

## LIGHT FIDELITY (LiFi)

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### Abstract

The increasing usage of the mobile network and WiFi has lead to the invention of visible light communication. This was named LiFi-Light Fidelity. Professor Harald Has has invented this technology and started a company called Pure LiFi. This is faster than the WiFi and other technologies present. LiFi uses LED as the transmitter and a photo detector as the receiver.

**Key Words:** LED, Visible Light Communication, Solar Panel.

## 1 INTRODUCTION

The present world is completely filled up with the RF used for WiFi and the mobile communication signals. The speed we have experienced till now are slow but are fast compared to the present technologies and are not sufficient to transfer large files. The WiFi signals are not too secure to use for some confidential works. This lead to the invention of LiFi (Light Fidelity).

LiFi was invented by Professor Harald Hass. Harald Hass is a professor at the University of Edinburgh. He cofounded the company pure LiFi and concentrates on the development of the LiFi technology.

This LiFi is similar to the television remote. The LED present in the remote transmits the frequency depending upon the button pressed, the frequency is transmitted by blinking the LED which can be seen only through the camera lens but not by naked eyes. The receiver in the television receives the frequency and performs the action depending upon the transmitted frequency.

LiFi is more secure than Wifi because the Rf waves used in WiFi can penetrate the walls whereas the visible light in LiFi cannot penetrate the walls. The present speed of WiFi is

nearly 200 Mbps but this can be easily achieved by LiFi just with the LED bulbs.

Generally white bulbs are used for the LiFi transmission but the usage of different colours like Red, Green, Blue increases the speed of the transmission due to different frequencies.

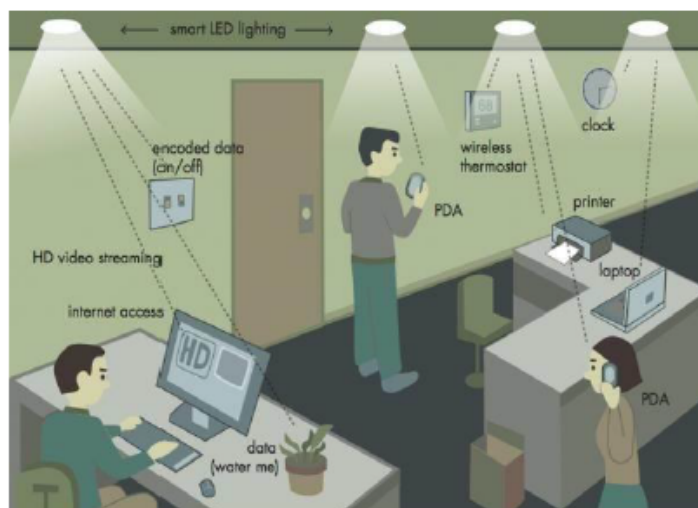
## 2 LITERATURE SURVEY

The advancement of the technology has given access internet to everyone through WiFi. IEEE802.11 is the IEEE standard for WiFi. This uses 2.4-5GHz RF to transmit wireless internet access to our homes, schools, offices and in public places. But this also has some limitations similar to many other technologies.

WiFi can cover the entire house or the public place but it is not secure and the data speed is insufficient to transfer the large data. Whereas LiFi can overcome these limitations. LiFi uses visible light spectrum to transmit the data. A photo detector can be used to receive the data. The other reason to use the LiFi is the increased usage of the mobile communication has decreased the spectrum available in the world.

LiFi uses LED as the transmitter and the solar panel as receiver which are cost efficient and are available to everyone.

