Linux and Software Defined Radio

Presented by

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February 20, 2014

Biographical Information

- Licensed January 2007 (Extra 2009)

- Police Amateur Radio Team (PART) President September 2009

- Linux since 1997:

    - Worcester Linux Users' Group (1997-2005?)

    - Chelmsford Linux Meetup Group (2006 - present)

- Taught Linux through Chelmsford Community Education 2004 – 2011

- Linux ham radio programs:

    - Xlog (maintainer)   RigExpert Analyzer

    - Andy's Ham Radio Linux   Byonics MicroFox

    - Byonics TinyTrak3 (in progress)

Software Defined Radio

- Radio components such as mixers, filters, (de)modulators are replaced by computer software

- Software does the signal processing

- What is needed?

  - Personal computer

  - SDR software

  - Sound card (analog to digital converter)

  - RF front end

  - Upconverter (optional)

  - Antenna

RF Front Ends

- Ettus Research USRP
  Universal Software Radio Peripheral

- Great Scott Gadgets
  HackRF Jawbreaker (recent Kickstarter success)

- DVB-T dongles based on RTL2832U

- Funcube Dongle

USB Dongle for DVB-T

- DVB-T = Digital Video Broadcasting - Terrestrial

- Cheap USB dongle: $25

- Ordered on eBAY, delivered from China

- Linux kernel hacker Antti Palosaari (Finland)

  - Digital television developer

  - Accidentally found I and Q signals

  - SDR needs these – the reset is "easy"!
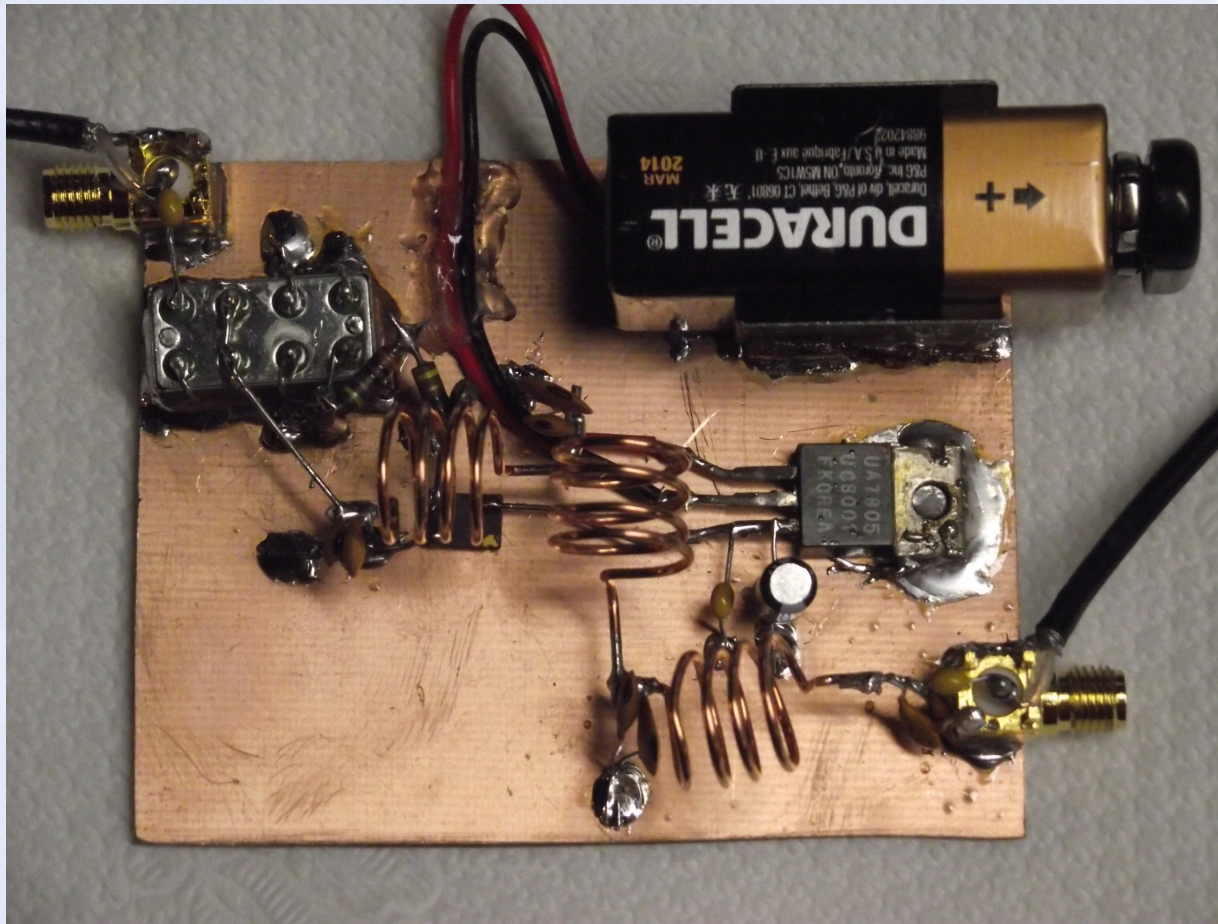
- Realtek RTL2832U DVB-T

