
SETT.
SDRuno MAIN SP
14.320.000
SDRplay
September 2016
SP
WF
SP+WF
COMBO
ZOOM
TIME
MIX
FREQ.
SETT.
MA
SDRuno MAIN
OPT
SR
REC PANEL
In SR: 250000
SP1
SP2
RX
ADD VRX
DEL VRX
LO LOCK
LNA
AGC
ADV
PERF
STOP
GR
BW 0.200 M
MEM PAN
6/24/2016 12:45:54 PM
St1: 11%
Sys: 20%
IFGR: 49dB
T.GR: 49dB
Err.: 0
favourite
SETT.
RDSW
EXW
SDRuno RX CONTROL
RSYN1
MCTR
TCTR
DEEM 50u
STEP:
500 Hz
14.320.000
-55.2 dBm
RMS
MODE
AM
SAM
FM
CW
DSB
LSB
USB
USER
VFO - QM
FM MODE
CW OP
FILTER
NB
NOTCH
VFO A
A > B
NFM
MFM
CWPK
2000
2200
NBW
NCH1
VFO B
B > A
WFM
SWFM
ZAP
2400
2700
NBN
NCH2
QMS
QMR
CWAFC
NR
NBOFF
NCH3
NCH4
-84 dB
AGC
SQLC
OFF
FAST
NCHL
MUTE
MED
SLOW
160
80
40
30
20
17
15
12
10
2
Clear
Enter

Contents

1. What is an SDR?
2. Why do I want one?
3. Review of SDR solutions
4. SDR software
   - Basic packages
   - Add-ons
5. Panadapters
6. Where to find further information

What is an SDR?

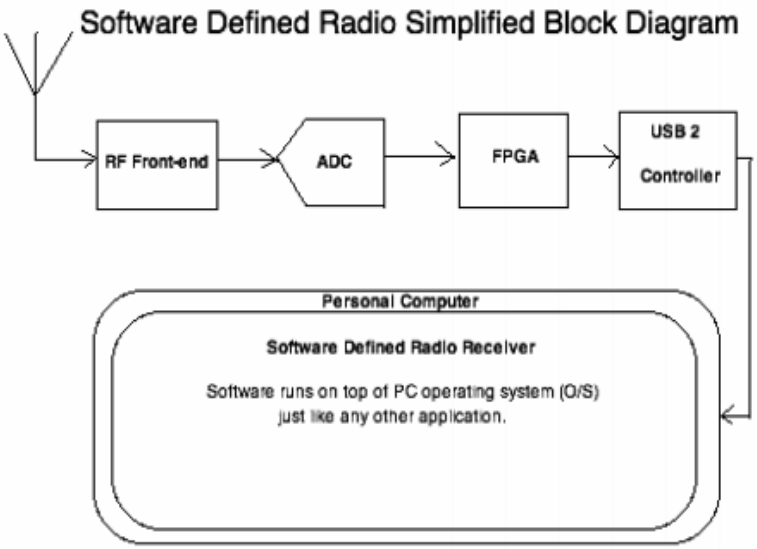
A radio communication system where components that have been traditionally implemented in hardware…

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

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

Simplified SDR Receiver

(courtesy K4FMH.com)



- First, as with any other radio receiver, the antenna is connected to the SDR's "hardware" RF front-end. Its purpose is to..
  - Interface physically with the antenna for optimum RF energy transfer to the receiver.
  - Serve as low-pass or band-pass filter
  - Amplify the signals.
  - Convert the frequency of signals down to an intermediate frequency (IF) suitable for the ADC stage that follows.
- The departure from a conventional receiver starts here.

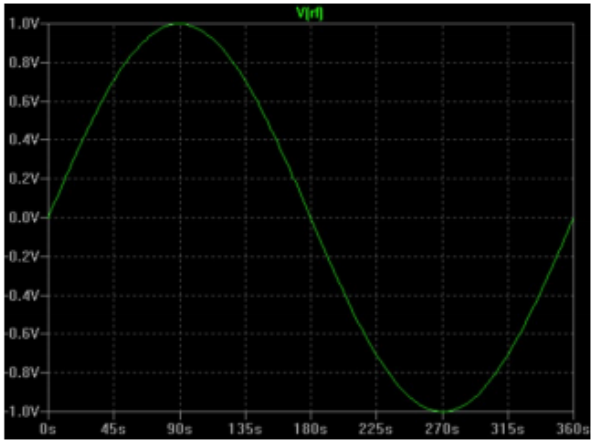
- The amplified IF analog signal produced by the RF front-end is fed to an analog-to-digital-converter (ADC).
- The digital output of the ADC is then fed to a Field Programmable Gate Array (FPGA).
- The FPGA extracts the "I" and "Q" components of the signal.
- The "I" and "Q" signal pair is called a complex signal. It is produced in the FPGA by two frequency mixers having a phase shift of 90° between them.
- The I/Q output of the FPGA is then fed to the USB 2 programmable controller.
- The software defined radio, running on the PC, takes its I/Q data from the USB 2 controller. The SDR software...

  ... extracts the information from the signal for audio output.

  ... displays a graphical user interface giving the user access to control functions and a variety of selectable visual outputs.
- All of the signal demodulation and spectral functions are done by the SDR software on your PC.
- Most SDR ham radio receiver implementations will usually (at least) support AM, WFM, USB, LSB, N-FM, DSB and CW with fully adjustable DSP filter bandwidths ... down to below 1 Hz in some cases!

What's all this IQ stuff?

- Simply put it's just a quadrature (vector) representation of the sampled RF waveform
- This makes it easier for the existing chipset in your PC (sound and graphics use vector processors) to demodulate the signals of interest.



Source: http://www.tek.com/blog/what%E2%80%99s-your-iq-%E2%80%93-about-quadrature-signals%E2%80%A6

Why do I want one? (Top Ten list!)

1. True general coverage
2. Work one frequency and still monitor the band
   - Panadapter (regular vision vs rifle scope!)
3. Filters! (brick-wall envelopes… software updatability)
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, aircraft monitoring, digital stations, TV, Ionosounds! etc etc
10. **Can you ever have too many receivers?** 😀

Review of SDR receivers:

The Catalyst for Hams: RTL Dongle

- see http://www.rtl-sdr.com
- Designed for mobile TV reception outside the US (esp. Europe)
- Italian ham realized that the hardware was broadband--very broadband--so he wrote a new firmware that can be used with the TV dongle and a PC to yield Software Defined Radio Reception
- Cheap! Began around $100 but now down to $10 or less for some models

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**

The story of SDRplay

Once upon a time……

Review of SDR receivers

Comparisons with other common Wideband Commercial Software Defined Radios

SDR	Tune Low (MHz)	Tune Max (MHz)	RX Bandwidth (MHz)	ADC Resolution (Bits)	Transmit? (Yes/No)	Price ($USD)
RTL-SDR (R820T)	24	1766	3.2	8	No	~20
Funcube Pro+	0.15 410	260 2050	0.192	16	No	~200
Airspy	24	1800	10	12	No	199
SDRPlay	0.01	2000	10	12	No	149
HackRF	30	6000	20	8	Yes	299
BladeRF	300	3800	40	12	Yes	400 & 650
USRP 1	DC	6000	64	12	Yes	700

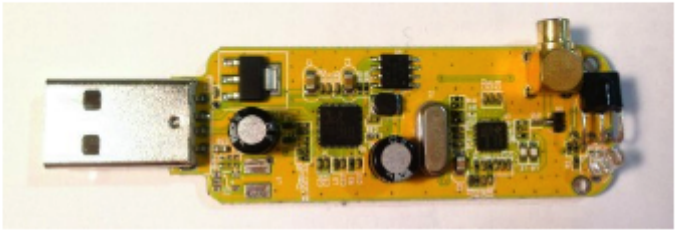
For those who just want to receive a wide range of signals, we recommend the Airspy or SDRPlay as an upgrade to the RTL-SDR. If you are mainly interested in narrowband signals the Funcube Dongle Pro+ may be worth considering.

source: rtl-sdr.com

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

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

The RSP

The RSP (Radio Spectrum Processor) from SDRplay is a Software Defined Radio which can turn a PC into a general coverage receiver or spectrum analyser spanning VLF (10kHz) 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 10 MHz slice of radio spectrum all in one go.

Great NF, Great sensitivity, Great selectivity, Great price!

