

# SatNOGS-COMMS

CubeSat Developers Workshop, 2021

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Libre Space Foundation

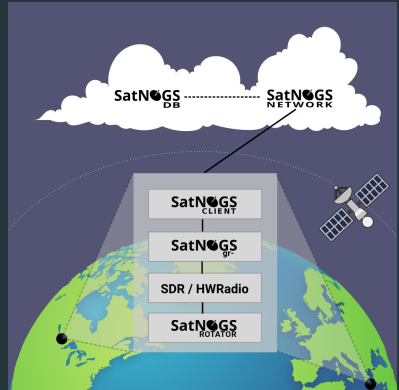


# Libre Space Foundation

- A non profit organization based in Athens, Greece
- Founded in 2015
- Focus on space applications
- Commitment to open technologies
- Operations in 4 countries (Greece, Germany, Netherlands, US)

# SatNOGS in a nutshell

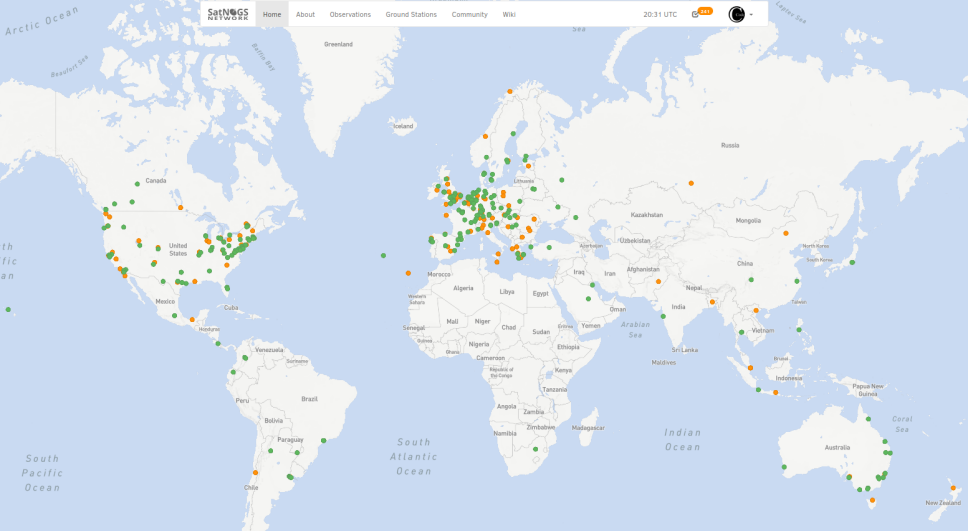
- Ground Stations Network
- Telemetry and TC&C capabilities
- Modular setup
- SDR based RF
- Complete open source stack
- VHF/UHF, L-Band, S-Band (expanding to X-band)





A crowdsourced network





400+

Stations

580

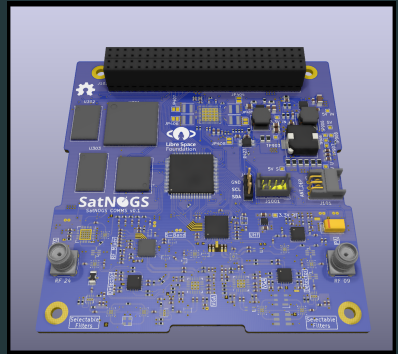
Satellites

100M+

Frames

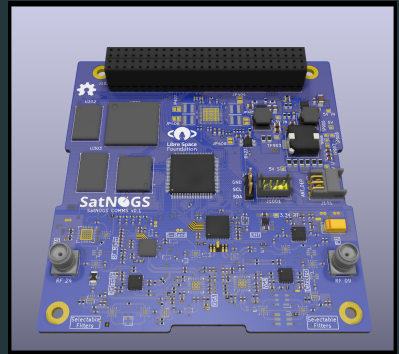
# SatNOGS-COMMS transceiver

- Co-funded by LSF and ESA
- UHF and S-Band dedicated transceivers
- STM32H7 main MCU
- ZYNQ-7020 FPGA
- Suitable for LEO up to 600 km
- Fully open software and hardware
- Seamless SatNOGS Network integration

