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IT : Impose Technology – Li- Wi

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Li- Fi is Visible Light Communications (VLC) system running wireless communications travelling at very high speeds. Li-Fi and Wi-Fi are quite similar as both transmit data electromagnetically. It provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved blisteringly high speed in the lab. It is wire and uv visible-light communication or infrared and near-ultraviolet instead of radio-frequency spectrum, part of optical wireless communications technology, which carries much more information and has been proposed as a solution to the RF-bandwidth limitations. In the coming generation, this technology will be used for transmitting data or information to smart phones, laptops etc. through the light in a room. This paper presents the detailed study on Li-Fi technology, its construction, advantages and its future scope.

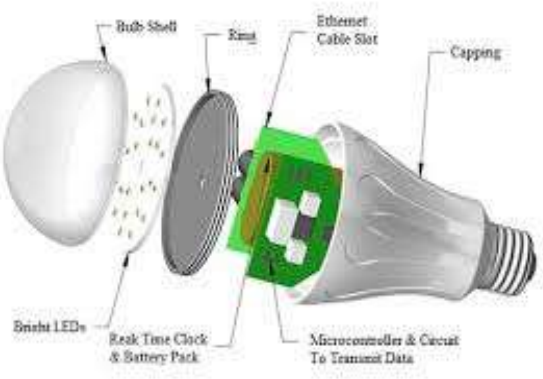
Keywords : *Li –Fi , VLC, LED, OWC, Wi- Fi*

Introduction

Light Fidelity or Li-Fi is a Visible Light Communications (VLC) system running wireless communications travelling at very high speeds. It uses common household.LED (light emitting diodes) light bulbs to enable data transfer, boasting speeds of up to 224 gigabits per second.

Light Fidelity (Li-Fi) is a bidirectional, high-speed and fully networked wirelesscommunication technology similar to Wi-Fi. The term was coined by Harald Haas[1] and is a form of visible light communication and a subset of optical wireless communications (OWC) and could be a complement to RF communication (Wi-Fi or cellular networks), or even a replacement in contexts of data broadcasting.It is wire and uv visible-light communication or infrared and near-ultraviolet instead of radio-frequency spectrum, part of optical wireless communications technology, which carries much more information and has been proposed as a solution to the RF-bandwidth limitations.

In the coming generation, this technology will be used for transmitting data or information to smart phones, laptops etc. through the light in a room.



Construction of a Li-Fi system

The affordable, speed change in the optical form of Wi-Fi is the Li-Fi and it is based on VLC i.e. Visible Light Communication where VLC is a medium of information communication which avails quick pulses of light to send the data wirelessly. The main constituents of a Li-Fi system are:

- An excel brightening white LED which plays the role of a transmitter.
- A silicon photodiode with a good response to visible light acts as a receiver.

LED's can be switched on and off through which different unions of digital chains consisting of 1's and 0's are produced. The LED can be used as a transmitter or a source, the response of LED appears consistent to the human eye due to the quick flickering of LED.

How it works

Li-Fi and Wi-Fi are quite similar as both transmit data electromagnetically. However, Wi-Fi uses radio waves while Li-Fi runs on visible light. As we now know, Li-Fi is a Visible Light Communications (VLC) system. This means that it accommodates a photo-detector to receive light signals and a signal processing element to convert the data into 'stream-able' content. An LED light bulb is a semi-conductor light source meaning that the constant current of electricity supplied to an LED light bulb can be dipped and dimmed, up and down at extremely high speeds, without being visible to the human eye. For example, data is fed into an LED light bulb (with signal processing technology), it then sends data (embedded in its beam) at rapid speeds to the photo-detector (photodiode).The tiny changes in the rapid dimming of LED bulbs is then converted by the 'receiver' into electrical signal. The signal is then converted back into a binary data stream that we would recognize as web, video and audio applications that run on internet enables devices.

The logic behind the working of light fidelity technology is much unmingled. If the LED is on, a digital string '1′ is transmitted and when the LED is off then a digital string '0′ is transmitted. For example, there is a LED at one end and a photodetector at the other end, whenever the LED is on, a binary '1′ and when the LED is off a binary '0′ is registered by the photodetector. Thus a message is build up by many flashes of LED.

Many other highly developed technologies can be used I increasing the data rate of VLC, a recent research in Berlin attained rates of 500 megabytes per second. Parallel data transmission where each LED generates a separate data stream and has been focusing on many teams in the University of Oxford and Edinburg.

