GDAŃSK UNIVERSITY OF TECHNOLOGY

Satellite Ground Station in Gdańsk

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Ewelina Omernik
analyst / designer

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Technical supervisor: **Wojciech Siwicki**, PhD

Agenda

- Motivation
- Project schedule
- Project Design & Architecture
- Hardware selection (antennas)
- Software for receiving process
- Tough problems we faced
- Summary, next steps

Long term objective:

Help building Polish space ecosystem by providing data downlink service

Project goals:

Design, implementation and operation of a ground station

- Omnidirectional antenna (fixed)
- UHF or VHF bandwidth
- SDR (Software Defined Radio)
- Embedded platform (Raspberry Pi)

Project Schedule

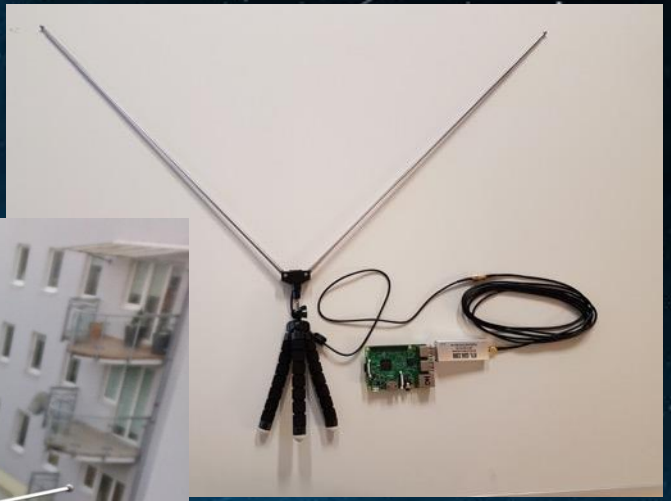
No.	Task	Deadline
1	**Feasibility study**	2019-10-17
2	**Hardware acquisition**	2019-11-07
3	**System integration**	2019-11-14
4	**Software automation design**	2019-11-21
5	**Software implementation**	2019-12-19
6	**Test campaign**	2020-01-09

Architecture

Problems solved

- Hardware (band, SDR, antenna, LNA, computing platform, …)
- UHF or VHF bandwidth
- Location (antenna installation, cabling)
- Software configuration
- Automation
- Results visualization