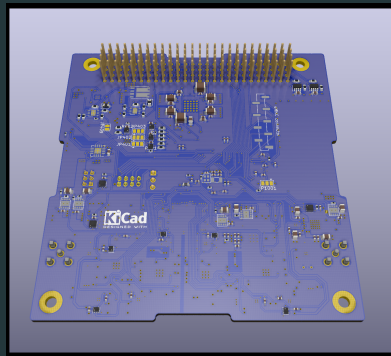
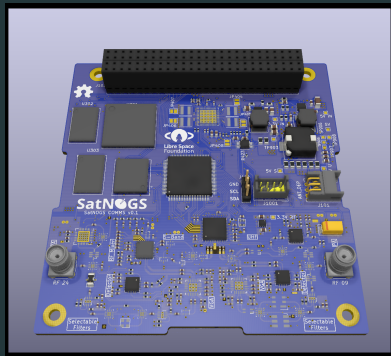


# SatNOGS-COMMS transceiver

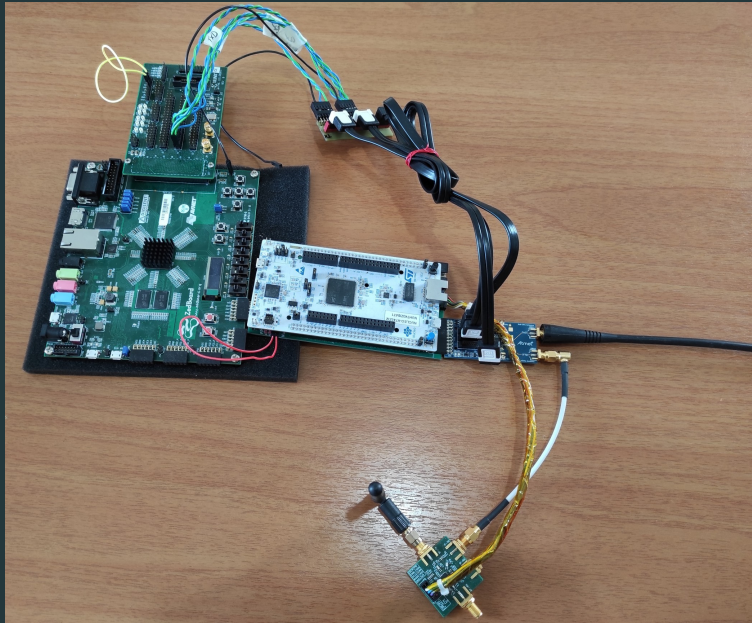
- GFSK, GMSK, BPSK and QPSK
- CCSDS encoding schemes
- Data rates:
  - up to 50 kbps for UHF
  - up to 1 Mbps for S-band
- IQ support
- Spectrum monitoring capabilities



