



# **SATNOGS-GDN**

## **Satellite Ground Station in Gdańsk**


Sławomir Figiel

Tomasz Mrugalski

Ewelina Omernik

Space and Satellite Technologies

9 January 2020

The background of the slide features a series of satellite dish antennas in silhouette, arranged in a row that recedes into the distance. They are set against a dramatic sky with warm, orange and red hues, suggesting a sunset or sunrise. The dishes are mounted on complex metal structures with cranes or jibs.

## Long term objective: **Help building Polish space ecosystem by providing data downlink service**

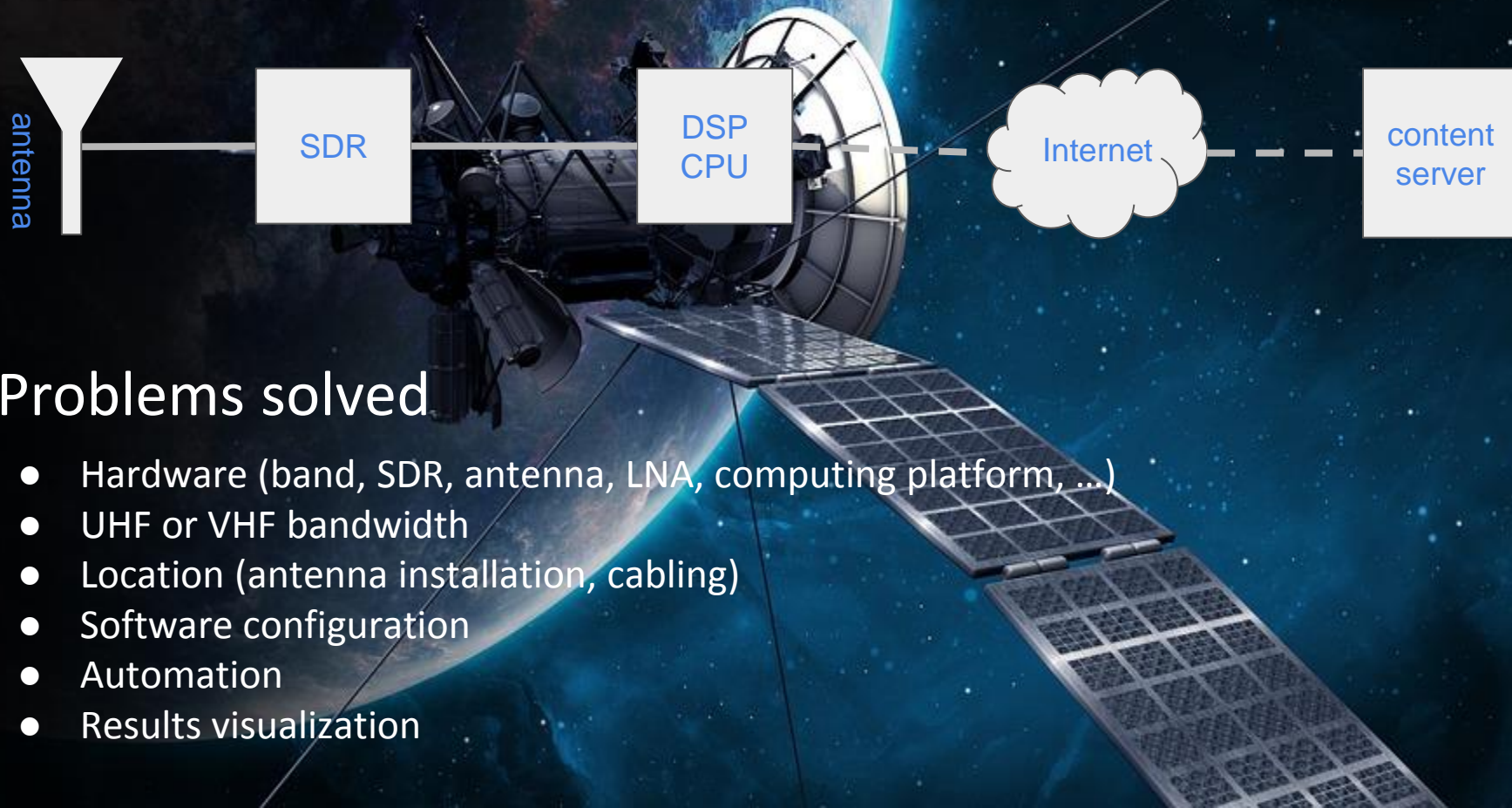
### Project goals:

Design, implementation and operation of a ground station

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



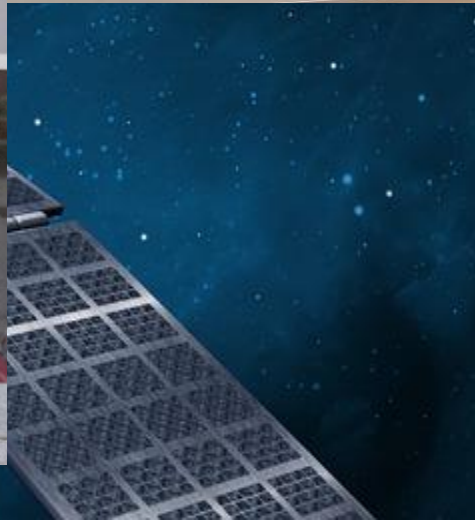
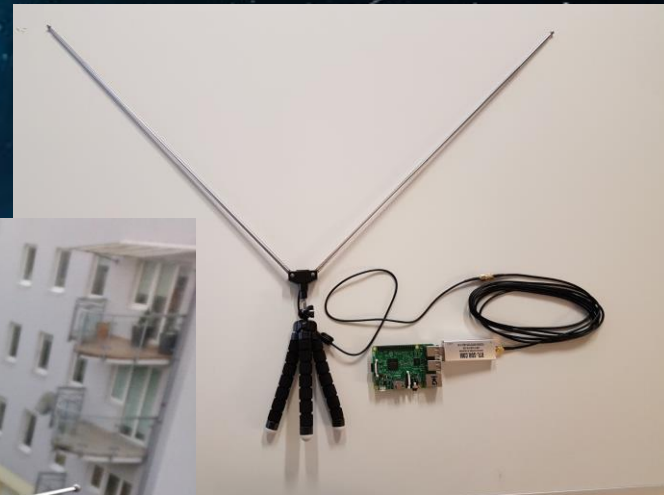
# Architecture



