Introduction to Cheap SDRs for Radio Monitoring

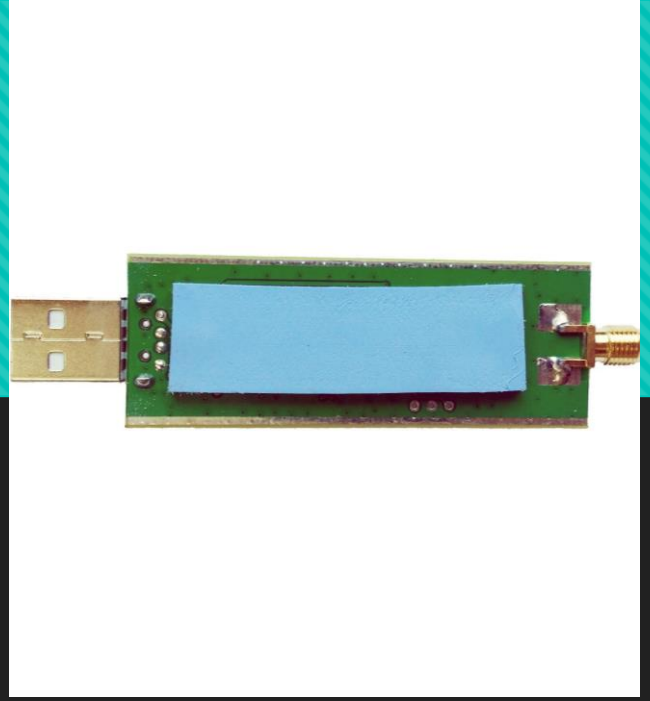
Ultra cheap software defined radio

Who Am I?

- Running the RTL-SDR.com blog since 2013
- Collecting stories relating to ultra cheap radio
- Redesigned the RTL-SDR dongle for improved SDR performance
- Started sigidwiki.com, a collection of signal sounds and spectrum analyzer/waterfall images.
- **www.rtl-sdr.com**

What is the RTL-SDR?

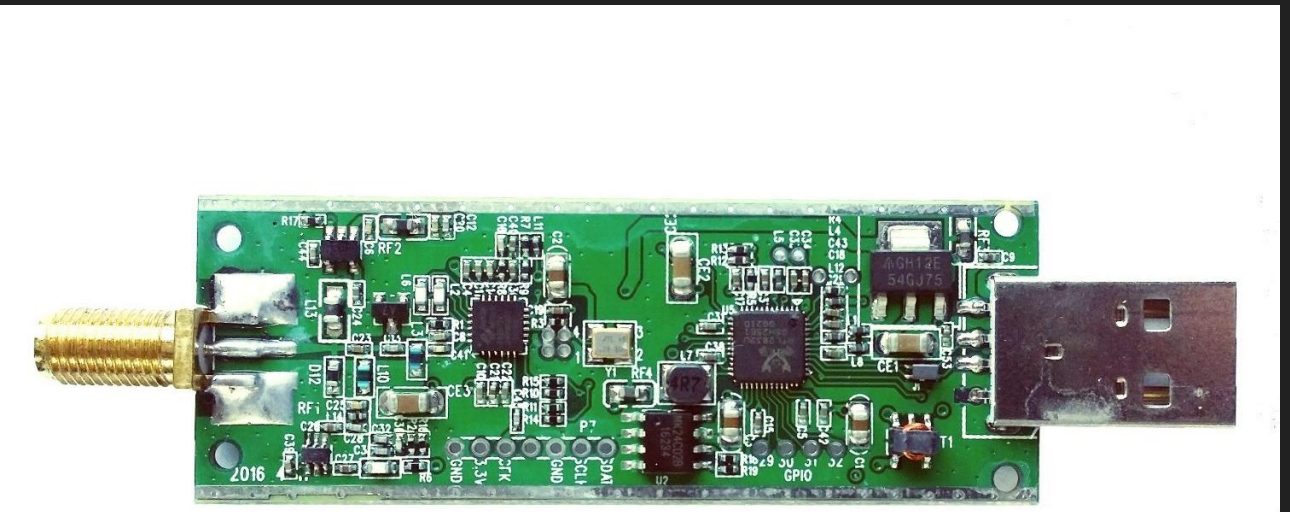
- A very cheap RX software defined radio
  - 2.4 MHz bandwidth, tuning range 24 – 1.7 GHz. Some go down to HF.
- Originally (and still is) a DVB-T TV Tuner
  - Highly mass produced in China – very cheap
- Hardware hackers found the SDR feature
  - Originally designed for FM radio reception
- Opened up a whole new world of experimentation.
  - New (and old) blood returning to the radio scene.



