



# RASPBERRY PI RADIO SDR, WSPR AND MORE!

OZARKCON, 2016

MIKE HEITMANN, NØSO

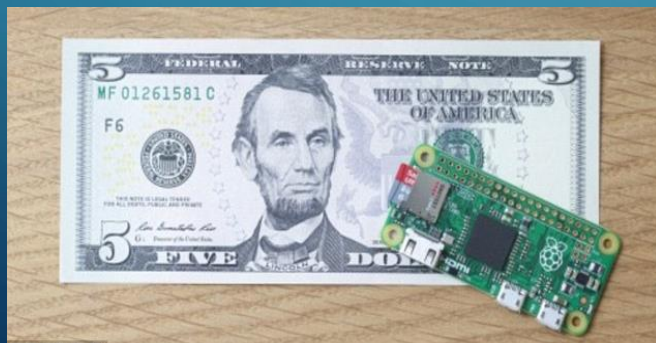
# TOPICS

- What's a Raspberry Pi?
- What can I do with it?
- How do I get started?

# WHAT'S A RASPBERRY PI?



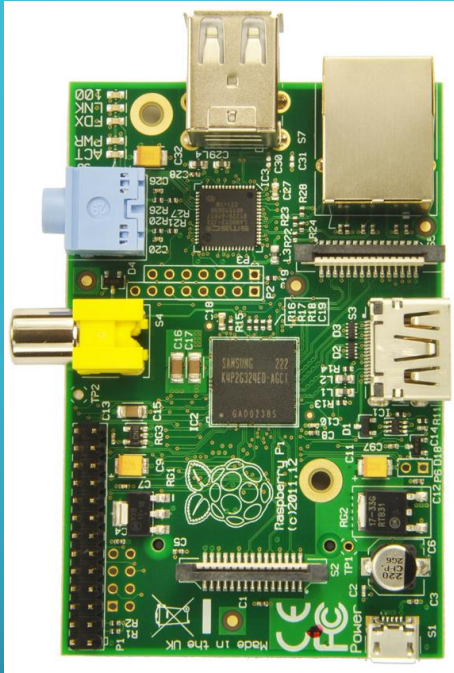
- A tiny, credit-card sized, low cost computer
  - The Raspberry Pi Foundation - UK based educational charity
  - Initially intended to be an educational tool
  - Been a big hit in schools and the “maker” world
  - Cheap! \$5 for the Rpi Zero, \$35 for an Rpi 3!
  - Linux OS



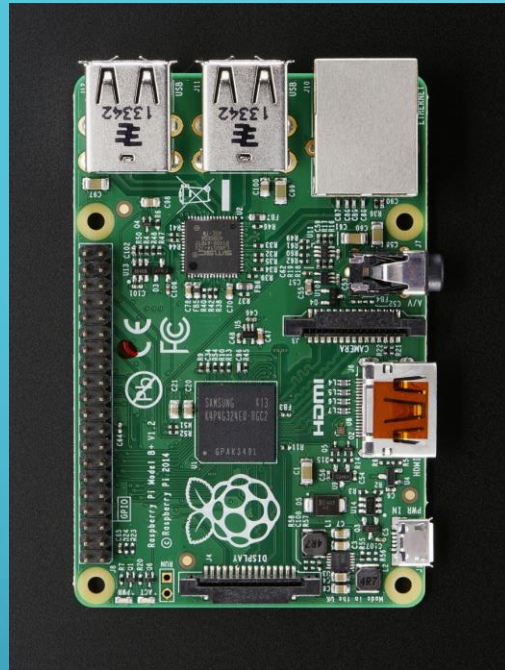
# RASPBERRY PI MODEL COMPARISON

Pi 1 B	Pi 1 B+	Pi 2 Model B+	Pi Zero	Pi 3 Model B+
256MB RAM	512MB Ram	1GB Ram	512MB RAM	1GB Ram
2 USB Port	4 USB Ports	4 USB Ports	1 Micro USB	4 USB Ports
26 GPIO Pins	40 GPIO Pins	40 GPIO Pins	40 GPIO Pins	40 GPIO Pins
700MHz CPU	700MHz CPU	900MHz quad-core CPU	1 GHz CPU	1.2GHz 64-bit quad-core CPU
SD Card	Micro SD Card	Micro SD Card	Micro SD Card	Micro SD Card
HDMI	HDIMI	HDMI	Micro HDMI	HDMI
Ethernet	Ethernet	Ethernet		Ethernet
				WiFi
				Bluetooth

