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FOSSASat-2E Constellation: Unleashing Space-based SatIoT for Industrial Applications through Picosatellites

Satellite and the Cloud programme, February 16th, 2023

State of the art

Traditional Space / NewSpace

NASA

ThalesAlenia Space

AIRBUS

esa

FOSSA

SATELIOT

astrocast

SWARM

Bulky / Costly User Terminal

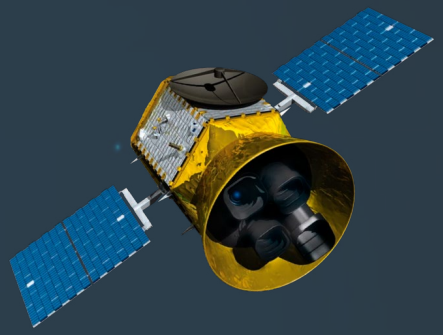
1

2

- Bulky GEO or parabolic terminals
- Costly terminals
- (Iridium, Orbcomm etc)

Inaccesible Constellations

3



- Costly Connectivity costs
- Lack of IoT Niche specialization
- Technological barrier for new hardware (integration)

- Evolution from “artwork” satellites.
- Lower costs and development times.
- Miniaturization of Space.

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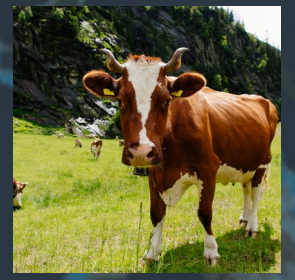
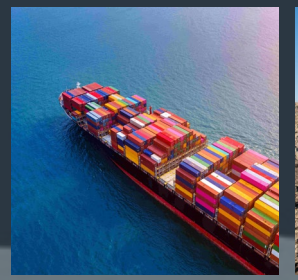
Why low-power SatIoT connectivity?

Costly **Connectivity Gap** for a growing number of Industrial connected devices, current technologies are expensive, proprietary & complex

+25B IoT connected devices (2030)

