

# Emerging Trends in Mobile Communications

Submitted by :- Anu(04), Anuradha(05), Kulpreet(14)

- Li-Fi (Light Fidelity)
- ZigBee
- NFC (Near-field communication)



# Li-Fi (Light Fidelity)

- Li-Fi is a technology for wireless communication between devices using light to transmit data and position.
- Li-Fi is a derivative of optical wireless communications (OWC) technology using light from light-emitting diodes (LEDs) as a medium to deliver networked, mobile, high-speed communication in a similar manner to Wi-Fi.
- It is a wireless internet connection standard that operates on visible light waves rather than radio waves
- The main components of Li-Fi consists of a silicon photodiode and a transmission source. Based on visible light communication (VLC), Li-Fi uses visible light between 800 THz (375 nm) and 400 THz (780 nm), as an optical carrier for illumination and data transmission.

# HOW LI-FI WORKS??

- Li-Fi is high speed bidirectional networked and mobile communication of data using light. Li-Fi comprises of multiple light bulbs that form a wireless network.
- When an electrical current is applied to a LED light bulb a stream of light (photons) is emitted from the bulb. LED bulbs are semiconductor devices, which means that the brightness of the light flowing through them can be changed at extremely high speeds. This allows us to send a signal by modulating the light at different rates. The signal can then be received by a detector which interprets the changes in light intensity (the signal) as data.
- The intensity modulation cannot be seen by the human eye, and thus communication is just as seamless as other radio systems, allowing the users to be connected where

there is Li-Fi enabled light. Using this technique, data can be transmitted from a LED light bulb at high speeds.