Upconverter

- DVB-T dongle receives:

  - 50MHz – almost 2GHz

  - What about the HF bands below 50MHz?

- Build an upconverter!

  - Add 100 MHz to the incoming signal

  - Puts it in range of the dongle

- Don't need it for:

  - NOAA (162.525 MHz)

  - Broadcast FM (88 – 108 MHz)

  - 6m, 2m, 70cm, and higher frequencies

Upconverter Schematic
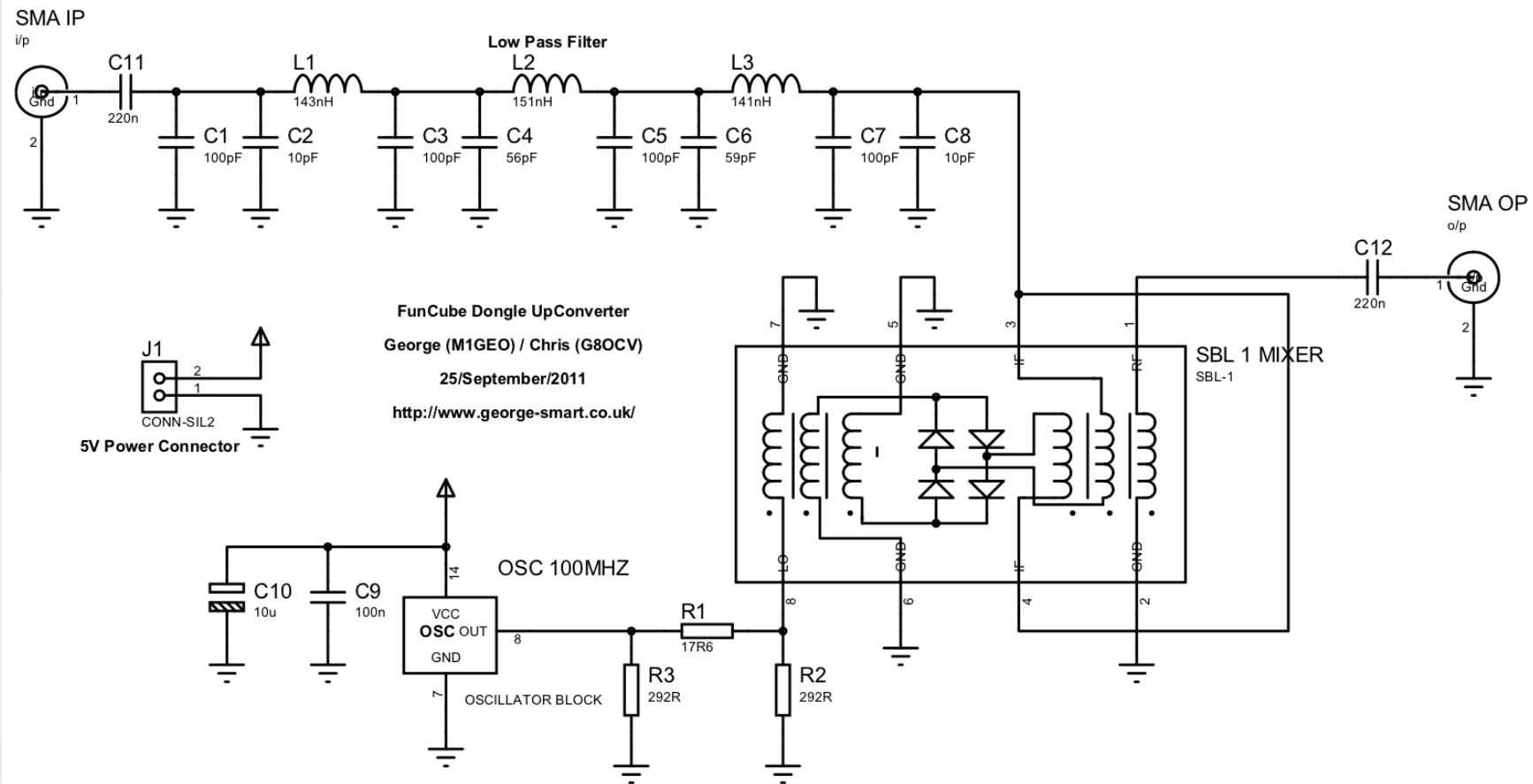
Ugly Construction - Upconverter

