

SatNOGS

**Un réseau open source de station sol
pour les satellites en orbites basses.**

Par Julien ADRI38 12/04/2019

- **Projet SATNOGS**
- **Un exemple de station sol**
 - **Perspectives**

De très nombreux satellites

- Satellites « défilants »
- Satellites « géostationnaires »
- Mais aussi : polaires, héliosynchrones ... etc

Satellites défilants

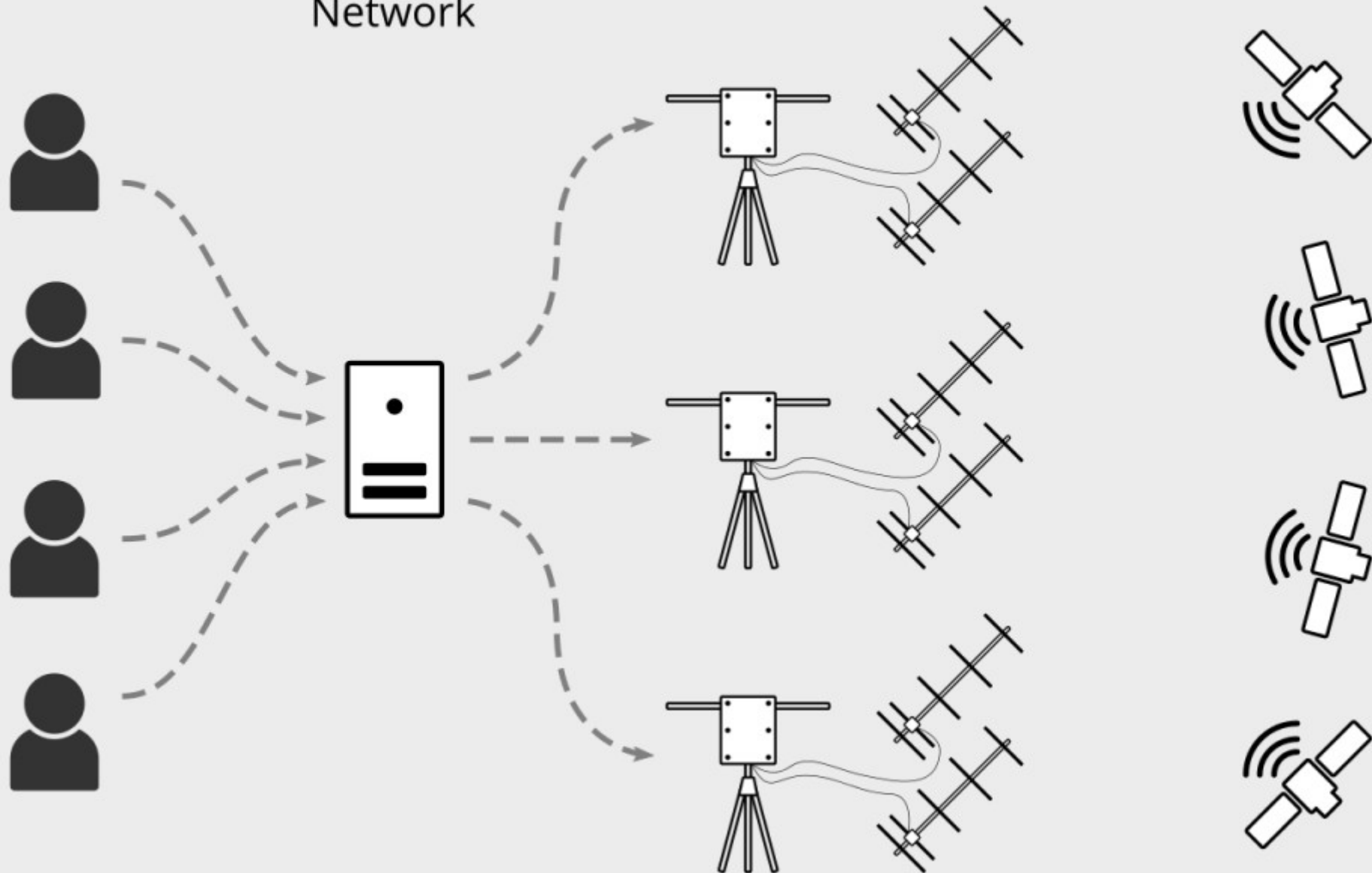
- Durée de LOS assez courte
- Donc station sol inactive très souvent
- Nécessite des stations sol tout autour du monde
- Un réseau de partage et une communauté ont donc du sens

Users

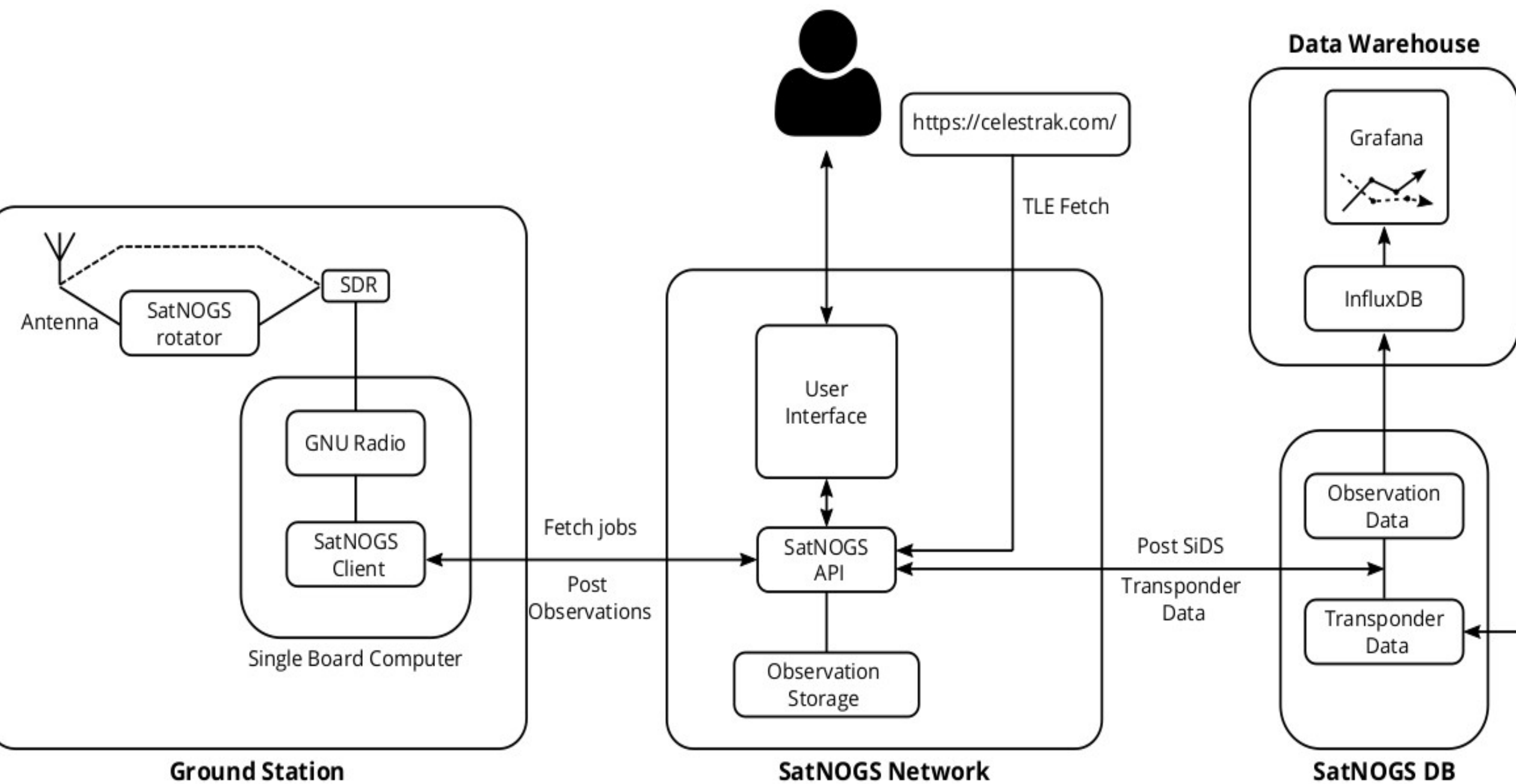
Global
Management
Network

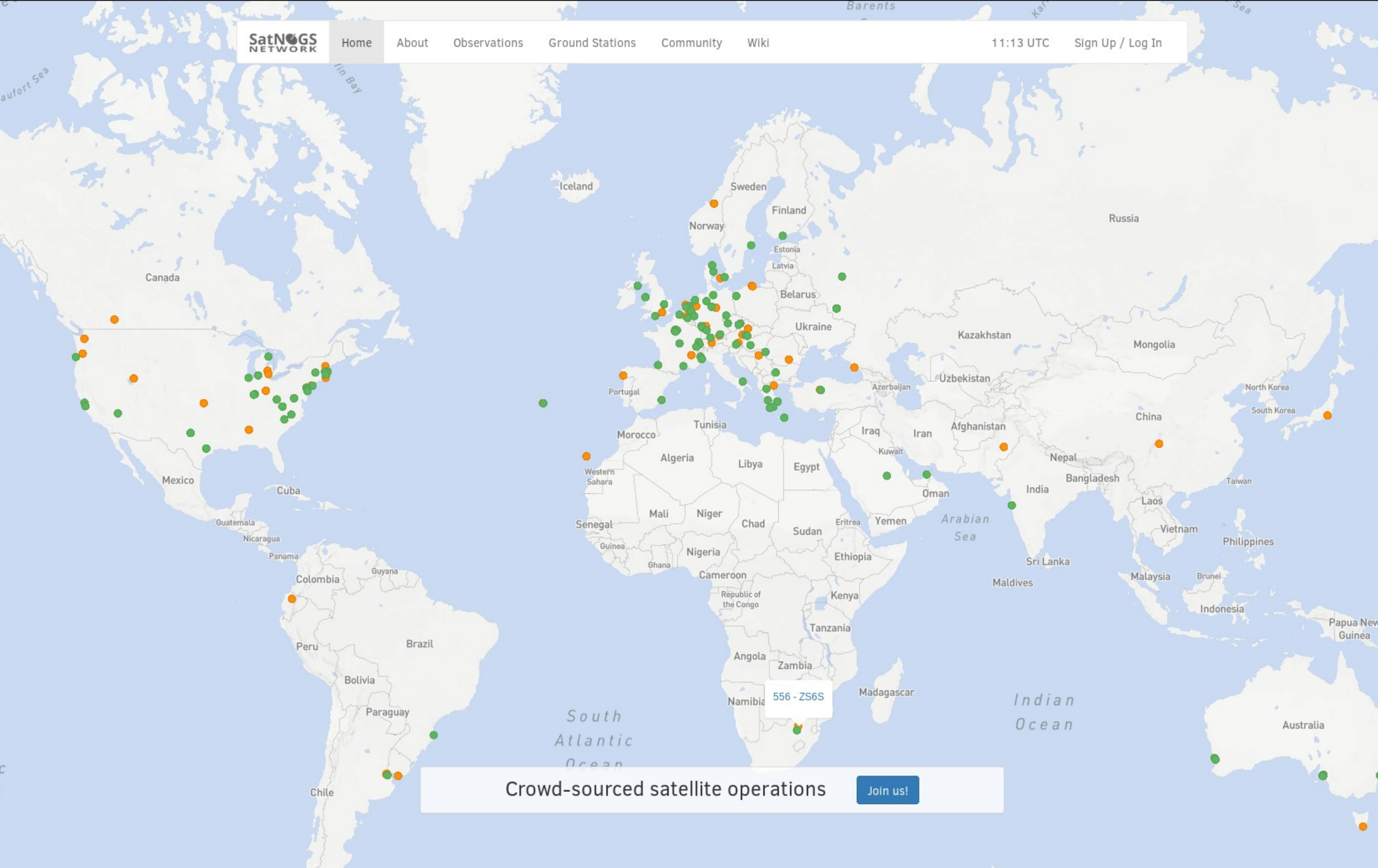
Ground Stations

Satellites



L'activité du réseau en temps réel





556 - ZS6S

Crowd-sourced satellite operations

Join us!

