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# Li-Fi Based Data Transmission with Network Security

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**Abstract:- Light-Fidelity is abbreviated as Li-Fi. Where the technique is new and was introduced in 2011 by Harald Haas, a physicist from Germany. Light Fidelity is a form of wireless networking technology that uses LEDs to transport data. Visible light communication, or VLC, is an optical communication system that uses the visible light as a medium to transmit data. Li-Fi is a type of light-based bidirectional communication. Wireless Fidelity is utilised for general cover in buildings, but Li-Fi is suitable for wireless data transfer in tight spaces and is very useful and beneficial where radio wave interference is an issue.Light Fidelity has already achieved rates from over 1 Gbps in the lab, outperforming Wi-Fi in terms of bandwidth, efficiency, and connectivity. In this study, it looks into the use of VLC with Li-Fi, which is a secure way of transferring information wireless that is far more secure than traditional Wi-Fi design.**

***Keywords:-*** *Li-Fi (Light Fidelity), Wi-Fi (Wireless Fidelity), VLC (Visible Light Communication), LOS (Line of Sight), LED (Light Emitting Diode), DDOS (Distributed Denial of Service), MITM (Man In The Middle).*

## I. INTRODUCTION

In today's overburdened (data communication) environment, Li-Fi is the most recent and effective way of wireless connectivity. Li-Fi employs LED lights to transmit data. Data is sent wirelessly. As the number of devices connected that use the Internet rises, wireless technology that connects us to the Internet becomes very slow, and the availability of rigid bandwidth makes it more difficult to use a rapid rate of data transmission and stay connected to a secure network. Only a limited portion of the electromagnetic spectrum can be used to convey data via radio waves.Li-Fi provides a substantially broader spectrum for data transfer than standard wireless systems that employ radio waves. The underlying notion on the other side of the this technology is that data may be transmitted via LED by adjusting light intensity considerably faster than the human eye can detect. Instead of employing Gigahertz radiowaves for data transfer, this method uses a part of the electromagnetic spectrum that is still underutilised: the Visible Spectrum. For the first time in July 2011, a German physicist called Harald Hass created the term "data through lighting" to describe Li-Fi. He *.

th to the previously used radio waves for data transfer.Because Light Fidelity works in the visual spectrum, it can help to alleviate concerns that Wi-Fi signals would affect people's health. Li-Fi technology has the potential to revolutionise how users access the Internet, get emails, and communicate via visible light. Because the data cannot be retrieved in the absence of light, security is not an issue. As a result, Li-Fi can be used in secure military circumstances where Radio Frequency is vulnerable to interception.

Security and speed are other important issues. Wi-Fi communications is vulnerable to cyber attacks since it can simply pass through walls.

## II. SCOPE OF THE STUDY

From a security aspect, Wi-Fi seems to have various security weaknesses that can be easily exploited. Wireless networks convey data in large and small workplaces, homes, and businesses, and if they have been compromised, a lot of data could be exposed. Sniffing, DDoS, and Attacks are just a handful of the many exploits that are commonly utilised and effective in getting information.Terrorists are planning new, more serious assaults, thus attack vectors will be on the decline 'for a while.' Because Li-Fi does not travel through walls and allows for visible access privileges, high information transfer rates, and safer light waves, it can be used to build and implement a variety of real-world access. This study focuses on the vast applications possibilities, particularly in the medical industry and underwater communications.

## III. OBJECTIVE OF THE STUDY

Unlike Wireless Fidelity, which uses radio signals, Li-Fi uses light rays to wirelessly exchange data. As a result, it successfully communicates between the light source and the permitted environment, avoiding users of sniffing network activity and packets to also be transmitted. Long-distance Wi-Fi capabilities, on the other hand, compromise security by allowing anyone from afar to analyse packets and possibly carry out an MITM attack, endangering data integrity and confidentiality.Li-Fi is a sort of beam of light that employs light waves that always travel in a straight line. This enables enterprises to create high security network zones using Visible Light Communication for improve privacy. Li-Fi technology, for example, is used in the IT department's network, which considerably secures the transmission of important company data. These security advantages relate to the fact of Light Fidelity has heavily centred in technology, which needs exact light and receiver alignment to provide optimal transmission. When compared to Wireless Fidelity with Light Fidelity, Light Fidelity has proven faster communication speeds. In lab tests, the potential Wi-Fi bandwidth was just 1 GB/s, while the Light Fidelity equivalent could reach 224 GB/s. Furthermore, the average internet connection in the United States in the first quarter of 2017 was only 18.7 mb/s, spite of the fact the Light Fidelity,

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a transmission technology that has already topped 1 gb/s in a lab environment, was only 18.7 mb/s.

