

# Unit 5

## Applications

**Dr. M K Pushpa**

Associate Professor and HoD,  
Dept. of EIE, RIT, Bangalore

# Content:

- Block diagram of analog and digital communication systems
- Block diagram of digital TV system
- Block diagram of Satellite communication
- Principle of operations of Mobile phone

# Analog Communication

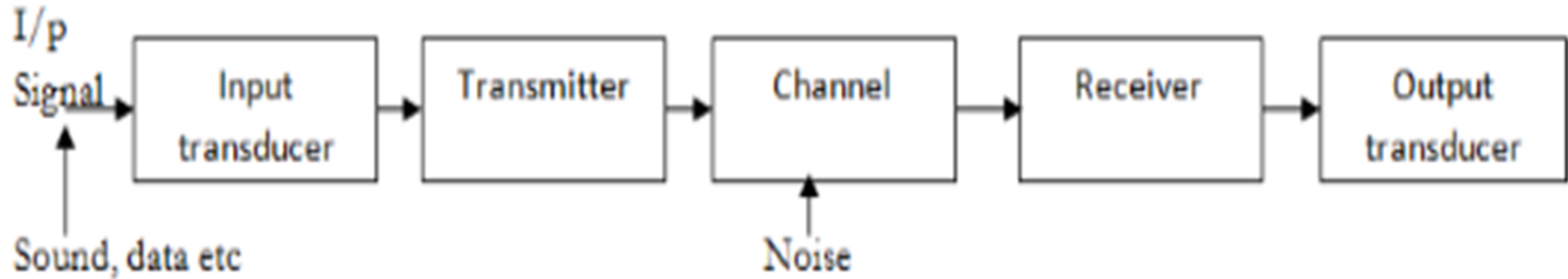


Fig: Basic analog communication system

The elements of basic analog communication system are input signal or information, input transducer, transmitter, channel, Noise, Receiver, Output transducer.

- **Information or Input signal:**

- The **information** is transmitted from one place to another.
- This information can be in the form of a **sound signal** like speech, or it can be in the form of **pictures**
- It can be in the form of data information.

- **Input transducer:**

- The information in the form of **sound, picture** or data signals cannot be transmitted as it is.
- First it has to be **converted into a suitable electrical signal**.
- The input transducer block does this job.
- The input transducer commonly used are **microphones, TV** etc.

- **Transmitter:**

- The function of the transmitter is to **convert the electrical** equivalent of the information to a **suitable form** so that it can **transfer over long distance**.
- Basic block in transmitter are: Amplifier, Oscillator, Mixer.

