

LI-FI: THE FUTURE TECHNOLOGY AT THE SPEED OF LIGHT

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Abstract— As we use Wi-Fi in our daily life, we have seen that speed is a major concern. This drawback of lower speed can be overcome with the advent of the new technology known as LI-FI whose speed is normally 1Gbps which can be extended to 10Gbps. Li-Fi is data transmission through LED bulbs. Li-Fi refers to a type of VLC technology that delivers a networked, mobile, high speed communication solution in a similar manner like Wi-Fi. Optical wireless enjoys certain advantages over radio waves like economical cost, high speed, secure which is the reason for it being a popular area of research.

Index Terms— LI-FI, WI-FI, LED (light emitting diodes), VLC

I. INTRODUCTION

Internet services are very highly demanding and essential accessories in information & communication technology. In Wi-Fi we use routers to enhance the strength of weakened signals. Where as in Li-Fi there is no such use of routers as the data can be transmitted within the building or area efficiently as well as the data will be secured.

Living in metropolitan cities is full of challenges as the life at those is growing very rapidly and no one has time to wait. While using in our workplaces, homes etc. When we receive slow speeds as more and more devices are accessed on to the network, we get frustrated at such slow speeds which can be overcome using a new upcoming technology.

The increasing demand for higher bandwidths, environmental and human friendly system, more secure data transmission and greater speeds have made it necessary to shift from radio waves to optical wireless. Optical wireless communication system is the need of the hour. As the 3G systems are being used now a day, but, we all know that human wants are never ending, thus, the researchers are now working on 4G systems and we have to think even beyond that.

II. ABOUT LI-FI TECHNOLOGY

Li-Fi technology is a milestone in the history of information technology. The person who gave light to this upcoming technology was Dr. Harald Haas. As the name suggests, LIFE FIDELITY is a mode of transmission of data from one place to another with the speed of light. With the invention of new upcoming Li-Fi technology, you will see lights of your car, lights in your rooms, streets lights providing you high speed internet access in the near future.

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Flickering lights are annoying but they may have an upside. By now, you must have understood that data is transmitted with the help of light emitting diodes (LEDs). As per statistics information, there are over 14 billion light bulbs used worldwide, they just need to be replaced with LED ones that transmit data.

In October 2011, a number of companies, universities and industrial groups formed a non-profitable organization named as Li-Fi consortium to promote high speed optical wireless system and to overcome to problem of limited spectrum available for radio waves wireless system. The goal of this consortium is to make every illuminated device such as television, night lamp, headlight of car to transmit data to gadgets such as mobile phones, laptops.

III. WORKING TECHNOLOGY

Today world is of digitalization which means everything around us is digital, so, is the data. Thus, if the LED is 'ON', you transmit 1 and if the LED is 'OFF', you transmit 0. You can transmit different



In wireless communication, we use radio waves which have a limited bandwidth. Due to urbanization, the demand for wireless communication is increasing rapidly. So, to fulfill this demand we must switch to visible light part of the electromagnetic spectrum which is still not utilized yet. Li-Fi is a high speed optical version of Wi-Fi that is based on Visible Light Communication (VLC). VLC is a mode of data transmission which uses visible light portion of the spectrum between 400THz (780nm) and 800THz (375nm).

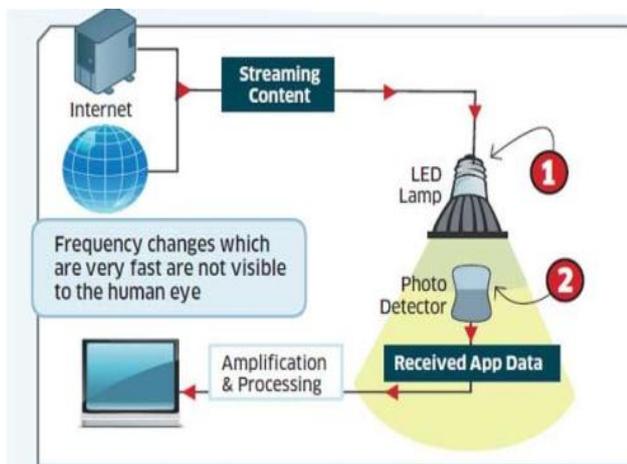
The biggest achievement till date in this technology is the data development of LEDs that are a thousand times smaller than the commercially used smallest LED. These newer LEDs are termed as micro LEDs which are merely 1 square micro meter in size which means 1000 light could be fit into the same space as the commonly used LEDs. Besides, micro LEDs can flicker 1000 times faster than commercial LEDs. 1000 micro

LEDs put together could transmit data a million times faster than a typical LED.

