



# Jon Hudson SDRplay





## What is an SDR?

A radio communication system where components that have been traditionally implemented in hardware...

(e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.)

...are implemented by software on a PC or embedded system.



# What comprises an SDR?

- 1. Hardware to amplify, filter and digitize radio signals
- Software to provide advanced filtering, demodulation/decoding and control functions

# Top Ten Reasons to buy a decent SDR SDRplau's

- 1. True general coverage
- 2. Visualise multiple bands
  - Suddenly your eyes can do 1000X what previously only your ears could do, one signal at a time!
- 3. Filters (brick-wall envelopes... improving all the time with s/w upgrades)
- 4. Audio and IF Digital Signal Processing (DSP)
- 5. Harness the power of your existing PC
- 6. Multiple VFOs
- 7. Record large bandwidths
- 8. Record/playback of audio
- 9. Special purpose receiver:
  - WX satellites, radio astronomy aircraft monitoring, digital stations, TV, lonosounds! etc etc
- 10. Powerful RF lab tool (RF Power meter, spectrum analyser)

# Review of SDR receivers – what to consider:



- Frequency Range: The range of frequencies the SDR can tune to.
- **ADC Resolution:** Higher is better. More resolution means more dynamic range, less signal imaging, a lower noise floor, more sensitivity when strong signals are present and better ability to discern weak signals. Some SDR's give their resolution in ENOB which stands for effective number of bits.
- Instantaneous Bandwidth: The size of the real time RF chunk available.
- RX/TX: Can the radio receive and/or transmit.
- Preselectors: Analogue filters on the front end to help reduce out of band interference and imaging.
- Price

# Review of SDR receivers - The 8-bit dongle



#### R820T RTL2832U a.k.a RTL-SDR

Cost: \$10 - 22 USD

Frequency Range: approx. 24 MHz – 1766 MHz

ADC Resolution: 8 Bits

Max Bandwidth: 3.2 MHz / 2.4 or 2.8 MHz max stable.

TX/RX: RX Only
Preselectors: None



The RTL-SDR is still the best 'bang for your buck' software defined radio out there. While it was never designed to be used as a general purpose SDR in the first place, its performance is still surprisingly good. If you're on a budget or are just starting out with SDR or radio this is the one to get. (Link)

source: rtl-sdr.com

## Cheap and cheerful!

## Review of SDR receivers High-end example - The Perseus:



#### Perseus SDR

Cost: \$1,100 USD

Frequency Range: 10 kHz - 40 MHz

ADC Resolution: 14 Bits Max Bandwidth: 1.6 MHz

TX/RX: RX Only

Preselectors: Yes 10 switched

Many owners of this SDR claim that it is one of the lowest noise SDRs available and that it is

great for DXing. (Link)



source: rtl-sdr.com

# Expensive and capable!

## Which RSP for me?



All RSPs from SDRplay are Software Defined Radios which can turn a PC into a general coverage receiver or spectrum analyser spanning VLF (1kHz) through to Microwaves (2GHz).

With dual 12 bit A/D front end converters and very sharp 5th order Chebyshev filters, the RSP allows processing of a 10MHz slice of radio spectrum all in one go.

- RSP1 has single antenna input, low-price.
- RSP2 adds:
  - Multiple inputs (for antenna switching)
  - More advanced filters
  - Metalised screening inside case
  - AM/FM Broadcast Band Filters
  - Bias-T availabe for powered antennae (5V)
  - TCXO (for greater accuracy)
  - Reference Oscillator In/Out (for even greater accuracy or synchronisation)
- RSP2pro is the same specification as RSP2 but in a rugged metal case

