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Wireless Communication: A Brief Review

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ABSTRACT: Within the communication arena, wireless communication is one of the fastest developing and most exciting technology domains. Wireless communication is a way of delivering data from one location to another without the use of wires, cables, or any other physical media. In a typical communication system, data is transferred from a transmitter to receivers located at various locations. Wireless communication allows the transmitter and receiver to be positioned anywhere from a few meters (like a television remote control) to thousands of kilometres apart (Satellite Communication).We live in a world of communication, and wireless communication in particular is an important component of our daily routine. Mobile phones, GPS receivers, remote controls, Bluetooth audio, and Wi-Fi are just a few of the commonly utilized Wireless Communication Systems in our daily lives.

KEYWORDS: Bluetooth, Wi-Fi, WiMAX, EM waves, Encoding, Encryption, Multiplexing, Modulation.

I.INTRODUCTION

As communication systems are frequently wired or wireless, the channel utilized for communication is frequently guided or unguided. The medium in Wired Communication can be a physical path such as Co-axial Cables, Twisted Pair Cables, and Glass Fibre Links, among others, that leads the signal from one place to another.
In wireless communication there is no physical medium. Antennas are used to transmit and receive signals in wireless communication, despite the fact that there are no cables involved. Antennas are electrical devices that convert electrical signals to radio signals and the other way around using Electromagnetic (EM) Waves. Waves that travel through space are known as electromagnetic waves. As a result, an antenna is used by both the transmitter and the receiver [1].
The electromagnetic energy of an electromagnetic field is carried over space by electromagnetic waves. Gamma Rays, X-Rays, Ultraviolet Rays, visible light, Infrared Rays, Microwave Rays, and Radio Waves are all examples of electromagnetic waves. In wireless communication, electromagnetic waves (typically radio waves) are used to hold the signals. Within the form of time-varying sinusoidal waves, electromagnetic radiation comprises of both electric and magnetic fields. Because both of these fields oscillate perpendicular to one another, the direction of electromagnetic radiation propagation is also perpendicular to both of them.

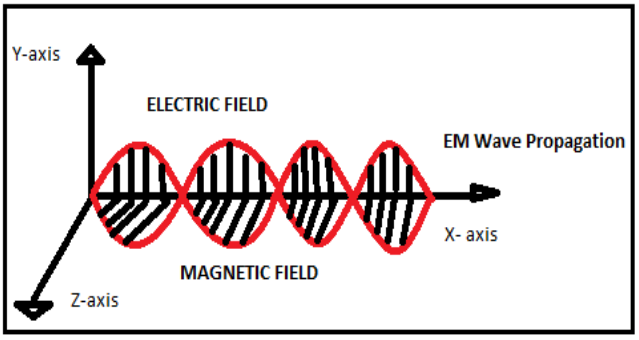

Fig.1 EM wave propagation [9]

II. HISTORY OF WIRELESS COMMUNICATION

Marconi successfully tested wireless telegraphy in 1897 by transmitting EM waves over a short distance of 100 meters. This demonstration paved the path for radio communication, and the term "radio" is derived from the word "radiant." Trans-Atlantic radio transmission had been established by the early 1900s, with Marconi successfully transmitting

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messages in Morse code. Since then, wireless communication and wireless system technology has improved significantly, allowing transmissions over longer distances at lower costs with less expensive devices [1].

III. ADVANTAGES AND DISADVANTAGES OF WIRELESS COMMUNICATION

Wireless Communication Technology, Wireless Networking, and Wireless Systems have various advantages over wired communication, including cost, mobility, ease of installation, and reliability.

1. Cost

When compared to wired communication, wireless communication removes the cost of constructing wires, cables, and other infrastructure, lowering the overall cost of the system. Installing a wired network in a structure, excavating the world for cables, and connecting those wires across streets is a tough, expensive, and time-consuming task.

2. Mobility

As previously said, the fundamental benefit of a wireless communication system is mobility. It allows you to move about while staying connected to the network.