# RASPBERRY PI MODELS



Pi 1 B



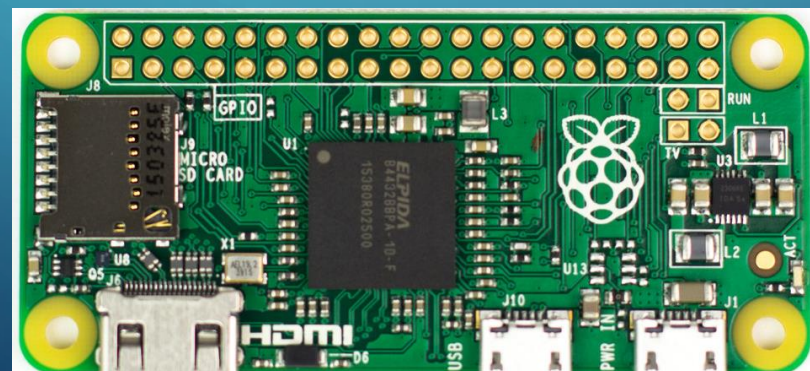
Pi 1 B+



Pi 2 B+



Pi 3 B+



Pi Zero

# WHAT CAN I DO WITH A RASPBERRY PI?

- **Build a low power transmitter!**

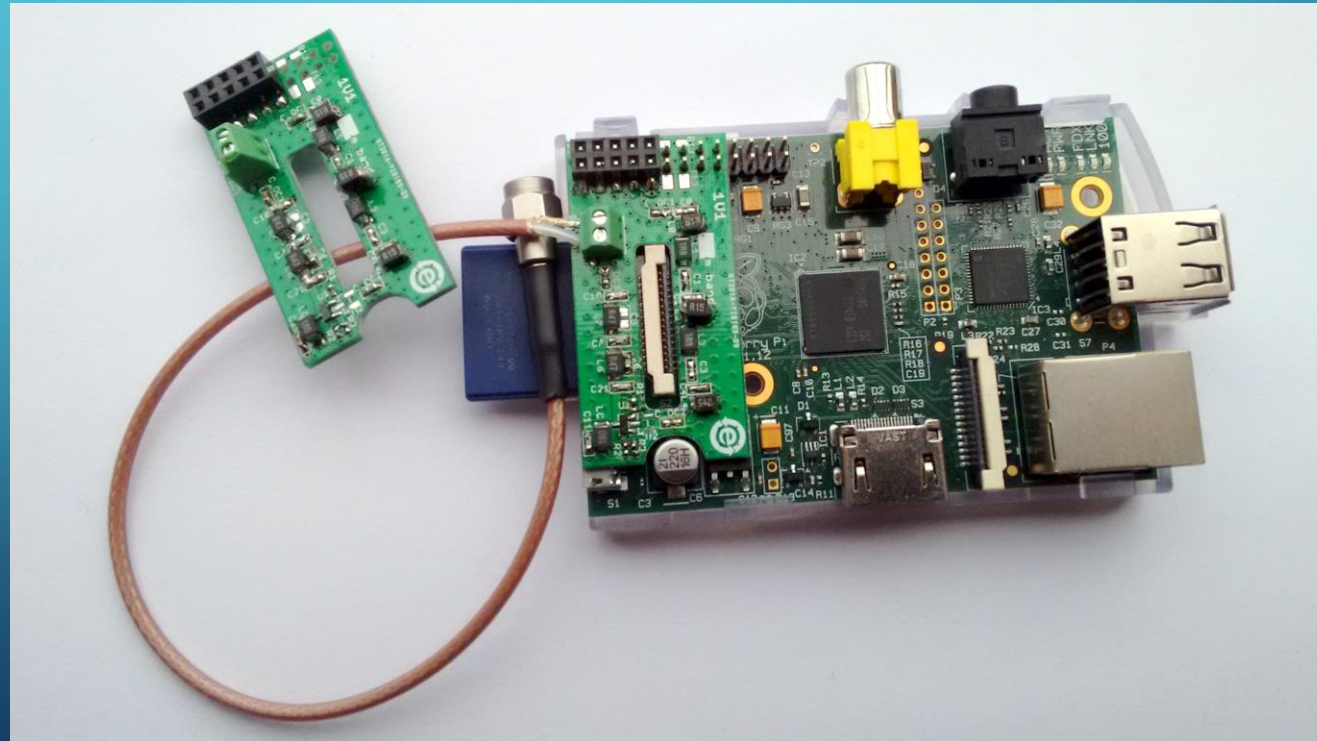
- Language Spy RPi-TX – A software based Raspberry Pi transmitter:
- Connect an antenna to GPIO Pin
- Software generated RF!
  - CW, FM, AM, SSB, SSTV, FSK, WSPR transmissions possible
- <http://hackaday.com/2015/11/04/rpitx-turns-raspberry-pi-into-versatile-radio-transmitter/>

- **PROBLEM:**

- Generating RF by wiggling a GPIO pin generates a square wave signal
- Even though output power is low level, a Low Pass filter is highly desirable.

