adafruit learning system

Getting Started with RTL-SDR and SDR-Sharp and CubicSDR

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Overview

Software-defined radio (SDR) is a technique for turning a computer into a radio. But not just an AM/FM radio - by using the computing power on your desktop you can listen and decode a wide variety of broadcasts. SDR can turn your computer into a weather-band receiver, a police/fire report scanner, a music listening station, and more! Instead of manually tuning inductors, its all done in software by chips fast enough to pick up and decode radio waves on the fly

If you've ever been curious about software defined radio (SDR), this USB stick is the easiest way possible to have fun with a powerful, configurable receiver. Packed with the powerful RTL2832U and R820T tuner, it can tune into signals from 24MHz to 1850MHz. That means you can use a computer (with Windows, Mac, or Linux) to tune into: FM Radio, AM signals (but not AM radio), CW (morse code!), unencrypted radio signals (such as those used by many police and fire departments), POCSAG pagers, and more.

In this tutorial we'll show how to get your very first listening adventure underway - listening to FM radio and decoding the RDS/RBDS data signal that is sent along with many FM radio stations as well.

Wan't lots more info? There's hundreds of tutorials, posts and projects over at http://www.rtl-sdr.com/

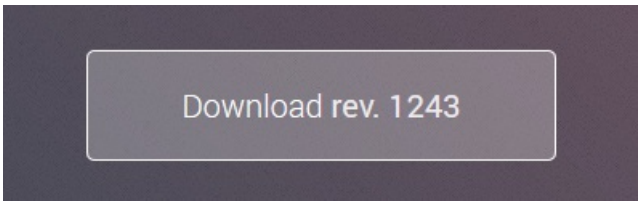
Next, we'll set up the software -- if you're using windows, head to the next page -- SDR-Sharp for Windows (https://adafru.it/Cd6). On mac os, jump to the page CubicSDR for mac os (https://adafru.it/Cd7).

To see some SDR action live, check out this episode of John Park's Workshop:

SDR-Sharp for Windows

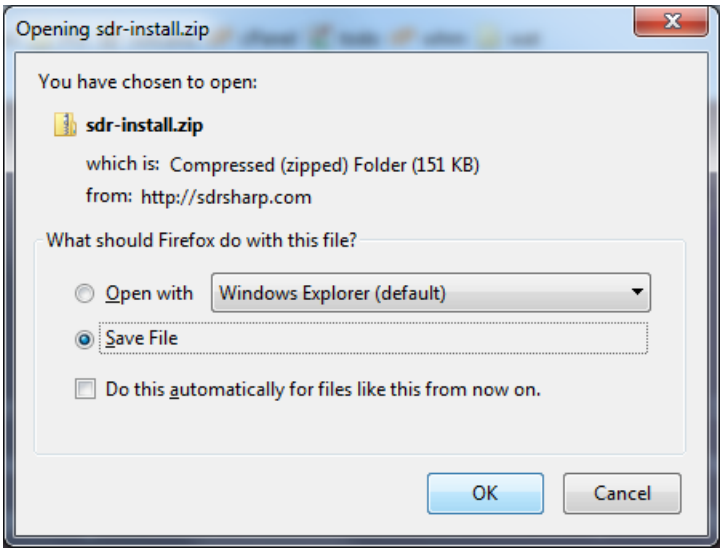
Download & Install Software

We'll be using the awesome SDR# software for windows, which is really easy to use and very powerful as well! Visit http://sdrsharp.com/ (https://adafru.it/dsT) to download - we're using Rev 1243

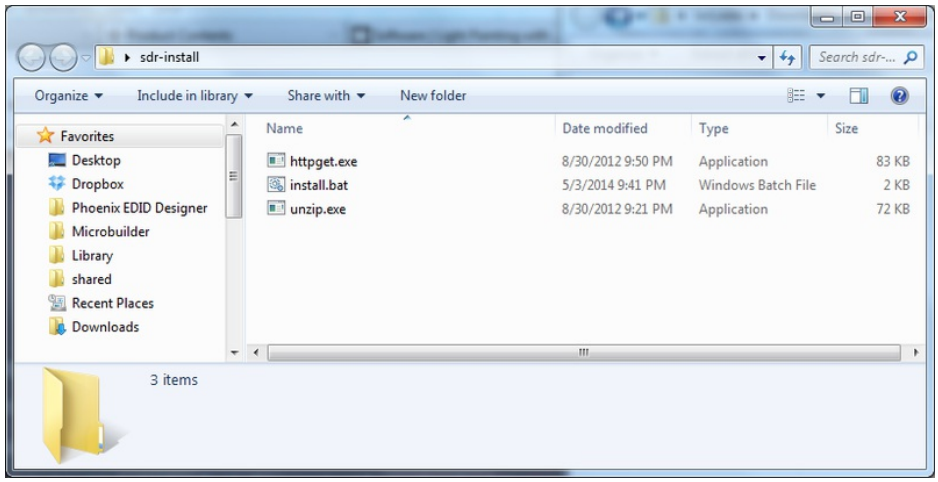


If for some reason the site is down, we have a mirror of the install folder from 5/19/2014 (https://adafru.it/dsU)

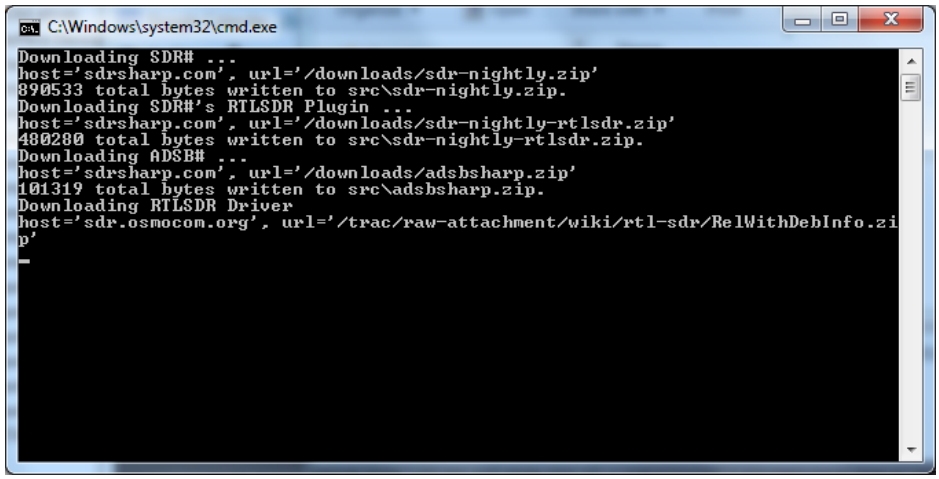
We suggest downloading the latest version as there will be minor bug fixes, etc!



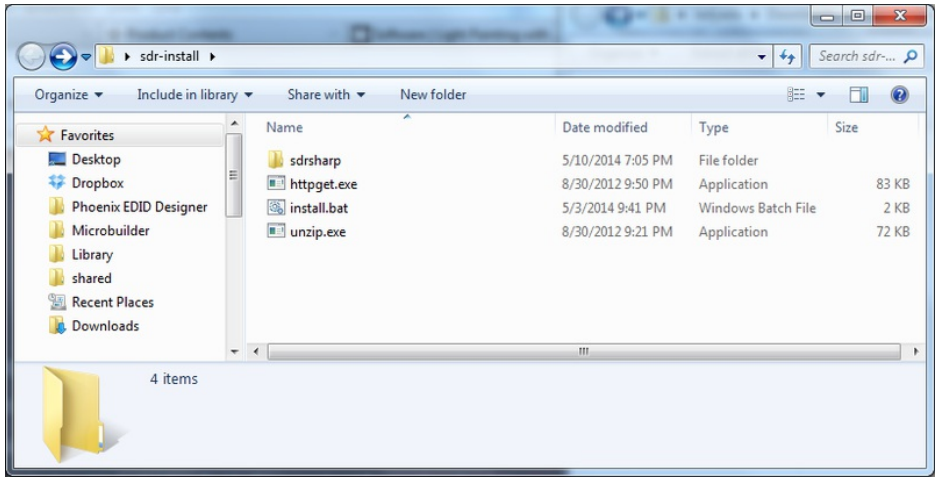
Save and uncompress the zip file



Double-click on **install.bat**



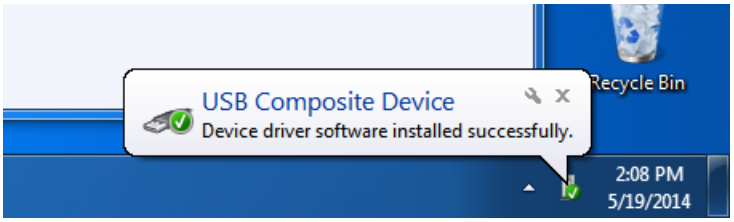
This will download the latest build and extract it into the current folder. SDR# does not install into the toolbar or start menu!