IV. DATA TRANSMISSION

LI-FI is a mode of wireless communication using LEDs for two purposes simultaneously, first for illumination and second for communication. The data is transmitted in LI-FI by changing the light intensity and these changes are combinations of binary coded data by controlling the rate of flickering of LED with the help of microcontroller. A LED bulb along with embedded microchip can produce data rates much speedier than an averaged broadband connection. If you have light, you can transmit or access the data. imperceptible to the human eye. The LEDs can be modulated at the required speed using an appropriate technique of modulation.

In the diagram shown, the two main components used are LED lamp which acts as a communication source and photo detector which acts as a communication destination. The data from the mobile or computer is encoded on the LED lamp by controlling the flickering rate of it. This data is transmitted at very high speeds to the photo detector.



The receiving dongle then converts the changes in the amplitude into an electrical signal which is converted back into data stream and fed into the destination computer or mobile.

Four computers can be connected to internet through one watt LED bulb using light as a carrier instead of traditional radio frequencies, as in WI-FI, said Chi Nan, an information technology professor with Shanghai’s Fudan University. The current wireless connection is highly expensive and low in efficiency. The new discovery dubbed as “LI-FI” overcomes these drawbacks as it is highly efficient at the same time being cost effective.

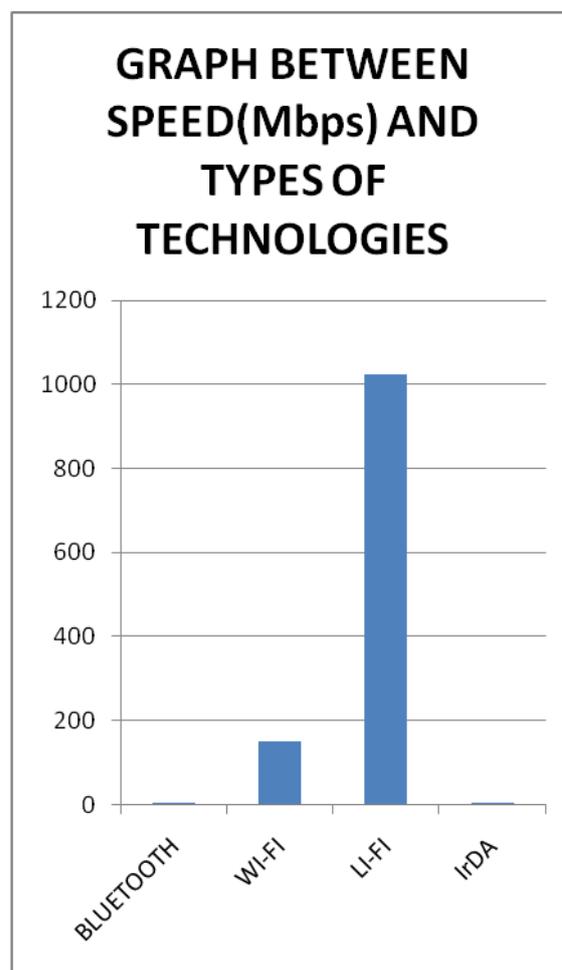
V. LI-FI: A CHEAPER, FASTER ALTERNATIVE TO WI-FI

The upcoming new technology got this name LI-FI due to its similarity with WI-FI using light in place of radio waves. In LI-FI, the modulated signal is light and in WI-FI, it is radio waves. Co-channel interference is a major issue in WI-FI which is non-existent in LI-FI. Average speed of LI-FI is greater than 1Gbps which can be extended to 10Gbps, whereas, average speed of WIFI is 150Mbps which can go up to 600Mbps.

TYPES OF TECHNOLOGY	AVERAGE SPEED
BLUETOOTH	3Mbps
WI-FI	150Mbps
LI-FI	>1Gbps
IrDA	4Mbps

A graph is plotted between speed in Mbps and the types of technology on the basis of above table from which it is observed that LI-FI has the highest speed among the different type of technologies.

With the help of such high speed we can download a **HIGH DEFINITION(HD)**movie in just 30 seconds which implies that in the near future, we don’t have to sit in front of our computers or laptops for hours waiting for important documents or movies to get downloaded, therefore, will not get frustrated at receiving slow speeds.



