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Build, Tune, Explore with OpenWebRX+

Web-Connected Software-Defined Radio Made Simple

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DIG a Little Deeper with Data Decoders

OpenWebRX+ offers many different data decoders, and new decoders seem to appear every few versions, so we'll try out only the more popular ones for now.

The Underlying Modulation

Back in What Lies Beneath..., on page ?, when were customising our band plan file to deal with Slow Scan Television transmissions from the International Space Station, we came across the notion of an "underlying modulation" of the signal. On the station, SSTV pictures are converted to an audio stream and fed to an FM transmitter, so FM is the underlying modulation.

This idea pops up with other digital modes. For example, selecting ACARS, the Aircraft Communications Addressing and Reporting System,[15] decoder, also highlights the AM mode button, because ACARS data is converted to sound and transmitted using the underlying AM modulation, for compatability with Air Band voice transmissions.

With SSTV mode, the FM, LSB and USB demodulator buttons all get highlighted in yellow, because any of them could underlie the picture's audio stream. We need to select one of them, depending on the band we transmit on:

- LSB for Amateur Radio on HF frequencies below 10MHz
- USB for Amateur Radio HF frequencies above 10MHz, or non-Amateur transmissions anywhere on HF
- FM for VHF transmissions, such as on the ISS.

Try this: Decode ACARS Status Messages

Air travel is such a part of modern life that in most parts of the world airliners pass over our heads every hour of every day. If in doubt, visit Flightradar24[16] or one of the other popular flight tracking web sites.

The pilots and air traffic control talk a lot, and we can monitor those transmissions, but the aircraft themselves have a lot to to say too! Let's create a

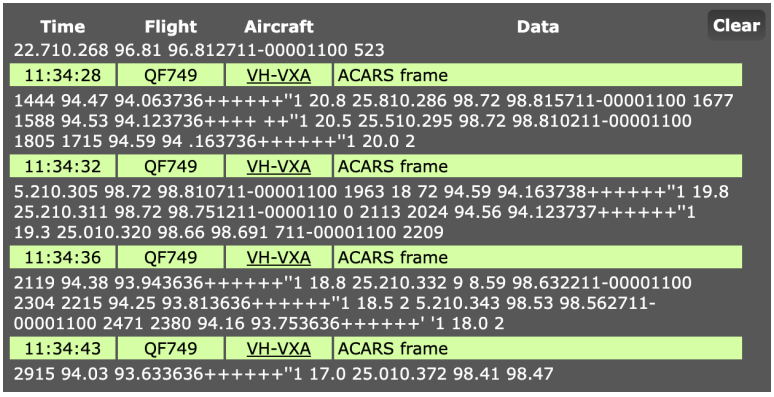
15. https://www.sigidwiki.com/wiki/ACARS
16. https://www.flightradar24.com/

band profile to capture the data that they transmit. Refer back to Try this: Create a Band Profile, on page ? if you'd like a refresher.

We'll use these settings:

- Profile name: ACARS test
- Center frequency: 131.55MHz, the World Primary ACARS channel
- Sample rate: 2.5 MS/s
- Initial frequency: blank to default to the Centre frequency
- Initial modulation: ACARS
- Tuning step: 10000 Hz

Click "Apply and save"; then go back to the receiver tab, and select "RTL-SDR ACARS test" from the band profile drop-down. Then wait for aircraft to fly overhead. After a while, ACARS messages should start appearing in a panel on the left side of the waterfall, like this:



Notice that in the third column, the aircraft registration, VH-VXA, is underlined: it's a browser link. We can click on it to see details of the aircraft and its current flight on the FlightAware[17] tracking site.

The rest of the ACARS data can be very cryptic, as above, though plain text messages can often be seen too. Here are a few more resources to help you understand this mode:

- What Is ACARS and How Airlines and Pilots Use It[18]
- ACARS Introduction[19]

17. https://www.flightaware.com/
18. https://www.aviationmatters.co/what-is-acars/
19. https://www.universal-radio.com/catalog/decoders/acarsweb.pdf

- and of course the Signal Identification Wiki[20]

Try this: Track Aircraft Movements with ADS-B

We can also follow the movements of the aircraft, often seeing flights that get filtered out of the commercial flight tracking web sites.

