

# SatNOGS: Satellite Networked Ground Stations



Dan White, AD0CQ

**SatNOGS**  
NETWORK

**SatNOGS**  
DB

**SatNOGS**  
CLIENT

**SatNOGS**  
GROUND  
STATION

# LibreSpaceFoundation.org

## Athens, Greece

Ioannis Giannelos, Agisilaos Zissimatos,  
Eleytherios Kosmas, Dimitrios Papadeas,  
**Pierros Papadeas, Matthaios Papamathaiou,**  
Nikolaos Roussos, **Vasileios Tsiligiannis,**  
Ioannis Charitopoulos

[community.satnogs.org](http://community.satnogs.org)

Corey Shields KB9JHU, Bloomington IN

Some of you are here!

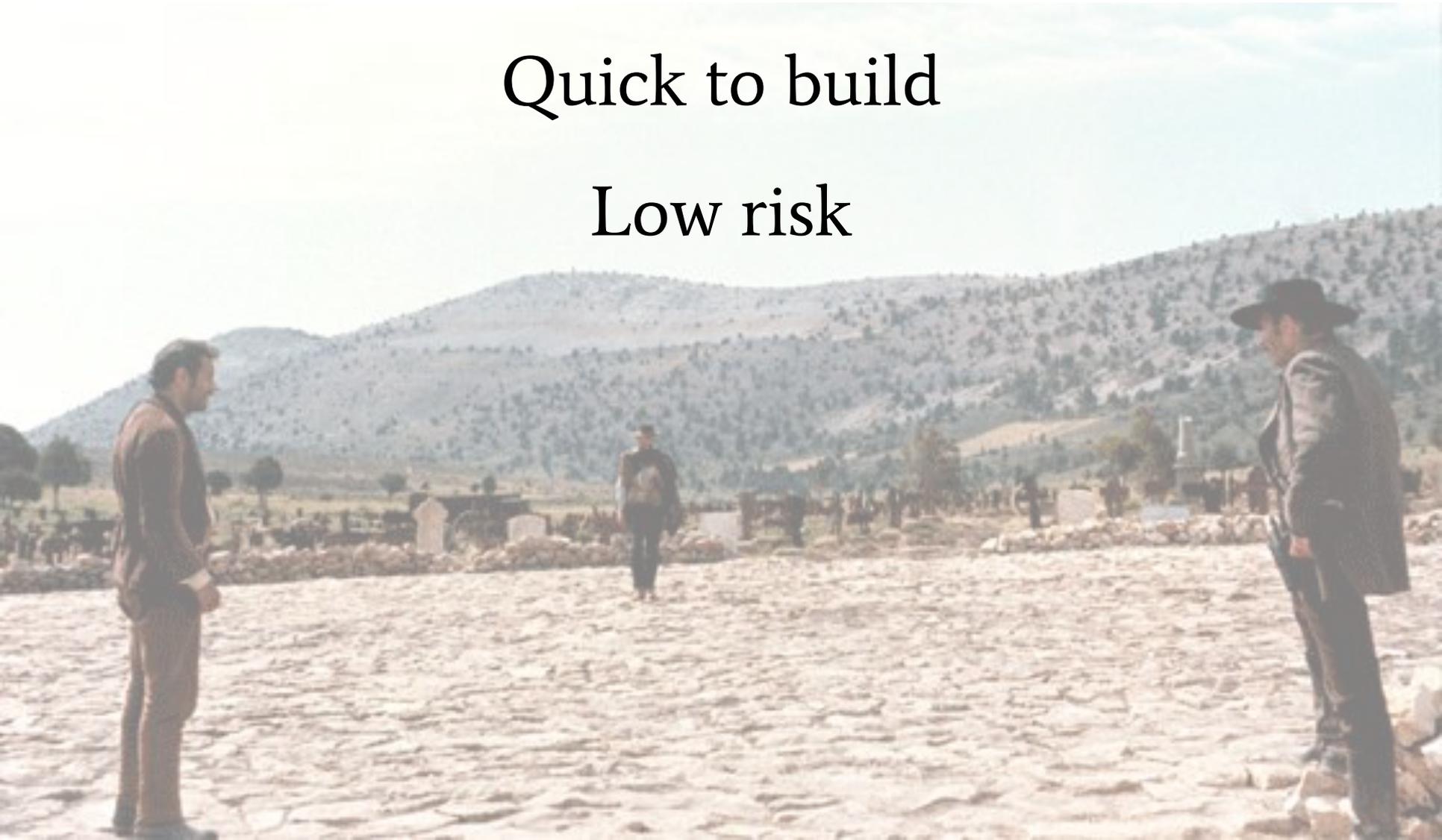


# CubeSats in Low Earth Orbit

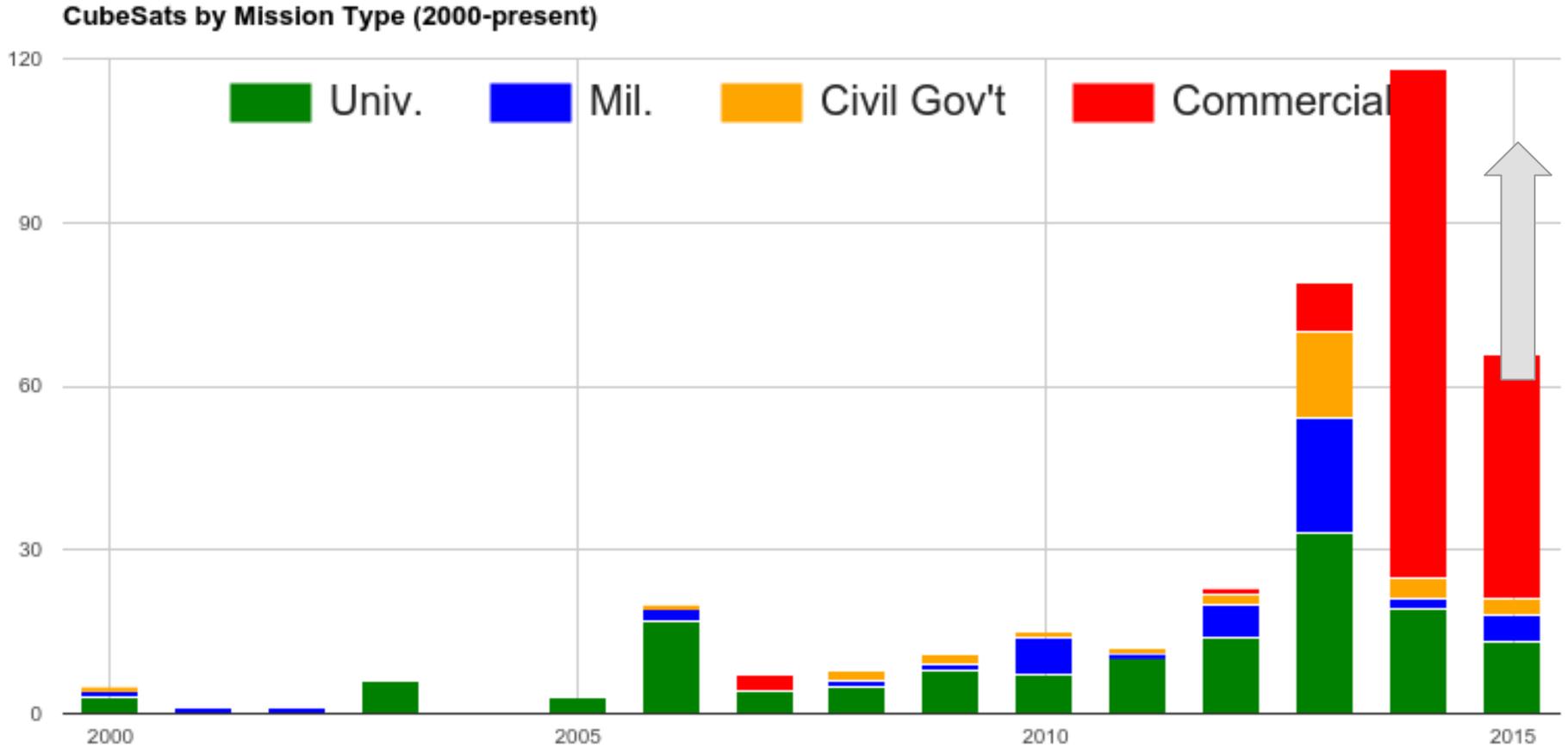
“Cheap” to launch -> rapidly decreasing

Quick to build

