DATA TRANSMISSION USING LI-FI

(Next-generation optical wireless communication solution)

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ABSTRACT

Wireless technology is advancing quickly and is becoming more prevalent in people's daily lives all across the world. Additionally, an increasing number of people are either directly or indirectly depending on technology. One of the major technological developments of the first decade of the twenty-first century has been the development of high-speed, low-power wireless radio technology. But as the number of wireless devices has grown, so has the overall demand for frequencies in the relevant regions of the electromagnetic spectrum. The demand for wireless data is making the already severe radio spectrum congestion much worse. The majority of us are familiar with how Wi-Fi provides wireless Internet connectivity across our homes, offices, schools, and other public spaces. It has its restrictions, just as most technology. Consequently, Modern wireless technology has greatly improved communication. Light Fidelity is a prominent and cutting-edge technology. Li-Fi is a new wireless technology that offers a lot of high speed, flexibility, and usability. Optical wireless technologies are also known as visible light communication and Li-Fi. A non-profit organization called the Li-Fi Consortium seeks to advance optical wireless technologies. For devices used in the home and workplace, the consortium pledges to provide wireless access that is always faster. Up to 8,000 times what we currently think of as high speed may be possible in the future. The development, uses, and benefits of Li-Fi technology will be covered in this article.

Keywords: Li-Fi, Light, Wi-Fi, Data transmission, Bulb, and VLC.

Introduction

With the launch of third-generation technology and the transmission of more than 900 terabytes of data per month by 16 billion mobile phones, there are already more than 1.4 million cellular radio base stations in use worldwide. In both our personal and professional lives, wireless communication has become a need for water and electricity. But it has its limitations. First, there is the issue of capacity and availability, because RF waves are expensive and scarce, they cannot meet our demand for such high usage (900 TB/month). Secondly, there is the issue of efficiency; base stations use only 5% of their total energy to transmit radio waves; the remaining 95% is used to keep them cool. The third concern is security. To prevent mishaps, you must turn off your phone while in a hospital or on a plane. However, there are 40 billion light bulbs in use, and light is a component of the electromagnetic spectrum. While infrared is employed at lower levels and radio waves are susceptible to interference and distortions, ultraviolet, X-rays, and gamma rays are detrimental to human health.

The visible light spectrum is in the middle there. Light has been used for millions of years; it produced us; it has generated life; and without light, the world would not exist. So it is secure by nature. When we compare the two spectrums, the most astounding difference is that the spectrum of light waves is 10,000 times wider than the spectrum of radio waves, giving us much wide spectrum available for communication. Some have referred to the quick and inexpensive wireless communication technology, known as Li-Fi, as the optical counterpart of Wi-Fi. Data is sent through an LED light bulb whose intensity changes more quickly than the human eye can keep up with it, taking the fiber out of fiber optics. A microchip that will handle data processing will be housed inside the LED light. By making minute amplitude changes, it is possible to control the light intensity and transmit data. The electromagnetic spectrum's visible spectrum, which is currently largely underutilized, is used in this technology. In actuality, the technology of data streams concurrently, in parallel, and at greater speeds.

The following figure shows the VLC revenue in the present and future.

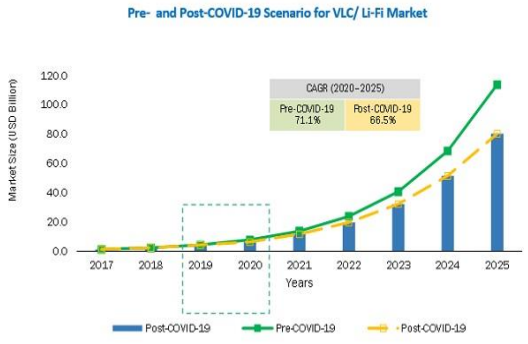

Fig 1

Describe Li-Fi:

