Review of Li-Fi Technology: New Future Technology- Light Bulb to Access the Internet!

Neha S.Jaiswal, Payal S.Chopade

Abstract—   Now a day with the advent of technology, communication became the backbone of Information and Communication Technology. ICT is made our globe like a town. Today everyone like Business, institutions ,organizations want s right information at the right time Which, needs fast internet connectivity. Present paper reflects the Future of Communication (LI-FI) which may affect all lives. Li-Fi technology that may be approximately   as fast as 500MBPS (30GBPS per minute) an alternative, cost effective and more robust, and useful than Wi-Fi Technology. It is the fast and low cost wireless communication system which is optical version of the Wi-Fi. The Visible light communication may be the future of Internet .
 Harald Haas has come up with a solution he calls "data with the help of illumination" – the fiber out of fiber optic cabel by sending data through LED. lights that varies in intensity faster than the human eye can follow. In future where data for personal computers ,laptops, smart phones, and tablets is transmitted through the light in a room. And security would be snap – if you can not see the light, you can not access the data through internet.

Keywords: LED based backlight, LED (Light emitted diode), LED based headlights, VLC, VLC Transmitter, Wi-Fi.

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1 Introduction :

LiFi (visible light communication) is the transformation of the light bulb into a wireless communication route that may displace WIFI. Li-Fi is transmission of data through illumination by taking the fiber out of fiber optics by sending data through a LED light that varies in intensity faster than the human eye can follow .Li-Fi is a term some have used to label the fast and cheap wireless-communication system, i.e the optical version of Wi-Fi. Li-Fi inventor, the German physicist .Haas believes   that the   visible light spectrum can be used to transmit data, as its spectral width is so much large than of the conventional radio frequencies, and it has the potential to transmit higher bandwidths. WiFi technology has become very famous, but there are complaints that the wireless signal is unstable, access is slow, and Wi-Fi hotspots are too few while users are ever increasing. Now, this is a new technology that can address issues.

The light bulb has long been regarded as a coveted symbol of inspiration. However, for Herald Haas, the light bulb itself brought him inspiration. With his team at the University of Edinburgh, Haas invented a new future technology, using a flashlight for wireless transmission of digital information in form of 0 & 1, a technique commonly referred to as visible light communication (VLC). Haas said: *"My greatest vision is that light bulbs will become broadband communications equipment, so that the light bulb is not only able to provide lighting and also become a more necessary tool."* Haas claims that by providing ordinary LED bulbs with an installed micro chips, This is capable to flicker at a frequency of millions of times per second, allowing to send data. In this way, LED   can rapidly transfer binary coded information..

Thus, this technology can provide you with a wireless Internet connection, as long as you have a LED light bulb. The total number of the world's light bulbs is estimated at about 14 billion. Its means that every street can become an Internet accesspoint.Yet the nicknamed"Li-Fi" technology not only can enhance the coverage of the Internet. The main wireless technology, WiFi work on radio frequency, which only make up a little part of the whole electromagnetic spectrum. With increasing user necessary demand for wireless internet, the available radio spectrum is going to more less and less.

The term was first used in this context by Haas Visible Light Communication. It is Very simple, if the LED is on, you transmit a digital 1,that means the LED is in working, if it's off you transmit a 0,LED not in working."Haas says, "They can be switched on and off very fast and easily,which gives nice opportunities for transmitted data."

Figure: Light Fidelity (Li-Fi) environments

Figure: LED Lamp For Li-Fi

This Awesome Technology can be used for all Electronics, Simply Light the Lamp LED! Li-Fi is a new way to establish wireless communication links using the LED lighting networks. The Li-Fi protocols are defined by the international standard IEEE 802.15 established from 2011 by the IEEE comities. This is the same comity that has defined previously the Ethernet 802.3 and Wi-Fi 802.11 standards.

After more than four years of scientific research at the University of Versailles, OLEDCOMM is the first European company that start to commercialize LiFi communication solutions all worldwide level.

When the lighting networks become wireless communication networks:

The world of Lighting companies experiences a true revolution with the development of Led lighting devices, LED appear as a solution that cannot be overlooked to face up to the challenge of the CO2 emission reduction at the worldwide scale. The sale of Led's Lighting units knows an impressive increase these last years.

Ten times higher data rates compared to Wi-Fi:

Led's are different from the other kinds of lamps because they are semiconductors. This characteristic gives the capability to switch-on and off within few nano seconds of a second. In order to compare, at best WiFi can reach 100 Mbits/s data rates and so 10 times lower.

