
Uniclogs Central Documentation

Portland State Aerospace Society

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Documentation for the UniCLOGS system as a whole.

Warning: This is still a work in progress with many pages to populate. So collaboration is very much encouraged. If you think a needed page is missing or see a stub-page that is in need of more detail, feel free to make a branch/fork and submit a pull request at our public [repo](#).

GLOSSARY

1.1 Glossary

C3 Command-Communication-and-Control board. See the [github repository](#) for more information.

CubeSat A relatively small satellite made up of one or more Units (U). A Unit is 10cs x 10cs x 10cs in volume. (For example, OreSat 1 will be a 2U satellite, i.e. 10cs x 10cs x 20cs).

Daemon A long-running Linux process that runs in the background.

Demodulate The process of extracting information from a Radio-Frequency (RF) signal carrier wave.

Doppler Correction The process of automatically correcting for frequency shifting that naturally occurs when observing a moving transmission source. (*i.e. a satellite in orbit*).

EDL Engineering Data Link. A bi-directional data link between the UniCLOGS ground station and the OreSat spacecraft. Specifically it's UpLink is sent by UniCLOGS on L band and received by OreSat, and it's DownLink is sent by OreSat on UHF and received by UniCLOGS. It can contain critical engineering data, software updates for OreSat's subsystems, or files from OreSat's subsystems.

L band Microwave band above UHF. The range of radio frequencies from 1GHz to 2 GHz.

OreSat The Portland State Aerospace Society's open-source and open-hardware CubeSat project. See the [OreSat website](#) for more information.

PSAS Portland State Aerospace Society. A student aerospace group at Portland State University. See the [PSAS website](#) for more information.

RTL-SDR: A relatively inexpensive Software Defined Radio (SDR) that can connect to any antenna via SMA, demodulate RF signals, and convert them to a digital format.

SatNOGS A network of crowd-sourced ground-stations coordinated and operated by the Libre Space Foundation. See the [SatNOGS website](#) for more information.

SDR Software Define Radio. Radio communications that are traditionally implemented in hardware are instead implemented in software.

UHF Ultra High Frequency. The range of radio frequencies from 300 MHz to 1 GHz.

UniCLOGS University Class Operation Ground Station. A ground-station made by and for PSAS. It will be the sole receiver of EDL packets. Since UniCLOGS is also a registered SatNOGS ground-station, it can also receive telemetry packets from SatNOGS-registered satellites. See the [hardware repository](#) and [software repository](#) for more information.

VHF Very High Frequency. The range of radio frequencies from 30 MHz to 300 MHz.

