IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 70-74

LIFI Technology

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Abstract: *This latest technology Li-Fi (Light Fidelity) refers to 5G Visible Light Communication systems using light-emitting diodes as a medium to high-speed communication in a similar manner as Wi-Fi. HaraldHaas 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. In the days where internet has become a major demand people are in a search for Wi-Fi hotspots. Li-Fi or New Life of data communication is a better alternative to WiFi in wireless communication. Li-Fi has thousand times greater speed than Wi-Fi and provides security as the visible light is unable to penetrate through the walls, which propose a new era of wireless communication. Such technology has brought not only greener but safer and cheaper future of communication.*
Keywords: *LI-FI, WI-FI, LED, D-Light (Data Light), Visible Light Communication*.

I. Introduction

In the period of overcrowded (data communication) world, Li-Fi is a modern way of wireless communication that uses LED lights to transmit data wirelessly[1]. Transmission of data is one of the most important day to day activities in the fast growing world. The current Wi-Fi wireless networks that connect us to the Internet are very slow when multiple devices are connected. Also with the increase in the number of devices which access the Internet, the availability of fixed bandwidth makes it much more difficult to enjoy high data transfer rates and to connect a secure network. Radio waves are just a small part of the electromagnetic spectrum available for data transfer. Li-Fi has got a much broader spectrum for transmission compared to conventional methods of wireless communications that rely on radio waves. The basic ideology behind this technology is that the data can be transferred through LED light by varying light intensities faster than the human eyes can perceive. This technology uses a part of the electromagnetic spectrum that is still not greatly utilized- The Visible Spectrum, instead of Gigahertz radio waves for data transfer. The idea of Li-Fi was introduced for the first time by a German physicist Harald Hass in the TED (Technology, Entertainment, Design) Global talk on Visible Light Communication (VLC) in July 2011, by referring to it as "data through illumination". He used a table lamp with an LED bulb to transmit a video of a blooming flower that was then projected onto a screen. In simple terms, Li-Fi can be thought of as a light-based Wi-Fi i.e. instead of radio waves it useslight to transmit data. In place of Wi-Fi modems, Li-Fi would use transceivers fitted with LED lamps that could light a room as well as transmit and receive information. By adding new and unutilized bandwidth of visible light to the currently available radio waves for data transfer, LiFi can play a major role in relieving the heavy loads which the current wireless system is facing. Thus it may offer additional frequency band of the order of 400 THz compared to that available in RF communication which is about 300 GHz.

Design Of LiFi

Li-Fi architecture consists of a number ofLED bulbs or lamps including manywireless devices such as Mobile Phones,Laptops and PDA. The following factorsshould be taken into concern whiledesigning Li-Fi:

- Presence of light.
- Line of sight (LOS)
- For better performance use fluorescent light and LED.
- A photo detector received data.

Hence all that is required is some LEDs and a controller that will code data into those LED switch

II. Working Of LI-FI

Basic Concept:

Light Fidelity (Li-Fi) technology is one of the wireless communication system based on the use of visible light between the violet (800 THz) and red (400 THz). Unlike Wi-Fi which uses the radio part of the electromagnetic spectrum, Li-Fi uses the optical spectrum i.e. Visible light part of the electromagnetic spectrum.

[2]The principle of Li-Fi is based on sending data by amplitude modulation of the light source in a well-defined and standardized way. LEDs can be switched on and off faster than the human eyes can detect since the operating speed of LEDs is less than 1 microsecond. This invisible on-off activity enables data transmission using binary codes. If the LED is on, a digital '1' is transmitted and if the LED is off, a digital '0' is transmitted. Also these LEDs can be switched on and off very quickly which gives us a very nice opportunity for transmitting data through LED lights, because there are no interfering light frequencies like that of the radio frequencies in Wi-Fi. Li-Fi is thought to be 80% more efficient, which means it can reach speeds of up to 1Gbps and even beyond. Li-Fi differs from fibre optic because the Li-Fi protocol layers are suitable for wireless communication over short distances (up to 10 meters)[2]

Working with LIFI

III. Application Of Li-Fi Education Systems:

As with the advancement of science the latest technology is the LIFI which is the fastest speed internet access service. So this will lead to the replacement of WIFI at institutions and at companies so that all the people can make use of LIFI with same speed intended in a particular area. Significantly Lower Power Consumption: Radio masts are very inefficient and require vast sums of power in order to broadcast and in some cases keep them cool enough to operate. LEDs on the other hand use very little power (much less than a fluorescent bulb), meaning Li-Fi also uses very little power. At the same time Li-Fi can also light a room, meaning it can do two jobs for the price of one. Reduction in accident numbers: At traffic signals, we can use LIFI in order to communicate with LED lights of the cars by the number of accidents can be reduced. Data can be easily transferred by making use of LIFI lamps with the street lamps. Airlines: Airline Wi-Fi Nothing says captive audience like having to pay for the "service" of dial-up speed Wi-Fi on the plane. The best I have heard so far is that passengers will be offered a "high-speed like" connection on some airlines. United is planning on speeds as high as 9.8 Mbps per plane. Li-Fi could easily introduce that sort of speed to each seat's reading light. Medical field: For a long time, medical technology has lagged behind the rest of the wireless world. Operating rooms do not allow Wi-Fi over radiation concerns, and there is that whole lack of dedicated spectrum. While Wi-Fi is in place in many hospitals, interference from cell phones and computers can block signals from monitoring equipment. Li-Fi solves both problems: lights are not only allowed in operating rooms, but tend to be the most glaring (pun intended) fixtures in the room.