## IV. LITERATURE REVIEW

Prof. Harald Haas made a name for himself in the year 2011, and Li-Fi technology has grown in popularity in recent years. It has taken a great deal of research to make this a reality as a key Wireless Fidelity alternative. Minor study was conducted to get a grasp of the Li-Fi program's know-how and system specs, as well as how to mimic in a controlled environment. As a consequence, this review of previous work will be carried out in order to gain a better knowledge of Li-Fi and possibly help us improve the limitations of previous research and resolve concerns.Where the wireless spectrum has indeed been insufficient, several researchers have tried to boost the frequency of broadcasts over 10GHz to fulfil the growing need for increased efficiency internet connections. On paper, this seems to be a fantastic idea, but it comes with a slew of disadvantages, including health hazards as well as the inability to get around obstructions without purchasing extra hardware. As a result of the higher radio frequency, there may be health concerns.Human health is not just at risk at existing frequency, such as those in the 2.4GHz and 5GHz bands, with performance and speed on par, but also with an increase in frequency, which might cause difficulties so because human body is not meant to endure high frequency settings. According to a study released in 2018, regular Wireless Fidelity transmissions are connected to a slew of health issues.With a basic grasp of Li-Fi, it's time to compare the current Wi-Fi architecture to Li-Fi to see if the distinction is important. According to a 2016 study, there are a few key differences that really can help us understand the impact of Li-Fi deployment. Light Fidelity provides a better and more future-proof foundation than Wi-Fi because the spectrum is 10000 times wider than that of the radio frequency spectrum.

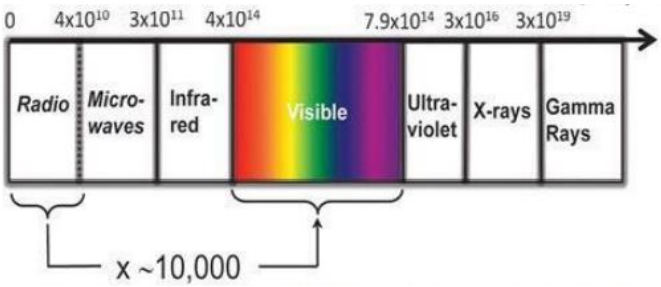


Fig. 1: (Difference of VLC vs RF frequencies)

The graphic above illustrates this. Li-Fi is approximately 100 times faster, and it is also healthier due to the visible light, which has no negative affects on humans or animals. Unlicensed spectrum, which is available worldwide, and non-interference with radio frequency bands, which is quite fast and provides communication security are just a few of benefits of Li-Fi. In addition to Wi-drawbacks, Fi's the security dangers identified in this study must be carefully evaluated.Numerous studies back this up. There appear to be several security weaknesses in Wi-Fi which can be easily abused. Wireless networks are utilised to carry data across large and small workplaces, homes, and businesses, and if they are breached, a great deal of information can be revealed. Eavesdropper, DDoS, or MITM assaults are examples of exploits that are common and effective in collecting data.Because of the heightened security, these types of attacks will become less common, and attackers will be forced to devise new, more lethal tactics. As a result of research, a new approach for preventing the threats posed for organisations, particularly those dealing with sensitive data, should be implemented. The advantages of adopting Light Fidelity seem to be constantly out of date when compared to Wireless Fidelity, especially in terms of security and developing in this contemporary era.According to a study published in 2014, Light Fidelity is much more secure because it cannot be penetrated thru the walls, allowing visible users to use, large data transmitting, and secure waves of light, which all allow for additional applications that can be used in the real world if developed and implemented. This study focuses on the vast application possibilities, particularly in medical applications and underwater military communications. As a consequence, Light Fidelity will be able to provide a diverse set of benefits.