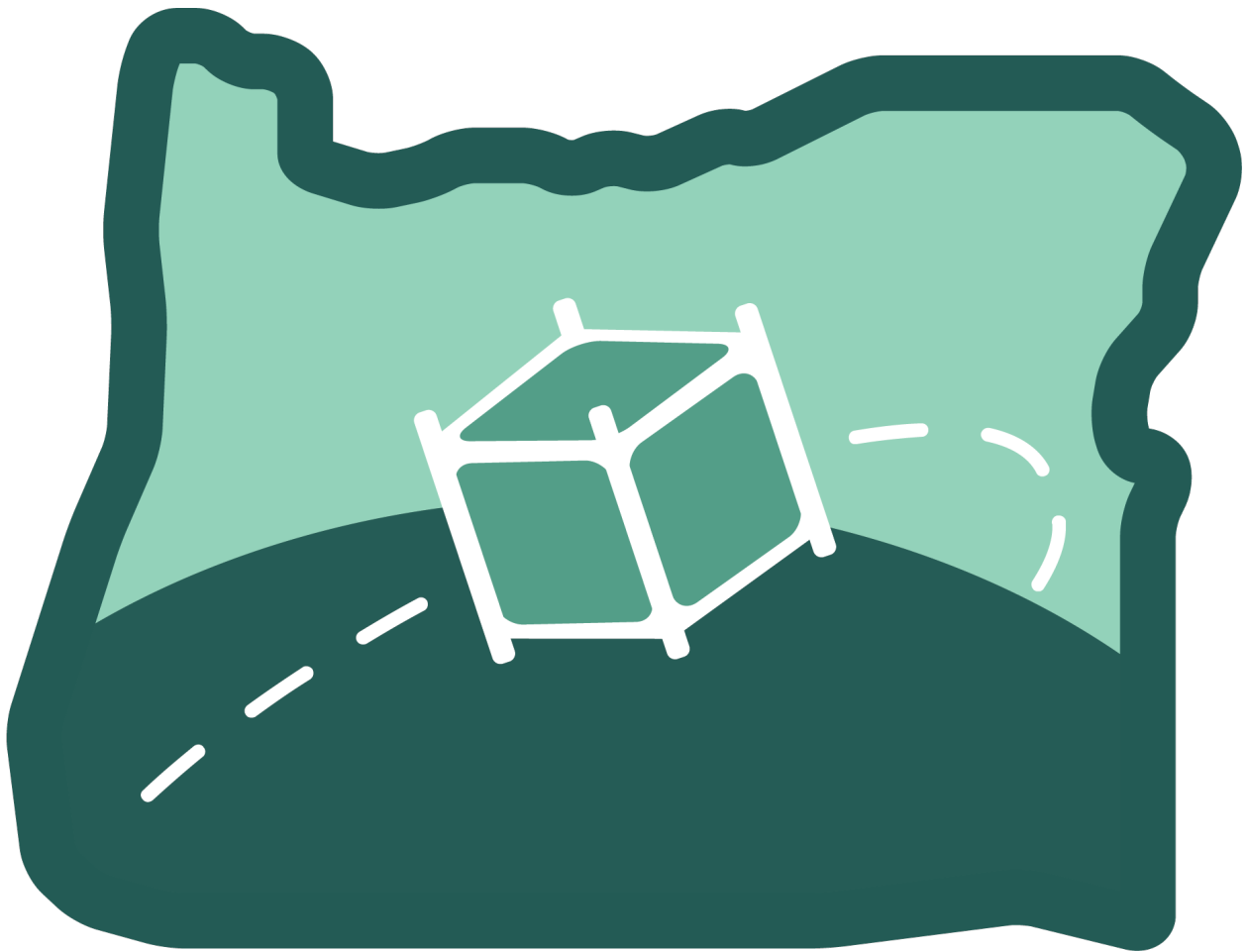
WHAT IS UNICLOGS?

UniCLOGS is an open-source and open-hardware ground station designed and used by the Portland State Aerospace Society.

The physical antenna is located on the roof of the Engineering Building on the PSU campus.



WHAT IS ORESAT?



OreSat is a open source CubeSat from Oregon by PSAS (Portland State Aerospace Society).

WHAT IS FLATNOGS?

4.1 FlatNOGS



4.1.1 Introduction

FlatNOGS is a mock-ground-station that is intended to simulate a generic SatNOGS ground-station capable of observing telemetry beacons from OreSat.

Taken from the [UniCLOGS Hardware Repository](#).

“The ground station infrastructure provides two communications functions between the ground and the spacecraft, (1) downlink communications on UHF for the Telemetry Beacons and Command Responses from the spacecraft, (2) uplink communications on L-Band for the Commands to the spacecraft, and (3) downlink communications on S-band for mission payload and camera data.”

FlatNOGS is primarily concerned with testing and demonstrating the functionality of link #1: downlink communications on the UHF band for the purposes of telemetry.

More specifically, we want to be able to capture telemetry from any ground-station in the SatNOGS network, where it will be demodulated and decoded, which will then be automatically uploaded to the SatNOGS Database, where we (the OreSat team) can re-obtain our telemetry via the SatNOGS DB API.

4.1.2 References and Guides Used

For the purposes of continuity and closest-simulation of a ground-station, this setup follows the guides provided by SatNOGS very closely with little deviation. A few extra tools have also been installed in order to aide in live-testing.

See:

1. [SatNOGS's Raspberry Pi Setup](#)
2. [SatNOGS's Client Setup](#)
3. [The rtl-sdr package wiki](#)
4. [GQRX Website](#)

Note: The *rtl-sdr* package is unofficial and not maintained by the owners of RTL-SDR.

