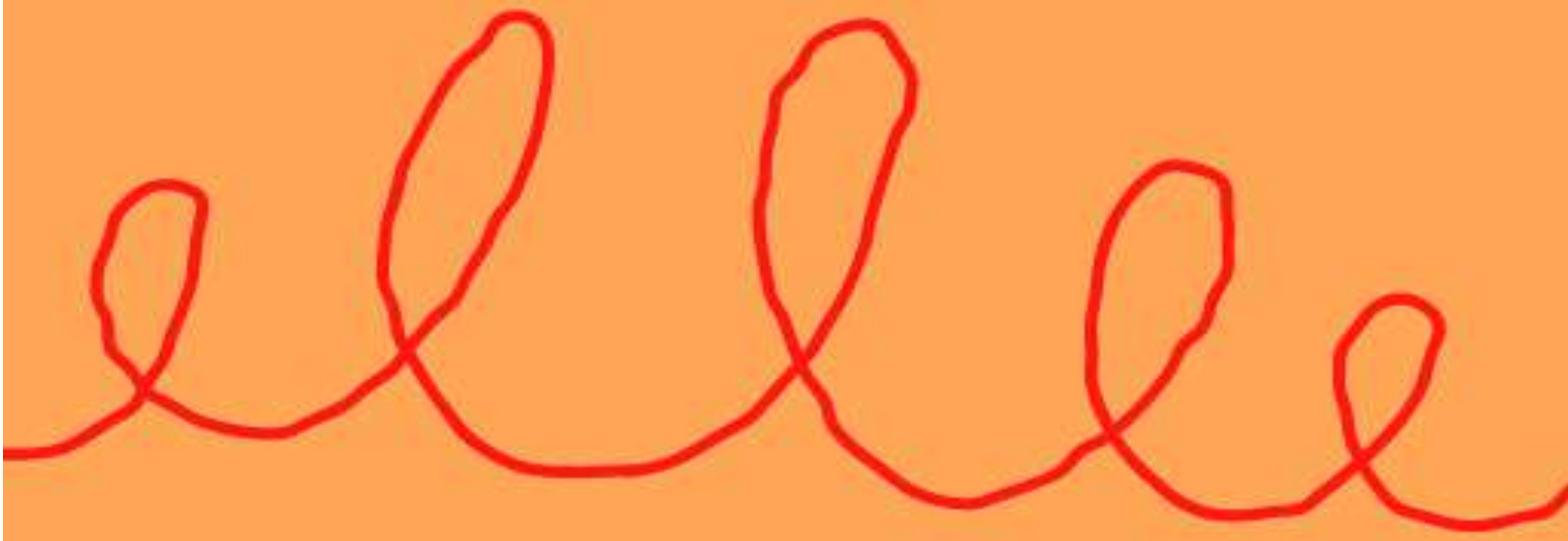
5 GENERATION OF WIRELESS COMMUNICATION



by Rodzah & Nor Asilah

5

GENERATION

OF

WIRELESS COMMUNICATION

COPYRIGHT

Writers

Rodzah binti Hj Yahya
Nor Asilah binti Surip
Electrical Engineering Department
Politeknik Merlimau Melaka

Published in 2021

e ISBN 978-967-2762-03-4

Published by:

Politeknik Merlimau, Melaka

KB1031 Pej Pos Merlimau,

77300 Merlimau Melaka

EDITORIAL BOARD

ACKNOWLEDGEMENT

In the name of Allah, Most Gracious, Most Merciful.

I would like to thank to e-learning group that made this task possible. Their support and advice propelled me through all the stages in writing this e-Book. I would also like to thank my e-Book partner for making it an exhilarating moment and for the thoughtful and accurate comments and suggestions.

I also want to say a special thanks to my family for all the support and understanding of those who persist in my efforts to expand my e-Book. Their prayers for me are what have supported me all this time.

Finally, I want to thank to Allah for letting me go through all the problems. It is Allah who gives inspiration and ideas from day to day until it is successfully completed. Only with your permission, this writing is completed successfully.

Alhamdulillah

PREFACE

All praise and gratitude to the Almighty. With His permission, this e-Book can be produced. This writing is concerned with the way humans communicate wirelessly without any interference on the near and far.

Wireless networks are becoming very important in today's digital age. GSM makes world communication happen smoothly. The evolution of wireless networks from 2G, 3G to 4G and 5G makes wireless communication the primary and preferred human intermediary medium. 5G in the evolution of communication makes wireless communication grow fast and fast.

The agency in charge of wireless networks has turned human beings into hardcore users in achieving the level of wireless communication globally.

Finally, this e-book will be a reference material in the field of wireless in communication. I am very aware and understand that this writing is still lacking and imperfect, so I am willing to accept suggestions for improvement. All the cooperation and retention of the readers is greatly appreciated and thanked.

TABLE OF CONTENT **PAGE**

INTRODUCTION

Communication has evolved into wireless communication, allowing us to send and receive data wirelessly. Data must be sent between two radio-wave-capable devices via a transmitter and a receiver. The transmitter uses a sine function to encode audio and video data and then broadcasts those electromagnetic waves into the air. With today's cutting-edge technical proficiency, all communication in the twenty-first century is digital. Communication has become impossible due to technological advancements, and even fundamental human needs are no longer met.

Better and more flawless communication techniques result from the management and upgrading of communication mediums. The communication agency's role is to enhance various communication demands in accordance with current needs. The development of wireless networks has made it possible to distribute information in a number of ways that are both rapid and easy. Improving and improving the system allows people to go beyond what they thought was possible. Telecommunications is growing at a rapid pace, allowing people to communicate through a variety of channels, allowing them to completely adopt their lifestyle patterns.

1G, 2G, 3G, 4G and 5G are the evolving stages of wireless communication. There are five generations of mobile networks. Mobile networks, contrary to popular belief, have been around since the 1980s, with new generations launched every decade or so. Generation (G) is a standard network developed for telephone networks. The speed of such networks improves with each generation. The first generation (1G) mobile phones perform the basic functions of a mobile phone, which is only voice communication.

