LAB 04 - CODE DIVISION MULTIPLE ACCESS (CDMA)

Friday, 01 July 2022

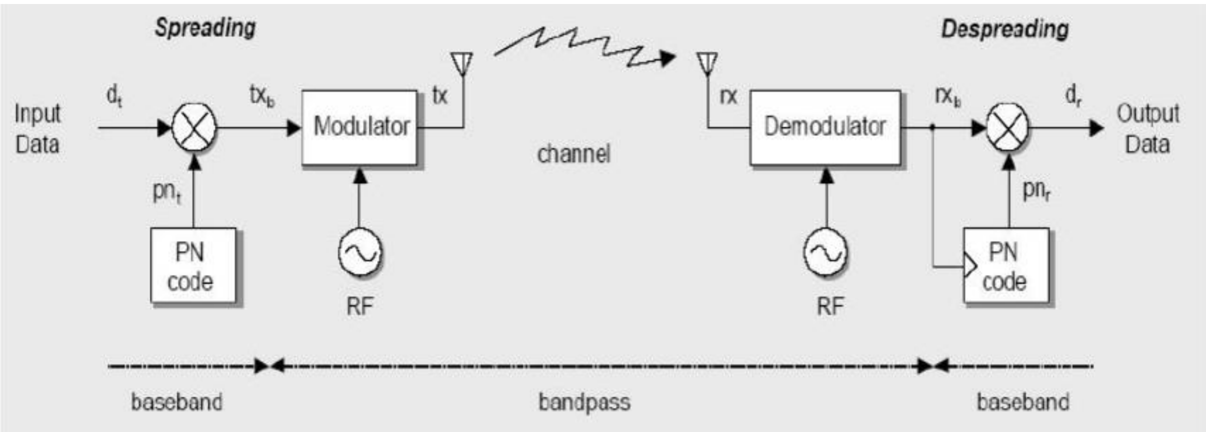
1.0 OBJECTIVE

To construct the model of direct sequence spread spectrum (DSSS) and analysed their performance.

2.0 THEORY

Spread spectrum is a type of modulation that spreads data transmission across available frequency band, in excess of minimum bandwidth required to send the information. Spreading makes signal resistive to noise and other interference. Spread spectrum is commonly used with personal communication devices such as cell phones and LAN's. Spread spectrum has many unique properties that cannot be found in other techniques like the ability to eliminate or alleviate multipath interference, communication privacy due to unknown random codes, multi user handling capacity over a single frequency, low power spectral density since signal is spread over a large frequency band. There are two techniques to achieve spread spectrum. The most common methods are the Direct Sequence Spread Spectrum (DS-SS) and Frequency Hopping Spread Spectrum (FH-SS) .

