



ELE476 Week-2 GNU Radio

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Outline

GNU Radio Intro

GR Companion

GR Flow Graphs

Signal Exploration with GR

GR with Sound Card

GNU Radio

- We will use GNU Radio to
 - analyze & simulate signals
 - teach signal processing
- So let's learn how to use it first!

GNU Radio is...

- A signal processing library
- Designed for real-time
- The software part of an SDR
- Not a radio application
- The tool to **build your own** transceivers
- **FOSS**: Free and Open Source Software



GNU Radio

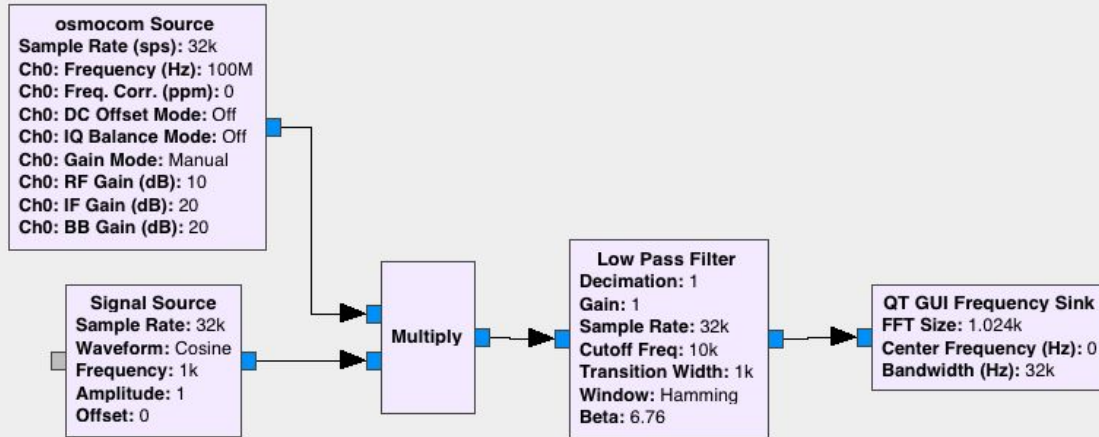
- GNU Radio is an open source framework to do DSP for radio (communications, RADAR, radio astronomy...).
 - Also useful for applications that do similar computing (even particle accelerators!).
 - It comes with:
 - A GUI application called “GNU Radio companion” where systems can be implemented by dragging and dropping blocks onto a canvas (making a “flowgraph”)
 - A rich library of processing blocks accessible both through GNU Radio companion, and C++ and Python APIs
 - A “runtime”, that moves data between these blocks and runs the code of each block
 - In the GNU Radio ecosystem there are out-of-tree modules, which implement new blocks that don’t fit into or exist in the in-tree library
 - There are also full applications that use GNU Radio for their DSP (for instance, GQRX, or QRadioLink)
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GNU Radio

- Open-source framework for SDR and signal processing
 - Founded by Eric Blossom in 2001
 - Block-based dataflow architecture
 - Each block runs in its own thread
 - Data flows through a graph called a Flowgraph
 - Blocks are nodes in a Flowgraph, and perform operations and signal processing
 - Signals normalized between -1.0 and +1.0
 - Similar in concept to MathWorks Simulink™
 - Running C++ and Python under-the-hood
 - Can write code directly, or use the GNU Radio Companion (GRC) graphical tool
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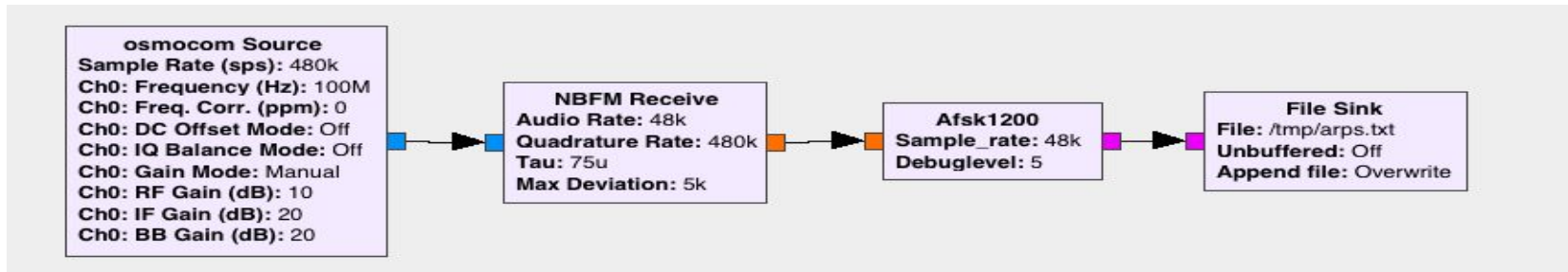
Basic Concept: Flow Graph