Low risk



# CubeSat launches to mid-2015



*[Chart created on Sat Oct 10 2015 using data from M. Swartwout]*

# CubeSats in Low Earth Orbit

10 minutes over horizon

3× / day

low power / bandwidth



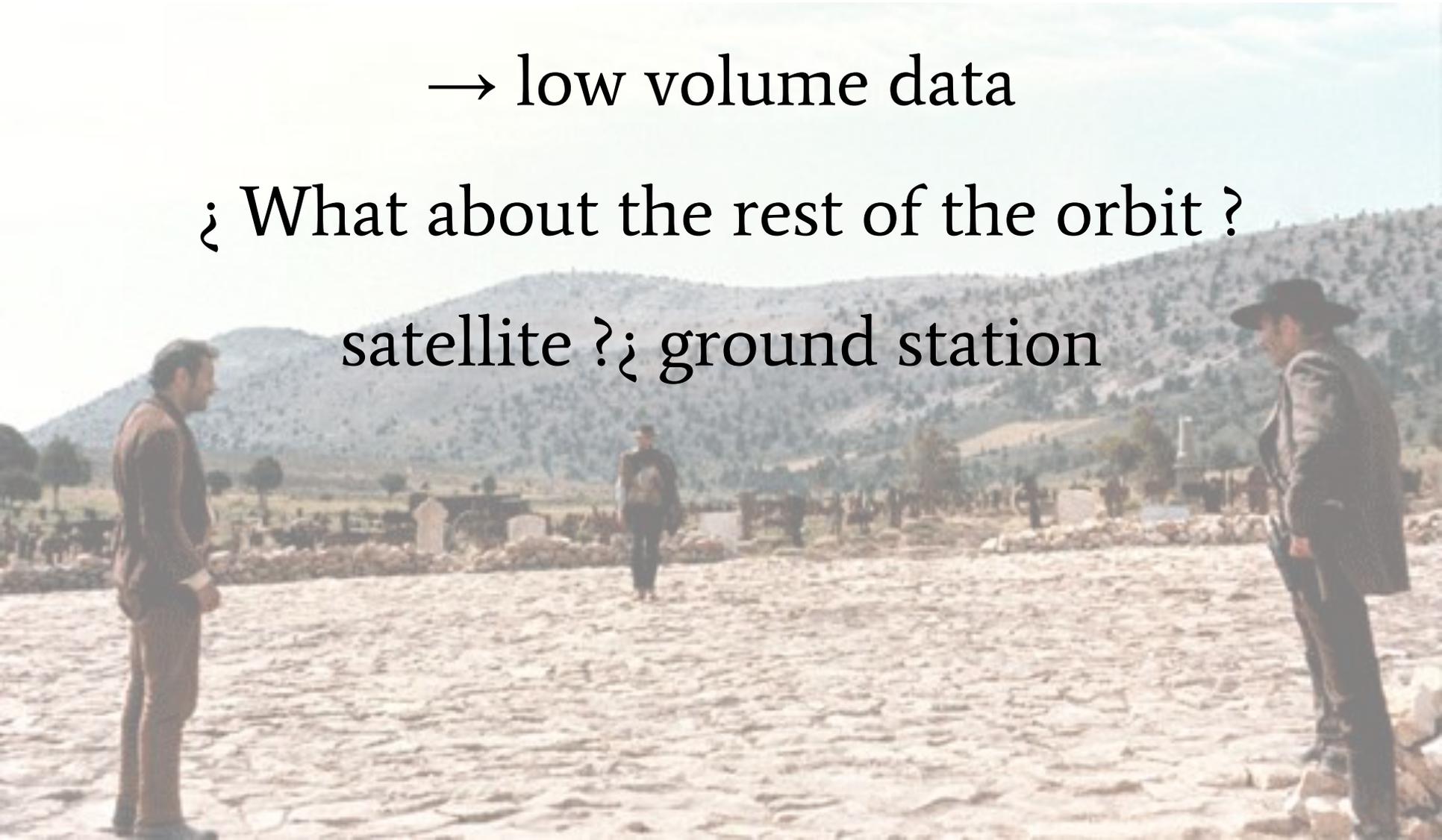
# CubeSats in Low Earth Orbit

this is 2% downlink duty cycle

→ low volume data

¿ What about the rest of the orbit ?

satellite ? ¿ ground station



By our powers combined, ...



from: [captainplanet.me](http://captainplanet.me)

# Group from: [hackerspace.gr](http://hackerspace.gr)

## 2014 Space Apps Challenge - People's Choice Finalist

dan : bash ? Konsole | SatNOGS | Space Apps Challenge - Google Chrome | Virtual Ground Station App ? Global Crowdsourcing of CubeSats | Space R