## 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 + RPi

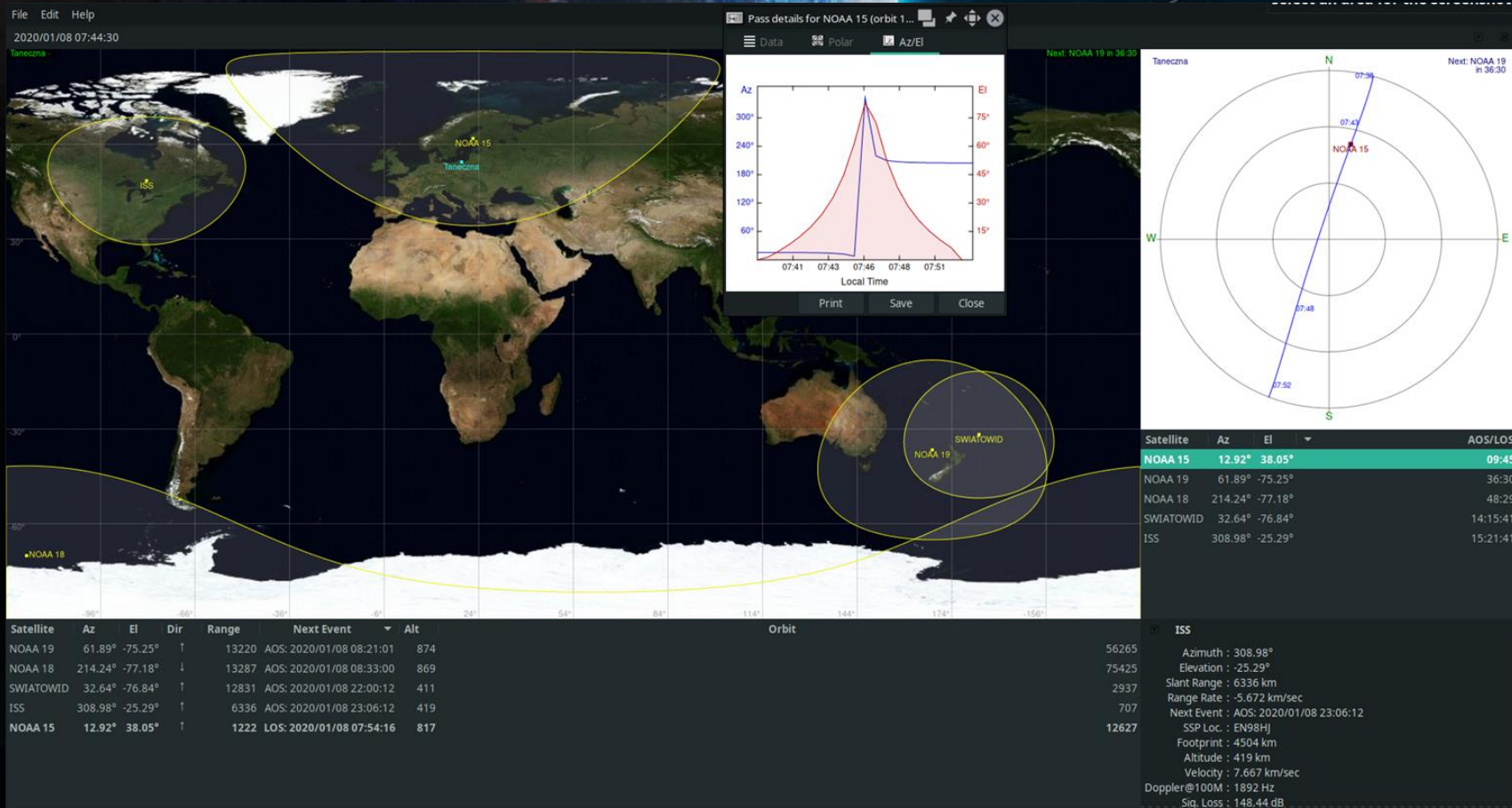




A detailed illustration of a satellite in orbit. The satellite features a central body with various instruments and a large, prominent parabolic dish antenna. Two long, rectangular solar panel arrays extend from the sides. The background shows the curved horizon of the Earth with blue oceans and white clouds, set against the blackness of space filled with distant stars.

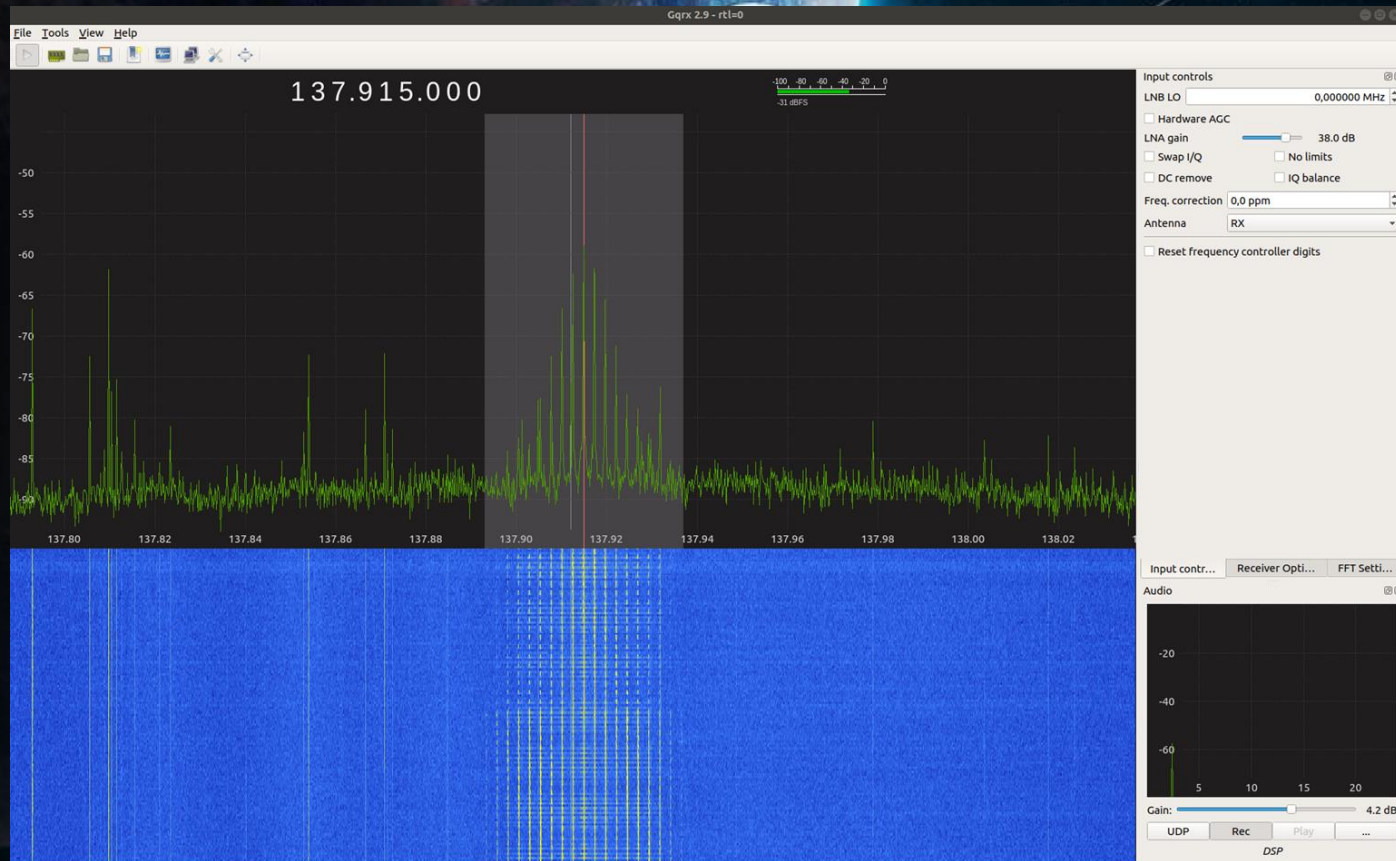
How to receive a sat transmission in 5 easy steps

