A frame is an array of n bits, , that are independent and identically distributed (i.i.d) as follows:

The bits are transmitted through a channel that outputs

where , are some constants and

The channel output is then mapped to bits as follows:

1. Bit Error Probability
2. What is the optimal ?
3. What is ?

Typical value of is

A decoder decodes the frame channel output successfully if the number of errors in the frame is lower than (meaning if , then the decoder output , otherwise, the decoder will report decoder fail, and .

1. Frame Error Probability
   1. What is the decoder frame error probability,

?

Typical error probabilities are

In a system, a super-frame, including different frames, is transmitted as described above (one frame after the other, a total of bits). The decoder is applied times. If any frame fails, the super-frame decoding fails. Typical value for is

1. Super Frame Error Probability
   1. What is the super-frame error probability ?
   2. Draw an estimated graph of versus around the working point (

It is suggested to transmit additional n bits to improve super-frame decoding performance.

1. Super Frame improved Scheme
   1. Suggest a simple scheme on how to use the n bits.
   2. Write a pseudo-code of the encoding and decoding scheme.
   3. What is the new super-frame error probability ?
   4. Draw an estimated graph of versus around the working point
   5. How much can we increase, so the performance of your scheme will be equal to the naive scheme?
2. Simulation
   1. Write a software (Matlab/Phyton/Other) of the analysis of , , and for different , and .
   2. Write a C/C++ monte carlo simulation of the system above, for some and .
   3. Compare the monte-carlo simulation results to the analysis.