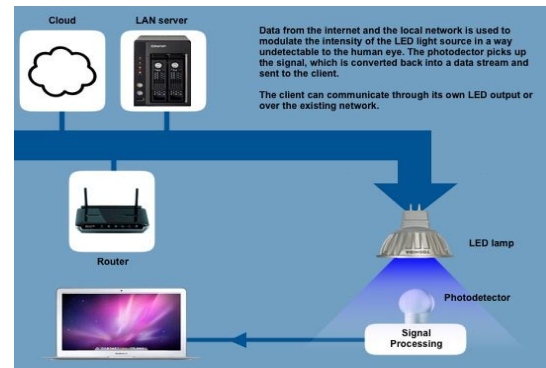


Fig. 2: LI-FI Working.

To more get a grasp of Li-Fi think about associate in nursing IR remote. It sends one knowledge stream of bits at the speed of 10,000-20,000 bps. Currently, replace the IR LED with a lightweight box containing an outsized LED array. This method, is capable of causing thousands of such streams at in no time rate. Lightweight is inherently safe and may be utilized in places, wherever, frequency communication is commonly deemed problematic, appreciate in craft cabins or hospitals. Thus, actinic ray communication not solely has the potential to resolve the matter of lack of spectrum house, however, can even modify novel application. The actinic ray spectrum is unused, it is not regulated, and may be used for communication at terribly high speeds.

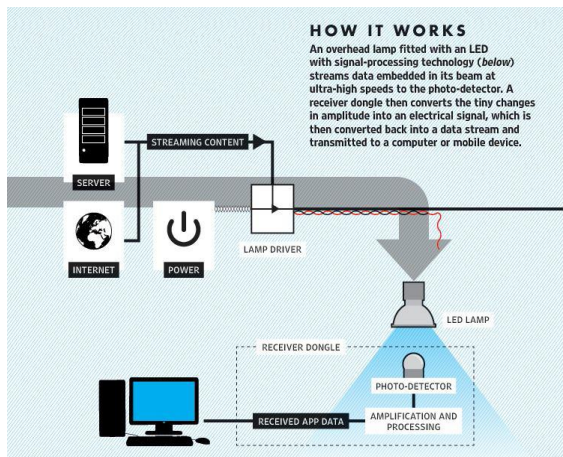


Fig. 3: Architecture of Li-Fi.

Imagine only needing to hover under a street lamp to get public internet access, or downloading a movie from the lamp on your desk. There is a new technology on the block that may, quite virtually additionally as metaphorically, 'throw light-weight on' a way to meet the ever-increasing demand for high-speed wireless property. Radio waves are replaced by light-weight waves during a new methodology of knowledge transmission that is being known as Li-Fi. Light-emitting diodes are often switched on and off quicker than the human eye will notice, inflicting the sunshine supply to look to get on endlessly. A unsteady light-weight are often unbelievably annoying, however, has clad to own its top side, being exactly what makes it potential to use light-weight for wireless information transmission. Light-emitting diodes (commonly named as LEDs and located in

traffic and street lights, automotive brake lights, device units and innumerable different applications) are often switched on and off quicker than the human eye will notice, inflicting the sunshine supply to look to get on endlessly, even if it is of course 'flickering'. This invisible on-off vie with typical Wi-Fi has impressed the popular characterization Li-Inactivity permits a sort of knowledge transmission victimisation binary codes: switch on associate junction rectifier could be a logical '1', switch it off could be a logical '0'. Info will so be encoded within the light-weight by varied the speed at that the LEDs flicker on and off to provide totally different strings of 1s and 0s. This method of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication (VLC), though it is potential.

VISIBLE LIGHT COMMUNICATION (VLC)-“A POTENTIAL SOLUTION TO THE GLOBAL WIRELESS SPECTRUM SHORTAGE”

Li-Fi (Light Fidelity) may be a quick and low cost optical version of Wi-Fi, the technology of that is predicated on actinic radiation Communication (VLC).VLC may be a electronic communication medium, that uses actinic radiation

between four hundred rate (780 nm) and 800 rate (375 nm) as optical carrier for knowledge transmission and illumination. It uses quick pulses of sunshine to transmit data wirelessly. The most parts of this communication system are 1) a high brightness white LED, that acts as a communication supply and 2) a semiconducting material photodiode that shows smart response to visible wavelength region serving because the receiving element? LED may be switched on and off to get digital strings of 1s and 0s. Knowledge may be encoded within the light-weight to get a replacement knowledge stream by varied the flicker rate of the LED.

