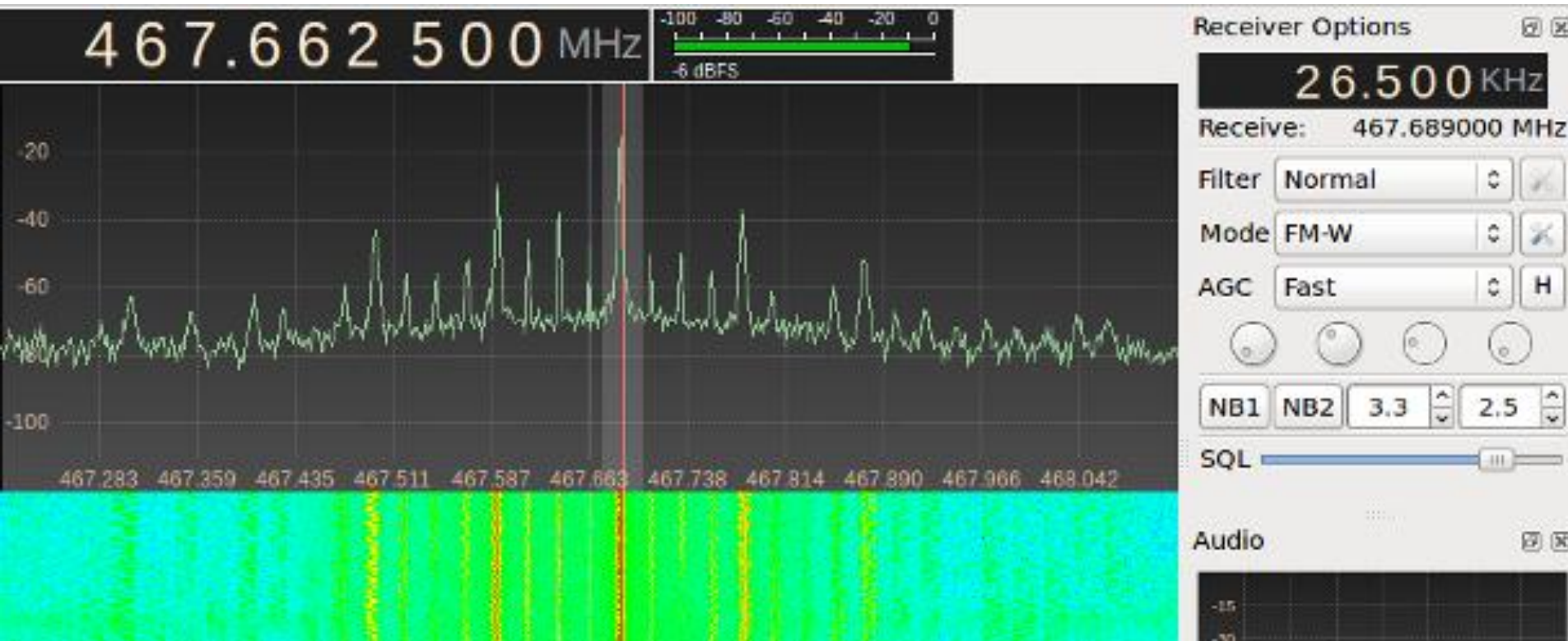


Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*



References, DEMO BUILD INSTRUCTIONS on Page 15, 16, 17 :

USB SDR Tuner: <http://www.nooelec.com/store/sdr/nedr-mini2-rtl2832u-r820t2.html>

Live Distro ISO File: <https://gnuradio.org/redmine/projects/gnuradio/wiki/GNURadioLiveDVD>

Evolution of Software Defined Radio (SDR); *Breakthroughs by Leveraging COTS Technology*

Presentation Outline

Evolution of Software Defined Radios:

- 1st Generation
Government and Military SDR Architecture (WJ, Condor Systems)
- 2nd Generation
Commercial and Educational Market (RFSpace SDR-14)
- 3rd Generation
Amateur Radio Market (Flex, Elecraft, Peaberry)
- 4th Generation and Future Direction
Hobbyist and Spectrum Hackers (GNURadio, Ettus, HackerRF)
- Demo of GQRX RTL-SDR on a LIVE Distribution

Cold War CEI/Watkins-Johnson Surveillance Receivers

CEI RS-111 (Mfg 1968):

Architecture:

Surveillance Receiver used in WATERGATE bugging

30 MHz – 1,000 MHz Continuous Coverage

$\leq 1\mu\text{V}$ Sensitivity, 20kHz AM

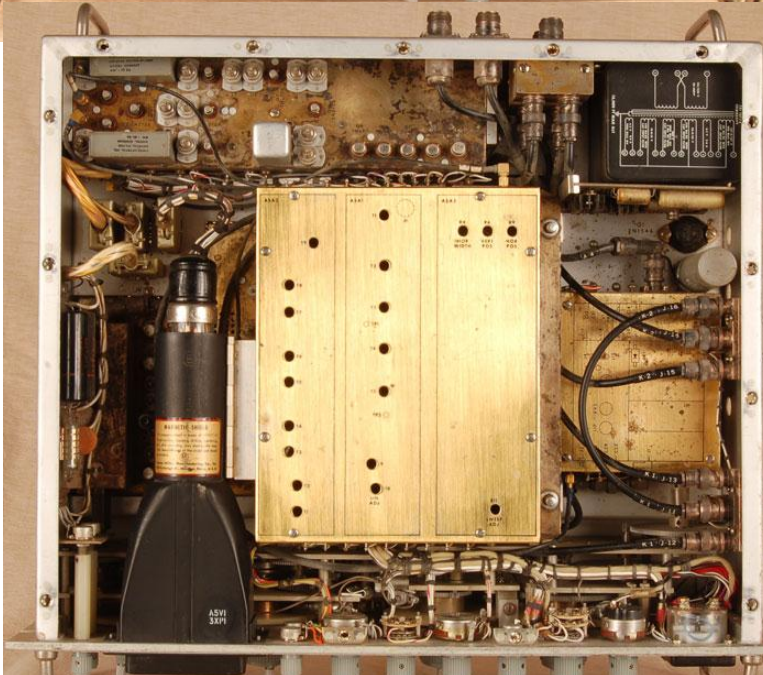
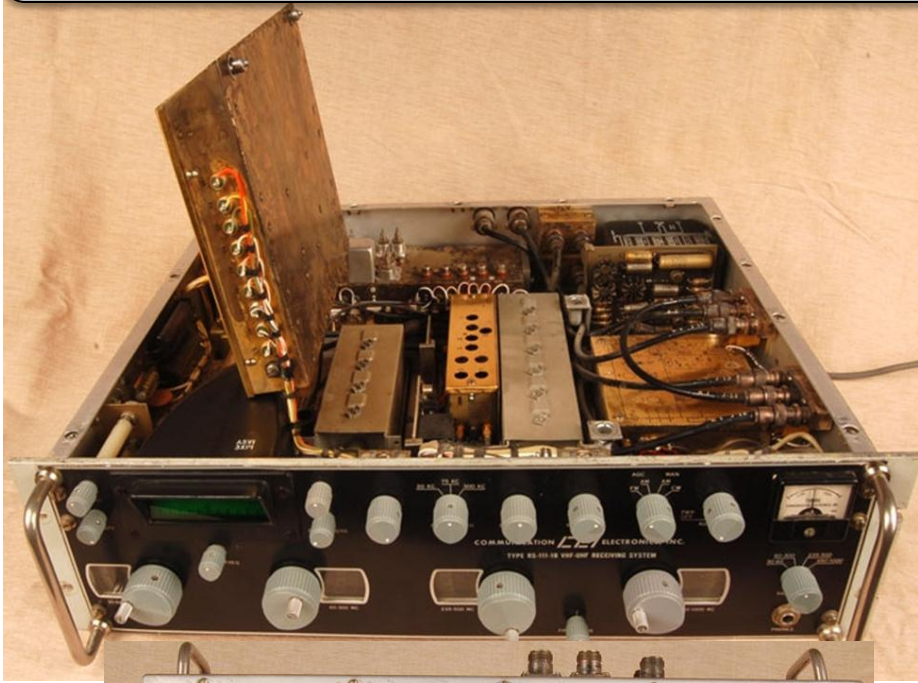
21.4 MHz IF Frequency

