

# GNU Radio Workshop

Marcus Müller and Bastian Bloessl



July 2017 ▪ HAMRADIO ▪ SDR Academy ▪ Friedrichshafen, Germany

# Master Plan

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- GNU Radio 101
- Building an FM receiver
- Using OOTs
- Extending GNU Radio



**Hands-On!**

# Material is Online

<https://github.com/bastibl/gnuradio-workshop>

The screenshot shows a web browser window displaying the GitHub repository page for `bastibl/gnuradio-workshop`. The browser's address bar shows the URL `https://github.com/bastibl/gnuradio-workshop`. The repository page includes a header with the repository name, a search bar, and navigation links for Pull requests, Issues, Marketplace, and Gist. Below the header, there are tabs for Code, Issues (0), Pull requests (0), Projects (0), Wiki, Settings, and Insights. The main content area features a description of the repository: "GNU Radio Workshop held at SDR Academy 2017" with a link to `http://2017.sdra.io/pages/gnuradio-wo...`. There are also tags for `sdr`, `gnuradio`, `hamradio`, and `workshop`. A summary bar shows 19 commits, 1 branch, 0 releases, and 1 contributor. At the bottom, there is a list of recent commits, including a commit by `bastibl` to rename the README, and a list of files in the repository, such as `gr-stdout`, `README.md`, `announcement.org`, `fm_receiver.grc`, and `fm_receiver.py`.

bastibl / gnuradio-workshop

Unwatch 2 Unstar 3 Fork 1

Code Issues 0 Pull requests 0 Projects 0 Wiki Settings Insights

GNU Radio Workshop held at SDR Academy 2017 <http://2017.sdra.io/pages/gnuradio-wo...> Edit

sdr gnuradio hamradio workshop Manage topics

19 commits 1 branch 0 releases 1 contributor

Branch: master New pull request Create new file Upload files Find file Clone or download

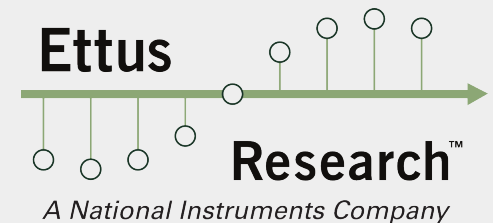
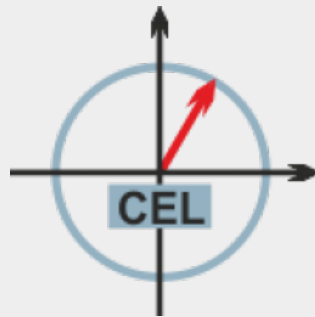
bastibl rename readme Latest commit b657529 6 minutes ago

gr-stdout	stdout implementation	2 hours ago
README.md	rename readme	6 minutes ago
announcement.org	add announcement	a month ago
fm_receiver.grc	stdout module	2 hours ago
fm_receiver.py	stdout module	2 hours ago

# About Us: Marcus Müller



- **Research Assistant @ CEL,**  
Karlsruhe Institute of Technology
- **Engineer @ Ettus Research**



# About Us: Bastian Bloessl



- **Researcher @** Connect Center  
Trinity College Dublin
- **Engineer @** SRS  
Software Radio Systems