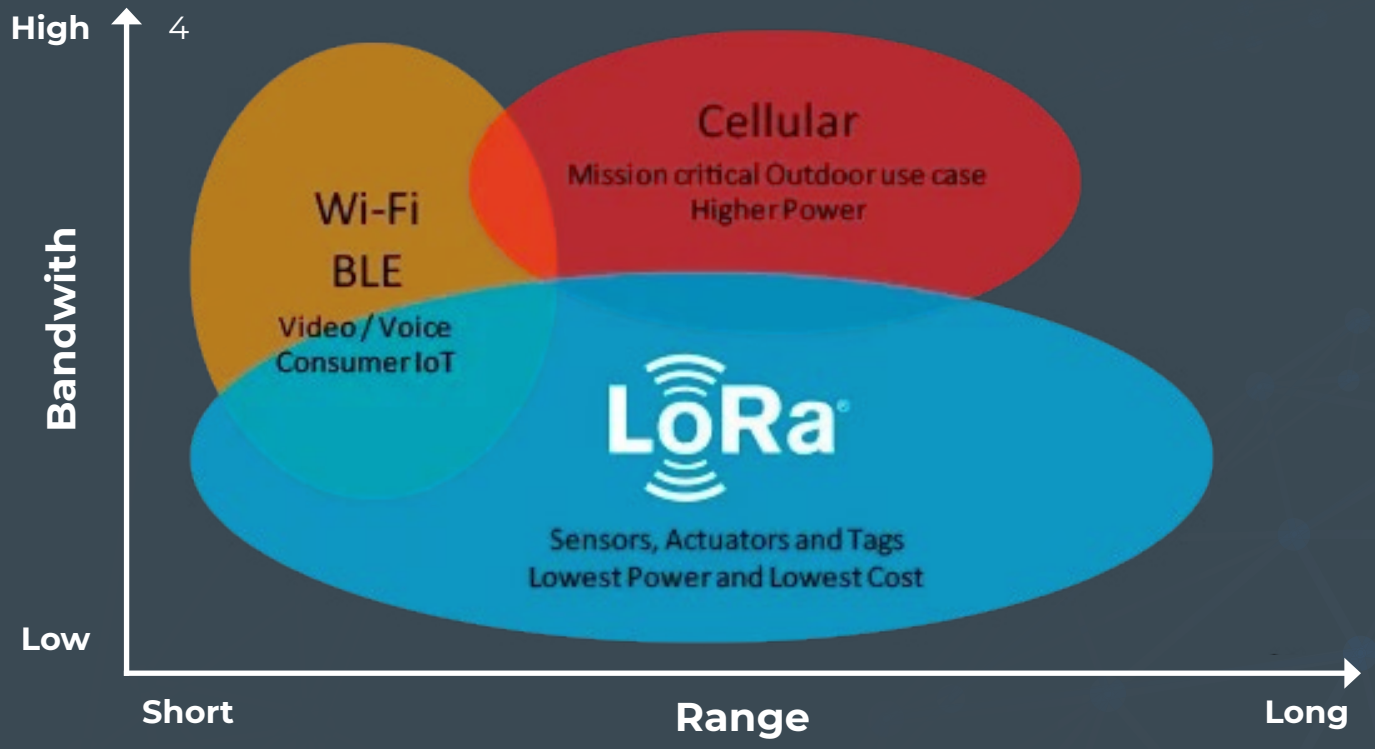
~ 80% Terrestrial connectivity gap





- 2G
- 3G
- 4G
- WiFi

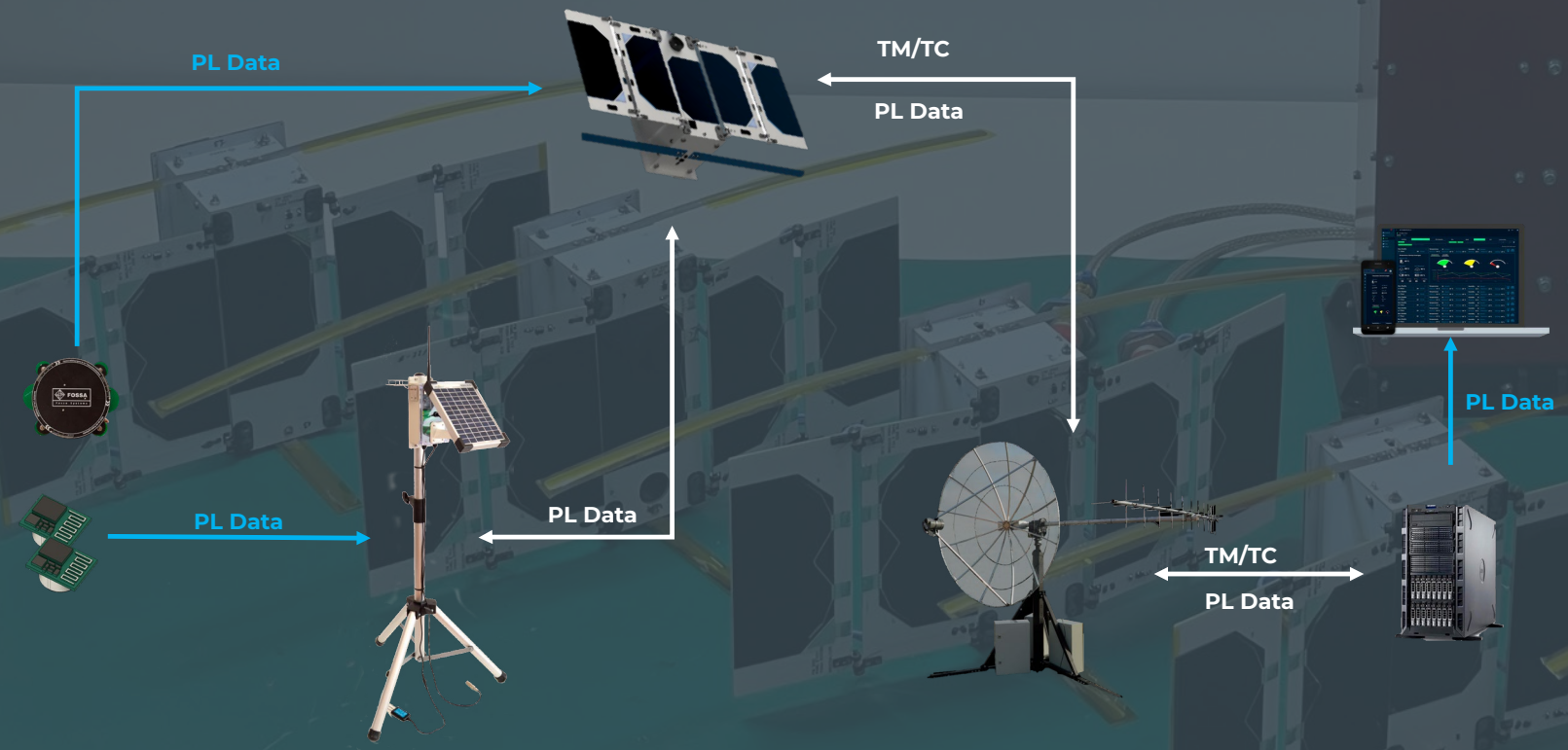
LoRa / IoT LPWAN Technology



- Low-Power Devices (<100mW TX Power)
- License Free Spectrum (ISM)
- High link budgets
- Interoperability with existing devices and networks
- Mass Adoptability of IoT Via Space
- Future use of other modulations as they become relevant (NB-IoT, Mioty etc)

