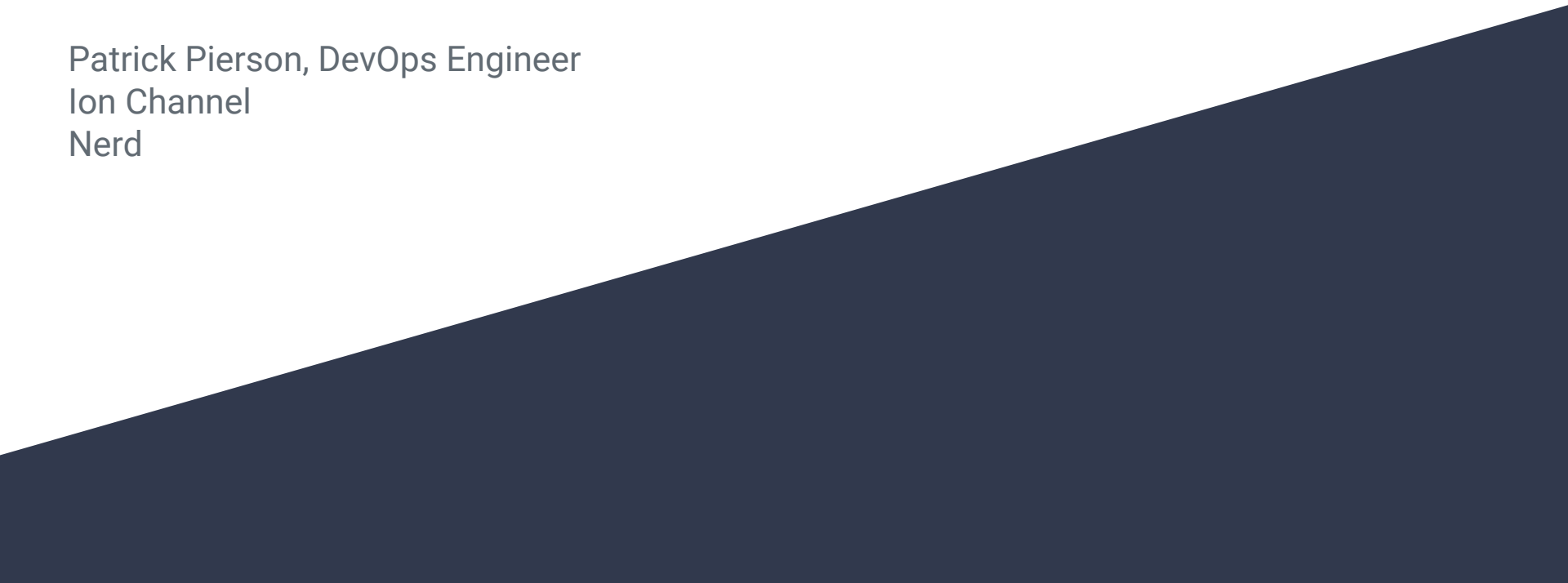


# Python + Software Defined Radios

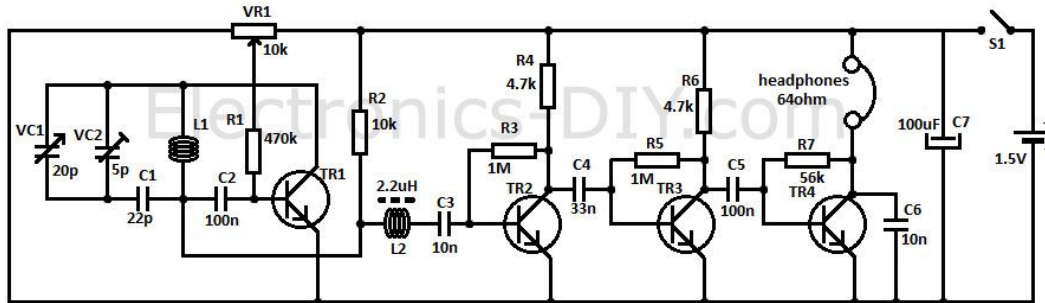
Patrick Pierson, DevOps Engineer  
Ion Channel  
Nerd

A dark blue diagonal gradient bar that starts from the bottom left and extends towards the top right, covering the lower half of the slide.

# What is Software Defined Radio?

Software-defined radio (SDR) is a radio communication system where components that have been traditionally implemented in hardware (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) are instead implemented by means of software on a personal computer or embedded system.

