

Telecommunications



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- Introduction to communication system.
- Type of communication system.
- Transmission types.
- Communication channel.
- Analog & digital modulation.
- Basic analog communication system.
- Need of modulation.
- Modulation types.
- Home work.
- References.

Learning outcomes

At the end of the lecture, the learner will be able to:

- Explain the principles of a communication systems
- Discuss the nature of medium channel.
- Make the distinction between analog and digital signal.
- Determine the need of modulation and differentiate various type of modulation techniques

Definitions

- **Communications:**
 - Transfer of information from one place to another.
 - Should be efficient, reliable, and secured.
- **Communication system:**
 - components/subsystems act together to accomplish information transfer/exchange

Definitions (Cont'd)

- **Electronic communication system**
 - transmission, reception and processing of information between two or more locations using electronic circuits.
- **Information source**
 - analog/digital form

Information, message and signals

- Information
 - The commodity produced by the source for transfer to some user at the destination.
- Message
 - The physical manifestation of information as produced by the information source.
- Signals
 - A physical embodiment of information – voltage signal or current signal

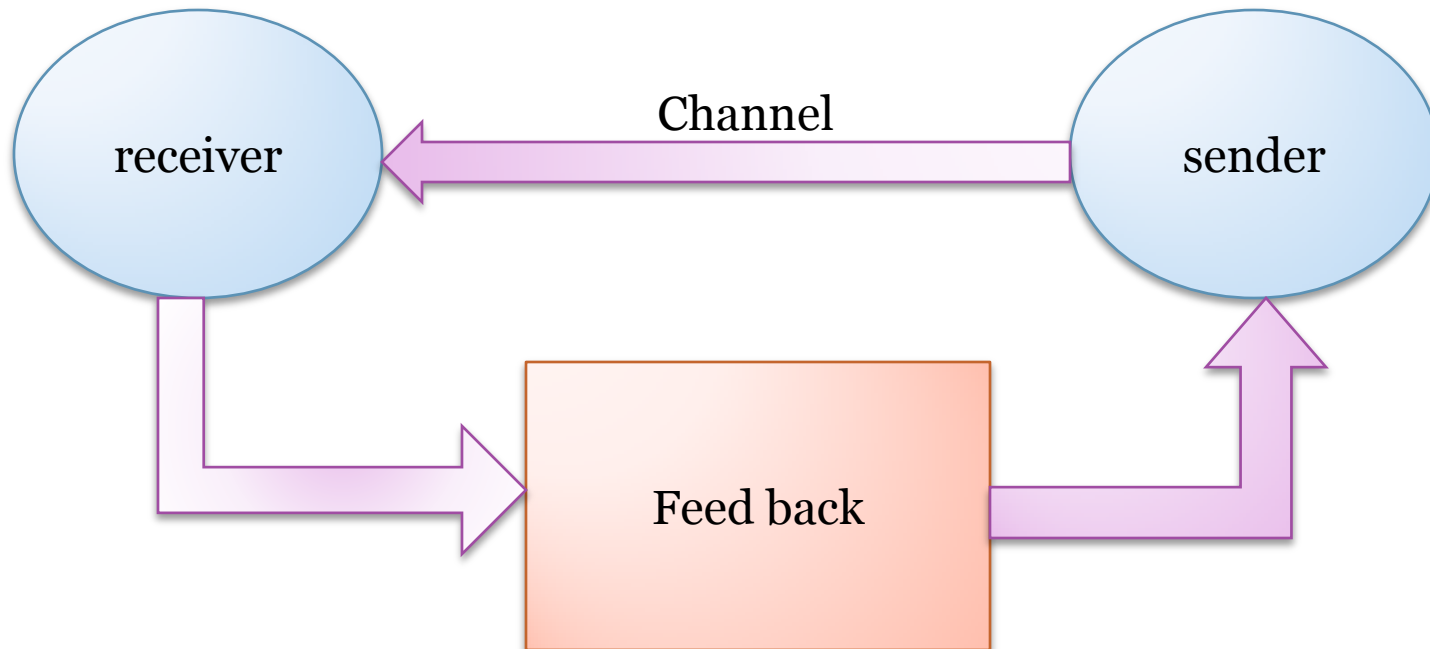
Need For Communication

- Importance of communication: exchange of information between two parties separated in distances in a more faster and reliable way.



Introduction to communication system

- Communication is participated process intent to transfer information from one place to another.
- A significant point about communication is that it involves a *sender* (transmitter) and *receiver*.



Information transfer system block diagram

Information sources

- > Audio
- > Video
- > Data

Processing
modulator

Transmitter

(with their respective
transducers)