4.1.3 Hardware

1. Raspberry Pi Model 4B rev1.1
2. RTL-SDR R820T SDR
3. USB3.0 Gigabit LAN Adapter

A word about the 2020-2021 FlatSat Network Infrastructure:

Due to the 2019-2021 pandemic and following restricted access to our labs in the Engineering Building, the FlatSat bench is physically separated from the UniCLOGS server.

FlatSat is located in the Portland State Business Accelerator (PSBA) building, whereas the UniCLOGS server is located in the Engineering Building (EB) on the PSU campus.

To enable easy access both physically and digitally to the FlatSat bench, a sub-network of devices has been created by bridging all devices in the PSBA lab to the MDC via USB (LAN over USB) of which the MDC is then bridged to the UniCLOGS server in the EB lab.

A word about Raspberry Pi 4B and OTG:

The Raspberry Pi 4 has had [documented issues](#) with its On-The-Go (OTG) capabilities which is related to their choice of implementation of the USB-C port. The fix involves the installation of several drivers, some unofficial, as well as the rather complicated process of [manually enabling hardware overlays and additional kernel modules](#).

Since a network connection over USB is required of FlatNOGS, (due to aforementioned network-requirements), this setup opts for the simpler solution: an Ethernet-to-USB adapter.

4.1.4 Operating System

1. Raspbian Buster 10 (arm71)

For purposes of continuity, the custom edition of Raspbian provided by SatNOGS is used, ([Release 2020122700](#)).

4.1.5 Software

On FlatNOGS:

1. *satnogs-setup*: SatNOGS's client and general configuration manager
2. *satnogs-client*: SatNOGS's daemon for scheduling and processing satellite observations.
3. *gr-satnogs*: SatNOGS's fork of *gr_satellites* which provides tools for analyzing RF IQ waterfalls
4. *rtl-sdr*: An unofficial package for binding raw RTL-SDR waterfall data to a TCP socket

Off FlatNOGS:

1. *gqrx*: A general-purpose SDR-receiver powered by GNU Radio.

4.1.6 Example Config

This is an example config taken from this [SatNOGS Observation](#). The section of importance is the “*radio*” dictionary, wherein all of the important radio parameters specifically for observing OreFlat from FlatNOGS are defined.

Any applicable parameters should be matched across tools, (*such as gqrx*), for the purposes of continuity.

```
{
  "radio": {
    "name": "gr-satnogs",
    "version": "v2.2-compat-xxx-v2.2.0.0",
    "parameters": {
      "soapy-rx-device": "driver=rtlsdr",
      "samp-rate-rx": "1.024e6",
      "rx-freq": "436500000",
      "file-path": "/tmp/.satnogs/data/receiving_satnogs_31527_2021-03-19T23-34-53.
↵out",
      "waterfall-file-path": "/tmp/.satnogs/data/receiving_waterfall_31527_2021-03-
↵19T23-34-53.dat",
      "decoded-data-file-path": "/tmp/.satnogs/data/data_31527",
      "doppler-correction-per-sec": "1",
      "lo-offset": null,
      "ppm": "48.1",
      "rigctl-port": "4532",
      "gain-mode": "Overall",
```