Software for Linux

- GNU Radio

    – Free and Open Source (GPL v3)

    – Software development toolkit

    – Python, C++

    – Filters, demodulators, vocoders, etc.

    – Handles the digital signal processing
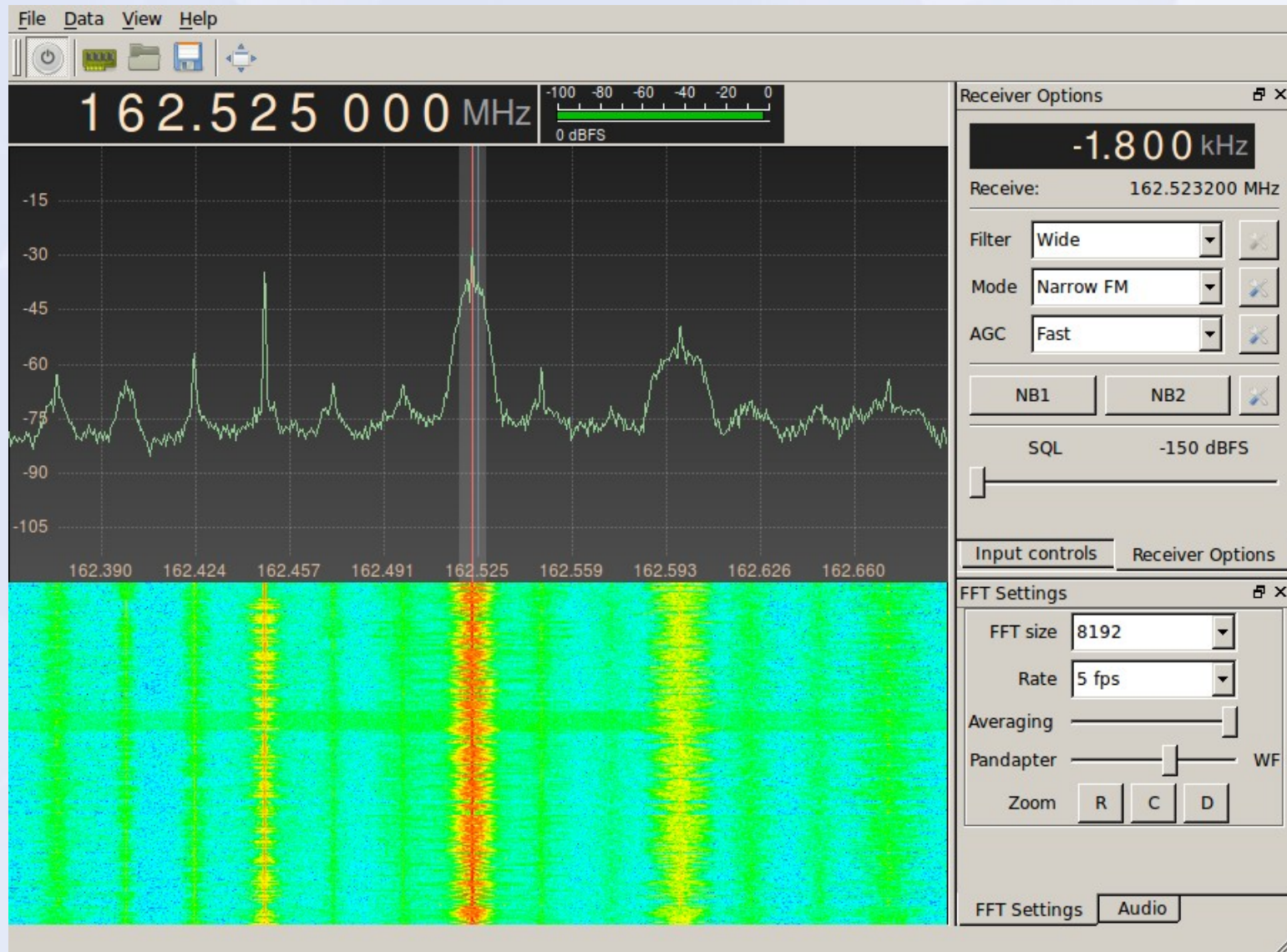
Software for Linux

