# Team LiFi

## Introduction of Team Members

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# Light Fidelity

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## What is lifi technology?

LiFi (light fidelity) is a bidirectional wireless system that transmits data via LED or infrared light. It was first unveiled in 2011 and, unlike wifi, which uses radio frequency, LiFi technology only needs a light source with a chip to transmit an internet signal through light waves.
This is an extraordinary advance over today's wireless networks. LiFi multiplies the speed and bandwidth of wifi, 3G and 4G. The latter have a limited capacity and become saturated when the number of users surfing increases, causing them to crash, reducing speeds and even interrupting the connection.
With LiFi, however, its band frequency of 200,000 GHz, versus the maximum 5 GHz of the wifi, is 100 times faster and can transmit much more information per second. A 2017 study by the University of Eindhoven obtained a download rate of 42.8 Gbit/s with infrared light with a radius of 2.5 metres, when the best wifi would barely reach 300 Mbit/s.

# The Evolution of Wireless Connectivity: LiFi’s Game-Changing Potential

**Wi-Fi, leveraging radio waves for data transmission, has profoundly impacted our digital age. Notable studies, such as the one conducted by Direct Line through Opinium Research, emphasize the significance of Wi-Fi in our daily lives. Yet, despite its pervasive presence, challenges like inconsistent internet connectivity persist. Emerging from this backdrop is LiFi, a transformative alternative poised to reshape our wireless communication experiences. By harnessing the vast bandwidth of the light spectrum, LiFi promises speeds that can eclipse conventional Wi-Fi by up to 100 times. But it’s not just about speed. With LiFi, connecting to the internet could be as straightforward as turning on a light. Utilizing LED-based light to convey data, this technological shift guarantees rapid data transfer, while also excelling in environments where electromagnetic interference is a concern, such as hospitals or airplanes.**