To provide unmatched connectivity in a localized data-centric environment, Li-Fi is a new paradigm for optical wireless technology. A group of researchers from the University of Edinburgh, including Dr. Gordon Povey, Prof. Harald Hass, and Dr. Mostafa Afgani, created the VLC technology known as Li-Fi. The Visible Light Communications (VLC) PAN IEEE 802.15.7 standard now includes it. Li-Fi is simply known as "light-based Wi-Fi". Instead of using radio waves to send data, it employs a light source with a chip. Simple white LED bulbs can be used to do this. By passing a steady current through the LED, these are typically utilized for illumination. The optical output can be made to vary at extremely high speeds, in a specific area without any radio interference problems. Li-Fi delivers more sophisticated networking features, faster speed, and various accesses. It uses light for bidirectional, high-speed, networked wireless communication. Even high rates greater than 1 Gbps have been attained in a lab setting.

Construction

The following figure represents the construction of the Li-Fi assembly

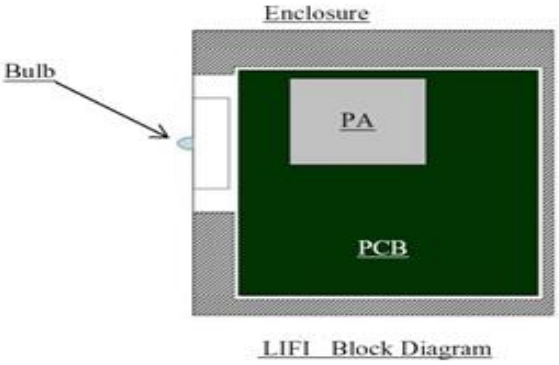

Fig 2

Four main sub-assemblies make up the LIFI product:

- Aluminum jacket (Enclosure)
- Bulb
- RF power amplifier circuit(PA)
- Printed circuit board(PCB)

The PCB houses the microcontroller that controls various lamp operations and regulates the electrical inputs and outputs of the lamp. The solid-state PA produces an RF signal that is directed into the electric field surrounding the light bulb. The center of the light bulb experiences a regulated plasma state due to the high energy density in the electric field, which produces a powerful source of light. These subassemblies are all housed inside an aluminum container.

The Bulb Assembly's Purpose

- The principal components of a bulb assembly are
- Bulb
- Dielectric Material

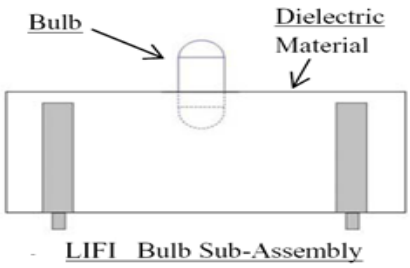

Fig 3

The sealed bulb sub-assembly, which is enclosed in a dielectric substance, is the essential component of LIFI. When compared to traditional light sources, which have electrodes that can degrade inside the bulb, this approach is more dependable. In addition to acting as a waveguide for the RF energy into the light bulb. Rapidly heated to a plasma state, the material inside the light bulb emits high-intensity, full-spectrum light as a result of the electric field's energy.

How Li-Fi Works

A photodetector receives data packed in the beam at extremely fast speeds from an overhead lamp equipped with an LED that uses signal processing technologies. The minute amplitude variation is then transformed into an electrical signal by a receiver dongle, which is subsequently transformed back into a data stream and transferred to a computer or mobile device.

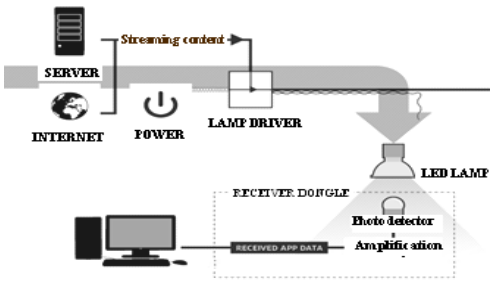

Fig 4

According to the fundamental tenet of Li-Fi, once tapped, visible light has a 10,000-fold wider spectrum than the radio frequencies used by Wi-Fi, resulting in substantially higher bandwidth. This is done by LED light bulbs flickering at a faster pace than the human eye can see to generate binary code (on=1, off=0). A flow of data may result from the order of these variances. Our lamp can process more data the more LEDs there are inside of it. Since our power cord instantly transforms into our data stream thanks to Li-Fi, we can access the Internet as long as we have electricity. A fitted light bulb is the only piece of infrastructure. We only need to connect to the signal relays that are located on the electrical grid and our internet provider will have us connected without even having to bring us a box.