CONNECT



# GNU Radio is...

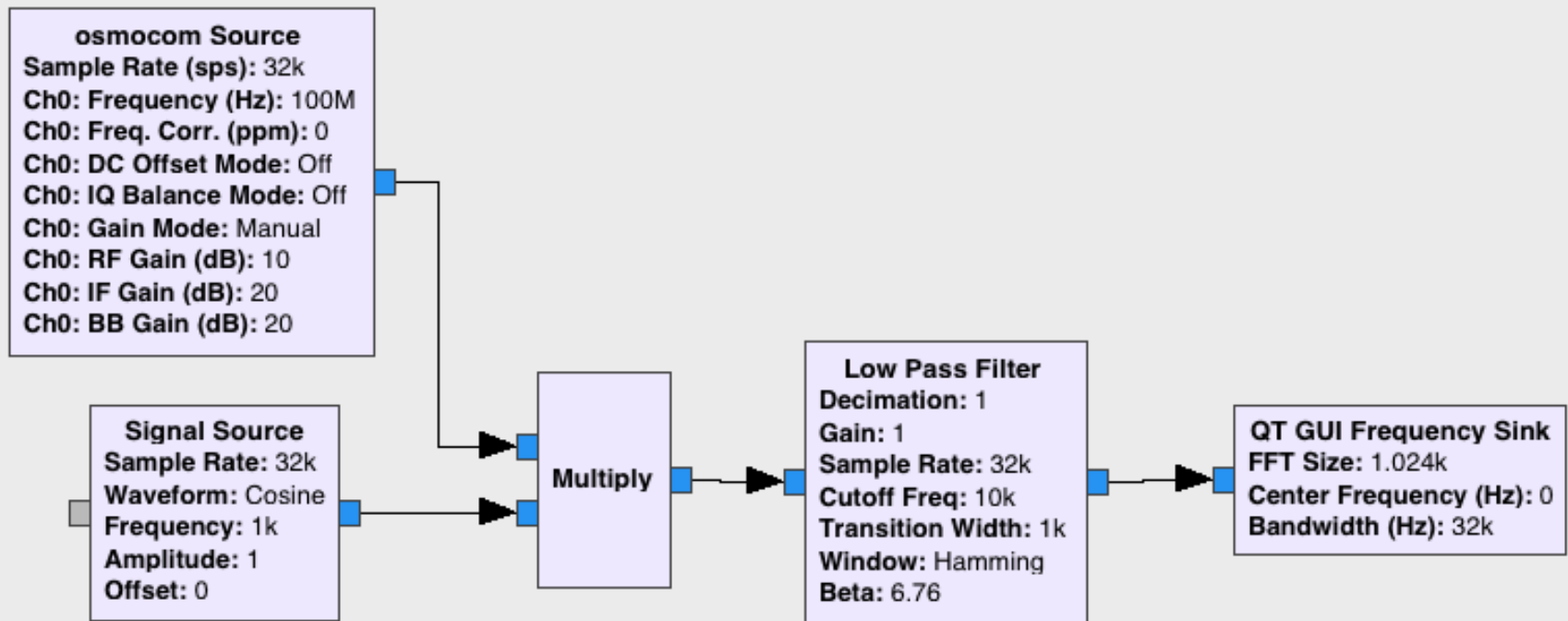
- A signal processing library
- Designed for real-time
- The software part of an SDR
- Not a radio application
- The tool to **build your own** transceivers



