

UNIT-4

MOBILE COMMUNICATION

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Thindal.

- Wireless communication systems
- Applications of wireless communication systems
- Types of wireless communication systems
- Trends in mobile communication systems
- Cellular Mobile Systems

What is Wireless Communication?

- Any transfer of information between points that do not have a physical connection, like wire or cable connection, would be **WIRELESS COMMUNICATION.**

- Therefore, when you talk to your friend sitting beside you, technically wouldn't you be communicating wirelessly?

Examples of wireless communication:

- Short Distance - TV controlled by remote
- Long Distance - Space Radio Communication

Introduction

- Wireless Communication is the fastest growing and most vibrant technological areas in the communication field.
- Wireless Communication is a method of transmitting information from one point to other, **without using any connection** like wires, cables or any physical medium.

- Generally, in a communication system, information is transmitted from transmitter to receiver that are placed over a limited distance.
- With the help of Wireless Communication, the transmitter and receiver can be placed **anywhere between few meters** (like a T.V. Remote Control) to few thousand kilometres (Satellite Communication).

Examples:

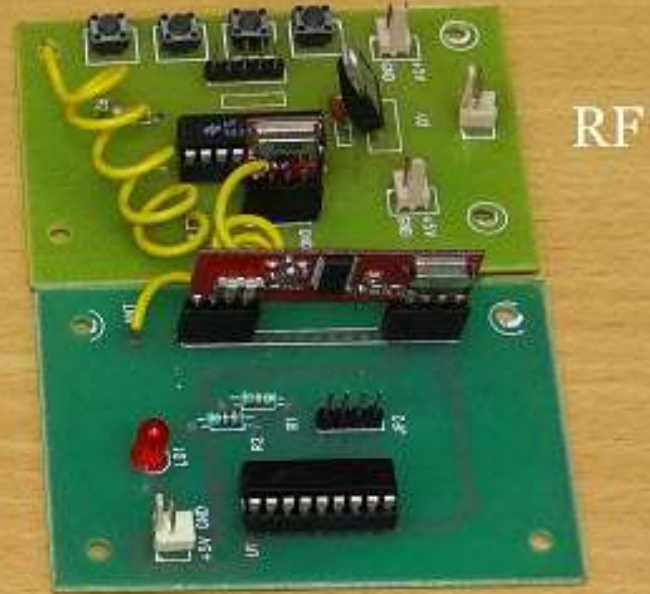
- Mobile Phones
- GPS Receivers
- Remote Controls
- Bluetooth Audio
- Wi-Fi etc.

GSM (Mobile Phones)

RFID



ELC



Wi-Fi



Infrared



Bluetooth



GPS



What is Wireless Communication

- Communication Systems can be **Wired or Wireless** and the medium used for communication can be **Guided or Unguided**.

Wired communication

- In Wired Communication, the medium is a physical path like **Co-axial Cables, Twisted Pair Cables and Optical Fiber Links etc** which guides the signal to propagate from one point to other.
- Such type of medium is called **Guided Medium.**

Wireless communication

- Wireless Communication **doesn't require any physical medium** but propagates the signal through space.
- Since, space only allows for signal transmission **without any guidance**, the medium used in Wireless Communication is called **Unguided Medium**.

If there is no physical medium, then how does wireless communication transmit signals?

- Even though there are no cables used in wireless communication, the transmission and reception of signals is accomplished with Antennas.