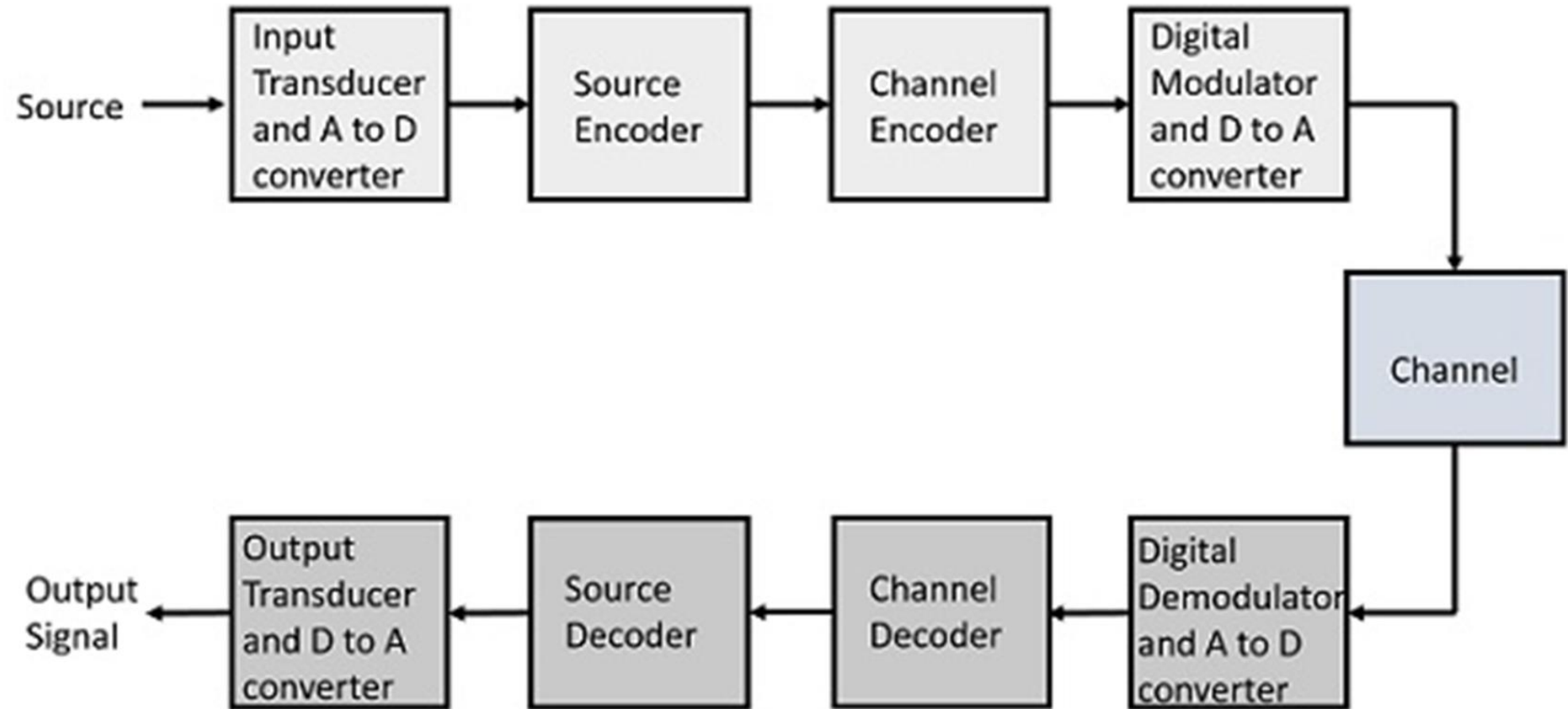
- **Channel:**

- The communication channel is the **medium used for transmission** of electrical signal from one place to other.
- The communication medium can be conducting **wires, cables, optical fibers or free space**.
- Depending on the type of communication medium, **two types of communication system** exists.

- **Line communication:**
- The line communication systems use the communication medium like the **simple wires or cables or optical fibres**. Eg: **Telephone, Cable TV**.
- **Radio communication:** The radio communication systems use the **free space** as their communication medium.
- The transmitted signal is in the form of **electromagnetic waves**. E.g. **Mobile communication, satellite communication**.
- **Noise:**
- Noise is an **unwanted electrical signal** which gets added to the transmitted signal when it is travelling towards the receiver.
- **Due to noise** quality of information gets **degrade**.
- Once added the noise cannot be separated out from the information

- **Receiver:** The receiver always **converts the modulated signal into original signal** which consist of Amplifier, Oscillator, Mixer.
- **Output transducer:** Output transducer **converts electrical signal into the original form** i.e. sound or TV pictures etc.
- E.g. Loudspeaker, data and image convertor.

# Digital communication



Basic Elements of a Digital Communication System



- **Source:**

- The source can be an **analog signal**. **Example:** A Sound signal

- **Input Transducer:**

- This is a transducer which takes a **physical input** and **converts** it to an **electrical signal** (**Example:** microphone).
- This block also consists of an **analog to digital converter** where a digital signal is needed for further processes.
- A digital signal is generally represented by a binary sequence.

- **Source Encoder:**

- The source encoder **compresses the data** into minimum number of bits.
- This process helps in effective utilization of the **bandwidth**.
- It **removes the redundant bits** (unnecessary excess bits, i.e., zeroes).