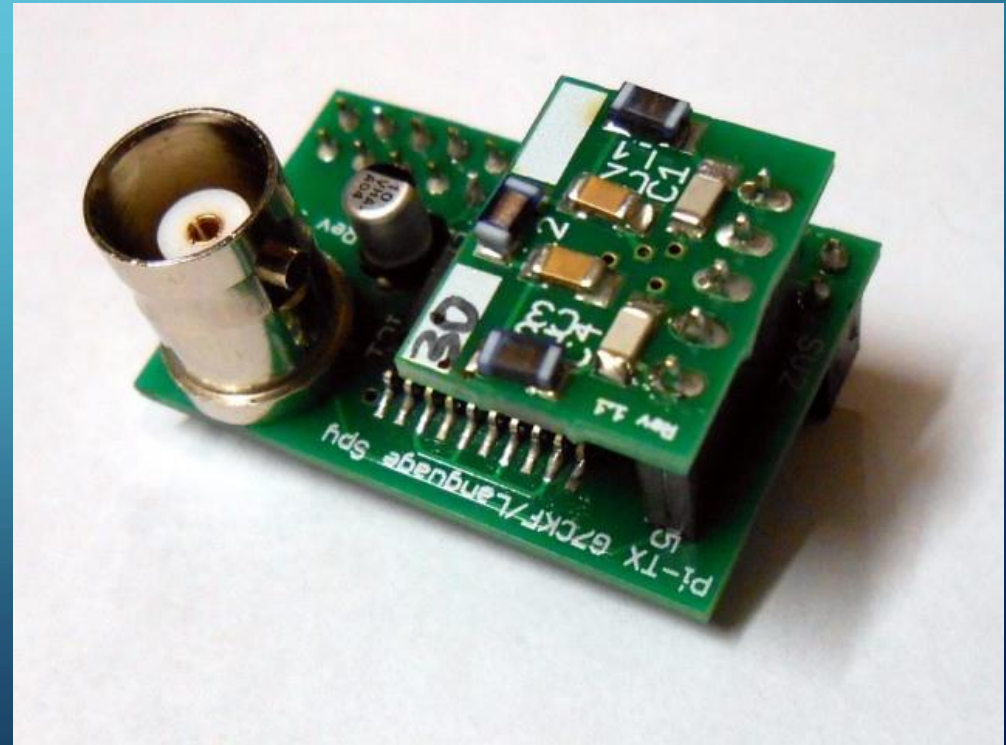
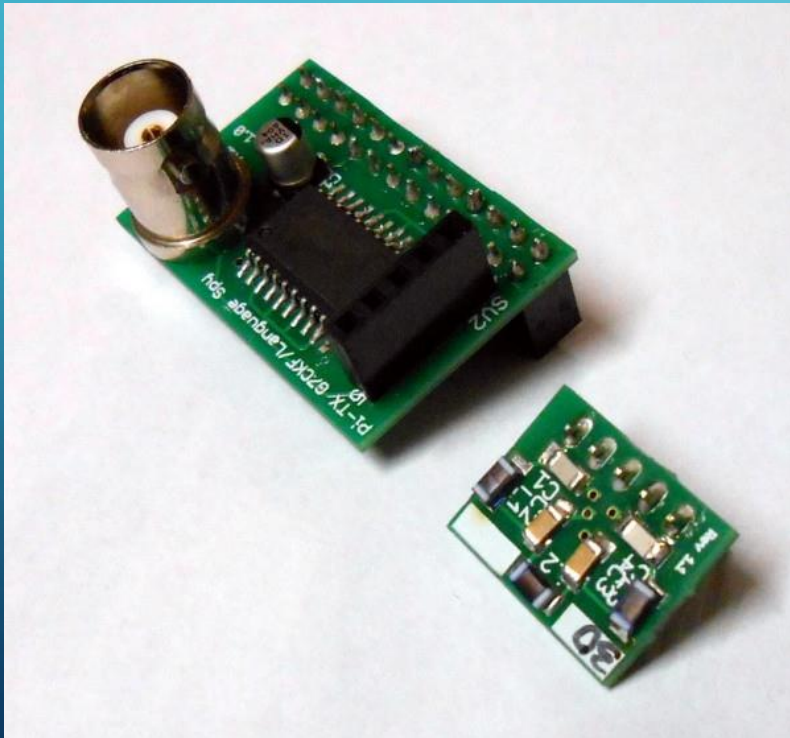
# WHAT CAN I DO WITH A RASPBERRY PI?

- QRPi (TAPR WSPR-Pi) Sheild:
  - <http://rfsparkling.com/qрпи/>
  - [https://www.tapr.org/kits\\_20M-wspr-pi.html](https://www.tapr.org/kits_20M-wspr-pi.html)
  - <https://www.youtube.com/watch?v=w-OTpw2Ai0k>