Ham Radio Science says…

Ham Radio Science

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Best SDR Radios of 2015 and 2016 (so far)

January 7, 2016 | Featured | 9 Comments

Looking back over some SDR Radio products that were reviewed here and some that were not. Here is our picks of the

Recent | Comments | Archives

SDRplay announces the acquisition of Studio 1 SDR software

6:05 pm By HRS Staff

28/April/2016, Wakefield UK:

SDRplay announces the acquisition of Studio 1 SDR software

Ham Radio Science also says…

Best "Bang For the Buck" – SDRPlay – $149

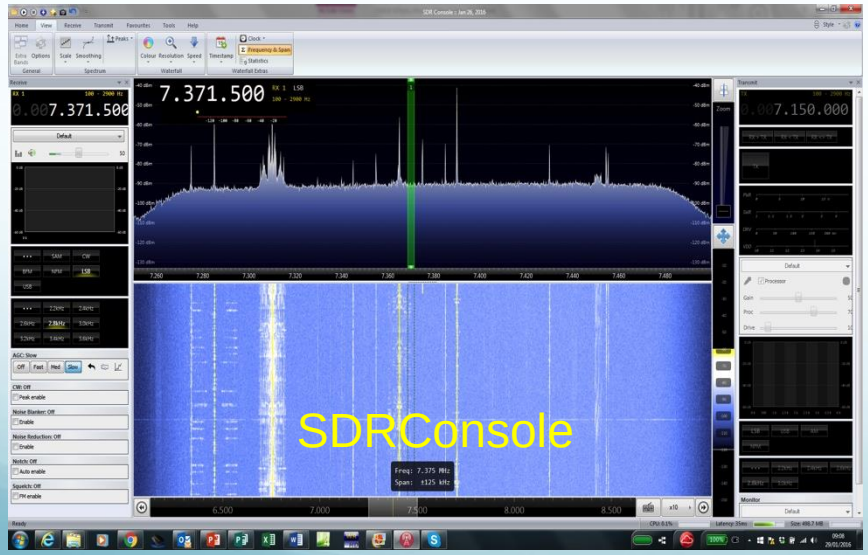
The recently reviewed SDRPlay is the perfect step up from the RTL-Dongles. Matter of fact if you decide to skip the dongle phase you may want to go straight to this one. With very wide coverage from 0.1MHz to 2GHz you can listen to just about anything. The very wide bandwidth up to 8MHz will you to view large swaths of frequencies at once in the SDR software client or even set up multiple VFO's to monitor several frequencies at once. Easy to set up with free SDR software such as HDSDR, SDR-Console, and CubicSDR. Great support from the SDRPlay team is included. This one is a winner.
SDRPlay Website

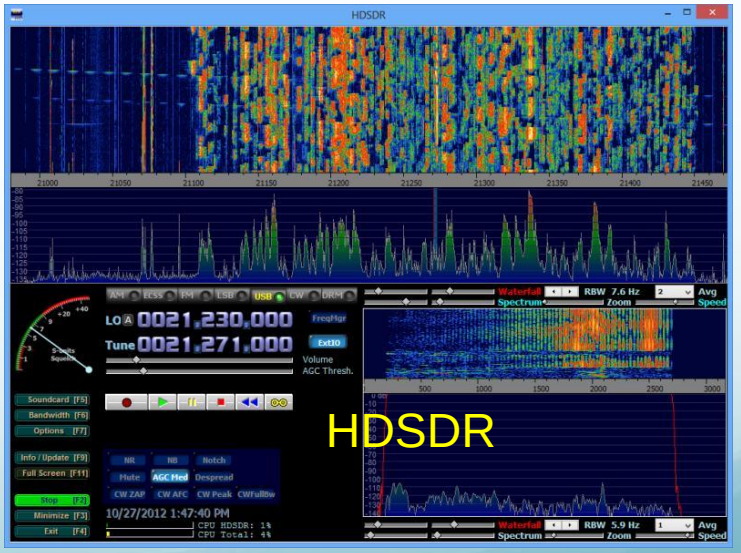
SDRPlay Wideband SDR

www.sdrplay.com

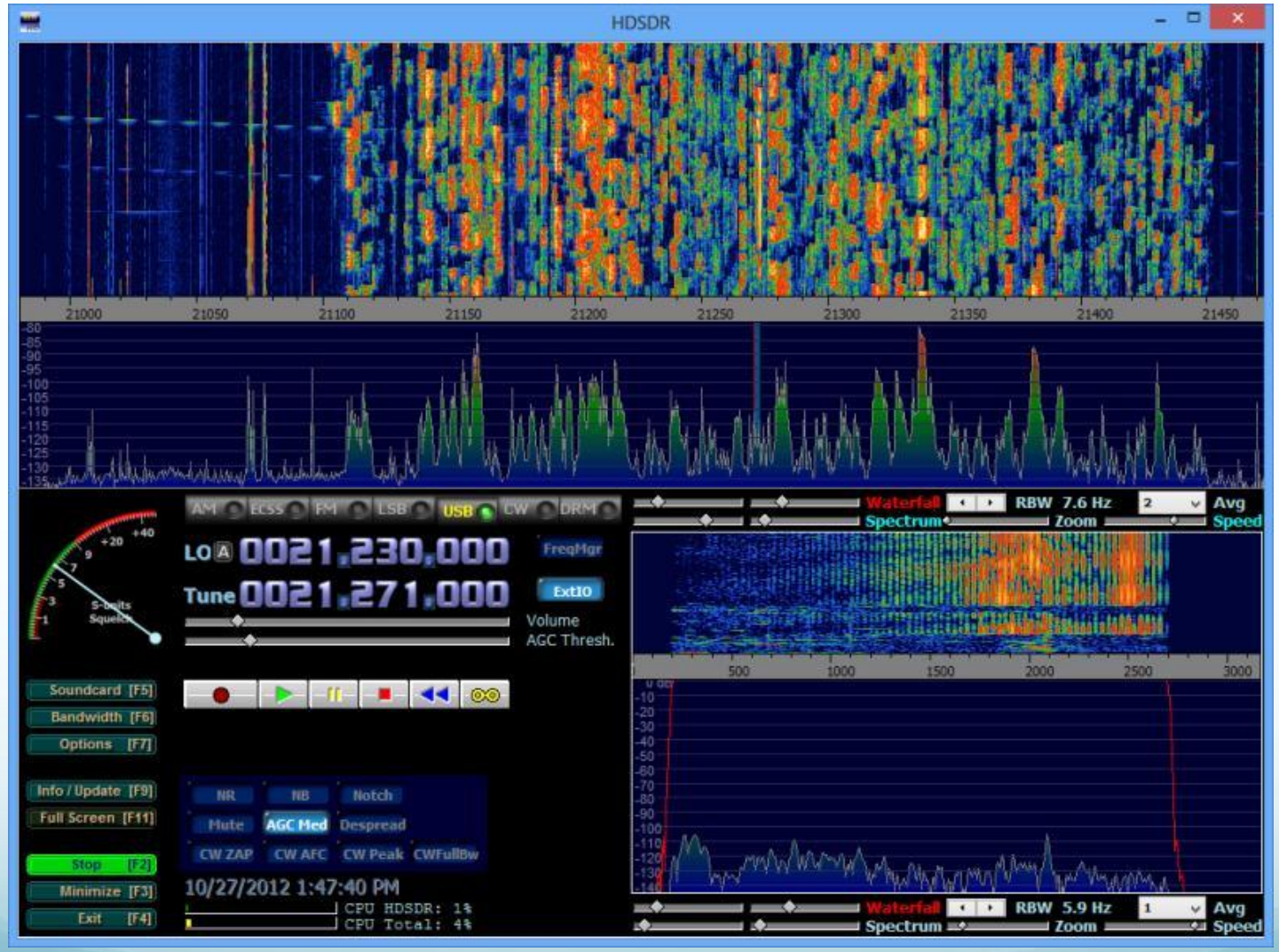
Software

- Multi-platform support for Windows, Mac, Linux, Android, Raspberry Pi 2/3
- SDRuno (based on Studio1) provided free of charge
- ExtIO based plugin ensures compatibility with growing number of packages
- Access to free Mirics Radio & TV decode software (Europe)
- Software upgradeable for future standards
- API provided to allow demodulator or application development
- 3rd Party ***free*** software including:

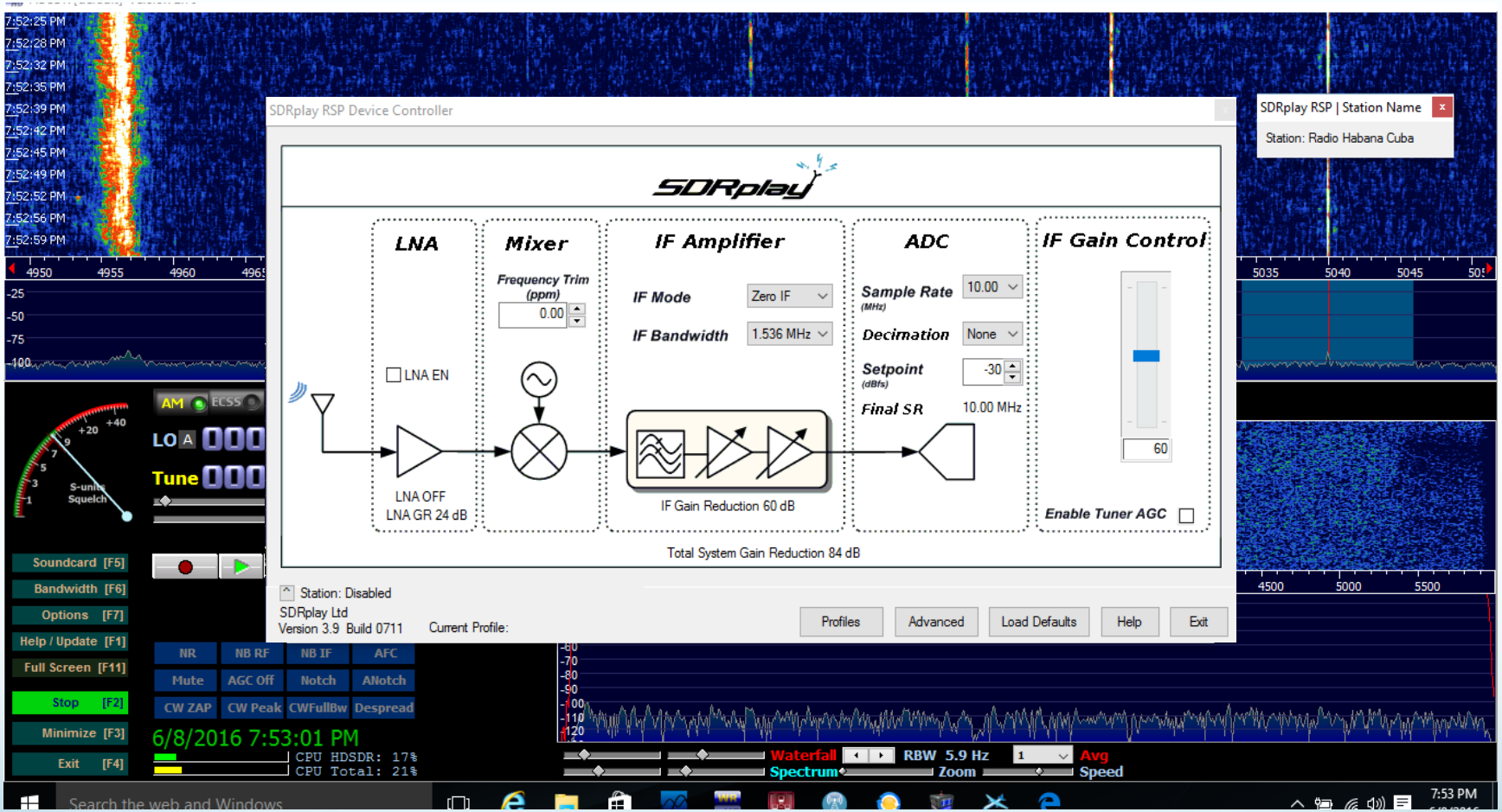




HDSDR

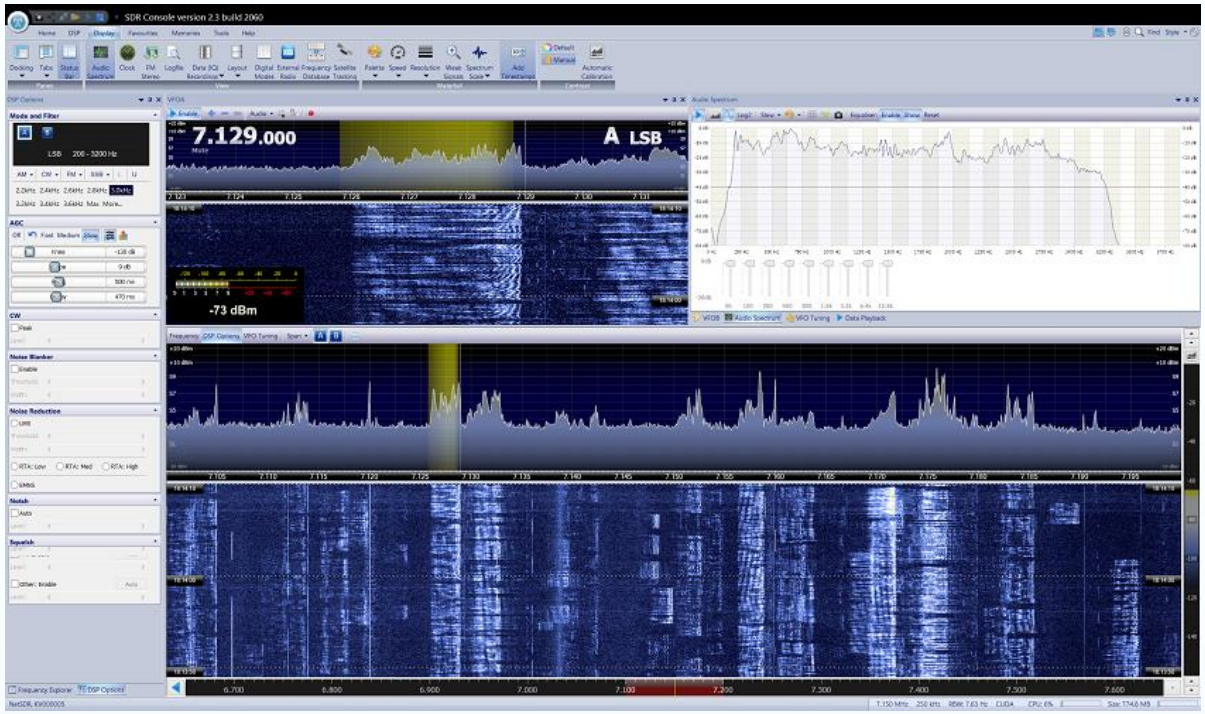

HDSDR
AM
ECSS
FM
LSB
USB
CW
DRM
LO A 0021,230,000
Tune 0021,271,000
FreqMgr
Ext10
Volume
AGC Thresh.
Soundcard [F5]
Bandwidth [F6]
Options [F7]
Info / Update [F9]
Full Screen [F11]
Stop [F2]
Minimize [F3]
Exit [F4]
NR
NB
Notch
Mute
AGC Med
Despread
CW ZAP
CW AFC
CW Peak
CWFullBw
10/27/2012 1:47:40 PM
CPU HDSDR: 1%
CPU Total: 4%
Waterfall
RBW 7.6 Hz
Avg
Spectrum
Zoom
Speed
Waterfall
RBW 5.9 Hz
Avg
Spectrum
Zoom
Speed

EXTIO Plug-in



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

SDR-Console



Software:

- 6 receivers (VFOs)
- SSB, CW, AM, FM, FM-Stereo
- WASAPI & ASIO audio support

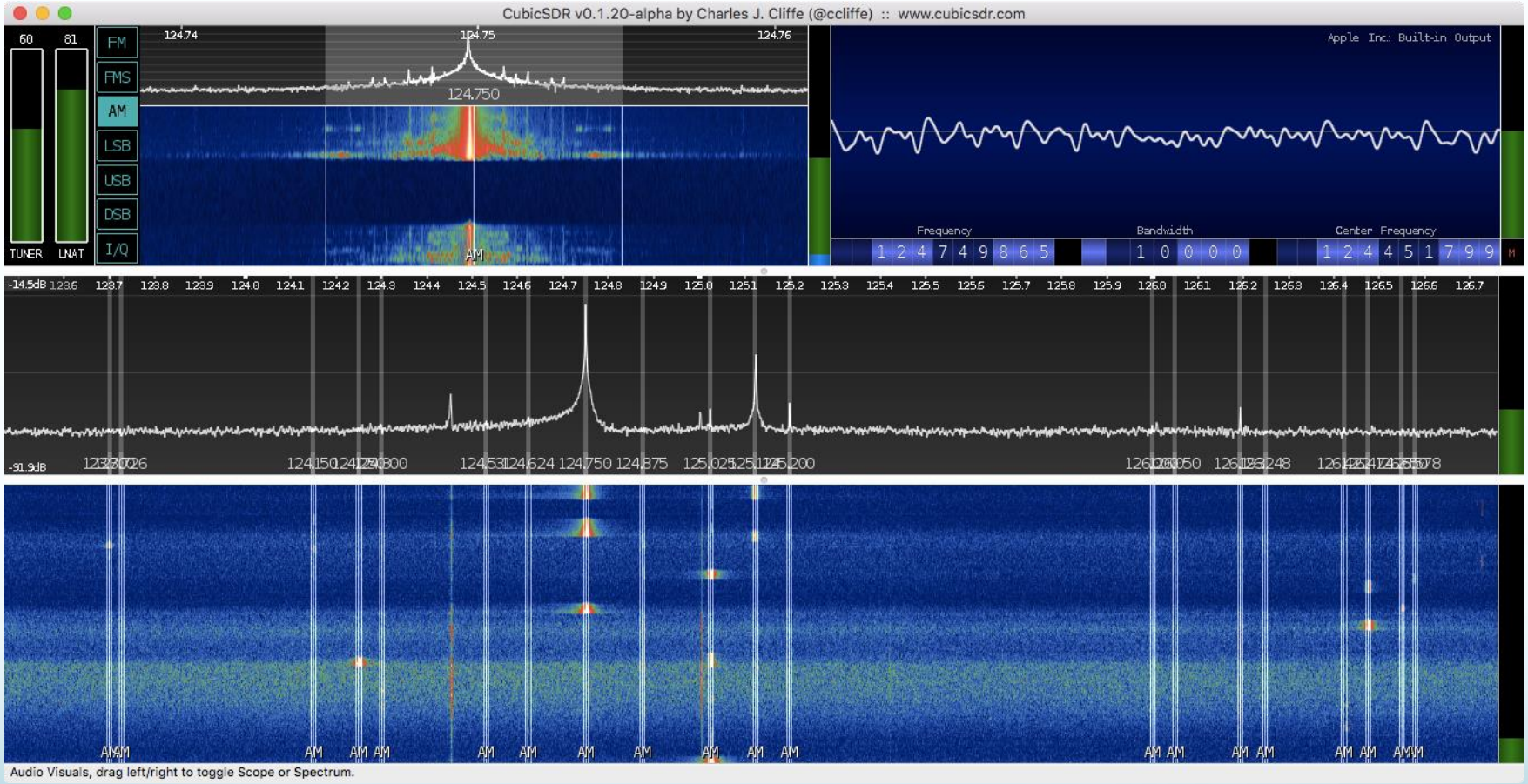
DSP:

- AGC
- CW Peak Filter
- Noise Blanker (NB)
- Noise Reduction (NR)
- Notch
- Squelch

Other:

- Audio Spectrum
- Data Record / Playback
- Favourites / Memories
- Server functionality

Cubic SDR


CubicSDR v0.1.20-alpha by Charles J. Cliffe (@ccliffe) :: www.cubicsdr.com
60
81
TUNER
LNAT
FM
FMS
AM
LSB
USB
DSB
I/Q
124.74
124.75
124.76
124.750
AM
Apple Inc.: Built-in Output
Frequency
Bandwidth
Center Frequency
1 2 4 7 4 9 8 6 5
1 0 0 0 0
1 2 4 4 5 1 7 9 9
Audio Visuals, drag left/right to toggle Scope or Spectrum.

SDRuno
– free to all RSP owners

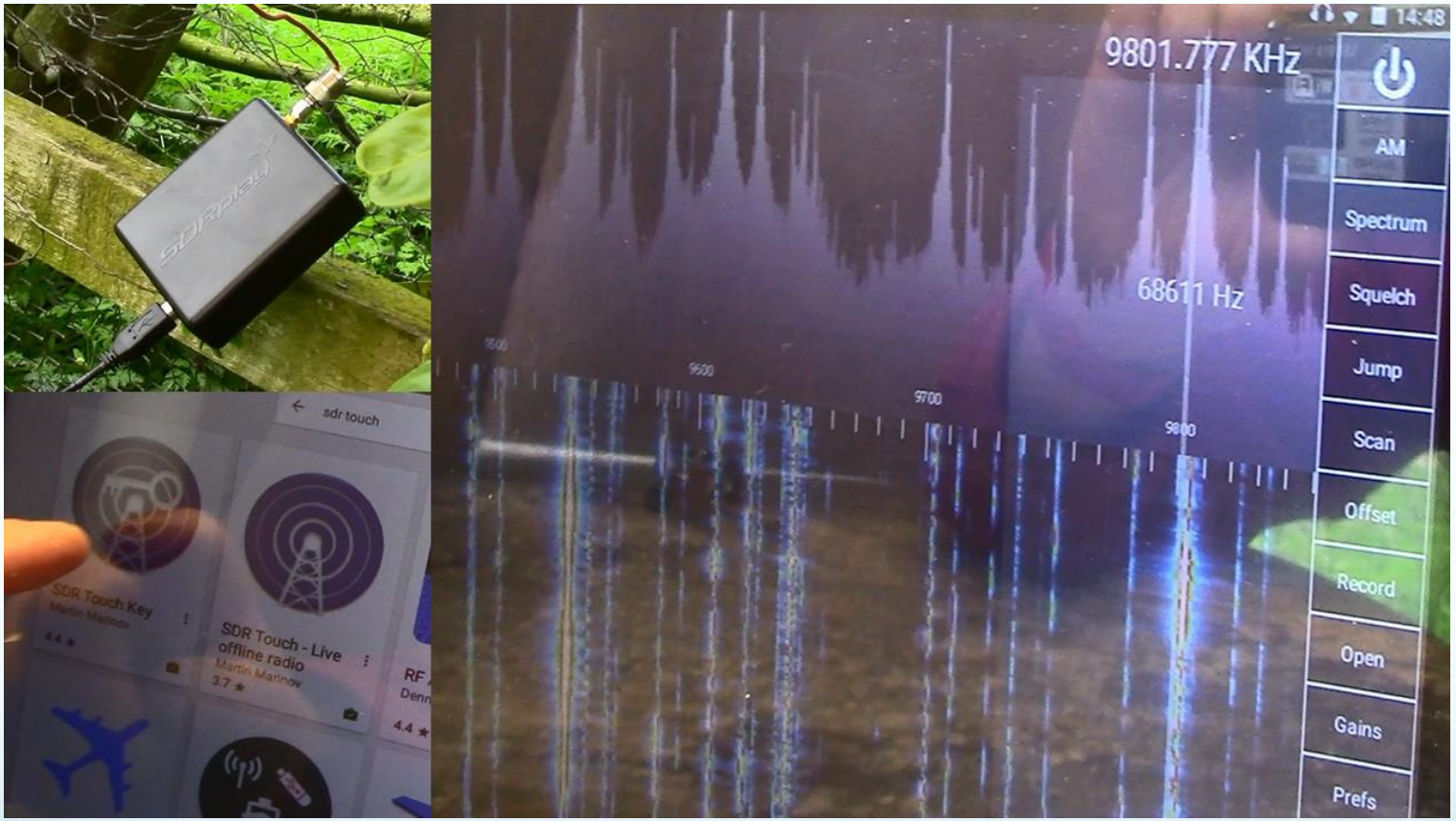
- Derived from Studio1
- Optimised for RSP
- Free download
- Supports other SDRs
  - Via EXTIO
  - Reduced functionality

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

SDRuno
– example screenshots

Android Phones and Tablets



- SDR Touch and SDRplay Driver, available from the Android Market
- The Android device must support USB On-The-Go

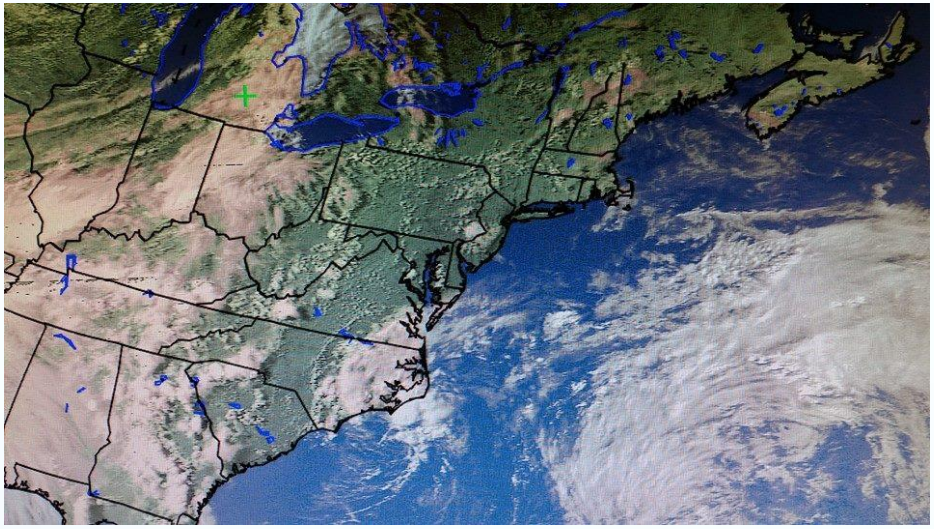
Summary - Platforms + software examples supported by RSP

- Windows (XP, 7, 8, 10) for SDR-Console, HDSDR, Studio1 etc.)
- Mac (CubicSDR)
- Linux (CubicSDR, gr-osmosdr)
- Android (SDR Touch & SDRplay plug-in)
- Raspberry Pi 2/3 (growing Github resources)