LOGIN

ABOUT

LOCATIONS

CHALLENGES



NEWS

AWARDS

PROJECTS



Hashtags:

#spacetech, #virtualgroundstationapp

Contact:

virtualgroundstationapp@spaceappschallenge.org

Tags:

# 2014 Hackaday Prize



# SatNOGS

THE HACKADAY PRIZE

Users

Global  
Management  
Network

Ground Stations

Satellites

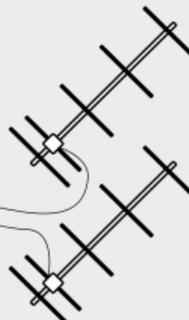
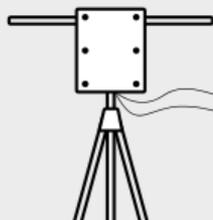
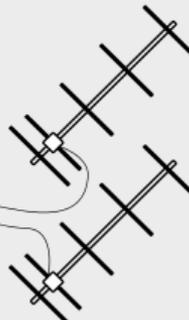
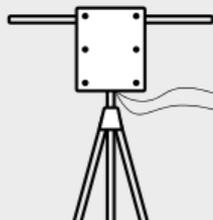
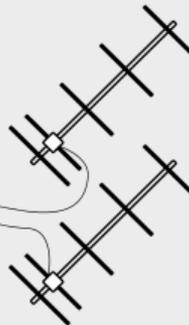
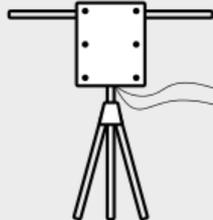


fig - Google Drive x 2015 DCC Presentati x 2015 ARRL / TAPR DCI x SatNOGS Network AP x SatNOGS x dan@valpo

