Software Defined Radio

The future of Ham Radio?

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What is Software Defined Radio?

Software Defined Radio (SDR)

“A software-defined radio (SDR) system is a radio communication system that uses software to process various signals (modulation, demodulation, decoding, etc.) in lieu of the traditional hardware components that are generally made for those dedicated tasks. It is mostly used in mobile communications, research and development, and military projects. A typical SDR setup involves an RF front-end connected to a computer that will perform the conversions from analog to digital, and the inverse for receiving or sending signals, respectively. Because of rapidly developing digital electronics, the capabilities of SDR continue to increase.”

A basic SDR system may consist of a personal computer equipped with a sound card, or other analog-to-digital converter, preceded by some form of RF front end.

Why Software Defined Radio?

Comments of ARRL:

“ARRL is most interested in this proceeding, not only because of the utility of the Amateur Radio Service as a testing ground for different configurations of SDRs, but also because of the potential long-term opportunities for SDRs to effect substantial changes, even conceptual changes, in traditional frequency assignment and spectrum allocations decision making in all services.”

ARRL comments to the Notice of Inquiry Regarding Software Defined Radios dated June 14, 2000 (ET Docket No. 00-47 released March 21, 2000). http://www.fcc.gov/searchtools.html

Why Software Defined Radio?

Dale Hatfield, WØIFO, Chief, Office of Engineering and Technology, Federal Communications Commission

“This could stimulate a whole new generation of amateur innovation that not only includes the more spectrally efficient systems I mentioned earlier, but also radios that could adapt to their environment as well.”

Speech to AMRAD’s 25th Anniversary Dinner June 17, 2000
http://www.fcc.gov/Speeches/misc/dnh061700.html

Why Software Defined Radio?

- To produce a radio that can receive and transmit a new form of radio protocol just by running new software
- A technique in which all the processing is done in software i.e., mixing, filtering, demodulation, etc.
- Used to implement different demodulation scheme and different standards can be implemented in the same device
- Can be updated so that device doesn't become obsolete with time
- Software-defined radios can talk and listen to multiple channels at the same time.
- Unlike traditional radio communication systems, these radio devices are highly flexible and versatile.

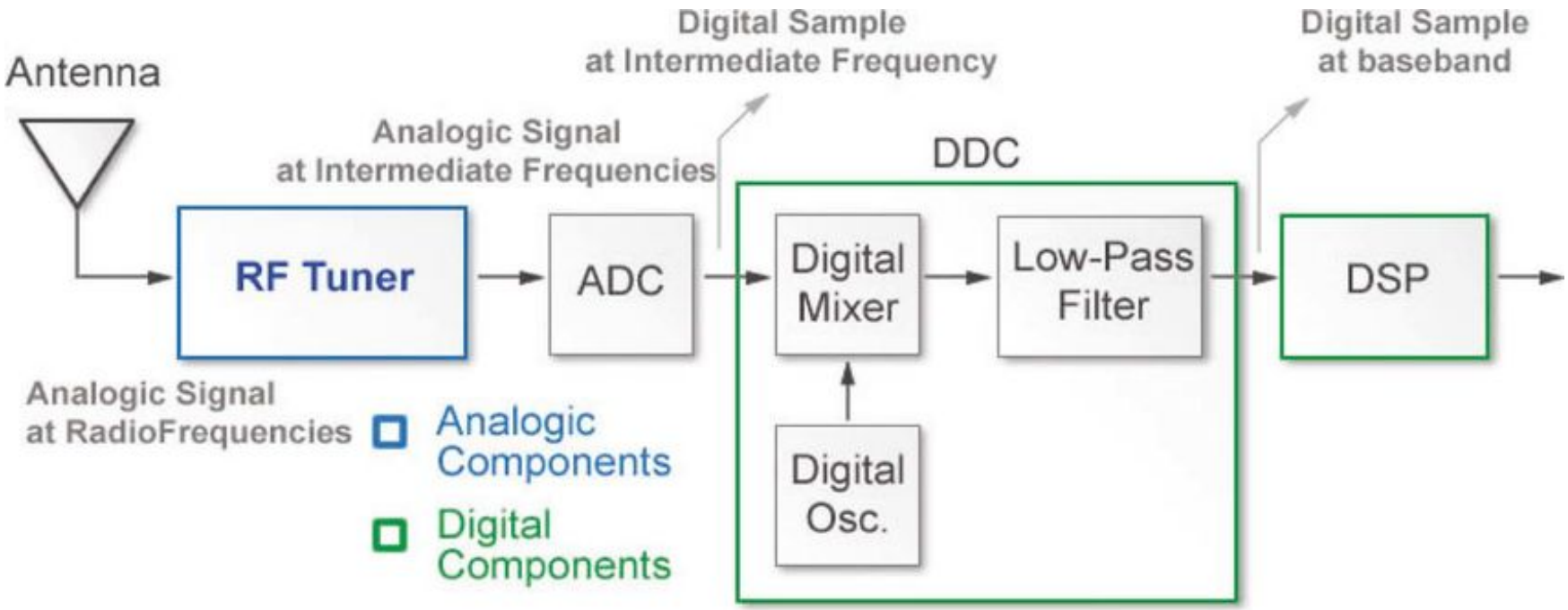
If software does everything, what is the role of hardware?

