

# Elegant Software Radio Tools for a More Civilized Age

...

Ben Hilburn  
March 2016

# Elegant Tools

- Enables you without getting in your way.
  - Keep easy things easy, make hard things possible.
  - Can focus on what matters.
  - Provides a delightful user experience.
- 
- Use the best tool for the job.

# Elegant Tools



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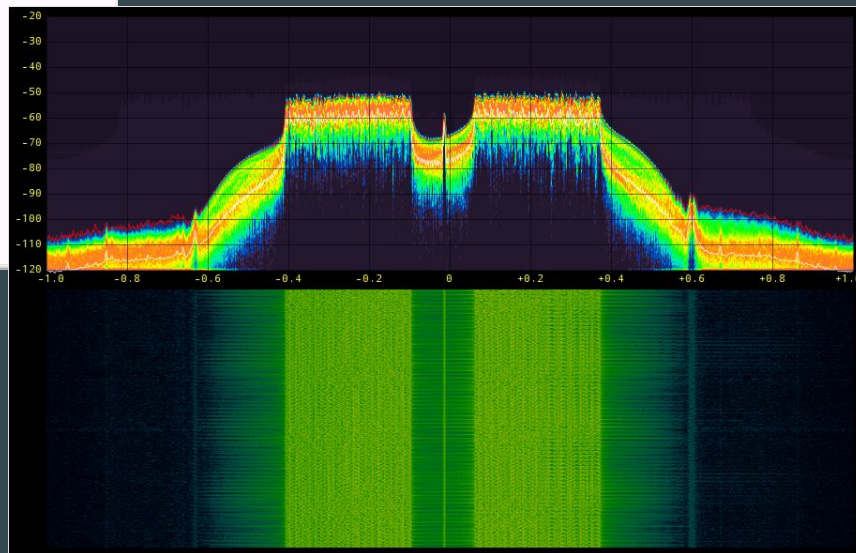
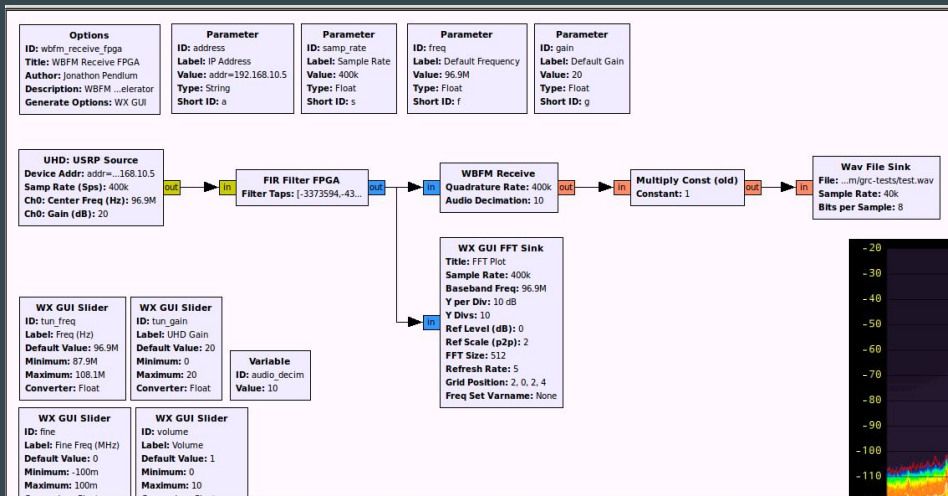
# A Survey of Tools

- There are lots of tools out there!
- Can't cover them all in ~20 minutes.
- Will just cover the tools we see used most commonly.

