



Getting Started With SDR

A Spur-of-the-Moment/Potpourri Presentation

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What Does “SDR” Mean?

- **Software-defined radio (SDR)** is a **radio** communication system where components that have been traditionally implemented in hardware (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) are instead implemented by means of **software** on a personal computer or embedded system.
- [Software-defined radio - Wikipedia](#)
- https://en.wikipedia.org/wiki/Software-defined_radio
- https://upload.wikimedia.org/wikipedia/commons/2/22/SDR_et_WF.svg

Why SDR?

- We would need a year-long (at least) college-level course to answer this thoroughly!
- A simple answer could be this example: Ham radio transceivers from a company like FlexRadio Systems (<https://www.flexradio.com/>) have undergone 3 major releases of their SmartSDR software that have revolutionized the way amateur radio equipment is developed and used.
- Features that simply have never been implemented in traditional hardware-based rigs are making their way into common use.

Advantages of SDR

- The ability to alter functionality by downloading and running new software at will;
- The ability to receive and transmit various modulation methods using a common set of hardware;
- The possibility of adaptively choosing an operating frequency and a mode best suited for prevailing conditions;
- The opportunity to recognize and avoid interference with other communications channels;
- Elimination of analog hardware and its cost, resulting in simplification of radio architectures and improved performance; and,
- Myriad opportunities for experimentation.

Anything Else?

- According to the Software Defined Radio Working Group of the ARRL dated 1 July 2002:
 - Dynamic range is the ratio of the largest tolerable signal to the smallest usable signal.
 - Receiver dynamic range is a central issue for software-defined radio (SDR) designers today
 - The challenge is to find an effective digital signal processing (DSP) implementation of receiver functions that achieves dynamic range sufficient for the frequency range of interest, whether it is HF, VHF or above.
 - It may be possible some day to digitally sample signals directly from the antenna while still maintaining high dynamic range.

Surprise! SDRs Are Doing This NOW!

- It is possible today to sample the entire electromagnetic spectrum at once, displaying multiple “slices” of that spectrum on your computer display simultaneously!
- FlexRadio offers a dedicated computer display called “Maestro” that takes the place of a traditional PC or laptop and offers easy-to-use remote operation over the Internet.
- One can sit in Starbucks or McDonalds with a Maestro and “work the world,” connected to a base 6xxx system anywhere in the world.
- There is also software for iOS & Android devices (SmartLink)

So You Enjoy the “Digital Modes?”

- With Software Defined Radios, no external devices like sound cards or extra cables are needed!
- All connections between/among software programs and the SDR are “virtual”
- You can run logging programs, digital mode programs, and the like simultaneously without interference
- For example, check out: <https://www.flexradio.com/ft8/>

Side-by-Side Comparison



See:
https://www.flexradio.com/comparison/?_ga=2.108487947.844894228.1555527271-1315547342.1555527271



My Flex 6300 and later 6700 were what I called "My black boxes of parts!" They only had an on/off switch, and connectors for a key/keyer paddle, microphone and DC power in & RF out!



Newer models now offer a more traditional front-panel with knobs and dials and displays



My Maestro served as a proxy for my PC.

Another Practical Benefit

- Friends and I have run two Flex 6700 transceivers in a contest, side-by-side, both connected to kilowatt amplifiers
- Both radios were connected to outdoor antennas on towers less than 100' apart
- Regardless of the bands (even running one on the CW portion and the other up in the SSB portion of the same band), neither radio was affected by interference from the other!
- I ran my Elecraft KX3 last Saturday in the NM QSO Party and was literally clobbered by a 100-watt radio several hundred feet away!

There is a Price, however....

- Full-function SDRs in the amateur radio market can be expensive.
- Prices for rigs that FlexRadio offers range from \$2k to \$7k!
- SmartSDR software is included with a new purchase, but subsequent, major upgrades currently cost about \$200
- Why spend the \$200 or so? If you want/need the features in the upgrade(s) it would be a lot cheaper than buying a brand-new hardware-based radio for many thousands of dollars!
- Version 3.0 offers “multiFLEX” (2 operators, 1 radio!)
- Minor (dot) upgrades are free. All upgrades are optional.

Several Models from FlexRadio

 FlexRadio



FLEX-6400

FLEX-6600

FLEX-6700

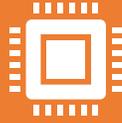
What About Non-Flex Radios?

- When Icom America announced their IC-7300 HF amateur radio, these radios literally flew off the shelves!
- It had an extremely reasonable price tag (around US\$1.2k) and offered some SDR capabilities.
- Icom's press release called it "A first in an amateur radio transceiver: the IC-7300 utilizes technology seen in Software Defined Radios (SDR) and other radio equipment. Its RF direct sampling system promotes a high-performance spectrum scope and superior phase noise."
- Well, it is not a super-heterodyne-based radio, for sure.
- The jury is still out on upgradeability. Minor firmware upgrades are available.

Icom America IC-7300



How Can You Get Started Cheaply?



Visit <https://www.sdr-radio.com/> and check out the hardware and software available through the consortium.



SDR dongles (with antenna) can be ordered from <http://adafruit.com> for \$22.50. They also sell adapter cables like the the “MCX Jack to BNC RF Cable Adapter” (a \$6 cable that lets you attach the dongle to a ham-band antenna).



Visit <https://www.adafruit.com/product/1497>



If our group orders 10 units or more, the dongle price drops to \$20.25 each and we save a bit on shipping.

Software Defined Radio Receiver USB Stick



I'm Interested in Learning More!

- I've included links to 3 presentations from friends of mine back in NJ.
- Dr. Joe Jesson (ex-KC2VGL, now W2JEJ) is an adjunct professor at the College of NJ;
- Dr. Rebecca Mercuri (KA3IAX) is a world-renowned expert witness in the fields of computer security, electronic voting, and electronic music;
- John Degood (NU3E) has worked for Sarnoff Labs, L3, and others as an engineer. He is also an avid yoga practitioner and teacher!
- Continued....

Useful Follow-up Presentations...

- Visit : princetonacm.acm.org/downloads.html and download the 3 slide PDFs on SDR from their Princeton ACM talks on Feb. 17, 2016:
- **Security Applications of Software Defined Radio, Feb 17, 2016 (PDFs)**
- Getting Started with SDR Software + Resources, Rebecca Mercuri KA3IAX (PDF, 134 KB)
- Security Applications of Software Defined Radio, Joe Jesson W2JEJ
- RTL-SDR Plane Spotting, John DeGood NU3E (PDF, 4.9 MB)



Questions?