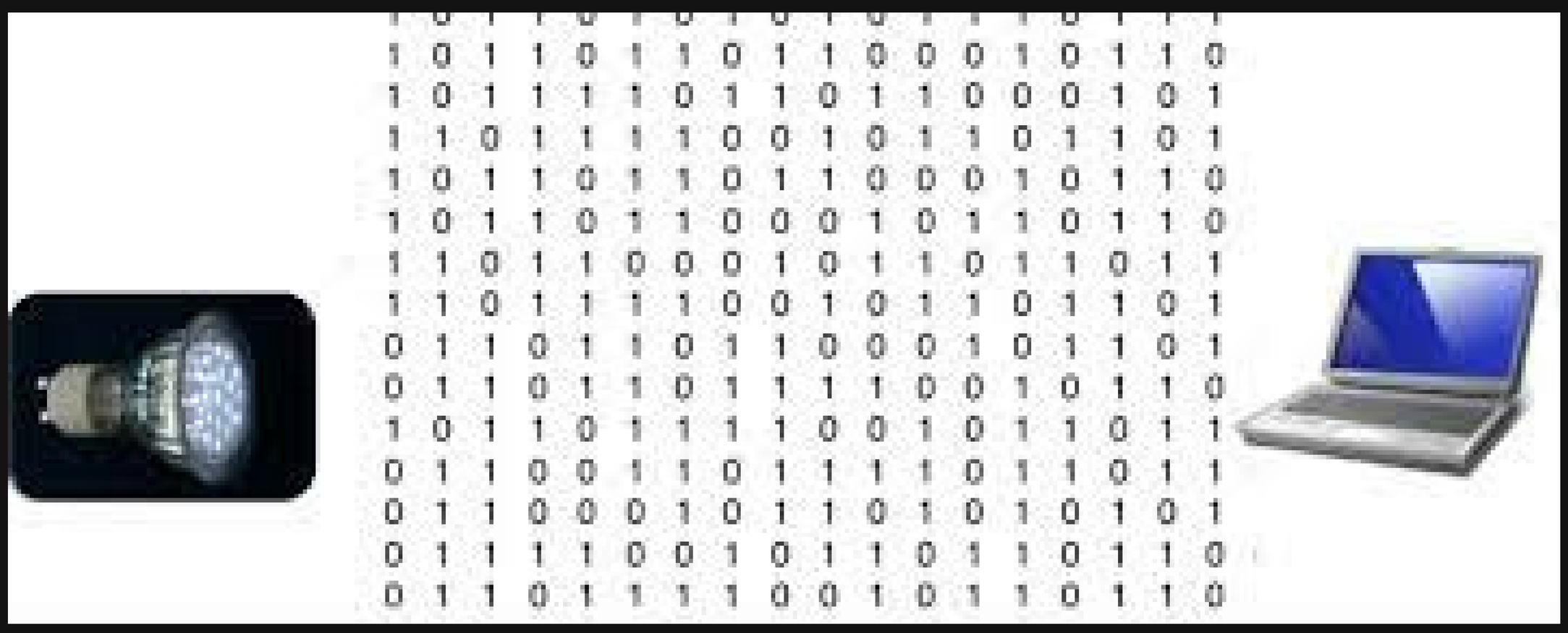
## Decoding the Mechanics of LiFi

**At its essence, LiFi operates as a Visible Light Communications (VLC) system, promising unparalleled wireless internet speeds. Central to this system are LED light bulbs. These bulbs emit swift light pulses, imperceptible to the human eye, laden with information. It’s akin to an advanced, hyper-speed Morse code. Devices fitted with the requisite receivers decode this influx of data at breathtaking speeds. Demonstrated potential transmission rates for LiFi have even surpassed 224 Gbps, a pace that dwarfs WiGig, one of the most rapid Wi-Fi technologies**

# Working of Li-Fi

- ## Basic Concept

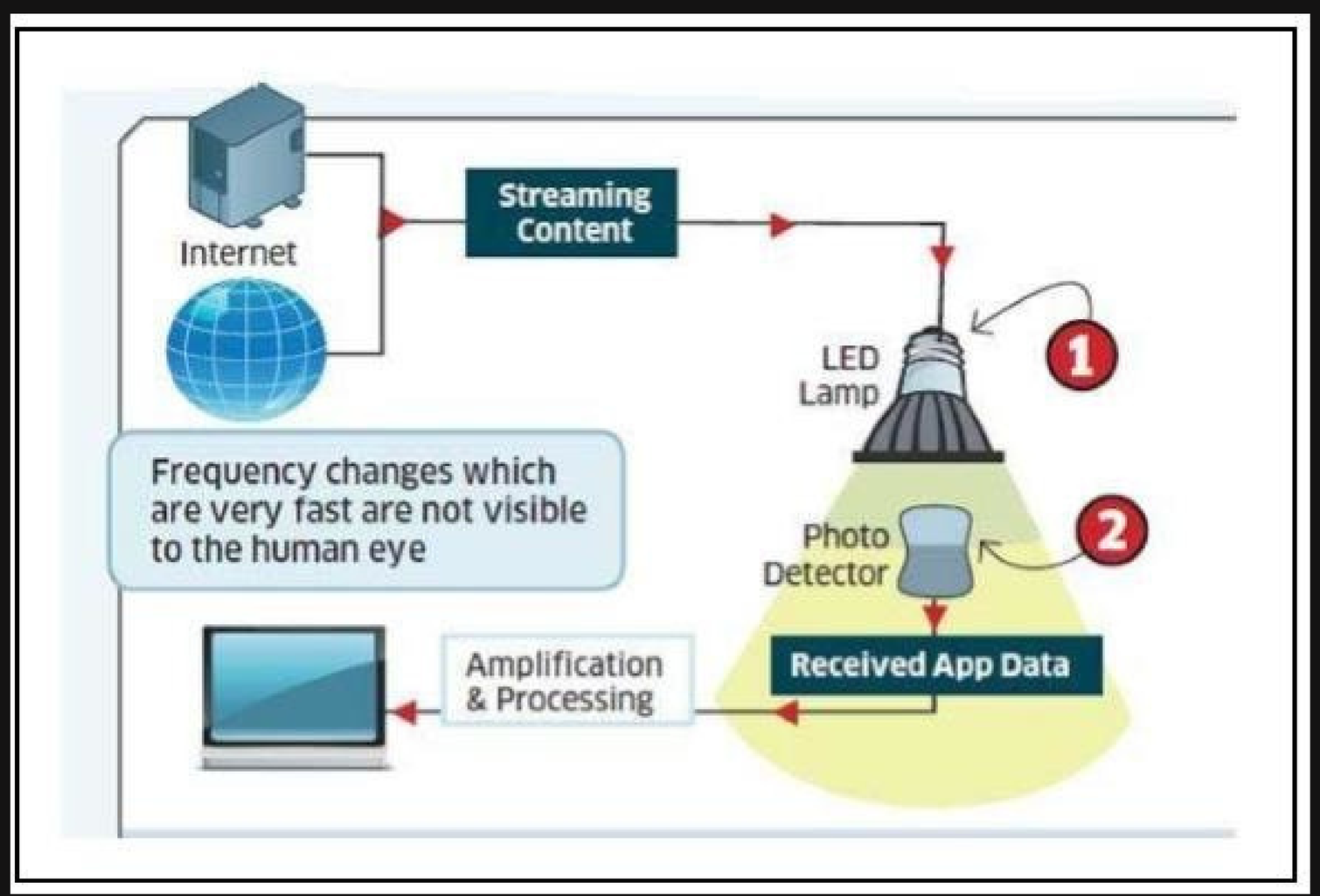
**Light Fidelity (Li-Fi) technology is a wireless communication system based on the use of visible light between the violet (800 THz) and red (400 THz). Unlike Wi-Fi which uses the radio part of the electromagnetic spectrum, Li-Fi uses the optical spectrum i.e. Visible light part of the electromagnetic spectrum. The principle of Li-Fi is based on sending data by amplitude modulation of the light source in a well-defined and standardized way. LEDs can be switched on and off faster than the human eyes can detect since the operating speed of LEDs is less than 1 microsecond. This invisible on-off activity enables data transmission using binary codes. If the LED is on, a digital '1' is transmitted and if the LED is off, a digital '0' is transmitted. Also these LEDs can be switched on and off very quickly which gives us a very nice opportunity for transmitting data through LED lights, because there are no interfering light frequencies like that of the radio frequencies in Wi-Fi. Li-Fi is thought to be 80% more efficient, which means it can reach speeds of up to 1Gbps and even beyond. Li-Fi differs from fibre optic because the Li-Fi protocol layers are suitable for wireless communication over short distances (up to 10 meters). 5 This puts Li-Fi in a unique position of extremely fast wireless communication over short distances.**



