Libre Space Foundation

SLIDE 1

Libre Space Foundation

SLIDE A

SatNOGS

Open Source Ground Station Network

by Alfredos Damkalis

What is SatNOGS Project?

- A network of ground stations
  - Open Source (Hardware, Software, Data)
  - Modular Design
- Automate Satellite Communications

What is SatNOGS Project?

Ground Station

- Client
- gr-satnogs
- Rotator

Web and other Services:

- Network
- DB
- Decoders
- Dashboard

Ground Station - SatNOGS Client

- Handles Ground Station – SatNOGS Network communication
- Performs and co-ordinates observations
- Installation from source, python package or ansible script in Linux.
- Reference setup uses ansible script coming with ready-to-flash Raspberry Pi Image for RPi3 or RPi4

Ground Station - SatNOGS Client

The last year:

- Added support for new gr-satnogs scripts
- Several bug fixes
- Improved codebase
- Release of v1.0

Future:

- Continue implementation of the new architecture
- Support transmission under SatNOGS COMMS project

Ground Station - gr-satnogs

- SatNOGS GNU Radio Out-Of-Tree Module
- Process and demodulate received signal
- Installation from source, package or ansible script in Linux.
- Reference setup uses ansible script coming with ready-to-flash Raspberry Pi Image for RPi3 or RPi4

Ground Station - gr-satnogs

Modes supported by gr-satnogs flowgraphs:

- CW
- APT
- DUV
- APRS1200 and APRS9600
- IEEE 802.15.4
- BPSK(1200-19200)
- FSK(1200-19200)
- MSK(1200-19200)
- AFSK(1200-9600)

Ground Station - gr-satnogs

The last year:

- Improved flowgraphs performance
- Added new flowgraphs
- Moved packaging to Open Build Service
- Added gr-soapy support

Future:

- More improvements on flowgraphs performance
- Transition from gr-osmosdr to gr-soapy
- Support transmission under SatNOGS COMMS project
- Metadata support for data frames

Ground Station – SatNOGS Rotator

- Hardware and Firmware components of a Rotator
- Moves directional antennas to aim satellites passes
- Detailed documentation in wiki.satnogs.org

Ground Station – SatNOGS Rotator

- Azimuth – Elevation or X – Y Type
- 16NM continuous torque (5kg antenna load)
- 1 deg pointing accuracy
- 0.04 deg measurement accuracy
- RS485(EasyComm3) interface, 48V at 1A
- Weather-proof - Operational at 5-40 °C
- Electromagnetically Shielded
- Wind Sustained 29-38 km/h

