

Libre Space Foundation



SLIDE 1

Libre Space Foundation



SLIDE A



SatNOGS

SatNOGS – State of the Union

by Alfredos (fredy) Damkalis

SatNOGS Project

A quick overview



SatNOGS Project – A quick overview



SatNOGS

An open source global network
of satellite ground stations
focused on automating ground
segment operations.



SatNOGS Project – An overview

Ground Segment Operations:

- Telemetry and TC&C capabilities
 - VHF, UHF, L-Band, S-Band
 - Telemetry and data visualization
- Observation Artifacts Collection
 - Data from satellites
 - Waterfall(spectrogram), audio and IQ data
- Orbit determination
- Orbital data generation
- Satellite identification
- Record of frequency violations

SatNOGS Project – A quick overview

An Open Source Stack:

- Software projects
- Hardware projects
- Services
- Collection of Data

SatNOGS Project – A quick overview

An Open Source Stack:

- Software projects
- Hardware projects
- Services
- Collection of Data

Contributors:

- Universities
- Organizations
- Space Agencies
- Satellite Teams/Missions
- The Radio Amateur Community
- Scientists
- Engineers
- Researchers
- Space Enthusiasts
- Individuals

SatNOGS Project – A quick overview

Ground Station:

- Control software (satnogs-client)
- Radio software (gr-satnogs & satnogs-flowgraphs)
- Hardware components

Web & other Services:

- Network (satnogs-network)
- DB (satnogs-db)
- Decoders (satnogs-decoders)
- Grafana dashboards

Operations:

- Observations scheduling
- Satellites identification
- Orbits determination
- Orbital data (TLE) generation

Ground Station – satnogs-client

Control Software:

- Receive Jobs from SatNOGS Network
- Performs Observations
- Uploads Observations Artifacts to SatNOGS Network & SatNOGS DB

Ground Station – satnogs-client

Last year:

- Transition to docker containers architecture
- Bug fixes & maintenance

Future:

- Add missing features in docker containers architecture
- New interfaces for radio control and Network communication
- Support SatNOGS Network based configuration
- Changes in Doppler shift compensation
- Add graphical user interface (GUI)
- Support TX to satellites

Ground Station – gr-satnogs & satnogs-flowgraphs

Radio Software:

- Responsible for processing, demodulating and/or decoding of received signals based on GNU Radio
- Produces observations artifacts (spectrogram, audio, data frames, IQ data)

Ground Station – gr-satnogs & satnogs-flowgraphs

Last year:

- Transition to GNU Radio 3.10
- Transition to docker containers architecture
- New interface for radio control
- New interface for sharing observation artifacts
- Bug fixes and maintenance

Future:

- Update to latest GNU Radio
- On-the-fly flowgraphs based on satellite transmitter parameters
- Improve current & support new modes/modulations
- Improve interfaces for radio control and artifacts sharing
- Support TX to satellites

Ground Station – Hardware components

Hardware components:

- Antennas
- Rotators
- Electronic components
(LNA, filter, multiplexer etc)
- Station kits

Last year:

- SatNOGS Kit development
- Development and showcasing of stations by our contributors (e.g. S-band stations)



Future:

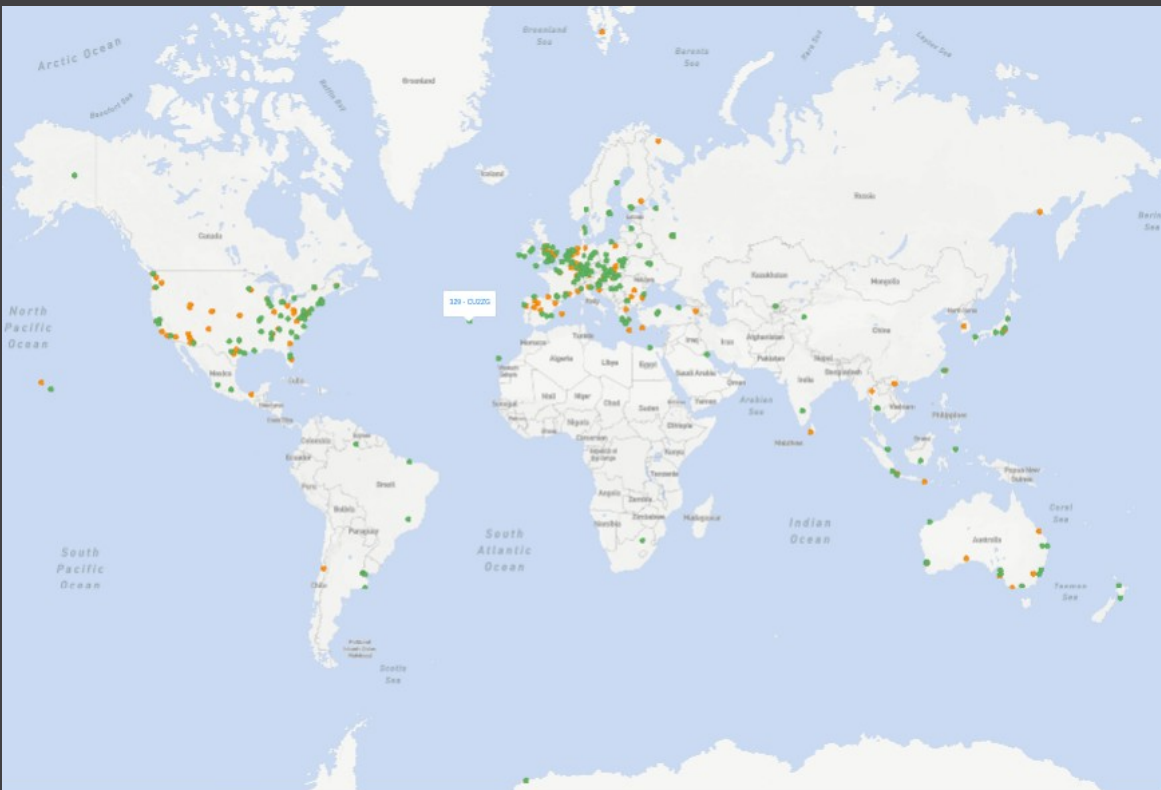
- More development, documentation, testing and experimentation with hardware components



Web & Other Services – satnogs-network

SatNOGS Network:

- Stations management
- Observations scheduling
- Store, display & rate observations artifacts



Web & Other Services – satnogs-network

Last year:

- Transition from NORAD ID to SatNOGS Satellite ID
- Performance improvements, bug fixes & maintenance
- UI/UX improvements

Future:

- Support multi-rating of observations artifacts
- Transition from spectrogram image artifact (waterfall) to spectrogram data artifact
- Automated scheduling with priority lists
- Improve API & API client
- Improve statistics UI/UX
- Improve user documentation

Web & Other Services – satnogs-network

Current Data	Last Year
~290 Online Stations	~270
~180 Testing Stations	~165
~5550 Observations/day	~5400
~43000 Demodulated Frames/Day	~69000

Web & Other Services – satnogs-db

SatNOGS DB:

- Crowded-sourced database for satellites & transmissions
- Observation artifacts storage
- Orbital data (TLE) storage

The screenshot displays the SatNOGS DB website. On the left is a dark sidebar with navigation links: Home, About, All Satellites, All Transmitters, All Launches, and Statistics. Below these are SatNOGS Links and version information (1.714-gd5952a.dirty, Backend Version: 1.001.1, © 2014-2023 Libre Space Foundation). The main content area is titled 'Welcome to SatNOGS DB' and features four columns of data cards. Each card represents a satellite or transmission, showing its name, ID, frequency, date, and a small image of the satellite or ground station. The columns are: 'New Satellites', 'Satellites close to decaying', 'Latest Data', and 'Recent Contributors'. The 'Recent Contributors' column lists various ground stations and their frame counts.

Section	Item	ID	Freq	Date	Notes
New Satellites	CyBEEsat	#UQTL-8834-3656-1268-4500	0	No Data	
	PRSC-S1	2025-164A			
	DIHG-1236-7880-5134-7678	#DIHG-1236-7880-5134-7678	1	No Data	
	KNACKSAT-2	#SCWJ-8858-4107-1493-6553	0	No Data	
	GXIBA-1	#CAOL-2416-3135-3240-8425	0	No Data	
Satellites close to decaying	KAIDUN-1	#BDQK-1293-6559-5114-9974	24582	2025-10-24 09:28:36	Venables_Shed_UHF
	Tianqi 3	Tao Xingzhi	0	No Data	
	Mirata	2017-03C	0	No Data	
	IKJO	3978-3757-3156-8710	0	No Data	
	FACSAT-2	2023-054AD, Chibiriquete	0	No Data	
Latest Data	BEEASAT	#XFUT-4878-1223-5887-3249	1243751	2025-10-24 09:28:00	ISAE Supaero UHF
	Connecta T1.1	#RLGA-3050-8635-4193-2562	118961	2025-10-24 23:57:04	SONIKS: Station_71
	IRIS-F1	#POUZ-9178-5050-3640-4549	120449	2025-10-24 23:45:35	SONIKS: Station_71
	PROITERES	#NHVG-4421-1523-2154-0492	518	2025-10-25 00:26:46	Drachten
	Connecta T-11	#QJFJ-4748-4397-6565-6149	17010	2025-10-25 00:25:44	DEOS_RALF
Recent Contributors	ISAE Supaero UHF	96287 frames			
	EU1XX	10994 frames			
	SONIKS: Station_1	5500 frames			
	Piszkesteto UHF	4867 frames			
	UXSUL	3949 frames			

