



Recent years have brought a surge of interest in using software defined radios (SDRs). One of the promises of an SDR is to have the option of re-configuring a radio, with no hardware changes, to handle a newer protocol. As processor speeds have continued to improve, we are now at a point where an SDR can have a significant portion of its processing occur on a standard PC.

This project combines digital communications theory with software to produce a digital modem which would be capable of communicating across a satellite. The goal is to produce a non-differential QPSK waveform with some additional constraints.

The GNURadio software suite (www.gnuradio.org) is a GPL'd set of libraries and utilities for building radios. The suite includes many common blocks for building a software defined radio. It comes with several examples including a differential QPSK transmitter/receiver and a mono FM receiver. The data processing blocks are written in C++ while Python is typically used as glue code. Analog to Digital and Digital to Analog conversions are performed using a supplied Ettus Research USRP board (www.ettus.com) which is the preferred hardware for the GNURadio suite.

Design objectives:

- Non-differential coherent QPSK
- Packet based waveform
 - Packets contain a preamble of 32 bits for detecting packet start and performing phase ambiguity resolution
 - Data follows packet preamble. Data for each packet is of a fixed length (2K bits), typically encapsulated in a higher level framing protocol (for example, HDLC)
- Carrier frequency will be 70 MHz or 35 MHz
- Bandwidth will be about 1 MHz
- Software shall provide an internal loopback for testing with a (software) channel simulator
 - A hardware based channel simulator might be available as well
 - Performance in terms of bit error rate (BER) vs signal-to-noise ratio (SNR) to be compared with theoretical performance numbers for an ideal demodulator.

Skill Sets Needed/Developed:

- Digital Modulation/Demodulation theory
 - Basic understanding of a modulator and demodulator
 - Ability to understand demodulation algorithms
 - Ability to compare observations to expected system behavior
- Software
 - Ability to implement algorithms in a new environment (GNURadio)
 - Ability to architect changes within a constrained environment
- General
 - Able to use oscilloscopes and spectrum analyzers