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Next of Wi-Fi an Future Technology in Wireless Networking Li-Fi Using Led Over Internet of Things

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Abstract—

Now a day's many people are using internet to accomplish their task through wired or wireless network. As number of users get increased in wireless network speed decreases proportionally. Though Wi-Fi gives us speed up to 150mbps as per IEEE 802.11n, it is still insufficient to accommodate number of desired users. To remedy this limitation of Wi-Fi, we are introducing concept of Li-Fi. The data through illumination–taking the fibber out of fiber optic by sending data through an LED light bulb that varies in intensity faster than the human eye can follow. It's the same idea behind infrared remote controls but far more powerful. It is called D-LIGHT, can produce data rates faster than 10 megabits per second, which is speedier than your average broadband connection.

Keywords — Wireless-Fidelity(Wi-Fi), Light-Fidelity (Li-Fi), Light Emitting Diode (LED), Line of Sight(Los) Visible Light Communication (VLC).

I. INTRODUCTION

Li-Fi comprises a wide 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, and unidirectional and bidirectional data transfer using line-of-sight or diffuse links, reflections and much 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 brilliant idea works 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. [1], [3].

Fig.1 Overview of Li-Fi

II. DESIGN OF LI-FI

Li-Fi architecture consist numbers of LED bulbs or lamps, many wireless devices such as PDA, Mobile Phones, and laptops. Important factors we should consider while designing Li-Fi as following:

- Presence of Light
- Line of Sight (Los)
- For better performance use fluorescent light & LED

As shown in figure 2 streaming content must have proper integration with server & internet network, so that it is easily possible to work efficiently [3].

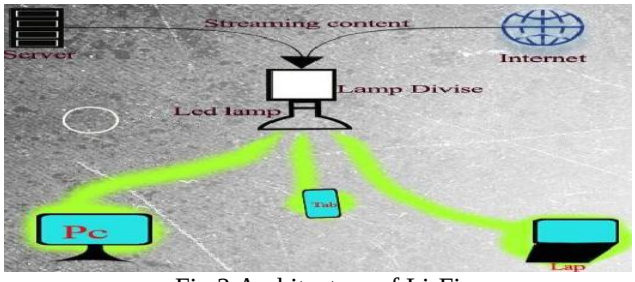

Fig.2 Architecture of Li-Fi

III. IMPLEMENTATION OF LI-FI

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 if the LED is on, you transmit a 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. Hence all that is required is some LEDs and a controller that code data into those LEDs. All one has to do is to vary the rate at which the LED's flicker depending upon the data we want to encode. Further enhancements can be made in this method, like using an array of 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. Such advancements promise a theoretical speed of 10Gbps – meaning one can download a full high-definition film in just 30 seconds. [2], [3], [4].

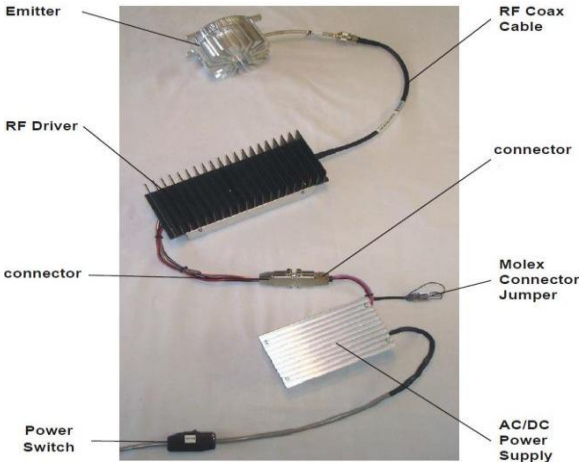

Fig.3 Implementation of LI-FI

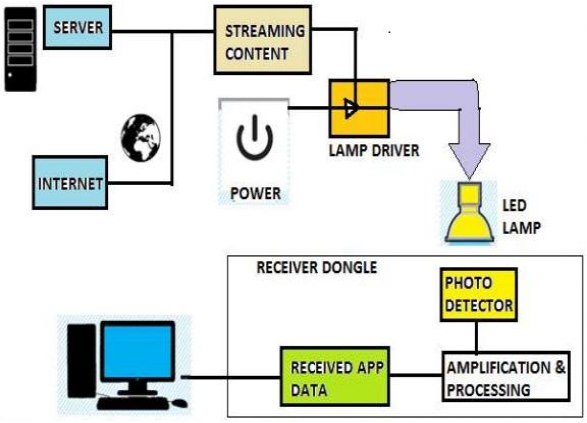

Fig. 4 Data transmission using LED

If the LED is on, you transmit 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." So what you require at all are some LEDs and a controller that code data into those LEDs. We have to just vary the rate at which the LED's flicker depending upon the data we want to encode. Further enhancements can be made in this method, like using an array of 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. Such advancements promise a theoretical speed of 10 Gbps –meaning you can download a full high-definition film in just 30 seconds. Simply awesome! But blazingly fast data rates and depleting bandwidths worldwide are not the only reasons that give this technology an upper hand. Since Li-Fi uses just the light, it can be used safely in aircrafts and hospitals that are prone to interference from radio waves. This can even work underwater where Wi-Fi fails completely, thereby throwing open endless opportunities for military operations. Imagine only needing to hover under a street lamp to get public internet access, or downloading a movie from the lamp on your desk. There's a new technology on the block which could, quite literally as well as metaphorically, throw light on how to meet the ever-increasing demand for high-speed wireless connectivity. Radio waves are replaced by light waves in a new method of data transmission which is being called Li-Fi. Light-emitting diodes can be switched on and off faster than the human eye can detect, causing the light source to appear to be on continuously. A flickering light can be incredibly annoying, but has turned out to have its upside, being precisely what makes it possible to use light for wireless data transmission. Light-emitting diodes

(commonly referred to as LEDs and found in traffic and street lights, car brake lights, remote control units and countless other applications) can be switched on and off faster than the human eye can detect, causing the light source to appear to be on continuously, even though it is in fact 'flickering'. This invisible on-off activity enables a kind of data transmission using binary codes: switching on an LED is a logical '1', switching it off is a logical '0'. Information can therefore been coded in the light by varying the rate at which the LEDs flicker on and off to give different strings of 1s and 0s. This method of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication (VLC), though it's potential to compete with conventional Wi-Fi has inspired the popular characterization Li-Fi.

