

GNU Radio Basics & Interfacing to Aselsan COMINT Receivers

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Kasım, 2018

Outline

- GNU Radio 101
- GNU Radio Interface to Aselsan COMINT Receivers
- GNU Radio Live Demos
- Future Work

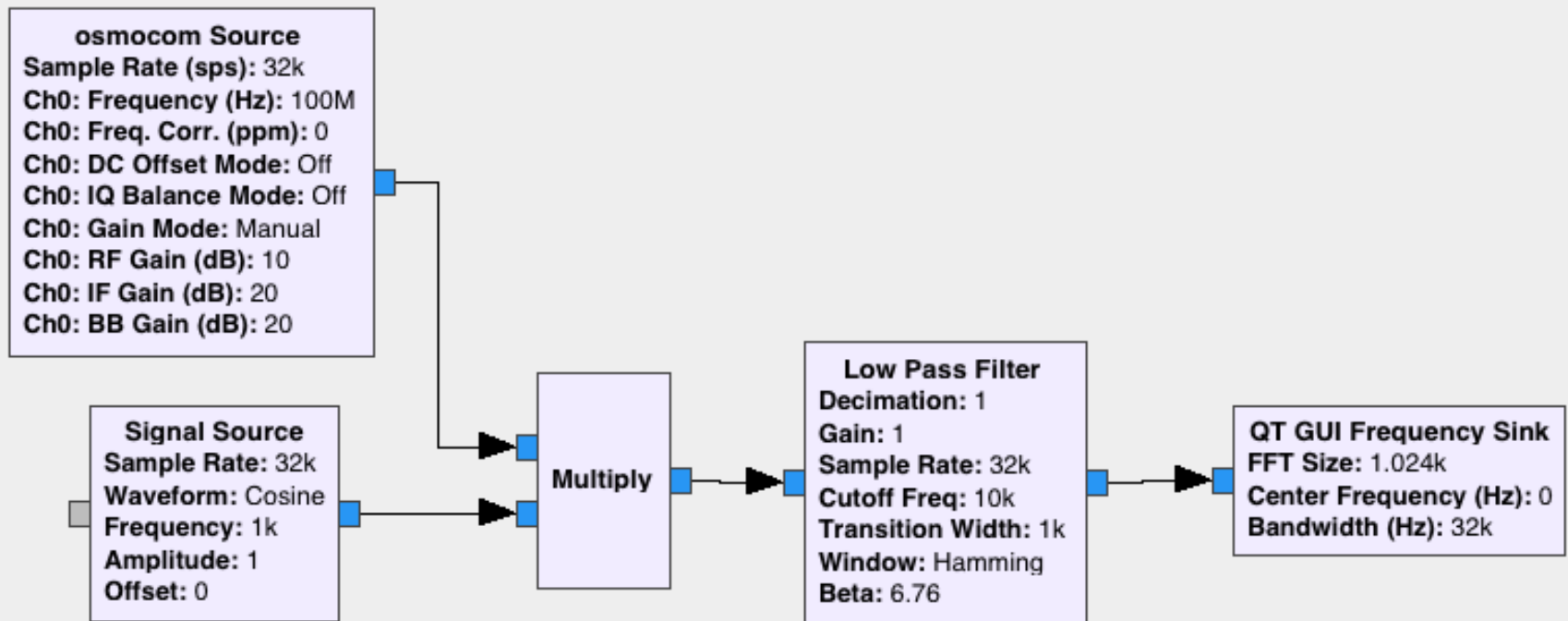
GNU Radio is...