The next generation is 2G has started and provided improvements and will increase the weaknesses of the first generation. This second iteration uses digital signals rather than analog signals and features a new digital instrument for wireless transmission known as the Global System for Mobile Communications (GSM). The main goal here is to create more reliable and secure communication alternatives. Over the years, SMS, conference calls, call

on hold, internal roaming and other capabilities have been added, and with improved data rates, the 2G standard can be used to send and receive text messages as well as email.

The development of the next generation of networks called 3G is a term we first hear when mobile phones are widely available to the general public. With this standard of technology, actions such as downloading videos, exchanging photos, video chatting, playing games and interacting in social networking platforms become easy and possible. The objective of 3G is to increase data capacity and data transfer services while keeping costs low and supporting a wide range of applications.

Long Term Evolution (LTE) became mainstream in this generation as 4G was launched by upgrading existing technologies. This allows the device to have faster data speeds and more multimedia capabilities. Faster speeds are expected, such as greater quality, more security and a cheaper price.

The fifth generation (5G) refers to the creation of new standards to accommodate the evolving Internet of Things. In particular, 5G -capable technologies are designed to accelerate data even further while lowering latency, increasing capacity and reliability, and maintaining consistency and performance. While this generation is still in its infancy, it is designed to create a more uniform experience for everyone.

WHAT IS WIRELESS

A wireless remote is one that operates without the need of cables or wires specifically, and instead relies on the transmission of electromagnetic waves. Using electromagnetic waves to send and receive voice and data in free space, the information from the sender to the receiver is transmitted across a channel. Each channel has a set bandwidth and capacity based on its frequency (bit rate). Information can be transmitted in simultaneously and independently through many channels. Modern protocols are required for new radio data transfer. Figure 1 is an overview of how the wireless signals are in our atmosphere and makes communication can occur. Voice or image can be sent and communication can occur.

Figure 1: Wireless signal symbol

Source: Shahid Abdullah from Pixabay

WIRELESS COMMUNICATION

Wireless communication is the fastest developing technology and it has grown in importance since the introduction of 5G networks. The researchers must have a fundamental understanding of the evolution of wireless communication systems. The following is a

timeline of wireless communication's history and advancement. Electro Magnetic (EM) waves are critical components in the progress of wireless communication.

Figure 2: Wireless Communication Scenario

Source: Joseph Mucira from Pixabay

Communication systems can be wired or wireless, and the communication medium can be directed or unguided. The medium in Wired Communication is a physical channel, such as Co-axial Cables, Twisted Pair Cables, and Optical Fibre Links, that directs the signal from one place to another.

This sort of medium is known as a Guided Medium. Wireless communication, on the other hand, does not require any physical media and instead sends the signal across space. Because space only allows for signal transmission without direction, the medium utilised in Wireless Communication is referred to as Unguided Medium. Antennas are electrical devices that convert electrical impulses into radio signals via Electromagnetic (EM) waves and vice versa. Electromagnetic waves are waves that travel through space. As a result, an antenna is used by both the transmitter and the receiver.

ADVANTAGES OF WIRELESS

Mobility

The primary advantages of a wireless communication system is mobility part. It enables us to move about while being connected to the network.

Installation Procedural Ease

The technology and architecture of a wireless communication network are relatively simple to set up and deploy. Setting a wireless system, such as a Wi-Fi network, takes far less time than setting up a full cabled network.

Reliability

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

Recovering from a disaster

The loss of communication infrastructure in a wireless communication system can be low in the event of an accident caused by fire, floods, or other calamities.

Capability

Enables many businesses to move toward a more mobile workforce by allowing team-based employees to access network resources.

DISADVANTAGES OF WIRELESS

Interference

Wireless communication systems that employ free space as a medium for signal transmission are known as interference wireless communication systems. As a result, there's a good possibility that radio signals from one wireless communication system or network will interfere with signals from other wireless communication systems or networks.

Bluetooth and Wi-Fi are the greatest examples (WLAN). Both of these technologies use the 2.4GHz band for communication, and there is a possibility of interference if both of these devices are operating at the same time.

Security

The security of data is one of the key problems of wireless communication issues. Because the signals are broadcasted in free space, any intruder may be able to intercept them and copy critical information.

Health Issues

Continuous exposure to radiation of any kind can be dangerous. Even though the exact quantities of Radio Frequency (RF) energy that might cause harm have yet to be determined, it is recommended that RF radiation be avoided to the greatest extent possible.

Relatively lower bandwidth speed

In comparison to Fiber Optics, there are usually extremely poor transmission rates for larger numbers of users.

Limited Spectrum

For newer technology telecommunications, there is a limited amount of spectrum frequency allotment available.

WIRELESS STANDARD

The Institute of Electrical and Electronics Engineers (IEEE) defined that the 802.11 standard for Wi-Fi technology, which is used by all wireless routers. The 802.11 standard establishes an over-the-air interface between a wireless client and a base station or between two wireless clients and applies to various WLAN standards.

The IEEE 802.11 and 802.11x standards for wireless LAN (WLAN) technologies are referred to as 802.11 and 802.11x. The 802.11 standard defines an over-the-air interface between a wireless client and a base station, or between two wireless clients. In 1997, the IEEE approved the standard.

802.11

802.11 is a wireless LAN standard that transmits 1 or 2 Mbps in the 2.4 GHz band using either frequency hopping spread spectrum (FHSS) or direct sequence spread spectrum (DSSS).

802.11a

An extension to the IEEE 802.11 standard for wireless network technology. 802.11a is a wireless local area network protocol that offers a maximum connect rate of 54 Mbps throughput in the 5GHz frequency. This standard is not backwards compatible with 802.11b/g and necessitates the use of specialised wireless adapters.

