

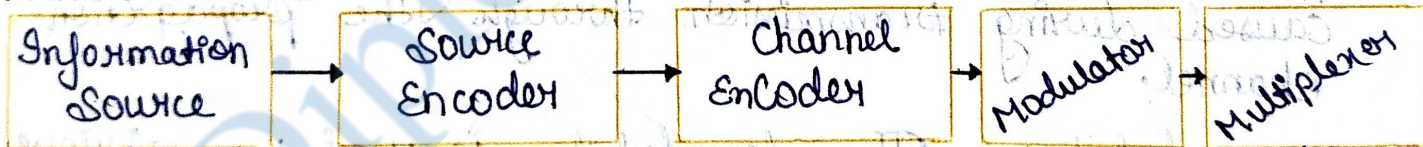
Unit → 1

1.) Wireless Communication...

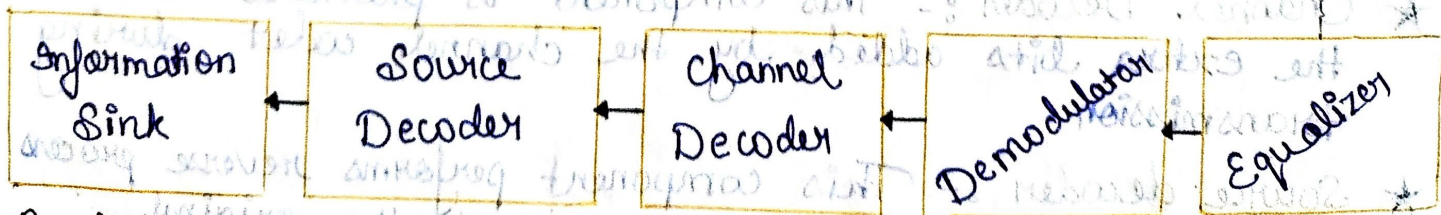
- The type of communication which involves the transfer of information from one point to another without using any physical connection or medium like wire, cable, optical fiber, etc. is referred to as wireless communication.
- Instead of physical mediums, wireless communication makes the use of electromagnetic waves of radio frequency to transmit information.
- Due to no physical limitations, it allows for transmitting information over very large distance across globe.
- Wireless communication is serving as the backbone of today's internet and mobile communication.
- It can be used to provide communication over a wide range of distances, from a few meters like in Bluetooth technology to several thousand kilometers like the internet.

Block diagram of Wireless Communication...

Transmitter side



Propagation channel



Receiver Side

- ★ Information Source :- It is the device that generates information that has to be transmitted. Examples of information source in wireless communication can be a mobile phone, computer, POS device, etc.
- ★ Source Encoder :- This component is responsible for encoding the information from the source into a form that can be transmitted through the channel.
- ★ Channel Encoder :- This component adds extra bits to the original information to protect it from errors during transmission.
- ★ Modulator :- It transforms the information into a signal suitable for transmission over the wireless communication channel. It combines the information signal with a carrier signal of higher energy.
- ★ Multiplexer :- This component combines multiple signals into one signal to improve transmission efficiency and resource utilization.
- ★ Propagation channel :- It is the wireless medium through which information signals travel to the destination. In wireless communication, air or free space is used as the propagation channel.
- ★ Equalizer :- This component is employed for compensating the distortions in the information signal that might be caused during transmission through the propagation channel.
- ★ Demodulator :- The demodulator is used to retrieve the original information from the received modulated signal. It separates the information signal from the carrier signal.
- ★ Channel Decoder :- This component is provided to remove the extra bits added by the channel coder during transmission.
- ★ Source decoder :- This component performs reverse process of the source encoder and reconstructs the original information message sent by the information source.

