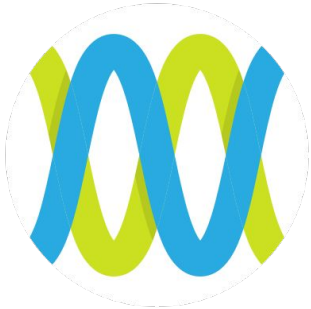


SDR makerspace

Presented by Alexandru Csete

FOSDEM 2019

esa

European Space Agency

Libre Space Foundation

About me...

Development engineer at Cobham Satcom

- First contact with open-source in 1995
- Hamradio (OZ9AEC) since 1991
- Playing with SDR since 2007
- Space geek since forever
- Libre Space since 2016
- @csete on Twitter

Libre Space Foundation

SDR makerspace

Claim Space, the Libre Way

Free and Accessible Space for all

Creating Open Source space technologies

SATNOGS

A global network of satellite ground stations, designed as an open source participatory project.

UPSAT

The first open source hardware and software satellite in the world.

ROCKETRY

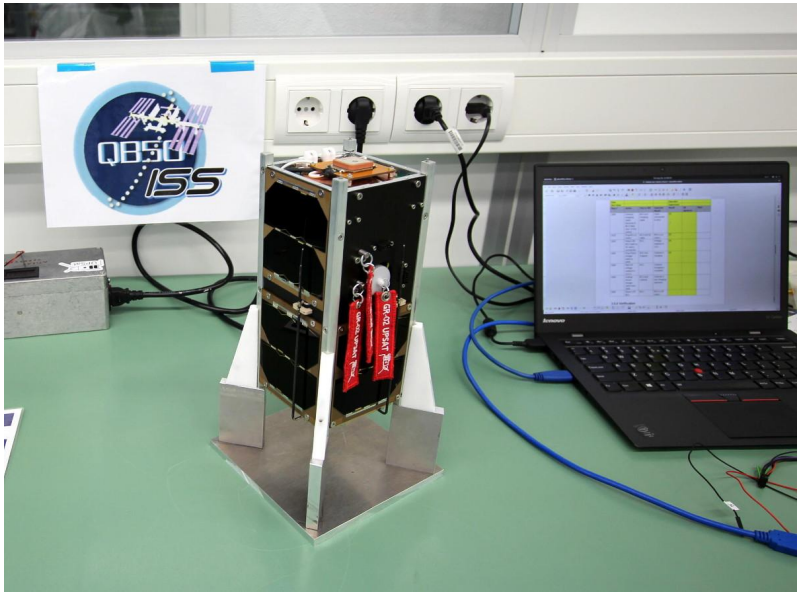
Full telemetry and ground segment system for High Power Rocketry

UPSat

SDR makerspace

First open-source cubesat

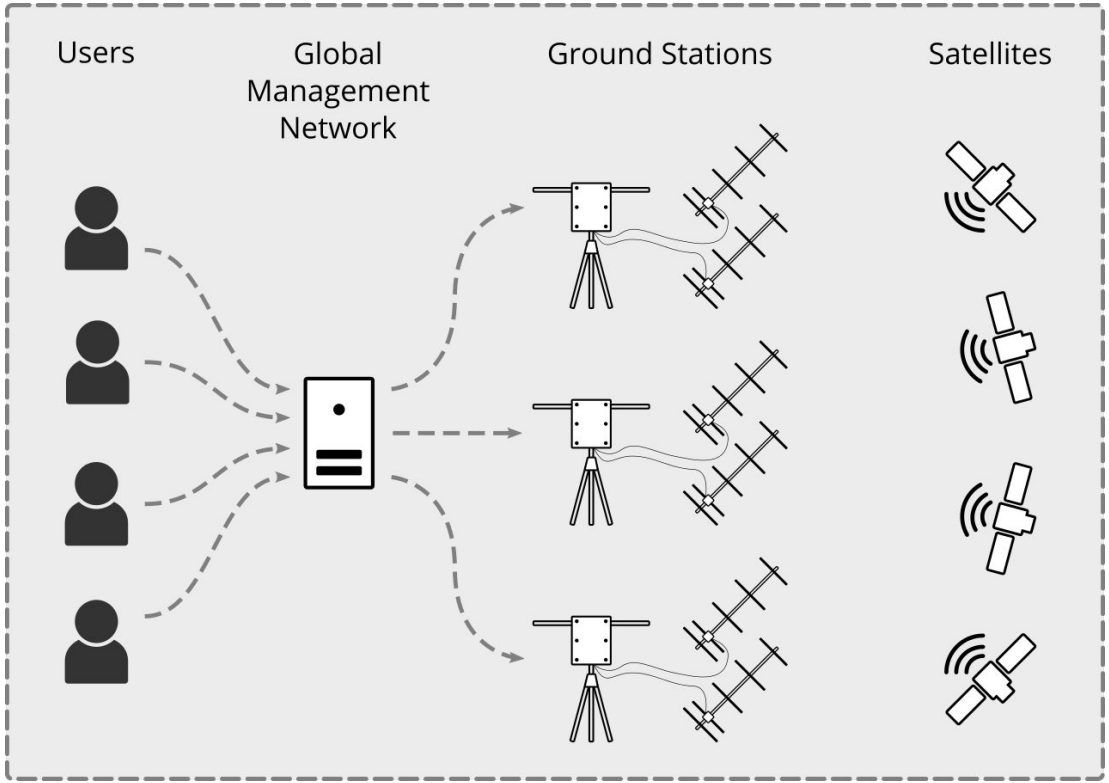
- Launched in 2017
- Part of the QB50 project
- Libre Space Foundation
- University of Patras



