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Basics of Software Defined Radio

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What is an SDR?

An SDR is a device that allows for relatively cheap and simple wireless communication research and development. The hardware component of the system consists of an analog front end connected to an antenna, analog/digital converters, and often contains an FPGA. These devices connect to a PC via USB or serial port and many of the traditionally hardware components (mixers, amplifiers, filters, etc.) are implemented in software.

Common SDR Hardware

USRP

- National Instruments
- Many different options with a wide variety of specifications
- High precision, industrial research grade, full duplex, multi antenna
- Several thousand dollars
- www.ni.com/en-us/shop/select/software-defined-radio-device

RTL-SDR

- Relatively low performance, half duplex, single antenna
- 22Mhz - 2GHz Freq. Range
- 3.2MHz Bandwidth
- Hobbyist/hacker grade
- RX Only
- <$20
- www.rtl-sdr.com

HackRF One

- Relatively good performance, half duplex, single antenna
- 1Mhz - 6GHz Freq. Range

- 20MHz Bandwidth
- Basic research grade
- $299
- www.greatscottgadgets.com/hackrf

LimeSDR

- Good performance, full duplex, multi antenna
- 100khz - 3.8GHz Freq. Range
- 61.44MHz Bandwidth
- Basic Research grade
- $289
- www.crowdsupply.com/lime-micro/limesdr

Common SDR Software

LabView

- National Instruments
- Useful for all kinds of research
- Ideal when using National Instruments hardware
- Windows/Mac (note: not all NI hardware works on mac)
- $20 for students

GNURadio

- Open source, easy to use
- Linux/Mac (Windows is not officially supported but installation is possible)
- Can be programmed using graphical GNURadio Companion environment or using Python
- Free
- www.wiki.GNURadio.org

GNURadio Installation

- Guide: www.wiki.gnuradio.org/index.php/InstallingGR
- Tips:
    - Simplest Installation on Linux

        - Linux Pentoo comes with GNURadio preloaded
    - Recommend partitioning hard drive with a Linux Distribution
        - Linux installation guide: www.tldp.org/HOWTO/Installation-HOWTO/index.html

HackRF Setup/Tutorials

- Connect to GNURadio
    - Guide: www.wiki.gnuradio.org/index.php/Hardware
        - Includes many hardware guides
- Video Tutorials: www.GreatScottGadgets.com/SDR

Additional Resources

- H. Stern, S. Mahmoud “Communication Systems: Analysis and Design”
    - Available at Texas State Library
- www.Radio-Electronics.com
    - Resource for basics of RF theory and electronics design