Worldwide Economic and Green Impact:

Thanks to the LiFi technology, the 14 billion lamps in the world will become gradually green mobile internet masts that will permit to respond to the impressive increasing demand of mobile connectivity. Also, this will allow reducing the electromagnetic pollution generated by the numerous radio wave solutions developed until now.

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2.HOW IT WORKS

This brilliant idea first show by Haas from University of Edinburgh, UK, in his TED Global talk on VLC. He explained," Very simple, if the LED is on, you transmit a digit 1, if it's off you transmit a digit 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data." So what you require at all are some LEDs and a controller that code data into those LEDs. We have to just vary the rate at which the LED's flicker depending upon the data we want to encode. Further enhancements can be made in this method, like using an array of LEDs for parallel data transmission. Such advancements promise a theoretical speed of 10 Gbps –meaning you can download a full high-definition film in just 30 seconds. Simply awesome! But blazingly fast data rates and depleting bandwidths worldwide are not the only reasons that give this technology an upper hand.

Since Li-Fi uses just the light, it can be used safely in aircrafts and hospitals that are prone to interference from radio waves. This can even work underwater where Wi-Fi fails completely, thereby throwing open endless opportunities for military operations. Imagine only needing to hover under a street lamp to get public internet access, or downloading a movie from the lamp on your desk. Radio waves are replaced by light waves in a new method of data transmission which is being called Li-Fi.Light-

emitting diodes can be switched on and off faster than the person eye can detect, causing the light source to appear to be on continuously. A flickering light can be incredibly annoying, but has turned out to have its upside, being precisely what makes it possible to use light for wireless data transmission. Light-emitting diodes (commonly referred to as LEDs and found in traffic and street lights, car brake lights, remote control units and countless other applications) can be switched on and off faster than the human eye can detect, causing the light source to appear to be on continuously, even though it is in fact 'flickering'. This invisible on-off activity enables a kind of data transmission using binary codes: switching on an LED is a logical '1', switching it off is a logical '0'. Information can therefore be encoded in the light by varying the rate at which the LEDs flicker on and off to give 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's potential to compete with Conventional Wi-Fi has inspired the popular characterization Li-Fi.

2.1 Visible light communication (VLC)

"A potential solution to the global wireless spectrum shortage" Li-Fi (Light Fidelity) is a fast and cheap optical version of Wi-Fi, the technology of which is based on Visible Light Communication (VLC).VLC is a data communication medium, which uses visible light between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission and illumination. It uses fast pulses of light to transmit information wirelessly.

The main components of this communication system are :

1) a high brightness white LED, which acts as a communication source

2) a silicon photodiode which shows good response to visible wavelength region serving as the receiving element.

LED can be switched on and off to generate digital strings of 1s and 0s. Data can be encoded in the light to generate a new data stream by varying the flickering 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.
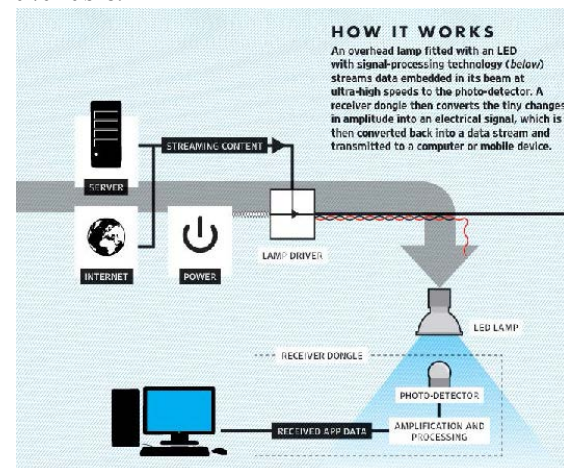

Figure: Data transmission with (Light Emitting Diode)

3. Li-Fi V/s Wi-Fi Technology

LI-FI is a term of one used to describe visible light technology applied to high speed wireless communication. It acquired this name due to the similarity toWI-FI, only using light instead of radio.WI-FI is great for general wireless coverage within buildings, and li-fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues, so the two technologies can be considered complimentary.

