Spectrum Painting

Richard Shipman
MW0RCZ
ADARS
6th Jan 2020

Introduction

Introduction

Introduction

Introduction

- Did you spot it?
- Text and images scrolling past in the waterfall.
- I've got to try that...

Introduction

Methods

- What is it called?
- How can I put something cool together?
- What hardware do I need?
- Obviously I need a computer and a radio?

Methods

- Useful information on rtl-sdr.com
- https://www.rtl-sdr.com/tag/spectrum-painter/
-

Methods

- First thing I found did not even need a radio
- Rpitx
- https://github.com/F5OEO/rpitx
- I have quite a few raspberry Pi computers, but they were all in use – Abertoir film festival

Methods

- Rpitx transmits direct from a GPIO pin on a PI
- Just attach a wire as an antenna to GPIO4 (pin 7)
- But – it is quite noisy, so recommend that you use a band pass filter
- Subtle warning ón the web page:

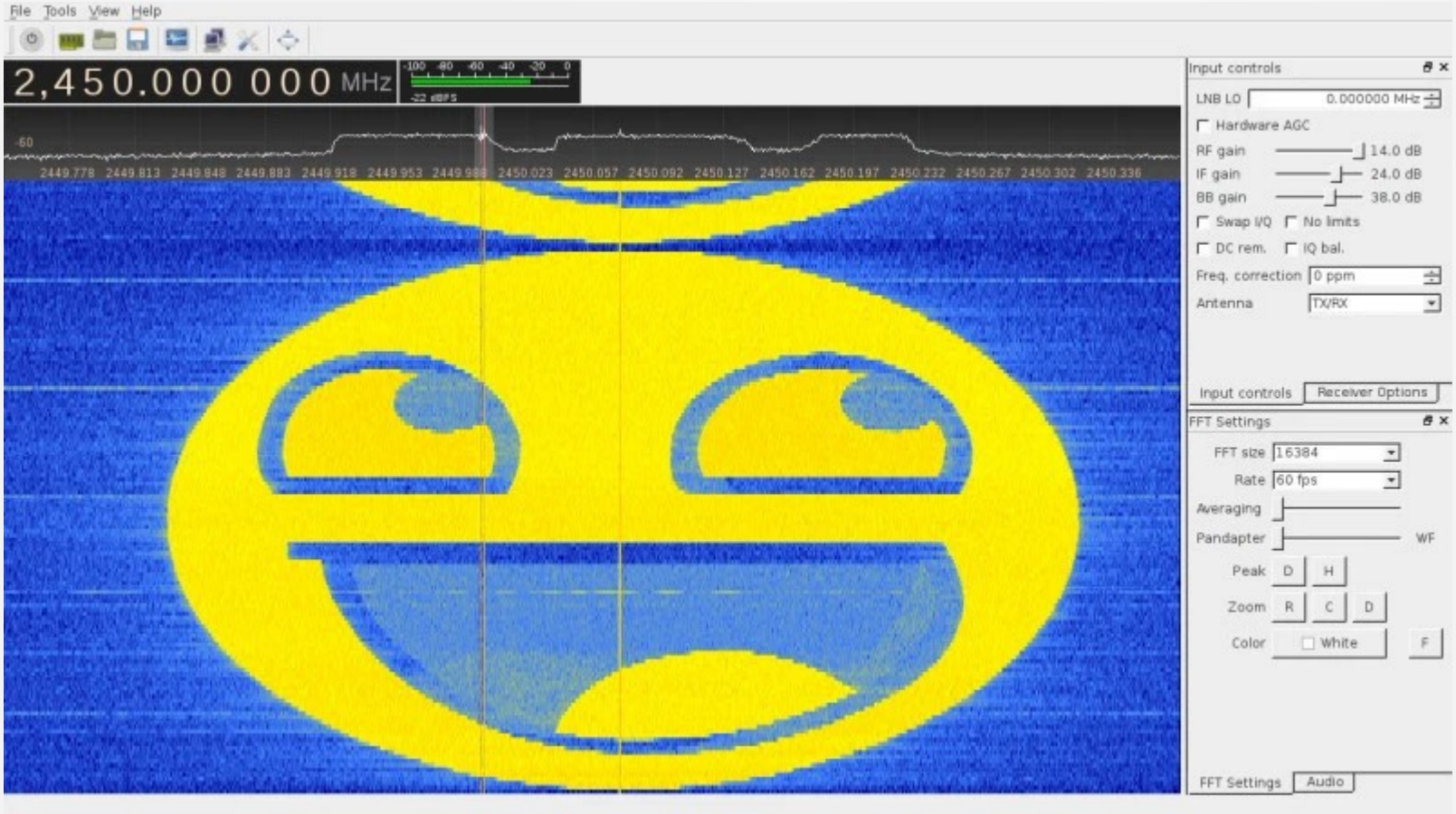
Warning:
Never transmit on antenna without a band-pass filter!