Redesigned RTL-SDR V3

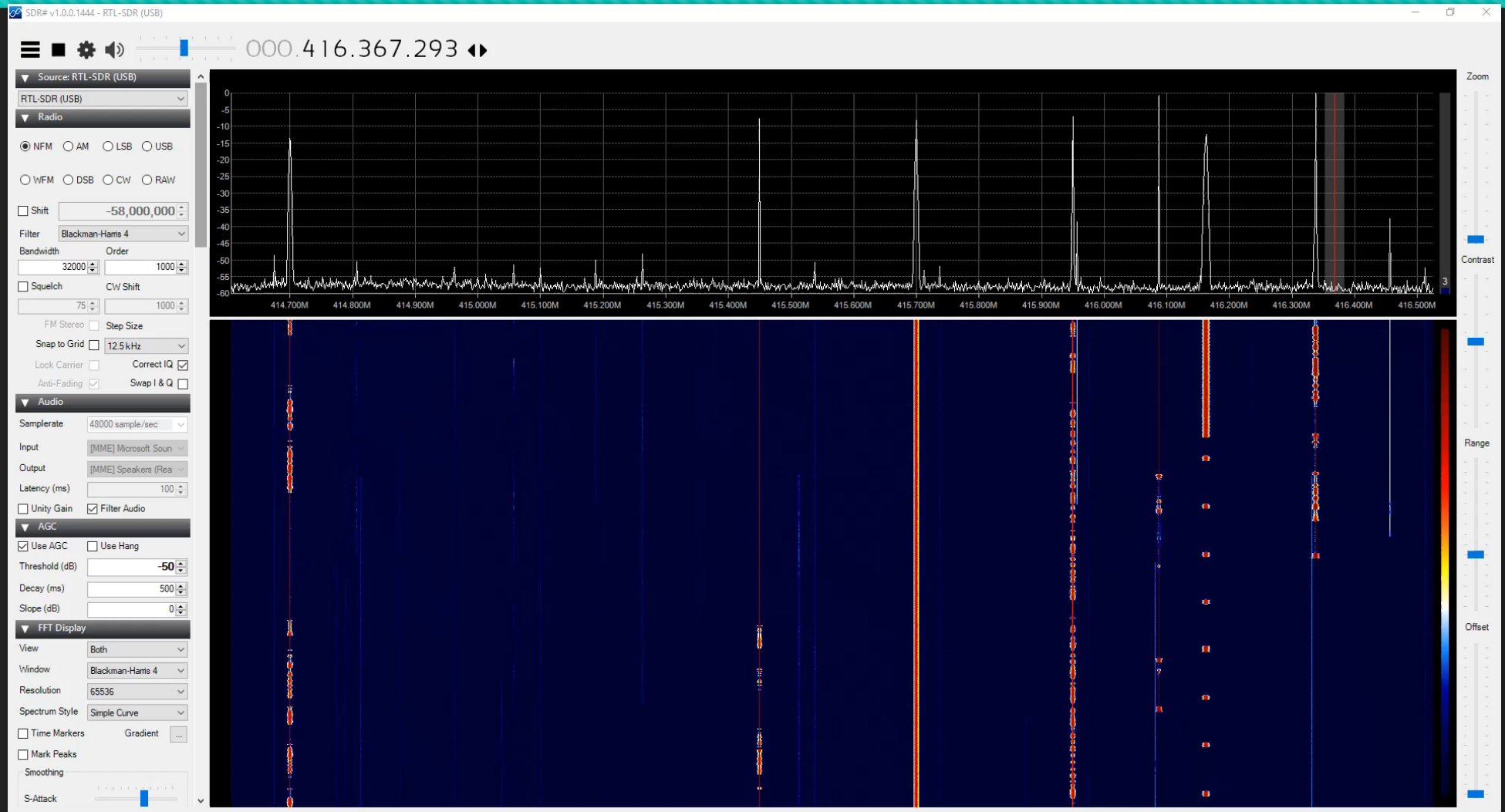
- Problems with "Generic" dongles
  1. Drifting oscillator (unstable frequency)
  2. No shielding
  3. Many spurs
  4. Problems with L-band reception
  5. Uncommon MCX RF connector

- RTL-SDR.com V3 fixes and added features
  1. TCXO Oscillator
  2. Metal case shielding
  3. Redesigned PCB, and additional noise filtering
  4. Thermal pad to metal case heat sink
  5. SMA connector
  6. Bias tee
  7. HF reception via direct sampling



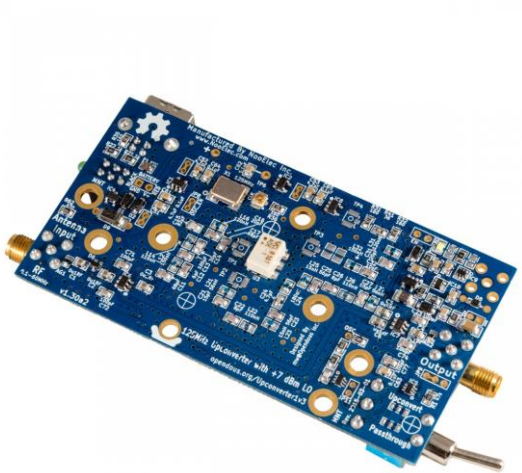
Different Types of RTL-SDR Dongles

RTL-SDR Software: SDR#



How to Receive HF with an RTL-SDR?

