Unit 5(Part 2)

Cellular network is fundamental technology for mobile phones, personal communication systems, wireless networking etc. The technology is planned to replace high power transmitter/receiver systems for cell radio phones. For data transmission, cellular networks use lower capacity, shorter range, and more transmitters.

It is not a complete wireless technology because the cellular network refers to a large area of mobile networks that is used for network access.

A mobile device is linked to its base station using an air-based interface and also using a physical and link layer protocol.

Every base station is connected to the Mobile Switching Centre to help set up a call and mobility network by connecting mobile phones to wide area networks. Whereas, devices used in wireless networks are used to access the internet.

For example, wireless fidelity is a network device used to connect to the WLAN network to access the internet and a wireless access point, AP.

Cellular networks rely on the availability of network ranges and Wi-Fi has a limited range.

Cellular Network communication

Let us understand the communication in step by step manner as given below −

Step 1 − When we turn on the cell phone, the Control Channel seeks to get the SID (System Identification Number).

Step 2 − The Control Channel is a special frequency used by the phone and base station to communicate with each other.

Step 3 − If the cell phone finds it difficult to get a connection to the control channel, a "no service" message is shown.

Step 4 − If the SID is accessed from the cell phone, it compares the SID to the SID programmed on the phone. If both SID's match, the phone recognises the portion of its home system as the cell it communicates with.

Step 5 − The handset, along with the SID, also transmits a registration request and the MTSO (Mobile Telephone Switching Office) keeps track of the location of your phone in a database. When it needs to ring the phone, MTSO understands which cell you are in.

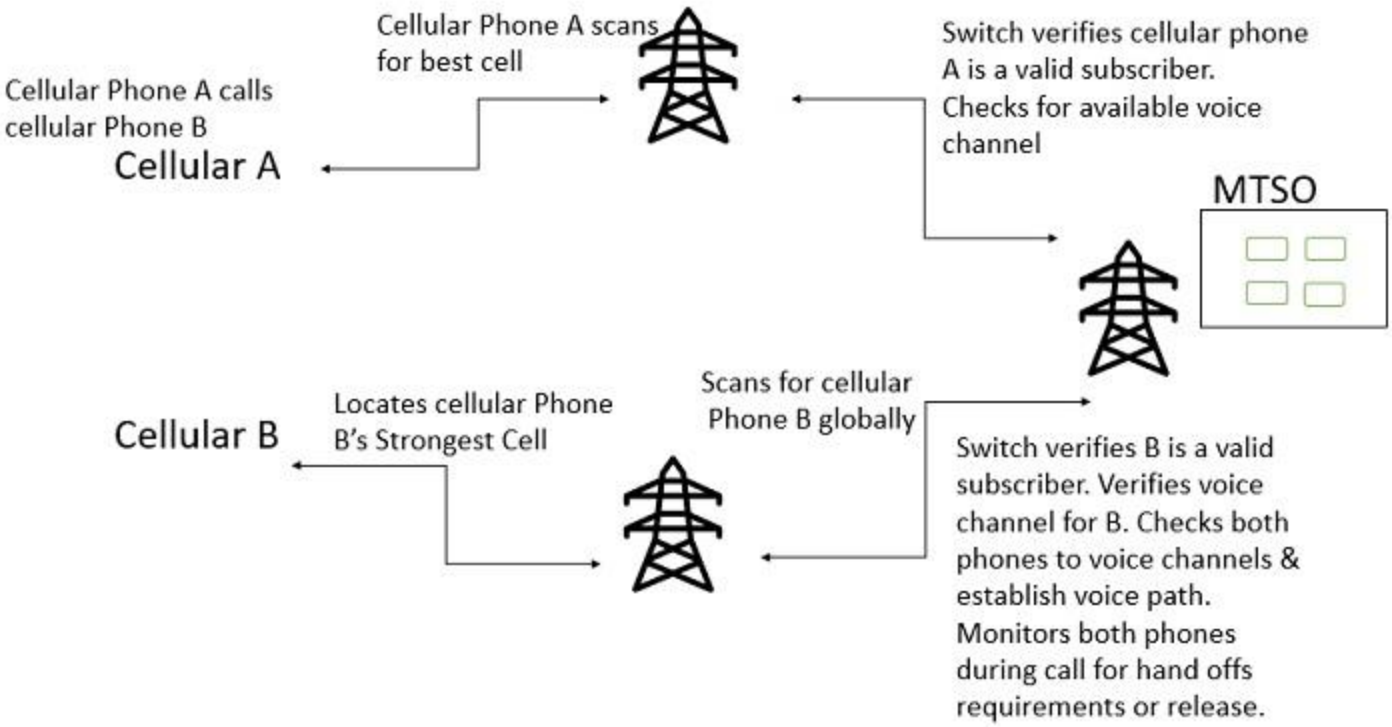
Step 6 − Then, the MTSO gets the signal and tries to locate the phone. In its database, the MTSO searches to find the cell in which the phone is stored. To take the call, the MTSO then chooses a frequency pair.