To be clearer, by modulating the LED light with the data signal, the LED illumination can be used as a communication source. As the flickering rate is so fast, the LED output appears constant to the human eye. A data rate of greater than 100 Mbps is possible by using high speed LEDs with appropriate multiplexing techniques. VLC. data rate can be increased by parallel data transmission using LED arrays where each LED transmits a different data stream. There are reasons to prefer LED as the light source in VLC while a lot of

other illumination devices like fluorescent lamp, incandescent bulb etc. are available.

NEED OF LI-FI

Whether you are exploitation wireless web in a very cafe, stealing it from the guy round the corner, or competitor for information measure at a conference, you have in all probability gotten annoyed at the slow speeds you face once quite one device is tapped into the network. As a lot of and a lot of folks and their several devices access wireless web, clogged airwaves square measure getting to create it progressively tough to latch onto a reliable signal. However, radio waves square measure only 1 a part of the spectrum that may carry our information.

What if we tend to may use different waves to surf the web?

One German physicist, Dr. Harald Haas, has come up with a solution he calls "Data through Illumination"-taking the fiber out of fiber optics by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It is the same idea behind infrared remote controls, but far more powerful. Haas says his invention, which he calls D-Light, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection. He

envisioning a future where data for laptops, smartphones, and tablets is transmitted through the light in a room. And security would be a snap-if you cannot see the light, you cannot access the data.

Li-Fi is a VLC, visible light communication, technology developed by a team of scientists including Dr Gordon Povey, Prof. Harald Haas and Dr Mostafa Afgani at the University of Edinburgh. The term Li-Fi was coined by Prof. Haas when he amazed people by streaming high-definition video from a standard LED lamp, at TED Global in July 2011. Li-Fi is now part of the Visible Light Communications (VLC) PAN IEEE 802.15.7 standard. "Li-Fi is typically implemented using white LED light bulbs. These devices are normally used for illumination by applying a constant current through the LED. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. Unseen by the human eye, this variation is used to carry high-speed data," says Dr Povey, Product Manager of the University of Edinburgh's Li-Fi Program 'D-Light Project'. In simple terms, Li-Fi can be thought of as a light-based Wi-Fi. That is, it uses light instead of radio waves to transmit information. And instead of Wi-Fi

modems, Li-Fi would use transceiver-fitted LED lamps that can light a room as well as transmit and receive information. Since simple light bulbs are used, there can technically be any number of access points.

This technology uses a vicinity of the spectrum that is still not greatly utilized the spectrum. Light-weight is after all much a part of our lives for millions and various years and does not have any major sick impact. Moreover, there is 10,000 times extra space offered during this spectrum and simply relying on the bulbs in use, it conjointly multiplies to 10,000 times additional convenience as associate in nursing infrastructure, globally. It is doable to write knowledge within the light-weight by variable the speed at that the LEDs flicker on and off to relinquish totally different strings of 1s and 0s. The diode intensity is modulated thus speedily that human eyes cannot notice, that the output seems constant. Additional refined techniques may dramatically increase VLC knowledge rates.

Table 1: Technology, Speed and Data Density.

Technology	Speed	Data Density
Bluetooth	3Mbps	*
IrDA	4Mbps	***
Wi -fi	150 Mbps	*
Li-Fi	>10Gbps	****

Teams at the University of Oxford and also the University of Capital are specializing in parallel knowledge transmission mistreatment arrays of LEDs, wherever, every semiconductor diode transmits a special knowledge stream. Different teams are mistreatment mixtures of red, inexperienced and blue LEDs to change the light's frequency, with every frequency encryption a special knowledge channel. Li-Fi, because it has been dubbed, has already achieved blisteringly high speeds within the work. Researchers at the Heinrich Hertz Institute in Berlin, Germany, have reached knowledge rates of over five hundred megabytes per second employing a commonplace white-light semiconductor diode. Haas has discovered a product firm to sell a client VLC transmitter that is due for launch

next year. It is capable of transmission knowledge at a hundred MB/s- quicker than most Britain broadband connections.