Ground Station – SatNOGS Rotator

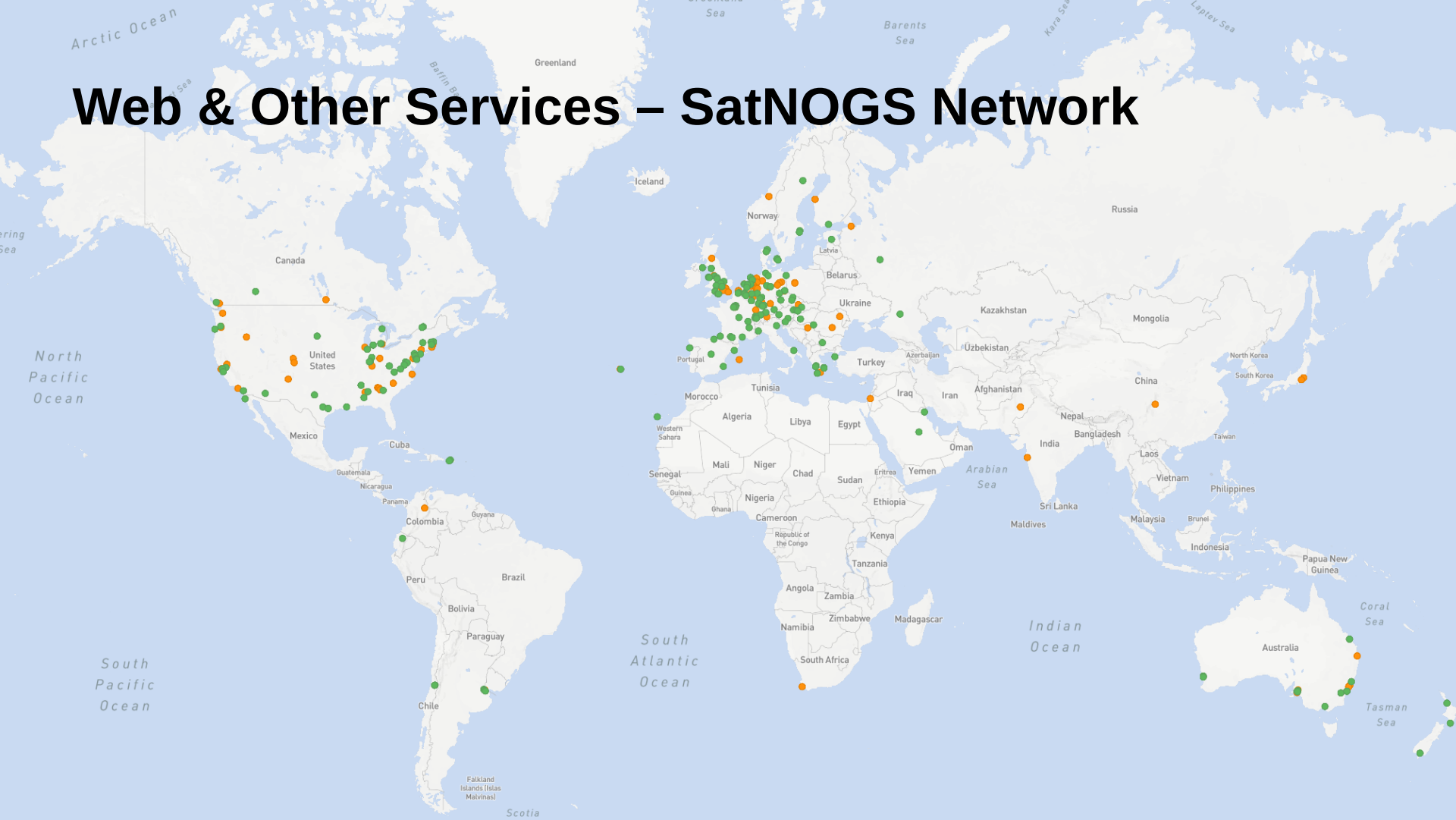
The last year:

- Release of v3.1
- Several fixes and improvements
- Extended Testing
- More users inside and outside SatNOGS Network

Future:

- Continue Testing and improvements
- Development of and updates on hardware components useful for ground stations, like diplexers, amplifiers and filters