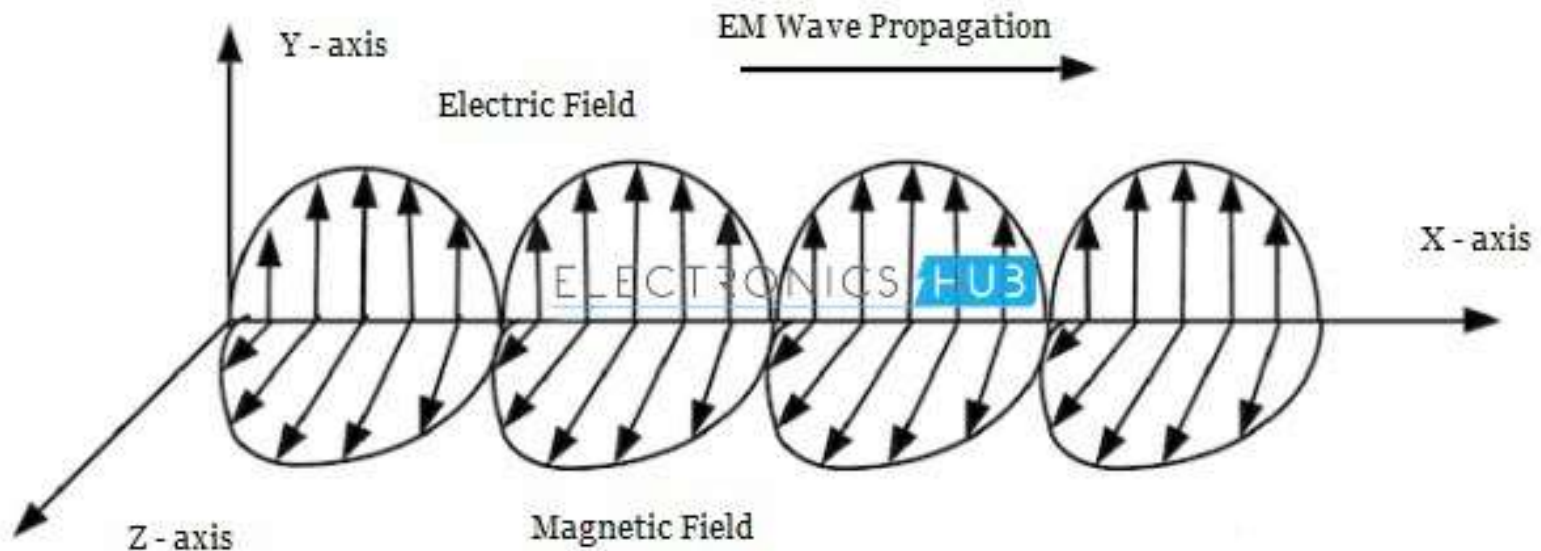
- Antennas are electrical devices that transform the electrical signals to radio signals in the form of Electromagnetic (EM) Waves and vice versa.
- These Electromagnetic Waves propagates through space.
- Hence, both transmitter and receiver consists of an antenna.

What is Electromagnetic Wave?

- An Electromagnetic Wave consists of both electric and magnetic fields in the form of time varying sinusoidal waves.
- Both these fields are oscillating perpendicular to each other and the direction of propagation of the Electromagnetic Wave is again perpendicular to both these fields.

- Electromagnetic Waves include Gamma Rays (γ – Rays), X – Rays, Ultraviolet Rays, Visible Light, Infrared Rays, Microwave Rays and Radio Waves.
- Electromagnetic Waves (usually Radio Waves) are used in wireless communication to carry the signals.

- Electric Field is acting in the Y – axis, magnetic field is acting in the Z – axis and the **Electromagnetic Wave propagates in X – axis.**



Why Wireless Communication?

- When wired communication can do most of the tasks that a wireless communication can, why do we need Wireless Communication?

- Flexibility and ease of use
- Mobile telephony can be made anywhere and anytime with a considerably **high throughput performance.**

- Wired communication systems is an **expensive and time consuming job.**
- The infrastructure for wireless communication can be installed **easily and low cost**

- In emergency situations and remote locations, where the setup of wired communication is difficult, wireless communication is a viable option.

Advantages of Wireless Communication

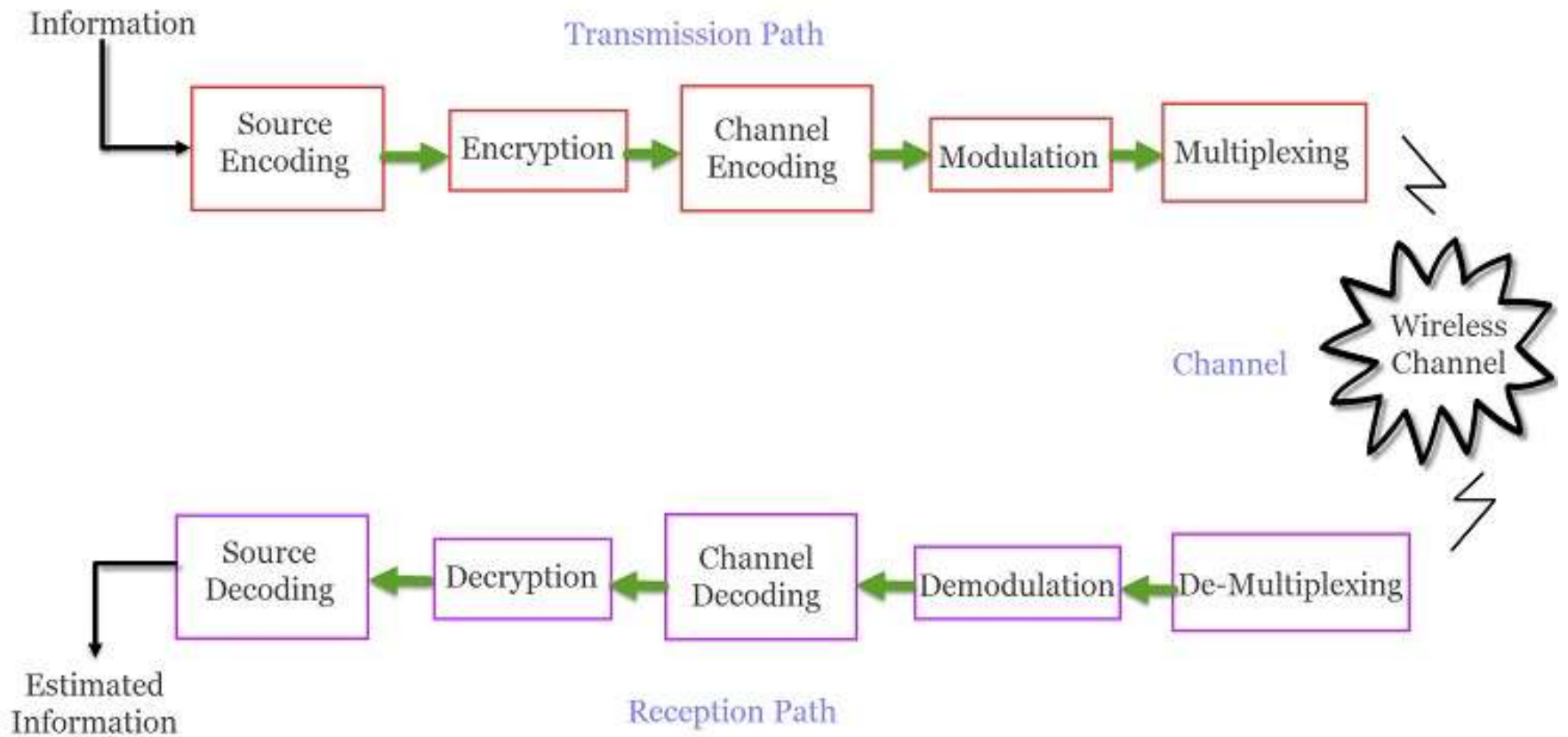
- Cost
- Mobility
- Ease of Installation
- Reliability
- Disaster Recovery

