

DELVE IN DIVERSE TECHNOLOGIES OF WIRELESS COMMUNICATION RESEARCH

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Abstract - In this 21th century human makes social relationship and interaction with familiars. Only instead of face to face communication, now we are interested with mobility. The word mobility completely gave a goodbye call to wire cable system. The paper discusses about different wireless technologies with special emphasis on NFC,WI-MAX,Li-Fi. The wireless fidelity WI-FI is the symptom in the first of wireless technology. The world with interoperability for microwave access (WI max) follow the line. The Wimax is 100 times faster than Wi-Fi, which is generally used in business purpose. Whether the WI-max worked in microwave interoperability in –Post Wi-Fi technology, the light fidelity (Li-Fi) can be complemented of RF communication and subset of visible light communication LIFI is 1000 times faster than Wi-Fi and much more efficient than WIMAX .

Key Words: Wi-Fi (Wireless Fidelity), Wimax, Li-Fi (Light Fidelity), NFC(Near Field Communication),LED(Light emitting diodes).

1.INTRODUCTION

In an era of modernization, we are interested with mobility and it becomes possible with wireless technology that is alternative to a network that uses the cable. Communication is one of the integral parts of science that has always been a focus point for exchanging information among parties at locations physically apart. Wireless communication is the example of mobility which transfers the information without using any current carrying conductor. Wireless operation Techniques permit services-such as long-range communications [1]. NFC devices can be used with wireless payment terminals and can replace the plastic card using RFID infrastructure. NFC tag and sender communicate with each other using mechanism called coupling This resistance against Man-in-the-Middle attacks makes NFC an ideal method for secure pairing of devices. LiFi is a wireless optical networking technology that uses LEDs for transmission of data. It provides the best bandwidth efficiency, availability and security than Wi-Fi and Wi-max.

2. NFC NFC is wireless technology which provides communication between two mobile phones which contain NFC tags, using short range radio waves. It uses the magnetic field induction for this purpose. Both devices can

communicate with each other using NFC technology when they touch each other or brought very close to each other. It requires a short range of approximately four centimeters to perform the exchange of information between two devices. NFC (Near Field Communication) provides wireless communication between two compatible devices.[2]. NFC is short range (4cm or less) technology that share data. It uses magnetic fields to connect devices. Payment, ticketing, data transfer between different services. Payment, ticketing is killer application it has a higher degree of security. NFC is a non contact technology, i.e. does not need physical contact It avoids corrosion, contact wear and dust experienced by systems having a connection. Transmission frequency of data across NFC is 13.56 megahertz and data can be sent at either 106, 212, 424, kilobits per second. The possible security attacks on NFC can be categorized as Eavesdropping ,Data Corruption, Data Manuplation ,Imposter Attack[3].In Imposter attack data are hacked by Imposter. Some protection measures are applied as Secure channel. imposter attack can be avoided by active passive pairing between devices. NFC key agreement and security functions can be applied.[4]

We can pay using our NFC enabled phone by swiping it out in front of the phone reader and then the purchase price will automatically pay by credit card or debit card. Our mobile phone can be used in place of a wallet, credit cards, debit cards , etc. We don't need to carry our credit card or debit card with us. But with these advantages, we will have to face disadvantages too. There are some security threats to the NFC technology, which should be prevented. NFC technology uses RFID (Radio Frequency Identification) for a data/information exchange between two devices over a short distance like Bluetooth and Wi-Fi technology. NFC enabled smart phone users can make transactions and access information with only a simple touch. NFC devices can send and receive data simultaneously. So this technology has a very bright future scope. This technology has several advantages over other wireless technology because it provides bidirectional communication for exchanging information.

NFC Modes

NFC works in active mode as well as passive mode. In active mode, both devices, tagged with an NFC chip, generate their

own electromagnetic field alternatively to exchange information. Both devices are active in this mode. One of the devices deactivates its electromagnetic field during data transfer. In passive mode, one of the devices act as a transponder and uses the electromagnetic field of other device for its own operating power. In other words, we can say that one device is active which generates its radio frequency field and the other device uses that field for data exchange. [2]

Wimax

Wi-max is hottest technology based on 802.16 which gives high quality broadband services. Wi-max World Wide interoperability for microwave access provides 4G levels broadband access for both mobile and fixed applications. It is based on wireless MAN to support European standard and applied to a system which met criteria specified by the Wi-max forum. It can connect 802.11 hotspots to provide internet campus connectivity. This provides wireless connectivity to cable, DSL last minute broadband access and uses medium 2.5GHz, 3.5GHz, and 5.8GHz frequency. Wi-max operates in different application modes such as point to point (PTP), point to multipoint (PMP), and mesh. 1 shows the IEEE Wimax notation.[5]



Fig 1 IEEE Wimax Notation

Wimax System

Wimax system consists of two parts.