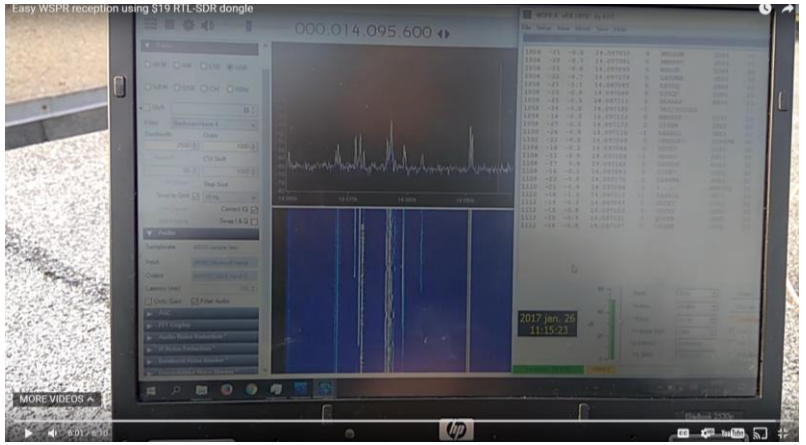
- Typical RTL-SDR tunes down to 24 MHz at the lowest
- The RTL-SDR.com V3 dongle tunes down to 500 kHz in ‘direct sampling mode’
  - Activated in software
- You can also use an ‘upconverter’
  - SpyVerter is probably the best choice
  - Alternatives like the ham-it-up of SV1AFN are also okay



Applications

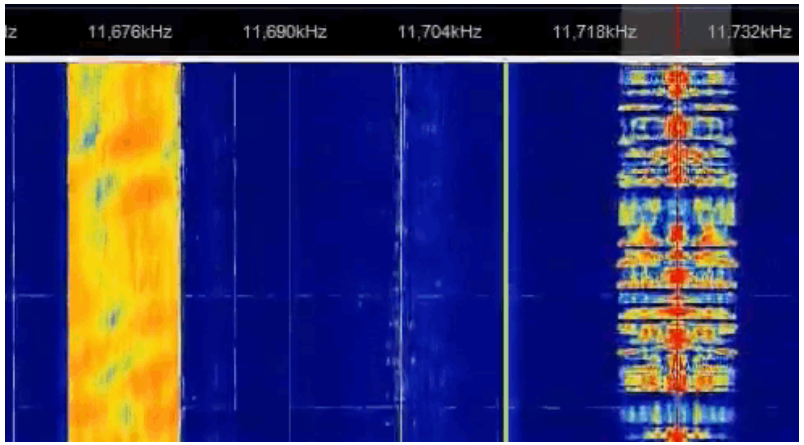
Monitoring WSPR

- Can monitor WSPR with a $20 USD RTL-SDR.com V3 dongle
  - One of the cheapest ways to monitor WSPR
- Steps include:
  - Sync your PC clock to NTP
  - Plug in RTL-SDR, and tune to WSPR frequency in SDR# or alternative
  - Pipe WSPR audio to WSPR-X.
  - Done!
- Check out ‘veryokay’ on YouTube, shows it in action.