3. Installation Procedural Ease

The equipment and architecture of a wireless communication network are relatively simple to set up and install because we don't want to deal with the hassle of cables. In addition, the time necessary to set up a wireless system, such as a Wi-Fi network, is far less than that required to set up a full cabled network.

4. Reliability

Because wireless communication does not employ cables or wires, there is no risk of communication failure due to cable damage, which can be caused by environmental factors, cable splices, or natural deterioration of metallic conductors.

5. Recovering from a disaster

The loss of communication infrastructure in wireless communication systems is frequently modest in the event of catastrophes caused by fire, floods, or other disasters.

Wireless communication has a number of advantages over conventional communication, but it also has a handful of drawbacks. Interference, security, and health are the most serious drawbacks.

1. Interference

As a result, there's a good probability that radio signals from one wireless communication system or network will interfere with signals from other systems or networks.

2. Security

The security of data is one of the most pressing challenges with wireless communication. Because the signals are broadcast in free space, it's possible that an intruder may intercept them and copy sensitive data.

3. Health Issues

Constant exposure to radiation of any kind can be harmful. RF radiation should be avoided to the greatest extent possible, despite the fact that the levels of RF energy that will cause damage remain unknown [2].

IV. WIRELESS COMMUNICATION SYSTEM'S BASIC ELEMENTS

The Transmitter, Channel, and Receiver are the three main components of a typical Wireless Communication System. The block layout of a wireless communication system is depicted in the Fig.2 below [2].

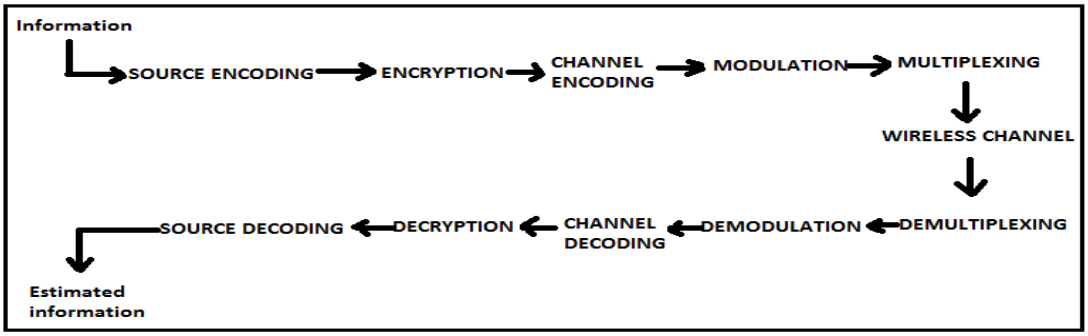

Fig.2 Basic elements of wireless communication system [10]

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1. The Transmission Path

Encoder, Encryption, Modulation, and Multiplexing are all part of a Wireless Communication System's typical transmission path. The signal from the source is sent through a Source Encoder, which turns it into a structure that can be processed using signal processing techniques.

In order to maximize resource efficiency, the redundant signal record is removed in this procedure. This signal is then encrypted using an Encryption Standard to ensure that the signal and data are secure and that unauthorized access is prevented.

Channel encoding is a technique that is applied to a signal to reduce the effects of noise, interference, and other factors. A little amount of redundancy is added to the signal during this process, causing it to become strong towards noise. The signal is then modulated using an appropriate Modulation Technique (such as PSK, FSK, or QPSK, for example) so that it may be transmitted using an antenna with ease.

To share the valuable bandwidth, the modulated signal is multiplexed with distinct warnings using particular Multiplexing Techniques such as Time Division Multiplexing (TDM) or Frequency Division Multiplexing (FDM).

2. The Channel

In Wireless Communication, the channel represents the signal's transmission medium, which is open space. The nature of a wireless channel is unexpected, as well as varied and random. A channel may be affected by interference, distortion, noise, scattering, and other factors, and as a result, the acquired signal may be riddled with mistakes.