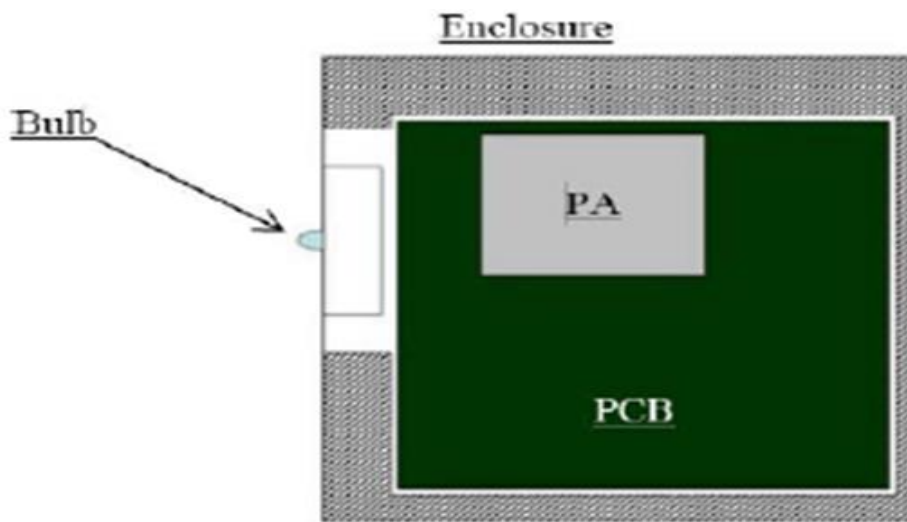


Fig. 1: block diagram of LI-Fi sub assemblies

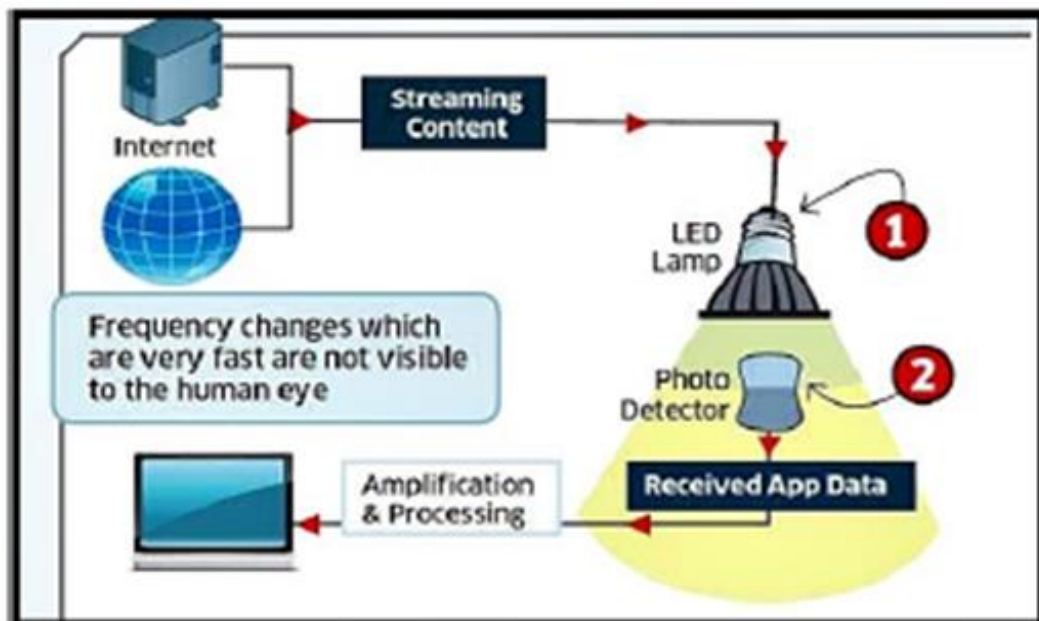


Fig. 2: different phases for the operation of LI-Fi system

# LI-FI vs WI-FI

LI-FI ( Light Fidelity)	WI-FI( Wireless Fidelity)
Works in high dense environment	Works in less dense environment due to interference related issues
uses light for data transmission	uses electro-magnetic waves at radio frequencies for data transmission
Do not have any interferences issues similar to radio frequency waves.	Have interferences issues near access points(routers)
Used in airlines, undersea explorations, operation theaters in the hospitals, office and home premises for data transfer and internet browsing	Used for internet browsing with the help of wi-fi kiosks or wi-fi hotspots
Li-Fi operates between wavelengths in the range from 380 nm to 780 nm.	Wi-Fi operates at different frequency bands viz. 2.4 GHz and 5 GHz.

# Advantages of Li-Fi

- The data transfer rate for internet application is higher.
- It provides high amount of security as data communication is line of sight (LOS). Moreover lifi signal covers low region does not pass through the walls. This will avoid unwanted access of lifi signal by unauthorized persons.
- The lifi devices consume low power for operation and hence used in IoT applications.
- It uses optical spectrum and hence avoids already crowded RF spectrum.
- As it operates on optical bands which are not harmful like RF spectrum. Hence there is no health concerns in LiFi based system.
- There is great amount of energy reduction in lighting industry which uses LiFi based devices.

# Disadvantages of LI-FI

- Internet can be used only where light of source device is available. Moreover light can not penetrate from walls and it works only in line of sight path. This limits access of internet where ever one requires. Moreover its range is limited.
- It can not be used in outdoor environment like RF signal. This is because of interference caused by sunlight and other optical sources present nearby. Moreover it can be intercepted by the unwanted people if used outdoors.
- Though the installation is simple, Lifi system requires whole new infrastructure. This will add cost to the companies/people wanting to take LiFi Internet service.
- lights need to be kept ON throughout day and night. As internet is need of the hour, this will waste energy more than any other internet system.

