Li-Fi - The Future of Internet

Nikhita Adidam,
Department of Computer Science,
Vasavi College of Engineering,
Hyderabad, India.
nikhita.aditham.26@gmail.com

Abstract- Wireless network has now become the most common form of internet. The use of wireless internet either at home or public places can sometimes lead to slow internet speed and increased processing time as more than one device is tapped into a network. As more and more devices are attached to a single network the airwaves can get clogged which make it difficult to stick to a reliable signal. At this juncture, the question of using waves other than radio waves to surf the internet rose as it was felt that radio waves were completely exploited.

A German physicist, Dr Harold Haas, proposed a solution called 'Data through Illumination' in which he used fiber optics to send data through an LED light bulb. This D-Light is more powerful and can produce data rates faster than ten mega bits per second. Hence, this laid as the foundation for the development of Li-Fi technologies which enable us to transmit data through light to our devices like laptops, mobile phones and tablets.

Keywords-Li-Fi, Wi-Fi, Visible Light Communication (VLC), LED, Photo detector.

I.INTRODUCTION

Li-Fi means 'Light Fidelity'. This term was coined by Prof. Harold Haas in Global TED Talk in 2012. It operates in the visible layer of the electromagnetic spectrum i.e. it uses the visible light communication (VLC) as the means of transmission rather than the overly used radio waves. Harold Haas has proposed the very simple technique of transmitting data using LED bulbs i.e. if the LED is ON, then the a digital signal 1 is transmitted else if the LED is OFF, the digital signal 0 is transmitted. Thus encoding of data by changing the rate of flickering of LED is the basic principle of Li-Fi.

Overview of Li-Fi

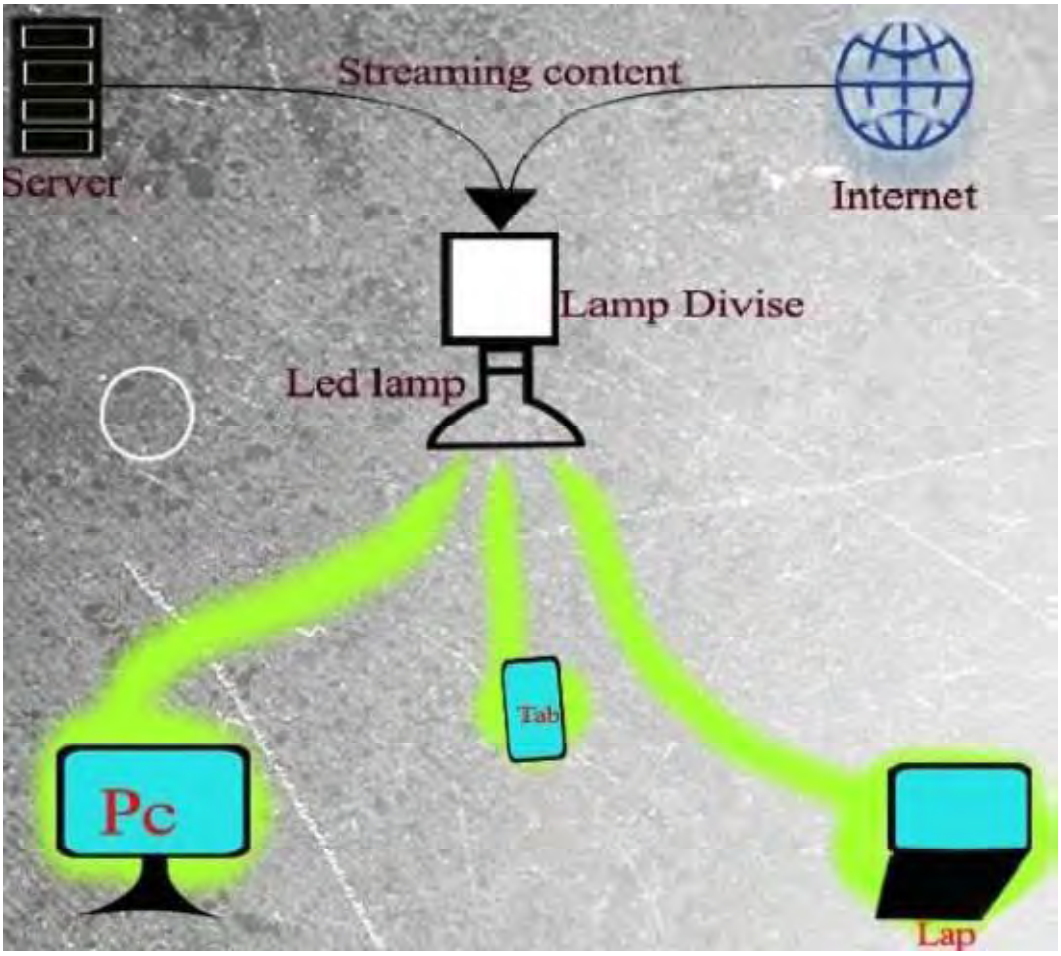
II.DESIGN AND IMPLEMENTATION OF Li-Fi

The architecture of Li-Fi consists of various LED bulbs or lamps, wireless devices such as PDAs, mobile phones, laptops etc.