- Transceivers are implemented as *flow graphs*
- Similar to Simulink / schematics
- Define structure and parameters of *blocks*



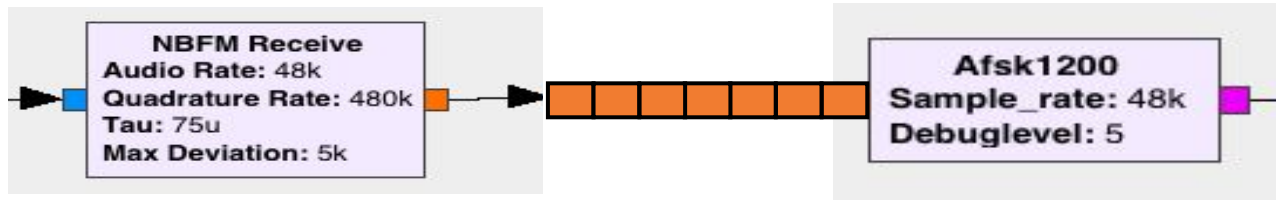
Basic Concept: Block

- Written in C++ or Python
- Implement one logical step
- Each block run in separate thread

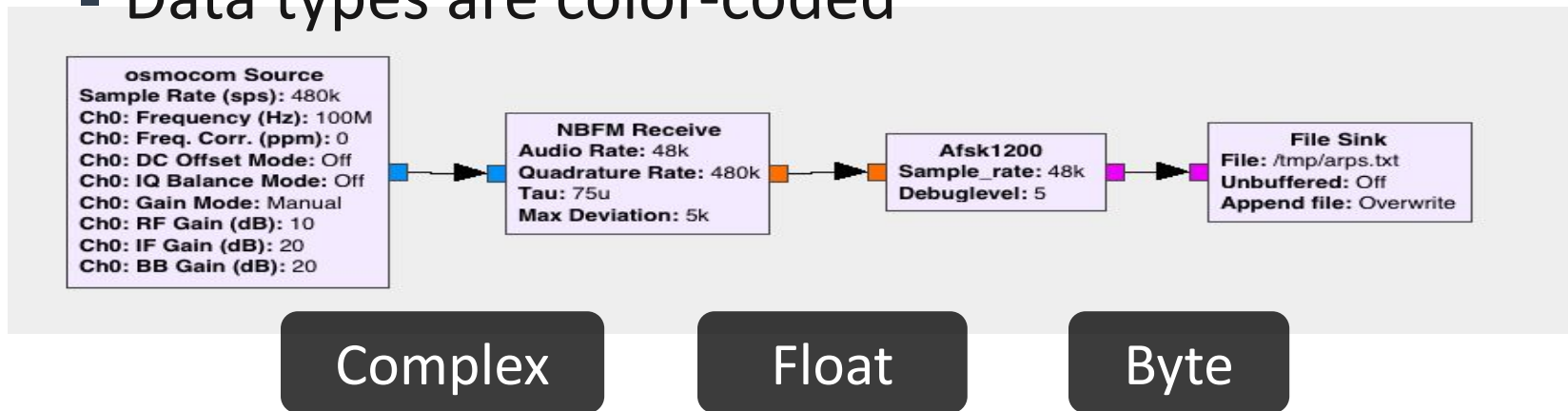


Data Streams

- Samples are buffered

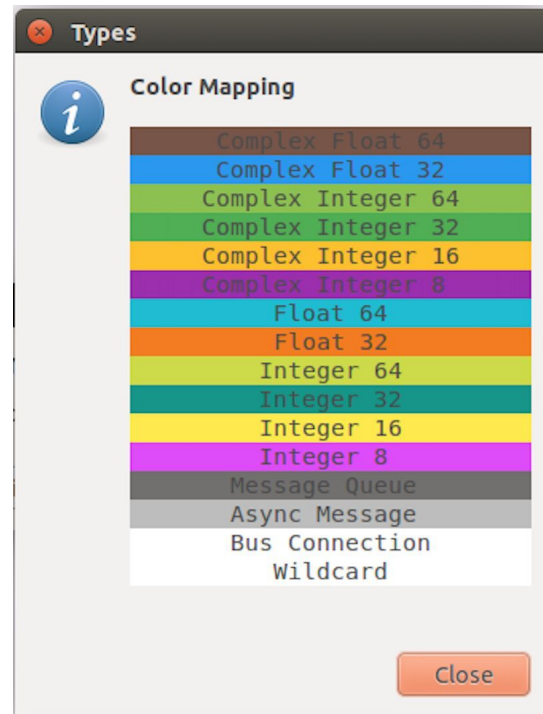


- Data types are color-coded



