

HOW LI-FI WILL IMPROVE THE RELIABILITY OF INTERNET OF THINGS: A REVIEW

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Abstract - Light fidelity (Li-Fi) is a new technology that applies light as a medium and offers a speed that is higher than the current wi-fi that we have. Li-Fi uses light as transmitters. Internet of Things (IoT) is a ubiquitous network where objects (things) are connected together to share data among them. In IOT, devices have to connect instantly to carry out their tasks efficiently. To achieve this, a very wide bandwidth is required because any delay would make people's lives at risk. This paper is subdivided into 3 parts. First, we will examine how Li-Fi works and its requirements, Second, We will look at what requires IoT to accomplish its work, and finally discuss on how Li-Fi would improve the behavior of IoT.

Key Words: Li-Fi, IoT, Wi-Fi

1. INTRODUCTION

With the increase of technology nowadays, the number of things that require connecting together increases day by day. By the year 2020, the number of things will escalate up to 20 billion which will require a very high bandwidth to withstand them. The current Wi-Fi transmissions of mass quantities of data are putting a strain on the current technologies. By the year 2019, Up to ten billion mobile devices will exchange data and that's just mobile devices. We can imagine how tremendous it would be if, big data servers and IoT devices were involved. It would be a tremendous load for the internet service providers (ISP) to satisfy the needs of different subscribers. This gives us a clear view on how the current speed of data would not suffice in coming 5 years. Li-Fi was proposed to provide a very wide bandwidth compared to what radio waves provide now. There are various challenges of how Li-Fi would be implemented in the indoor and outdoor environment. Wi-Fi is an incredible resource, but it is still limited, and as connectivity spreads, both across the world and throughout the Internet of Things, problems will arise if Wi-Fi is our only option. Li-Fi devices work so well because they attempt to transmit not one data stream, but thousands of data streams in parallel, at higher speeds. You're all trying to share a limited resource: the radio spectrum. Think of it as a lake and there are as many people as possible trying to get as much water as possible. [11] The current Wi-Fi has security and propagation mechanisms issues and its characteristics keep adding additional loss.

2. LI-FI

Li-Fi can be considered as a Wi-Fi which uses light. That is, light is used in lieu of electromagnetic waves to broadcast data and instead of Wi-Fi routers, Li-Fi would use lamps as transmitters that can light a hall and simultaneously transmit and receive information (figure 2). Since light bulbs are simple and can be used almost anywhere, it is feasible to have a high number of access points [9].

Li-Fi differs from Wi-Fi in the type of modulation that is used. For Li-Fi, direct modulation is used avoiding the addition of extra components like intermediate frequencies as done in radio frequency systems.

Li-Fi is a category of Visible Light Communication; an LED light flickers at speeds undetectable to the naked eye to transmit data. In fact, it's been demonstrated that information can be transmitted at as much as 224 gigabits per second [10], the equivalent of 18 movies of 1.5 GB each being downloaded every single second in lab conditions. In an office setting, speeds up to 100 times faster than average Wi-Fi speeds were achieved. The LED lights require so little energy; they can be powered by a standard Ethernet cord. It was suggested by Harald Haas who invented Li-Fi that the smart light bulbs could be energized by cell based charging batteries. In addition, Li-Fi does not cause harm to humans, unlike Wi-Fi that uses electromagnetic waves which cause interference, meaning it could have important applications in sensitive locations like healthcare facilities.

A light node can send in real-time the magic world of the very far deep underwater and underground. Light nodes enable divers to readily communicate among themselves and with dolphins and other protected sea life.

A light node can send data about petrol reservoirs and nuclear reactors from some kilometers deep. A Li-Fi node can be embedded in security access cards to allow persons to access secured gates/areas.

Astronauts can share information using light node that makes it possible in free space gravity through light and sends data to outer Li-Fi nodes which in turn send it to earth through satellites networks in a reliable and secure manner.

While the light enables eyes to see in the dark, the Li-Fi node uses the light to enable internet users to communicate anytime anywhere in a secure and energy efficient way than

ever before. Li-Fi communication and networking technology is, therefore, a true candidate of the Internet of Things and ubiquitous communications.

3. INTERNET OF THINGS

Internet of Things (IoT) is a Ubiquitous network in which all things in a network are connected together remotely using sensors in order to share data. [1]

There are three basic important requirements of IoT; Sensing data, Processing, and connectivity. All these requirements provide obstacles to implementing IoT in future by challenging us by several issues related to the huge number of devices and huge data transferred in the world.

The challenges of IoT-devices can simply be clarified as follows [1]:

Signaling:

A reliable bidirectional signaling is very important with IoT connected devices to make the routing data easy. Data needs to be shared between point A and point B in a fast, secure and reliable way.

Security

Security is a very important factor in IoT's connectivity. When sending or receiving a stream of data, it is essential to make sure that the IoT device or server has a correct authorization to send or receive the data. Open ports: An IoT device is dangerously defenseless when it's about an open port out to the Internet. Therefore, an end to end encryption between IoT devices is needed.

Omnipresent Detection

It is the ability to know immediately when an IoT device drops off or connects to the network. Omnipresent detection gives an exact state of all devices connected to a network. This gives the ability to monitor IoT devices and fixes any problems that may arise within the network.

Power consumption

Sending data among IoT Devices takes a toll on power and CPU consumption. With all this, communication needs an efficient cellular system using HetNet 4G or 5G as a long battery life, and also a smart sensor built in IoT device.