Visible light communication (VLC)-"A potential solution to the global wireless spectrum shortage" Li-Fi (Light Fidelity) is a fast and cheap optical version of Wi-Fi, the technology of which is based on Visible Light Communication (VLC).VLC is a data communication medium, which uses visible light between 400 THz (780 nm) and 800 THz (375 nm) as optical carrier for data transmission and illumination. It uses fast pulses of light to transmit information wirelessly. The main components of this communication system are 1) a high brightness white LED, Which acts as a communication source and 2) a silicon photodiode which shows good response to visible wavelength region serving as the receiving element. The 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 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.

How it is different from current technologies?

Li-Fi technology is based on LEDs for the transfer of data. The transfer of the data can be with the help of all kinds of light, no matter the part of the spectrum that they belong. That is, the light can belong to the invisible, ultraviolet or the visible part of the spectrum. Also, the speed of the internet is incredibly high and you can download movies, games, music etc in just a few minutes with the help of this technology. Also, the technology removes limitations that have been put on the user by the Wi-Fi. You no more need to be in a region that is Wi-Fi enabled to have access to the internet. You can simply stand under any form of light and surf the internet as the connection is made in case of any light presence. There cannot be anything better than this technology.

Technology	Speed	Data density
Wireless (current)		
Wi-Fi — IEEE 802.11n	**150 Mbps**	*
Bluetooth	**3 Mbps**	*
IrDA	**4 Mbps**	* * *
Wireless (future)		
WiGig	**2 Gbps**	* *
Giga-IR	**1 Gbps**	* * *
Li-Fi	**>1Gbps**	* * * *

Table 1.Comparison between current and future wireless technology

MULTIPLE ACCESSES

A seamless all-optical wireless network would require ubiquitous coverage provided by the optical front-end elements. This necessitates the usage of a large amount of Li-Fi enabled lighting units. The most likely candidates for front-end devices in VLC are incoherent solid-state lighting LEDs due to their low cost. Due to the physical properties of these components, information can only be encoded in the intensity of the emitted light, while the actual phase and amplitude of the light wave cannot be modulated. This significantly differentiates VLC from RF communications. A networking solution cannot be realized without a suitable multiple access scheme that allows multiple users to share the communication resources without any mutual cross-talk.

Multiple access schemes used in RF communications can be adapted for OWC as long as the necessary modifications related to the IM/DD nature of the modulation signals are performed. OFDM comes with a natural extension for multiple accesses – OFDMA. Single-carrier modulation schemes such as M-PAM, OOK and PWM require an additional multiple access technique such as frequency division multiple access (FDMA), time division multiple access (TDMA) and/or code division multiple access (CDMA). The results of an investigation regarding the performance of OFDMA versus TDMA and CDMA are presented in Fig. 3.18 FDMA has not been considered due to its close similarity to OFDMA, and the fact that OWC does not use super heterodyning. In addition, due to the limited modulation band width of the front-end elements, this scheme would not present a very efficient use of the LED modulation band width.

IV. ADVANTAGES OF LI-FI

- A free band that does not need license.
- High installment cost but very low maintenance cost.
- Cheaper than Wi-Fi.
- Theoretical speed up to 1 GB per second: Less time & energy consumption.
- No more monthly broadband bills.
- Lower electricity costs.
- Longevity of LED bulb: saves money.
- Light doesn't penetrate through walls: secured access.

V. APPLICATION OF LI-FI

5.1 You Might Just Live Longer

For a long time, medical technology has lagged behind the rest of the wireless world. Operating rooms do not allow Wi-Fi over radiation concerns, and there is also that whole lack of dedicated spectrum. While Wi-Fi is in place in many hospitals, interference from cell phones and computers can block signals from monitoring equipment. Li-Fi solves both problems: lights are not only allowed in operating rooms, but tend to be the most glaring (pun intended) fixtures in the room.

5.2 Smarter Power Plants

Wi-Fi and many other radiation types are bad for sensitive areas. Like those surrounding power plants. But power plants need fast, inter-connected data systems to monitor things like demand, grid integrity and (in nuclear plants) core temperature. The savings from proper monitoring at a single power plant can add up to hundreds of thousands of dollars. Li-Fi could offer safe, abundant connectivity for all areas of these sensitive locations. Not only would this save money related to currently implemented solutions, but the draw on a power plant's own reserves could be lessened if they haven't yet converted to LED lighting.

5.3 Airlines

Whenever we travel through airways we face the problem in communication media, because the whole airways communications are performed on the basis of radio waves. To overcome this drawback LI-FI is best for use.

VI. 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 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.

VII. FUTURE ENHANCEMENT

Further enhancements can be ma in this method, like using an array of LEDs for parallel data transmission or using mixture of red, green and blue LEDs to alter the light's frequency with each frequency encoding a different data channels. Such advancements promise a theoretical speed of 10 Gbps - meaning one can download a full high definition film in just 30 seconds.

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