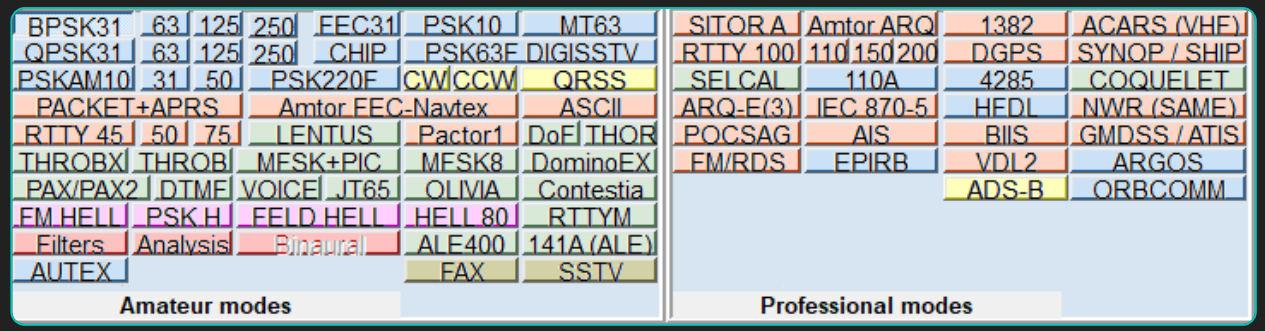
Digital Radio Mondiale: DRM

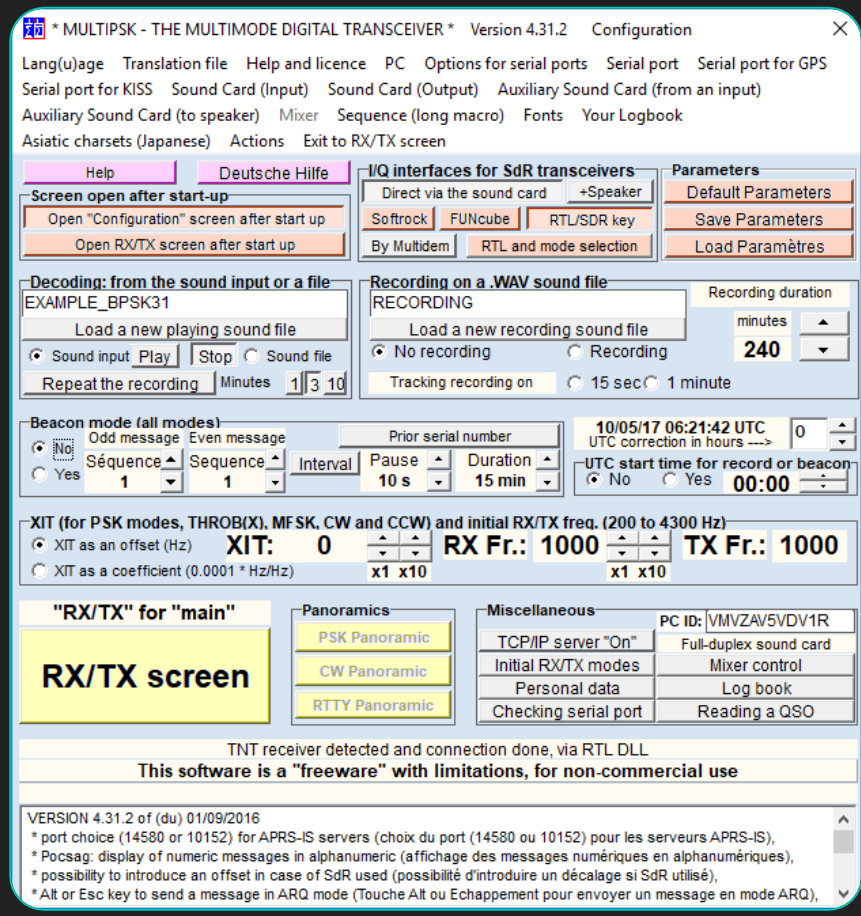
- Receive digital DRM broadcast
- Similar to WSPR, just tune to it, and pipe audio into a decoder
- Decoder is called ‘Dream’.
  - Full set up on the blog
- DRM capable Receivers are expensive and rare
  - PantronX Titus II may change that?



MultiPSK

- Popular multi mode decoder ‘MultiPSK’ supports the RTL-SDR directly.
  - No need to open up SDR# or any other software first, and no need to pipe audio.
- Dozens of digital modes instantly accessible





Raspberry Pi 3: Remote Monitoring

- The RTL-SDR can be used as a locally networked receiver.
- Software like rtl_tcp and spyserver enables this.
- You need a decent network connection.

- Other software like OpenWebRX enables internet web browser based streaming.
  - sdr.hu