Pass predictions



Success Rate



Max Elevation



Overlap



☐ Include unsupported satellites

Name	AOS	LOS	↑ ↔ ↓	Polar plot	
42775-AALTO-1 	15:46 2018-10-30	15:57 2018-10-30	↑ 6° ↔ 53° ↓ 203°		schedule 40% overlap
965-TRANSIT 5B-5 	16:11 2018-10-30	16:30 2018-10-30	↑ 186° ↔ 62° ↓ 355°		schedule 29% overlap
43137-FOX-1D 	16:13 2018-10-30	16:25 2018-10-30	↑ 6° ↔ 49° ↓ 205°		schedule
43155-Xiaoxiang-2 	16:32 2018-10-30	16:44 2018-10-30	↑ 11° ↔ 87° ↓ 194°		schedule 43% overlap

Programmer une observation

New Observation

Satellite

39433 - HUMSAT-D ▾

Transmitter

CW Beacon - 437.325 MHz - ▾

Start Time

2015-09-09 18:20 

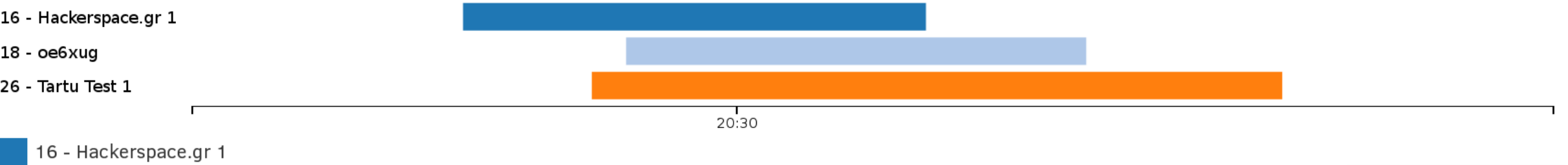
End Time

2015-09-09 18:45 

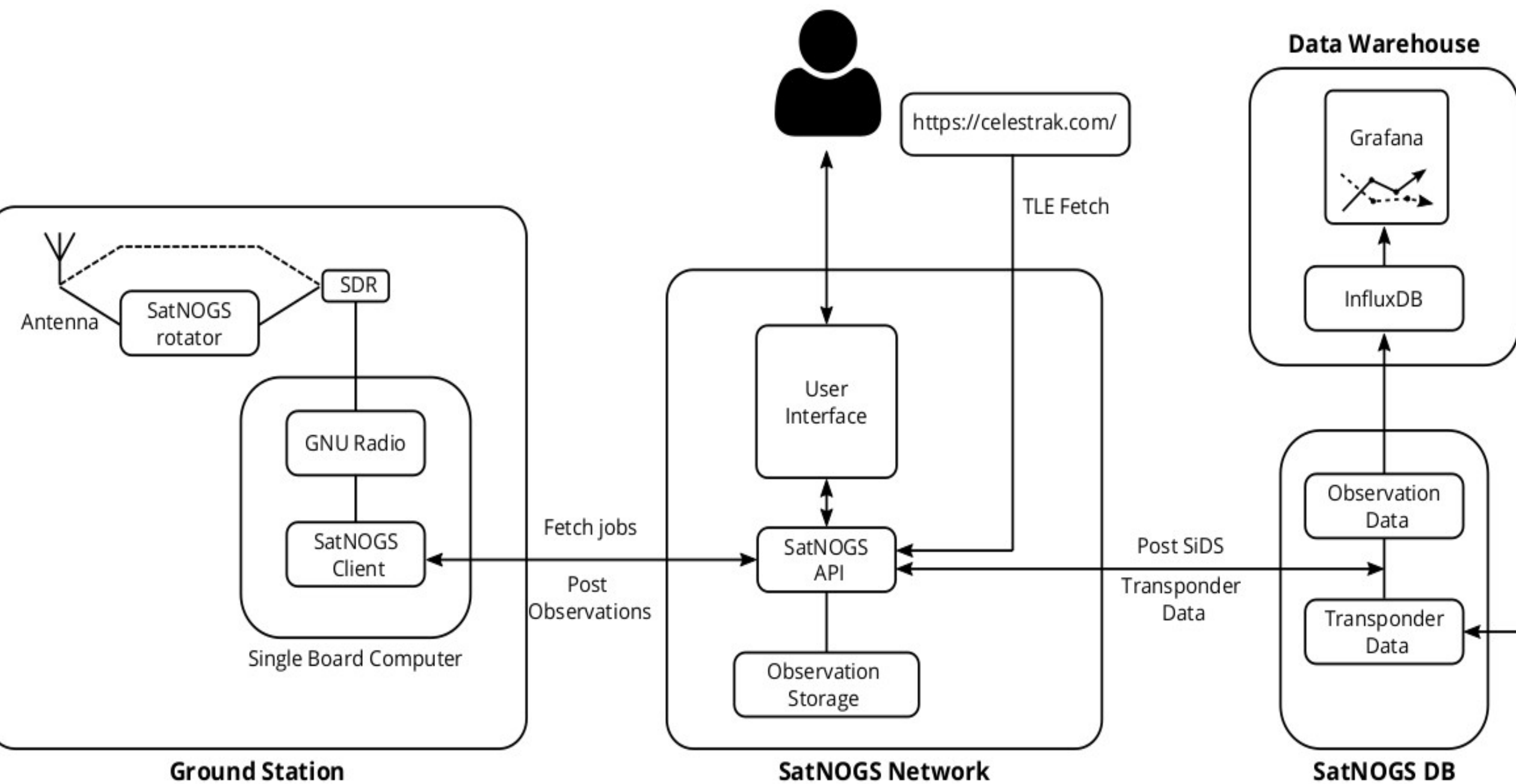
IMPORTANT: Timeframe is considered to be in UTC tmezone.

Calculate Observation

Calculated Timeline



Schedule Observation



La station sol

- Image carte uSD pour raspberry
 - Client en python qui exécute les observations
 - Interface web propre à la station
 - Démodulation avec Gnuradio

Options

ID: satnogs_cw_decoder

Title: CW Decoder

Author: Manolis...@gmail.com)

Description: A CW ... Decoder

Generate Options: No GUI

Run Options: Run to Completion

Import

Import: satnogs

Import

Import: math

TCP rigctl Message Source

IP Address: 127.0.0.1

Port: 4.532k

Mode: Client

Update interval (ms): 1k

MTU: 1.5k

osmocom Source

Device Arguments: uhd

Sample Rate (sps): 500k

Ch0: Frequency (Hz): 99.9M

Ch0: Freq. Corr. (ppm): 0

Ch0: DC Offset Mode: Automatic

Ch0: IQ Balance Mode: Off

Ch0: Gain Mode: Manual

Ch0: RF Gain (dB): 50

Ch0: IF Gain (dB): 0

Ch0: BB Gain (dB): 0

Ch0: Antenna: TX/RX

Ch0: Bandwidth (Hz): 500k

Variable

ID: xlate_filter_taps

Value: firdes.low_pass(1, ...

Variable

ID: samp_rate_rx

Value: 500k

SDR device
TX sampling rate

Parameter

ID: lo_offset

Value: 100k

Type: Float

To avoid the SDR carrier at the DC
we shift the LO a little further

Variable

ID: xlating_decimation

Value: 5

Variable

ID: lpf_decimation

Value: 5

Parameter

ID: doppler_correction_per_sec

Value: 1k

Type: Int

Parameter

ID: rx_sdr_device

Value: usrbp200

Type: String

Parameter

ID: rigctl_port

Value: 4.532k

Type: Int

Parameter

ID: rx_freq

Value: 100M

Type: Float

Parameter

ID: file_path

Value: test.txt

Type: String

Parameter

ID: waterfall_file_path

Value: /tmp/waterfall.dat

Type: String

Parameter

ID: ppm

Value: 0

Type: Int

Parameter

ID: wpm

Value: 20

Type: Int

Parameter

ID: udp_IP

Value: 127.0.0.1

Type: String

Parameter

ID: udp_port

Value: 16.887k

Type: Int

Parameter

ID: rf_gain

Value: -1

Type: Float

Parameter

ID: if_gain

Value: -1

Type: Float

Parameter

ID: bb_gain

Value: -1

Type: Float

Parameter

ID: antenna

Value:

Type: String

Parameter

ID: dev_args

Value:

Type: String

Variable

ID: audio_samp_rate

Value: 48k

Parameter

ID: iq_file_path

Value: /tmp/iq.dat

Type: String

Parameter

ID: enable_iq_dump

Value: 0

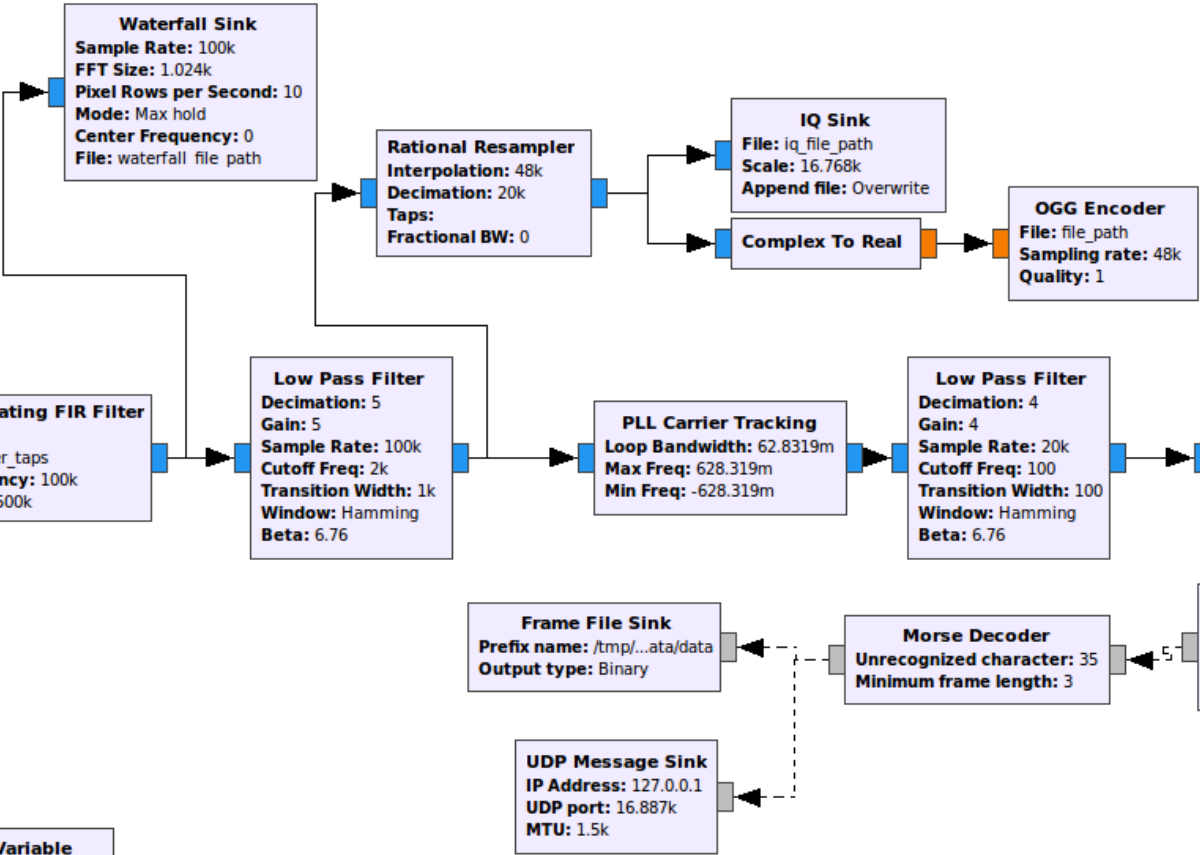
Type: Int

Parameter

ID: decoded_data_file_path

Value: /tmp/sa...s/data/data

Type: String



Satellite

Station

Observer

Status

Transmitter

Frequency

Encoding

Timeframe

Rise

Max

Set

Client Version

Metadata

Polar Plot

Downloads

40012 - UNISAT-6

50 - N5CNB-UHF

n5fxh

Good

i

?

×

!

