

# Probabilistic Models

What is a model?

- Description of reality.
- helps us simplify things To capture important / highlight of something.

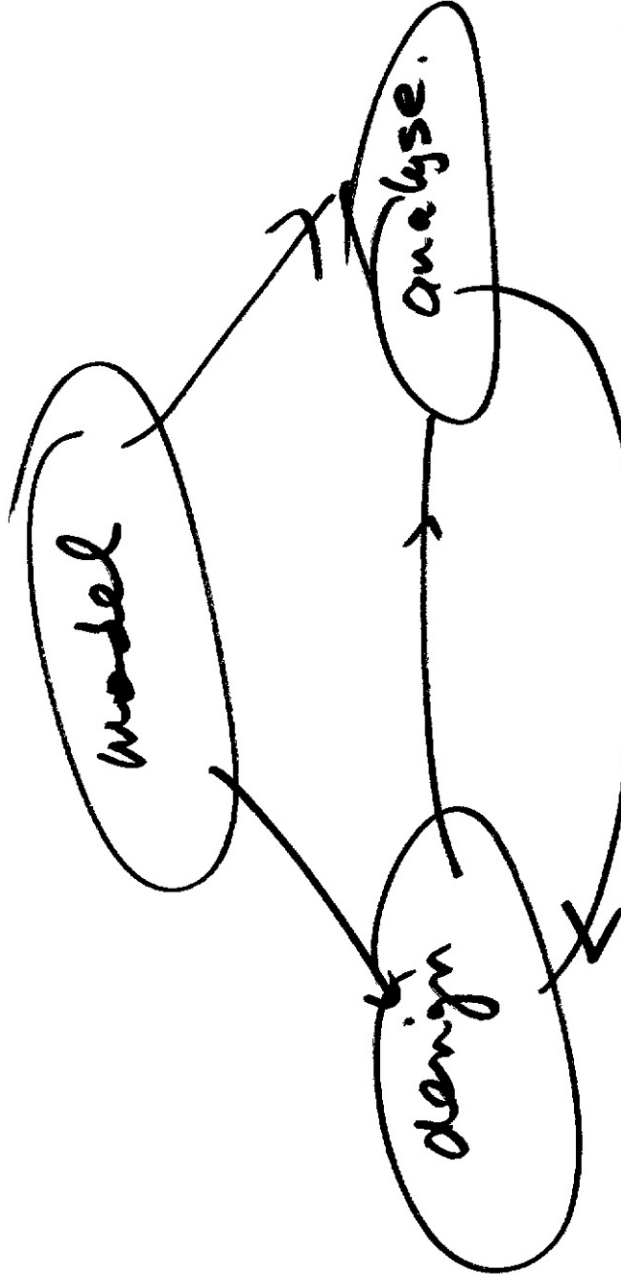
So that . . . analysis, design.

- ideally come up with a simplest possible model that explains reality

Ex  $F = \omega \omega$

Ex Toss a coin : H or T.

Use models  $\rightarrow$  Design + Analysis.



What about probabilistic models:

Systems have to operate in face of uncertainty, outcomes can not be predicted ahead of time.

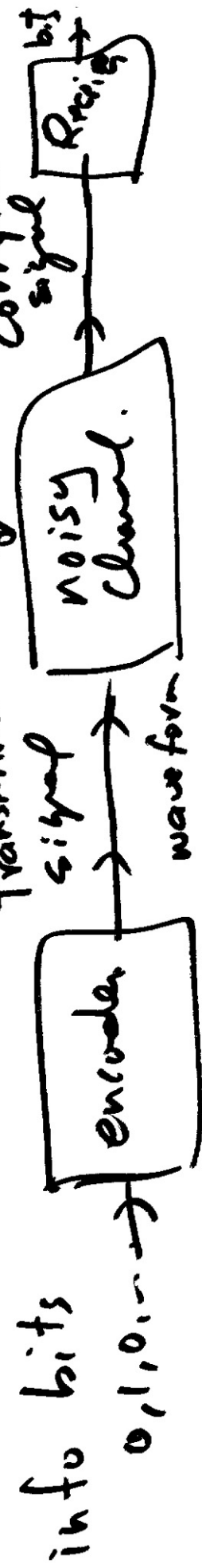
Ex 1. Thermal noise in com system

- 2. imperfect knowledge.
- 3. Too complex To model deterministic way.

Prob Performance Criteria

Design: make rational decision that do well on average on most of time.

Ex Dig. Com.