# WHAT CAN I DO WITH A RASPBERRY PI?

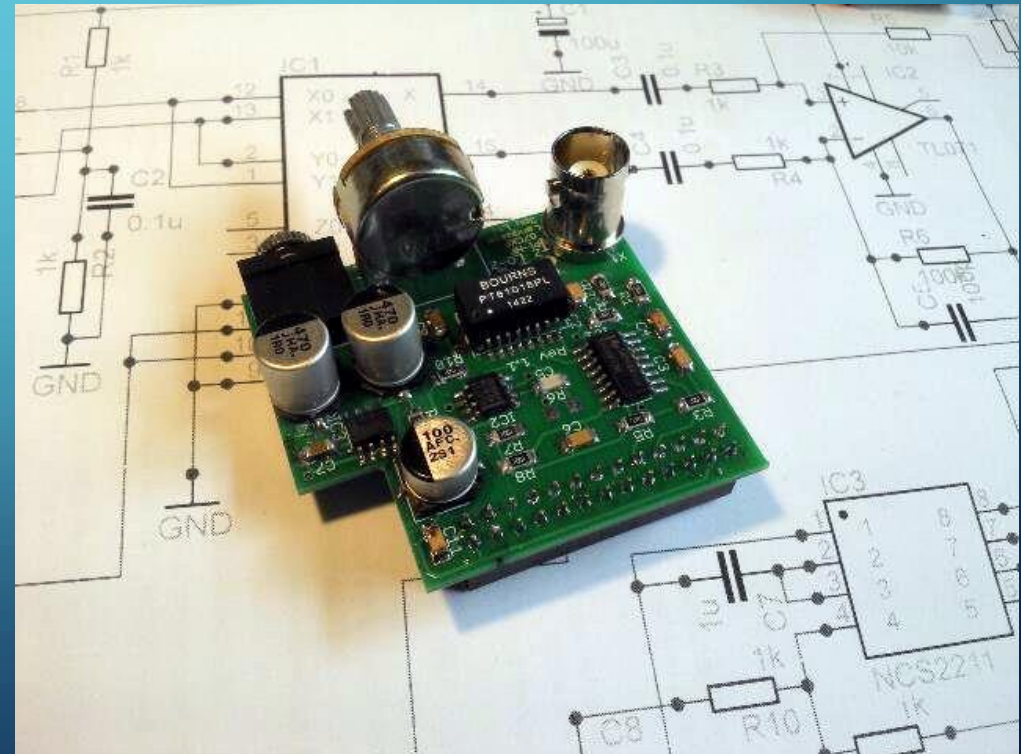
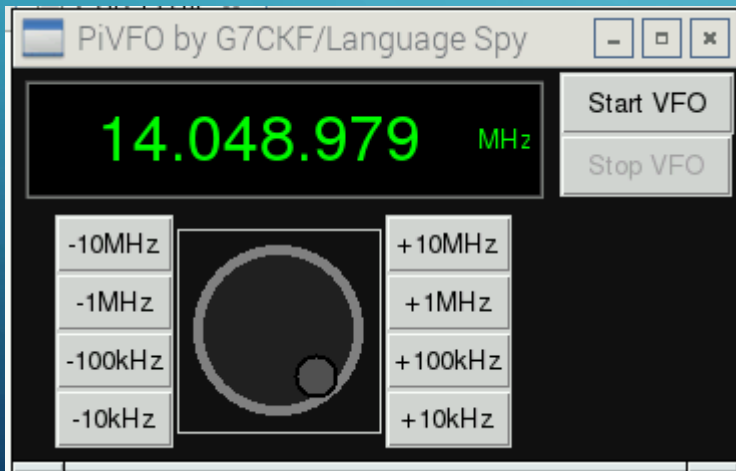
- Language Spy Pi-TX Kit:
  - <http://shop.languagespy.com/collections/electronic-kits-for-the-raspberry-pi/products/pi-tx-transmitter-kit-for-the-raspberry-pi>





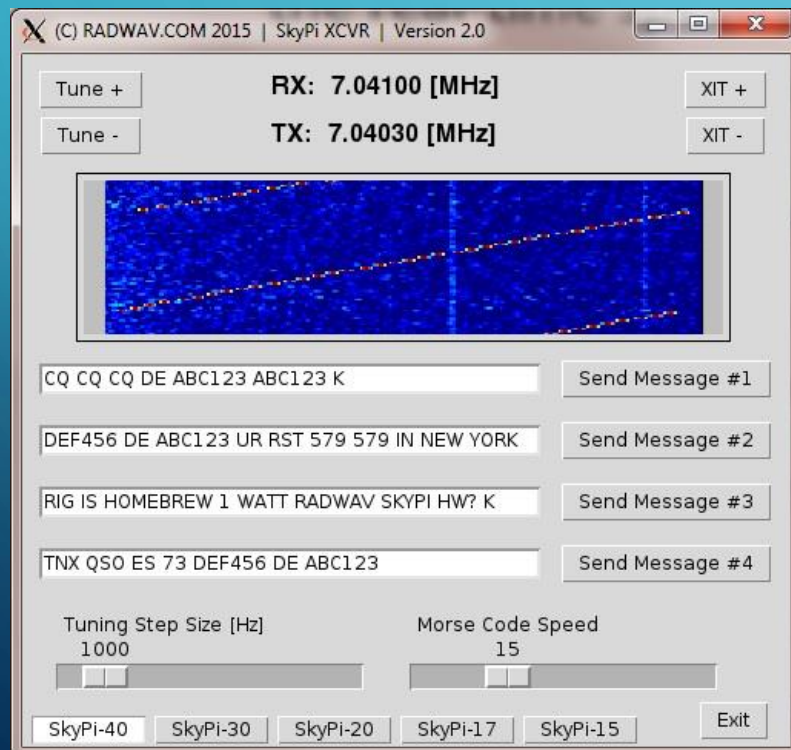
# WHAT CAN I DO WITH A RASPBERRY PI?