**Matches perfectly with the ham spirit**

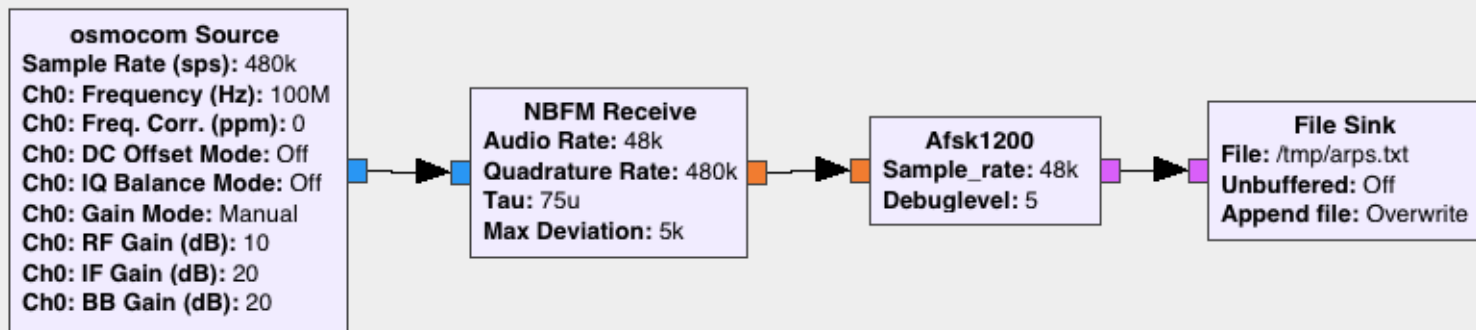
# Basic Concept: Flow Graph

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



# Basic Concept: Block

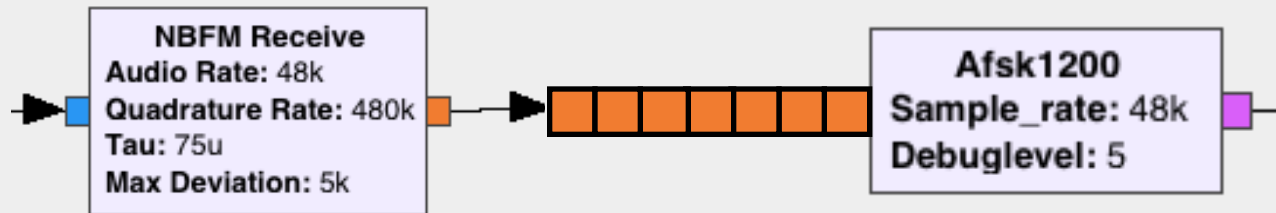
- Written in C++ or Python
- Implement one logical step
- Each block run in separate thread
- Can be encapsulated into hierarchical blocks