FOSSA Network

A full vertically integrated IoT ecosystem pursuing the integration and interoperability of terrestrial and space solutions



LoRaWAN®

Interoperability

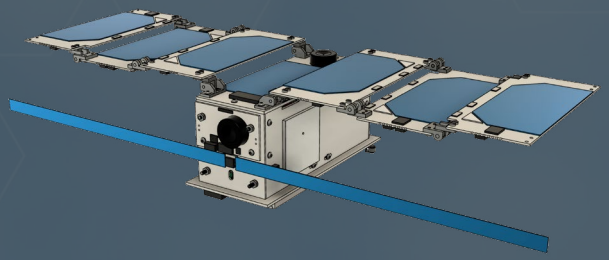
+1M devices by 2024

Lowest power consumption & fees

FOSSA Constellation

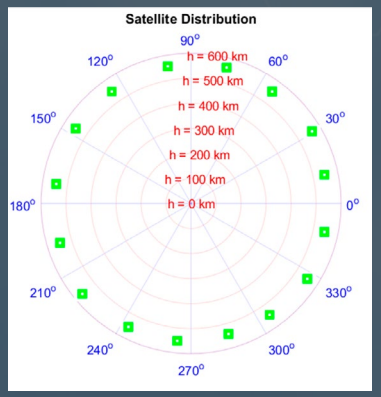
Nearly real-time, ubiquitous coverage for Industrial Applications