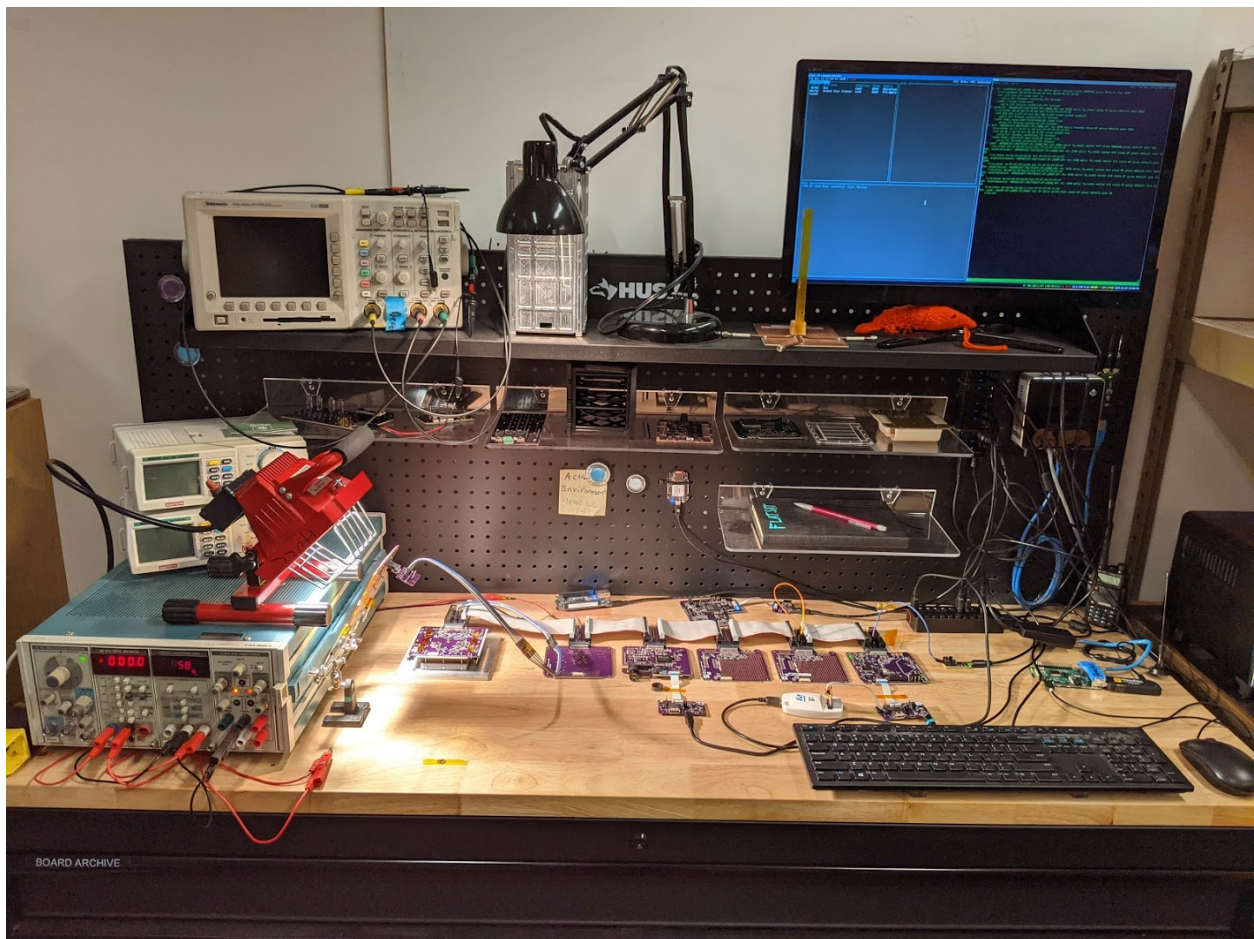
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```
    "gain": "24",
    "antenna": "RX",
    "dev-args": null,
    "stream-args": null,
    "tune-args": null,
    "other-settings": null,
    "dc-removal": null,
    "bb-freq": null,
    "bw": "34000",
    "enable-iq-dump": "1",
    "iq-file-path": null,
    "wpm": null,
    "baudrate": "9600",
    "framing": "ax25"
  },
  "latitude": 45.509,
  "longitude": -122.681,
  "elevation": 17,
  "frequency": 436500000
}
```


WHAT IS OREFLAT?

5.1 OreFlat



5.1.1 Introduction

OreFlat is a live-development version of OreSat[0/1], also referred to as FlatSat. It is laid out flat on the satellite-development-bench, hence the name OreFlat.

SOFTWARE COMPONENTS

6.1 Software Components

6.1.1 COSMOS

- [Github Repository](#)

6.1.2 CoSSI

- [Github Repository](#)

6.1.3 Pass Calculator

- [Github Repository](#)

6.1.4 RADS

- [Github Repository](#)

6.1.5 StationD

- [Github Repository](#)

6.1.6 ULTRA

- [Github Repository](#)

These are the various libraries and services that support UniCLOGS and its ground-station capabilities.

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