← → ↻ 🏠 🔒 GitHub, Inc. [US] https://github.com/satnogs 🔑 ☆ 2d 🗨️ 🔄 on ☰

🔍 Search GitHub Pull requests Issues Gist 🔔 + 👤



## SatNOGS

Satellite Networked Open Ground Station

📍 Space 🌐 http://satnogs.org ✉ info@satnogs.org

📁 Repositories 🧑 People 10

Filters 🔽 🔍 Find a repository...

### satnogs-ansible

Shell ★ 3 📄 1

Ansible scripts for SatNOGS infra

Updated 3 hours ago

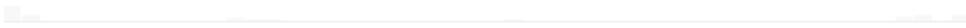


### satnogs-org

★ 3 📄 0

Organizational Repo for management

Updated a day ago



### satnogs-rotator

★ 36 📄 23

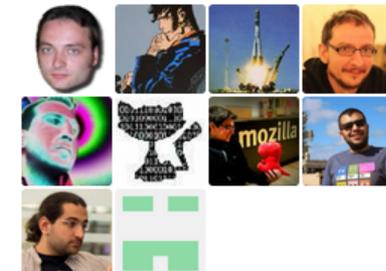
SatNOGS Rotator project

Updated 10 days ago



### People

10 >



# SatNOGS Network

SatNOGS NETWORK | Home | About | Observations | Ground Stations | Community | Sign Up | Log In

Ground stations swarm control, at your fingertips. [Join us!](#)

## Featured Ground Station



<https://network.satnogs.org/#scheduled>

## Latest Observations

## Scheduled Observations

ID	Satellite	Frequency	Encoding	Timeframe	Observer
21	JAS-2 (FO-29)	435.795 MHz	-	2015-09-27 20:15:00 2015-09-27 20:52:00	<a href="#">Pierros Papadeas</a>
20	ITUPSAT 1	437.325 MHz	CW	2015-09-27 19:00:00 2015-09-27 19:30:00	<a href="#">Pierros Papadeas</a>
19	JAS-2 (FO-29)	435.800 MHz	SSB	2015-09-27 18:30:00	<a href="#">Corey Shields</a>

# SatNOGS Network

Web server - Python: Django, requests, +more

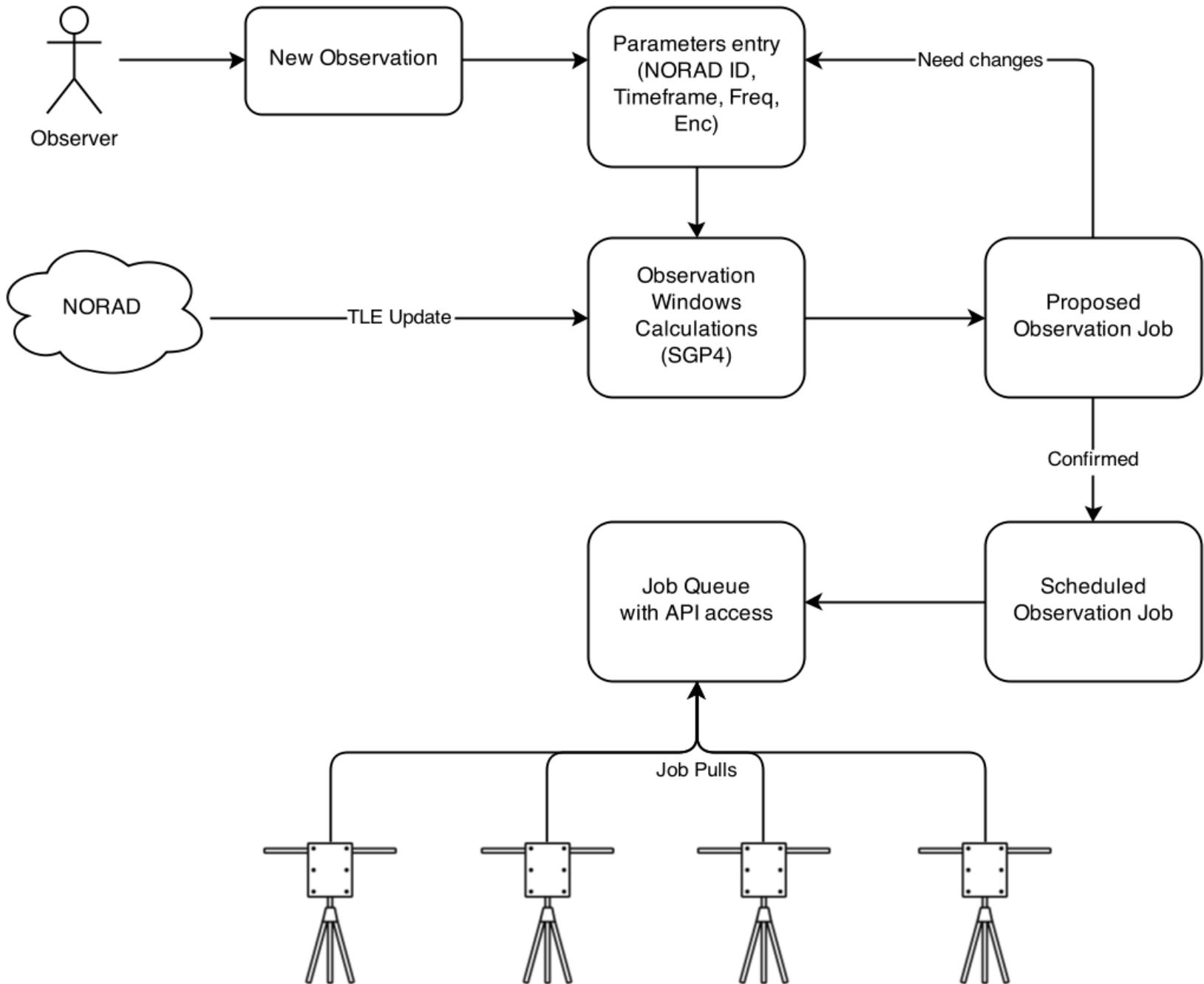
[github.com/satnogs-network](https://github.com/satnogs-network)