- Language Spy Pi-HF Direct Conversion Receiver Kit:
  - <http://shop.languagespy.com/collections/amateur-radio-kits/products/pi-hf-direct-conversion-radio-receiver-for-the-raspberry-pi>
  - Pair with Pi-TX for a transceiver
  - Two Raspberry Pi's required



# WHAT CAN I DO WITH A RASPBERRY PI?

- Raspberry Pi based Transceiver:
  - RadWav SkyPi – 20 and 40M kits
  - Outputs 1W
  - Companion receiver option
  - <http://radwav.com/index.html>



# WHAT CAN I DO WITH A RASPBERRY PI?

- Build a Digital Voice Hotspot
  - DVMega Shield for Raspberry Pi
  - Raspberry Pi DVMega board creates a low power simplex repeater
  - D-STAR, System Fusion, DMR, etc.
  - <http://www.dvmega.auria.nl/>



# WHAT CAN I DO WITH A RASPBERRY PI?

- Add an RTL-SDR USB Dongle



- Inexpensive SDR Receivers that look like USB sticks 25MHz – 2200MHz
- Low cost (\$20)
- Wide frequency coverage
- Many uses

# WHAT CAN I DO WITH A RASPBERRY PI?

- Transmit capable USB SDR Dongles:



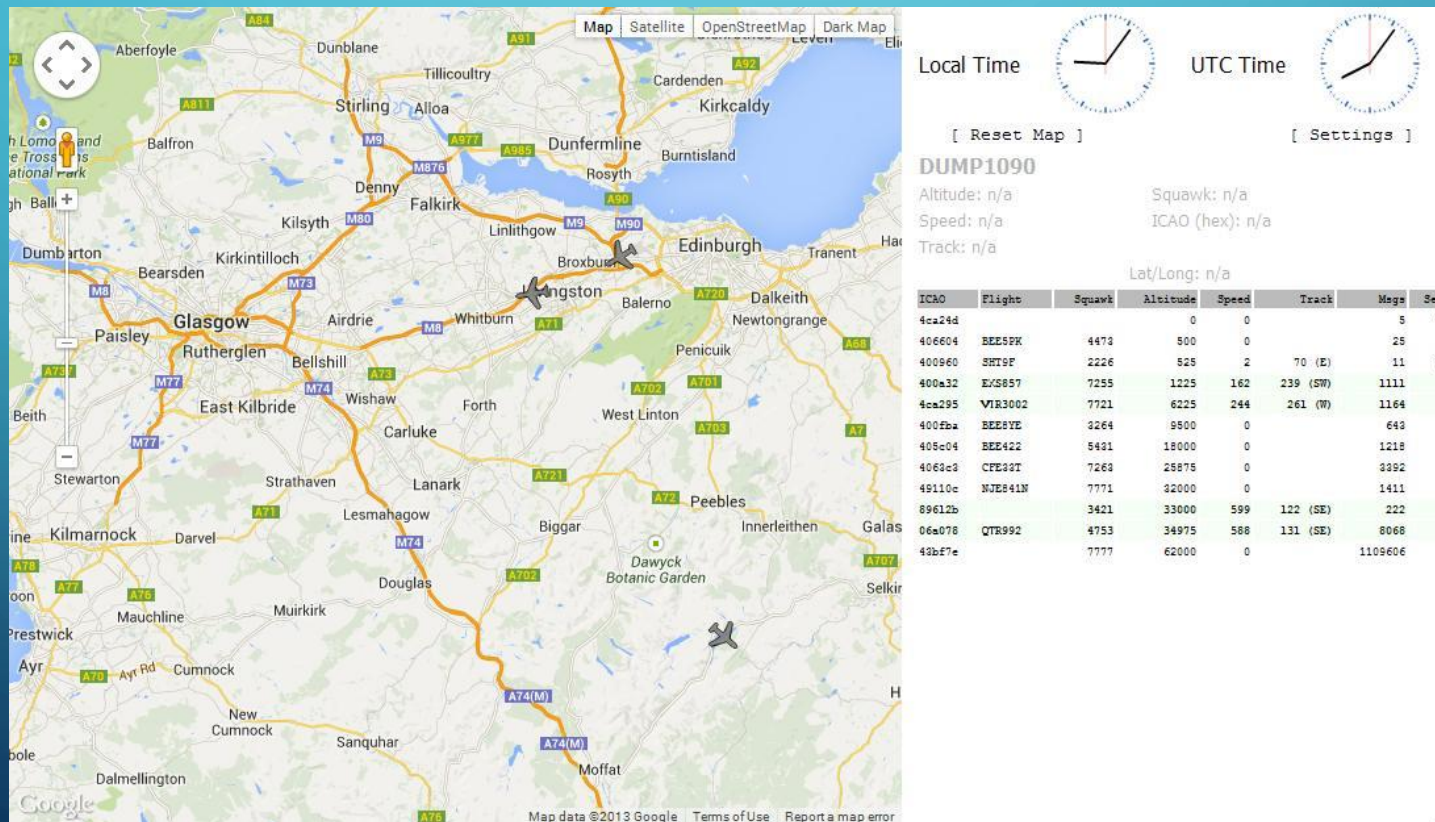
HackRF - \$300





BladeRF - \$400 +

# WHAT CAN I DO WITH A RASPBERRY PI?

- An Rpi / RTL-SDR USB Dongle can track airplanes
  - Dump1090 / Flight Aware
  - Tracking software receives aircraft transponder signals using SDR
  - <http://www.satsignal.eu/raspberry-pi/dump1090.html>