- 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



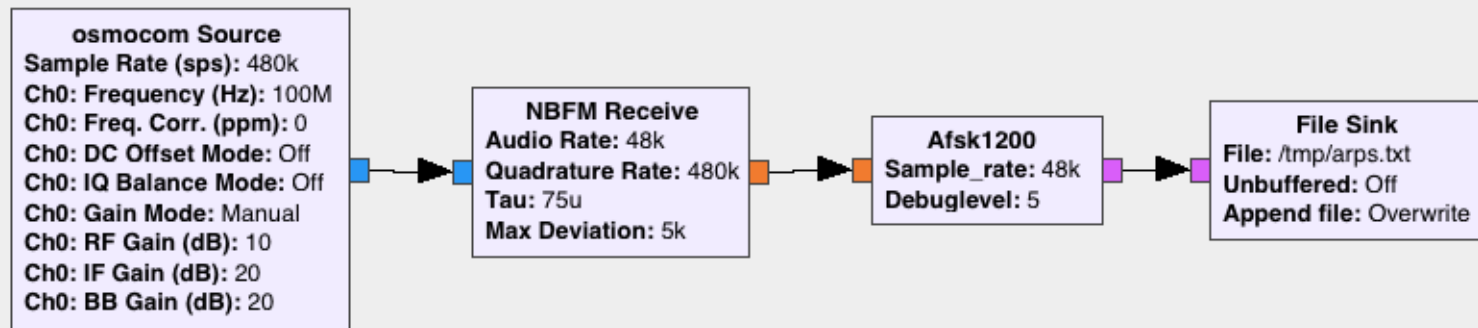
Basic Concept: Flow Graph

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



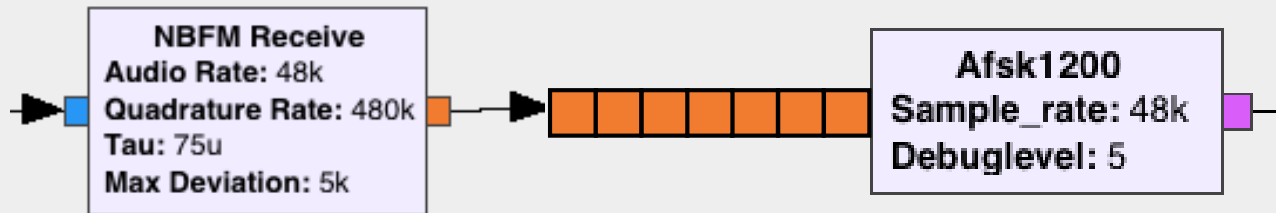
Basic Concept: Block

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