Hardware is still needed for the RF front end and Analog to Digital Converter (ADC) and Digital to Analog Converter (DAC)

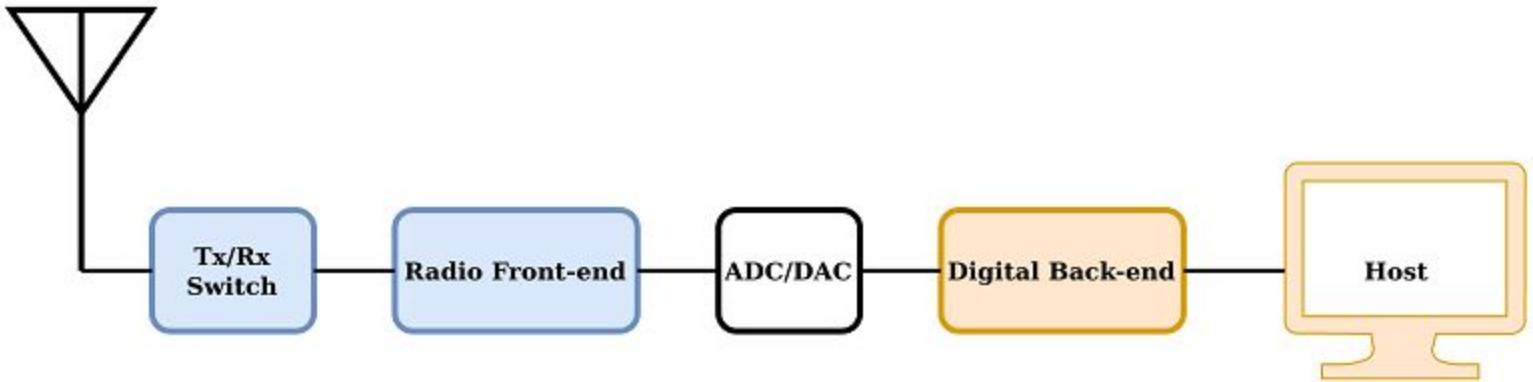
So, What does this all boil down to?

SDR uses the latest in DSP technology to make a receiver (only) that works from 50kHz to 30mHz in “chunks” as large as 192kHz. Very few components in the unit, mostly the DSP chip. Also, the software defines the filters, the frequency coverage, the mode (USB, LSB, CW, FM, etc), the attenuators, etc.