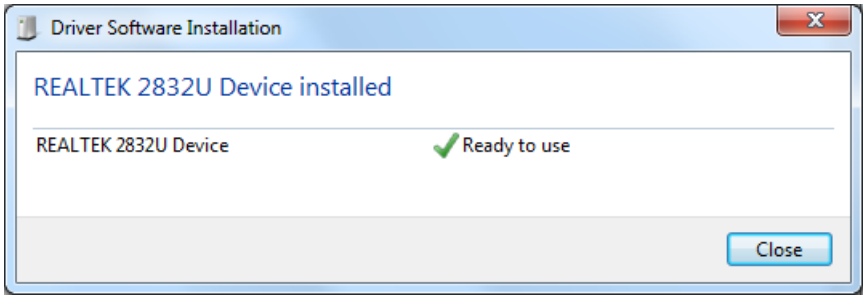


Driver Fix

Before we continue, we'll have to install the Windows driver for the RTL USB stick and then swap it for a 'low level access' driver. The default driver assumes you'll just be using the RTL-SDR for watching TV or radio but we want to be able to control it to do much more.

Plug in the stick, Windows should automatically install the REALTEK 2832U driver



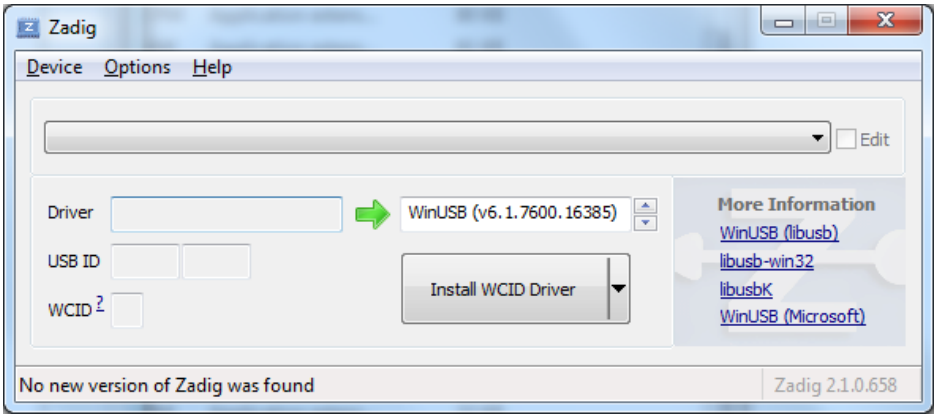


Now from inside the SDR# directory, run **Zadig** which will do the driver swapping for us.

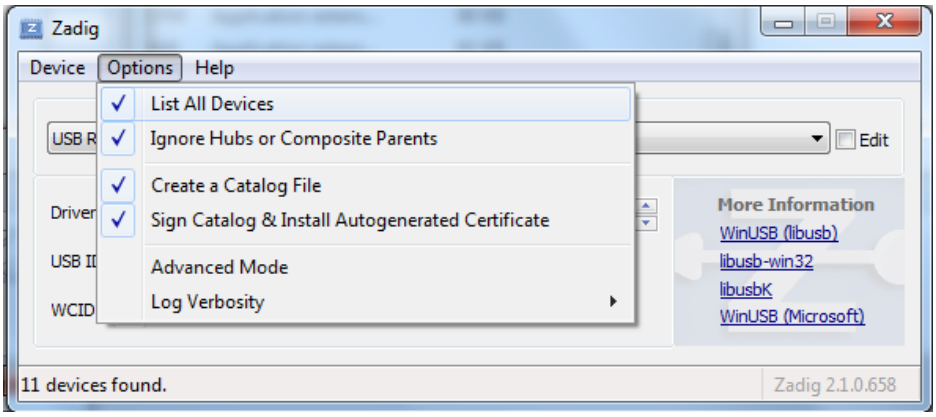
Here's a version 2.2 exe if you need it:

https://adafru.it/DkS

https://adafru.it/DkS

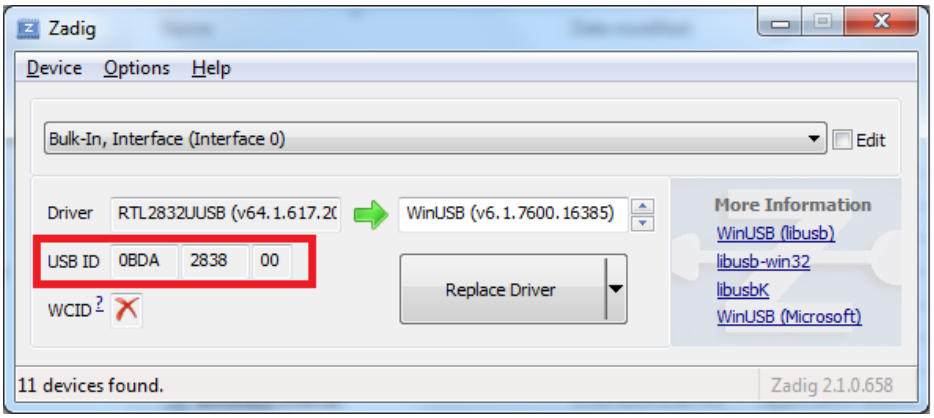


From the Options menu, select **List All Devices**



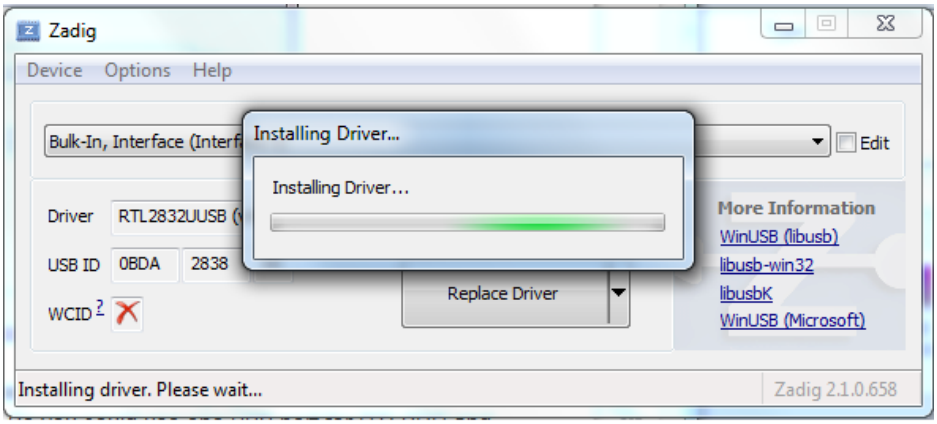
Then from the devices drop-down, find one that says **Bulk-In, Interface (interface 0)**. If there's more then one, select one at a time, and verify below to get the right one.