# Step 1: Predict satellite fly-over

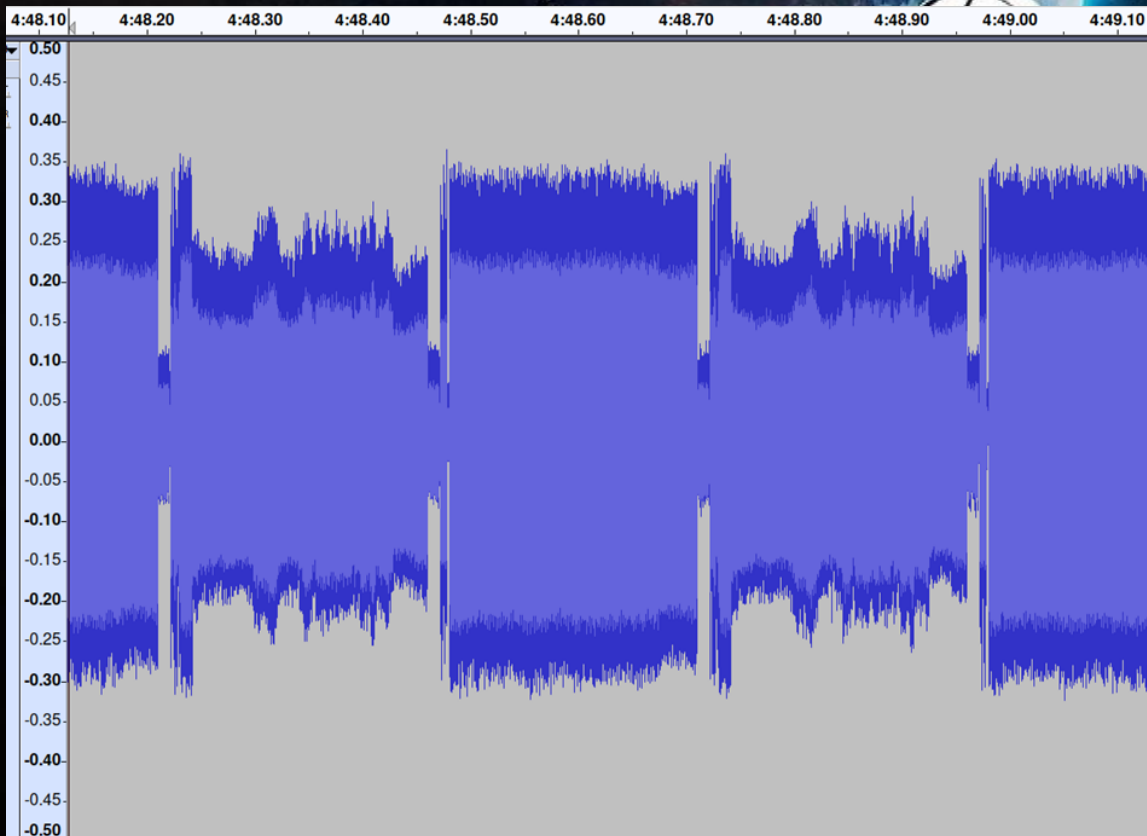




# Step 2: Tune SDR to transmission frequency



# Step 3: Decode transmission



noaa-apt

Tools Help

Input file (None)

Output file

Advanced settings

- ☒ Sync frames
- ☐ Save WAV steps
- ☐ Save resample "expanded\_filtered" step

Contrast adjustment: Keep 98 percent

Ready

Start

About noaa-apt

noaa-apt

1.1.1

[noaa-apt website](#)

This program comes with absolutely no warranty.  
See the [GNU General Public License, version 3 or later](#) for details.