# Design Tools

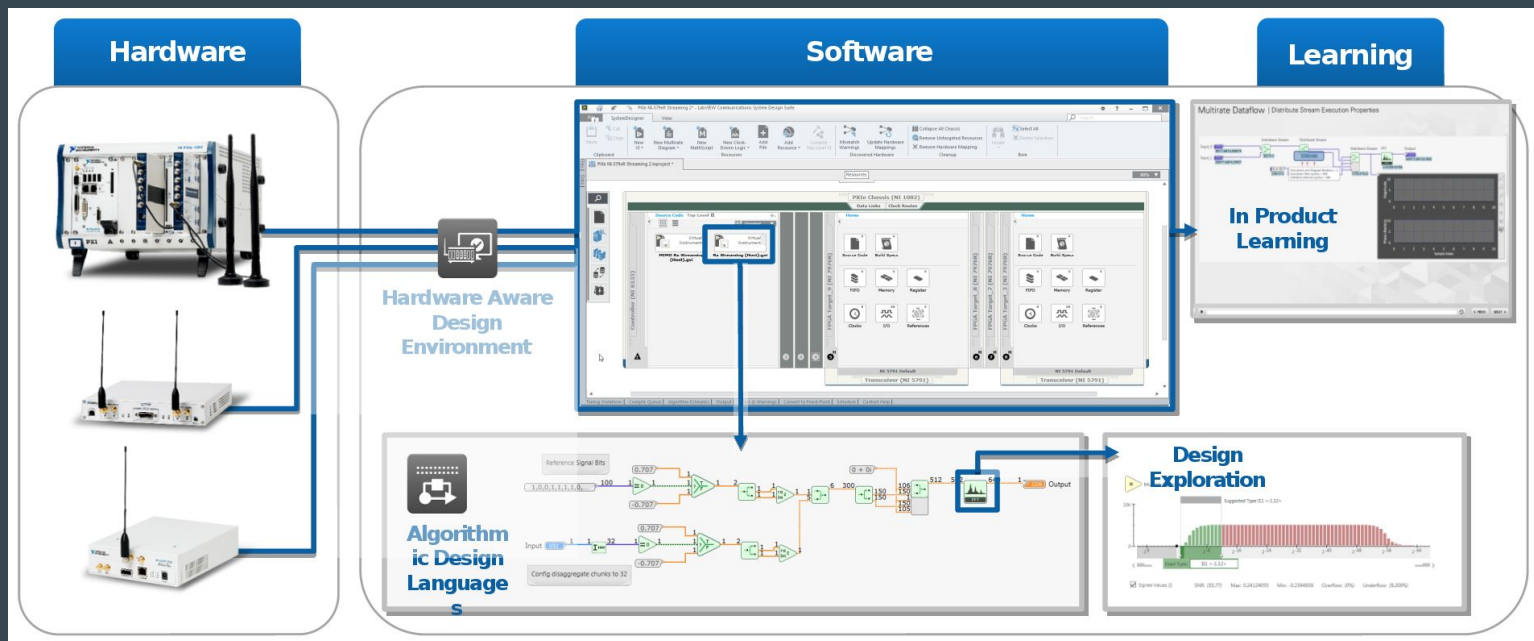


# GNU Radio



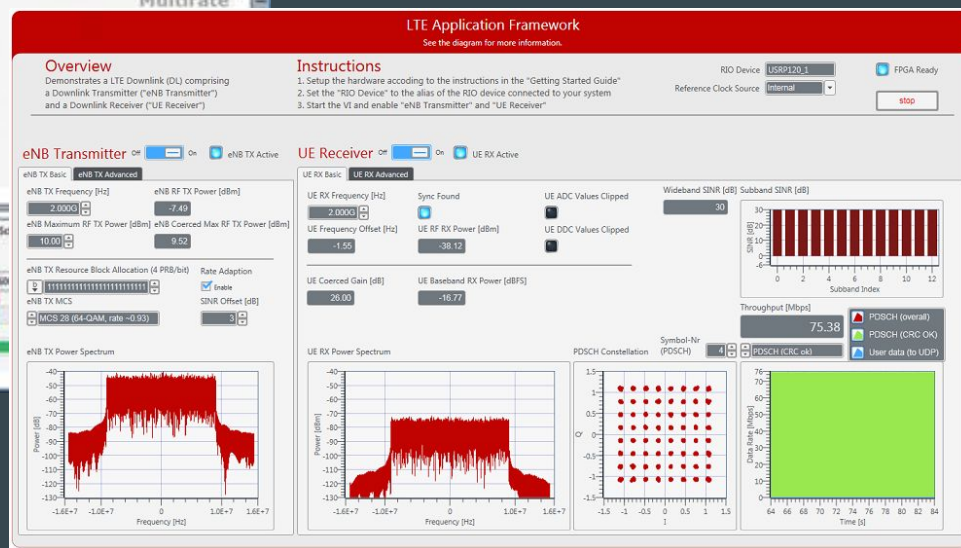
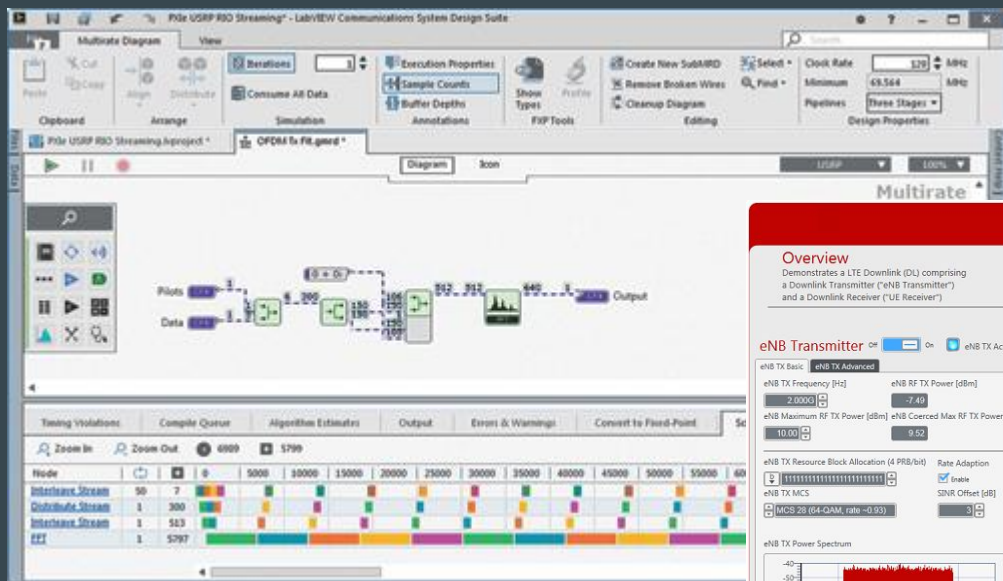
- Very popular, active community
- Lots of blocks ready-to-use
- GPL

# LabVIEW Communications



- From Design to Test
- Reference Designs, Examples, Support
- Commercial Product

# LabVIEW FPGA



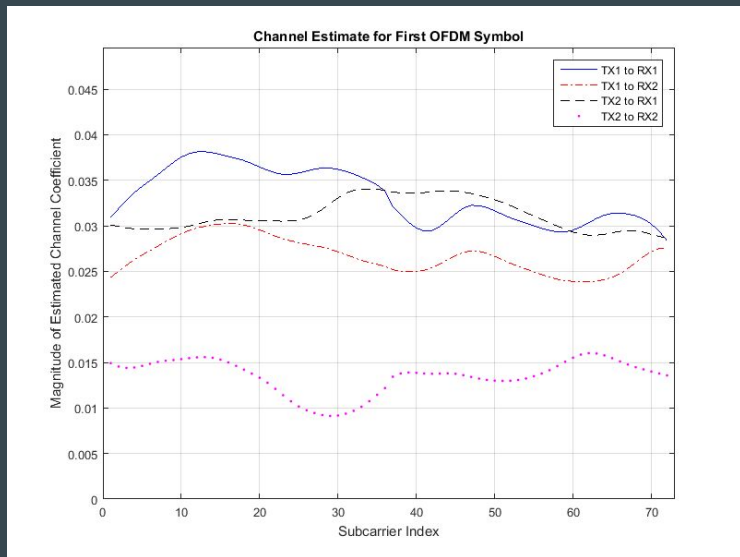
- Graphical FPGA Design
- LTE, 802.11 App Frameworks
- Commercial Product

# Matlab

```
radioFound = false;
radiolist = findsdru;
for i = 1:length(radiolist)
    if strcmp(radiolist(i).Status, 'Success')
        if strcmp(radiolist(i).Platform, 'B210')
            radio = comm.SDRuReceiver('Platform','B210', ...
                'SerialNum', radiolist(i).SerialNum);
            radio.MasterClockRate = 1.92e6 * 4; % Need to exceed 5 MHz minimum
            radio.DecimationFactor = 4;          % Sampling rate is 1.92e6
            radioFound = true;
            break;
        end
        if (strcmp(radiolist(i).Platform, 'X300') || ...
            strcmp(radiolist(i).Platform, 'X310'))
            radio = comm.SDRuReceiver('Platform',radiolist(i).Platform, ...
                'IPAddress', radiolist(i).IPAddress);
            radio.MasterClockRate = 184.32e6;
            radio.DecimationFactor = 96;          % Sampling rate is 1.92e6
            radioFound = true;
        end
    end
end
end
```

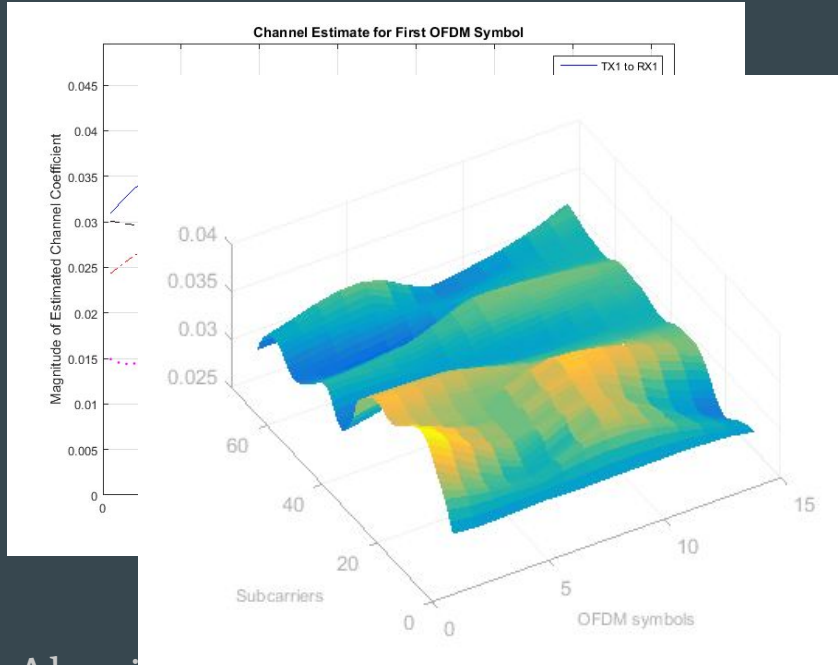
- Algorithm Design
- Great support for USRPs!
- Commercial Product