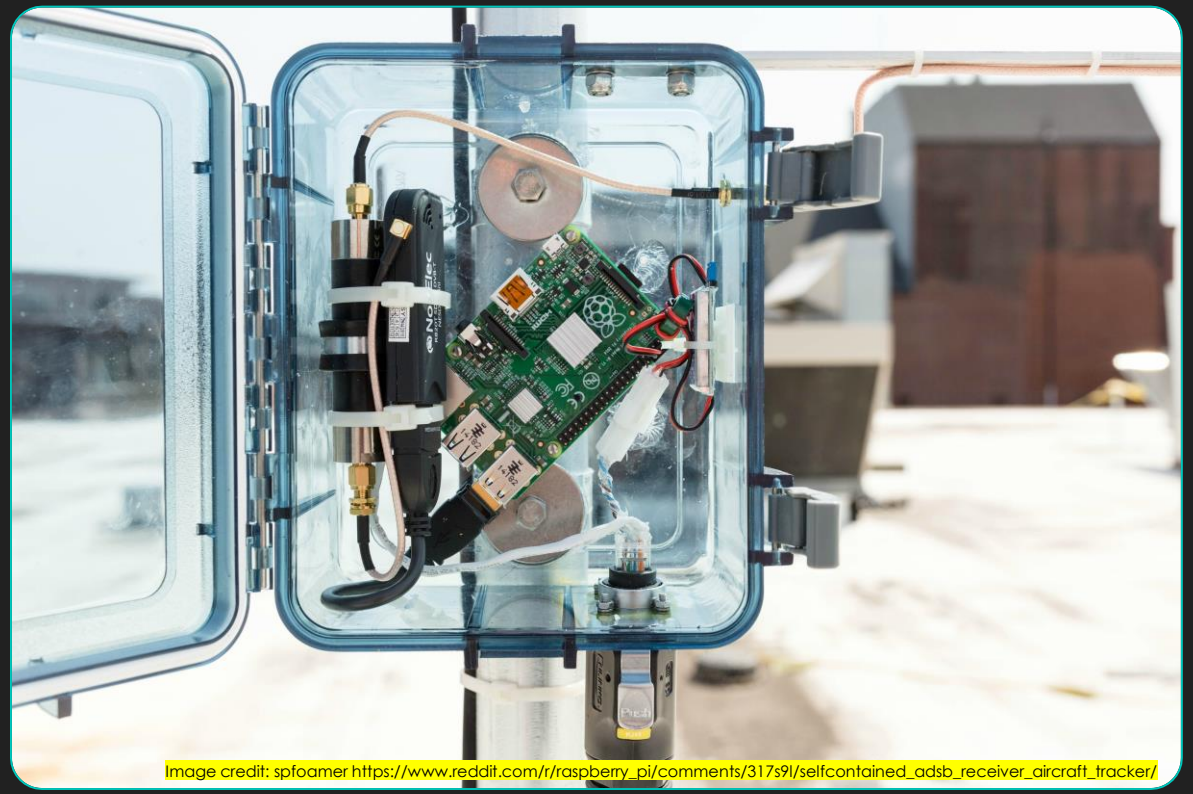
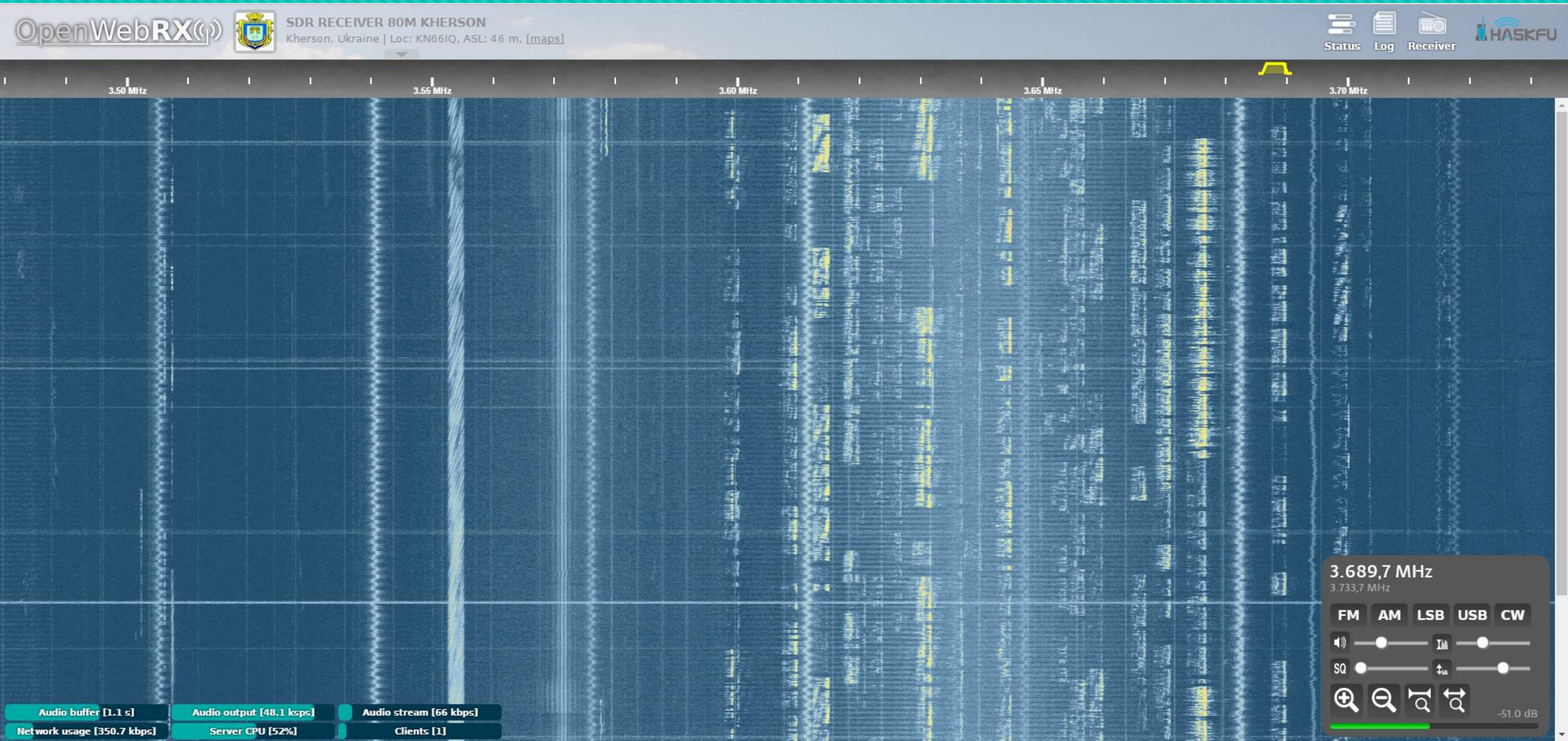


