An Introduction to RTL-SDR

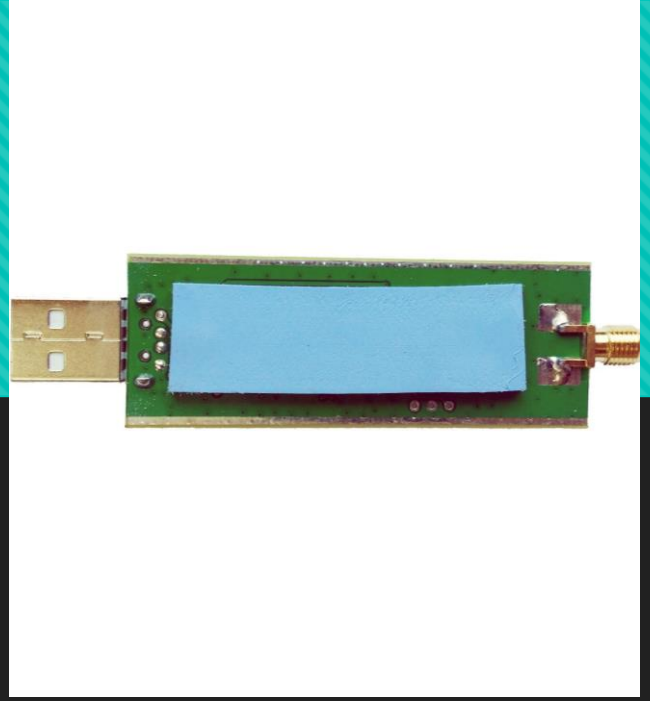
Ultra cheap software defined radio

Who Am I?

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

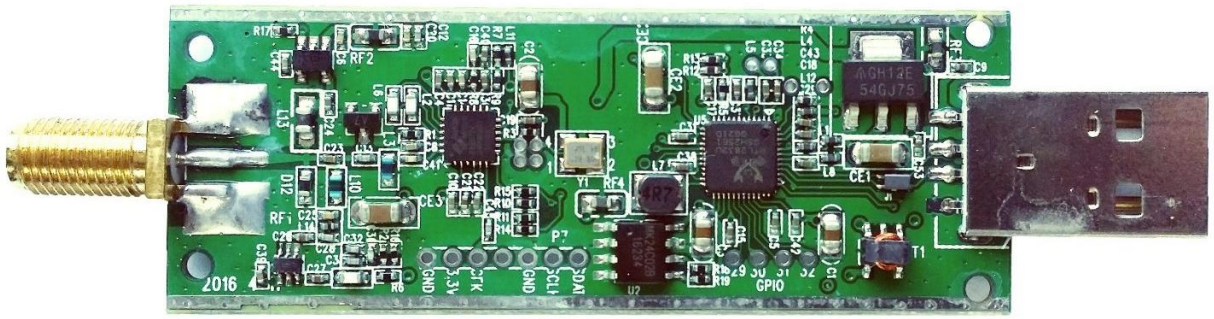
What is the RTL-SDR?