https://gitlab.com/librespacefoundation/upsat

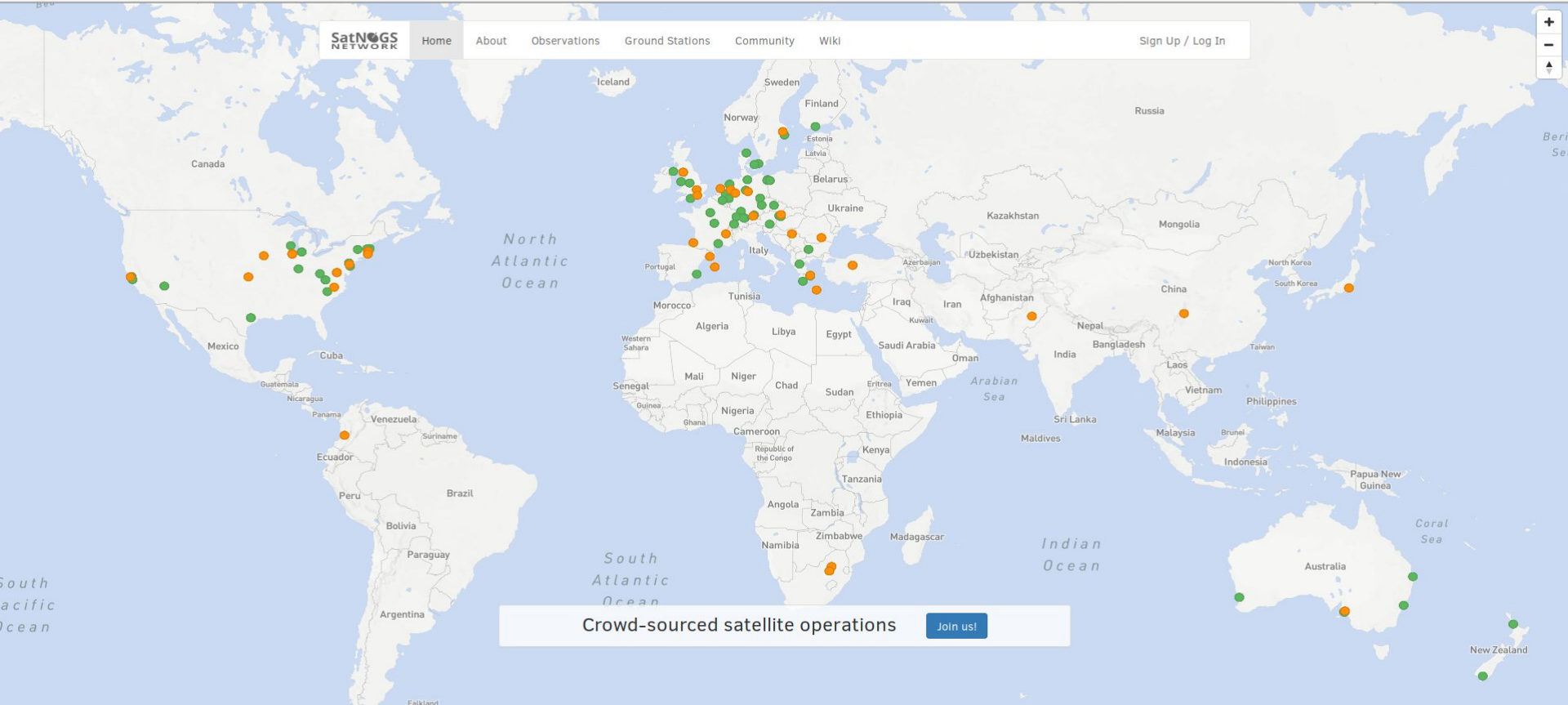
SatNOGS

SDR makerspace



SatNOGS

SDR makerspace

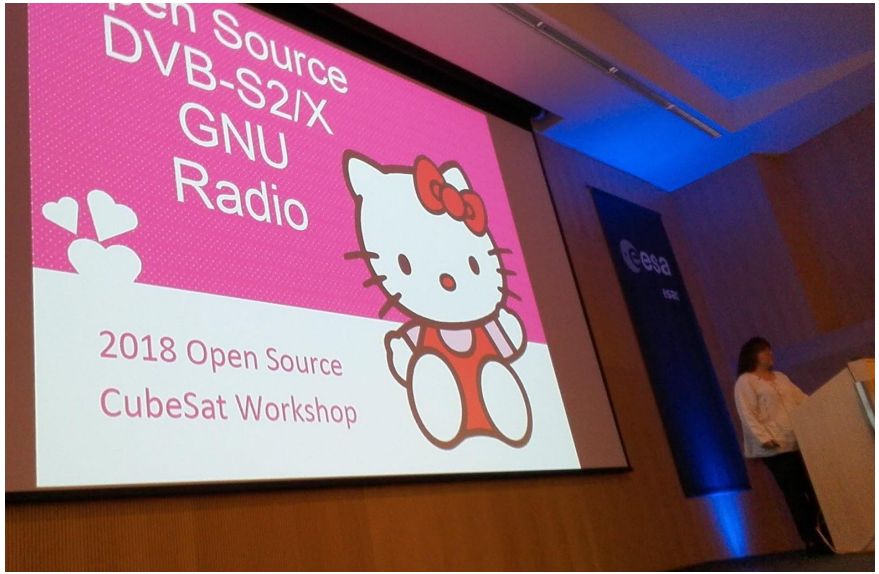


Open Source Cubesat Workshop

SDR makerspace

Open Source Cubesat Workshop

SDR makerspace



SDR makerspace

Cubesat activities at ESAC: Ground Station

SDR Makerspace

Space is hard and so is SDR. Trying to use SDRs in space missions without sufficient understanding can add unnecessary risks to the mission.