Credits

Close



# Step 4: Upload to content server

```
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] Found 1391 samples
2020-01-08 18:50:45,973 INFO [noaa_apt] Resampling to 4160
2020-01-08 18:50:46,154 INFO [noaa_apt::noaa_apt] Adjusting contrast
2020-01-08 18:50:46,360 INFO [noaa_apt] Writing PNG to 'gqrx_20200108_172745_137912500.png'
2020-01-08 18:50:46,707 INFO [noaa_apt] Finished
pi@raspberrypi:~$ python3 devel/satnog-gdn/tools/submit_obs.py "2020-01-08 18:33:00" "2020-01-08 18:41:20"
Detected python: 3.7.3
Uploading file: cmd=[scp gqrx_20200108_172745_137912500.png satnog-gdn:/var/www/html/]
gqrx_20200108_172745_137912500.png
Adding record in the db: sqlcmd=[INSERT INTO observations(aos,tca,los,satellite,image,'aos_ts','tca_ts','los_ts') VALUES ('2020-01-08 18:26:29', '2020-01-08 18:26:29', 'NOAA 15', 'gqrx_20200108_172745_137912500.png', '2020-01-08 18:26:29', '2020-01-08 18:26:29', '2020-01-08 18:26:29')]
INSERT 0 1
pi@raspberrypi:~$
```

## 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.

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
32	2019-12-15 08:54:53	2019-12-15 08:54:53	2019-12-15 08:54:53	NOAA-18	20191215-0854-noaa-18.png
33	2019-12-15 19:46:48	2019-12-15 19:46:48	2019-12-15 19:46:48	NOAA-18	<a href="#">gqrx_20191215_184701_137912500-telemetry_contrast.png</a>
34	2019-12-16 14:59:20	2019-12-16 14:59:20	2019-12-16 14:59:20	NOAA-19	<a href="#">output-curves.png</a>
35	2019-12-17 18:23:00	2019-12-17 18:23:00	2019-12-17 18:23:00	NOAA-18	<a href="#">output.png</a>
36	2019-12-26 20:59:00	2019-12-26 20:59:00	2019-12-26 20:59:00	NOAA-18	<a href="#">output2.png</a>
37	2020-01-08 18:26:29	2020-01-08 18:26:29	2020-01-08 18:26:29	NOAA 15	<a href="#">gqrx_20200108_172745_137912500.png</a>

### Satellites

ID	Name
NOAA-15	25338
NOAA-18	28654
NOAA-19	33591

```
pi@raspberrypi:~$ gqr_x_20200108_172745_137912500.png gqr_x_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] Found 1391 s
2020-01-08 18:50:45,973 INFO [noaa_apt] Resampling to 4160
2020-01-08 18:50:46,154 INFO [noaa_apt::noaa_apt] Adjusting co
2020-01-08 18:50:46,360 INFO [noaa_apt] Writing PNG to 'gqr_x_2
2020-01-08 18:50:46,707 INFO [noaa_apt] Finished

pi@raspberrypi:~$ python3 devel/satnog-gdn/tools/submit-obs.py
29" "2020-01-08 18:33:00" "2020-01-08 18:41:20"
Detected python: 3.7.3
Uploading file: cmd=[scp gqr_x_20200108_172745_137912500.png sat
gqr_x_20200108_172745_137912500.png
Adding record in the db: sqlcmd=[INSERT INTO observations(aos,
-08 18:26:29', '2020-01-08 18:26:29', 'NOAA 15', 'gqr_x_20200108
INSERT 0 1

pi@raspberrypi:~$
```

## 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 Mrugański and Ewelina Omernik, three students of Space and Satellite Technologies studies of Gdańsk University of Technology.