Color Types

Click on menu item Help->Types

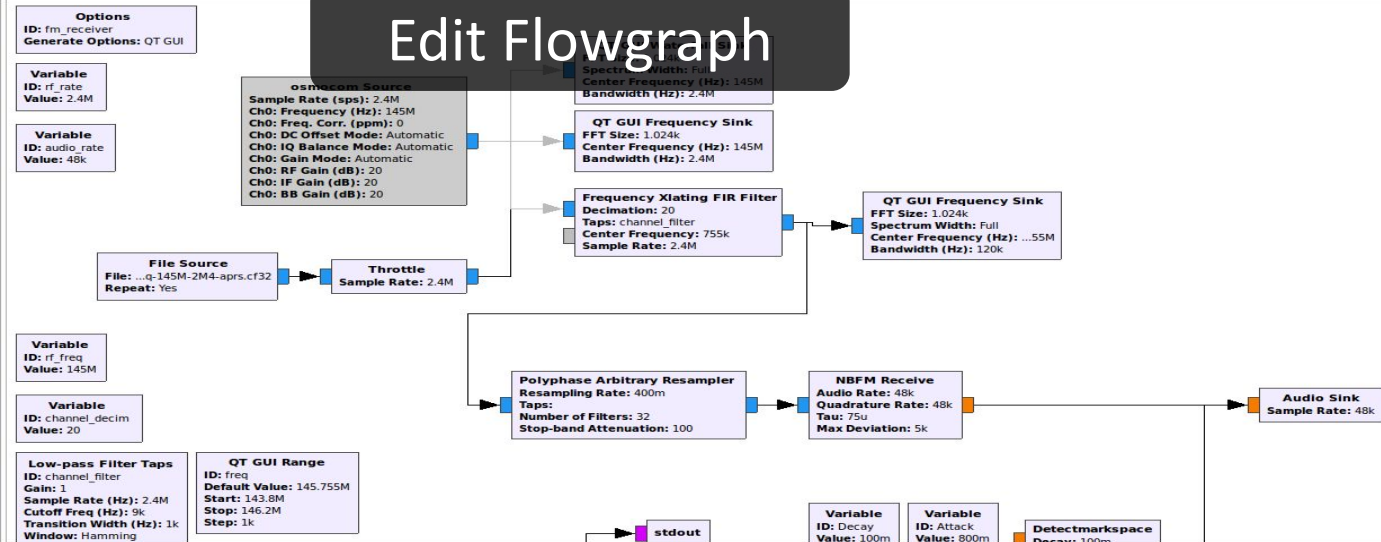


GNU Radio Companion

File Edit View Run Tools Help



fm_receiver x rds_rx x



<<< Welcome to GNU Radio Companion 3.7.12git-1109-gcbf30e9c >>>

Block paths:

/home/basti/.gnc_gnuradio
/home/basti/.gnuradio-next/share/gnuradio/gc/blocks

Loading: "/home/basti/.gnc-workshop/fm_r...
>>> Done
Loading: "/home/basti/.gnc-rds/apps/rds_rx.grc"
>>> Done