3. The Reception Path

The Receiver's role is to collect the channel's signal and reproduce it as the source signal. Demultiplexing, Demodulation, Channel Decoding, Decryption, and Source Decoding are all part of a Wireless Communication System's reception path. The receiver's venture is just the inverse of the transmitter's, based on the components of the reception path. The Demultiplexer extracts the signal from the channel and separates it from other signals. The authentic message signal is recovered when the character indications are demodulated using appropriate Demodulation Techniques. Using the Channel, the unnecessary bits from the message are removed. Because the message is encrypted, decrypting it removes the security and converts it into a simple series of bits. Finally, the Source Decoder receives this signal in order to recover the unique delivered message or signal [2].

V. TYPES OF WIRELESS COMMUNICATION SYSTEMS

Video conferencing, cell phones, paging, TV, radio, and other services are available through wireless communication systems. Specialized Wireless Communication Systems have been developed in response to the demand for a wide range of communication services. The following are some of the most important Wireless Communication Systems available today [7]:

1. Television and Radio Broadcasting
2. Satellite Communication
3. Radar
4. Mobile Telephone System (Cellular Communication)
5. Global Positioning System (GPS)
6. Infrared Communication
7. WLAN (Wi-Fi)
8. Bluetooth
9. ZigBee
10. Paging
11. Cordless Phones

VI. MODES OF TRANSMISSION

Simplex, Half Duplex, and Full Duplex are the three types of wireless communication structures. A one-way conversation is referred to as a simplex dialogue. A good example is the radio broadcasting system. Half Duplex is two-way communication, but not at the same time. A good example is walkie-talkie (civilian band radio). Full Duplex is two-way communication that takes place at the same time. Cell phones are the best example of full duplex. In full duplex transmission mode, the sender and receiver can communicate at the same time. Data can be sent and received

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simultaneously by both the transmitter and the receiver. Full duplex transmission mode works in the same way as a two-way street, allowing traffic to flow in both directions at the same time. In a Smartphone discussion, for example, two humans connect, and each is free to talk and listen at the same time.

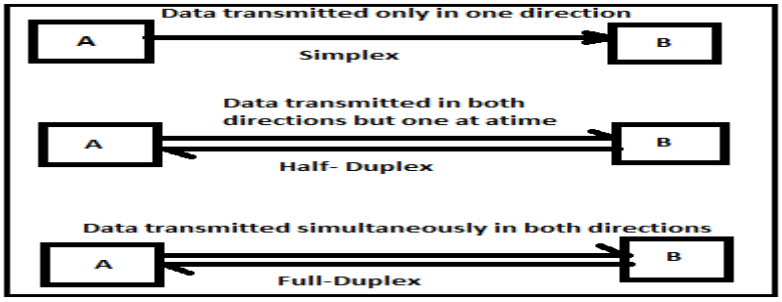

Fig.3 Transmission mode

VII. EVOLUTION OF WIRELESS COMMUNICATION

Table1. Comparison of different generation of wireless communication [5]

GENERATION	SPEED	TECHNOLOGY	KEY FEATURES
1G (1970-1980s)	2.4 kbps	AMPS,NMT, TACS	Only voice services
2G (1990-2000)	40 kbps	TDMA-GSM, CDMA	Voice and data services
2.5G to 2.75G (2001-2004)	400 kbps	GPRS	Voice, data and web mobile internet, low speed streaming services and email services.
3G (2004-2005)	7 Mbps	CDMA 2000 UMTS, EDGE	Voice, data, multimedia, support for smart phone applications, video calling, T.V streaming.
3.5 G (2006-2010)	42 Mbps	HSPA	All the services from 3G network with enhance speed and more mobility.
4G (2010 Onwards)	100-300 Mbps	WiMax, LTE and Wi-fi	High speed, High quality voice over IP, HD multimedia streaming, 3D gamming, HD video conferencing and worldwide roaming.
5G (2019 Onwards)	1 to 10 Gbps	LTE advanced schemes, OMA and NOMA	Super fast mobile internet, security and surveillance.

VIII. CONCLUSION

This study aimed to address wireless network systems, which are increasingly being favoured by many users over wired networks. The paper begins with an overview of wireless networking and a discussion of the various technologies employed. Wireless networks give freedom from location restrictions, scalability, and flexibility. The paper found that the most appealing feature of wireless networks is their mobility. Despite their benefits, there are a few that have been highlighted. Wireless networks have a number of challenges that need to be addressed. Specifically, concerns with quality assurance and security.