*(Li-Fi Transmission)*

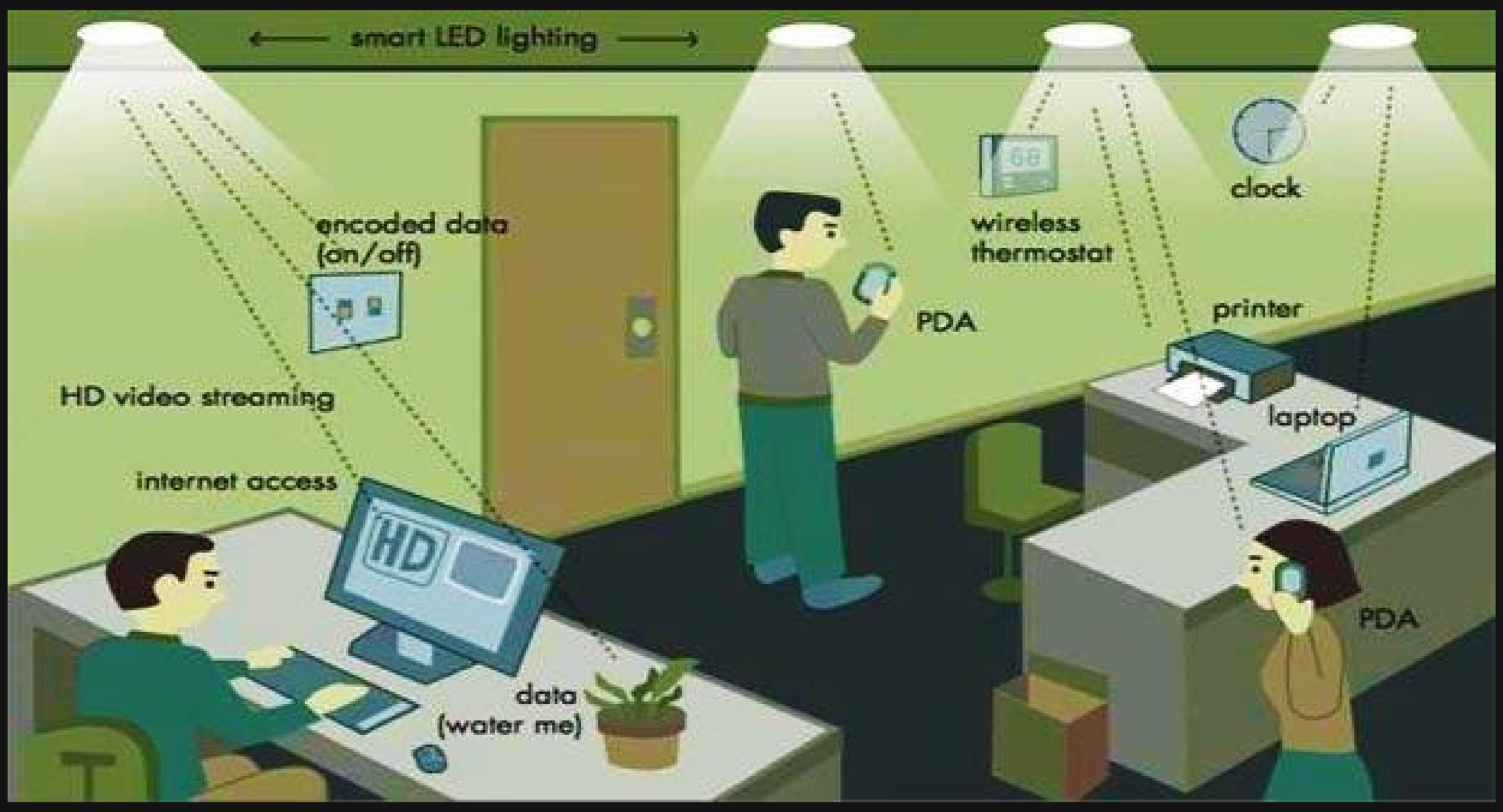
- **How it Works**

**The working of Li-Fi is very simple. There is a light emitter on one end i.e. an LED transmitter, and a photo detector (light sensor) on the other. The data input to the LED transmitter is encoded in to the light (technically referred to as Visible Light Communication) by varying the flickering rate at which the LEDs flicker ‘on’ and ‘off’ to generate different strings of 1s and 0s. The onoff activity of the LED transmitter which seems to be invisible (The LED intensity is modulated so rapidly that human eye cannot notice, so the light of the LED appears constant to humans), enables data transmission in light form in accordance with the incoming binary codes: switching ON a LED is a logical '1', switching it OFF is a logical '0'. By varying the rate at which the LEDs flicker on and off, information can be encoded in the light to different combinations of 1s and 0s. In a typical setup, the transmitter (LED) is connected to the data network (Internet through the modem) and the receiver (photo detector/light sensor) on the receiving end receives the data as light signal and decodes the information, which is then displayed on the device connected to the receiver. The receiver (photo detector) registers a binary ‘1’ when the transmitter (LED) is ON and a binary ‘0’ when the transmitter (LED) is OFF. Thus flashing the LED numerous times or using an array of LEDs (perhaps of a few different colours) will eventually provide data rates in the range of hundreds of Mbps. The Li-Fi working is explained in a block diagram**




*(Block diagram of Li-Fi Sub System)*

Hence all that is required, is some or an array of LEDs and a controller that controls/encodes data into those LEDs. All one has to do is to vary the rate at which the LEDs flicker depending upon the data input to LEDs. Further data rate enhancements can be made in this method, by using array of the LEDs for parallel data transmission, or using mixtures of red , green and blue LEDs to alter the light's frequency, with each frequency encoding a different data channel. Figure 7 shows working/deployment of a Li-Fi system connecting the devices in a room.




*(Li-Fi system connecting devices in a room)*

# Why Visible Light Communication?

The frequency spectrum that is available to us in the atmosphere consists of many wave regions like X-rays, gamma rays, u-v region, infrared region, visible light rays, radio waves, etc. Any one of the above waves can be used in the upcoming communication technologies but why the Visible Light part is chosen? The reason behind this is the easy availability and lesser harmful effects that occur due to these rays of light. VLC uses the visible light between 400 THz (780 nm) and 800 THz (375 nm) as medium which are less dangerous for high-power applications and also humans can easily perceive it and protect themselves from the harmful effects whereas the other wave regions have following disadvantages:-

- Radio waves are expensive (due to spectrum charges) and less secure (due to interference and possible interception etc.)
- Gamma rays are harmful because it could be dangerous dealing with it, by the human beings due to their proven adverse effects on human health.
- X-rays have health issues, similar to the Gamma Rays.
- Ultraviolet light can be considered for communication technology purposes at place without people, otherwise they can also be dangerous for the human body when exposed continuously
- Infrared, due to high safety regulation, can only be used with low power

Hence the Visible light portion (from red to blue) of the electromagnetic spectrum does not cause any harm to the people as visible rays are safe to use, provide larger bandwidth and also have a promising future in the communication field.

