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Light fidelity (LiFi): Future of Wireless Technology

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ABSTRACT
It is frustrating when the slow speed of network leads to limited connected users and long processing hours while using wireless internet either at home or shopping mall or coffee shop. As number of users are increases in using Wi-Fi, speed decreases. To overcome this problem of WIFI, we are introducing the new concept of Li-Fi technology. Light emitting diodes (LED) are used many areas in our daily life. We have made study on technology of Li-Fi and its applications in transferring data from one device to another device. We have also explained the advantages as well as disadvantages of using Li-Fi.
Keywords:- Wi-Fi technology, Li-Fi technology, LED

I. INTRODUCTION

Li-Fi is a VLC, visible light communication technology, having a various range of frequencies and wavelengths from the infrared through visible. It includes sub-gigabit and gigabit-class communication speeds for short, medium and long ranges, unidirectional and bidirectional data transfer using line-of-sight, reflections and many more. Li-Fi is a framework for all of these providing new capabilities to current and future services, applications and end users. This concept was introduced by Harald Haas from University of Edinburgh, UK, in his TED Global talk on VLC. He explained very simple, if the LED is ON, you are transmitting the data means you transmit a digital 1; and if the LED is OFF, you transmit a digital 0,or null or no data transfer happens. The LEDs can be switched on and off very quickly, which gives nice opportunities for transmitting data[1].

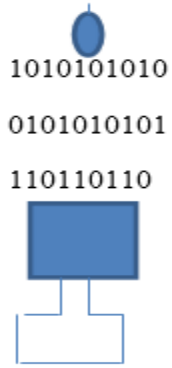

Figure1 data transmission in Li-Fi

Working of Li-Fi

Li-Fi is implemented using white LED light bulbs at downlink transmitter.

- By fast variations of the current , optical output can be made to vary at extremely high speeds.
- An overhead lamp fitted with an LED with signal processing technology streams data embedded in its beam at ultra high speeds to the photodiodes.
- A receiver dongle then converts the tiny changes in amplitude into an electrical signal, which is then converts back into a

data stream & transmitted to a computer or mobile device.[2]

II. TECHNIQUES OF MODULATION USED IN LI-FI

Some common modulation techniques used in Li-Fi are:

I. **PPM:** pulse-position modulation(PPM) is a form of signal modulation in which M message bits are encoded by transmitting a signal pulse in one of possible required time-shifts

II. **OFDM:** Orthogonal frequency-division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies.

III. **PWM:** pulse-width modulation (PWM) is a technique used to encode a message into a pulsing signal.

IV. **OOK:** On-off keying (OOK) means the simplest form of amplitude-shift keying (ASK) modulation that represents digital data as the presence or absence of a carrier wave.

V. **SIM-OFDM:** Sub-carrier Index Modulation Orthogonal frequency-division multiplexing is a method which adds an extra dimension to the two dimensional phase/amplitude modulation technique that is Quadrature Amplitude Modulation (QAM) and Amplitude Shift Keying (ASK). SIM uses the sub-carrier index to carry information to the receiver. Unlike the traditional OFDM technique, the Sub-carrier Index Modulation Orthogonal frequency-division multiplexing technique splits the serial bit stream into two bit sub-streams of the same length.

III. APPLICATIONS OF Li-Fi

Some of the applications are:

a) **Education system:** Li-Fi can replace Wi-Fi in educational organizations and offer faster internet speed.

b) **Medical Applications:** In operation theatre Li-Fi can be used for modern medical instruments.

c) **Traffic signals:** In traffic signals Li-Fi can be used which will communicate with the LED lights and it will decreases the accident numbers.

d) **Internet access in aircrafts**: In aircraft Li-Fi can be used for data transmission with high speed.

e) **Disaster management:** Li-Fi can be used in times of natural disaster such earthquakes.

f) **Radio broadcast:** A large amount of power is required by radio masts in order to broadcast and this method is quite inefficient. Li-Fi require very low power to operate.

g) **Information Delegation:** Suppose your city is affected by earthquake and normal resident is not aware of safety measures to be taken. He won't be aware of the emergency broadcasts Until he pass under a street light,. Recall with Li-Fi ,till its light you are online.

h) **Satellite navigation:** GPS usage has been one of the most significant technological advances of the last 40-50 years. Tools have been developed that smartly use Wi-Fi triangulation and hybrid GPS but these are incorrect and generally undependable. Byte Light is making efforts to change this particular situation with a system that uses LED lighting to offer devices with correct location data. [3] Indoor location of Byte Light system works by controlling the pulses of LEDs so they work in a definite pattern.This particular pattern is not noticeable to the human eye but can be traced by the camera in a tablet or smartphone

IV. ADVANTAGES OF LI-FI OVER WI-FI

- Li-Fi uses light rather than radio frequency signals so are intolerant to disturbances.

- VLC could be used safely in aircraft without affecting airlines signals.
- Under water in sea Wi-Fi does not work but light can be used.
- It can be easily used in such places where Bluetooth, infrared , Wi-Fi and internet are broadly in use. For example: in operation theatres.
- Li-Fi technology worldwide every street lamp would be a free data access point.
- Security is a side benefit of using light for data transfer as it does not penetrate through walls.
- The issue of shortage of radio frequency bandwidth may be sorted out by LI-Fi.

V. COMPARISON OF LI-FI AND WI-FI TECHNOLOGIES

S.no	Parameters	Light Fidelity	Wireless Fidelity
1	Speed for data transfer	1-3.5 Gbps	54-250 Mbps
2	Range	10 meters	20-100 meters
3	Medium	Used light as a carrier	Used radio spectrum
4	Spectrum Range	10000 times than WI-FI	Radio spectrum range
5	Network topology	Point-to-point	Point-to-multipoint
6	Frequency band	100 times of THz	2.4 GHz

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