Console

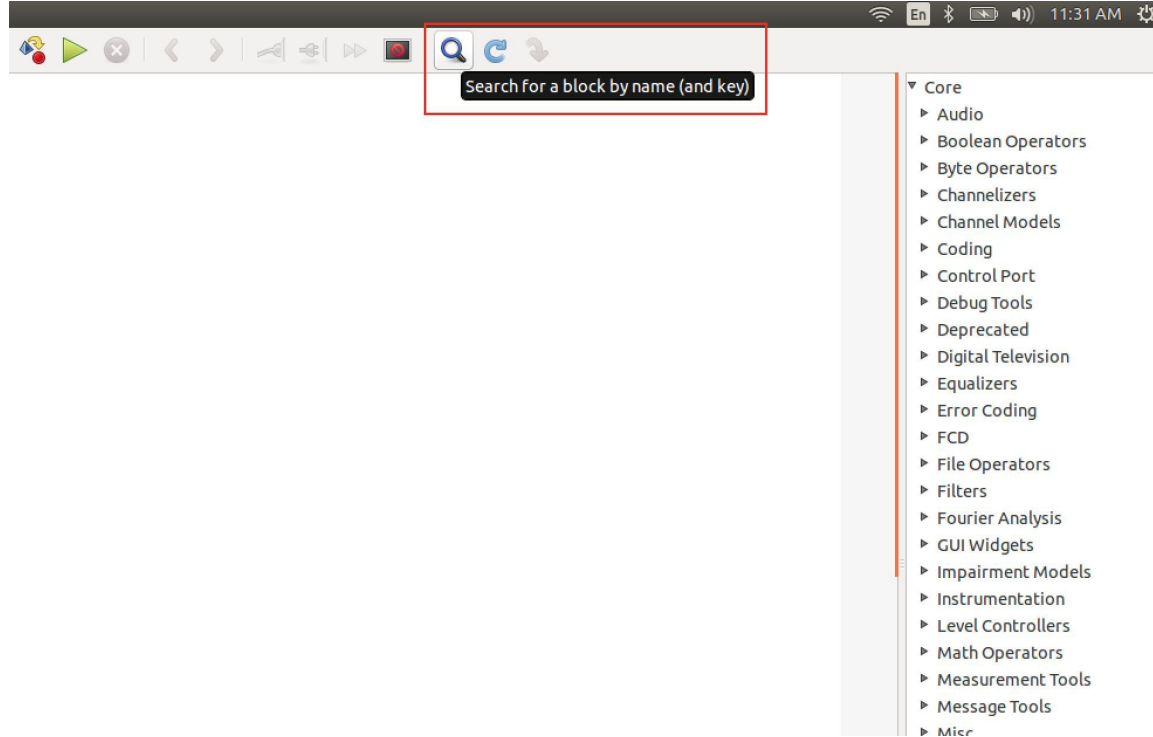
Id		Value
Imports		
Variables		
Attack	0.8	
audio_rate	48000	
channelLc	20	
channelLc	<Open Properties>	
Decay	0.1	
freq	<Open Properties>	

