

## LIFI : LIGHT FIDELITY IN THE SCHOOL LIBRARY

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### Abstract

Light is energy lighting that can be used to transmit data and can reduce the use of the access point for local access in a building. The purpose of this paper is to implement technology Light Fidelity (Li-Fi) on the school library. Li-Fi has a very high potential in generating the connection data delivery fast. Li-Fi is even referred to as a technology that is better or superior than Wi-Fi (Wireless Fidelity). This is due to the broad scope of the installation is wider than Wi-Fi as well as the speed of sending data that far exceeds the Wi-Fi. Wi-Fi uses radio waves as a mediator while Li-Fi uses light as a mediator to transmit data. For installation its own Li-Fi using tools such as server, lamp driver, Li-Fi dongle, as well as the device to be connected, such as computers, smartphones, and tablets.

## 1.0 INTRODUCTION

Importance of internet access in the era of digitalization is currently making the internet became part of our lives. With this breadth of data exchange, as well as the multiplicity of interests that each person had, the internet is able to provide solutions in various fields and in various ways depending on its own use. Wireless technology can transmit data has exceeded 7000 terra byte each day while the use of energy saving light bulb is only used as a means of illumination [1,7]. However, if we take advantage of the good then we can send data by utilizing the light energy is. Thus, up to the technology of the future to allow the communication of information to the user with just wearing the rays of lighting. Regarding this would reduce significantly the number of wifi/access point that is located in the building at the conclusion resulted in the saving power [13,14,15]

The technology of making the light bulb as a data communication medium is known as Li-Fi (Light Fidelity) which promises speeds of 100 times the speed of Wi-Fi. Meanwhile, The electromagnetic spectrum has sufficient capacity to accommodate data and has 10,000 times as much availability as infrastructure, globally. There is great potential in this technology to transform everything we use to access data via the internet, or stream video, receive email, etc. [16]. Until now, LiFi technology has not yet reached the public [1,17,20,21] due to the fact that technology infrastructure has not been fully realized in remote areas in Indonesia [22,23]. Some of the current realization that there is a visible light communication or VLC (Visible Light Communication) with the use of LEDs as the sender [2,4,5,17] and the realization of a prototype form still needs to be developed [3,18,19]. While Wi-Fi is based on the availability of microwave signals, Li-Fi can hypothetically turn off any light to a network connection [20]. Li-Fi operates at a much higher frequency than Wi-Fi. With the application of Li-Fi, it is clear that schools can reduce electromagnetic pollution generated by WiFi because they do not use cables and are not within the range of radio waves and have data transfer speeds of up to 100Gbps [20,24]. The light that we use in an everyday life are not only used to provide an illumination, it can also be used as a medium of communication through a

lighting. The use of a visible light for data transmission includes many advantages and eliminates the disadvantages of transmitting data via electromagnetic waves [17,25]. The drawback is that the range is still very short for local communication because it still uses LED (Light Emitting Diode) in general, not only that communication is still sent in one a direction. Data have transmitted through a light can cause health problems [25]. Whereas the main challenge for this technology is the retransmission of data back to the transmitter [27].

In an educational institution, a library is a central place of gathering information. In addition, this place also became one of the main destinations for students to work on school assignments. This is because the library has components that can help the students to work on school assignments, such as books, computer, and internet access. In the school library also provides a place for students to discuss, namely the meeting room. However the internet connection is often limited, and the slow speed of access makes the job of the students to be inhibited [14]. In this research tried to implement Lifi in the school Library SMAN 23 Tangerang Sub District. Li-Fi itself is a technology similar to wi-fi, but has some advantages that are not owned wi-fi and the speed that far exceeds the wi-fi itself [7]. With this, we hope we can be one way to improve the quality of internet access in the school Library.

## **2.0 THEORETICAL**

### **2.1. Light Fidelity**

Light Fidelity or commonly called Li-Fi is a technology for wireless communication between devices using light to transmit data at high speed [4,5,6]. Currently only LED lights that can be used for the transmission of visible light. This provision was first introduced by Harald Haas in 2011 in the event the TED Global talk in Edinburgh. In terms of technical, Li-Fi is a communication systems visible light that is able to transmit data at a high speed through the visible light spectrum, ultraviolet, and infrared radiation [5,11].

Basically the technology is similar to Wi-Fi. The difference is that Wi-Fi uses radio frequency to transmit data. Using light to transmit data to make Li-Fi has some advantages such as the bandwidth is high, it functions in areas susceptible to electromagnetic interference such as an aircraft cabin and hospitals, as well as offers a transmission speed that is high again. The current Li-Fi technology is still actively developed by several organizations around the world.