Web & Other Services – SatNOGS Network

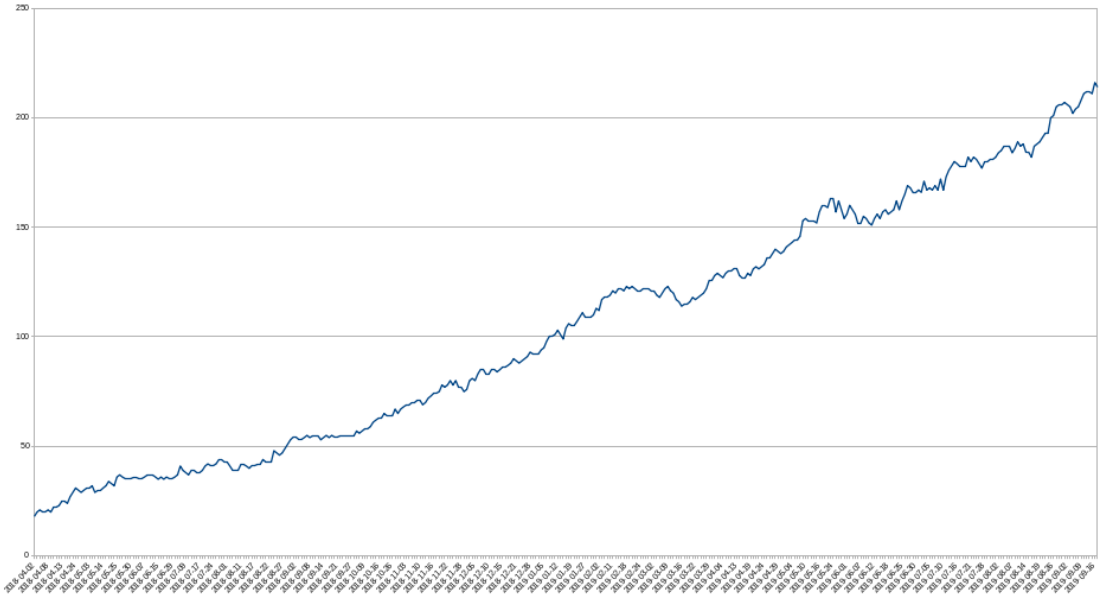


Web & Other Services – SatNOGS Network

- Network station management
- Station/Satellite scheduling
- Observation results collection and display

