Newcomers and Elmers Net: SDR Radio 12-22-13 Robert AK3Q

SDR

For those who might not know about SDR, or *software-defined radio*, the main idea is that everything needed to receive (and transmit for those units so equipped) is contained on a computer circuit board.
-- With simple SDRs using a computer's built-in sound support (or an optional sound card unit), signals are received, decoded, and sent through a software interface for control.
-- modern radios have been using computer technology to one degree or another for many years, but only in the last decade or so has the physical radio been removed completely from the equation.
-- More advanced SDRs use highly refined ADCs, or audio-to-digital converters, and therefore do not even need the soundcard.
-- There are a number of benefits in using computers for radio reception, and of course some drawbacks.
-- One advantage is the manipulation of a signal which has been converted from analog to digital.
-- Much like an audio recording where sampling rates, filters, and various minute adjustments can be made at any point in the audio process, so too radio signals can be processed before any mixing is done.
-- Instead of having expensive component pieces to amplify audio or modulate/demodulate a signal, the basic computer processor can do most of the heave lifting.
-- This cuts down dramatically on cost, as well as complex filtering needs to deal with the products of mixing and modulation.
-- Another rather exciting advantage to such a system is that the computer can sample the signals received over a wider bandwidth than a typical radio, so that rather than seeing one signal on your screen, you may see many.

SDR Basics

SDRs commonly come in two flavors: the older (and least expensive) method is to use one's PC to provide the computational power and audio for the radio, while newer (and more expensive) models often include both the processor and the audio capability in an external unit.
-- There are advantages and disadvantages to both.
-- Since almost all radio enthusiasts have at least one computer, using that computer drastically reduces the price of an SDR.
-- Another advantage to using a standard PC is software integration. The SDR can easily be used with many different digital-mode packages, logging programs, and even computer control interfaces.
-- Updates are easy using standard Internet connections, and memory/storage capabilities are easily expandable.

-- On the downside, specialized digital signal processors can allow stand-alone units some incredibly fast processing times, and the level of signal manipulation is therefore much greater.
-- Some units almost look like a regular analog radio, and indeed work much like a conventional radio, which can be important for folks who are either not comfortable with a computer, or who are looking to operate contests where speed is a real issue.
-- While software interfaces have advanced by leaps and bounds, working through them with a mouse is rather tedious at best when trying to operate a contest.

Software does the Real Work
While hardware is necessary for an SDR to work, it is the software which carries most of the load.
-- Software can take the place of hardware for many functions, thereby both reducing cost and increasing direct control of a signal.
-- Software manipulation of a signal is possible because of the technology which converts an analog signal to a digital one: a processing chip called an ADC, or analog-to-digital converter, puts the received electrical signal into a discrete-time and discrete-amplitude digital signal.
-- Once a signal has been converted to a digital format, all kinds of manipulation or *processing* of the signal is possible.
-- This conversion is done through *sampling*, where the ADC takes a predetermined number of readings or samples, rather than one single conversion.
-- *Oversampling* is a process by which signals are sampled at a high frequency and then digitally filtered to reduce the bandwidth.
-- The signal is then usually dropped to a very low intermediate frequency, and thus enhancing the ability of the software to manipulate the signal.
-- With the right combination of filters, for example, a digitally-filter signal can have a sharper filter-form without as much damage to the signal as a similar analog filter.

As impressive as the software is behind the scenes, the front-end of most software packages for SDRs presents a level of control many users find extremely useful.
-- In addition to functions such as AGC (automatic gain control), noise reduction, and notch filtering, SDRs allow for rather advanced digital signal manipulation.
-- For those familiar with operating CW, for example, traditional analog filters are often either too steep or too wide.
-- An SDR can accomplish extremely tight narrow filtering without unnecessary clipping of the audio with the click of a mouse.

-- Similarly an SDR can lock on to portion of a signal and track it, much like the synchronous detect feature of some higher-end radios, but often with better results than its analog cousins.
-- The result is a stronger continuous signal less prone to fading.
-- Broad spectrum coverage is another advantage to an SDR receiver as signals from across the chosen spectrum are visible on a typical waterfall display (so called because of the movement of the graphical representation of the band which resembles a waterfall).
-- For those who have used some of the digital modes such as PSK31 or MT63, the waterfall display is a familiar one, and it can become addictive!