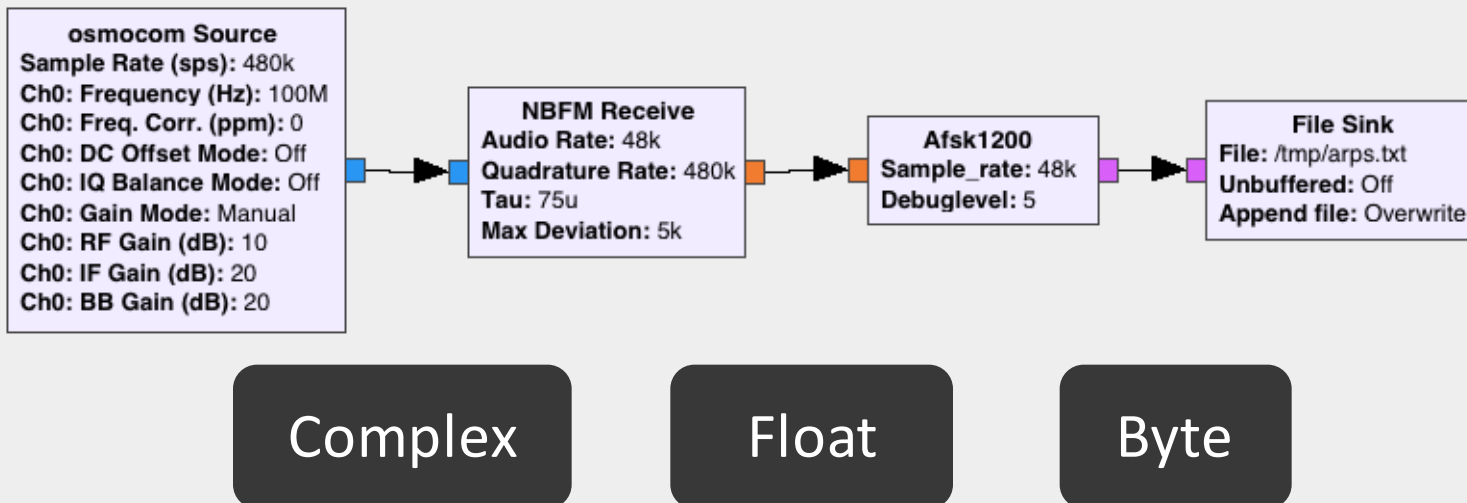


# Data Streams

- Samples are buffered



- Data types are color-coded

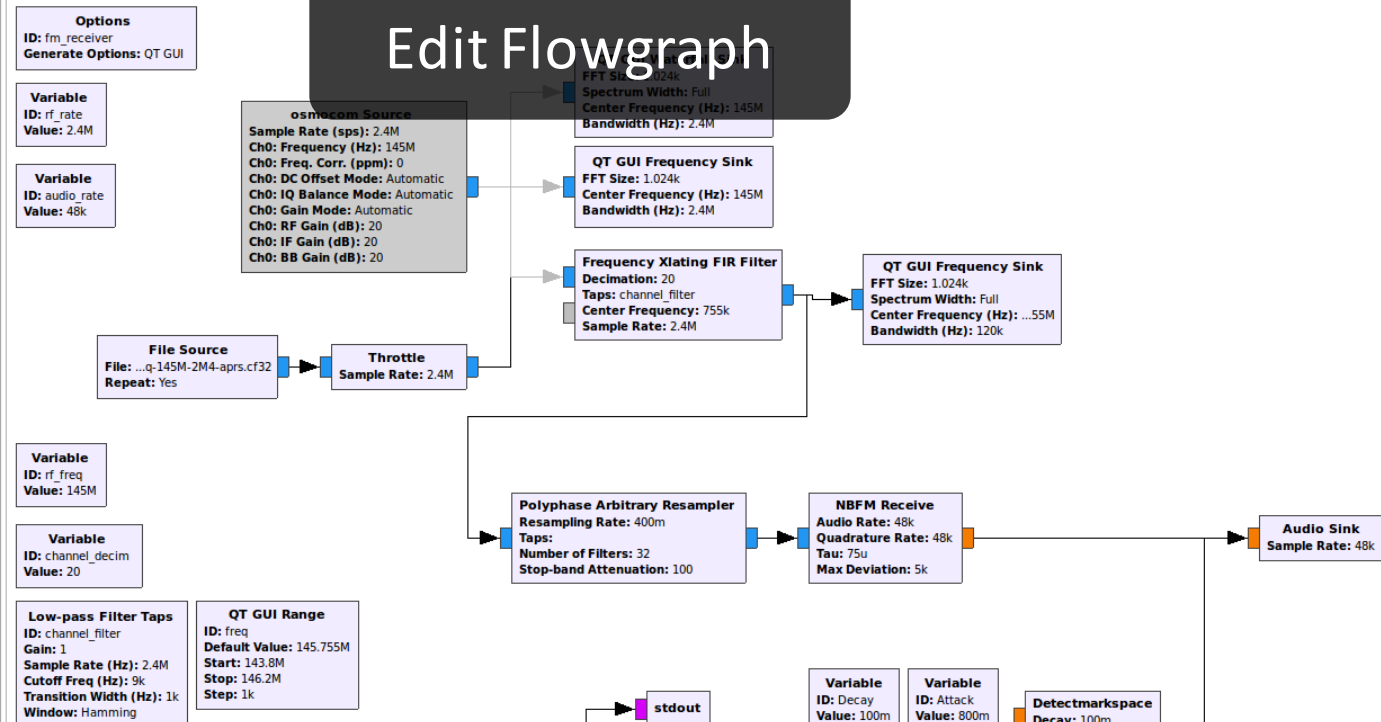


# GNU Radio Companion

File Edit View Run Tools Help



fm\_receiver x rds\_rx x



## 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 Tool Tools

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

Block paths:

/home/basti/.grc\_gnuradio  
/home/basti/.usr/share/gnuradio-next/share/gnuradio/grc/blocks

Loading: "/home/basti/.src/gr-workshop/fm\_receiver.grc"  
>>> Done

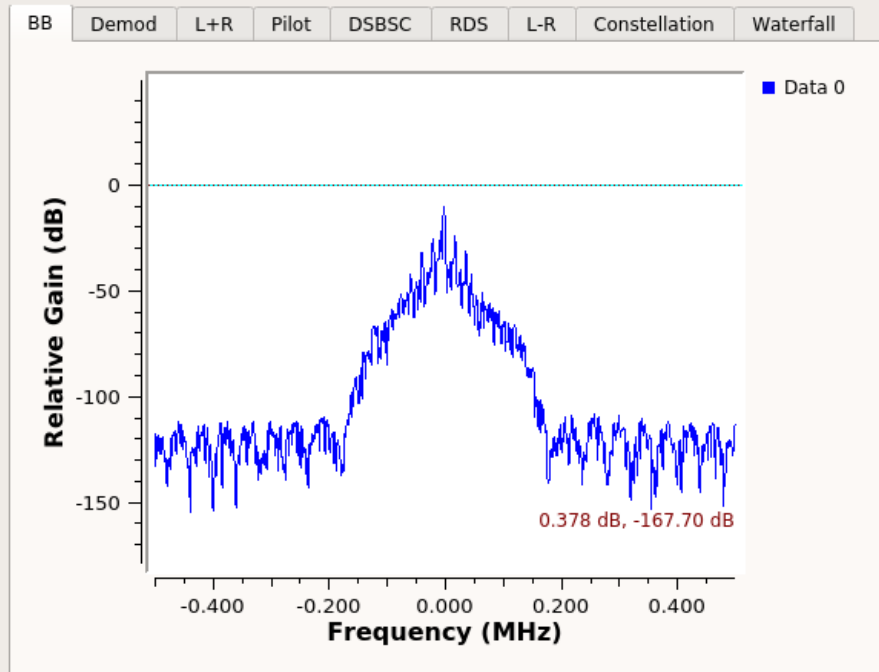
Loading: "/home/basti/.src/gr-rds/apps/rds\_rx.grc"  
>>> Done