  www.sdrplav.com

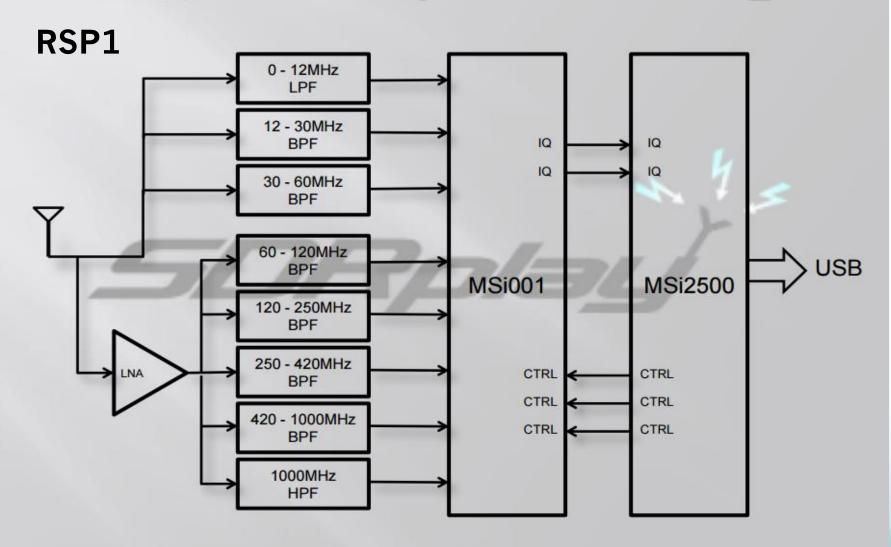


## The story of SDRplay

Once upon a time.....

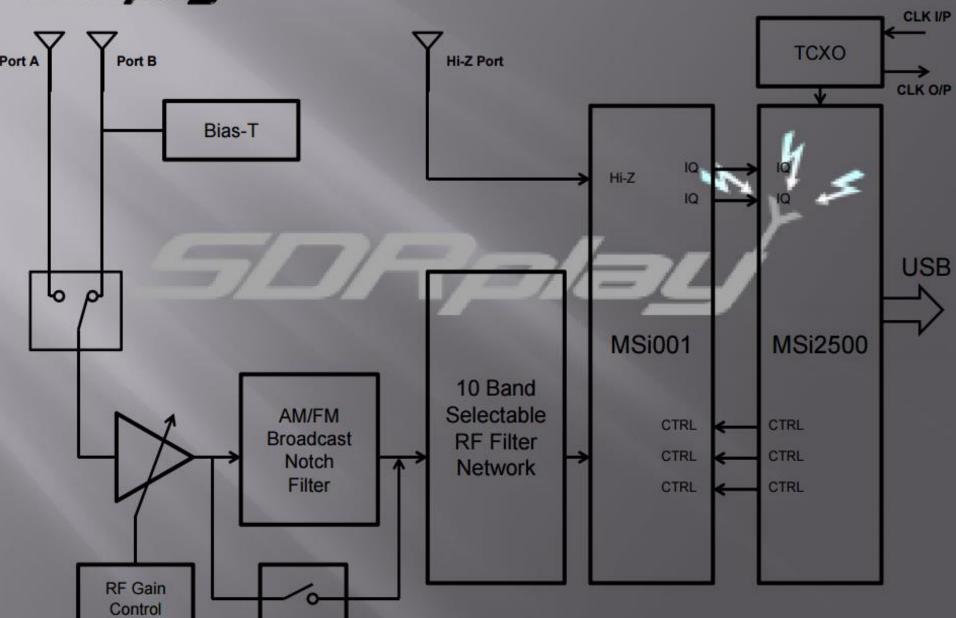


#### Conceptual Block Diagram





#### **RSP2 Conceptual Block Diagram**



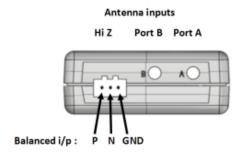


KEY FEATURES	RSP1	RSP2	RSP2pro	
Continuous coverage from 1 kHz to 2 GHz (RSP1 from 10 kHz)	✓	✓	✓	
Up to 10 MHz visible bandwidth	✓	✓	✓	
Powers over the USB cable with a simple type B socket	✓	✓	✓	
High Performance ADC silicon technology (not another 8 bit dongle!)	✓	✓	✓	
8 built in front-end pre-selection filters	✓			
10 high-selectivity, built in front-end preselection filters		✓	✓	
Software selectable (On/Off) Low Noise Preamplifier	✓			
Software selectable multi-level Low Noise Preamplifier		✓	✓	
SDRuno—World Class Windows SDR software	✓	✓	✓	
Open API for new apps development	✓	✓	✓	
Single SMA antenna socket	✓			
2 x SMA Software Selectable Antenna Inputs		✓	✓	
1 x High Impedance Input for long wire antennas		✓	✓	
Software selectable MW /FM notch filters		✓	✓	
Highly stable 0.5PPM TCXO trimmable to 0.01PPM		✓	✓	
24MHz Reference clock input / output connections		✓	✓	
4.7V Bias-T (Port B only)		✓	✓	
Robust and strong plastic case	✓	✓		
RF shielding layer inside case		<b>✓</b>		
Rugged metal case			✓	