Disadvantages of Wireless Communication

- Interference
- Security
- Health Concerns

Basic Elements of a Wireless Communication System

- Transmitter
- Channel and
- Receiver



The Transmission Path

- Source Encoder- removes redundant bit
- Channel Encoder- Removes noise
- Encryption-security purpose
- Modulation
- Multiplexing-Multiple i/p single o/p

The Channel

- The channel in Wireless Communication indicates the medium of transmission of the signal i.e. **open space**
- A wireless channel is unpredictable and also **highly variable and random in nature.**
- A channel maybe subject to interference, **distortion, noise, scattering etc.** and the result is that the **received signal may be filled with errors.**

The Reception Path

- Demultiplexing
- Demodulation
- Channel Decoding
- Decryption and
- Source Decoding

Applications of wireless communication systems

- video conferencing,
- cellular telephone,
- paging,
- TV,
- Radio
- Television and Radio Broadcasting
- Satellite Communication
- Radar

- Mobile Telephone System (Cellular Communication)
- Global Positioning System (GPS)
- Infrared Communication
- WLAN (Wi-Fi)
- Bluetooth
- Paging
- Cordless Phones
- Radio Frequency Identification (RFID)

Types of Wireless Communication Systems

- Simplex

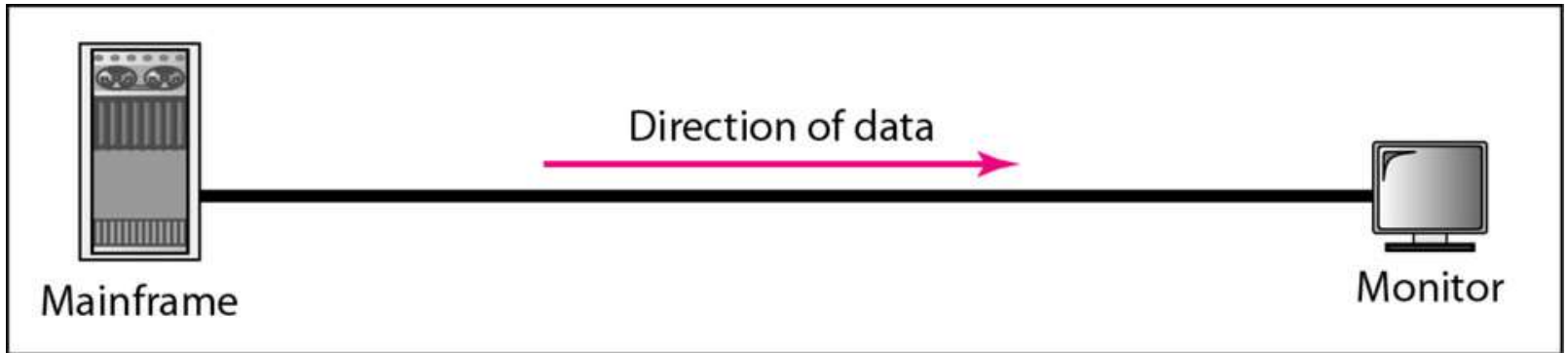
Ex: Radio broadcast system or pager

- Half Duplex

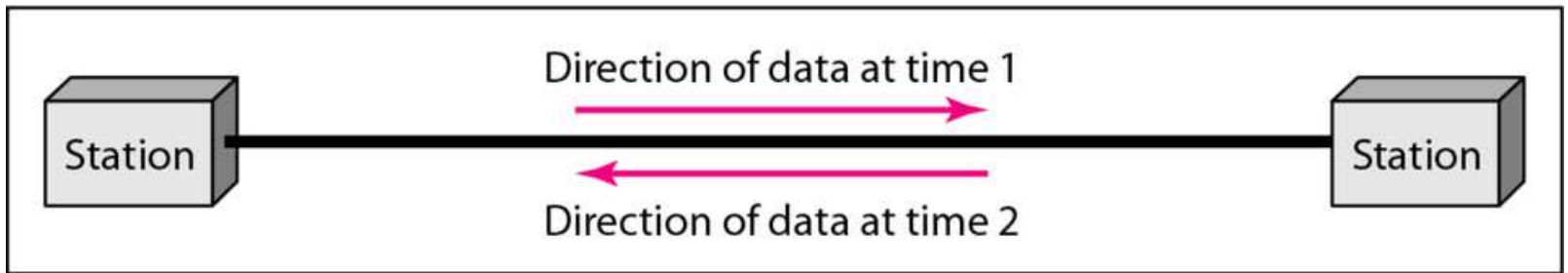
Ex: walkie – talkie (civilian band radio)

- Full Duplex

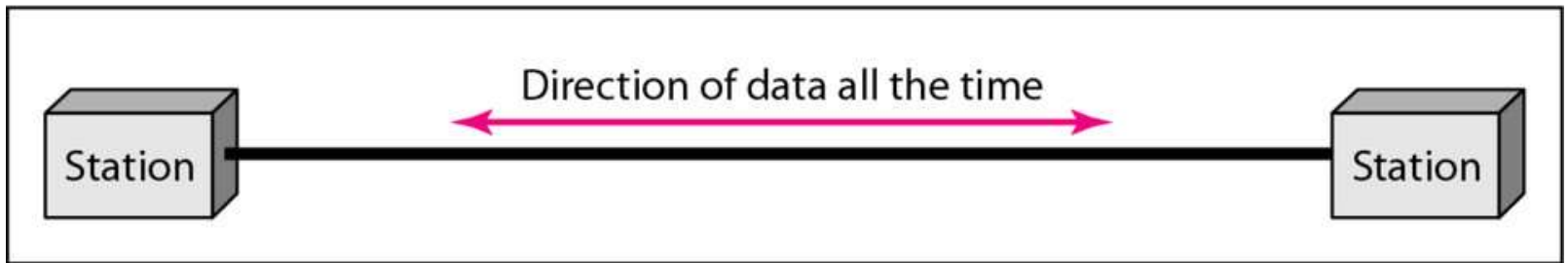
Ex: mobile phones



a. Simplex



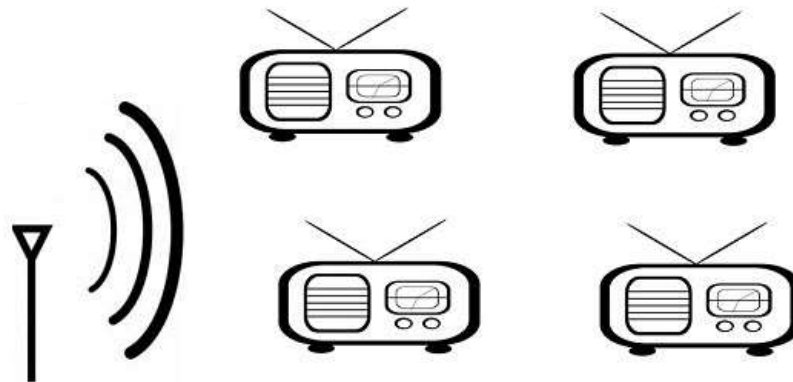
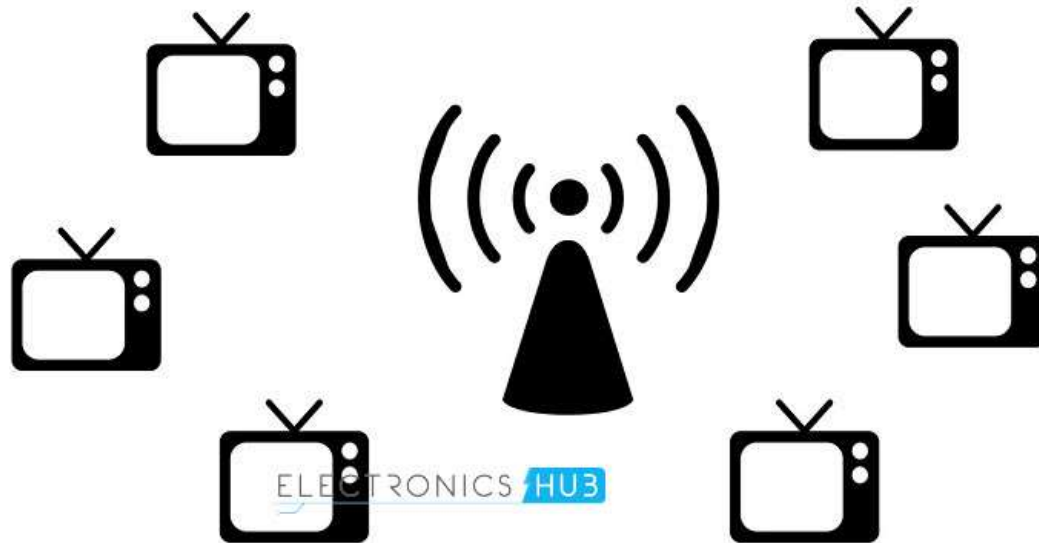
b. Half-duplex