Variables

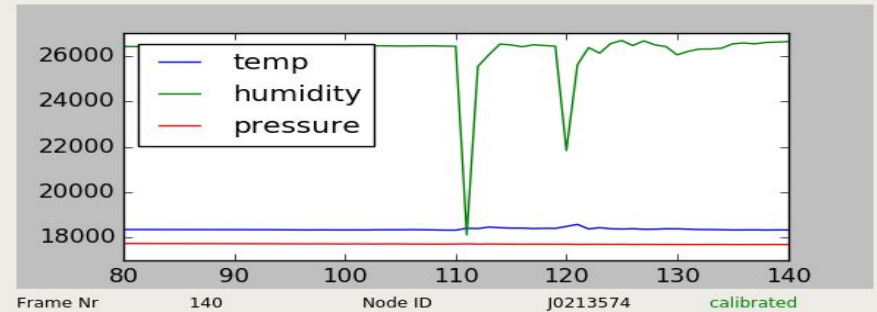
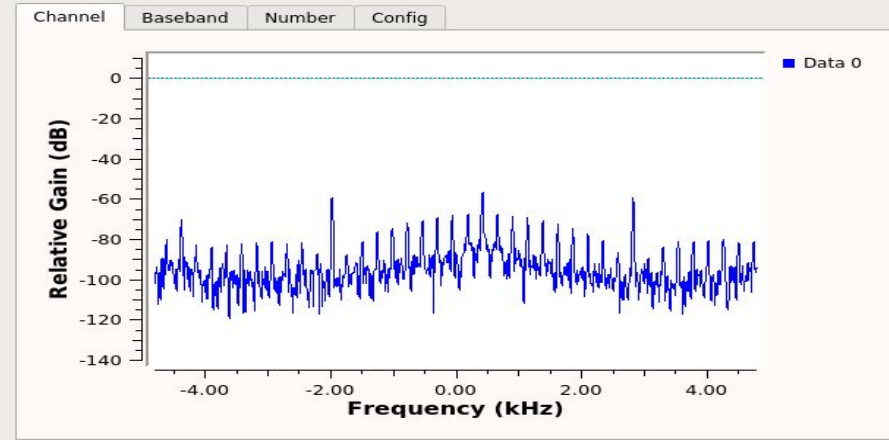
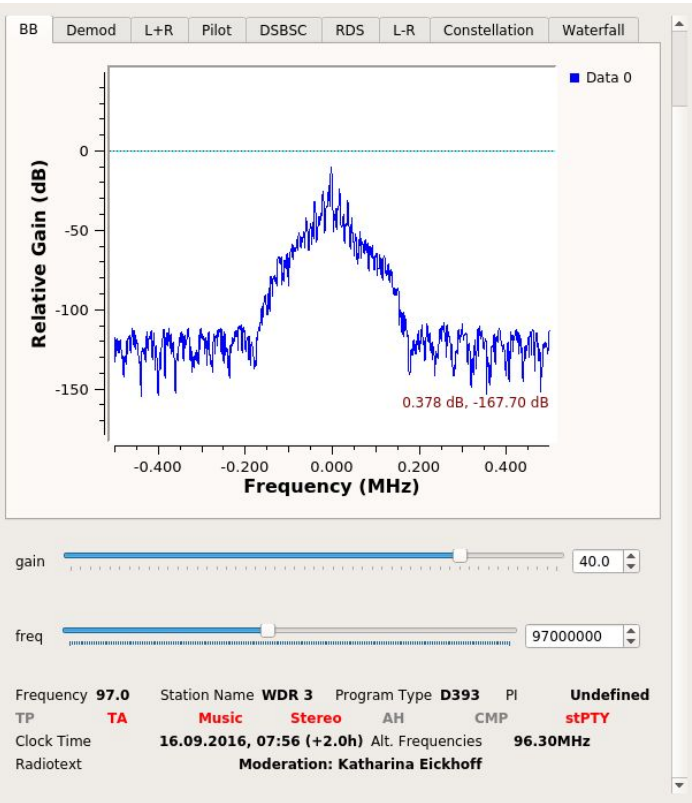
Block Library

- Core
- Audio
- Boolean Operators
- Byte Operators
- Channelizers
- Channel Models
- Coding
- Control Port
- Debug Tools
- Deprecated
- Digital Television
- Equalizers
- Error Coding
- File Operators
- Filters
- Fourier Analysis
- GUI Widgets
- Impairment Models
- Instrumentation
- Level Controllers
- Math Operators
- Measurement Tools
- Message Tools
- Misc
- Modulators
- Networking Tools
- OFDM
- Packet Operators
- Peak Detectors
- Resamplers
- Stream Operators
- Stream Tap Tools