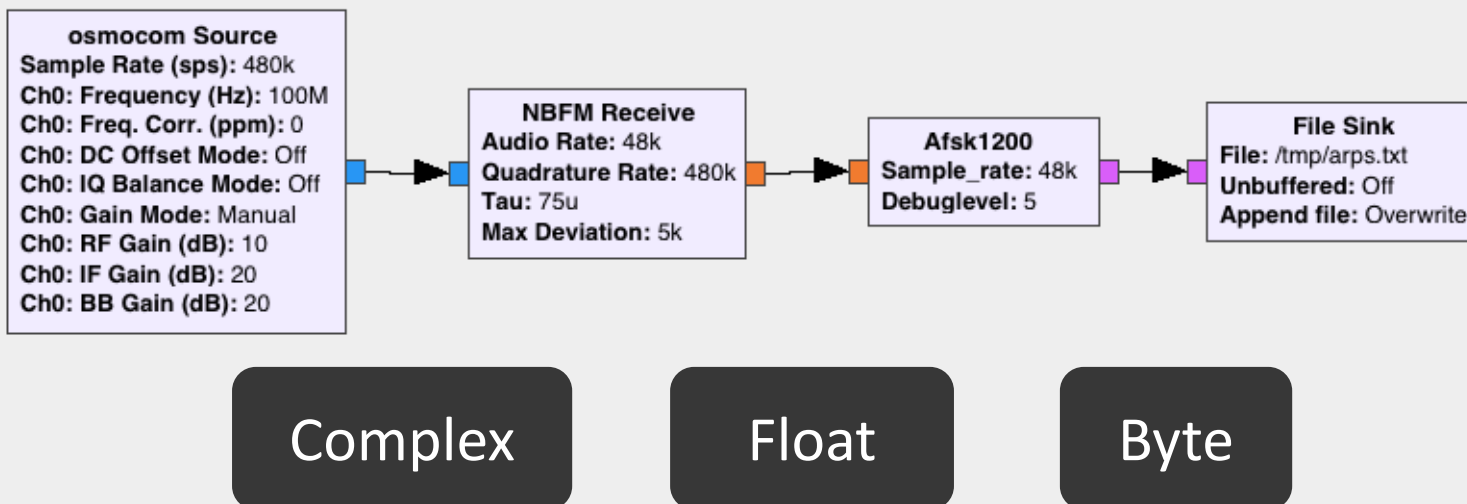


Data Streams

- Samples are buffered

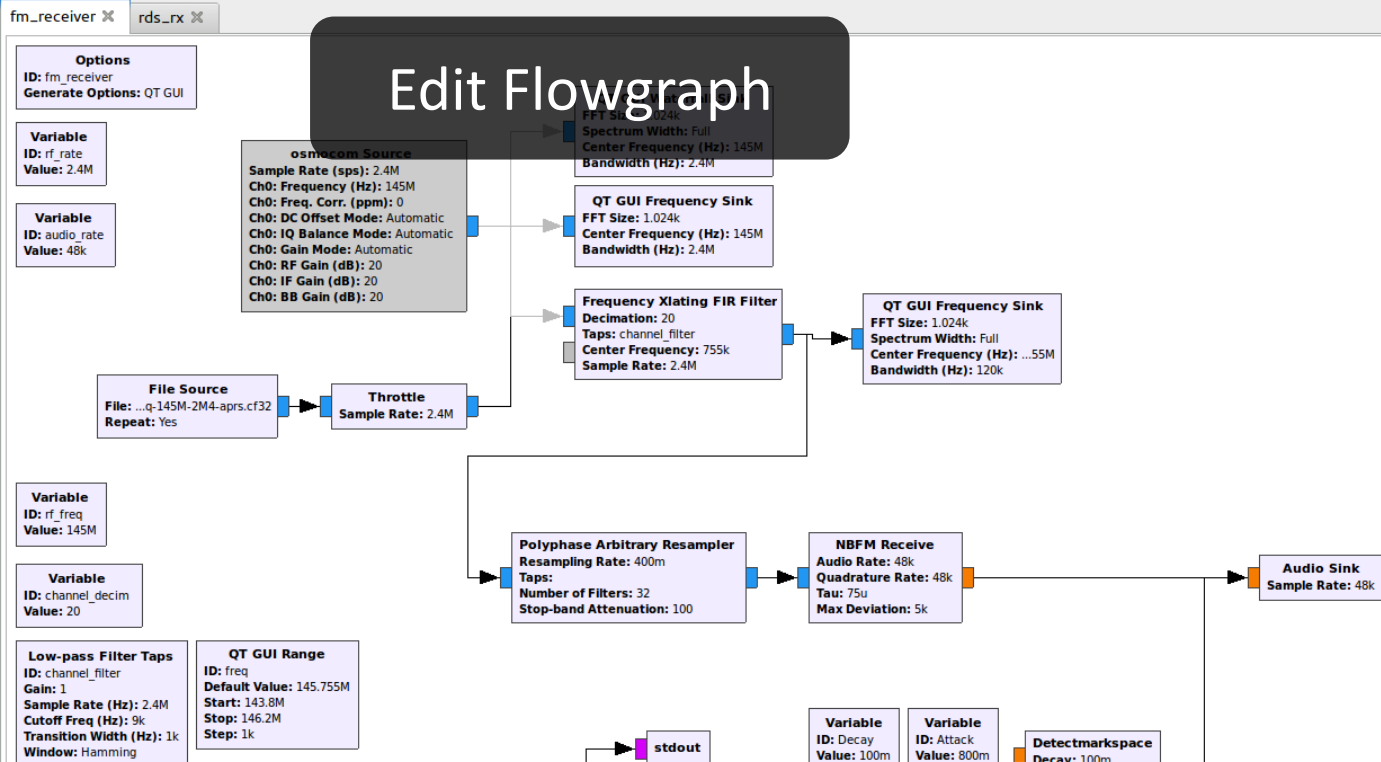


- Data types are color-coded



GNU Radio Companion

File Edit View Run Tools Help



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/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"