Panoramic Spectrum Display Built-in

Transistor + Tube Design

Mfg: US 1968

Cost New: \$6,250

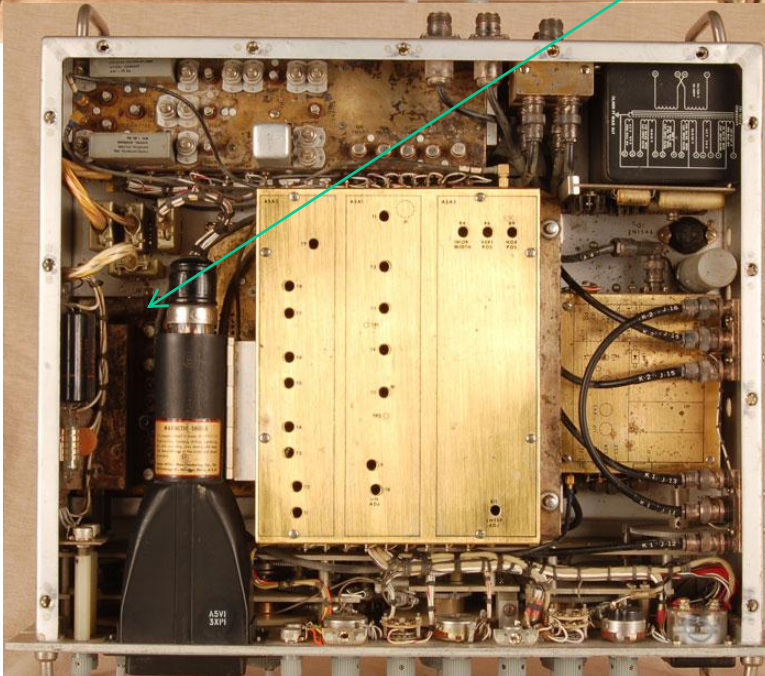
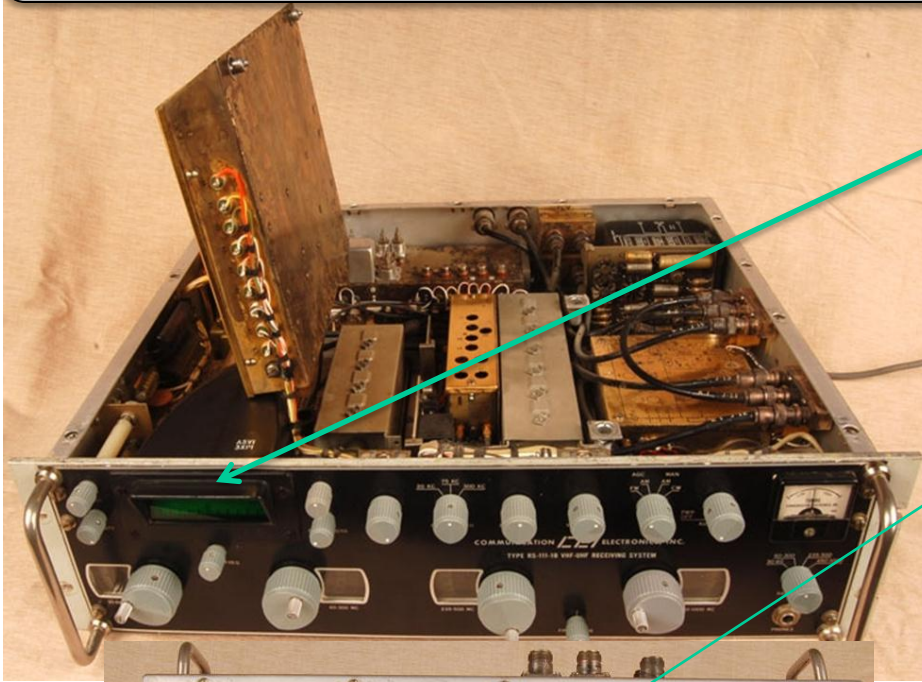


Cold War CEI/Watkins-Johnson Surveillance Receivers

Panoramic Display - RF Band-limited - Spectrum Monitor Replacement:

Initial Entry Point - Substitute Swept-Spectrum Display with a Fast Fourier Transform (FFT) Spectrum Display

Second DSP Entry Point is the Bandpass Filter and Demodulator.



