Introduction to SDR Hands-On Lab

For the introduction to SDR lab, we'll focus on using inexpensive RTL-SDR receivers with some free, cross-platform SDR tools that should run on most operating systems. While a lot of people think of SDR as an advanced skill that requires the use of Linux, you can easily use Windows or MacOS for this part of the training.

We assume that you have a laptop or desktop system, and that you have at least one RTL-SDR compatible receiver and a suitable antenna.

Please acquire and install all software listed below, and have the required RTL-SDR hardware in hand before the day of the Introduction to SDR class. Most hardware links are affiliate links (I get a small portion of the proceeds of sale) but you can also search for your own hardware and antenna configurations if you do not already own them.

Hardware

You need at minimum one RTL-SDR Compatible receiver, and a monopole antenna to participate in the SDR lab.

RTL-SDR + Antenna Bundles

RTL-SDR Blog v3 Bundle (Affiliate Link)

NESDR Smart Bundle (Affiliate Link)

This tiny SDR gets very hot and in my experience may not be as reliable as the larger ones, but is good for Raspberry Pi and Android SDR apps:

NooElec NESDR Nano 3 with USB-OTG Bundle (Affiliate Link)

HackRF One / PortaPack

I will demonstrate wide-band reception, and replaying signals with the HackRF One during the lab. **Owning a HackRF One is not a prerequisite.** I will be hosting a HackRF One / PortaPack Mayhem Boot Camp course later this summer, though.

Either the HackRF One by itself, or the HackRF One PortaPack (with a recent build of Mayhem installed) will work. If Mayhem came pre-installed, you will likely need to upgrade it. The genuine hardware is very expensive: $350 for the HackRF One, and $190 for the PortaPack without a battery or any accessories:

Hacker Warehouse: Genuine HackRF One
Hacker Warehouse: Genuine PortaPack H2 (HackRF Not included)

Clones and counterfeits are everywhere because the circuitry and firmware have been open-source for a decade. NooElec is probably the most trustworthy clone with decent warranty support in the USA. It's basically the same price as the Genuine HackRF One, but comes with more accessories:

NooElec HackRF One Bundle (Affiliate Link)

Most of the clones on AliExpress seem to work fine but some people have problems. Caveat Emptor, or something like that. They come pre-assembled, with a battery built-in. These are starting to show up on Amazon, which has a pretty good return policy, so may be safer than AliExpress. Example:

Clone HackRF+PortaPack H2 bundle, assembled (Affiliate Link)

RTL-SDR WinUSB Drivers (Windows only)

Zadig

Before using SDR tools on Windows, you also must download Zadig. If you plan on using Windows for the SDR Lab, download Zadig for Windows from here: https://zadig.akeo.ie/

At the beginning of the lab portion, we will go through using Zadig to load the winUSB drivers correctly, but if you want to get it working before the class:

1. Run Zadig
2. Insert your RTL-SDR receiver into a USB Port
3. The device option window should go from being blank to listing a “Bulk-in Interface”
4. Click the button to install WinUSB drivers with the default options. This takes a few minutes.
5. Close Zadig.

Software

The presentation demo will be focused on Windows, but if you install it on Mac or Linux, the tools will work the same way. Please try to install these applications before the class begins. If you have trouble getting them installed, please contact me for help. I will have some time available in the evenings and weekend before the class to assist students if needed.

SDR++

SDR++ (Also called SDR Plus Plus or SDRPP) is a relatively new “waterfall” style tool for visualizing the RF spectrum and listening to analog radio transmissions. It is not the easiest to use, but it’s probably the best waterfall style SDR app that runs on Windows, Mac and Linux. It’s also available for Android devices.

Download SDR++ for your platform here:
https://github.com/AlexandreRouma/SDRPlusPlus/releases/tag/nightly

Installation:
On Windows and Mac, “Extract All” from the ZIP file, and you can run SDR++ directly from the extracted folder. DEB packages (for Debian and Ubuntu derived OSes) exist. It may be available in your distribution’s package repositories. On Manjaro and Arch, I installed it via AUR.

SDRTrunk

SDRTrunk allows you to tune into unencrypted, trunked digital voice trunked systems such as those used by public safety and law enforcement. This tool works best if you have multiple RTL-SDR tuners, but with only one, you might get it to work well enough for a demo. P25 trunk systems use a proprietary voice decoder that requires a commercial license, but SDRTrunk can

install a reference decoder for personal research and evaluation purposes.

Download SDRTrunk for your platform here:
https://github.com/DSheirer/sdrtrunk/releases/tag/v0.6.0

Installation:
“Extract All” from the ZIP file, and you can run SDRTrunk directly from the extracted folder.

SDRAngel

SDRAngel is an advanced tool for SDR that is capable of decoding both analog and digital signals. We will use it to decode ADS-B airplane transponders in real time and chart airplane traffic on a map, as well as demonstrate using it for analog audio reception.

Download SDRAngel for your platform here:
https://github.com/f4exb/sdrangel/releases

Installation:
Windows: Run the .exe file to set up and install SDRAngel
Mac: Open the DMG and run directly or copy it to your Applications folder
Linux: Install via package repositories

Universal Radio Hacker

URH is a cross-platform tool for intercepting, reverse engineering and replaying wireless protocols. It supports transmitting via the HackRF One and several other mid-range SDR as well.

Download & Installation:
Follow the install guide from the URH GitHub