# KEY FEATURES

## Lifi v/s Wifi

### Faster

The current speed of wifi oscillates between 11 and 300 Mbit/s, while that of LiFi is also highly variable according to the last studies carried out. The most widely accepted speed is 10 Gbit/s, but it has been proven that it could reach 224 Gbit/s and that a 1.5 Gbit film could be downloaded in thousandths of a second.

### Cheaper and More Sustainable

It is up to 10 times cheaper than wifi, requires fewer components and uses less energy. All you have to do is turn on a light!

### More Accessible

Any light fitting can easily be converted into an internet connection point, as only a simple LiFi emitter needs to be fitted.

### More secure

Light does not pass through walls like radio waves do, and this prevents intruders from intercepting LiFi communications through a wireless network

### More Bandwidth

The light spectrum is 10,000 times wider than the radio spectrum, which increases the volume of data it can carry and transmit per second

### More Reliable

LiFi transmits its signal without interruptions, making communication more stable than with wifi.

### No Interference

Electronic light does not interfere with radio communications, interact with other systems or compromise transmissions from aircraft, ships, etc.

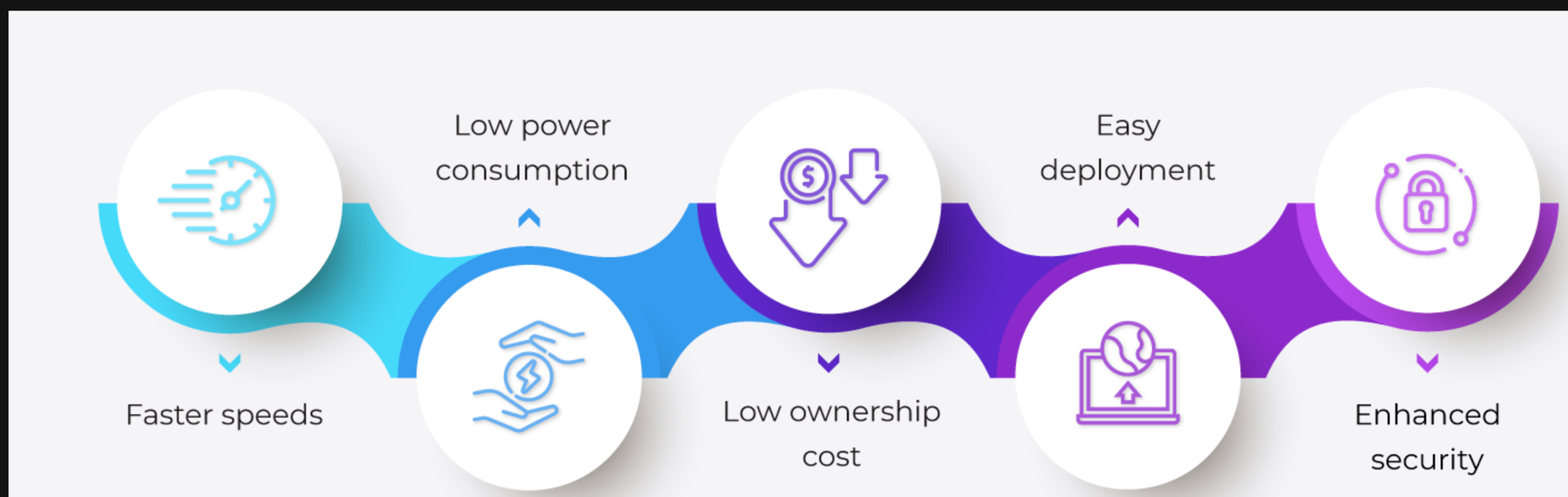
### Wireless and Invisible

LiFi takes advantage of lights and dispenses with the router, so it works without the need for cables. In addition, it can operate with infrared light, which is invisible to the human eye, or with visible LED light at very low intensity so as to avoid disturbance.

### No Saturation

Internet connection via light could prevent the collapse of the radio spectrum which, according to LiFi's inventor Harald Haas, could take place by 2025.

# BENEFITS OF LIFI




# APPLICATIONS

- **Live Streaming**
- **LiFi in Hospital**
- **Li-Fi in Pharmacies and the Pharmaceutical Industry**
- **Li-Fi in the Workplace**
- **Li-Fi in Schools**
- **Li-Fi in Retail**
- **Li-Fi and Airplanes**
- **Li-Fi in Disaster Management**
- **Li-Fi and Industry 4.0**
- **Li-Fi and Augmented Reality**