

Network Security: Li-Fi: Data Onlight Instead of Online

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Abstract— With the vast growing gadgets, their usage and their developments led to the advancement in the Wi-Fi which provides a technology so called Li-Fi. Li-Fi is a technology that makes use of LED light which helps in the transmission of data much more faster and flexible than data that can be transmitted through Wi-Fi. Light reaches nearly everywhere so communication can also go along with light freely. Light Fidelity is a branch of optical wireless communication which is an emerging technology. By using visible light as transmission medium, Li-Fi provides wireless indoor communication. The bit rate achieved by Li-Fi cannot be achieved by Wi-Fi. Dr herald Haas the professor of mobile communications at the university of Edinburgh school of engineering ,first time publically displayed the proof of Light Fidelity (Li-Fi) ,a method of Visible Light communication(VLC). Li-Fi is the transfer of data through light by taking fiber out of fiber optics and sending data through LED light.He envisions a future where data for laptops, smart phones, and tablets is transmitted through the light in a room. And security would be snap – if you can't see the light, you can't access the data.

Keywords-LI-FI,WI-FI,LED,D-Light

I. Introduction

Li-Fi is a label for wireless communication system which is used to describe visible light communication technology applied to high speed wireless communication. It acquired this name due to similarity to Wi-Fi, using light instead of radio waves. This term was first used by German physicist, Harald Hass in 2011 in TED Global Talk on visible light communication [1].

Demand for wireless data is increasing day by day which is escalating the congestion in radio spectrum. In present scenario the bandwidth capacity which is available is finite & is not capable enough to sustain with the constantly increasing demand of wireless data. Wireless Fidelity dubbed as Wi-Fi has been in use from almost years to provide the internet services to all the required places right from home to humungous organizations. But it has limited bandwidth of about 54-100 megabits per second (Mbps). With High definition video &

audios available for the viewers, it is becoming intricate to transfer them to the user flawlessly. The problem of speed & consistency even doubles when support is to be given to multiple devices because of splitting up of bandwidth between devices. The beauty of Wi-Fi is its easy & simple to set up network but threatening part is to provide security. To overcome technological boundaries of Wi-Fi, a new paradigm is in, which is Li-Fi. An emerging technology using Visible Light Communications (VLC) for high speed wireless coined by Prof. Harald Haas who is one of the scientists in the team, to develop this technology along with Dr. Gordon Povey & Dr. Mostafa Afgani at the University of Edinburgh. It uses white LED light bulbs to transmit the information as well as fulfilling the

purpose of illumination. Through fast and slight variations of the current (which is applied to the LED), the optical output can be made to vary at very high speeds. The variation caused in the current which is passed to the LED will carry data at high speed and cannot be seen by the human eye.

In simple terms, Li-Fi can be thought of as a light-based Wi-Fi. That is, it uses light instead of radio waves to transmit information. And 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. Since simple light bulbs are used, there can technically be any number of access points

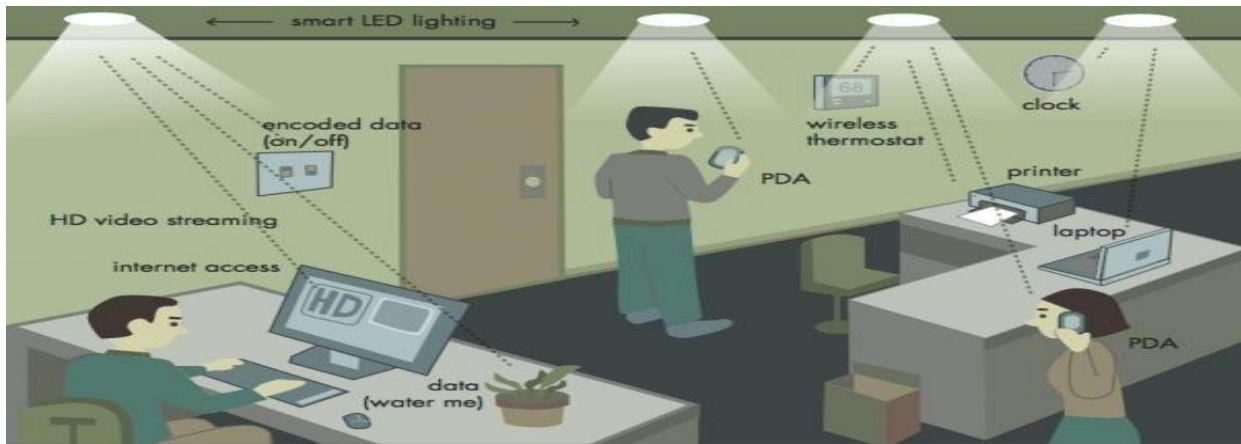


Fig-1 LI-FI environment

II. Principle Of Li-Fi Technology

Heart of Li-Fi technology is high brightness LED's. Light emitting diodes can be switched on and off faster since operating speed of LED's is less than 1 μ s, than the human eye can detect, causing the light