## V. RESEARCH METHODOLOGY

Light Fidelity is a sort of wireless communication visible light with a band length of 400-800 THz that falls between violet and red. Unlike Wireless Fidelity, that uses the radio frequency part of the electromagnetic spectrum, Li-Fi uses visible light. The assumption of Li-Fi is that data is sent and has a well and standardized amplitude - modulated of the source of light. LEDs can flip ON and OFF faster than the human eye can detect since they work at a speed of less than 1 microsecond.Because of this unnoticed switching action, information is delivered in binary form. When the LED is turned on, a data output of '1' is transmitted, and when the LED is turned off, a digital signal of '0' is transmitted. Furthermore, because there are no competing light frequencies like those present in Wi-Fi, and because LEDs can be turned on and off quickly, there is a good likelihood of transmitting information via LED lights. Light Fidelity is reported to be 80 percent more productive than Wi-Fi, enabling it to reach rate by up to 1 gigabit per second or even higher.Li-Fi differs from fibre optic connections in that the Li-Fi protocol layer were built towards wireless communication across short distances. As a result, Light Fidelity is a one-of-a-kind way of wireless communication across short distances that is both fast and efficient.

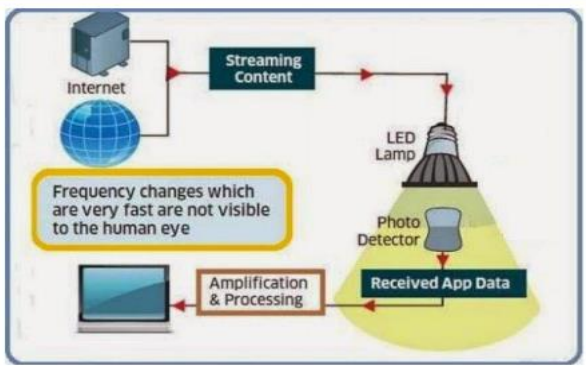


Fig. 2 (Diagram for Li-Fi System)

## VI. WORKING

Light Fidelity is indeed a straightforward technology. On one hand, there is a light emitter, such as an LED, while on the other hand, there will be a light sensor. Data supplied to LED for transmitters is encrypted in light by altering the pace at which LEDs turn on then off to form a variable string of 1 and 0. The on/off activity of the LED transmitter, which appears to be undetectable, allows data transfer to light form using binary codes: switching on an LED also is logic '1', and turning it off is logic '0.'By changing the rate where the LEDs turn in and out of it, data can be encoded in light in various combinations with 1 and 0. LED is hooked up to The internet through modem, as well as the light sensor just on receiving end receives data in the form of light signals, which are decoded and displayed on the device connected to the receiver. The photo detector detects a binary '1' when the LED transmitter is turned on, and a binary '0' when it is turned off.Thus, flashing the LED frequently and using an array of LEDs will eventually result in data rates of thousands of mbit / s.

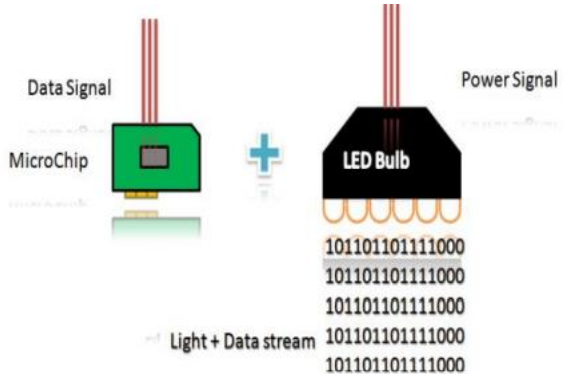

Fig. 3: (Working)

As a consequence, all that is required is a controller to encode the data into the LEDs, as well as one or more LEDs.

The remainder of Radio Communication, as well as Light Fidelity & Wireless Fidelity, are contrasted. Users may access the internet using either Wi-Fi or Li-Fi, which both use the electromagnetic radiation to carry data. Li-Fi is a wireless communication device that transmits data at high speeds using visible light. Wi-Fi uses radio waves to transport data, whereas Light Fidelity uses light beams. Light Fidelity is nice for high information coverage inside a limited around it room and, unlike Wi-Fi, is free of interference. Wireless Fidelity is nice for wireless modems inside a building, office, as well as campus, whilst also Light Fidelity is nice for maximum information covers on the inside of a building, office, as well as campus.

