

The Latest

HackRF One - Beacon update

Up

Posted by AG6QV Frank

Tags:

I have made 3 different versions of the HAM Radio beacon project using GNU Radio and my HackRF One SDR hardware. The first version, described in the previous previous post and covered 5 HAM bands and used a QT GUI to select the beacon frequency. The second version eliminated the GUI and automatically switched between the 5 frequencies in the VHF and UHF bands. Since there was one additional HAM band I edited the Python file directly to add the 6th band. The 3rd version was similar to the second version but cover the 5 bands from 23cm to 3cm. Since 3cm or 10GHz is above the max frequency the HackRF One can operate on this would have to rely on a harmonic of a frequency below 6GHz.

Over the weekend the PNW Microwave group met to discuss SDR projects and work on other beacons and I got a few suggestion for improvements, especially to the version with a GUI as that will allow for more interactive control of the beacon.

The first suggestion was to increase the output power. The HackRF One is controlled by a "Soapy" GNU Radio block that provides input for center frequency, bandwidth, CGA gain and to turn the output amplifier on/off. In my original version I had left the amplifier off. Turning it on would make it easier to receive the harmonics on 10 GHz. A final version would need some filtering to avoid transmitting on the base frequency, that would be outside of the HAM bands. It will also be necessary to add a bit more power to make the beacon useful, but more about that in a future post.

Another suggestion was to allow the user to switch between CW and FM modulation. The beacon is design to send morse code and when listening to the beacon on an FM receiver it is difficult to hear the actual morse code if the beacon is transmitting a carrier. Implementing a system to generate a FM modulated signal and keep the carrier on while turning the modulation on and off would make it possible to use a FM receiver.

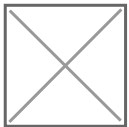
Today I started to implement the additional functionality. There was a few experiments to find the correct blocks to use and to ensure the selection of modulation would make the system work for both CW and FM. The flow graph is shown on the image below.



You can download the GNU Companion flowgraph file [here](#).

The GUI provides fixed variables for audio, RF sampling rate, drive for the CW mode and the message that will be translated into morse code. There are currently no GUI elements to changes these interactively. The GUI does provide elements for changing the frequency, switching between CW and FM and to change the frequency used for the tone in FM modulation. The basic functionality uses a custom Python block named "Beacon Block". This is the code that can transform a string of characters into morse code. The output of this block is fed into two multipliers. Since the output is switching between 0 and 1 the effect will be to have the multiplier turning the signals on and off. The output of the multipliers are then connected to the selector, controlled by the selected modulation. The selected signal will then be fed into the Soapy HackRF sink and also to a FFT Frequency display to visually show the output.

The image below is taken from the version where I edited the Python file to provide beacon frequencies for all the HAM bands from 60 MHz to 10 GHz. The frequencies used is .080 on 6m and 33cm, .280 on all other bands to 23cm and .380 on all bands above 23cm. That way the frequencies all fall within the allocated beacon sub bands according to ARRL's band plan.



Finally the two Python files that were generated by GNU Radio Companion, and edited to allow more than frequencies can be downloaded from these links: [Beacon.py](#) and [Beacon_epy_block_0.py](#). Beacon.py is the main file that includes the code to the custom block to handle the translation of characters to morse code. The two files should be located in the same directory.

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[October 2024 {5}](#)

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[May 2023 {1}](#)

[April 2023 {1}](#)

[March 2023 {1}](#)

[January 2023 {2}](#)

Tags

[10 GHz {1}](#)

[2m {3}](#)

[GNU Radio {4}](#)

[HackRF One {4}](#)

[HAM {6}](#)

[HF {1}](#)

[PNW Microwave {1}](#)

[X-Band {1}](#)

Calendar

October 2024

Su	Mo	Tu	We	Th	Fr
		1	2	3	4
		5			
6	7	8	9	10	11
		12			
13	14	15	16	17	18
		19			
20	21	22	23	24	25
		26			
27	28	29	30	31	