80 satellites

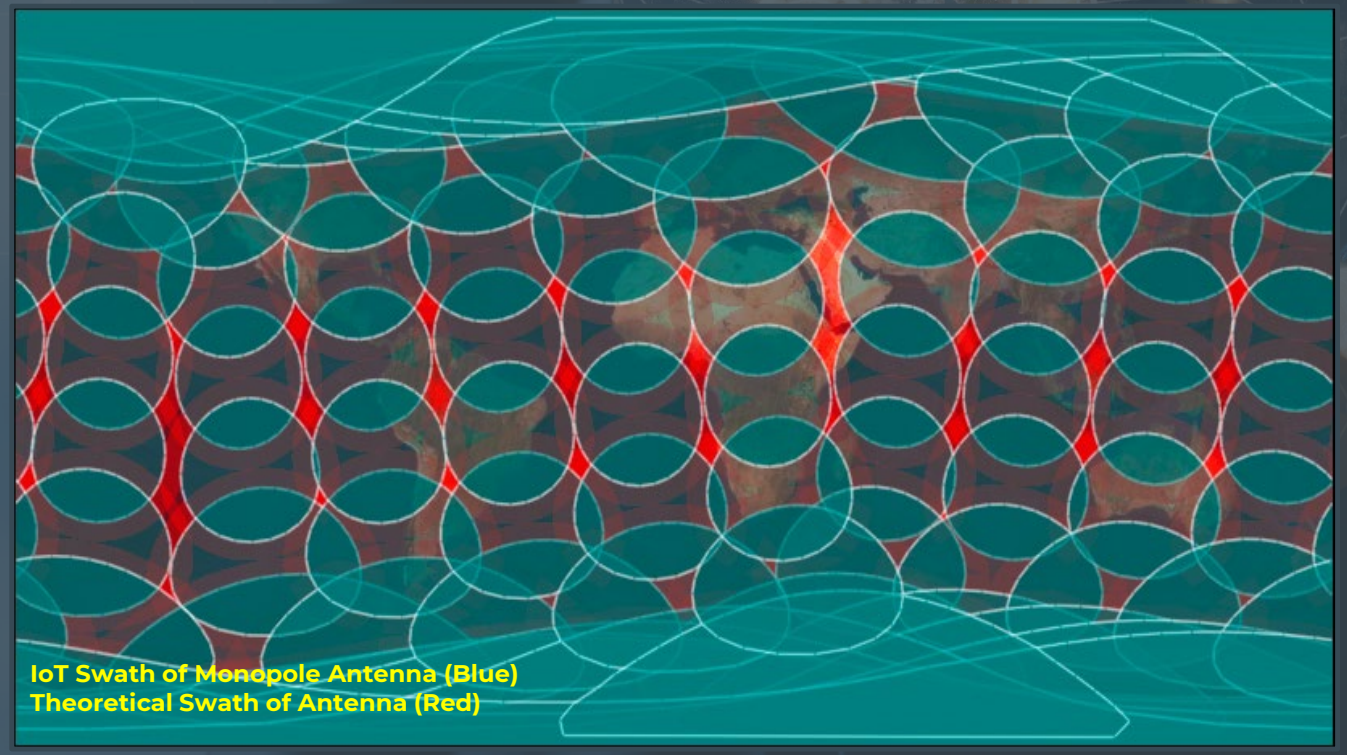


5 SSO planes

16 satellites/plane



FOSSA Constellation coverage by 2024



Picosatellites: FOSSASat-2 Evolved

OBDHS

UART/SPI/I²C/CAN/CSP
Up to 16 GB

ADCS

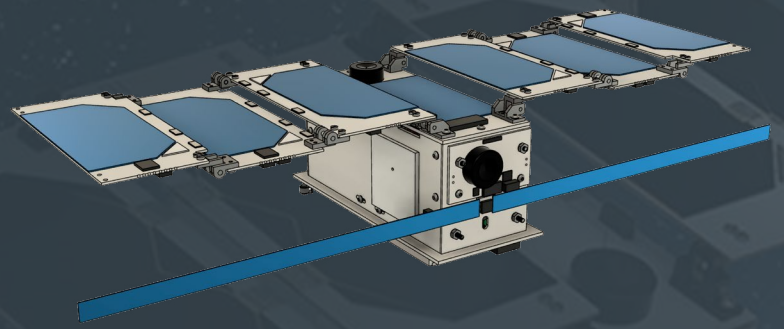
3-Axis Stabilization
Pointing Accuracy <3°

EPS

MPPT
Regulated Bus 3.3V/5V
Up to 10W Power Generation

COMMS

UHF @ 9k6bps
S-Band @ 1Mbps



PAYLOAD

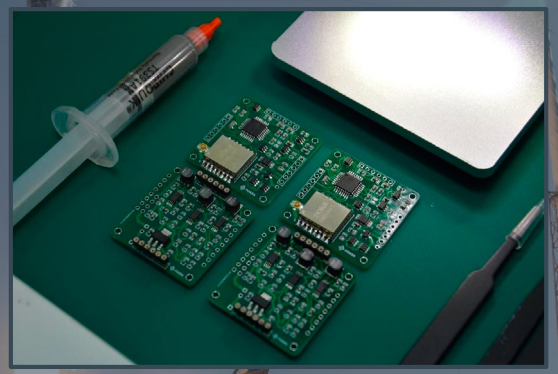
IoT Gateway [868 MHz & 915 MHz]
Low-Mid Resolution Optics