Transmission
medium

Reproduced information

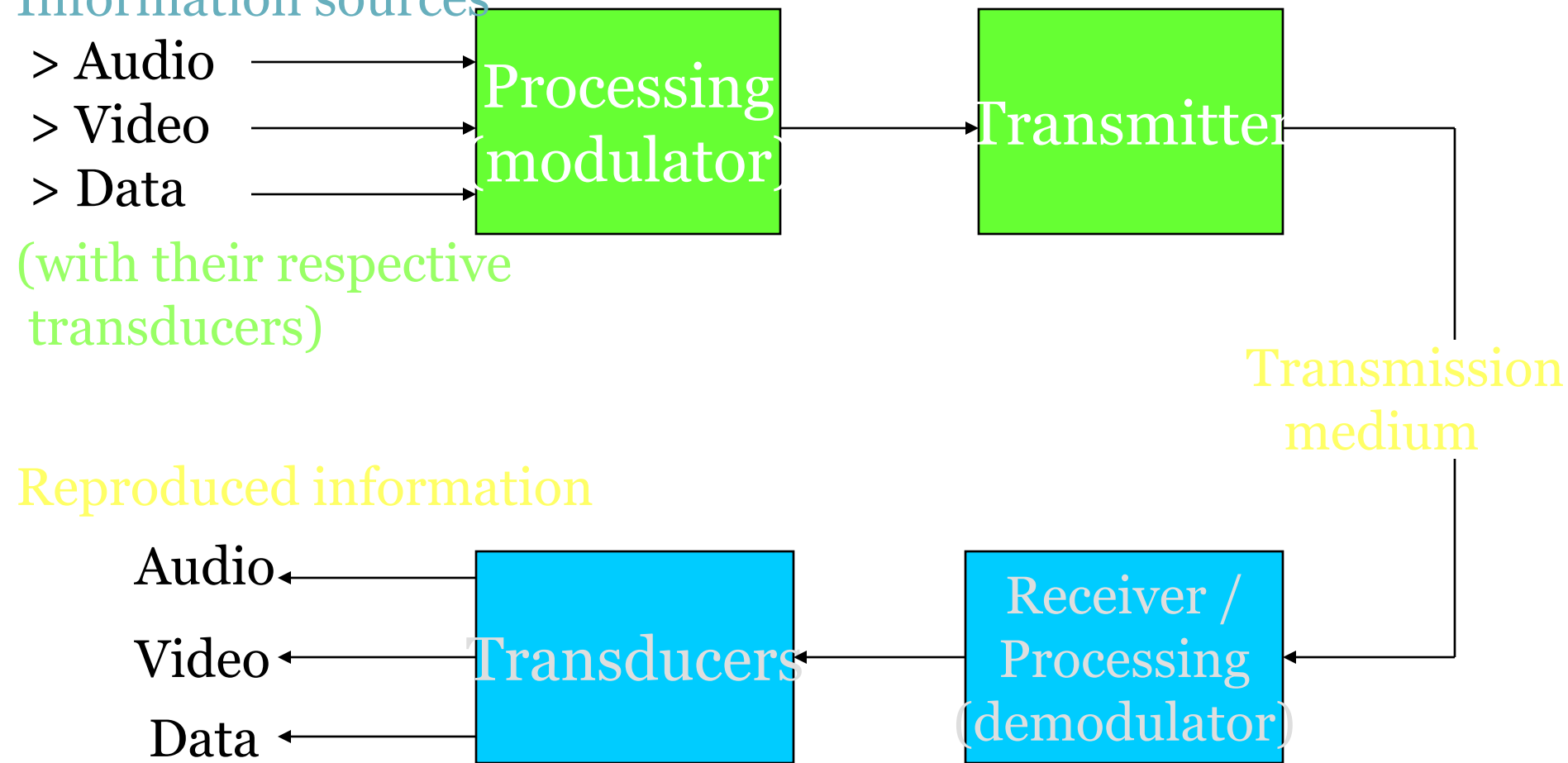
Audio

Video

Data

Transducers

Receiver /
Processing
(demodulator)





The World Without Engineers

Type of communication system

- Electronic communications are classified according to whether they are
 1. Type of transmission:
 - a. One-way (simplex) transmissions.
 - b. two-way (full duplex or half duplex) transmissions.
 2. Type of channel medium:
 - a. Wire-less communication.
 - b. Wire-line communication.
 3. Type of modulating signal:
 - a. Analog modulation.
 - b. Digital modulation.

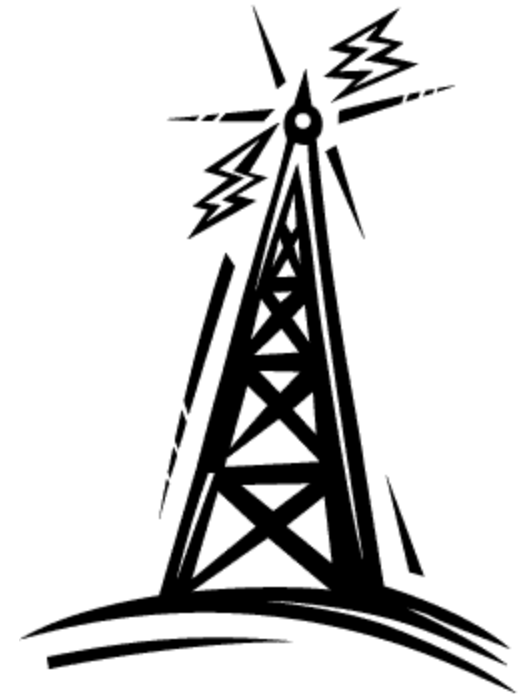
Transmission types-I

❖ Simplex

□ The simplest method of electronic communication is referred to as **simplex**.

□ This type of communication is one-way. Examples are:

- Radio
- TV broadcasting



Transmission types-II

Full Duplex

- Most electronic communication is two-way and is referred to as **duplex**.
- When people can talk and listen simultaneously, it is called **full duplex**.
 - Telephone, Cell phone
 - Internet



Transmission types-III

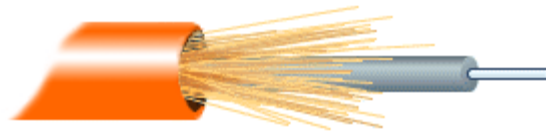
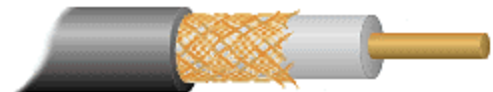
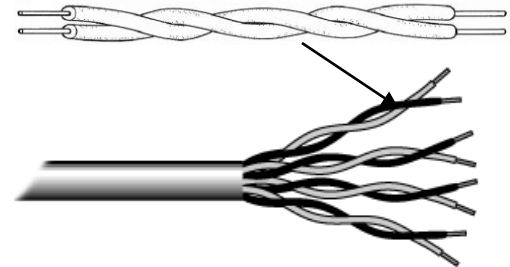
Half Duplex

- The form of two-way communication in which only one party transmits at a time is known as **half duplex**. Examples are:
 - Police, military, etc. radio transmissions
 - Walky-talky



communication channel

- The **communication channel** is the medium by which the electronic signal is sent from one place to another through it.
 - **Types of media include**
 - Free space
 - Electrical conductors
 - Optical media
 - waveguide



Analog & Digital modulation-I

- Analog referred to the system that used analog signals (continuous with time) for all processes that preferred in transmitter and receiver.

- Sine wave
- Voice
- Video (TV)

Analog signal



- Digital referred to the system that used digital signals (discrete with time) for all processes that preferred in transmitter and receiver.

- Most digital signals use binary or two-state codes.