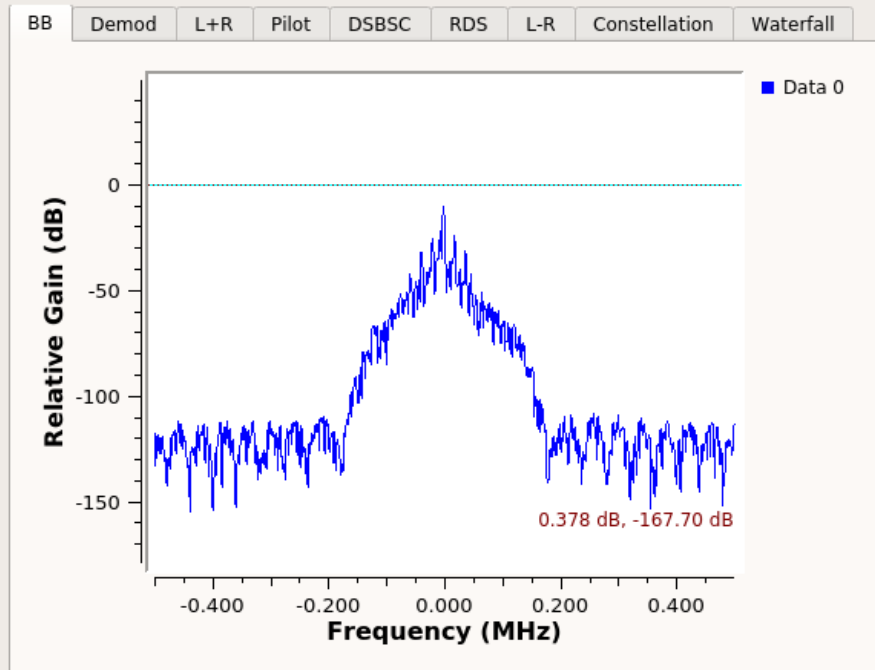
>>> Done

Console

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

Variables

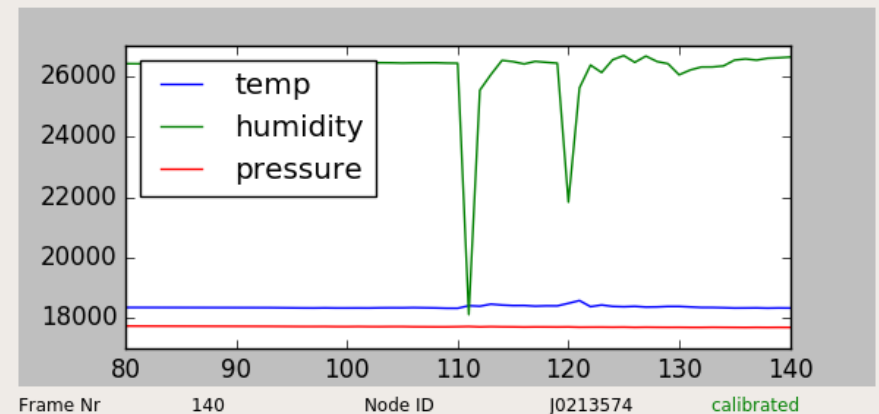
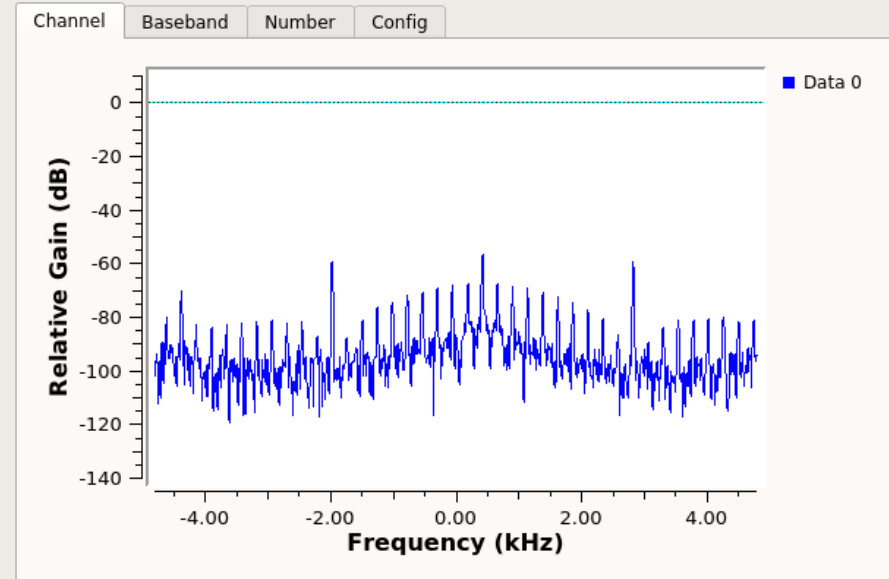
GUI Output and Instrumentation



