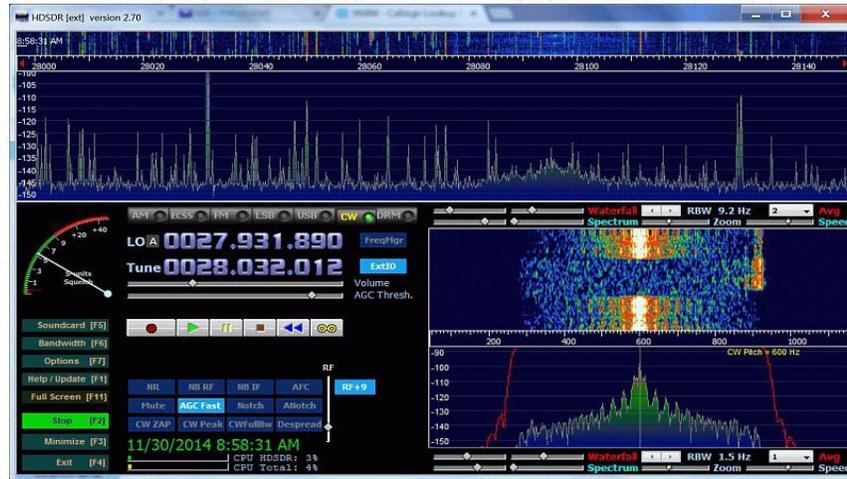*SOFTWARE DEFINED RADIO*
SARA presentation by Lyle, KØLR

This is an update of a SARA presentation I made about 10 years ago. It reviews what SDR is and how it's different from conventional radio, looks at where the technology is today and talks about new products. The presentation included a demo of a $15 device that you can use to experiment with SDR on your own.

The screenshot above was taken with the $15 device connected to my G5RV antenna during a DX contest last November.

Definition of SDR

Transceiver hardware components
(mixers, filters, amplifiers, modulators,
demodulators, detectors, etc.) are replaced
by software processes

Although a modern "analog" ham rig looks a lot different from what it did 60 years ago, the basic building blocks are still there – just a lot smaller. With SDR, though, these components are nearly all replaced by digital circuits.

Block diagram of analog receiver
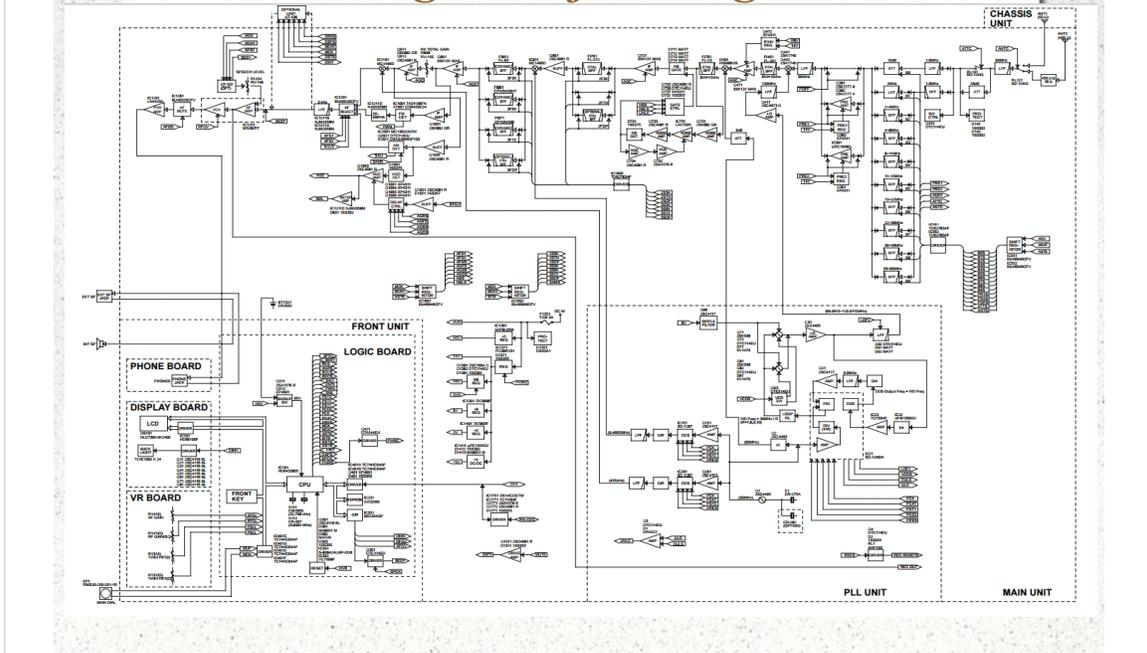
This diagram of a triple-conversion receiver shows the traditional grouping of mixers, bandpass filters, local oscillators and demodulators – all of which can be replaced by SDR technology.