Antenna v1

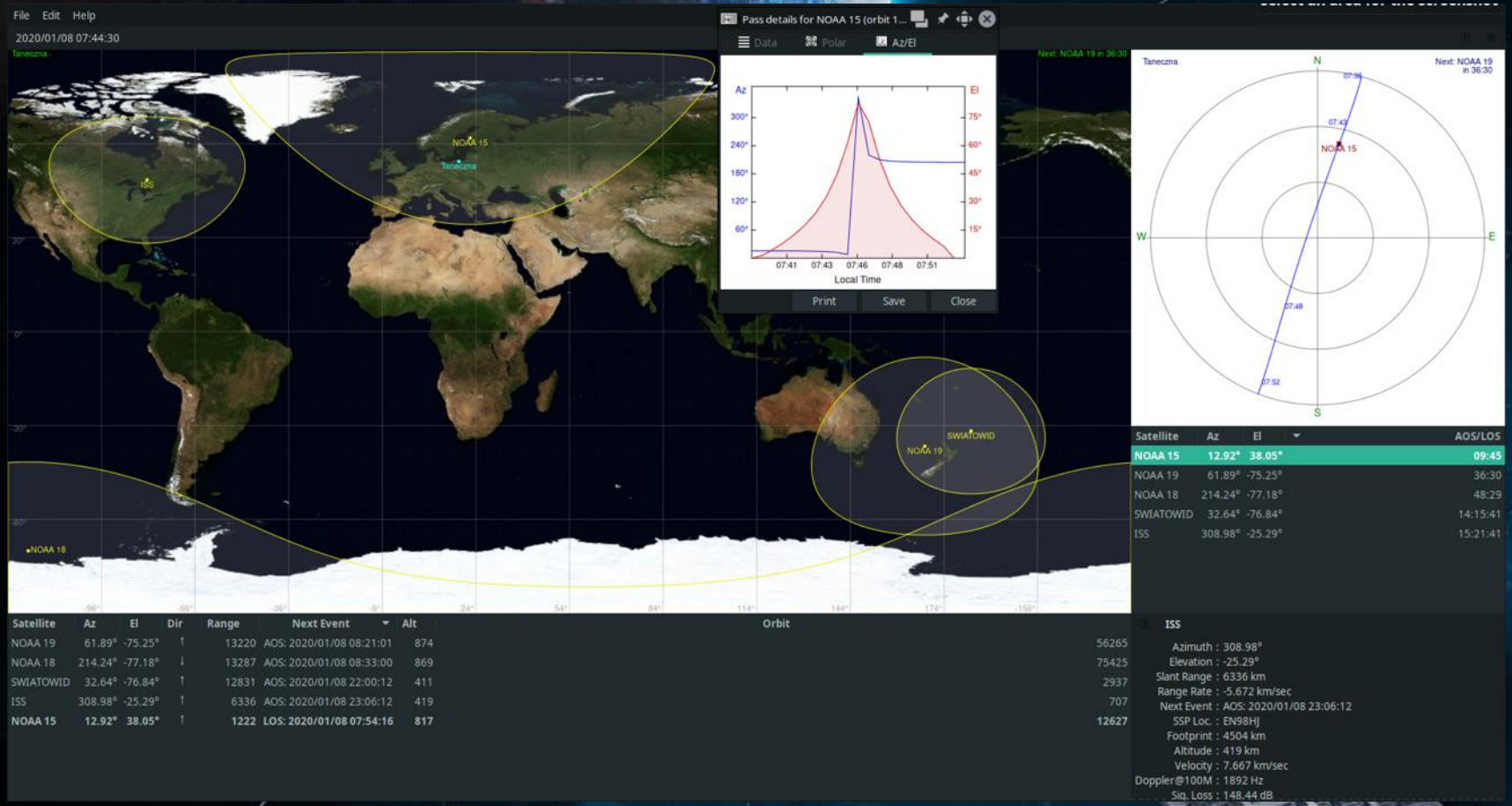


Antenna v2 - TA-1 Turnstile

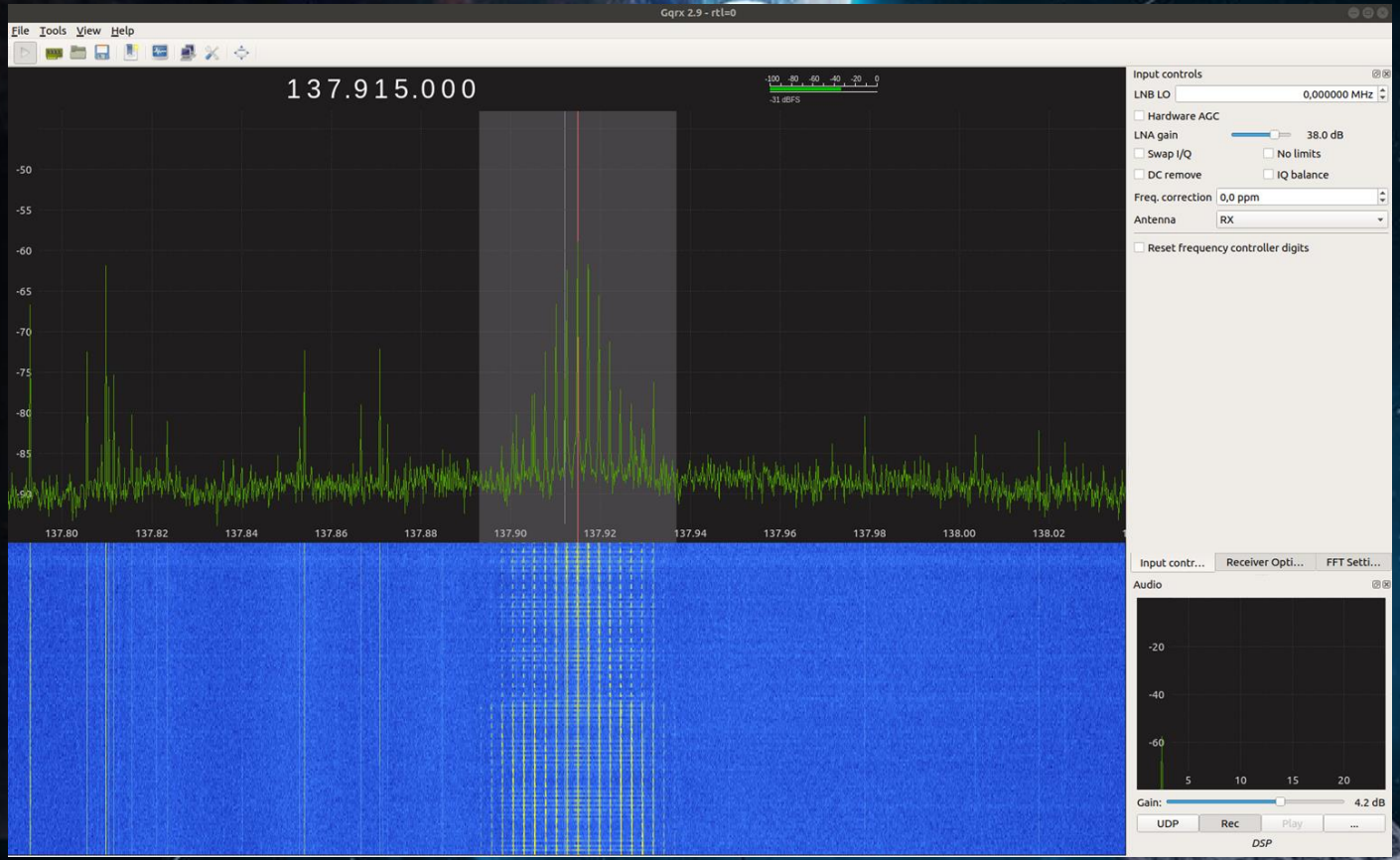
SDR + Raspberry Pi


How to receive a sat transmission in 5 easy steps

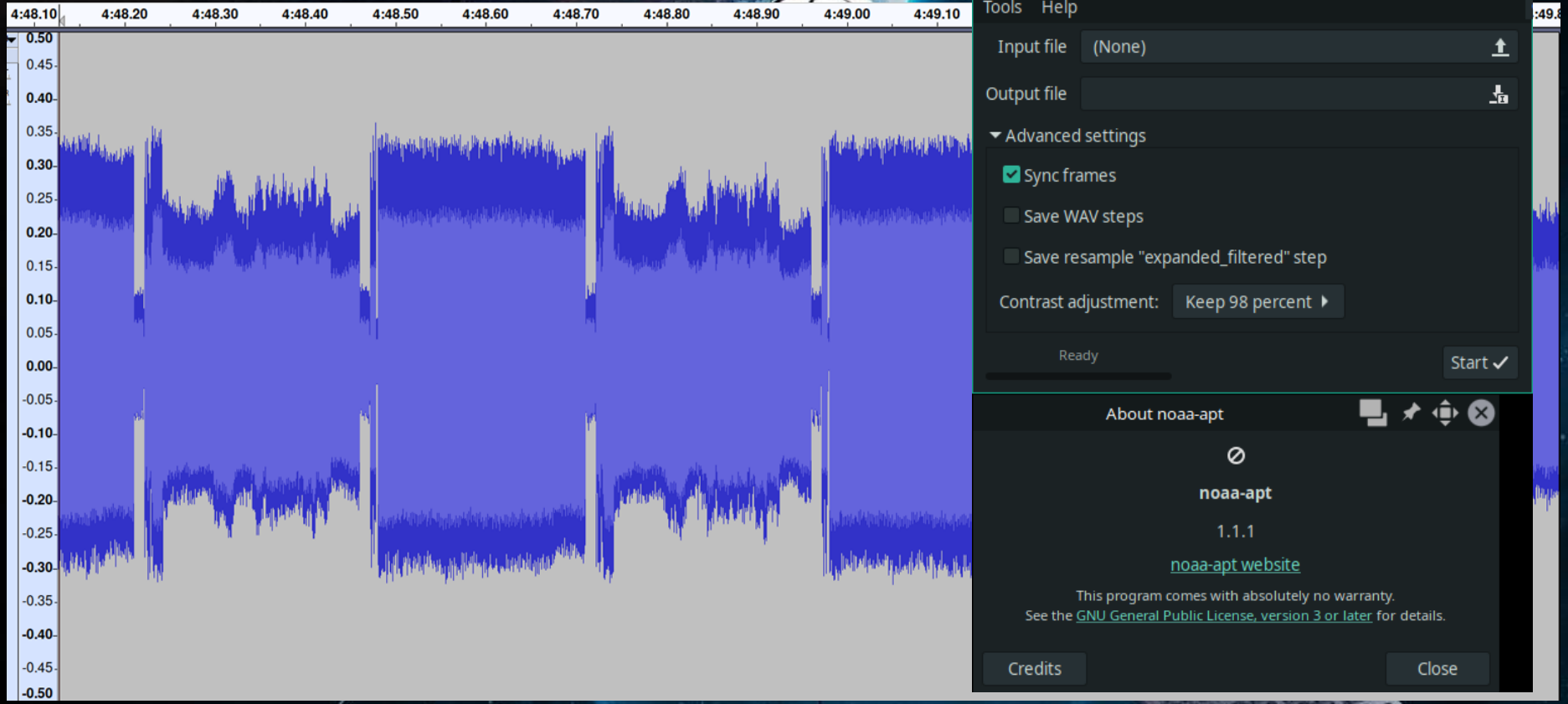
Step 1: Predict satellite fly-over



Step 2: Tune SDR to transmission frequency



Step 3: Decode transmission



Step 4: Upload to content server

https://satnogs.klub.com.pl/

```
pi@raspberrypi:~ $ noaa-apt -o gqrx_20200108_172745_137912500.png gqrx_20200108_172745_137912500.wav
noaa-apt image decoder version 1.1.1
2020-01-08 18:50:17,068 INFO  [noaa_apt] Reading WAV file