**Console**

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

**Variables**

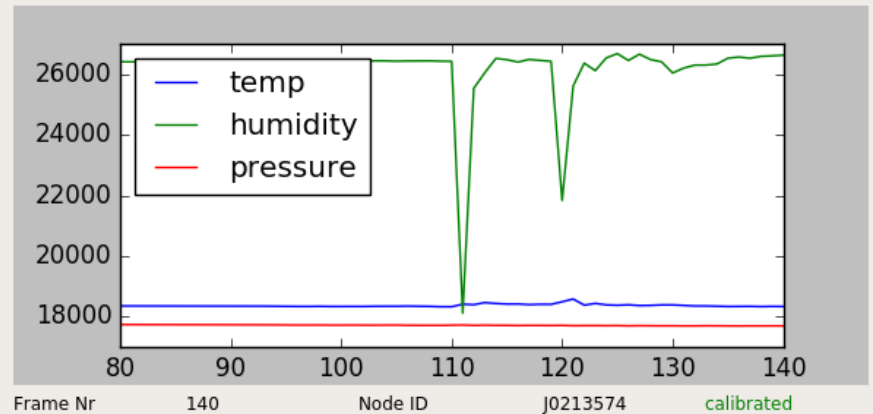
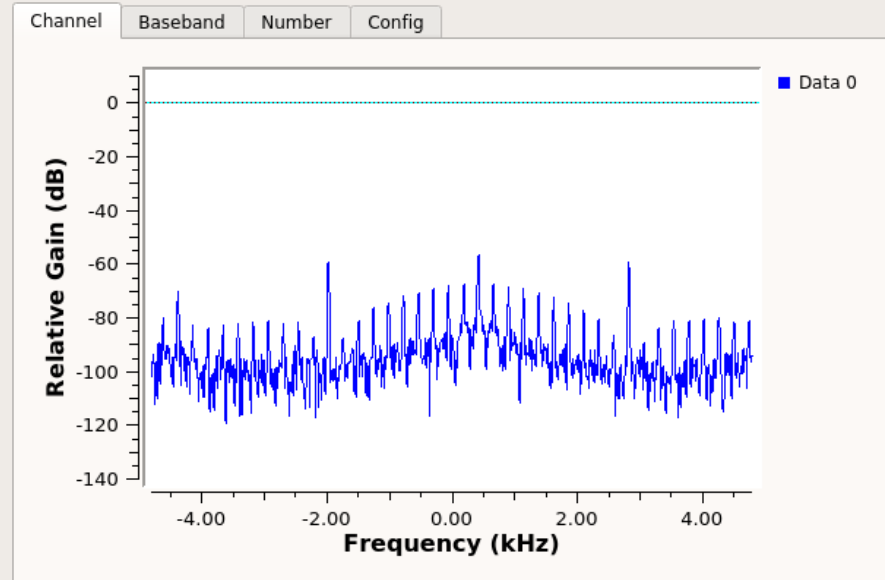
# GUI Output and Instrumentation