# Matlab



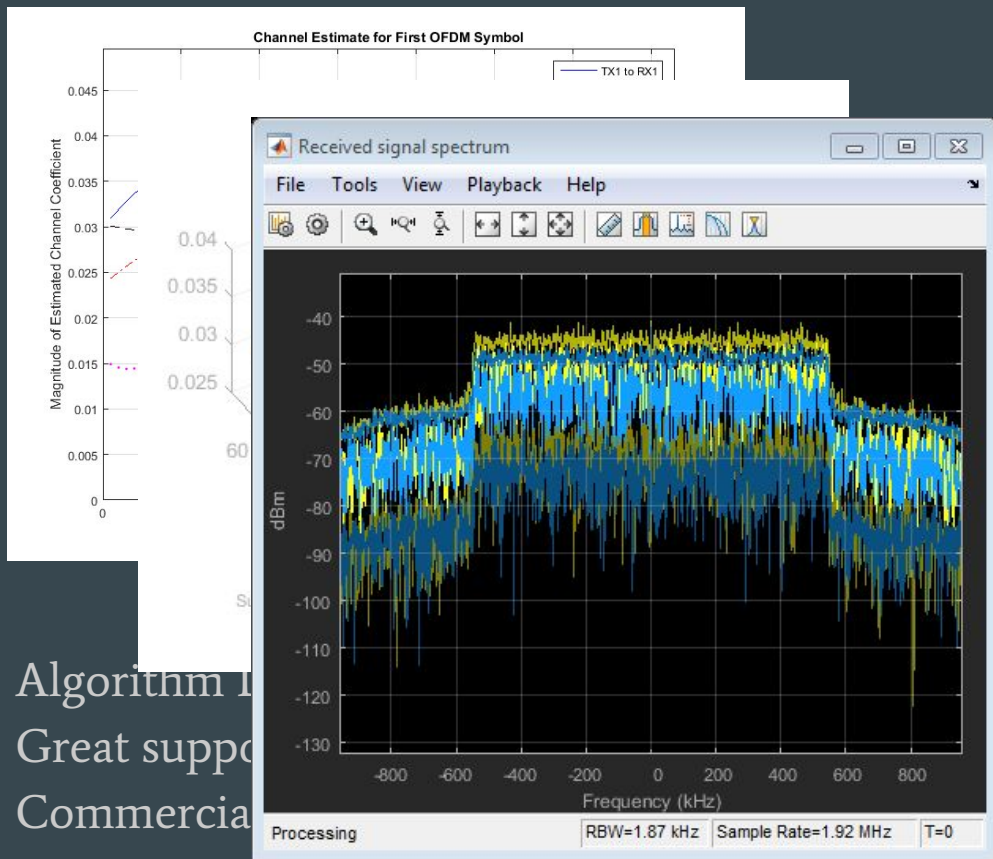
- Algorithm Design
- Great support for USRPs!
- Commercial Product

# Matlab



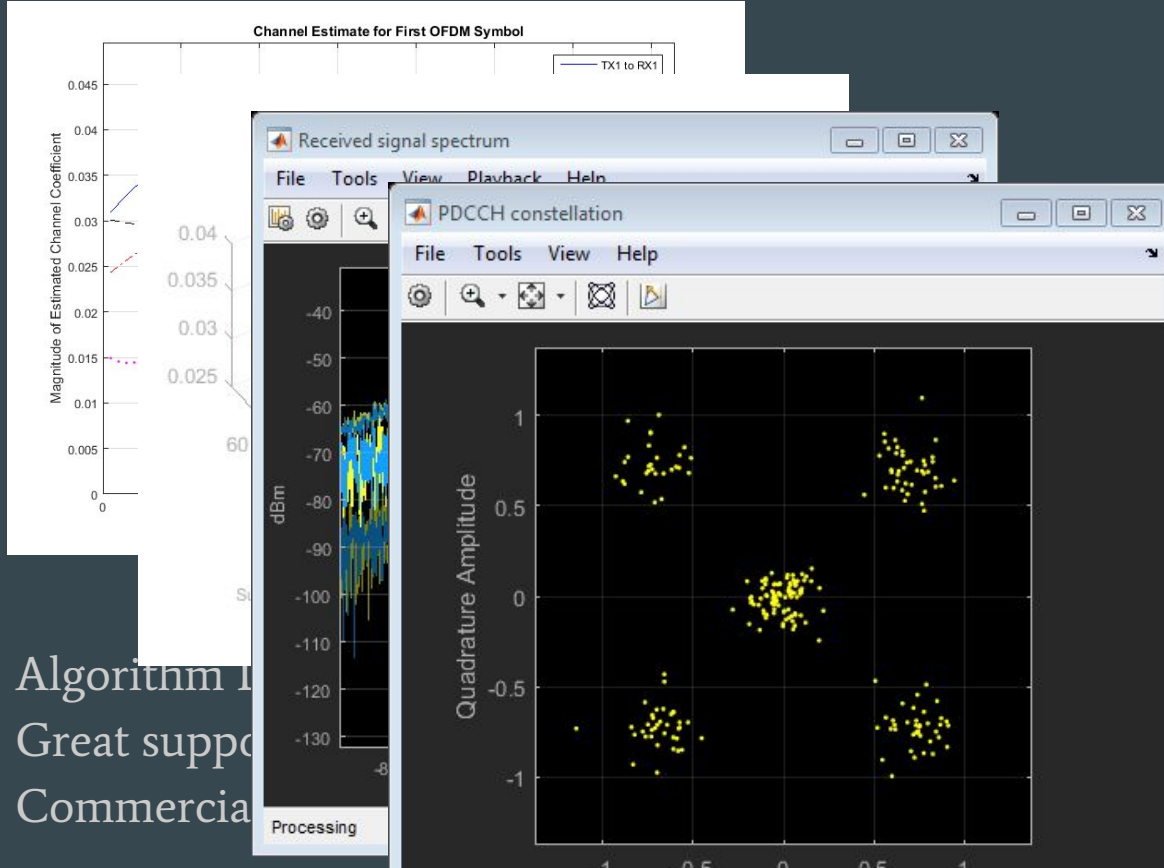
- Algorithm Design
- Great support for USRPs!
- Commercial Product