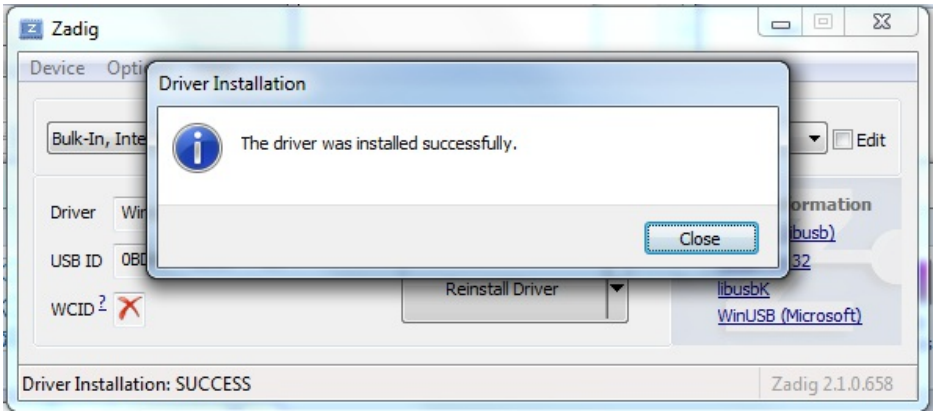
Check that you get **USB ID 0x0BDA** (vid) and **0x2838** (pid) and the **RTL2832UUSB** driver



Make sure to the right of the green arrow you see **WinUSB**

Click **Replace Driver**



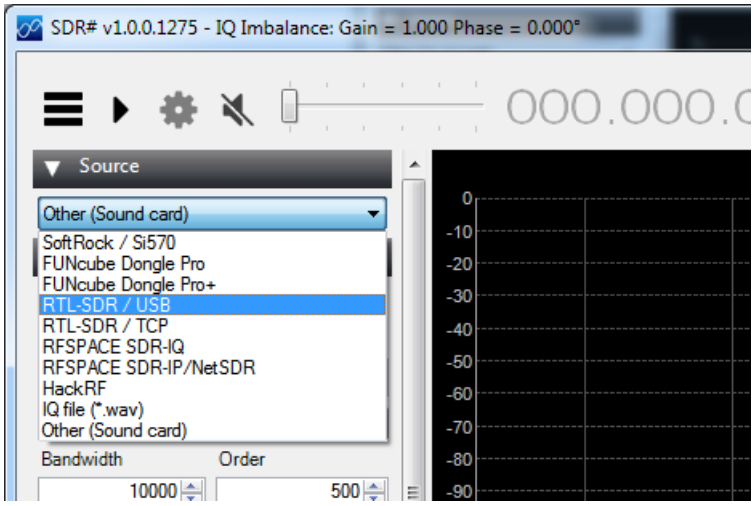

Zadig
Device
Driver Installation
The driver was installed successfully.
Close
Edit
Driver
USB ID
WCID
Reinstall Driver
libusbK
WinUSB (Microsoft)
Driver Installation: SUCCESS
Zadig 2.1.0.658

That's it!

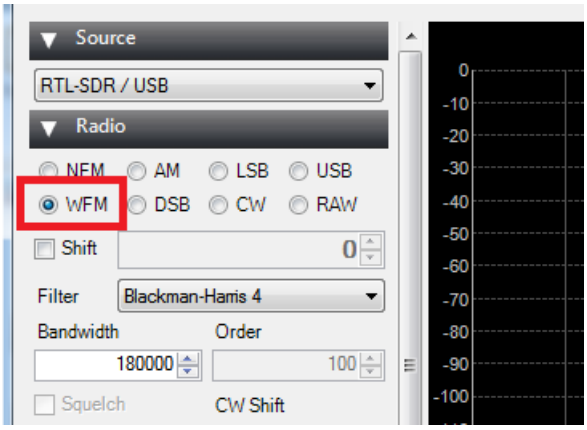
SDR# FM Radio

Lets start by just listening to every-day FM radio. Open up **SDRsharp.exe** (you can close Zadig)

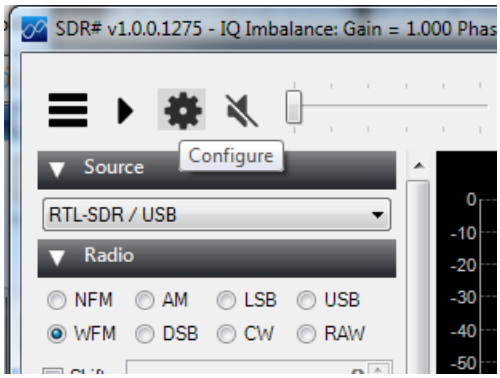
Begin by selecting the RTL-USB dongle instead of audio card



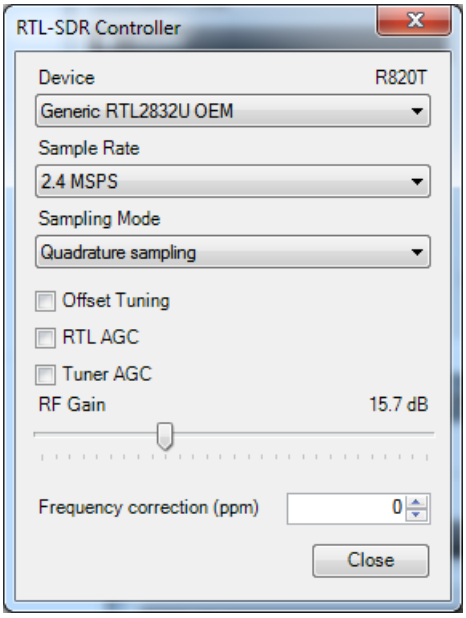
Select **WFM** (wide-band FM radio) under the Radio signal type



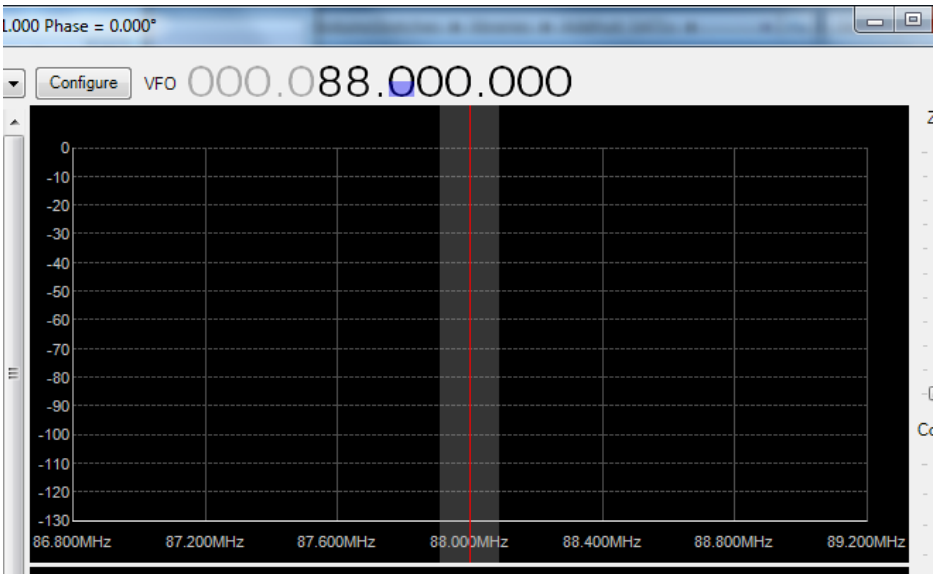
Click on **Configure**



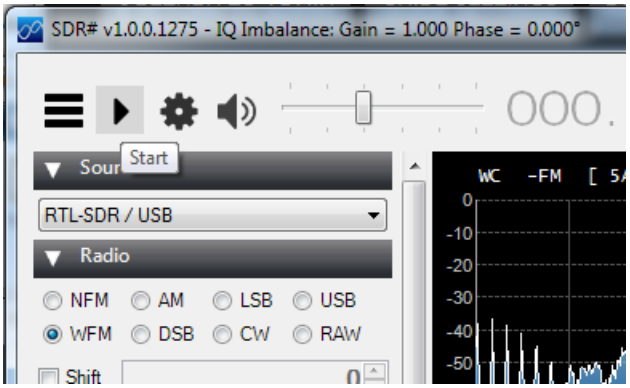
And set the gain about half-way up



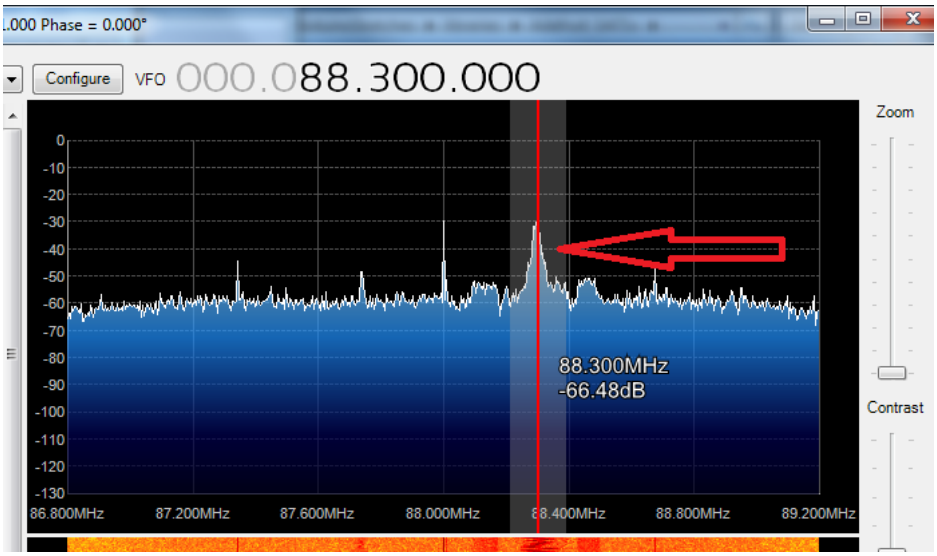
You can set your favorite frequency (FM station) by clicking on the large numbers up top



