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Survey on Li-Fi Technology

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ABSTRACT

Now-a-days, Wireless technology has bloomed to a great extent that it requires wireless technology to transmit a lot of data every day. Moreover, Wireless communications has become important in each and every communication process. The simplest way to transmit wireless data is by making using electromagnetic waves which is also known as radio waves. As we all know, Radio waves can support less bandwidth because of intrusion and compact spectrum availability. Visible Light Communication (VLC) is the solution to this is data transmission. Wi-Fi provides us with wireless coverage within premises, whereas Li-Fi is said to be perfect for high compactness wireless data coverage for defined area and also for mitigating radio interference problems. In Li-Fi, basically we deal with transmitting multimedia data between two terminals with the use of LED's. Li-Fi focuses on transmission of data through illumination, in which data can be sent through a LED light bulb which may varies in intensity faster than human eye can follow. The light which is used in our daily life is not only used in providing light but also helps in communication by illumination. Transmission of image through Li-Fi technology is done easily.

Keywords: VLC, Li-Fi, Wi-Fi, LED, radio spectrum

INTRODUCTION

Li-Fi having a various range of frequencies and wavelengths, from the infrared through visible and down to the ultraviolet spectrum. It includes sub-gigabit and gigabit-class communication speeds for short, medium and long ranges, unidirectional and bidirectional data transfer using line-of-sight, reflections and many more. It is not limited to LED or laser technologies or to a particular receiving technique. Li-Fi is a framework for all of these providing new capabilities to current and future services, applications and end users. This idea was first showcased by Harald Haas from University of Edinburgh, UK, in his TED Global talk on VLC. He explained, very simple, if the LED is on, you transmit digital 1, if it's off you transmit a 0. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data.

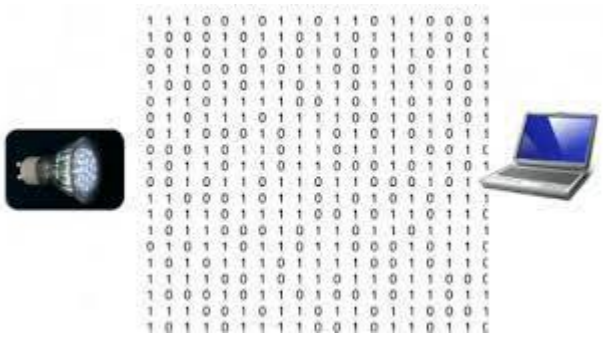

Figure 1: Data Transmission in Li-Fi

Li-Fi basically known as "LIGHT FEDILITY" is an outcome of twenty first century. The basic idea behind this technology is that the data can be transmitted through LED light whose intensity varies even faster than the human eye. As the transmission of the data takes place through the light emitting diodes (LED's) the amount is comparatively small .In modern times, it is called as the optimized version of WI-FI .The advantageous thing is the wireless communication which decreases the cost enormously. HARALD HASS, who is considered to be the father of Li-Fi, says that the heart of this technology lies in the intensity and the potential of the light emitting diodes. The major reason which lead the modern man through this invention is that the confinement of Wi-Fi to comparatively small distance.

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. Li-Fi uses visible light instead of Gigahertz radio waves for data transfer.

Li-Fi can play a major role in relieving the heavy loads which the current wireless systems face since it adds a new and unutilized bandwidth of visible light to the currently available radio waves for data transfer. Thus it offers much larger frequency band (300 THz) compared to that available in RF communications (300GHz). Also, more data coming through the visible spectrum could help alleviate concerns that the electromagnetic waves that come with Wi-Fi could adversely affect our health.

WORKING PRINCIPLE

Light Fidelity (Li-Fi) technology is a 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. 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 switching activity enables data transmission using binary codes. If the LED is on, a digital signal '1' is transmitted and if the LED is off, a digital signal '0' is transmitted. Also these LEDs can be turned 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).This puts Li-Fi in a unique way of extremely fast and efficient wireless communication over short distances.

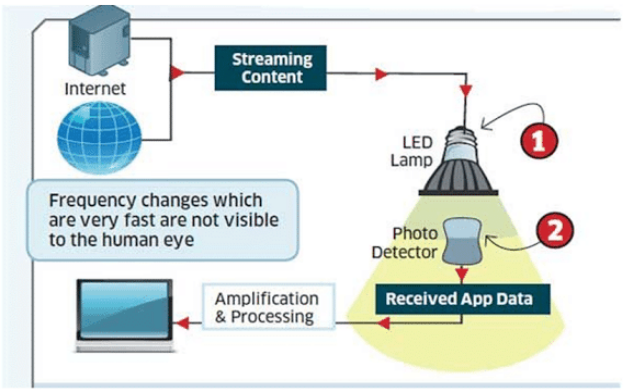

Figure 2: Block Diagram of Li-Fi Sub System

on the receiving end receives the data as light signal and decodes the information, which is then displayed on the device connected to the receiver. The receiver (photo detector) registers a binary '1' when the transmitter (LED) is ON and a binary '0' when the transmitter (LED) is OFF. Thus flashing the LED numerous times or using an array of LEDs (perhaps of a few different colors) will eventually provide data rates in the range of hundreds of Mbps. The Li-Fi working is explained in a block diagram (Fig. 2).