802.11ax

802.11ax often known as Wi-Fi 6, improves on Wi-Fi 5 by providing additional speed, capacity, and security.

802.11b

802.11b (also known as 802.11 High Rate or Wi-Fi) is a wireless LANS enhancement that allows 11 Mbps transmission (with a fallback to 5.5, 2 and 1-Mbps) in the 2.4 GHz range. 802.11b

exclusively use DSSS. 802.11b was a 1999 amendment to the original 802.11 standard that enabled wireless capabilities equivalent to Ethernet.

The IEEE's 802.11 standard for wireless network technology has been updated. 802.11b is a wireless local area network standard that offers a maximum connect rate of 11 Mbps in the 2.4GHz ISM band, with fallback to 5.5, 2, and 1 Mbps. In 1999, this standard was ratified.

802.11g

IEEE 802.11g is a Wi-Fi standard for data transmission over a wireless network. It has a 2.4 GHz bandwidth and can enable data transmission speeds of up to 54 Mbps. Although 802.11g hardware is backward compatible with 802.11b technology, if there are any 802.11b-based machines on the network, the entire network must operate at 11 Mbps (the max speed that 802.11b supports).

802.11n

Multiple transmitter and receiver antennas are used to enhance data speed and range (also known as multiple-input multiple-output, or MIMO). In 2009, this standard was ratified. Commercially available pre-standard gear is incompatible with PittNet Wi-Fi.

WIRELESS CATEGORIES

There are essentially just two alternatives for personal usage and small enterprises among these four WPAN and WLAN. A WPAN would connect devices within a 30-foot range, making it ideal for a home office or extremely tiny office setting. However, if you want coverage to extend across your home or large commercial facility, a WLAN is the best option because it gives coverage throughout a local region and can handle user totals in the thousands.

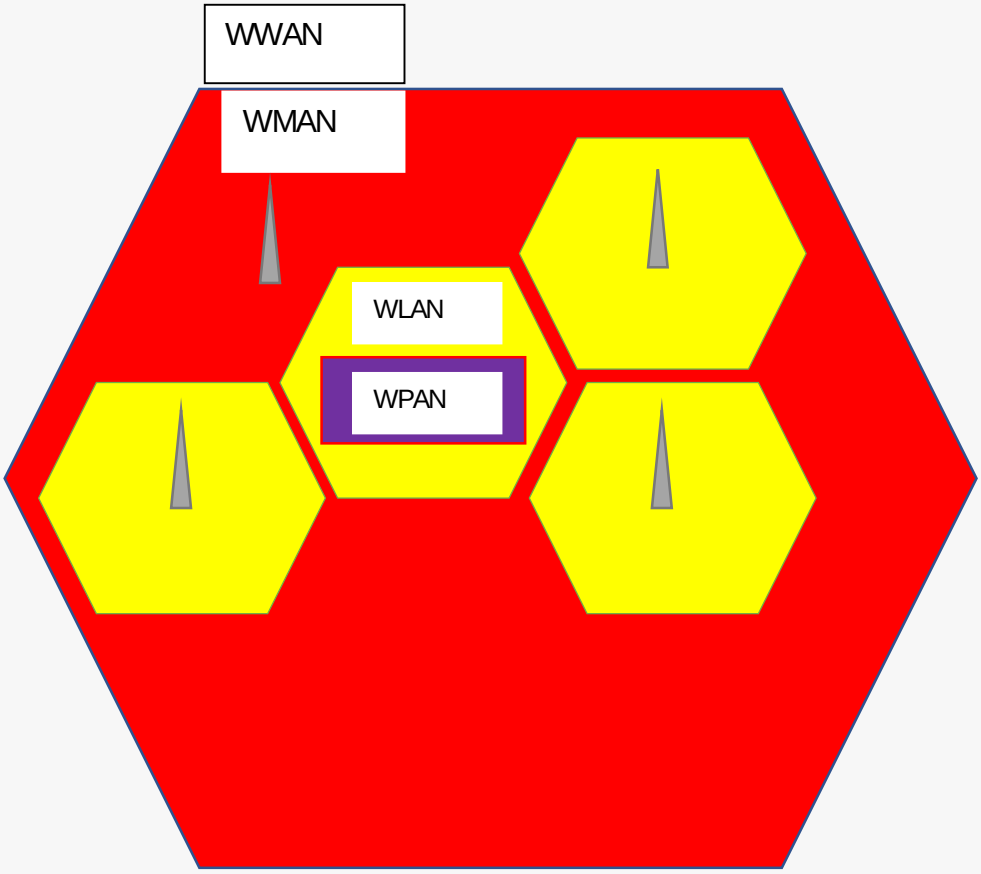


Figure 3: Wireless Communication Categories boundaries

Wireless Personal Area Networks Categories: WPAN

WPANs (Wireless Personal Area Networks) are short-range networks that link devices in a limited area. A WPAN links devices that are within a person's reach, however the range can be up to 30 feet. A WPAN may link suitable devices near a central location using Bluetooth technology, such as connecting a headphone to a laptop on our desk.

Wireless Local Area Networks Categories: WLAN

WLANs (Wireless Local Area Networks) are wireless networks that employ radio waves rather than Bluetooth technology, like WPANs do. A wired internet connection entering into a router, which subsequently distributes the wireless signal to other devices, is generally at least one cable that serves as an access point for internet access. WLANs are used to connect to both local and internet resources. With spread-spectrum or OFDM technology, the range can be restricted to a single room or residence or stretched across a whole building or campus.

Wi-Fi, or wireless internet, is a technology that uses radio waves to allow multiple electronic devices to share data or connect to the internet wirelessly. In most cases, this connection is referred to as a wireless LAN. For Industrial Scientific Medical (ISM) frequency radio bands, the 2.4 GHz (12 cm) UHF and 5 GHz (6 cm) SHF frequencies are primarily used. A WLAN is often password secured, but it can also be open, allowing any device within its range to access the network's services. WLAN product certified by the Wi-Fi Alliance in accordance with IEEE 802.11 specifications.