COMPARISION BETWEEN LI-FI AND WI-FI

LI-FI could be a term of 1 wont to describe actinic ray communication technology applied to high speed wireless communication. It nonheritable this name thanks to the similarity to WI-FI, solely mistreatment lightweight rather than radio. WI-FI is nice for general wireless coverage among buildings, and Li-Fi is right for top density wireless knowledge coverage in confined space and for relieving radio interference problems, therefore, the two technologies are often thought-about complimentary. The table conjointly contains these wireless technologies which will be used for transferring knowledge between devices nowadays, i.e., Wi-Fi, Bluetooth and IrDA. Solely, Wi-Fi presently offers terribly high knowledge rates.

It provides up to 150Mbit/s (in theory the standard can go to 600Mbit/s) although in practice you receive considerably less than this. Note that one out of three of these are an optical technology.

HOW IT IS DIFFERENT?

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. Also, the speed of the internet is incredibly high and you can download movies, games, music etc. in just a few minutes with the help of this technology. Also, the technology removes limitations that have been put on the user by the Wi-Fi. You no more need to be in a region that is Wi-Fi enabled to have access to the internet. You can simply stand under any form of light and surf the internet as the connection is made in case of any light presence. There cannot be anything better than this technology.

REPLACEMENT FOR OTHERS TECHNOLOGIES

This technology does not deal with radio waves, so it can easily be used in the places where Bluetooth, infrared, WI-FI and Internet are banned. In this way, it will be most helpful transferring medium for us. It includes other benefits like:

- A very wide spectrum over visible wave length range.
- Instant start time.
- Easy terminal Management.
- Dynamic dark, i.e., brightness Modulation of lamp output to enhance video contrast.
- Trouble-free integration into existing light engine platform.

Li-Fi is that the approaching and on growing technology acting as competent for numerous alternative developing and already fabricated technologies. Since lightweight is the major supply for transmission during this technology it is terribly advantageous and implementable in numerous fields that cannot be through with the Wi-Fi and alternative technologies. Therefore, the long run applications of the Li-Fi are often foreseen and extended to totally different platforms like education fields, medical field, industrial areas and plenty of alternative fields.

APPLICATION OF LI-FI

Airlines

Airline Wi-Fi Ugh Nothing says captive audience like having to procure the "service" of dial-up speed Wi-Fi on the plane. And do not get Pine Tree State

started on the rating. The simplest I have detected up to now is that passengers can "soon" be offered a "high-speed like" affiliation on some airlines. United is designing on speeds as high as 9.8 Mbps per plane. Uh, I even have double that capability in my lounge. And at constant worth as checking a bag, I expect it. Li-Fi might simply introduce that kind of speed to every seat's reading lightweight. I will be the guy Wo Wing next to you. It is higher than being attentive to you tells Pine Tree State concerning your wildly thriving son, ma'am.

Smarter Power Plants

Wi-Fi and lots of different radiation varieties are dangerous for sensitive areas. Like those close power plants. However, power plants would like quick, inter-connected information systems to observe things like demand, grid integrity and (in nuclear plants) core temperature. The savings from correct observation at one power station will add up to many thousands of greenbacks. Li-Fi may provide safe, exuberant property for all areas of those sensitive locations. Not solely would this save cash involving presently enforced solutions, however, the draw on an influence plant's own reserves may well be lessened if they have not nevertheless born-again to LED lighting.

Undersea Awesomeness

Underwater ROVs, those favorite toys of treasure seekers and James Cameron, operate from giant cables that offer their power and permit them to receive signals from their pilots on top of. ROVs work nice, except once the tether is not long enough to explore a district, or once it gets stuck on one thing. If their wires were cut and replaced with light-say from a submerged, high-powered lamp-then they might be a lot of freer to explore. They might additionally use their headlamps to speak with one another, process knowledge autonomously and referring findings sporadically back to the surface, all the whereas getting their next batch of orders.