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

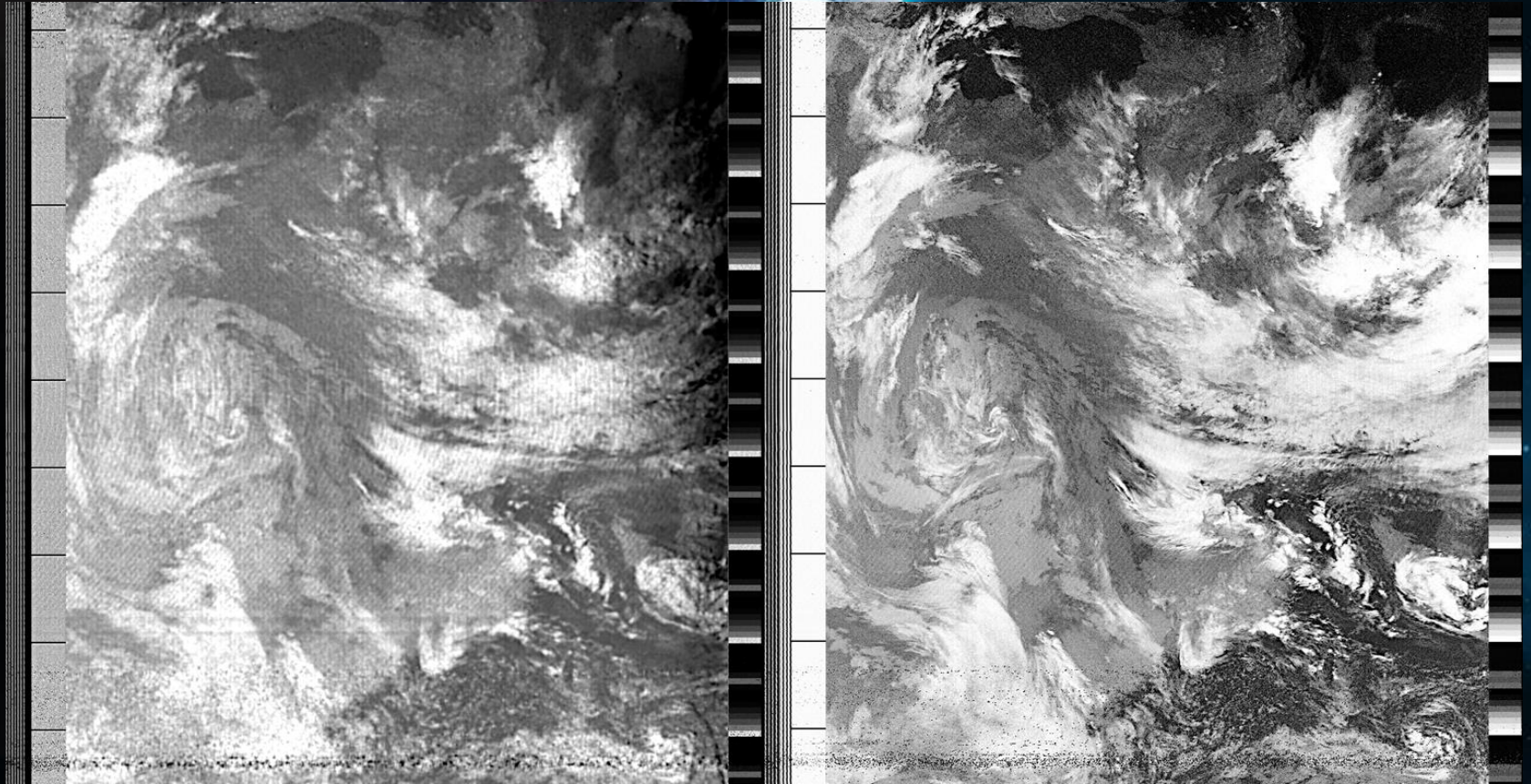
## Observations

ID	AOS	TCA	LOS	Satellite	Image
32	2019-12-15 08:54:53	2019-12-15 08:54:53	2019-12-15 08:54:53	NOAA-18	20191215-0854-noaa-18.png
33	2019-12-15 19:46:48	2019-12-15 19:46:48	2019-12-15 19:46:48	NOAA-18	gqrx_20191215_184701_137912500-telemetry_contrast.png
34	2019-12-16 14:59:20	2019-12-16 14:59:20	2019-12-16 14:59:20	NOAA-19	output-curves.png
35	2019-12-17 18:23:00	2019-12-17 18:23:00	2019-12-17 18:23:00	NOAA-18	output.png
36	2019-12-26 20:59:00	2019-12-26 20:59:00	2019-12-26 20:59:00	NOAA-18	output2.png
37	2020-01-08 18:26:29	2020-01-08 18:26:29	2020-01-08 18:26:29	NOAA 15	gqrx_20200108_172745_137912500.png