- Wimax tower – Wimax tower can provide coverage up to 3000 square miles.
- Wimax receiver- Wimax receiver can be a small box, PCMCIA card or could built into the laptop.

The Wimax tower station can connect directly to the internet using high bandwidth, wired connection and to another Wimax through line of sight, microwave link.

Wimax system consists of base stations (BS) and Wimax subscriber status (SS) referred as customer premise equipment.[6]

Application mode of Wimax/ Topology

Point to Point (PTP)

PTP link is a dedicated link that connects two nodes BS and terminal equipment. High cost and results in the improper utilization of resources used for the user who required high data rate, high bandwidth, video production houses as a business customer. It generated high bandwidth. Interference is minimized and it secure maximum. Point to point topology is shown in fig 2.

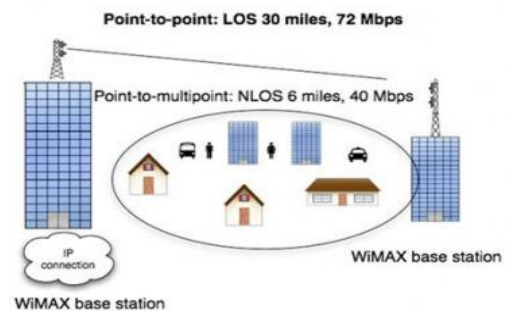


Fig 2 Point to point topology

Point to Multipoint (PMP)

In a PMP model group of subscriber are connected to BS separately, used for user who do not need to use entire bandwidth. Sectoral antennas with high direction parabolic dishes are used for frequency reuse. The topology is more cost most effective and shared bandwidth between

Group of users. Point to multipoint topology of Wimax is shown in fig 3.

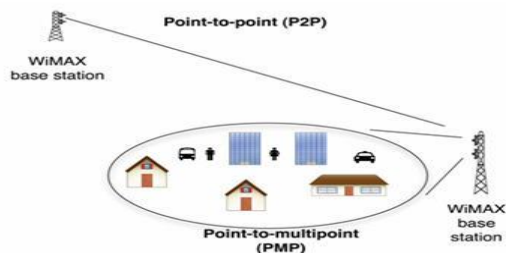


Fig 3 Point to Multipoint Topology

Mesh Topology

The topology is more flexible, reliable, adjustable portable. Mesh network gives SSs more intelligence than traditional wireless transmitter and receiver. In a mesh topology every SS can act as an access point and is able to route packets to its neighbor to enlarge geographical coverage. Fig.3.3 shows

mesh topology. Similarly hotspot backhaul mode adapts Wimax network to haul the hotspot service of remote Wi-Fi back to the core network, many more application modes as terminal access CPN (Customer premises network access), wireless bridge etc.[7]

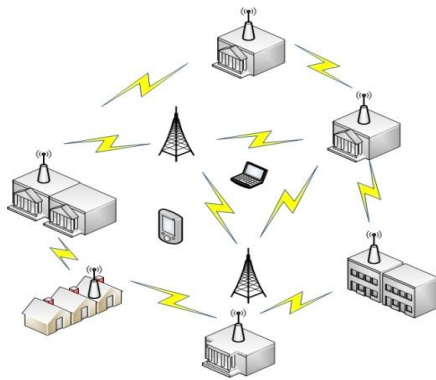


Fig 4 Mesh Topology

Advantages of Wimax

- It reduces production cost due to economies of scale.
- Wide market acceptance of developed components.
- Supply of low cost component chip
- There is a wider choice of terminals.
- Lower service rates over time.
- Lower investment risk due to multiple vendors there is freedom of choice.
- The good probability of terminal while mooring between different operators.
- Lower service rates due to cost efficiencies.
- The network can be tailored to specific. [7]

Limitations of Wimax

It is a misconception that Wimax can deliver 70M bites/S over 50Km, but in the reality when it is operating over, more than 50KM bit error rate increases. So bitrate should be lowered fixed Wimax networks has a high range and throughput due to directional antenna installed near client. The Wimax network includes CPE "Customer Premises Equipment", modem, laptops with mobile Wimax lower gain due to omnidirectional antenna.