- **Observers** schedule **Observations**
  - Satellite + transmitter
  - Time window of interest

# SatNOGS Network

Web server - Python: Django, requests, +more

- **Network** (the server) finds available and visible ground stations
  - Creates a **Job** for each station



# SatNOGS Network

This is the stage enviroment. Feel free to test it and [report bugs](#). Production deployment is at [network.satnogs.org](http://network.satnogs.org).



## New Observation

Satellite 39444 - FUNCUBE-1 (AO-73)

Start Time 2015-10-10 16:06

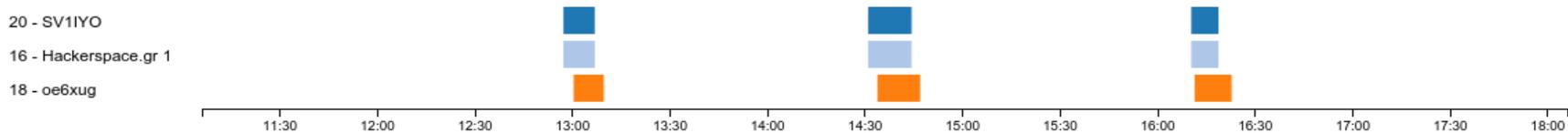
Transmitter BPSK Telemetry - 145.935 MHz - BFSK

End Time 2015-10-10 23:06

**IMPORTANT:** Timeframe is considered to be in UTC timezone.

Calculate Observation

## Calculated Timeline



Schedule Observation

# SatNOGS Network

Web server

Python: Django, requests, +more

```
HTTP 200 OK
```

```
Content-Type: application/json
```

```
Vary: Accept
```

```
Allow: GET, HEAD, OPTIONS
```

```
[  
  {  
    "id": 788,  
    "start": "2015-10-12T02:10:01Z",  
    "end": "2015-10-12T02:18:11Z",  
    "ground_station": 18,  
    "tle0": "BEESAT",  
    "tle1": "1 35933U 09051C 15282.12865753 .00000385 00000-0 98729-4 0 9998",  
    "tle2": "2 35933 98.4227 42.6629 0005953 14.2858 345.8506 14.55715956320639",  
    "frequency": 436000000  
  },  
  {  
    "id": 787,  
    "start": "2015-10-12T00:28:03Z",  
    "end": "2015-10-12T00:42:12Z",  
    "ground_station": 18,  
  }  
]
```

## Ground Stations execute jobs

- Upload received signal to **Network**
- **Observation** available for all via web / API