Local Time  UTC Time 

[ Reset Map ] [ Settings ]

**DUMP1090**  
Altitude: n/a Squawk: n/a  
Speed: n/a ICAO (hex): n/a  
Track: n/a

Lat/Long: n/a

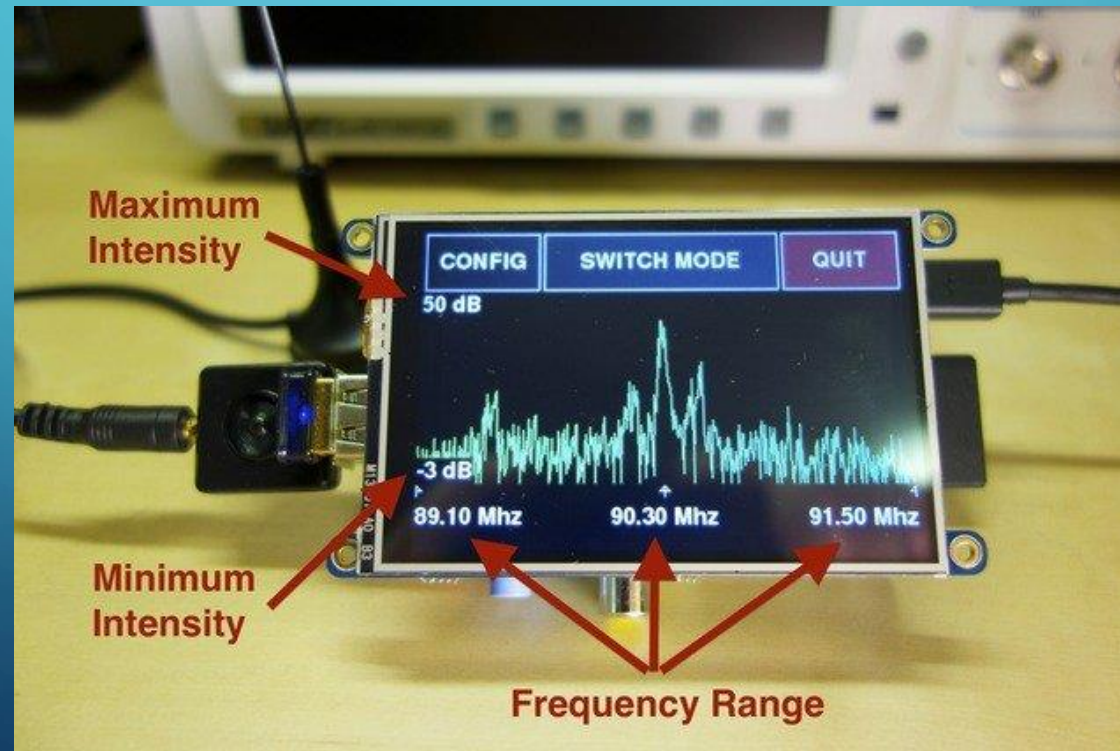
ICAO	Flight	Squawk	Altitude	Speed	Track	Msg	Seen
4ca24d			0	0		5	49
406604	EEESK	4473	500	0		25	0
400960	SHT9F	2226	525	2	70 (E)	11	58
400a32	EK857	7255	1225	162	239 (SW)	1111	0
4ca295	VIR3002	7721	6225	244	261 (W)	1164	0
400fb2	BEESYE	3264	9500	0		643	0
405c04	BE422	5431	18000	0		1218	0
4063c3	CPE33T	7263	25875	0		3392	4
45110c	NJE841N	7771	32000	0		1411	0
89612b		3421	33000	599	122 (SE)	222	0
06a078	QTR992	4753	34975	588	131 (SE)	8068	0
40bf7e		7777	62000	0		1109606	2

# WHAT CAN I DO WITH A RASPBERRY PI?

- An Rpi / RTL-SDR USB Dongle can track airplanes
  - Decode ACARS (*Aircraft Communications Addressing and Reporting System*) messages
    - *Air to Air*
    - *Air to Ground*
  - <https://sourceforge.net/projects/acarsdec/>

# WHAT CAN I DO WITH A RASPBERRY PI?

- An RPi / RTL-SDR USB Dongle can serve as:
  - a station monitor receiver
  - A simple spectrum analyzer
  - <https://learn.adafruit.com/freq-show-raspberry-pi-rtl-sdr-scanner/overview>