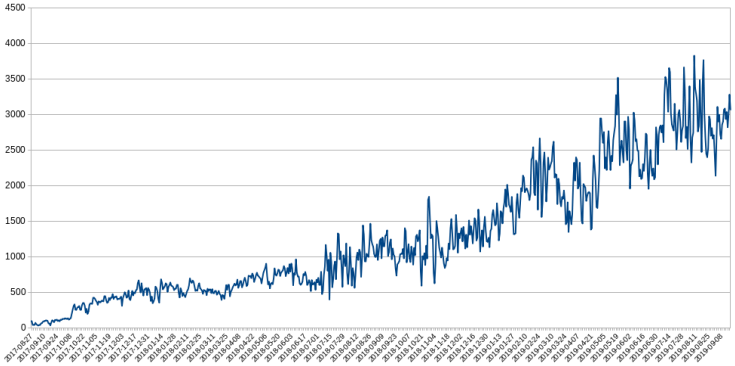
Web & Other Services – SatNOGS Network

- 220 Online Stations
- 110 Testing Stations

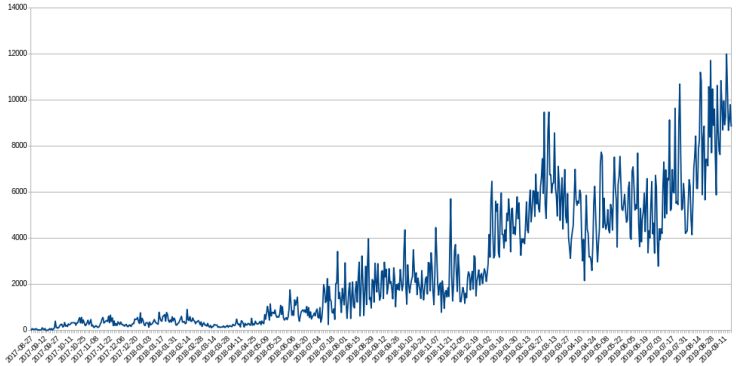


Web & Other Services – SatNOGS Network

~3000 Observations/Day

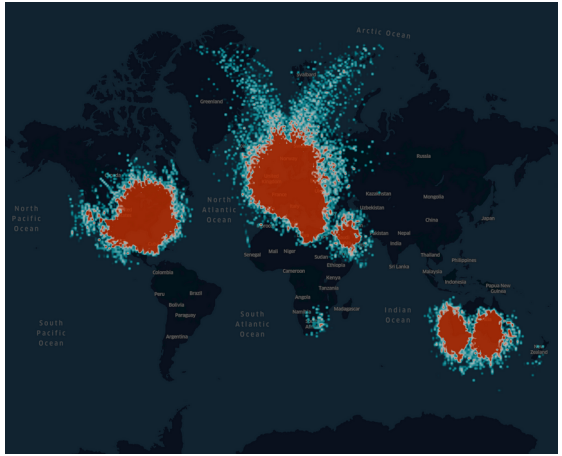


~9000 Demodulated Data/Day

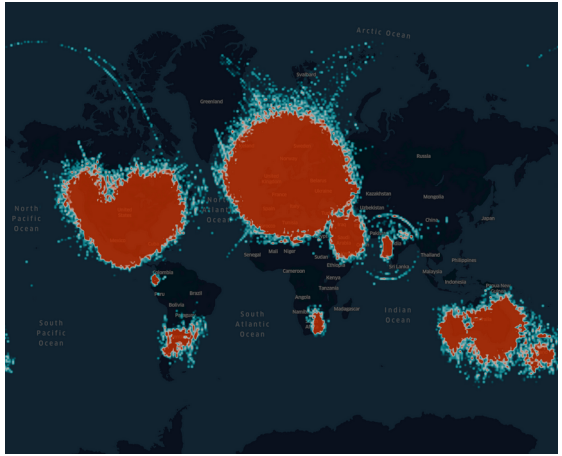


Web & Other Services – SatNOGS Network

From 2017-08 until 2018-09



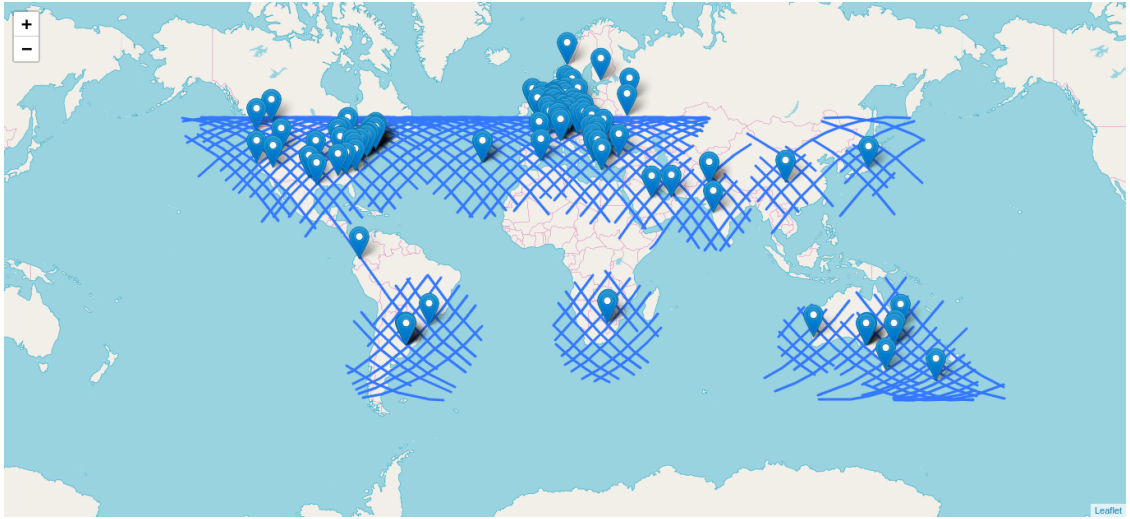
From 2018-09 until 2019-09



Web & Other Services – SatNOGS Network

ARISS – SSTV event April 2019:

- Total duration of the event:
  - 3d 34min 58s (announced ~3d)
- Total coverage (with or without decoded data):
  - 1d 2h 25min 52s
  - ~36.42% of the total event time
- Total coverage (with decoded data):
  - 8h 45min 26s
  - ~12.07% of the total event time
- Total time of observations (includes overlapped observations):
  - 7d 19h 9min 22s



Web & Other Services – SatNOGS Network

The last year:

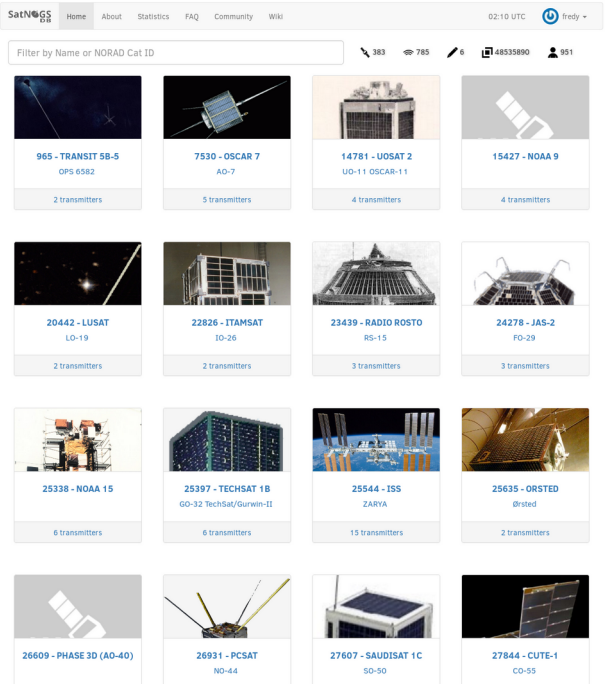
- Refactored Observation Scheduling
- Scheduling API
- Scheduling Automation
- Several fixes and performance improvements
- Reached 1 million observations!!!