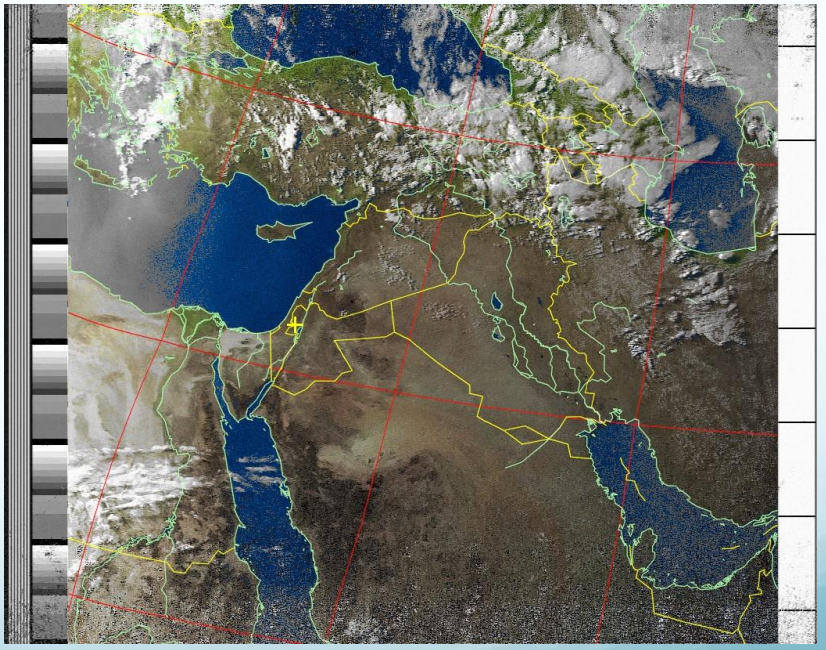
Add-on Software - Satellite working

WD9EWK VHF crossed dipole
& Tablet + RSP for telemetry

NOAA Weather satellite - Wxtoimg



Credit: Jeff Broughton, WB8RJY



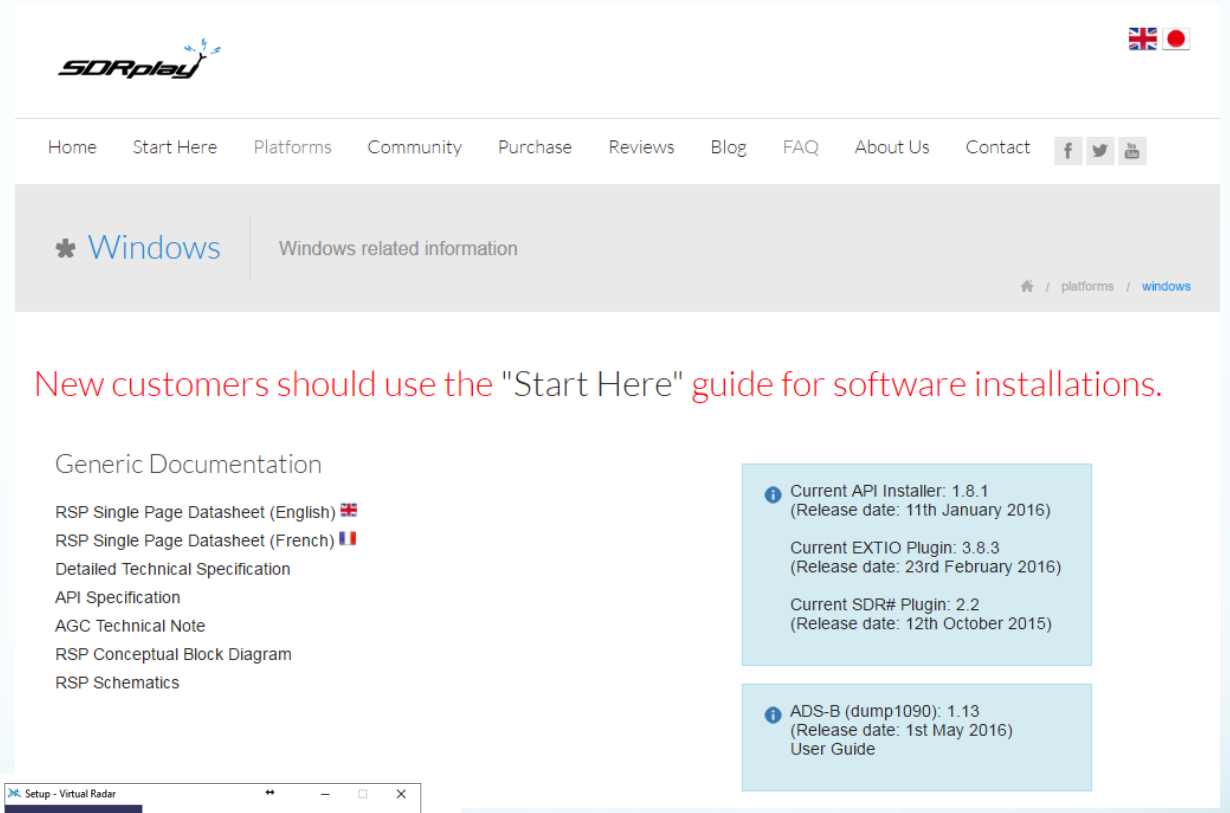
Credit: Sefi Merkel

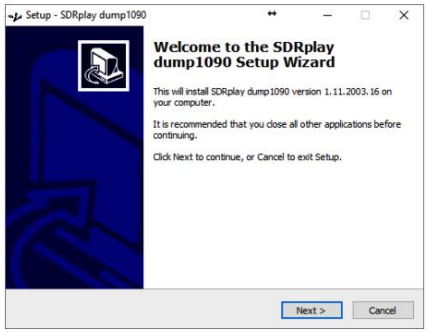
User pictures from the facebook group:
www.facebook.com/groups/sdrplay/

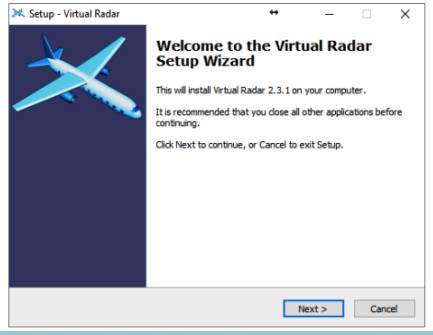
Wxtoimg:
http://www.wxtoimg.com

ADS-B using Dump1090

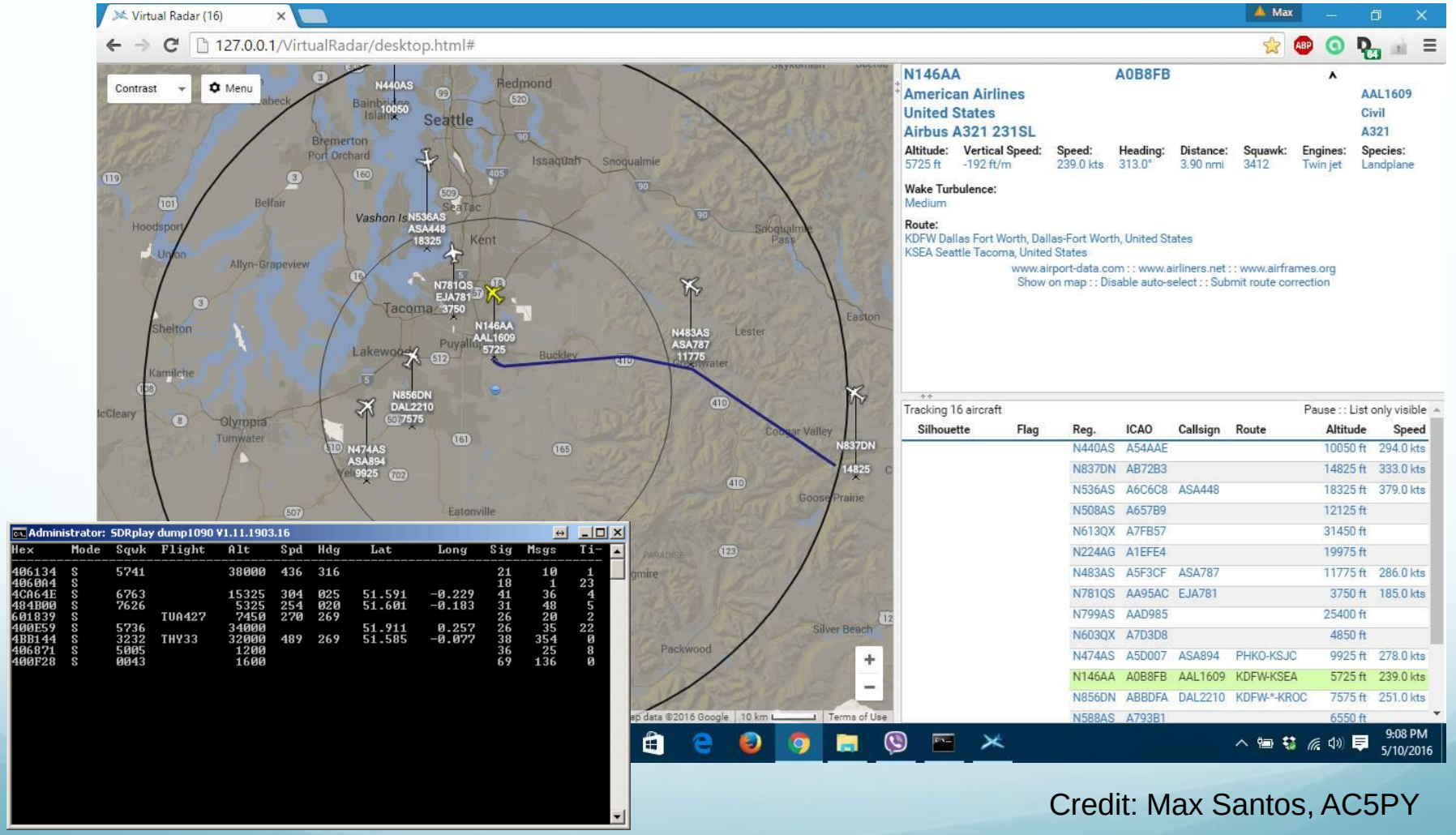
Detect aircraft in your vicinity – SDRplay provides s/w and set-up wizards to drive ‘Virtual radar’ mapping software