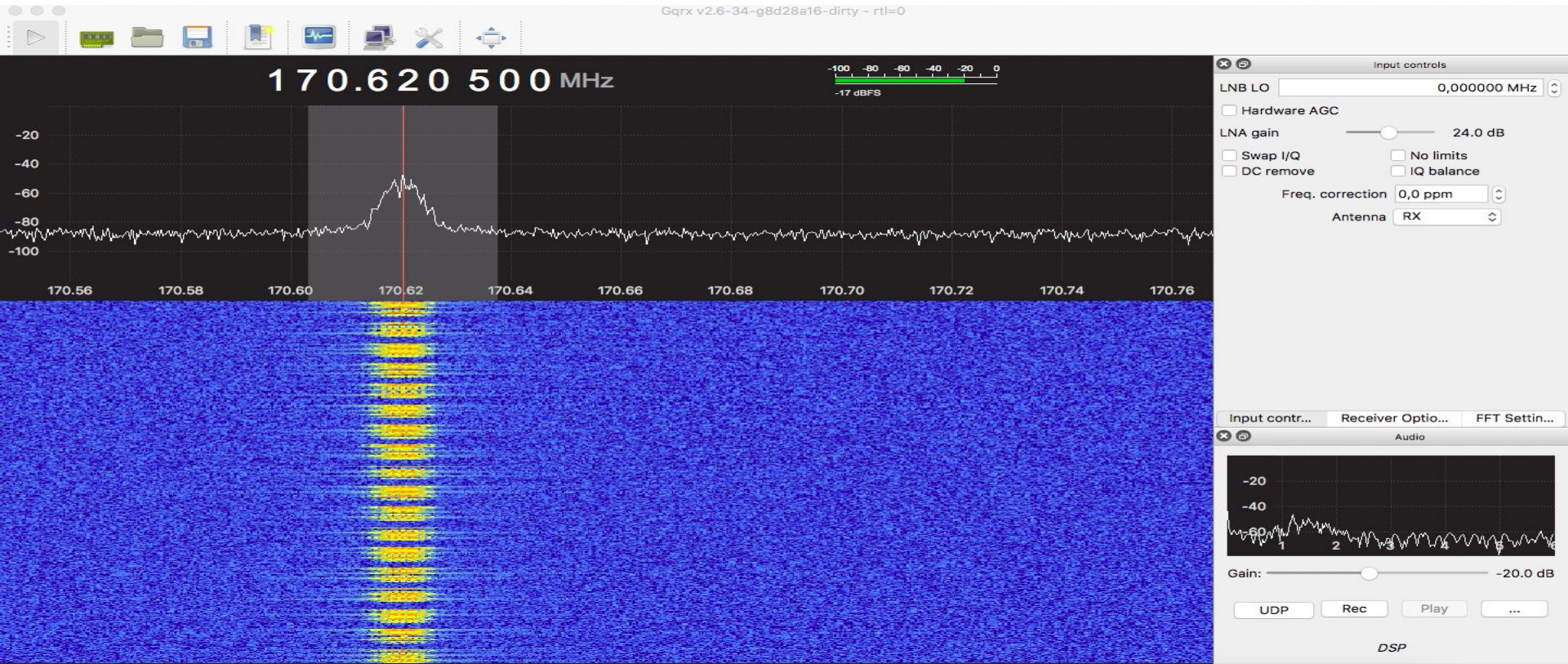
Search Blocks



GUI Output and Instrumentation




GQRX - a GNU Radio Application



Out Of Tree Modules

- GNU Radio can be extended with OOTs
- OOTs cover more specific functionality
- There is a large number available
- CGRAN is our central database




[CGRAN](#) [Projects](#) [Documentation](#) [GNU Radio](#) [VOLK](#)