Examples are:

- Telegraph (Morse code)
- Continuous wave (CW) code
- Serial binary code (used in computers)

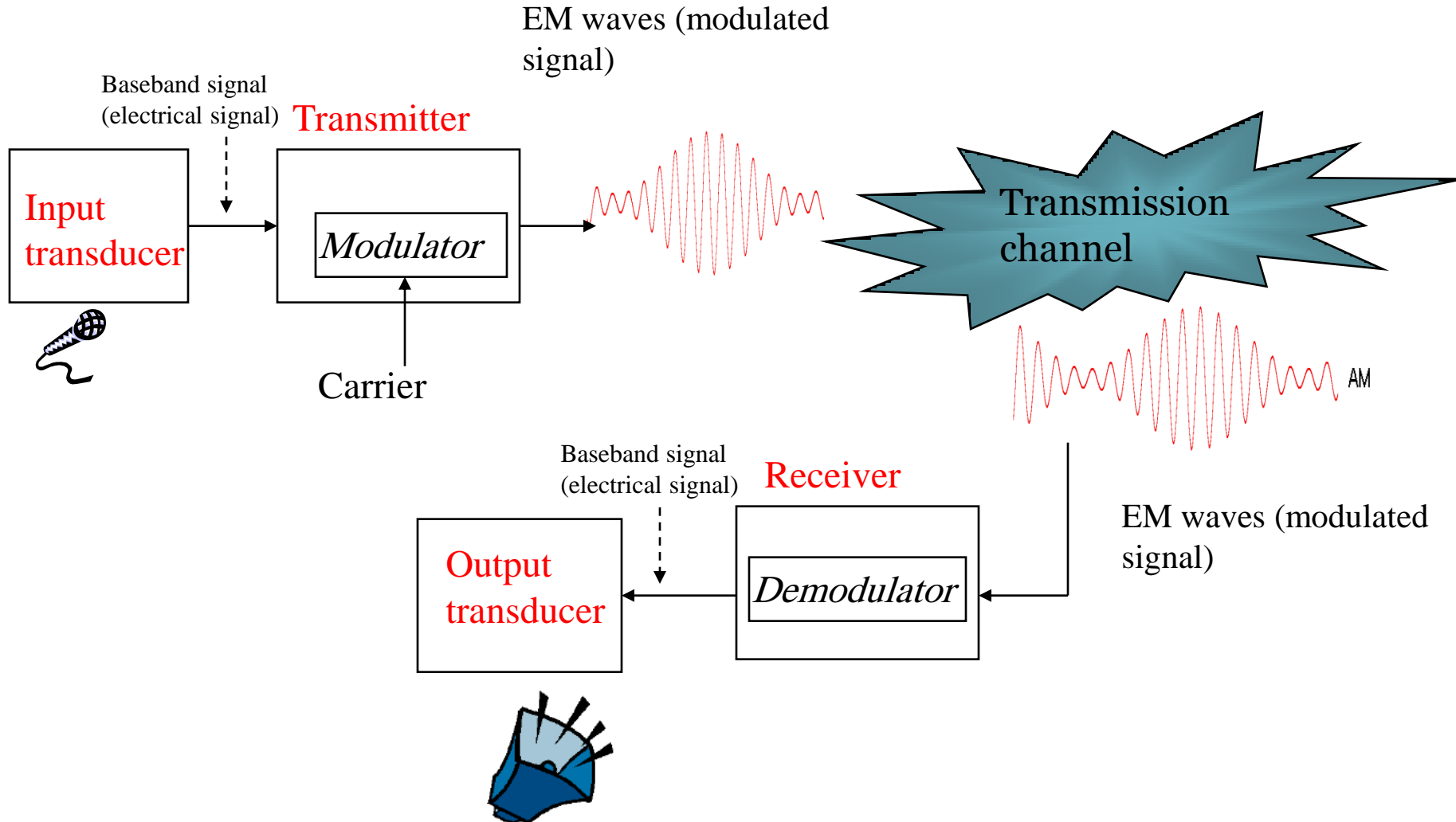
Digital signal



Analog & Digital modulation-II

- Modulation is the process of changing some property of the information sources into suitable form for transmission through the physical medium/channel.
 - **It is performed in the Transmitter by a device called *Modulator*.**
- Demodulation is the reverse process of modulation by converting the modulated information sources back to its original information (it removes the carrier from the information signal).
 - **It is performed in the Receiver by a device called *Demodulator*.**

Basic analog communication system



Analog vs. Digital

- Analog
 - Continuous Variation
 - Assume the total range of frequencies/time
 - All information is transmitted
- Digital
 - Takes samples:
 - non continuous stream of on/off pulses
 - Translates to 1's and 0's

Analog vs. Digital

- Digital CS

Advantages:

- Privacy preserved(data encrypted)
- Can merge different data
- error correction
- high immunity to noise

Disadvantages:

- synchronization problem is relatively difficult

- Analog CS

Disadvantages:

- No privacy preserved
- Cannot merge different data
- No error correction capability
- Susceptible to noise

Advantages:

- synchronization problem is relatively easier.

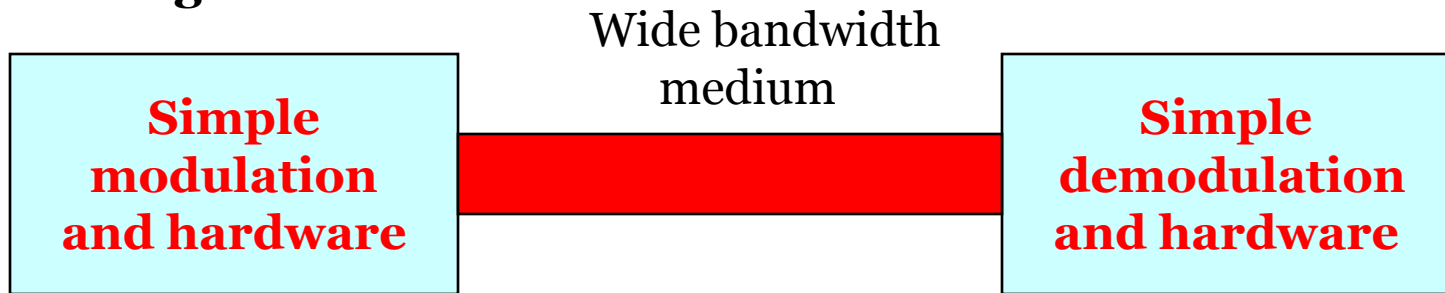
Basic Requirements of Communication System