Li-Fi has a data speed is many-fold compared with free Wi-Fi is caused due to a type of LED which is semiconductor has properties different from the kind of other lamps. With the nature and characteristics of this LED is able to switch on and off in a few nanoseconds, or billionths of a second.

Nanosecond this if converted in the speed of data equivalent to 1 Gbits/s. Therefore when Wi-Fi can only reach 100 Mbits/s data speed, then this means that the Li-Fi has a speed 10 times faster than Wi-Fi. Things that affect the Li-Fi itself in the speed of data transfer is: the Number of LEDS, the Size of the LED, and On-Off LED [27,28]. Here's the explanation:

#### **A. Number of LEDS**

The transfer speed can be improved by increasing the number of LEDS. Number of LED fit the available space inside the lamp. Number of LEDS that can be set, this will allow data transfer speed is comparable with the number of LEDS that are there.

#### **B. LED size**

Diversity on the speed of data transfer with the LED size is very important in the Li-Fi technology. firmness data transfer motley can be obtained with the LED size is different also. The size of the LED to normal can be scaled down to micro-LED, which resulted in millions of changes in light intensity. Light micro-LED can move to 3.5 Gbps and allow more data transfer speed of 10 Gbps. Micro-LED small allows the light is emitted in parallel and transfer data in large quantities in Gbps. Microchip LED can transfer data of up to 150 Mbps with a single lamp that provides connectivity and fast internet service. You could say that the speed of data transfer can beat the size of the LED.

#### **C. On-Off LED**

Change of state is on (On) off (Off) the LED light can make the data binary 1 and 0. For example 1 for the lights on and 0 for off light. Micro LED overcome millions of alternation in the seriousness of rays per second as well as more lightning turn On - Off, up to the transfer of information in a large amount with a huge speed. The turn On - Off the LED light on the speed

of very large so that the human eye can not see the changes. Micro LED capable of sending the transfer of information 1000 times more flash than on On - Off LED is reasonable, transfer of information in a large amount with a huge speed [5,26].

The Data transferred is a series of 1s and 0s. on the amount of data required time switch which is very slow. On-Off can be improved with OFDM (Orthogonal Frequency Division Multiplexing) which allows micro LED handle millions of changes in the intensity of light per second. Because this is the data transfer speed is directly proportional to the turn On-Off the LED [29].

## 2.2. The difference of Li-Fi with Wi-Fi

As described before, the abnormality of the most major between Li-Fi with Wi-Fi located on the usage of the object to convey the data. When Wi-Fi uses radio waves, then the Li-Fi uses light as a medium of sending data. In terms of care and cost required overall Li-Fi and Wi-Fi can issue the same cost. It is based on the durability of the device Wi-Fi is longer and the power or wattage on the lamp used in Li-Fi. When the device is Wi-Fi the new replaced if damaged good that the friction on the cord or so, then different for Li-Fi because the LED lights he used have a watt is limited so that the LED lamp must be replaced periodically. In addition Wi-Fi devices tend to be more expensive than Li-Fi so as to make both of these devices have the same position in terms of care and cost. But in terms of functionality of Li-Fi is superior to Wi-Fi in some aspects, the following advantages and disadvantages of Li-Fi [5,25]:

### a. The Advantages of Li-Fi

Li-Fi has several advantages compared to Wi-Fi, which is :

- In terms of data transfer speed, LiFi is clearly faster than the technologies that exist today, such as Wireless. For comparison, up until now, the highest speed that can be captured Wireless up to 7 GBps.
- While LiFi, because it relies on the speed of light, LiFi able to record the transfer speed reaches 100 Gbps.
- To use it, we don't need many tools or additional cables. We just need the LED as a means to transfer the data.
- Because of not using a cable and not within the reach of radio waves, the technology is believed to be able to reduce the electromagnetic pollution generated by the Wireless.
- This technology cannot penetrate walls, that's why, LiFi safe from hacker attacks.
- This technology can also be applied in remote areas not reached by the optical cable.

### b. The weakness Of Li-Fi

In spite of the various advantages offered by the Li-Fi, the technology itself still has weakness, some are:

- Although the 'base station', or can be attached on the ceiling of the room, this technology still requires direct line of sight or view directly to the objective gadget.
- In contrast to radio waves, light used Li-Fi could not penetrate the walls. So, to enjoy it, we can only surf in the virtual world while still being in one room with this technology. Make this technology becomes practical.