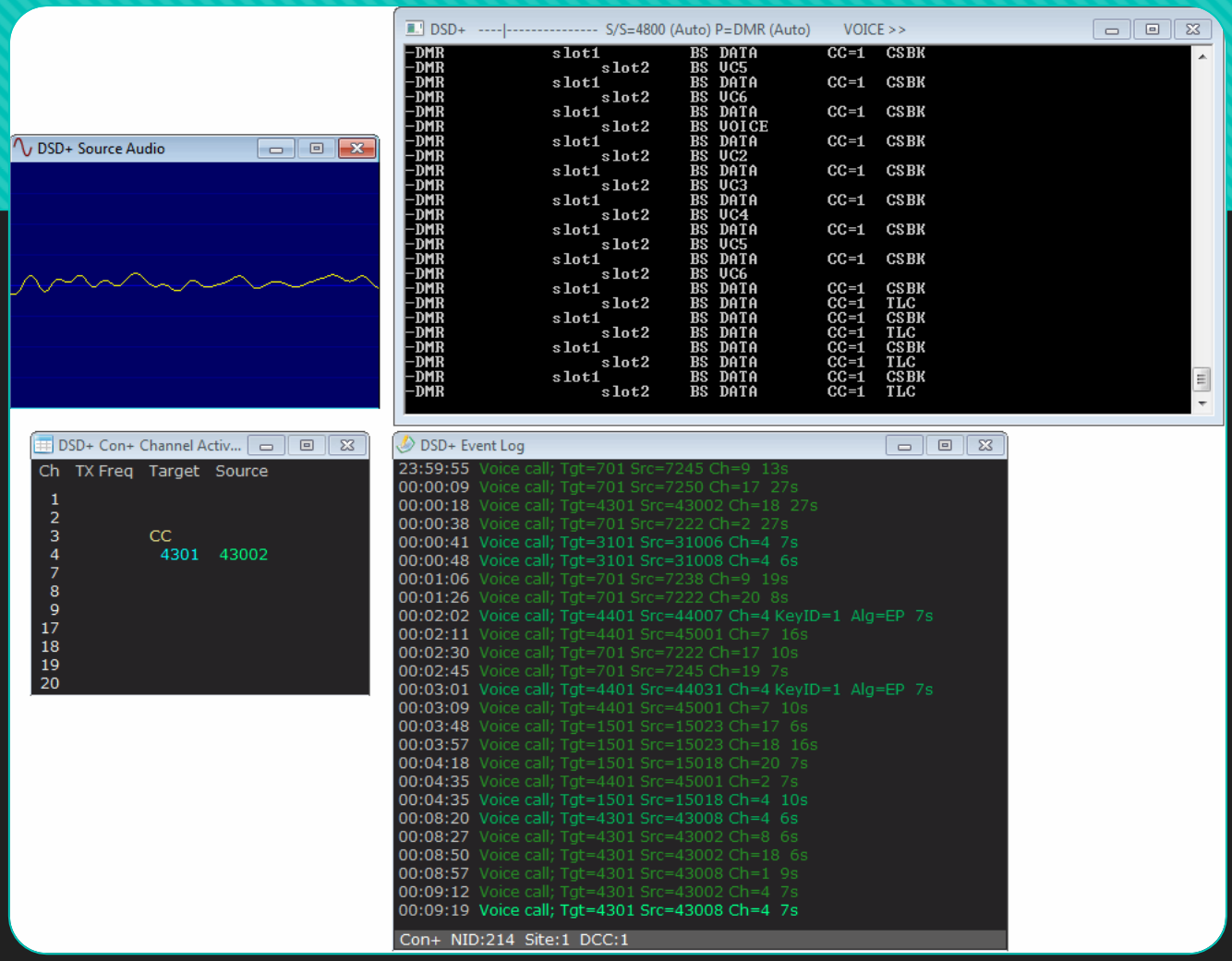
Image credit: spfoamer https://www.reddit.com/r/raspberry_pi/comments/317s9l/selfcontained_adsb_receiver_aircraft_tracker/