Wireless Wide Area Networks Categories: WMAN

Multiple satellite systems, antenna sites, or mobile phone signals can be used to sustain Wireless Wide Area Networks (WWAN) over vast regions, such as cities or nations. WWANs give a method to stay connected when other types of network connectivity are unavailable due to their large coverage area.

Wireless MAN, or long-range area network, is a network that uses the IEEE 802.16 standard to provide considerably greater coverage in a vast region.

WiMAX was originally thought to be a Wireless MAN radio frequency technology that delivers a broadband wireless communications standard for fixed, portable, and mobile devices.

In 2009/2010, WiMAX was the first carrier system to launch a 4G cellular broadband network for wireless internet access in major cities, allowing for quicker downloads and greater data rates.

For mobile situations, speeds of up to 40Mbps per channel and a cell radius of up to 10km are possible. - Up to 15Mbps download speed and a 3km cell radius.

Wireless Categories: WWAN

WLANs in a metropolitan region, such as various buildings in a city, are connected via Wireless Metropolitan Area Networks (WMAN).

Cellular Wireless Communication is the world's fastest-growing communication sector.

It's also improved from wireless systems' voice and data to provide access to Web-based internet applications.

Wireless WAN is a wireless communication network that is described as a long-range mobile telecommunications network that connects numerous buildings, areas, districts, metropolitan, regional, national, or global borders utilising network transportation systems.

Table 1: Wireless Communication Categories vs technology

Wireless Communication Categories	**Technology**
Wireless Personal Area Networks (WPAN)	GSM GPRS UMTS (3G)
Wireless Local Area Networks (WLAN)	WiMAX
Wireless Metropolitan Area Networks (WMAN)	Wi-Fi Hiper LAN
Wireless Wide Area Networks (WWAN)	Bluetooth Infrared Home RF

WIRELESS COMMUNICATION GENERATION

The "G" stands for "GENERATION" terms. While connected to the internet, the speed of your connection is determined by the signal strength, which is shown next to the signal bar on your home screen in alphabetical order such as 2G, 3G, 4G, and so on. Each Generation is described as a set of telephone network standards that describe how a certain mobile phone system is implemented technologically. As the rate of change rises, so does the technology needed to accomplish that pace.

For instance, 1G provides 2.4 kbps, 2G provides 64 kbps and is based on GSM, 3G provides 144 kbps-2 mbps, and 4G provides 100 Mbps-1 Gbps and is based on LTE technology.

Wireless communication, like wired communication (fiber optics), aims to deliver high-quality, dependable communication, and each new generation of services marks a significant stride (or jump) in that direction. This evolutionary adventure began in 1979 with 1G and is now ongoing with 5G. To use the G term formally, each Generation has its own set of requirements.

Each generation of mobile technology is subject to standardisation by institutions. Each generation includes standards that must be satisfied, such as throughput, latency, and so on, in order to be deemed part of that generation. Each generation builds on the research and development that occurred in the previous generation. 1G was not used to identify wireless technology until the advent of 2G, or the second generation. When wireless networks switched from analogue to digital, it represented a significant advancement in technology.

Wireless Communication Generation: 1G

1G is an analogue technology, and the phones had usually low battery life, poor voice quality, and occasionally lost calls. These are the analogue telecommunications standards that were launched in the 1980s and lasted until they were superseded by 2G digital telecommunications in the 1990s.

Wireless Communication Generation: 2G

2G is a digital technology that has mostly supplanted 1G networks. These networks have been improved from 1G to allow users to make highly secure phone conversations, send text messages (SMS), and access restricted mobile data services. Some digital technologies were employed to deploy 2G networks throughout the world. The Global System for Mobile Communications (GSM) is a widely used communication system.

Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) are two novel access techniques approaches used in the second generation of mobile networks. The radio component of a mobile network employs access technologies to wirelessly link mobile phones to the network through radio waves.

General Packet Radio Service (GPRS) was a feature of GSM networks that introduced new network nodes to the GSM architecture in order to deliver effective mobile data (internet) services. GPRS is also known as 2.5G since it prepared the door for 3G data services to use the same network nodes built by GPRS. These network nodes are referred to as SGSNs (Serving GPRS Support Nodes) and GGSNs (Global GPRS Support Nodes) (Gateway GPRS Support Node)

Wireless Communication Generation: 3G

The 3G technology, also known as the universal mobile telecommunications standard (UMTS), has been proven to be three times better than GSM, thus the name 3GSM, with a maximum data throughput of eight megabits per second. For voice conversations, it assigns a low data rate channel, while for video calls, it assigns a high data rate channel. In 1999, the Worldwide Telecommunication Union (ITU) signed the International Mobile Telecommunications 2000 (IMT 200) to set the international standard for 3G cellular networks.

Figure 4: Wireless communication apps today

Source:Thomas Ulrich Pixabay

Wireless Communication Generation: 4G

The term 4G refers to the fourth generation of mobile networks. It is made possible through a technology known as LTE, which stands for Long Term Evolution (of mobile networks). LTE serves as the 4G migration path for important 3G technologies such as UMTS and CDMA2000. Despite the fact that another technology, WiMAX (Worldwide Interoperability for Microwave Access), is capable of meeting 4G standards, LTE has been the dominant technology for global 4G installations.

Unlike prior 2G and 3G networks, which were both circuit and packet-switched, LTE networks are packet-based. Voice over LTE (VoLTE), a packet-based technique, can allow the voice and SMS portions of LTE.

In comparison to 3G networks, LTE may provide peak downlink data speeds of up to 300 Mbps and reduced latency. Because of the typical speeds that 4G LTE networks can provide, they can provide dependable mobile broadband services to customers. LTE on your phone may potentially be used as a mobile hotspot to supplement your home connection.