Any proper Li-Fi architecture must possess the following characteristics:

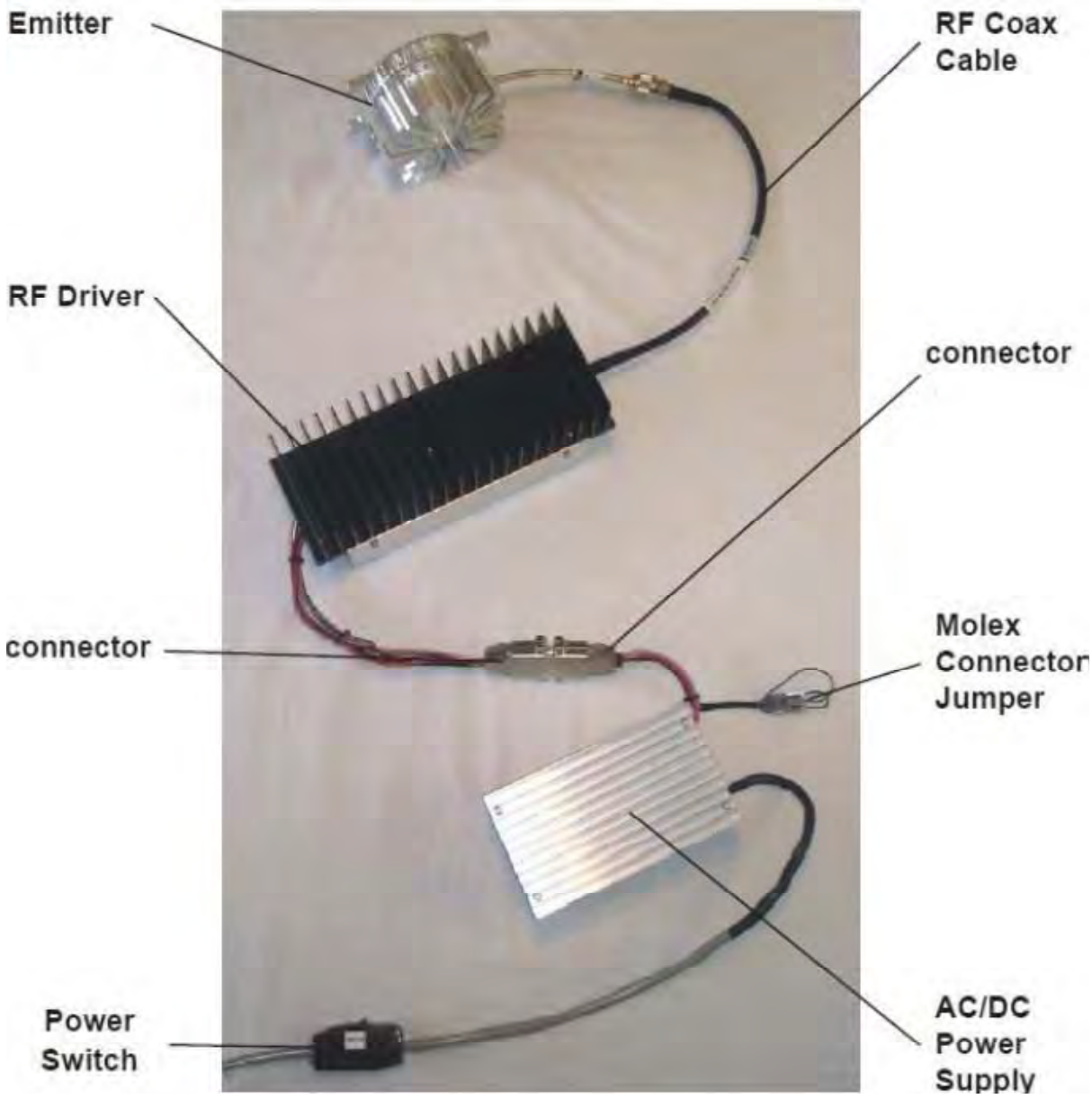
- Presence of Light
- Line of Sight(LoS)
- Proper LED bulbs or lamps
- Proper photo detector.