Methods

- Second method listed used a HackRF One SDR
- I have wanted one for a while – so I bit the bullet and purchased one. (Thanks Ray for the time pressure)
-

Methods

- Followed the hackaday article
- https://hackaday.com/2015/08/22/spectrum-painting-on-2-4-ghz/
- Apart from using 2.4Ghz, as that appeared to cause issues with the simple SDR dongle on the receiver
-



Methods

- Two computers:
  - 1. transmitter with HackRF One
  - 2. Reciever with SDR dongle and gqrx software

- I use linux, and command line, but it's basically 2 steps
  - Prepare the image
  - Transmit the image
  -

Methods

- Prepare the image:
  - Img2iqstream.py from https://github.com/polygon/spectrum_painter
  - Python script:

- Usage: img2iqstream [OPTIONS] [SRCS]...
-
- Options:

-s, --samplerate INTEGER	Samplerate of the radio
-l, --linetime FLOAT	Time for each line to show
-o, --output FILENAME	File to write to (default: stdout)
--format [float|bladerf|hackrf]	Output format of samples
--help	Show this message and exit.

- img2iqstream -s 1000000 -l 0.004 -o smiley.iqhackrf --format hackrf examples/smiley.png

Methods

- Transmit the image
  - hackrf_transfer from hackrf_tools at https://github.com/mossmann/hackrf
  - C program library
-
- rcs@stinky /home/rcs $ hackrf_transfer -h
- Usage:
- -h # this help
- [-d serial_number] # Serial number of desired HackRF.
- -r <filename> # Receive data into file (use '-' for stdout).
- -t <filename> # Transmit data from file (use '-' for stdin).
- [-f freq_hz] # Frequency in Hz [0MHz to 7250MHz].
- [-a amp_enable] # RX/TX RF amplifier 1=Enable, 0=Disable.
- [-x gain_db] # TX VGA (IF) gain, 0-47dB, 1dB steps
- [-s sample_rate_hz] # Sample rate in Hz (4/8/10/12.5/16/20MHz, default 10MHz).
- [-b baseband_filter_bw_hz] # Set baseband filter bandwidth in Hz.
- Possible values: 1.75/2.5/3.5/5/5.5/6/7/8/9/10/12/14/15/20/24/28MHz, default <= 0.75 * sample_rate_hz.
-
- hackrf_transfer -t smiley.iqhackrf -f 2450000000 -b 1750000 -s 1000000 -x 20 -a 1

Methods

- Fldigi also has a “videotext” mode
- You can add a short text message that can be read in the waterfall as a preamble to a transmission
- eg. to identify the data mode of the transmission easily.
- Two rows of 8 characters each.

Results

- Rpitx
  - I didn’t have the time to actually get this working…
  - Didn’t build a band pass filter in time.
  -
  - I did install the software on a pi 4, but didn’t attach an antenna.

Results

- Hackrf
  - After a bit of fiddling got this to work repeatably.
  - Took a bit of experimenting with frequencies and bandwidths
  -
  - Max transmit power is 15 dBm (32mW), frequency dependent.
  -

Discussion

- OK, it is a cool effect, but what use is it?
- http://www.w1hkj.com/FldigiHelp-3.21/html/id_configuration_page.html
-

Discussion

- Demo time?

Acknowledgements

- a

References

- https://hackaday.com/2015/08/22/spectrum-painting-on-2-4-ghz/
- https://www.rtl-sdr.com/tag/spectrum-painter/
- https://www.rtl-sdr.com/painting-on-the-rf-spectrum-with-a-hackrf/
- https://www.reddit.com/r/amateurradio/comments/3hnpt7/transmitting_arbitrary_images_viewable_in_the/
- https://github.com/polygon/spectrum_painter
- http://jmfriedt.free.fr/lm_fmcapture_eng.pdf