Visible Light Communication

VLC = Illumination + Communication

Imagine a flash light which you might use to send a morse code signal. When operated manually this is sending data using the light signal, but because it is flashing off and on it cannot be considered to be a useful illumination source, so it is not really VLC by our definition. Now imagine that the flash light is switched on and off extremely quickly via a computer, then we cannot see the data and the flash light appears to emitting a constant light, so now we have illumination and communication and this does fits our definition of VLC. Of course we would need a receiver capable of receiving the information but that is not too difficult to achieve.

In literal terms any form of information that can be sent using a light signal that is visible to humans could be considered to be VLC, but by our definition we should be able to see the light, but cannot "see" the data. So although there seems to be no universally agreed definition of VLC is, we can at least agree what we mean by VLC.

The opportunity to send data usefully in this manner has largely arisen because of the widespread use of LED light bulbs. LEDs are semiconductor devices similar to silicon chips. Consequently we can switch these bulbs at very high speeds that were not possible with older light bulb technologies such as fluorescent and incandescent lamps. The rapid adoption of LED light bulbs has created a massive opportunity for VLC. The problem of congestion of the radio spectrum utilized by Wi-Fi and cellular radio systems is also helping to create the market for VLC.

There are other terms used in the VLC space which are quite widely used but have slightly different meaning to VLC. Three terms closely associated with VLC are:

Free space optical (FSO) communication is similar to VLC but is not constrained to visible light, so ultraviolet (UV) and infrared (IR) also fall into the FSO category. Additionally, there is no illumination requirement for FSO and so this tends to be used in

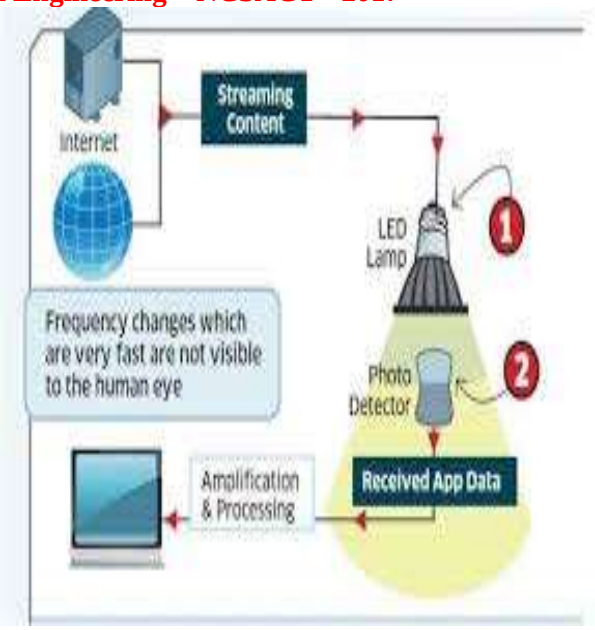
narrow beams of focussed light for applications such as communication links between buildings. FSO often uses laser diodes rather than LEDs for the transmission.

Li-Fi is a term often used to describe high speed VLC in application scenarios where Wi-Fi might also be used. The term Li-Fi is similar to Wi-Fi with the exception that light rather than radio is used for transmission. Li-Fi might be considered as complementary to Wi-Fi. If a user device is placed within a Li-Fi hot spot (i.e. under a Li-Fi light bulb), it might be handed over from the Wi-Fi system to the Li-Fi system and there could be a boost in performance.

Optical Wireless communication (OWC) is a general term which refers to all types of optical communications where cables (optical fibres) are not used. VLC, FSO, Li-Fi and infra-red remote controls are all examples of OWC.

Working Of Li-Fi

A new generation of high brightness light-emitting diodes forms the core part of light fidelity technology. The logic is very simple. If the LED is on, a digital 1 is transmitted. If the LE D is off, a digital 0 is transmitted. These high brightness LEDs can be switched on and off very quickly which gives us a very nice opportunities for transmitting data through light . The working of Li-Fi is very simple. There is a light emitter on one end, for example, an LED, and a photo detector (light sensor) on the other. The photo detector registers a binary one when the LED is on; and a binary zero if the LED is off. To build up a message, flash the LED numerous times or use an array of LEDs of perhaps a few different colors, to obtain data rates in the range of hundreds of megabits per second. The block diagram of Li-Fi system



System Design

Li-Fi is typically implemented using white LED light bulbs at the downlink transmitter. These devices are normally used for illumination only by applying a constant current. However, by fast and subtle variations of the current, the optical output can be made to vary at extremely high speeds. This very property of optical current is used in Li- Fi setup. The operational procedure is very simple, data from the internet and local network is used to modulate the intensity of the LED light source if any undetectable to the human eye. The photo detector picks up signal, which is converted back into a data stream and sent to the client. The client can communicate through its own LED output or over the existing network. An overhead lamp fitted with an LED with signal-processing technology streams data embedded in its beam at ultra-high speeds to the photo-detector. A receiver dongle then converts the tiny changes in amplitude into an electrical signal, which is then converted back into a data stream and transmitted to a computer or mobile device.