# Matlab



- Algorithm 1
- Great support
- Commercial

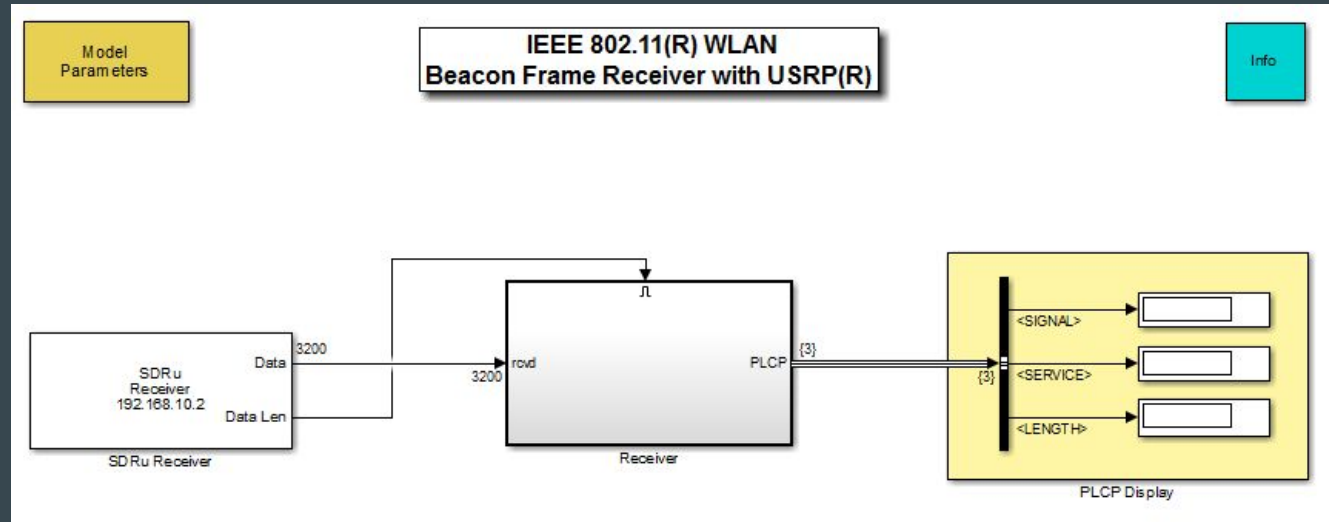
# Matlab



- Algorithm 1
- Great support
- Commercial

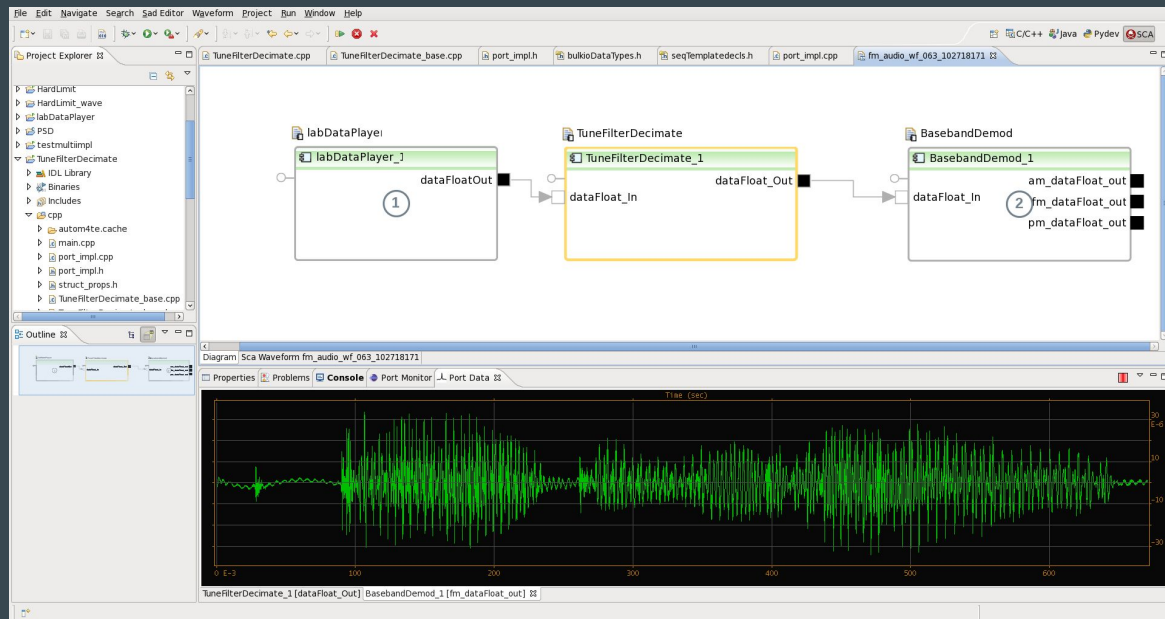


# Simulink



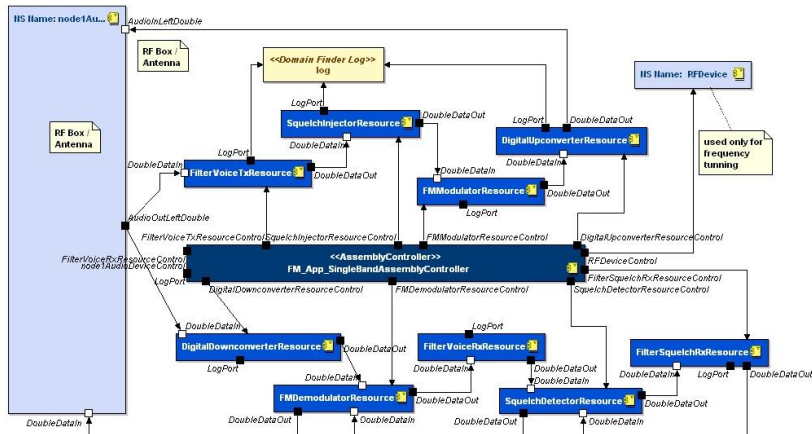
- Model-Based Design
- Generate HDL from Block Diagrams
- Commercial Product

# REDHAWK



- Eclipse-based Design Tool
- SCA Framework
- LGPL

# NordiaSoft SCARI



NordiaSoft Radio Manager

File View Application Tools Window Help

**Radio Hierarchy**

- Radio
  - SCARI/DomainManager
    - LinuxAudioNodeDeviceManager
      - USRP\_UHD\_Device
        - SCARI/USRP\_UHD\_AM\_Transceiver/ExecutableDevice
          - SCARI/USRP\_UHD\_AM\_Transceiver/Re
            - SCARI/USRP\_UHD\_AM\_Transceiver/Filt
              - SCARI/USRP\_UHD\_AM\_Transceiver/AM
                - SCARI/USRP\_UHD\_AM\_Transceiver/Sig
                  - SCARI/USRP\_UHD\_AM\_Transceiver/US
                    - LinuxAudioNodeAudioDevice
                      - LinuxAudioNodeLogger
                        - USRP\_UHD\_AM\_Transceiver
                          - USRP\_UHD\_FM\_Transceiver
                            - USRP\_UHD\_Wideband\_FM\_Receiver

**Radio Topology**

USRP\_UHD\_AM\_Transceiver USRP\_UHD\_Wideband\_FM\_Receiver USRP\_UHD\_FM\_Transceiver