- 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



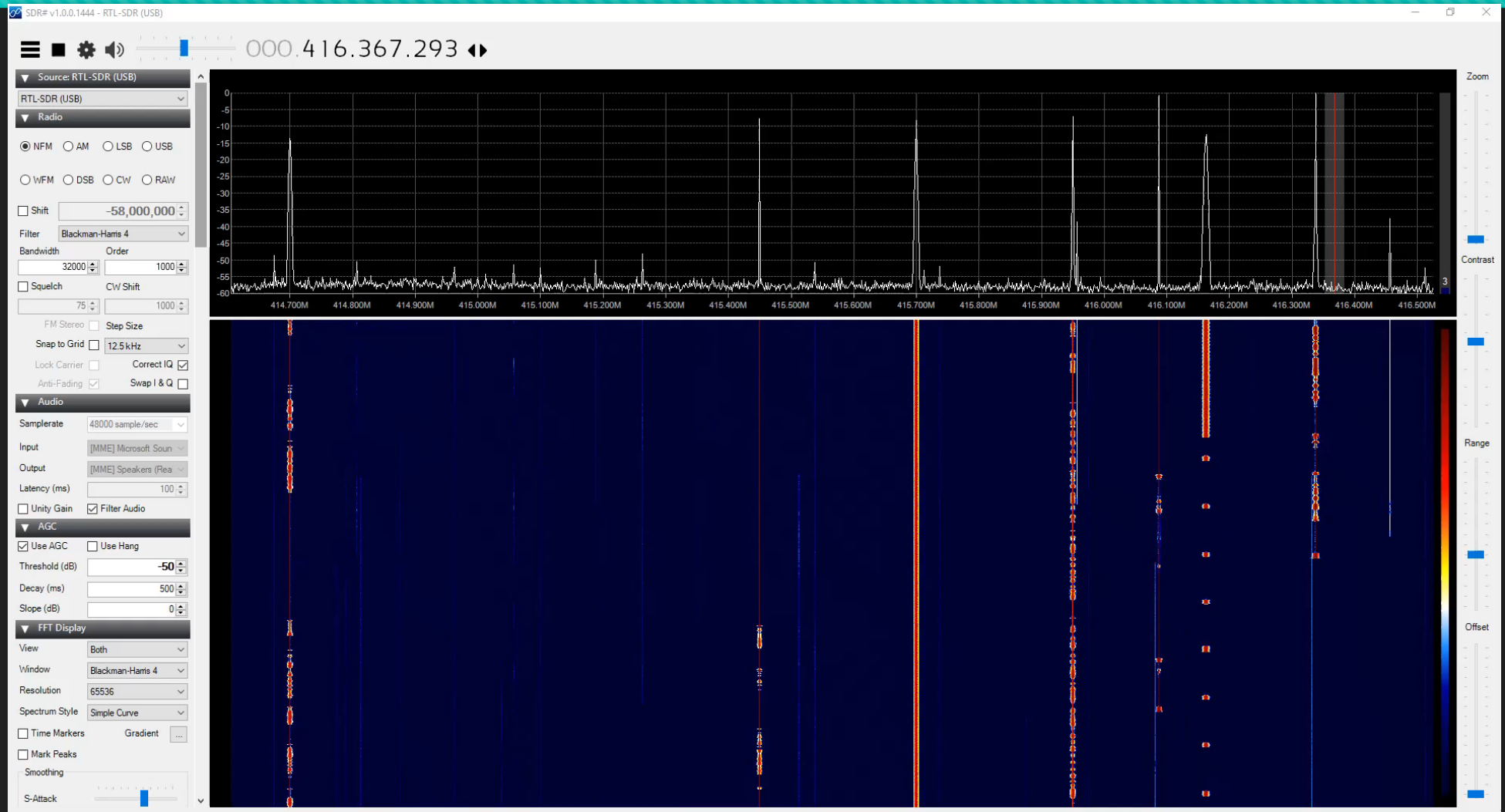
- RTL-SDR.com V3 fixes and added features
  1. TCXO Oscillator
  2. Metal case shielding
  3. Redesigned PCB, and additional noise filtering
  4. Thermal pad to metal case heat sink
  5. SMA connector
  6. Bias tee
  7. HF reception via direct sampling

Different Types of RTL-SDR Dongles

How to set up an RTL-SDR (Windows)

- Not plug and play, but extremely easy to set up
- www.rtl-sdr.com/qsg
- Works on Windows, Linux, Raspberry Pi's/Odroids etc, MacOS
  - Windows: SDR#, SDR-Console, HDSDR
  - Raspberry Pi: Command line tools, GQRX
  - Linux/MacOS: GQRX