## 3.0 METHODOLOGY

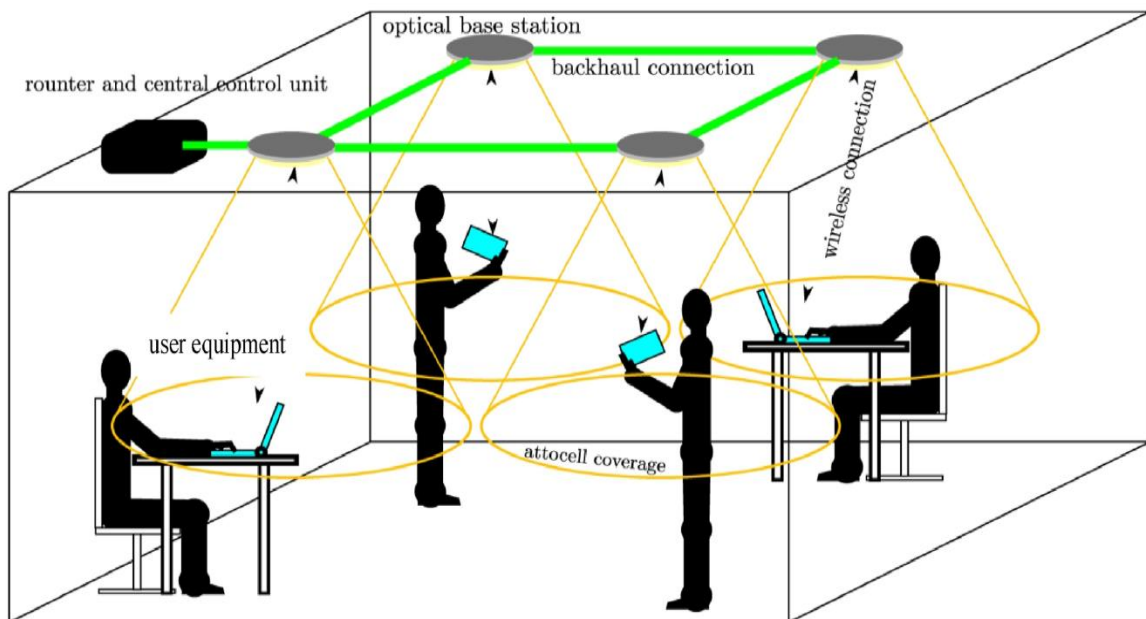
Data such as audio, video, web, and application information sent from the server on the local network or the internet in the form of binary. This is called streaming. Before the data is forwarded to the LED lights, there are components of the lamp driver as a controller consisting of:

1. PCB (Printed Circuit Board), tasked with control of the input and output power of the lamp and the microcontroller of the house that is used to manage the functions of the different lights.
2. PAC (Power Amplifier Circuit), is tasked with generating a radio frequency signal that guides the flow of data to the electric field around the Bulb.
3. Bulb, a bulb that is implanted dielectric material to guide the waves of radio frequency energy emitted by the PAC and as a material concentrator electric field that focuses on the energy in the Bulb.

4. The Enclosure is a box made of aluminum that protects the PCB, PAC, and Bulb in one package. Aluminum is the introduction of electricity and light for the use of long-distance electrical transmission.

When the Bulb emits a constant current to the LED bulb with a very high speed, a constant stream of photons are emitted from the lamp is observed as VLC. To detect the flow of data on the intensity of the light high-speed necessary a component of the detection photos (photo detector). This component also serves to change the flow of the data in light intensity (amplitude) to the signal electric current.

Unit amplification and signal processing (amplification and signal processing) in charge of changing the flow of data in the form of binary data to be original as audio, video, web, and application information which is then transmitted to a computer or mobile device. The function of detection of the photo and signal processing packed in a device called the receiver dongle. A computer must have LED infrared to be able to communicate in the channels of the uplink of the [6]. The following illustration of the workings of Li-Fi in a room:



**Figure 1.** The concept of LiFi attocell networks applied to indoor wireless networking [15]

#### 4.0 RESULTANTS AND DISCUSSION

In the school Library there are tables that can be used by students to do the activity. Some among the tables, there is a chandelier that is attached right on it. With the presence of the lamp allows for the installation of Li-Fi technology. Not only on the lamp-hanging lamp, the installation can also be done on the lights in the ceiling of the library so as to maximize the flow of the internet connection of the li-fi.



**Figure 2.** Illustration of a Library school

Even though the Wi-Fi technology is very potential, Li-Fi has weaknesses compared to a conventional Wi-Fi. Although implemented through a kind of a base station attached to the

ceiling of the room, a lifi requires a direct line of a sight directly to the destination device which is equipped with a special receiver. The Wi-Fi facilities at SMAN 23 tangerang district are already available with a limited capacity. It is hoped that by implementing a lifi in schools it can help and increase internet connection access, it can reduce the burden on school fees because it can optimize the use of lights not only for a lighting but also for data communication or the internet. For the implementation stage, we need a server, a lamp driver, a led lamp, Li-Fi dongle, and the device you want to connect to.



