**Teensy Busy Detector Implementation**

Rick Muething, Rev 1, 3/13/2020

1. The busy detector will use the exact same hardware and software (single compile) as the Teensy HF/VHF channel simulator. The Busy detector function will be enabled and controlled by simple USB serial text commands. When in operation the audio path of the busy detector will be modified from the Simulator to reduce latency.
2. The busy detector (at least initially) will be independent of protocol mode and only look for energy within a serial command specified frequency range (300 Hz to 6300 Hz).
3. There will be a mechanism for computing and using a rolling average of FFT bins a specified number of averages. This will allow simple tradeoff of response time (low number of averages) to sensitivity (high number of averages). The typical range will be something like 1 to 50 averages. The tradeoff of course is in response time as each average will take approximately 11 ms. (the time it takes to complete the 1024 bit FFT on the Teensy 4). The baseline noise fluctuation of the FFT computation will reduce by approximately the square root of the number of averages. E.g. 16 averages (about 176 ms) will reduce the noise variation by about 4 x or 12 dB.
4. There will be a simple command to set the upper and lower frequencies of interest. This only needs to be done when there is a change in operational bandwidth…e.g. when switching from a 3KHz wide channel to a 500 Hz wide channel. The bandwidth selected should include any required tuning offsets (either due to remote station transmitter offset or local receiver dial offset).
5. There will be a command that sets the trip level for detection. The detector will look for energy in the selected frequency range that is above the detection threshold level. (after FFT bin averaging). When a detection is found a serial command notice will be sent from the Busy detector to the host indicating a busy detect. At that time a new average will be started and a Non busy detection will not be sent until at least that averaging time is completed and a no busy condition is detected.
6. The busy detector will initially use a Hanning window for FFT to provide the sharpest frequency detection. Alternate windows could be used to trade off detection threshold and bin resolution.