- **Channel Encoder:**

- The channel encoder, does the **coding for error correction**.
- **During the transmission** of the signal, **due to the noise** in the channel, the **signal may get altered** and hence to avoid this, the channel **encoder adds some redundant bits to the transmitted data**.
- These are the **error correcting bits**.

- **Digital Modulator:**

- The **signal** to be transmitted is **modulated** here **by a carrier**.
- The signal is also converted to analog from the digital sequence(**DAC**), in order to make it travel through the channel or medium.

- **Channel:**

- The channel or a medium, **allows the analog signal to transmit** from the **transmitter end to the receiver end**.

- **Digital Demodulator:**

- This is the **first step at the receiver** end.
- The **received signal is demodulated** as well as converted again from analog to digital(**ADC**).
- The signal gets **reconstructed** here.

- **Channel Decoder:**

- The channel **decoder**, after detecting the sequence, does some **error corrections**.
- The distortions which might occur during the transmission, are corrected by **adding some redundant bits**.
- This addition of bits helps in the complete **recovery of the original signal**.

- **Source Decoder:**

- The **resultant signal** is once again **digitized by sampling and quantizing** so that the pure digital output is obtained **without the loss of information**.
- The source decoder **recreates** the source output.

- **Output Transducer:**

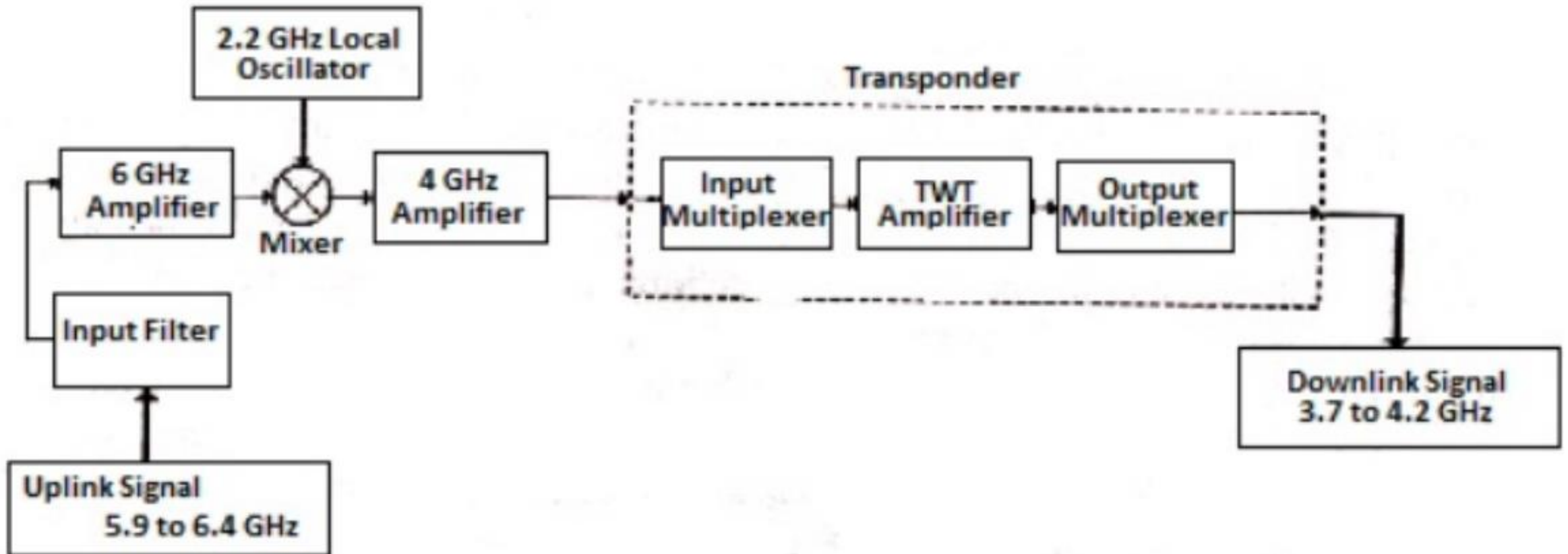
- This is the last block which **converts** the **signal into** the **original physical form**, which was at the input of the transmitter.
- It converts the **electrical signal into physical output** (**Example:** loud speaker).