Web & Other Services – satnogs-db

Last year:

- Restructure & documentation for satellite and transmissions “suggestions” functionality
- Performance improvements, bug fixes & maintenance
- UI/UX improvements

Future:

- New API endpoints for data/frames reception
- More detailed transmission parameters
- Crowed-sourced launches database and related UI/UX
- Improve API & API client
- Improve statistics UI/UX
- Improve user documentation

Web & Other Services – satnogs-db

Current Data	Last Year
2398 Satellites	1867 Satellites
2161 Satellite suggestions	2443 Satellite suggestions
4355 Transmitters	3391 Transmitters
1835 Transmitter suggestions	2113 Transmitter suggestions
~290 million frames by ~5116 stations (Network & 3rd party)	~239 million frames by ~4693 stations (Network & 3rd party)

Web & Other Services – satnogs-decoders

Decoders Service:

- Describe the satellite frames encoding in katai.io structure
- Automatically produced decoder scripts based on the structure descriptions

Web & Other Services – satnogs-decoders

Last year:

- 27 new decoders
- Improvements & bug fixes on existing decoders
- More people and satellite teams involved in the process
- Decoded ~43% of all DB frames

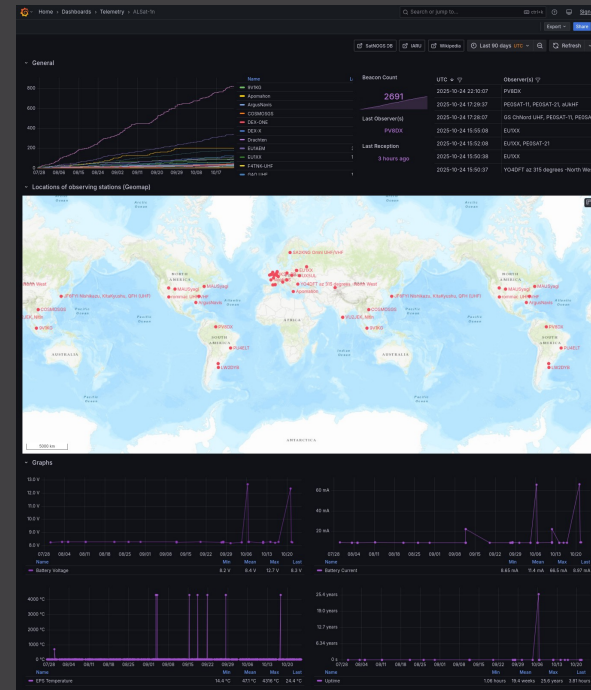
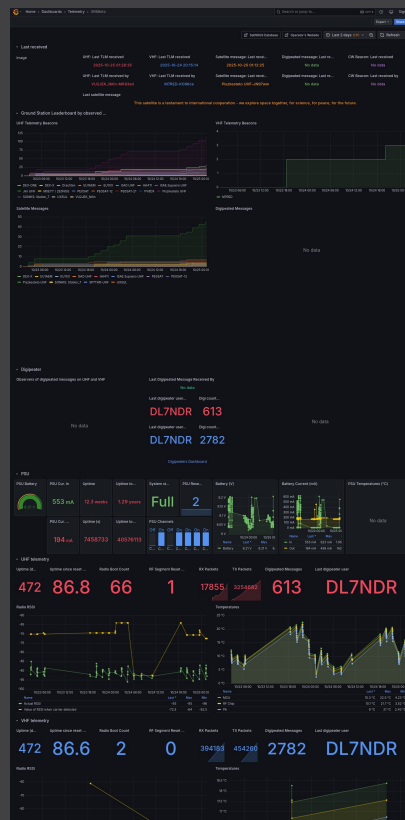
Future:

- New Decoders
- Involve more people and satellite teams
- Improve process and documentation

Web & Other Services – Grafana Dashboards

Dashboards Service:

- Display/Visualize decoded data from satellite transmissions in Grafana dashboards



Web & Other Services – Grafana Dashboards

Last year:

- New dashboards created by the community and satellite teams, some before deployment
- Dashboards use by satellite teams for mission analysis
- Dashboards use for radio amateurs services/needs
- Grafana software update

Future:

- New Dashboards
- Involve more people and satellite teams
- Keep Grafana updated
- Experiment with Grafana features (e.g. alerts)