Step 7 − The MTSO communicates over the control channel with the cell phone to tell it what frequencies to use. Once those frequencies are switched on by the cell phone and the tower, the call is associated.

Step 8 − When the mobile phone moves towards the edge of the cell, the base station of the cell will experience a drop in signal power. The base station in the cell in which the phone travels will be able to see the signal intensity of the phone rise at the same time.

Step 9 − By means of the MTSO, the two base stations coordinate themselves. At some level, on a control channel, the cell phone gets a signal and guides it to change frequencies. This will make the phone move to a new cell.

The diagram for cellular network communication is given below −



Wireless Communication

Wireless communication involves the transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors.

Evolution of Mobile Radio Communication Fundamentals

Generations of Wireless Communication

1G

- This is the first generation of wireless telephone technology, mobile telecommunications, which was launched in Japan by NTT **in 1979.**
- The main technological development in this generation that distinguished the First Generation mobile phones from the previous generation was the use of multiple cell sites, and the ability to transfer calls from one site to the next site as the user travelled between cells during a conversation.
- It uses analog signals.
- It allows the voice calls in one country.

Disadvantages

- Poor quality of voice
- Poor life of Battery
- Size of phone was very large
- No security
- Capacity was limited
- Poor handoff reliability

2G

- This is the second generation of mobile telecommunication was launched in Finland in 1991.
- It was based on GSM standard.
- It enables data transmission like as text messaging (SMS - Short Message Service), transfer or photos or pictures (MMS ? Multimedia Messaging Service), but not videos.
- The later versions of this generation, which were called 2.5G using GPRS (General Packet Radio Service) and 2.75G using EDGE (Enhanced data rates for GSM Evolution) networks.
- It provides better quality and capacity.

Disadvantages

- Unable to handle complex data such as Video
- Requires strong digital signals

3G

- 3G is the third generation was introduced in early 2000s.
- The transmission of data was increased up to 2Mbits/s, which allows you to sending or receiving large email messages.
- Faster communication
- High speed web or more security

- Video conferencing
- 3D gaming
- TV streaming, Mobile TV, phone calls etc. are the features of 3G.

Disadvantages

- Costly
- Requirement of high bandwidth
- Expensive 3G phones
- Size of cell phones was very large.

4G

- 4G is the fourth generation of mobile telecommunication which was appeared in 2010.
- It was based on LTE (Long Term Evolution) and LTE advanced standards.
- Offer a range of communication services like video calling, real time language translation and video voice mail.
- It was capable of providing 100 Mbps to 1Gbps speed.
- High QoS (Quality of Service) and High security.