## Antenna ports on RSP2

#### RSP2 - Guide to using the High Z Port



#### **Background information**

Ports A and B are intended as general purpose RF ports, but the Hi-Z port is really intended as the prime port for HF and below and has been optimised as such. This is one of the major changes in thinking from the RSP1. The reasoning here is that you seldom get a single antenna that gives optimised performance from VLF to UHF, and so the majority of people will tend to use separate antennas for HF and VHF/UHF. We chose a 1 K ohm impedance for this port, to simplify the connection to a random wire antenna which is the antenna of choice for HF for many of our customers and is also a good choice for frequencies below 1 MHz. Because of the long wavelengths involved at HF, this port also works well for 50 ohm antennas as long as the feed cable is not excessively long, but for long feed cables, you can simply use a reverse 9:1 balun between the Hi-Z input and the end of the feed cable to achieve an adequate match to 50 ohms for this purpose. When operating below 1 MHz (down to VLF), though, the direct connection will work best, even with a 50 ohm feed as the high impedance termination will deliver the highest terminal voltage at the input to the RSP2 and reflections will really not be a problem because the wavelength is so long.

# High Z input (1kHz to 30 MHz only) 50Rplau



#### **Practical connection options**

In summary, the 'High-Z' port is ideal for operation from 1kHz to 30 MHz and has been designed to have an input impedance of  $1k\Omega$ 

This is ideal for connecting a longwire antenna directly to the P terminal and a grounding arrangement to the N and GND terminals (see below):

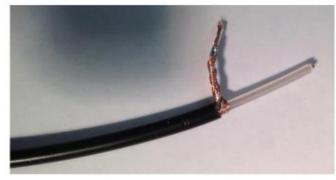


A balanced ladder line feeder (typically 450 ohms) will also be very effective when connected across the P and N terminals (see below):





Also, in practice a short length of coax can be terminated directly to the outer terminal connections of the supplied CTB9208/3 plug, without significant loss of signal. Losses due to mismatch are small if the length of the coax is kept well below \(^1/4\) wavelength at the frequency of interest.



Connect the coax inner to the P terminal and the outer to the N and GND terminals as in this example which is using a short length of RG58



The short length of coax can be terminated with a suitable flying socket (e.g. BNC for use with active loop antennas or SO239 for connection to other existing LF antenna choices.

If terminating the short length of coax with a flying BNC socket presents difficulties, one solution is to buy a short cable or 'pigtail' with the desired socket at one end and to cut off the unwanted plug. The coax can then be connected direct to the green plug.

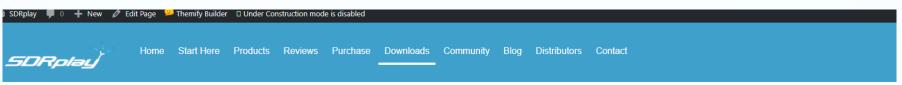


# If you have long coax AND need to SDRplage use the same antenna above and below 1.5 MHz v

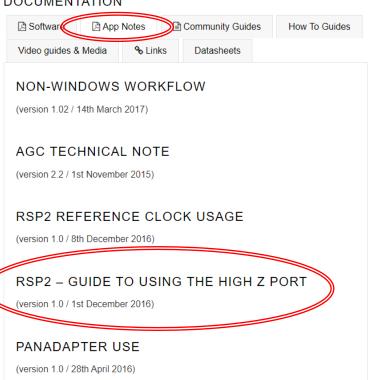
For connecting to longer lengths of coax, adding a low cost 9:1 balun (such as the Nooelec balun shown below ) will produce very good results and improved SNR:







#### SOFTWARE DOCUMENTATION **Windows** ∆ Linux x86 8 Raspberry Pi ☑ Software Android ARM64 SDRUNO - VERSION 1.13 (RSP1/RSP2) Includes hardware driver HDSDR - VERSION 2.76 (RSP1/RSP2) Includes hardware driver/API/EXTIO plugin **EXTIO PLUGINS - VERSION 1.0** (RSP1/RSP2) Includes hardware driver/API SDR-CONSOLE - V2.3 2760 (RSP1/RSP2) Includes hardware driver/API SDR-CONSOLE - V3.0 PREVIEW 5A (RSP1/RSP2) Includes hardware driver/API

