**THE EVOLUTION OF WIRELESS COMMUNICATION: ON HIFI, LIFI AND WIFI**

**USMAN UMAR**

**(ST/CS/ND/21/030)**

**A SEMINAR PRESENTED TO THE DEPARTMENT OF COMPUTER SCIENCE, SCHOOL OF SCIENCE AND TECHNOLOGY, FEDERAL POLYTECHNIC MUBI, ADAMAWA STATE, NIGERIA**

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**Abstract**

Computer networks have played a major role in expanding the operational boundaries in

*Computer networks have played a major role in expanding the operational boundaries in organizations today. Until now traditional methods of networking, which involves computers, wired directly to a hub or switch are the norm. Recent advances in networking technology have made it possible for devices to communicate using various light and wave emitting technologies. Wireless Fidelity (Wi-Fi), Light Fidelity (Li-Fi) and High-Fidelity communication technology has made tremendous impact in the growth of broadband wireless networks. Wireless broadband networks are expected to grow in terms of broadband speed and coverage. This paper explores their meaning, advantages and applications of the various communication methods****.***

**Keywords**: High Fidelity, Light Fidelity, Wireless Fidelity, Network.

**Introduction**

In wireless communication network which we use, face the difficulty of access speed when connected to various devices. It creates a general problem when connected to multiple users, the fixed bandwidth which is available for the particular user makes it more difficult to revel high data transfer rates and connect to a secure network. When the many users increase, it creates some aperture between the connections through which it is convenient for the hackers to get through the connections. Nowadays, the rising demand for wireless data communication, the existing radio spectrum below 10 GHz has become inadequate. The wireless communication company has replied to this challenge by considering the radio spectrum beyond 10 GHz. There are many reasons which have been considered for the necessity to converge wireless network technologies. Expected to ever-increasing stipulation for wireless communications, Wi-Fi is facing many challenges, manageability, service scalability, capacity, namely interoperability, cost effectiveness, availability, efficiency and security (Huang et al., 2015).

## Literature review

This review of literature focuses on the applications and improvement of wireless technology. Highlighting some of the possible ways via which wireless technology has been employed in our daily lives. Tan-Hsu, et al. (2017), presented a new ubiquitous emergency medical service system (UEMS) that consists of a ubiquitous tele-diagnosis interface and a traffic guiding subsystem. The UEMS manages the sensor wires for eliminating inconvenience for both patients and paramedics in an ambulance, providing ubiquitous accessibility of patients’ biosignals in remote inaccessible areas using wireless biosensors, and offering availability of real-time traffic information using webcam; can be simultaneously transmitted to an emergency room for pre-hospital treatment via WiMAX/3.5 G networks. Results validates the feasibility of the proposed system for application in real-life scenarios (Gomez & Kai, 2015).

Bassma and Vijay (2019), investigated wireless virtualization (WiVi) where wireless resources for virtual wireless networks are adapted based on availability of leasable RF slices as well as the demands from the users of virtual wireless networks. With the help of software defined network controller, wireless infrastructure providers (WIPs) slice their RF bands to sublease those slices to mobile virtual network operators (MVNOs). In wireless virtualization, MVNOs work as independent service provides, and thus, the end users negotiate directly to MVNOs regardless of WIPs used behind the scene.

Alfonso and Matilde (2019), proposed a network and physical layer solution based on LTE-A and future 5G capabilities to improve public safety communications, which are currently conveyed through narrowband private mobile radio (PMR) systems and mainly focused on offering limited voice services. Performance was analyzed in terms of capacity of an amplify-and-forward relay network when massive multiple-input multiple-output (MIMO) textile technology is deployed at the user side. Additionally, the optimal relay location was evaluated, with the purpose of maximizing the achieved capacity in the two-hop network. Results illustrated the viability of the proposed design, specifically for low SNR scenarios where the relay node will allow us to extend the coverage and the MIMO textile technology to improve the capacity.

Yvonne and Keat (2020), reviewed and briefly describes some common wireless technologies and modern advancements, as well as their strengths and suitability for use in implantable medical devices. The applications of these wireless technologies in treatments of orthopedic and cardiovascular injuries and disorders are described. Such that, with remote data collection and control of implantable devices, these wireless technologies help researchers and clinicians to better understand diseases and to improve medical treatments. And then concludes with a discussion on the technical challenges and potential solutions of implementing wireless technologies in implantable devices.

