

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

Li-Fi Technology: Data Transmission through Visible-Light

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ABSTRACT

Li-Fi stands for light fidelity and it is made up using LED(light emitting diode) light bulb which is energy saver and available throughout the world. It may be used in all environments against Wi-Fi such as airplanes, chemical and power plants. Visible light spectrum is 10,000 times wider than the spectrum of radio waves. It provides better bandwidth, efficiency, availability and security than Wi-Fi.

Keywords- Membership function, Fuzzy-fication, De-fuzzy-fication.

1. INTRODUCTION

Li-Fi stands for Light-Fidelity. Li-Fi technology, proposed by the German physicist— Prof. Harald Haas, provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. Wi-Fi is great for general wireless coverage within buildings, whereas Li-Fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues. Li-Fi provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved blisteringly high speed in the lab. By leveraging the low-cost nature of LEDs and lighting units there are many opportunities to exploit this medium, from public internet access through street lamps to auto-piloted cars that communicate through their headlights. Prof. Haas envisions a future where data for laptops, smartphones, and tablets will be transmitted through the light in a room.

The World has never been so connected. Communicating with each other using mobiles, laptops etc. are a part of life now. The sites like Facebook, LinkedIn, WhatsApp etc. use most of our daily data consumption. Unfortunately this increased data transfers created more congestion. To improve the situation, Optical fiber technology was launched. But when it comes to wireless communication, bulk transfer of data is still difficult. Considering this scenario, Prof. Haas's work is ground-breaking, as it gives us the opportunity to send and receive huge quantity of data transfer with least cost.

Professor Harald Haas, the Chair of Mobile Communications at the University of Edinburgh, is recognized as the founder of Li-Fi. He coined the term Li-Fi and is the co-founder of pure Li-Fi. He gave a demonstration of a Li-Fi prototype at the TED Global conference in Edinburgh on 12th July 2011. He used a table lamp with an LED bulb to transmit a video of a blooming flower that was then projected onto a screen. During the talk, he periodically blocked the light from the lamp with his hand to show that the lamp was indeed the source of the video data. Li-Fi can be regarded as light-based Wi-Fi, i.e. instead of radio waves it uses light to transmit data. In place of Wi-Fi modems, Li-Fi would use transceivers fitted with LED lamps that could light a room as well as transmit and receive information. It makes use of the visible portion of the electromagnetic spectrum which is underutilized. Li-Fi can be considered better than Wi-Fi because there are some limitations in Wi-Fi. Wi-Fi uses 2.4–5 GHz radio frequencies to deliver wireless internet access and its bandwidth is limited to 50-100 Mbps. With the increase in the number of Wi-Fi hotspots and volume of Wi-Fi traffic, the reliability of signals is bound to suffer. Security and speed are also important concerns. Wi-Fi communication is vulnerable to hackers as it penetrates easily through walls.

2. ISSUES OF WI-FI

In his TED talk, Professor Haas highlighted the following key problems of Wi-Fi that need to be overcome in the near future:

- Capacity: The radio waves used by Wi-Fi to transmit data are limited as well as expensive. With the development of 3G and 4G technologies, the amount of available spectrum is running out.
- Efficiency: There are 1.4 million cellular radio masts worldwide. These masts consume massive amounts of energy, most of which is used for cooling the station rather than transmission of radio waves. In fact, the efficiency of such stations is only 5%.
- Availability: Radio waves cannot be used in all environments, particularly in airplanes, chemical and power plants and inhospitals.
- Security: Radio waves can penetrate through walls. This leads to many security concerns as they can be easily intercepted.

3. LI-FI OVER WI-FI

Li-Fi addresses the aforementioned issues with Wi-Fi as follows:

- a) Capacity: The visible light spectrum is 10,000 times wider than the spectrum of radio waves. Additionally, the light sources are already installed. Hence Li-Fi has greater bandwidth and equipment which is already available.
- b) Efficiency: LED lights consume less energy and are highly efficient.
- c) Availability: Light sources are present in all corners of the world. Hence, availability is not an issue. The billions of lightbulbs worldwide need only be replaced by LEDs.
- d) Security: Light of course does not penetrate through walls and thus data transmission using light waves is more secure.