SDR Makerspace aims to bring open-source SDR technology to the space industry, focusing on the practical aspects of satellite communications.

SDR Makerspace

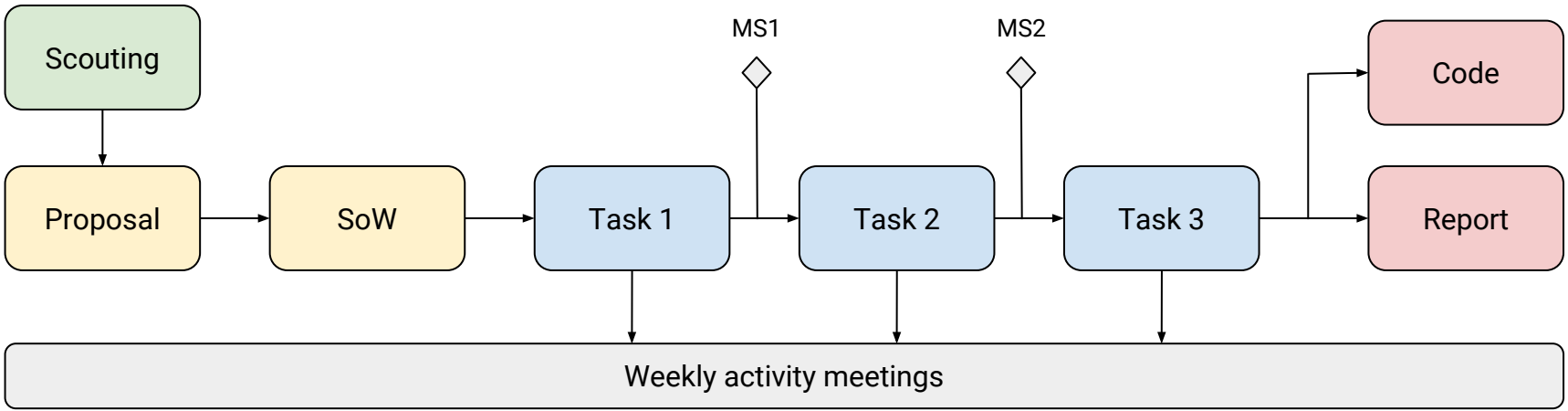
Investigate the use of SDR technology in space applications

- Collaboration between ESA and LSF
- 500 k€ budget over 14 months
- Open-source HW and SW projects running up to 3 month
- Bring some “maker culture” into the space industry
- Focus on satcom
- Activities at various TRL levels

How?