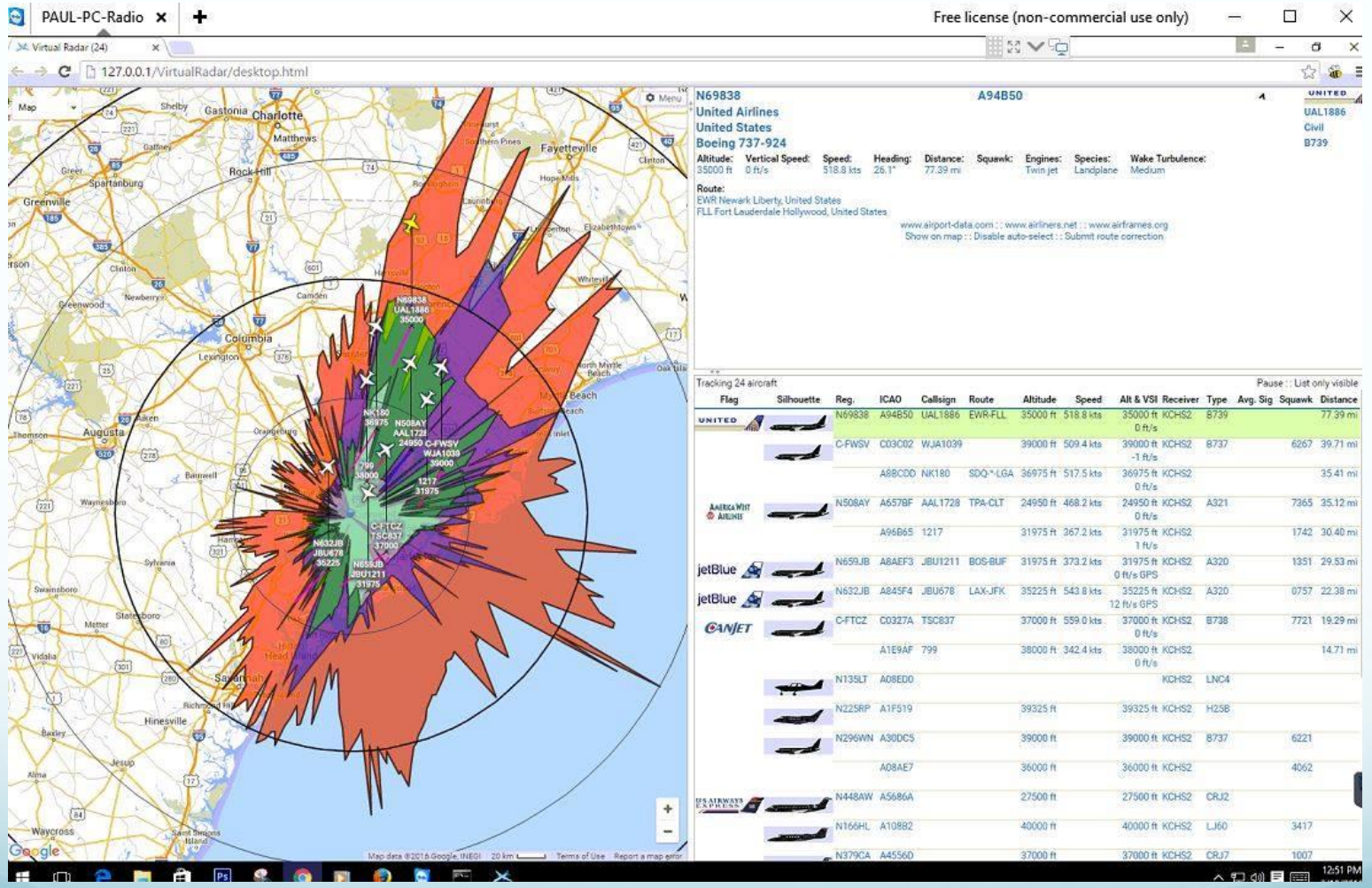


ADS-B decoding example using Dump1090 and VRS



Credit: Max Santos, AC5PY

Another example: Dump1090 and VRS

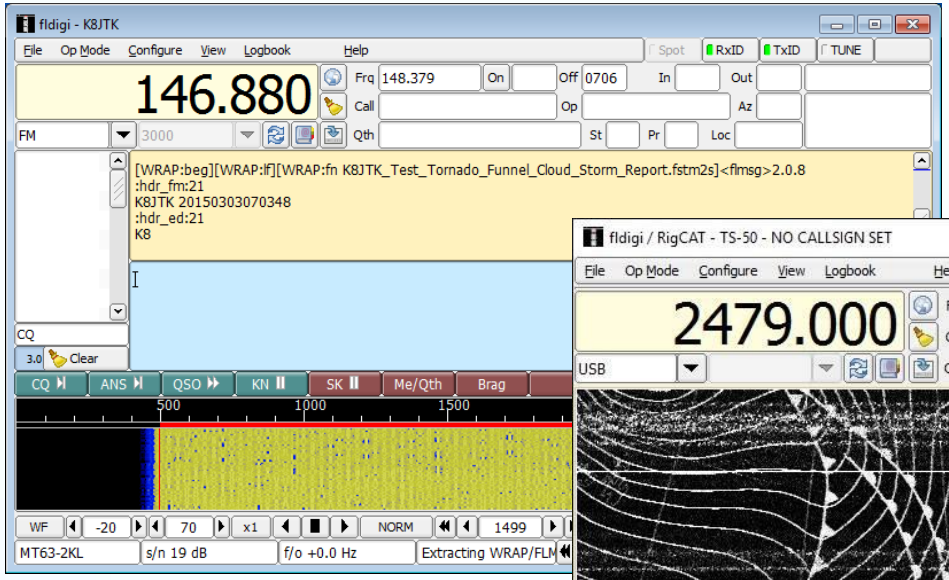


Virtual Radar Server: http://www.virtualradarserver.co.uk

Credit: Paul Jones, NN4F

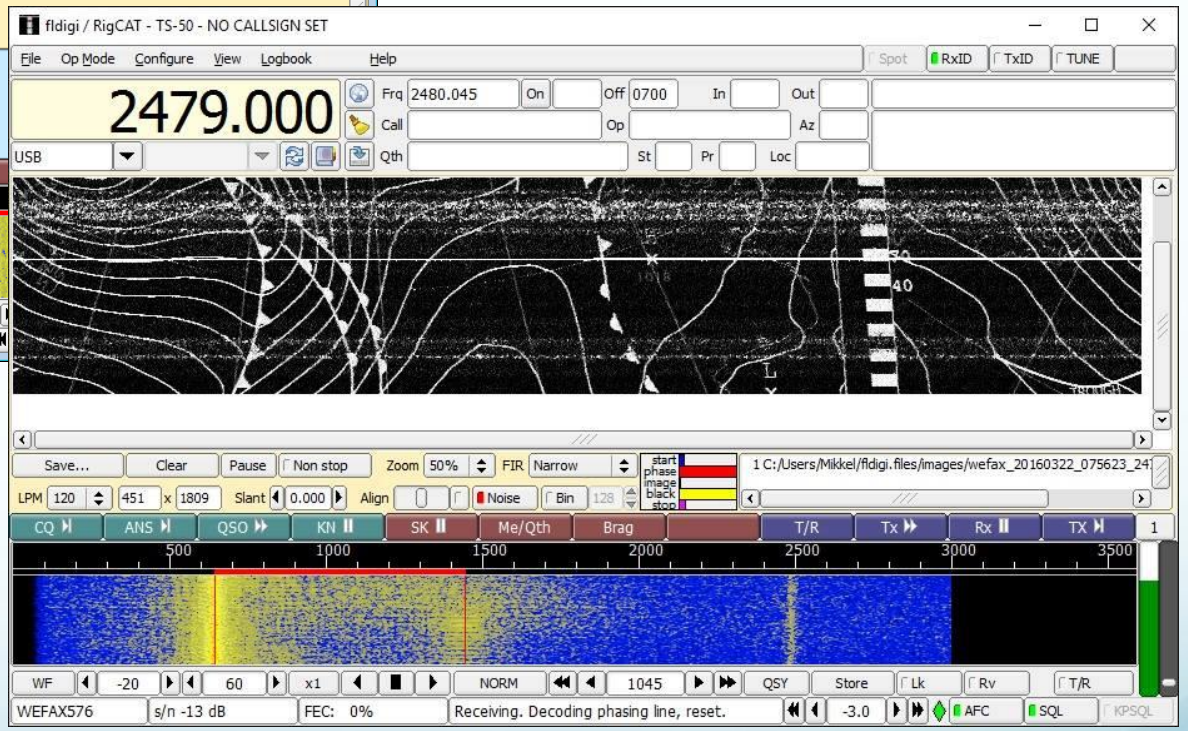
FLdigi

NBEMS (Narrow Band Emergency Messaging System)