## VII. EXPECTED OUTCOME

Whenever it comes to Wi-Fi results that need to be overcome,

- **Capacity**: Wireless Fidelity transfers data using scarce and expensive radio waves. Due to the rapid adoption of 3G & 4G technologies, the quantity of free spectrum is rapidly diminishing.
- **Efficiency**: There are 1.4 million cellular radio towers in the world. These towers require enormous amounts of energy, the majority of which is used to cool the station rather than delivering radio waves. Some stations, in fact, have a 5 percent efficiency rate.
- **Availability**: In some contexts, such as flights, hospitals, power plants, and chemical plants, radiowaves are not appropriate.
- **Security**: Radiowaves have had the ability to penetrate solid objects. Because they are easily intercepted, they pose a number of security concerns.

The following is just how Light Fidelity addresses the drawbacks of Wi-Fi:

- **Capacity**: The visible spectrum of light is 10,000 times than that radio frequencies. Where are the light sources that are now in use.
- **Efficiency**: LED lights are more energy efficient and use less power.
- **Availability**: There really are light sources all across the world. As just a result, there really is no shortage of resources. Billions upon billions of bulbs will be replaced by LEDs around the world.
- **Security**: Because light does not flow through barriers, data is sent by light waves, which is far more secure.

Li-Fi technology can be used in a variety of ways. Is below an in look at its various applications.

- **Medical and Healthcare**: - Because of the radiation, Wi-Fi is not permitted in operating rooms, and in hospitals when Wi-Fi is offered, disturbance like laptops and mobile devices can impair equipment signals. That's where Li-Fi enters the picture. Light Fidelity can be used to power current medical devices since lights are a crucial component in operating rooms. Furthermore, medical instruments such as MRIs have no effect on Li-Fi because it emits no electromagnetic interference.
- **Airlines and The Aviation**: - On aeroplanes, wireless fidelity is frequently restricted. However, because planes already have a lot of light, Li-Fi could be used to send data.
- **Power PlantsEnvironments**: - Wireless Fidelity is compatible with sensitive areas like power plants. Power plants, on either hand, continue to rely on integrated information systems to obtain grid intensity, demand, and temperatures, among other things. Permission to send across the power station can be achieved using Li-Fi rather than Wi-Fi. In places like petrochemical plants and mines, for example.
- **Traffic**: - Light Fidelity can use the communication among LED lights on vehicles to reduce and avoid traffic accidents. LED lights and taillights are being used in a variety of vehicles. LED traffic signals, lighting, and signs are being phased in. As a result, not only would traffic management be enhanced, but also safety.
- **Smart Light**: -Inside the end, street lamps can be used to produce Li-Fi hotspots and provide lighting and information control.
- **Indoor Wireless Communication**: - Li-Fi is well-suited to wireless radio communication and information transmission. Li-Fi uses an unlicensed, unregulated band that is immune to RF interference. Because Li-Fi cannot

pass through walls, most interior situations would have sufficient light sources and give additional safety.

- **LOS Applications**: - Whenever the LOS is crucial, Light Fidelity can also be used.
- **Smart Class**: - It is used in smart classroom equipment, which is becoming more and more of a necessity in forward-thinking schools and institutions all over the world. Every child observes when, why, what, and how events occur, and they completely comprehend the concepts. To access the server, all the devices in this technology require a connected LAN. In a wired LAN, the physical transceiver is wires, either unshielded twisted - pair or fibre optics.

## VIII. CONCLUSION

While there is still a long way to go before Li-Fi becomes economically feasible, the internet business holds a lot of promise. This concept is now being researched by a wide group of experts 15 and businesses, and it has the potential to address issues such as radio spectrum limitations, space limits, and poor internet connections. With the application of this technology, we can begin to create a green, clean, and secure internet network. Light Fidelity is indeed a relatively new but fast developing approach that acts as a catalyst for a wide range of new & developing findings and technologies. As a consequence, future Li-Fi technologies that may be used in several locations and to address various elements of human life are almost certain to arise.

Finally, according to the study, adopting VLC as just a Light Fidelity system for data transmission is recognised as a very reliable and secure typical Wireless Fidelity architecture. As both a result, we contrasted Li-Fi to Wi-Fi in order to determine its level of security. Wi-Fi has security problems such as data leakage and session hijacking due to light propagation characteristic, that prevents light rays from penetrating opaque objects, however Light Fidelity does not.

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