Li-Fi: Light Fidelity

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Introduction

Light Fidelity is a light-based technology. The term "Li-Fi" was coined by its inventor, Dr. Harald Haas of the University of Edinburg, in 2011 during a TED talk to promote and market this new technology (Li-fi information, n.d.). With Li-Fi, data is transmitted electromagnetically using visible light waves (Mercer, 2017). With small modifications, Li-Fi employs a resource already in homes and businesses: the light bulb. Light Emitting Diode (LED) light bulbs are outfitted with a chip that modulates the intensity of the light signal. A photo-sensitive detector then converts the binary data of the light pulses into electronic form to be used in our devices (Grossman et al., 2011).

Li-Fi was featured as one of Time Magazine's top inventions in 2011. In "The 50 Best Inventions, " Grossman et al. (2011) warn that the continued growth of mobile phone use will exhaust the current radio frequencies used for cellular and wireless networks. With ten thousand times the frequency spectrum of radio, the capacity to handle this growth is just one of the advantages of Li-Fi (Rouse, n.d.). Also cited by Rouse, are the advantages of higher speeds, data security, and lack of interference with other sensitive electronics or danger to humans. This pronouncement by Time was a "Technology Trigger" in the Gartner Hype Cycle (Parsons, 2016, p. 522), triggering publicity and speculation about potential products and applications that would use this new technology.

Nevertheless, the current technology used in local and wide area networks (LAN and WAN, whether wireless (Wi-Fi), wired, or Bluetooth, has the advantage of being a legacy industry (Parsons, 2016, p. 523). The information industry is one of the world's largest economic sectors (Parsons, 2016, p. 516), and "wireless communications has become a utility like electricity and water" (Morra, 2016). New technology, like Li-Fi, is beneficial for

businesses when it produces cost saving, improves service, saves time, and increases productivity. It can be detrimental if it sweeps away effective processes and tries to replace proven technologies with substitute processes that are unsustainable (Parsons, 2016, p. 523).

What is Li-Fi

Using light instead of radio waves, light fidelity technology uses LED lamps to transmit and receive information. LED light bulbs are outfitted with a chip that modulates the intensity of the light signal. The optical current is used in the traditional binary operational procedure: if the current flows, the light is on, a binary 1; if the current is off, so is the light, a binary 0 (Saini, 2016, p. 13). A photo-sensitive detector then converts the binary data of the light pulses into electronic form to be used in our devices. The human eye cannot perceive the miniscule change in light intensity (Grossman et al., 2011). Li-Fi's developmental models are capable of 150 Mbps. Some commercial kits enabling that speed have been released. (Rouse, n.d.). Researchers have created Li-Fi networks with download speeds over 200 Gbps (Morra, 2016).

Companies who are developing applications for Li-Fi are capitalizing on the "Technology Trigger" and "Peak of Inflated Expectations" in the Gartner Hype Cycle (Parsons, 2016, p. 522). Their research and the applications can be analyzed as a starting point with an eye toward resolving problems Li-Fi faces and improvements that can be made. First, companies are developing kits to building Li-Fi into devices so early innovators can modify their computer equipment to use Li-Fi technology. A lighting company, ByteLight, is building systems for supermarket and retail store applications using visible light communication (Morra, 2016). This competitive consumer market wants to be able to allow customers to use smartphone apps to find products. Other lighting companies are investigating technology to help build smart cities

where each street lamp can be used as a free data access point, and to use Internet lighting systems for offices, hospitals, and smart buildings (Morra, 2016).

Li-Fi Advantages

As the use of cell phones, tablet, and other devices in the Internet of Things (IoT) explodes, radio frequencies used for wi-fi and cellular networks are running out. With ten thousand times the frequency spectrum of radio, the capacity for growth is just one of the advantages of Li-Fi (Rouse, n.d.). Also cited by Rouse, is the advantage of higher speeds. The number of users does not affect the speed of a system transmitting data via Li-Fi. When the number of internet users increases, the decrease in network speed is proportional (Mallick, 2016). Since a device has to be in direct visual range of the light, data security is enhanced with Li-Fi. Wi-Fi usage in hospitals, airplanes, and airports is restricted because of the interference with other sensitive electronics and the concerns over radiation (Saini, 2016). Li-Fi could be used in these settings since it does not compromise the effectiveness of other electronics; and light is safe for the human body, so the concerns of cell mutation are mitigated (Saini, 2016).