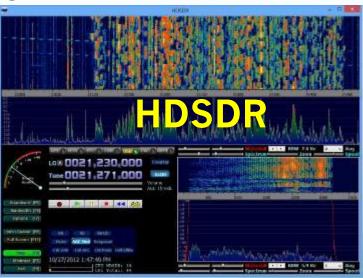


#### Software



- Multi-platform support for Windows, Mac, Linux, Android, Raspberry Pi 2/3
- SDRuno Windows SDR s/w (based on Studio1 which cost \$179) provided free of charge
- ExtIO based plugin ensures compatibility with growing number of packages
- Supports CubicSDR for MAC users
- Software upgradeable for future standards
- API provided to allow demodulator or application development
- Works well with 3<sup>rd</sup> Party *free* software including:



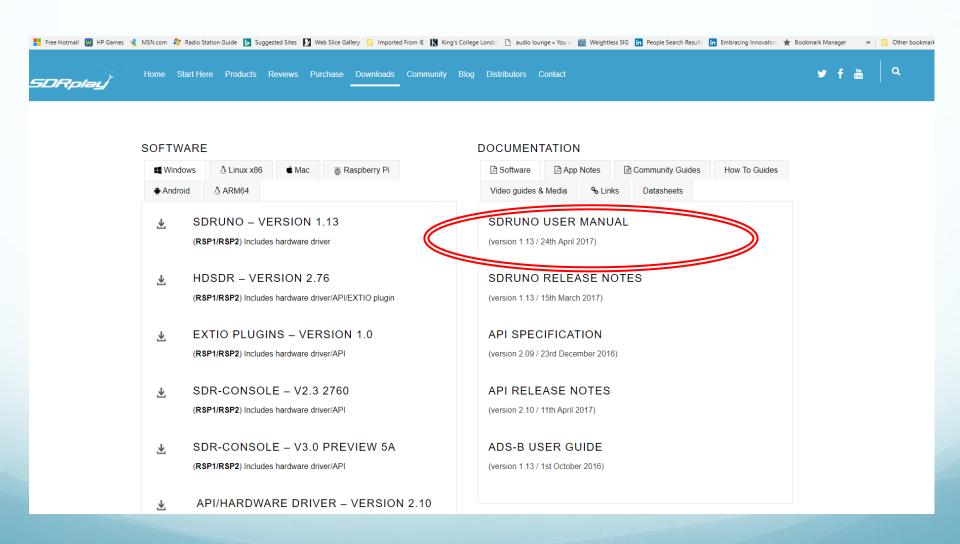




#### **SDRuno**

- SDRuno provides a rugged and flexible, high performance SDR receiver capability, featuring:
  - Multiple 'Virtual Receivers' which allow for simultaneous reception and demodulation of different types of signals within the same receiver bandwidth
  - A selectivity filter with an ultimate rejection greater than 140 dB
  - A unique distortion-free double stage AGC with fully adjustable parameters
  - Multiple notch filters with BW adjustable down to 1 Hz, Notch Lock feature
  - A unique synchronous AM mode with selectable/adjustable sidebands, dedicated PLL input filter, and selectable PLL time constants





#### 2.2 Main window



(Left: RSP-1 Right: RSP-2/2PRO (RSP2/RSP2pro has antenna port and MW/FM notch filter selection options)

The first time you run SDRuno only this window is shown. The main window is the control centre of a SDRuno instance. Here you can open the VRX windows, enable/disable VRX, create and manage workspaces, change the instance settings, select the input source and sample rate (where applicable), open the recorder window etc. It can be closed or minimized to the task bar.