The crucial features of conductive and non-conductive textile materials used in designing wearable antennas were reviewed. This review can be the benchmark used to choose the materials and techniques to design a textile wearable tag in the Body Area Network. The embroidery textile slotted patch design antenna with specific materials proved in this study to have high performance (Bahaa et al., 2020).

**Characteristics of Wireless Technology**

Here is some inherent characteristic of wireless communications that make the networks more efficient in usability to the users of networks nodes (Prashant et al., 2015):

1. Mobility: Users can access files, network resources, and the Internet without having to physically connect to the network with wires. The Wireless users are provided with access to the real time information even when they are away from their home/offices and even from their society.
2. Rapid Installation: The time required for installation is reduced as network connections can be made without moving or adding wires, or pulling them through walls or ceilings, or by making modifications to the infrastructure cable plant.
3. Flexibility: Enterprises can also enjoy the flexibility of installing and taking down wireless devices in locations for temporary needs such as a conference, trade show, or standards meeting. The Wireless users are provided with access to the real time information even when they are away from their nativity.
4. Multihopping: A multihop network is a network the spot that the path from source to destination traverses’ other nodes.
5. Scalability: Wireless network topologies can easily be configured to meet specific application and installation needs and to scale from small peer-to-peer networks to very large enterprise networks that enable roaming in a broader area.
6. Cost: Networks can be extended at any level with limited cost or almost no cost, no wired system and hence setting up a wireless network is much easy and fast; it eliminates the need for pulling out the cable through walls and ceilings.
7. Self-organization: the ad hoc network must autonomously determine its very own configuration parameters including: addressing, routing, clustering, position identification, power control, and so on.
8. Energy conservation: most ad hoc nodes have limited power supply, no power to generate their particular power. High efficiency protocol design is important for longevity with the mission.

**Advantages of Wireless Technology**

There are numerous advantages of Wireless Communication Technology, Wireless Networking and Wireless Systems over Wired Communication such as (Mohaiminul & Shangzhu, 2019):

1. Cost: The cost of installing wires, cables and other infrastructure is eliminated in wireless communication and hence lowering the overall cost of the system compared to wired communication system. Installing wired network in building, digging up the Earth to lay the cables and running those wires across the streets is extremely difficult, costly and time-consuming job. Thus, wireless communication such as Wi-Fi or Wireless LAN is the only option.
2. Mobility: This is the main advantage of wireless technology system. It offers the freedom to move around while still connected to network.
3. Ease of Installation: The setup and installation of wireless technology network’s equipment and infrastructure is very easy compared to wired technology. Also, the time required to setup a wireless system like a Wi-Fi network for example, is very less when compared to setting up a full cabled network.
4. Reliability: Since no cables and wires involved, no chance of communication failure due to damage of these cables which may be caused by environmental conditions, cable splice and natural diminution of metallic conductors.
5. Disaster Recovery: In case of accidents due to fire, floods or other disasters, the loss of communication infrastructure in wireless communication system can be minimal.

**Wireless Fidelity Technology**

Wireless Fidelity (Wi-Fi), IEEE 802.11 standard, is also known as Wireless Local Area Network (WLAN). It is a protocol used to connect devices wirelessly, to provide internet access and also connect different devices to the wired network. Its range is always greater than 100 meters and works on either on 2.4 GHz or 5 GHz. These frequencies are the part of the ISM band and are free to use. Wi-Fi uses radio waves to transmit information for wireless communication between devices or internet access. To establish communication, there are two devices required, namely Wireless adapter and Wireless router Himanshu and Hardik (2016), highlighted three major standards applied for the security purpose of Wi-Fi which are: Wireless Equivalent Privacy (WEP) uses 40- or 104-bit encryption and WPA provides authentication; Wi-Fi Protected Access (WPA); Wi-Fi Protected Access-2 (WPA-2) uses 128-bit encryption methods. Wi-Fi uses 2.4 or 5GHz high frequency so that it can carry more data. Wi-Fi can be used to share internet, to share files, to share resources between devices and much more.