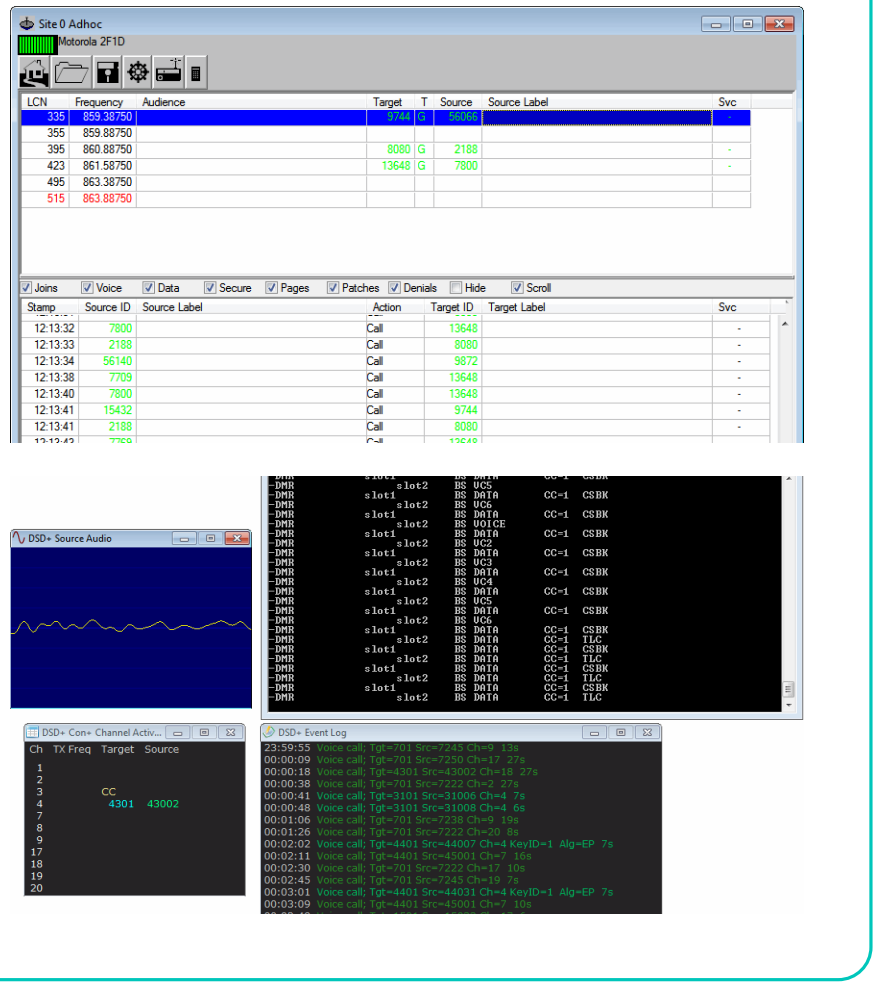
RTL-SDR Software: SDR#



Applications

Digital Voice Monitoring

- A program called “DSD+” can be used to decode P25 and DMR
  - Only unencrypted comms of course
  - dsdplus.com
- Another version of DSD can be used to listen to D-STAR amateur radio comms.
- Two dongles can be used to ‘follow’ trunked radio conversations.
  - One dongle decodes the control channel
  - The other dongle listens to the voice channel.
  - Unitrunker.com