9k6 FSK TLM

437.421 MHz

FSK9k6

2019-04-12 14:32:23

2019-04-12 14:45:47

● 158.0°

57.0°

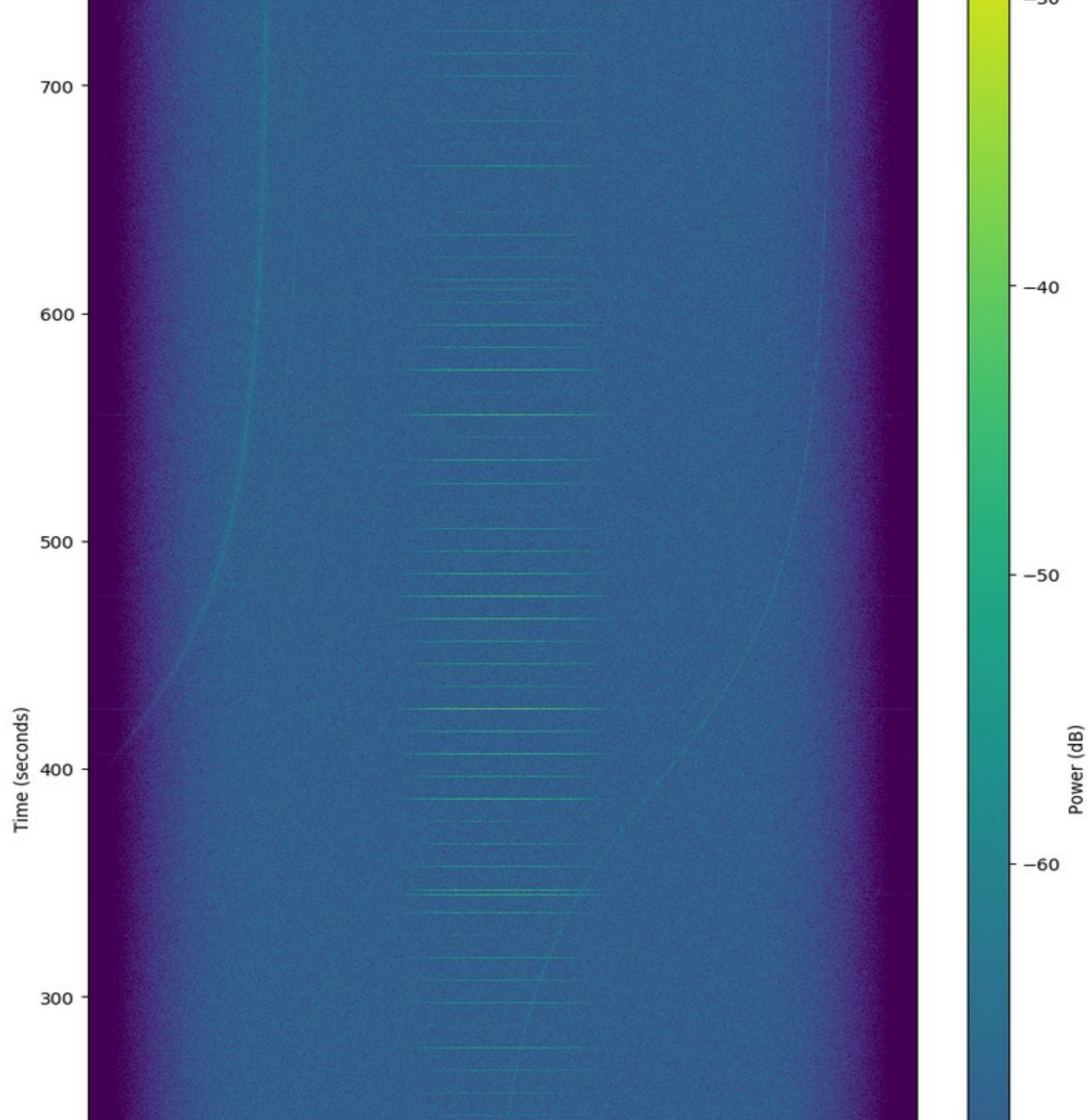
● 354.0°

0.8

▶ { 4 items }

📶 Audio

📶 Waterfall



Observation #526273



Discuss

Timeframes are in UTC

Satellite

40968 - BISONSAT

Station

488 - W7KKE

Observer

W7KKE Ken Swaggart

Status

Good

Transmitter

Telemetry

Frequency

437.375 MHz

Encoding

FSK9k6

Timeframe

2019-03-11 05:33:01

2019-03-11 05:36:54

Rise

236.0°

Max

70.0°

Set

19.0°

Client Version

0.9

Metadata

▶ { 5 items }

Polar Plot

Downloads

Audio

Waterfall

Waterfall

Audio

Data 5

ASCII

HEX

data_obs/526273/data_526273_2019-03-11T05-33-22

AE 90 64 B0 A0 9A 60 9C 6E A6 96 86 40 E1 03 F0 50 00 00 00 00 01 00 42 45 41 57 48 32
58 50 4D 11 02 11 05 48 47 48 A0 32 CB 8D 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 A6 FF F3 99 F2 FF F3 FF F3 02 F0 FF F3 FF F3 B5 F2 FF F3 FF F3 02 F0 FF F3
A2 F2 FF F3 44 F1 9E F0 FF F3 48 F3 43 F1 9F F0 0E F3 18 F3 FF F3 3F F3 E8 F2 FF F3 C4
FE BC FF C4 FE 60 F2 F4 FD 3B FF D5 FF 00 00 00 00 00 00 03 05 01 06 01 08 02 00 00 00
01 F0

data_obs/526273/data_526273_2019-03-11T05-34-23

AE 90 64 B0 A0 9A 60 9C 6E A6 96 86 40 E1 03 F0 50 00 00 00 00 00 01 00 42 45 41 57 48 32
58 50 4D 11 02 11 05 49 49 05 AC 4A CB 8D 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 A6 FF F3 AB F2 FF F3 FF F3 02 F0 FF F3 FF F3 C0 F2 FF F3 FF F3 03 F0 FF F3
B3 F2 FF F3 44 F1 9F F0 FF F3 48 F3 45 F1 A0 F0 0E F3 17 F3 FF F3 3F F3 FA F2 FF F3 C8
FE E0 FF B0 FD B0 F1 0C FD D0 00 10 00 00 00 00 00 00 00 03 05 01 06 01 08 02 00 00 00
01 F0

data_obs/526273/data_526273_2019-03-11T05-35-25

AE 90 64 B0 A0 9A 60 9C 6E A6 96 86 40 E1 03 F0 50 00 00 00 00 00 01 00 42 45 41 57 48 32
58 50 4D 11 02 11 05 50 50 61 B8 62 CB 8D 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 A6 FF F3 BE F2 FF F3 FF F3 02 F0 FF F3 FF F3 C9 F2 FF F3 FF F3 02 F0 FF F3
C3 F2 FF F3 45 F1 9F F0 FF F3 48 F3 44 F1 A1 F0 0E F3 18 F3 FF F3 3F F3 0B F3 FF F3 A0
FF 9C FF 4C FE 00 F1 8A FD 42 FF E7 FF 00 00 00 00 00 00 03 05 01 06 01 08 02 00 00 00
01 F0

data_obs/526273/data_526273_2019-03-11T05-35-54

AE 90 64 B0 A0 9A 60 9C 6E A6 96 86 40 E1 03 F0 00

Observation #588503

🕒 Timeframes are in UTC



Discuss

Satellite

Station

Observer

Status

Transmitter

Frequency

Encoding

Timeframe

Rise

Max

Set

Client Version

Metadata

Polar Plot

Downloads

25338 - NOAA 15

91 - MOEYT / 2E0NOG

uhf-satcom

Good



APT Downlink

137.620 MHz

APT

2019-04-12 06:47:58
2019-04-12 07:03:01

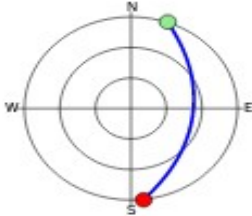
 20.0°

 37.0°

 173.0°

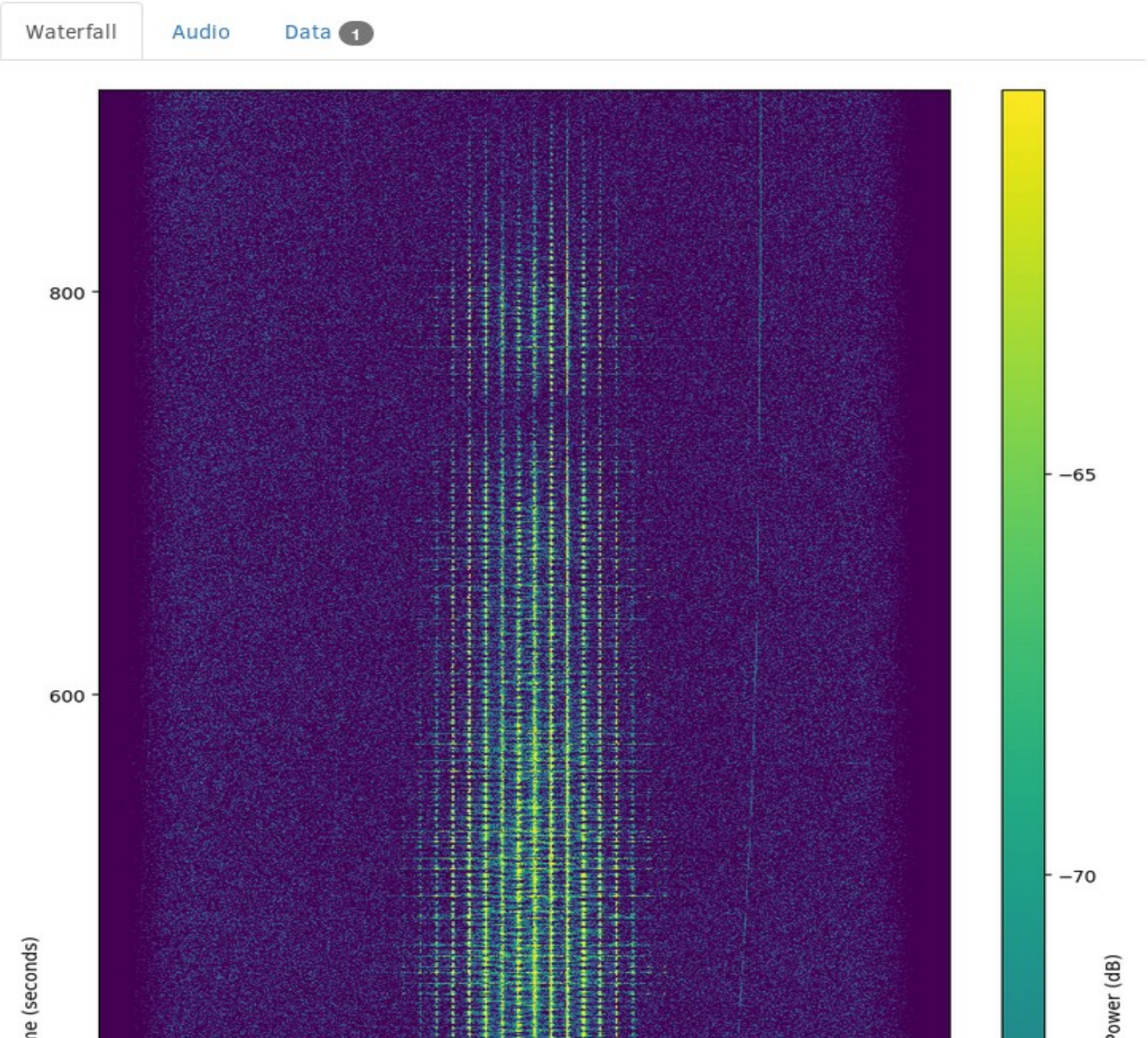
0.9

▶ { 5 items }



 Audio

 Waterfall



Observation #588503

⌚ Timeframes are in UTC

Satellite

Station

Observer

Status

Transmitter

Frequency

Encoding

Timeframe

Rise

Max

Set

Client Version

Metadata

Polar Plot

Downloads

25338 - NOAA 15

91 - MOEYT / 2E0NOG

uhf-satcom

Good

i

?