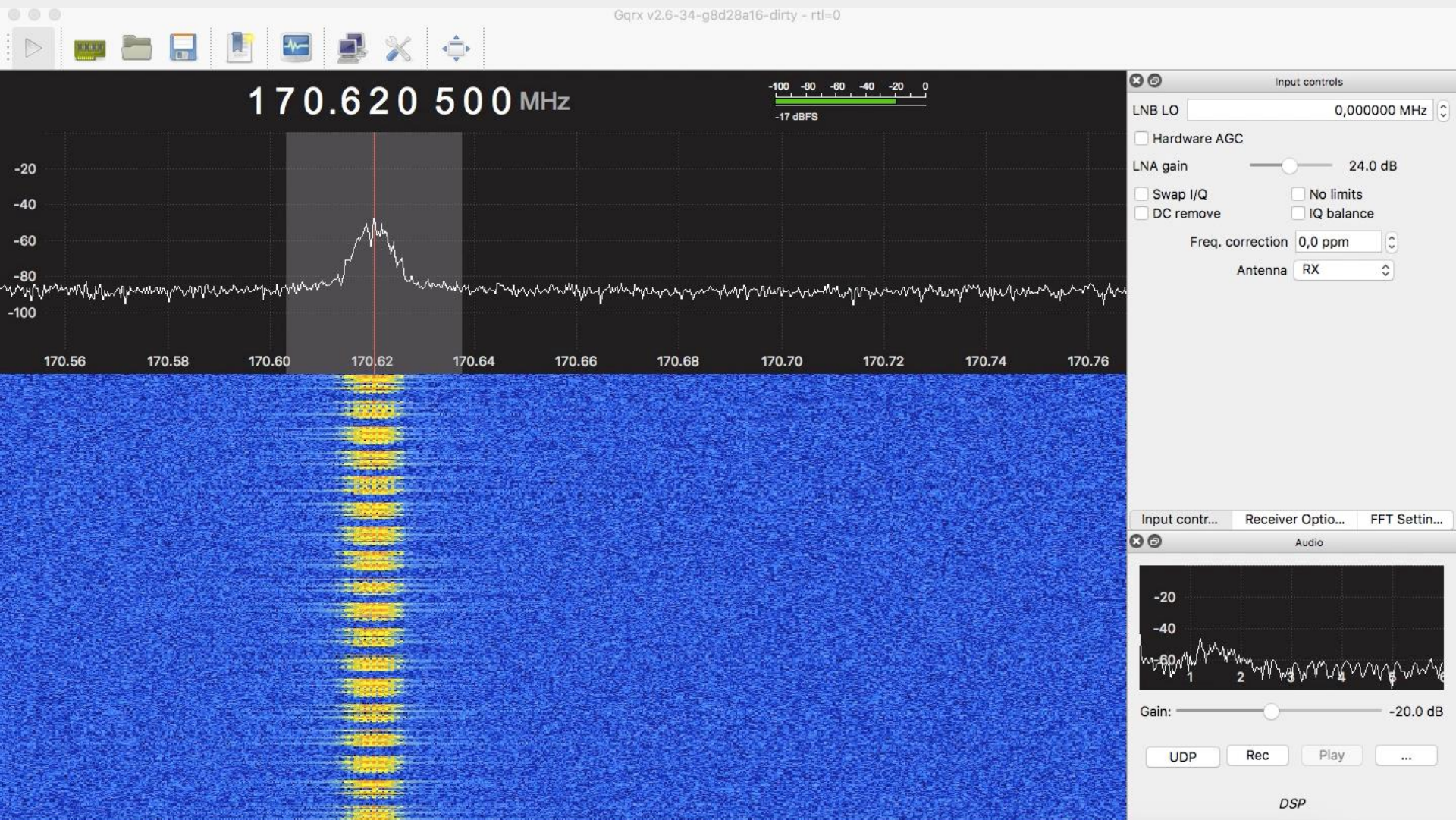
gain 40.0

freq 97000000

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.