Disadvantages

- Uses more battery
- Difficult to implement
- Expensive equipment are required

5G

- It is refered to fifth generation wireless connection which will be probably implemented by 2020, or even some years earlier.
- Machine to machine communication can be possible in 5G.
- 5G will be able to perform Internet of Things (IoT) for smart home and smart city, connected cars etc.
- This generation will be based on lower cost, low battery consumption and lower latency than 4G equipment.
- There will be much faster transmission rate of data to the previous versions. Thus the speed of 5G will be 1Gbit/s.

Advantages and disadvantages of Wireless Communication

The interconnection of systems, people, or things with the help of a communication media can be referred to as a network. The type of communication which use electromagnetic waves as communication media for transmitting and receiving data or voice is called wireless communication. The electromagnetic spectrum is divided into a well-defined channel for data transmission.

Advantages:

- **Freedom from wires:** Can be configured with the use of any physical connection.
- **Easy to setup:** Wireless network is easy to expand and setup
- **Better or global coverage:** It provides global reach by providing networking in places such as rural areas, battlefields, etc… where wiring is not feasible.
- **Flexibility:** Wireless network is more flexible and adaptable compared to a wired network.
- **Cost-effectiveness:** Since it is easy to install and doesn't require cables, the wireless network is relatively cheaper.

- **Mobile and portable:** Wireless network is easy to carry and re-install in another place.
- **Mobility -:** It has good mobility of usage.
- **Data transmission is fast:** In wireless network data transmission is fast.
- **Low maintenance:** In any wireless communication low maintenance cost.
- It can be accessed from anywhere and anytime. for ex. professional can complete their work from remote location.
- **Network planning:** Network planning in wireless communication is very easy as compare to wired network due to wireless software configuration of frequency, power and other parameter.
- **Expandable:** Wireless networks can server a large number of client without resorting the new hardware.

Disadvantages:

- As communication is done through open space, it is less secure.
- Unreliability
- More open to interference.
- Increased chance of jamming.
- Transmission speed is comparably less.
- it has a limited amount of bandwidth for communication and breaches of network security.
- Wireless networks can be easily hacked.
- Wireless networks require a careful radio frequency when they are installed.
- Wireless networks are usually inexpensive, but the cost of installation is very high, setting up a wireless network is very costly.
- Difficult to set up little experience people.

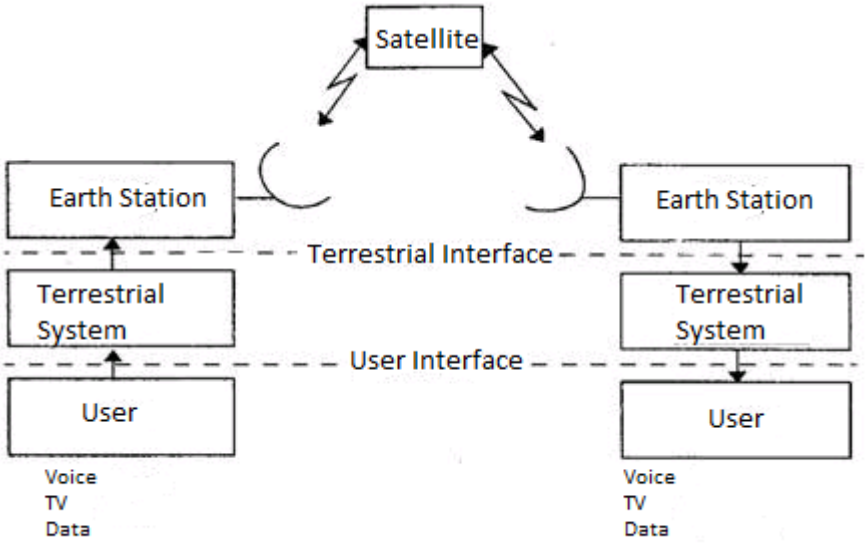
Applications of Wireless Communication:

- Satellite system
- Television remote control
- Wi-Fi
- Paging system
- Wi-Max
- Security systems
- Cellphones
- Computer interface devices
- Bluetooth
- GPS
- GSM