✖

⚠

APT Downlink

137.620 MHz

APT

2019-04-12 06:47:58

2019-04-12 07:03:01

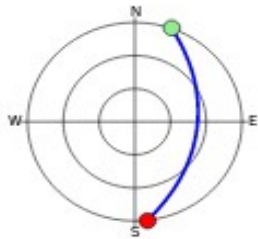
● 20.0°

37.0°

● 173.0°

0.9

▶ { 5 items }



📶 Audio

📶 Waterfall

Waterfall

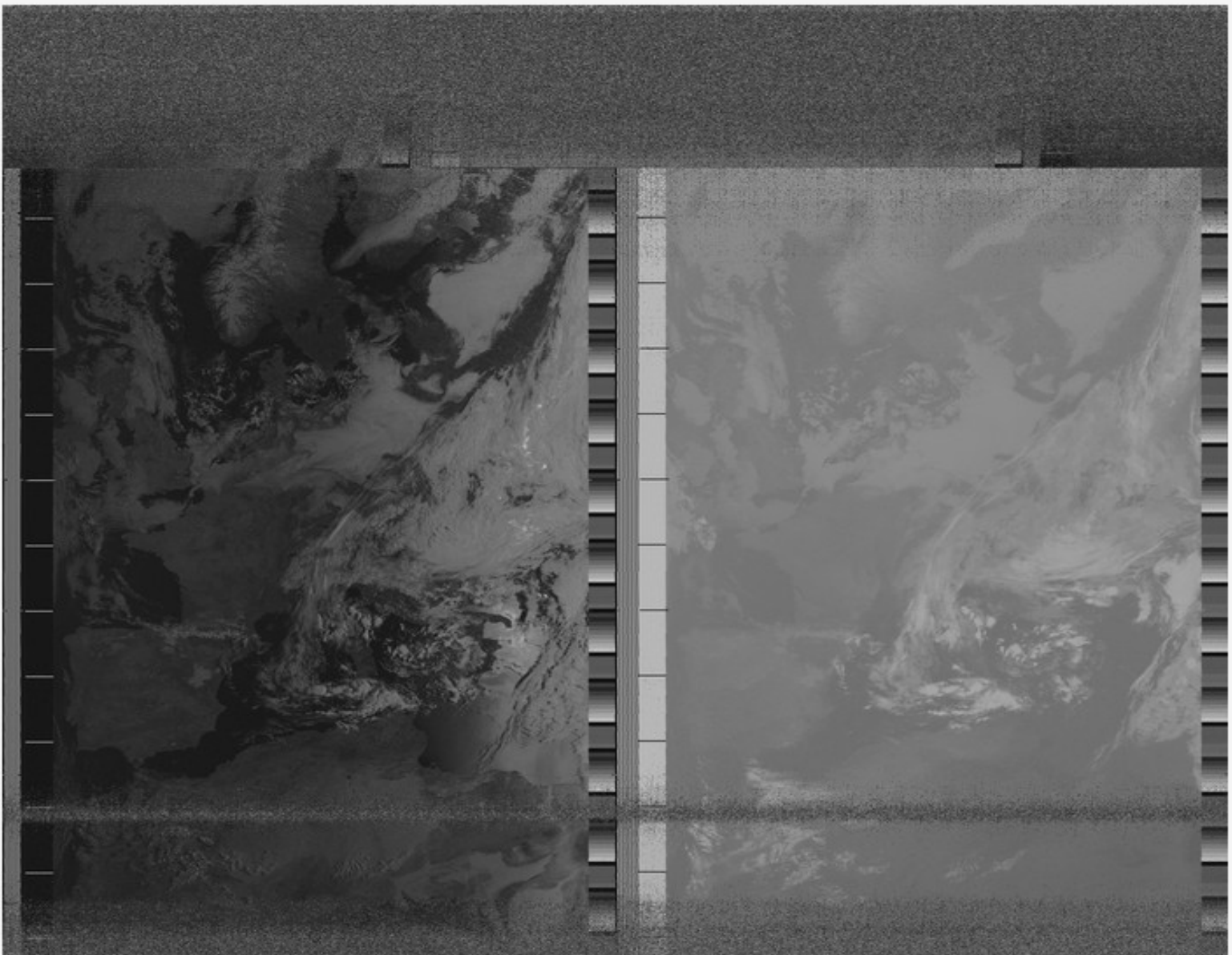
Audio

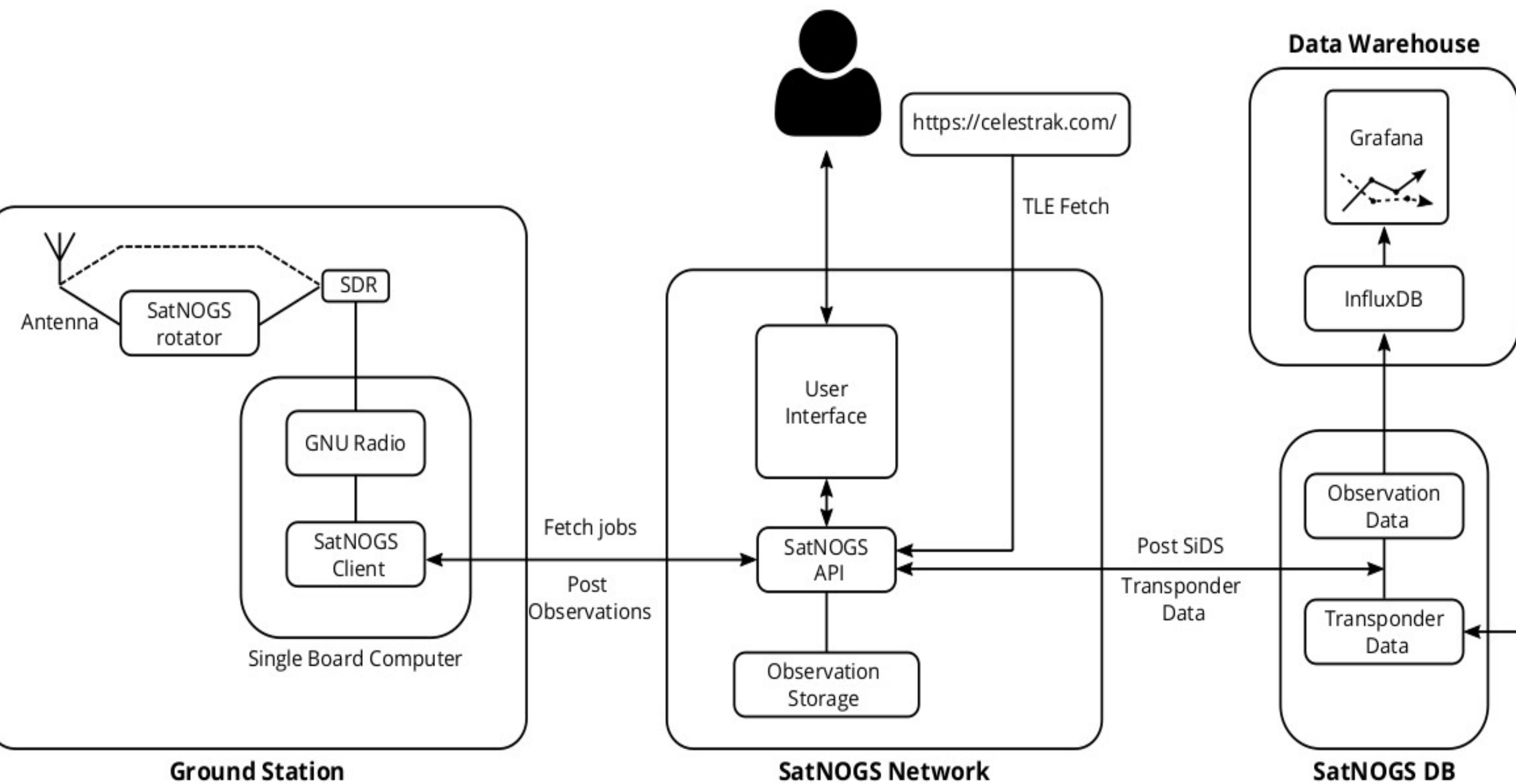
Data 1

ASCII

HEX

data_obs/588503/data_588503_2019-04-12T06-47-58.png

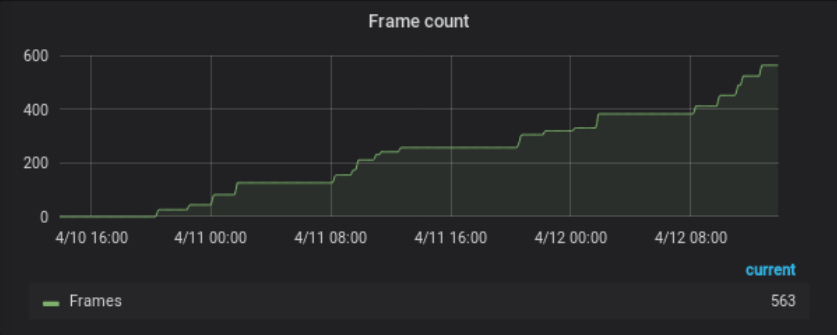




suid 40014

Messages

Time	message
2019-04-12 12:47:28	EMAIL :tita@satellogic.com Upt: 16:30:00 Bat:12.14v Temp:33.1C Gyr:1.46d/s
2019-04-12 12:44:45	EMAIL :tita@satellogic.com Upt: 16:27:15 Bat:12.09v Temp:32.9C Gyr:1.48d/s
2019-04-12 12:44:43	EMAIL :tita@satellogic.com Upt: 16:27:15 Bat:12.09v Temp:32.9C Gyr:1.48d/s



Mode
4

Last frame
12:47:59

Last Frame Rcvd By
CGBSAT-UHF-J032eu

Reset Count
1910

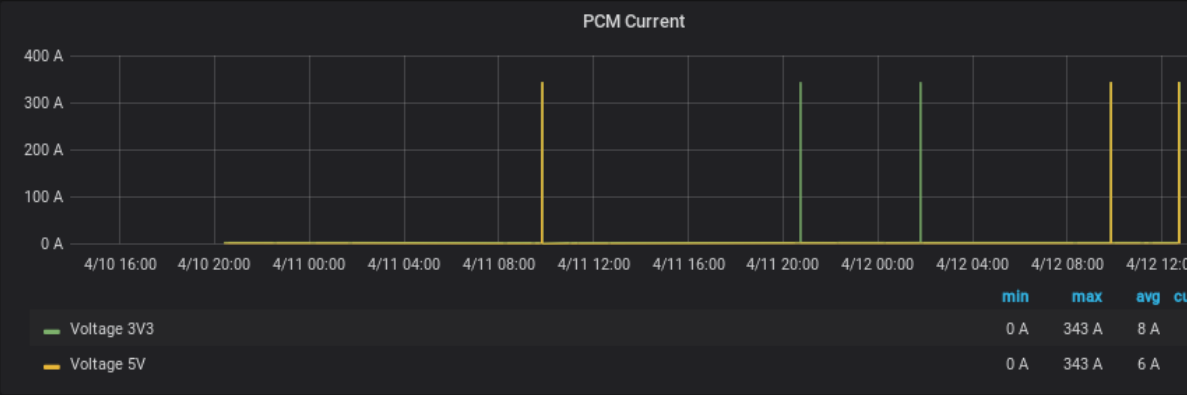
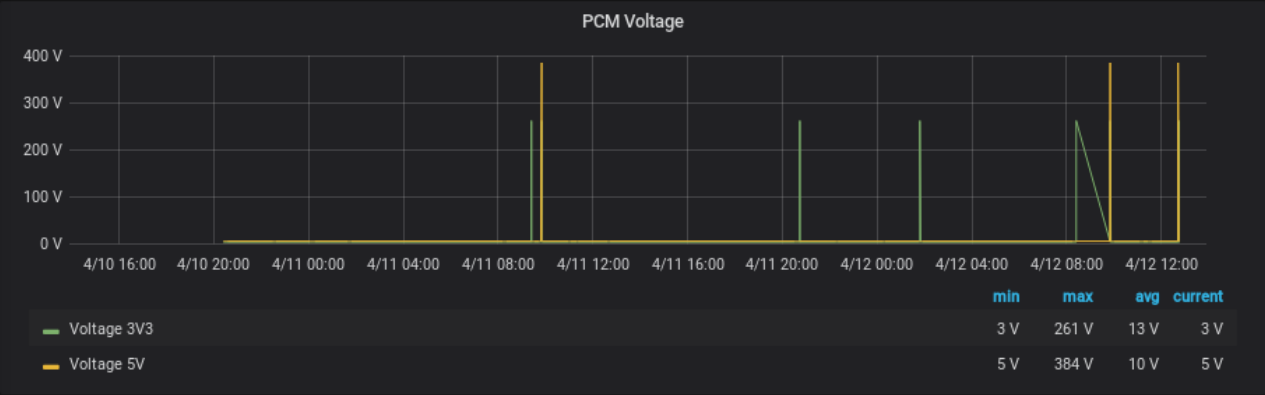
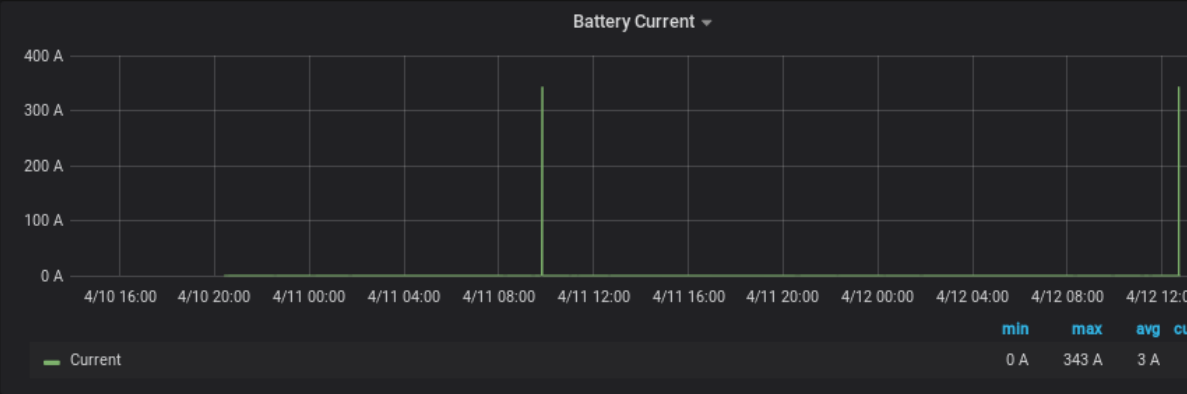
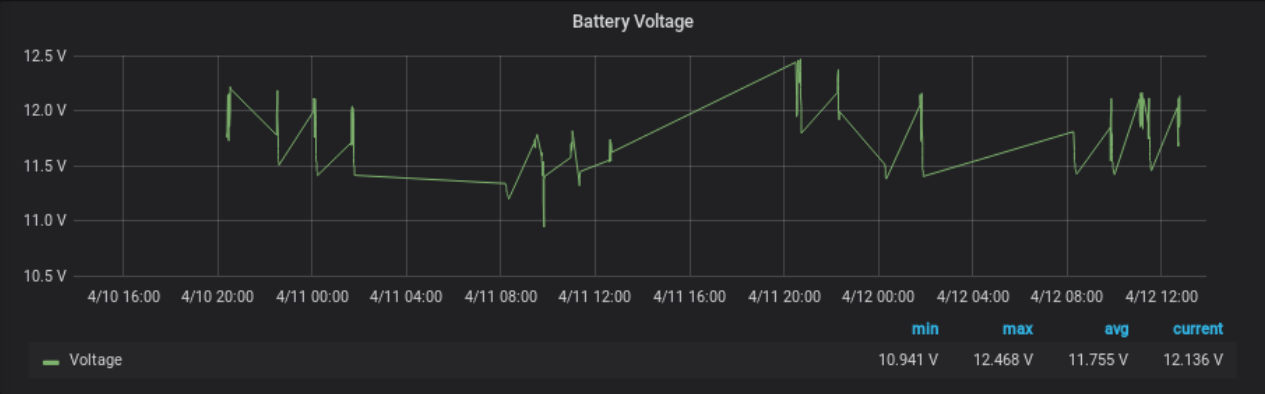
Fm
LU7AA