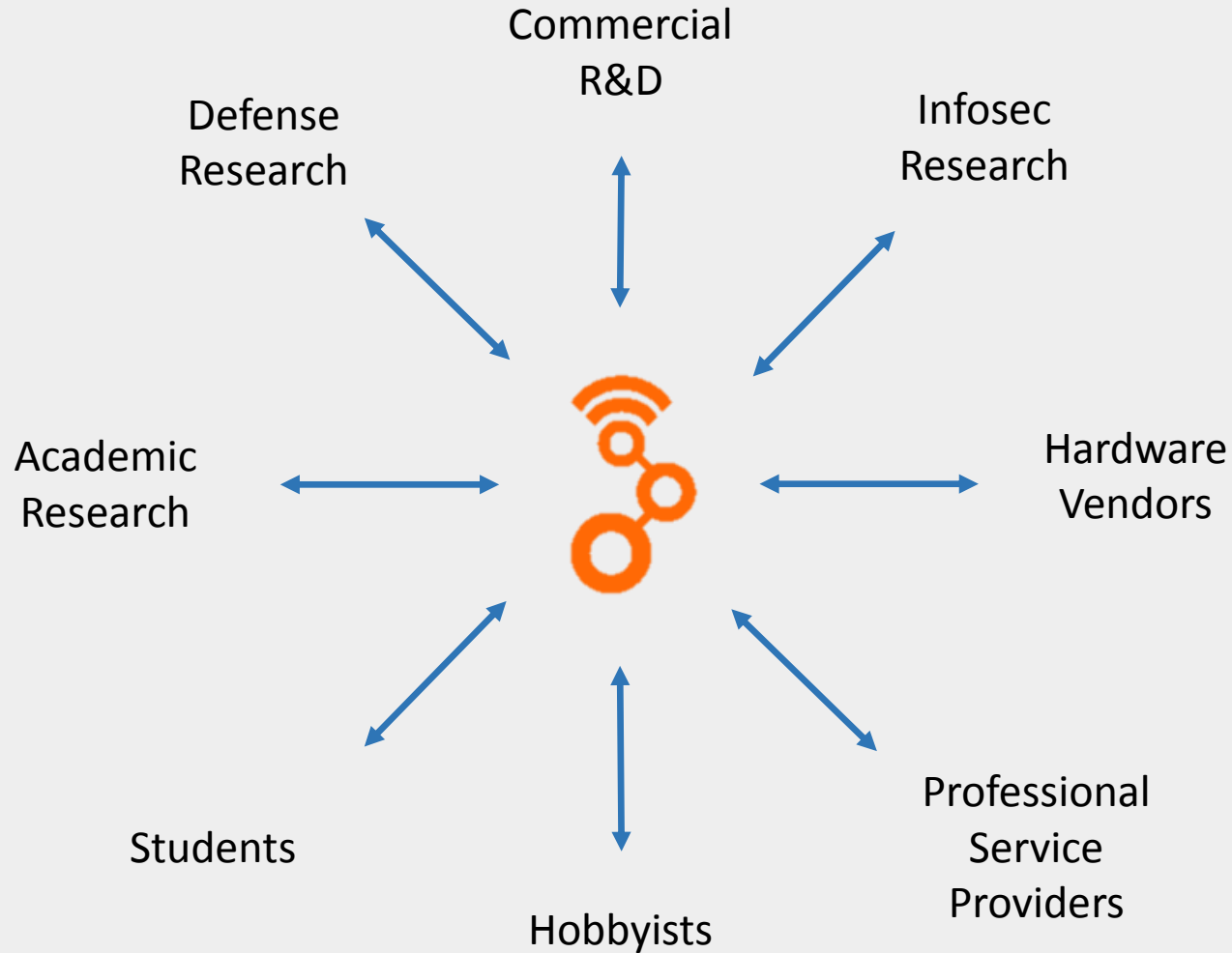
▼

Browse~Checkout~Hack

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



Installing GNU Radio

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

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)

It all began...

- New hardware access library written for HF-ED Project
- No working GUI available at that time
- Need to verify FFT and IQ data
- Make sure receiver is configured right
 - center frequency, bandwidth...
- Visualize data

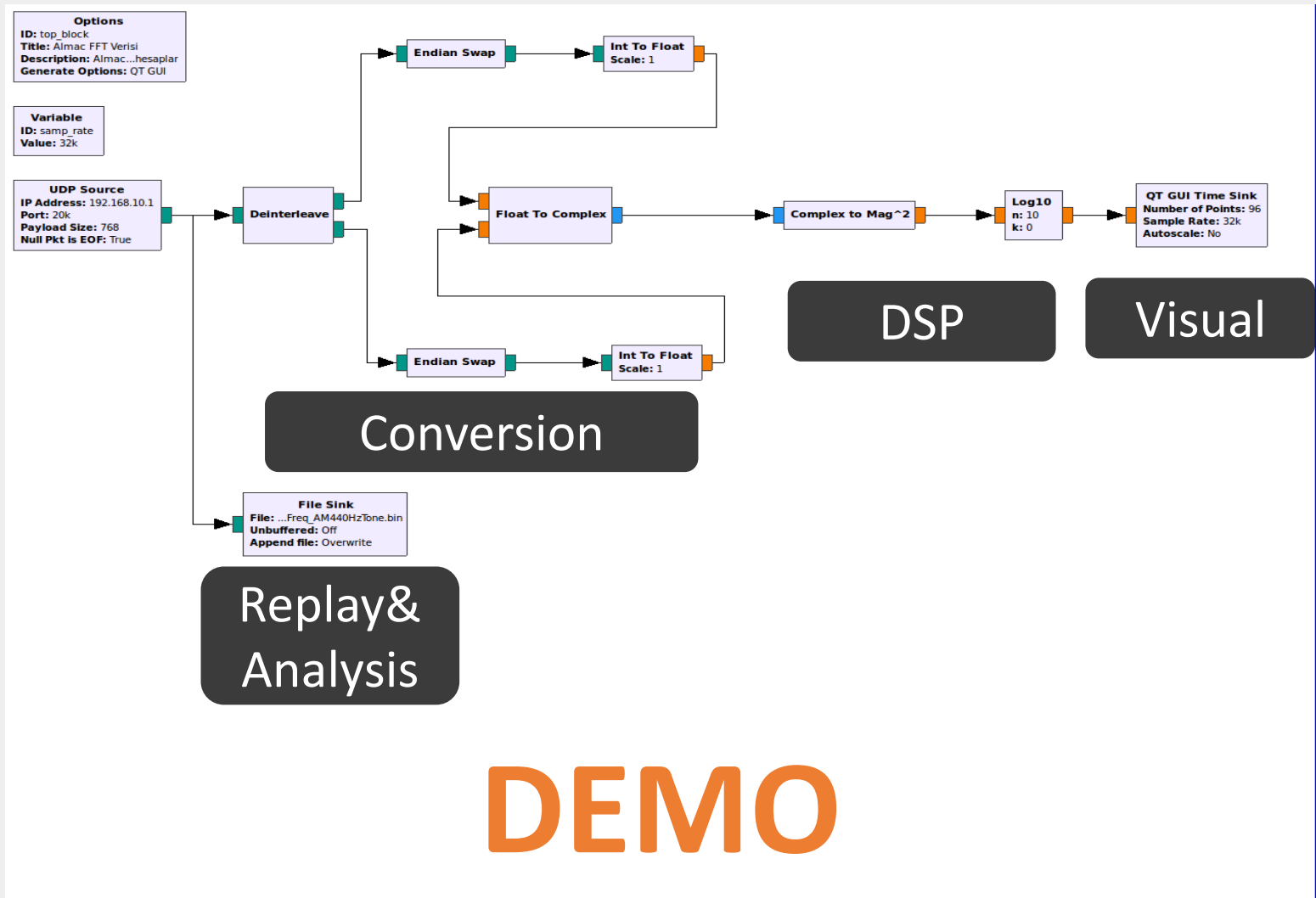
GNU Radio Interface to Aselsan Comint Receivers