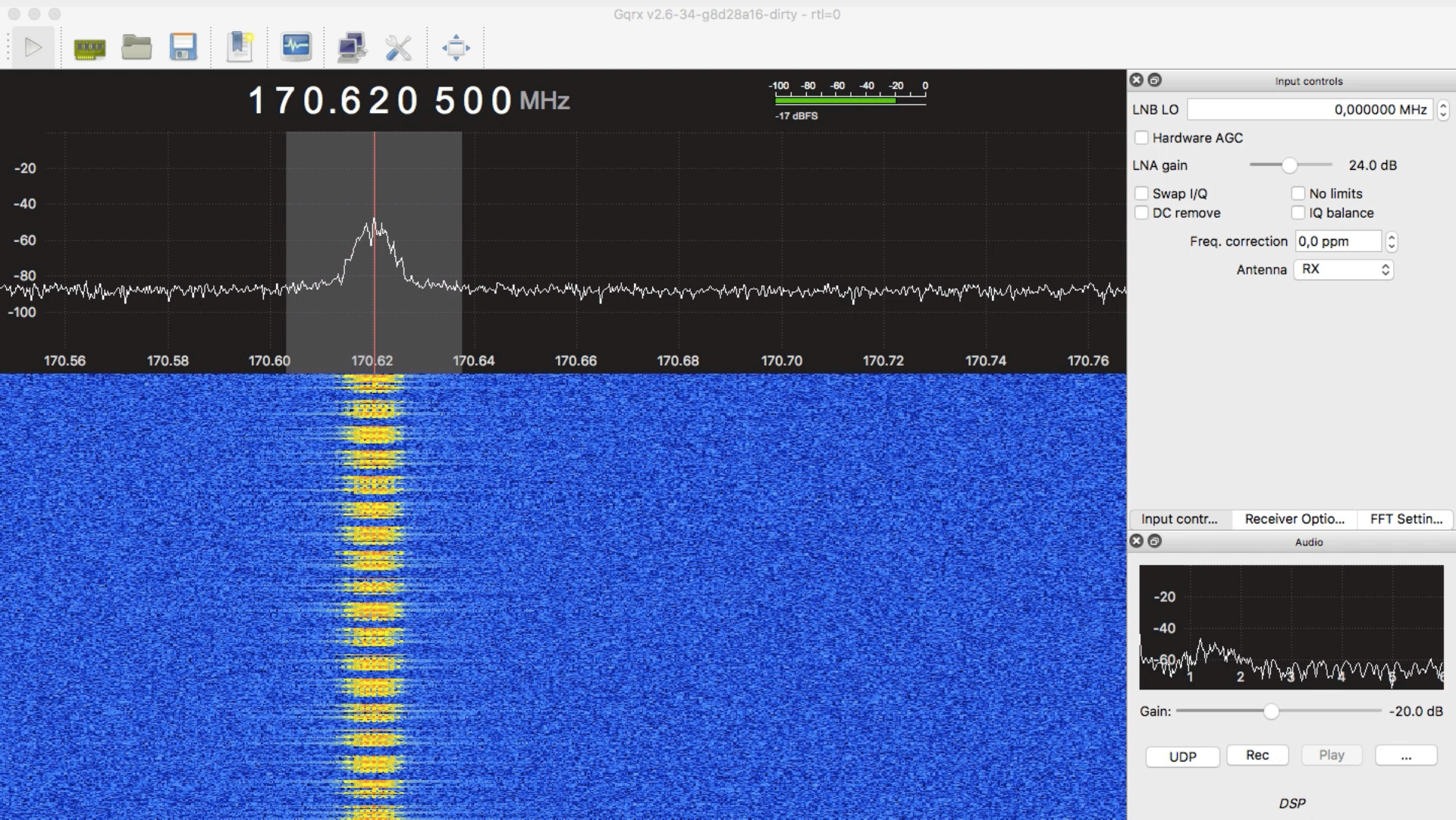
gain

freq

Frequency **97.0** Station Name **WDR 3** Program Type **D393** PI **Undefined**  
TP **TA** **Music** **Stereo** **AH** **CMP** **stPTY**  
Clock Time **16.09.2016, 07:56 (+2.0h)** Alt. Frequencies **96.30MHz**  
Radiotext **Moderation: Katharina Eickhoff**