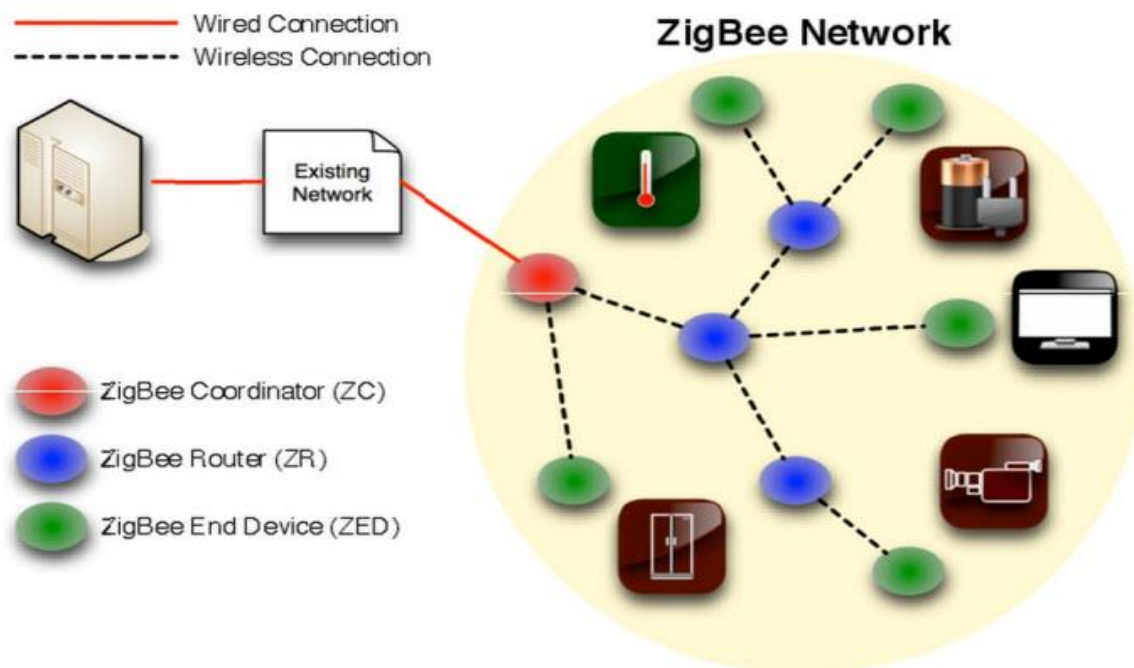
# ZIGBEE

- ZigBee is an open global standard for wireless technology designed to use low-power digital radio signals for personal area networks.
- ZigBee operates on the IEEE 802.15.4 specification and is used to create networks that require a low data transfer rate, energy efficiency and secure networking. It is employed in a number of applications such as building automation systems, heating and cooling control and in medical devices.
- ZigBee is a cost- and energy-efficient wireless network standard. It employs mesh network topology, allowing it provide high reliability and a reasonable range.
- One of ZigBee's defining features is the secure communications it is able to provide. This is accomplished through the use of 128-bit cryptographic keys.

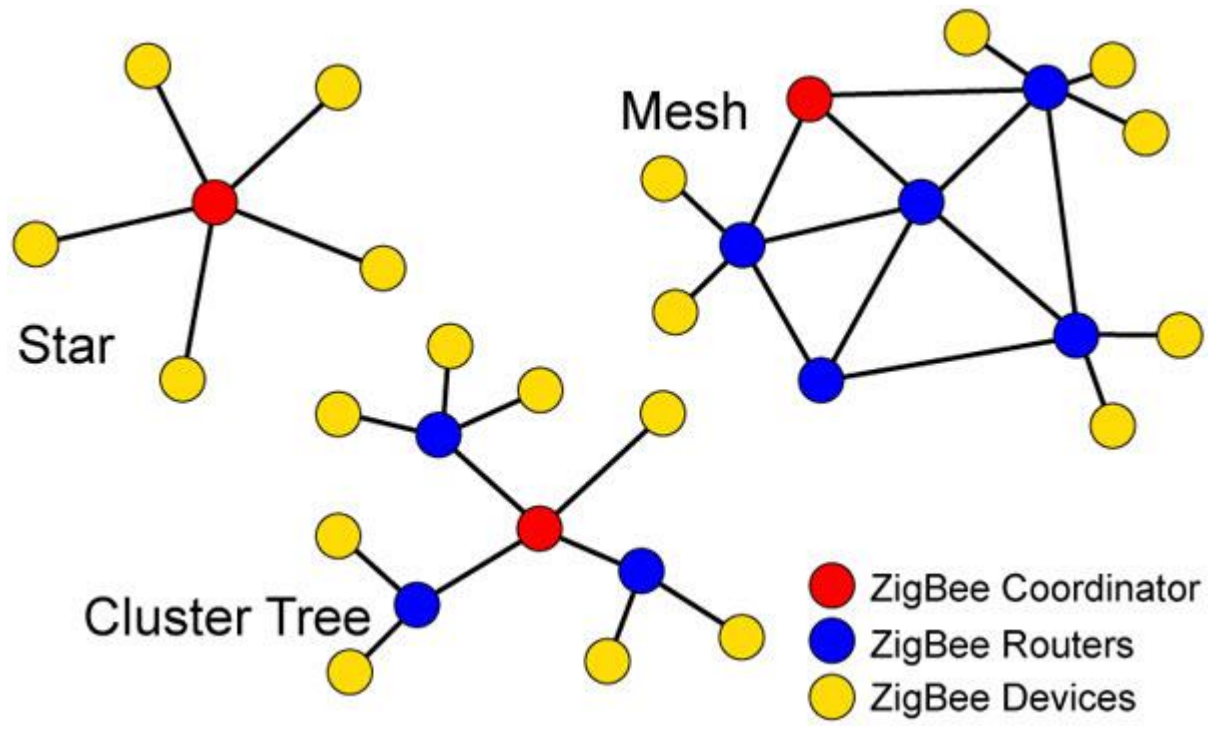


# How Zigbee Works?

ZigBee basically uses digital radios to allow devices to communicate with one another. A typical ZigBee network consists of several types of devices. A network coordinator is a device that sets up the network, is aware of all the nodes within its network, and manages both the information about each node as well as the information that is being transmitted/received within the network. Every ZigBee network must contain a network coordinator. Other Full Function Devices (FFD's) may be found in the network, and these devices support all of the 802.15.4 functions. They can serve as network coordinators, network routers, or as devices that interact with the physical world. The final device found in these networks is the Reduced Function Device (RFD), which usually only serve as devices that interact with the physical world.