Hardware Diagram



FM Radio Receiver

## Software Definition (GNURadio)

```
<block>
  <key>low_pass_filter</key>
  <param>
    <key>beta</key>
    <value>6.76</value>
  </param>
  <param>
    <key>alias</key>
    <value></value>
  </param>
  <param>
    <key>comment</key>
    <value></value>
  </param>
  <param>
    <key>affinity</key>
    <value></value>
  </param>
  <param>
    <key>cutoff_freq</key>
    <value>100000</value>
  </param>
  <param>
    <key>decim</key>
    <value>1</value>
  </param>
  <param>
    <key>_enabled</key>
    <value>True</value>
  </param>
  <param>
    <key>type</key>
    <value>fir_filter_ccf</value>
  </param>
</block>
```

# SDR isn't new!

- "digital receiver" in 1970
- "software radio" in 1984
- SPEAKeasy phase I - 1990 to 1995
  - demonstrate a radio for the military
  - 2 MHz to 2 GHz
  - interoperate with ground force radios (frequency-agile VHF, FM, and SINCGARS), Air Force radios (VHF AM), Naval Radios (VHF AM and HF SSB teleprinters) and satellites (microwave QAM)
- GNURadio - 2001- a free software development toolkit that provides signal processing blocks to implement software-defined radios and signal-processing systems

# Linux SDR Applications

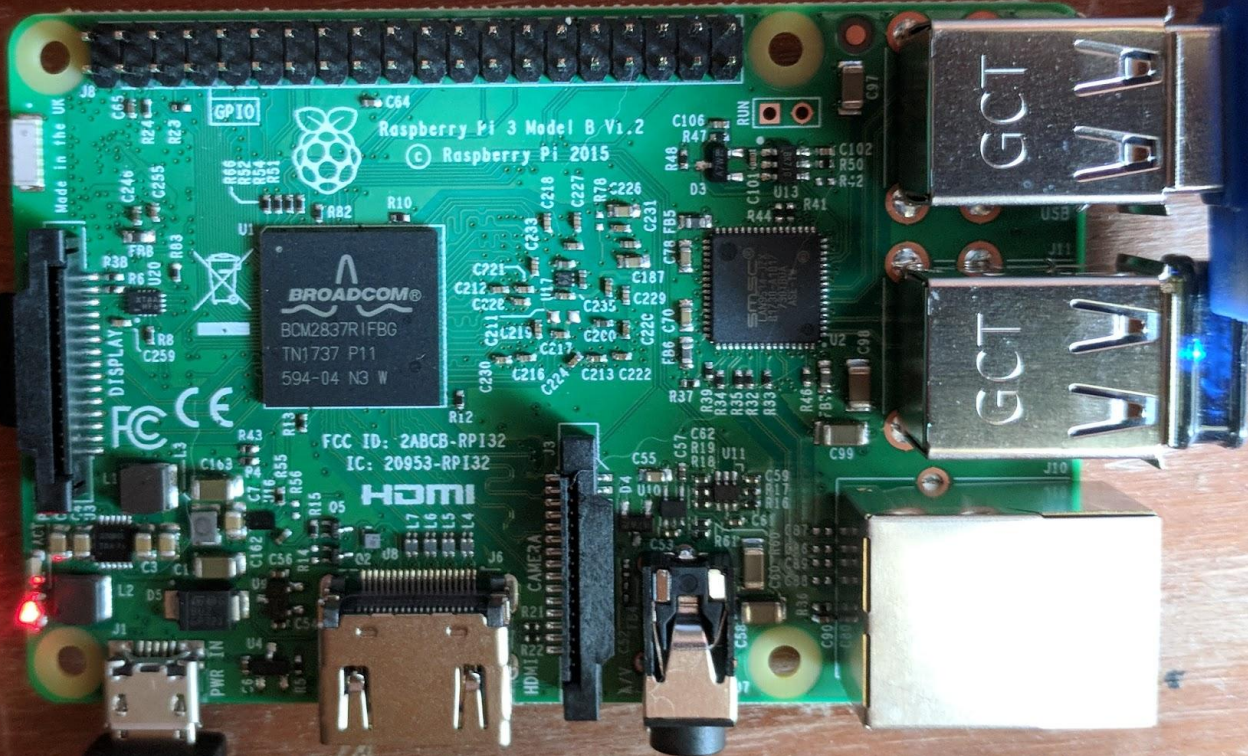
GQRX - An open source software defined radio receiver (SDR) powered by the GNU Radio and the Qt graphical toolkit.

Nrsc5 - An open source digital radio tuner

SDRTrunk - A cross-platform java application for decoding, monitoring, recording and streaming trunked mobile and related radio protocols using Software Defined Radios (SDR).

# ADS-B

A surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked.