c. Full-duplex

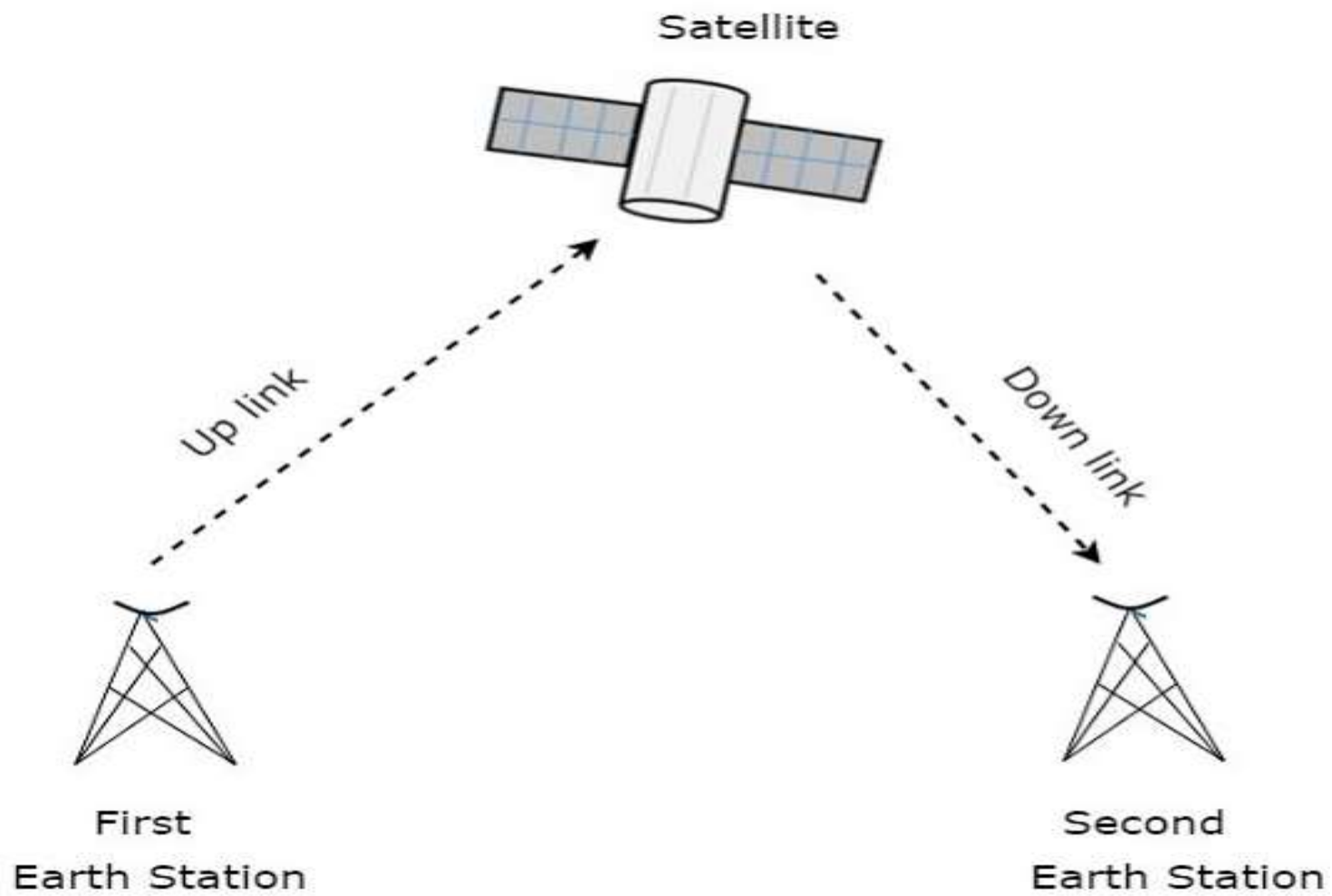
Television and Radio Broadcasting

- Radio is considered to be the first wireless service to be broadcast.
- It is an example of a Simplex Communication System where the information is transmitted only in one direction and all the users receiving the same data.