# ZigBee Network Topologies



**Star Topology** :- Easy to synchronize, Low latency

**Mesh Topology**:- Robust multihop communication, Network is more flexible, Lower latency

**Cluster Tree**:- Low routing cost, Allow multihop communication

# ZigBee and Bluetooth

## Comparison

➡ *Optimized for different applications*

- **ZigBee**

- Smaller packets over large network
- Mostly Static networks with many, infrequently used devices
- Home automation, toys, remote controls, etc.

- **Bluetooth**

- Larger packets over small network
- Ad-hoc networks
- File transfer
- Screen graphics, pictures, handsfree audio, Mobile phones, headsets, PDAs, etc.

## **Advantages of Zigbee networks**

- Zigbee has a flexible network structure
- It has very long battery life
- Zigbee has a mesh network topology with low cost, multi hop data transmission and is power effective
- It is less complex than Bluetooth
- It is easy to install and more reliable
- Zigbee support a large number of nodes
- It is a short working period result in power saving and power consumption of communication

## **Disadvantages of Zigbee networks**

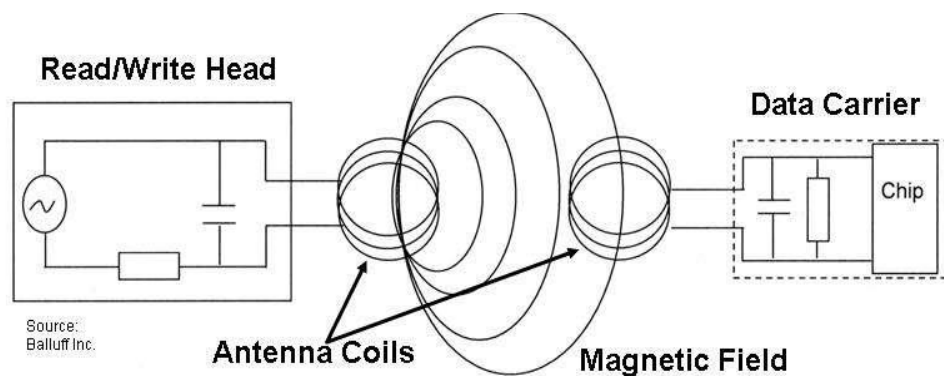
- Zigbee disadvantages mainly include short range
- Low complexity, and low data speed
- Its high maintenance cost, lack of total solution, and slow materialization,
- Low transmission, as well as low network stability, are also some of its disadvantages that takes it a step back as compared to others
- Replacement with Zigbee compliant appliances can be costly
- Zigbee is not secure like WiFi based secured system
- It does not have end devices available yet

# Near-field communication

- NFC or Near Field Communication is a short range high frequency wireless communication technology.
- A radio communication is established by touching the two phones or keeping them in a proximity of a few centimeters.
- NFC is mainly aimed for mobile or handheld devices.
- NFC is an extension of Radio frequency identification or RFID technology.
- RFID is mainly used for tracking and identification by sending radio waves.
- In 2004, NFC Forum was formed by Nokia, Philips, Sony, to set standards for NFC . Every NFC enabled device will have “N-Mark” trademark ,developed by NFC Forum.

# OPERATION OF NFC

- Near field communication is based on inductive-coupling.
- NFC works using magnetic induction between two loop antennas located within each other's 'near field'.
- operating frequency 13.56 MHz.data rate 106 kbit/s to 424 kbit/s.
- NFC use an initiator and a target; the initiator actively generates an RF field that can power a passive target.



# APPLICATION OF NFC

## ➡ *Touch and Go*

Applications such as access control or transport/event ticketing, where the user needs only to bring the device storing the ticket or access code close to the reader. Example for picking up an Internet URL from a smart label on a poster.



## ➤ **Touch and Confirm**

Applications such as mobile payment where the user has to confirm the interaction by entering a password or just accepting the transaction.



## ➤ **Touch and Connect**

Linking two NFC-enabled devices to enable peer to peer transfer of data such as downloading music, exchanging images or synchronizing address books.





# COMPARISON WITH EXISTING TECHNOLOGY

	NFC	RFID	IrDa	Bluetooth
Set-up time	<0.1ms	<0.1ms	~0.5s	~6 sec
Range	Up to 10cm	Up to 3m	Up to 5m	Up to 30m
Usability	Human centric Easy, intuitive, fast	Item centric Easy	Data centric Easy	Data centric Medium
Selectivity	High, given, security	Partly given	Line of sight	Who are you?
Use cases	Pay, get access, share, initiate service, easy set up	Item tracking	Control & exchange data	Network for data exchange, headset
Consumer experience	Touch, wave, simply connect	Get information	Easy	Configuration needed