Wireless Communication Generation: 5G

The fifth generation of mobile networks, or 5G, is the most recent cellular generation. It is made possible by the New Radio (NR) technology, which is based on OFDMA. 5G differs from previous generations of mobile networks in that it can accommodate a wide range of use cases because to its inherent flexibility. 5G is extremely fast and is capable of supporting a huge number of devices, which can aid in the digitization of many sectors. It also has the ability to work in a variety of frequency ranges, including both high and low frequencies. The 5G higher frequency bands have limited coverage but extremely low latency (less than 1 millisecond), making them ideal for real-time services.

WIRELESS COMMUNICATION TECHNOLOGY

Wireless technology is a type of communication that does not require the use of cables or wires. RF and IR waves are used in wireless technologies. Radio frequency and infrared are abbreviated as RF and IR, appropriately.

There are two primary forms of wireless technology available right now:

Access to a local Wi-Fi network

Tablets, video gaming consoles, printers, and cell phones can all communicate over the Internet via Wi-Fi. Wi-Fi is also used by medical equipment, computers, and digital audio players. The term "Wi-Fi" was coined in the 1990s as "Wireless Fidelity."

Wireless cellular network (mobile phone network)

This technology enables electronic gadgets to interact with one another via the internet utilising cell phones.

BLUETOOTH

Figure 5: Symbol of Bluetooth

Source: flag Pixabay

Figure 6: Bkuetooth cennection symbol

Source:guangpeng Pixabay

Bluetooth is an open wireless technology standard for short-range data transmission between fixed and mobile electronic devices. Bluetooth uses Radio Frequency (RF) Technology in the unlicensed 2.4GHz ISM Frequency Band and was defined as IEEE 802.15.1. Piconet and Scatternet is one of two types of Bluetooth networks.

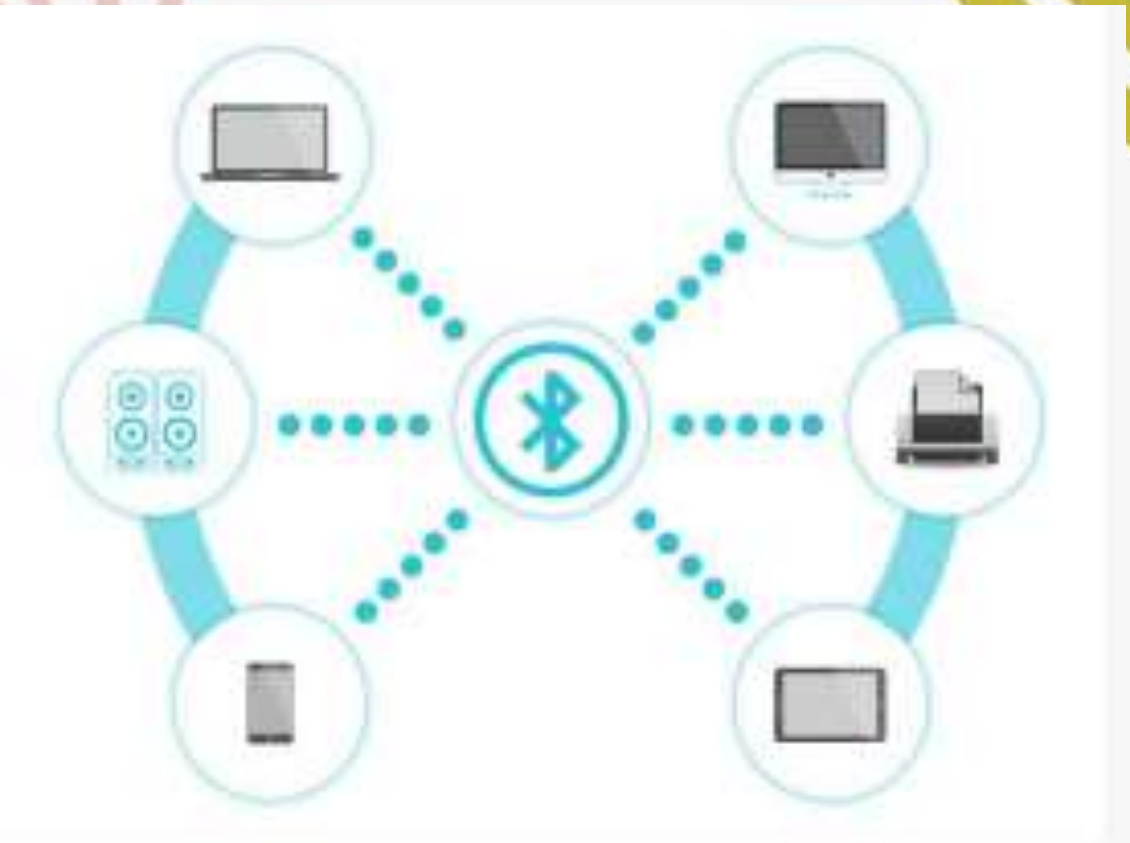


Figure 7: Bluetooth connecting to devices

Sources : 200 Degrees Pixabay

The following are the properties of Bluetooth technology:

- ✓ Cables can be replaced by wireless technology (e.g., headphones or mouse)
- ✓ The radio band used is 2.4 GHz.
- ✓ The distance is short (up to 5 meters, with variations up to 10 or 50 meters)
- ✓ A device can be either a master or a slave.
- ✓ Slave receives permission from master.
- ✓ The maximum data rate is 721 Kbps.

Bluetooth Layers

- Applications
- Profiles
  - Data Audio
  - Control
- L2CAP Layer
  - Logical Link Control And Adaptation Protocol Provides Multiplexing, Segmentation
- Baseband layer
  - The actual radio frequency (RF) link between Bluetooth units that comprise a piconet is established and managed by this component.
- Radio layer
  - The lowest specified layer is the radio (layer). It specifies the Bluetooth transceiver device's requirements for operation in the 2.4GHz ISM band. Data is sent to and from the baseband.