Low Voltage Count
4

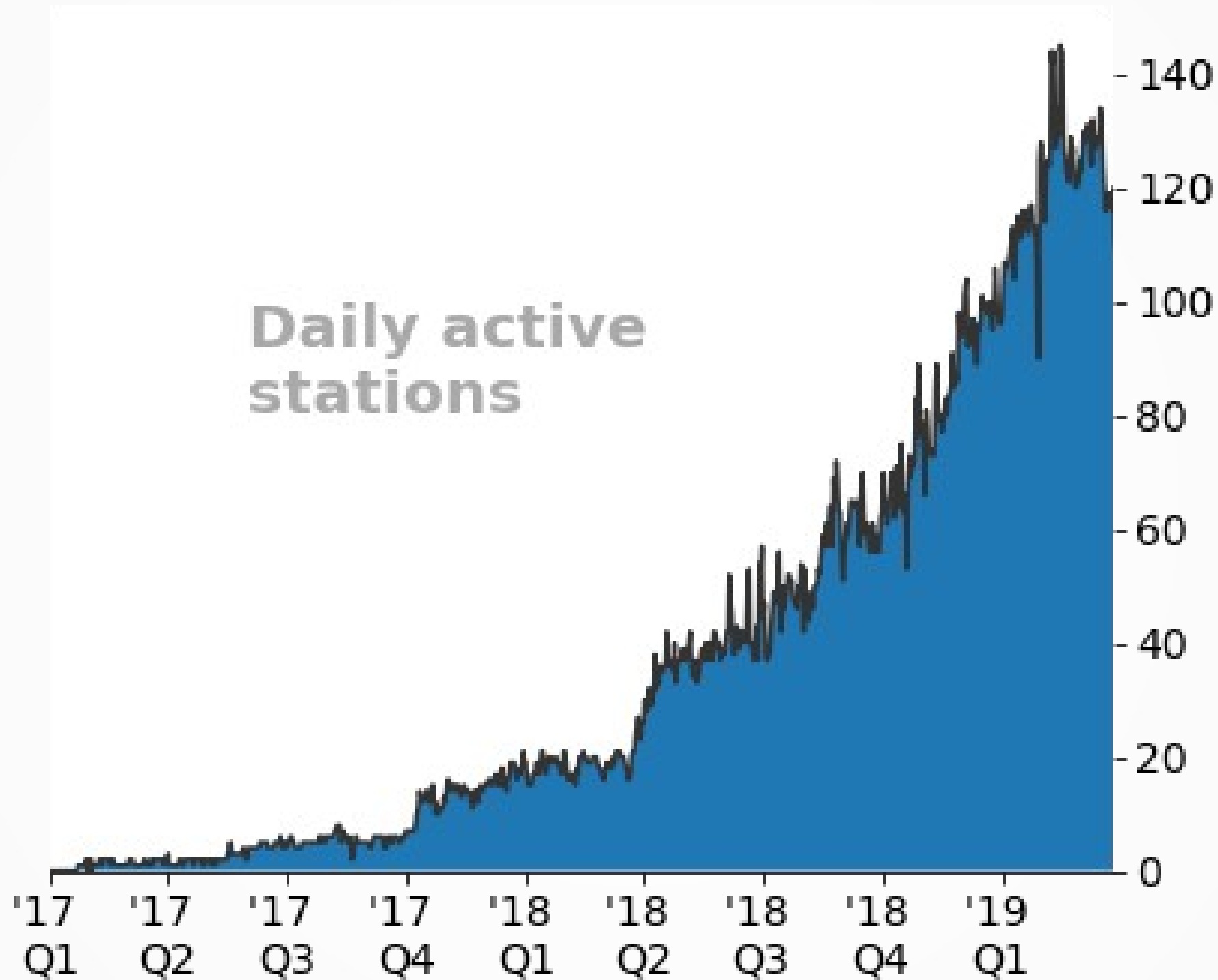
To
CQ

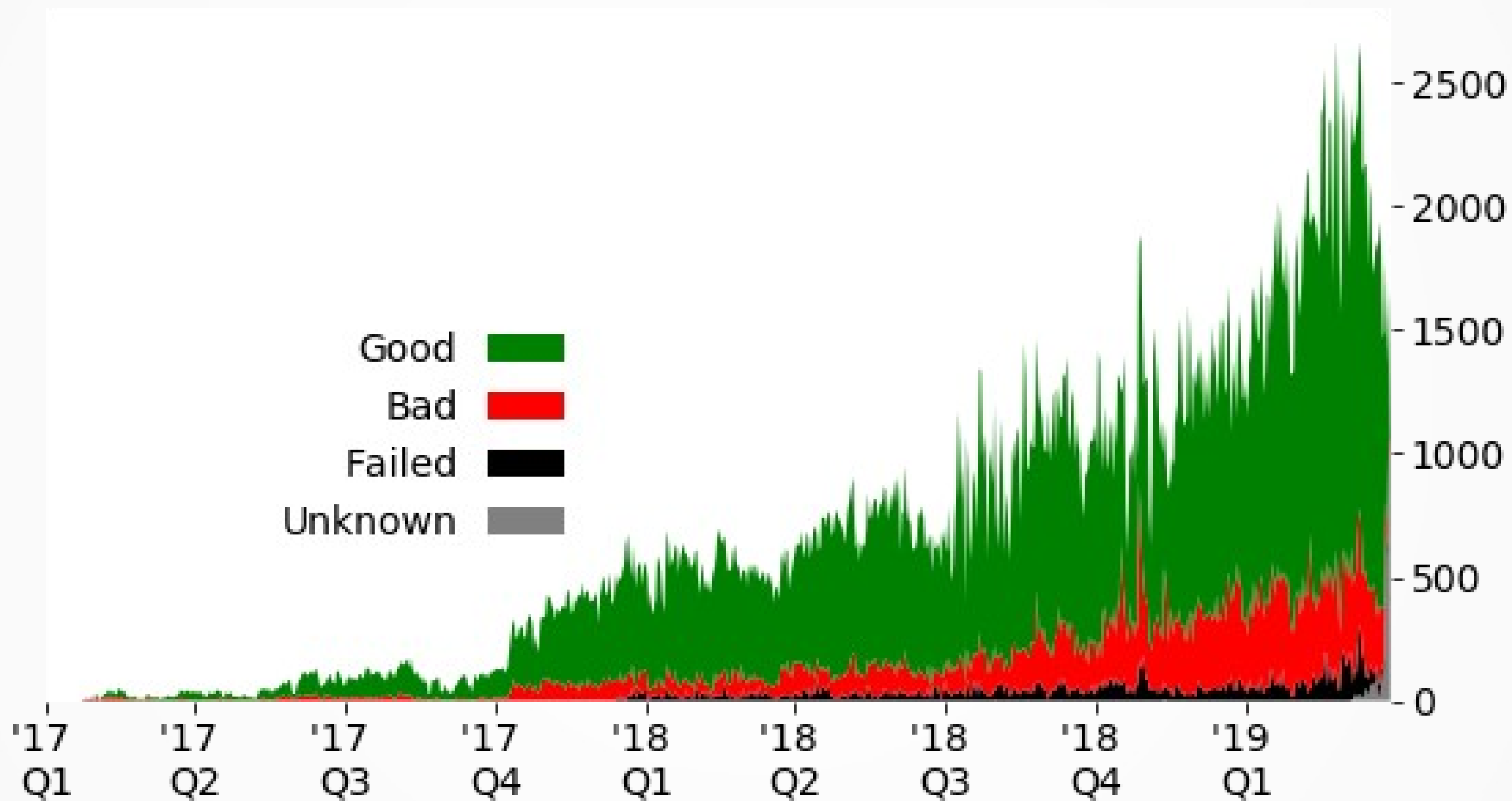
Uptime
16 hours, 30 minutes, 30 seconds

Timestamp
1555073275

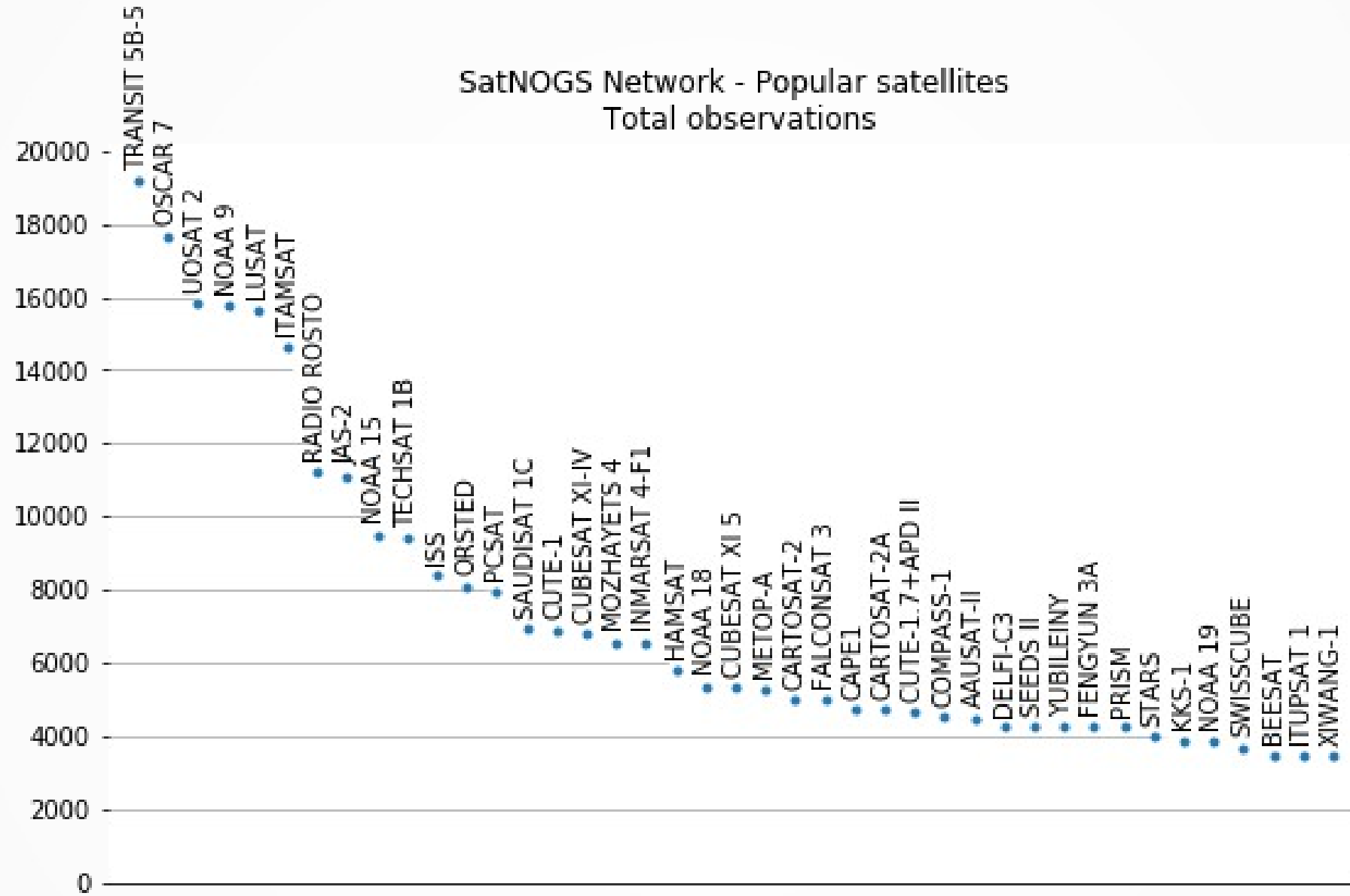


Daily active stations





SatNOGS Network - Popular satellites
Total observations



Un exemple de
station sol

Station sol basique

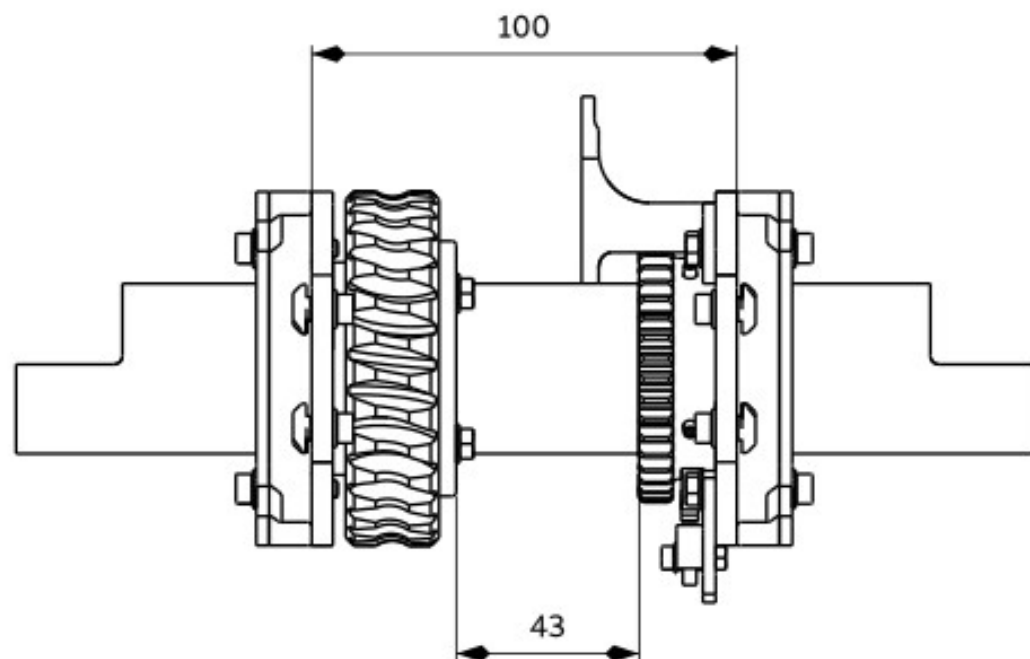
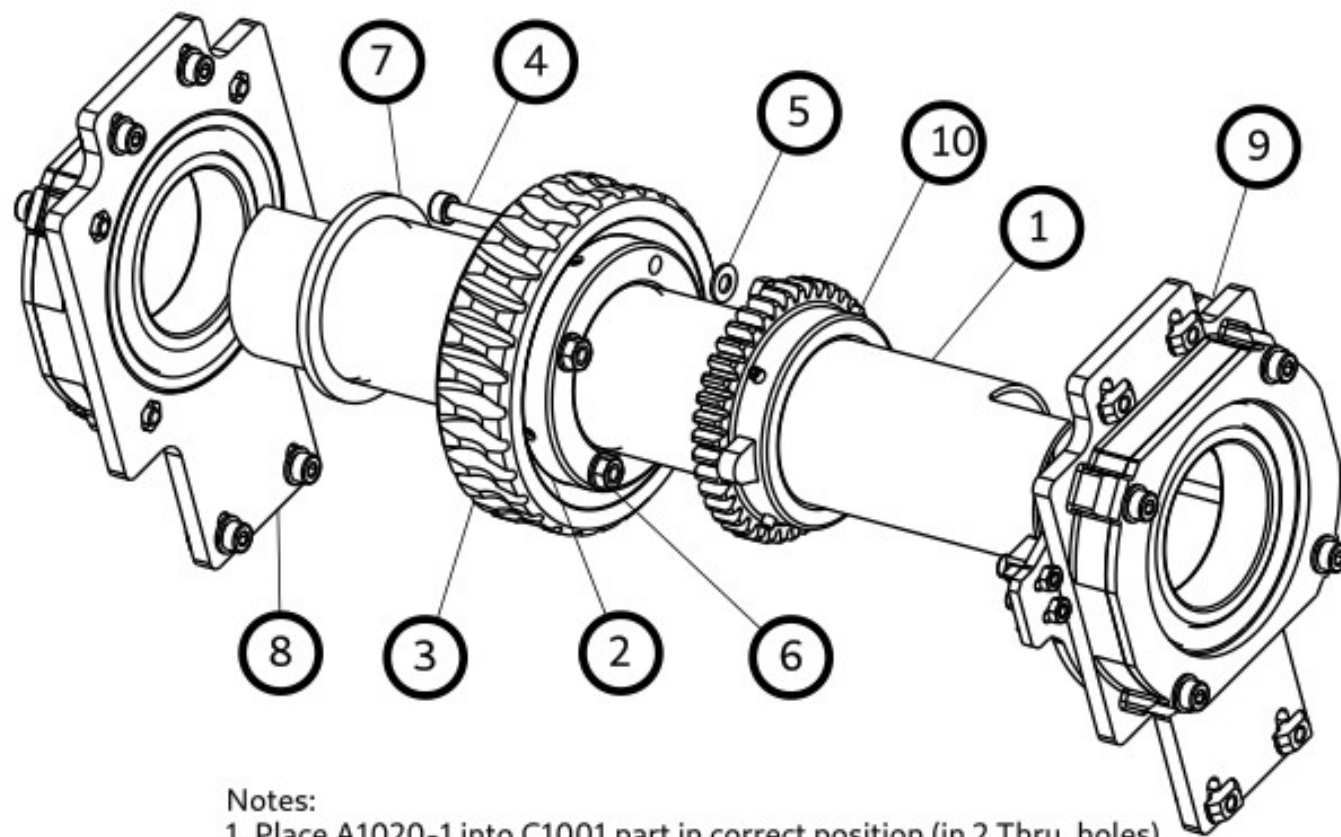
- Raspberry pi : 30 euros
- Clef rtl-sdr : 6 euros
- Antenne : fil de cuivre + tube pvc



Station sol avec antennes directionnelles

- Raspberry
- Rtl-sdr ou mieux : USRP, hackrf, airspy, lime-sdr ...
- Antennes directionnelles : hélix/yagi/parabole
 - tube de cuivre/alu et support
- Motorisation des antennes
 - Imprimante 3D + rail alu + moteurs et contrôleur chinois
- Amplificateur à faible bruit
- Filtres
 - Amusant à fabriquer

part #	source file	quantity
1	C1001-1_symmetric_tube	1
2	A1020-1_shaft_collar	1
3	C1020-1_shaft_gear	1
4	H1100-1_screw_M4L25_din912	4
5	H1110-1_washer_M4_din125	4
6	H1080-1_nut_M4_din934	4
7	C1022-3	1
8	A1031-1_bearing_side	1
9	A1032-1_bearing_side	1
10	A1033-1_encoder_gear	1



Notes:

1. Place A1020-1 into C1001 part in correct position (in 2 Thru. holes)
2. Tight set screws of A1020-1
3. Place C1020-1 into above sub-assembly, align the holes for part screws #4
4. Tight the screws with #5 and #6
5. Place the A1033-1 (#10) in correct position (as shown: 43) and tight the set-screws
6. Place C1022-3, #7
7. Put bearing sides (#8, #9) the dimension between is 100 (as shown)
8. Bearing inner ring tolerances: +0.003 -0.013 (K6), Normal ISO tolerance class
9. Aluminum tube 6063 OD tolerances: +0.0 -0.3 (h12)
10. Fit Type: 40 K6/h12, Transition fit
11. Same process for A1030-3, by using different aluminum tube, C1001-3

Notes:

12. Adjust end-stop to work properly for both directions
13. Install rotary encoder to C1043-1, encoder base, and adjust

DESIGNED BY:

Azisi

DATE:

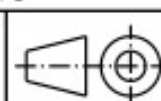
20/08/2018

SIZE

A4

SCALE

1:2



WEIGHT (kg)