2020-01-08 18:50:17,069 WARN  [noaa_apt::wav] WAV file has 2 channels (probably stereo), processing only the first one
2020-01-08 18:50:28,332 INFO  [noaa_apt] Resampling to 12480
2020-01-08 18:50:39,819 INFO  [noaa_apt] Demodulating
2020-01-08 18:50:39,966 INFO  [noaa_apt] Filtering
2020-01-08 18:50:41,497 INFO  [noaa_apt] Syncing
2020-01-08 18:50:45,877 INFO  [noaa_apt::noaa_apt] Fo
2020-01-08 18:50:45,973 INFO  [noaa_apt] Resampling t
2020-01-08 18:50:46,154 INFO  [noaa_apt::noaa_apt] Ad
2020-01-08 18:50:46,360 INFO  [noaa_apt] Writing PNG
2020-01-08 18:50:46,707 INFO  [noaa_apt] Finished
pi@raspberrypi:~ $ python3 devel/satnog-gdn/tools/sub
29" "2020-01-08 18:33:00" "2020-01-08 18:41:20"
Detected python: 3.7.3
Uploading file: cmd=[scp gqrx_20200108_172745_137912
gqrx_20200108_172745_137912500.png
Adding record in the db: sqlcmd=[INSERT INTO observat
-08 18:26:29', '2020-01-08 18:26:29', 'NOAA 15', 'gq
INSERT 0 1
pi@raspberrypi:~ $
```

satnogs.klub.com.pl

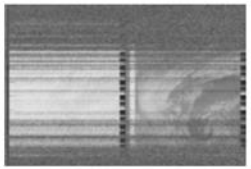
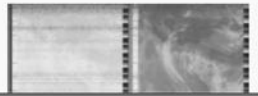
SATNOGS-GDN

This is a Gdańsk ground station, aiming to join the global network of satellite ground-stations. It's a project created by Sławek Figiel, Tomek Mrugalski and Ewelina Omernik, three students of Space and Satellite Technologies studies of Gdańsk University of Technology.

