

CT 216

Introduction to Communication Systems

Project Title: POLAR CODES

Assigned by Prof Dr. Yash Vasavada

LAB-GROUP-1

PROJECT-GROUP-2



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Honor Code:

- The work that I am presenting is my work.
- I have not copied the work (the code, the results, etc.) that someone else has done.
- Concepts, understanding, and insights we will be describing are our own.
- We make this pledge truthfully. We know that violation of this solemn pledge can carry grave consequences.

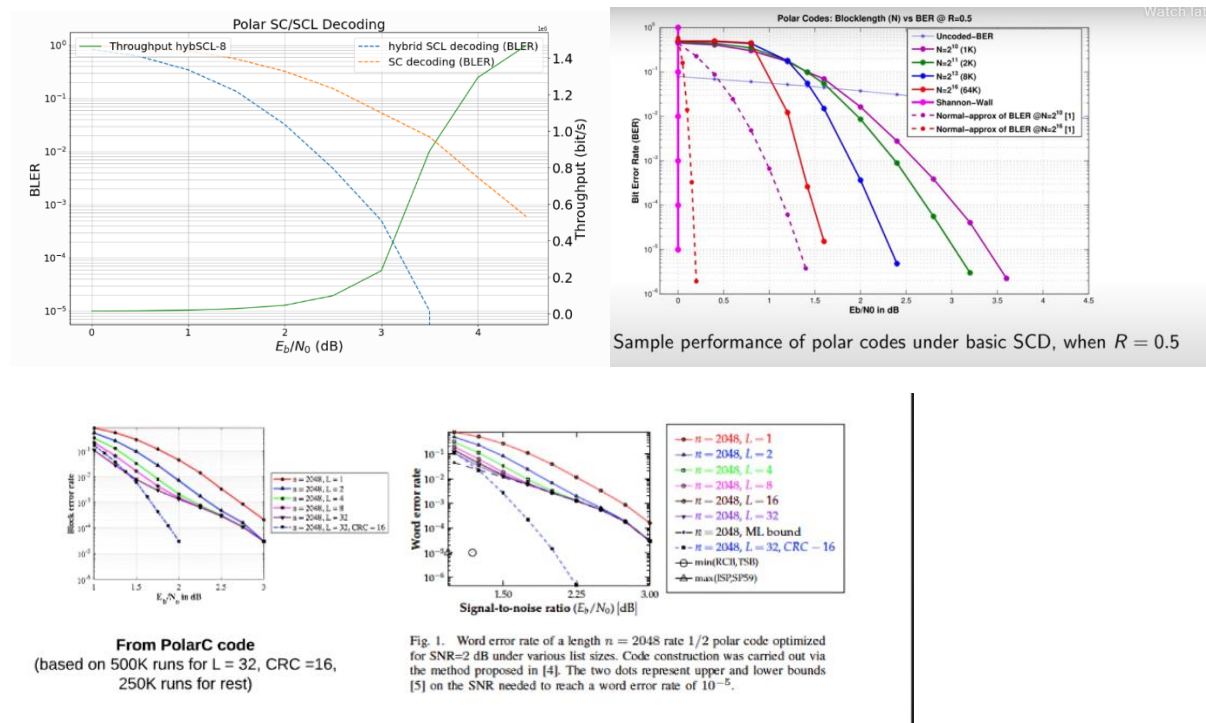
Expected results V/S Outputs obtained from simulations:

Expected outputs and Conclusions:

I have gathered various internet graphs about BER vs. SNR, BLER vs. SNR, SC vs. SCL, and so forth. With the aid of conceptual comprehension, I have deduced some of the outcomes that I would be obtaining from the simulation.

Indeed, I was able to conclude even though I did not receive any results from open sources.