- Rate of information transfer:
 - how fast the information can be transferred
- Purity of signal received:
 - whether the signal received is the same as the signal being transmit
- Simplicity of the system
 - the simpler the system, the better
- Reliability

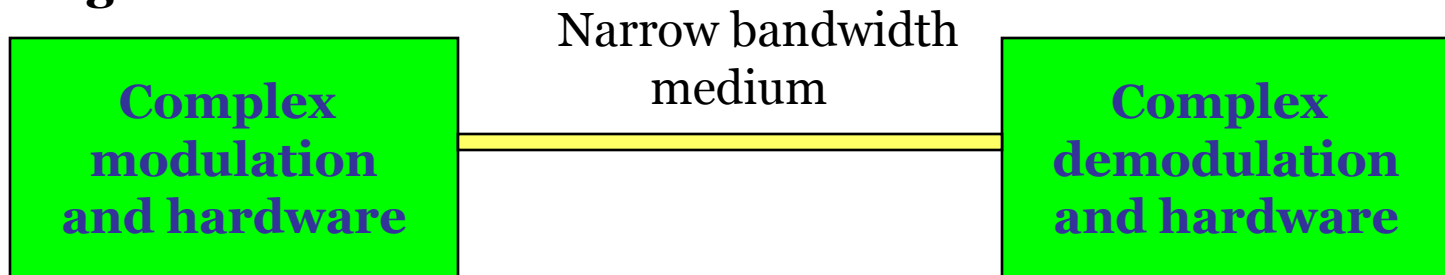


Trade-off between analog and digital modulations

Analog modulation

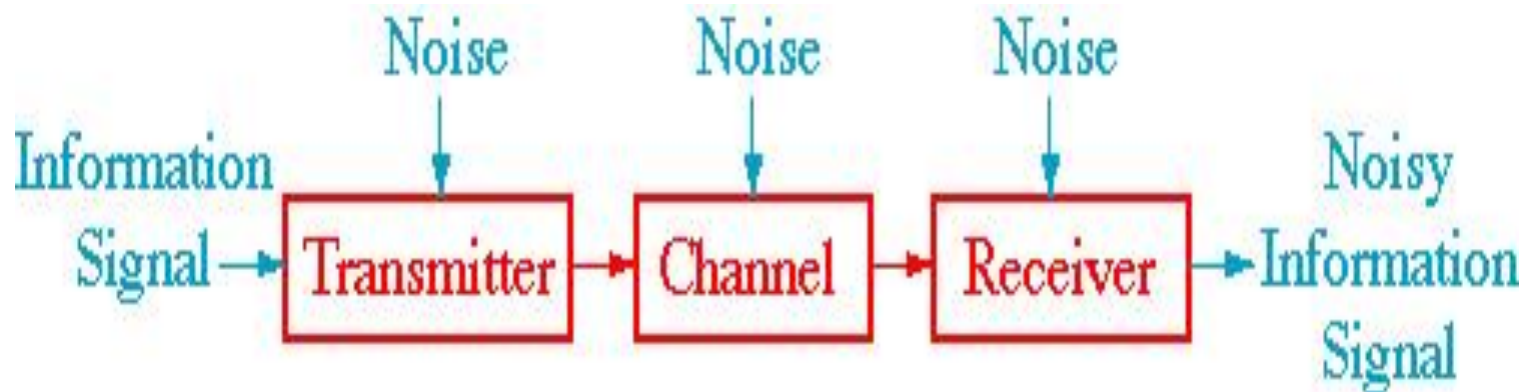


Digital modulation

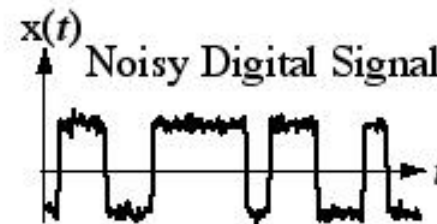
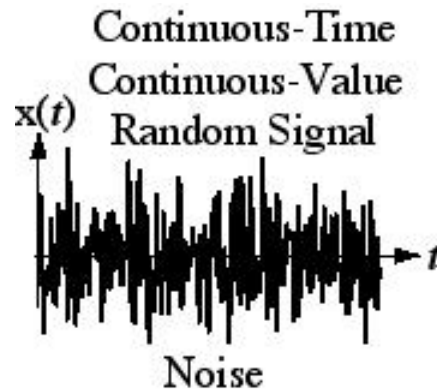
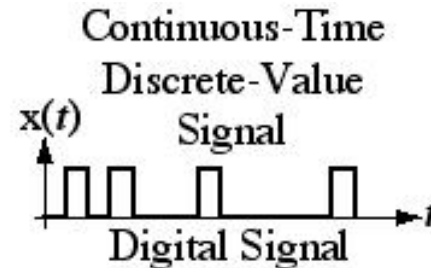
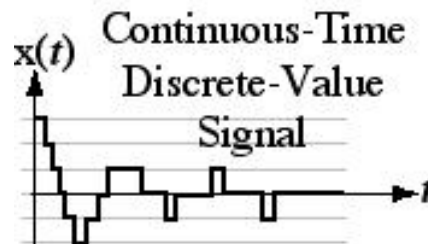
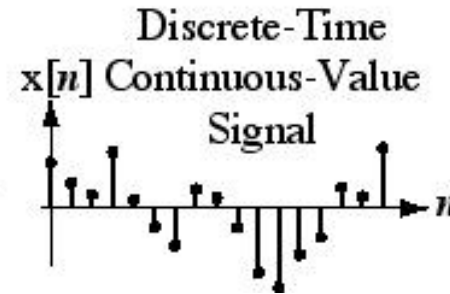
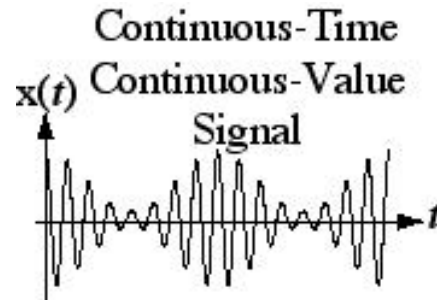


