Li-Fi Technology- Next Generation Wireless Technology

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Abstract - Li-Fi stands for Light Fidelity. Li-Fi technology, proposed by the German physicist—Harald Haas has come up with the solution of illumination. He calls "Data through Illumination". IT 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 wireless coverage buildings whereas Li-Fi is for wide and high density coverage area. Li-Fi provides great security than Wi-Fi technology. It provides efficiency, better bandwidth and very high speed.

Keywords- Wireless-Fidelity (Wi-Fi), Light-Fidelity (Li-Fi), Light Emitting Diode (LED)

Fig (1) Li-Fi bulb [1]

I.   INTRODUCTION

Li-fi basically known as "Light Fidelity". 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 small. In modern times, it is called as the optimized version of WI-FI. In simple terms, Li-Wi 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 the room as well as transmit and receive information. Since, simple light bulbs are used, there can technically be any number of access points. This technology uses a part of the electromagnetic spectrum that is still not greatly utilized-The Visible Spectrum [2].Li-Fi, as it has been dubbed, has already achieved blisteringly high speeds in the lab. Researchers at the Heinrich Hertz Institute in Berlin, Germany, have reached data rates of over 500 megabytes per second using a standard white-light LED. Haas has set up a spin-off firm to sell a consumer VLC transmitter that is due for launch next year. It is capable of transmitting data at 100 MB/s - faster than most UK broadband connections. [3]
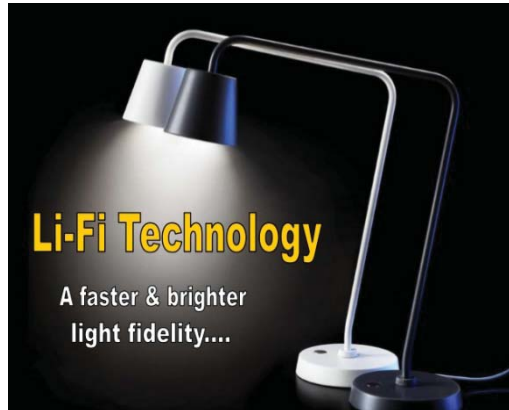
Fig (2). [11]

II. GENESIS OF Li-Fi

Harald Haas, a professor at the University of Edinburgh who began his research in the field in 2004, gave a debut demonstration of what he called a Li-Fi prototype at the TEDGlobal conference in Edinburgh on 12th July 2011. He used a table lamp with an LED bulb to transmit a video of blooming flowers that was then projected onto a screen behind him. During the event he periodically blocked the light from lamp to prove that the lamp was indeed the source of incoming data. At TEDGlobal, Haas demonstrated a data rate of transmission of around 10Mbps -- comparable to a fairly good UK broadband connection. Two months later he achieved 123Mbps.

Fig (3) [7]

III. PRESENT SCENARIO

- At present, we have around 1.5 million radio waves base stations across the world.
- We also have around 5 billion mobile connections which transmit a data over 600TB.
- Now a days, mobile devices have great influenced into our lives that this led to Wi-Li technology.

Fig (4) [9]

IV. WORKING TECHNOLOGY

- *BASIC CONCEPT:*

Li-Fi technology is a wireless communication system based on the use of visible light between the blue (670 THz) and red (480 THz). Unlike the Wi-Fi which uses the radio part of the electromagnetic spectrum, Li-Fi uses the optical spectrum. The principle of Li-Fi is based on sending data by amplitude modulation of the light sources [4]. It is in a well-defined and standardized way.

- *HOW IT WORKS:*

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 LED 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. [5]

All that is required id some LED and a controller that code data into those LEDs flicker depending upon the data we want to encode. The more LEDs in your lamp, the more data it can process.

For example, there is a LED and photo detector on the other side. 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.
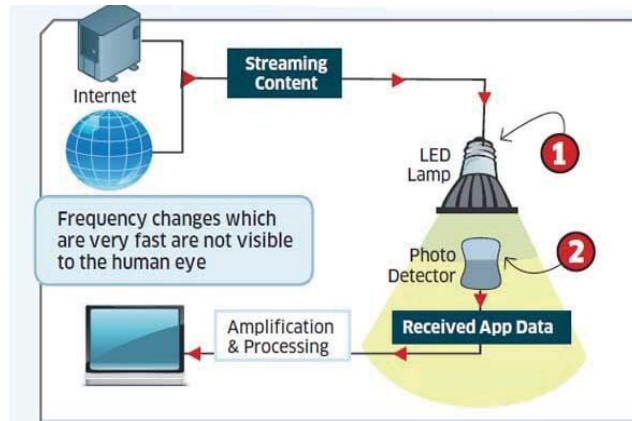
Fig (5) [10]

