Li-Fi: A protected Wireless Network Structure for Prospect of Internet Services

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ABSTRACT:Wireless data has become an essential commodity in our daily life, synonymous with electricity and lighting. Wi-Fi is everywhere, free in shops, restaurants, trains and airports. To avoid jamming and heavy traffic load on radio spectrum, a fastest technology that has a speed of 30Gbps/min has evolved which deals with visible light and called Li-Fi (LightFidelity).Li-Fi is high speed, robust wireless technology. Here it uses light instead of radio waves for transmitting data.Li-Fi would use transceiver Fitted LED lamps that can light a room as well as transmit and receive information. The spectrum now has to accommodate more mobile users. Connected devices are forecasted increase to 20 billion IoT devices by the year 2020.

Keywords:*Wi-Fi, LED, Radio spectrum, Li-Fi, Wireless technology*

INTRODUCTION:

Li-Fi is a wireless communication system where light is used as a carrier signal instead of conventional radio frequency as in Wi-Fi [2]. The term Li-Fi was coined by pure Li-Fi's CSO, Professor Harald Haas, at a Ted Global Talk back in 2011 where he demonstrated Li-Fi for the First time.It wasdeveloped as a solution to the growing radio spectrum congestion problems.[4]Li-Fi,like Wi-Fi, enables electronic devices like laptops, tablets, and smart phones to connect wirelessly to the internetusing the light spectrum which can enable exceptional data and bandwidth. Radio frequency technology like Wi-Fi is running out of spectrum to support this digital revolution and Li-Fi can help power the next generation of immersive connectivity.[9] With Li-Fi, anywhere there is an LED light there can be data for access. Li-Fi creates a platform which extends the capabilities of wireless communications to places beyond our imagination.Li-Fi is a potential candidate for other applications such as underwater communications, intelligent transportation systems, indoor positioning, and the Internet of Things (IoT). [5] .With Li-Fi, we can secure our future communication by utilizing the spectrum more than 1000 times greater than today's used radio spectrum in Wi-Fi technology.

WORKING:

Li-Fi is high speed bi-directional networked and mobile communication of data using light. Li-Fi is a fast and cheap optical version of Wi-Fi, the technology of which is based on Visible Light Communication or VLC that uses visible light between 400THz(780nm) and 800THz (375 nm) as optical carrier for data transmission and illumination[8]. LED can be switched "on" if it transmits strings of 1s and can be switched "off" if it transmits strings of 0s. In this way data is possible to encode in the light by varying the rate at which LED's flicker on and off to give different strings of data's. Modulation is so fast and quick that human eye does not notice.The LED can be switched on and off very quickly that gives good opportunities for transmitting data. On the receiver end, photo detector is there to detect the encoded light. Li-Fi comprises of multiple LED bulbs to form a network so large amount of data transmission takes place.

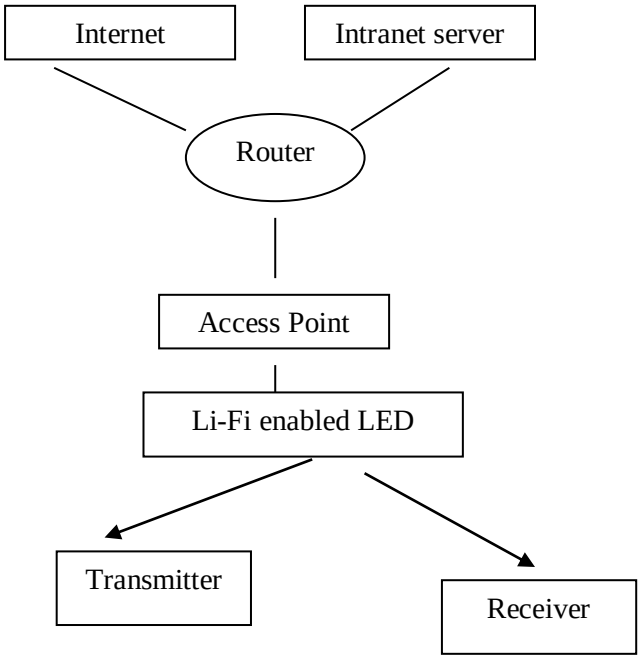

Fig: 1: Working operation of Li-Fi

LI-FI MODULATION TECHNIQUE:

InLi-Fi, visible light transmitters, LEDs are used so only intensity modulated direct detected modulation techniques can be utilised. One bit or single carrier modulation techniques are simple to be used in Li-Fi, for low to moderate data rates applications. On the other hand, multicarrier modulation techniques offer a feasibleway out for Li-Fi in terms of power, spectral and efficiency. Orthogonal frequency division

multiplexing (OFDM) based modulation techniques offer a practical solution for Li-Fi. The modulation bandwidth most commercially availableLEDs can be considered flat is around 2-20 MHz [11], [12]. However, the usable bandwidth in Li-Fi could be extended beyondthe 3 dB cutoff frequency.Therefore, modulation techniques with higher spectral efficiencies are key elements in a Li-Fi system design. Satisfyingthe illumination requirements is a key element in Li-Fi. Single carrier modulation techniques were first proposed for IM/DD optical wireless communications based on infrared communications [7]. Modulation techniques, such as OOK, where by switching the LED between"on"and"off" states, the incoming bits can be modulated into the light intensity.Pulse amplitude modulation (PAM), pulse width modulation (PWM), and PPM, are useful for Li-Fi systems.Fig (2) explained the process of modulation through optical wireless channel where x(t) is incoming signal is getting modulated and generate y(t) as a modulated signal.