## Advantages of Wi-Fi Technology

1. Wi-Fi allows LANS to be deployed without cabling for client’s devices, typically reducing the costs of network deployment and expansion. Spaces where cables cannot be run, such as outdoor areas and historical buildings, can host wireless LANS.
2. Wi-Fi is widely available in more than 250,000 public hotspots and tens of millions of homes, corporate and university campuses worldwide. WiFi Protected Access (WPA and

WPA2) is not easily cracked if strong passwords are used and WPA2 encryption has no known weakness. New protocols for Quality of Service make Wi-Fi more suitable for latencysensitive applications.

1. As of 2007, wireless network adapters are built into most modern laptops. The prices of chipsets for Wi-Fi continues to drop, making it an economical networking option included in ever more devices. Wi-Fi has become widespread in corporate infrastructures, which also helps with the deployment of Real Time Location Systems (RFID) technology that can ride on Wi-Fi.
2. Different competitive brands of access points and client network interfaces are Inter-operable at a basic level of service. Products designated as ‘Wi-Fi Certified’ are backwards interoperable. Wi-Fi is a global set of standards. Unlike mobile telephones, any standard Wi-Fi device will work anywhere in the world.

**Light Fidelity Technology**

Li-Fi is a state-of-the-art technology for short range wireless communication system which is convenient for data transmission via LEDs by illumination. Light Fidelity or Li-Fi is a Visible Light Communications (VLC) system running wireless communications travelling at very exalted speeds. The Li-Fi utilization common household LED (light emitting diodes) light bulbs to enable data transfer, boasting speeds of up to 224 gigabits. Li-Fi stands for Light Fidelity. Li-Fi is transmission of data through illumination by taking the fiber out of fiber optics by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. Li-Fi is the term some have used to label the fast and cheap wireless-communication system, which is the optical version of Wi-Fi. Light reaches nearly everywhere so communication can also go along with light easily. Light Fidelity is a branch of optical wireless communication which is an emerging technology (Yvonne & Keat, 2020).

Li-Fi technology can find application in an extensive variety of fields. Li-Fi is particularly appropriate for many popular internet content consumption applications such as video and audio downloads, live streaming. These applications place bulky demands on the downlink bandwidth, but need minimal uplink capacity (Bahaa et al., 2020). A detailed discussion of its various applications is given below.

1. **Smart Lighting:** The private or public lighting including street lamps can be utilized to endow LiFi hotspots and the same communications and sensor infrastructure can be consumed to monitor and control lighting and data.
2. **Mobile Connectivity:** The smart phones, tablets, laptops, and other mobile devices can interconnect directly using Li-Fi. Use short range links give very high data rates and also provides security.
3. **RF Avoidance:** Some people’s insistence they are hypersensitive to radio frequencies and are looking for an alternative. Li-Fi is a better solution to this problem.
4. **Location Based Services (LBS):** Theextremely accurate location-specific information services such as advertising and navigation that enables the recipient to receive appropriate, pertinent information in a timely manner and location.
5. **RF Spectrum Relief:** Additional capacity demands of cellular networks can be offloaded to Li-Fi networks where available. This is circumstantially effective on the downlink where bottlenecks tend to occur.
6. **Education:** Li-Fi is the leading technology that makes better the internet accessibility speed with high bandwidth. Consequently, educational institutions and organizations can use this technology for internet access with fast speed for video conference, digital tutorial downloads and online learning.
7. **Disaster Management:** Li-Fi can be installed, the communication in natural disaster times such as earthquakes, cyclones, tsunami or hurricanes. Li-Fi bulbs could be fixed in the streets to provide light and economical high speed internet access in each corner of the street.
8. **Hazardous Environments:** Li-Fi provides a safe substitute to electromagnetic interference from radio frequency communications in environments like as mines and petrochemical plants.
9. **Hospital & Healthcare:** Li-Fi no release electromagnetic interference and so does not interfere with medical instruments, nor is it interfered with by MRI scanners.
10. **Aviation:** Li-Fi can be used to reduce weight and cabling and add pliability to seating layouts in aircraft passenger cabins where LED lights are beforehand deployed. In the flight entertainment (IFE) systems can also be supported and integrated with passengers’ own mobile devices.
11. **Game Consoles:** A modern idea would be to put sensors on a television in order to receive information from game consoles. This would allow the unit to be placed literally somewhere within the room as long as there is a direct line of sight to the sensor.
12. **Underwater Communications:** Due to strong signal absorption in water, RF use are unsuitable. Acoustic waves have the mostly low bandwidth and disarrange marine life. Li-Fi provides a solution for short-range communications.