Many sub-activities, each running for up to 3 months

- LSF scouts for potential implementers
- Implementers send in proposal and carry out the work
- Use online collaboration tools like Gitlab



Subactivities

GNU Radio:

- gr-soapy
- gr-leo
- gr-ccsds
- IQ storage

Testing:

- SDR hardware
- SDR software
- FPGA toolchains
- Radiation tests

R&D:

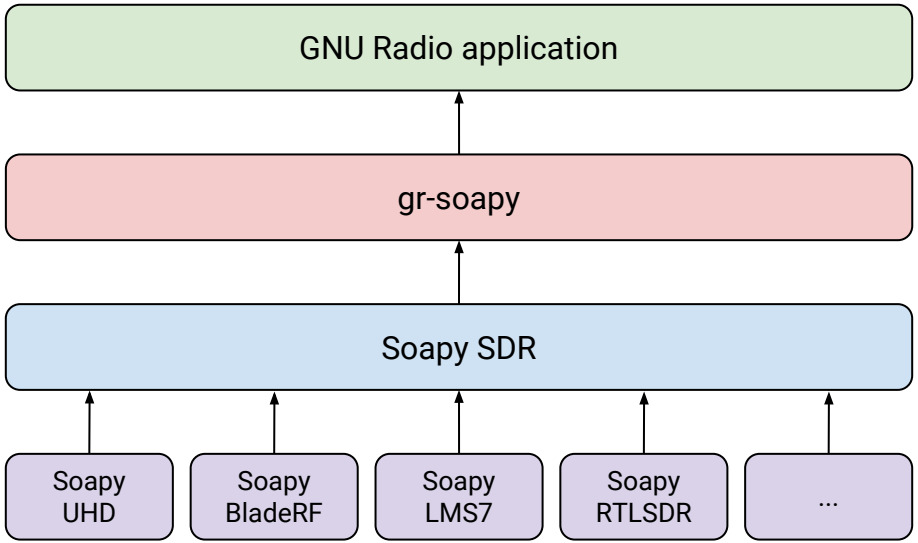
- LDPC SIMD
- Direct sampling
- AI, ML, DNN
- FPGA in the cloud

More to come!

gr-soapy

SDR makerspace

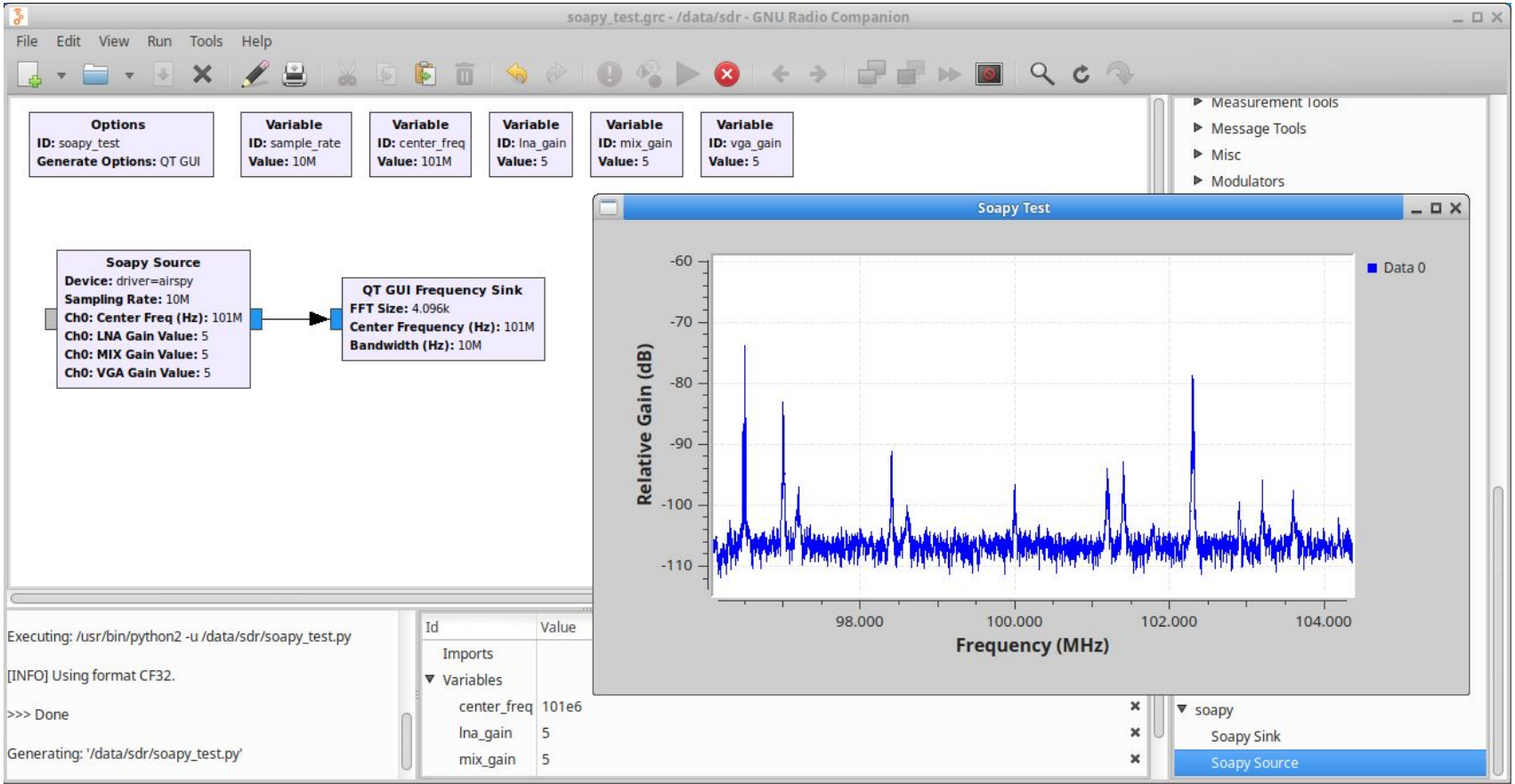
Similar to gr-osmosdr but using plugins as back-ends