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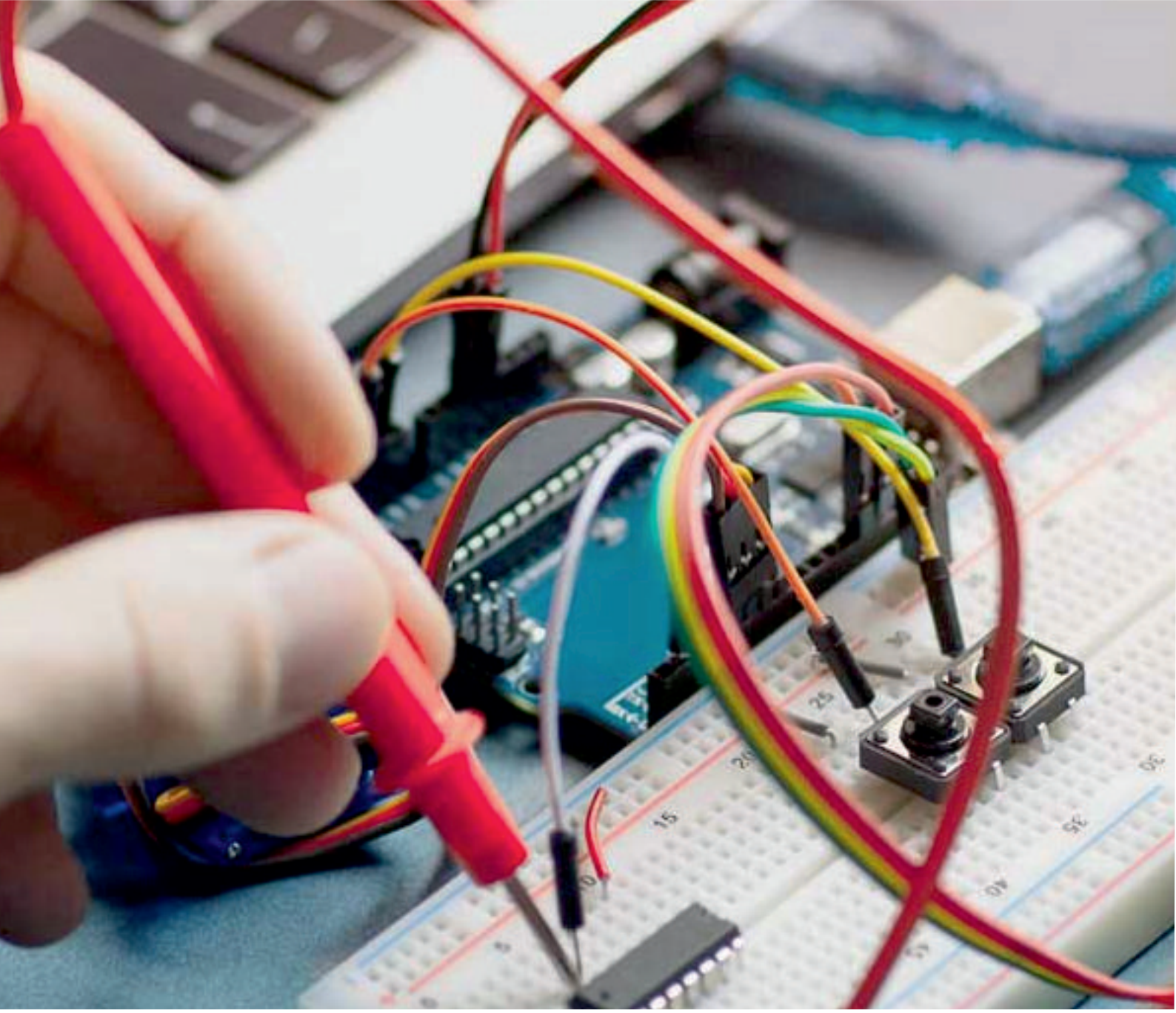

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