Bluetooth Protocol Stack

- Application
- Presentation Layer
- Session Layer
- Transport Layer
- Network Layer
- Data Link Layer
- Physical Layer (PHY)
- OSI/ISO Layers

Type of Bluetooth networks

- Piconet

  A piconet, or small net, is a Bluetooth network.

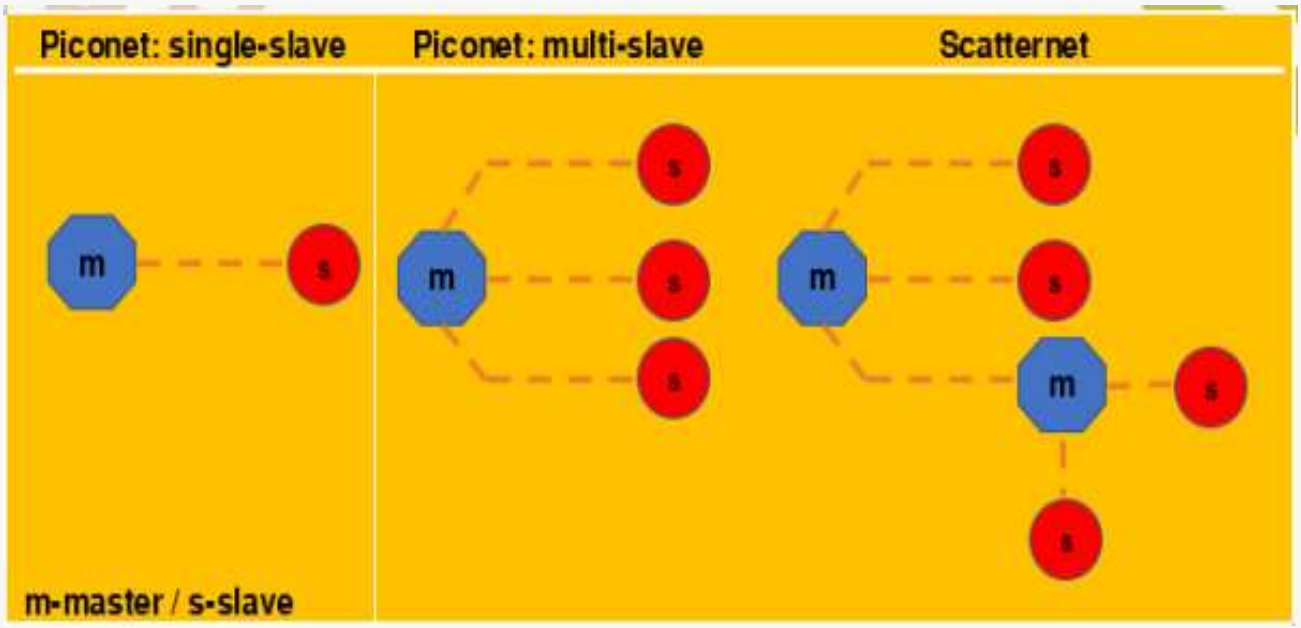
  A piconet can contain up to eight stations, with one being the primary and the rest being secondary.

- Scatternet

  A secondary that is parked is synchronised with the primary, but it cannot participate in communication until it is unparked.

  Because a piconet may only have eight active stations, activating a station from the parked state requires an active station to return to the parked state.

Table 2: Bluetooth networks (an Ad-Hoc-networking)



ZigBee

Based on the IEEE 802.15.4 standard for Wireless PAN, ZigBee is a specification for a set of high-level communication protocols that use tiny, low-cost, and low-power digital radios. ZigBee is known for its dependable wireless performance and extended battery life. Allow for more freedom and flexibility.

To transfer data over greater distances, ZigBee devices are frequently employed in mesh networks, transmitting data across intermediate devices to reach more distant ones.

Figure 8: ZigBee radio module

Source: https://www.directindustry.com/prod/digi-international/product-1602

This enables ad-hoc ZigBee networks to emerge without the need for centralised control or a high-power transmitter/receiver capable of reaching all devices. The network may be controlled by any ZigBee device.

RADIO FREQUENCY IDENTIFICATION (RFID)

RFID (radio-frequency identification) is a technology that uses electronic tags and labels to identify items across short distances wirelessly. Data from a tag or label is recorded by a device and will stored in a database, RFID is comparable to barcoding. RFID, on the other hand, provides numerous advantages over barcode asset tracking software. The most noticeable difference is that RFID tag data may be read without needing to be aligned with an optical scanner, whereas barcode data must be aligned with an optical scanner.

RFID has four components:

a. Tag reader or transceiver
b. RFID tag or transponder
c. Antenna
d. Provide a computer and software system as a host

RFID tag types are:
a. passive tags
b. active tags
c. read-only
d. read/write tags

List of RFID frequency operational;

- ✓ LF band: 125 and 135 KHz generally use passive tags.
- ✓ HF band : 3 MHz to 30MHz
- ✓ Typical Frequency : 13.56 MHz system uses passive tags.
- ✓ HF systems are also widely used, especially in hospitals.
- ✓ These frequency bands can be used freely worldwide.
- ✓ UHF band: 300 MHz to 1 GHz

- ✓ Typical Frequency : 915 MHz uses both active and passive tags.
- ✓ MW band > 1GHz
- ✓ Typical Frequency: 2.4 GHz or 5.8 GHz uses Semi active and passive tags.

How RFID work

RFID is part of the Automatic Identification and Data Capture (AIDC) technology group (AIDC). With little or no human interaction, AIDC techniques automatically detect items, gather data about them, and enter that data straight into computer systems. Radio waves are used in RFID techniques to accomplish this. An RFID tag or smart label, an RFID reader, and an antenna are the three basic components of an RFID system. RFID tags are made up of an integrated circuit and an antenna that send data to an RFID reader. The radio waves are then converted to a more useable kind of data by the reader. The data gathered from the tags is subsequently transmitted to a host computer system through a communications interface, where it may be saved in a database and evaluated later.

