Li-Fi Technology in Wireless Communication

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Abstract:

Li-Fi or optical Wi-Fi ,Li-Fi Technology is the another milestone in the history of Wireless Communication, This technology comes to be ten times cheaper than the Wi-Fi and also much safer , because regardless of access control systems and passwords. In Li-Fi, light pulses cannot penetrate on walls. The electric light does not disturb or interfere with communication, without taking the frequency bands. The light sources are providing you internet access at very high speed. Yes, Li-Fi technology transmits data wirelessly in the use of LED. Then it would be the best optimum solution over Wi-Fi technology, Li-Fi technology was first demonstrated by Harald Hass, a German Physicist.

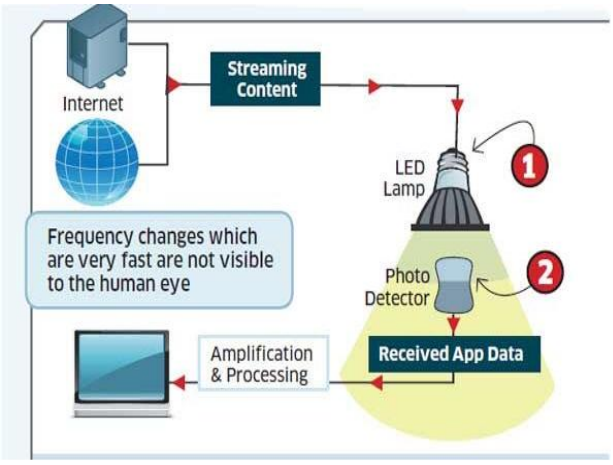

Figure: 1.1

The virtue of operating at such high frequencies in hundreds of terahertz, in a well beyond the sticky tentacles of the wireless spectrum crunch and regulatory licensing. But, Li-Fi can be used

Keywords*:* LED (Light emitted diode), Wi-Fi (Wireless Fidelity), VLC (Visible light communication), Li-Fi (Light Fidelity).

1. INTRODUCTION:

What if, all lights in your rooms will communicate each other and creates a bridge of wireless networks to provide internet access? , Li-Fi Technology would be the best optimum solution over Wi-Fi technology. it can also be used to extend wireless networks at your home, office or university for data transfer at 10 Gbps, “on the move" data transfer rate at 100 Mbps, home wireless data network with local cloud & server. In figure 1.1 shows how the internet will connect to the laptop using Li-Fi.

in areas where there’s extensive RF noise is generally prohibited (hospitals, airplanes). this is a digital system that translates the classic binary language of zeros and ones in light pulses off or on, respectively, through tiny light bulbs led able and off millions of times per second, The pioneers of data transmission through say enlightenment through blinking of LEDs can create wireless Internet access with data transmission speeds of close to 500 megabits per second (Mbps). These benefits come at a fivefold transits currently offering fiber optic lines, to benefit from this technology requires a luminous router (which can adhere cheaply and easily into any conventional electric bulb) which is capable of emitting the binary signal. Moreover, the pulses are captured by few light receptors are required, and are installed on all types of connected devices , from computers to tablets , to phones, televisions or appliances, Matter experts make clear that light pulses are imperceptible to the human eye , without

causing damage or discomfort of any kind. In addition, any lamp, lamp or flashlight can become a hotspot.

2. How Li-Fi Works:

Li-Fi using visible light instead of gigahertz radio waves. How Li-Fi works is very simple: You have a light on one end (an LED in this case), and a photo detector (light sensor) on the other. If the LED is on, the photo detector registers a binary one; otherwise it's a binary zero. Flash the LED enough times and you build up a message.