USES IN VARIOUS AREAS

Can be utilized in the places, wherever, it is tough to get the glass fibre like hospitals. Operating theatre Li-Fi will be used for contemporary medical instruments. In traffic signals LiFi will be used which is able to communicate with the light-emitting diode lights of the cars and accident numbers will be ablated. Thousand and immeasurable street lamps will be transferred to Li-Fi lamps to transfer knowledge. In craft Li-Fi will be used for knowledge transmission. It will be utilized in fossil fuel or chemical plants

wherever different transmission or frequencies may well be venturous.

FUTURE APPLICATIONS

Education Systems

As with the advancement of science the newest technology is that the LI-FI that is that the quickest speed net access service. So, will end up in the replacement of WI-FI at establishments and at corporations in order that all the folks can create use of LI-FI with same speed meant in a very specific space.

Extends our Life Span

As operation theatres do not enable LAN because of radiation issues. Usage of LAN at hospitals interferes with the mobile and laptop that blocks the signals for watching equipment's. Therefore, the replacement for this Wi-Fi is Li-Fi as Hass has mentioned in his tough guy speak that LIFI has 10,000 times the spectrum of Wi-Fi. As a result of the lights are not solely allowed operational theatres, however, additionally the foremost dazzling fixtures within the area.

Reduction in Accident Numbers

At traffic signals, we can use LIFI in order to communicate with LEDlights of the cars by the number of accidents can be

reduced. Data can be easily transferred by making use of LIFI.

ADVANTAGES OVER WI-FI

- High speed, as high as 500mbps or 30GB per minute.
- Li- Fi uses light rather than radio frequency signals.
- VLC could be used safely in aircraft.
- Integrated into medical devices and in hospitals as this technology does not deal with radio waves, so it can easily be used in such places where Bluetooth, infrared, Wi-Fi and internet are banned. In this way, it will be most helpful transferring medium for us.
- Under water in sea Wi-Fi does not work.
- There are around 19 billion bulbs worldwide, they just need to be replaced with LED ones that transmit data. We reckon VLC is at a factor of ten, cheaper than WI-FI.
- Security is another benefit, he points out, since light does not penetrate through walls.
- In streets for traffic control. Cars have LED based headlights, LED based backlights, and Car can communicate each other and prevent accidents in the way that they exchange Information.

Traffic light can communicate to the car and so on.

- By implementing the Technology worldwide every street lamp would be a free access point.
- Li-Fi may solve issues such as the shortage of radio frequency bandwidth.

DISADVANTAGES

Still there are some backdrops like it can only transmit when in the line of sight well it can be sorted out someday I hope. “There has been a lot of early hype, and there are some very good applications”.

CONCLUSION

The possibilities area unit various and may be explored any. If his technology is place into sensible use, each bulb is used one thing sort of a Wi-Fi hotspot to transmit wireless information and that we can proceed toward the cleaner, greener, safer and brighter future. The conception of Li-Fi is presently attracting an excellent deal of interest, not least as a result of it should supply a real and really economical various to radio-based wireless. As a growing range of individuals and their several devices access wireless net, the airwaves are getting more and more clogged, creating it additional and harder

to urge a reliable, high-speed signal. This might solve problems resembling the shortage of radio-frequency information measure and additionally enable net wherever ancient radio based mostly wireless is not allowed resembling craft or hospitals. One amongst the shortcomings but is that it solely add direct line of sight.

REFERENCES

1. Available at: www.seminarprojects.com.
2. Available at: www.seminar-report-on-lifi.com.
3. Available at: <http://wikipedia.org>.
4. Available at: www.way2project.com.
5. Available at: [www.scribsize li-fi.com](http://www.scribsize-li-fi.com).
6. Available at: www.slideshare.com.
7. Available at: www.li-fi-internet-at-the-speed-of-light.com.
8. Available at: [http.wikipedia.org/wiki/Li-Fi](http://wikipedia.org/wiki/Li-Fi).
9. Available at: [http:www.123seminar.com](http://www.123seminar.com).
10. Will Li-Fi be the new Wi-Fi? New Scientist, by Jamie Condliffe.
11. Available at: <http://www.digplanet.com/wiki/Li-Fi>.
12. Visible-light communication: Tripping the light fantastic: A fast and cheap optical version of Wi-Fi is coming; 2012.