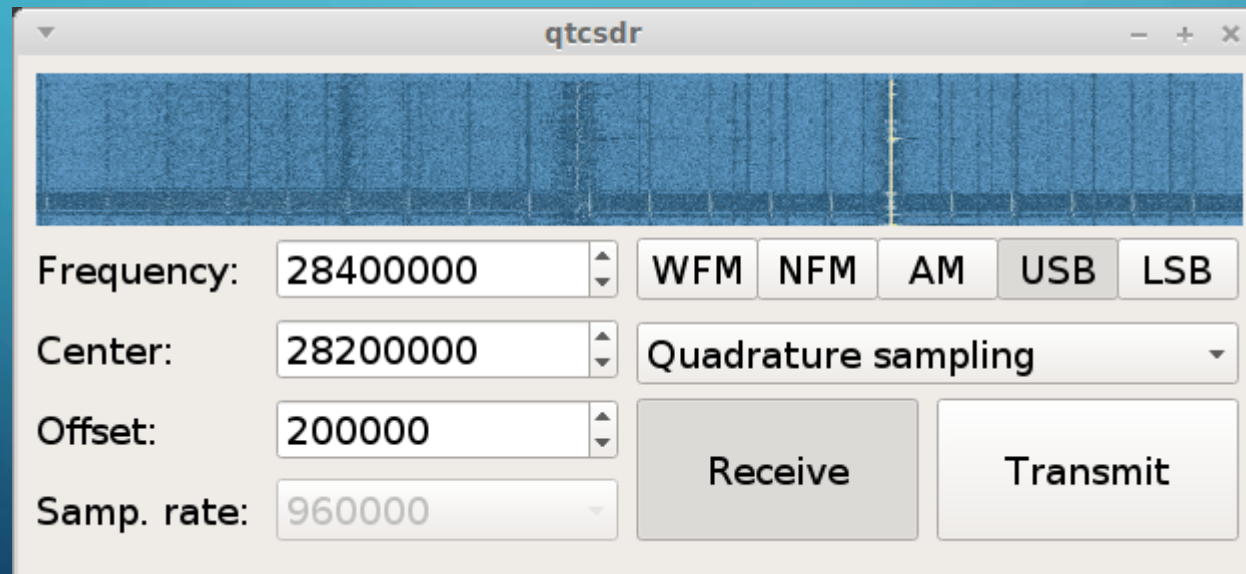




# WHAT CAN I DO WITH A RASPBERRY PI?

- QTCSDR

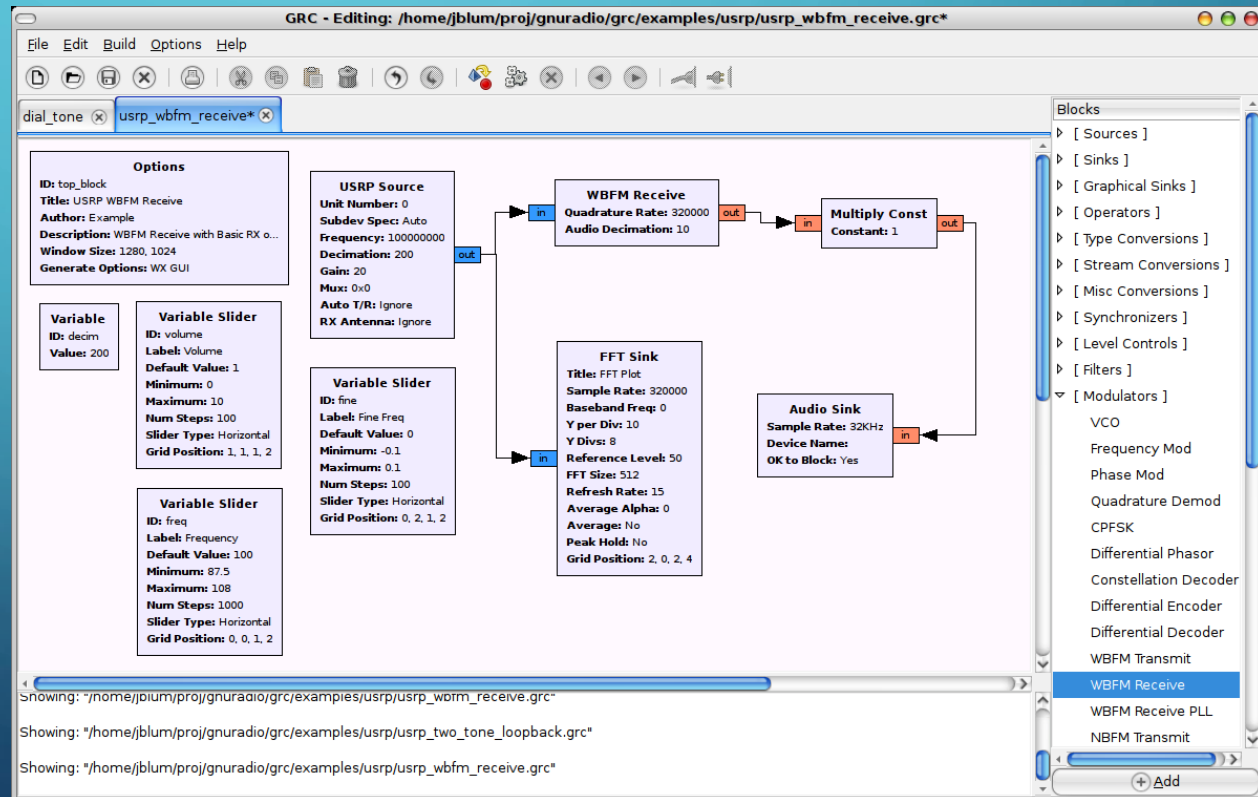
- Pairs RTL-SDR Dongle with Pi-TX to form an SDR Transceiver
- <https://github.com/ha7ilm/qtcsdr>