- Aselsan Comint Receivers
 - Two main data streams
 - FFT: Upon request
 - IQ: Continuous
 - They are both in
 - Complex
 - Int32
 - Big Endian
 - Split form (like IIII...IQQQ...Q)
- GNU Radio expects in complex, float32 and interleaved ☹️

GNU Radio Demo: FFT

- Receiver tuned to 10MHz center frequency, 25k bandwidth
- 440Hz AM modulated signal is supplied by signal generator
- We request 1024-pt FFT every second

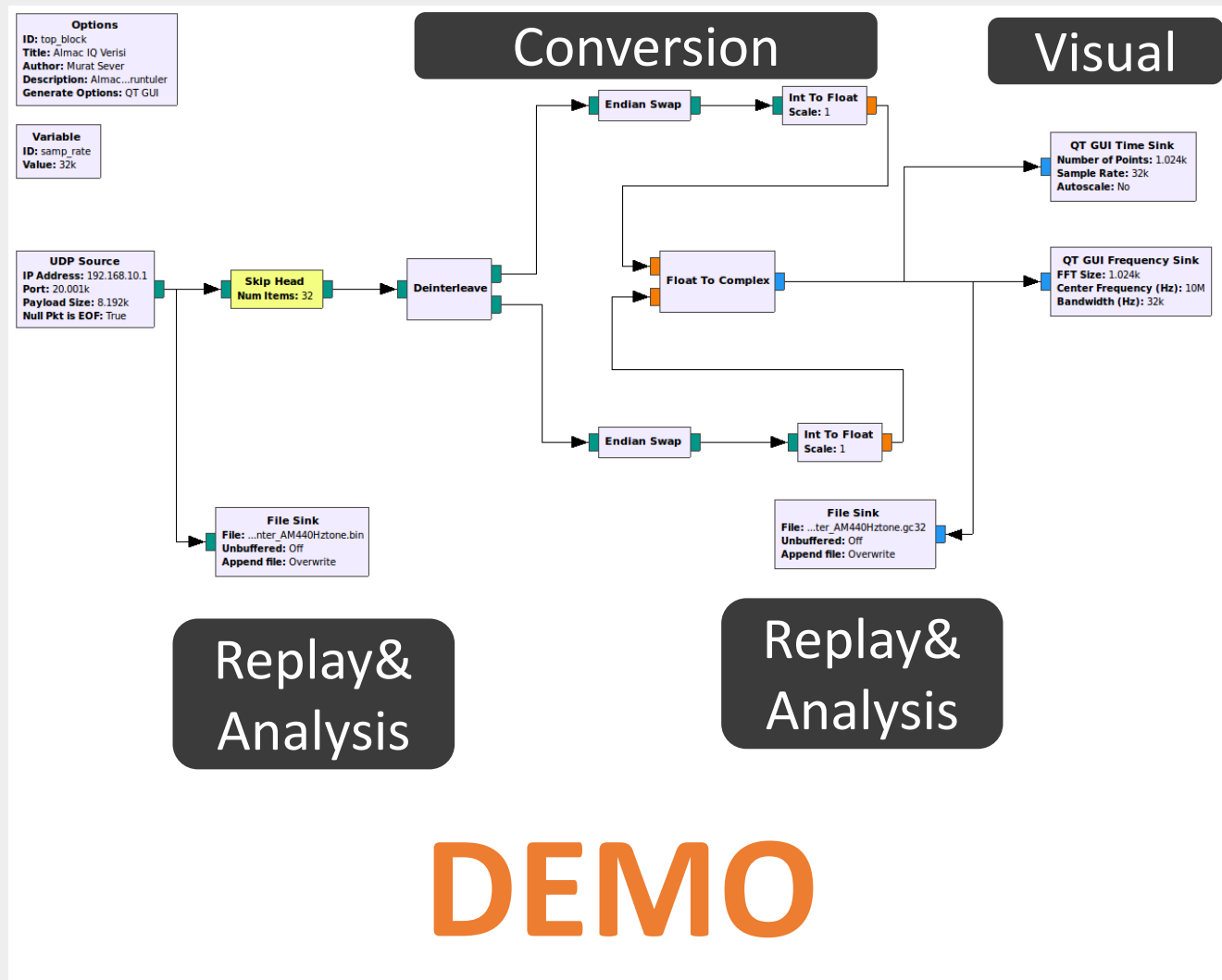
GNU Radio FFT



GNU Radio Demo: IQ

- Receiver tuned to 10MHz center frequency, 25k bandwidth
- We receive continuous IQ data and **calculate and display real-time 1024-pt FFT**
- Records given to System Eng. for offline analysis

