

Li-Fi Based Device Switching

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Abstract— *Communication can be done using wired and wireless mediums. Since last two decades, excessive studies and research is being done on wireless communication. One such protocol being explored currently is Light Fidelity, well known as LiFi. This paper throws light on the current trends and methodologies implemented for LiFi.*

Keywords: *LiFi, visible light communication, LiFi applications, Device Switching*

I. INTRODUCTION

Presently, public areas like hospitals, airports, offices make use of Wi-Fi technology universally for communication purpose, for internet access. Wi-Fi uses radio frequencies for the transmission of data. But like most technologies, it has its own limitations. Data trafficking is increased due to the usage of these radio frequencies. As we dependent on ‘the cloud’ to store our files which includes movies, music, pictures, we will want more bandwidth and speed. Therefore RF-based technologies such as Wi-Fi are not the optimal way.

Optical wireless technologies, sometimes called visible light communication (VLC), and more recently referred to as Li-Fi (Light Fidelity) offer an entirely new paradigm in wireless technologies in terms of communication speed, flexibility and usability.

Li-Fi in detail can be said as light fidelity in which the data is transmitted where light is the medium of transmission. It is possible to encode data in the light by varying the rate at which bulb flicker ON and OFF to give different strings of 1’s and 0’s. If bulb is ON, it is considered to be digital 1 else it is digital 0. The bulb intensity is modulated so rapidly that human eyes cannot notice, which makes the bulb appear ON continuously. Thus Li-Fi has certain advantages like better efficiency, security, bandwidth and high speed.

II. LITERATURE SURVEY

Presently, radio spectrum only below 10 GHz is being used for wireless data communication [1]. Hence it has become inadequate. Therefore, in this paper Li-Fi technology is explained in detail wherein, Li-Fi uses radio spectrum above 10 GHz. According to this paper for high speed wireless data communication light emitting diodes are being used. Since the energy efficiency of LED’s are high, it is being used in homes, street lights and offices which is an advantage for the usage of Li-Fi technology. Another added advantage is the reduction in cell size which leads to the creation of Li-Fi atto cells. In heterogeneous wireless networks Li-Fi atto cells forms an additional network layer which has zero interference towards radio frequency counter part. This paper

compares Li-Fi with VLC and shows that VLC is a point-to-point data communication technique whereas Li-Fi is a wireless networking system which can also be said as point-to-multipoint and multipoint-to-point communication (creation of atto cells). Li-Fi can use different modulation techniques such as single carrier modulation wherein ON-OFF keying, pulse position modulation and pulse amplitude modulation techniques. Increase in data rate leads to many ill effects such as non-linear signal distortion and inter symbol interferences in ON-OFF keying, pulse position modulation and pulse amplitude modulation. In order to overcome these ill effects Multi-Carrier Modulation (MCM) technique is used. In MCM techniques data streams are transmitted parallelly with the help of orthogonal sub-carriers. Li-Fi specific modulation is a type of modulation technique where colour shift keying method is used.

Since Li-Fi can be used in various applications such as IoT, 5G, car-to-car communication, security and defence and so on. Li-Fi ASIC’s can be developed. Thus a transmitter ASIC and a receiver ASIC using Complementary Metal Oxide Semiconductor (CMOS) technology is designed. NOMA is a power domain multiplexing technique which helps in serving large number of users and can also be used in 5G wireless communications. At the receiver end, in order to cancel the inter-user-interference successive interference cancellation is used. The placement of AP’s plays a major role in the system performance of a Li-Fi atto cell network. The interference is caused due to the light signal from a neighbour AP. Hence the transmission data cannot be coherent IM/DD helps in encoding the data. The bandwidth is used effectively by dividing and sharing it among different optical AP’s. The model used for cellular RF networks can be used for Li-Fi networks such as hexagonal shape, voronoi tennellation, square lattice technology.

With the development of optical AP’s the efficiency of Li-Fi network can be increased. By using Wi-Fi overlay the system performance and quality of service is improved among users. There is no interference between Li-Fi and Wi-Fi because they use different spectra. Thus we can make use of hybrid Li-Fi and Wi-Fi to achieve sum of throughput of both Li-Fi and Wi-Fi.

The Li-Fi atto cell network is developed by the research done on LED based VLC higher data rates per unit area can be achieved by Li-Fi atto cell network when compared to RF small cell solution. The 5G key performance indicator is well assigned with user data rates, number of users served and increase in total traffic. This is enabled by the reduction of cell size. Thus the spectrum efficiency of existing RF network and vast

wireless capacity can be achieved using complementary wireless network that is Li-Fi technology.

According to [2], the light besides having a visual effect also has an impact on human health which affects our mood, feelings, stress, emotions and productivity. As the energy level in blue light is high, it affects our circadian rhythm which maintains melatonin levels and cortisol. If the circadian rhythm is disrupted then there is a decrease in melatonin levels which leads to chronic diseases and conditions such as cancer, cardiovascular diseases, obesity, depression etc.

The emitted light quality depends on driving current of LED. The change in the light properties such as hue and colour till has an impact on human productivity, mood and physical surrounding aesthetics. The change in the chromaticity leads to blue light hazard including eye problem however data transmission through Li-Fi is done by varying driving current of LED. The quality of light emitted by the LED is measured with the help of tricolour (RGB) and phosphor converted white LED's for data transmission by keeping a constantly driving current. The light quality with and without Li-Fi is measured with the help of correlated colour temperature and chromaticity metrics. It is observed that the shift in chromaticity and CCT is negligible between RGB and PC white LED. Thus the LED can be modulated using a DC balance ON-OFF keying signal which does not affect the emitted light quality.

In the paper [3] automatic billing system using Li-Fi is demonstrated using transmission of data between mobile phone and the products. Every product consists of a Li-Fi transmitter. The product id, cost and quantity is encoded and stored on a Li-Fi transmitter. Mobile consists of a Li-Fi receiver. The information of the product chosen by the consumer is received by the Li-Fi receiver. Trolley contains Li-Fi module in order to verify product identity. The payment is done using online banking. Then, the cart section verifies if the product is purchased. Once the transaction is completed, the payment details will be sent to the gate module using mobile Li-Fi. The gate will be opened only if the payment is done else alarm is triggered.

Thus by using this technology, we can utilize time effectively as there is no need to stand in a queue for billing. We can make sure that the payment is done only for the products purchased by a particular consumer. Single Li-Fi light has limited bandwidth. In order to overcome this parallel Li-Fi wicks are used to transmit data simultaneously.

III. CONCLUSION

Since bulb is used commonly at home, offices, hotels and many other place it is an added advantage to use Li-Fi technology than using LED for transmission of data. As the colour of the LEDs affects human health such as cancer, visual effects, and psychological disorders it is better to use white LED. Light follows the principles of refraction and reflection. Hence using this concept data can be transmitted for a longer distance.

Thus, each bulb can be converted to a medium of transmission of data which is cost effective. It is easily implemented making our environment safer and greener.

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