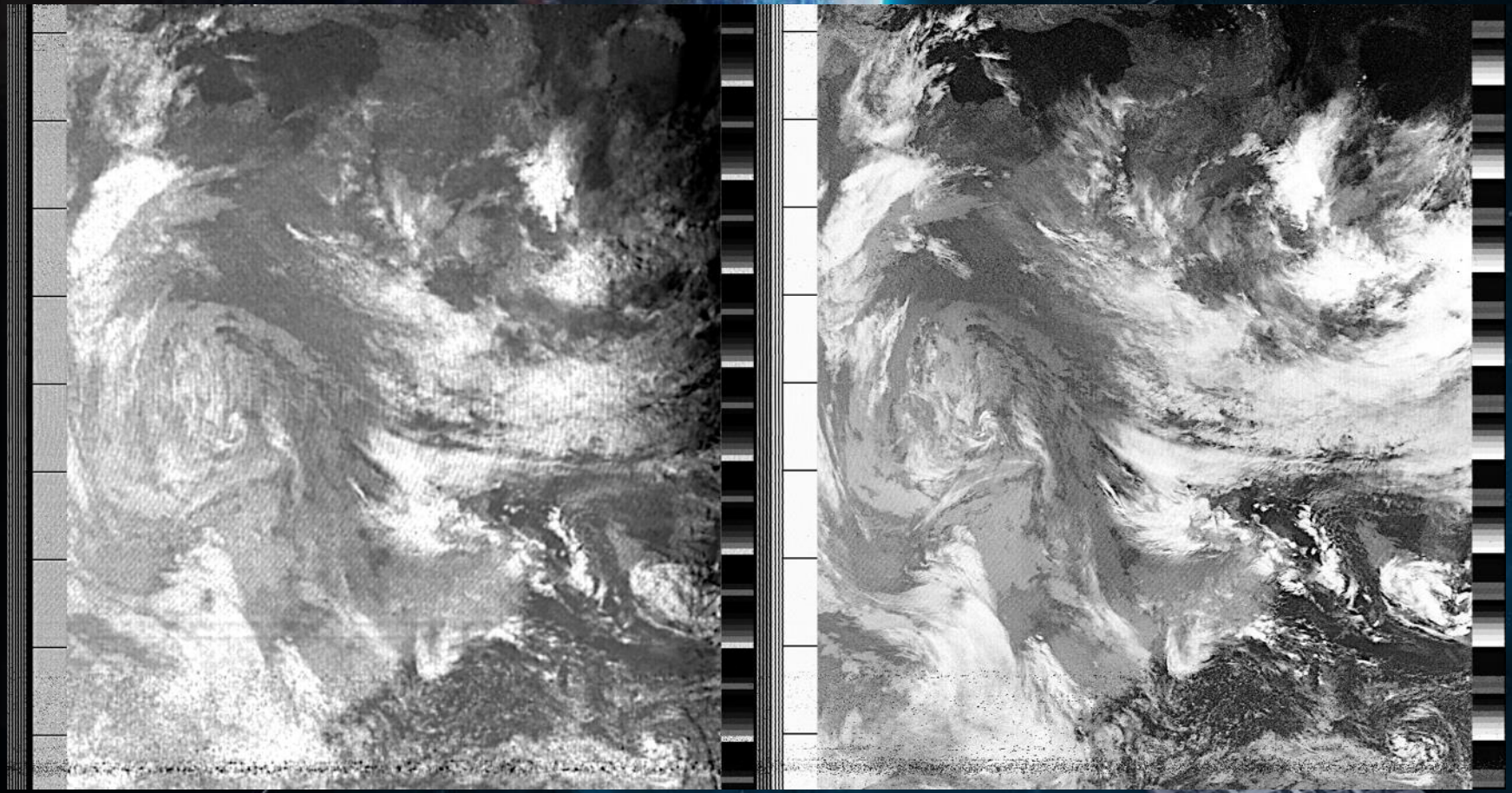
Software project homepage: link

6 observations from 4 satellite(s), between 2019-12-15 08:54:53 and 2020-01-08 18:26:29.