N/A

A1030

Rotator Axis, -1 and -3

UNLESS OTHERWISE SPECIFIED
TOLERANCES

DIN ISO 2768- mk

ROUGHNESS

DIMENSIONS ARE IN MILLIMETERS
DO NOT SCALE

DEBURR AND BREAK SHARP EDGES ± 0.2

SHEET

1/1

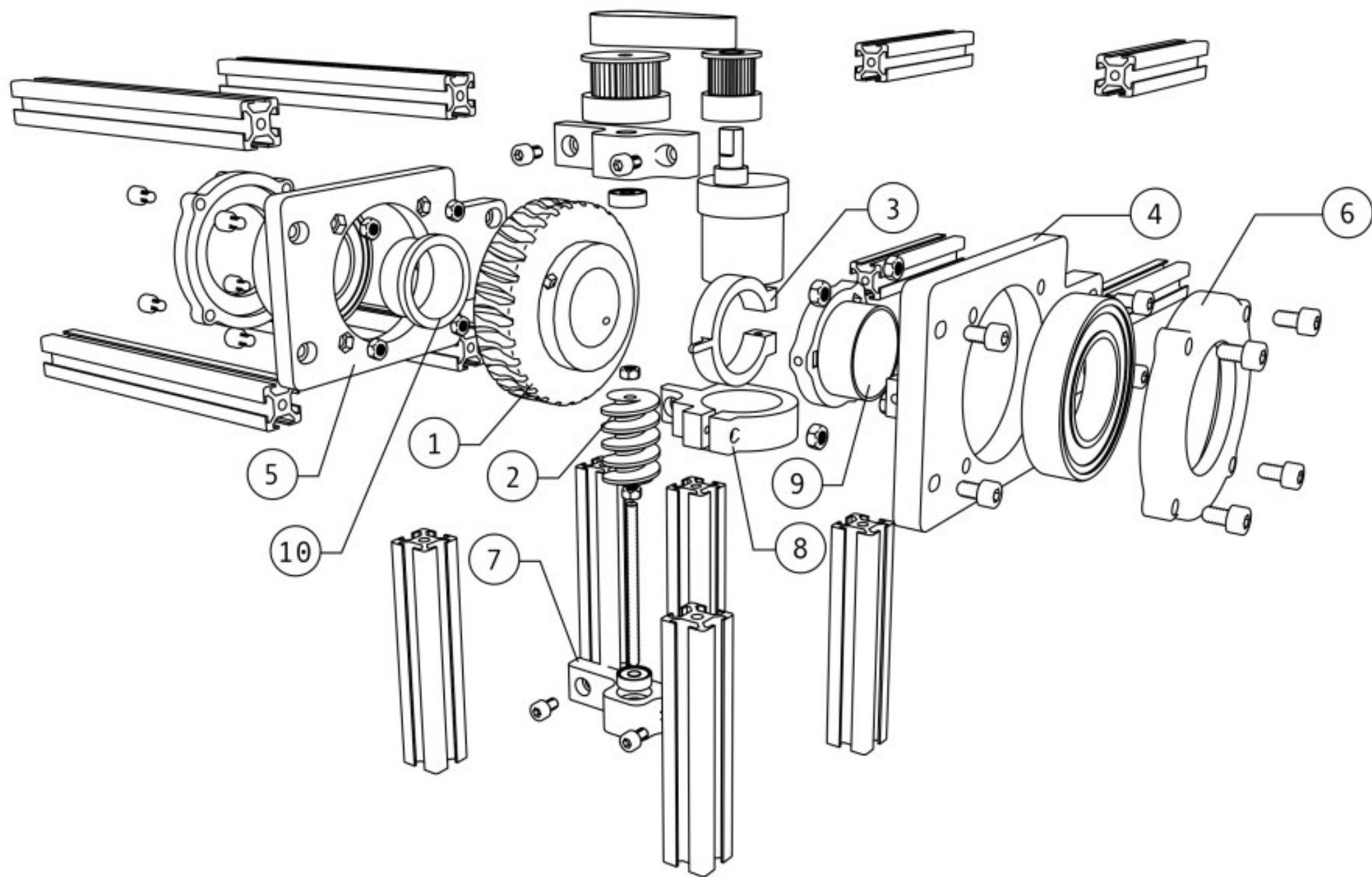
REV

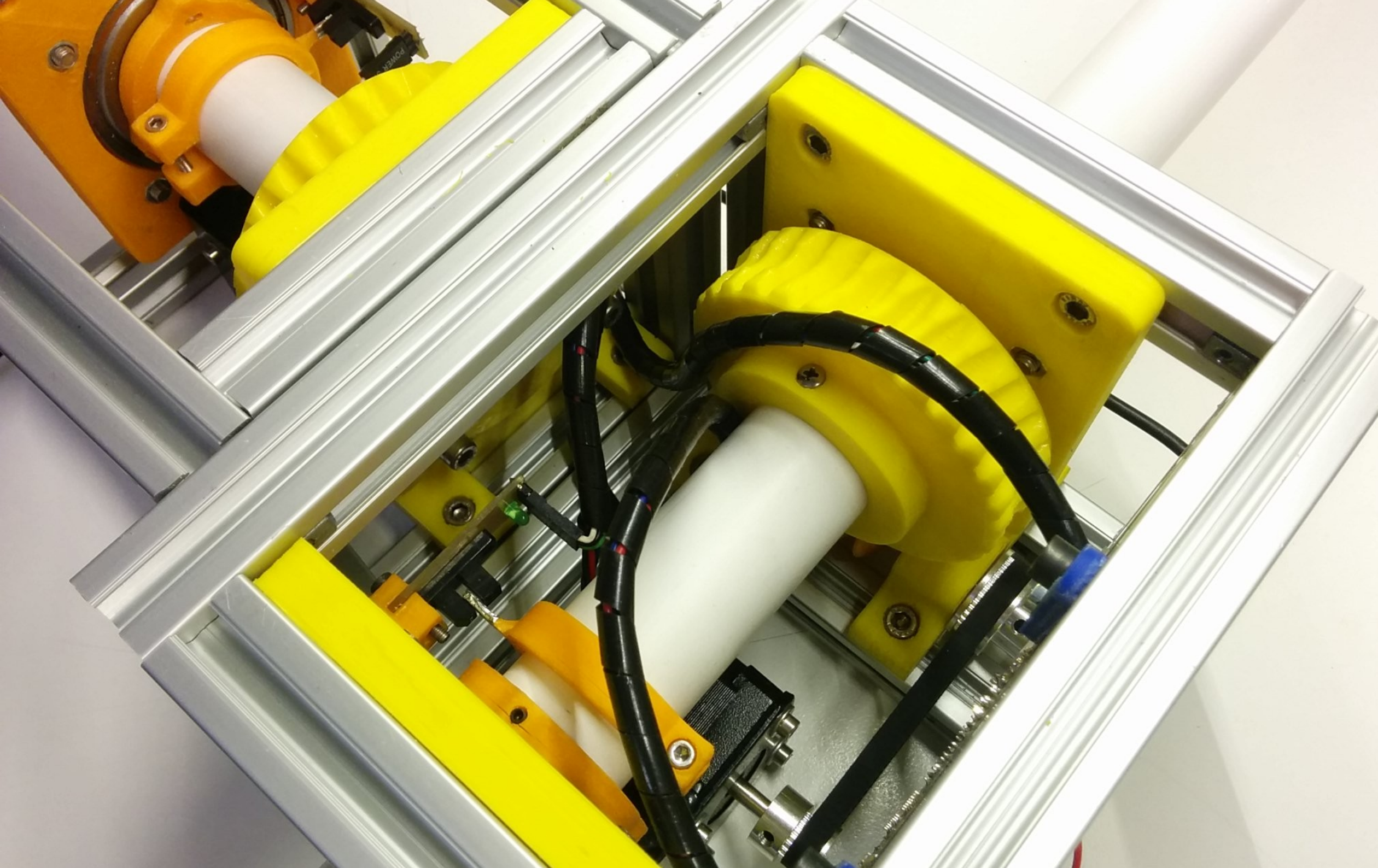
A

MATERIAL

-