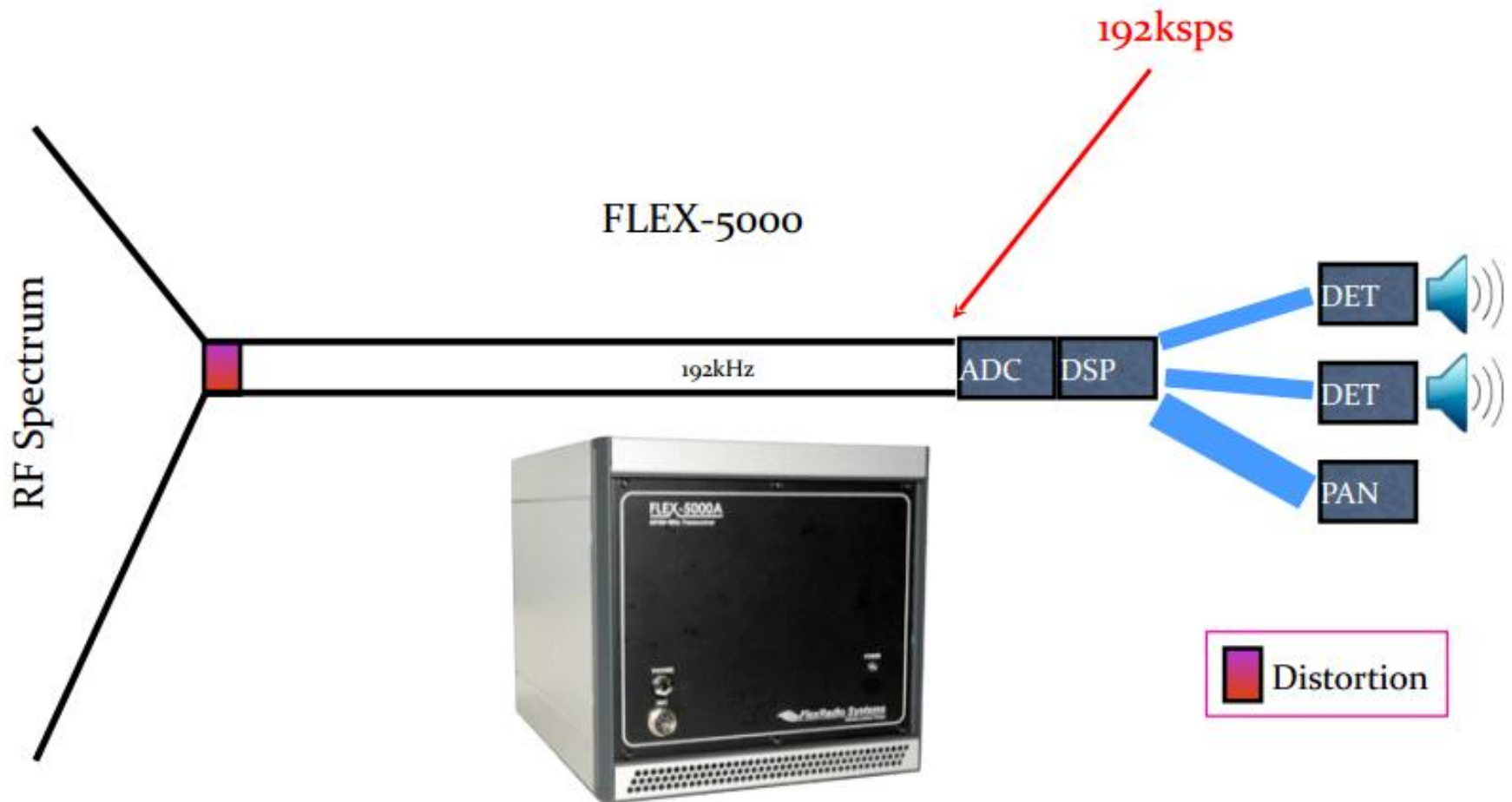
RFspace SDR-14 Commercial SDR



UR

The **RFspace SDR-14** is a 14-bit software defined radio receiver. It offers a broad range of spectrum analyzer and demodulation capabilities. The hardware samples the whole 0-30 MHz band using a sampling rate of 66.667 MHz. The digital data from the ADC is processed into I and Q format using a direct digital converter (DDC). The I and Q data is then sent to the PC for processing using a USB interface. All of the demod and spectral functions are done on the PC side

Direct Conversion



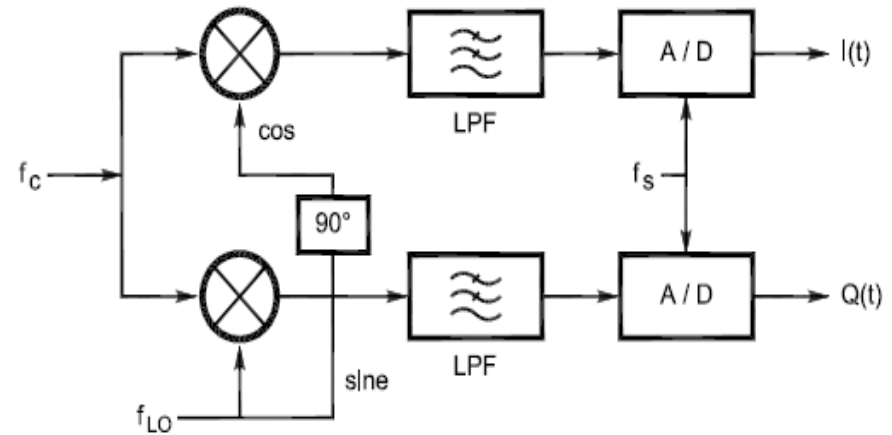
Softrock Low-Cost SDR (Partial SDR)

Softrock board includes Simple RF Filter (single band) and Direct Conversion Tayloe Mixer but Requires PC for A/D Converter (Audio), FFT and Demodulator Application . PC Audio is typically limited to 48Kb sampling rate.



Softrock Low-Cost SDR (Partial SDR)

Softrock board includes Simple RF Filter (single band) and Direct Conversion Tayloe Mixer but Requires PC for A/D Converter (Audio), FFT and Demodulator Application . PC Audio is typically limited to 48Kb sampling rate.



Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

USB Tuner, 25MHz – 1750 MHz

“Say hello to the newest member of NooElec's popular NESDR SDR-range, the **NESDR Mini 2**. The Mini 2 uses a brand-new tuner IC, the **R820T2** made by Rafael Micro, to provide **increased sensitivity and improved SNR**.

A greatly-**improved telescopic metal antenna** is also included with your SDR set at no extra charge. If you liked the NESDR Mini, you will love the NESDR Mini 2!

