EC 322 Introduction to Communication Systems

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Lecture # 1

Outline

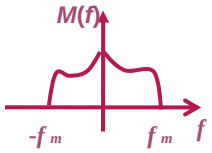
- Introduction to Communication systems
  - Analog Modulation
    - AM
    - PM
    - FM
  - Digital Modulation
    - ASK
    - PSK
    - FSK

PURPOSE OF COMMUNICATIONS

- The purpose of a communication system is to transmit information (***baseband***) signals located at one point (***source***) in space to another point (***destination***).
- The term ***baseband*** is used to designate the band of frequencies representing the original signal as delivered by the input transducer.
  - For example, the voice signal from a microphone is a baseband signal, and contains frequencies in the range of 300-3400 Hz

WHY DO WE NEED COMMUNICATION SYSTEMS (CONT.)

- Messages are in the form of baseband signals (low frequencies).



- Example human voice (speech)
  - Small distances.

  - Longer distances
    - Microphones and loudspeakers.

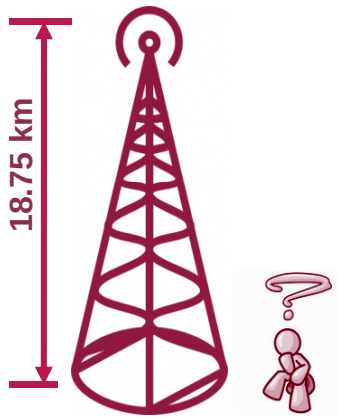
  - Very long distances??
    - Communication system.

Why Do We Need Communication Systems

- Speech frequency 300-3400 Hz.
- Antenna length is directly proportional to $\lambda/4$.

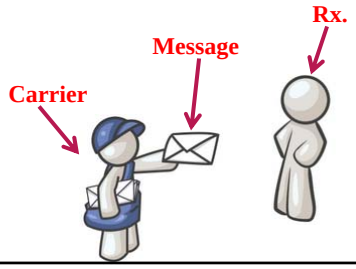
$$f = \frac{c}{\lambda}, c = 3*10^8 \text{ m/sec}$$

- Antenna length 18.75 km ??
- Need solutions…
- Higher frequencies??

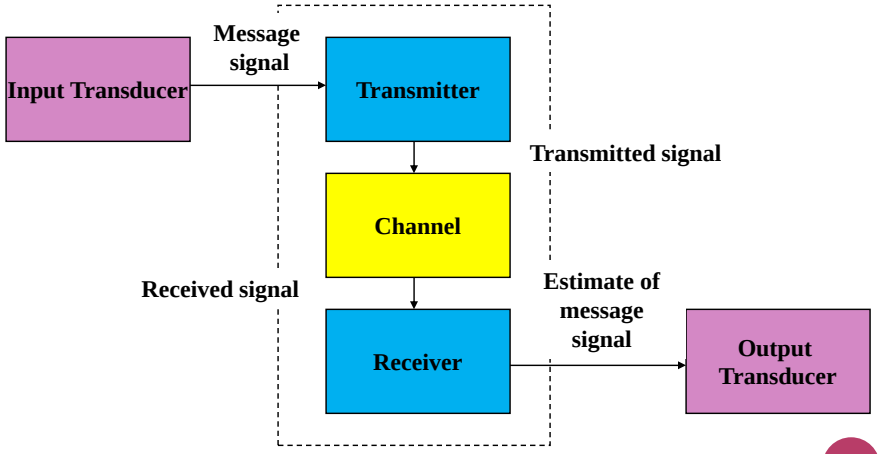


Concept of Modulation

- Have baseband signal.
- Have carrier signal (typically high frequency).
- Modulate carrier with message.
- Demodulate signal (remove carrier at the receiver (Rx.).
- Restore original signal.