Satellite Communication

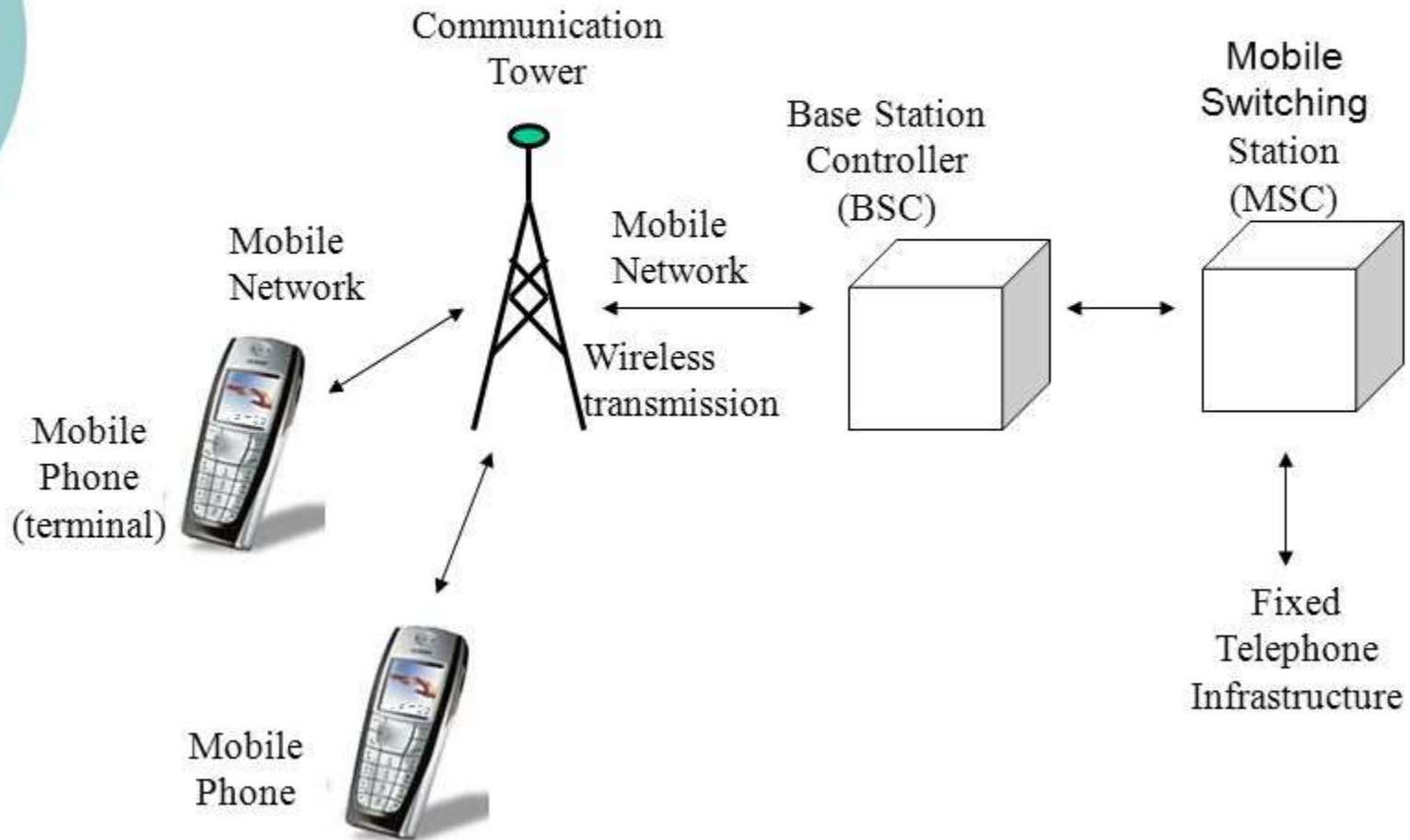
- Satellite Communication Systems offer telecommunication (Satellite Phones), positioning and navigation (GPS), broadcasting, internet, etc.
- Other wireless services like mobile, television broadcasting and other radio systems are dependent of Satellite Communication Systems.



Mobile Telephone Communication System

- Today's mobile phones are not limited to just making calls but are integrated with numerous other features like Bluetooth, Wi-Fi, GPS, and FM Radio.