LinuxAudioNodeLogger LinuxAudioNodeAudioDevice USRP\_UHD\_Device

SCARI/USRP\_UHD\_AM\_Transceiver/USRP\_UHD\_AM\_TransceiverAssemblyController

LinuxAudioNodeExecutableDevice

SCARI/USRP\_UHD\_AM\_Transceiver/SignalDetectorResource

SCARI/USRP\_UHD\_AM\_Transceiver/AMDemodulatorResource

SCARI/USRP\_UHD\_AM\_Transceiver/AMModulatorResource

SCARI/USRP\_UHD\_AM\_Transceiver/FilterVoiceResource

**Log**

LinuxAudioNodeLogger

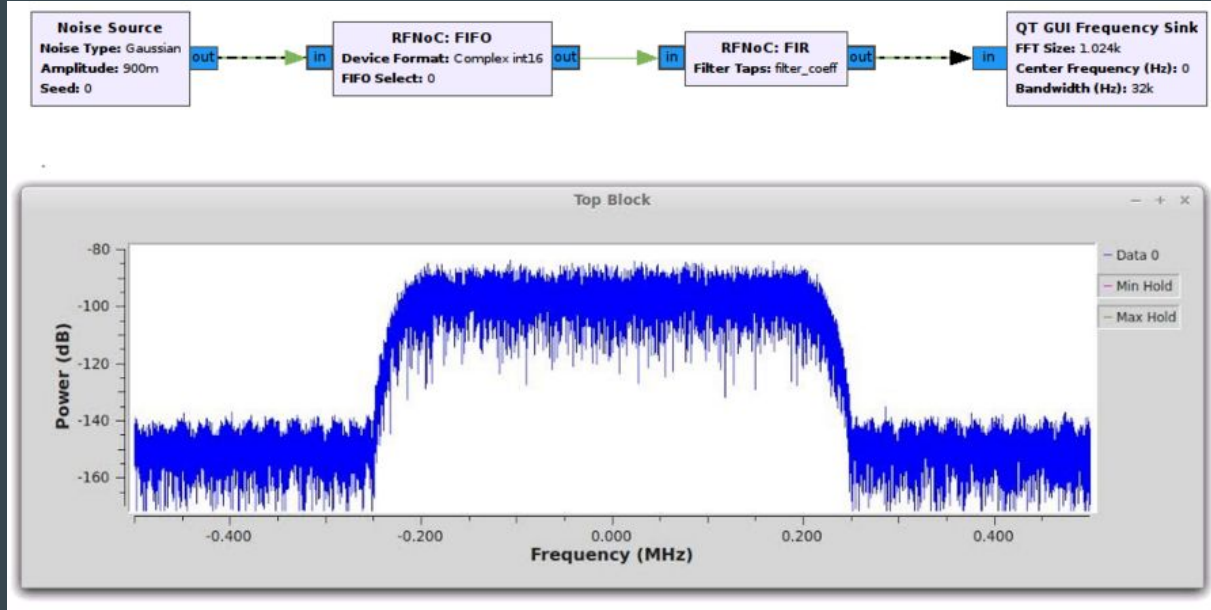
Log Level... RegEx Filter... Refresh Clear Max message count: 200 Auto refresh 1

| Source              | Level | Data  | Time                      |
|---------------------|-------|---|---------------------------|
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:fileMgr:777] FileManager obtained by a client           | 20150923 04:26:43:799.667 |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:fileMgr:777] FileManager obtained by a client           | 20150923 04:26:43:825.74  |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:fileMgr:777] FileManager obtained by a client           | 20150923 04:26:43:850.193 |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:deviceManagers:668] DeviceManager list obtained by a    | 20150923 04:26:51:343.688 |
| SCARI/DomainManager | 8     | [ApplicationFactoryManager.cc:getApplicationFactories:1200] ApplicationFacto  | 20150923 04:26:51:345.593 |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:applications:730] Application list obtained by a client | 20150923 04:26:51:346.041 |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:fileMgr:777] FileManager obtained by a client           | 20150923 04:26:51:359.842 |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:fileMgr:777] FileManager obtained by a client           | 20150923 04:26:51:376.602 |
| SCARI/DomainManager | 8     | [DomainManagerImpl.cc:fileMgr:777] FileManager obtained by a client           | 20150923 04:26:51:393.887 |

App USRP\_UHD\_AM\_Transceiver: DCE:b319e441-e9a9-4c31-b517-a491b6c6f66e:USRP\_UHD\_AM\_Transceiver

- SCA CF & Design Tools
- SCA Compliant!!
- Commercial Product

# RFNoC



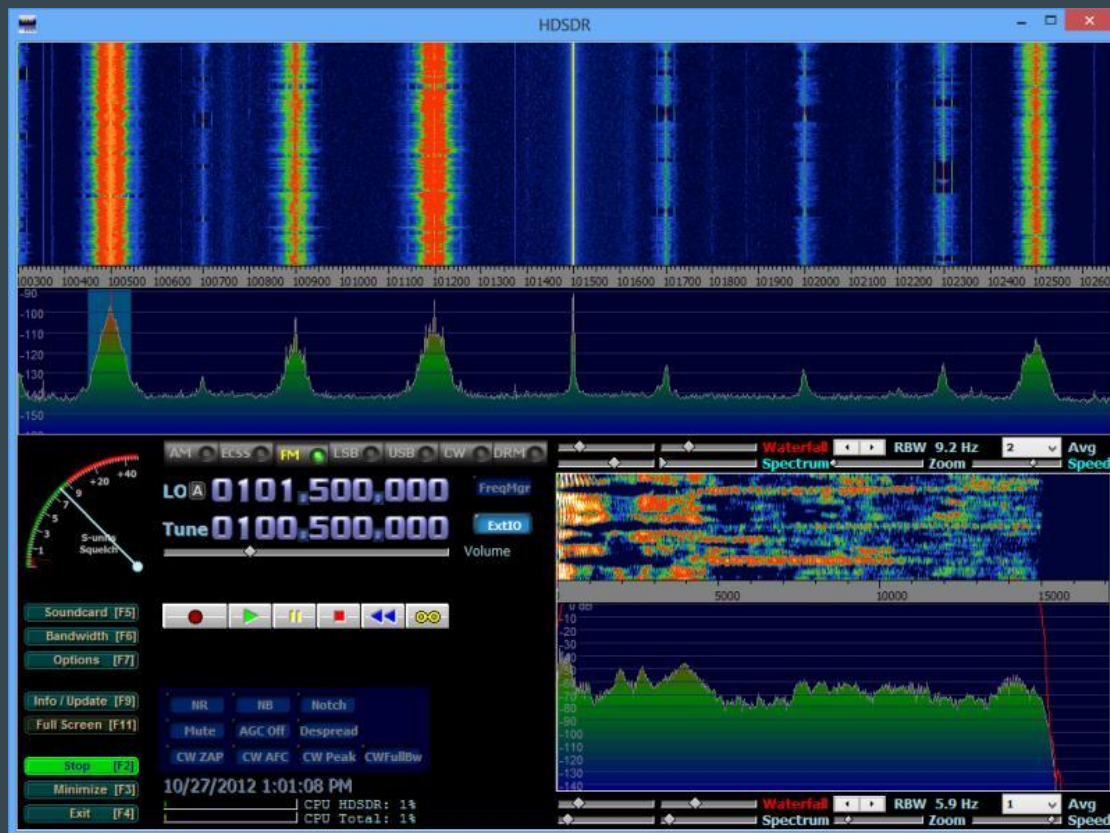
- Heterogenous Processing (focused on FPGA right now)
- Built on GNU Radio
- GPL

# User Front-Ends

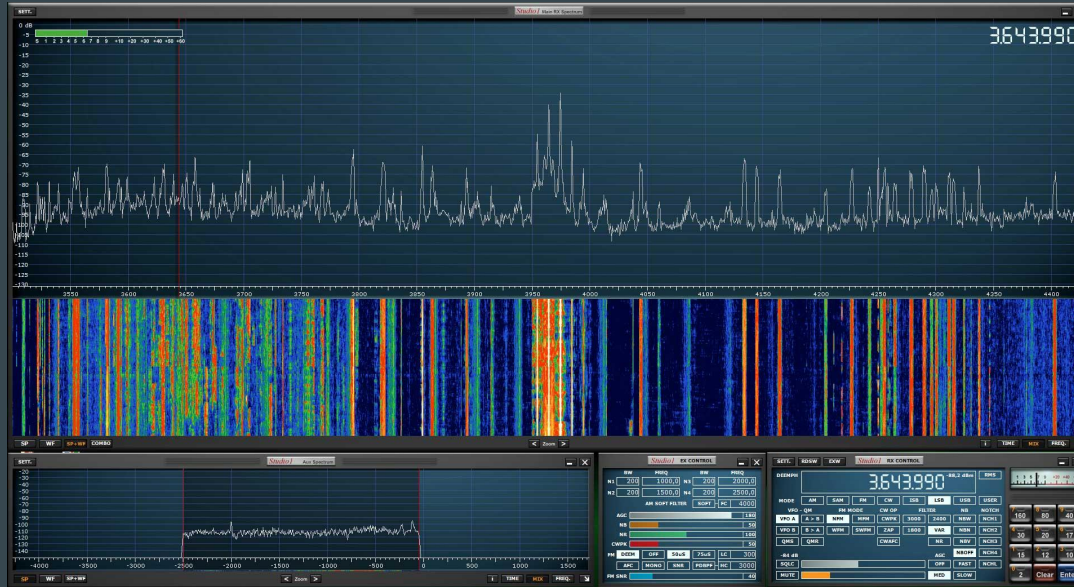
# HDSDR

- Spectrum Analysis
- Click-to-Tune!
- Send to Audio
- Windows Only
- Proprietary