A Communication System as a System Example

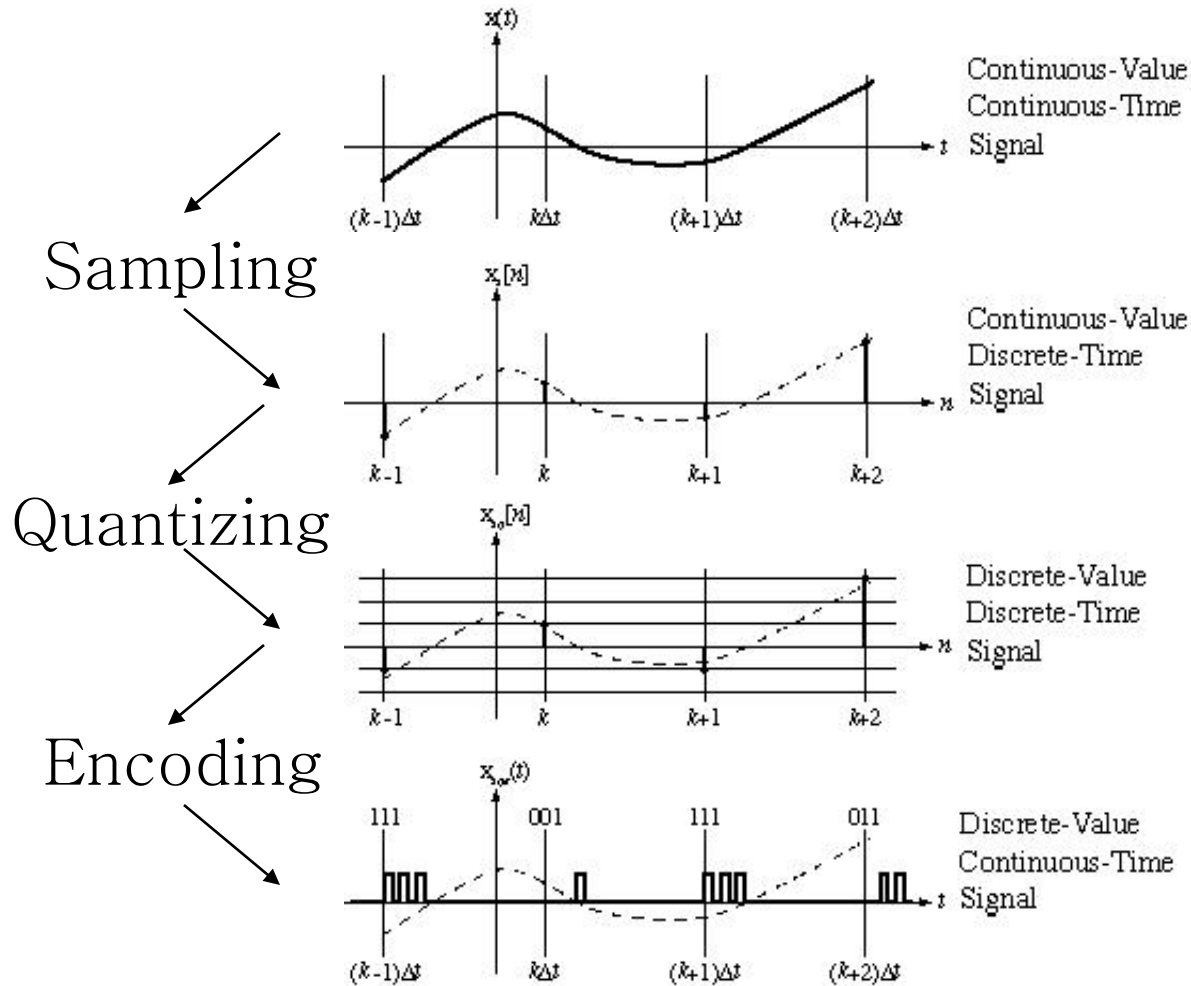
- A **communication system** has an **information signal** plus **noise signals**
- This is an example of a **system** that consists of an interconnection of smaller **systems**