SATELLITE COMMUNICATION

A **communications satellite** is an artificial satellite that relays and amplifies radio telecommunication signals via a transponder; it creates a communication channel between a source transmitter and a receiver at different locations on Earth. Communications satellites are used for television, telephone, radio, internet, and military applications

Elements of Satellite Communication



Elements of Satellite Communication

Earth or Ground Station: A ground station, Earth station, or Earth terminal is a terrestrial radio station designed for extraplanetary telecommunication with spacecraft (constituting part of the ground segment of the spacecraft system), or reception of radio waves from astronomical radio sources. Ground stations may be located either on the surface of the Earth, or in its atmosphere. Earth stations communicate with spacecraft by transmitting and receiving radio waves in the super high frequency (SHF) or extremely high frequency (EHF) bands (e.g. microwaves).When a ground station successfully transmits radio waves to a spacecraft (or vice versa), it establishes a telecommunications link. A principal telecommunications device of the ground station is the parabolic antenna.

Terrestrial Networks: A terrestrial communication system is arranged having cable connection to a data communication network, a public or private telephone network or cable network.

Satellite: A satellite is a body that moves around another body in a particular path. A communication satellite is nothing but a microwave repeater station in space. It is helpful in telecommunications, radio and television along with internet applications.

Uplink Downlink Frequency and Transponder: Uplink frequency is the frequency at which, the first earth station is communicating with satellite. The satellite transponder converts this signal into another frequency and sends it down to the second earth station. This frequency is called as Downlink frequency. In similar way, second earth station can also communicate with the first one.

SATELLITE ORBITS

	GEO (36,000km)	MEO (5,000-20,000km)	LEO (500-1,200km)
Altitude latency[1]	High	Low	Very low
Earth coverage	Very large	Large	Small
Satellites required	Three	Six	Hundreds
Data gateways	Few fixed	Regional flexible	Local numerous
Antenna speed	Stationary	1-hour slow tracking	10-minute fast tracking

Advantages and Disadvantages of Satellite Communication

In this section, let us have a look at the advantages and disadvantages of satellite communication.

Following are the **advantages** of using satellite communication:

- Area of coverage is more than that of terrestrial systems
- Each and every corner of the earth can be covered
- Transmission cost is independent of coverage area
- More bandwidth and broadcasting possibilities

Following are the **disadvantages** of using satellite communication −

- Launching of satellites into orbits is a costly process.
- Propagation delay of satellite systems is more than that of conventional terrestrial systems.
- Difficult to provide repairing activities if any problem occurs in a satellite system.
- Free space loss is more
- There can be congestion of frequencies.

Applications of Satellite Communication

Satellite communication plays a vital role in our daily life. Following are the applications of satellite communication −

- Radio broadcasting and voice communications
- TV broadcasting such as Direct To Home (DTH)
- Internet applications such as providing Internet connection for data transfer, GPS applications, Internet surfing, etc.
- Military applications and navigations
- Remote sensing applications
- Weather condition monitoring & Forecasting