IV. Comparison Of Lifi And Wifi

Both LiFi and WiFi technologies are mainly used for internet based applications. LiFi uses light as medium for data communication where asWiFi uses Electromagnetic waves for data communication. LiFi is optical communication technology where asWiFi is radio communication technology.

Characteristic	Wi-Fi	Li-Fi
Standard	IEEE 802.11	IEEE 802.15
Range	100 meters	Base on LED light
Primary application	Wireless local area networking Cost Low Medium high	Wireless local area networking
Data transfer rate	800 Kbps - 11 Mbps	>1Gbps
Power consumption	Medium	Low
Cost	Medium	High
Security	Its medium secure	Its high secure

V. Advantages Of Li-Fi Over Wi-Fi

- There are billions of bulbs worldwide which just need to be replaced with LED's to transmit data.
- Integrated into medical devices and in hospitals as this technology doesn't deal with radio waves, so it can easily be used in all such places where Bluetooth, infrared, Wi-Fi and internet are broadly in use.
- Under water in sea Wi-Fi does not work at all but light can be used and hence undersea explorations are good to go now with much ease.
- Security is a side benefit of using light for data transfer as it does not penetrate through walls.
- The issues of the shortage of radio frequency bandwidth may be sorted out by Li-Fi.
- Using this Technology worldwide every street lamp would be a free data access point.

VI. Some Limitations Of Li-Fi

The lights flicker.

We subtly modulate the current supply to the LED devices at relatively high speeds. We are not harshly switching the LEDs on and off, and we are not modulating at speeds everywhere near those perceptible to the human eye. Your TV and computer displays do flicker at just higher than perceptible rates; the same is true of some LED dimming technologies. VLC (Visible light communication) does not flicker the lights like this, it will not give you a headache!

You cannot dim the lights.

There are VLC patents pending on methods to dim the LED while maintaining high data rates until the current is dimmed to about 50%. After that the data rates will begin to diminish in a very graceful manner. So yes, you can dim the lights and maintain communications reliably.

VLC is Uni-directional (downlink or broadcast only).

VLC can be used for transmission in either direction. The uplink and downlink can be isolated in a number of ways – wavelength, time, code and also by spatial or optical isolation. For practical and cost reasons VLC might be implemented for downlink only since this is where bottlenecks exist with existing technologies, e.g. Wi-Fi may already provide a reliable uplink where congestion is less likely and Li-Fi provides a high capacity uncongested downlink.

There will be interference from sunlight.

It is simple to eliminate the vast majority of interference from natural and artificial sources using optical filters (which avoids receiver saturation). After the photo-detector further analogue and digital filtering ensure remaining interference is negligible.

Lights need to be on so this is inefficient.

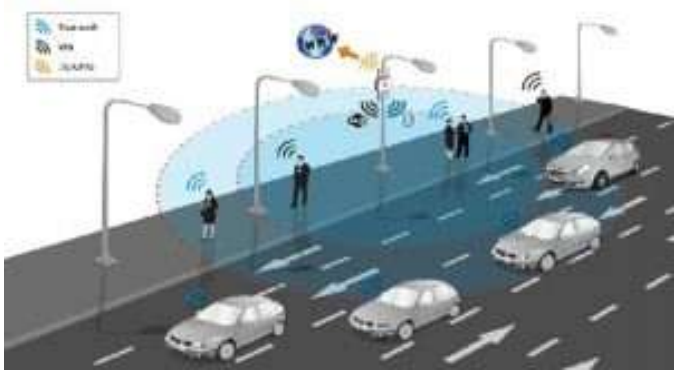
To use VLC the lights do need to be on. However in the vast majority of industrial, commercial and retail environments the lights are on when the area is occupied. Given that the lights are usually on, VLC transmission power comes free as it is already used for illumination so this is highly efficient.

In domestic environments we do tend to switch off lights during daylight. Where the lights would have been off the power required for VLC is not free but the lights only need to be dimmed up to transmit data. The illumination need not be above ambient levels so will not be noticed. The power consumed is comparable with

the watts/bit for radio transmission and so on aggregate even in domestic environments there is a significant net saving in power.