#### 2.3 Virtual Receiver (VRX)



A VRX is a receiver implemented in software; each VRX takes the signal from the input device, processes it and outputs the demodulated signal to an output device of your choice (currently only WME devices are supported). For the RSP, SDRuno can create and run multiple VRX inside the same application instance. When you run an instance of SDRuno, one VRX is always created: it is the "master" VRX or VRX #0. VRX #0 has some peculiarities:

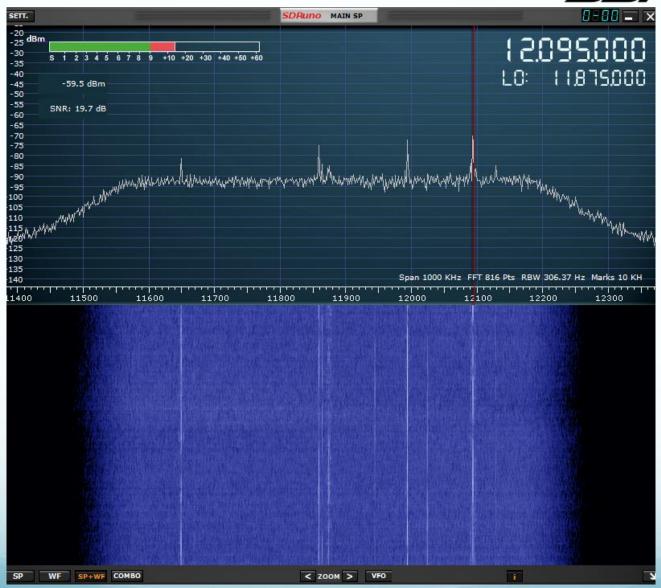
- can't be disabled or deleted
- it is the only VRX that can change the LO of the external hardware
- it is (currently) the only working VRX when using the ASIO driver



(Left: RSP-1 Right: RSP-2/2PRO)

A VRX includes four windows: SP1, SP2, RX Control & RX EX Control.

SDRplay







SP2 or "Aux spectrum" window: it shows the spectrum in the down-converted bandwidth.
Here you can modify the selectivity filter, place notches etc.

This window is resizable and its settings are stored and recalled together with the relative VRX.

Also it can be closed or minimized to the task bar.



RX Control is the VRX control center: here you can set the VRX output device, frequency, receiving mode and many more parameters. Its settings are stored and recalled together with the relative VRX and it can be closed or minimized to the task bar.





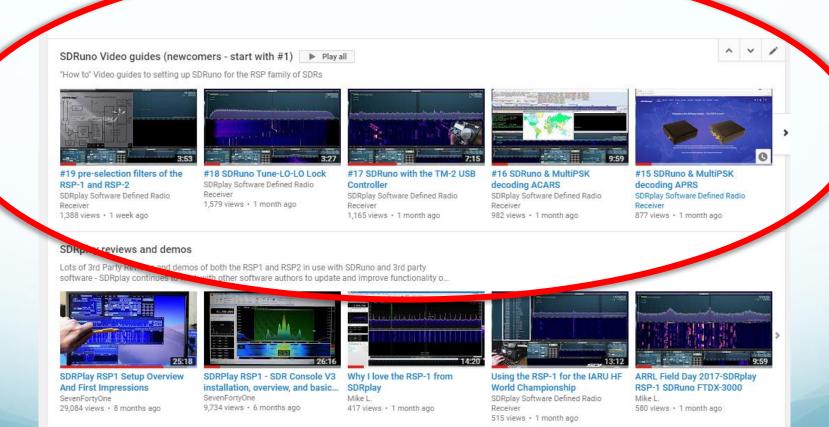
**RX EX Control** groups additional controls for the VRX that are (generally) less frequently used. The purpose of this separation is to spare screen space when possible. Here you have access to all the parameters relative to notches, noise blanker, noise reduction, soft filter, SNR and more. These settings are stored and recalled together with the relative VRX and it can be closed or minimized to the task bar.



Note: Each VRX stores and recall its own settings.

# YouTube Video guides: SDRplay 'channel'







	Q		
	SDRplay Software Defined Radio Receiver	Videos Playlists Channels Dis	scussion About
	TDX 3000, Omnirig & LOG4OM Logger In Action ware Defined Radio Receiver		11:04
	TDX 3000, Omnirig & LOG4OM Logger ware Defined Radio Receiver		12:10
	M Broadcast RDS data decoding ware Defined Radio Receiver		7:05
	tching filter function ware Defined Radio Receiver		4:17
	adapter with the SDRplay RSP ware Defined Radio Receiver		7:44
	for accurate RF power Measurement ware Defined Radio Receiver		7:31
	guide for the RSP2 ware Defined Radio Receiver		19:11
SDRuno Video o Gunpiay Sorti	guide for the RSP1 ware Defined radio res		13:39
	sic layout and settings ware Defined Radio Receiver		6:26
17 by SDRplay Soft	ware Defined Radio Receiver		2:54
	C 2of 2 (showing MultiPSK ) ware Defined Radio Receiver		3:50