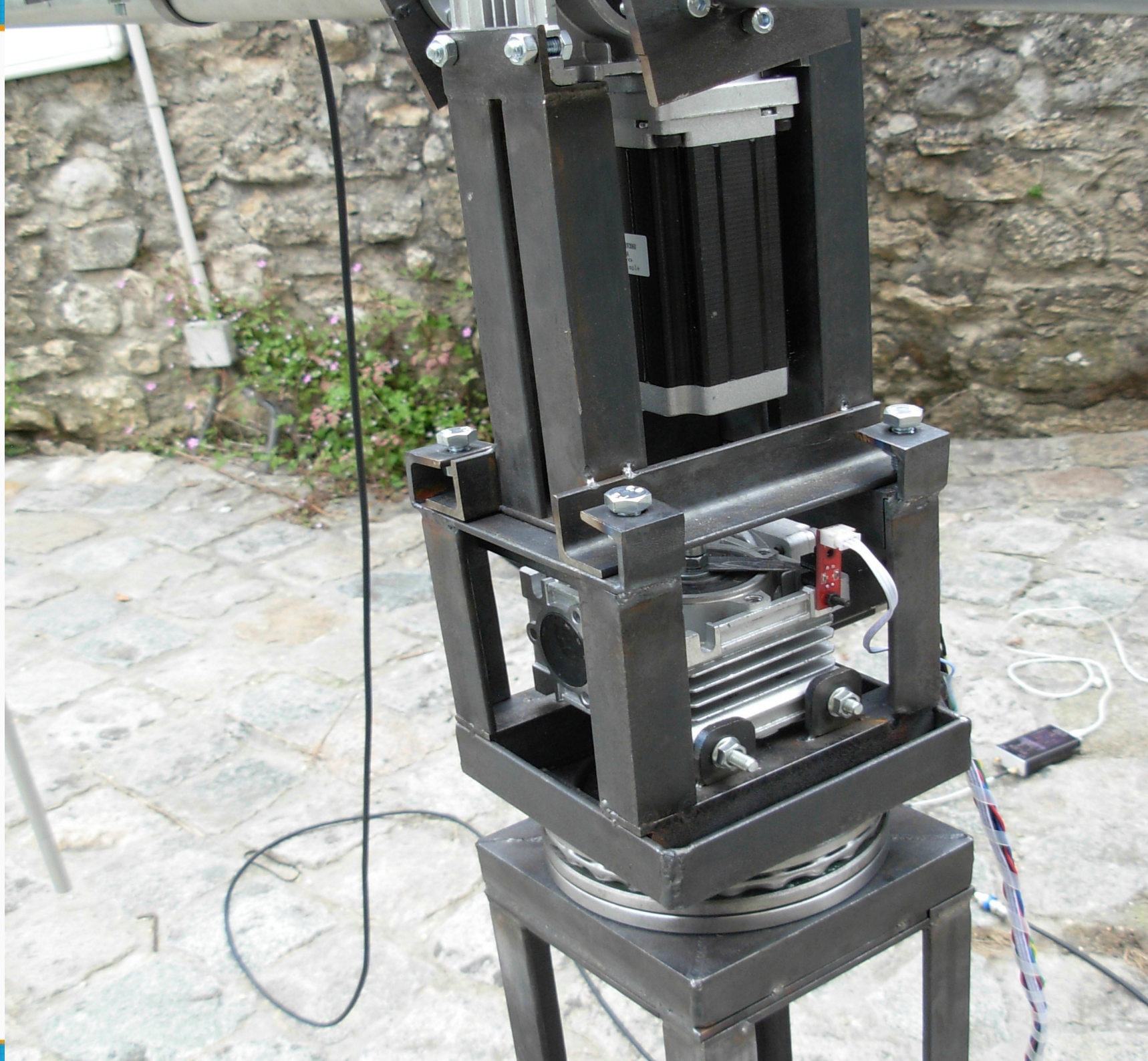






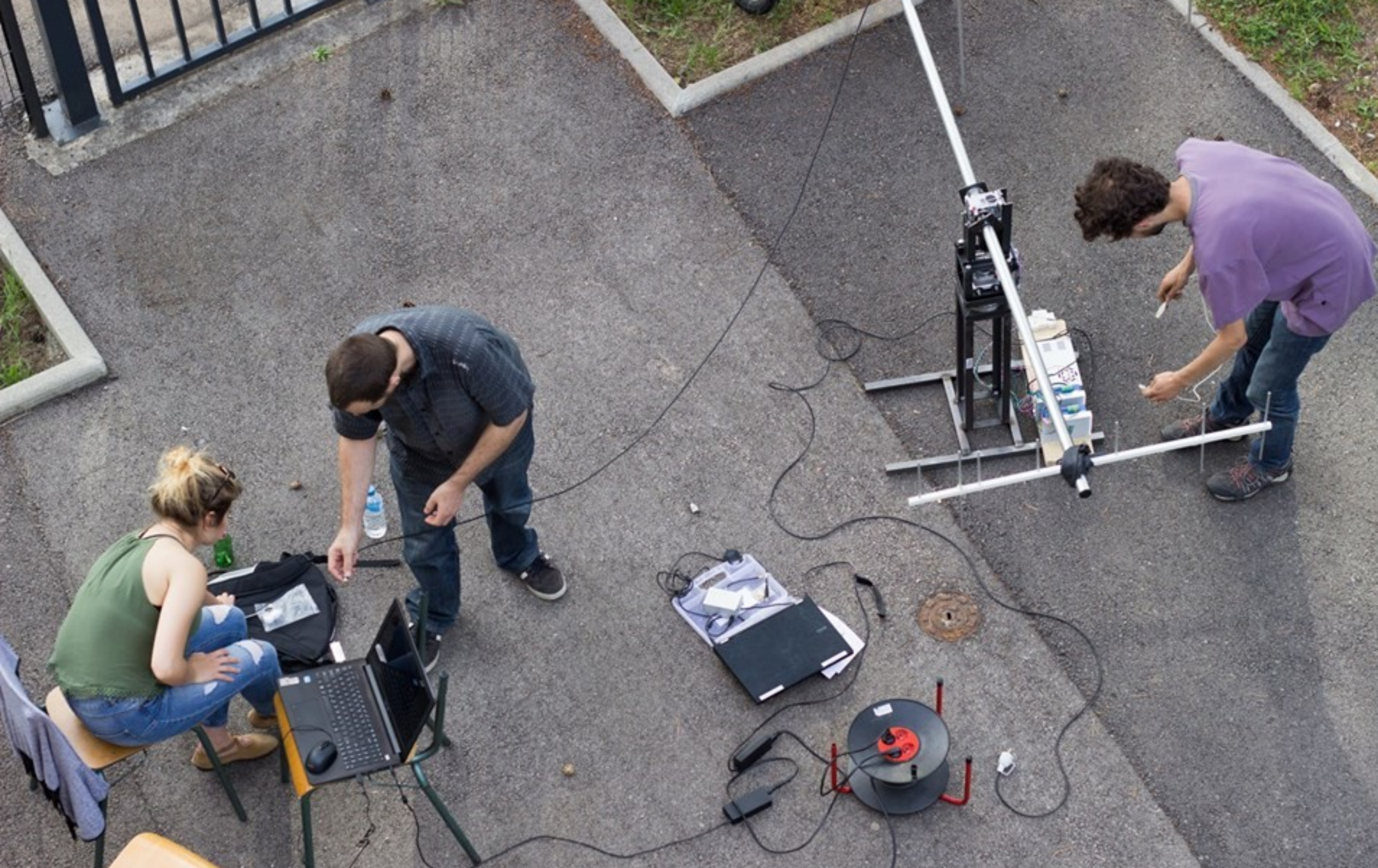
Un exemple d'évolutions possibles

**motorisation/nouvelles bandes de
fréquences**







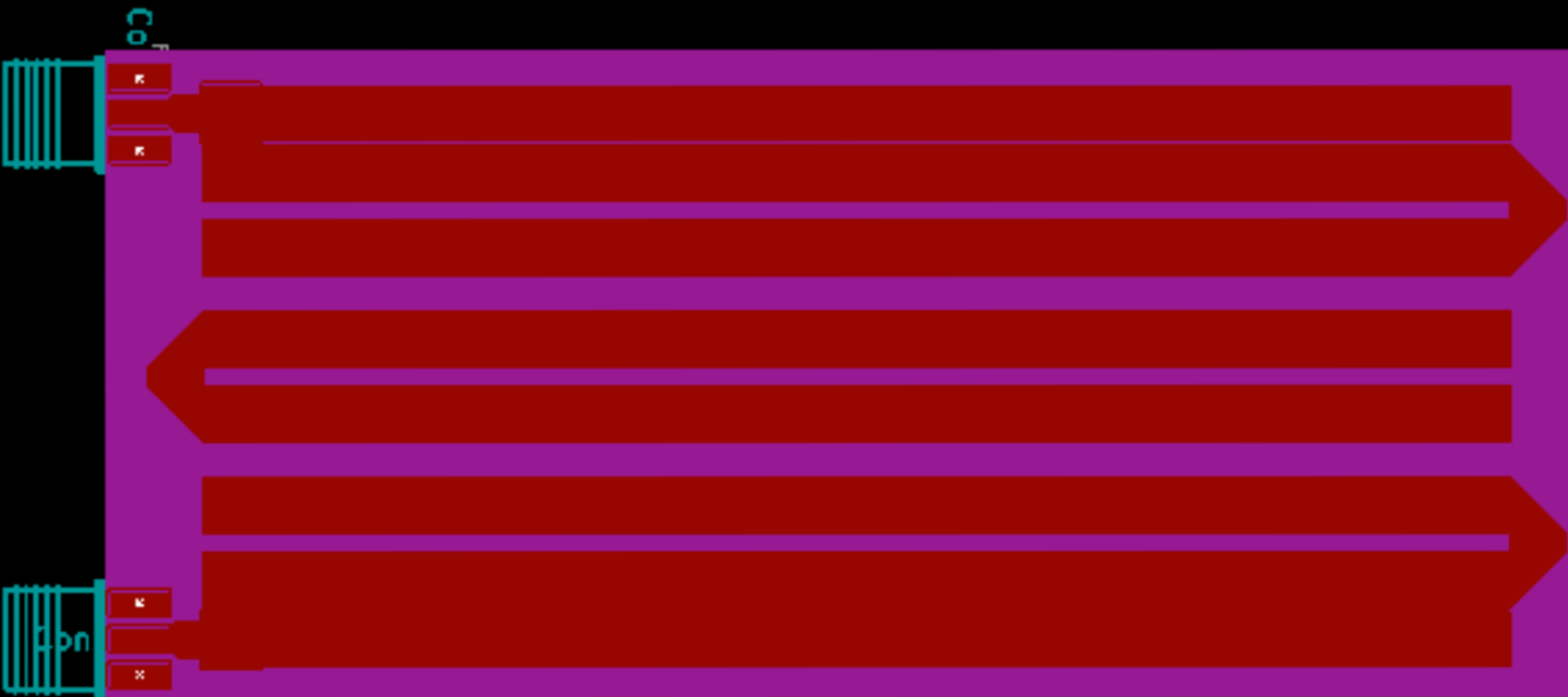


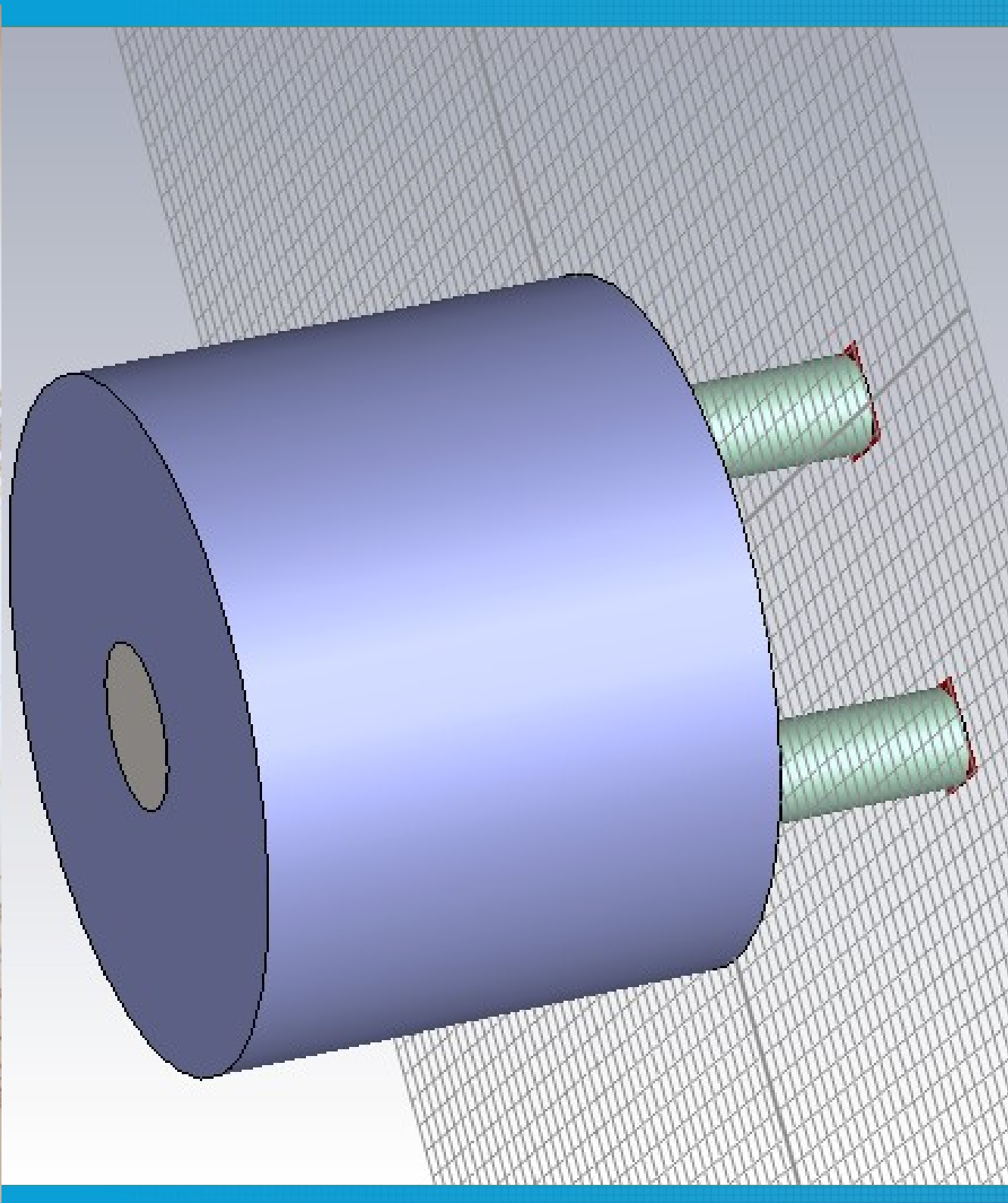
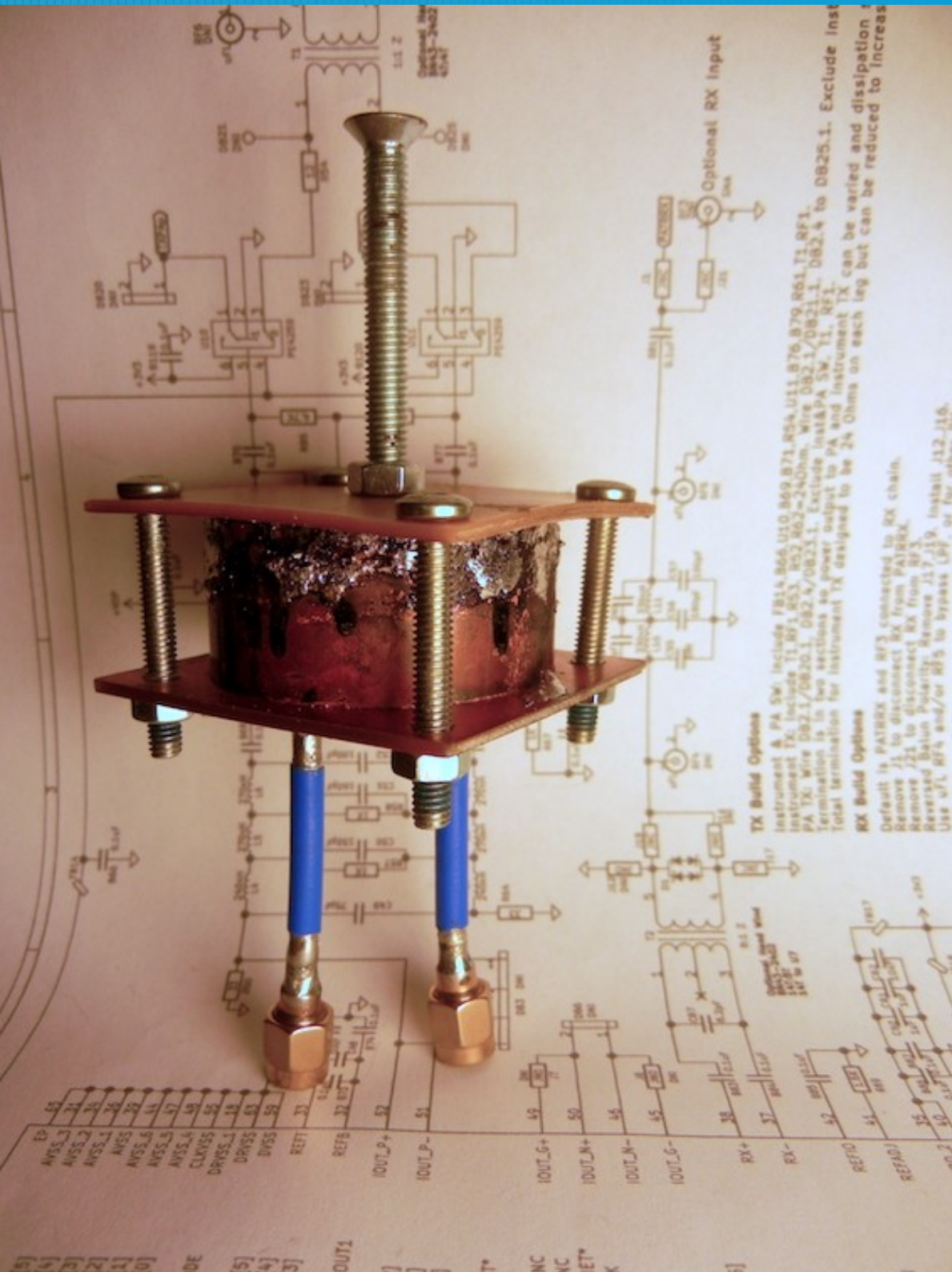