# WHAT CAN I DO WITH A RASPBERRY PI?

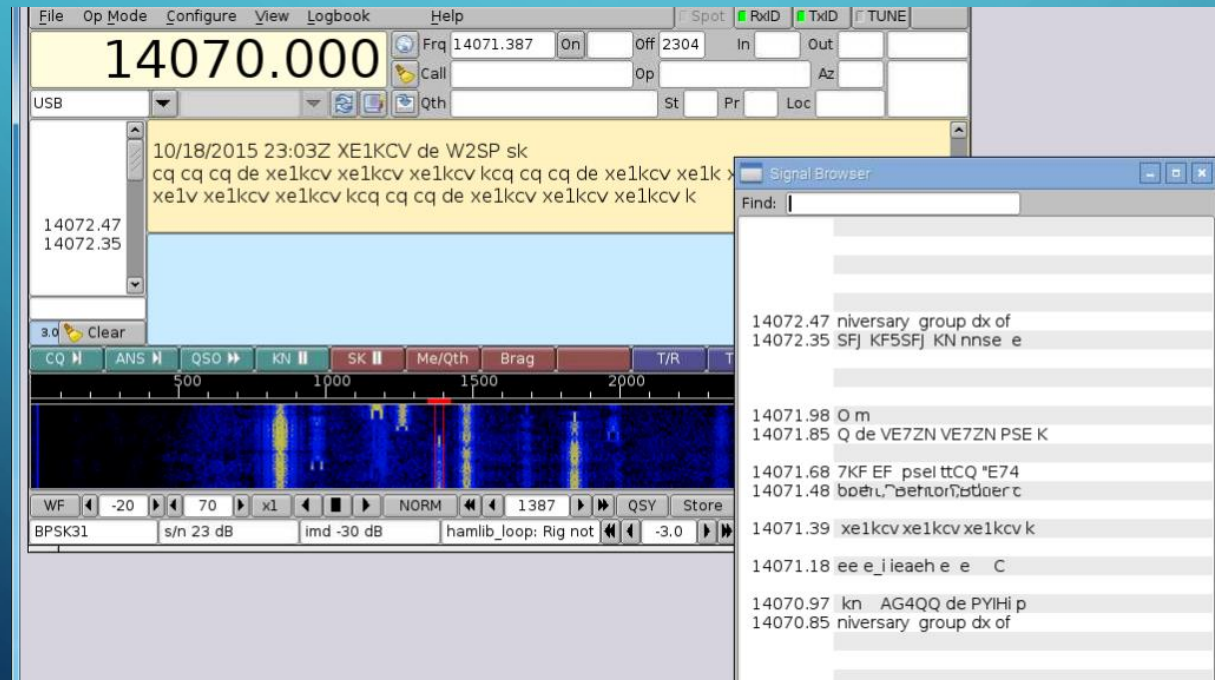
- GNURadio:

- GNU Radio is a free software development toolkit that provides the signal processing runtime and processing blocks to implement software radios using readily-available, low-cost external RF hardware and commodity processors.
- Previous examples all use GNURadio tools
- <https://gnuradio.org/redmine/projects/gnuradio/wiki/WhatsGR>



# WHAT CAN I DO WITH A RASPBERRY PI?

- An Rpi 2 or 3 with a USB sound dongle can be a:
  - Portable station computer
    - Run FLDigi for digital modes
    - Serve as a logging station for portable ops
    - <https://www.jeffreykopcak.com/2015/10/13/running-fldigi-flmsg-and-flwrap-on-the-raspberry-pi-2/>



# GETTING STARTED

- Get a Raspberry Pi (Pi 3B+ recommended)
  - Google “Raspberry Pi”
  - <https://www.adafruit.com/?q=ras&>
  - <http://www.mcmelectronics.com/content/en-US/raspberry-pi>
- You will also need:
  - USB Keyboard
  - USB Mouse
    - I use Logitech wireless keyboard with trackpad
  - Monitor (HDMI is best)
  - 4GB or larger Micro SD card to hold “Image” file.
  - Internet connection
  - PC to download Raspberry Pi OS “Image” and write to the SD card.

# GETTING STARTED

- The Raspberry Pi uses the SD card as its “hard drive”. You will need an image file from:
  - <https://www.raspberrypi.org/downloads/>
- The hardest part about getting started the first time is getting the RPi “image” onto the SD card
  - Not really hard, it’s just intimidating the first time you try it.
- Instructions for setting up the SD cards are here:
  - <https://www.raspberrypi.org/documentation/installation/installing-images/README.md>
- Alternately, you can purchase an SD card with a pre-installed image.

# MORE TIPS AND INFORMATION

- If you get stuck, there are lots of resources on the Internet. Search for “Setting up a Raspberry Pi” and you will find lots of resources.
- <https://www.raspberrypi.org/help/quick-start-guide/>
- The Raspberry Pi is a Linux based computer. A good Linux reference guide may be very useful if you're not familiar with Linux.
- Seek out a Linux “elmer”



QUESTIONS?