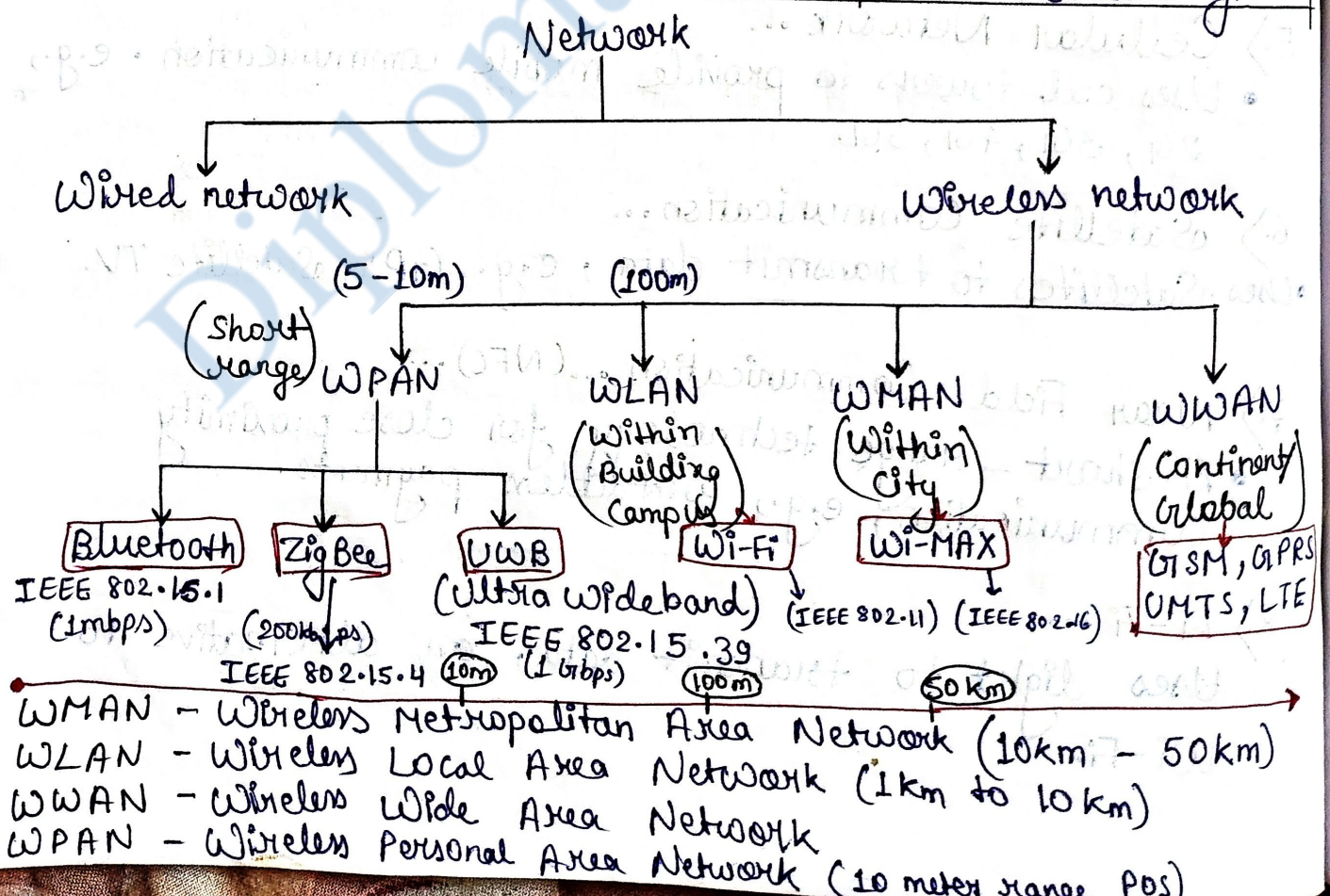
★ Information sink :- It represents the destination of the transmitted information and is the device that receives the message.

Types of wireless communication...

- 1.) Radio Frequency (RF) communication...
 - Uses radio waves to transmit data, e.g., radio broadcasting, mobile phones.
- 2.) Infrared (IR) Communication...
 - Uses infrared light to transmit data, e.g., TV remotes, IrDA (Infrared data Association) devices.
- 3.) Bluetooth ...
 - A personal area network (PAN) technology for short-range communication between devices.
- 4.) Wi-Fi...
 - A local area network (LAN) technology for wireless internet access.
- 5.) Cellular Network...
 - Uses cell towers to provide mobile communication. e.g., 2G, 3G, 4G, 5G.
- 6.) Satellite Communication...
 - Uses Satellites to transmit data, e.g., GPS, Satellite TV.
- 7.) Near Field Communication...(NFC)...
 - A short-range technology for close proximity communication, e.g., contactless payments.
- 8.) Li-Fi...
 - Uses light to transmit data, an alternative to Wi-Fi.

Frequency spectrum used in different WCS...

| S.No. | Frequency Band | Wavelength | Applications |
|-------|--|-----------------------------|---|
| 1. | 30Hz - 300Hz. Extremely low frequencies (ELF) | 10^4 km to 10^3 km | Power transmissions |
| 2. | 300 Hz - 3KHz. Voice frequencies (VF) | 10^3 km to 100 km | Audio applications |
| 3. | 3KHz - 30KHz. Very low frequencies (VLF) | 100 km to 10km | Submarine communications, Navy, Military Communication |
| 4. | 30KHz - 300kHz. Low Medium frequencies (LMF) | 10 km to 1km long waves. | Aeronautical and marine navigation these frequencies act as subcarriers |
| 5. | 300 kHz - 30MHz. Medium frequencies (MF) | 1 km to 100m. Medium waves. | AM radio broadcast, Marine and aeronautical communications |
| 6. | 3 MHz - 30 MHz. High frequencies (HF) | 100m to 10m. Short waves | Shortwave transmission, Amateur and CB Communication. |
| 7. | 30 MHz - 300 MHz. Very High frequencies (VHF) | 10m to 1m | T.V. broadcasting. F.M. broadcasting. |



2.) Wireless Metropolitan Area Network (WMANs)...