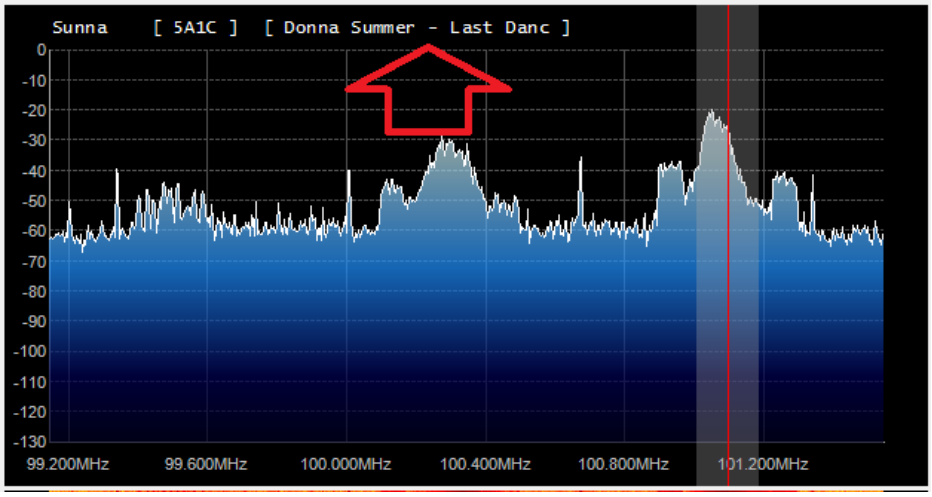
Click **Play/Start** and set the volume starting from low to high so you don't hurt your ears!



You can 'seek' for radio stations by looking for peaks. Click on them to tune in



With the latest versions of SDR-Sharp it will automatically detect and decode RBDS/RDS data that is sent along with FM radio



Chances are your radio station is also playing Donna Summer!

SDR# NWR (Weather) Radio

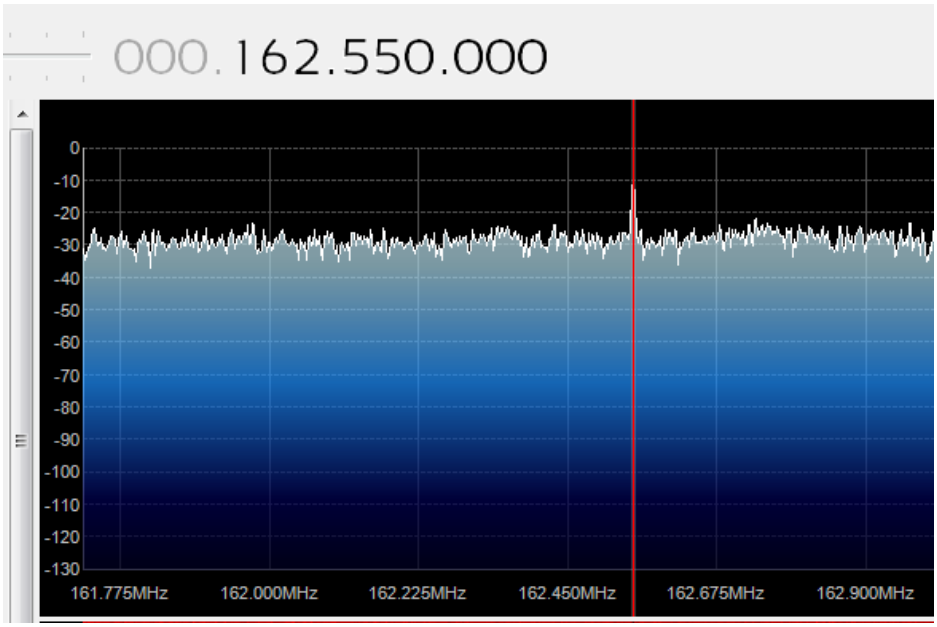
Most every-day AM/FM radios can't tune into theNOAA Weather Radio (NWR) All Hazards network but with RTL-SDR we can! NWR is the national weather alert system, which broadcasts weather data as well as emergency alerts. (https://adafru.it/Cd8)

Let's tune into the closest weather station to Adafruit Southern California, which is in Los Angeles. You'll want to tune into whatever station is closest to you.

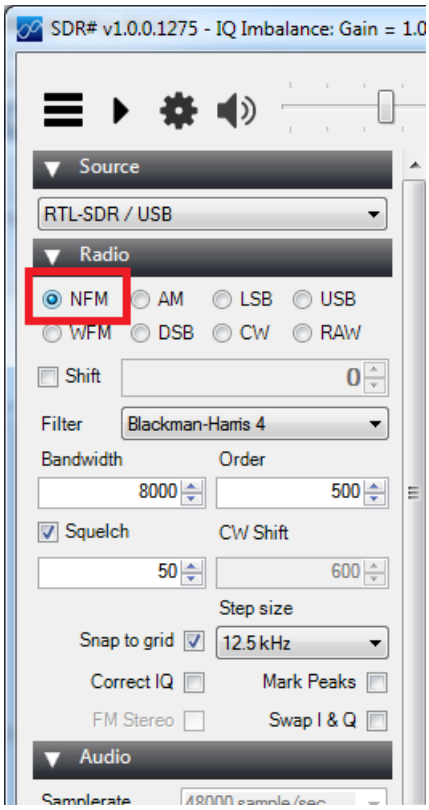
To begin, visit the NOAA weather station frequencies-by-county index here (https://adafru.it/Cd9)

Montgomery	036057	Albany	WXL34	162.550	ALL
Montgomery	036057	Cooperstown	WWH35	162.450	ALL
Montgomery	036057	Middleville	WXM45	162.425	ALL
Nassau	036059	Meriden	WXJ42	162.400	N
Nassau	036059	New York City DEGRADED	KWO35	162.550	ALL
Nassau	036059	Riverhead	WXM80	162.475	Central/E
New York	036061	New York City DEGRADED	KWO35	162.550	ALL
Niagara	036063	Buffalo	KEB98	[illegible]	ALL
Oneida	036065	Cooperstown	WWH35	162.450	S
Oneida	036065	Middleville	WXM45	162.425	ALL
Oneida	036065	Syracuse	WXL31	162.550	W
Onondaga	036067	Syracuse	WXL31	162.550	ALL

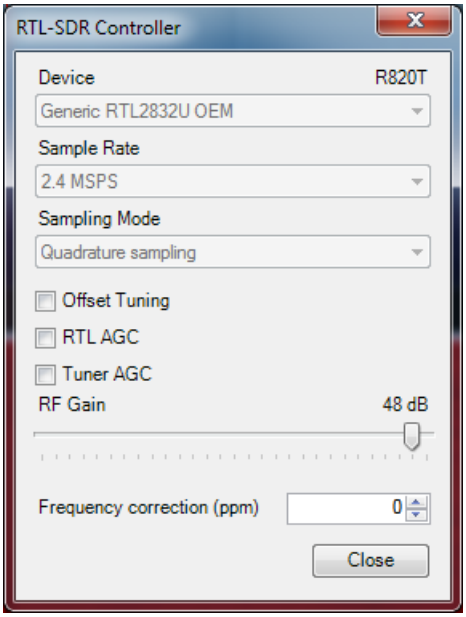
The frequency is 162.550 MHz, type that into the SDR# frequency window



You can see a little peak, its much smaller signal than the FM radio stations. It's also much *thinner* which makes it a narrow-band FM rather than wideband. Since its voice, not stereo music, they use less of the frequency band, so select **NFM** as the decoding type



The station is marked as degraded, but by amplifying the gain on the RTL-SDR we were able to tune in



You should be able to hear a computer-generated voice speaking out the weather forcast. It's not terribly exciting but it is very thorough, often giving very detailed reports. The signal continuously transmits so you can tune in at any time!