  
**FlightAware**

Pro Stick Plus v1.0 ADS-B/Mode S Receiver  
R820T2 + RF Amp + 1090 MHz Filter  
<https://flightaware.com/adsb/prostick>

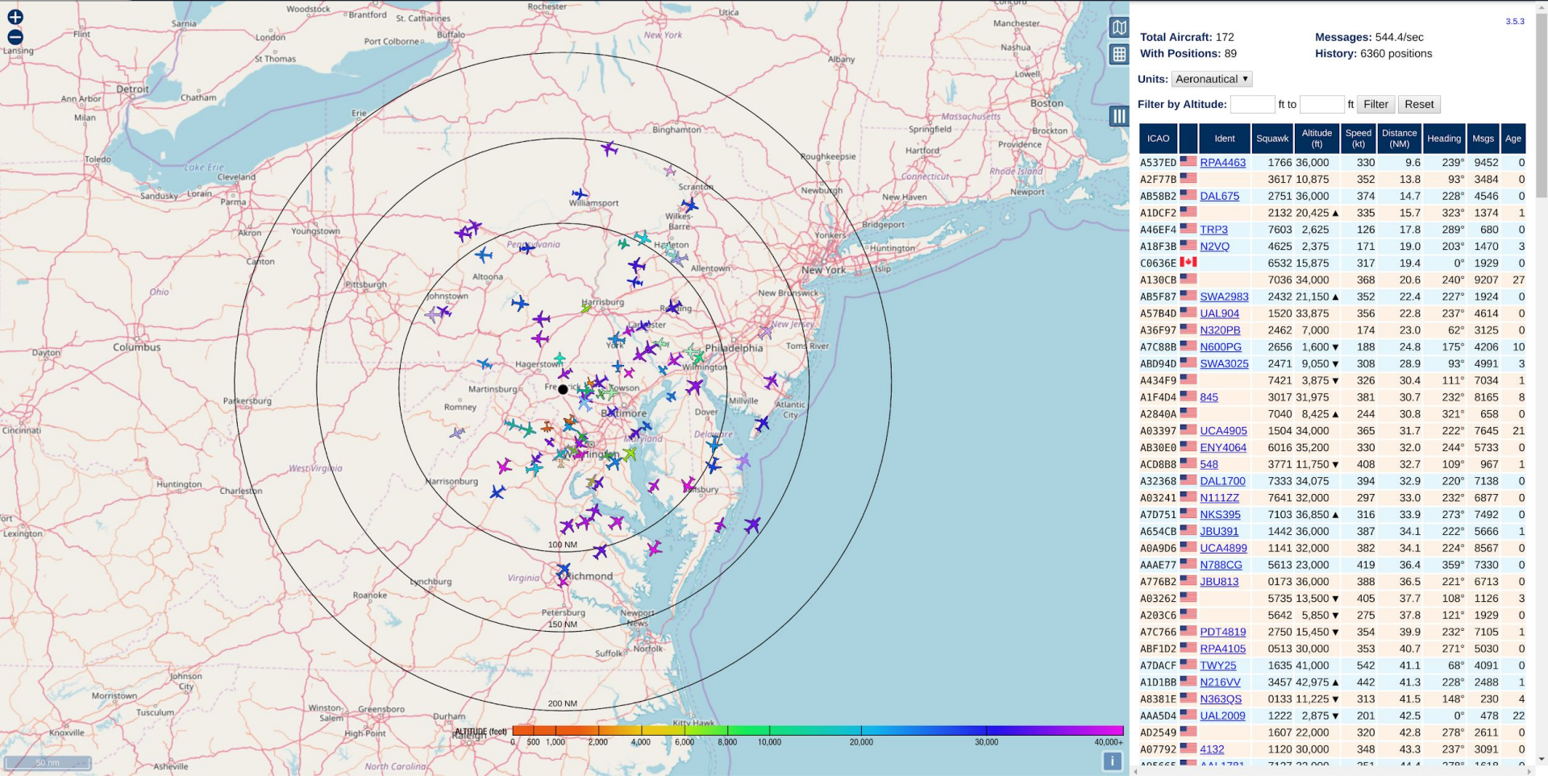
1090MHz Mode S Filter  
SMA-M SMA-F

<http://flightaware.com/adsb>

PCT-BPF-980-1150  
Made in Taiwan

CE





Total Aircraft: 172

With Positions: 89

Messages: 544.4/sec

History: 6360 positions

Units: Aeronautical ▾

ft to

ft

Filter

Reset

Filter by Altitude:

ft to

ft

Filter

Reset

ICAO	Ident	Squawk	Altitude (ft)	Speed (kt)	Distance (NM)	Heading	Msgs	Age
A537ED	<a href="#">RPA4463</a>	1766	36,000	330	9.6	239°	9452	0
A2F77B		3617	10,875	352	13.8	93°	3484	0
AB58B2	<a href="#">DAL675</a>	2751	36,000	374	14.7	228°	4546	0
A1DCF2		2132	20,425 ▲	335	15.7	323°	1374	1
A46EF4	<a href="#">TRP3</a>	7603	2,625	126	17.8	289°	680	0
A18F3B	<a href="#">N2VQ</a>	4625	2,375	171	19.0	203°	1470	3
C0636E	<a href="#">CZVQ</a>	6532	15,875	317	19.4	0°	1929	0
A130CB		7036	34,000	368	20.6	240°	9207	27
AB5F87	<a href="#">SWA2983</a>	2432	21,150 ▲	352	22.4	227°	1924	0
A57B4D	<a href="#">UAL904</a>	1520	33,875	356	22.8	237°	4614	0
A36F97	<a href="#">N320PB</a>	2462	7,000	174	23.0	62°	3125	0
A7C88B	<a href="#">N600PG</a>	2656	1,600 ▼	188	24.8	175°	4206	10
ABD94D	<a href="#">SWA3025</a>	2471	9,050 ▼	308	28.9	93°	4991	3
A434F9		7421	3,875 ▼	326	30.4	111°	7034	1
A1F4D4	<a href="#">845</a>	3017	31,975	381	30.7	232°	8165	8
A2840A		7040	8,425 ▲	244	30.8	321°	658	0
A03397	<a href="#">UCA4905</a>	1504	34,000	365	31.7	222°	7645	21
AB30E0	<a href="#">ENY4064</a>	6016	35,200	330	32.0	244°	5733	0
ACD88B	<a href="#">548</a>	3771	11,750 ▼	408	32.7	109°	967	1
A32368	<a href="#">DAL1700</a>	7333	34,075	394	32.9	220°	7138	0
A03241	<a href="#">N111ZZ</a>	7641	32,000	297	33.0	232°	6877	0
A7D751	<a href="#">NKS395</a>	7103	36,850 ▲	316	33.9	273°	7492	0
A654CB	<a href="#">JBU391</a>	1442	36,000	387	34.1	222°	5666	1
A0A9D6	<a href="#">UCA4899</a>	1141	32,000	382	34.1	224°	8567	0
AAAE77	<a href="#">N78BCG</a>	5613	23,000	419	36.4	359°	7330	0
A776B2	<a href="#">JBU813</a>	0173	36,000	388	36.5	221°	6713	0
A03262		5735	13,500 ▼	405	37.7	108°	1126	3
A203C6		5642	5,850 ▼	275	37.8	121°	1929	0
A7C766	<a href="#">PDT4819</a>	2750	15,450 ▼	354	39.9	232°	7105	1
ABF1D2	<a href="#">RPA4105</a>	0513	30,000	353	40.7	271°	5030	0
A7DACF	<a href="#">TWY25</a>	1635	41,000	542	41.1	68°	4091	0
A1D1BB	<a href="#">N216VV</a>	3457	42,975 ▲	442	41.3	228°	2488	1
AB381E	<a href="#">N363QS</a>	0133	11,225 ▼	313	41.5	148°	230	4
AAASD4	<a href="#">UAL2009</a>	1222	2,875 ▼	201	42.5	0°	478	22
AD2549		1607	22,000	320	42.8	278°	2611	0
A07792	<a href="#">4132</a>	1120	30,000	348	43.3	237°	3091	0
AAE5EE	<a href="#">AAL1701</a>	7127	32,000	351	44.4	278°	1618	0



# Parsing ASD-B

Demo show\_aircraft.py [https://github.com/python-frederick/talks/tree/master/2018-04-software-defined-radio/show\\_aircraft.py](https://github.com/python-frederick/talks/tree/master/2018-04-software-defined-radio/show_aircraft.py)

```
Number of aircraft seen: 3429
Average altitude seen: 27762
Highest speed seen: 634
Total number of messages recieved: 1284062075
Average number of messages recieved: 374471
```

Demo distance.py <https://github.com/python-frederick/talks/tree/master/2018-04-software-defined-radio/distance.py>

```
Positions found are messages with positions in them
-----
Positions found within 5 miles: 902
Positions found between 5 and 30 miles: 13540
Positions found between 30 and 100 miles: 96366
Positions found between 100 and 200 miles: 75330
Positions found past 200 miles: 295
```

# Python SDR Library Demo

<https://github.com/roger-/pyrtlsdr>

```
from rtlsdr import RtlSdr

sdr = RtlSdr()

# configure device
sdr.sample_rate = 2.048e6 # Hz
sdr.center_freq = 70e6    # Hz
sdr.freq_correction = 60  # PPM
sdr.gain = 'auto'

print(sdr.read_samples(512))
```

<https://github.com/python-frederick/talks/tree/master/2018-04-software-defined-radio>

# Demo Python FM Radio

```
git clone https://github.com/th0ma5w/rtl\_fm\_python
```

```
cd rtl_fm_python
```

```
virtualenv .venv
```

```
source .venv/bin/activate
```

```
pip install flask
```

```
./build
```

```
./start_web.sh
```

```
http://0.0.0.0:10100/
```