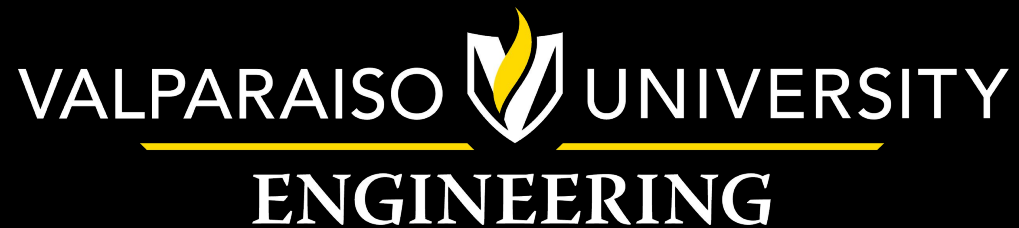


Hams, Hackers, and Makers

Open Source Ground Stations for
Fun, Education, and Inspiration

Daniel J. White, Ph.D. ADØCQ
Electrical and Computer Engineering
dan.white@valpo.edu
valpo.edu/college-of-engineering



Hams

Radio Comms
... in space



... have a long history

- Homebrew
- Experimental
- Sharing

Hackers

Computing

... have a long history

- Tools
- Curious
- Open source



open source
initiative

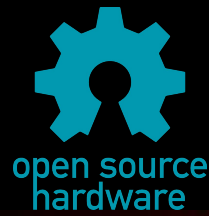


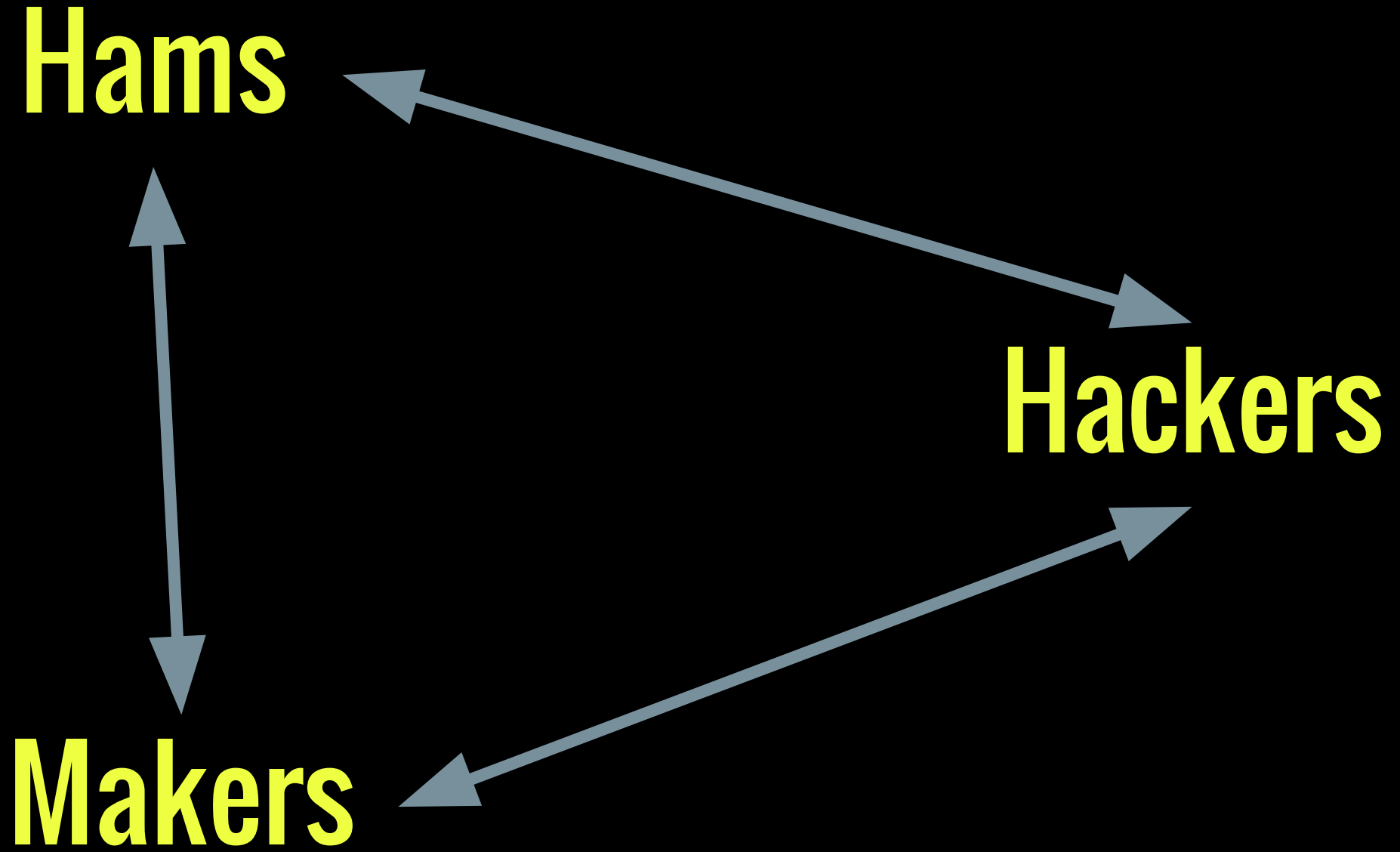
Makers

3D printing
laser cutters

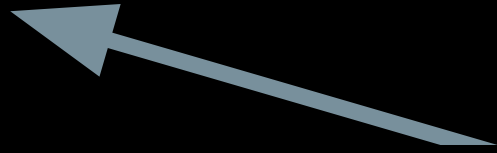
... have a long history

- DIY culture
- Experimental
- Collaborative





Hams



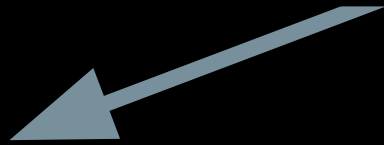
These groups are
more similar
than different



Hackers



Makers



By our powers combined, ...



Hackerspace.gr → SatNOGS.org

Satellite Networked Open Ground Stations

2014 People's Choice Finalist

ABOUT

LOCATIONS

CHALLENGES



NEWS

AWARDS

PROJECTS

**VIRTUAL GROUND STATION APP
– GLOBAL CROWDSOURCING OF
CUBESATS**

2014 Challenge

DESCRIPTION

PROJECTS

HACKPAD

2014 Hackaday Prize

(\$200k)



SatNOGS

THE HACKADAY PRIZE

satnogs.org

librespacefoundation.org

LIBRE SPACE FOUNDATION

Let's claim space, the libre way!

Problem

CubeSat-class downlinks

LEO ground coverage

GS coordination

Data collection

Approach

DIY antenna pointing
RTL-SDR type receiver
Raspberry Pi computing
Network coordination

Goals

Autonomous RX

Low cost → more stations

Independent GS owners,
coordinated observation

Fully open-source

+ data publically available

SatNOGS
NETWORK

SatNOGS
DB

SatNOGS
CLIENT

SatNOGS
GROUND
STATION



Modular options:

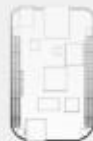
SatNOGS
NETWORK

SatNOGS
CLIENT

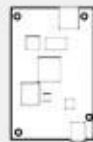
No Network
Connectivity

Commercial
Software

Gpredict
& Gqrx



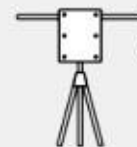
Beaglebone
Black



Odroid
U3



Commerical
Rotator



SatNOGS
v2 Ground
Station

Yagi



UHF

Yagi



VHF

Helical



VHF

Helical



UHF

Helical



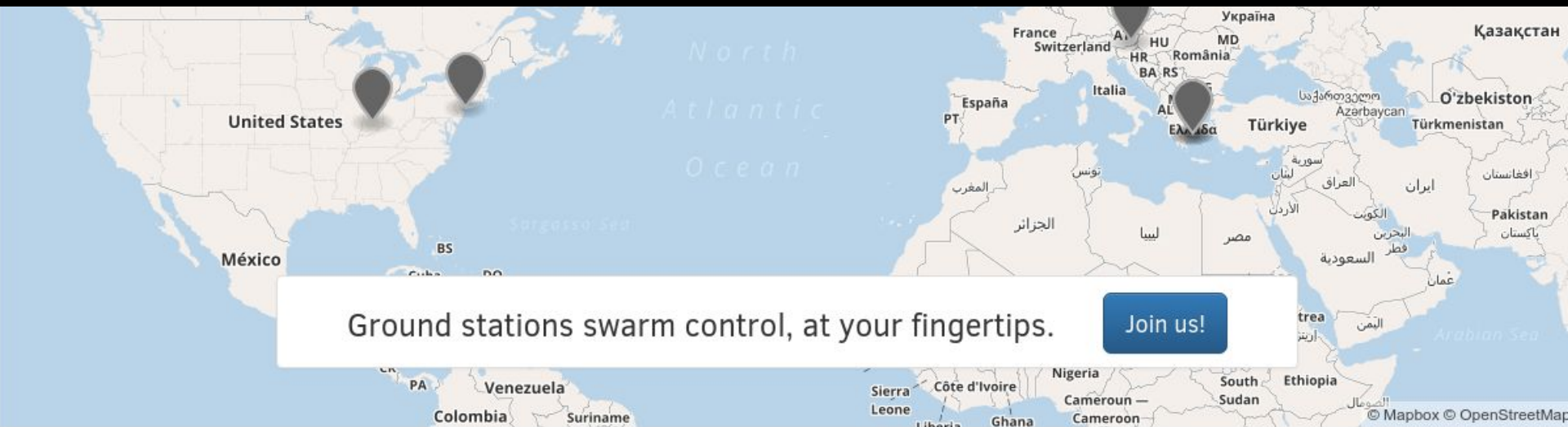
UHF

Yagi



UHF

Users schedule an **Observation** of a **Satellite/TX**
Network creates **Jobs** for each visible GS, who upload **recordings**



Featured Ground Station



Hackerspace.gr 1

Owner	Nikos Roussos
Coordinates	23.73°, 38.02°
Antennas	UHF yagi
Success Rate	<div><div></div></div>

Latest Observations

Scheduled Observations

ID	Satellite	Frequency	Encoding	Timeframe	Observer
166	ISS (ZARYA)	145.800 MHz	FM	2016-02-23 17:07:00 2016-02-23 18:07:00	Nikos Roussos
165	TIANWANG 1B (TW-1B)	437.645 MHz	GMSK4k8	2016-02-21 17:50:00 2016-02-21 18:20:00	Dimitrios Papadeas
164	M-CUBED & EXP-1 PRIME	437.485 MHz	-	2016-02-21 13:50:00 2016-02-21 14:20:00	Dimitrios Papadeas
163	UKUBE-1	145.840 MHz	CW	2016-02-21 10:27:00 2016-02-21 11:27:00	Pierros Papadeas
162	ISS (ZARYA)	145.800 MHz	FM	2016-02-19 12:13:00 2016-02-19 16:45:00	Robert Kiendl
161	SOMP	437.499 MHz	CW	2016-02-13 22:03:00 2016-02-13 23:03:00	Corey Shields

