Li-Fi-Light Fidelity Technology

Richa kaushal
Atma Ram Sanatan Dharma College, University of Delhi.

Abstract: With the development of humans there dependency on the technology has also increased. There is a huge demand for communication and data sharing using wireless technology at a very high speed which led to the invention of new wireless communication technology Li-Fi (light fidelity). Li-Fi is capable of transferring huge amount of data at a very high speed using visible light as the communication medium. This paper aims at exploring the need of Li-Fi, its working technology, advantages and its limitations along with the areas where this technology can be used.

Introduction

Li-Fi is a high speed fully networked wireless communication technology that provides bidirectional data transfer at a high speed by using visible light as the communication medium. The visible data light communication uses visible light between 400 and 800 THz that is capable of carrying more information as compared to the other wireless medium. The need for the invention of Li-Fi arises as the most famous wireless technology Wi-Fi that uses 2.4GHz-5GHz radio frequencies is unable to provide interference free communication when multiple users in small vicinity shares the channel. The Wi-Fi uses radio waves which have limited bandwidth of 50Mbps-100Mbps that makes it unsuitable to transfer heavy data files such as HDTV movies, games, videos and songs at a high speed. The more we are getting dependent to store data and large files on our own media servers the more we are in need of larger bandwidth in order to have high speed data transfer. Wi-Fi also lacks in to provide precision indoor positioning and gesture recognition. These are the concerns that lead to development on Li-Fi. The basic idea behind the working of Li-Fi is that data can be transferred through the light source such as light emitting diode (LED) by varying its intensity. This light source can be switched on and off very quickly which provides us the opportunity to encode the data. The data in the binary format can easily be encoded by denoting the off light source as binary 0 and on light source as binary 1.

The change of light intensity produces the flicker of light that generates the strings of 0 and 1. These strings are then streamed to play audios, videos and movies. The success of this technology depends upon the intensity and potential of Light emitting diodes.

Working of Li-Fi Technology

Li-fi is a visible light communication system for data transmission. Li-Fi essentially requires two main components to enable data transfer using visible light spectrum. The first component is the light source which is equipped with the signal processing unit capable of processing the data received from the internet access point. The second component is a device with the photo diode capable of receiving light signals and to convert them to electric current. Li-Fi system requires extremely high rate of light output that can be provided by a LED, thus LEDs are used as light source. LED is a semiconductor light source which can amplify the light intensity and also can be switched on and off quickly faster than the human eye can detect causing the light source to appear continuous rather than flickering. It also provides a bidirectional data transfer and we have two separate links for data communication i.e. uplink and downlink. To send the data in a downlink, LED bulbs fitted with a controller chip are used. These LED are linked to the internet access points to receive the data from the internet to be sent to the data receiving devices. The controller chip processes the data and modulates the intensity of light by quickly switching on and off on the LED. These changes in the light intensity are interpreted by the receiving photo diode and are converted to electric current. The electronic signals are then demodulated.
and it is converted into a continuous stream of binary data comprising of audio, video, and website pages to be streamed on the receiver device. To send the data in the uplink a device such as a laptop and a mobile phone which is fitted with the photo sensitive unit is used. These devices uses infra-red light to create separate channel. The infra-red lights are fitted with the controller chip that varies the intensity of light .The change in the light intensity is detected by the photo receiver that interpret the intensity and convert it to the current, which is then demodulated and converted to the continuous stream data to be send on the internet. In this way Li-Fi enables us to send and receive data through the wireless data communication by using a humble and simple LED lights that are used in our homes, offices, factories, school and colleges.

Benefits of using Li-Fi Technology

Li-Fi technology provides high speed data transfer. It enables users to transfer HDTV movies, videos and songs to be uploaded and downloaded within few milliseconds. It uses LED lights that are natural beam which makes it easy to create separate uplink and downlink and hence provide more secure data transmission as the intruder have to intercept both the uplink as well downlink to capture the complete information. Li-Fi does not have limitation over frequency bandwidth and hence it can support multiple users without affecting their data transfer rate. It can only work in a small area thus it does not have any neighbor network interference issues. Li-Fi uses visible light that can travel underwater unlike radio waves which get absorbed by water thereby making it suitable to be used under water for data communication. Li-Fi technology can also be used to provide high speed internet access in areas where optical fibers are not easy to install. It can also be used in places such as air space where radio frequency can create electromagnetic interference with radio equipment. Li-Fi also provides gesture recognition and precision indoor recognition and eliminates the health issue concerns that arises due to the use of radio frequency as its communication medium is visible light which do not have any adverse effect on humans health. It also enhances energy efficiency by combining data communication and illumination. Thus Li-Fi provides many advantages and hence motivates humans to use it as the new communication technology.