Mobile system architecture



Global Positioning System (GPS)

- GPS is solely a subcategory of satellite communication. GPS provides different wireless services like navigation, positioning, location, speed etc.
- with the help of dedicated GPS receivers and satellites

Real Time Tracking & Monitoring

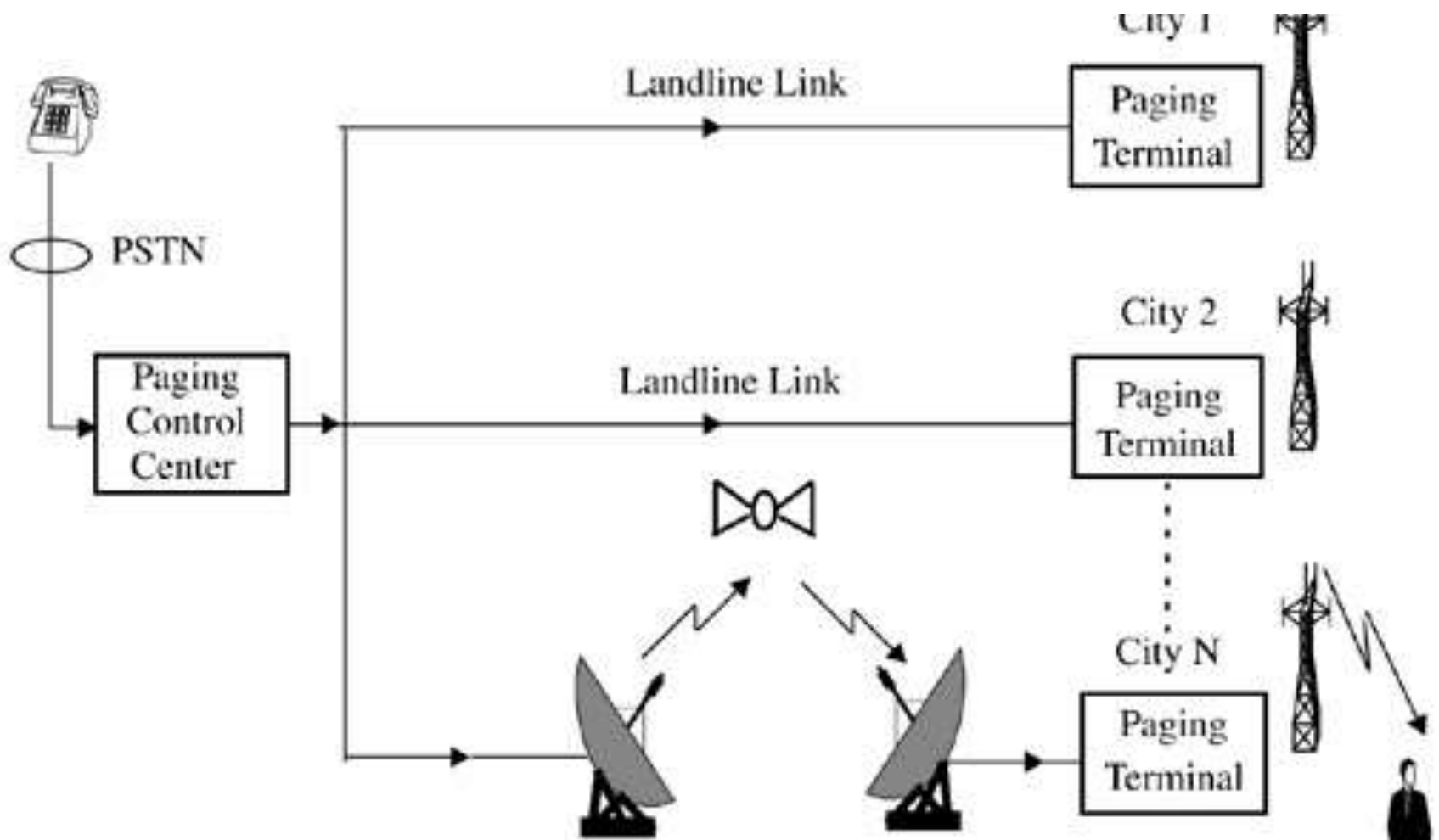


Bluetooth

- Bluetooth is another important low range wireless communication system.
- It provides data, voice and audio transmission with a transmission range of 10 meters.
- Almost all mobile phones, tablets and laptops are equipped with Bluetooth devices.
- They can be connected to wireless Bluetooth receivers, audio equipment, cameras etc.

Paging

- Although it is considered an obsolete technology, paging was a major success before the wide spread use of mobile phones.
- Paging provides information in the form of messages and it is a simplex system i.e. the user can only receive the messages.



Wireless Local Area Network (WLAN)

- Wireless Local Area Network or WLAN (Wi-Fi) is an internet related wireless service.
- Using WLAN, different devices like laptops and mobile phones can connect to an access point and access internet.