The perfect device for learning software defined radio, on the cheap. Amateur radio, ADS-B, police & fire scanning, trunking, satellite images--you name it, this little guy can probably do it. Outperforms many devices 10x its cost!

This custom NooElec SDR is a modified DVB-T USB dongle tuned for SDR usage, including upgraded crystal, capacitors and inductors compared to generic devices. Full compatibility with a large array of software packages, such as MATLAB®, HDSDR, SDR Touch, SDR#, Planepilot--too many to list.”

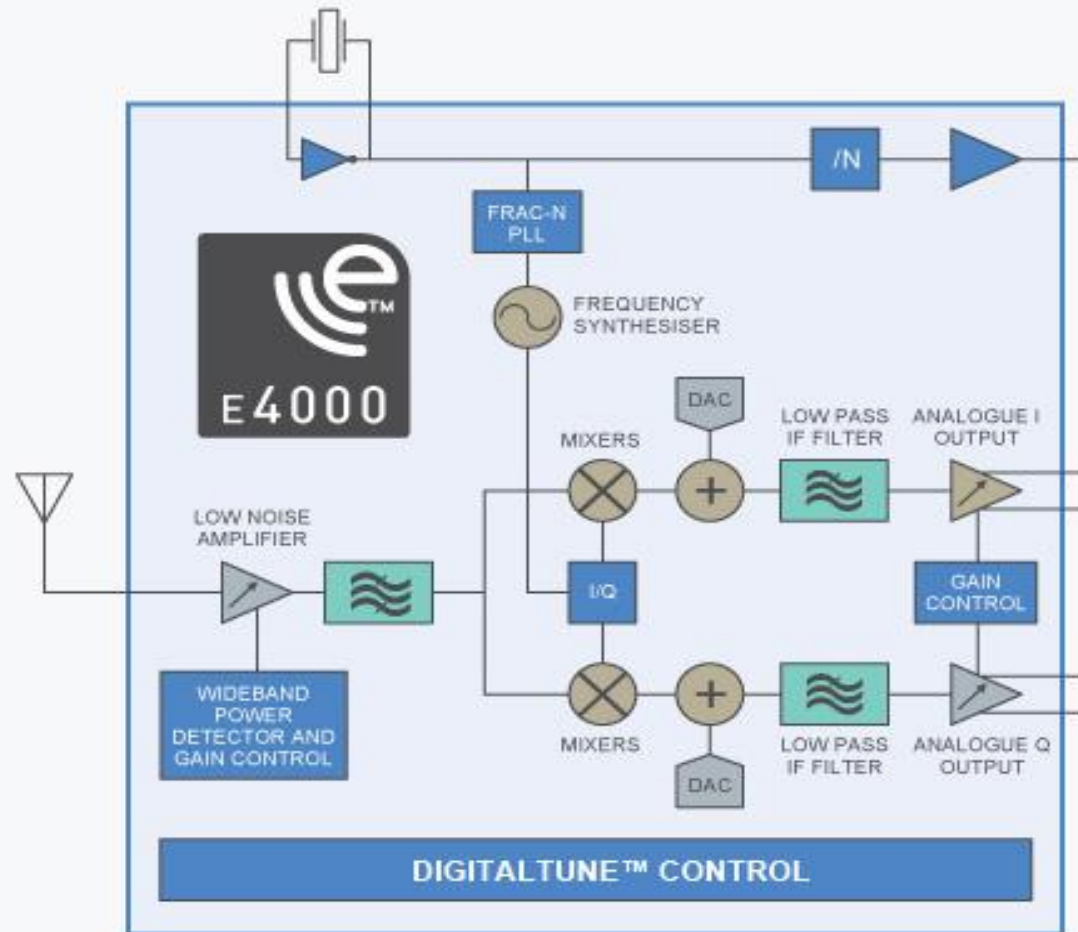


<http://www.nooelec.com/store/sdr/nesdr-mini2-rtl2832u-r820t2.html>

Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

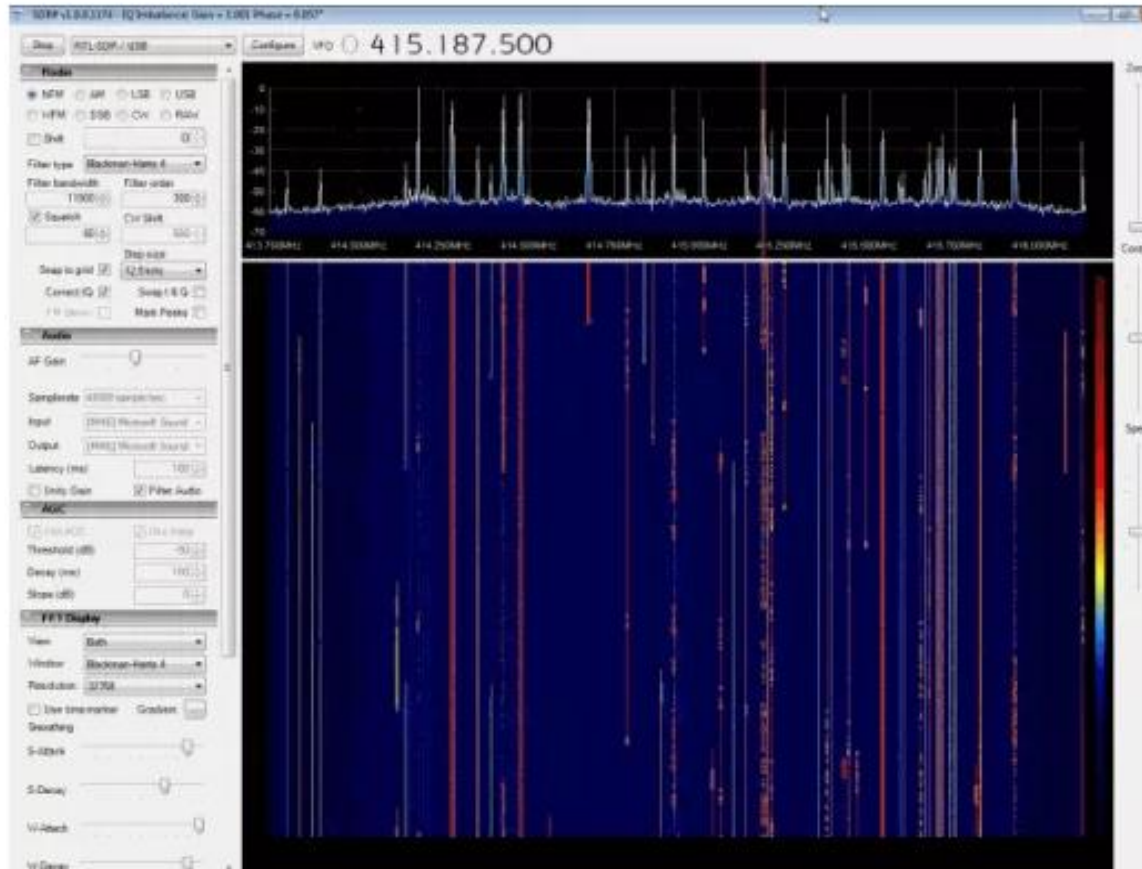
Low-Cost DVB TV Tuner Architecture

ASIC Digital TV
Tuner Chip TV USB
(~\$12.00) Block
Diagram Showing
I/Q Demodulator.
This follows a Fast
8/11-bit A/D