**High Fidelity System**

High fidelity (Hi-Fi or HiFi), is a term used by listeners, [audiophiles](https://en.wikipedia.org/wiki/Audiophile), and [home audio](https://en.wikipedia.org/wiki/Home_audio) enthusiasts to refer to high -quality [reproduction of sound](https://en.wikipedia.org/wiki/Sound_reproduction) (Gomez & Kai, 2015). This is in contrast to the lower quality sound produced by inexpensive audio equipment, [AM radio](https://en.wikipedia.org/wiki/AM_radio), or the inferior quality of sound reproduction that can be heard in recordings made until the late 1940s.150 years ago music was a service. Making business with music was only possible by giving a live performance in a music theatre. Music consumption was not possible without music performers. Separating music production from music consumption was not possible until the late 19th century when Thomas Edison invented music became a product. In the next 100 years the music business grew from a little seed to a very giant tree and began to do global business when it enabled everybody to buy recorded music and music playing devices. In the late eighties this industry reached its zenith. The invention of the CD brought maximum quality and high comfort into every home. The industry made a rather easy business because every music enthusiast replaced his analog records by digital audio CDs. The world seemed to be perfect (Gomez & Kai, 2015).

## Advantages of a Hi-Fi System

[Hi-fi audio systems](https://www.avi-utah.com/2018/09/18/what-is-hi-fidelity-audio/) are beneficial for a number of reasons, from the quality of sound provided to the comprehensive component coverage included. Another major plus, especially when compared to other high-quality audio systems: Hi-fi systems are customizable to an incredible degree, depending on your needs for sound in various rooms and in differing noise conditions.

Each unit you include in your system has one specific task it’s meant to perform, meaning it can devote 100% of its energy to doing so. This is what helps reduce noise or distortion to bring you the best possible sound at all times.

Our subsequent sections will look into the primary components we’ll source for you when installing a McIntosh or another type of component audio system.

## Audio Sources

For starters, we’ll spend time discussing the sources of your audio ahead of time. Are you bringing in musical files from a hard drive, or do you mostly utilize streaming services like Spotify or Apple Music? If so, we’ll recommend a network player that can properly combine your tracks from each of these sources.

What about those who have an old vinyl record collection? No problem – we can help you connect a record player as part of the system. The same goes for CDs or any audio format you can think of.

## Amplifier Choice

From here, it’s time to consider the amplifier, which is in charge of powering your music and controlling volume. Depending on your needs, we may recommend a power amp, a pre-amp, an integrated amp or some other solution.

## Speakers

Finally, you have to select your speaker units to provide the actual sound itself. We’ll give you advice on the size of speakers you should consider based on room size and positioning needs, ensuring you don’t choose options that are too small or too large.

## System Cables

In addition to your actual units, we’ll arrange all your cable and wire connections simply and easily. We handle everything from basic power cables to interconnects and speaker cables, which we’ll measure to the precise length you need them so you won’t have cables hanging around or getting in your way.

**Conclusion**

This paper is focused on elements of wireless technology, types, advantages, as well as literature review on various applications and improvements of wireless technology and systems. Additionally, a comparative analysis between the various types of wireless technology based on different aspects and their characteristics was discussed. Although wireless technology is not void of challenges, issues with security regarding access to a person’s personal information or the negative impact on society are a few things that are holding back the progress that wireless technology could be making. But with more research and experimentation, the challenges faced by wireless technology can be reduced. Wireless technology will be very important in the near future where the need for wires connecting individual devices seems to be coming to an end.

**Recommendations**

The paper also recommends that users should change from pure consumers to music artists because they will be enabled to (re)create content. Together with a very user-friendly, light weighted digital rights management system the peer-to-peer sharing network will build a marketing and distribution platform for young and often unknown artists.

The paper also recommends that based on the advantages of the technology reviewed users should use the appropriate and suitable technology for the suitable task as reviewed in this paper.

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