#### **SDRuno**

# SDRplay)

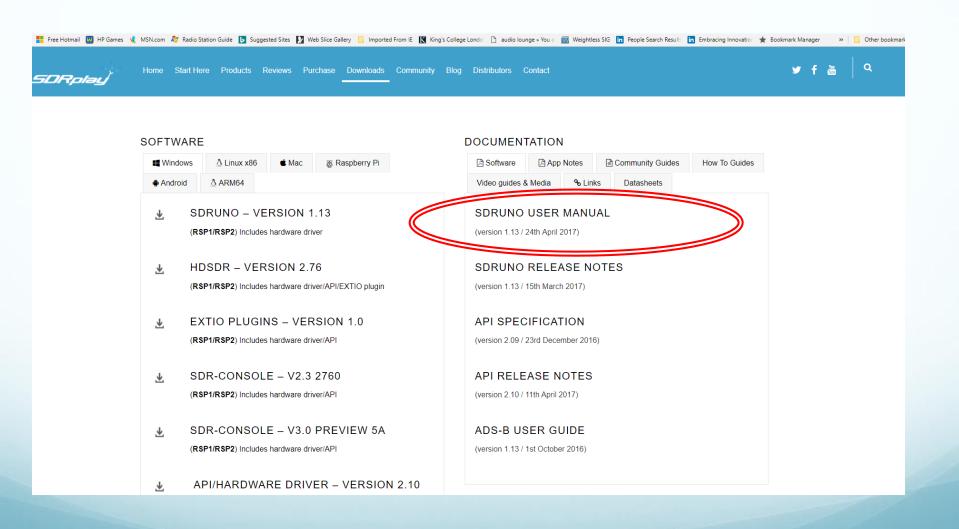
## example screenshots



User Group:

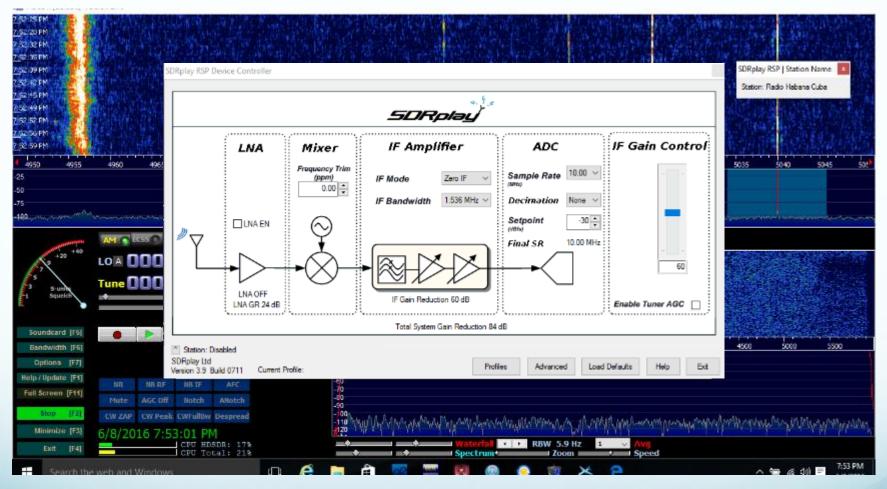
https://www.facebook.com/groups/sdruno/





## EXTIO Plug-in

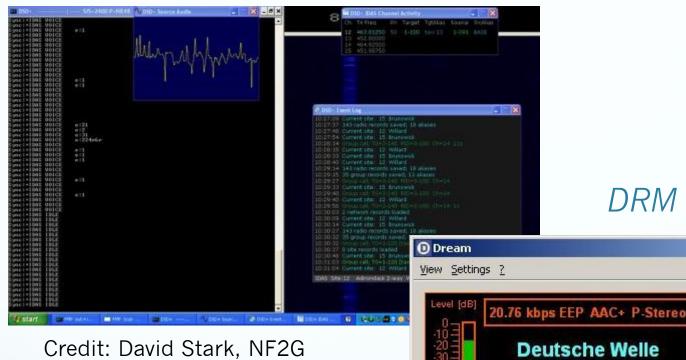




- Set RSP settings for gain, LNA, sample rate etc.
- Can be updated for future enhancements