Credit: Jeff Kopcak, k8jtk

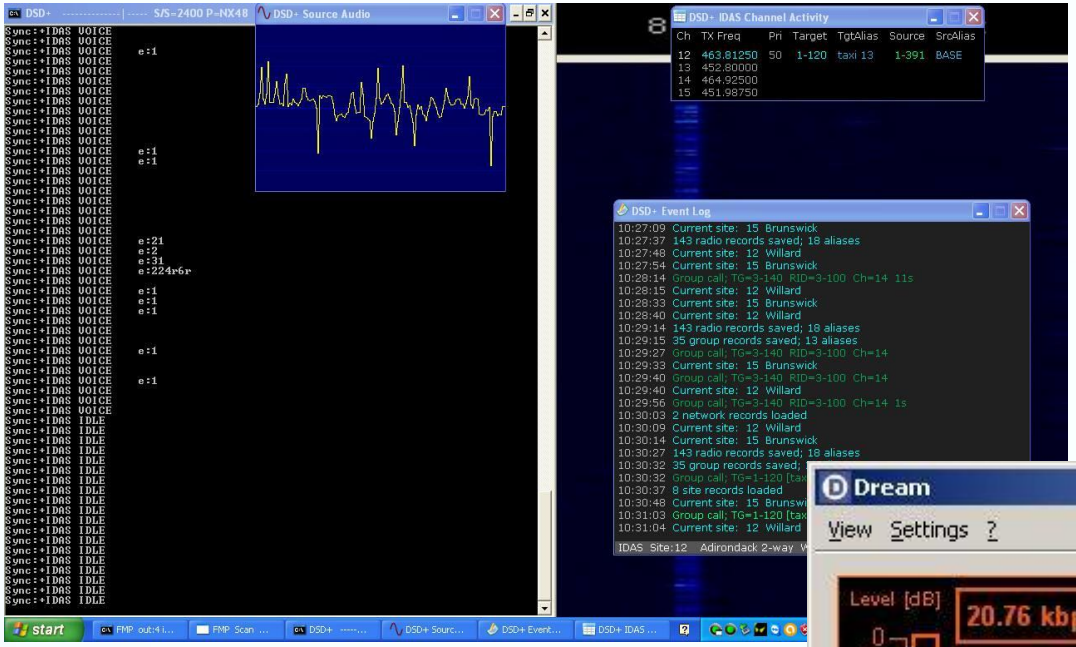
…and WEFAX Decoding



Fldigi: http://www.w1hkj.com

Credit: Erik Mikkel Wied

Digital Speech Decoding with DSD+



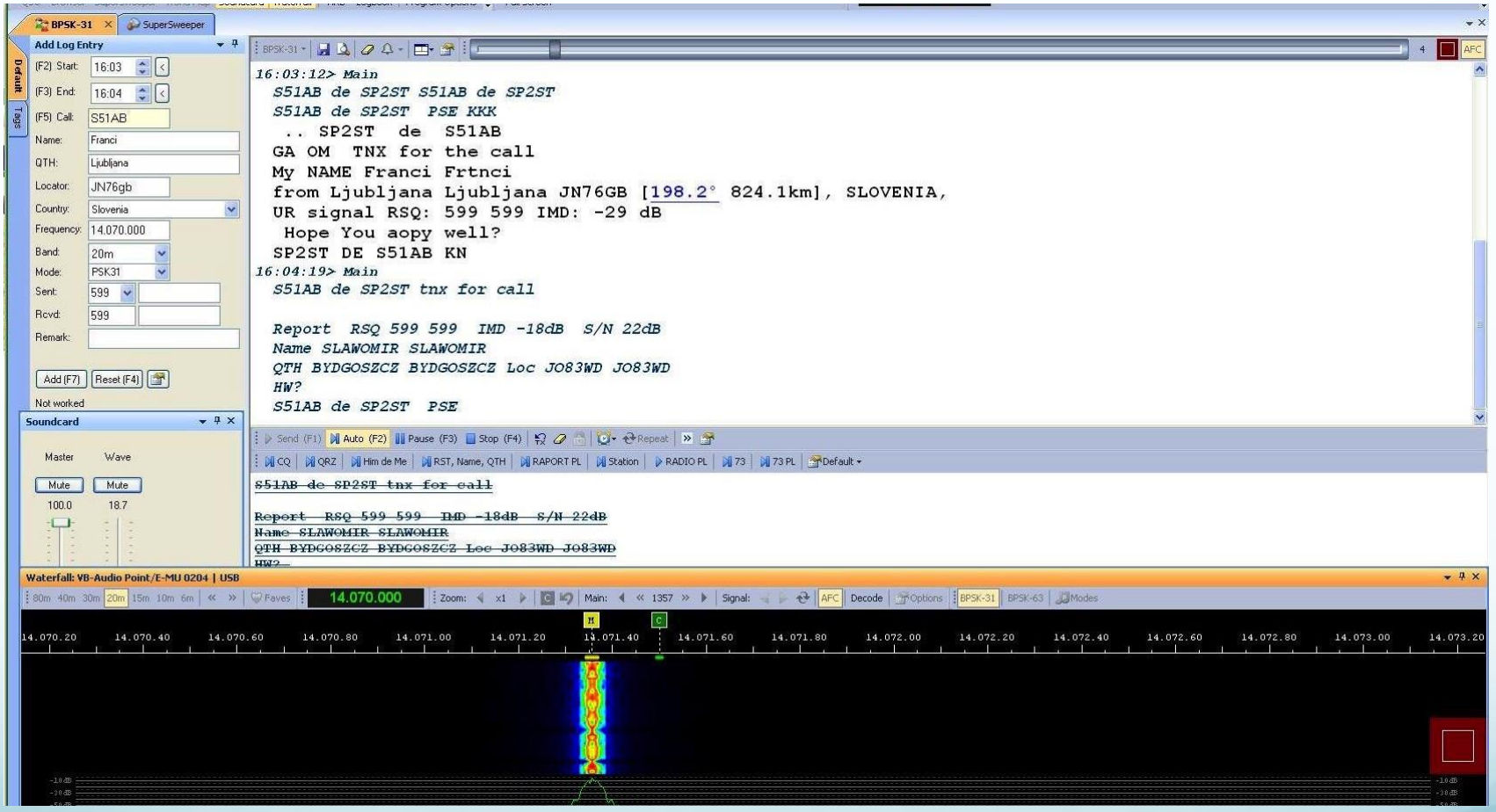
Credit: David Stark, NF2G

DSD+:
http://www.dsdplus.com

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

DRM with Dream

Digital Master 780 (Ham Radio Deluxe)