Going forward

now that you have some basic functionality working, try tuning into other frequencies, and trying the different kind of decoding (e.g. CW/AM/NFM) to tune into AM radio!

CubicSDR for mac os

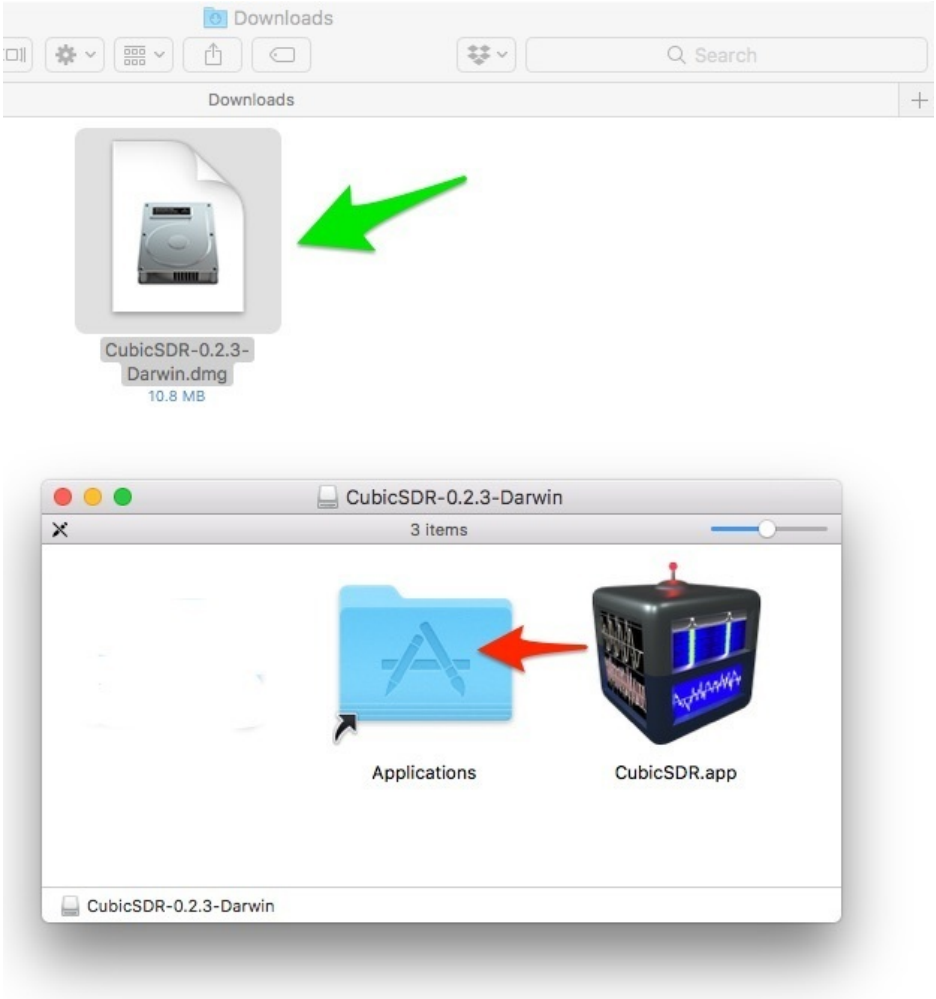
Download & Install Software

On mac os, we'll be using the excellent CubicSDR (https://adafru.it/Cda) cross-platform, open source software. For this tutorial we'll use release version 0.2.3 Head to the Downloads (https://adafru.it/Cdb) page to grab the latest version, or click this link to directly download 0.2.3

https://adafru.it/ARI

https://adafru.it/ARI

Once you've downloaded the installer (in this case named **CubicSDR-0.2.3-Darwin.dmg**), double-click it to mount the disk image, and then drag the **CubicSDR.app** to your **Applications** folder as shown here.

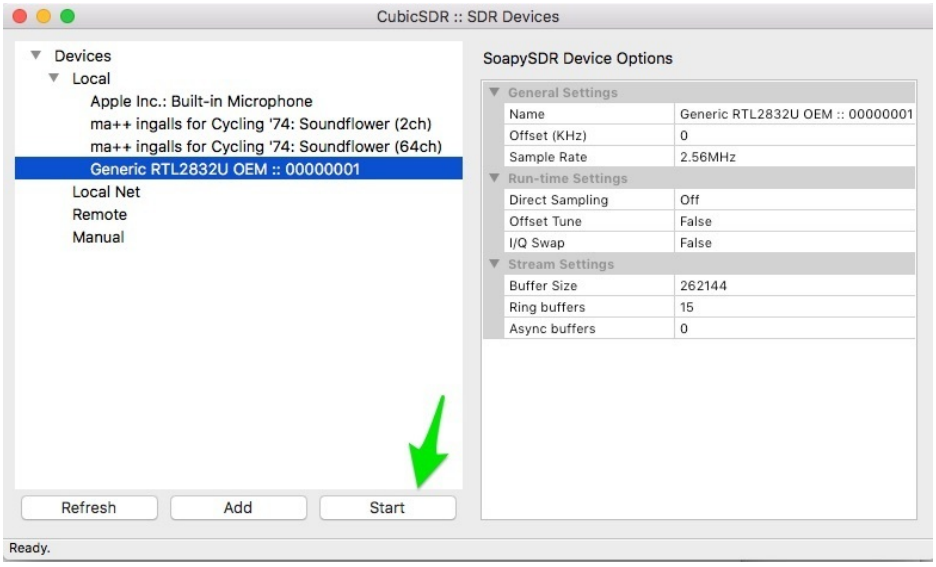


Now, plug your RTL-SDR dongle into a USB port on your mac, and then double-click the CubicSDR.app in your

Applications folder to run it.

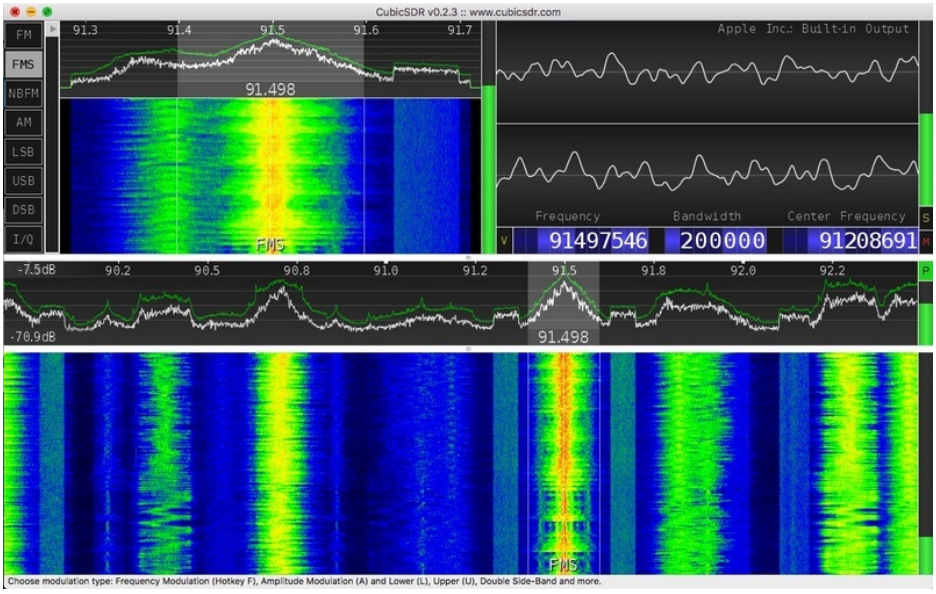
Start the SDR Device

When you launch CubicSDR, it will pop up a window asking you to select and start your SDR device. Pick the one named **Generic RTL2832U OEM :: 00000001** and then click **Start.**