<http://www.hdsdr.de/index.html>



# Studio1



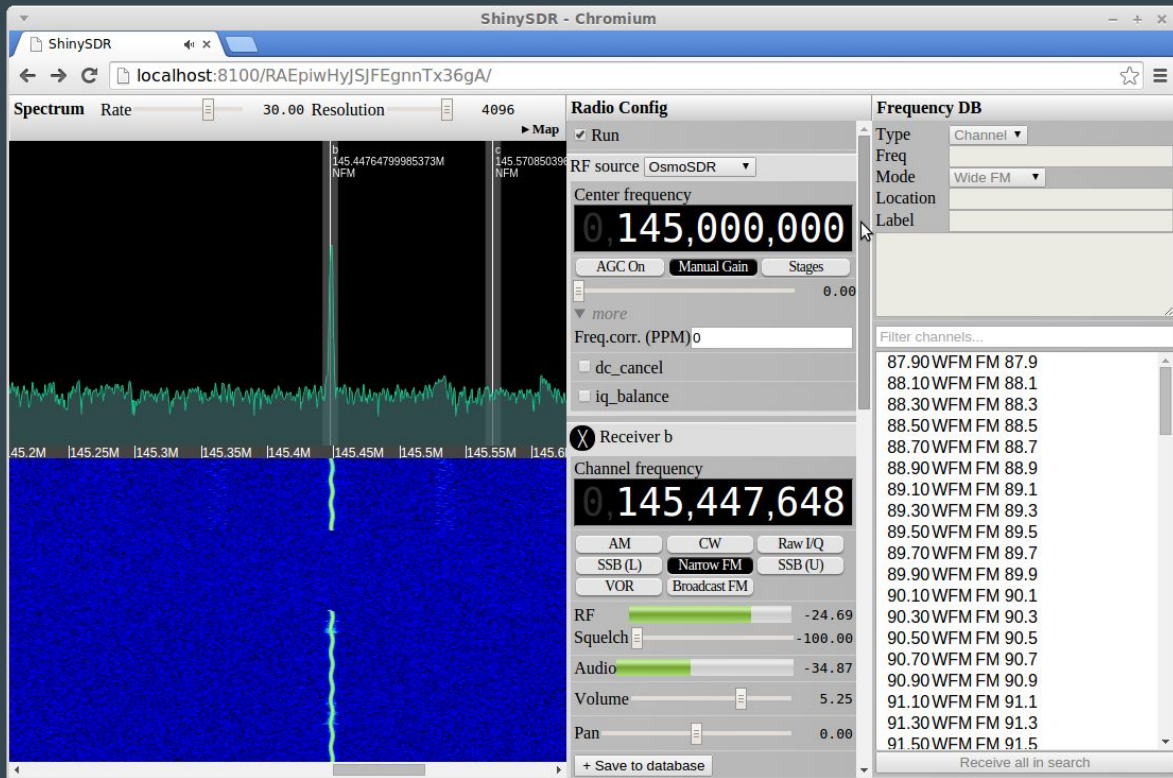
- HAM
- Includes Demod
- Windows Only
- Proprietary

