

**TERM PAPER (FINAL DRAFT)**

***Would Li-Fi Take The Internet Of Things To A New Level?***

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**SECTION 30**

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**1.0 INTRODUCTION**

Light Fidelity (Li-Fi) is the use of the visible light portion of the electromagnetic spectrum to transmit information at very high speeds. This is in contrast to established form of wireless communication such as Wi-Fi which use traditional radio frequency to transmit data. The term Li-Fi was discovered by Harald Haas during a TED Global chat on the topic Visible Light Communication. Hass envisioned light bulbs that could act as wireless router.

Internet of Things (IoT) is a concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). This includes everything from cellphones, laptops, coffee makers, washing machines, headphones, lamps and wearable devices. It can enable an exchange of data never available before and bring users information in a more secure way. Cisco estimates the IoT will consist of 50 billion devices connected to the Internet by year 2020.

Li-Fi works by transmitting data electromagnetically using visible light medium. Information is passed through and light emitting diodes (LED), a semi-conductor light source. This means that the constant current of electricity supplied to an LED light bulb can be dipped and dimmed, up and down at extremely high speeds, without being visible to human eye.

According to Tsonev, Videv, and Haas (2014) over the past decade, tremendous research has been done especially in the field of electromagnetic spectrum that potentially offload a large portion of the network traffic from the overcrowded RF domain. This shows that Li-Fi is the forthcoming and on developing technology that can be implemented in many fields that could not be achieved with Wi-Fi before. Many constraints exist in current internet connection, Wi-Fi, which led to a high user’s demand for a faster internet connection that can be solved through Li-Fi which can transfer data faster, more secure, more reliable, wider coverage and with a cheaper cost. .

**2.0 CAUSE THAT LEAD TO Li-Fi DEVELOPMENT**

Wi-Fi comes with many disadvantages compared to Li-Fi. In the world of medical technology, Wi-Fi are left out because most medical apparatus could not be disrupted by radio wave otherwise it could harm other people life. In hospital building, there are only certain area that has access for Wi-Fi connection such as lobby and patient ward. For example, if medical lifesaving machine reading is interrupt, it can cause life threatening issues to bedridden patient that depend on medical machine. According to Dutta et.al (2013), in the wireless world, medical technology has been left out. Due to radiation concerns and a lacked of dedicated spectrum, operating rooms in hospital does not allow any Wi-Fi enable devices (p.8).

Security is a major concern when discussion about Wi-Fi. Due to its nature of using radio waves, these waves naturally have the power to propagate in all directions and in a relatively wide range. This means it is difficult to limit and control the waves so that it can be confined to a limited area. Kajal, Gupta, and Saini (2014) pointed out that radio waves can penetrate through walls so they are less secure (p.14). Hackers with bad intention can easily access the Wi-Fi Signal and hack into it to steal information.

In addition, Wi-Fi are not recommended to be used in aircraft. Safety of passenger in an aircraft is a huge concern because Wi-Fi contains RF waves that can disrupt the radio connection of the pilot. Sharma, Raunak, and Sanganal (2014), stated that using mobile phones at places like petrochemical plants and petrol pumps, and in aircraft is not recommended (p.153).

Next, upgrading and installing Wi-Fi required more advanced equipment. Simple and basic router only support bandwidth up to certain speed(Mbps) and number of user limited to the router configuration. Wider coverage also need advanced router that can support dual link signal to increase the range of the radio waves. Due to high radio frequency interference, Wi-Fi router are not recommended to be placed closely, thus placing the router and switch across a bigger platform will required more cable and longer time to install. Elbasher, Mustafa, and Osman (2014) expressed that the “Wi-Fi technology is characterized by its mobility and flexibility besides its acceptable coverage area, however Wi-Fi is expensive, prone to interference (noise), and is characterized with low reliability” (p.3).

Moreover, Wi-Fi uses router to send and receive data from the devices and the internet. As stated above, router has a finite number of bandwidth and user access. If there are a lot of people connected to the internet via a router, the bandwidth will be consumed. For example, if the bandwidth for a router is limited to 100 Megabytes per second (Mbps) and there are ten devices connected to the router, the bandwidth will be divided equally to each devices that is 10Mbps. Hossain et.al (2014) explained that mobile devices consume a lot of data and the router soon will run out of radio-frequency bandwidth (p.805).

