EE 567

Project

Due Tuesday, November 27, 2018 at 6:40 p.m.

Work all 2 Parts.

Instructions.

Your project should be typed on one side of the paper only and stapled in the upper left hand corner. You should include a cover page, an Introduction, an Analysis section, a Results section, a Summary section and an Appendix (where you include your Matlab code). Do not place your project inside any kind of binder. This is to be an individual effort. You may consult any written material (hard or soft copy) but you may not solicit input from any person except that you may ask the professor or TA questions regarding your project. Your project report should be self-contained, that is, the reader should be able to understand the project and your solutions from your report without consulting the actual project assignment.

Project Description.

Assume you have been hired to design a communication signaling system. There are 8 users all transmitting their data to a common receiver. The users are not coordinated with each other. Each user tries to transit data to the receiver when the data is available. Each user's data is composed of packets. Each packet has a header followed by the encoded data. The header contains information required by the receiver to make sure the data is processed properly. The header itself also has an error correction code applied.

You can assume each user will start the transmission of a packet sometime between 0 and 128 seconds where the start time is uniformly distributed between 0 and L seconds where L is such that L plus the packet time is 128 seconds (this assures that the end of a packet transmission will always occur on or before the 128 second boundary marker). Each user will only transmit one packet per 128 second interval.

The header is composed of 16 information bits. An (n, k) binary BCH code is applied. More information about this code will be supplied in class.

The data is composed of one or more codewords. Each group of 8 information bits is mapped to an 8-bit symbol for Reed-Solomon (RS) coding. The RS code is an (n, k) code. This code will be discussed in class.

The encoded header combined with the encoded data make up a packet. Each user's packet is the same length.

At the receiver if two or more packets collide then all the data in each of the affected packets is considered lost. Furthermore, if there is one or more uncorrectable errors in the header then all the data in the corresponding packet is lost. Also, if any uncorrectable errors occur in the RS codewords then all the data in that codeword is lost. You can assume that the transmit time from each user to the receiver is the same. Your task is to design the packet lengths and coding structure.

You may assume an operating point of $E/N_0 = 6.5$ dB, where E/N_0 is the energy available per bit (coded or uncoded). Each bit time is 1 msec. Each bit is transmitted using BPSK modulation.

Part 1.

Design the system so that the expected throughput for each user is maximized.

Part 2.

Design the system to maximize the throughput such that each user's information in a packet is received and decoded successfully at least 95% of the time.

In the Summary section include the following information:

Part 1:
The BCH header is an (n,k) code (specify n and k).
The RS code is an (n,k) code (specify n and k).
The packet length is x seconds (specify x).
There is/are x RS codewords per packet (specify x).
The expected throughput for each user is x information bps (specify x).

Part 2:
The BCH header is an (n,k) code (specify n and k).
The RS code is an (n,k) code (specify n and k).
The packet length is x seconds (specify x).
There is/are x RS codewords per packet (specify x).
The throughput for each user to assure 95% reliability is x information bps (specify x).