- **Output Signal:**

- This is the output which is produced after the whole process.  
**Example** – The sound signal received.

- This unit has dealt with the introduction, the digitization of signals, the advantages and the elements of digital communications.
- Digital system is **not immune to noise** but the **effect** can be **reduced**.
- The main **advantage** of digital system is the use of **multiplexing and switching**.
- **Time division multiplexing** is used to **multiplex different signals together on the same channel** the **bottleneck** of this system is the **complexity** of the system and **larger bandwidth** requirement.

# Satellite Communication



- Satellite is a powerful long distance and point to multipoint communication system.
- A satellite is a radio frequency repeater.
- The disadvantages offered by the line of sight communications overcome by the satellite communication.
- The function of satellite is to communicate between different earth stations over thousands of kilometers.

- The signal **path** from the **earth station** transmitter to the **satellite receiver** is called the **Uplink**.
- The path from the **satellite to the earth** is known as the **downlink**.
- Usually **Geosynchronous orbit** is chosen to **place the satellite**.
- This orbit is such that occupies a **circular orbit above the equator** at a distance of **35000 km above earth surface**.
- The **satellite period** in this orbit is **same** as that of **earth rotational period**.
- If the **satellite is rotating** in the **same direction** as that of **earth's rotation**, the satellite will appear as almost **stagnant with respect to earth surface** hence these satellites are called as **Geostationary satellites**.
- The **orbit** is termed as **geostationary orbits**.