Converter



Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

SDR# (Windows/Linux with Mono) (Free)



SDR#

SDR#
Windows SDR Application

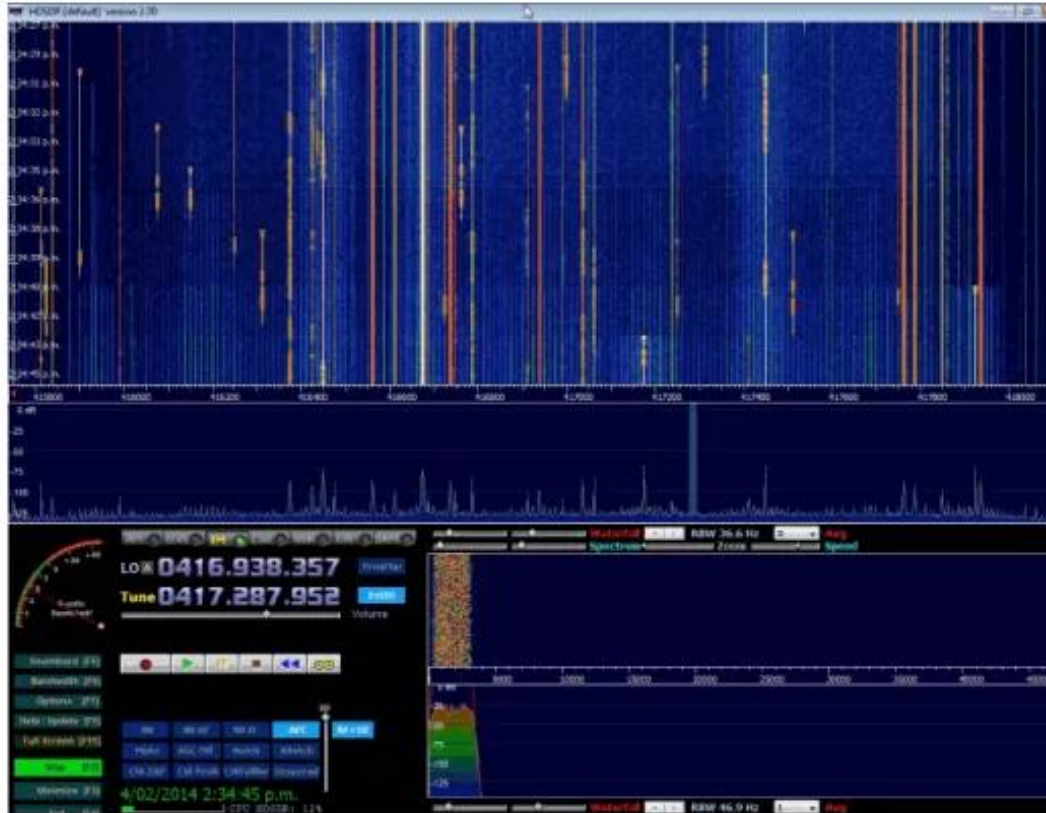
Reference:
<http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software/>

SDR# (pronounced "SDR Sharp") is the most popular free RTL-SDR compatible software in use at the moment. It is relatively simple to use compared to other SDR software and has a simple set up procedure. We have a full overview of the installation procedure on our [Quick Start Page](http://www.rtl-sdr.com/quick-start-page/).

<http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software>

Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

HDSDR (Windows) (Free)



HDSDR

HDSDR

Windows SDR Application
I like the S-Meter in this
Excellent SDR Application.

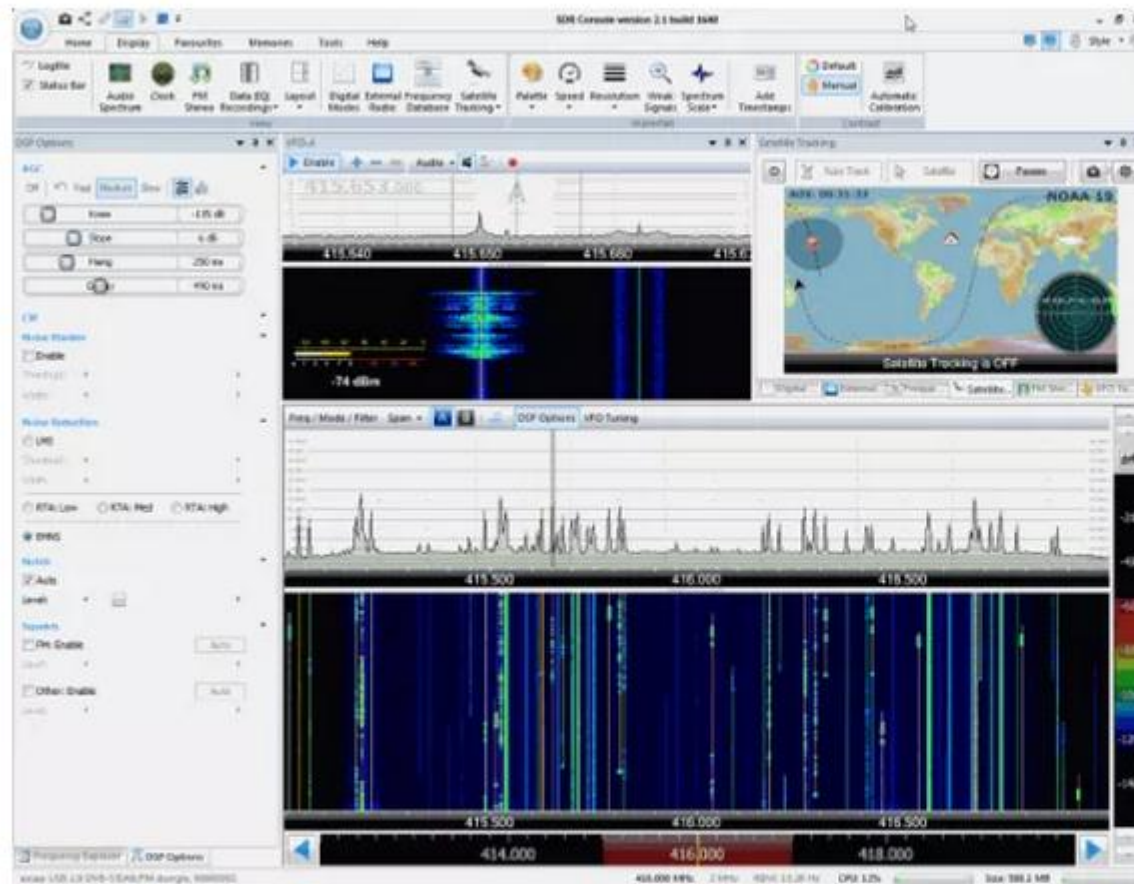
Reference:

<http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software/>

HDSDR is based on the old WinRAD SDR program. HDSDR supports the RTL-SDR through use of an ExtIO.dll module. To install HDSDR, download the program from the link on the main HDSDR page, then to use the RTL-SDR you will need to download the ExtIO_RTL2832.dll file and place it into the HDSDR folder. When opening HDSDR, select the newly copied ExtIO_RTL2832.dll. The other dlls that come with HDSDR will not work with the RTL-SDR, even though they have RTL-SDR in their filename. The official installation instructions [can be found here](http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software).

Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

SDR-RADIO.COM V2 (Windows) (Free)



SDR-RADIO.COM V2

SDR-RADIO

Windows SDR Application

This one has the most number of built-in features but requires a fast processor.

Reference:

<http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software/>

SDR-RADIO.COM V2 is a popular SDR program with many advanced features. As such is it a fair amount more difficult to learn and use compared to SDR# and HDSDR. Be sure you install version 2 and not V1.5 as only V2 has RTL-SDR support.
<http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software>

Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

New Software Definable Radio on Live Distro

Pre-Installed GNU Radio Applications

GQRX Spectrum Display will be Demoed

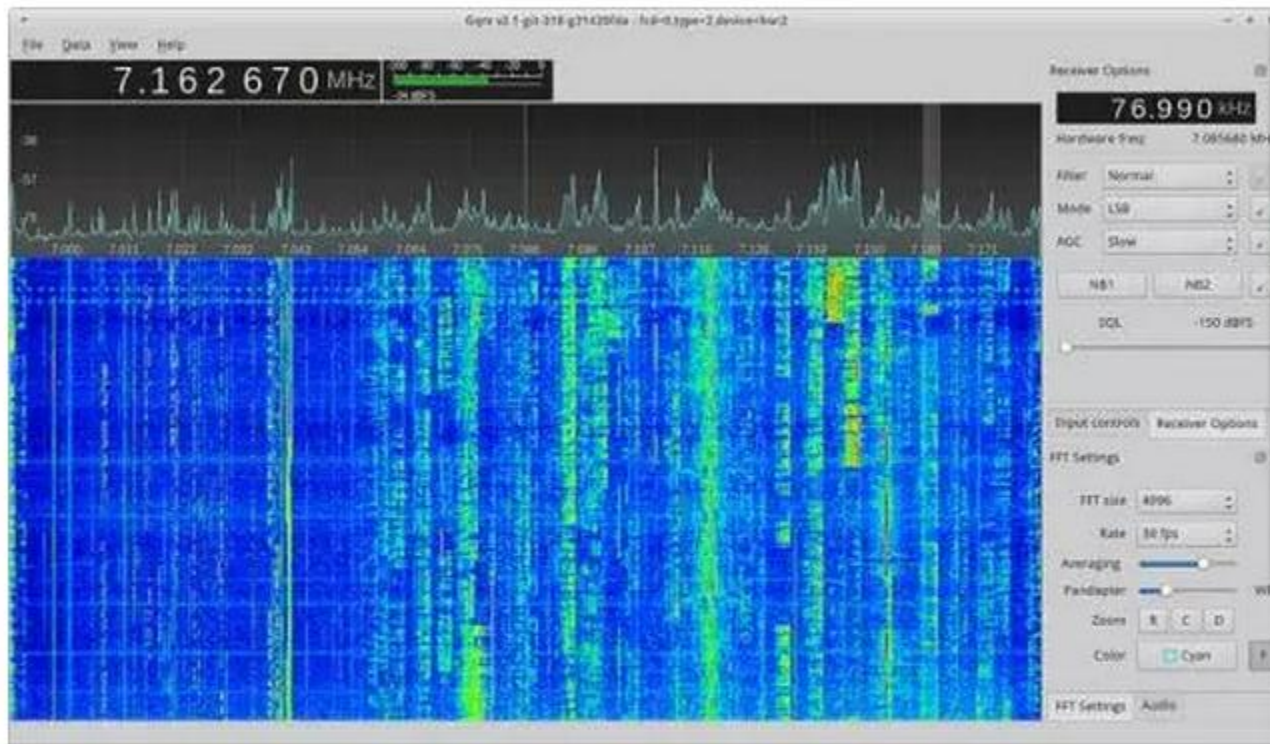
There are many 3rd-party applications, demos, drivers, and block libraries produced by the GNU Radio community. Below is a list of pre-installed packages that highlight some of the diverse capabilities of GNU Radio:

- `gr-osmosdr` (46bb1ad1) (**updated**), a set of blocks supporting various hardware SDRs and applications, and related dependencies
- `gqrX` (v2.3.2) (**updated**), a narrowband SDR receiver application by Alexandru Csete
- `GNSS-SDR` (g9b95919d) (**updated**), a fully software-based GPS, Galileo, and GLONASS real time receiver
- `gr-air-modes` (g9891907e), a Mode-S/ADS-B aircraft telemetry receiver
- `gr-dvbs2` (g5d075c64), a software defined DVB-S2 digital television transmitter
- `gr-dvbt` (g434494c1), a software defined DVB-T digital television transceiver
- `gr-ieee-80211` (g7805bae2) (**updated**), an IEEE 802.11a/g/p transceiver
- `gr-ldpc` (g63cca16b), an implementation of generic LDPC codecs
- `gr-lte` (ge9df3951) (**updated**), an implementation of a 3GPP LTE receiver
- `gr-radar` (g0e81f1c9), the GNU Radio Radar Toolbox
- `gr-rds` (gffica151) (**updated**), an implementation of broadcast FM radio RDS reception
- `gr-specest` (g5113c1f4), an implementation of several spectral estimation algorithms
- `OpenLTE` (g76945c80) (**updated**), an open source 3GPP LTE implementation

New with this release is `gr-fosphor`, a GPU-accelerated real-time spectrum analyzer display component. However, due to distribution restrictions, the GNU Radio Live SDR Environment only comes pre-installed with the Intel CPU Open CL driver, and `gr-fosphor` is not able to take advantage of any graphics chipsets in the PC that boots it. It is possible, after converting the ISO image to a USB drive, to further download, install, and configure additional Open CL support for `gr-fosphor`.

Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

GQRX (Mac/Linux) (Free)



GQRX

GQRX

Linux/Mac SDR
Application

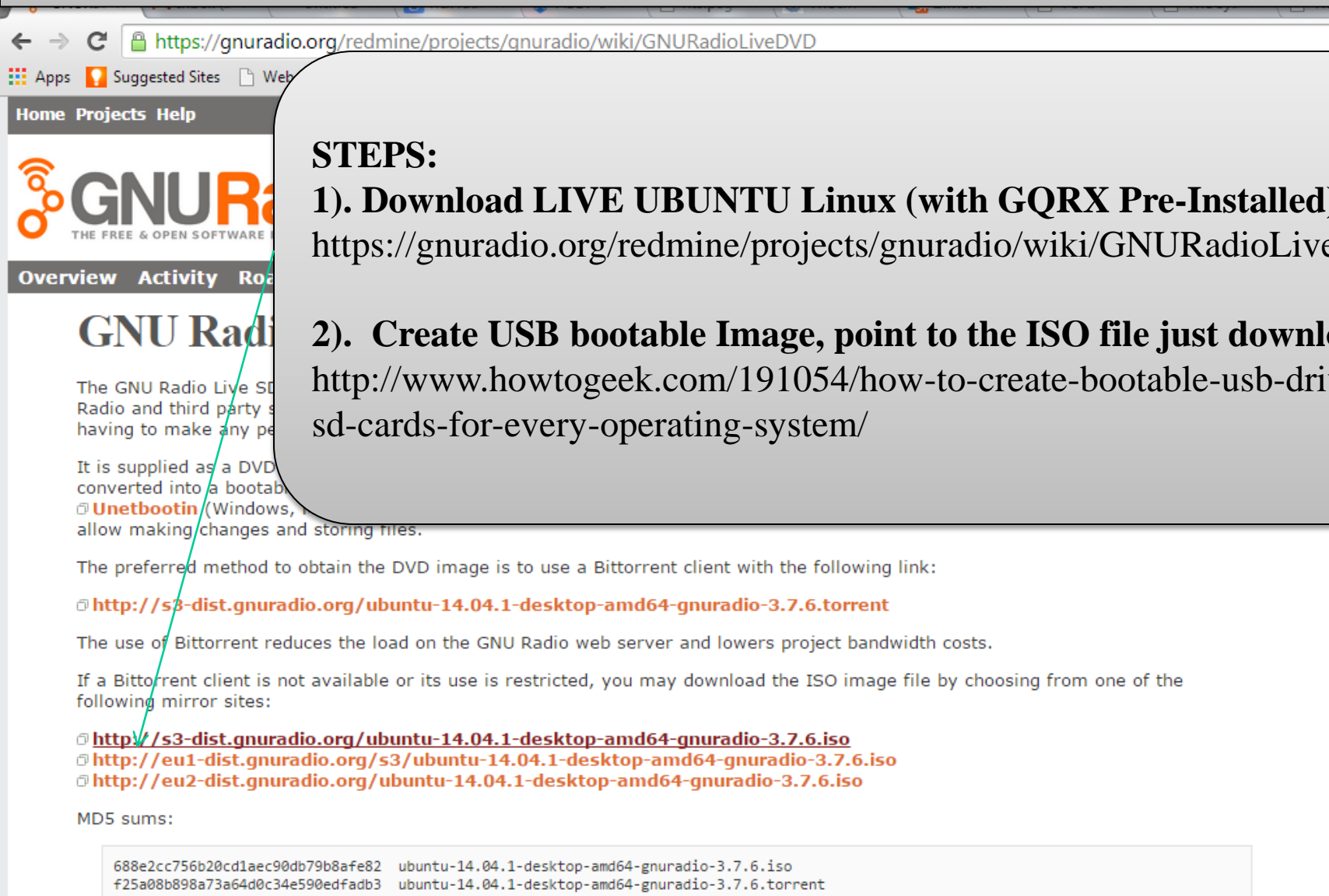
GQRX is pre-installed on
several Linux Live
Distributions, e.g.
GNURadio

Instruction Steps Follow
– see Next Two Slides

GQRX is a free simple to use SDR receiver which runs on Linux and Mac systems. It is similar to SDR# in terms of features and simplicity of use. GQRX comes with a standard FFT spectrum and waterfall display and a number of common filter settings.

Evolution of Software Defined Radio;

Preparing the Bootable Live UBUNTU/GQRX USB Drive



The screenshot shows a web browser window displaying the GNURadioLiveDVD wiki page. The browser's address bar shows the URL <https://gnuradio.org/redmine/projects/gnuradio/wiki/GNURadioLiveDVD>. The page has a navigation bar with 'Home', 'Projects', and 'Help'. The main content area features the GNURadio logo and a heading 'GNU Rad'. Below this, there is text about the GNU Radio Live SD and a list of links for downloading the ISO image file. A grey callout box with rounded corners is overlaid on the right side of the page, containing the title 'STEPS:' and two numbered steps. A green line points from the first step to the first link on the page.

STEPS:

- 1). Download LIVE UBUNTU Linux (with GQRX Pre-Installed)**
<https://gnuradio.org/redmine/projects/gnuradio/wiki/GNURadioLiveDVD>
- 2). Create USB bootable Image, point to the ISO file just downloaded**
<http://www.howtogeek.com/191054/how-to-create-bootable-usb-drives-and-sd-cards-for-every-operating-system/>

The GNU Radio Live SD...
Radio and third party s...
having to make any pe...