Ham Radio Deluxe / DM780: http://ham-radio-deluxe.com

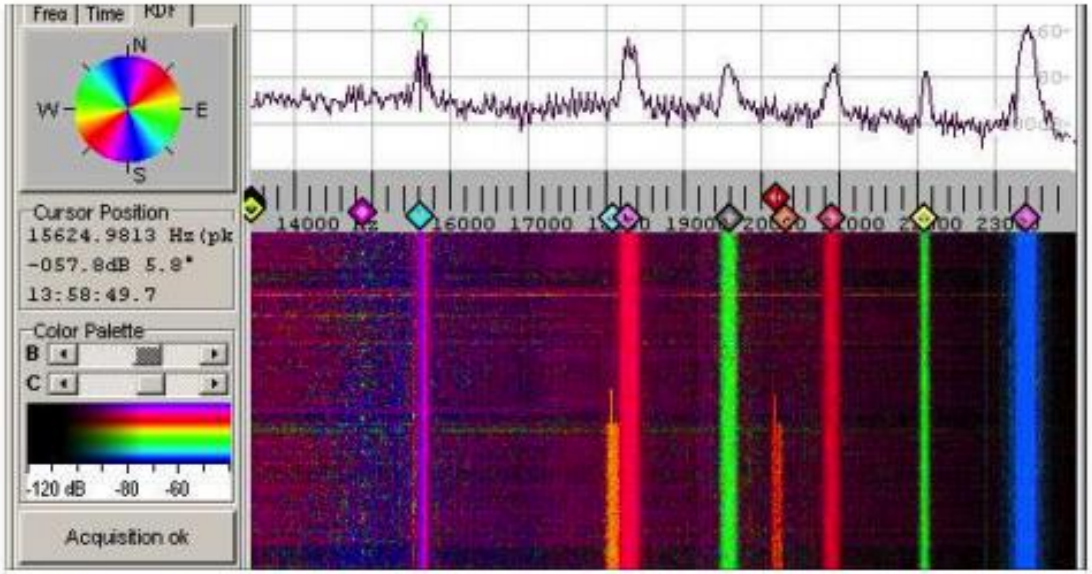
Credit: Sławomir Tecław, SP2ST

Other EXTIO-based software:

- Spectrum Analyzer example

"I took the SDRplay HDSDR ExtIO DLL file and loaded it into Spectrum Lab, and it works 🙂 - needs more investigating, but it sure works.... "

The Spectrum Analyzer software can be downloaded from
http://www.qsl.net/dl4yhf/spectra1.html



DL4YHF's Audio Spectrum Analyser

Spectrum Laboratory for Soundcard with Waterfall and FFT.

QSL.NET

Panadapters

- Hardware Requirements

- An RSP1 – to acquire signals across the frequencies of interest.
- A TRX (or main RX)- preferably with either RxOut or IF Out capabilities, and CAT (Computer Aided Transceiver) capability to allow interaction with the SDR software.
- A PC – to run the SDR software and allow control signals to pass back and forth between the SDR software and the transceiver.

- Please see our website for an overview of panadapters, including these slides.
- www.sdrplay.com/Panadapterintro1.pdf

Panadapters - Antenna Considerations

- The RSP1 can share the same antenna as your transceiver, or in some situations you may prefer to use an entirely separate antenna.
- If a separate antenna is used care must be taken with the physical layout to ensure that near-field effects do not overload the RSP1 when you are transmitting from the transceiver.
  - Article discussion of near-field effects: http://www.w8ji.com/antenna_coupling.htm
- If a shared antenna is used it may either be connected “behind” the transceiver, in which case internal circuitry in the transceiver will protect the RSP1, or using a splitter “in front of” the transceiver. If a splitter is used it is essential that a switch is implemented that isolates the RSP1 from the antenna during transmit!
- **In any configuration the maximum input power to the RSP1 must not exceed 0dBm**

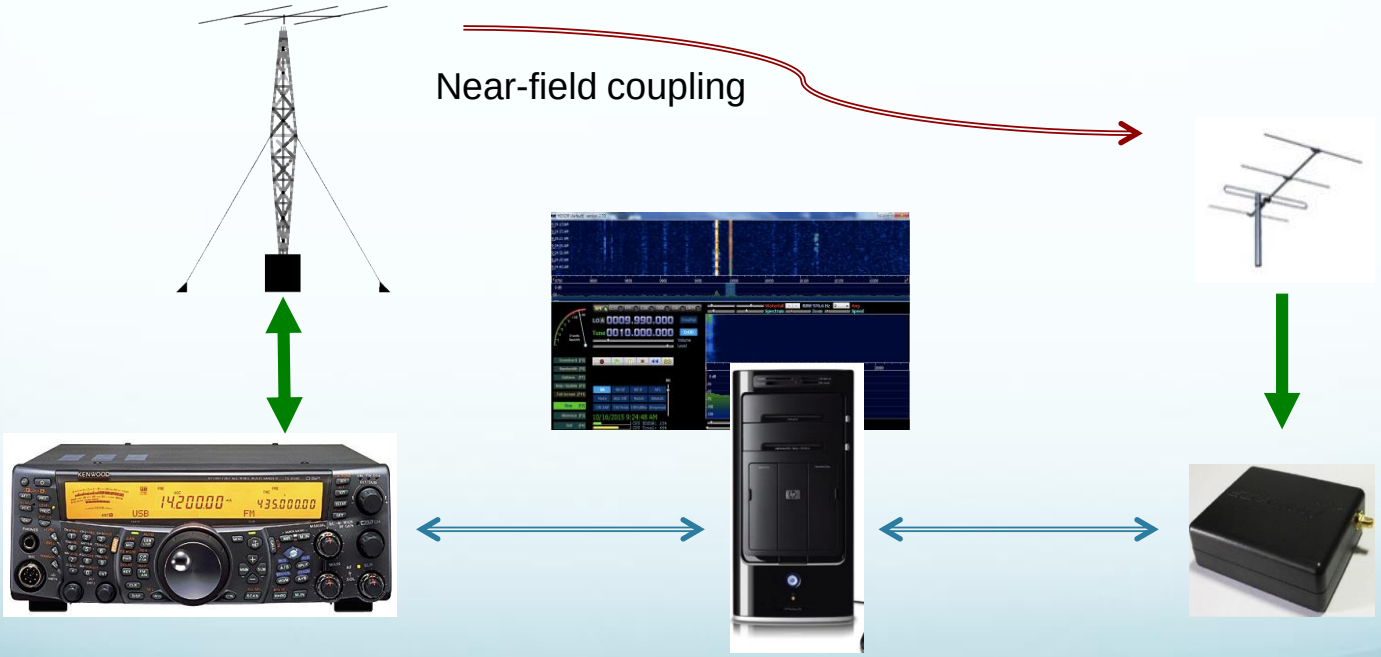
On the following slides we will look at these configurations in more detail…

DO NOT directly connect the RSP to the same antenna as your transmitter, or to an antenna in the near field of a transmitting antenna, as this is likely to result in irreversible damage to your RSP and invalidate your warranty.

Panadapters - Antenna Considerations

Separate antenna

- Care must be taken with the physical layout to ensure that near-field effects do not overload the RSP1 when you are transmitting from the transceiver.
  - See this article for a discussion of near-field effects: http://www.w8ji.com/antenna_coupling.htm



DO NOT directly connect the RSP to an antenna in the near field of a transmitting antenna, as this is likely to result in irreversible damage to your RSP and invalidate your warranty.

Panadapters
- Antenna Considerations

Shared antenna using splitter

- A switch must be used to isolate the RSP 1 during transmit!

DO NOT directly connect the RSP to the same antenna as your transmitter as this is likely to result in irreversible damage to your RSP and invalidate your warranty.

Panadapters - Antenna Considerations

Shared antenna “behind” the transceiver

- Internal circuitry isolates the RSP1

IF Out: - Displayed bandwidth limited by transceiver on-board filters
- RSP1 tuned to IF frequency

RF Out: - RSP1 can display up to the full 10 MHz bandwidth capability

Panadapter
- Software Requirements

- Any of the SDR Software programs that support RSP1 can be used to provide a basic spectrum display.
- SDRuno, HDSDR and SDR Console have built-in capabilities for CAT and other add-on software, to allow for communication between the SDR software and the transceiver.
- Ham Radio Deluxe and OmniRig are commonly used for synchronization/control between the TRx and SDR Rx.
- We recommend you research the available options and select according to your expectations and requirements:

HDSDR:	www.hdsdr.de
SDR-Console:	www.sdr-radio.com
CubicSDR:	cubicsdr.com
Ham Radio Deluxe:	ham-radio-deluxe.com
OmniRig:	www.dxatlas.com/omnirig/
N4PY:	http://www.n4py.com/

For more information:

- Company website: www.sdrplay.com
- Community Forums: www.sdrplay.com/community/
- Email: support@sdrplay.com
- Facebook: https://www.facebook.com/groups/SDRplay/ & https://www.facebook.com/groups/SDRuno/
  (Independent groups run by enthusiastic users!)
- Google / YouTube
  - Many videos covering how to use the various software packages, implementing panadapters and much more. Use the Google search function.
  - SDRplay channel: https://www.youtube.com/c/SDRplayRSP

Now it's your turn….

- Questions?
- Come and play