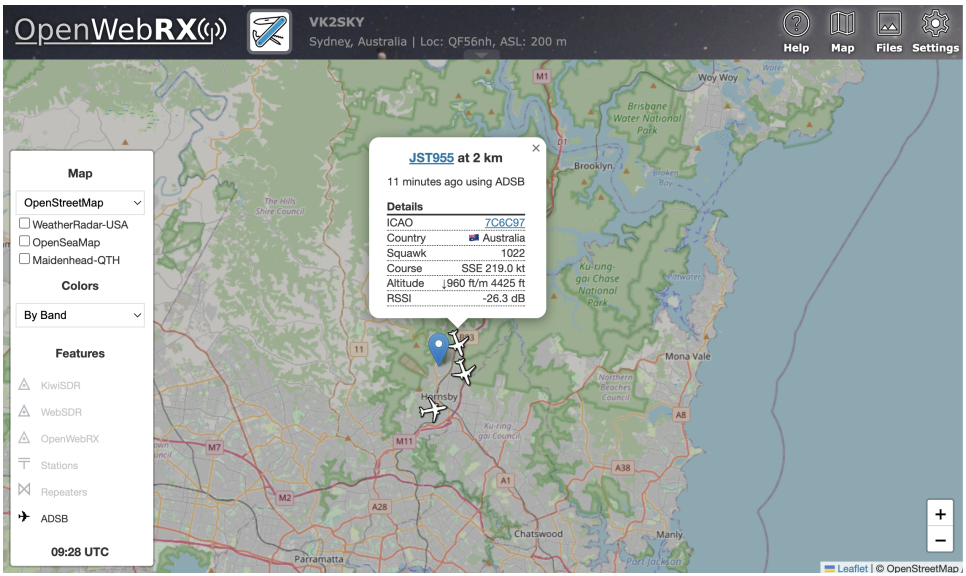
Let's create another profile, called ADS-B Test, with a "Center frequency" of 1090MHz and an "Initial modulation" of "ADSB". With this new profile active, a table builds up on screen with ADS-B[21] data transmitted by nearby aircraft:

Flight	Aircraft	Squawk	Dist	Alt (ft)	Speed (kt)	Signal
	7C68A8	1004	3 km	256↓ 4875	SSE 202	-27.8 dB
	7C6DB2	4073		896↓ 3550	SE 215	-34.3 dB
	7C6C92	1175	2 km	512↓ 5325	SSE 215	-28.2 dB
	896326	3442	3 km	640↓ 3425	E 228	-31.8 dB
	7C39FC	1060	4 km	1088↓ 5250	SSW 209	-31.9 dB
	7C495B	4276	3 km	576↓ 4100	SE 192	-32.4 dB

This table contains different information than ACARS mode:

- Flight: the flight number may or may not appear; if it does, click on it for more flight information;
- Aircraft: the ICAO (International Civil Aviation Organization) 24 bit identifier:[22]; this field can sometimes show the aircraft tail number instead. In either case, click on it for more aircraft information;
- Squawk: the aircraft's Squawk code, a four digit numeric code assigned by local Air Traffic Controllers to tag the aircraft on their radar screens. Codes 7500, 7600, and 7700 signify on board emergencies;[23]
- Dist: the aircraft's distance from our receiver: click to show the aircraft on a map;
- Alt (ft): ascent or descent rate, and altitude, both in feet;
- Speed (kt): aircraft heading and speed in knots;
- Signal: the relative signal strength.

20. https://www.sigidwiki.com/wiki/ACARS
21. https://www.sigidwiki.com/wiki/Automatic_Dependent_Surveillance-Broadcast_(ADS-B)
22. https://www.aerotransport.org/html/ICAO_hex_decode.html
23. https://www.youtube.com/watch?v=3BpIPDYHHIs



The Map display opens in a new browser tab, so we can see the movements of all detected aircraft on a display similar to commercial tracking web sites.