#### Digital Speech Decoding with DSD+





DRM with Dream

DSD+:

http://www.dsdplus.com

Dream:

https://sourceforge.net/projects/drm/

Deutsche Welle
Information
English

Deutsche Welle | AAC+ P-Stereo (20,76 kbps) + MM (0.20 kbps)

Deutsche Welle | Data: Journaline (0.20 kbps)

# Add-on Software - Satellite working





# NOAA Weather satellite (137 MHz)

*SDRplay* 

- Wxtoimg (RSP1)



Credit: Jeff Broughton, WB8RJY

User pictures from the facebook group: <a href="https://www.facebook.com/groups/sdrplay/">www.facebook.com/groups/sdrplay/</a>

Wxtoimg:

http://www.wxtoimg.com



Credit: Sefi Merkel

Hi Resolution satellite images

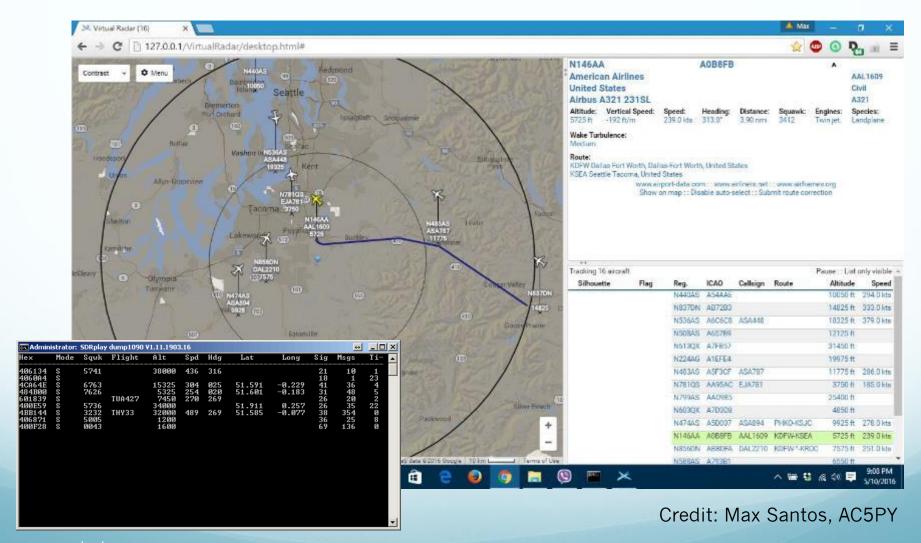
*SDRplay* 

(1.7GHz) RSP2

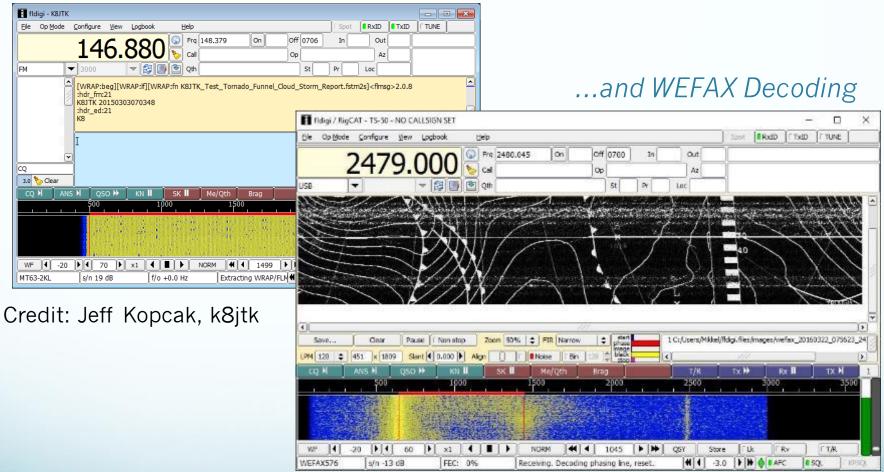


# ADS-B decoding example using Dump1090 and VRS





# FLdigi NBEMS (Narrow Band Emergency Messaging System)



Fldigi: <a href="http://www.w1hkj.com">http://www.w1hkj.com</a>

Credit: Erik Mikkel Wied

Doubles as a new piece of RF lab kit: An RF Power meter



## Remote access using SDR-Console SDR-L www.SDRSpace.com/Version-2



SDRSpace.com	Home  Home	Versio		Version 2	SDR-Radio	.Com	Q
1	and preamplifier is allowed only to sysop Use user/password guest/guest.		1011110010	tadi.dooon took o			
ON5UM-FiFisdr- K9AY single loop Version 2.3 build 2729	Cannot access 81.83.126.1 port 7999. Location is Wilrijk, Antwerpen, Belgium.	Idle	ON5UM 2016	M / OP5T- FiFi SDR	1-		
PA3ANG, Zwolle Version 2.3 build 2381	Cannot access 83.162.238.4 port 7999. Location is JO32am. Website is pa3ang.nl . Antenna is ALA1530+. Afedri 100kHz - 60MHz	Idle	Afedri-L	_AN			
RZ3DVP (MSK) Version 2.3 build 2760	Location is Nakhabino, Moscow region, Russia. Website is <a href="www.rz3dvp.ru">www.rz3dvp.ru</a> . Antenna is Wellbrook ALA1530. On balcony of the 10th floor house with big noise.	Idle	FDM-S1	1 (HF)			
RZ3DVP (MSK2) Version 2.3 build 2760	Location is Khimki, Moscow region, Russia. Website is <a href="www.rz3dvp.ru">www.rz3dvp.ru</a> . Antenna is Wellbrook ALA330S, about 3m up of the ground.	Idle	Afedri-L	_AN			