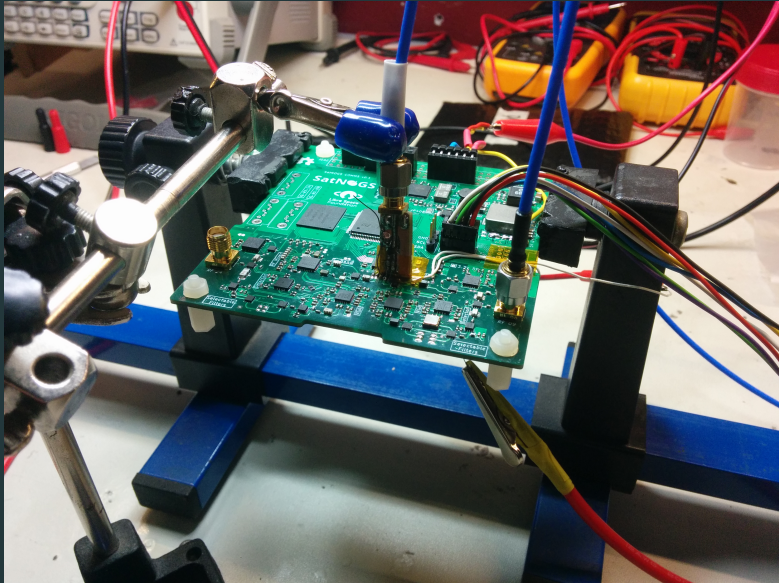
# SatNOGS-COMMS transceiver



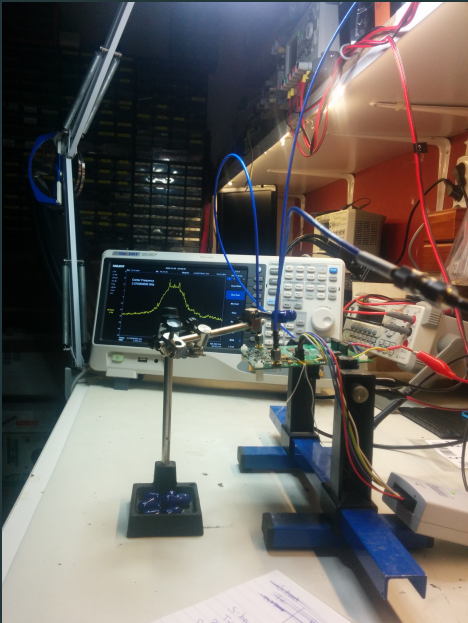
# SatNOGS-COMMS transceiver



# SatNOGS-COMMS transceiver

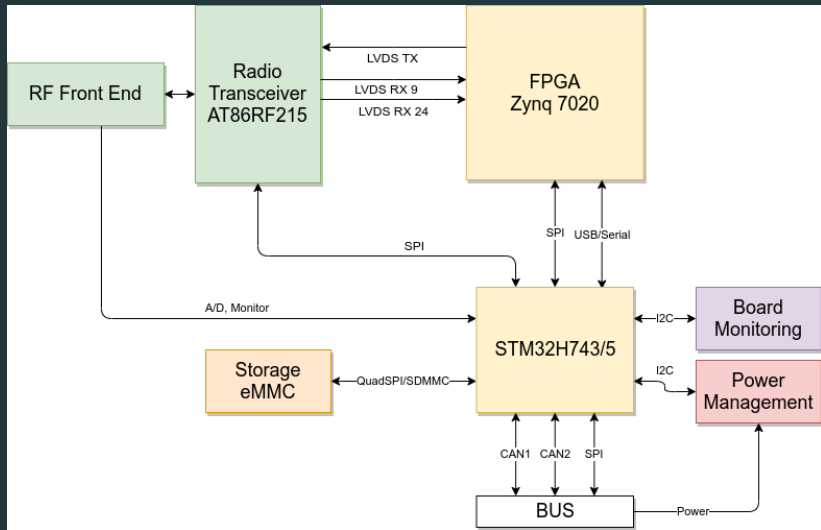


# SatNOGS-COMMS transceiver



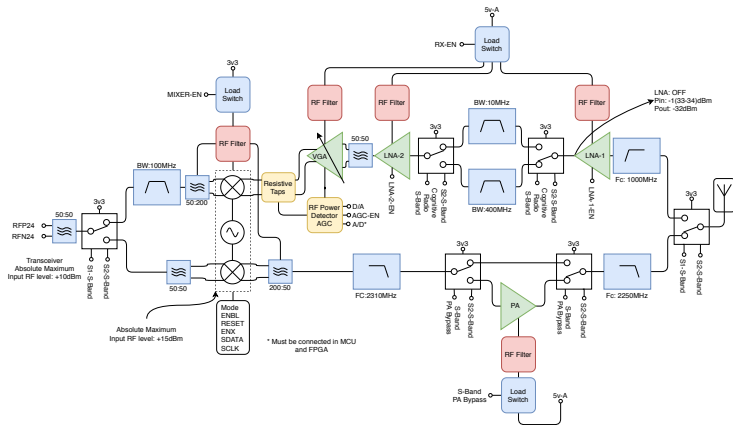


# System components



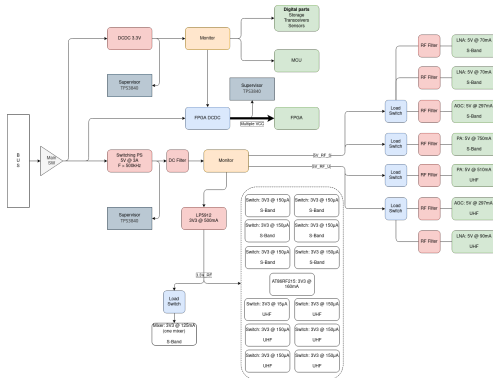
- **UHF:** 395 – 450 MHz
- **S-Band:**
  - Rx: 2025 – 2110 MHz
  - Tx: 2200 – 2290 MHz
  - Radio amateur bands support upon request
- **Tx Power:** 26 - 32 dBm (1 dB step)
- **SFCG 21-2R4** compliant emissions
- Low noise figure (1.4 dB)
- Custom analog AGC mechanism
  - **UHF:** 58 dB dynamic range
  - **S-Band:** 41 dB
  - Switchable filters to improve selectivity

# RF Frontend



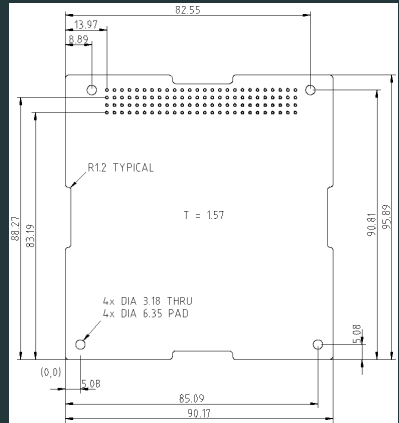
# Power Management

- 3 primary DC-DC power supply modules
  - 5V for RF
  - 3.3V for DIO
  - PMIC for the FPGA
- DC-DC FET latch-up mitigation mechanism