Figure 3. Implementation of device Life

After all devices are available then we need to connect the server with the internet, after that connect the server with lamp driver, next connect the lamp driver with each of the LED Lamp to be installed. Then to be able to access the Li-Fi we have to install the Li-Fi dongle on every device you want to connect. Li-Fi dongle this function to receive the data and distribute it on the device. For more details, here's an overview of the architecture:

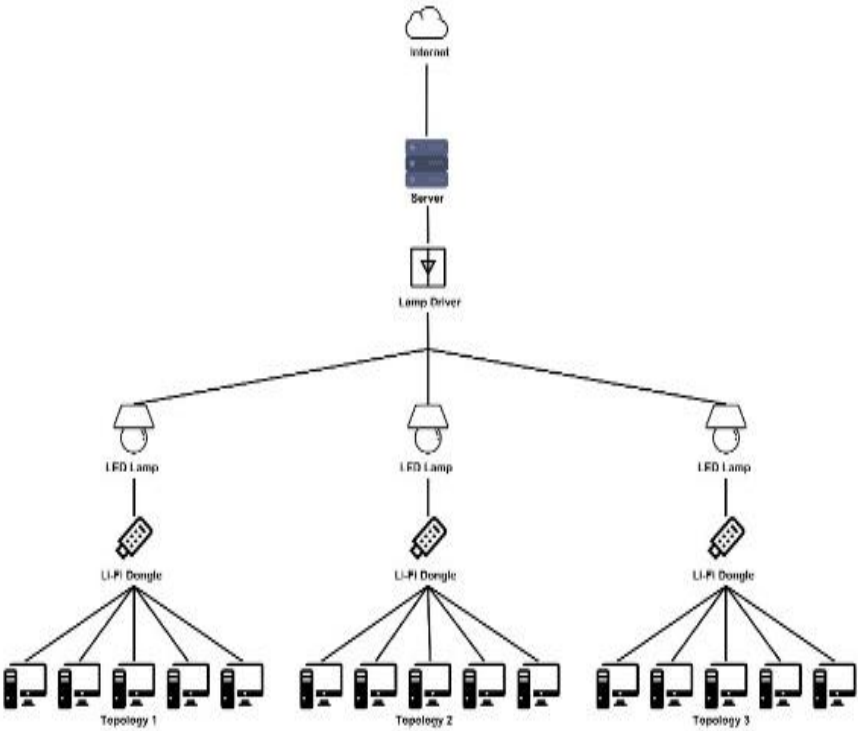


Figure 4. Li-fi architecture in the library



In its implementation, the Li-fi System or Visible Light Communications (VLC) will accommodate photo detectors to receive light signals and signal processing elements to convert data into 'streamable' content. The LED bulb is a semiconductor light source, which means that the constant current supplied to the LED bulb can be adjusted in such a way, up and down at a very high speed, without being seen by the human eye. For example, data is fed into an LED light bulb with signal processing technology, then transmits the data embedded in the light beam at high speed to a photo detector. Small changes in the fast dimming of the LED lamp are then converted by the receiver into an electrical signal. The signal is then converted back into a binary data stream that we will recognize as web, video and audio applications that can run on devices that can communicate via wireless internet network connectivity. The results of the application of Li-Fi are expected to help and increase internet connection access, reduce the burden of school fees because it can optimize the use of lights not only for lighting but also for data communication or the internet. In addition, Li-Fi is able to reduce electromagnetic pollution caused by radio waves by WiFi.

## 5.0 CONCLUSION

### 5.1. Conclusion

The concept of light to transmit data is an alternative that is very brilliant. In addition to improving the quality of data transfer speed, Li-Fi is more secure from hackers because of its spreading data into places that are only illuminated by the light of LED lights. Nevertheless, Li-Fi technology is still fairly new and still in the development stage, even to the availability of the installation still does not exist in Indonesia. It is therefore likely in the near future we will still be difficulties to be able to feel the technology. But we can still experiment to make Li-Fi technology, There are tutorials scattered on the internet for creating simplified versions of the technology. There fore do not rule out the possibility of a little experiment that we can also participate in the development of Li-Fi technology and publish it to all regions in Indonesia can feel the impact. Given that Li-Fi can even be placed in areas not covered by the free Wi-Fi, then we can participate and increase the quality of life of the citizens of Indonesia and advance this country is more advanced.

### 5.2. Suggestion

Although it has a long durability, power or watt a lamp remains limited. There fore for the sake of smoothness and speed of access to a stable internet, a manager must periodically replace the lamp attached and make sure when the right time to replace it. In addition, to maximize the quality of Li-Fi itself we need to remember that the size and number of LED lights can be very large effect. It is therefore recommended to install the LED lights that have the size and number of which is proportional to the places that we want to attach with this technology.

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