db.satnogs.org

Crowd-sourced database of satellite information
→ machine-readable API ←

SatNOGS
DB

Home

About

FAQ

Community

Sign Up

Log In

Filter by Name or NORAD Cat ID

 93

 149

 3

 58



32788 - AAUSAT
CUBESAT-2

1k2 MSK TLM



40949 - AAUSat-5

CW TLM

1k2 GMSK TLM

9k6 GMSK TLM

4k8 BFSK TLM



39087 - AAUSAT3



40054 - AISAT

CW Beacon



35933 - BEESAT

GMSK 4k8 9k6

CW Beacon



39136 - BEESAT-2

CW Beacon



40014 - BUGSAT-1

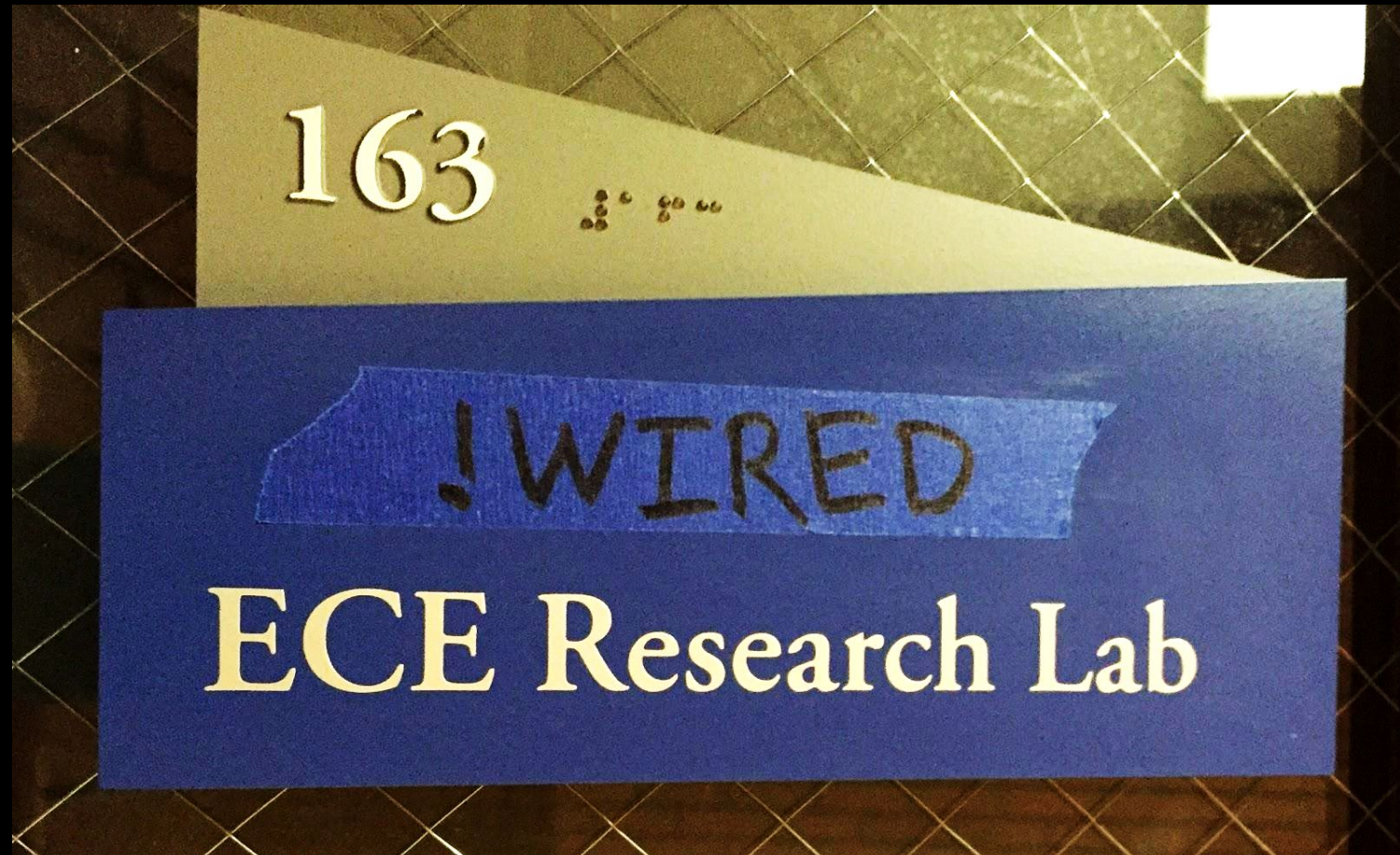


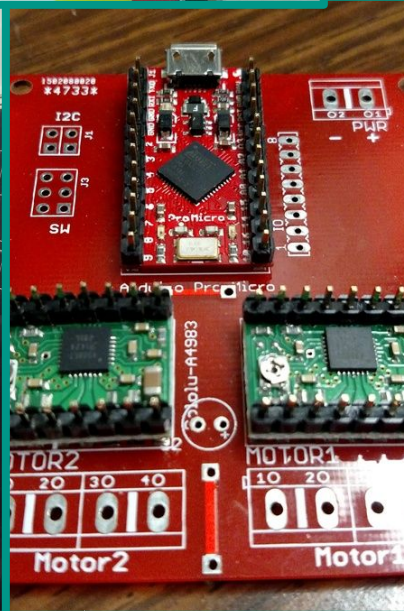
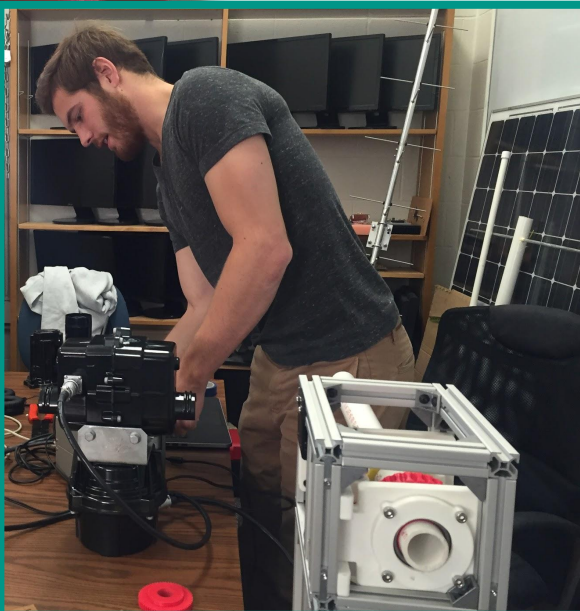
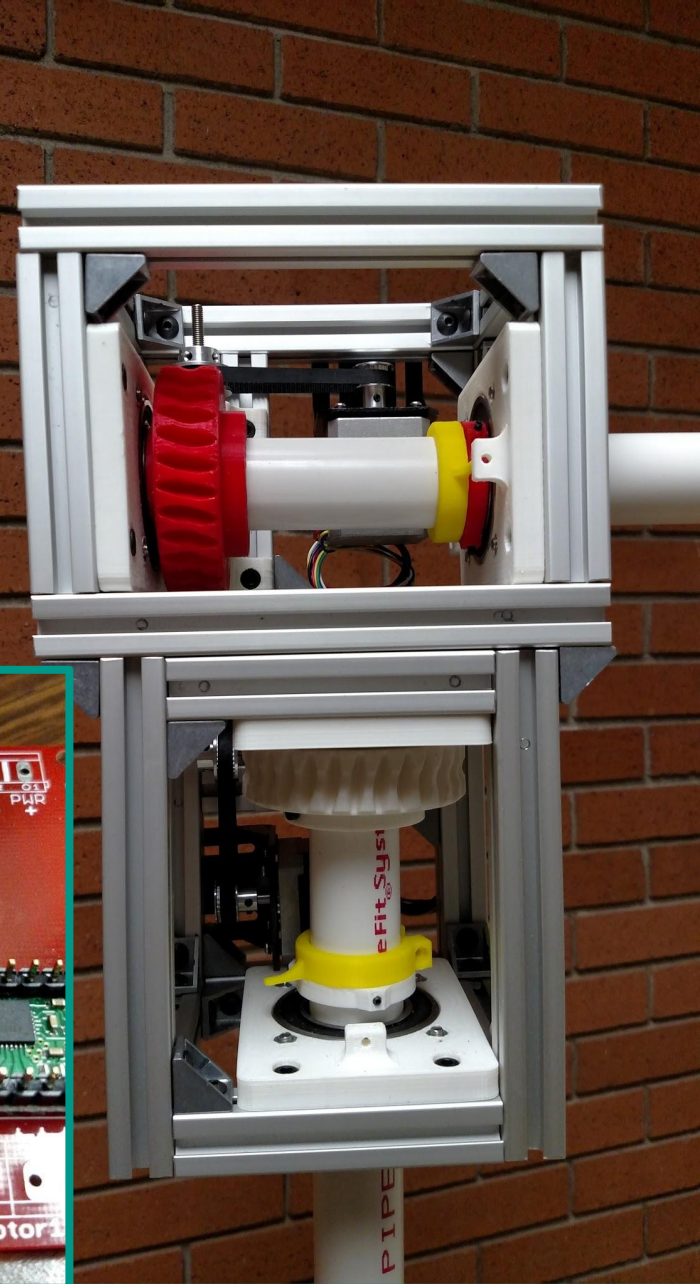
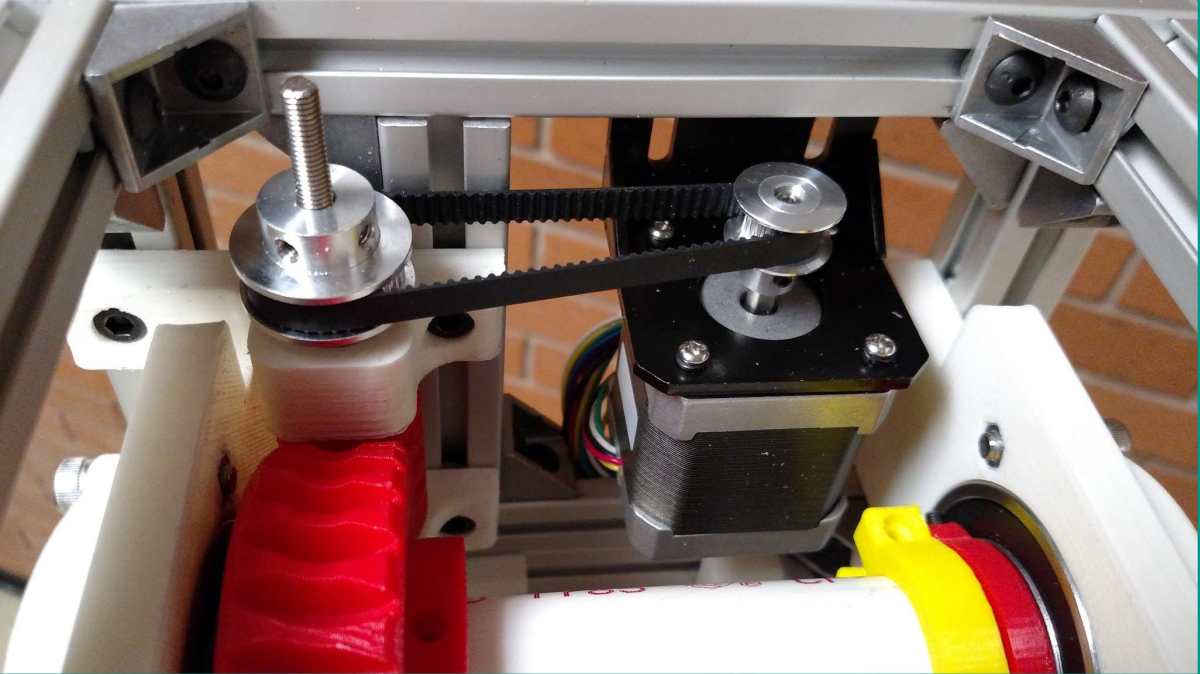
39153 - CUBEBUG-1