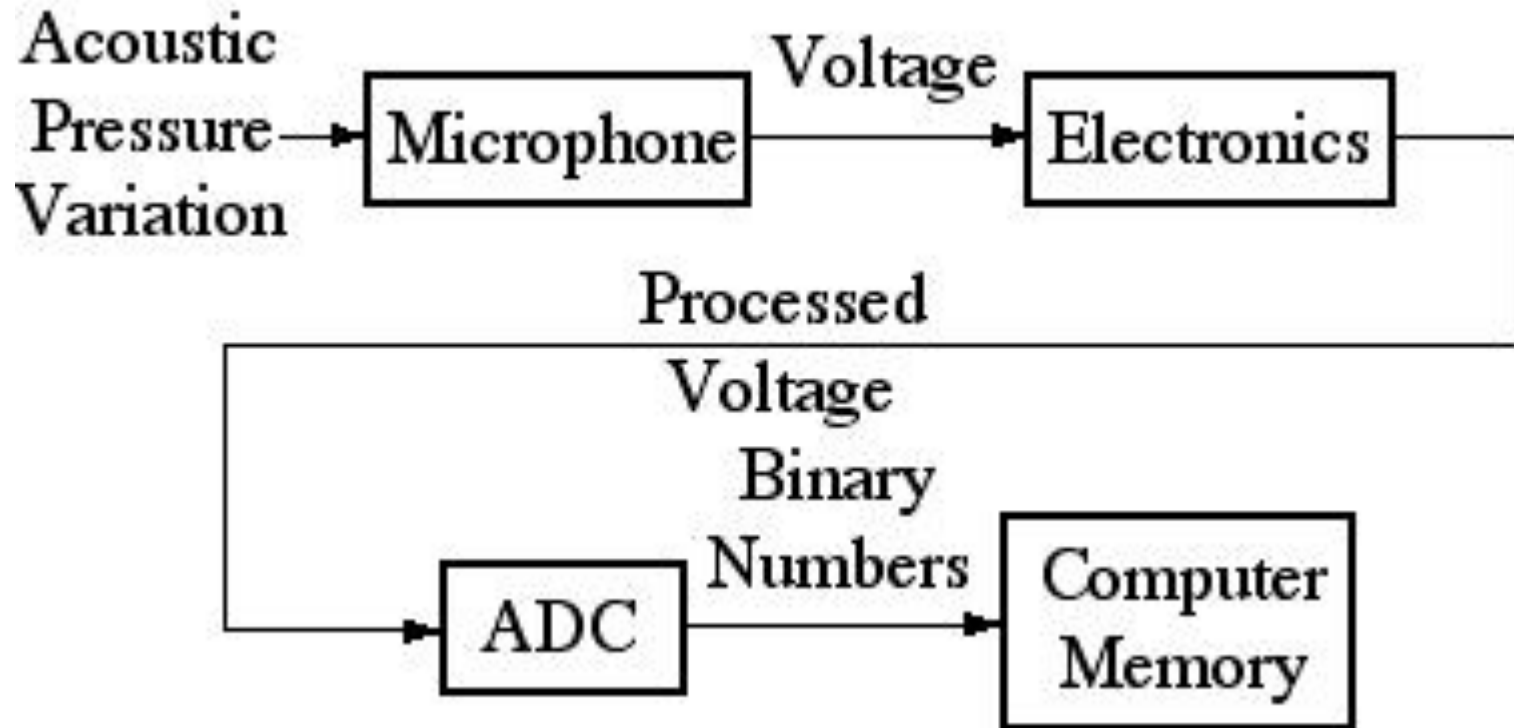
Signal Types



Conversions Between Signal Types

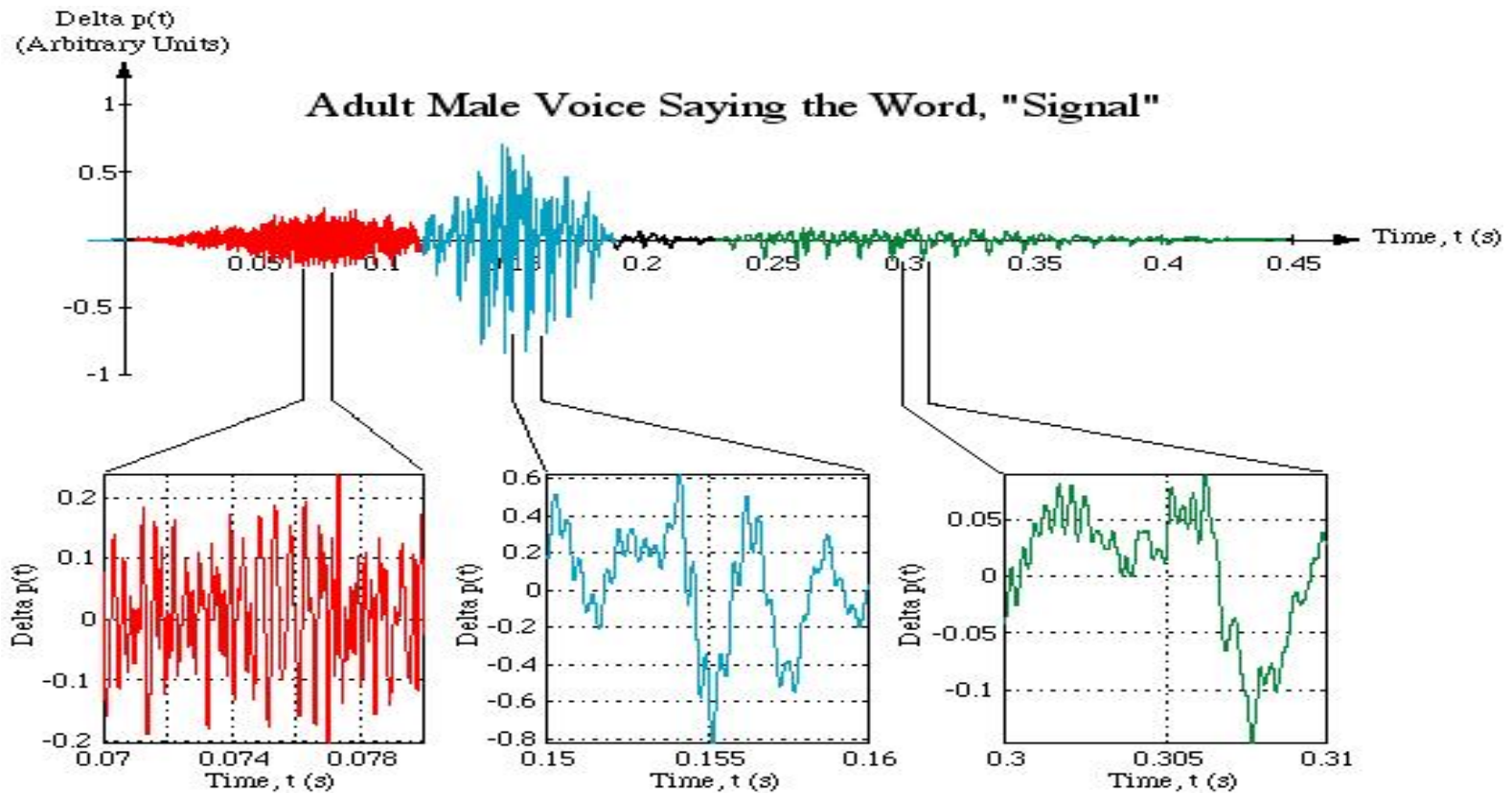


Sound Recording System

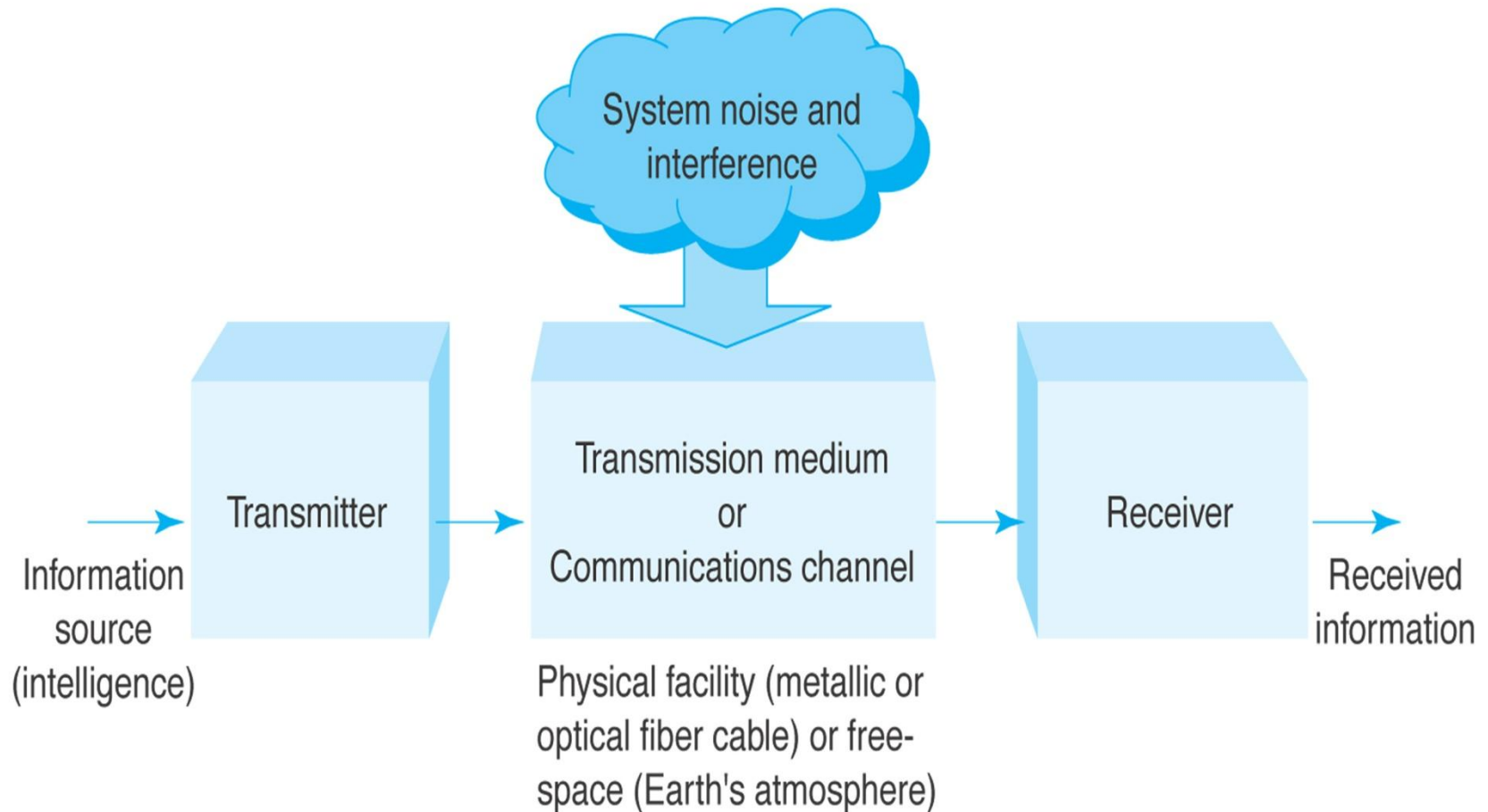


Recorded Sound as a Signal Example

- “s” “i” “gn” “al”



Elements of Communication System(CS)



Elements of CS(cont'd)

- Information
 - The communication system exists to convey a message.
 - Message comes from information source
 - Information forms - audio, video, text or data



cont'd...

- **Transmitter:**

- Processes input signal to produce a transmitted signal that suited the characteristic of transmission channel.
- E.g. modulation, coding, mixing, translate
- Other functions performed - Amplification, filtering, antenna
- Message converted to into electrical signals by transducers
- E.g. speech waves are converted to voltage variation by a microphone



Elements of CS(cont'd)

- Channel (transmission media):