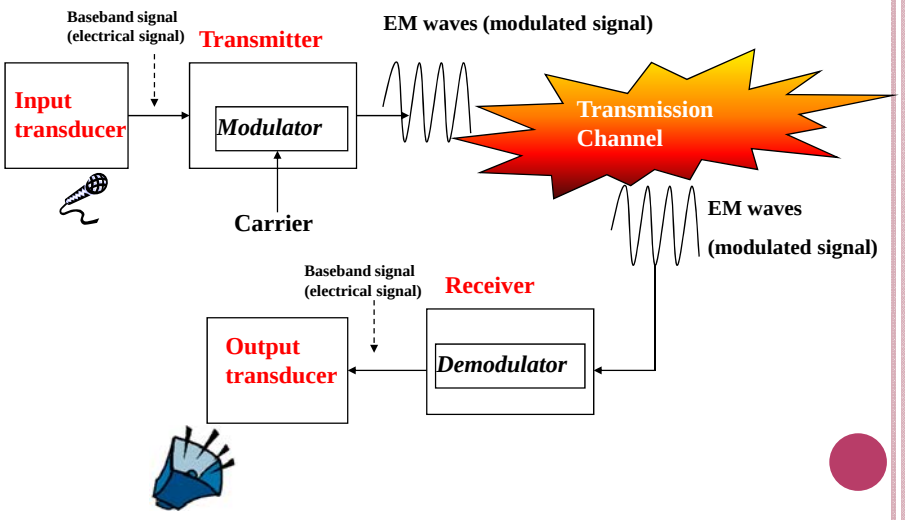
GENERIC COMMUNICATION SYSTEM



COMPONENTS OF COMMUNICATION SYSTEMS:

- ***Input transducer:*** The device that converts a physical signal from source to an electrical, mechanical or electromagnetic signal more suitable for communication.
- ***Transmitter:*** The device that sends the transduced signal.
- ***Transmission channel:*** The physical medium on which the signal is carried
- ***Receiver:*** The device that recovers the transmitted signal from the channel.
- ***Output transducer:*** The device that converts the received signal back into a useful quantity.

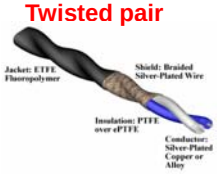
BASIC ANALOG COMMUNICATIONS SYSTEM



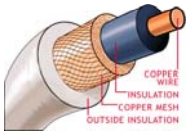
TRANSMISSION CHANNEL

- Wire-line channel

Twisted pair



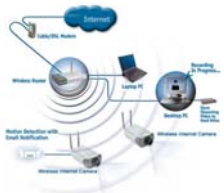
Coaxial cable



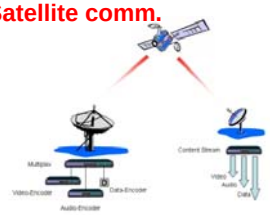
Fiber optics

- Wireless Communication channel

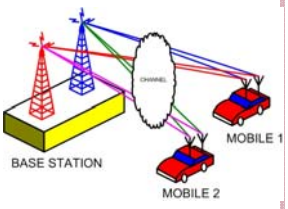
Wireless networks



Satellite comm.



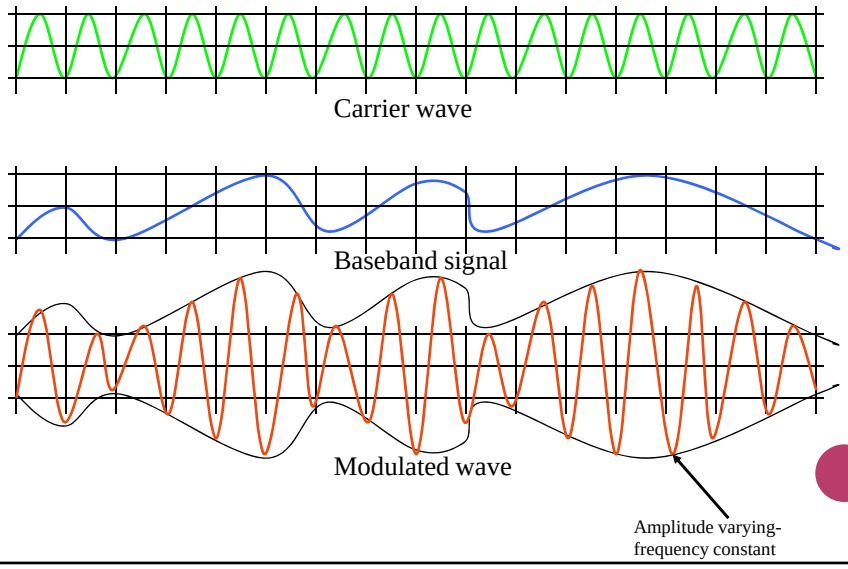
Mobile comm.