- Performance degrades when many active layers in a single sector.
- For increasing capacity and radio cards are added to the base station.
- Through Multihop Relay (MHR) task group and independent development various

Networks Architectures are incorporated to Wimax

LiFi

Li-Fi stands for light fidelity technology and is proposed by Harald Hass in 2011. Li-Fi is the use of the visible light portion of the electromagnetic spectrum to transmit information at very high speeds. It provides transmission of data through illumination by sending data through LED light bulb that varies in intensity faster than the human eye can follow. It is a wireless optical networking technology that uses LEDs for transmission of data. It provides the best bandwidth efficiency, availability and security than Wi-Fi and Wi-max. [8] Li-Fi is a wireless communication system in which light is used as carrier signal instead of traditional radio signals [9]. Wireless radio frequencies are getting higher, complexities are increasing and RF interferences continue to grow. In order to overcome this problem in the future, light-fidelity (Li-Fi) become a better technology. Li-Fi has a thousand times greater speed than Wi-Fi and provides security as the visible light is unable to penetrate through the walls, which propose a new era of wireless communication [10]. Such technology has brought not only greener, but also safer and cheaper future of communication. So we proposed a new method that not only reduces this problem, but also increase the performance of this technology IEEE LiFi notation is shown in Fig 5.



Fig 5 IEEE Notation of LiFi

Anurag Sarkar, et.al in [11] explained working of LiFi, High brightness LED's are the heart of LiFi., If the LED is on digital 1 is transmitted, if LED off, then digital 0 is transmitted. To transmit continuously then can be switched. On and off very quickly. Light flickering is not detected by eye, so LED light set is used along controlled microchip to detect changes in light flickering to help in converting light into data in its digital form. Digital data are converted into a form of light by microchip when LED is turned on and detected by light sensitive device. Then this light is amplified, processed and fed to the device. Suggests we have to very rate at which LED's flicker depending upon the data we want to encode. An Array of LEDs and mixture of Red, Green, Blue light can be used to alter light's frequency with each frequency encoding different data channel. Fig.6 shows working of LiFi. [12]

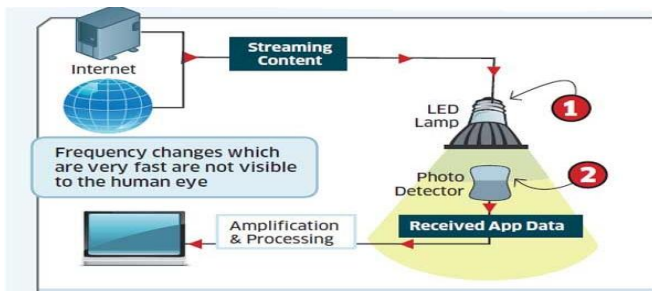


Fig 6 Working of LiFi

Advantages of LiFi

LiFi technology is based upon lights might be any sort of lights. The transfer of data takes place in the presence of any kinds of light whatever may be the bandwidth. Due to which they depend of transmitting the data or information will be great and also sufficient information, music, movies, games anything can be downloaded using very less time.[13]

1. **Capacity:** Light itself has 10000 times wider bandwidths than radio waves. Due to which the transfer of data is more effects possible. So LiFi has better capacity.
2. **Efficiency:** LED lights consume less energy and very efficient. As it uses less energy it is cheap and easy to use.
3. **Availability:** As light is present everywhere, LiFi is available everywhere. But for more efficient use of LiFi technology LED bulbs must be placed for proper transmission on data for proper transmission on the data.
4. **Security:** Light waves cannot penetrate through walls. So they cannot be misused.
5. **Bandwidth:** The visible light is unlicensed and free to use and gives a very large bandwidth.
6. **Data Density:** Li-Fi can achieve about 1000 times the data density of Wi-Fi because visible light can be well contained in the light illumination area.
7. **Low Cost:** As it requires very few components the cost of its comparatively low.

Limitations of Li-Fi

1. As LiFi technology uses light as a transmission medium, so if the receiver is somehow blocked in a way, then the signal will immediately will be cut out.
2. While data transfer interference from external light sources such as sunlight, normal bulbs, and opaque materials can cause loss of reliability and network.
3. As LiFi works in direct line of s light. S light disturbance can cause to interruption.