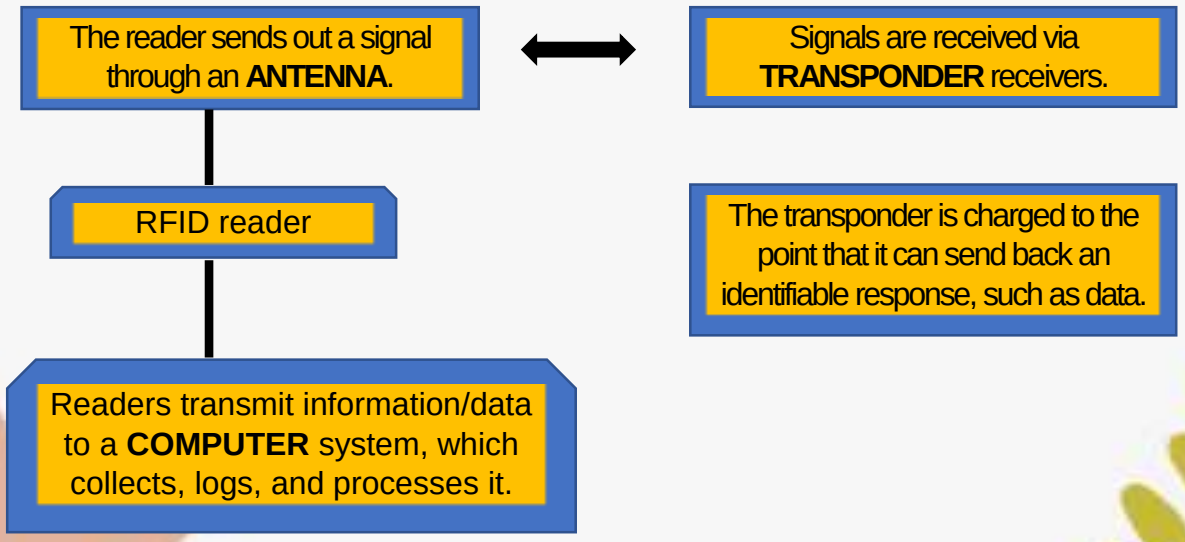


Figure 9: Block diagram of How RFID work

Applications of RFID

Many industries use RFID technology to complete task such as:

– Inventory management

– Asset monitoring

– Personnel tracking

– Access control to limited areas

– ID Badging

– Supply chain management

– Anti-counterfeiting

WIRELESS COMMUNICATION DEVICES

People nowadays use mobile phones for a variety of purposes, including conversing, surfing the internet, and watching videos. All of these services must be available to the user when they are on the move, that is, while they are on their mobile device. We may send speech, data, movies, and photos with the aid of these wireless communication services. Different types of Wireless Communication Systems have been created in response to the demand for a variety of communication services.

The following are some of the most important Wireless Communication Systems on the market today;

- Television and Radio Broadcasting
- Satellite Communication
- Radar
- Mobile Telephone System (Cellular Communication)
- Global Positioning System (GPS)
- Infrared Communication
- WLAN (Wi-Fi)
- Bluetooth
- ZigBee
- Paging
- Cordless Phones
- Radio Frequency Identification (RFID)

FIXED WIRELESS COMMUNICATION

The functioning of wireless devices in fixed places such as homes and offices is referred to as fixed wireless networking. Fixed wireless devices are often powered by utility mains, as opposed to mobile wireless devices, which are typically battery operated. Fixed wireless internet is the most common type of internet delivered in regions with no internet cable infrastructure, primarily in rural areas. Fixed wireless is typically part of a wireless LAN infrastructure.

MOBILE WIRELESS COMMUNICATION

Mobile communication is represented by a mobile phone (also known as a mobile cellular network, cell phone, or hand phone) (wireless communication). It is an electric gadget that is used to communicate in full duplex two-way radio via a cellular network of base stations known as a cell site.

Mobile communication make our lives simpler and saves our time and effort. A mobile phone also known as a mobile cellular network, dell phone or hand phone is an example of mobile communication. It is an electric device used for full duplex two-way radio communication across a cellular network of base stations known as cell sites.

ORGANISATION OF COMMUNICATION STANDARD

IEEE : Institute for Electrical and Electronic Engineers

ITU : International Telecommunication Union

MCMC : Malaysian Communication Multimedia Commission

Institute for Electrical and Electronic Engineers (IEEE)