Transfer of data in WI-FI is vulnerable to hackers as the radio waves can pass through the walls and buildings, whilst, the data in case of LI-FI is more safe and secure due to the fact that light waves cannot penetrates through walls and buildings which states that the data remains within the building itself as required for example in bank for securing the data.

Instead of running close to the cables where the WI-FI signals are stronger, now you can sit back comfortably on your bed or couch and access the internet. In LI-FI, there is no need of providing additional cables from one access point to the other which is most essential in WI-FI. Thus, the new discovery dubbed as LI-FI is affordable as all we need is a LED that can transmit the data.

LI-FI is pretty simpler to manage as compared to WI-FI. A LED source has very high lumen intensity. A single LED source can produce 2,300 lumens of white light. So, it is efficient to use one LED source per street light. Thus, LI-FI is a cheaper, faster alternative to WI-FI.

VI. CHALLENGES FACED BY LI-FI

LI-FI is a new technology in which data is transferred using light as a carrier. If there is light, there is an internet connection. Turn off the light and there is no signal. If the light is blocked, then the signal will get cut off.

The biggest disadvantage of this technology is that either you or your laptop, mobile device should be in sight of the LED bulb. You cannot go to the next room until there are wired LED bulb there too.

VII. ADVANTAGES OF LI-FI

1. Under water such as in seas, WI-FI does not work but light does travel there, so, LI-FI can be used.
2. LI-FI may handle issues such as shortage of radio frequency bandwidth available.
3. Security is yet another benefit, which is most prevalent in LI-FI.
4. By the help of this upcoming new technology, every street lamp would be a free access point.
5. As the data travels with the speed of light, so, speed of this technology is as high as 1Gbps which can reach up to 10Gbps.

This new technology is cost effective, thus, it is affordable.

VIII. PRACTICAL APPLICATIONS

There are various practical applications of this technology, some of which are discussed below:

A. Smarter Museums:-

This is an area where communication and radiation level are intensely monitored. Museums have strict rules and regulations regarding the environment in which they keep their treasure. All they allow is a light, thus, LIFI could provide the museum much more information on its collections than those tiny cards that they stick on the walls. You could gather information about recent auctions; artist's history. You can extend this concept even to art galleries.

B. Lecture Halls:-

Lecture halls are fun for some, may be not for others. Imagine a lecture hall, how interactive it would be having connectivity between 500 devices. Annotate lecture Notes, share your queries not only with the teachers but also with other class fellow. The entire lecture can be shown in HD, downloaded and then played back on every individual device present in the room. Suddenly a boring lecture can change into energetic learning lecture owing to LI-FI.

C. OFFICES:-

Offices that you are working in have provided you WI-FI but you are receiving slow speed through them and you request your boss for fiber optics cable but he replies no. Then LI-FI cheaply solves your problem as it is cost effective at the same time provides high speed as well as security is an added benefit. Thanks to the geographically specific nature of LI-FI that helps you to keep your data safe from your competitors.

D. THEFT IN THE SHOPS:-

As of now, retailer complains a lot about people coming into the store, gathering data and finally buying online. There is more data available online about each and every item of the store than the store sales person can provide us. A customer can gather data about the reviews and pricing of item from the blogs and ultimately walk up to the store and buy the item or can purchase the item online. Not only LI-FI will make the process less annoying but also provide high speed connection for researching and purchasing at home.

E. HOSPITALS:-

Medical technology had advanced a lot but still it is far behind the wireless world. Operating rooms have banned WI-FI owing to radiations concerns. If WI-FI is used in hospitals, interference from mobiles and computers can block the signals coming from monitoring equipment's. Thus LI-FI can overcome these problems as the operating rooms make use of the lights.

IX. CONCLUSION

With the advent of this technology and its practical applications in areas such as hospitals, aircrafts etc. where the radio waves are banned, there every light bulb could be transformed into 10Gbps wireless modem. LIFI has become an area of interest since it is safer, greener and cheaper.

The possibilities of this technology are numerous but it is still in its infancy. Professor Chi Nan's research team is presently working in this technology which includes scientist from the Shanghai Institute of Technical physics at the Chinese Academy of Sciences. The technology needs further improvements in microchips designing and manufacturing as well as light communication controls which are in experimental period. Professor Chi's team is planning to show 10 samples of LI-FI kit at the China International Industrial Fair in Shanghai on 5th November 2013. When LI-FI will be put to use, it will prove to be a boon for the whole world but there is still a long wave to go to making it commercially successfully.

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