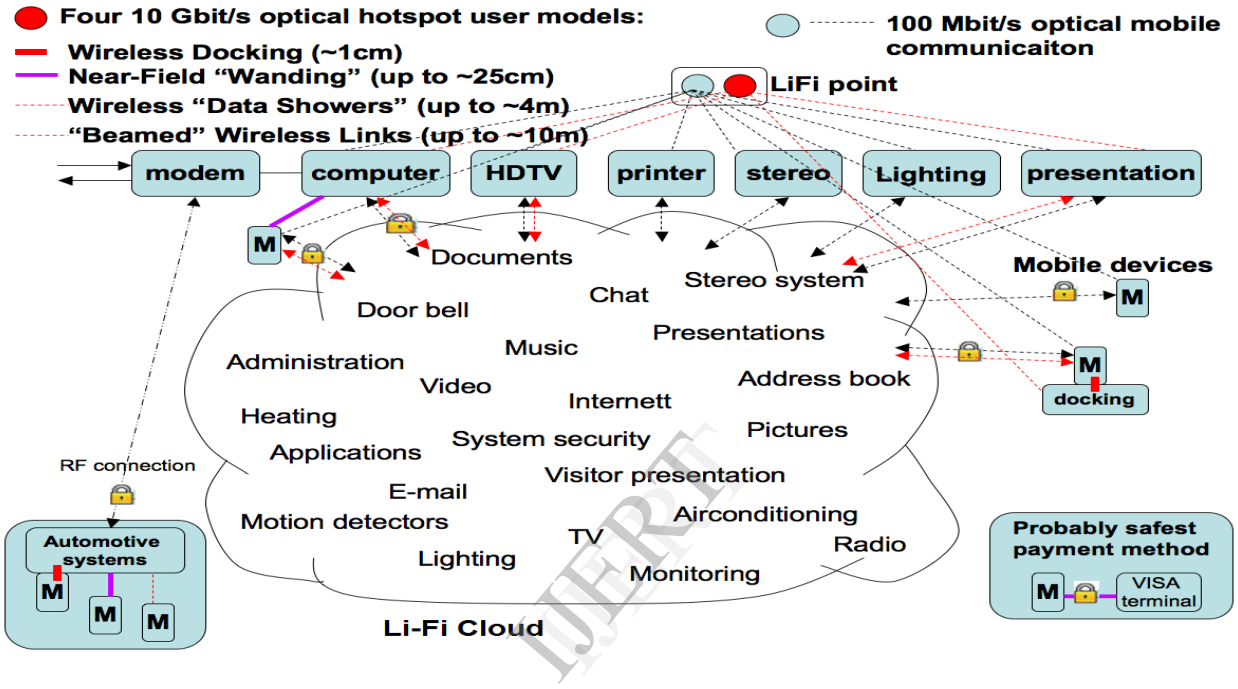

Figure: 1.2

Use an array of LEDs, and perhaps a few different colors, and very soon you are dealing with data rates in the range of hundreds or megabits per second, This is accomplished by the flickering of LED light bulbs to create binary code (on = 1, off = 0), and is done at higher rates than the human eye can detect. The more LEDs in your lamp, the more data it can process. in figure 1. 2 shows how the Li-Fi cloud will get communicated with others devices.

The only infrastructure is an equipped light bulb. Your internet provider doesn't even need to bring you a box, they just connect you to their power-grid-mounted signal relays, and you're online. At the moment, commercial LEDs don't get much smaller than $1mm^2$. The Scottish researchers, however, are developing LEDs that are just $1\mu m^2$ — one micron, its one thousand times smaller. Not only can you cram more of these micron-sized LEDs into the same space as a larger LED, but apparently they can also flicker on and off 1,000 times faster. A grid of 1,000 micro-LEDs, flashing 1,000 times faster, would be able to transmit data a million times faster than a normal LED. Furthermore, these micro-LEDs are ultimately just pixels — and at one micron, these LEDs would be a lot smaller than those in your Smartphone's Retina display. You could have a huge array of these LEDs that double up as a room's light source and a display — and provides networking capability on the side. Perhaps a next-next-gen console would communicate with your gamepad, Smartphone, and other peripherals via a LiFi-equipped TV. How about a highway lighting that illuminates

the road, provides up-to-date traffic info/warnings, and provides internet access to your car, plus all of the devices on-board?

Figure: 1.3

Figure 1.3 is the model of li-fi led lights, on a more general level; Li-Fi might be used to extend wireless networks throughout the home, workplace, and in commercial areas. Li-Fi is restricted by line of sight, so it won't ever replace Wi-Fi, but it could augment it nicely. Instead of trying to find the perfect sweet spot for your home's Wi-Fi router, it would be much simpler if every light in your house simply acted as a wireless network bridge. Its shown in the figure 1.4.