Methods of Visible Light Communication:

i) Devices used for Visible Light Communication. ii) Communication using Image Sensor.

Technology behind Li-Fi

Li-Fi technology makes use of the light received from light-emitting diodes (LEDs) to act as a medium which delivers high-speed communication across all mobile networks. This is quite similar to the working of Wi-Fi. With a compound growth rate of more than 82 percent during 2013 – 2018, the concept of visible-light communication works when the Led current is switched on and off at a very high speed. This happens too quickly for the human eye to notice as well as realize.

Even though Li-Fi LEDs have to be kept in the on state in order to transmit data, it can also be dimmed accordingly to below the range of human visibility, while the same time emitting plenty of light to carry data from one point to another.

The benefit of using Li-Fi technology is that its light waves cannot penetrate through walls and hence create comparatively stronger range which is more secure than Wi-Fi when it comes to protection from hacking threats. There is also no need for Direct Line of Sight for Li-Fi to transmit a signal. This is because the light which is reflected back from the walls is capable of achieving 70 Mbit/s.

Security Concerns of Li-Fi

It is a proven fact that Li-Fi is more secure as compared to traditional Wi-Fi. This is because Wi-Fi routers are generally used by attackers to enter a network and strong firewalls are also unable to safeguard your network from these attackers. One of the common reasons behind this is that the range of Wi-Fi routers is an important factor which enables these security breaches into your Wi-Fi network.

On the other hand, Li-Fi uses light which limits the range of the internet connection and it cannot be increased at any cost. Thus, not letting the bulb be lightened or dimmed manually. This peculiar feature of Li-Fi will protect your network from interference from your neighbors.

Drawbacks of Li-Fi

One difference between Li-Fi and Wi-Fi is that it Li-Fi is more secure than Wi-Fi. You can only use the internet using Li-Fi when the light is coming out of the bulb. Hence, you have to be present there!! Moving away from the bulb will result in losing your internet connection.

One of the most common **drawbacks of Li-Fi** is that all electronic devices are to be configured with the bulb for them to get connected to the internet.

Comparison between Wi- Fi and Li-Fi

Parameters	Li-Fi	Wi-Fi
Speed	High	High
Range	Low	Medium
Data Density	High	Low
Security	High	Medium
Reliability	Medium	Medium
Power Available	High	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

1. Li-Fi can be considered as a light-based Wi-Fi. It uses light instead of radio waves to transmit information.
2. Li-Fi is transmission of data using illumination i.e. sending data through an LED lamp that varies intensity of light faster than what human eye can perceive.
3. 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.
4. Wi Fi is great for general wireless coverage within building and Li-Fi is ideal for high density wireless date coverage in confined area and for relieving radio interference issues.
5. So the two technologies can be considered complimentary.

Pros:

1. Li-Fi can solve problems related to the insufficiency of radio frequency bandwidth because this technology uses Visible light spectrum that has still not been greatly utilized.
2. High data transmission rates of up to 10Gbps can be achieved.

3. Since light cannot penetrate walls, it provides privacy and security that Wi-Fi cannot.
4. Li-Fi has low implementation and maintenance costs.
5. Can be used in RF restricted environments where EM waves are restricted.
6. By not using radio and serving same use case, it eases out interference and congestion of highly occupied radio bands i.e. ISM band used popularly in WPAN technologies.

Cons:

1. Light can't pass through objects.
2. A major challenge Li-Fi is facing; how the receiving device will transmit back to transmitter.
3. Interference from external light sources like sun, light, normal bulbs, opaque materials.
4. Line of Sight requirement, so area coverage is limited and indoor mostly.

Conclusion

Li-Fi is the future and on upward technology acting as capable for various other developing and already invented technologies. Since light is the major source for transmission in this technology it is very beneficial and implementable in various fields that can't be done with the Wi-Fi and other technologies. The concept of LiFi is currently attracting a great deal of interest, not least because it may offer a true and very efficient alternative to radio-based wireless.

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