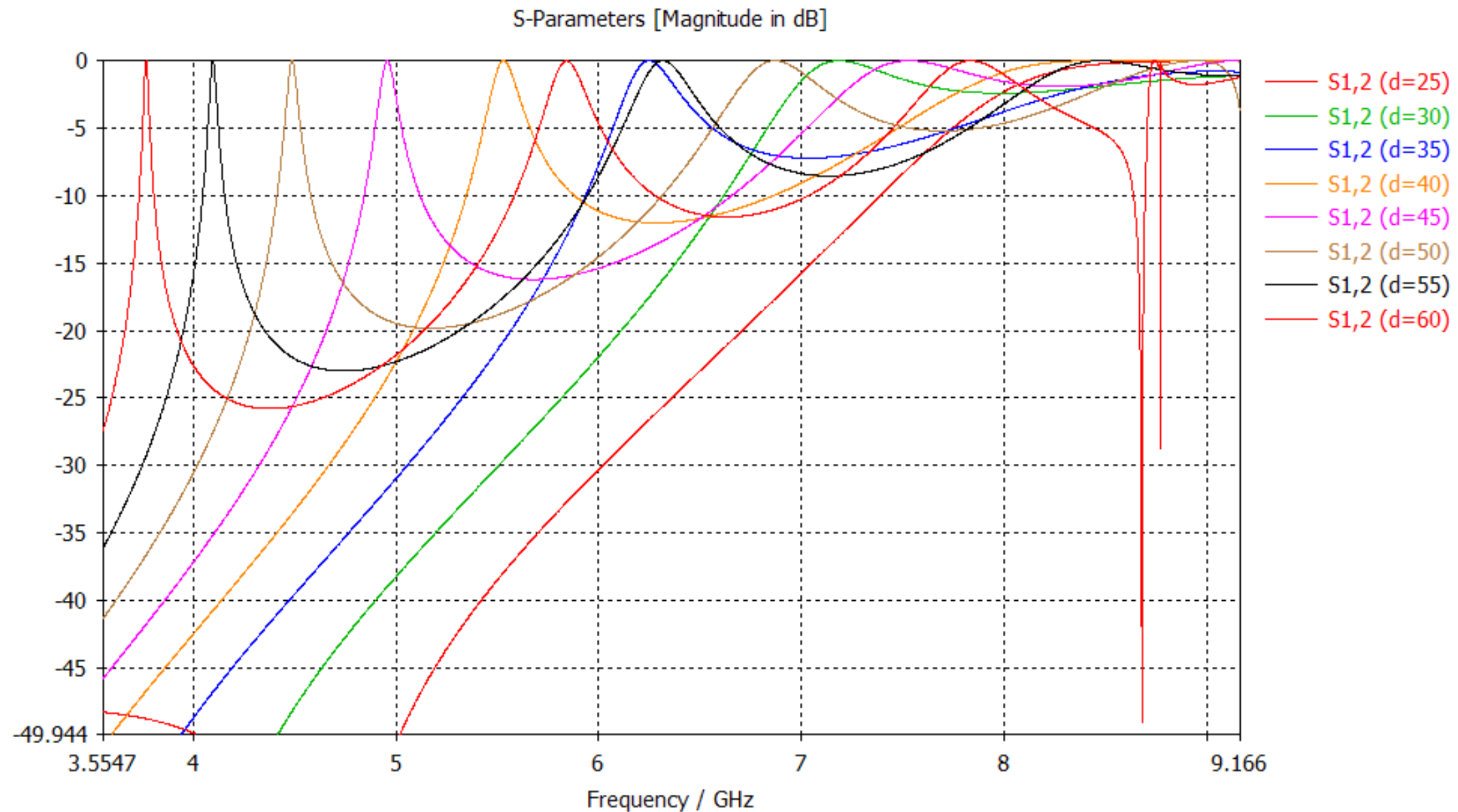




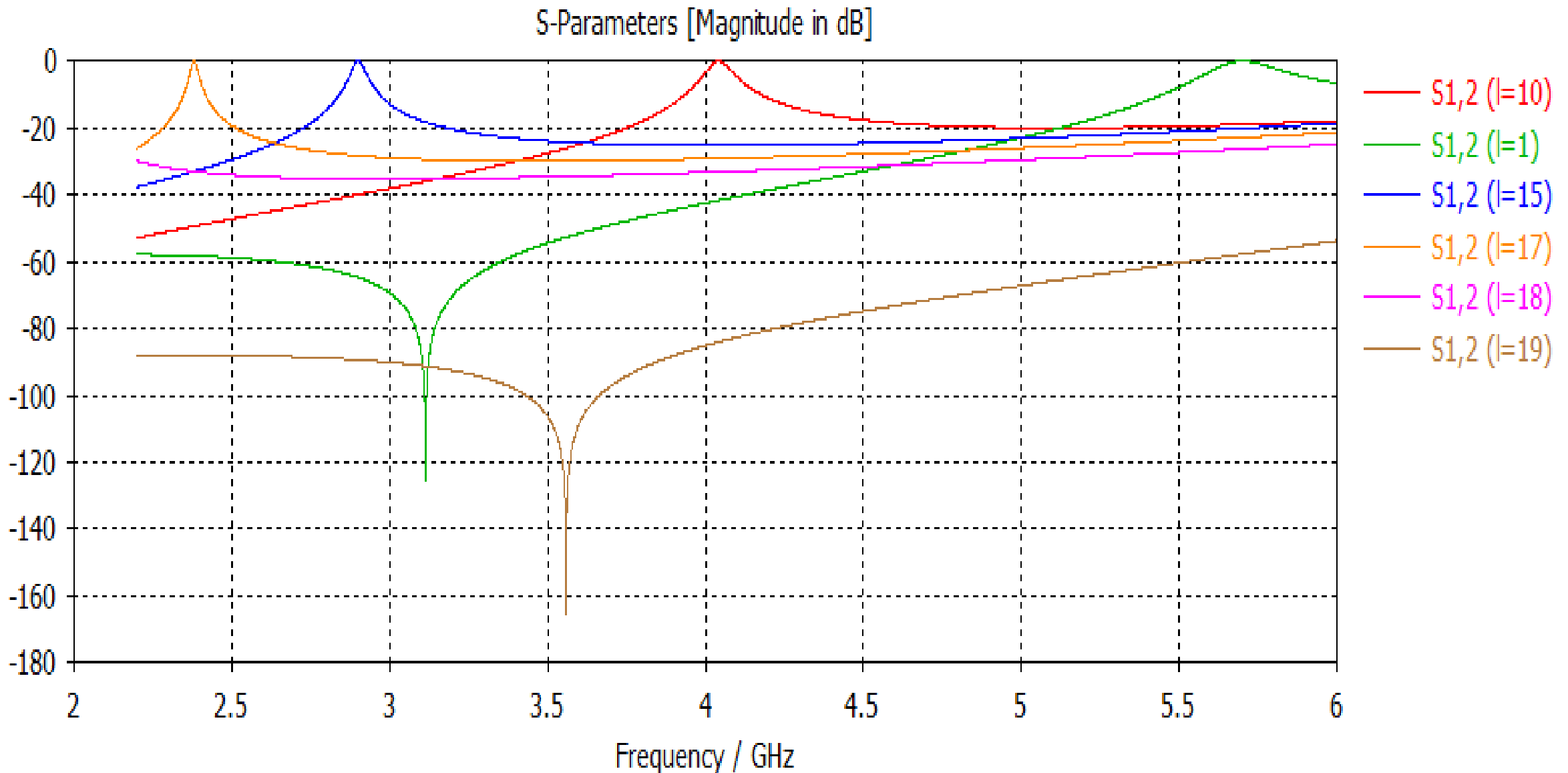




Variation du diamètre



Variation de la taille de la vis





Perspectives

- Workshop Gnuradio
- Workshop SDR
- Workshop fabrication d'antenne/filtre
- Une GS pour l'asso ?
- Fabriquez une GS et rejoignez le réseau SATNOGS