As shown below, the streaming content must have proper synchronization with server and network so that it can work efficiently.



Architecture of Li-Fi

The implementation of Li-Fi is usually done using white LED light bulbs at the transmitter which are used for illumination by applying a constant current. By varying the current at a fast rate, the optical output varies at higher speeds. This is the optical current property of the Li-Fi architecture. Hence, all that is required is an LED and a controller which can code the data into these LEDs. Further, for parallel data transmission an array of LEDs can be used, these advancements promise a hypothetical speed of 10Gbps.

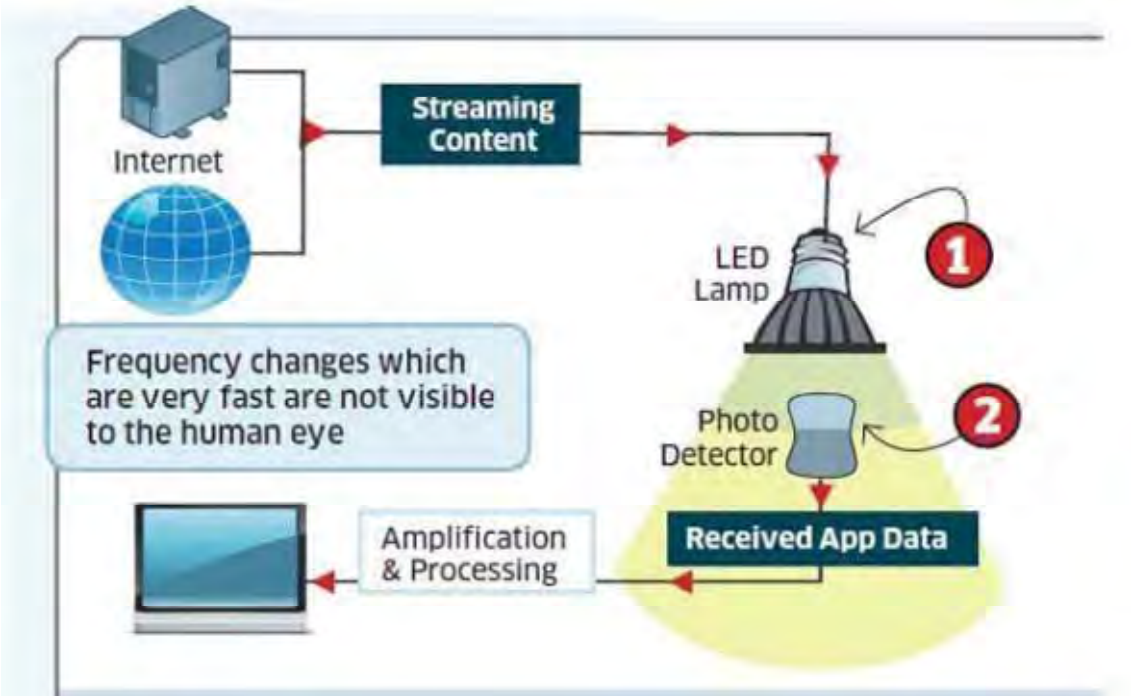


Implementation of Li-Fi

III.WORKING OF Li-Fi

The working of Li-Fi is rather very simple. Let us take for instance that a light emitter is placed at one end and an LED lamp and a photo detector or light sensor at the other end. The photo detector is used to detect the signals on the LED and it registers a binary one when the LED is ON and a binary zero when the LED is OFF. So, when we want to build up a stream of data, then flash the LED numerous times or use an array of LEDs of different colors (as per our requirement) to obtain the data rate in ranges of hundreds of megabits per second.

The block diagram of Li-Fi technologies is as follows:



Block diagram of Li-Fi

By changing the flickering rate of the LEDs from ON to OFF, the data can be programmed to generate strings of 0s and 1s which can further form different combinations of 0s and 1s. This swift shifting of ON-OFF is almost invisible to the human eye as human eye cannot capture signals varying at a high swift rate which causes the light to appear to be continuous even though it is actually flickering. This technique of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication (VLC), though it is popularly called as Li-Fi as it is competent to the radio-based rival Wi-Fi.