Future:

- Move to Python 3 and Django 2
- Improve API
- Release API client
- Move from waterfall image to waterfall data
- Support transmission under SatNOGS COMMs project

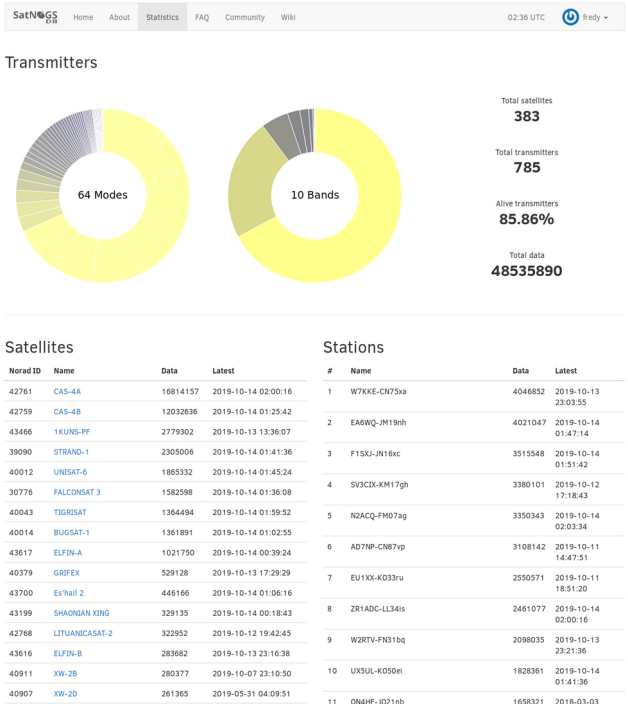
Web & Other Services – SatNOGS DB

- Crowd-sourced satellite/transmitters database
- Repository for collected telemetry and payload frames



Web & Other Services – SatNOGS DB

- 383 Satellites
- 785 Transmitters
- 654 Contributors collected more than 48.5 million frames
  - SatNOGS Network
  - DK3WN TLM Forwarder
  - Gr-satellites sids forwarder



Web & Other Services – SatNOGS DB

The last year:

- Moved to Python 3 and Django 2.x
- Improved codebase
- Several fixes and performance improvements

Future:

- Improve API
- Realease API Client
- Integrate MetaSat Schema
- Provide better statistics
- Improve and automate frames validation

Web & Other Services – SatNOGS Decoders

- Collection of kaitai.io structs
- Describe encoding of satellite dataframes
- Structs are used to generate python decoders

Web & Other Services – SatNOGS Decoders

Supported Decoders

- AAUSAT4
- ACRUX-1
- ARMADILLO
- AMSAT FOX DUV
- AX.25 frame decoder
- CAS-4A & CAS-4B
- CHOMPTT
- CubeBel-1
- Elfin-A & Elfin-B
- Entrysat
- Lightsail-2
- QBEE
- Siriussat-1 & Siriussat-2
- skCUBE
- Strand-1
- TBEX-A/TBEX-B
- Unisat-6

Web & Other Services – SatNOGS Decoders

The last year:

- New Decoders
- Improved codebase
- Several fixes and performance improvements

Future:

- More decoders to come
- Involve more people/satellite teams before their satellite deployment

Web & Other Services – SatNOGS Dashboards

- Collection of satellite dashboards in Grafana Environment
- Display/Visualize decoded data from satellite data frames

Web & Other Services – SatNOGS Dashboards

The last year:

- New Dashboards created by the community and satellite teams
- Satellite teams used dashboards for mission analysis

Future:

- More dashboards to come
- Involve more people/satellite teams before their satellite deployment

THANK YOU!

SatNOGS COMMUNITY

Join us

Wiki: https://wiki.satnogs.org

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

Community: https://community.libre.space

Thank you!