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

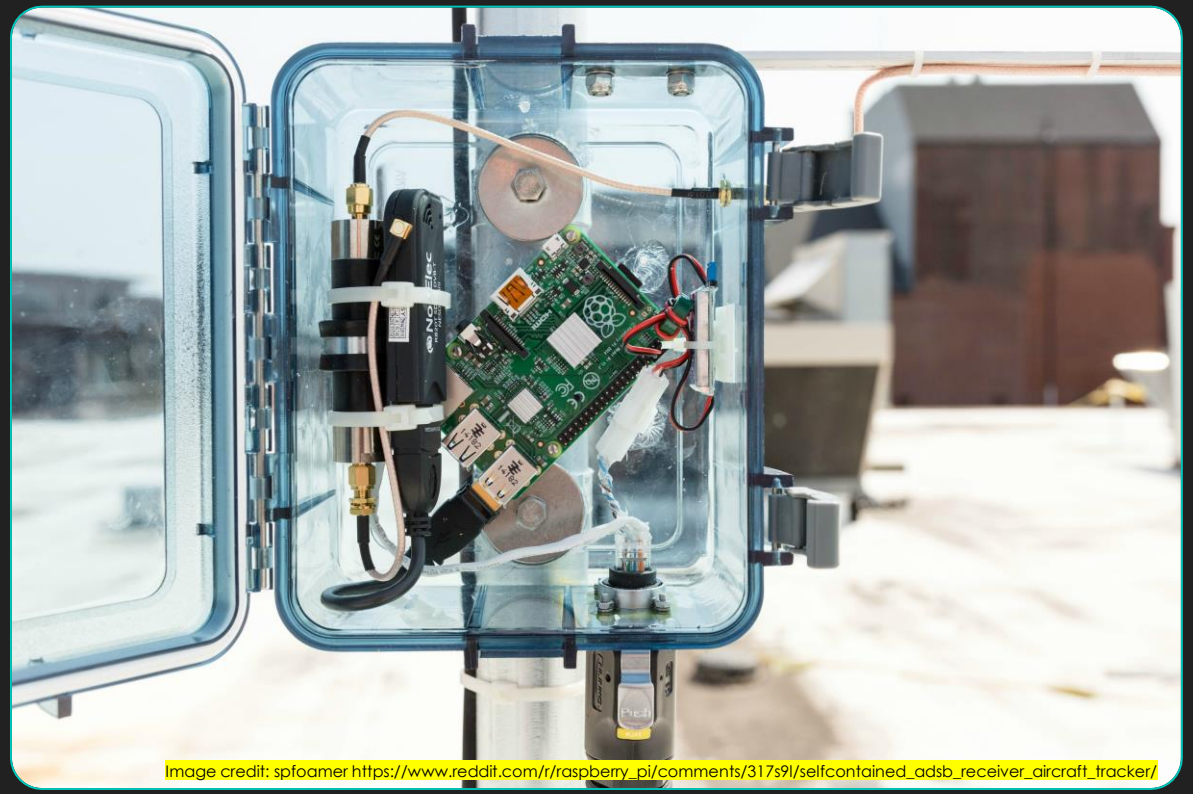
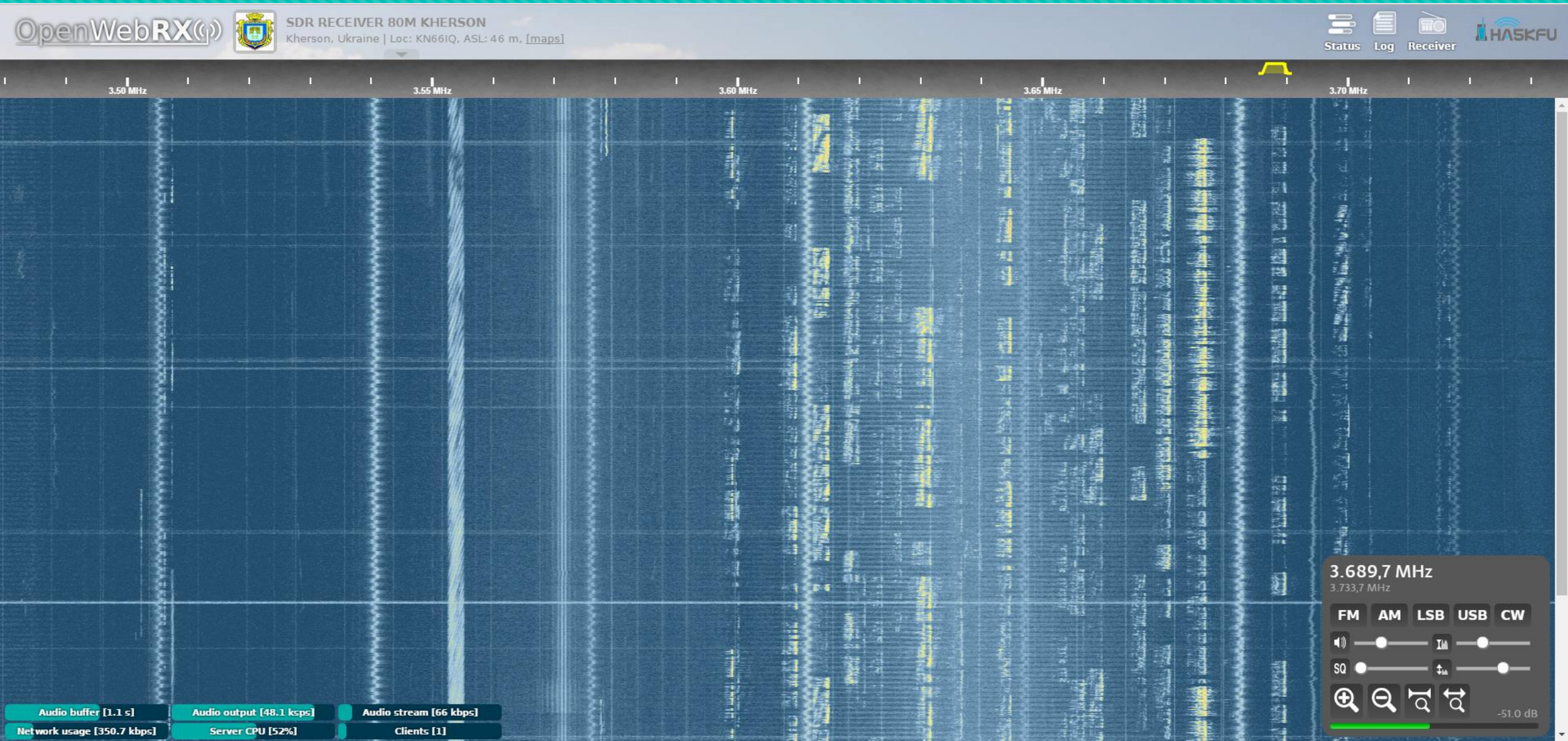