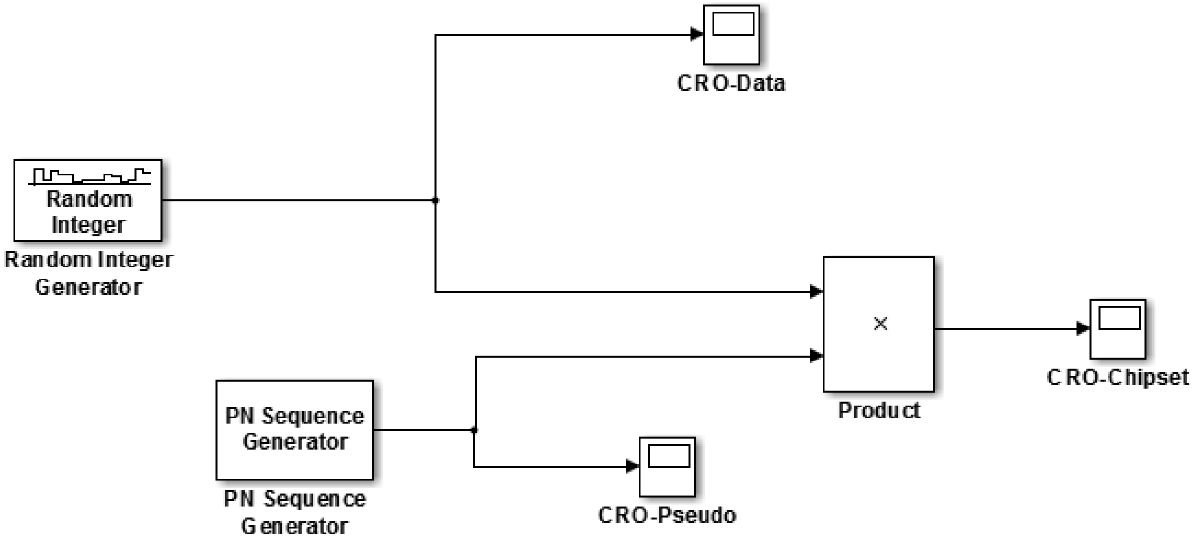
In case of DS-SS, the transmitter converts an incoming data (bit) stream into a symbol stream. Using a digital modulation technique like BPSK or QPSK, a transmitter multiplies symbols with a pseudo random noise code. This multiplication operation artificially increases used bandwidth based on length of chip sequence. A CDMA system is implemented via these coding. Each user is assigned a unique PN code sequence. Hence, more than one signal can be transmitted on same frequency.



The following model simulates the use of direct sequence spread spectrum to send a signal through a channel with noise.

3.0 EXPERIMENT-DSS TIME DOMAIN CHARACTERISTICS

1. Construct the model shown below in SIMULINK.



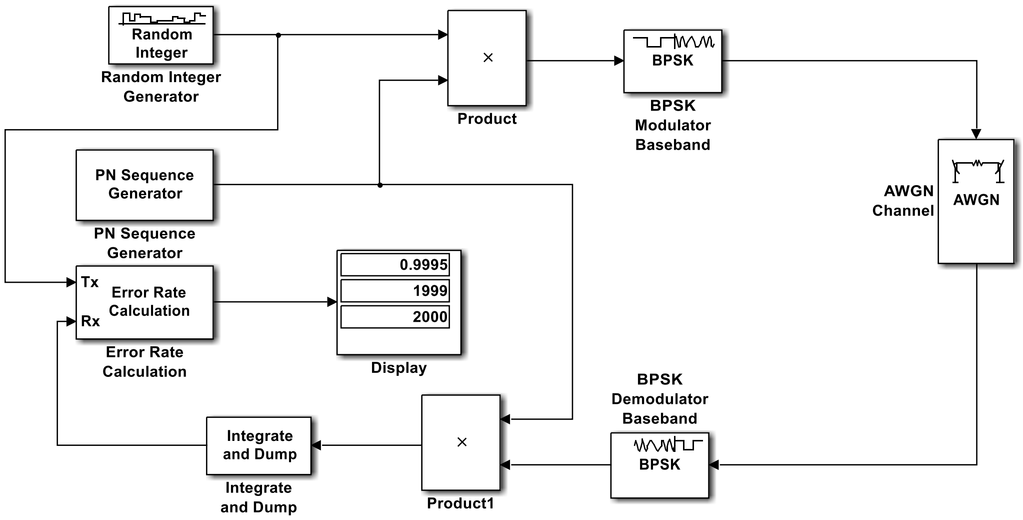
1. Set the parameters for the model blocks as follows.

a) M-ary Number M = 2 sec (random integer generator)
b) sample time, Ts = 0.001 sec (random integer generator)
c) sample time, Ts = 1/32000 sec (PN sequence generator)

2. Change the Sample time for the random number generator in the range {1/100, 1/200, ,,, 1/1000} and observe the output on the CRO Chipset.