Block diagram of the SDR receiver

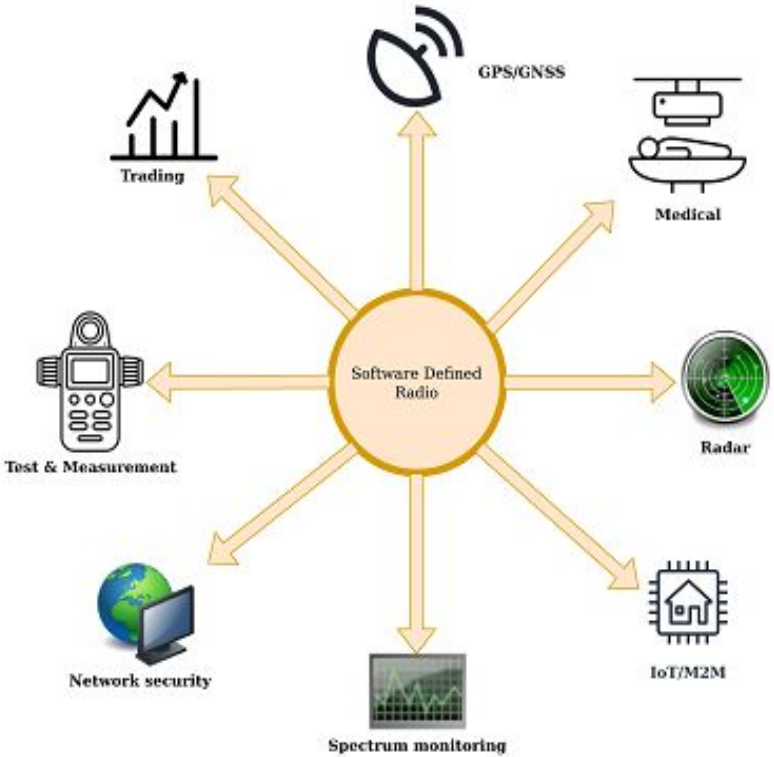


Or, more simply……



The flexibility of the SDRs make them a suitable choice for a broad array of markets.

- Radar
- Test and measurement
- Magnetic Resonance Imaging (MRI)
- Global Navigation Satellite System (GNSS)
- Low Latency Links (Since SDR systems can tune to different frequencies, they are capable of selecting the least congested band. This capability helps to minimize the overall latency of a communication link.)
- Spectrum Monitoring and Recording


GPS/GNSS
Trading
Medical
Software Defined Radio
Test & Measurement
Radar
Network security
IoT/M2M
Spectrum monitoring

What about for the radio amatuer?

- To have fun
- Extend the hobby
- Chance to learn something new
- Projects/Builds
- SWL
- Receiver/integration with transmitter (SDRplay, RF sensing T/R switch)
- Transmitting via stand alone SDR (HackRF one, YARD Stick one)
- Track ships via AIS transmissions
- Track aircraft via Mode S transmissions

What do you need to set up an SDR?

- SDR
- Antenna(s)
- Computer running SDR software (PC, Apple, Linux)

SDR Considerations

RTL -SDR

$30

Frequency Range,
500kHz-.75 GHz

SDR Considerations

HackRF One (Transceiver)

$330

Operating Frequency,
1mHz-6gHz

SDR Considerations

KiwiSDR Board and Kit (2 versions)

Board only, $222

With GPS antenna and Beaglebone $333

Linux stand alone unit

SDR Considerations

SDRplay

$109

RSP1A

covers the complete radio spectrum from 1kHz (VLF) to 2GHz (Microwaves) with up to a massive 10MHz visible bandwidth