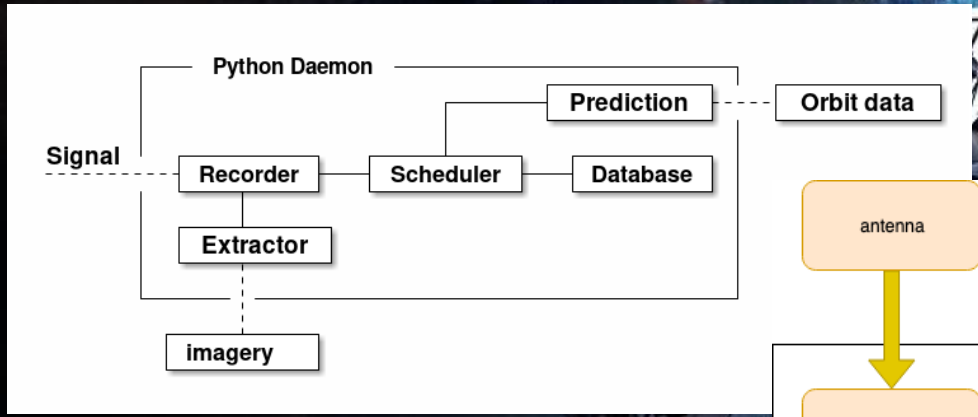
Observations

ID	AOS	TCA	LOS	Satellite	Image
37	2020-01-08 18:26:29	2020-01-08 18:26:29	2020-01-08 18:26:29	NOAA 15	
36	2019-12-26 20:59:00	2019-12-26 20:59:00	2019-12-26 20:59:00	NOAA-18	

Step 5: Profit!