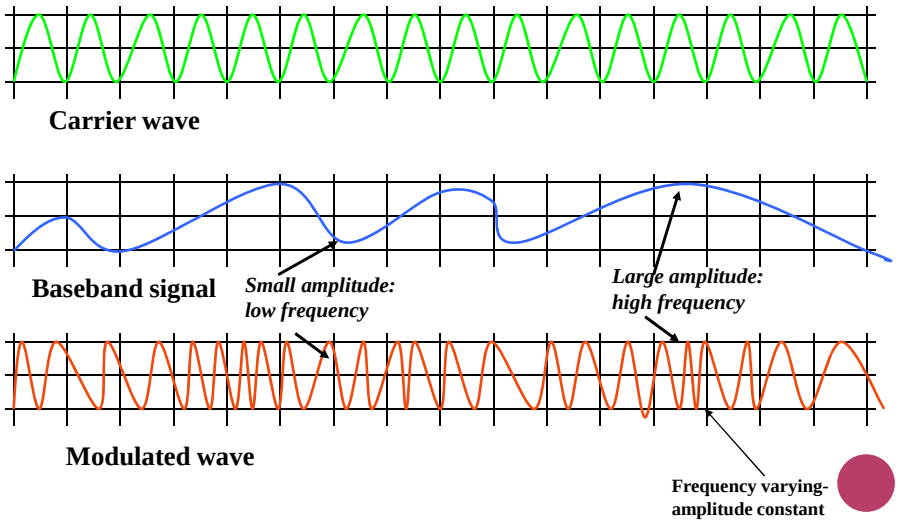
TYPES OF ANALOG MODULATION

- ***Amplitude Modulation (AM)***
  - Amplitude modulation is the process of ***varying the amplitude of a carrier wave in proportion to the amplitude of a baseband signal.*** The frequency of the carrier remains constant
- ***Frequency Modulation (FM)***
  - Frequency modulation is the process of ***varying the frequency of a carrier wave in proportion to the amplitude of a baseband signal.*** The amplitude of the carrier remains constant
- ***Phase Modulation (PM)***
  - Phase modulation is the process of ***varying the phase of a carrier wave in proportion to the amplitude of a baseband signal.*** The amplitude of the carrier also remains constant.

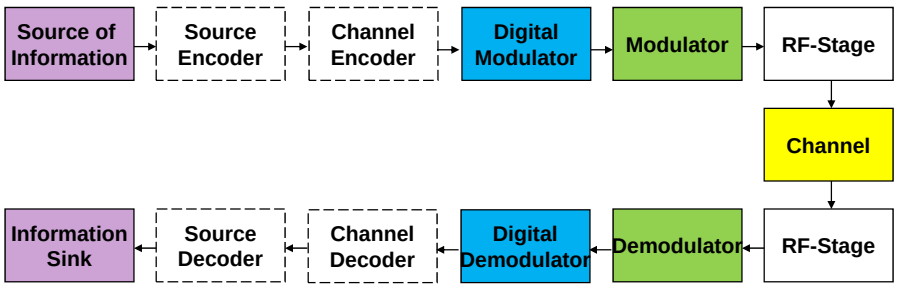
AMPLITUDE MODULATION (AM)



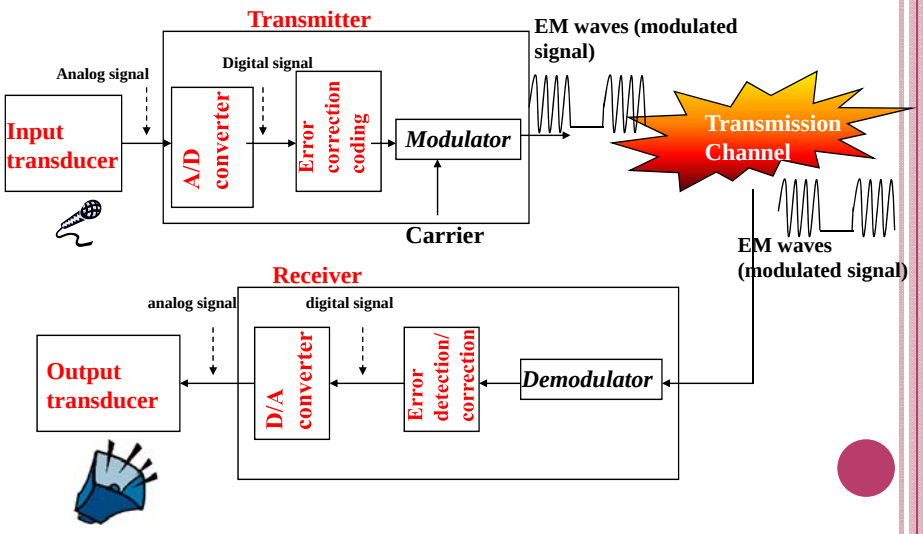
FREQUENCY MODULATION (FM)