Here are some of the open-source results obtained:



(The above images have been taken from the internet to verify the results that will be obtained from Monte Carlo simulations)

Ref:

https://github.com/nvlab/sionna/blob/main/examples/5G_Channel_Coding_Polar_vs_LDPC_Codes.ipynb

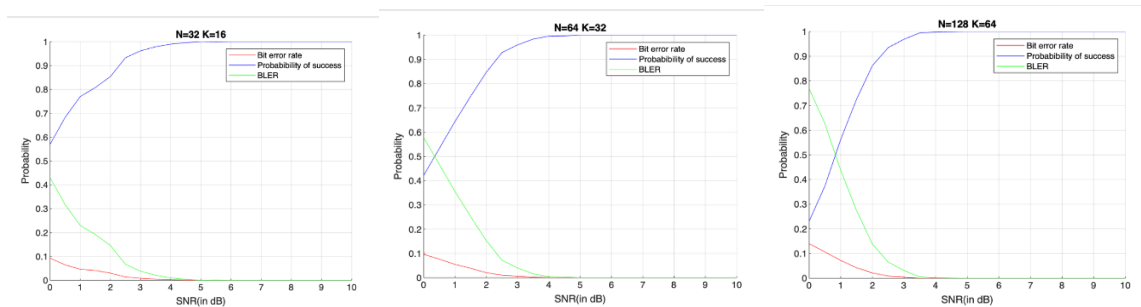
<https://www.semanticscholar.org/paper/List-decoding-of-polar-codes-Tal-Vardy/860726bf9c59ea8ed3b91450d25d85f7cfc8b64f>

Observations and Conceptual Conclusions:

- As the value of SNR increases BER and BLER both decrease. (As SNR is directly proportional to E_b/N_0 , we may use it interchangeably)
- The SCL (Successive Cancellation list decoding) provides the opportunity to select the codeword, and the chances/probability of getting the error is reduced as compared to ordinary SC (Successive Cancellation) decoding.
- We can view SC decoding as SCL decoding with list size=1.

The Obtained Results from Simulations:

- SC decoding for fixed code rate $1/2$ ($r=K/N$), for different values of N and K.
N: Number of encoded bits
K: number of information bits

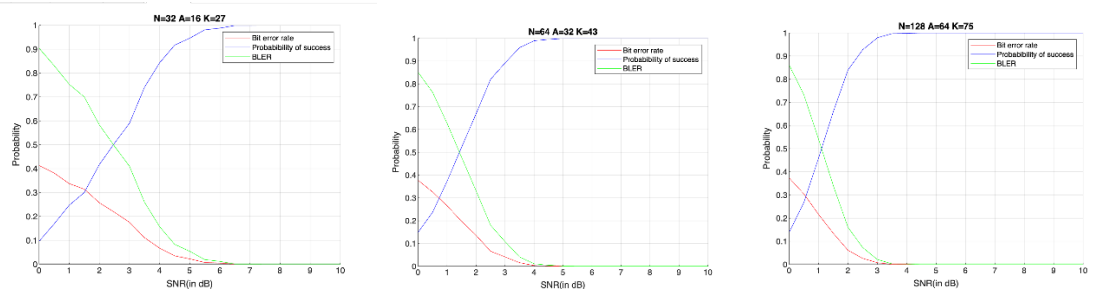


Conclusions:

1) As the value of N increases BER and BLER approach to 0 at lower values of SNR.

2) As $N \rightarrow \infty$ probability of error approaches to 0. Hence, we can say that Polar codes achieve Shannon's Channel Capacity.

- SCL decoding for fixed code rate $1/2$ ($r=K/N$), for different values of N and K.
K: Information bits
L: CRC (Cyclic Redundancy Check) bits
A: L+K bits
N: encoded bits
(In simpler terms CRC bits can be treated as information bits, not the actual message bits but the additional information bits added to recover the data at the receiver)



Here, also we can draw similar conclusions that as the value of N increases BER and BLER both decrease.

Note: The value of SNR at which BER and BLER approach 0 is lesser in the case of SCL decoding.

➤ “Thus, we can say SCL decoding is more reliable than SC decoding.”
The plots below justify the above statement.