https://gitlab.com/librespacefoundation/gr-soapy

gr-soapy

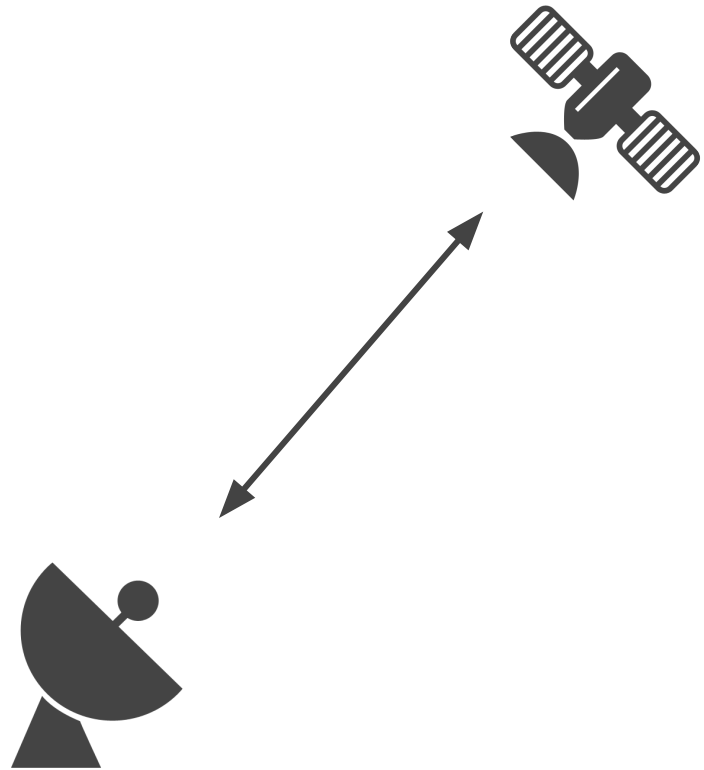
SDR makerspace



gr-leo

Satellite communication channel simulator

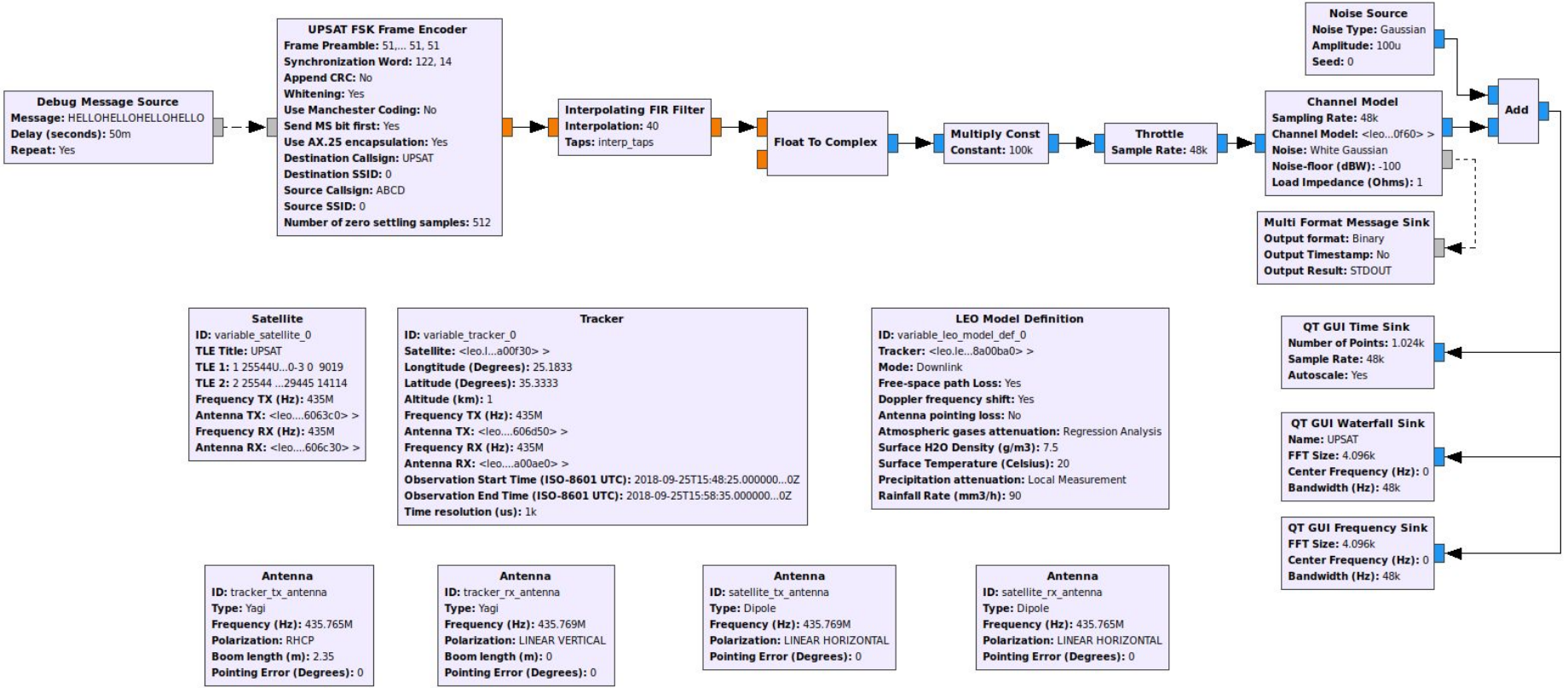
- Free space loss
- Atmospheric gasses attenuation
- Rainfall attenuation
- Doppler shift
- Pointing losses
- Models from ITU-R P.xxx