4. We still need radio frequency in cellular systems.[14]

Applications of Li-Fi

Some of the future applications of Li-Fi are as follows[11]:

1. **Education system:** LiFi is the latest technology that can provide fastest speed internet access. So it can replace the Wi-Fi at Educational Institutions and at companies so that they can use the same internet with faster speed.
2. **Medical applications:** As Wi-Fi uses radiation waves which can cause hazardous to the patient in OT (Operation Theatres) while radioactive operations. So Wi-Fi is not allowed there as it can block the signals.
3. **Internet in aircrafts:** In aircrafts Wi-Fi cannot be used as it can interface with the navigational systems of the pilots. Thus LiFi can be used for data transmission. LiFi can provide high speed internet using the every light source such as overhead reading bulbs.
4. **Underwater Applications:** LiFi can work underwater where Wi-Fi fails completely, thereby providing open endless opportunities for military operations.
5. **Disaster Management:** LiFi can be powerful means of communication in times of earthquakes or hurricanes. LiFi bulbs could provide cheap high speed Web Access to every street corner.
6. **Applications in Sensitive Areas:** Wi-Fi are bad for sensitive areas such as power plants. LiFi can provide much safer connectivity in such sensitive areas. Also LiFi can be used in petroleum or chemical plants where other transmission medium can be hazardous.
7. **Traffic Management:** In traffic signals LiFi can be used which will communicate with the Led Lights of the car which can help in traffic management. Also LED car lights can alert other drivers when other vehicles are too close, thus reducing the chances of accidents.
8. **Replacement for other technologies:** LiFi can be used in the areas where radio wave technologies such as Wi-Fi are banned.
9. **Spectrum Relief**
Excess capacity demands of cellular network can be offloaded to LiFi networks where available.
[15] [10]

3.Comparison

In this paper , we compare different technologies with each other and well known technology.

NFC v/s Bluetooth

Bluetooth. Bluetooth operates on features of adaptive frequency Hoping(AFH) and Forward Error Correction (FEC) It provides universal short range wireless capability. Operates in 2.4 GHz frequency band devices within 10cm range, share data having capacity 720 Kbps Authenticated technology as an acknowledgment from receiver to transmitter before making connection between devices.

NFC over Bluetooth is described as follows.

- Range of NFC lower than Bluetooth.
- Bluetooth transmission I under section,whereas NFC bidirectional.
- In crowded condition due to Interference Bluetooth can't be used or faces problem.
- Data rate of NFC less than Bluetooth 106 Kbit/Sec to 848 Kbits
- NFC operates on 13.56 MHz band.
- NFC has not used to exchange large amounts of data due to lower bit rate.
- There can be Imposter attack or theft in NFC Imposter pretend to be different Identity.

NFC v/s Bluetooth,NFC and Bluetooth are compared in table 1

TABLE 1 Comparison of NFCv/s BLUETOOTH

Aspect	NFC	Bluetooth
RFID Compatible	ISO 18000-3	Active
Standardization body	ISO/IEC	Bluetooth
Network Standard	ISO 13157 etc.	IEEE 802.15
Network type	Point to Point	WPAN
Cryptography	Not with RFID	Available
Range	< 2m	< 100 (class)
Frequency	13.56MHz	2.4-2.5 GHz
Bit rate	424 Kbit/s	2.1 Mbit/s
Set up time	< .1s	< 6s
Power consumption	< 15ma	Varies by class

WI-FI V/S WIMAX

The Paper Compared Wi-Fi VS Wimax in table 2.

TABLE 2 Comparison b/w WI-FI,WIMAX

Features	WI-FI	WIMAX
IEEE Standards	IEEE 802.11	IEEE 802.16 based
Range	Few hundred Meters	Up to 40 miles
Bit rate	Works at 2.7 bps/Hz and peak 54 Mbps at 20 MHz Channel	Works at 5 bps/Hz,Peak up to 100Mbps in 20MHz channel
Frequency Band	2.4 GHz ISM	Licensed/ Unlicensed
Channel Bandwidth	20-25 MHz	Adjustable
Radio Technology	OFDM (64-Channel)	OFDMA(256-Channel)
Bandwidth Efficiency	2.7 bps/Hz	5 bps/Hz

NFC v/s Bluetooth v/s Wi-Fi v/s WIMAX

We compare above technologies in table 3.