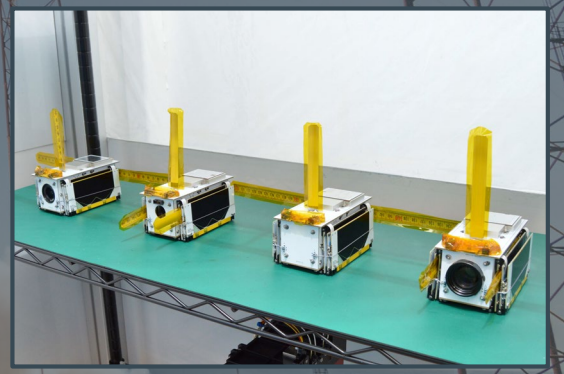
Strengths	Weaknesses
• Lower Cost (10x vs Nanosatellite) • Rapid & Agile Mission Development (3 – 9 Months) • More Distribution of Satellites • Lower Risk of Mission • Satellite-Level Redundancy	• Payload Volume (EO) • Power Budget (5-10W Max) • Low Throughput (0.01 – 1 Mbps)
Opportunities	**Threats**
• Distributed Communications Coverage • Low-Power IoT Communications • Rapid IoD & Deployment	• Legislation & ITU • COTS Availability

First Mission: Road to Orbit

From design to operations: a full hands-on project

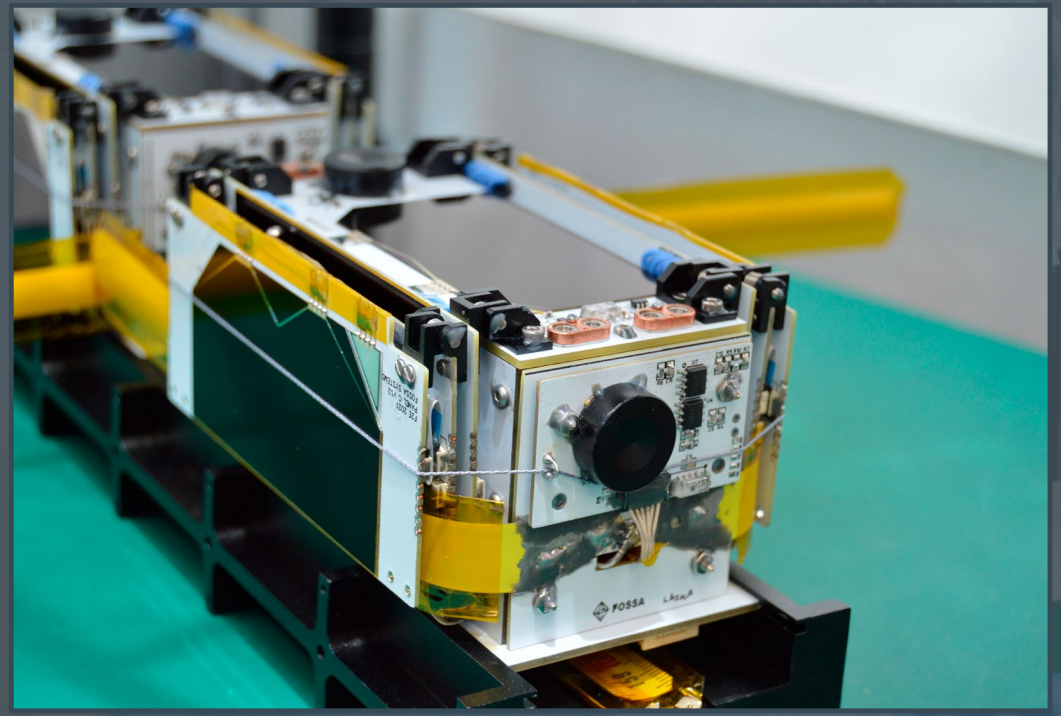
- From Scratch & Iterative Design
- <18 months from thoughts to launch
- Subsystem Sizing & Analysis
- In-house development & MAIT
- Full “hands-on” mission
  - » Cost optimization
  - » Quality control
  - » Agility & Flexibility