SDR.HU Example



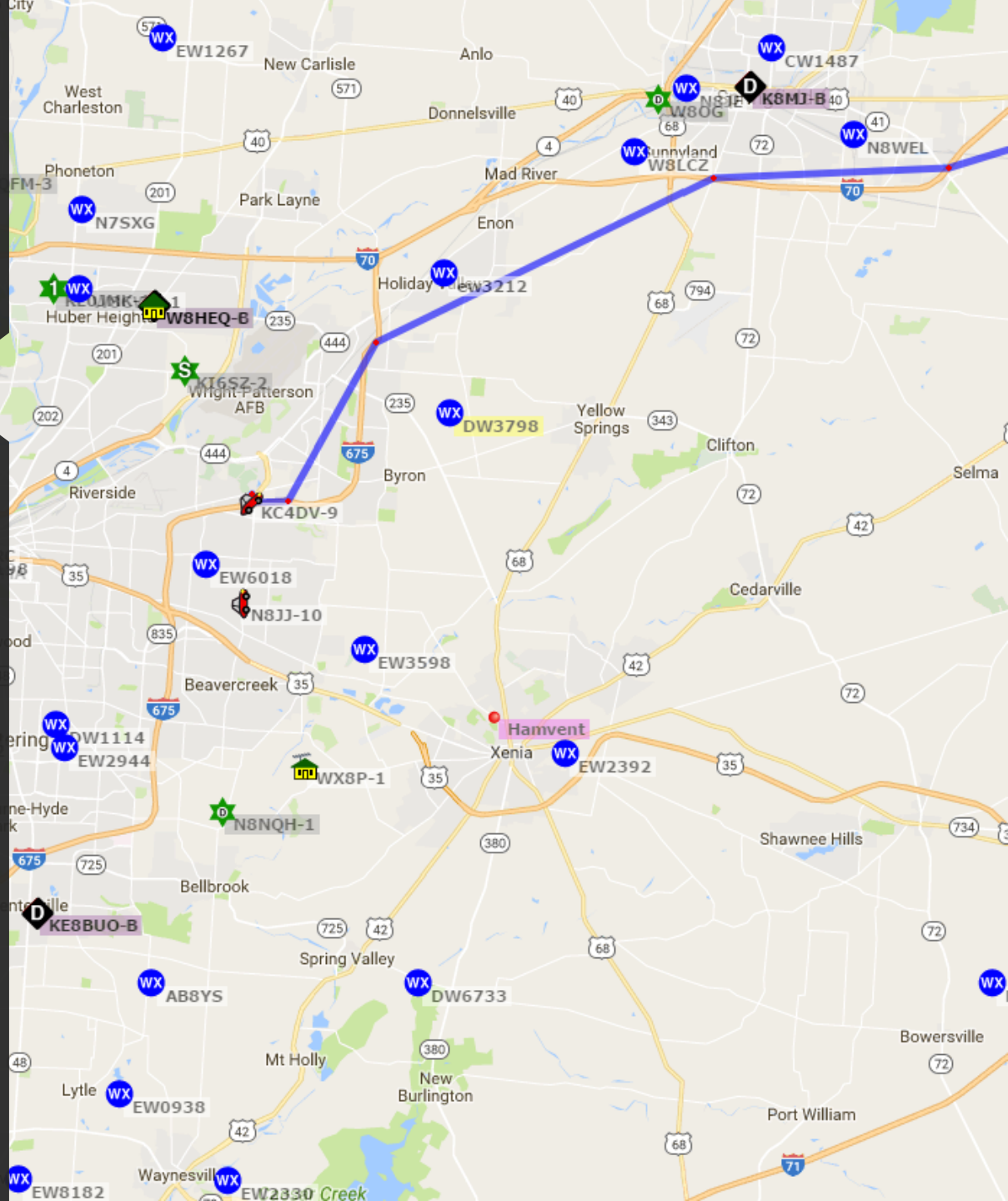
Digital Voice Monitoring

- A program called “DSD+” can be used to decode P25 and DMR
  - Only unencrypted comms of course
- Can also decode LRRP on DMR
- Another version of DSD can be used to listen to D-STAR amateur radio comms.