"Almost ideal" SDR Receiver
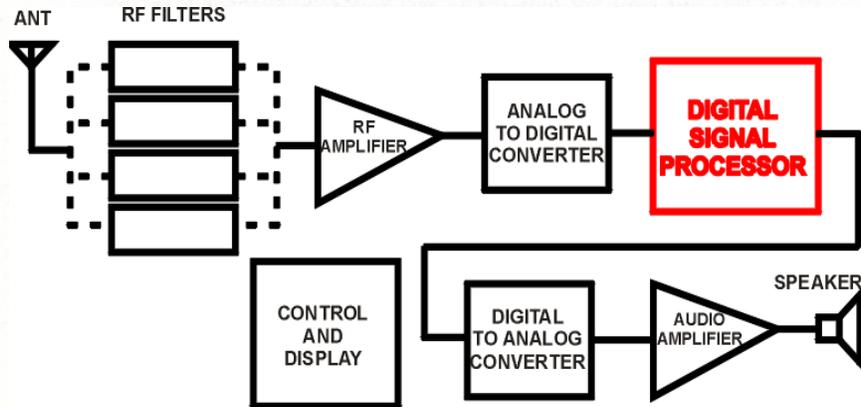
Today's top-of-the-line SDR rigs still use RF bandpass filters and an RF preamplifier, but digital technology has progressed to the point where "direct to digital" is practical, even at frequencies as high as 144 MHz!

Details of digital signal processing
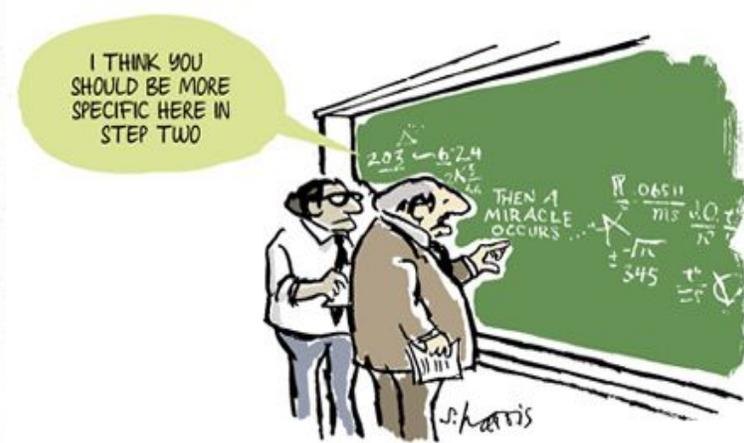
The mathematical concepts and software techniques involved in SDR are beyond the grasp of most hams, including me. One of the basic mathematical concepts used in SDR is the Fourier Transform. Fourier was a science adviser to Napoleon. I like to think that "SDR" has been sitting there for 200 years, waiting for the right hardware to run on.

Unique features of SDR

- Waterfall and panoramic spectrum display
- Point and click tuning
- Completely configurable filters
- Multiple simultaneous receivers
- Recording feature (Audio <u>or</u> RF)

A panoramic spectrum display is useful in that it shows everything that is present within the displayed bandwidth at the moment, and the waterfall shows what has been there in the recent past. Clicking on the display tunes to that signal. And there are no more add-on filters to buy! Some radios can monitor up to 8 RX channels at a time. You can also record not just the audio output, but all of the signals in a designated band.