Antenna Considerations

The antenna you use depends on what your intent is gonna be

Receive only

Transmit

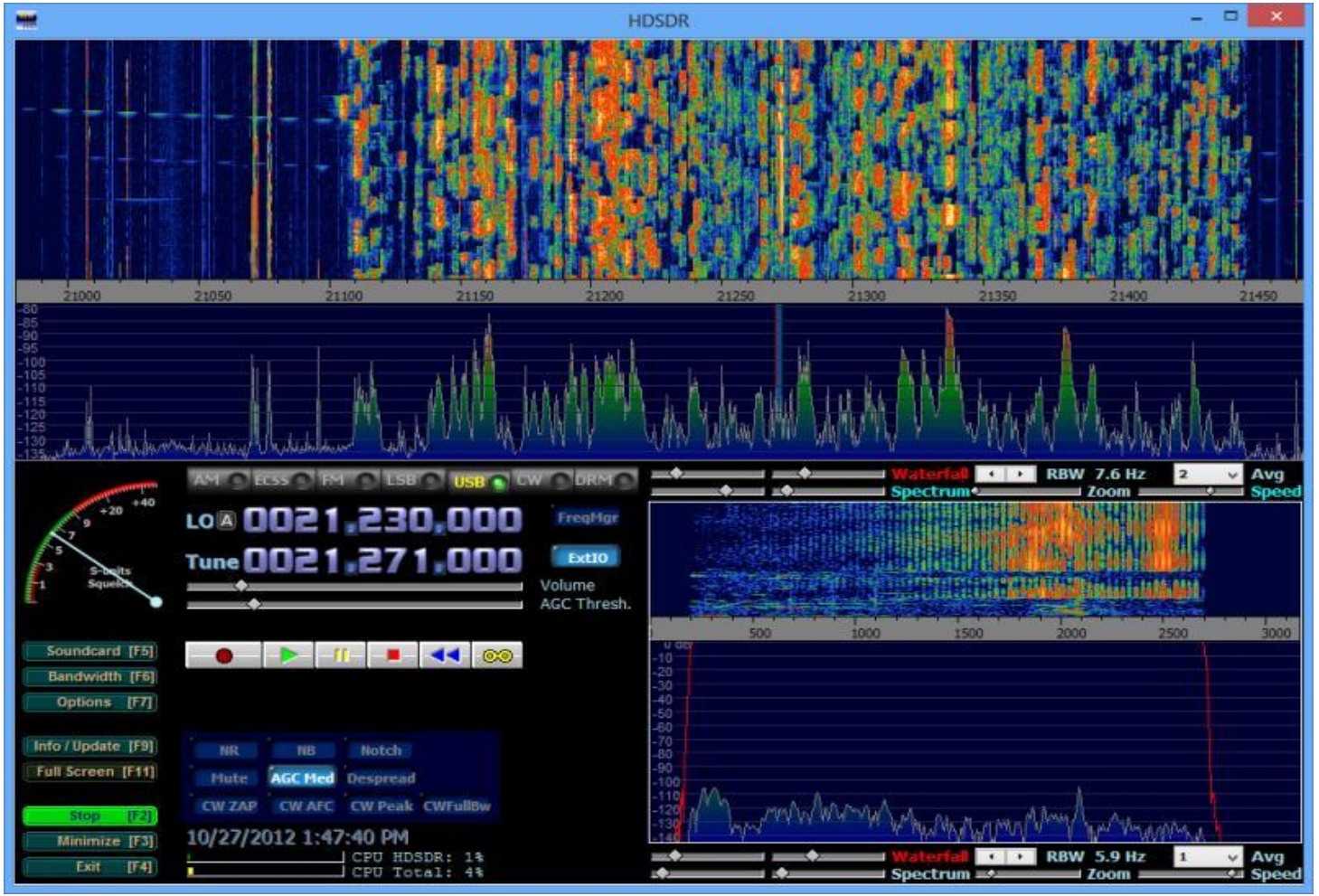
What you have already will probably be sufficient