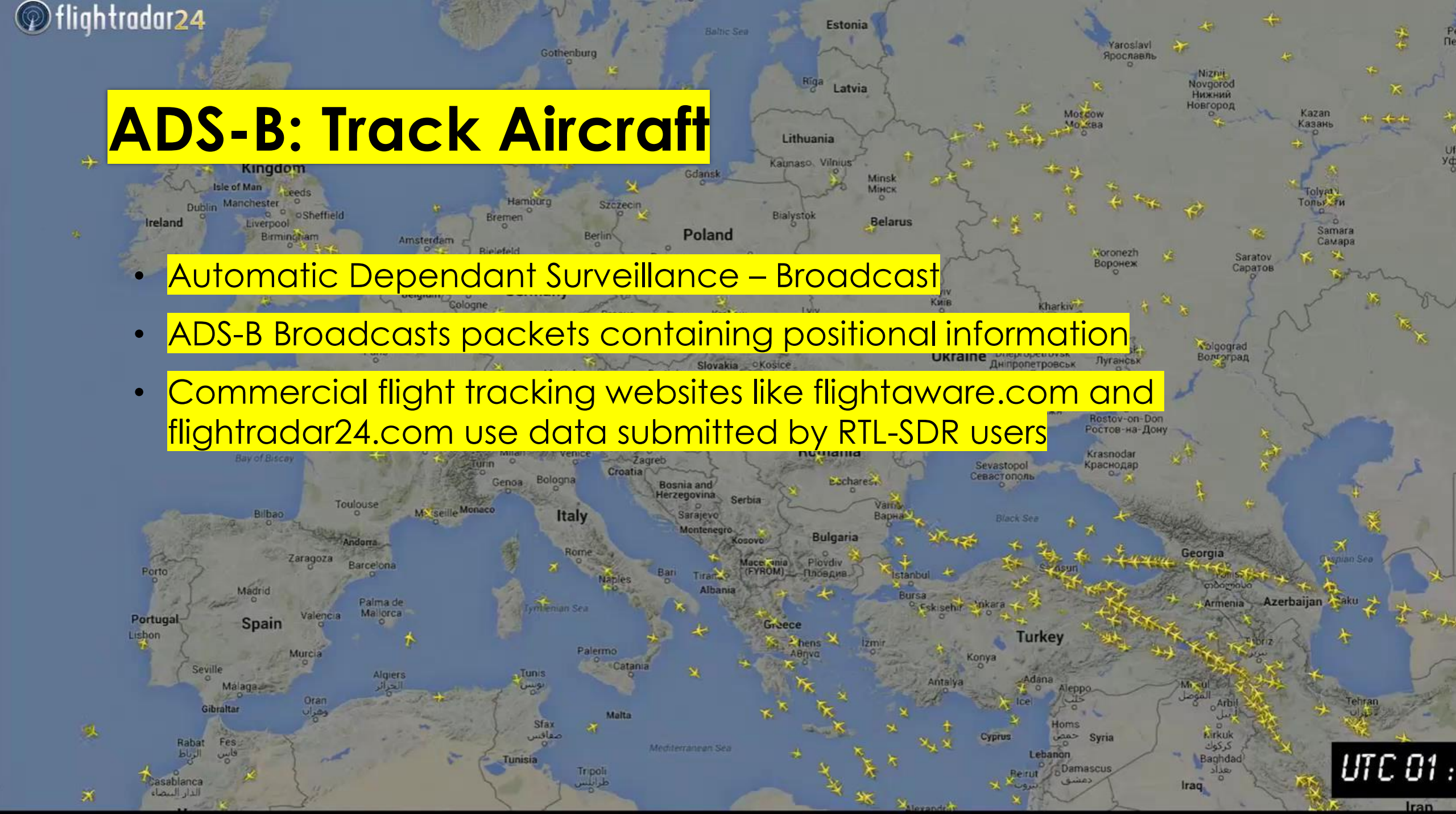