- gqrx – written by Alexandru Csete

    - Free Software (GPL)

    - Qt graphical interface

    - GNU Radio

    - Supports many RF front ends

    - Linux, FreeBSD, Mac

    - AM, FM, SSB, CW

    - FFT plot and waterfall
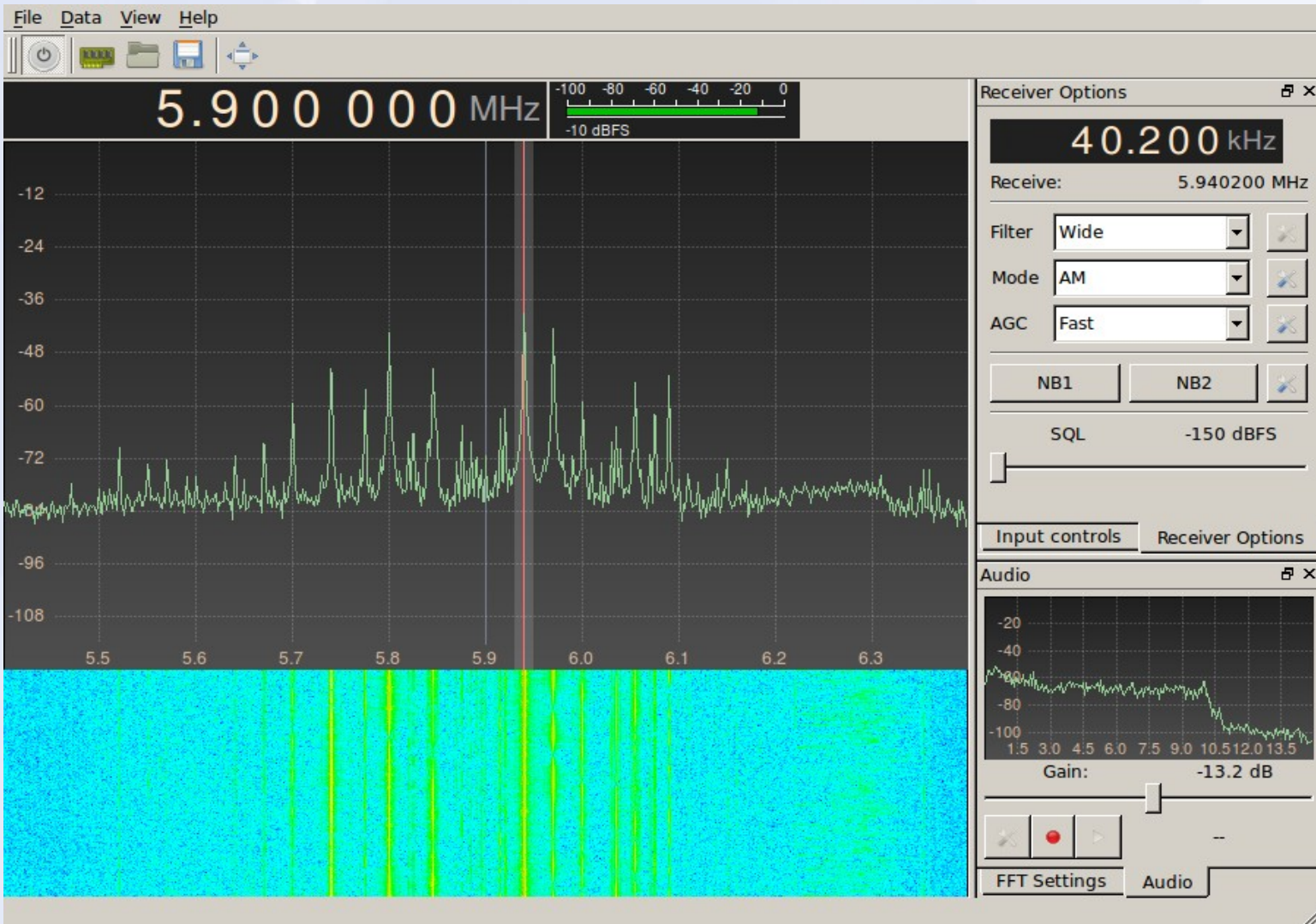