The below picture shows the LiFi environment in an office

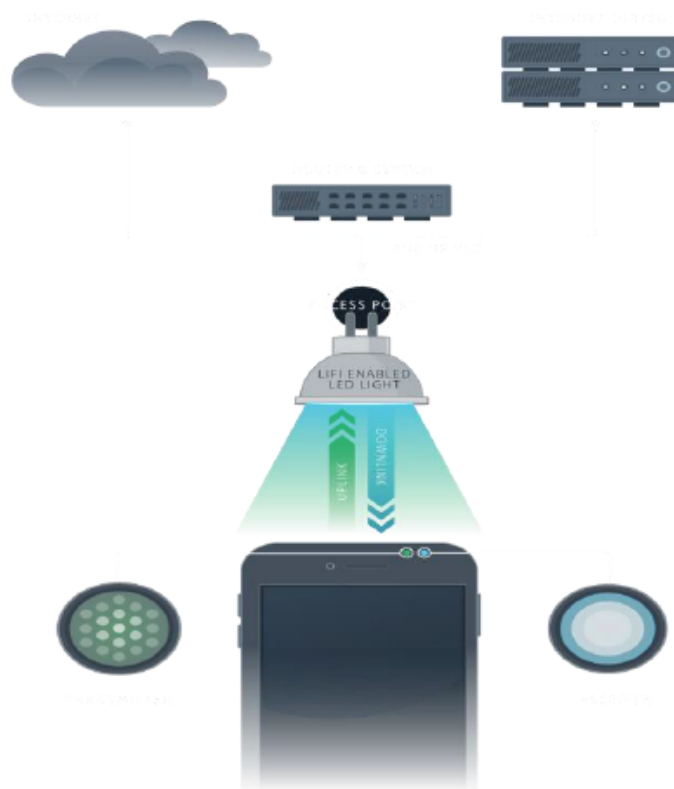


### 3 PRINCIPLE OF LiFi

The heart of the LiFi lies in the LED. These bright LEDs are used to transmit the data. These are similar to the TV remote as said earlier. When the data is transmitted then the LEDs blink so fast that a normal eye cannot detect the blinking. This is used to transfer the data in the form of bits. If the LED is on that is when the light is transmitted then it is a logic 1 and when the LED is off then it is a logic 0. These are detected by a

light sensitive detector (photo detector). This converts the received binary data to original data. This method of using rapid pulses of light to transmit wireless information is called the Visible Light Communication (VLC).

The example for Visible Light Communication is given below



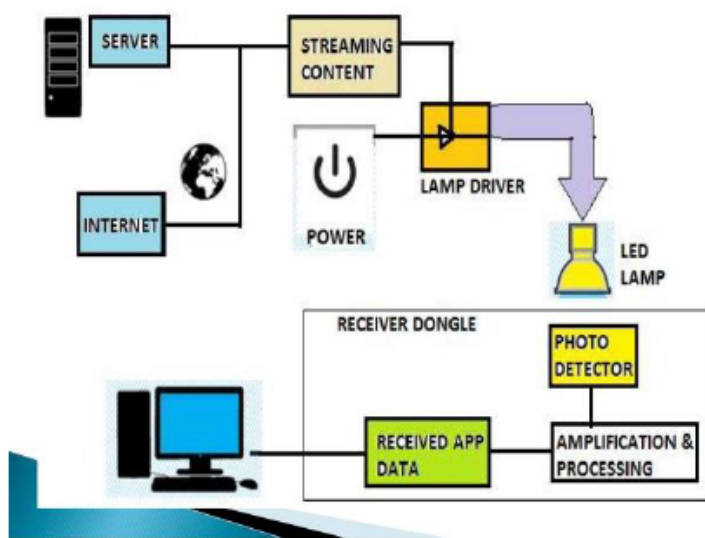
In the above figure it is shown that a mobile consists of a LiFi detector and a transmitter for the communication.

#### 4 WORKING OF LiFi

Visible light has the wavelength ranging from 390nm to 740 nm which can be used for visible light communication. The LiFi architecture consists of LED bulbs and a photoreceiver. The transmitter consists of the data which has to be transmitted. The LEDs transmit the data in the form of 1s and 0s by flickering or blinking. I.e the data is converted into the digital form. The speed at which the data can be transferred depends upon the flickering rate of the LED bulb to on and off to generate different signals of 0s and 1s.

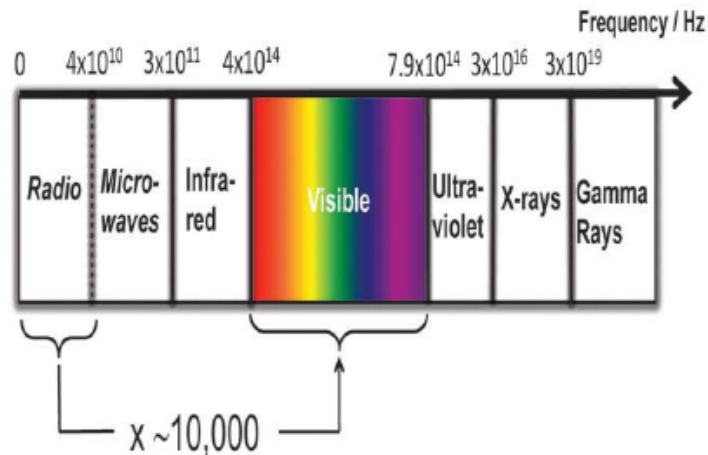
The receiver consists of a photoreceiver like a solarpanel. When the light strikes the receiver the receiver registers logic 1 and when the light is off the the receiver registers the logic 0. The data is again converted into its original form at the receiver side.

The below figure shows the basic LiFi architecture



The above figure shows that the data to be transmitted is transmitted to the LED Lamp. The photodetector at the receiver receives the data and processes it to the original data.