# SatNOGS Network

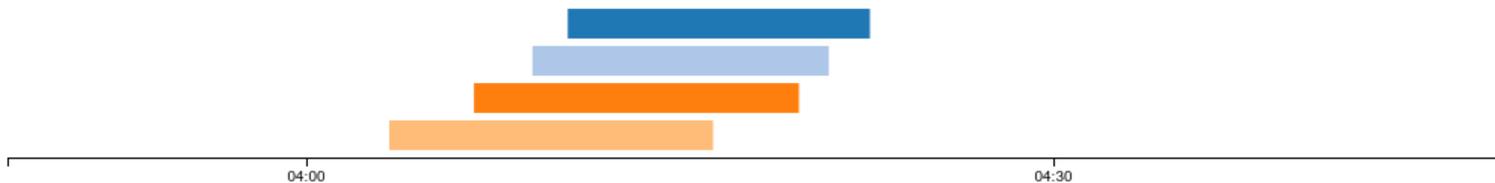
fig - Google Drive x 2015 DCC Preser x 2015 ARRL / TAPI x SatNOGS Netwoi x SatNOGS Netwo x SatNOGS Netwo x SatNOGS Netwo x dan@valpo

https://network-dev.satnogs.org/observations/223/

This is the stage enviroment. Feel free to test it and [report bugs](#). Production deployment is at [network.satnogs.org](http://network.satnogs.org).

## Timeline

- 17 - Rocket
- 16 - Hackerspace.gr 1
- 18 - oe6xug
- 26 - Tartu Test 1



## Data

### Data payload #735 from 17 - Rocket

Waiting for data

Timeframe 2015-09-22 09:10:30 ~ 2015-09-22 09:22:38



Data

### Data payload #733 from 16 - Hackerspace.gr 1



Timeframe 2015-09-22 09:09:05 ~ 2015-09-22 09:20:59



Data

# SatNOGS DB Central place for sat TLEs, TX, mode.

## JSON API

Browser tabs: fig - Google Drive, 2015 DCC Presentati..., 2015 ARRL / TAPR DC..., SatNOGS Network - C..., SatNOGS DB, dan@valpo

Address bar: <https://db.satnogs.org>

DB

Filter by Name or NORAD Cat ID

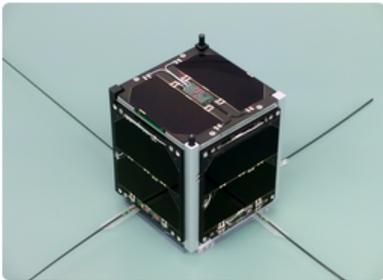
65 82 32

 <b>39087 - AAUSAT3</b>	 <b>40054 - AISAT</b> CW Beacon	 <b>35933 - BEESAT</b> GMSK 4k8 9k6 CW Beacon
 <b>39136 - BEESAT-2</b> CW Beacon	 <b>40014 - BUGSAT-1 (TITA)</b> AX.25 beacon	 <b>39153 - CUBEBUG-1 (CAPITAN BETO)</b> AFSK 1200
 <b>39440 - CUBEBUG-2 (LO-74)</b>	 <b>27848 - CUBESAT XI-IV (CO-57)</b> Mode U CW Be... Mode U AFSK TLM	 <b>28895 - CUBESAT XI-V (CO-58)</b> Mode U BEACON Mode U TLM
 <b>27844 - CUTE-1 (CO-55)</b> Mode U Beacon Mode U TLM	 <b>32785 - CUTE-1.7+APD II (CO-65)</b> Mode U TLM 1 Mode U TLM 2 Mode L/U Digip...	 <b>32789 - DELFI-C3 (DO-64)</b> Mode V BPSK T... Mode V BPSK T...

<https://db.satnogs.org/satellite/39153/>

# SatNOGS DB

## 39444 - FUNCUBE-1 (AO-73)



Suggest New Transmitter

### Mode U/V Linear



Alive	True
Invert	True
Uplink Low	435.130 Mhz
Uplink High	435.150 Mhz
Downlink Low	145.950 Mhz
Downlink High	145.970 Mhz

### CW Beacon



Alive	True
Mode	CW
Downlink Low	145.815 Mhz

### BPSK Telemetry



Alive	True
Mode	BFSK
Invert	True
Downlink Low	145.935 Mhz

# SatNOGS Client

The software which runs at the ground station.

- Pulls **Jobs** from the **Network**
- Waits for **Job** start time
- Controls receiver - RTL2832U - based, *any*
  - Band, doppler
- Sends commands to rotator
  - Easycomm → use your own !