## Satellites

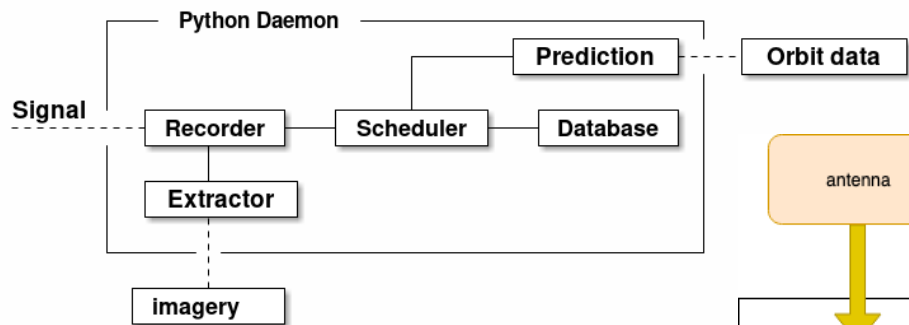
ID	Name
NOAA-15	25338
NOAA-18	28654
NOAA-19	33591

## Step 5: Profit!



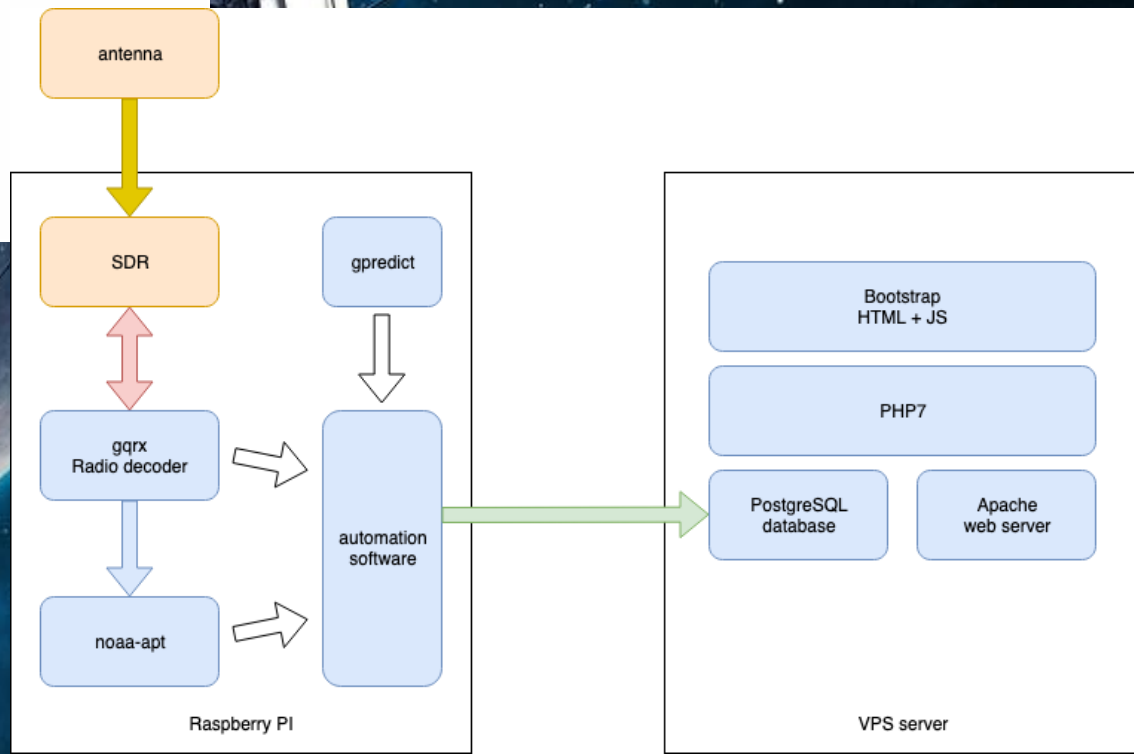


# Automation

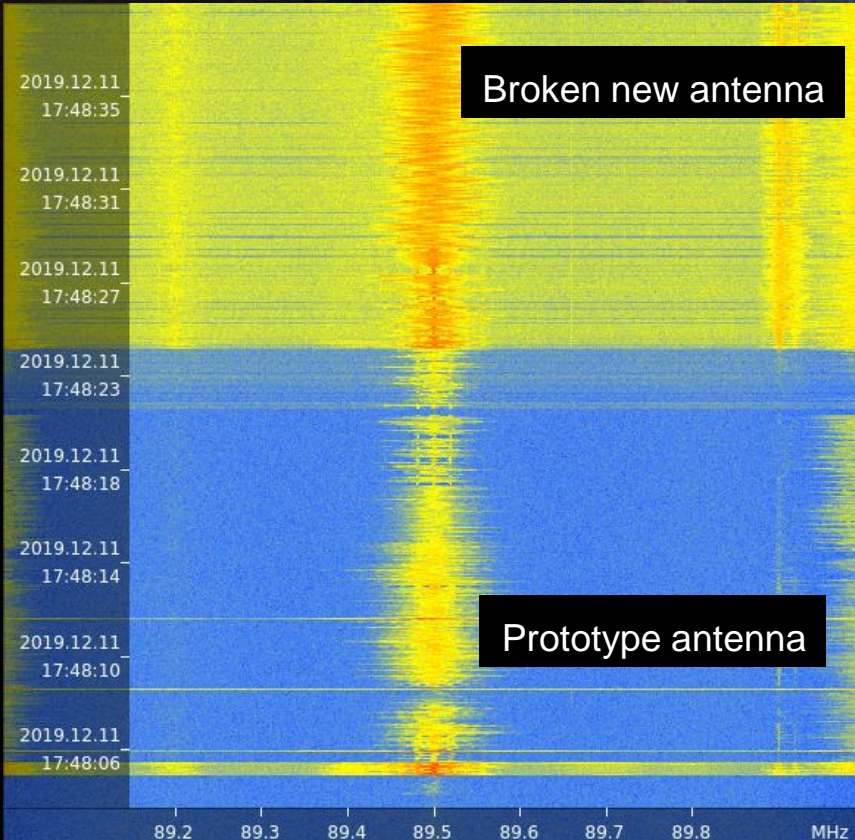


Realization

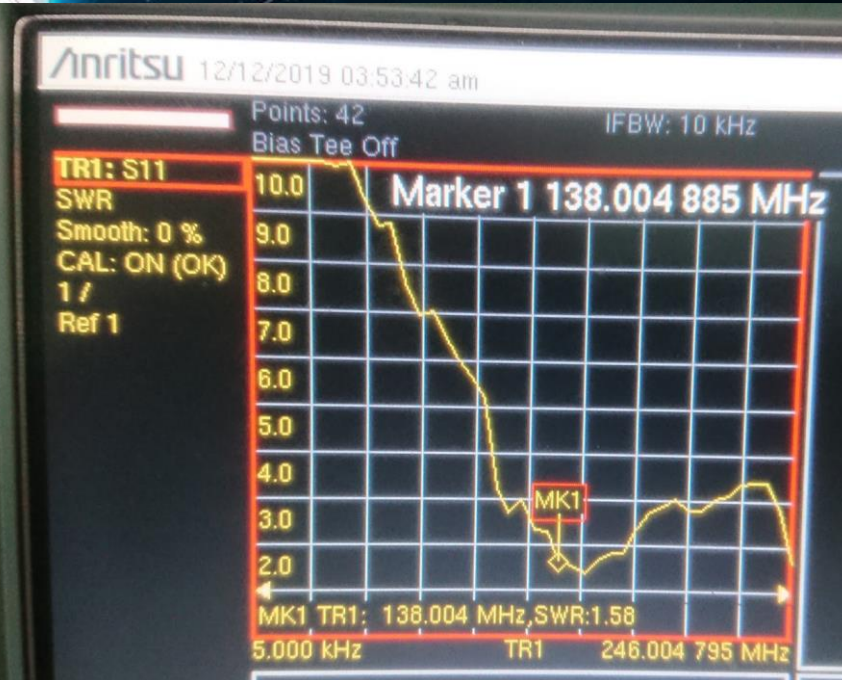
Concept



# Troubleshooting



SWR measurements

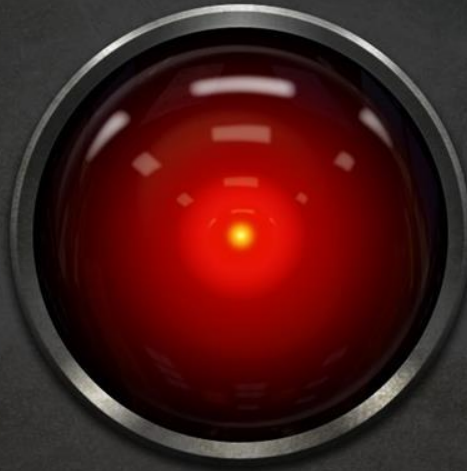




# Next steps

- Better code and web interface
- Connect to SATNOG network
- Switch to directional antenna
- Switch to UHF and S band
- Cooperation with amateur Cubesat projects

Q&A



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