Wi-Fi And Li-Fi

The only Wi-Fi variant is Li-Fi, a novel optical wireless technology. Compared to Li-Fi, Wi-Fi has some drawbacks. Data transmission over Wi-Fi occurs at a frequency of 2.45 GHz. Although it can reach the entire house, its bandwidth is often about 50 to 100 megabits per second (Mbps). Although it offers a respectable speed for the present Internet services, it is insufficient for transporting massive data files like HDTV movies, music libraries, and video game libraries. Some of the drawbacks of Wi-Fi include security concerns, subpar multiple access tactics, and congestion issues. High-

intensity LEDs found in light bulbs, flash bulbs, and cameras may carry data at very high rates that are quicker than Wi-Fi.

The comparison of various wired and wireless communication methods in terms of speed is shown in the following table.

TECHNOLOGY	SPEED	DATA DENSITY
WIRED		
FIRE WIRE	800 Mbps	*****
USB3.0	5 Gbps	*****
THUNDERBOLT	2X 10 Gbps	*****
WIRELESS (CURRENT)		
WI-FI-IEEE (802.11N)	150 Mbps	*
BLUETOOTH	3 Mbps	*
IrDA	4 Mbps	***
WIRELESS (FUTURE)		
Wi-Gig	2 Gbps	**
Giga-IR	1 Gbps	***
Li-Fi	>10 Gbps	****

Table 1 examines the data density and speed of several wired and wireless connections with those of Li-Fi.

Applications

- Adding more bandwidth in areas where licensed and/or unlicensed communication channels are crowded
- Enables wireless home communication, media streaming, and internet access. It also enables smart household and industrial lighting.
- Promoting the deployment of wireless networks in applications where (Wi-Fi) presents a security risk is important for corporate and organizational security.
- Location-based services allow for indoor navigation and tracking.
- Underwater communications facilitate communication between divers and/or remotely operated vehicles.
- Enabling wireless data connectivity for commercial aviation purposes including inflight entertainment and personal communications.
- Integrating mobility and data connections in hospitals is part of the hospital and healthcare category.
- Facilitating high-speed wireless communication inside military vehicles and aircraft.

Potential For Improvement

Li-Fi is only suitable for indoor and close-by applications at this level of development. Due to the high frequency (400-800THZ) used. it can only be used for point-to-point communications over very small distances. Before it can be extensively used, standards must be established, devices must be recognized and the infrastructure and associated entities must be made available.

Li-Fi Council

Dedicated to introducing optical wireless technology, the Li-Fi Council is a nonprofit group. Several of the world's top optical communication technology businesses and research Universities are founding members of the Li-Fi alliance. The group is built on a concept and road plan that was jointly designed to introduce new wireless technology to the market that surpasses the capabilities and qualities of wireless RF technology.

There are numerous goals of the li-Fi Council:

- Promote optical wireless communications up to the multi-gigabit range in all of their implementations;
- Let prospective implementers know about the organizations and tools available to assist them in achieving their product goals;
- Develop comprehensive solutions in front of customer needs; and
- Assemble a comprehensive package of technical and marketing support for OEM customers by coordinating with standardization committees and other industry organizations.

Conclusion

Relating Li-Fi to certain other wireless technologies, it has numerous features. It is also user-friendly and simple to apply. One of the promising VLC technologies of the present is Li-Fi. It is proposed that data transmission can be accomplished by using very little variation in light intensity. Light does not interact with other devices the way standard wireless transmission does, which is one advantage of this technology. An LED light that would be utilized for Li-Fi could simply take the place of the illumination that is already present everywhere, which is typically on the ceiling. Additionally, a far higher throughput is anticipated than with any previous wireless standard. Several options can be further investigated. We can move toward a cleaner, greener, safer, and brighter future if this technology can be implemented practically and every bulb can be used similarly to a Wi-Fi hotspot to send wireless data.

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