    - Record/playback to/from WAV file
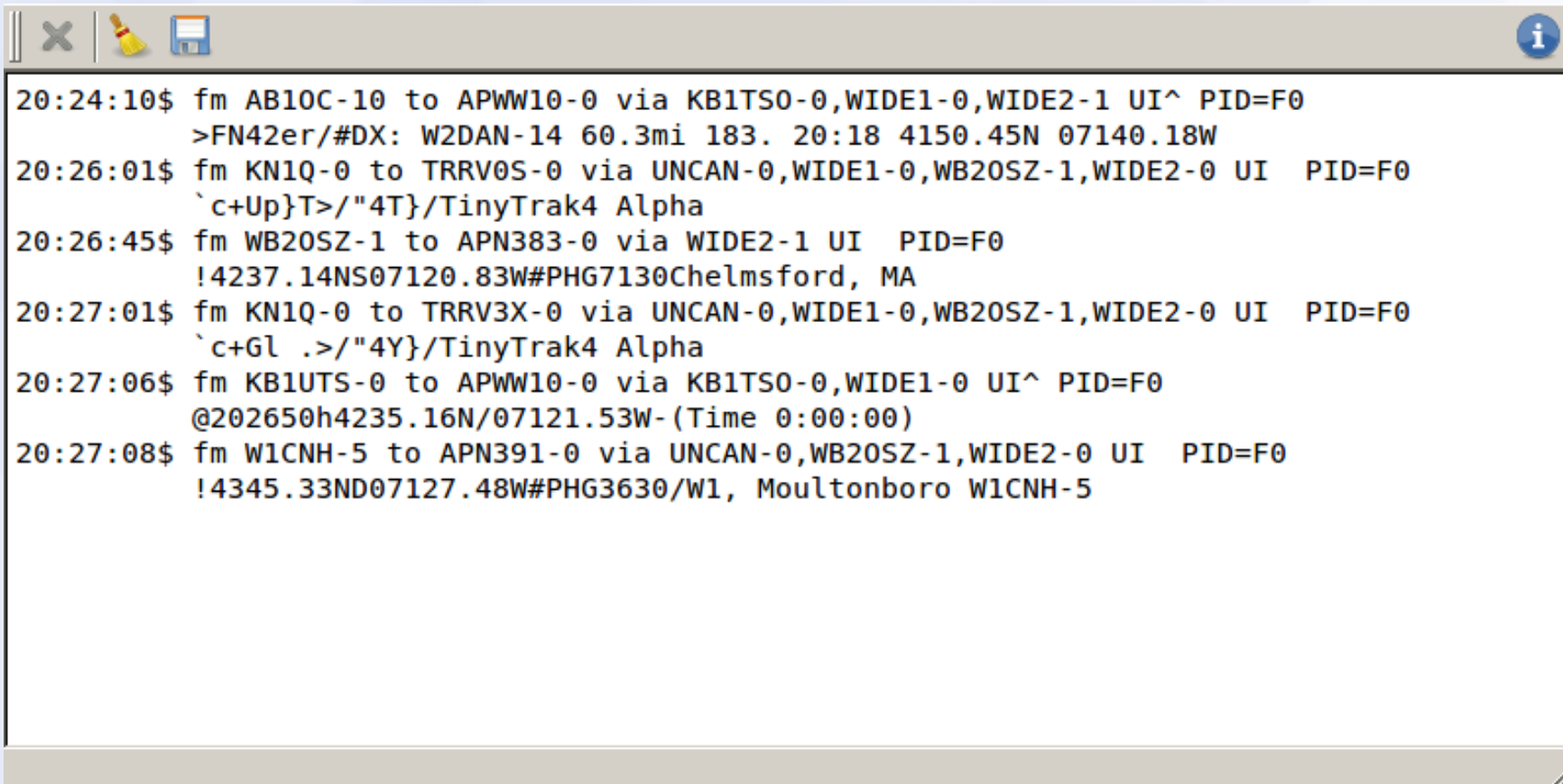
Broadcast FM
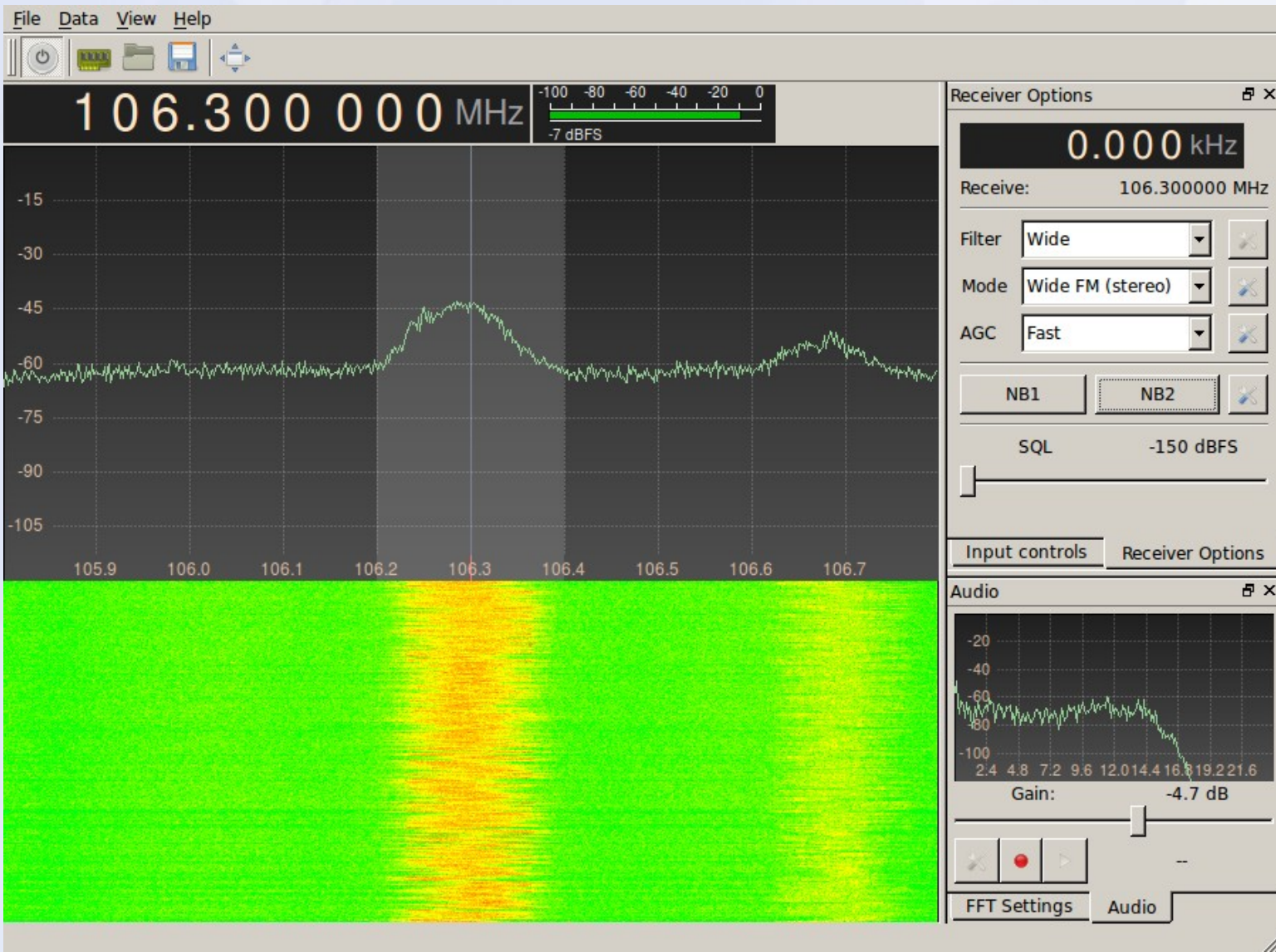
NOAA weather