source to be appear continuously. This invisible on-off activity enables a kind of data transmission using binary codes. Switching on and LED is a logical '1', switching it off is a logical '0'. It is

possible to encode data in the light by varying the rate at which LED's flicker on and off to give different strings of 1s and 0s. Modulation is so fast that human eye doesn't notice .A light sensitive device (photo detector) receives the signal and converts it back into original data. This method of

using rapid pulses of light to transmit information wirelessly is technically referred as Visible Light Communication (VLC) though its potential to compete with conventional Wi-Fi has inspired the popular characteristics Li-Fi.

III. Visible light communication (VLC)-“A potential solution to the global wireless spectrum shortage”

Li-Fi is a fast and cheap version of Wi-Fi, which is based on visible light communication (VLC). The Visible light communication is a data communications medium using visible light

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
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

between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission and illumination.

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.

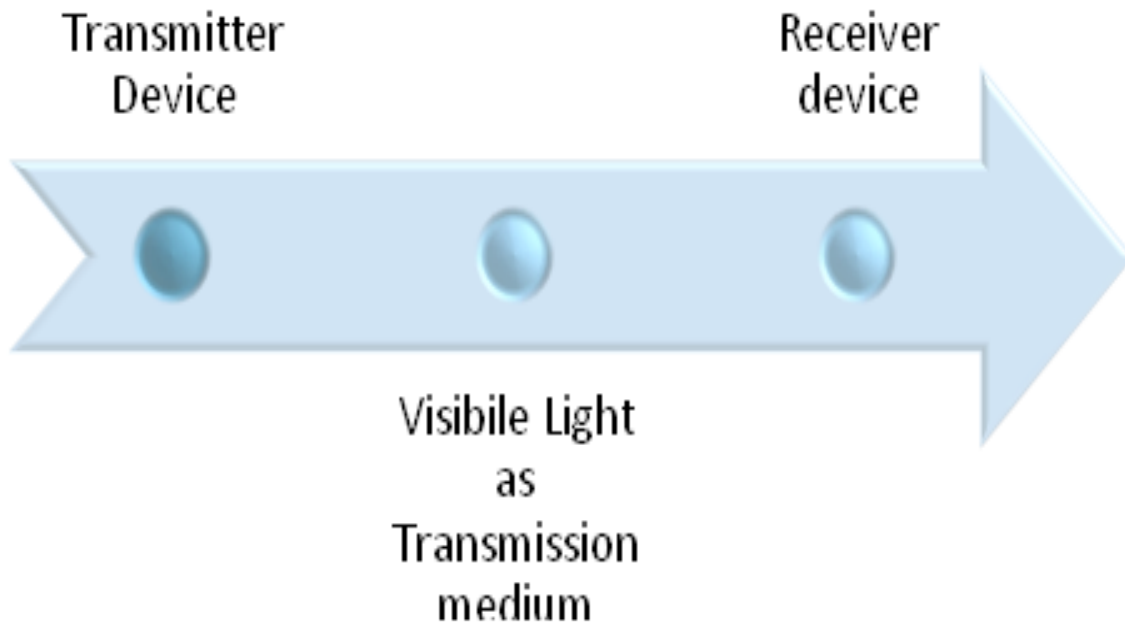


Fig 2 Data transmission from source to destination by visible light as medium

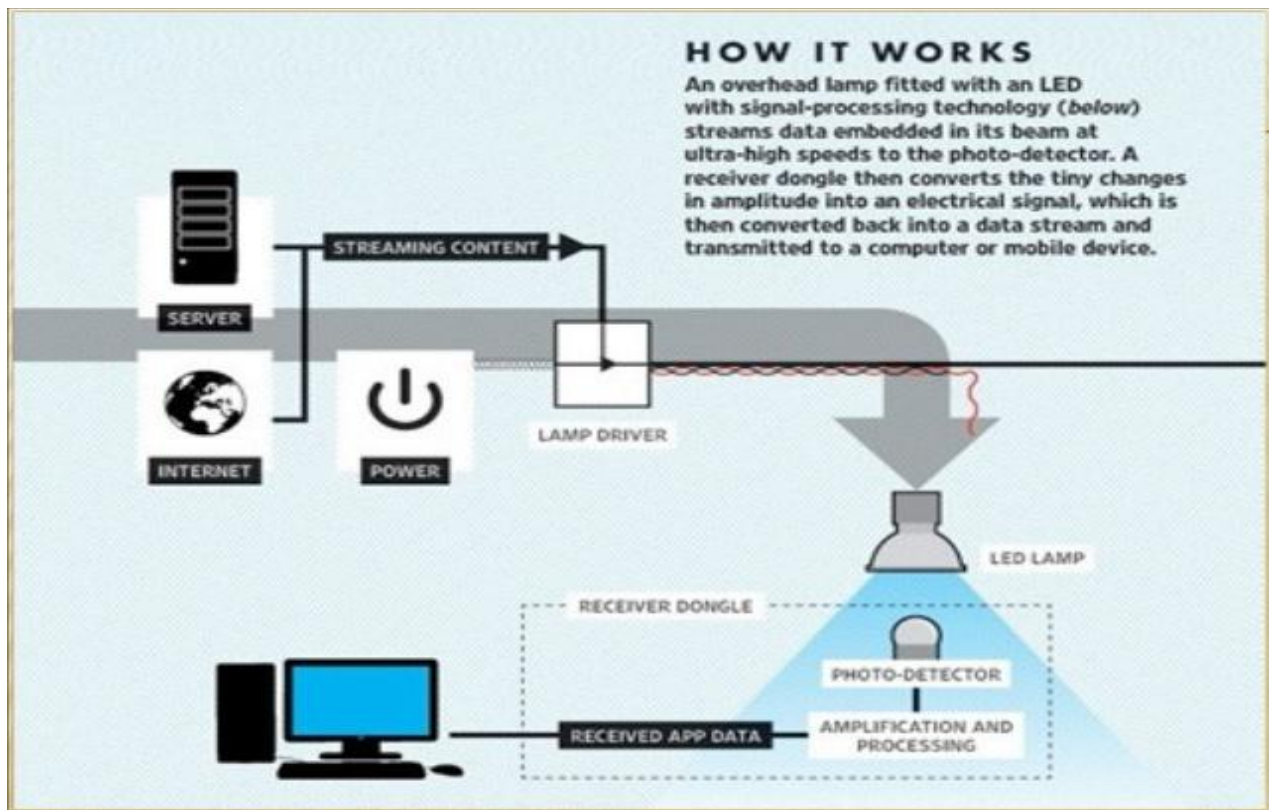


Fig. 3 Data transmission using LED

IV. Benefits Of Li-Fi Over Wi-Fi

- High speed, as high as 500mbps or 30GB per minute.
- Li-Fi uses light rather than radio frequency signals.
- VLC could be used safely in aircraft.
- Integrated into medical devices and in hospitals as this technology does not deal with radio 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.
- Under water in sea Wi-Fi does not work at.
- There are around 19 billion bulbs worldwide, they just need to be replaced with LED ones that transmit data. We reckon VLC is at a factor of ten, cheaper than WI-FI.
- Security is another benefit, since light does not penetrate through walls.
- By implanting the technology worldwide every street lamp would be a free access point.
- LI-FI may solve issues such as the shortage of radio frequency bandwidth.
- Visible light spectrum has 10,000 time broad spectrum in comparison to radio frequency used in WI-FI.