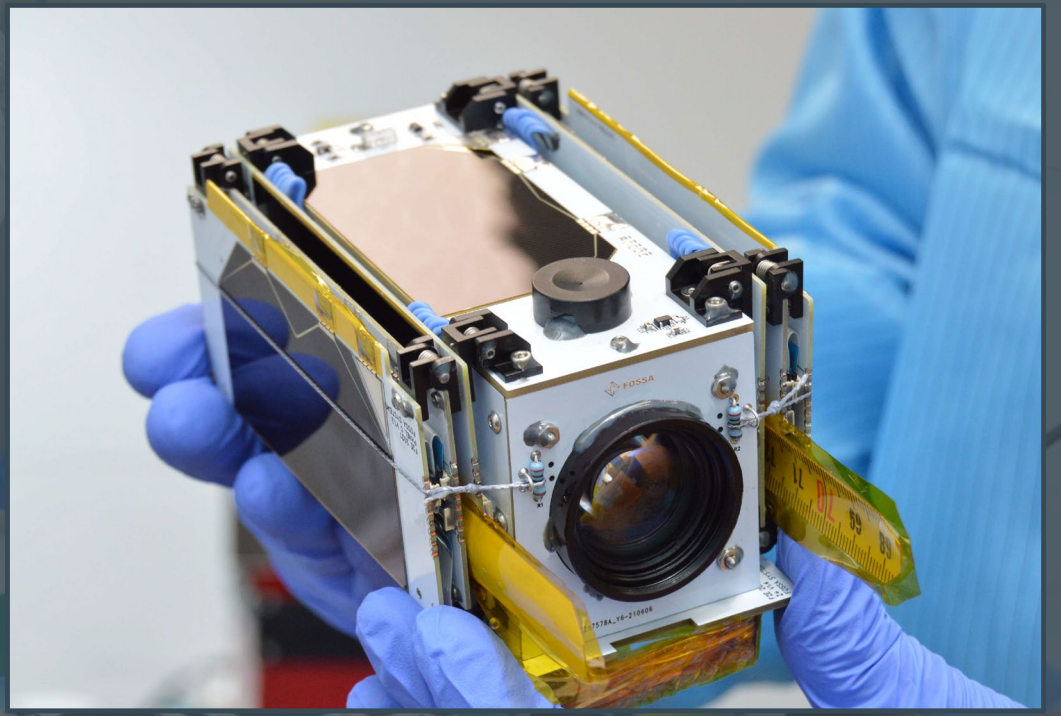


FOSSASat-2 Evolved Demonstrations

First IODs aboard FOSSASat-2 Evolved



Pulsed Plasma Thruster Demonstration



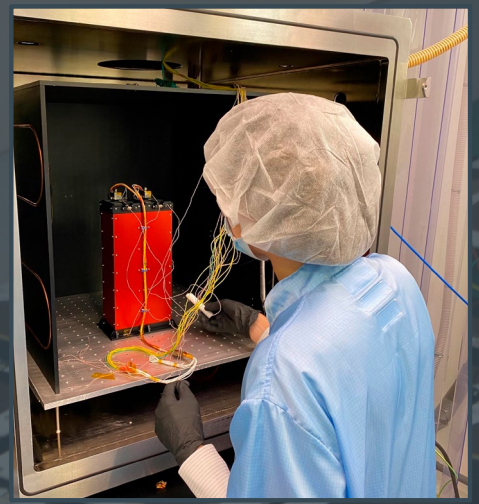
Medium-Resolution EO Payload (25m/px)