TABLE 3 Comparison of NFC v/s Bluetooth v/s Wi-Fi v/s WIMAX.

	NFC	Bluetooth	Wi-Fi	Wimax
Maximum coverage	< 4m	< 100 m	< 100 m	10km
Frequency of Operation	13.56 MHz	2.4-2.5 GHz	2.4.5 GHz 802.11(n)	License d/ Unlicen sed
Directional Communication	Two Way	Two Way	Two Way	Two Way
Bit rate	106/212/ 424 k bit/s	22 Mbit/sec	2.7bps/ Hz and peak 54 Mbps in 20 MHz channel	5bps/H z and peak up to 100 Mbps in 20 MHz channel
Potential Uses	e-Ticket Credit Card Payment	Communication b/w Phones Peripheral device	Wireless Internet LAN	Wireless Internet Broadband

LiFi VS Wi-Fi

Sinku U Gupta in [10] compared Wi-Fi and LiFi technology and also discuss about LiFi.

TABLE 4 Comparison of LiFi and Wi-Fi

LiFi	Wi-Fi
Data transmission using bits and light	Data transmitted through radio waves
Speed is fast	Speed is slow
	Radio spectrum range
Point to Point network technology	Point to Multipoint network technology
Range Limited up to 10m	Extended range is from 20-100m
Security More	Less secure
Market maturity, low	High Market maturity
Data density High	Data density low
Less Cost	Expensive
Operating frequency 100 of THz	10 GHz
Data density is more	Data density is less
Bandwidth expansion is exceptional	Bandwidth expansion Limited

LIFI VS WI-FI VS WIMAX

Md. Bipetal in [16] evaluated and studied LiFi and then compared with Wi-Fi, Wimax on the bases of Interoperability, Last effectiveness manageability, Interfere etc. He also discussed the advantages of LiFi.

TABLE 5 Comparison b/w Wi-Fi/ LiFi/ WIMAX

Features	Wi-Fi	LiFi	Wi-MAX
Speed	54Mbps	7Gbps	70-100 Mbits/sec
Connection	Wireless EMF	Light	Wireless EMF

Security	Good	Excellent	Better
Reach	Excellent	Excellent	Excellent
Impact	unknown	None	unknown
Cost	Good	Low	Good
Bandwidth	Limited	Expendable	Dynamic

4. CONCLUSIONS

This chapter includes the conclusion of this dissertation with the suggestion for further work. Wireless networks have decreased installation and deployment costs, increased productivity and better convenience through flexibility compared to wired networks. We concluded that NFC is a short-range technology. NFC would enable all the users to make payments simply by tapping their mobile phones with mobile phone reader like a debit card or credit card transactions. Many banks, mobile operators, vendors and companies are implementing NFC technology. NFC needs collaboration among banks, merchants and mobile companies to provide a secured platform to users that support NFC technology. NFC is better than Bluetooth and is a short range technology. WI-MAX is superior to Wi-Fi and other short range technologies. WI-MAX is the dominant standard for wireless MAN networks in world technology. WI-Max has better reliability, flexibility than other technologies. Li-Fi is the only solution for high speed, bidirectional, fully mobile wireless communication. Li-Fi is also a very effective alternative to electromagnetic spectrum and is extended to many platforms such as educational field, medical field, industrial area and many more. As Light is everywhere and free to use. With the growing technologies and increasing use of internet services, possibilities is very high that use of LiFi technology increases and every will be replaced by li-Fi bulbs and might be used like a Wi-Fi hotspot for the transmission of data .A cleaner, greener and brighter future and environment will be granted by using Li-Fi technology. It gives a golden opportunity to replace or to give an alternative to the radio based wireless technologies. GiFi follows tradition of Li-Fi and more and more research can be done. It has more no. Of applications and can be used in devices such as smartphones, wireless network. We should focus on LiFi and its related technologies, but, we also need to follow on Wi -MAX. The future Li-Fi implementation cost will be randomly decreased because of the production

of micro-chip transceiver, integration of transceivers with computers and mobiles, replacement of semiconductor diodes by laser diodes and the reduction of modulation complexity with a different algorithm. All mobile screens will come with LiFi Connected Screens for charging purposes and Li-Fi internet i.e. transmitter and receiver of internet data which is practiced by Sun partner Technologies. In the near future, Li-Fi technology will replace other technology markets as a result of data rate, data security and free spectrum of un-limited bandwidth and the power consumption by huge radio base stations will be reduced.

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