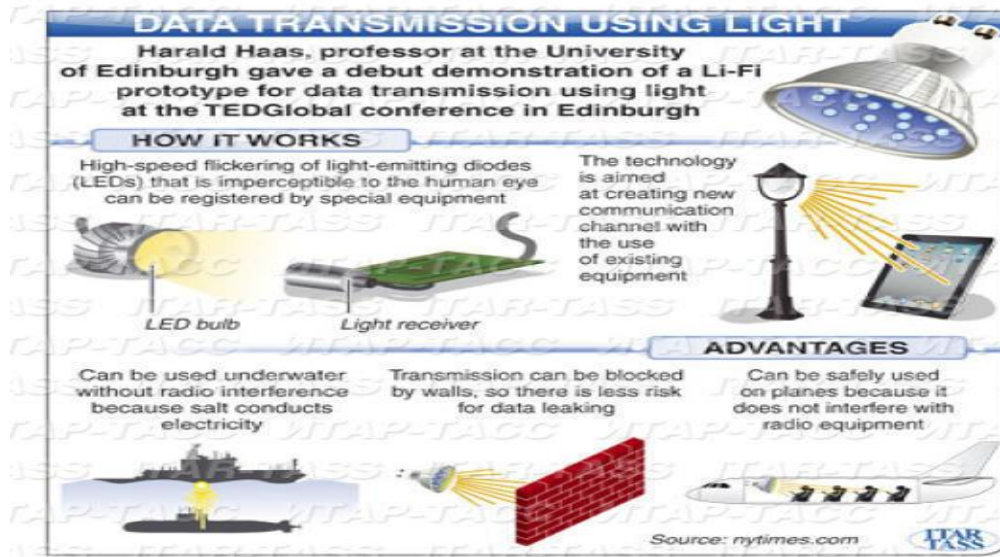


Fig. 4 Show the LI-FI benefits over WI-FI

V. Future Applications

Li-Fi is the upcoming and on growing technology acting as competent for various other developing and already invented technologies. Since light is a major source for transmission in this technology it is very advantageous and implementable in various fields that can't be done with the Wi-Fi and other technologies. Hence the future applications of the Li-Fi can be predicted and extended to different platforms like education fields, medical field, industrial areas and many other fields.

A. Smart Lighting

With the advent of VLC smart lighting will be provided which in turn will be used for illumination as well as communications. Various types of controlling can also be done by using this concept. In all energy consumption and wiring incorporated will also be reduced as lights are already on for illumination, so no additional energy is required for data transmission [2], [3]. Its use can also be extended in Projection Display Systems. Lamp Technology which is electrode free using Li-Fi has been created for projection display applications [4]. An optics set is used to convert light into an output which is efficiently accepted by the projector. It offers flexibility in the type of output. It allows the system integrator to convert between collimated and focused output. This flexibility helps in the use of the same lamp for many projector types.

B. Precision Lighting Solution for Medical and Analytical Applications

Lambda XL is the new microscopy and analysis light source showcased by Sutter Instrument . Earlier xenon HID light sources were used which has been redesigned using the Li-Fi light source [4]. By using light sources in hospitals and laboratories, maintenance costs can easily be lowered down because its lifetime has been increased more than five times relative to the used previously. The problem of HID (High intensity discharge) sources was flicker and variation in light intensity which is removed in this. Features like stability and quality imaging are provided, hence making it useful for high speed fluorescence microscopy analysis. Using VLC in hospitals and in healthcare will be highly advantageous as mobile phones and Wi-Fi's are obstructed in some parts of hospitals, especially near MRI scanners and in operating theatres . The prototype of mobile phone incorporated with VLC systems was presented by Casio at the Consumer Electronics show in Las Vegas in January 2012. Also in Germany, a company named *Axiomtek Europe* presented such a product at the Embedded World exhibition.

C. Underwater Communications

For short distances underwater visible light can support high speed data transmission as RF doesn't work. This could enable the divers and underwater vehicles to pass voice messages to each other [6]. In such systems, microphone is installed in the LED light. The voice from a diver will be picked up with that microphone and will be sent to other diver over

the light. The second diver will receive the light, accept the audio signal from the light and send acknowledgement to the other diver. the voice through a bone-conductive speaker. This underwater communications technology will make scuba diving not only more enjoyable but also safe and more secure . In 2008, Nakagawa Laboratories based in Tokyo demonstrated underwater visible communication technology for scuba divers.

D. It could keep you informed and save life

Say there's an earthquake in New York. Or a hurricane. Take your pick — it's a wacky city. The average New Yorker may not know what the

VI. Challenges For Li-Fi

Apart from many advantages over Wi-Fi, Li-Fi technology is facing some challenges. Li-Fi requires line of sight. When set up outdoors, the apparatus would need to deal with ever changing conditions. Indoors, one would not be able to shift the receiving device. A major challenge facing Li-Fi is how the receiving device will transmit back to transmitter. One more disadvantage is that visible light can't

VII. Conclusion

The possibilities are numerous and can be explored further. If this 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

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. Subway stations and tunnels, common dead zones for most emergency communications, pose no obstruction. Plus, in times less stressing cities could opt to provide cheap high-speed Web access to every street corner.

E. Traffic signals

In traffic signals, LI-FI can be used which will communicate with the LED lights of the car and number of accidents can be decreased.

penetrate through brick walls as radio waves and is easily blocked by somebody simply walking in front of LED source [7]. A side effect of Li-Fi is that your power cord immediately becomes your data stream, so if you have power, you have internet[6].

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 clogged, 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 shortcomings however is that it only work in direct line of sight.

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