https://gitlab.com/librespacefoundation/gr-leo

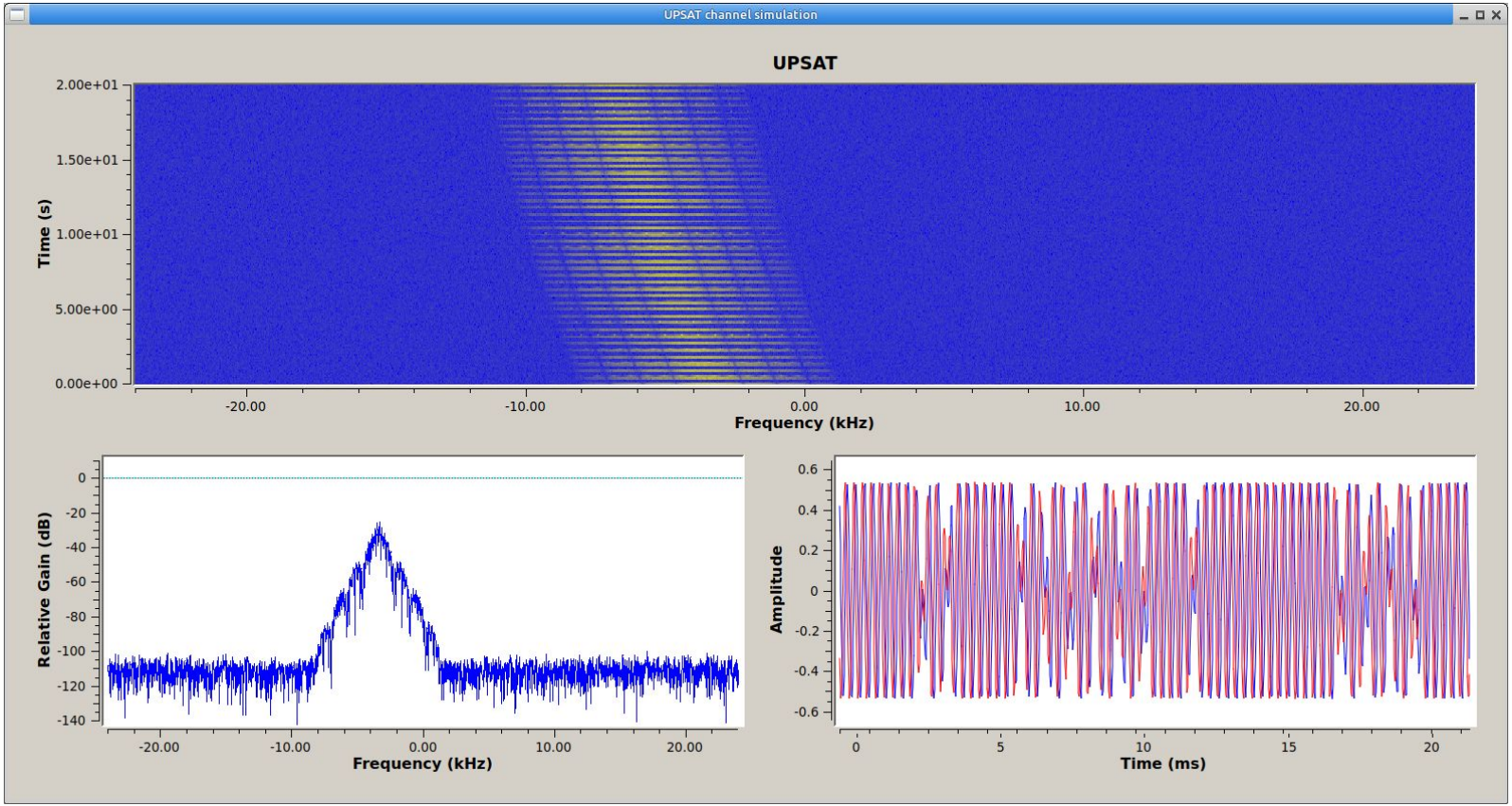
gr-leo

SDR makerspace



gr-leo

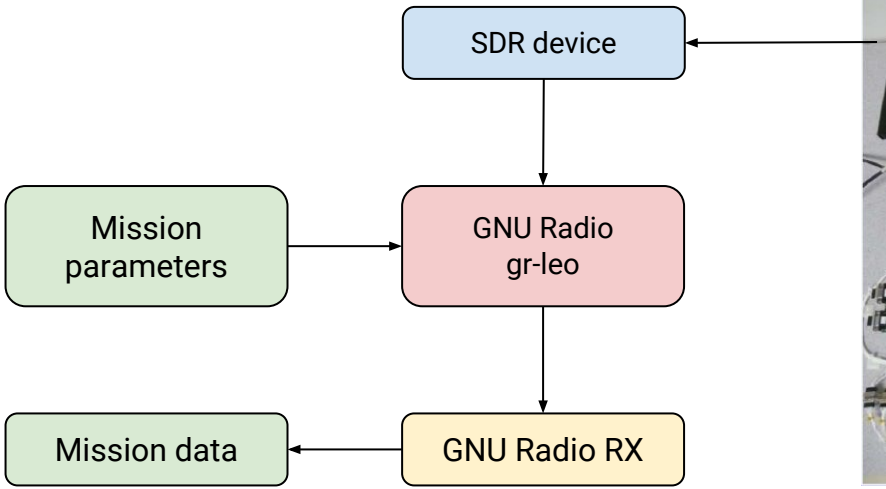
SDR makerspace



gr-leo

SDR makerspace

Simulation with hardware in the loop



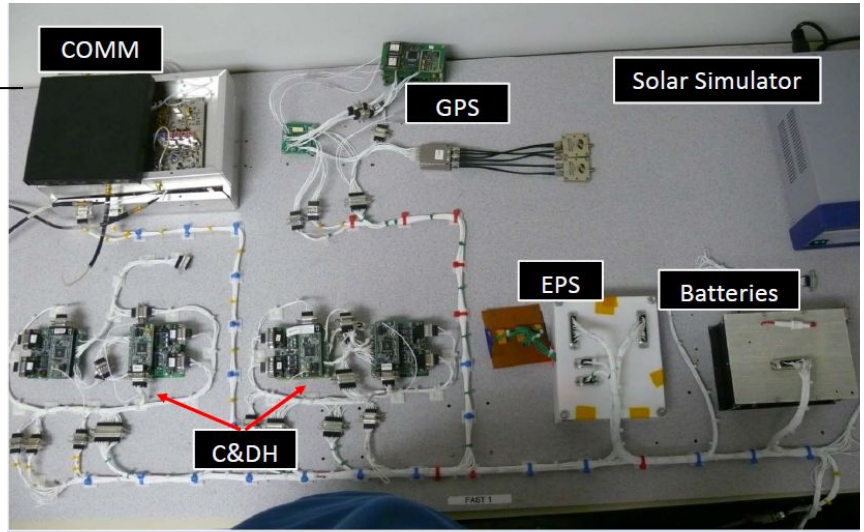