It is supplied as a DVD...
converted into a bootab...
☐ **Unetbootin** (Windows, ...
allow making changes and storing files.

The preferred method to obtain the DVD image is to use a Bittorrent client with the following link:

☐ <http://s3-dist.gnuradio.org/ubuntu-14.04.1-desktop-amd64-gnuradio-3.7.6.torrent>

The use of Bittorrent reduces the load on the GNU Radio web server and lowers project bandwidth costs.

If a Bittorrent client is not available or its use is restricted, you may download the ISO image file by choosing from one of the following mirror sites:

☐ <http://s3-dist.gnuradio.org/ubuntu-14.04.1-desktop-amd64-gnuradio-3.7.6.iso>
☐ <http://eu1-dist.gnuradio.org/s3/ubuntu-14.04.1-desktop-amd64-gnuradio-3.7.6.iso>
☐ <http://eu2-dist.gnuradio.org/ubuntu-14.04.1-desktop-amd64-gnuradio-3.7.6.iso>

MD5 sums:

688e2cc756b20cd1aec90db79b8afe82	ubuntu-14.04.1-desktop-amd64-gnuradio-3.7.6.iso
f25a08b898a73a64d0c34e590edfadb3	ubuntu-14.04.1-desktop-amd64-gnuradio-3.7.6.torrent

<https://gnuradio.org/redmine/projects/gnuradio/wiki/GNURadioLiveDVD>

Evolution of Software Defined Radio;

Boot into Live UBUNTU/GQRX

Ubuntu Desktop

12:02 PM

GNU Radio
Companion

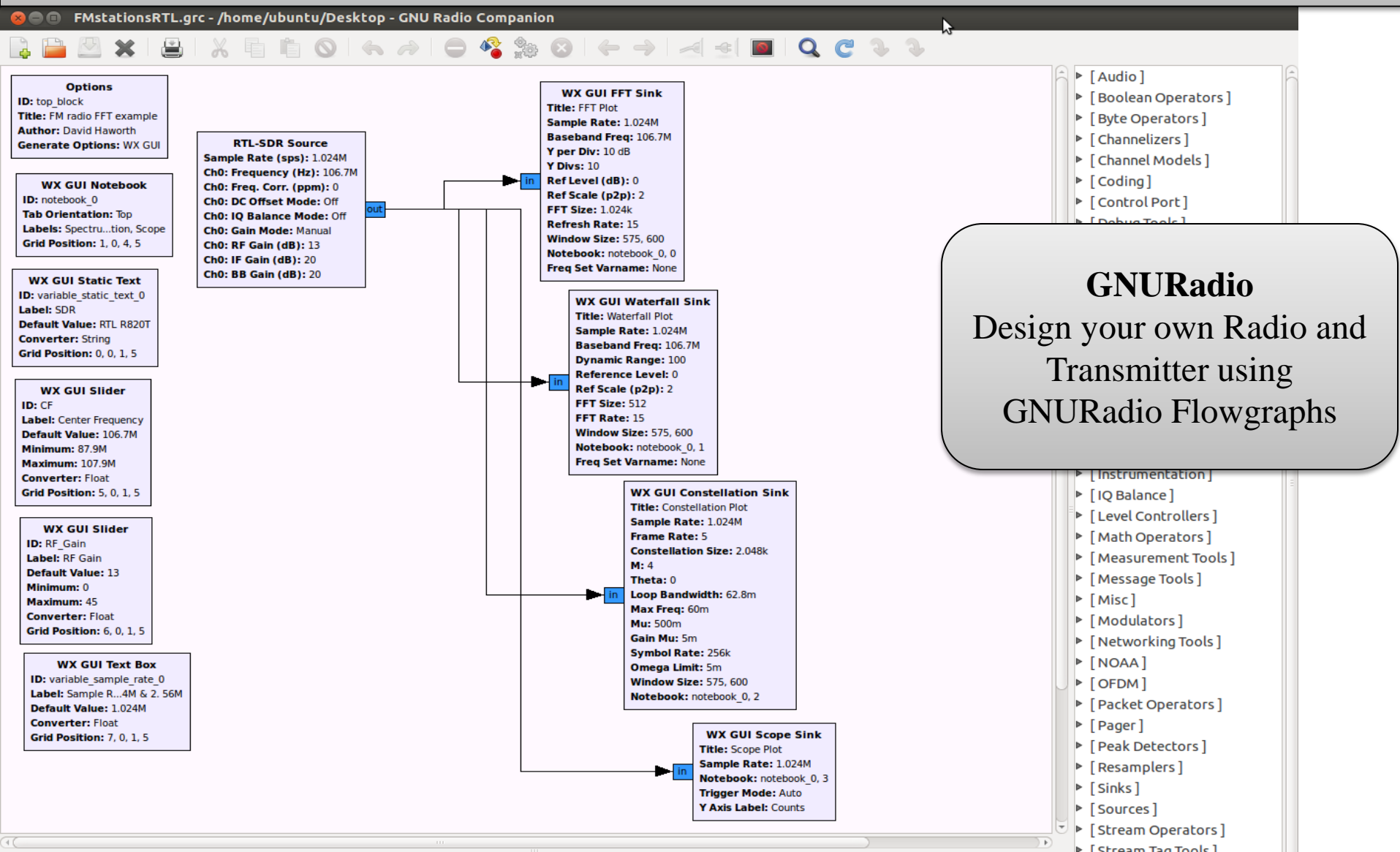
GQRX LAUNCH STEPS:

- 1). Insert the bootable USB in the powered-off PC
- 2). Press Power ON switch, immediately tap **F12**
- 3). Select and Press Enter to **Boot from USB stick**
- 4). Approximately 1-2 minutes, you will be in UBUNTU Linux
- 5). Insert TV Tuner SDR USB Stick
- 6). Select **TERMINAL (>__)** window and type **gqr x** (enter)

HOW TO SOLVE BOOTABLE USB PROBLEM in WIN8

See: <https://help.ubuntu.com/community/UEFI>

Evolution of Software Defined Radio; *Build Your Own SDR for Fun!*



GNURadio
Design your own Radio and
Transmitter using
GNURadio Flowgraphs

Evolution of Software Defined Radio; *Breakthroughs by Leveraging COTS Technology*