Image credit: spfoamer https://www.reddit.com/r/raspberry_pi/comments/317s9l/selfcontained_adsb_receiver_aircraft_tracker/

SDR.HU Example



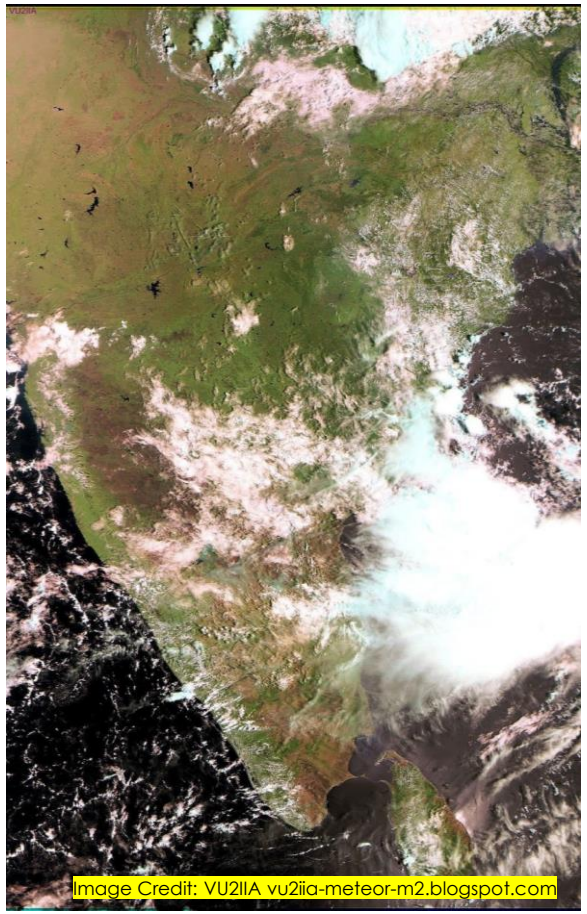


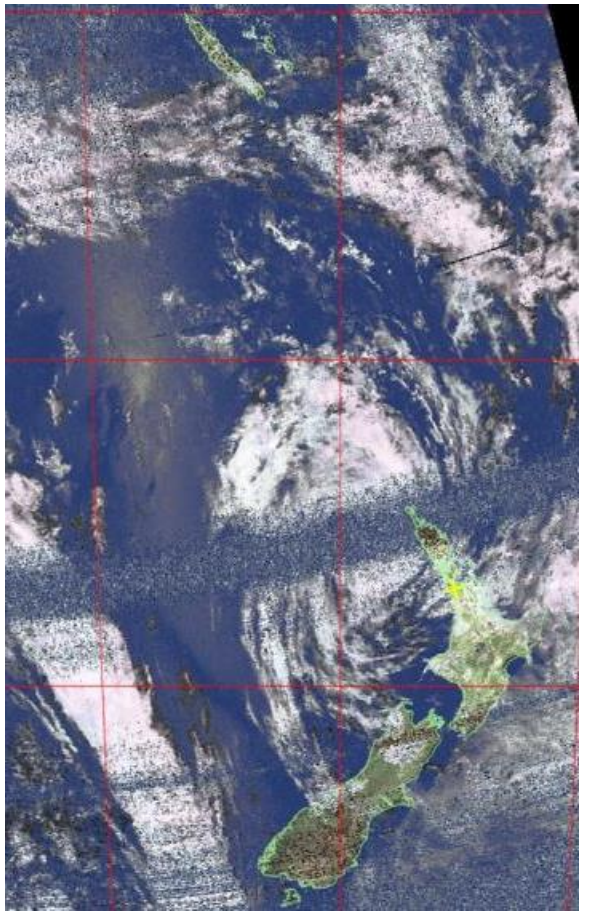
ADS-B: Track Aircraft

- Automatic Dependant Surveillance – Broadcast
- ADS-B Broadcasts packets containing positional information
- Commercial flight tracking websites like flightaware.com and flightradar24.com use data submitted by RTL-SDR users

NOAA + Meteor Weather Satellites

- Receive live weather images
- NOAA active satellites
  - NOAA 15 – 137.6200 MHz
  - NOAA 18 – 137.9125 MHz
  - NOAA 19 – 137.1000 MHz
- Transmits an analogue “APT” (Automatic Picture Transmission) signal
- Will pass over every location on earth several times in one day
- Meteor M-N2 Russian Weather Satellite
  - Higher resolution LRPT digital images
  - 137.9 MHz



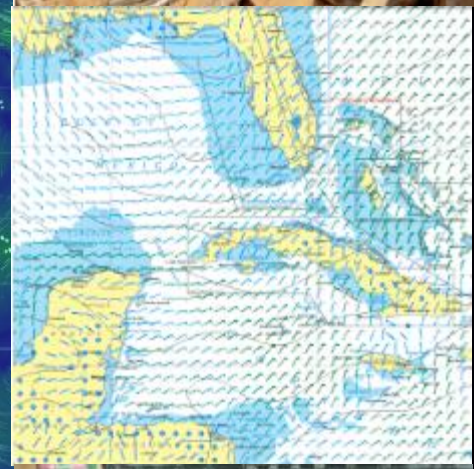


OUTERNET

Search in folders: Weather

Receiving The Outernet

- One way (download only) satellite filecasting service
  - Uses Iridium/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.
- Uses an RTL-SDR for reception



