# **EE 306 : Digital Communications**

# Assignment Report Topic: Li-Fi(Light Fidelity) Technology

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#### **Introduction**

Li-Fi stands for Light-Fidelity. Li-Fi is wireless communication technology which utilizes light to transmit data and position between devices. The term was first introduced by Harald Haas during a 2011 TEDGlobal talk in Edinburgh . Light based communication system is the backbone of the future of the communication system. Li-Fi is a wireless technology that uses light emitting diodes (LEDs) for transmission of data.

In terms of its end use, the technology is similar to Wi-Fi Technology, the key technical difference being that Wi-Fi uses radio frequency to induce a voltage in an antenna to transmit data whereas Li-Fi uses the modulation of light intensity to transmit data. Li-Fi can theoretically transmit at speeds of up to 100 Gbit/s. Li-Fi's ability to safely function in areas otherwise susceptible to electromagnetic interference (e.g. aircraft cabins, hospitals, military) is an advantage.

Li-Fi is a wireless communication system in which light is used as a carrier signal instead of traditional Radio Frequency as in Wi-Fi. Li-Fi technology communicates with the help of Visible Light Communication (VLC) spectrum and has no side effect as we know the light is very much part of our life. Moreover Li-Fi makes possible to have a wireless Internet in specific environments, where Wi-Fi is not allowed due to interferences or security considerations [1].

Li-Fi provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved high speeds in the lab. Like Wi-Fi, Li-Fi is wireless and similar 802.11 protocols, but it uses ultraviolet, infrared and visible light communication (instead of radio frequency waves), which has much bigger bandwidth.

Parameter	LI-FI	WI-FI
Speed	High	High
Spectrum	10,000 times broader than that of Wi-Fi	Narrow spectrum
Data density	High	Low
Security	High security due to non-penetration of light	Less secure due to transparency
	through walls	
Reliability	Medium	Medium
Bandwidth	High due to broad spectrum	Low
Transmit/receive power	High	Medium
Ecological Impact	Low	Medium
Device-to-device connectivity	High	High
Obstacle interference	High	Low
Bill of materials	High	Medium
Market maturity	Low	High
Latency	In the order of microseconds	In the order of milliseconds

Fig 1. Table of Comparison Between Li-Fi and Wi-Fi [2].

### **Working**

Light emitting diodes (LEDs) can be switched on and off faster than the human eye can detect since the operating speed of LEDs is less than 1  $\mu$ s, thereby causing the light source to appear to be continuously on. This invisible on-off activity enables data transmission using binary codes. Switching on an LED is binary '1', switching it off is binary '0'. It is possible to encode data in light by varying the rate at which LEDs flicker on and off to give different strings of 1s and 0s. Modulation is so rapid that humans cannot notice it. A light sensitive device (photo detector) then receives the signal and converts it back into original data.

This method of using rapid pulses of light to transmit information wirelessly is technically referred to as Visible Light Communication(VLC). The term Li-Fi has been inspired due to its potential to compete with conventional Wi-Fi. The VLC uses visible light between 400 THz (780 nm) and 800 THz (375 nm) as the optical carrier for data transmission and for illumination.

Data rates of greater than 100 Mbps can be achieved by using high speed LEDs with adequate multiplexing. Parallel data transmission using arrays of LEDs where each LED transmits a separate stream of data can be used to increase the VLC data rate. Though the lights have to be kept on in order to transmit data, they can be dimmed to the point that they are not visible to humans but still be capable of transmitting data[2].

## Advantages of Li-Fi Technology

- 1) Li-Fi is 100 times faster than data transmission using Wi-Fi. Li-Fi connection can transmit data at the rate of 224 GB per second.
- 2) **Security:** Since light cannot pass through opaque structures, Li-Fi Internet is available only to the users within a room and cannot be breached by users in other rooms or buildings.
- 3) **Efficiency:** Li-Fi communication systems are based on LED lamps which consume less energy and provide communication in addition to the illumination function. Thus, Li-Fi is more energy-efficient.
- 4) **Cost-Effective:** The cost of a Li-Fi system is much less than a WiFi system or any radio comparable system.
- 5) **Availability:** Wherever there is a light source, there can be Internet. Light bulbs are present everywhere in homes, offices, shops, malls and even planes, meaning that high-speed data transmission could be available everywhere.

# **Challenges and Issues with Li-Fi Technology**

- 1) **Limited Range**: Light can't penetrate through walls might be a good thing when it comes to security but this also means that LiFi has a very limited range. In open spaces, Wi-Fi's coverage can go up to 32 meters but LiFi can only go up to 10 meters.
- 2) Limited Compatibility: Since LiFi is a new technology, not many devices are compatible with it.
- 3) There is an Infrastructure shortage for this technology, But in the near future whole new infrastructure for Li-Fi would need to be constructed.

- 4) Internet cannot be used without a light source. This could limit the locations and situations in which Li-Fi could be used.
- 5) There might be a possibility of interference of other light signal which can result in an interrupted signal [4].

#### **Feasible Solutions**

These are some of the challenges with the Li-Fi Technology but these challenges are overshadowed by the advantages and the effectiveness of the Li-Fi Technology over the existing WiFi Technogy . But some of the challenges with the Li-Fi Technology will overcome in the coming future like, The limited range of the Li-Fi Technology can be increased by using Concave mirror and better Positioning of the LEDs used for this Technology[5]. With increase in demand of this technology , the existing infrastructure will be changed in such a manner so that newer as well as older devices will be compatible with the Li-Fi Technology.

#### **Future Scope**

The Li-Fi technology can be used for various purposes, it matters the data transmission through LEDs thus all the screens which illuminate light can be served as a platform for data communication. The screen of the mobile phone, television, bulbs can act as a source of light. On the other hand, the receiving platform, the photo detector can be replaced by a camera in mobile phone for scanning and retrieving data. Its other applications are Li-fi for desktops, smartcard Li-fi, Li-fi for schools, hospitals, Li-fi in cities, smart guides, museums, hotels, fairgrounds, events indoor and LBS(Location-based Services), access control and identification crisis, malls, airport and dangerous environments like thermal powerplants.[7]It also has the advantage of being useful in electromagnetic sensitive areas such as in aircraft cabins, hospitals and nuclear power plants without causing electromagnetic interference[6].

#### References

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