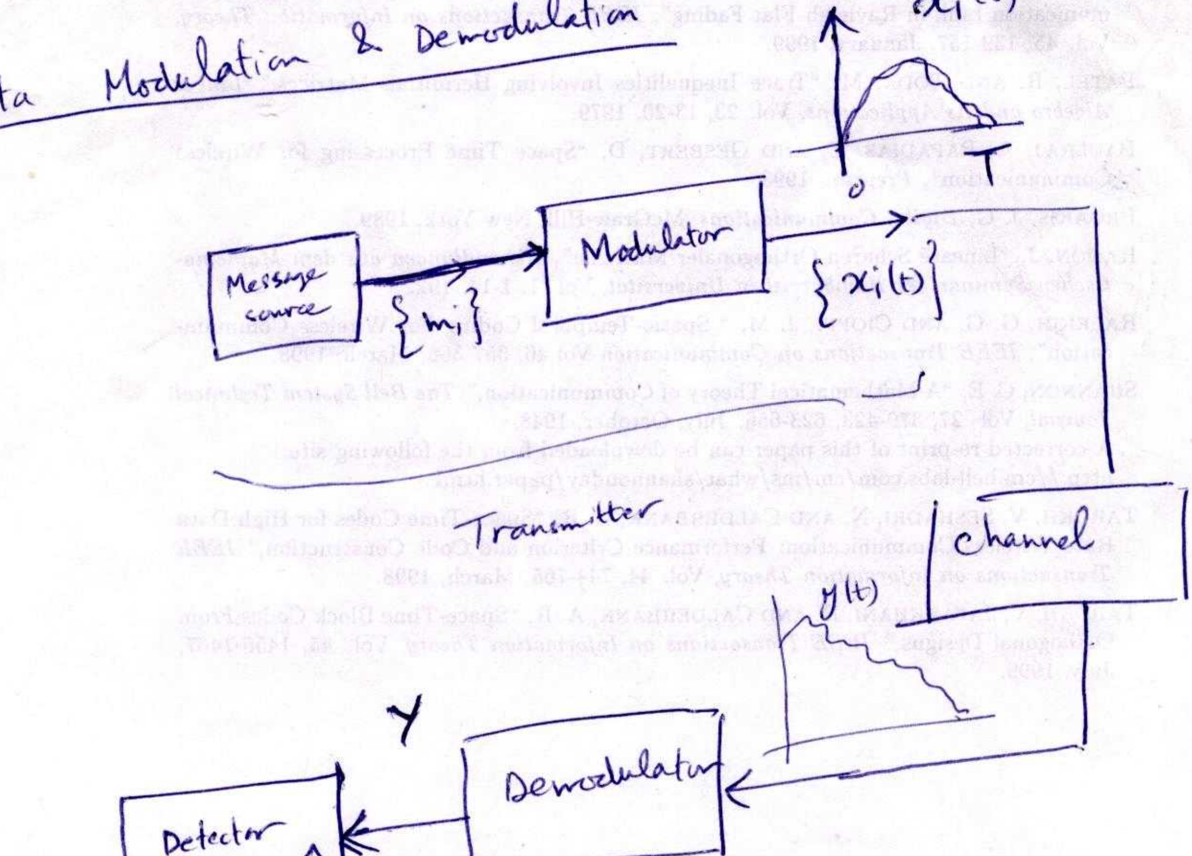
Discrete Data Transmission

page 1

Discrete data trans.: tx of one message from a finite set of messages through a communication channel

Successive Tx of discrete data messages is digital communications

Data Modulation & Demodulation



(pag 2)

~~A message from~~

- There are a set of M messages (symbols) m_i, $i = 0, 1, \ldots, M-1$

- A message is sent every T seconds

  T is the symbol period

  * one message per T second
  * symbol rate $1/T$ symbol/sec
  * number of messages is also measured in bits

    $b = \log_2 M$

  * data rate $= \log_2 M / T$ bits/sec

- Modulator converts message into a continuous time (usually analog) deterministic waveform.
  - waveform is chosen to suit the channel charectristics
  - waveform might have a duration larger than T.
  - There are M possible signal waveforms

    $x_i(t)$ $i = 0, 1, \ldots, M-1$

Demodulator converts ~~continuous~~ $y(t)$ which is

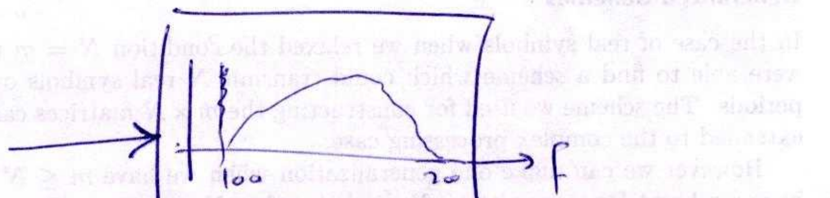
- continuous time
- analog
- deterministic ~~or random~~ (depending on whether we have noise or not)

into a vector y

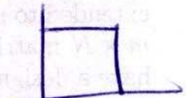
Detector detects the signal $\hat{m}$ so as to minimize probability of error

Example

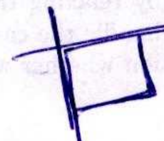
Channel



We can not Transmit "1" & "0" as



and



as the output in both cases will be almost zero.

Instead, we use the two waveforms

$$s_0(t) = \begin{cases} \cos(2\pi \cdot 150 \cdot t) & 0 < t < T \\ 0 & \text{otherwise} \end{cases}$$

$$s_1(t) = \begin{cases} -\cos(2\pi \, 150 \cdot t) & 0 < t < T \\ 0 & \text{otherwise} \end{cases}$$

For these two waveforms, most of their spectrum is centred around $f = 150$ Hz the freq. for which the gain of the channel is maximum.

Given the waveforms $x_1(t), \dots, x_M(t)$ that we transmit out of the modulator.

1) Are these waveforms transmitted with equal probability?

2) What is the avg. energy transmitted? How do you calculate it? Would you like this energy to be high or low?

3) What is the avg. energy per bit?

4) What is the symbol rate?

5) What is the bit rate?