1 Project 2: Spread Spectrum in a Jammed Environment

For this project, your team will improve the performance of a WIFI communication link in the presence of a microwave oven. In this description, some important parameters will be given to help your team decide on an engineering plan. For the proposal, your team will present a concise description of the specific augmentations to be explored in preparation for the final report.

1.1 WIFI

The 1Mbps WIFI physical layer will be considered. The spreading waveform is an 11-chip BPSK signal, obtained from the Barker code 10110111000. The chip rate for this system is 11Mcps, and the data is DBPSK-modulated onto the carrier at the rate of 1Mbps. We will not consider modifying the Physical Layer Convergence Protocol (PLPC) synchronization field, parity check bits or PLPC header. We will only consider changes to the data field. Some other important physical-layer parameters include:

- P The received power is 1 μW
- N_0 The noise power spectral density has the value 10 nW/Hz
- W The transmission bandwidth is 22 MHz
- M The maximum number of channel symbols in the data field is 8×1655

For this project you will ignore multipath and assume that the physical layer detector is a correlator (perfectly synchronized to the incoming signal). You will assume that in the current, uncoded link, the optimal DBPSK detector is used (and therefore you can use the expression for detection error in the text.)

1.2 Microwave Oven

The dominant source of interference in the WIFI link is a microwave oven, which may be modeled for this project as a pulsed-noise jammer. The microwave oven sweeps periodically into the transmission band 120 times per second, and remains in the band for 10 μs each time. The received power J

of the oven is 10 mW during this on-time, otherwise the received power from the oven is zero. You may assume that the microwave oven is AWGN while it is on, with a power spectral density of J/W.

1.3 Jammer State Information

The correlator output magnitude will be used to determine the jammer state information. At each channel baud, the magnitude will be compared to a single threshold, and if the magnitude exceeds the threshold, the jammer will be declared on, otherwise, it will be assumed off. One of the tasks of this project is to set the threshold, and determine the probability that a correct decision will be made.

1.4 Project Goals

Your team is to determine if it is possible to return the probability of bit error to within 1 order of magnitude from the value in the absence of the jammer. If not, then determine the smallest bit error rate possible using coding, interleaving, and jammer state information. If several solutions yield an error rate within 1 order of magnitude, then choose a system with the least cost among them (interleaver delay, code rate, etc).

1.5 Proposal Guidelines

Your team should consider any or all of the solutions suggested in class for jamming countermeasures, including interleaving and coding. Your proposal should be specific as to the interleaving/coding options to be studied. What is the interleaving method to be explored, and what minimum size will you need? What is the overall delay introduced by interleaving? Will your team be using hard- or soft-decision decoding, if any? Which convolutional code will you use (k, L, n and d_{free}) if any, and why? This report should not exceed 2 pages in length and should be emailed to *brady@ece.neu.edu* in Postscript or PDF format by the date and time listed on the web.

1.6 Final Report

The final report must provide a convincing argument that your design achieves the goals described above. You may use any combination of analysis or simulation that you wish. The report must completely described your receiver design. The report is limited to six pages in length, and must be emailed to *brady@ece.neu.edu* by the last day of final examinations.