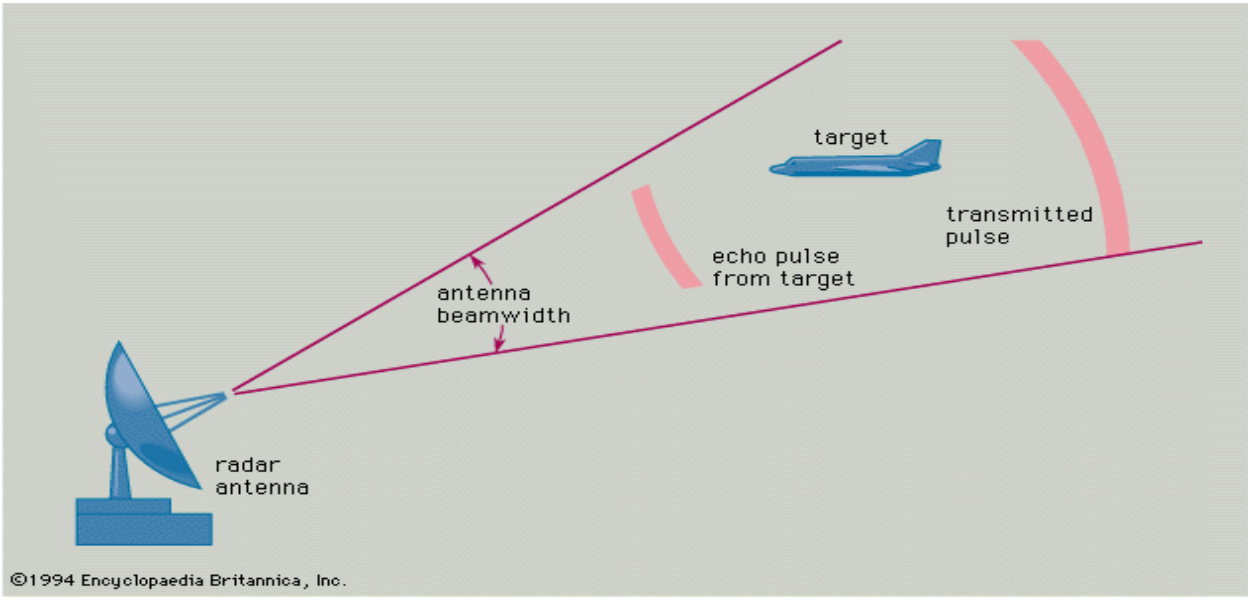
RADAR COMMUNICATION

RADAR is an electromagnetic based detection system that works by radiating electromagnetic waves and then studying the echo or the reflected back waves.

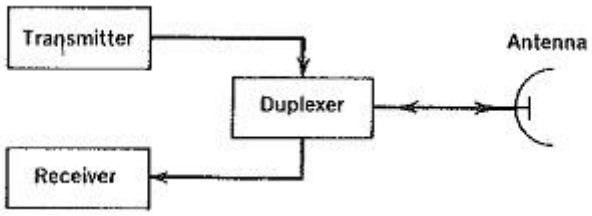
The full form of RADAR is RAdio Detection And Ranging. Detection refers to whether the target is present or not. The target can be stationary or movable, i.e., non-stationary. Ranging refers to the distance between the Radar and the target.

Working Principle

The **radar working principle** is very simple because it transmits electromagnetic power as well as examines the energy returned back to the target. If the returned signals are received again at the position of their source, then an obstacle is in the transmission way. This is the working principle of radar.



Block Diagram of RADAR



- **Transmitter:** The radar transmitter produces high-frequency RF pulses and is transmitted into space by the antenna.
- **Duplexer:** It switches the antenna between transmitter and receiver alternately. This is required because high power pulses of the transmitter will destroy the receiver if energy were allowed to enter the receiver.
- **Receiver:** It amplifies and demodulates the received RF signals. It provides video signals on the output.
- **Radar antenna:** The antenna transfers the transmitting signal to space with the required distribution and efficiency.

RADAR Applications:

1. Military Applications: In Air defense as it is used for target detection.
2. Air Traffic Control: It is to guide the aircraft to land in bad weather using precision approach radar.
3. Remote Sensing: Radar can be used for observing weather.
4. Ground Traffic Control: RADAR can also be used by traffic police to determine speed of the vehicle.
5. Space: To guide the space vehicle for safe landing on moon

You tube Links

https://www.youtube.com/watch?v=aC6jSAB-2To **Satellite communication**

https://www.youtube.com/watch?v=VtPUPdGiPpM&list=PL3rE2jS8zxAwdVGmzgxYOripcrJQPixOk&index=1
Radar Communication