The Comprehensive GNU Radio Archive Network

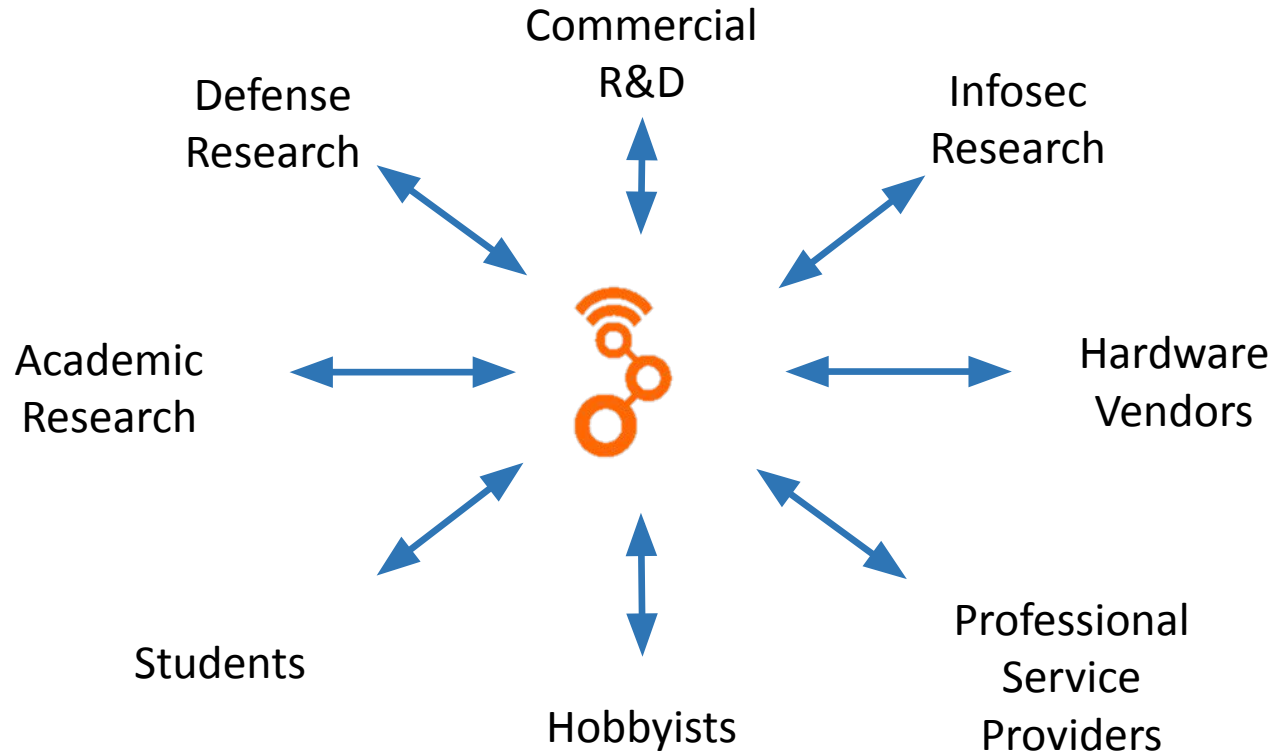
The Comprehensive GNU Radio Archive Network (CGRAN) is a free open source repository for 3rd party GNU Radio applications a.k.a Out Of Tree Modules that are not officially supported by the GNU Radio project.

[Browse~Checkout~Hack](#)

Name	Tags	Description	Repository
gr-eventstream	scheduler, streams, bursty	The event stream scheduler	Github

GNU Radio is used by



GNU Radio is an Ecosystem

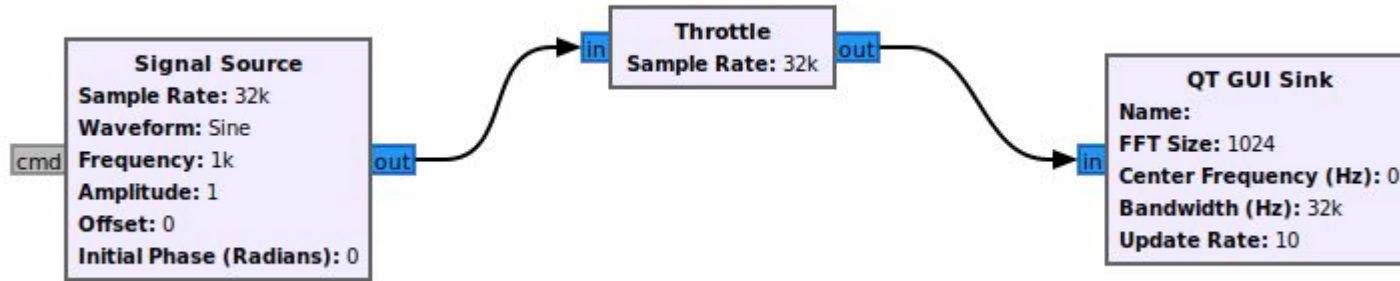
- Active Open Source community since 2001
- PyBombs, OOTs
- GRCon since 2011
- GNU Radio Foundation
- FOSDEM SDR DevRoom
- GSoC, SoCIS, R&S Competition, SDR Academy
- GNU Radio Europe



Learn // Discuss // Connect

- Website: www.gnuradio.org
 - Development: github.com/gnuradio
 - **Mailing List:** discuss-gnuradio@gnu.org
 - Wiki: wiki.gnuradio.org
 - Slack: slack.gnuradio.org
 - Facebook: [gnuradioproject](https://www.facebook.com/gnuradioproject)
 - Twitter: [@gnuradio](https://twitter.com/gnuradio)
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Exploration of Signals in Frequency Domain





Thanks!

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