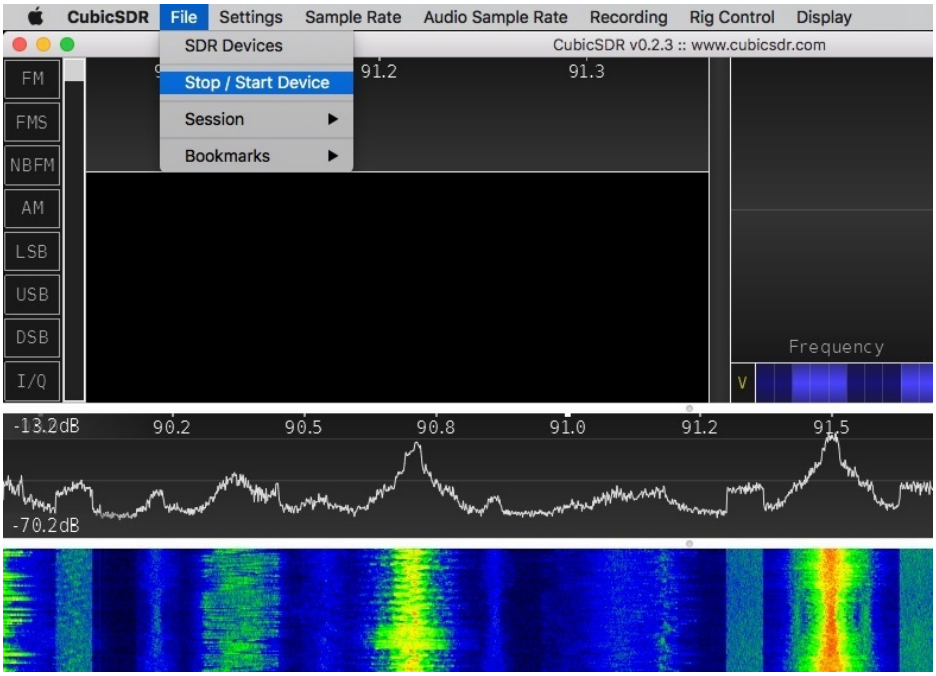


CubicSDR FM Radio

We'll begin by listening to some broadcast FM radio.

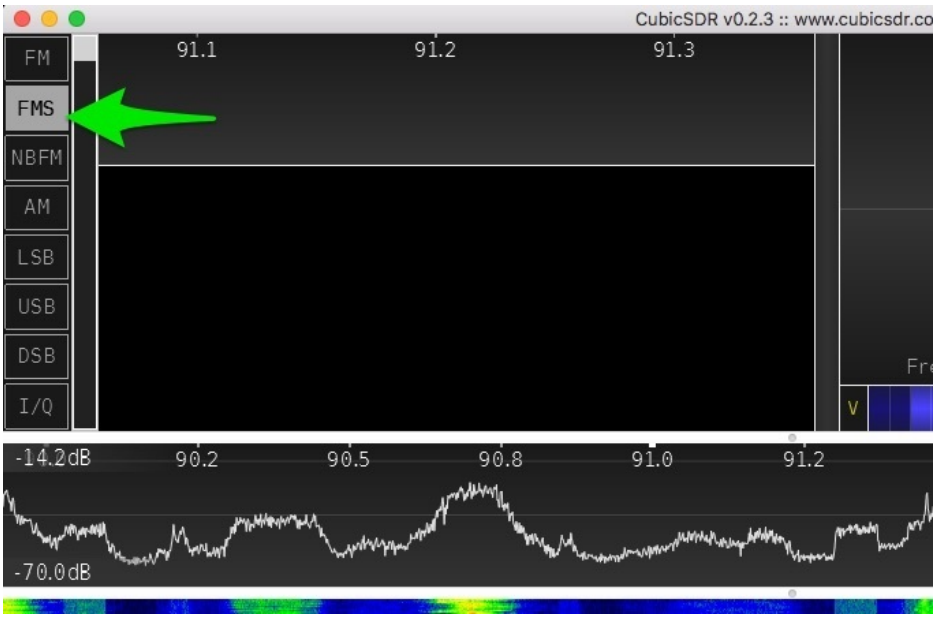


First, make sure your RTL device has started by clicking the **File** > **Stop** / **Device** menu item. When it is running you will see the waterfall frequency display moving at the bottom of the interface, as well as some moving waveforms in the other areas.



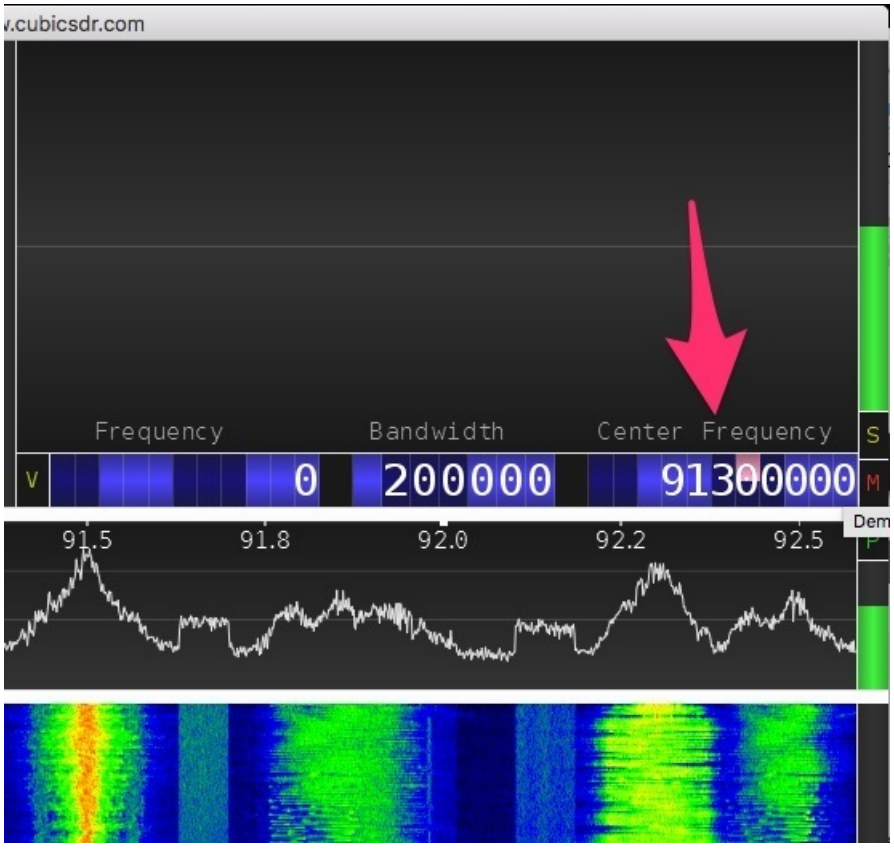
Signal Type

The CubicSDR software in combination with the RTL dongle can tune and demodulate different ranges and types of radio signals. For this example, we'll select Frequency Modulation Stereo (**FMS**) as the signal type.



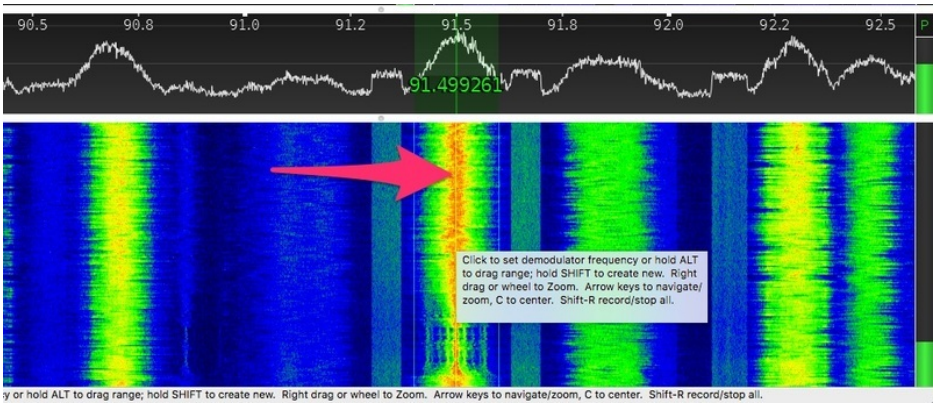
Center Frequency

Next, you can tune in a station! Start by setting a center frequency for a station you like, by clicking on the numbers under the "Center Frequency" heading.