Li-Fi Disadvantages

Li-Fi is a great solution to internet connectivity issues – where you no longer need to be within a certain distance, all you need is to be in a light. But there lies a problem within the solution itself – and that is the fact that Li-Fi can only function with a light source. Without any electricity, there is no light. When there is no light, there is no Li-Fi. Whenever a power outage may occur, all devices in the household would be unable to connect to any service.

Another issue that may arise with Li-Fi is how light cannot pass through opaque objects. When an object blocks the light, it will block the ability to receive any connection. A momentary window of any solid object passing through the light source could cut off the connection, or whenever the lights begin to flicker on and off. This is a huge inconvenience, especially in situations such as when you needed to send an urgent email or save an important file from off the web, which now is lost due to the sudden cut from connection. Though this may sound silly and trivial, there will always be a case-to-case situation where this will most definitely occur.

Settling in with the last problem: the costs of Li-Fi. The installation of Li-Fi is quite hefty (Mallick, 2016) and may present a barrier to use for the middle-class and lower-class parts of any country (the middle-class makes up the majority of any population). The price for installing Li-Fi just does not seem worth the expense just to get internet connection with lights. Considering all financial circumstances, Li-Fi just does not seem to be worth using for anyone within the middle to lower class. Installation is not just pricey (Mallick, 2016), it is the ability to pay for the monthly electric bill. Because the lights will have to be left on for a prolonged length of time, the bulbs' lifespan would be reach more quickly. The electricity bill will be much higher than you would pay when using regular wi-fi.

Applications

There are many companies that have already started the trend of using Li-Fi. One of these famous companies include OLEDCOMM. It is a French firm that manufactures routers that have Li-Fi technology, which is a major key towards the LED lighting systems. The company has

claimed that they are far more advanced than any other firm in the Li-Fi technology field. They offer several services on their Li-Fi LED drivers (FN Division TEC, 2017).

One of their offers include GEO Li-Fi, an indoor location-based service. It has been remarked to have an extremely efficient LED driver; when connected to an IPS (Indoor Positioning System) it shall work as a Li-Fi broadcasting system (FN Division TEC, 2017). This can be quite useful for locating objects around the area.

Compare Li-Fi with Wi-Fi & Bluetooth

Today, much of our wireless technology for data transmission is provided by Wireless Fidelity (Wi-Fi) and Bluetooth. Both of these technologies use radio signal waves. The speed of data transfer is for Wi-Fi and Bluetooth is 54 Mbps and 1 Mbps, respectfully (Mallick, 2016). There are a limited number of frequencies that can be used and limited bandwidth (Mallick, 2016). The signal range of Wi-Fi depends on the frequency band, the power output, and the modulation techniques, is generally ten to one hundred meters. The range for Bluetooth is much smaller, usually around ten meters (Mallick, 2016). As radio signal waves can be intercepted and misused, the security of data travelling over of Wi-Fi and Bluetooth can be compromised. Another thing in the operation of Li-Fi is the similar technology is operated by transmission and reception of radio signals. Li-Fi is also operated by frequently flickering LED bulbs for the data transmission all coming together to make up Gi-Fi technology that uses milimetre waves to transmit data over the air (Mallick, 2016).

Conclusion

In conclusion, Li-Fi will play a major role in the future of data sharing and communications. It will be a disruptive technology if the infrastructure of smart cities and office buildings is realized. Innovative businesses who invest in this optical wireless networking technology that uses light-emitting diodes (LED) for data transmission will gain a competitive edge in speed and volume of data that can be processed. By using LED lights bulbs similar to those currently in use, especially in energy-conscious homes and offices, this technology may have the unintended benefit of energy conservation as businesses convert their space to high efficiency LED lighting. Li-Fi may solve the issues with the shortage of radio-frequency bandwidth and also allow internet where traditional radio-based wireless is not allowed such as aircraft or hospitals (Saini, 2016). Even with all these benefits, Li-Fi is not likely to push Wi-Fi into obsolescence. Wi-Fi's strength of range of radio wave signal will insure its continued used. H. Haas, inventor of Li-Fi says, "Merging light bulbs and wireless communications is not about displacing older technologies but about recognizing the role of wireless technology in our lives" (Morra, 2016).

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