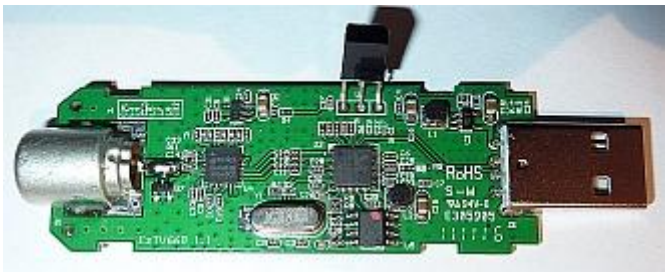
Expense
Even though software defined radios can be somewhat expensive, their capabilities are impressive, and costs are decreasing fairly rapidly, all things considered.
-- While mid- to high-end transmitters/receivers still have a performance edge, current SDRs are closing the gap quickly, and in some areas already out-perform their analog counterparts.
-- Add to this the responsiveness of the software designers to the feature wish lists of their user base, and SDR technology is going to gain popularity quite rapidly.
-- On the opposite end of things, there are ridiculously inexpensive SDRs coming on the market which offer a lot of room for experimentation without a significant investment.
-- With much of the software development happening in the open-source user community, there is definitely room for anyone who wants to get their feet wet without giving up their traditional radios (or selling the family farm!).

Software
There is a lot of versatility in software. One is SDR-Radio, another, which I use a lot and like very much is HDSDR
-- On the HDSDR you can alter a lot of things to suit your taste or your needs, bandwidth is continuously adjustable up to 10 kHz (depends on the soundcard sampling speed)
-- there is an attenuator, a noise blanker, several adjustable notch filters, a peak filter for CW
-- You can receive digital broadcasts (DRM), which sounds like a CD on a short wave radio... There is a zapper for zero beating on a mouse click
-- AFC, a synchronous detector for AM with selectable sidebands for dodging QRM, and on and on

DAB Dongle

An inexpensive entry into SDR is the DAB Dongle.

-- For a bit of technical background, the USB SDR dongle I have been using is based on an RTL2832U integrated chip and the R820T tuner chip.



-- The dongle has a tuning range of about 25MHz-1700MHz with the R820T chip, while some based on the E4000 chip or the FC0013 chip are slightly different.

-- These dongles were designed for Digital Video broadcast reception in Europe, but their design architecture allowed for SDR use

A typical example of the coverage capability for one of these dongles is the FM broadcast band.

-- Depending on your unit, you may see as much as 2MHz width of signal at one time displayed in a waterfall on the computer screen

-- The noise level is obvious, and the signals rising significantly above the noise level is likely a broadcast station.

-- When you click on the signal (using a software program like SDR# see below), the receiver is tuned to that frequency, and you hear it through your computer audio.

-- The bandwidth can be recorded depending on your setup, allowing you to go back and listen to the various channels. Cool. Way cool!

-- Of course, all of the typical VHF/UHF bands may be covered, such as marine, military and civilian aircraft, local businesses, etc..

-- Pretty much anything you can pick up with a regular scanner can be received with one of these units.

-- This also means you can monitor satellites with these units, as well as listen for meteor bursts, NAVSPASUR 216.97927 MHz (**Nav**al **Spa**ce **Sur**veillance)

Software Defined Antennas

Finally, the future may some day hold antennas which adapt to changing band conditions, and either change their radiation pattern or seamlessly connect to other SDRs as part of a larger system.

-- Currently only the stuff of high-end laboratory experiments, software defined antennas (SDAs) have been used in the microwave spectrum to manipulate and direct radiation patterns depending on propagation.

-- Work is already being done to maximize bandwidth efficiency through spread spectrum usage of bands, as well as frequency hopping with SDRs.

-- SDAs could eventually allow for more exact coordination and efficient signal detection, minimizing interference with other spectrum users.