Setting up an APRS iGATE

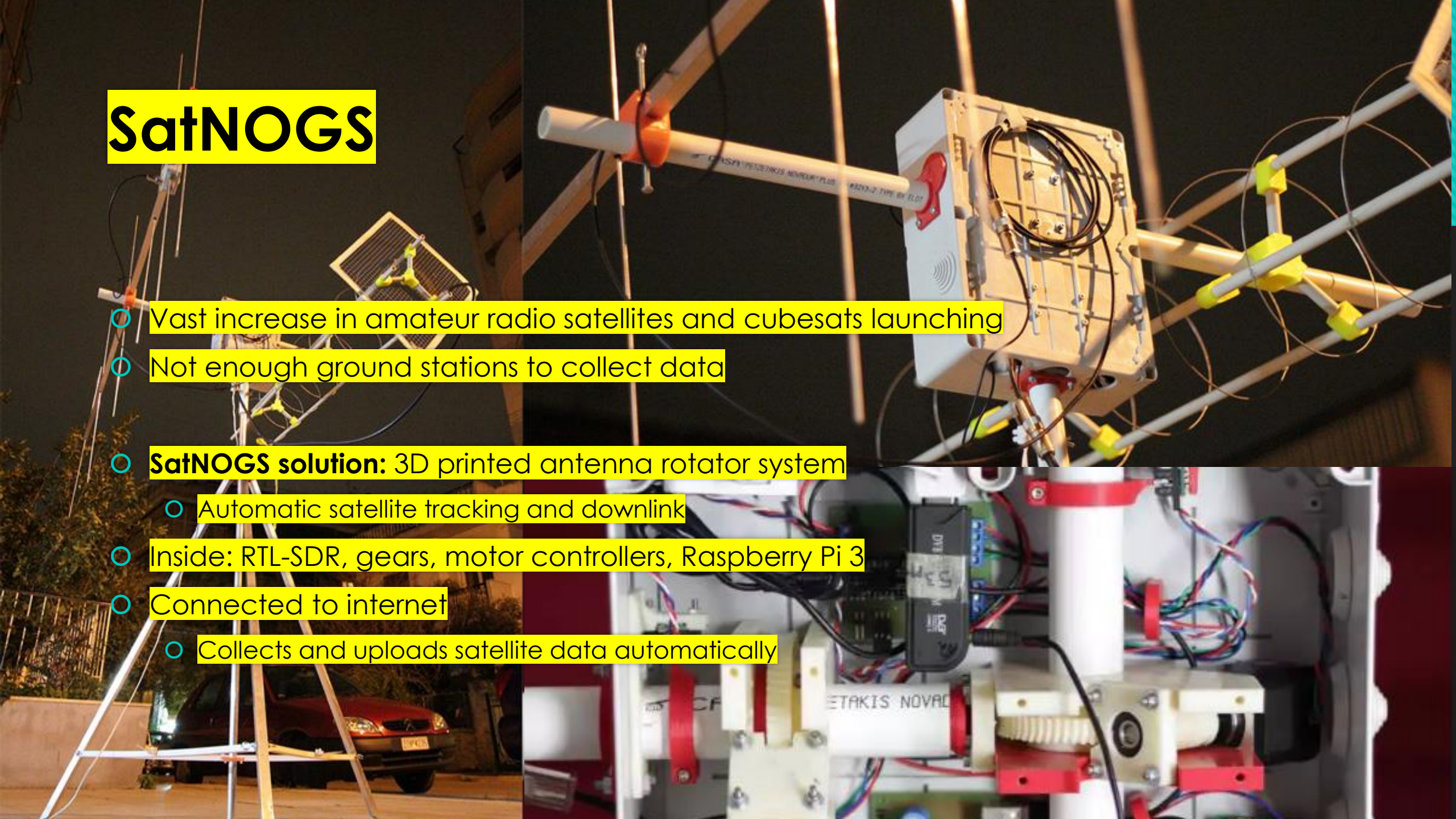
- The RTL-SDR can be used to set up a low cost APRS iGATE
  - RX Only
- Simply combine with a Raspberry Pi and the “Dire Wolf” software and you’re good to go



SatNOGS

- Vast increase in amateur radio satellites and cubesats launching
- Not enough ground stations to collect data

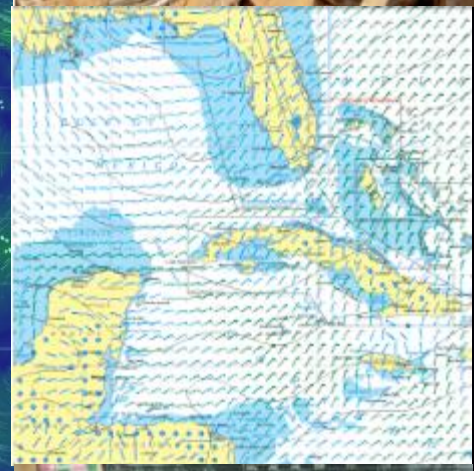
- **SatNOGS solution:** 3D printed antenna rotator system
  - Automatic satellite tracking and downlink
- Inside: RTL-SDR, gears, motor controllers, Raspberry Pi 3
- Connected to internet
  - Collects and uploads satellite data automatically



OUTERNET

Search in folders: Weather

Receiving The Outernet



- One way (download only) satellite filecasting service
  - Uses Inmarsat/Alphasat satellites on L-band
- What data can you receive?
  - Latest News
  - Weather Updates
  - Amateur Radio repeater repeats (ISS APRS, AMSAT etc)
  - Wikipedia Articles
  - Grib files (for mariners at sea)
  - Free books
- Good for disaster preppers, sailors, remote areas, countries with censored internet, third world countries.
- Outernet use RTL-SDR based receivers

earth

Conclusion

- The RTL-SDR is an extremely cheap, yet highly versatile receiver
- Hundreds of applications
  - See the rtl-sdr.com blog history for many more applications.
  - I have a book on Amazon called "The Hobbyists Guide to RTL-SDR".
- Where can I buy RTL-SDR V3 Dongles at Hamvention?
  - TAPR booth 5001-5003 Building 5
  - R&L Electronics in Building 1
  - SDRguys at Booth #7919 in the Flea Market (west end) – also selling Outernet antennas and LNA's