Wireless LAN



Wireless Station 3



Access Point



Wireless Station 1



Wireless Station 4



Wireless Station 2

Infrared Communication

- Infrared Communication is another commonly used wireless communication in our daily lives. It uses the infrared waves of the Electromagnetic (EM) spectrum.
- Infrared (IR) Communication is used in remote controls of Televisions, cars, audio equipment etc.



TV



IR Remote

Point to Point



TV



IR Remote

Diffuse

Trends in mobile communication systems

- Wireless mobile communication system has become more popular due to rapid changes in **mobile technology**.
- Fast development of wireless communication systems are due to very high increase in **telecoms customers**.

- The revolution of mobile communications is from
- 1G-the first generation,
- 2G-the second generation,
- 3G-the third generation,
- 4G-the fourth generation,
- 5G-the fifth generation

First Generation (1G)

- The first generation of mobile communication technology emerged in **1980s**.
- The first generation mobile communication system used **analog transmission of speech signal services**.

- At that time the most popular analogue systems were **Nordic Mobile Telephones (NMT)** and **Total Access Communication Systems (TACS)**, some other analog systems also introduced in 1980s across the Europe.

Drawback

- The first generation is all of those systems offered handover and roaming capabilities but cellular networks were unable to interoperate between the countries.



Nordic Mobile
Telephones (NMT)



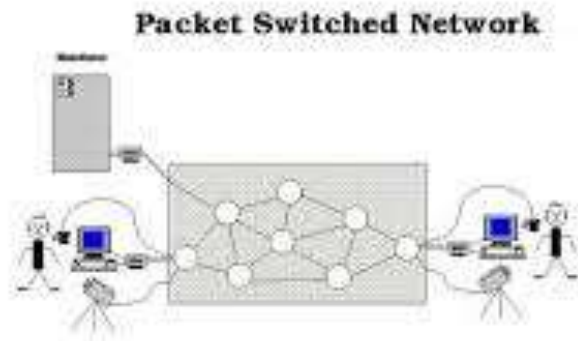
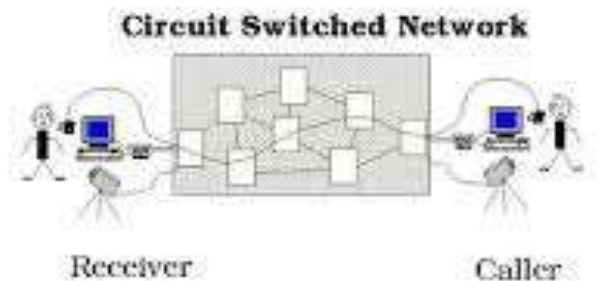
Total Access Communication
Systems (TACS)

Second Generation (2G)

- Second generation enabled to provide the services such as **text messages, picture messages and Multimedia messages (MMS)** for various mobile phone networks.
- The second generation telecommunication networks were commercially launched on the Global system for Mobile communications **(GSM) standard in 1991.**

- Second generation can be divided into two standards based multiple access used:
- **TDMA based-** several users to share the same frequency channel by dividing the signal into different time slots.
- **CDMA based-** multiple access where several transmitters can send information simultaneously over a single communication channel.

- 2.5G was GPRS which could enable much faster communications uses **packet switching** and **circuit switching** domain to provide data rate up to 144kbps.



Circuit-switched Networks

- ◆ Entire message is passed.
- ◆ There is a dedicated communication link.

Packet-switched Networks

- ◆ The message is broken down into small packets.
- ◆ Every packet follows a different route.

- In less populous areas, the weaker digital signal may not be sufficient to reach a cell tower.
- This tends to be a particular problem on 2G systems deployed on higher frequencies, but is mostly not a problem on 2G systems deployed on lower frequencies.

Third Generation (3G)

- The first commercial **3G technology** was launched by NTT DoCoMo in Japan on 1 October 2001.
- Advantages of using 3rd generation in fixed Wireless Internet Access, Wireless Voice Telephony, Video calls, Mobile Internet Access and Mobile TV.

- Recent 3G releases often denoted 3.5G and 3.75G also provide mobile broadband access of several Mbps to **smart phones and mobile modems in laptop computers.**

Fourth Generation (4G)

- (4G) wireless communications in mobile technology.
- In contrast to 3G, the new 4G framework to be established will try to accomplish new levels of user experience and **multi service capacity by also integrating all the mobile technologies** that exist (e.g. GSM, GPRS, IMT-2000, Wi-Fi, Bluetooth, ZigBee).

- 4G technology data transfer will be much **faster and will be less expensive.**
- 4G will be so smart for friendly operating functions flexibility and any desired service with reasonable quality of services (QoS) at anytime,

Fifth Generation (5G)

- Fifth generation technology is very fast and reliable to be a new mobile revolution in mobile market.
- All the services of the networks and applications are going to be accessed by the single IP as telephony, gaming and many other multimedia applications.