39440 - CUBEBUG-2

Wireless Research and Electronic Discovery Laboratory





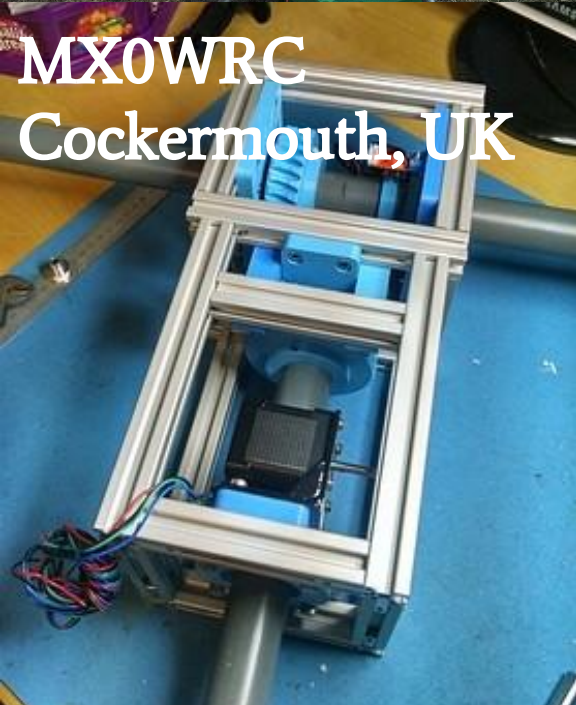
Corey Shields - KB9JHU
Bloomington, IN



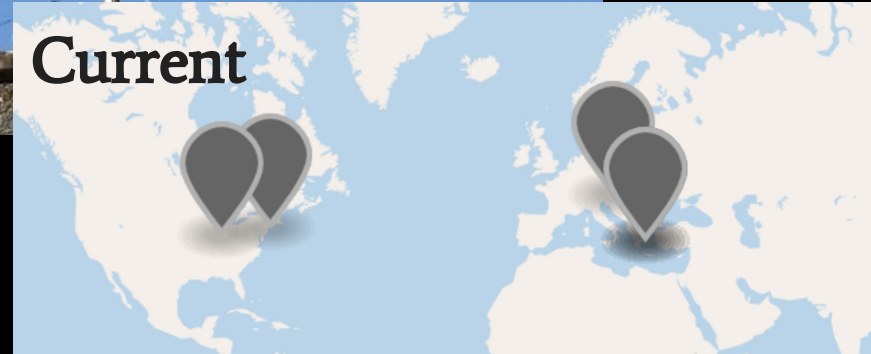
**OE6XUG - University of
Technology Graz, Austria**