Limitation of Li-Fi Technology

Li-Fi is a very promising new technology in the wireless communication with so many advantages but it does have few limitations too. The major limitation of Li-Fi is it can be used only in small area since it uses visible light as communication medium. Light requires absolute perfect line of sight to transfer data and it cannot penetrate any solid object and hence it cannot cover all the areas. Li-Fi also lacks the reliability of optimal data transfer as compared to other wireless communication technology. It requires the constant use of light source and LED have to be switched on all day and night thereby it makes is inconvenient to use every time. Using LED lights in the day time also waste lots of electricity power. The implementation cost for creating complete new infrastructure to enable users to use Li-Fi is also high.

Applications of Li-Fi Technology

Li-Fi can be used in military operations and under water to provide communication between divers, diver to drilling rig as light can penetrate for large distances whereas the radio frequency gets quickly absorbed by the water. Li-Fi is suitable to be used in aircrafts by using Li-Fi enabled lighting to allow high data rate connectivity for each passenger without creating any electromagnetic interference with sensitive radio frequency, also a reduction in cabling will not affect the weight of aircraft. It can also in high security and sensitive areas such as defense offices ,ministries and companies where sensitive data needs to be shared within the small area network as it provides high security as compared to other wireless technology. Li-Fi can also be used in hospitals where no other wireless medium that uses radio waves can be used as it emits no electromagnetic interference and so does not interfere with medical instruments, nor is it interfered by MRI scanners. Li-Fi can be used in explosion hazard environments where the use of electrical equipment is not allowed; also it will simplify the configuration of data network and enhance security. It can be used in hotel corridors or reception halls and in hotel rooms to provide high speed interference free wireless communication. Li-Fi hotspots can be created by using public and private lights and the same communications and sensor infrastructure can be used to monitor and control lighting and data. Li-Fi can be used to provide accurate location-specific information services such as advertising and navigation that enables the recipient to receive appropriate, pertinent information in a timely manner. The car to car communication can be enabled by the use of Li-Fi which leads to development of anti-collision system and exchange of driving condition between vehicles. LED Lights in the traffic light can be used to monitor traffic and enable car system to download information from the network about the optimal routes and real time traffic conditions thus providing a traffic management system. Devices such as Laptops, smart phones, tablets and other mobile devices can interconnect directly using Li-Fi and these short range links give
very high data rates and security. Many toys incorporate LED lights and these can be used to enable extremely low-cost communication between interactive toys.

Comparison of Li-Fi with Wi-Fi

The Wi-Fi (wireless fidelity) is the well known wireless technology that is being used from many years where as Li-Fi (light fidelity) is relatively a new technology in wireless data communication domain. Wi-Fi transfer data using radio waves with the help of Wi-Fi router and Li-Fi uses visible light to transfer data using LED. Li-Fi transfer data at the speed of about 1Gbps that is faster than the Wi-Fi data transfer speed of 150 Mbps. Li-Fi can be used to provide data communication only within the small area as visible light cannot penetrate any solid objects such as walls whereas Wi-Fi covers large area to provide data communication as radio waves can penetrate objects. Since Li-Fi can be used only in small vicinity it is provides more secured data transmission as compared to Wi-Fi. The use of radio waves as transmission medium in Wi-Fi makes it unsuitable to be used such as hospitals, aircrafts, petro-chemical plants where RF transmission is considered hazardous due to its harmful electromagnetic spectrum. Li-Fi on the other hand transfer data using visible light that do not have any adverse affect and hence can be used in all these places. Li-Fi can also be used under water and can help in studying about underwater world. Light does not suffers from interference issues similar to radio frequency waves and also its frequency spectrum is 10,000 times larger than the radio waves making it suitable to provide internet access.

Further scope

There are two products in the current market namely Li-Flame Ceiling Unit which is connected to an LED light fixture and Li-Flame desktop unit which connects to a device via a USB. The aim of these two devices is to provide light and data connectivity. LED lights can be arranged in a line to form array of light source where each LED transfer a different data stream. A mixture of red, green and blue light can also be used to alter the light frequency in order to create different data channels.

Conclusion

Li-Fi is a very effective alternative way to provide wireless data communication. It does not have any restriction over its bandwidth and it provides high data transfer rate too in a dense network. Li-Fi uses visible light as the communication medium and therefore it can be used in places where the use of radio waves is not permitted such as hospitals, aircrafts, petro-chemical industry. Li-Fi has many advantages but due to its in capability to transfer data in a wide area and in outdoor it cannot replace Wi-Fi completely. Li-Fi wireless network would complement existing RF wireless networks, and would provide significant spectrum relief by allowing wireless-fidelity systems to off-load a significant portion of wireless data traffic. Hence by using Li-Fi as wireless communication the security and data transfer speed will be increased also wireless communication will be available in all the possible regions.

References

[1]. U. Suganya, C. Subalashmiri, "Li-Fi(light fidelity technology) International journal of research in Computer application and robotics , Vol.3 Issue.1, Pg.: 26-32 January 2015
[4]. Zimu Zhou*, Zheng Yang†, Chenshu Wu‡, Wei Sun* and Yunhao Liu†, LiFi: Line-Of-Sight Identification with WiFi, presented in IEEE Conference on Computer Communications IEEE INFOCOM 2014