<http://www.woodboxradio.com/studio1.html>



# ShinySDR

- Web Based
- Remote Access
- Includes Demods
  - Custom Blocks
- GPL

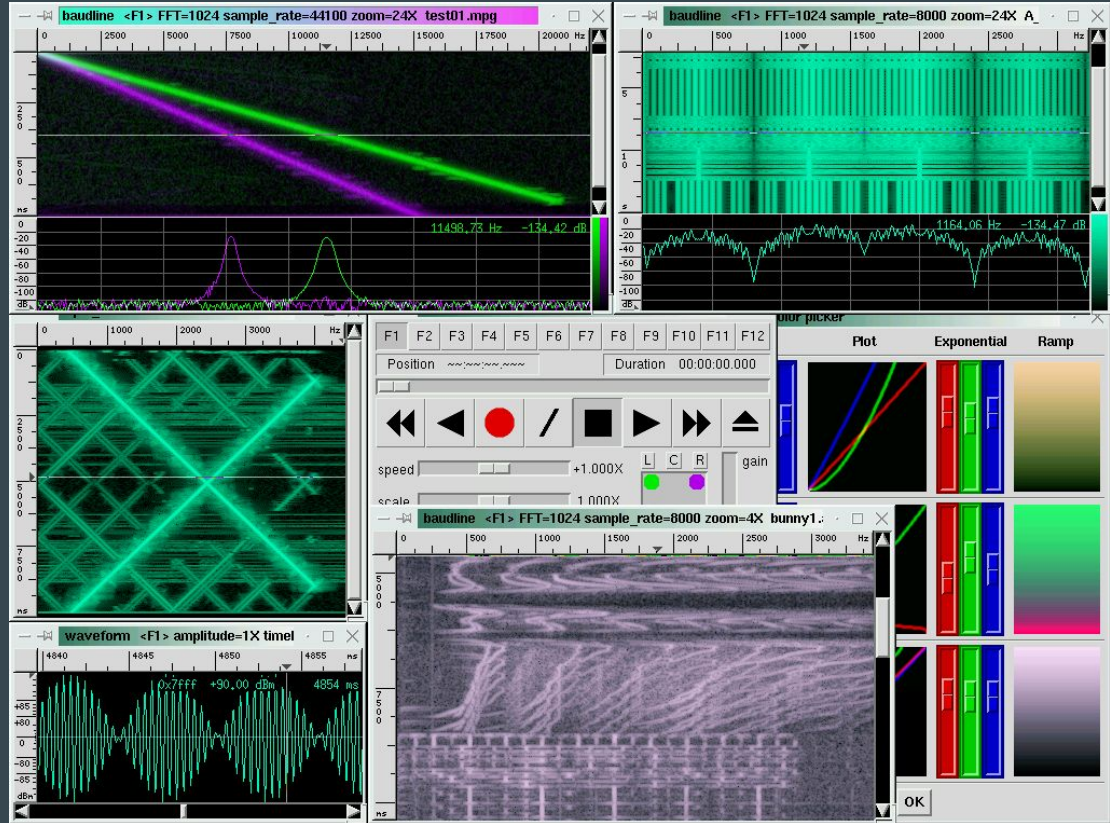


<https://github.com/kpreid/shinysdr>



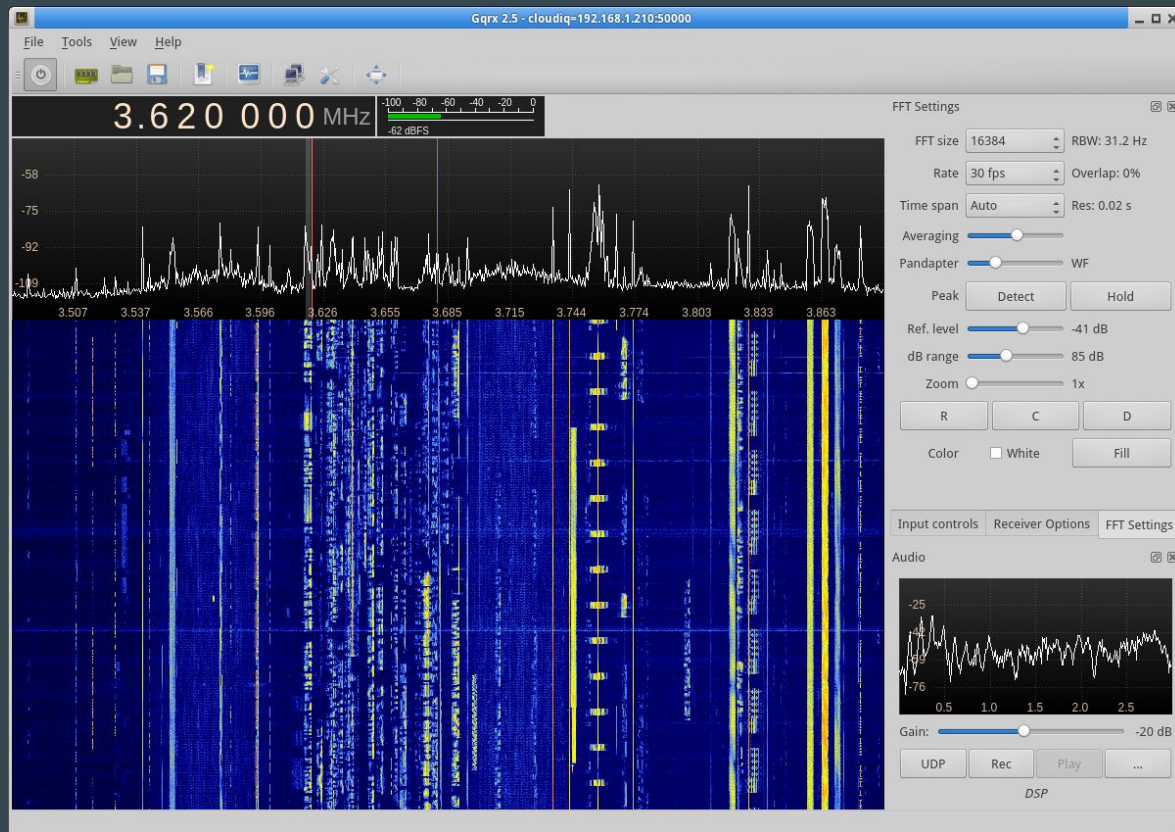
# Baudline

- Signals Analysis
- Post Processing
- Proprietary



<http://www.baudline.com/>

# Gqrx

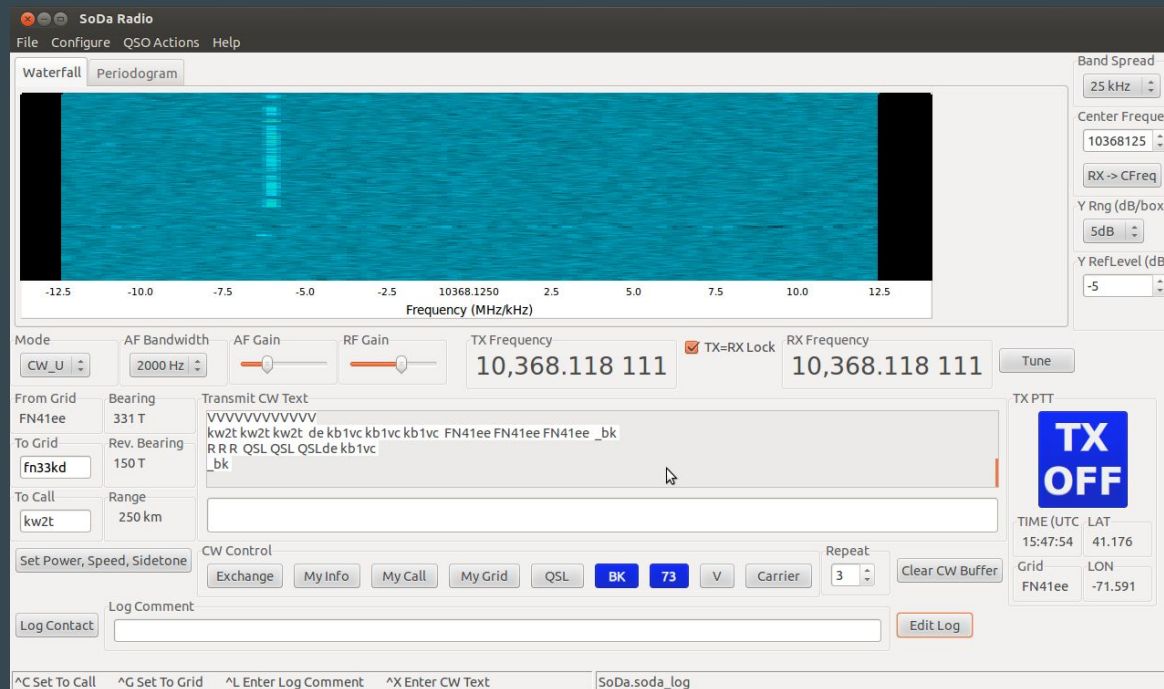


- Spectrum Analysis
- Includes Demods
- AGC, Squelch, etc.,
- Uses GNU Radio
- GPL