Software Considerations

you choose the radio software based on the SDR product you use

- SDR#
- HDSDR
- SDR-RADIO.COM V2/V3
- Linrad
- GQRX
- Studio1
- SDRUno

HDSDR


HDSDR
21000
21050
21100
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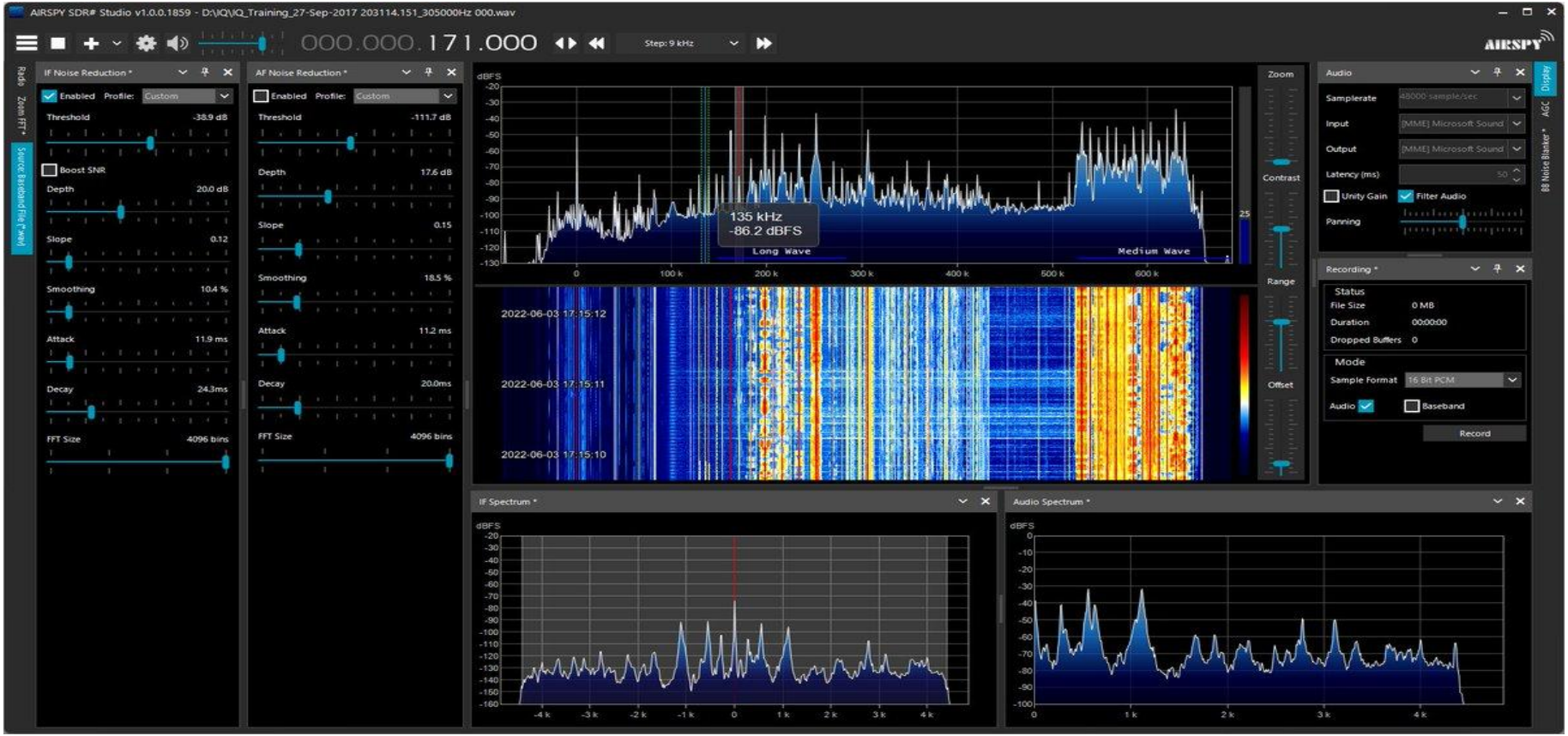
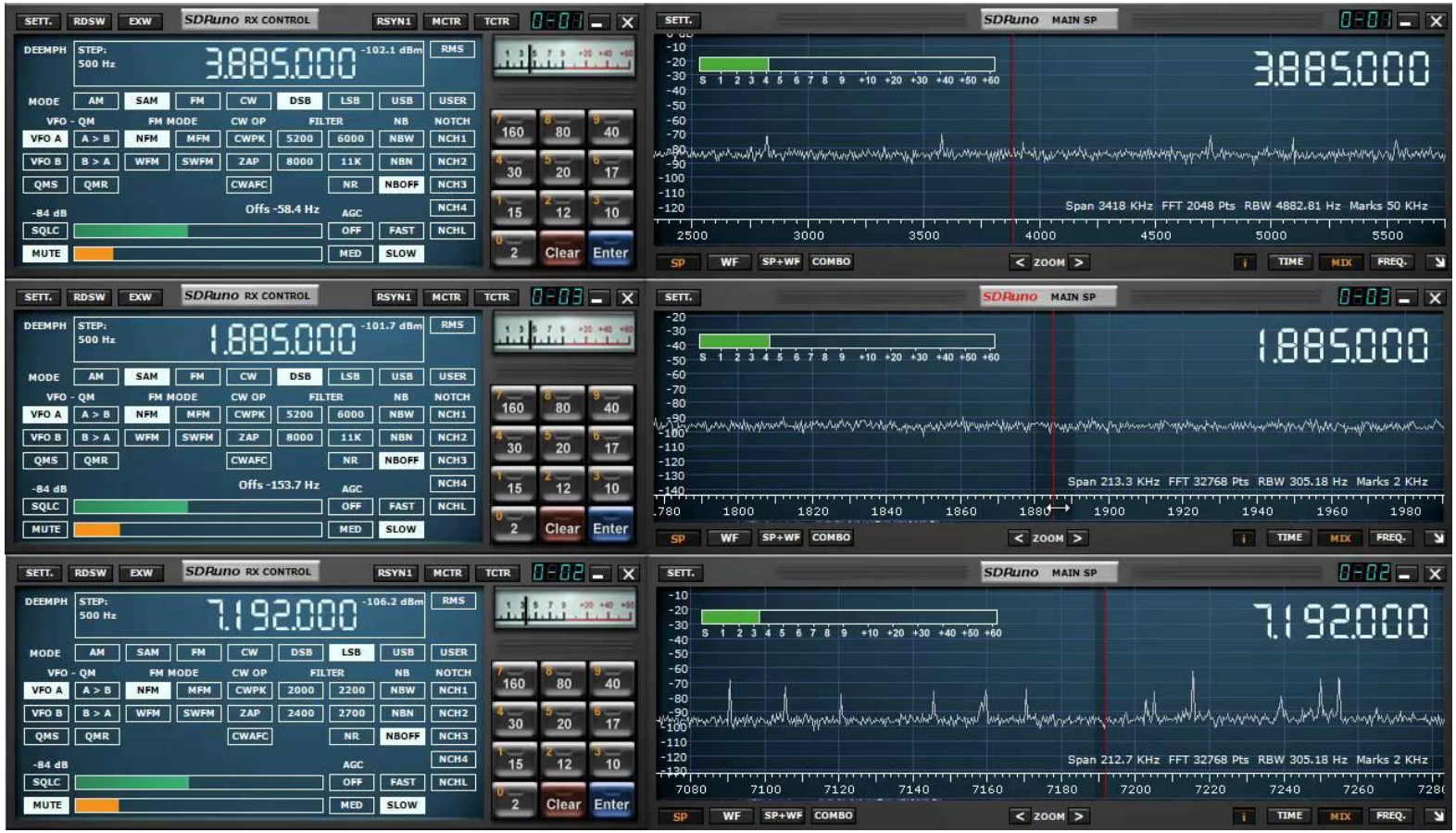
21300
21350
21400
21450
AM
ECSS
FM
LSB
USB
CW
DRM
LO A 0021,230,000
Tune 0021,271,000
FreqMgr
Ext10
Volume
AGC Thresh.
Soundcard [F5]
Bandwidth [F6]
Options [F7]
Info / Update [F9]
Full Screen [F11]
Stop [F2]
Minimize [F3]
Exit [F4]
NR
NB
Notch
Mute
AGC Med
Despread
CW ZAP
CW AFC
CW Peak
CWFullBw
10/27/2012 1:47:40 PM
CPU HDSDR: 1%
CPU Total: 4%
Waterfall
Spectrum
RBW 7.6 Hz
Zoom
Avg
Speed
500
1000
1500
2000
2500
3000
RBW 5.9 Hz