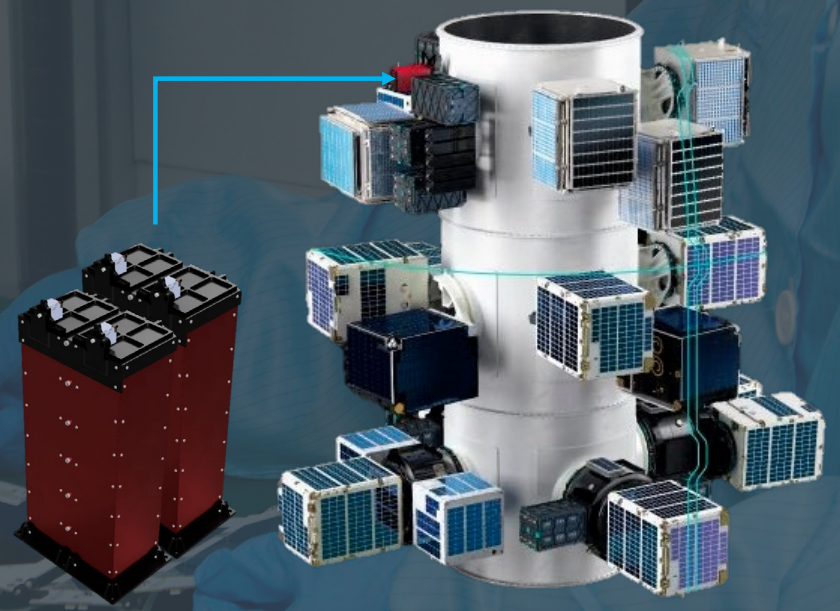
Galileo Science Office GNSS Transceiver

PocketPOD Deployer for PQs

World's most accessible way to orbit for satellites

- 8P PocketQube Capacity
- In-house design & manufactured
- Vertical or Horizontal mounting





Transporter-3 render

- 1st Flight: Transporter-3 (2xPocketPODs)
- Flight Heritage

Ground & User Segment

FOSSA's Ground Station: La Línea

- UHF & S-Band
- SDR
- Self-Contained (Power, 4G & RF)
- Network Security (Firewalls, etc.)

Pilot Sensor Testing: Agriculture

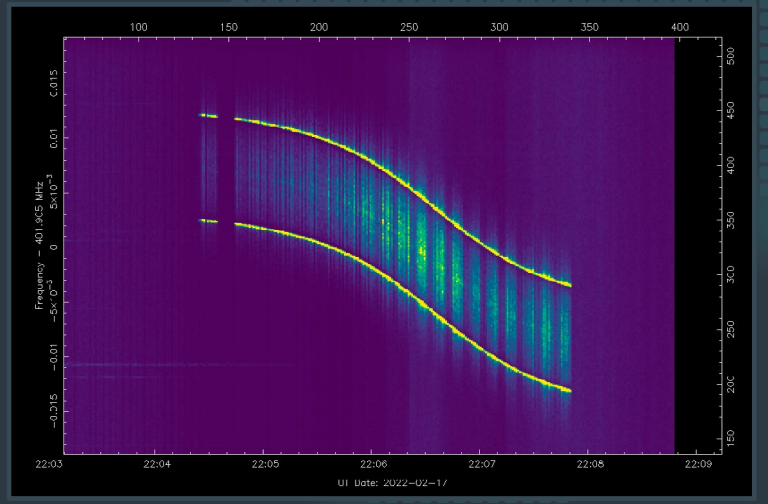
- LoRaWAN Devices
- Application Specific Sensors
- Direct Satellite Communications
- Low Power (25-100mW)

Mission Results

Successful PocketPOD Deploy

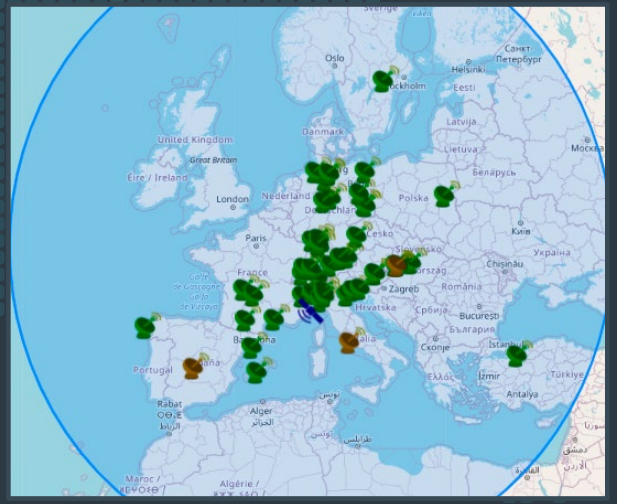
- Flight Heritage Obtained
- Correct Insertion
- Lowest-Cost Access to Space

First Packets & Data Streams



- Downlink 1h after deploy
- Commissioning Period Underway
- > 6000 Packets Received in 4 weeks