**3.0 BAD EFFECTS OF Wi-Fi**

Wi-Fi also has bad effects that contribute to the advance research of Li-Fi. Nowadays, Wi-Fi are widely used in hospital for patients, nurses, and doctors to ease the communication between them. These radio waves that are emitted from Wi-Fi enable devices and routers are risky. It could interfere with dialysis machines, defibrillators, and ventilators. Karthika & Balakrishnan (2015) expressed that monitoring equipment in hospital such as heart rate monitor and MRI scanner are sensitive to radio waves. Interference from cell phones and computer that emits Wi-Fi signal can alter the reading of the monitoring equipment. The patient’s health may be affected by the radio waves (p.38). This effects are vital is there are bedridden patient’s life depends on the machine.

Next, Wi-Fi did not fully provide a secured connection. Although there are securing protocol implemented in Wi-Fi such as WEP and WEP2, the signal can still be accessed by everyone that is within the signal transmitted range. Someone with the right tools and knowledge can hack their way into the network. There are two famous method to crack a Wi-Fi network that is BackTrack and Reaver. Sharma, Raunak, and Sanganal (2014) stated that the major security concern of Wi-Fi is that the radio waves emitted can pass through walls and they can be intercepted. If there are someone that has a bad intention, they may exploit it (p.153). Once a hacker found its way into the network, it can intercept all the network traffic causing a leakage of important or confidential information.

As technology advances, more people will own a gadget that have a Wi-Fi signal such as cell phone, camera and laptop. When there are high demand in Wi-Fi connectivity, the router needs to be upgraded to increase efficiency and reliability. Higher efficiency means faster connection speed and speed of the network are one of the most important factor in network connection. Rate of data transfer will reduced as more and more user connected to the network thus make the network unreliable. So when people with their many gadgets access wireless internet, clogged airwaves are going to make it increasingly difficult to latch onto a reliable signal (Dutta et.al, 2013).

Implementing Wi-Fi connection is not easy and required a lot of time and cost. If the user are five to ten people, the installation is easy. If it involves a lot of people, for example at seminar hall, or at a library or cafeteria, it will require huge amount of resources. Higher number of user will required advanced router and switch and the cost for a high end router is expensive. For example, Cisco Aironet 3700 Access Point with Controller cost around 6000$. According to Gerhardt et.al (2012), due to a high cost of Wi-Fi deployment and maintenance caused by the inadequacy backhaul and hanging rights, internet service providers limit their Wi-Fi investment by building and operating the service on traditional mobile network (p.5). Network backhaul means the process of getting data to the network backbone such as a satellite. Internet service provider only provide internet via traditional mobile network that are 3G and 4G connection as the cost of installation of Wi-Fi is expensive.

**4.0 SOLUTIONS BY USING Li-Fi**

Li-Fi only uses light waves. Its limitation is that light can only travel through air and will stop when there are obstacle like walls. Unlike radio waves that are transmitted in all direction, Li-Fi are transmitted only in one direction. This function enables the signal to be controlled easily to prevent any unnecessary access to the network. Robyn (2013), mentioned that visible-light waves cannot penetrate through walls so that the transmission range is shortened and the information is confined within the wall. However, this feature makes Li-Fi more secure from hacking. In this way, energy harvest sensors could easily deliver environmental parameters quickly for control purposes. Sharma, Raunak and Sanganal (2014)also mentioned that light waves can‘t be intercepted and misused because it cannot penetrate through walls (p.153). For example, if the network provider only want to provide access to certain area such as seminar hall, they can use Li-Fi as light waves transmitted will not penetrate through wall. When the signal are confined to one particular space, anyone who are not in the area cannot access the network thus make the network more secure.

In medical technology, Li-Fi can be widely use. Medical equipments at the hospital will not be affected by radio waves interference anymore. Karthika and Balakrishnan (2015) expressed that radio waves aren’t used by Li-Fi. So, the place where Wi-Fi, Bluetooth and infrared are banned, Li-Fi can be easily used. Chauhan and Kulai (2015) also state that, potential market of Li-Fi in healthcare is that it can be used by patient in hospital to communicate with visitors and can be used to track movement of medical equipment such as wheelchair for related patient that need to use the wheelchair. This can help healthcare practitioner save time and can effectively help them to provide their best services.