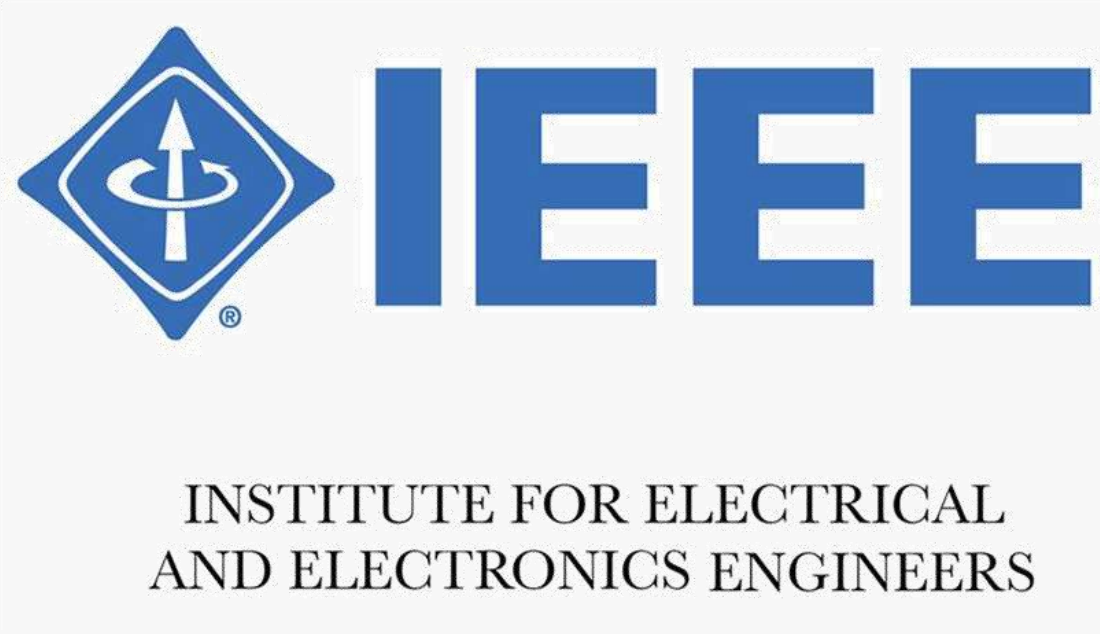


Figure 10: Institute for Electrical and Electronics Engineers

Source: https://donate.sc.edu/AG/sfp/cec/ieee

An international non-profit engineering association that provides a forum for the improvement of all sorts of technology relating to the usage of electricity and electronics on a global scale.

Resolve conflicts between competing groups whose fields of competence were becoming increasingly entwined.

In a wide number of industries, IEEE is a key developer of worldwide standards.

- Through IEE's widely referenced publications, conferences, technological standards and professional and educational activities, IEEE and its members in spire a worldwide community.
- Wireless PAN (802.15), wireless LAN (802.11) and Wireless Man working groups (802.16)
- The institute of Radio Engineers (IRE, founded in 1912) and the American Institute of Electrical Engineers merged to become it in 1963. (AIEE founded 1884)

Figure 11: International Telecommunication Union

Source: https://www.itu.int/en/ITU-T/Workshops-and-

International Telecommunication Union (ITU)

- American National Standards Institute [ANSI] - 1918
- International Organization for Standardization [ISO] – 1947
- Nippon Telegraph and Telephone [NTT] – 1985
- European Telecommunications Standards Institute [ETSI] – 1988
- Telecommunications Industry Association [TIA] – 1988
- Electronic Industries Alliance [EIA] -2011
- Federal Communications Commission [FCC]
- 3rd Generation Partnership Project [3GPP]
- Australian Communications Authority [ACA]
- Korean Information Security Agency [KISA]
- Ministry of Industry and Information Technology [MIIT] Republic of China

Figure 12: International Telecommunication Union

Source: https://www.mcmc.gov.my/en/mcmc-logo

Malaysian Communication Multimedia Commission (MCMC)

- Malaysia's communications and multimedia sector is regulated by the Malaysian Communications and Multimedia Law.
- Concerning national policy goals and changes for the growth of Malaysia's communications and multimedia industries.
- The MCMC identifies industry-relevant standards that encompass cutting-edge technologies.
- Implement and enforce the communication and multimedia law's requirements.
- Supervise and oversee activities using communication and multimedia.
- Supervising the implementation of a new regulatory framework for the telecommunications, broadcasting, and online activities industries.
- Provide Malaysian industry with a spectrum frequency licence.

THE QUIZZES

1. Define wireless communication.
2. In the world of cell phones, 2G signifies second-generation wireless digital technology. Fully digital 2G networks replaced analogue 1G which originated in the 1980s. What are the improvements that have been made in 2G system compared to 1G system.
3. Describe wireless communication in term of characteristics, advantages and disadvantages.
4. Define fixed and mobile wireless communication.
5. Explain wireless Personal Area Network (WPAN).
6. Explain the variation of IEEE 802.11 as wireless Local Area Network (WLAN) by its operation frequency, maximum data rate and range distance.
7. International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies. State the main role of ITU as the standard body in wireless communication.
8. With the aid of s suitable diagram, identify the categories of wireless communication with an example for each category.
9. the Second Generation (2G) to the Fourth Generation (4G) in terms of the technology standard and channel bandwidth in a table.
10. List 2 (two) advantages and disadvantages of wireless communication.

11. “with reliable wireless performance and long life battery operation, zigBee gives you the freedom and flexibility to do more.” From the statements above, give 4 (four) examples of applications that may be are using this technology.
12. State why the Long Term Evolution (LTE) is develop.
13. Compare 1st Generation and 3rd Generation wireless communication technology in terms of switching technique and type of service.
14. Wireless Communication evolves from analogue system (1st Generation) to digital system 2nd Generation (2G), 3rd Generation (3G) up to 4th Generation (4G) with various types of standard system in each generation.
15. List FOUR (4) 3G (3rd Generation) standard systems.
16. Describe TWO (2) roles of organization listed below;
    i. Institute of Electrical and Electronic Engineers (IEEE)
    ii. Malaysian Communications and Multimedia Commission (MCMC)
17. Explain the following short range wireless communication services;
    - Bluetooth
    - Zigbee
18. Explain the following wireless communication services listed below;
    - Wireless Wide Area Network.
    - Broadband Wireless Access.

REFERENCES

David Tse, P. V. (2005). *Fundamentals of Wireless Communication.* Cambridge University Press.

Heiner, G. (. (2011). *GSM Networks: Protocol, Terminology and Implementation.* ARTECH HOUSE INC.

Kavesh Pahlavan, P. K. (2009). *Principle of Wireless Network.* PHI Learning Private Limited

Poole, I. (2006). *Cellular Communication Explained: From Basics to 3G.* Newmes

SAHA, I. (2009). *Wireless Communication and Networks.* TATA MACGRAW HILL.

Martin Sauter (2014). From GSM to LTE: An Introduction to Mobile Networks and Mobile Broadband. Wiley Publication.

William C. Y. Lee (2006). Wireless & Cellular Telecommunications. 3rd Edition. McGraw-Hill

www.Pixabay.Com

e ISBN 978-967-2762-03-4