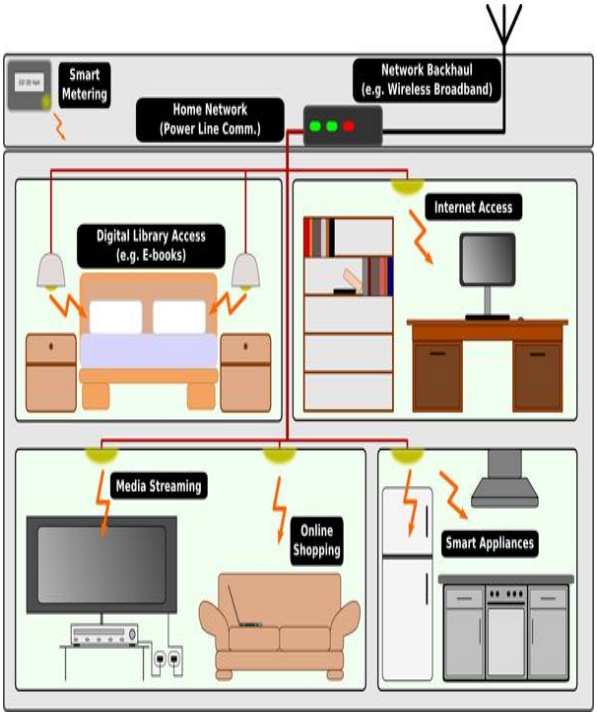

Figure: 1.4

3. Li-Fi Communication:

Li-Fi communication is modeled after communication protocols established by the IEEE 802 workgroup. This standard defines the physical layer (PHY) and media access control (MAC) layer. The standard is able to deliver enough data rates to transmit audio, video and multimedia services. It takes count of the optical transmission mobility, its compatibility with artificial lighting present in infrastructures, the defiance which may be caused by interference generated by the ambient lighting. The MAC layer allows to use the link with the other layers like the TCP/IP protocol. The standard defines three PHY layers with different rates.

- The PHY I was established for outdoor application and works from 11.67 kb/s to 267.6 kb/s.
- The PHY II layer allows reaching data rates from 1.25 Mb/s to 96 Mb/s.
- The PHY III is used for many emissions sources with a particular modulation method called color shift keying (CSK). PHY III can deliver rates from 12 Mb/s to 96 Mb/s.[6]

The modulation formats preconized for PHY I and PHY II are the coding on-off keying (OOK) and variable pulse position modulation (VPPM). The Manchester coding used for the PHY I and PHY II layers include the clock inside the transmitted data by representing a logic 0 with a OOK symbol "01" and a logic 1 with a OOK symbol "10", all with a continue component. This is an important point because they continue component allows avoiding the light extinction in case of an extended line of logic 0.

The new high-speed optical wireless usage models both indoors and outdoors. The Li-Fi provides resources for OEM and ODM developers to create exciting new products. With the emergence of high-speed cable connections like Thunderbolt and USB 3.0, the stage is set for a wireless equivalent. While Wi-Fi is very popular for pervasive 100+ Mbps service, multi-Gigabit short-range optical wireless interconnects provide an alternative to the proposed WiGig Gigabit RF solution.

Some of the advantages of optical wireless communications include:
a) Scalability to 10+ Gbps,
b) A wide variety of beaming angles and distances,
c) No spectrum license required,
d) High physical link security,
e) No RF interference and
f) No possible harmful RF radiation
.
The technology is ideal for wireless docking, data links with kiosks and mobile displays, medium-range beaming, data showers and optical cellular networks. Users will be able to enjoy a wireless RF-free user environment with data rates that can transfer a 2-hour HDTV video in less than 30 seconds and wirelessly link their bus-connected heavy-lifting peripheral cabinets located elsewhere in the room.