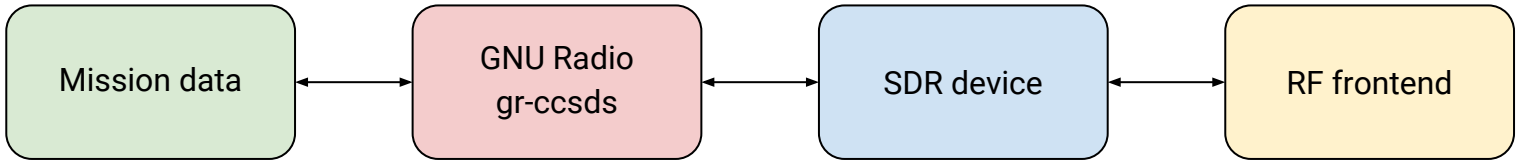
Image: Flatsat by FASTRAC

gr-ccsds

SDR makerspace

SDR transceivers implementing the CCSDS standards:

- CCSDS 131.0: Telemetry
- CCSDS 231.0: Telecommand
- CCSDS 401.0: RF and modulation

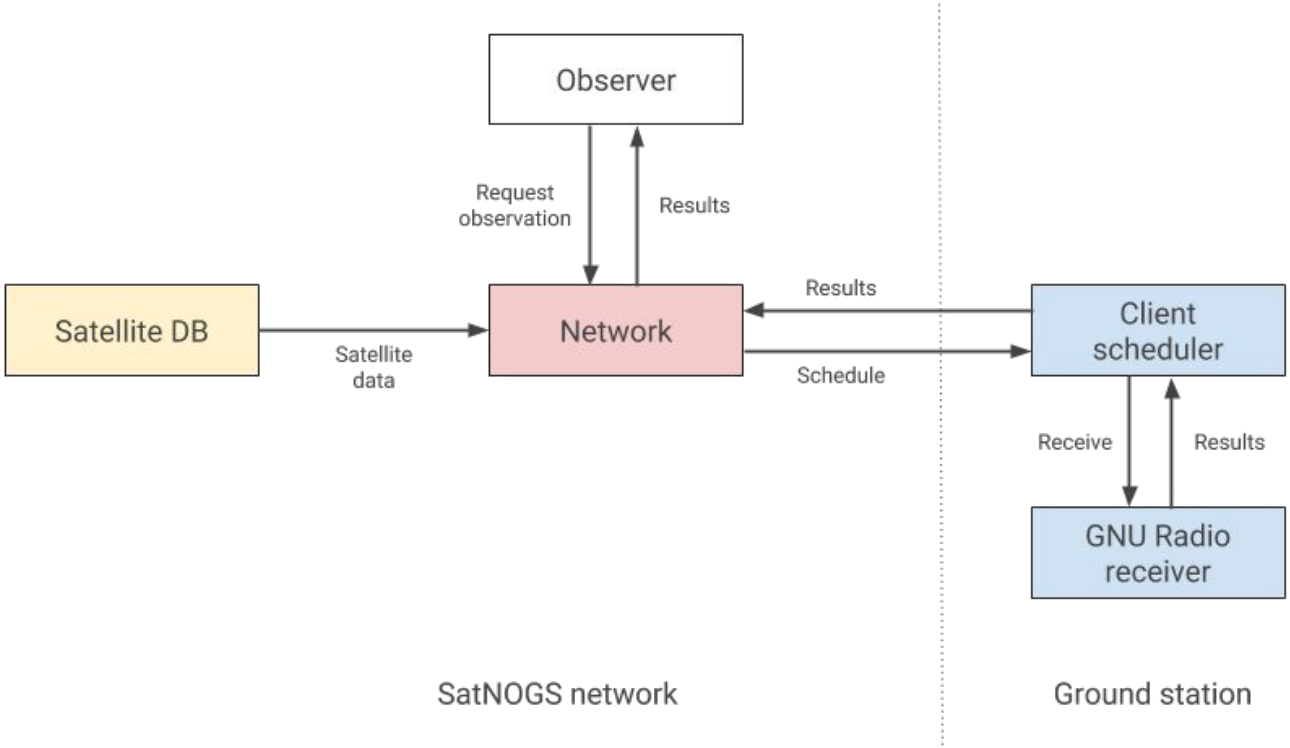


https://gitlab.com/librespacefoundation/gr-ccsds

IQ database

SDR makerspace

Investigate IQ data compression and storage



Tests and evaluations

Survey and tests of SDR hardware and software

- Performance under realistic conditions
- Radiation testing of selected devices
- FPGA toolchains
- Complexity
- Open-source friendliness

sdrmaker.space