 - a medium that bridges the distance from source to destination. Eg: Atmosphere (free space), wires, coaxial cable, fiber optics, waveguide
 - signals undergoes degradation from noise , interference and distortion



Elements of CS(cont'd)

- Receiver:
 - to recover the message signal contained in the received signal from the output of the channel, and convert it to a form suitable for the output transducer.
 - E.g. mixing, demodulation, decoding
 - Other functions performed: Amplification, filtering.
 - Transducer converts the electrical signal at its input into a form desired by the system used

Various forms of communication system

- Broadcast: radio and television
- Mobile communications
- Fixed communication system- land line
- Data communication-internet



Need of modulation

1. Ease of radiation

Wavelength (λ) = speed of light (c) \div frequency (f)

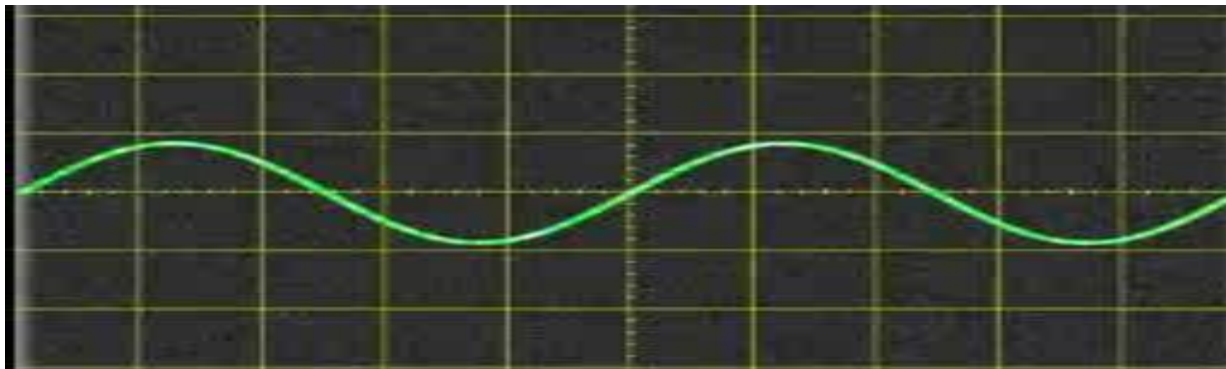
Length of antenna (L) = wavelength \div 10