V.   COMPARISON BETWEEN Wi-Fi AND Li-Fi

Li-Fi is a term, one used to describe visible light communication technology applied to high speed wireless communication. It acquired this name due to the similarity to WI-FI, only using light instead of radio. Wi-Fi is great for general wireless coverage within buildings and li-fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues, so the two technologies can be considered complimentary. Late last year the IEEE802.15.7 draft standard for VLC was produced. This standard covers both the physical layer (PHY) air interface and the medium-access control (MAC). We might consider the MAC layer in more detail in later articles but for now I will focus on the physical layer since this is the bit that actually uses the visible light. [6]

VI. PROBLEMS OF Wi-Fi TECHNOLOGY

A.   SECURITY:

Wi-Fi is less secure as radio waves can penetrate through walls. They can be traced. If someone has knowledge about this and has bad intentions, they can misuse it. This create a major security issue.

B.   CAPACITY:

Wireless data is transmitted through radio waves which are limited and expensive. It has certain or limited amount of bandwidth.

C.   LIMITED RANGE:

Wi-Fi networks have limited range. A typical Wi-Fi home router might have a range of 45m (150ft) indoors and 90m (300ft) outdoors.

D.   EFFICIENCY:

It is very costly. It contains many radio base stations which consume more heat.

VII. ADVANTAGES OF Li-Fi

Li-Fi is based on data transmission through lights.

A.   SECURITY:

Li-Fi is secure as radio waves cannot penetrate through walls. They cannot be misused and traced by other people.

B. *CAPACITY:*

Light has 10000 times wider bandwidth than radio waves. Li-Fi has got good capacity compare to Wi-Fi.

C. *AVAILABILITY:*

Availability is not an issue in this technology as light sources are available everywhere. There are billions of light bulbs across worldwide, they just need to be replaced with LEDs for transmission of data.

D. *EFFICIENCY:*

It is not costly as Wi-Fi is. LED lights consume less energy. It is highly efficient.

VIII.   DISADVANTAGES OF Li-Fi TECHNOLOGY

❖ These signals do not penetrate walls. So, the person needs wired bulb in that room also otherwise there will be no connection.
❖ In this, presence of lights are essential.
❖ There should be line of sight.
❖ It works better with fluorescent light and LEDs but very low efficiency with bulbs.[7]

IX. APPLICATIONS

There are many applications of this technology. They are as follows:
1)   *LIGHT:*
Li-Fi uses light rather than radio frequency signal.
2)   *EDUCATION:*
Li-Fi is the latest technology. It provides fattest access of internet than Wi-Fi. So, it can replace Wi-Fi at educational centers or institutions and at companies or an organizations so that people can access it on same speed in a particular region or area.
3)   *MEDICAL APPLICATIONS:*
Operation theatres (OTs) do not allow Wi-Fi due to radiation concerns. Usage of Wi-Fi at hospitals interferes with the mobile and pc which blocks the signals for monitoring equipments. So, it may be hazardous to the patient's health. To overcome this and to make OT tech savvy Li-Fi can be used to accessing internet and to control medical equipments. This can even be beneficial for robotic surgeries and other automated procedures. [8]
4)   By implementing the Technology worldwide every street lamp would be a free access point.
5)   Li-Fi may solve issues such as the shortage of radio frequency bandwidth.
6)   *UNDERWATER APPLICATIONS:*
Underwater ROVs (Remotely Operated Vehicles) operate from large cables that supply their power and allow them to receive signals from their pilots above. But the tether used in ROVs is not long enough to allow them to explore larger areas. If their wires were replaced with light — say from a submerged, high-powered lamp — then they would be much freer to explore. They could also use their headlamps to communicate with each other, processing data autonomously and sending their findings periodically back to the surface. Li-Fi can even work underwater where Wi-Fi fails completely, thereby throwing open endless opportunities for military operations. [8]

X. CONCLUSION

Li-Fi is the upcoming technology. Since, light is the major source of transmission in this technology, so it is very beneficial. 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 brighter future. This concept promises to solve issues such as the shortage of radio-frequency bandwidth and boot out the disadvantages of Wi-Fi.

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