TECHNOLOGY	SPEED	DATA DENSITY
WIRED		
FIRE WIRE	800 Mbps	*****
USB3.0	5 Gbps	*****
THUNDERBOLT	2X 10 Gbps	*****
WIRELESS (CURRENT)		
WI-FI-IEEE (802.11N)	150 Mbps	*
BLUETOOTH	3 Mbps	*
IrDA	4 Mbps	***
WIRELESS (FUTURE)		
Wi-Gig	2 Gbps	**
Giga-IR	1 Gbps	***
Li-Fi	>10 Gbps	****

Table 1 .Comparison(current and future wireless technology)

The table shows the current wireless technologies that can be used for transferring data between devices today, i.e. Wi-Fi & Bluetooth . Only Wi-Fi currently offers very high data rates.

3.1 How it is different than others wireless Technology?

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, does not 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 sort out limitations that have been put on the user by the Wi-Fi. You can normally stand under any form of light and surf the internet as the connection is made in case of any light available. There cannot be anything better than this LiFi technology.

4. APPLICATION OF LI-FI

4.1 You Might Just Live Longer

For a long time, medical technology has lagged behind the rest of the wireless world. Operating rooms are not allow.Wi-Fi over radiation concerns, and there is also that whole dedicated spectrum. Wi-Fi is place in many hospitals, interference from smart phones and personal computers can block signals from monitoring equipment. Li-Fi solves two problems: lights are not only allowed in operating rooms, but tend to be the most glaring fixtures in the room. And, as Haas mentions in his Lecture, Li-Fi has 10,000 times the spectrum of Wi-Fi, so maybe we can, I dun no, delegate red light to priority medical data.

4.2 Airlines used in plane

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've heard so far is that passengers will "soon" 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. I'll be the guy wowing next to you. It's better than listening to you tell me about your wildly successful son.

4.3 Smarter Power Plants(Small Industries)

Wi-Fi and so many other radiation types are bad for sensitive locations. Like those surrounding power plants. But power plants required fast, inter-connected data systems to monitor things like demand, grid integrity and (in nuclear plants) core temperature. Li-Fi could provide safe, abundant connectivity for all areas of these sensitive Area. Not only would this save money related to currently implemented solutions, but also the draw on a power plant's reserves could be lessened if they haven't yet converted to LED lighting.

4.4 Under water sea Awesomeness

Underwater ROVs work great, except when the tether isn't long enough to explore location, or when it gets stuck on something. If their wires were cut and replaced with light — say from a submerged, high-powered lamp — then they would be so much free to explore. They could also use their headlamps to communicate with each other, processing data autonomously and referring findings periodically back to the surface, all the while obtaining their next batch of orders.

4.5. It Could Keep You Informed and Save Lives

what the protocols are for those kinds of disasters. Until they pass under a street light, that is. Remember, with Li-Fi, if there's light, you're online. Stations and tunnels, common dead zonesfor most emergency communications. Plus, in times less stressing cities could opt to provide cheap high-speed Web access to every street corner.

5. ADVANTAGES&LIMITATIONS

5.1Advantages:

1. High speed, as high as 500mbps or 30GB /minute
2. Li- Fi can uses light rather than radio frequency signals,
3. 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.
4. There are around 19 billion bulbs worldwide, they just required to be replace with LED ones that transmit data.VLC is at a factor of ten, cheaper than WI-FI.

5. Security is another benefit, he points out, since light does not penetrate through walls.
6. In streets for traffic control. Cars having LED based headlights, LED based backlights, and Car can communicate each other and prevent accidents in the
7. way that they exchange Information. Traffic light can communicate to the car and so on.
8. By implementing the Technology worldwide every street lamp would be a free access point.
9. Li-Fi may solve issues such as the shortage of radio frequency bandwidth.

5.2 Limitations:

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

2. Although this technology sounds like a replacement to Wi-Fi but this high speed data transferring technology also has some limitations that is the inability of light to pass through obstacles .

CONCLUSION:

If this technology can be put into practical use, every LED bulb can be used something like a Wi-Fi hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and highly bright future. The concept of Li-Fi is currently attracting a great deal, not least because it may offer a genuine and very efficient alternative to radio-based wireless communication. As a growing number of people and their many devices access wireless internet, that the airwaves are goning to becoming increasingly clogged, making it more difficult to get a reliable, more useful, very high speed signals. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn't allowed such as aircraft or hospitals.

Similarly 3G, where the system is getting increasingly congested thereby turning from a high speed transmitting data scheme to a silkworm speed accessing method.

With this technology accessing data in aircraft, where radio waves can be a dangerous this technology will come into see, it is of great use in underwater oil rigs where communication through radio waves is not possible.

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