4.0 EXPERIMENT_ DSS ERROR RATE

2. Construct the model shown below in SIMULINK.



3. Set the parameters for the model blocks as follows.

d) sample time, Ts = 0.001 sec (random integer generator)
e) sample time, Ts = 1/32000 sec (PN sequence generator)
f) symbol period, = 0.001sec (AWGN)
g) Eb/No = 2 (AWGN)
h) integration period, Ti = 32
i) receive delay = 1 (Error Rate Calculation)

4. Observe the output of each block and state their functions.

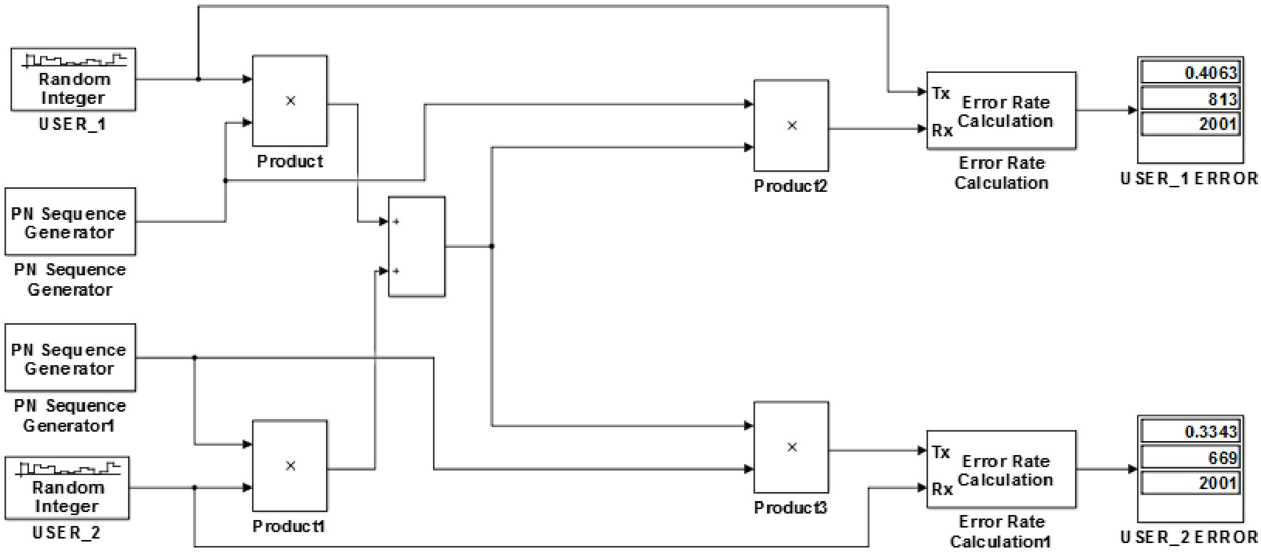
5. Change the parameter settings in Eb/No to vary in the range {2, 5, 7, ... 20} and tabulated in a table.

6. Plot the semilog graph, BER vs Eb/No. State your assumption.

7. Comment the results.

5.0 EXPERIMENT – ERROR RATE IN A TWO-USER DSS SYSTEM

1. Construct the following model of DSSS modulator.



2. The random integer generators must have different initial seeds to ensure two different independent sequences (users).

3. Assign to each user different PN code by using different initial states to each one of them. For example [1 0 0 1 0 0] for the first user and [1 1 0 0 0 0] for the second one.

4. Assign the blocks the parameters used in the last experiment.

5. Run and observe the output result.

Comment the result.

6.0 RESULTS

Attach the all results including tables, figures (completely labels) and any related calculations.

7.0 DISCUSSION

Discuss and analyzed your results including comparison, problem, suggestion. Every figure must be explained clearly.

8.0 QUESTION

1. Explain the principle of DSSS.
2. How to decrease the value of BER in DSSS model?
3. Based on graph in Section 4.0, relate between BER and Eb/No parameters.
4. Compare the aim of simulation between model in Part A and Part B.
5. What will happen to output of DSSS model in Section 4.0 if the digital modulation technique is changed to QPSK. Explain.