Later, in Visit the Linking Memorial, on page ?, we'll learn how to control what happens when we click on the links in this table.

Try this: Track Vehicles with APRS

The Automatic Packet Reporting System[24] is a tactical communications protocol over packet radio.[25] One popular use of APRS is to send vehicle positions, so we'll sometimes hear it referred to (incorrectly) as the Automatic *Position* Reporting System.

But APRS is also useful for communicating other situational information like weather station data, and hazards such as fires, floods, earthquakes etc. The popular web site, APRS.fi[26] displays information gathered by the APRS Internet Service (APRS-IS) from all over the world.

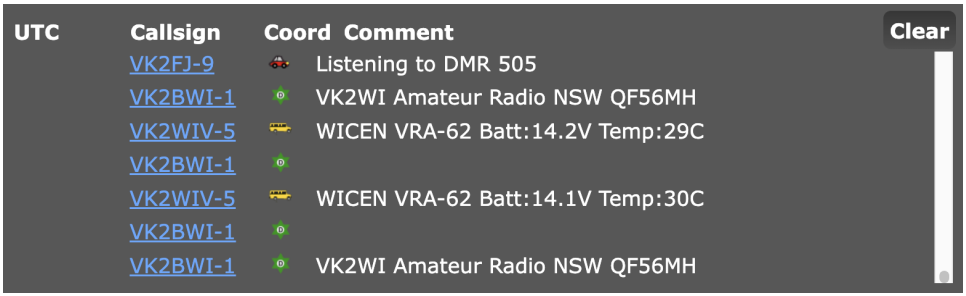
We can select a known packet radio frequency,[27] such as 145.175MHz, the Australia national APRS channel. If we checked and updated our regional band plan file in Think Regional, Act Local, on page ?, then the frequency

24. https://www.sigidwiki.com/wiki/APRS
25. https://www.sigidwiki.com/wiki/PACKET
26. https://aprs.fi/
27. https://www.sigidwiki.com/wiki/APRS

will have a green PACKET bookmark. We can just click it to open the packet/APRS decoder panel to monitor the traffic.

If there is no bookmark, simply tune to the frequency, and select Packet from the Digital Modes drop-down list.

In either case, a mini-waterfall and decoded data panel should pop up on the left side of the screen like this:



Notice that the call signs in the second column are clickable links; these take us to a web site with more info about the clicked station.

In What's So Great About Aggregators?, on page ? we'll see how to share this received information with the APRS Internet Service.

OpenWebRX+ supports many other digital decoders, which we can pick from the adjacent drop-down list. What each of them is used for is outside the scope of this book, but searching for the modes on the Signal Identification Wiki[28] will get you started with frequencies and identifying signals by ear.

Some of the better known modes in the list are:

- AIS: Automatic Identification System, like ACARS and ADSB, but for maritime traffic;
- Fax: facsimile images, typically weather service charts;
- FT4 and FT8: popular in the Amateur Radio community, these "weak signal" modes can be effective for very long distance communications at very low power levels; received signal reports are collected online by the PSK Reporter[29] aggregator;
- RTTY: Radioteletype is another data communications mode popular with Amateurs and news agencies. There are several RTTY selections on the list, common presets for different speeds and data formats;

28. https://www.sigidwiki.com/wiki/Signal_Identification_Guide
29. https://pskreporter.info/pskmap.html

- SSTV: Slow Scan Television is another mode popular with radio hams, to send still images over a voice channel; even the International Space Station sometimes sends SSTV. Received images are archived and can be accessed by clicking the Files button at the top of the screen;
- WSPR: pronounced “whisper”, or Weak Signal Propagation Reporter, is another popular mode. Reports of received WSPR signals also go to PSK Reporter. Some researchers believe that analysis of archive WSPR signal data could help pinpoint the final resting place of Malaysian Airlines flight MH-370,[30] but this has yet to be proven.

30. https://www.mh370search.com/category/wspr/