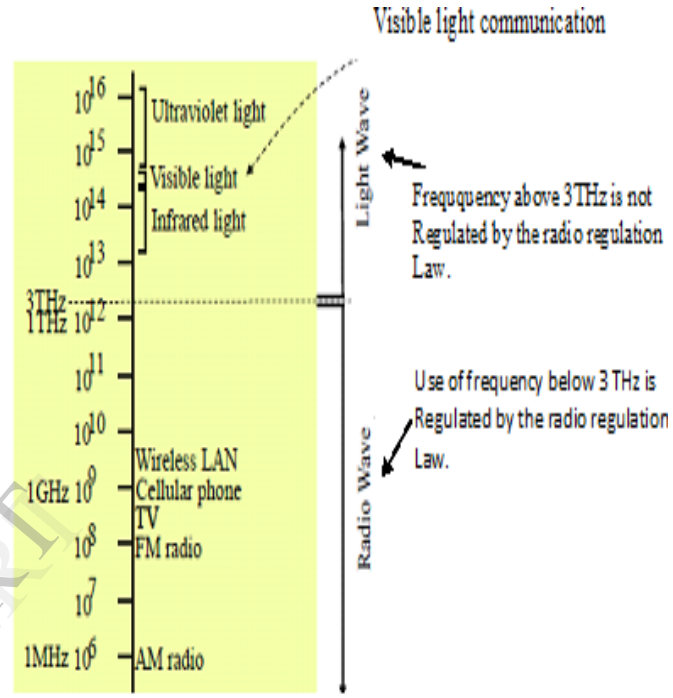

Figure: 1.5

For communication purpose light wave carry data in a fast manner, but in radio wave the data transfer rate is slow. so for that reason we are looking for light wave communication. Its shown by the figure 1.5.

TABLE 1. Comparison of Bluetooth, Wi-Fi & Li-Fi.

Characteristic	Bluetooth	Wi-Fi	Li-Fi
Frequency	2.4 GHz	2.4 GHz to 5 GHz	No frequency for light
Standard	IEEE 802.15	IEEE 802.11	IEEE 802.15
Range	10 meters	100 meters	Base on LED light
Primary application	Wireless public area networking	Wireless local area networking	Wireless local area networking
Data transfer rate	800 Kbps	11 Mbps	>1Gbps
Power consumption	Low	Medium	LOW
Cost	Low	Medium	high
Security	Its less secure	Its medium secure	Its high secure
Primary devices	Mobile phones, mouse, keyboards, office and industrial automatic devices , PDAs, consumer Electronics, and others offices.	Notebook computers, desktop computers, servers, TV, Latest Wi-Fi mobiles.	Mobile phones, office and industrial automatic devices, notebook computers, desktop computers , servers computers, TV and latest upcoming devices with Li-Fi
Primary users	Traveling employees; electronics consumers; office and industrial workers	Corporate campus users, homes and others public places	Traveling employees ,home users ,others public places ,office and industrial workers,
Usage location	Anywhere at least two Bluetooth devices exist — ideal for roaming outside buildings	Within range of WLAN infrastructure, usually inside a Building	Where ever light is available, it may a public place ,home, office and road etc
Development started	1998	1990	2011

4. Li-Fi Technology:

LiFi is a new way to establish wireless communication links using the Led lighting networks. The LiFi protocols are defined by the international standard IEEE 802.15 established since 2011 by the IEEE comity. This is the same comity that has defined previously the Ethernet 802.3 and WiFi 802.11 standards. For numerous specialists, LiFi is a major breakthrough technology for the mobile Internet community and for the connected objects domain.

After more than 4 years of scientific research at the University of Versailles, OLEDCOMM is the first European company that starts to commercialize LiFi communication solutions a worldwide level.

5. LED Revolution:

The revolution of the Leds known by the world of lighting comes with a second unexpected revolution: Light becomes a vector of wireless communications. All data (files, music, videos…) are only series of ordered ‘0’ and ‘1’. This is the era of Digital world. To transmit data, you only have to transmit series of ‘0’ and ‘1’ from one point to the other one. Hence, by combining ‘0’ to a state where the Led light is switch off and a '1' to a state where the Led light is switch on, by switching on and off the light according the series you can send information all around you by the lighting networks. However, in order that this twinkling was insensitive for human eyes and also in order to send a large quantity of data, it is necessary to have a very low switch-time. This was impossible before the development of Led lighting devices.

6. First Commercially Product:

Li-Fi - or optical Wi-Fi - consists of using the lighting networks as wireless communication networks. OLEDCOMM sells the first commercially available products based on Li-Fi technology, contributing hence to reduce the radio electromagnetic wave pollution. From your Led lighting device, you will be able: to send data, to listen music, to look at videos and ultimately to connect to Internet. Our know-how is based on more than 5 years of scientific researches made at the University of Versailles in France.

7. Conclusion:

The possibilities are numerous and can be explored further, this technology is in manufacturing process to produce every bulb to become a Wi-Fi hotspot to transmit wireless data and we will proceed towards the cleaner ,greener ,safer and brighter future without radio wave ,because radio waves create a harmful effect for living thing ,but Li-Fi is the optical wireless communication for data ,audio and video streaming in LEDs, this type of new invention can be encouraged to produce a safe and green technology.

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