MX0WRC
Cockermouth, UK



Current



In progress



ThumbSat.com

Same GS needs:

- Low-cost, wide deployment
- STEM-focused



THUMBSAT

TINY SATELLITE = TINY TIMESCALE

TOUCHDOWN

THUMBSAT

THUMBNET

MISSION CONTROL

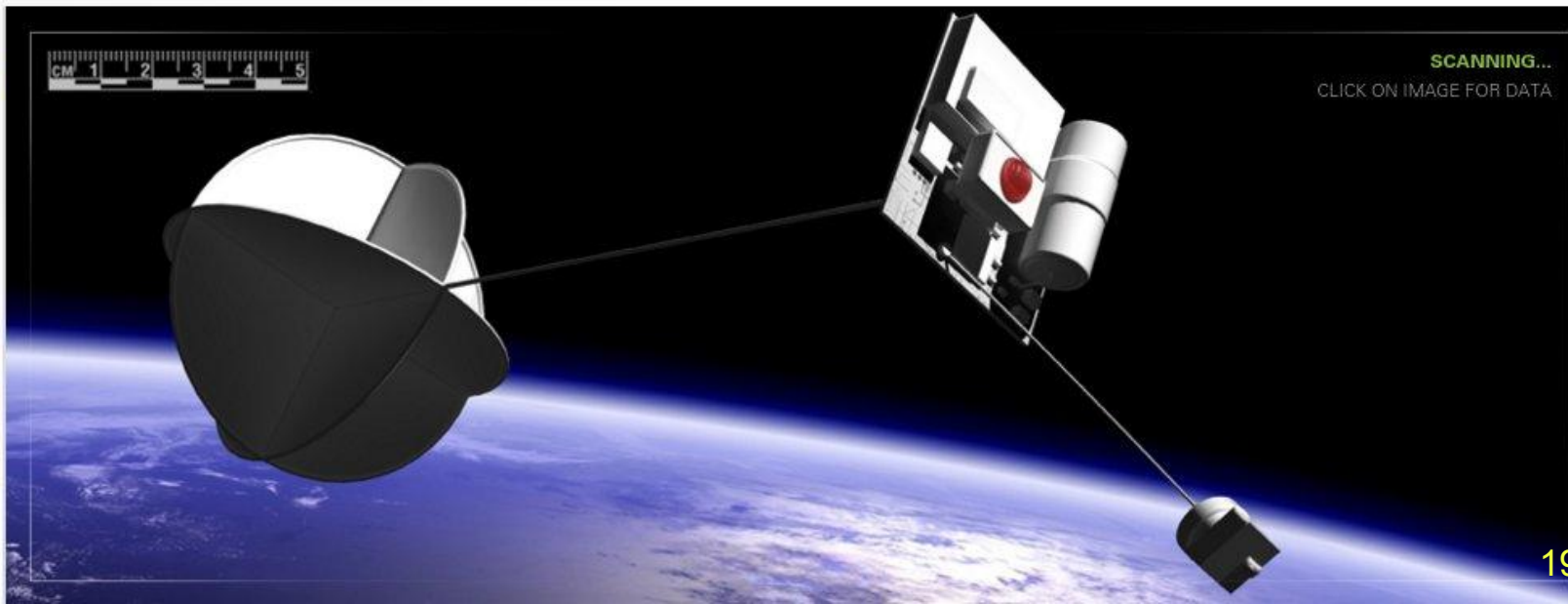
MISSION BUILDER

RENDEZVOUS

FAQ

THUMBSAT STORE

CONTACT US



Benefits:

LEO downlink volume

Engage + train next generation

How can S/C operators work
with distributed G/S
networks?

Questions?