SDR#


AIRSPY SDR# Studio v1.0.0.1859 - D:\IQ\IQ_Training_27-Sep-2017 203114.151_305000Hz 000.wav
000.000.171.000
Step: 9 kHz
AIRSPY
IF Noise Reduction *
Enabled
Profile: Custom
Threshold -38.9 dB
Boost SNR
Depth 20.0 dB
Slope 0.12
Smoothing 10.4 %
Attack 11.9 ms
Decay 24.3ms
FFT Size 4096 bins
AF Noise Reduction *
Enabled
Profile: Custom
Threshold -111.7 dB
Depth 17.6 dB
Slope 0.15
Smoothing 18.5 %
Attack 11.2 ms
Decay 20.0ms
FFT Size 4096 bins
dBFS
135 kHz
-86.2 dBFS
Long Wave
Medium Wave
2022-06-03 17:15:12
2022-06-03 17:15:11
2022-06-03 17:15:10
Zoom
Contrast
Range
Offset
Audio
Samplerate 48000 sample/sec
Input [MME] Microsoft Sound
Output [MME] Microsoft Sound
Latency (ms) 50
Unity Gain
Filter Audio
Panning
Recording *
Status
File Size 0 MB
Duration 00:00:00
Dropped Buffers 0
Mode
Sample Format 16 Bit PCM
Audio
Baseband
Record
IF Spectrum *
Audio Spectrum *
Radio
Zoom FFT *
Source Baseband File (.wav)
Display
AGC
NB Noise Blanker *

SDRuno


SDRuno RX CONTROL
SDRuno MAIN SP
3.885.000
1.885.000
7.192.000
Span 3418 KHz FFT 2048 Pts RBW 4882.81 Hz Marks 50 KHz
Span 213.3 KHz FFT 32768 Pts RBW 305.18 Hz Marks 2 KHz
Span 212.7 KHz FFT 32768 Pts RBW 305.18 Hz Marks 2 KHz

Conclusion……