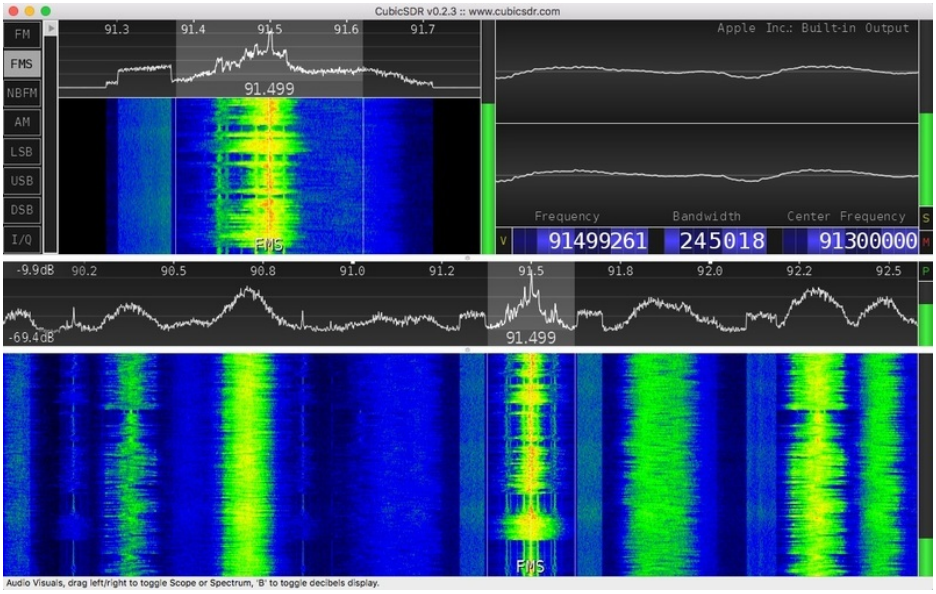


This will bring a range of frequencies into view -- approximately 3MHz at a time are available. Now, you can set a demodulator down on a range you want to tune. This is done by clicking in the waterfall display, with the cursor at the center of the frequencies you want to hear. This will usually be the orange and red display section, showing you where

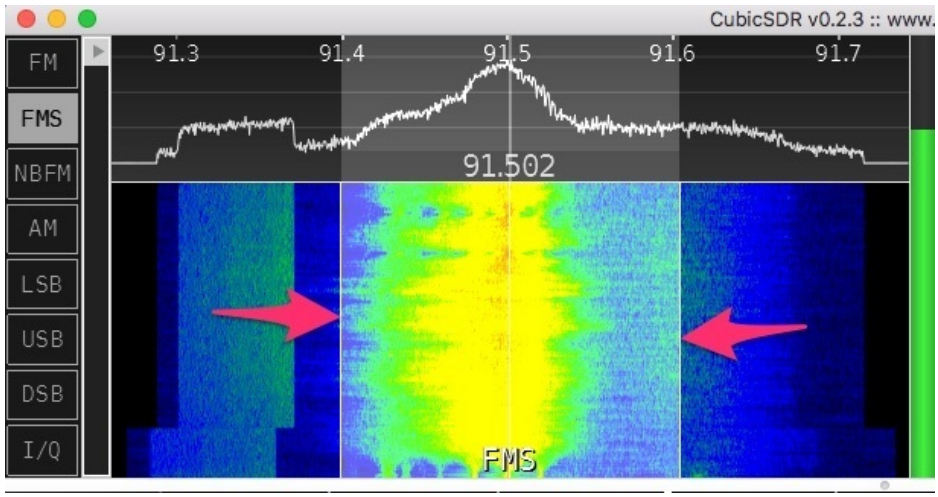
the strongest signal lies.



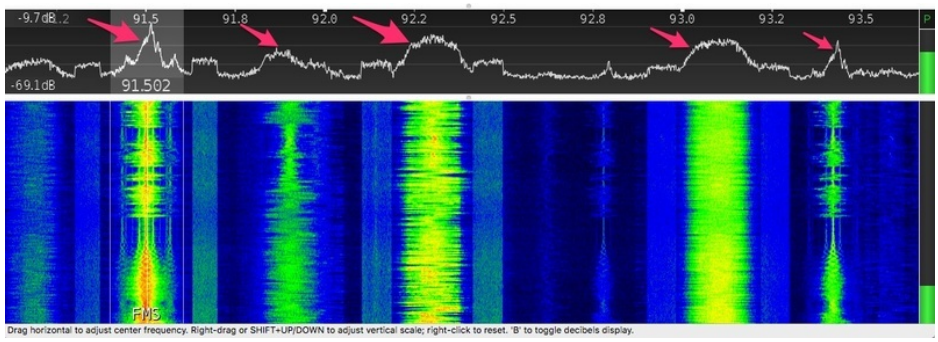
Here, the demodulator has been set at 91.499261MHz, and we have a nice strong signal. Music plays!



You can see the fine tuning section in the upper left corner gives us a zoomed in view of the demodulator. You can drag this one left and right in the waterfall section to fine tune, or grab one of the outer edges of the demodulator to change the bandwidth that is being processed. Too wide and you'll pick up unwanted signals, too narrow and you'll start to cut off important parts of the signal.



You can search for other stations by scrubbing the peaks display left or right and looking for strong peaks. Set down a demodulator in the waterfall area under a strong peak to listen in.



The frequency band for FM broadcast radio is 88MHz to 108MHz.

CubicSDR NWR (Weather) Radio

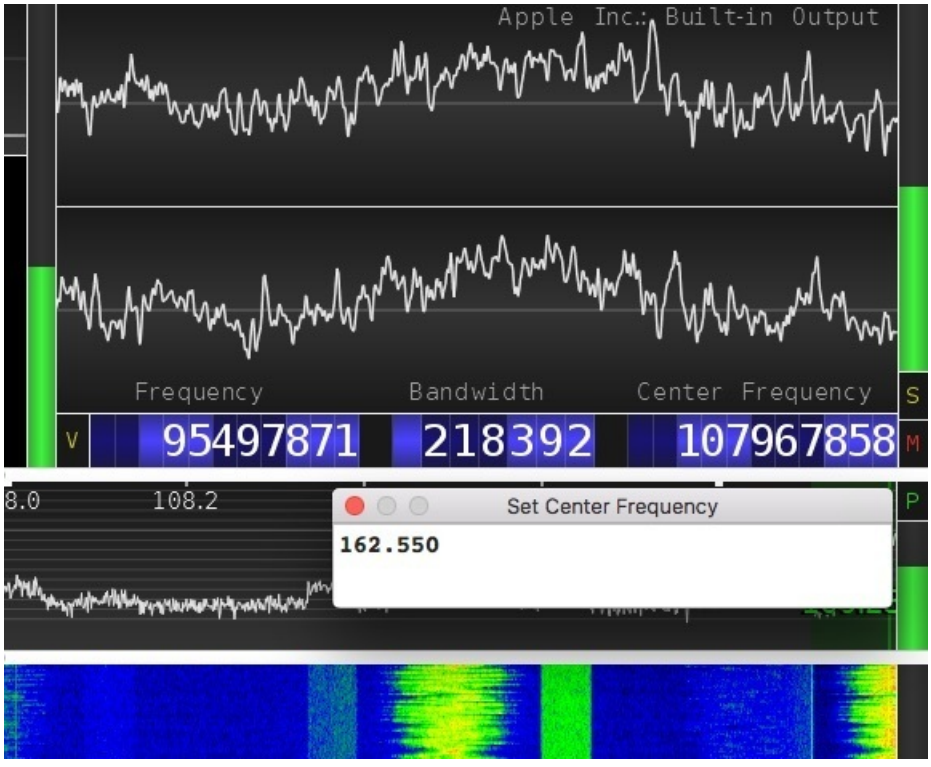
Most every-day AM/FM radios can't tune into theNOAA Weather Radio (NWR) All Hazards network but with RTL-SDR we can! NWR is the national weather alert system, which broadcasts weather data as well as emergency alerts. (https://adafru.it/Cd8)