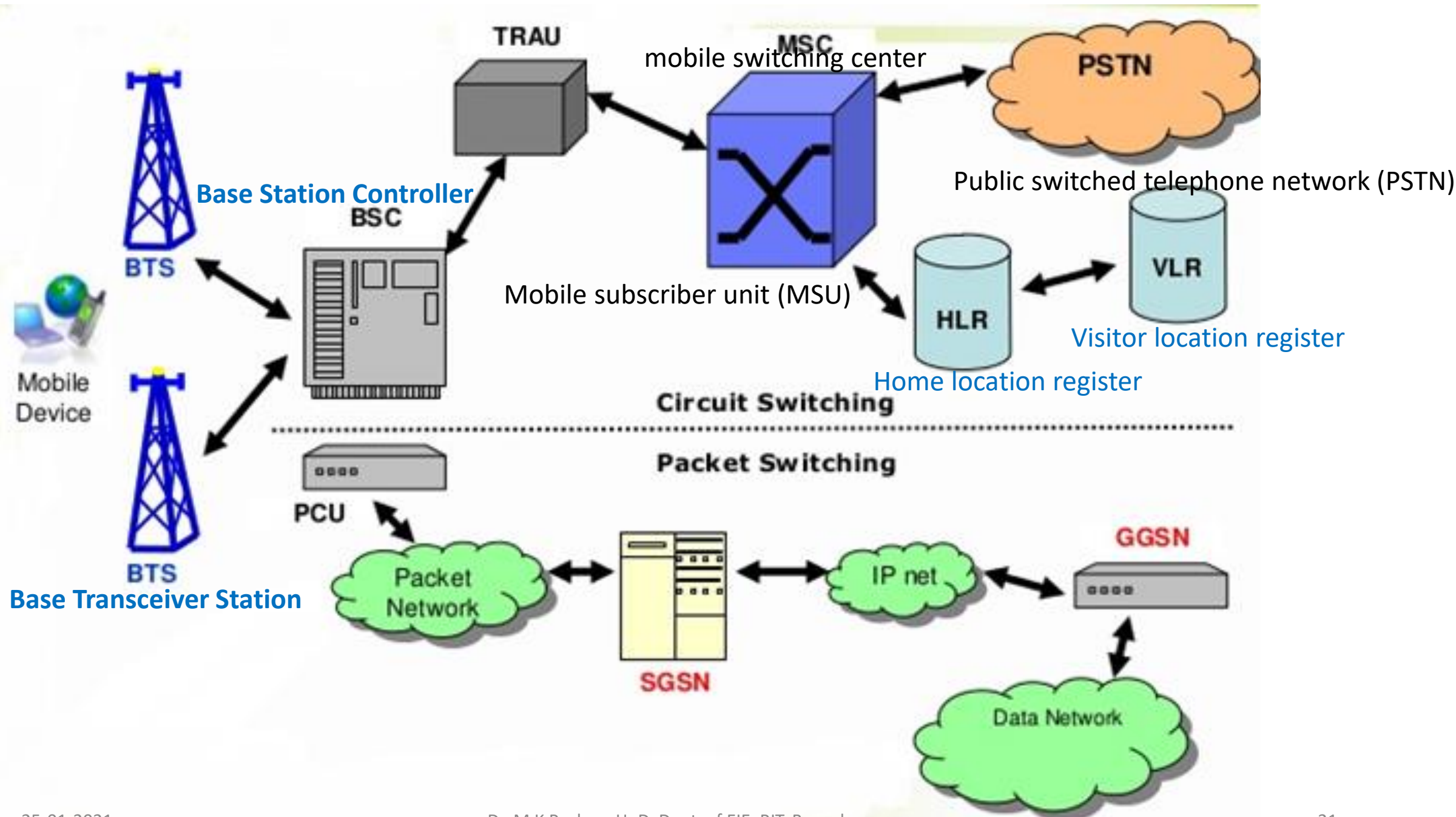
- Signals obtained from satellites are at different frequencies.
- These signals are amplified and then moved to another frequency for transmission by an equipment called Transponder. A Traveling-Wave Tube or **TWT Amplifier** is a high power, high-frequency amplifier that is built using traveling wave tubes.
- Two way communications is established with the help of Transponder.
- Satellites equipped with two transponders are capable of TV signals and 240 telephone lines.
- These transmitting and receiving signal frequencies are widely separated to avoid interferences.

- Design of the earth stations depend on whether they are used for sending the signals to satellite or used for receiving the signals from them.
- The design also varies on type of signals (TV, data...) communicated between them.
- The earth station consists of dish antenna capable of transmitting at high frequency.
- These antennas have high directivity and gain.

- Satellite can also be placed in Low and medium earth orbits to avoid the use of high gain antennas and high powered transmitters.
- They are accompanied with fare share disadvantages like
  - i) They are not stagnant with respect to earth station,
  - ii) They tend to disappear below the horizon,
  - iii) Doppler effect.-refers to the change in wave frequency during the relative motion between a wave source and its observer.

# Principle of operation of Mobile phone

- Traditional mobile service was structured in a fashion **similar to television** broadcasting.
- One very powerful **transmitter** located at the highest spot in an area would broadcast in a radius of **up to 50 kilometers**.
- The cellular concept structured the mobile telephone network in a different way.
- Instead of using **one powerful transmitter, many low-power transmitters** were placed throughout a **coverage area**.



- The cellular communications system consists of the following four major components that work together to provide mobile service to subscribers.
- Public switched telephone network (PSTN)
- Mobile telephone switching office (MTSO)
- Cell site with antenna system
- Mobile subscriber unit (MSU)
- **PSTN:**
- The PSTN is made up of local networks, the exchange area networks, and the long-haul network that interconnect telephones and other communication devices on a worldwide basis.

- **Mobile Telephone Switching Office (MTSO):**

- The **MTSO** is the **central office for mobile switching**. It houses the mobile switching center (MSC), field monitoring, and relay stations for switching calls from cell sites to wireline central offices (PSTN).
- In analog cellular networks, the **MSC** controls the system operation. The **MSC controls calls, tracks billing information, and locates cellular subscribers**.