Hence all that is required, is some or an array of LEDs and a controller that controls/encodes data into those LEDs. All one has to do is to vary the rate at which the LEDs flicker depending upon the data input to LEDs. Further data rate enhancements can be made in this method, by using array of the LEDs for parallel data transmission, or using mixtures of red , green and blue LEDs to alter the light's frequency, with each frequency encoding a different data channel. Figure 3 shows working/deployment of a Li-Fi system connecting the devices in a room.

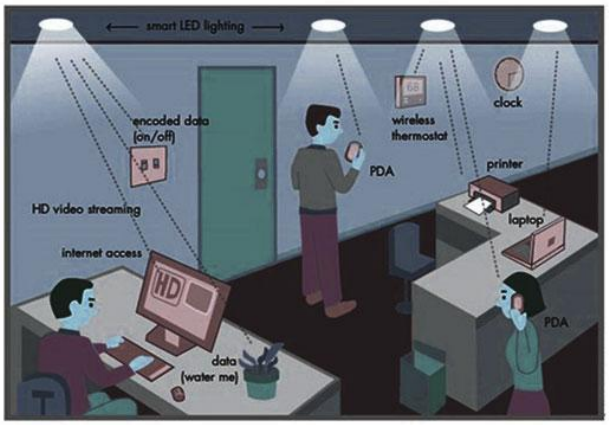

Figure 3: Li-Fi system connecting devices in a room

COMPARISION BETWEEN LI-FI AND WI-FI

Differences between Li-Fi and Wi-Fi technologies. Following table mentions features comparision between both.

Table 1: Li-Fi vs Wi-Fi

Parameter	**LI-FI**	**WI-FI**
Speed	High	High
Spectrum	10,000 times broader than that of Wi-Fi	Narrow spectrum
Data density	High	Low
Security	High security due to non-penetration of light through walls	Less secure due to transparency
Reliability	Medium	Medium
Bandwidth	High due to broad spectrum	Low
Transmit/receive power	High	Medium
Ecological Impact	Low	Medium
Device-to-device connectivity	High	High
Obstacle interference	High	Low
Bill of materials	High	Medium
Market maturity	Low	High
Latency	In the order of microseconds	In the order of milliseconds

APPLICATIONS

A. In Hospitals: Wi-Fi is not allowed in sensitive area of hospitals because of following reasons:

• Radiations of radio frequency may affect the patients' health.

.• It may also interrupt the medical equipment.

Li-Fi uses light for data transmission therefore Li-Fi can replace Wi-Fi in medical applications for safety purpose.

Figure 4: Li-Fi in operation Theater

B. In Aircrafts: When we travel in airplanes, the crew member of plane asks us to keep our mobile phone on airplane mode because the radio frequency may interfere with navigation system of plane. Thus, LiFi is a safe alternative to Wi-Fi in aircrafts

Figure 5: Li-Fi in aircraft Cabins

C. Underwater: Wi-Fi technology completely fails in underwater communication because radio frequency is comfortable to travel underwater. Un Tethered Remotely Operated Vehicle (UTROV) is used for underwater communication. UTROV is an application of VLC technology.

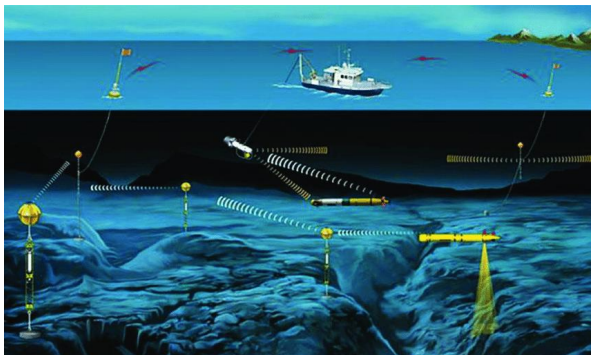

Figure 6: Li-Fi under ocean beds

D. In Disaster Management: Wi-Fi may fail during natural disasters like earthquakes, tsunami, cyclones etc. because tower may get distorted during natural disaster. As a single tower cover large area. If LED blubs are used in street light then Li-Fi can easily replace Wi-Fi. Since Street lights are placed in few meters apart from each other. So, the communication system will be alive after natural disaster. The idea of using street light for data transmission can be used in building the smart cities.

E. In Defense: Defense is fourth pillar of developing India. It is very essential to provide a secure communication system for defense. Jammer can block the signal of radio frequency which leads to failure of communication system. In Li-Fi technology light is used, which cannot be blocked by jammer.

ADVANTAGES

- Light Fidelity uses light rather than radio frequency signals so are intolerant to disturbances.
- VLC could be used safely in aircraft without affecting airlines signals.
- Integrated into medical devices and in hospitals as this technology doesn‘t deal with radiowaves, 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.
- There are billions of bulbs worldwide which just need to be replaced with LED‘s to transmit data.
- Security is a side benefit of using light for data transfer as it does not penetrate through walls.
- On highways for traffic control applications like where Cars can have LED based headlights, LED based backlights, and they can communicate with each other and preventaccidents. Using this Technology worldwide every street lamp would be a free data access point.
- The issues of the shortage of radio frequency bandwidth may be sorted out by Li-Fi.

CONCLUSION

The possibilities are numerous and can be explored further. If his technology can be put into practical use, every bulb can be used something like a Wi-Fi hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and brighter future. The concept of Li-Fi is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing number of people and their many devices access wireless internet, the airwaves are becoming increasingly logged, making it more and more difficult to get a reliable, high-speed signal. 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. One of the short coming showever is that it only work in direct line of sight.

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