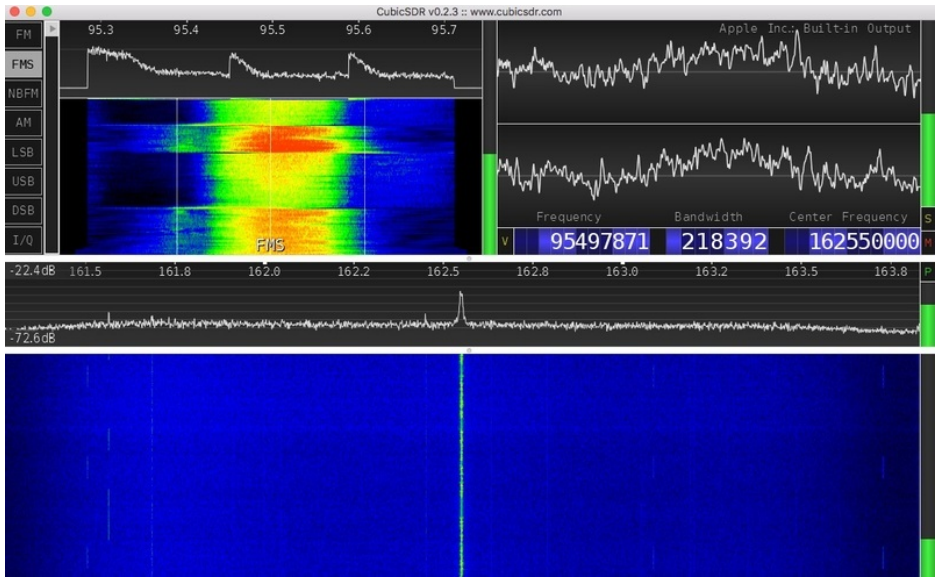
Let's tune into the closest weather station to Adafruit Southern California, which is in Los Angeles. You'll want to tune into whatever station is closest to you.

To begin, visit the NOAA weather station frequencies-by-county index here (https://adafru.it/Cd9)

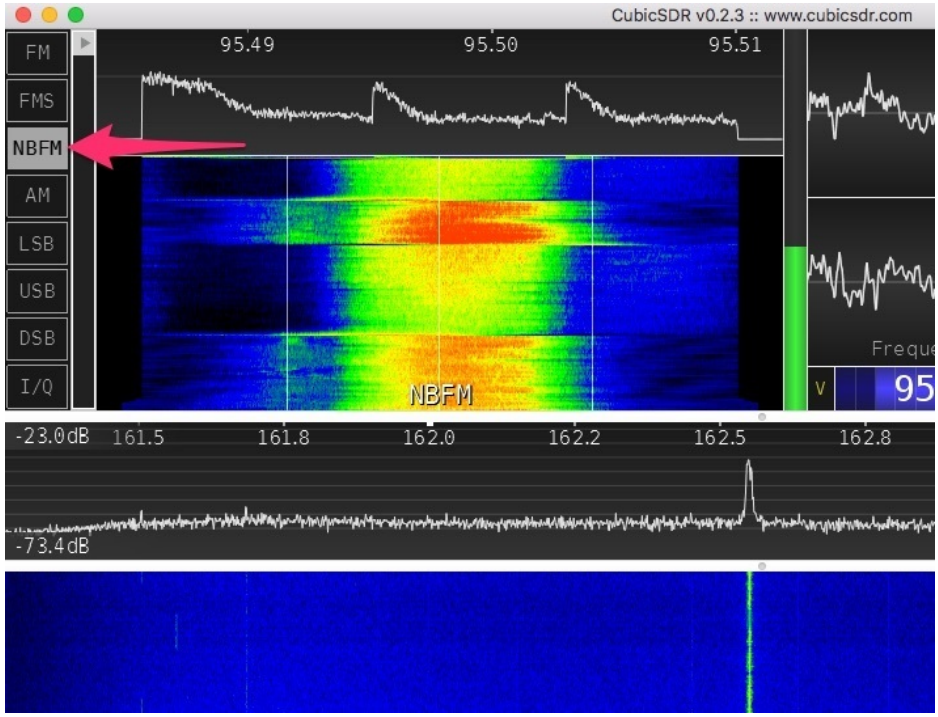
Kings	006031	Bakersfield	WXL89	162.550	ALL
Kings	006031	Fresno	KIH62	162.400	ALL
Lake	006033	Ukiah	WNG720	162.525	NORTHERN
Lassen	006035	Fernley	WWG20	162.450	ALL
Lassen	006035	Susanville	WZ2530	162.500	ALL
Los Angeles	006037	Avalon	WNG584	162.525	EXTREME WEST
Los Angeles	006037	El Paso Mtns.	WNG659	162.425	N
Los Angeles	006037	Los Angeles	KWO37	162.550	ALL
Los Angeles	006037	Malibu Marine	KWL22	162.425	ALL
Los Angeles	006037	Sandberg	WZ2505	162.425	NORTH CENTRAL
Madera	006039	Fresno	KIH62	162.400	W
Marin	006041	Big Rock Ridge	KDX54	162.500	ALL
Marin	006041	San Francisco	KHB49	162.400	ALL
Mariposa	006043	Fresno	KIH62	162.400	SW
Mariposa	006043	Yosemite	KAD94	162.450	NORTH CENTRAL
Mendocino	006045	Point Arena	KIH30	162.550	W

The frequency is 162.550 MHz, type that into the CubicSDR tuner window by hovering over the Center Frequency box and hitting spacebar.

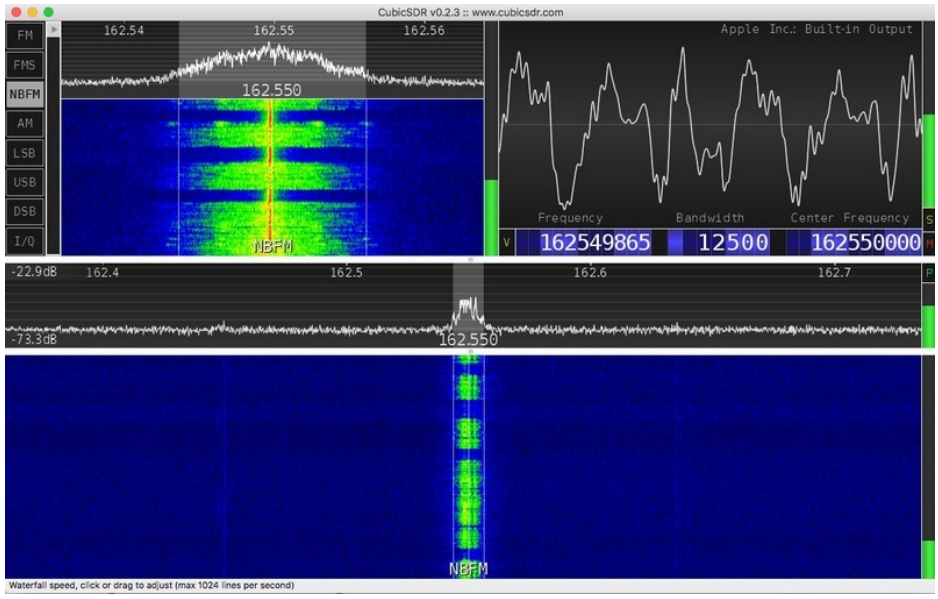




You can see a little peak, its much smaller signal than the FM radio stations. It's also much *thinner* which makes it a narrow-band FM rather than wideband. Since it's voice, not stereo music, they use less of the frequency band, so select **NFM** as the decoding type.



Click to set a demodulator at the 162.550 MHz peak.



You should be able to hear a computer-generated voice speaking out the weather forecast. It's not terribly exciting but it is very thorough, often giving very detailed reports. The signal continuously transmits so you can tune in at any time!

Going forward

Now that you have some basic functionality working, try tuning into other frequencies, and trying the different kind of decoding (e.g. CW/AM/NFM) to tune into AM radio!

F.A.Q.

The SDR dongle seems to get hot!

Yep, these run pretty warm. As long as it's still working, you should be good to go. There's a pretty advanced chipset inside which can consume a lot of power

What kind of computer do I need?

You need a computer with at least one USB 2.0 or higher port. You will also need admin privs to install the software, we used it on Windows 7, XP should be the same. There's also software for Mac and Linux but we don't have tutorials for it. Google around for RTL-SDR and what you wanna do for lots of ideas!