IV. DEVELOPMENT IN Li-Fi

Li-Fi has already achieved swelteringly high speed at the laboratories. Researchers at the Heinrich Hertz Institute in Berlin, Germany have reached data rates of over 500 megabytes per second [3]. This technology was further demonstrated using a pair of Casio smart phones, at the 2012 Consumer Electronics Show in Las Vegas to exchange data using light of varying intensity given off from their screens, measurable at a distance of up to ten meters [3]. Group of companies and industry groups came forward to form a 'Li-Fi Consortium' in October 2011 to promote high-speed optical wireless systems and to overcome the limited availability of radio-based wireless spectrum. According to the Li-Fi Consortium, a high-definition film can be downloaded in just 30 seconds i.e. it is possible to achieve more than 10 Gbps of speed [4]. Further, Researchers at the University of Strathclyde in Scotland have begun the task of bringing high-speed, ubiquitous, Li-Fi technology to market [4].

V. ADVANTAGES OF Li-Fi

a) Capacity: Light has 10000 times wider bandwidth than radio waves [7]. Also, since light sources are already installed and equipments are already available, it has got better capacity.
b) Efficiency: Transmission of data using Li-Fi is very cheap as the LED lights consume less energy and are highly efficient.
c) Availability: Availability is not an issue as visible light communication takes place here i.e. light sources are present everywhere. Proper LEDs should be placed for proper transmission of data.
d) Security: As the light waves cannot break through the walls, they can't be interrupted and misused.

VI. DISADVANTAGES OF Li-Fi

a) If there is no light or if it is blocked when you need to use your device to send information — you can seamlessly switch back over to radio waves, Harold says i.e. if the receiver is accidentally blocked in any way, light waves get cut-off. This is the major issue with Li-Fi because the light can't pass through objects.

b) Any unwanted presence / interference from the external light sources like normal bulbs, opaque materials in the path of transmission will cause interruption in communication.

c) Reliability and Network coverage are also major issues.

VII. APPLICATIONS OF Li-Fi

a) Institutions: It is the cheapest source of internet with minimum load and cost, so it can effectively be used in various educational institutions, meetings, conferences etc.

b) Sophisticated Hospitals: Wi-Fi cannot be installed at hospitals/operation theatres as these radio waves can interfere with the mobile which can block the signals for monitoring equipments thus proving perilous to the patient's health. Usage of Li-Fi provides more advanced monitoring techniques and operation strategies.

c) Internet in Aircrafts: Often, we have to put our electronic devices in the Flight Mode or No Internet Mode when we are in an aircraft as these signals may interfere with the navigation signals. Hence, Wi-Fi is practically impossible in this scenario. Usage of Li-Fi can be beneficial as the source of light can be the overhead reading light inside the plane.

d) Traffic Control: Li-Fi can be used in traffic signals which communicate with the LED lights of the cars which can prove beneficial in managing the traffic and can also help in reducing the accidents.

e) Underwater Awesomeness: Li-Fi can even work under water where Wi-Fi completely fails. If the wires of the Remotely Operated Vehicles (ROVs) which operate at a long distance from the surface are replaced with light, say from a high-powered lamp which is submerged then it is easier to access the internet.

VIII. CONCLUSION

Li-Fi technologies can prove highly beneficial and can change the face of world. There is a surfeit of opportunity to improvise and to make this technology practically possible to make it widely used. It has already become the most significant topic of research and is being scrutinized in every detailed manner to enhance its performance. It surely can replace the traditional Wi-Fi networks and can further be extended to different platforms to make it easily accessible and portable which will thus cater to the growing demands of the increasing population.

IX. REFERENCES

[1] http://thetrinitycollege.wordpress.com/2013/07/20/lifi/
[2] http://en.wikipedia.org/wiki/Li-Fi
[3] Jyoti Rani, PrernaChauhan, RitikaTripathi, ―Li-Fi (Light Fidelity)-The future technology In Wireless communication‖, International Journal of Applied Engineering Research, ISSN 0973-4562 Vol.7 No.11 (2012).
[4] Rahul R. Sharma, Raunak, Akshay Sanganal ― Li-Fi Technology-Transmission of data through light, International Journal of Computer Technology & Applications, ISSN:2229-6093 Vol. 5 No.1
[5] Dhakane Vikas Nivrutti, Ravi Ramchandra Nimbalkar ― Light-Fidelity: A Reconnaissance of Future Technology, International Journal of Advanced Research in Computer Science and Software Engineering, ISSN: 2277 128X Vol. 3, Issue. 11, Nov 2013.
[6] http://www.slideshare.net/doddarangaiah/lifi-technology-in-wireless-communication?related=1
[7] http://edition.cnn.com/2012/09/28/tech/lifi-haas-innovation
[8] seminarprojects.com/s/seminar-report-on-li-fi