## 5 WHY ONLY VISIBLE LIGHT?



There are so many frequency spectrum in the atmosphere like x-rays, gamma rays, UV rays, IR region, Radio waves, Micro waves. We generally use the Radio waves but as seen above the visible light frequency spectrum is nearly 10,000 larger than the radio frequency spectrum. This shows that there will be no problem in handling the capacity of users. The visible light is cheap and eco friendly. It does not harm the humans and less dangerous for low power applications. But the other regions have the following disadvantages:

Gamma rays are harmful human beings and are already proven in many aspects that they are harmful. Radio waves are expensive due to the spectrum charges and also they are less secure.

X-Rays are similar to the gamma rays. They are harmful to health.

UV rays are extremely dangerous when exposed to human beings otherwise they can be used for communication in the absence of human beings.

Infrared due to high safety regulation, can also be used with low power.

Hence visible light spectrum is used for the communication which is harmless for humans and they have a promising future in the field of communication.

## 6 COMPARISION BETWEEN WiFi and LiFi

Both Wifi and LiFi serve the same purpose to give everyone the access to the internet but there are many differences between. Wifi use the RF waves for the connectivity and is not ideal for huge amount of data transfer. It is not secure when compare ti LiFi. Whereas LiFi uses visible light for the connectivity and is

ideal for huge amount of data transfer.LiFi is more secure than the WiFi.

The below table compare WiFi and LiFi

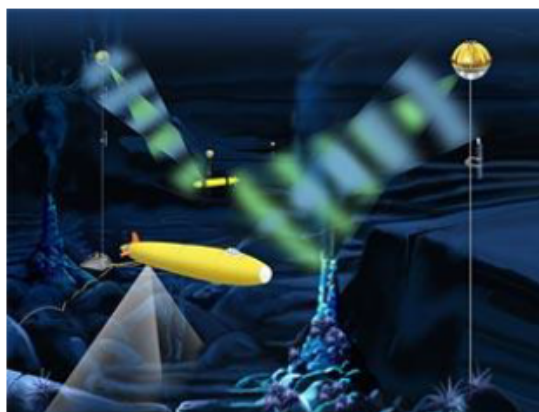
Feature	LiFi	WiFi
Abbreviation	Light Fidelity	Wireless Fidelity
Operation	LiFi transfers data using kight with the help of LED bulbs	WiFi transfers RF waves with the help of WiFi router
Interference	LiFi does not have interference issues	WiFi have some inteference issues
Security	Data transfered through LiFi cannot be breached.	By using some meathods the data transfered through WiFi can be breached and used
Speed of Data transfer	Nearly 1Gbps	1 to 2 Gbps can be achieved
Data Density	Works in high dense Environment	Works in Less dense environment

## 7 APPLICATIONS IOF LiFi

### UNDERWATER

Most of the under water operations include remotely operated vehicles which uses cabes to communicate. With the help of LiFi a

light ray can replace the cable to send and receive the information. But the only limitation in this case is that light does not penetrate further a particular depth like 200 meters.



## 8 HOSPITALS & HEALTHCARE

In hospitals WiFi is used in many places like operation theatre, reception, to transfer the data to other departments, to obtain the scanned report from the scanners etc. This increases the amount of RF radiation in hospital which affects many patients. This can be avoided by using LiFi, as visible light is harmless.



## 9 AVIATION

As we know the usage of mobile and WiFi in the aircraft is prohibited as the signals may interfere with the signals of the aircraft. So

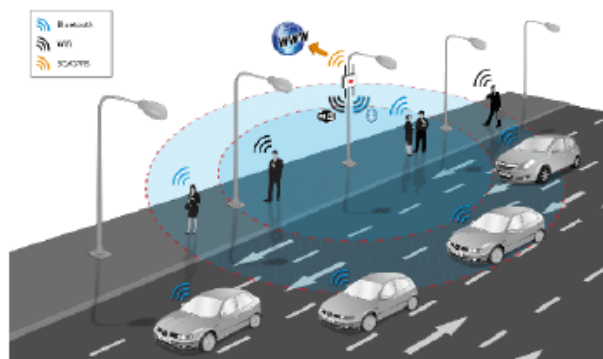


LiFi can be used in place of WiFi in aircraft to have a faster access to internet for the passengers.



## 10 VEHICLES

LiFi helps to develop the communication between the vehicles and also the vehicles and the traffic signals.



## 11 LIMITATIONS OF LiFi

The user has to be in the line of sight of the light source to receive the data.

The light cannot penetrate through the walls.

Natural light, sunlight, electrical light can affect the data transmission.

Opaque objects can affect the data transmission.  
Internet cannot be accessed without a light source.

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