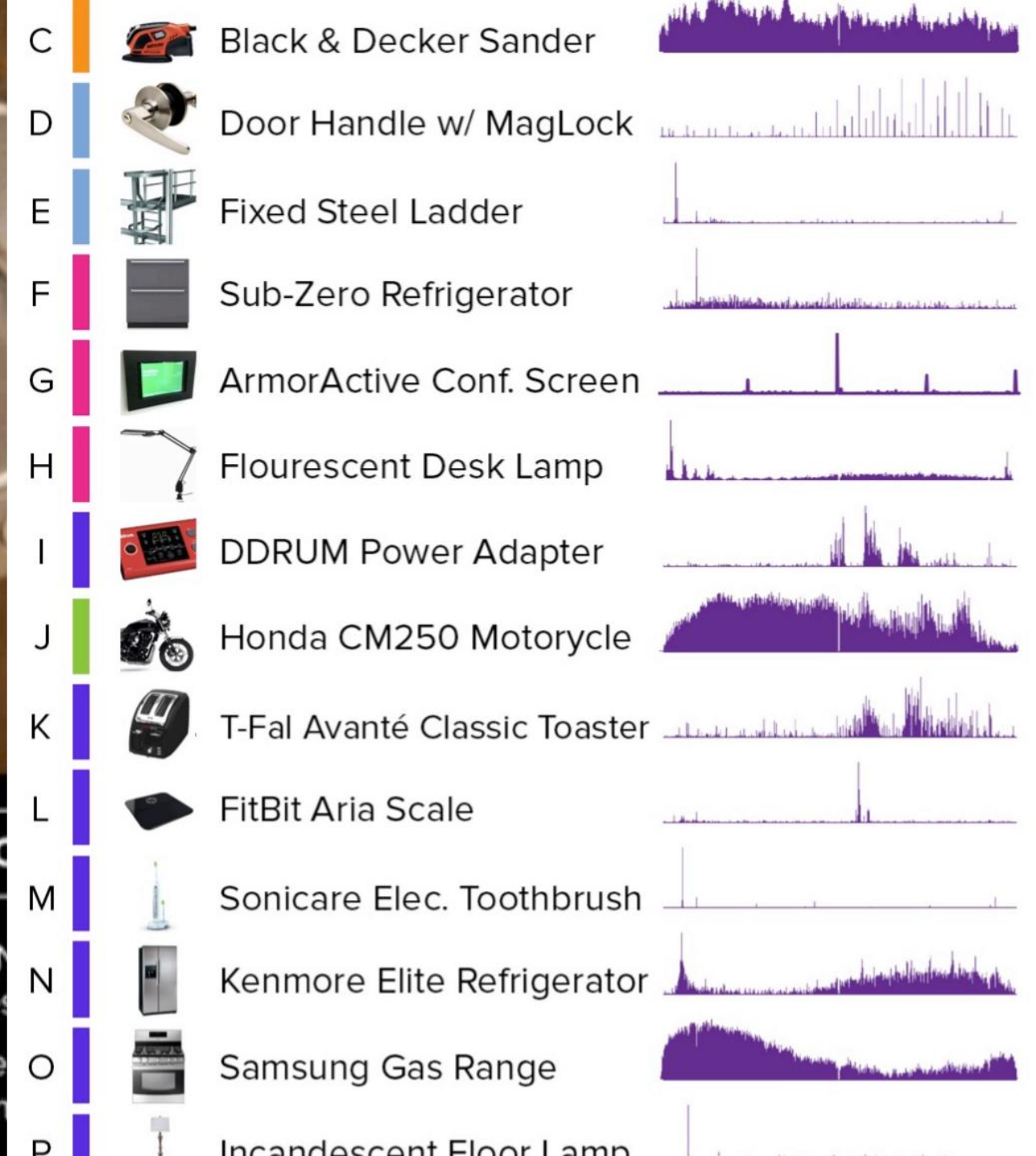
earth

QRM/Noise Detection and Locating

- Tim Havens "Driveby" System: QRM Detector
- Uses multiple RTL-SDR dongles running on an Odroid XU3
  - Scans multiple bands
- Log QRM levels together with GPS data
  - Find the hotspots on a heatmap
- Source found: Power pole with broken ground connection

Disney's EM Sense

- A watch that knows exactly what the wearer is touching
- Works by classifying EMI
- RTL-SDR Based



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".
  - If you're coming to the TAPR banquet talk, I will show many more applications in that talk.
- 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