Examples of current SD Radios

- FlexRadio ($700 - $7500)
- Apache Labs (ANAN) ($1000 - $4300)
- FunCube dongle (LF-UHF RX, ~$210)
- SoftRock Lite kit (HF RX, single band, $21)
- RTL-SDR dongle (RX, 24-1700 MHz, $15)

April QST has a review of the recent FlexRadio 6000 series, and there are other ham SDR transceivers at prices ranging from $700 up. Receive-only devices start at about $15 for the "RTL-SDR dongle".

FlexRadio SmartSDR screenshot
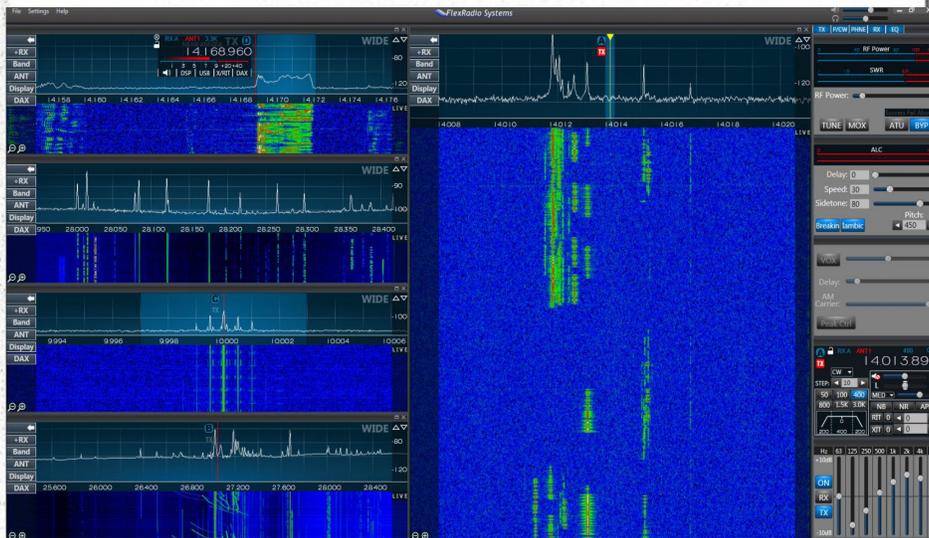
Here is a screenshot of the software provided by FlexRadio
   for use with their latest rigs. In this picture, 5 portions of the
   RF spectrum are being monitored simultaneously.

SDR negatives (for some people)

- Not a "single box" radio
- Computer (probably Windows) required
- Non-traditional user interface
- Too many choices
- Might be necessary to read the manual
- Accessibility
- $$$

While SDR offers many advantages, it's hard for some of us old-timers to get fully on board. In most cases you need a computer to use the radio at all, the familiar knobs and buttons are gone, and there can be a bewildering array of options such as filters, equalizers, etc. There is no basic reason why SDR should not be blind accessible, but I don't think we're there with most implementations. And of course price is always a factor in choosing a radio.

If the cost of digital circuits continues its downward trend, I would expect a greater integration of SDR technology into the ham radio transceivers of the future.

Special uses for SDR receivers

- VHF/UHF band monitor (with transverter)
- IF Panadapter
- "IF DSP" for existing transceiver

The ability to monitor an entire band for activity is useful even
on HF, and especially so for VHF and UHF where openings
are infrequent and unpredictable.

Connecting a low-cost SDR receiver to the IF output of a
conventional ham rig can provide many of the advantages
of a full-blown SDR rig, such as a panoramic spectrum
display and a full suite of DSP filtering, demodulation and
noise reduction options.

Demos (if they work)

- RTL-SDR dongle
- Playback of DX contest on 20m
- "SDR-enhanced" IC-706

I had a recording available but did not play it during the presentation because it was possible to do a live demo using TeamViewer to access my home computer. The RTL-SDR dongle plugged into my home computer gets its input from the 69 MHz IF on the IC-706.
HDSDR software, in combination with Omni-Rig, allows full syncing (in both directions) between the computer display and the radio's frequency readout.

SDR Resources

- QST product reviews
- "Cheap and Easy SDR", QST, January 2013
- http://en.wikipedia.org/wiki/List_of_software-defined_radios
- http://www.rtl-sdr.com/big-list-rtl-sdr-supported-software/

There is a wealth of information about SDR on the Internet. These links will get you started.