**ECE 430.**

**Laura and Joshua (Radio Rebels).**

**Radio Wars E1.**

**Theory:**

**-Bandwidth:** OFDM works on long symbol duration, which corresponds to lower bandwidth consumed by the symbol on the frequency domain. This makes it possible to pack/modulate many subcarriers (which are done in an orthogonal manner so that they don’t interfere with each other’s). Thus, increasing the bandwidth would enable one to include a greater number of subcarriers, and to implement this in the radio, both the -b and -M flags need to be used to change bandwidth and number of subcarriers.

**-Modulation scheme:** QAM is one of the most widely used modulation scheme. However, on increased bandwidth scenarios, higher order of QAM modulation doesn’t work (in the case of the N210 radios). This can be probably because the radio is not able to demodulation the received constellation at the high data rate. The x310s can perfectly handle this. So, there needs to be a good balance between the QAM modulation order and the bandwidth so that the highest transfer rates are achieved.

**-Frame duration:** Since the symbol duration is large in OFDM (as mentioned before), this makes it robust to the delay encountered in multipath fading using cyclic prefix. We don’t vary the cyclic prefix length while testing (nor tapered length of the frame). Guard symbols are also used to avoid doppler shift causing intercarrier interference. Since the radios are immobile, we expect no doppler effect. Thus, we reduced the guard size to the lowest we could (of 0.001 secs).

**-Frame design:** Dragon radio runs on liquid-dsp package, which enables one to design frames manually by determining the placement of data, pilot and null symbols using –subcarriers flag (.=null, P=pilot, +=data). We tried various 64 sized frames by placing the nulls at the ends and pilots intermixed between the data symbols to achieve good data rates. However, the default always worked better.

**-Error correction codes:** Liquid-dsp by default runs on inner forward error correction codes. It uses the Reed Solomon code for this purpose. We tried various other codes for the inner and the outer. However, since there is no doppler shift, this didn’t benefit much as the processing required is great, and also, error codes reduces the data rate by injecting itself along with the actual data that is needed to be transmitted.

**Command:**

Tx**: dragonradio ~/gnu\ files/lab\_files/lab3/sdr-class-radio.py -f 1.31e9 -i 2 -b 5e6 -m qam64 --guard-size 0.001 --slot-size 0.075 -M 128**

Rx: **dragonradio ~/gnu\ files/lab\_files/lab3/sdr-class-radio.py -f 1.31e9 -i 1 -b 5e6 -m qam64 --guard-size 0.001 --slot-size 0.075 -M 128**

**Results:** A screenshot of a computer

Description automatically generated with medium confidence

**Final Radio Wars EI submission:**

Graphical user interface

Description automatically generated with low confidence