Dense Urban Environments (Interference-Free Wireless Communication)

Dense urban environments cover larger area with artificial lighting. The area with lighting infrastructure can provide high data rate access for users as the users move through that environment. For example, in a hotel corridor or reception hall a number of users can receive high data rate at any point. Moreover, high speed wireless communication would be available in every room since the light waves cannot propagate through walls. This results in interference-free wireless communication. Other employments of Li-Fi innovation in outside urban territory is that Li-Fi can empower road lights that would give a system of access focuses for web. In cell correspondence, the separation between radio base stations is less. In this way, rather than conveying new radio base stations in our urban areas, road lights could give both, light amid night and information correspondence at International Journal of Information Sciences and Techniques (IJIST).



Smart Urban Communication Network

VII. Emi Sensitive Environments

Use of Li-Fi in aircraft, allow passenger to take the advantage of high data rate connectivity at all time without generating electromagnetic interference (EMI) interference (EMI) with sensitive radio equipment on the flight deck. The reduction in cabling requirement also means a lighter aircraft. Communications in Airlines 4.4 Augmented Reality Exhibitions in museums and galleries are illuminated with artificial lighting. Li-Fi technology enables lighting can provide localized information. So that a visitor s camera or mobile phone can be used to download further information regarding the object being viewed from the light. Localized Advertising By merging street lights and lighting display means of a shop as a Li-Fi broadcast channel, it is possible to transmit advertising information like special offers and coupons. So, this provides opportunity to emerge novel retail business model. Product information, catalogue information, discount coupons and advertising videos could all be provided to shoppers.

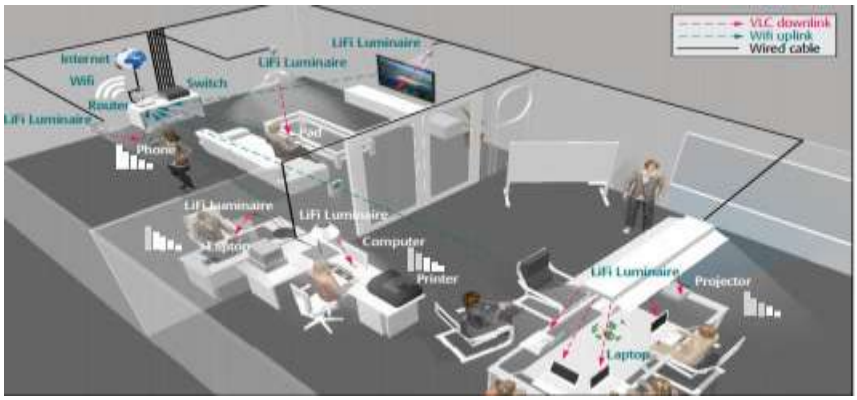
VIII. Underwater Communication

In the case of Wi-Fi, it is not possible to communicate through water as radio waves are quickly absorbed in water that prevents underwater radio communications, but light can penetrate for large distances. Therefore, Li-Fi can enable underwater communication.

IX. Acknowledgement And Future Scope

As the future technology is advancing there are numerous possibilities that can be explored. Li-Fi is one of the technology if brought into practical implementation, every single bulb or every light source or every

Li-Fi lightening can be used somewhat like a Wi-Fi hotspot to transmit wireless data and we will advance towards the eco-friendly future. So the concept of Li-Fi is an efficient substitute to radio-based wireless transmission. With the growing population as number of users are increasing day by day traffic is increasing and congestion makes it difficult for users to gain and transmit data at a faster pace so replacement of wireless radio waves with optical waves is an efficient way to transmit data despite of having reduced bandwidth and more number of users accessing in limited bandwidth. So Li-Fi is one of the best option for accessing internet in a confined space with cheaper cost also in future limitations of artificial light will be overcome for faster transmission.



X. Result

Li-Fi Technology is an emerging technology to work with high data transfer speed in different areas.With Li-Fi, your light blub is essentially your router. It uses common household LED light bulbs to enable data transfer, boasting speeds of up to 224 gigabits per second.As light is everywhere and free to use, there is a great scope for the use and evolution of LiFi technology. If this technology becomes mature, each Li-Fi bulb can be used to transmit wireless data. As the Li-Fi technology becomes popular, it will lead to a cleaner, greener, safer communications and have a bright future and environment. The concept of Li-Fi is deriving many people as it is free (require no license) and faster means of data transfer.

XI. Conclusions

Li - Fi is an emerging and vast technology, a lot of research can lead us to the betterment of the world. If this technology becomes justifiably marketed, then every bulb can be used analogous to a Wi-Fi hotspot to transmit data wirelessly. As the amount of available bandwidth is limited, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. The LI-FI technology can solve this crisis. Moreover, it will allow inter access in places such as operation theaters and aircrafts where internet access is usually not allowed. The concept of Li - Fi gives the solution to many issues like shortage of radio-frequency bandwidth and boot out the disadvantages of Wi-Fi. Hence the future applications of Li-Fi can be predicted to solve the problems of human life style and make it more simple.

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