Sasta USB Versi: So build 2381	Location is Kiikoinen/Sastamala Finland. Website is <a href="http://www.kolumbus.fi/~kb2826/oh2mee/english.html">http://www.kolumbus.fi/~kb2826/oh2mee/english.html</a> . Antenna is G5RV.	Idle	AFEDR	(I-SDIN-Not Audio			
SDRplay in UK Version 2.3 build 2760	Location is central England, IO92RF. Website is <a href="www.sdrplay.com">www.sdrplay.com</a> . Antenna is G5RV on Antenna Port A. This is an RSP2 with10 MHz visible bandwidth. Off air 1945 each day for approximately one hour. Username sdrplay and password rsp.	Idle	SDRpla	ay RSP2			
SDRPlay-LI Version 2.3 build 2381	Cannot access 21.195.194.227 port 7000 Location is Stamford, Connecticut, United States.	raie	SDRpla	ay			
SDRPlay, Lohja Finland Version 2.3 build 2760	Cannot access 93.106.201.240 port 7999. Location is Finland.	Idle	SDRpla	ay			
Sever Crates Version 2.3 build 2274	Cannot access 217.118.79.27 port 7995. Location is Raduga. Novosibirskaya obl. Russia. Website is <u>SDR-Elad SW2.hldns.ru</u> . Antenna is Dipole 40m. Welcome to my SDR radio	Idle	DVB-T	dongle			
SK3GA - SDR - AFEDRI-net Version 2.3 build 2760	Location is JP81NR - Hudiksvall, Sweden. Website is <a href="http://sk3ga.se">http://sk3ga.se</a> . Antenna is Loop 4x20 m. Welcome to SK3GA SDR-server!	Idle	Afedri (2	(2), DVB-T dongle			
SM2AYE Ostvik 2x19,5 dipol Version 2.3 build 2381	Location is North part of Sweden. Website is <a href="https://www.sm2aye.com">www.sm2aye.com</a> . Antenna is 2 x 19,5 m dipole. Hej Leif	Idle	SDRpla	ay			

# Great reviews, demos and huge support community



- Go to www.sdrplay.com and click on 'Reviews'
- Go to Youtube and search SDRplay channel
- Go to www.sdrplay.com and click on 'Community'
- Search for 'SDRplay' within Facebook Groups and join 6000+ Facebook community pioneered by Paul NN4F









# Thank you Demos now until 12.30 Luentosali 1 (EDXC Room)



# A few additional RSPs available today:

RSP1 90 Euros

RSP2 155 Euros

RSP2pro 175 Euros

or give email address to receive offer email and purchasing link (10% discount of regular GBP price + shipping)