- Various monitors

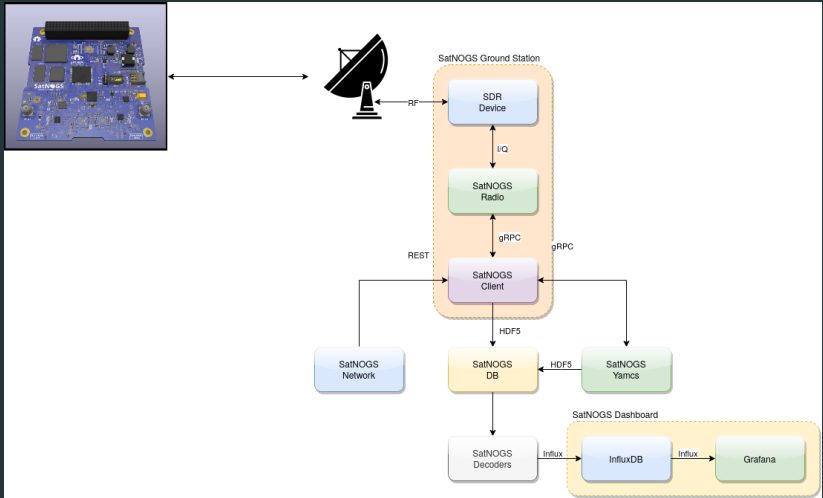


# IO Interfaces

- 2× CAN-FD backwards compatible with CAN-2.0
- 1× SPI up to 8 Mbps
- 2× antenna deployment interfaces
- SAMTEC ESQ-126-39-G-D
- PCB dimensions, mounting holes, connector type and location follow LibreCube (<https://librecube.org>) directives



# Ground Segment Support



- Abstract C++ interface for all COMMS peripherals
- Embedded Template Library (ETL) usage
- CCSDS Space Packet support for TC&C
- Static memory model
- FreeRTOS on the MCU
- AXI4-Lite and AXI4-Stream IP cores for DSP and common tasks
- Vivado reference design

# Availability

- Q4 2021
- 2000 € for the FM
- EM also available
- Custom RF filter and PA options
- Basic support via Gitlab issue tracking
- Extended support available upon request



`#satnogs-comms:matrix.org`

`https://gitlab.com/librespacefoundation/  
satnogs-comms`

`libre.space`

`info@libre.space`



Thank you!