<http://gqrx.dk/>

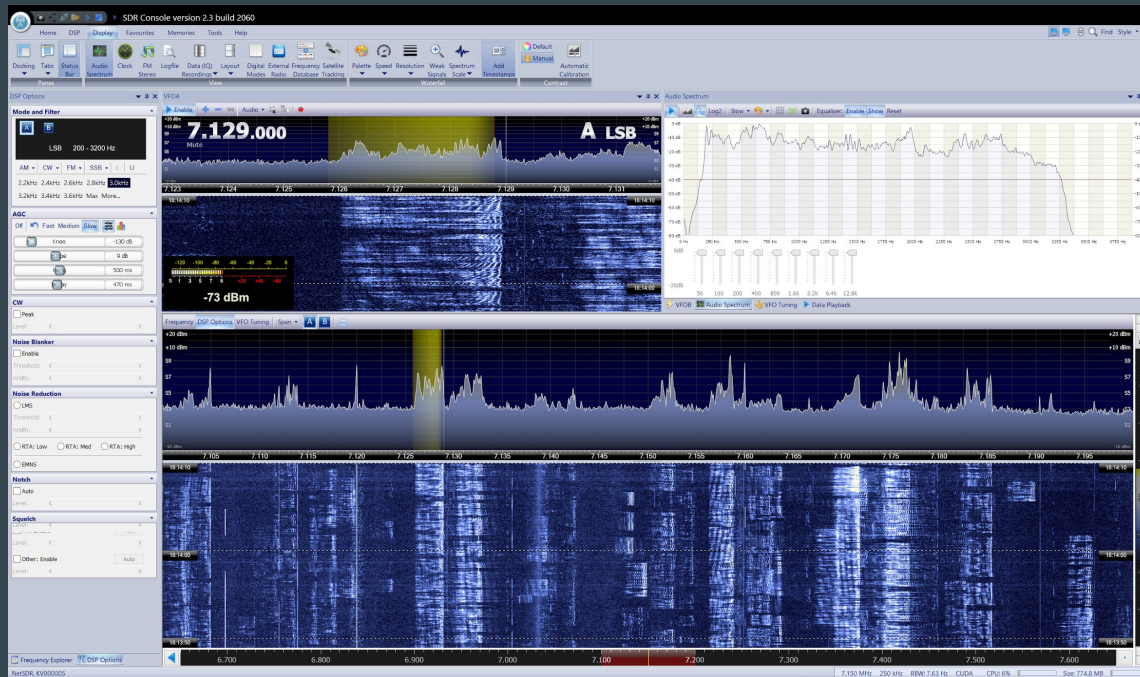
# SoDaRadio

- HAM Front-End
- Direct Text Entry
- BSD



<http://sodaradio.sourceforge.net/Site/SoDaRadio.html>

# SDR-Console



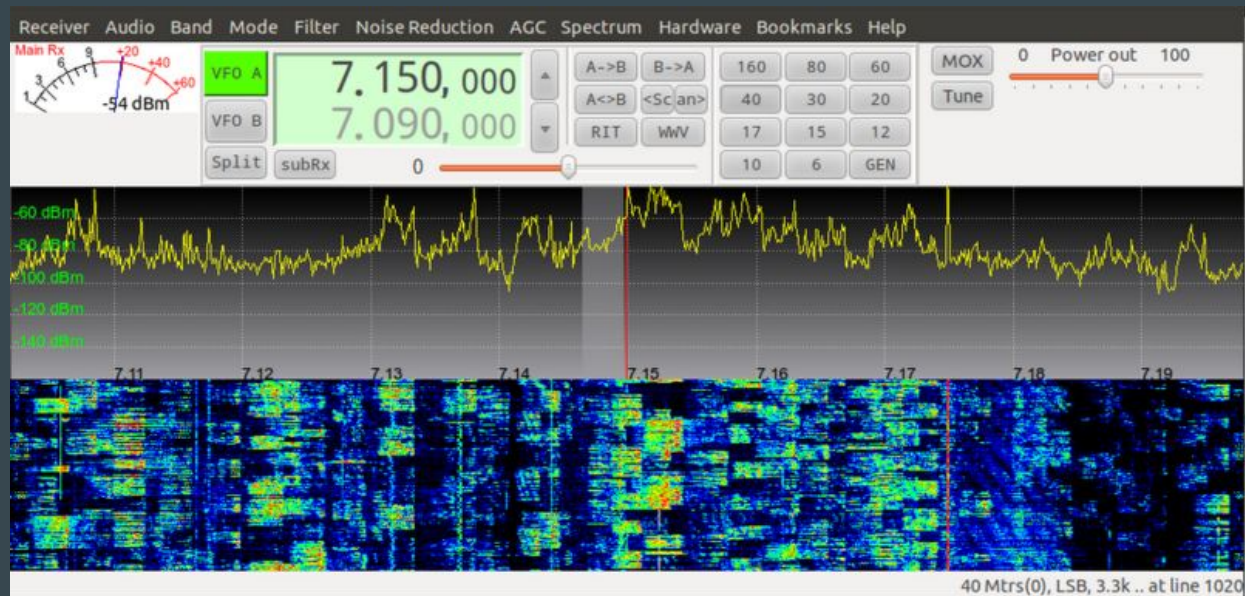
- HAM Focus
- Includes Demods
- Signal to Audio
- Proprietary

<http://sdr-radio.com/Software>



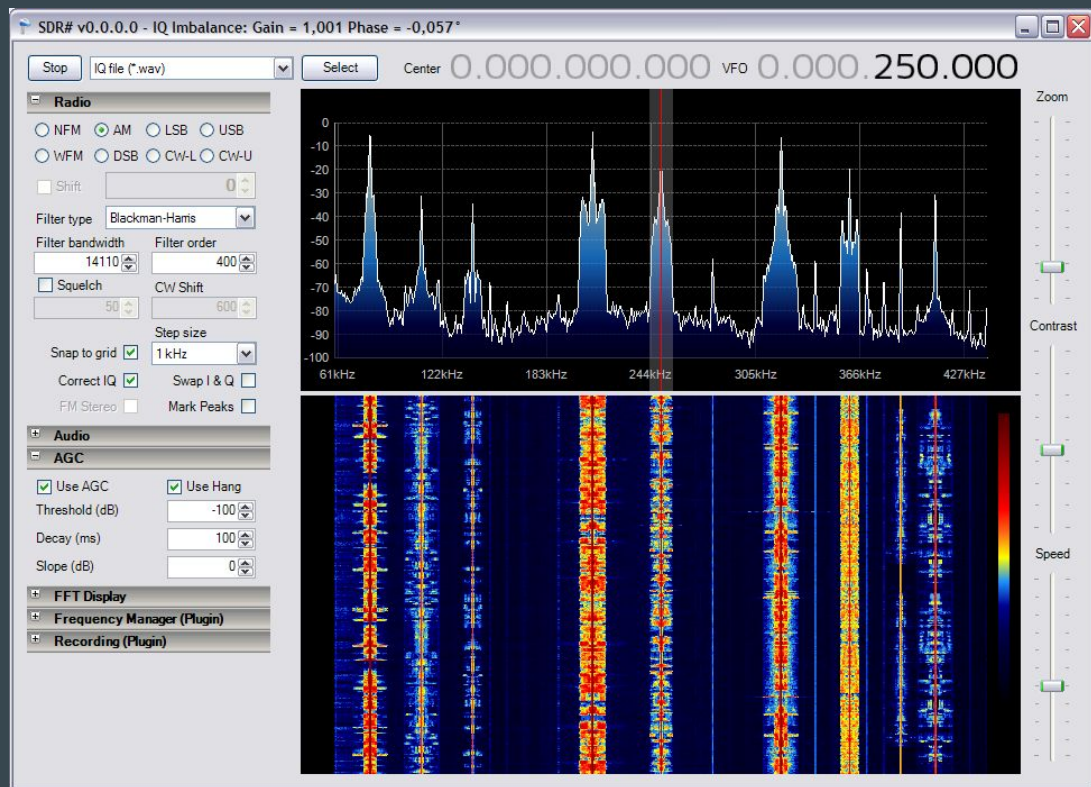
# QtRadio / ghpsdr3-alex

- Server / Client
- Remote Access
- Map of Servers
- GPL



[http://napan.ca/ghpsdr3/index.php/Main\\_Page](http://napan.ca/ghpsdr3/index.php/Main_Page)

# SDR#



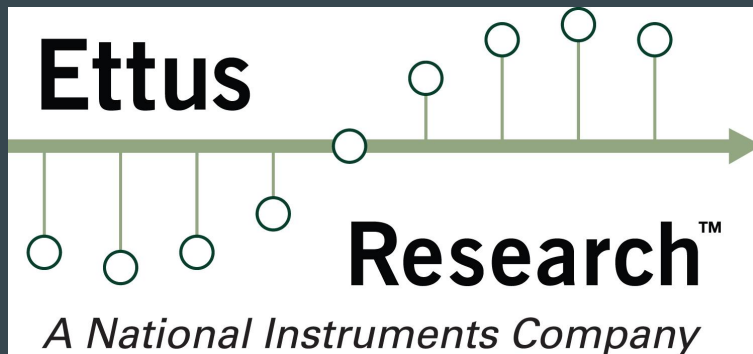
- Monitoring
- Windows Only
- Proprietary

<http://airspy.com/download/>

**Through the magic of software  
abstraction...**

# USRP Hardware Driver (UHD)

- Every tool in this presentation uses UHD to talk to USRPs
- C or C++ Interfaces
- Compile into dynamic or static library
  - Easy to package with your own application that uses USRPs!
- GPL or Proprietary Licenses Available





# USRP