# 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.

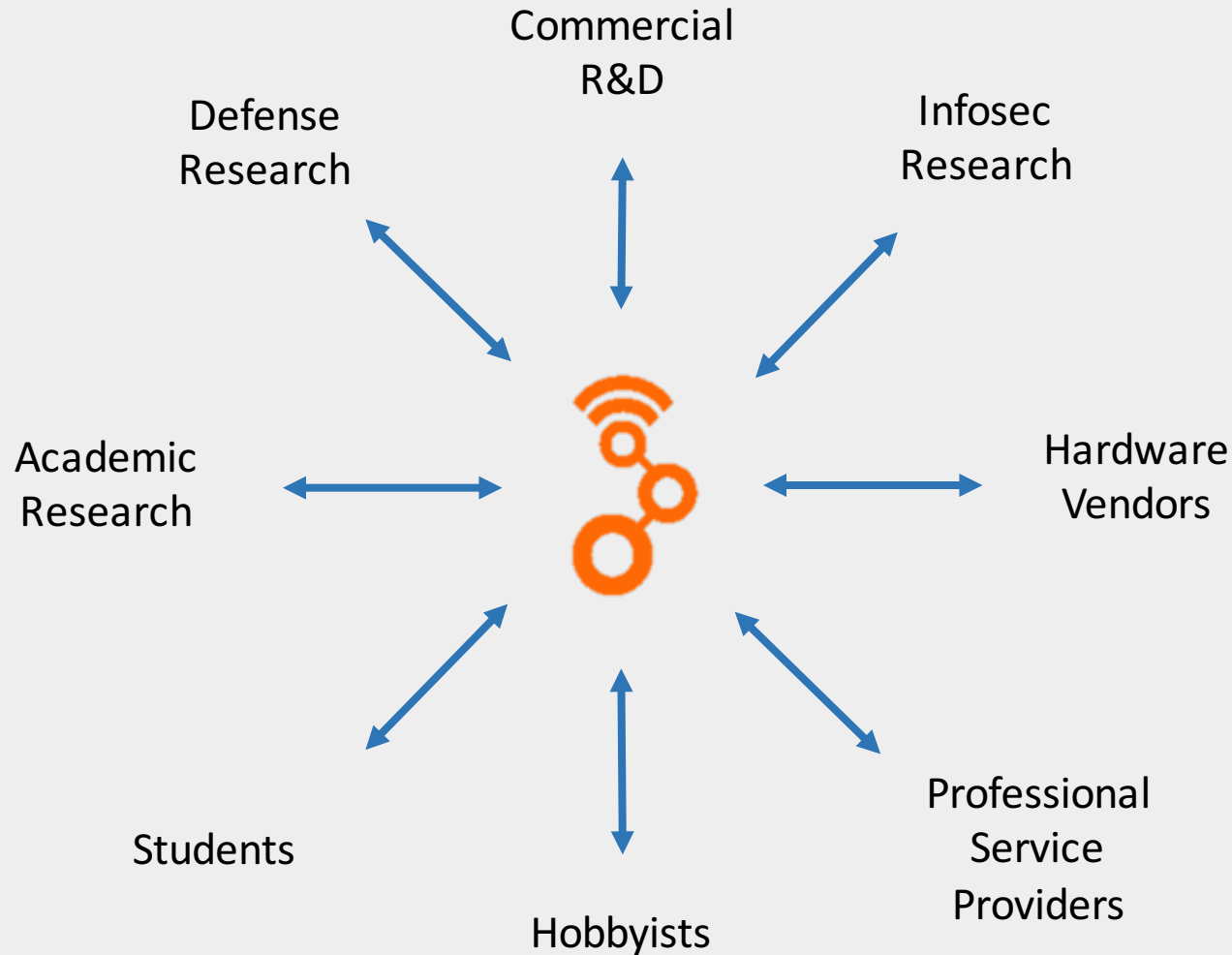


## Browse~Checkout~Hack

Name	Tags	Description	Repository
<a href="#">gr-eventstream</a>	scheduler, streams, bursty	The event stream scheduler	 <a href="#">Github</a>
<a href="#">Receiver for Vaisala Weather Sonde</a>		Receiver for Vaisala Weather Sonde	 <a href="#">Github</a>
<a href="#">gr-pyqt</a>	gui, plotting, pyqt, pyqwt	Python QT Plotters and Message Tools Repo	 <a href="#">Github</a>
<a href="#">gr-pcap</a>	pcap, packet	PCAP recording and playback	 <a href="#">Github</a>

# GNU Radio is used by



# GNU Radio is an Ecosystem

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





# Installing GNU Radio

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- From source: GitHub
- Package manager
  - Some are pretty outdated
- macOS / homebrew
- **PyBombs**: integrated dependency management and 3rd party application installation



# Learn // Discuss // Connect

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- Website: [www.gnuradio.org](http://www.gnuradio.org)
- Development: [github.com/gnuradio](https://github.com/gnuradio)
- **Mailing List:** [discuss-gnuradio@gnu.org](mailto:discuss-gnuradio@gnu.org)
- Wiki: [wiki.gnuradio.org](http://wiki.gnuradio.org)
- Slack: [slack.gnuradio.org](https://slack.gnuradio.org)
- Facebook: [gnuradioproject](https://www.facebook.com/gnuradioproject)
- Twitter: [@gnuradio](https://twitter.com/gnuradio)

# GNU Radio Workshop

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 @dEnergy\_dTime

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