Light Fidelty (Li-Fi) - A New Era of Communication

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***Abstract-* Communication can be defined as the flow of information from one point to another point and it can be accomplished by using wire or wireless. Wireless fidelity is one of the communication technique in which we can used wireless system of communication. On the lines of Wi-Fi, a new paradigm of communication, light fidelity (Li-Fi) was introduced by Harald Haas and is a type of Visible Light Communication (VLC) which uses 400 THz to 800 THz frequency and a sub type of Optical wireless communication. The Wi-Fi provides the speed upto 150 mbps as per IEEE 802.11n, while Li-Fi gives upto 10 mbps speed. This can overcome the issue of increased number of users in Wi-Fi. In this paper description of the technological implementation and overview of Li-Fi is given.**

Keywords: Li-Fi; Wi-Fi; VLC

I. INTRODUCTION

With the ever increase in demand of bandwidth and data rate, advancement in technology is taking place day by day. Starting from the zero generation of telephone system to beginning of 5th generation data rate keeps on increasing, but with the increase in data rate, numbers of users are also increasing rapidly. The telephone system that was come into existence a few decades ago used wire as the medium of communication. Then wireless technology came into existence where we use electromagnetic waves as the carrier waves for transmission of signals and information. Wireless networks like adhoc wireless network, wireless sensor networks, mobile adhoc

networks and wireless fidelity were established for users.

Wireless Fidelity which is commonly called as Wi-Fi came into existence when Federal Communications Commission (FCC) in 1985 taken a decision to allow a few bands of spectrum to be used without taking license. These bands of spectrum are termed as industrial, scientific and medical bands. Wi-Fi use 2.4 GHz of frequency which falls under ISM band and it can provide a speed of 150 mbps.

As the number of users and need of bandwidth is increasing day by day a new concept was given by Professor Harald Haas named as Light Fidelity (Li-Fi) similar to Wi-Fi which is a light based communication works on the principle of optical communication. It provides a high speed, bidirectional network and can accommodate more number of users. As the Visible light portion of electromagnetic spectrum is used to transmit signal as compared radio frequency signals is used in Wi-Fi to transmit signal.

Data is transmitted in Li-Fi by modulating the light's intensity, which is received by a photo-sensitive detector and the light signal is then demodulated at the receiver into the form of electronic signal.

Li-Fi consists of a wide range of frequencies from infrared to ultraviolet spectrum via visible and it also provides unidirectional and bidirectional transfer of data using line of sight (LoS) or diffuse links [1]. Laser or LED is used as a source in Li-Fi for transmission of signal in which if source is on '1' can be transmitted and if it is off '0' can be transmitted.

The source can switch on or off very rapidly which can provide better opportunities for transmission of data [2,3]

II.   ARCHITECTURE OF LI-FI

The architecture of Li-Fi as shown in figure 1 consists of LEDs, lasers as source of visible light and wireless devices such as mobile phones, laptops etc. Presence of light source and line of sight (Los) should be taken into consideration for designing of Li-Fi. To work efficiency the screaming content should be properly connected with the internet and server as shown in figure 1.
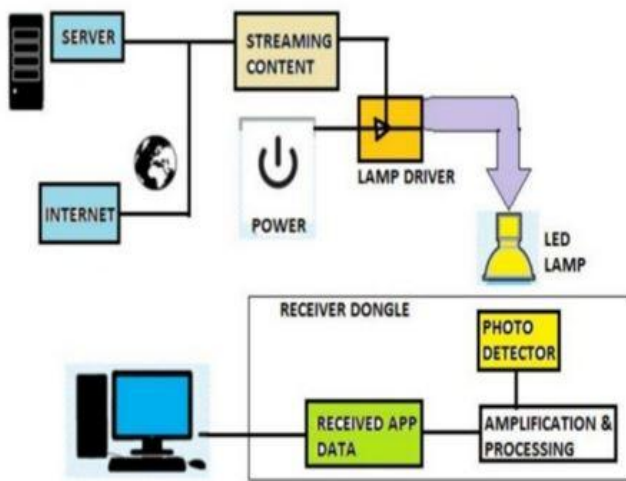

Figure 1 Architecture of Li-Fi [4]

III.   IMPLEMENTATION OF LIFI

In Li-Fi sinusoidal signal is transmitted from one device to another using visible light. As modems are used in Wi-Fi, transceiver fitted light sources can be used in Li-Fi for sending and transmitting of information. These light sources like LEDs or laser which are fluorescent in nature can also light the room.

The information that is desired to be transmitted was data packets consists of voice or text information which is then applied to ADC to convert it into digital form which are further modulated keeping noise into consideration. The original information is in the form of sinusoidal signal which is taken from signal generator and given to the arduino processors to which light source like LED is connected. Before it is given to LED sinusoidal signal is sampled at a particular sampling frequency by using arduino. The LED blinks in variance to the sampled signal. So the information signal is converted into digital form. The signal transmitted by LED is received by photo receiver which is connected to another arduino and is decoded and given to low pass filter which produces a sinusoidal signal again.

IV.   VISIBLE LIGHT COMMUNICATION

The visible light communication range is 400THz (780nm) to 800 THz (375nm) which is secure and harmless range as compared to other portion of electromagnetic spectrum. The details of the electromagnetic spectrum are given below with description of each portion.

Radiowaves-Expensive-Limited
Bandwidth-Less secure
Infrared- Low power application
Visible-Safe to use-bandwidth is larger
Ultraviolet: Good but harmful to use.
X-rays: used for hospitals.
Gamma rays: Is not generally used.

V.   APPLICATIONS OF LIGHT FIDELTY

Smart Lightening, mobile connectivity, hospital and healthcare, aviation, underwater communications,

vehicles, transportation and location based services are some of the applications of light fidelity.

As Li-Fi overcome the issues of insufficient radio frequency bandwidth in Wi-Fi, it also proved to be cost effective and safe for humans as light is used instead of radio frequency in Wi-Fi. It is secure as compared to Wi-Fi. Besides pros there are cons like requirement of proper line of sight (los), obstacles interference to light, use of high frequency allows communication for short distances only and cost of installation of visible light communication system.

1.   TABLE I. COMPARISON OF WI-FI AND LI-FI

Light Fidelity	Wireless Fidelity
Faster transfer speed (>1Gbps)	Less transfer speed (150mbps)
Used light as a carrier	Use radio spectrum
Cheaper	Costlier
Point to point	Point to point
Oprtaing frequency is in terms of terahertz	Operating frequency is 2.4GHz

VI.   Conclusion:

In this paper the overview of light fidelity is given in which the high speed can be achieved by using visible light communication and Li-Fi can be described as a subset of optical communication. Since, light is used as a mode of communication so line of sight is needed in order to achieve the desired level of communication with accurate signal and data speed. So, precautionary techniques are required to achieve line of sight. Since, the concept of light fidelity is new and much more is needed to explore for the full implementation of this type of communication technique. There are many demerits like how communication can be achieved for mobiles and laptops as proper line of sight cannot maintained for mobile devices, communication range i.e., short distances and high installation cost.

Refernces:

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