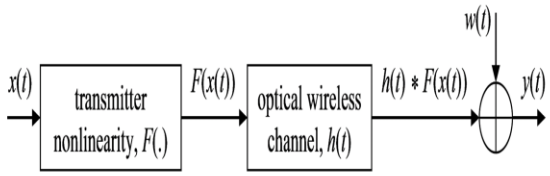

Fig: 2 Modulation technique for Li-Fi

LI-FI ENABLED IoT:

IoT or Internet of Things extends the internet connectivity beyond conventional usable devices like desktop and smart phones and tablets to a diverse range of devices [13]. Businesses can influence with several type ofIoT applications for performing real-world applications. As the market for IoT devices grows and sensorsare added to more and more things and places,faster and heavier data transmission will be required. Current internet infrastructure simply cannot handle the quantity of data that will need to be transmitted if the IoT continues to grow at predicted rates. Solution is to useLi-Fi in all IoT applications which provide better connectivity compared to Wi-Fi as discussed earlier.Li-Fi uses IM-DD modulation which uses inexpensive optical LEDs and photo detectors for transmitting and receiving operation.By using LEDs, it is possible to create places such as labs, libraries, classrooms and cafeterias can act as Li-Fi hotspots enable to stay connected to the world of information. Speed of Li-Fi is further expected to reach 3 to 5 GB per second making it ideal for the Internet of Things (IoT) and to eliminate the limitations and hassles with Wi-Fi technology.The reason behind the enormous speed of Li-Fi is its high-speed parallel transmission of thousands of data stream as compared to traditional Wi-Fi methods that transmit one data stream at a time. Furthermore, it uses light source instead of radio waves technology for providing high-speed internet.

APPLICATIONS OF LI-FI:

Different types of applications are listed below that can employLi-Fi technology

A. **Security:** The ability to strictly define the communication area of Li-Fi Access Point allows precise portioning of the working environment [4].

B. **Smart Lighting:**Anywhere there is a LED lighting infrastructure, there can be a wireless Li-Fi communication network which provides value added enhanced efficiency and control.

C. **Hospitals & Healthcare**: Li-Fi offers an unprecedented opportunity for connectivity within hospitals and healthcare facilities. Advantage is that Li-Fi does not emit EM radiation which does not interfere with medical instruments and health care services.

D. **Enterprise Wireless Solution**: For daily work, conference streaming, remote desktop along with video, Li-Fi can provide an enhanced user experience with the confidence of robust security. The directionality of light propagation can effectively reduces interferences in heavily populated offices.

E. **Smart Home & Life Style**: Li-Fi enable simple secure and reliable wireless communication.Li-Fi can offer data aggregation and wireless offloading.Smart home can be truly wireless; users can understand the best coverage locations by seeing the light.Home users no longer will worry for "man in the middle attack" as they can simply drop the curtains and shut their doors to secure their Li-Fi network.[4]

F. Zac Hall has stated that iPhone 7 is designed to tether the headphones using Li-Fi on 2016 onwards. It leads to remove the wired and wireless bluetooth technology headset jack in favor of wireless audio. An iOS software is designed with lightning adapter for wired headphones and speakers [18].

LIMITATIONS:

1. Thou the light will not go throughthe solid objects so users, in other room or building cannot access the same network.
2. The mainconfront of Li-Fi technology is to estimate how the receiving device will transmit data to the transmitter.
3. The data transmission is possible only if the LED light transmitter and the photo diode receiver are in line of sight. Obstacles in betweentransmitter and receiver and the photodiode may cause loss of data. And the distance in between the LED and the photo-diode is also limited.[36]
4. Li-Fi applications based on LED lighting are more attractive in environments where the lights are always switched on, for instance, in industrial settings, public transport, or medical areas. Some low data rate transmission can be achieved by making the light emitted to be low enough so that human eyes perceive it as being switched off [23]

CONCLUSION:

According to a new market research report published by Markets and Markets in 2015, Li-Fi technology isexpected to reach a market value of 8,500 Million USD by 2020 [30].It has tobe ensured, however, that the Li-Fi systems do not pose any health hazards (photosensitive epilepsy orpsychological effects of the LED colors) and that they are correctly installed so that they do not produceany EMI.Although Li-Fi technology does offer numerous benefits, there are still important challenges that must beovercome before it becomes a ubiquitous part of everyday wireless communications.There have been news reports that Apple is experimenting with Li-Fiwireless data for future iPhones and iPads [34].

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