- Wireless MAN, also known as Wireless Metropolitan Area Network (WMAN), is a wireless communication network which is larger than WLAN but smaller than WWAN.
- This network is designed to provide wireless connectivity within a city or neighboring cities.

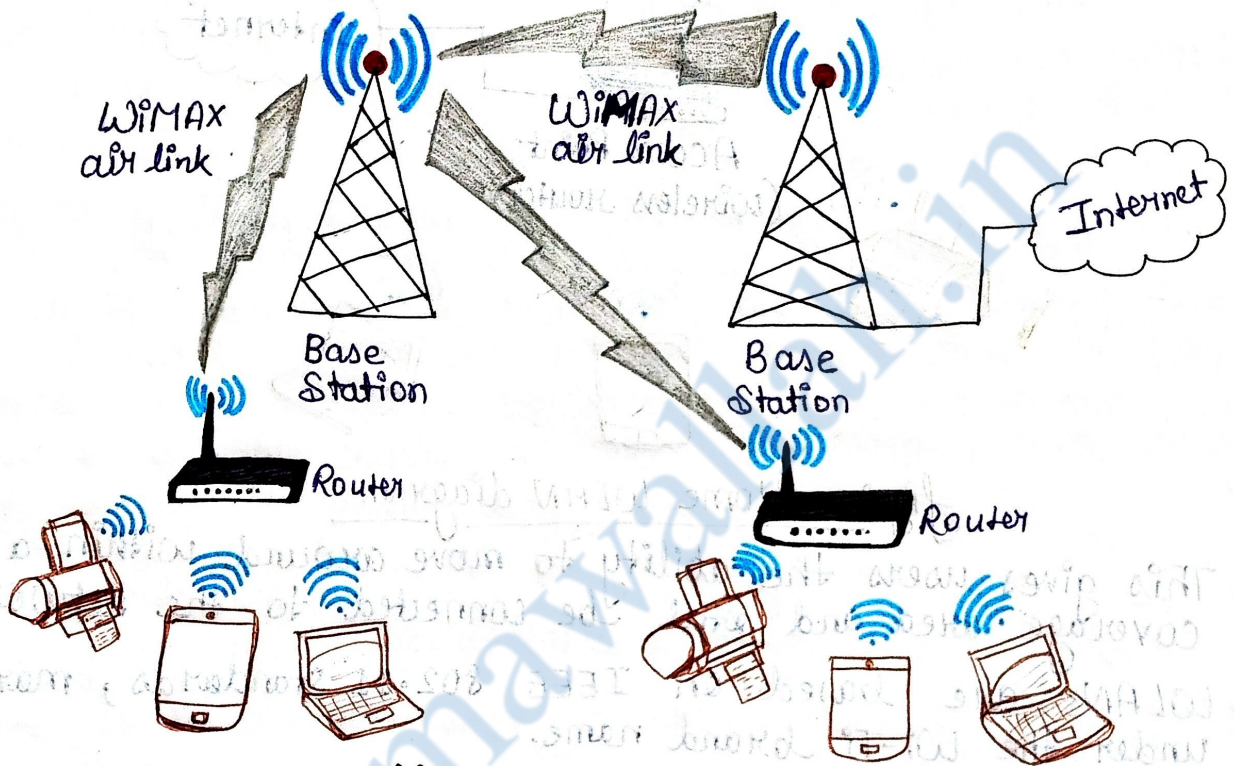


fig:- WiMax network diagram

- WiMAX is a communications technology that supports point to multipoint architecture aimed at providing high-speed wireless data over metropolitan area network.
- This enables smaller wireless LANs to be interconnected by WiMAX creating a large WMAN. Thus, networking between cities can be achieved without the need for expensive cabling.
- WiMAX is ^{similar} smaller to Wi-Fi, but provides coverage over greater distances.
- Higher frequency transmissions are used for line-of-sight service. This enables towers/ antennae to communicate with each other over a greater distance.

Wireless Local Area Networks (WLANs) ...

- Wireless Local Area Networks (WLANs) are designed to provide wireless access in areas with a typical range up to 100 meters and, are used mostly in home, school, computer laboratory, or office environments. (fig).



Fig:- Home WLAN diagram

- This gives users the ability to move around within a local coverage area and still be connected to the network.
- WLANs are based on IEEE 802.11 standards, marketed under the Wi-Fi brand name.
- Wi-Fi networks, operate primarily in the 2.4 GHz and 5 GHz frequency bands.
- The IEEE 802.11b was the first accepted standard, supporting up to 11 Mbps in the 2.4 GHz unlicensed spectrum band.
- The IEEE 802.11 is a family of different standard for wireless local area network.
- WLAN is used within a limited area like in a home or office. Wi-Fi is a common example of WLAN.