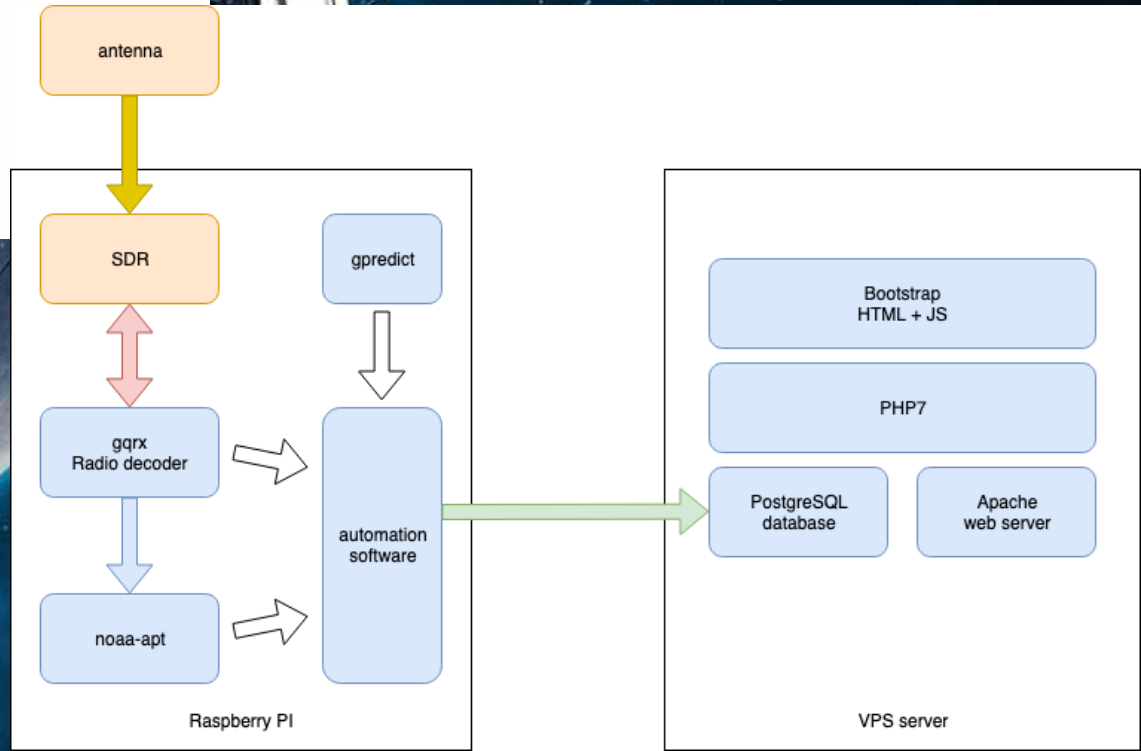


Automation

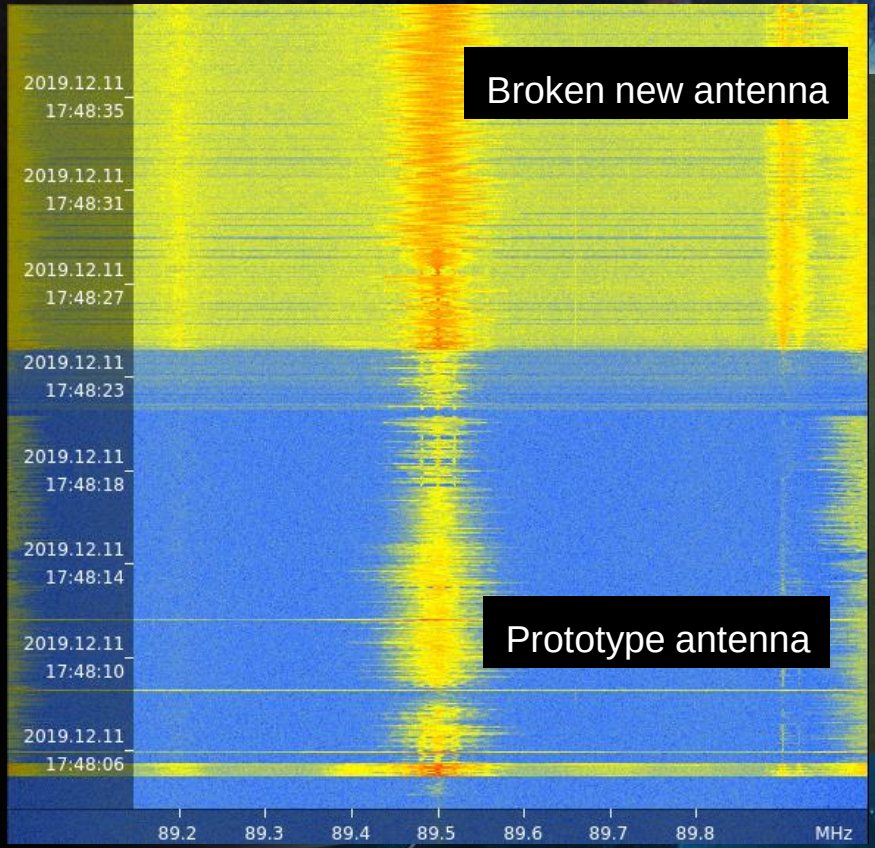


Realization

Concept



Troubleshooting



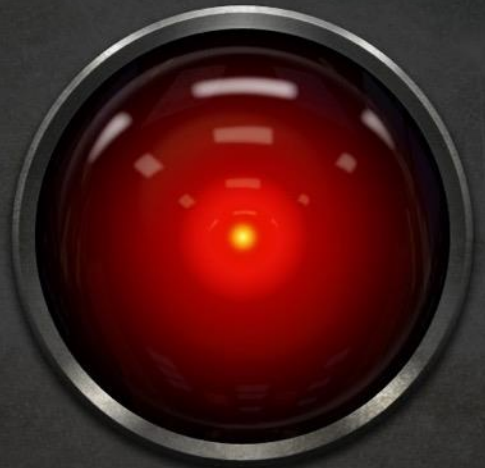
SWR measurements

Results

- First SatNOG satellite ground station in northern Poland
- Research data gathering started
- 100% open source

Next steps

- Publish on Github
- Better code and improve web interface
- Connect to SATNOG network
- Switch to directional antenna
- Switch to UHF, S and X band
- Cooperation with amateur Cubesat projects



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