2. Reduce noise & interference

3. Overcome equipment limitation

4. Frequency assignment

5. For multiplexing



Need of modulation

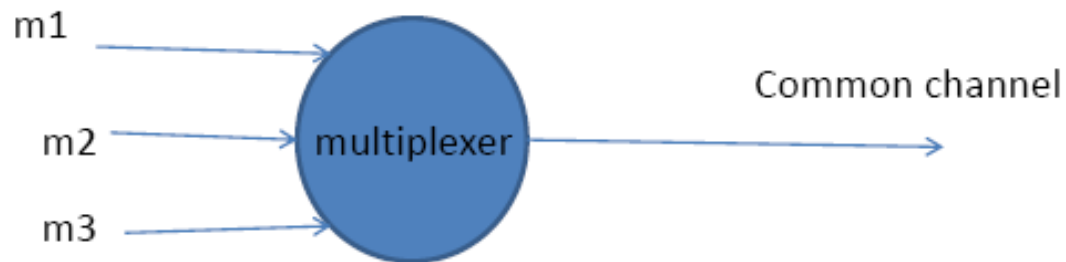
- **To reduce noise and interference**
- Interference can be eliminated, although in theoretically noise cannot be eliminated.
- So certain modulation methods are used to reduce noise but usually by increasing bandwidth
- Bandwidth needed \gg Original bandwidth

Need of modulation

- **•Frequency assignment**
- Proper assignment of frequencies for different types of communication, reduce inter-symbol-interference ISI and increase data rate.

Need of modulation

- **For Multiplexing**
- Sending many signals in one channel (wire, cable

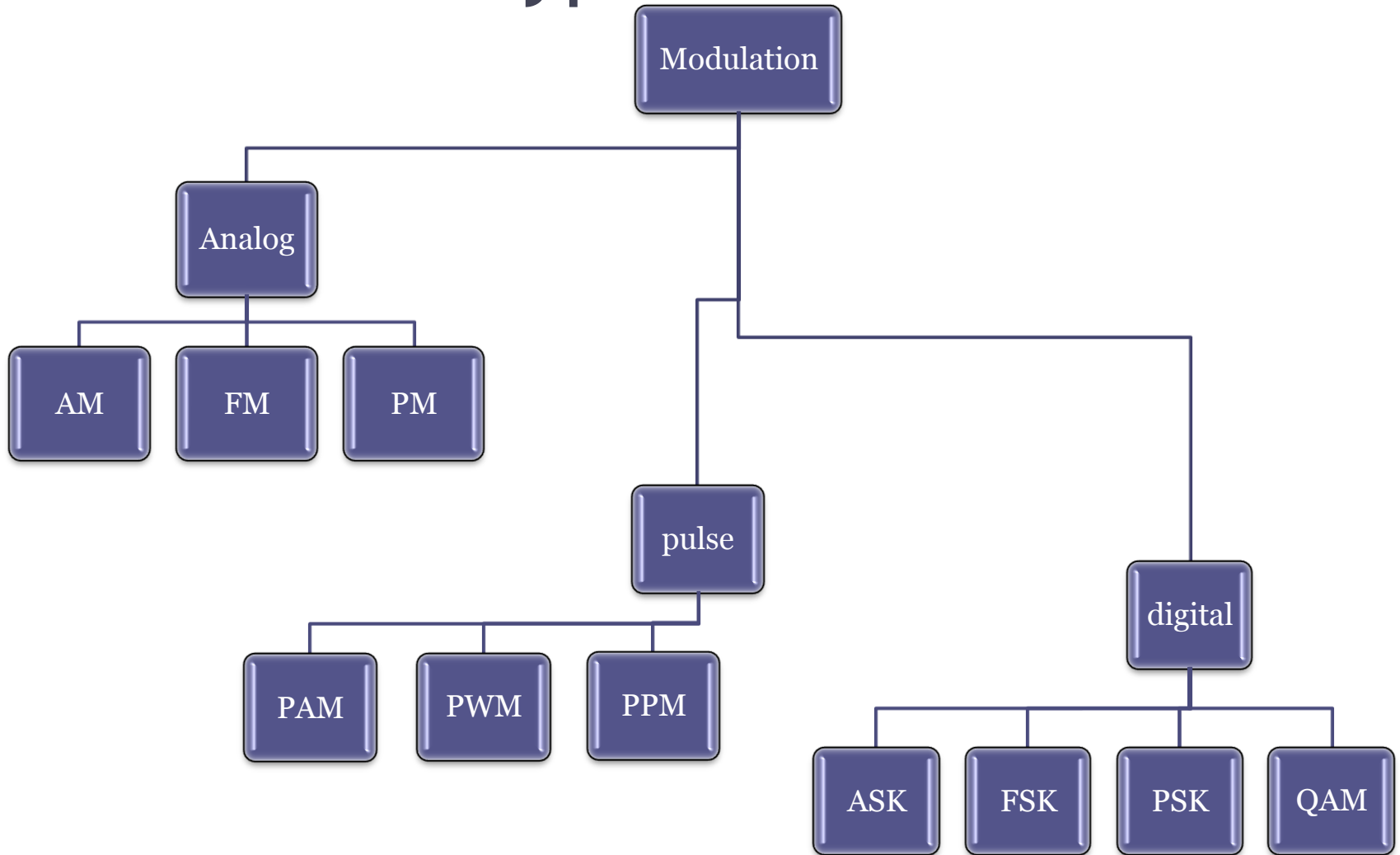


- Ex: telephone

Need of modulation

- **To overcome equipment limitation**
- To place signals in the proper frequencies where equipment are available.

Modulation types



Home work

- Determine the wavelength and antenna size for the following devices:
 - Home electricity.
 - FM radio device.
 - Satellite device.
 - Mobile device.
 - Microwave oven.

Use internet, catalogs or device features to determine the operate frequency.

references

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