4. TECHNOLOGY

Below fig shows different types of waves and their wave lengths. As we can see that the visible light has maximum bandwidth.

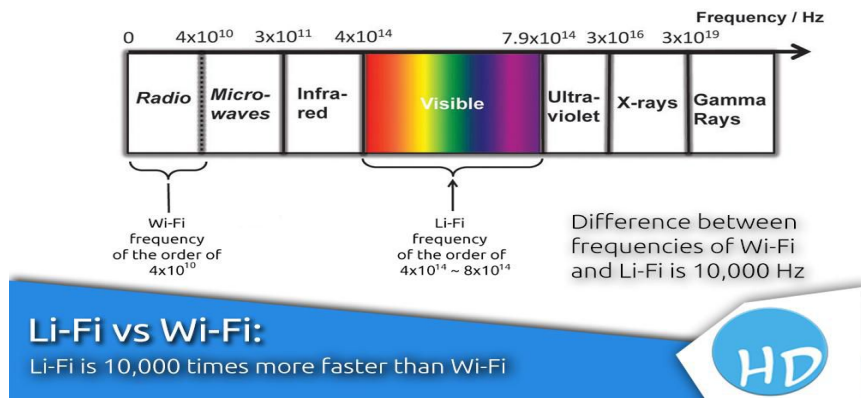


Fig 1: Spectrum of different wavelengths

The technology through which Li-Fi can be successfully employed is given in the figure below.

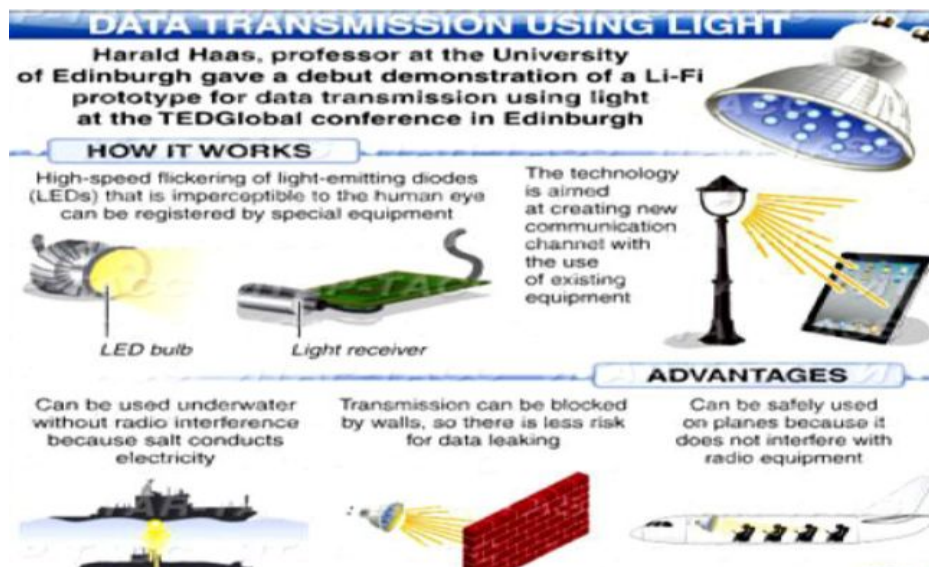


Fig 2: working technique of Li-Fi

5. APPLICATIONS OF LI-FI

Here are some of the areas where Li-Fi can be successfully employed.

- Airlines and Aviation
- High bandwidth and hidden information of military and space application
- Power plants
- Traffic

- Giga-speed technology
- Smart lighting
- Mobile connectivity
- Interactive toys
- Retail analytics

6. CONCLUSION

Li-Fi as a technology is still in its nascent stage. But Researcher are working on it, and they have developed systems which can transmit data upto 10Gbps. Oxford university researchers have been able to attain bi-directional speeds of 224Gbps, which much more than the current Wi-Fi enabled technology (700Mbps max). Though the technology is promising, but it has its own barriers. However every new technology faces this challenge to survive. What's worth noting that our future communication system will have humongous amount of data getting transferred, and Li-Fi has the potential to achieve that. As far as the design and viability constraint goes, nothing seems impossible these days

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