41m shortwave AM

AFSK Decode of APRS


```
20:24:10$ fm AB1OC-10 to APWW10-0 via KB1TSO-0,WIDE1-0,WIDE2-1 UI^ PID=F0
          >FN42er/#DX: W2DAN-14 60.3mi 183. 20:18 4150.45N 07140.18W
20:26:01$ fm KN1Q-0 to TRRV0S-0 via UNCAN-0,WIDE1-0,WB2OSZ-1,WIDE2-0 UI  PID=F0
          `c+Up}T>/"4T}/TinyTrak4 Alpha
20:26:45$ fm WB2OSZ-1 to APN383-0 via WIDE2-1 UI  PID=F0
          !4237.14NS07120.83W#PHG7130Chelmsford, MA
20:27:01$ fm KN1Q-0 to TRRV3X-0 via UNCAN-0,WIDE1-0,WB2OSZ-1,WIDE2-0 UI  PID=F0
          `c+Gl .>/"4Y}/TinyTrak4 Alpha
20:27:06$ fm KB1UTS-0 to APWW10-0 via KB1TSO-0,WIDE1-0 UI^ PID=F0
          @202650h4235.16N/07121.53W-(Time 0:00:00)
20:27:08$ fm W1CNH-5 to APN391-0 via UNCAN-0,WB2OSZ-1,WIDE2-0 UI  PID=F0
          !4345.33ND07127.48W#PHG3630/W1, Moultonboro W1CNH-5
```

15m CW

Demonstration

- Try to receive:

    - NOAA 162.525 MHz

    - Broadcast FM 106.3 MHz

    - AFSK Decoder 144.390 MHz

    - Local police/fire 154-155 MHz, 450 – 480 MHz

    - Shortwave

        - 49m (5900 – 6200 khz)

        - 41m (7250 – 7500 khz)

        - 31m (9400 – 9900 khz)

    - WWV 5, 10, 15 MHz

What you might hear...

Downloads and Information

- Linux Ham Radio CD

    – http://www.sf.net/projects/kb1oiq-andysham

- Rig Expert program

    – http://www.sf.net/projects/aa-analyzer

- gqrx software

    – http://www.oz9aec.net/index.php/gnu-radio/gqrx-sdr

- Upconverter

    – http://www.george-smart.co.uk/wiki/FunCube_Upconverter

- GNU Radio

    – http://gnuradio.org/

The End

Thanks for coming!

I hope you enjoyed this presentation.

73 de Andy KB1OIQ