# SatNOGS Ground Station

## The Hardware

**SatNOGS**  
NETWORK

No Network  
Connectivity

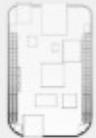
**SatNOGS**  
CLIENT

Gpredict  
& Gqrx

Commercial  
Software



Raspberry  
Pi



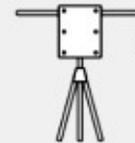
Beaglebone  
Black



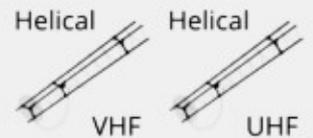
Odroid  
U3



Commerical  
Rotator

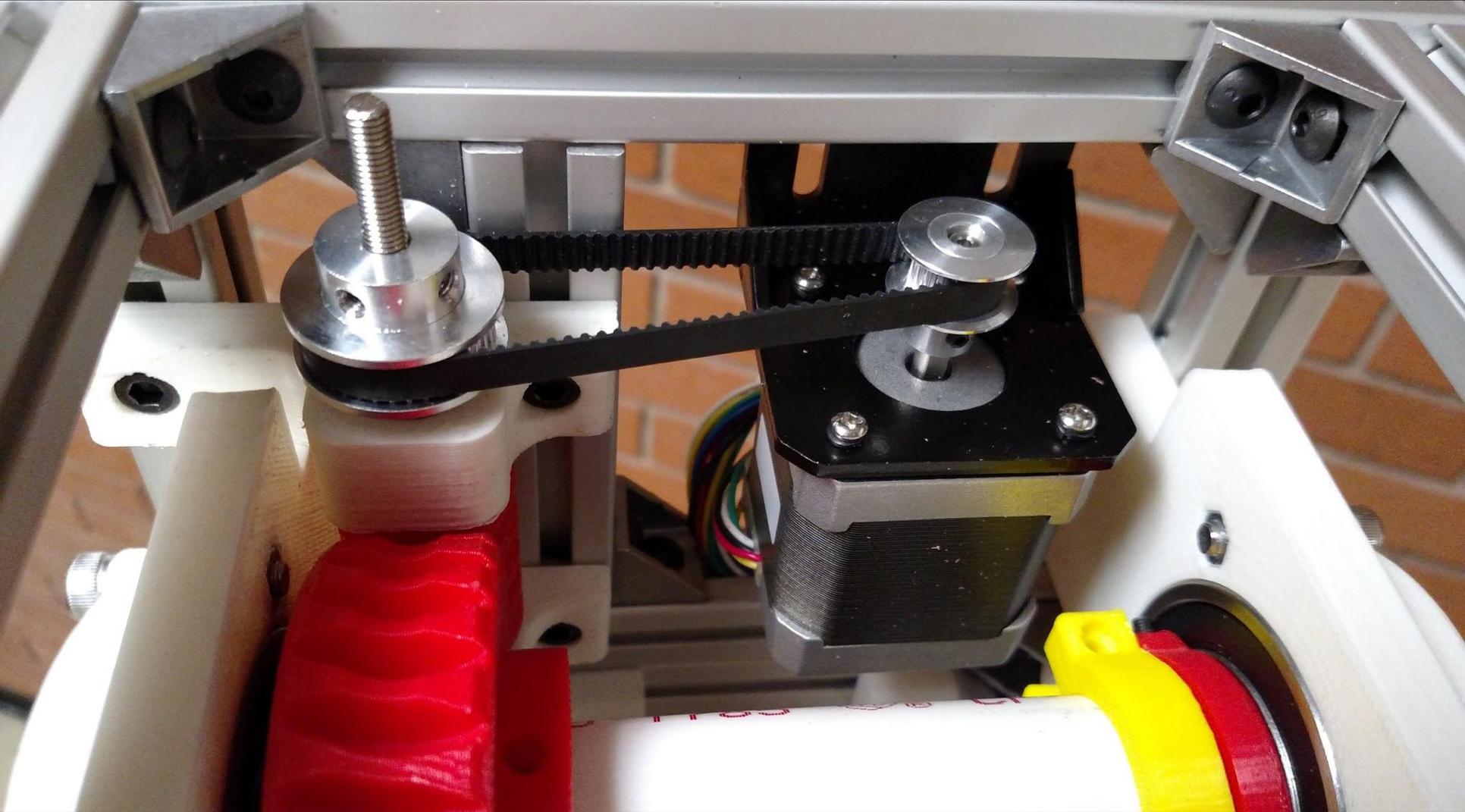


**SatNOGS**  
v2 Ground  
Station





# SatNOGS Ground Station - v3



# Receivers

RTL2832u dongle - software ready

Yours via CAT

HackRF

Ettus

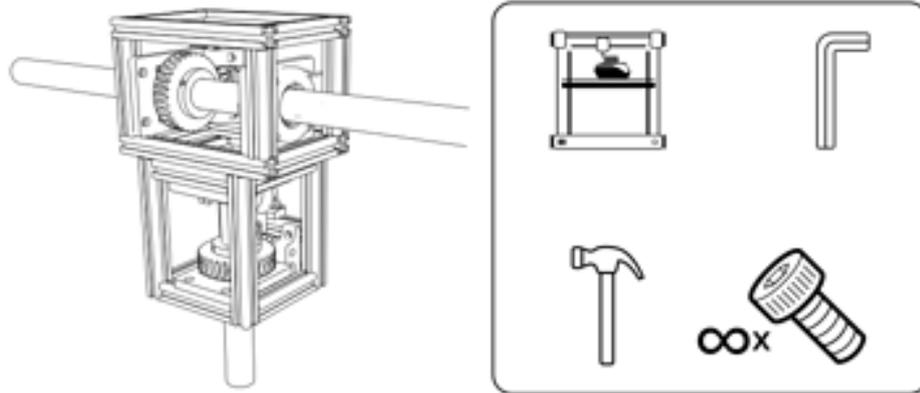




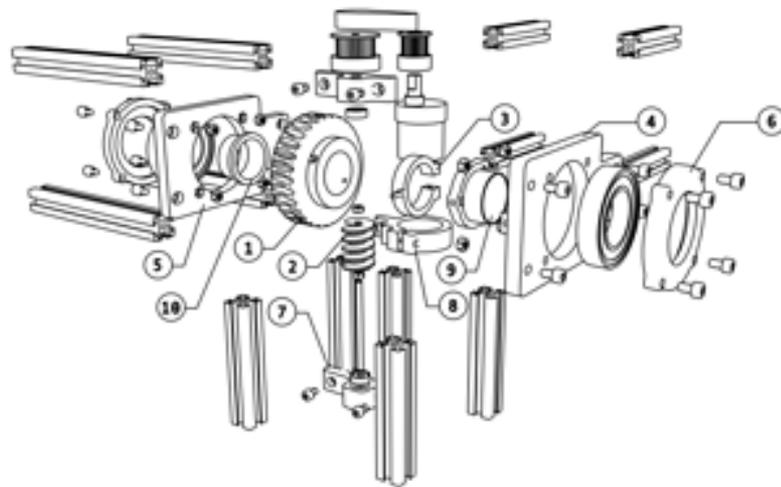
manthos

If SatNOGS was designed from a carpenter somewhere in the Scandinavian peninsula... 😊

# SJATNÖGS



1.





# HACKADAY

HOME BLOG HACKADAY.IO STORE HACKADAY PRIZE SUBMIT ABOUT October 10, 2015

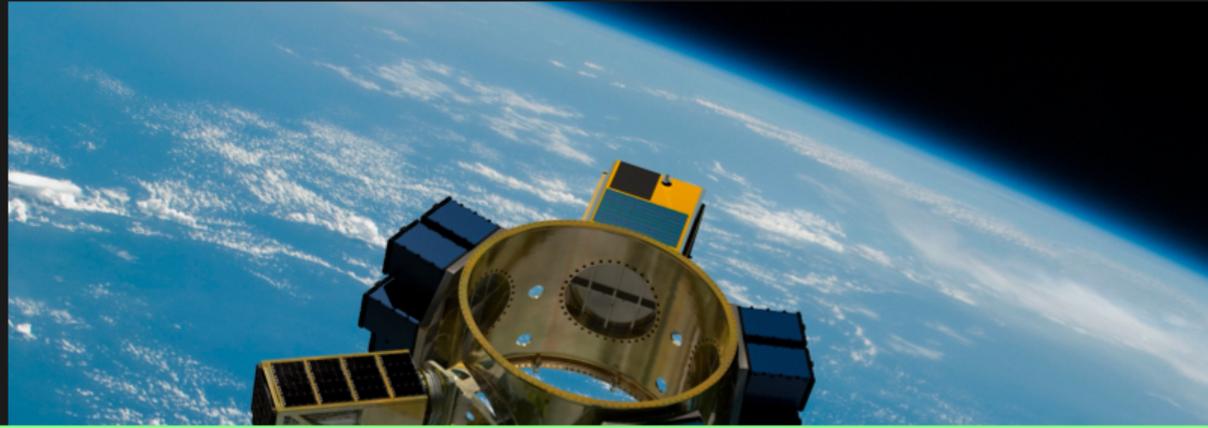
## ORIGINAL HACKERS' NEW SATELLITE IN ORBIT

by: Rud Merriam



No comments

October 10, 2015



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LIGHTBLUE BEAN

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## A Dream Job

Daniel Blood '10 expands Valpo's mission through Engineers Without Borders

[Learn More >](#)

Valparaiso University's College of Engineering

[www.valpo.edu/news/2015/07/09/a-dream-job-daniel-blood-10-expands-valpos-mission-through-engineers-without-borders/](http://www.valpo.edu/news/2015/07/09/a-dream-job-daniel-blood-10-expands-valpos-mission-through-engineers-without-borders/) and

**INTRODUCTION TO  
MICROCONTROLLERS &**

First time hearing SO-50



Fox-1A

LilacSat-2

# Hands-on engagement

The next generation →  
(it's not me)

FM capture theory + reality

Doppler shift



# Future ground station ??

Valpo' dual-pol radar

Az:  $360^\circ / 10 \text{ s}$



satnogs.org  
community.satnogs.org  
github.com/satnogs

#satnogs on freenode IRC

valpo.edu • dan.white@valpo.edu