- **The Cell Site:**

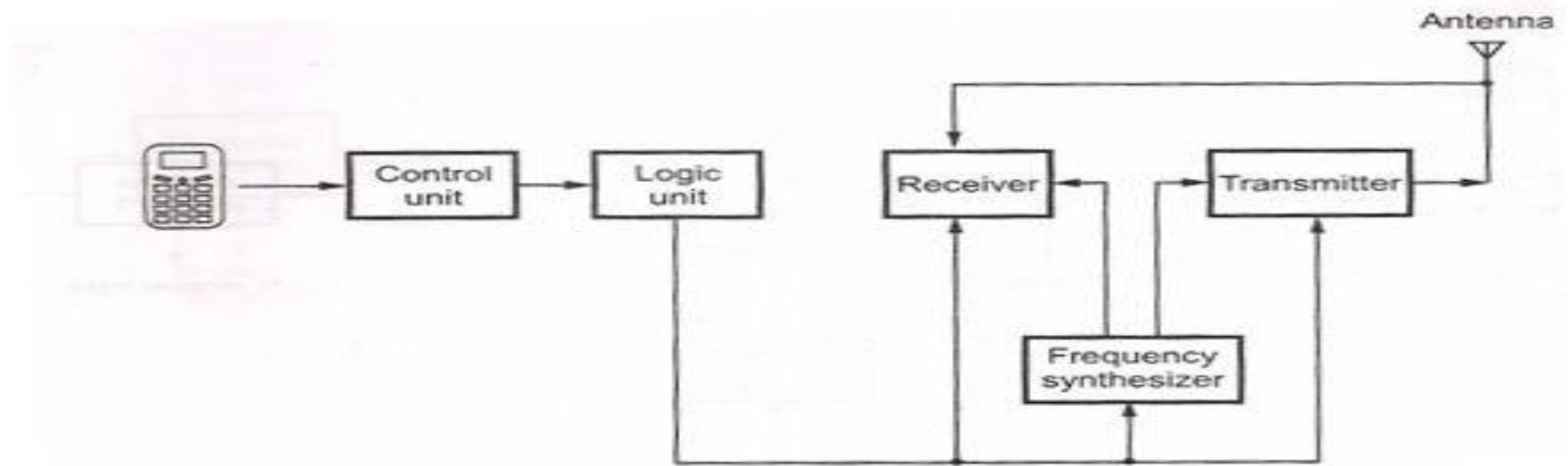
- The term cell site is used to refer to the **physical location of radio equipment** that provides coverage within a cell.
- A list of **hardware** located at a cell site includes **power sources, interface equipment, radio frequency transmitters and receivers, and antenna systems**.

- **BTS (Base Transceiver Station ):**
  - Main component of a cell and it **connects** the **subscriber to the cellular** network. For transmission and reception of information it uses several antennas.
- **BSC (Base Station Controller):**
  - It is an **interface between BTSs** and it is linked to BTS by cable or microwave links.
  - It routes calls between BTSs. It is also connected to MSC
- **MSC (Mobile Switching Center):**
  - It coordinates all the activities in a cellular network as it is connected to several BSCs
  - It routes calls between BSCs
  - Links cellular network with other networks like PSTN through fiber networks, microwave or copper cable.



- **HLR (Home location register):** database maintained by the service provider containing the data about each subscriber (like location, activity status, call forwarding preferences)
- **VLR (Visitor location register):** data base that store temporary data about a subscriber.
- It is kept in the MSC of the area that the subscriber is located in.
- When the subscriber moves to the new location the new MSC requests this VLR from the HLR of the old MSC.
- **EIR (Equipment identity register):** database located near the MSC and contains information identifying cell phones like IMEI number.

# Cellular telephone unit



- It consists of transmitters, receivers, synthesizer, logic unit and control unit.
- The mobile unit contains built-in rechargeable batteries to Provide operating power.
- The transmitter and receiver in the unit share the common antenna



Thank You!