Criteria : prob of error.  
Design : minimizer of "  $\uparrow$

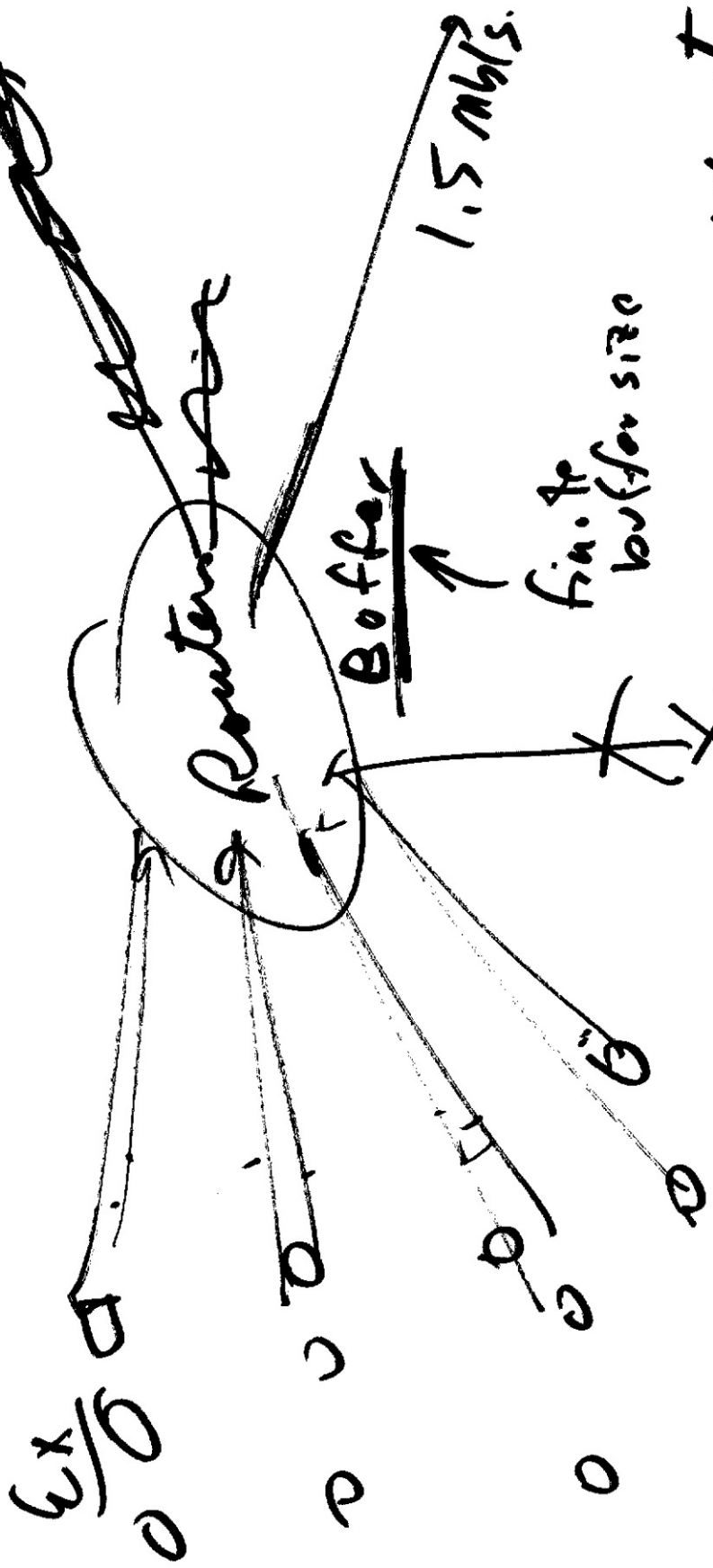
Prob model ) BSC  
 Binary Symmetric Channel



performance criteria =  $\epsilon$  must be 10<sup>-3</sup>

How to increase reliability :

- Redundancy band width.
  - BUT This wastes error probability.
- Trade off data rate with error probability.



incoming rate is too high, packets get dropped.

- stat. multiplexing going on. of packet loss.

Criteria : minimize prob of packet loss

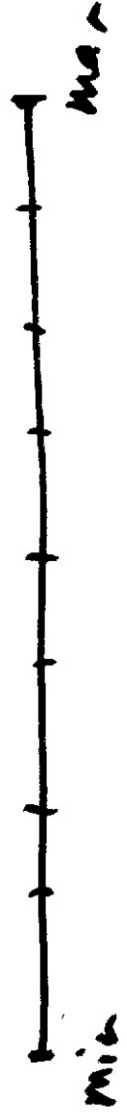
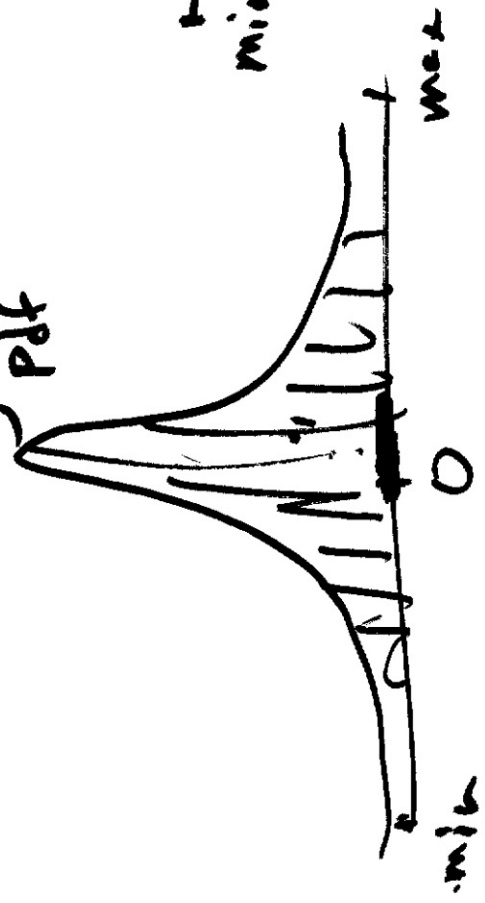
- how many users should I admit so that I achieve certain prob of packet loss

Ex

Speech



Quantizing amplitude of speech wavefor.



4bit  
A/D  
 $2^4 = 16$

Criteria minimize Quantization error