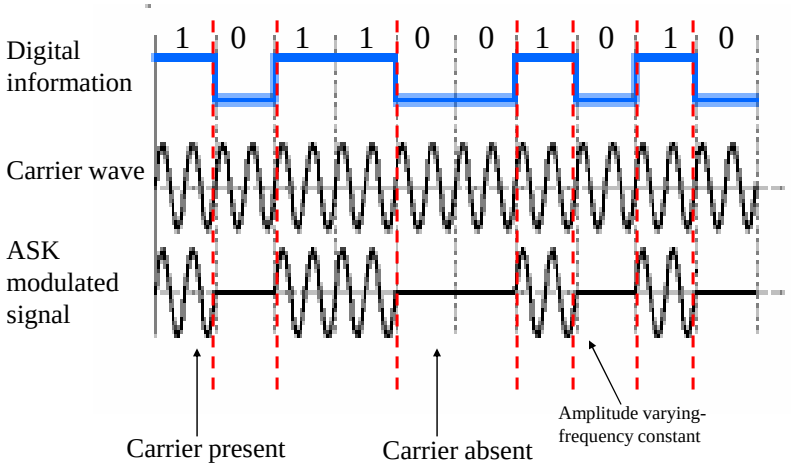
DIGITAL COMMUNICATION SYSTEM



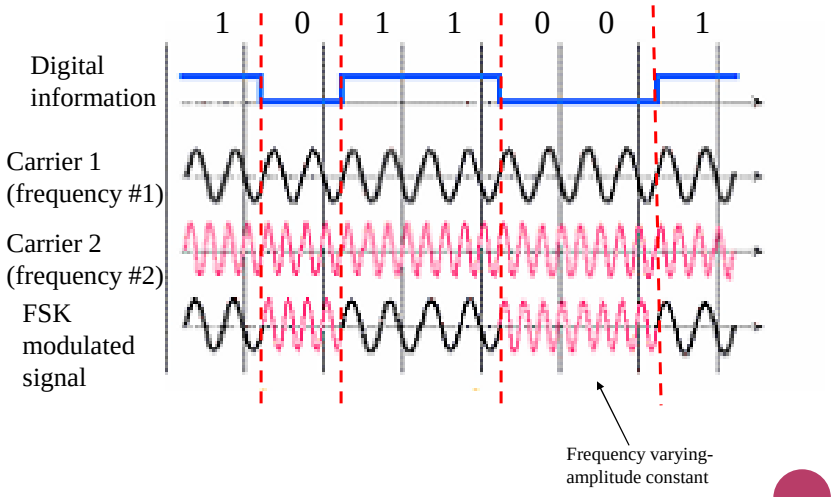
BASIC DIGITAL COMMUNICATION SYSTEM



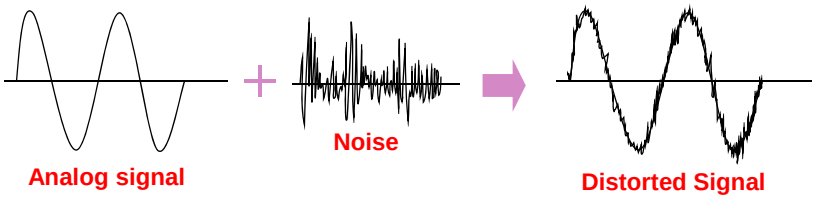
AMPLITUDE SHIFT KEYING (ASK)



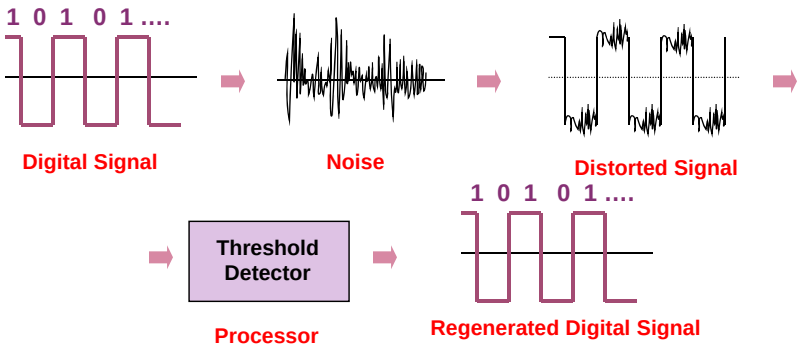
Frequency Shift Keying (FSK)



Digital vs. Analog Transmission



Digital vs. Analog Transmission (cont.)



Examples of Analog and Digital Devices:

- **Analog**
  - Microphone
  - Cassette player
  - Radio (AM, FM)
  - Photograph camera
- **Digital:**
  - DVD
  - Digital camera
  - HDTV
  - CD player
  - New cell phones
  - Fiber-optics

Some Frequency Bands

Frequency band	Abbreviation	Frequency range
Very low frequency	VLF	10 kHz – 30 kHz
Low frequency	LF	30 kHz – 300 kHz
Medium frequency	MF	300 kHz – 3 MHz
High frequency	HF	3 MHz – 30 MHz
Very high frequency	VHF	30 MHz – 300 MHz
Ultra high frequency	UHF	300 MHz – 3 GHz
Super high frequency	SHF	3 GHz – 30 GHz
Extra high frequency	EHF	30 GHz – 300 GHz

Any Questions??