Wireless Personal Area Network (WPAN) ...

- Wireless Personal Area Network or WPAN is a type of wireless communication system that used to connect devices within a very short range, of about 10 meters. It is used in personal areas like within a room or house.
- WPAN is connected through signals such as Zigbee, ultrawide band or Bluetooth. This type of Wi-Fi is used for communication and data transfer between the connected devices.
- For an application point of view, Bluetooth is intended for a cordless mouse, keyboard, and hands-free headset, IrDA is intended for point-to-point links between two devices for simple data transfers and file synchronization, Zigbee is designed for reliable wirelessly networked monitoring and control networks and, UWB is oriented to high-bandwidth multimedia links.
- ▶ Bit Rate is the number of bits transferred or received per unit of time (Unit: bps or bit/s).
- ▶ A Modem is a device that enables a computer to transmit and receive data.

3.) Wi-Fi ...

- Wi-Fi stands for Wireless Fidelity. Wi-Fi It is based on the IEEE 802.11 family of standards and is primarily a local area networking (LAN) technology designed to provide in-building broadband coverage.
- Currents Wi-Fi systems support a peak physical-layer data rate of 54 Mbps and typically provide indoor coverage over a distance of 100 feet.
- Wi-Fi has become the de facto standard for last-mile broadband connectivity in homes, offices, and public hotspot locations. Systems can typically provide a coverage range of only about 1,000 feet from the access point.

In other words

- Wi-Fi is a wireless technology that allows electronic devices to connect to the internet and communicate with each other without a physical cable.
- This uses radio waves to transmit the data between a Wi-Fi router and compatible devices like smartphones, computers, and smart home gadgets.
- These Wi-Fi networks are common in homes, offices, and public spaces providing convenient internet access and local connectivity.
- This technology has become an essential part of modern digital life enabling wireless internet browsing, file sharing, and device communication in various settings.

★ What is Wireless Access Point?

- The WAP means a wireless access point is the networking device that allows Wi-Fi enabled devices to connect to the wired network. It acts as the central hub broadcasting the Wi-Fi signal that devices can detect and join.
- Access points are commonly used to extend the range of existing networks, create separate network segments, or provide Wi-Fi connectivity in large spaces like offices, schools or public areas.
- They can be standalone devices or integrated into a router and they enable multiple devices to access network resources and the internet wirelessly within their coverage area.

Features of Wi-Fi...

- **Wireless connectivity** :- Wi-Fi allows devices to connect to a network without the use of physical cables, providing greater mobility and flexibility.
- **High speed** :- Wi-Fi network can provide high speed internet access, allowing users to upload data quickly and download high speed and

- **Easy Setup** :- Wi-Fi networks are easy to set up and configure, requiring minimal technical knowledge. Most modern devices come with Wi-Fi connectivity built-in.
- **Multiple device Connectivity** :- Wi-Fi networks can support multiple devices at the same time, allowing multiple users to connect to the same network and access the internet simultaneously.
- **Security** :- Wi-Fi networks can be secured using encryption and other security measures, which protect against unauthorized access and hacking.
- **Range** :- Wi-Fi networks can cover a wide range of distances, depending on the type of router and the environment in which it is used.

Applications of Wi-Fi ...

- It transfer photos & videos from your digital camera.
- Share files with nearby computers.
- Send documents to your printer from any computer or smartphone.
- Stream audio to any speakers in the house.
- Stream movies to any TV in the house.
- Use your smartphone as a remote control.
- **Hotspots**: Wi-Fi can be used to create temporary internet access points for others to connect to.
- Wi-Fi can be used in home security systems for monitoring and alerts.
- Wi-Fi is used for online gaming on various devices.
- Wi-Fi can be used in conjunction with other technologies (like GPS) for tracking and locating devices.

Significance of hotspot ...

★ Hotspot:

A Wi-Fi hotspot is a physical location where people can access the internet, typically using a Wi-Fi network via a router connected to a ISP.

★ Types of Hotspots:

- Public Hotspots :- Offered in coffee shops, airports, hotels.
- Private Hotspots :- Personal routers at homes.
- Mobile Hotspots :- Smart phones or dedicated devices providing portable internet access.

★ Importance and Advantages ...

- (i) Internet Access Anywhere: Allows users to go online without wired connections.
- (ii) Supports Mobile Work: Ideal for business professionals and students.
- (iii) Cost Saving: Reduces mobile data uses.
- (iv) Tourism and convenience: Helps travelers stay connected abroad.
- (v) Increased Customer Satisfaction: Business offering Wi-Fi attract more customers.
- (vi) Public Services: Governments provide free hotspot to bridge the digital divide.