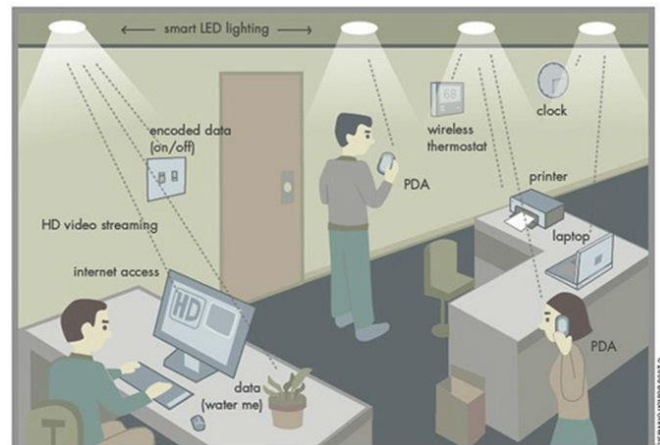


Fig-1 Li-Fi environment

Bandwidth

As expected in future, billions of IoT devices are connected to the network, so the bandwidth consumption is another challenge for IoT connectivity. Bandwidth on a cellular network is expensive.

As foreseen, billions of IoT devices are to be connected to the network, so the bandwidth consumption is brought into question for IoT connectivity. Bandwidth on a cellular network is expensive.

IOT is not to be thought as Machine to machine (M2M) communication but they are different (figure 3).

3. LI-FI IN IOT

There are, by all means, drawbacks. In the very sunny day, the receivers wouldn't be able to differentiate the signal, and unlike Wi-Fi, Li-Fi signal cannot pass through walls.

Of course, these constraints could be overmastered with technologies like smart architecture where the light follows the user around the space. Algorithms will determine lighting and access to data more and more.

Lights do not create an electromagnetic reaction like the way Wi-Fi does. This emphasizes that it could have applications in medicine, healthcare, and life sciences.

The idea that Li-Fi cannot penetrate through walls results in a more secure data stream; users must be physically in the space in order to access the data but some consider this as a drawback because two people in the same house in different rooms cannot access same data.

Li-Fi uses direct modulation, unlike RF systems. Besides, it uses cheap components such as LEDs and photodetectors. It is, hence, possible to create cheap and tiny transceivers that enable any LED light to behave as a high-speed data transmitter (figure 1).

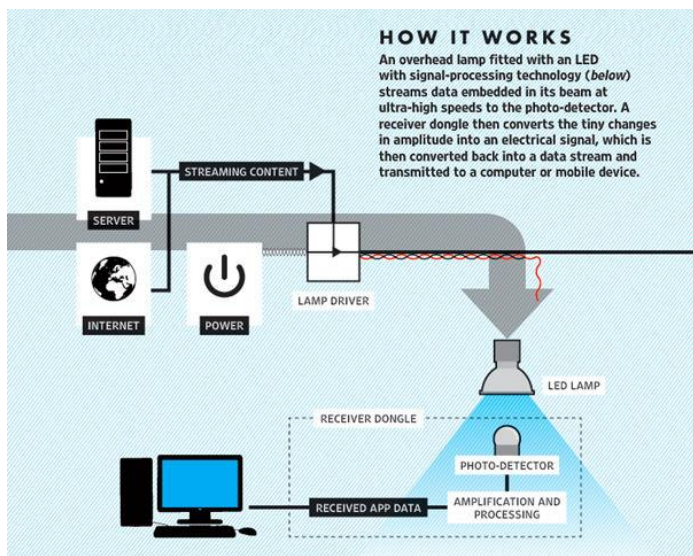


Fig -2: How li-fi works

IoT would fit well and well in Li-Fi and be enabled by it. IoT needs multiple access points and this is easily done in Li-Fi since simple light bulbs are used and these can technically be any number of access points.

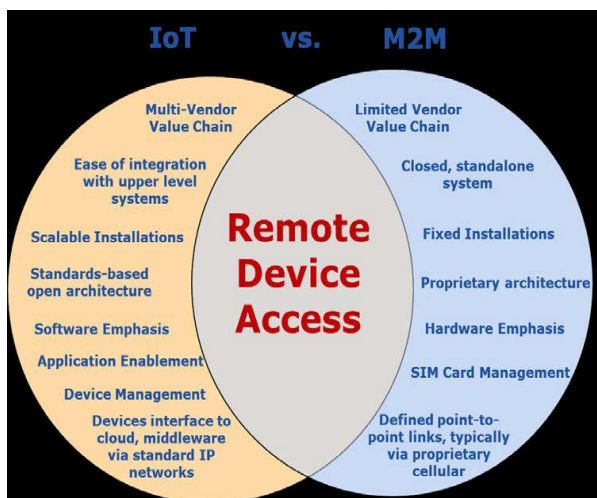


Fig-3: IOT Vs M2M

Li-Fi would improve IoT to becoming a ubiquitous network because it could be installed anywhere users might like light and data services: bus shelters, train stations, street lights, tourist information kiosks could all provide data transmission as well as light (figure 4).

IoT can be enabled by Li-Fi in indoor communication for it has a small range of coverage compared to Wi-Fi. [2]

Undersea, things connected to above sea level, will continue connectivity because light reaches undersea.



Fig- 4: LEDs in Cars Communicating via the Li-Fi Lighting Network

4. CONCLUSION

As this paper has demonstrated, Li-Fi is a promising technology that can be used to provide affordable wireless technology access to unreachable areas, where light can reach. The throughput set to be achieved by Li-Fi technology shows that Li-Fi is the perfect tool in IoT networks as it (Li-Fi) offers higher speed compared to convention Wi-Fi.

Though it offers high-speed, IoT systems are not constraints exempt, some challenges arise such as security, signaling and omnipresent detection. With Li-Fi, IoT systems can overcome signaling and security related challenges and with a proper monitoring of IoT systems connected over LiFi, the omnipresent detection can be tackled. The features of not passing through walls, less radiation, and the possibility of having a good number of access points make Li-Fi suitable for IoT.

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