CAIRO UNIVERSITY
FACULTY OF ENGINEERING

ECTRONICS AND COMMUNICATIONS DEPT

3RD YEAR

Digital Communications
MODULATION
Project
Due on 10 May 2023, 11:59 PM

Project Details

The project's purpose is to introduce the students to the simulation of the single carrier communication systems. The requirements of the project are described in the following sections.

- The project's deadline is 10 May 2023, 11:59 PM.
- The teams may consist of up to two students.
- No late submission is allowed.
- Plagiarism in any part of the report will lead to the two teams receiving 0 marks.

1. Single Carrier System

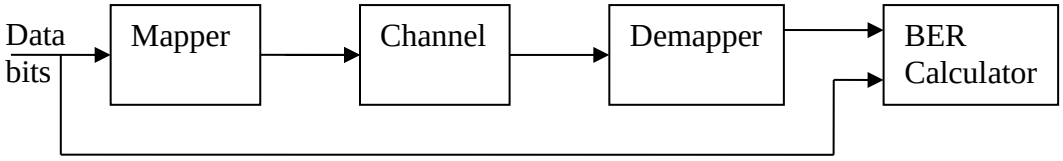


Figure 1. Single carrier communication system.

1.1 The Mapper

The first block in the communication system under consideration is the mapper. The mapper takes the I/P data bits and produces the symbols to be transmitted on the channel. The modulation schemes under consideration are the BPSK, QPSK, 8PSK, BFSK and 16QAM systems. Figure 2 shows the constellations.

1.2 The channel

The channel is an AWGN channel. In this model, the channel just adds noise to the transmitted signal. In MATLAB, the command "randn" should be used to generate the AWGN.

1.3 The Demapper

The simple demapper in the model under consideration will take the output of the channel and decide on the symbol transmitted. The output bit stream of the receiver is compared to the input bit stream and the BER is calculated.

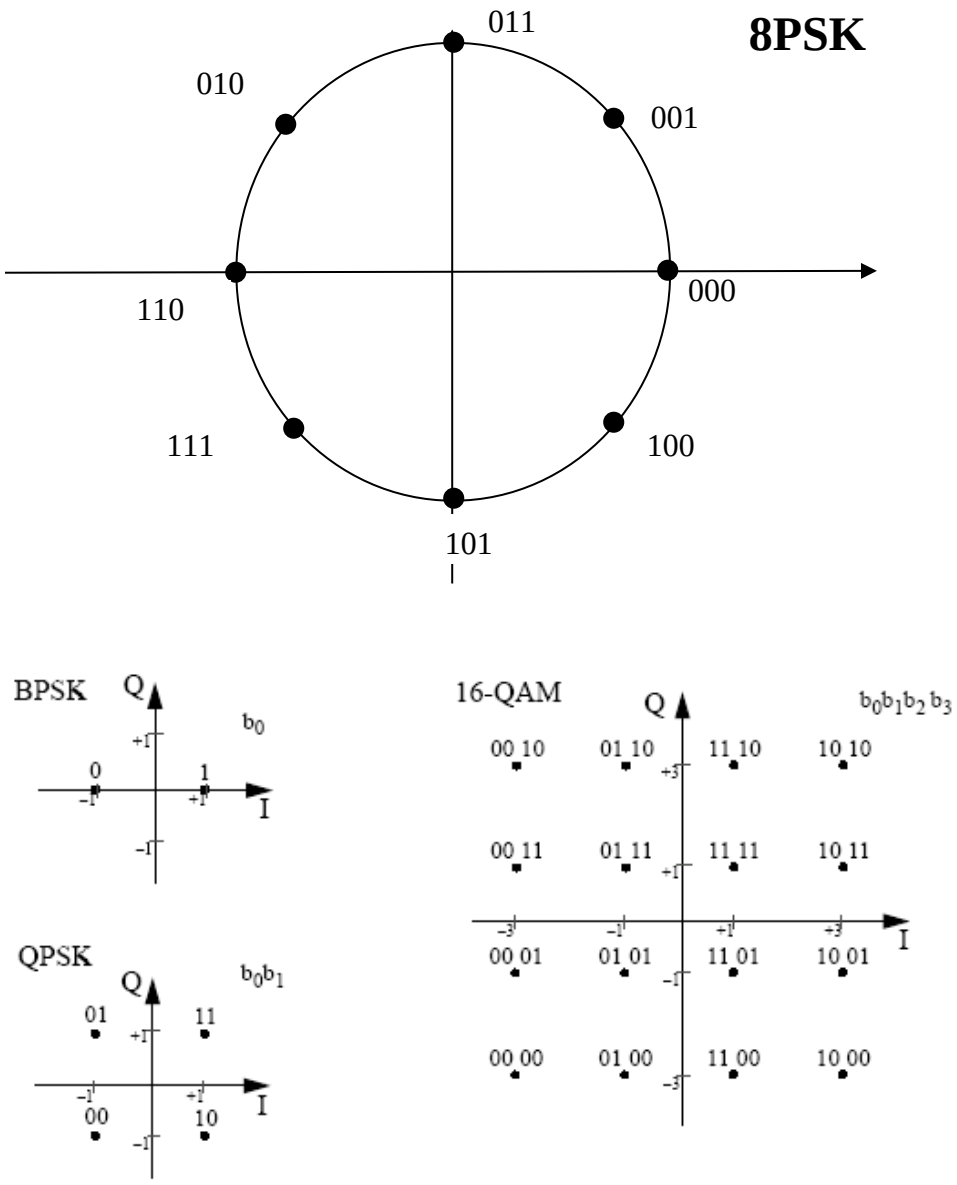
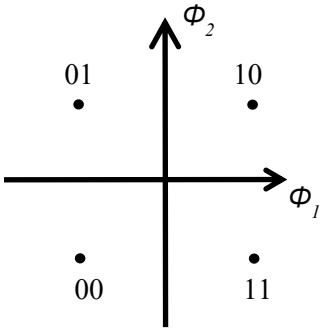


Figure 2. 8PSK, BPSK, QPSK, and 16-QAM constellations

1.4 Tasks

- All simulations are done on the baseband equivalent system, with no carriers.
- It is required to plot curves for the BER vs. Eb/No for the four modulation schemes on the same graph. The theoretical BER or a tight upper bound should be drawn for each one of the 4 modulation schemes on the same graph too using dashed lines. Comment on the results.



- Plot the BER vs Eb/No for the QPSK case shown in Figure 2 and the case shown in Figure 3 on the same graph and comment on your findings.

Figure 3.

1.5 BFSK

Consider the BFSK signal given by

$$s_i(t) = \begin{cases} \sqrt{\frac{2E_b}{T_b}} \cos\left(2\pi f_i t\right), & 0 \le t \le T_b \\ 0 & \text{otherwise} \end{cases}$$

The Tx frequency is $f_i=(n_c+i)/T_b$, $i=1,2$

Consider the system shown in Figure 1 to be used for the BFSK signal set.

- What are the basis functions of the signal set?
- Write an expression for the baseband equivalent signals for this set, indicating the carrier frequency used.
- Use the baseband equivalent system to draw the BER curve vs. Eb/No. Also draw the theoretical BER curve on the same graph.
- Simulate the PSD of the signal set using the baseband equivalent signal.