Operations – Observations Scheduling

Last year:

- Improvement on external auto-scheduler software
- Scheduling for several special events (e.g. ARISS)
- Scheduling for 15+ satellites deployments
- Support satellite teams after public requests

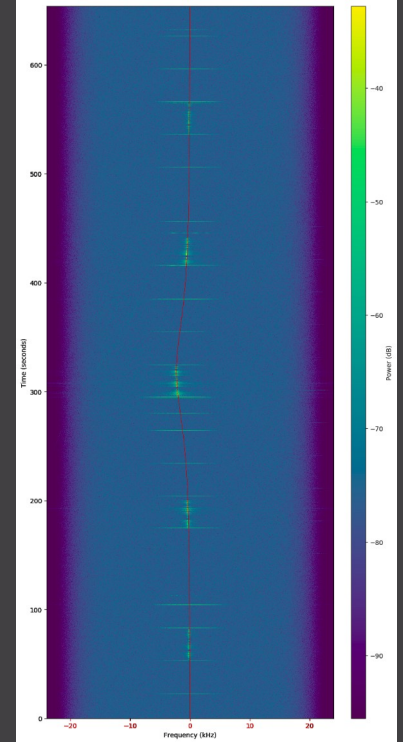
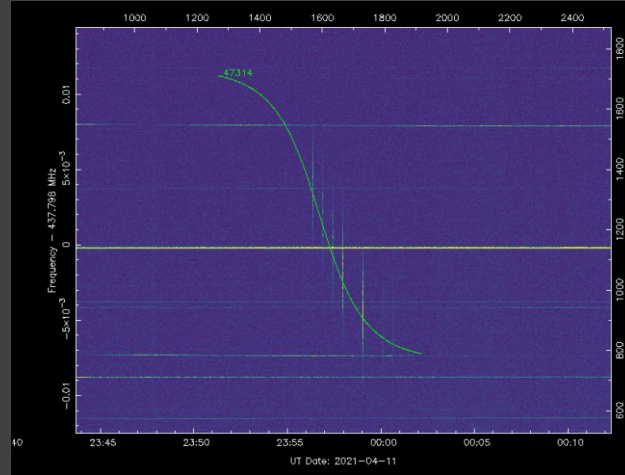
Future:

- Integrate automated scheduling in SatNOGS Network
- Continue support special events & scheduling requests
- Continue support new satellite deployments

Operations – Satellite Identifications

Using Strf Tools & Ikhnos:

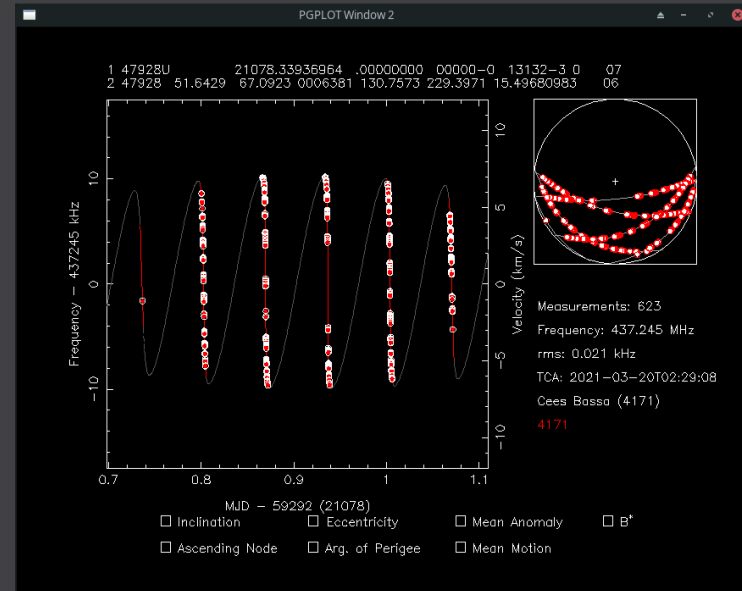
- Identified more than 220+ Satellites
- Spot mis-identifications



Operations – Orbit Determination & Orbital Data Generation

Using SatNOGS Network observations and strf tools:

- Generated more than 300 TLE sets the last year (1k+ in total)
- Generate preliminary TLE sets
- Generate TLE sets the first hours after deployment and hours before re-entry



**A sincere and special
THANK YOU!
to the SatNOGS Community**

SatNOGS – Join us!

Web Sites: <https://satnogs.org> & <https://libre.space>

Wiki: <https://wiki.satnogs.org>

Community Forum: <https://community.libre.space>

Repos: <https://gitlab.com/librespacefoundation/satnogs>

Contact me: fredy@libre.space

Thank you!