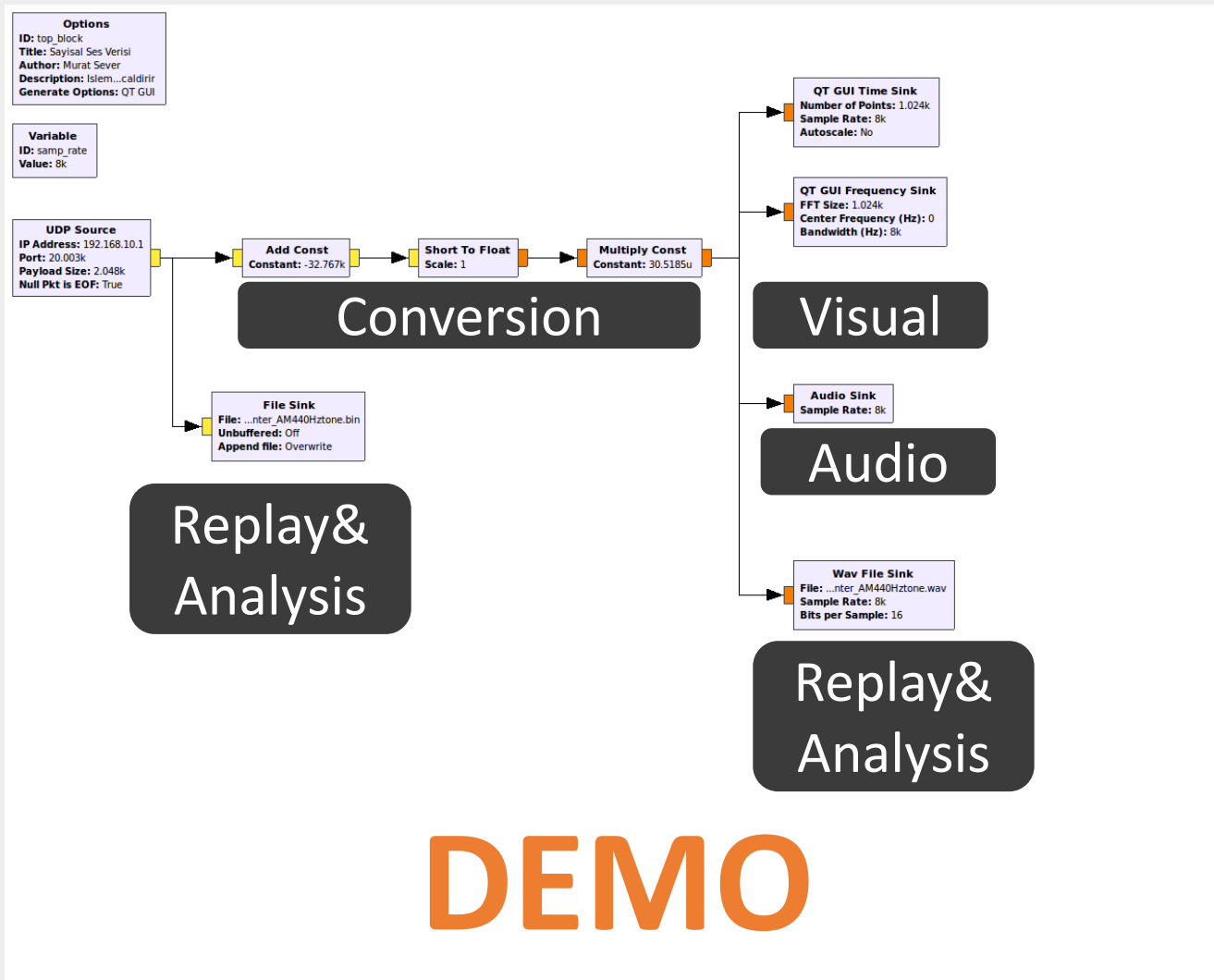
GNU Radio IQ



Later demod blocks have arrived...

- Later, demod blocks have been added to the Project
- Still need to verify they work as expected
- But again no GUI or player available to listen to the digital audio stream (DAUD)
- GNU radio to the rescue 😊

GNU Radio DAUD



Future Work

- Aselsan Source block need to be written
- Multi-channel data can be received
- Phase measurements can be made online
- Easy data recording
- All COMINT algorithms can be implemented and prototyped
- Digital demodulation blocks ready to use
- Key to other FOSS apps
 - Inspectrum, gr-inspector, ...

Thanks