Congested network traffic caused by too many access over the Wi-Fi connection are not a problem as Li-Fi does not use any radio waves. Light waves differ from radio waves as light waves can support many user without congesting the network traffic. Hossain et.al (2014) stated that “Li-Fi could free up bandwidth, especially as much of the infrastructure is already in place” (p.805). When there are too many devices connected to a Wi-Fi router, network will be throttled as a router can only support limited number of devices. Once the router reach its limit, other devices cannot connect to the network. Li-Fi solve this problem because it uses light that can support as many user as it can. The only limitation is if the network provider limit the number of devices that can connect to the network.

Unlike Wi-Fi, Li-fi does not need an expensive router or switch to implement. Light-emitting diode (LED) can be found in car brake lights, traffic and street lights, remote control units and countless other applications. Moreover, Li-Fi connection only required a small board to be installed next to the LED light. This will save up a lot of time and cost as installing the board will be easy and there are numerous LED available nowadays. Elbasher, Mustafa and Osman (2014)said that Li-Fi is represented by low cost, and is more suitable when a connection between point to-point is required (p.3).

**5.0 CONCLUSION**

In a nutshell, Li-Fi provided a lot of advantages compared to Wi-Fi. Li-Fi can solve congested spectrum issue, improved network security, reduce cost of implementation and improved connection in medical field. The Internet of Things will be improved with Li-Fi as this technology show huge and bright possibilities. Imagine the world where data transfer are very fast that it only take seconds to download a movie from the internet, communication in hospital are efficient and people don’t have to worry about privacy and security when transferring data .

As we already know even though Li-Fi is a rising innovation and yet it still has limit potential for the moment. As of now, a considerable measure of researchers are included in broad exploration in this field. Li-Fi has solved the problem that raised from Wi-Fi to fulfill users demand with faster data transfer, more secure, more reliable, wider coverage connection and with cheaper cost. Li-Fi technology has shown lots of improvements since it has discovered. Thus, the future scope of this brilliant technology with some developments could improve the people life in near future.

**6.0 REFERENCES**

Chauchan, M. & Kulai, A. (2015). Li-Fi – Let There Be Light. *International Journal of Engineering Trends and Technology (IJETT)*, 28(4).

Dutta, S., Sharma, K., Gupta, N., & Bodh, L. (2013). Li-Fi (Light Fidelity)- A New Paradigm in Wireless Communication. *International Journal of Innovative Research in Computer and Communication Engineering*, 1(8), .

Elbasher, S., M., Mustafa, B., & Osman, A. (2015). A Comparison between Li-Fi, Wi-Fi, and Ethernet Standards. *International Journal of Science and Research (IJSR)*, 4(12), 3.

Gerhardt, W, Medcalf, R & Taylor, S., Touli, A. (2012). Profiting from the Rise of Wi-Fi New, Innovative Business Models for Service Providers. *Cisco Internet Business Solutions Group*, 1(7), .

Hossain, S., Islam, S., Abadin, Z., & Hossain, A. (2014). Methodology to Achieve Enhanced Data Transmission Rate using Li-Fi in VLC Technology. *International Journal of Engineering Research*, 3(12),.

Kajal, Gupta, K. & Saini, A. (2014). INTERNATONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY. *FIR Filter Design using Different Window Techniques*, 1(5),.

Karthika, R & Balakrishnan, S. (2015). Wireless Communication using Li-Fi Technology. *SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE)*, 2(3), 38.

Robyn, W., The internet on beams of LED light, The Science Show, 7 December 2013.

Sharma, R., R., Raunak, Sanganal, A.(2014). Li-Fi Technology Transmission of data through light. *International Journal Of Computer Technology and Applications*, 5 (1), 150-154, .

Tsonev, D., Videv, S., & Haas, H. (2013). Light fidelity (Li-Fi): towards all-optical networking. In B. B. Dingel, & K. Tsukamoto (Eds.), Proc. SPIE 9007, Broadband Access Communication Technologies VIII. [900702] (Proceedings of SPIE; Vol. 9007). BELLINGHAM: SPIE. [10.1117/12.2044649](http://dx.doi.org/10.1117/12.2044649).