

# Introduction

## Chapter - 1

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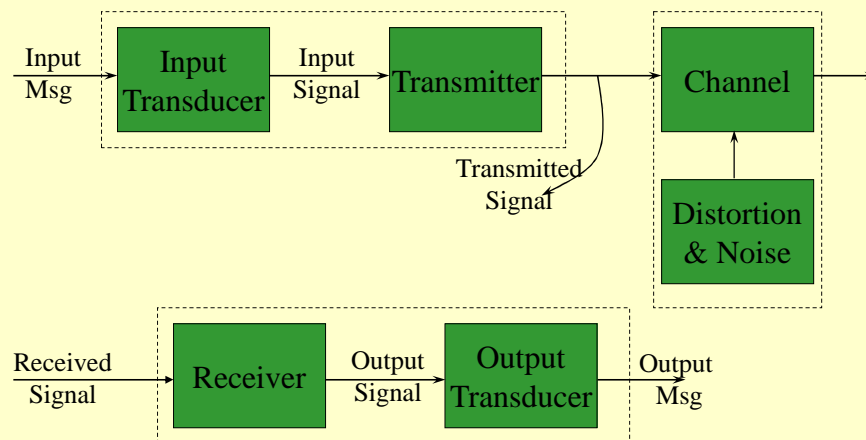
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Text used for the course: <Modern Digital and Analog Communication Systems>, 4<sup>th</sup> Edition, Lathi and Ding, Oxford

# Introduction

- General Block Diagram (three blocks essentially)



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- Block diagram of Digital Communication System (Figure 1.2, Sklar's book)
- General Trend
  - Switching from analog system to digital system
  - Digital TV

## Introduction...

- Benefits
  - Robust against noises, distortion
  - Easy to be manipulated

Bit stream  $\Rightarrow$  mix  $\Rightarrow$  multimedia
- Disadvantage: A greater system bandwidth (data expansion)  
So, data compression is a necessity.

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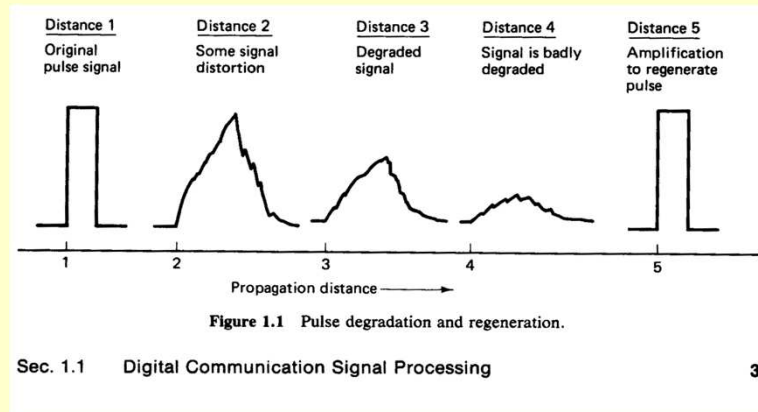
- Principal feature of a digital communication system (DCS)
  - A digital communication system transmits signals that represent **digits**. These digits form a **finite** set (alphabet), which is known a priori to the receiver.
  - An analog communication system sends a **waveform** from a continuum, which forms an **infinite** set.
  - The former is easy to be regenerated → robust.
  - The latter is difficult to be regenerated.

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- In a DCS, the objective at the receiver is not to reproduce a transmitted waveform with precision.
  - Instead, it is to determine from a noise-perturbed signal which digits from the finite set (alphabet) had been sent by the transmitter
- Main Advantage: less subject to distortion & interference

## Pulse degradation & regeneration

Fig. 1.1, <Digital Communications> by Sklar,1988



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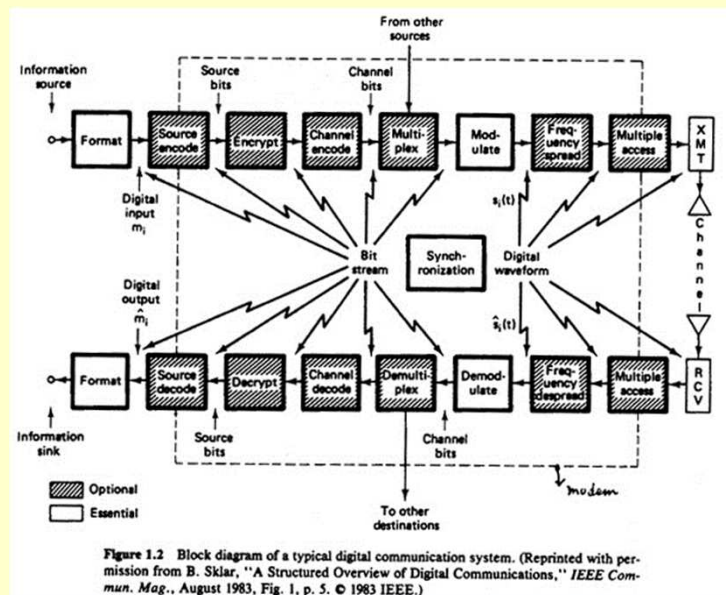
- Other advantage: More reliable, low cost, more flexible
- Major Disadvantage: Digital transmission requires a greater system bandwidth to communicate the same information in a digital format as compared to an analog format.
- Block diagram of a typical digital communication system

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Fig. 1.2., <Digital Communications> by Sklar,1988



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- Explain each block
  - Format → digital symbols
  - Source encode → remove redundant information
  - Encrypt → security
  - Channel Encode → reduce error probability ( $P_E$ )
  - Multiplex → more signals are dealt with, share channel
  - Modulate → symbols are converted to waveforms that are compatible with the transmission channel

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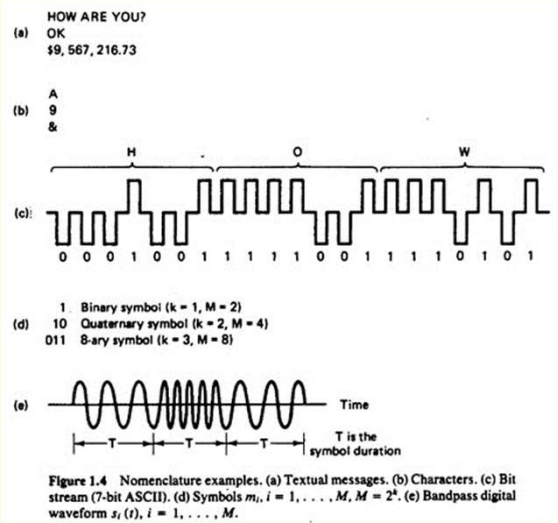
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- Frequency Spread → produce a signal that is less vulnerable to interference, enhance privacy (fixed or slowly changing)
- Multiple access → similar to Multiplex (often remote sharing)

## Nomenclature Examples

Fig. 1.4, from <Digital Communications> by Sklar, 1988



## Basic Digital Communication Nomenclature

- Information Source
- Textual Message
- Character
- Binary Digit (bit)
- Bit Stream
- Symbol (digital msg)
- Digital Waveform
- Data rate: (bit/s)

## Performance Criteria

- Digital (DCS):
  - The probability of error ( $P_E$ )
- Analog:
  - SNR signal-to-noise ratio
  - Percent distortion
  - Expected mean-square error between transmitted & received waveforms