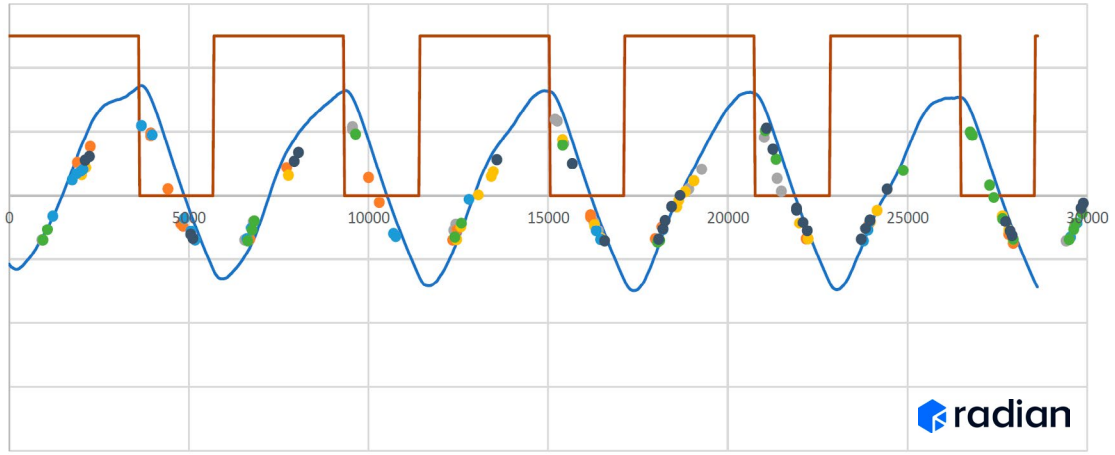
LoRa IoT Reception



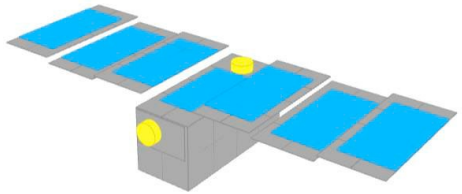
- Thousands of LoRa 20$ Stations Receiving Packets
- Open-Source TinyGS Network
- Multicast & Link Budget Demonstration

From Simulation to Results

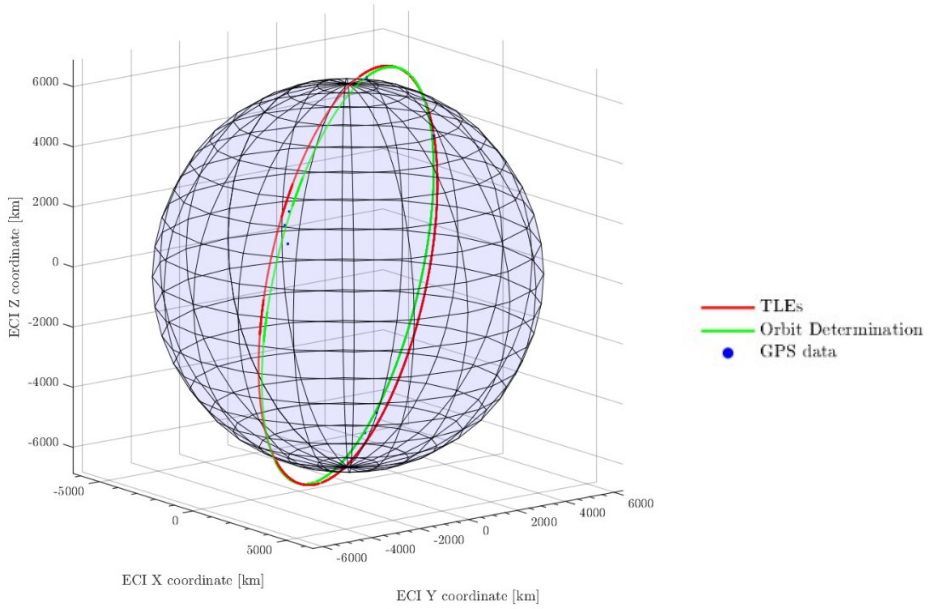
Thermal Analysis



- Accurate Thermal Prediction & Modelling
- Thermal Control Systems Implemented



Orbit Determination

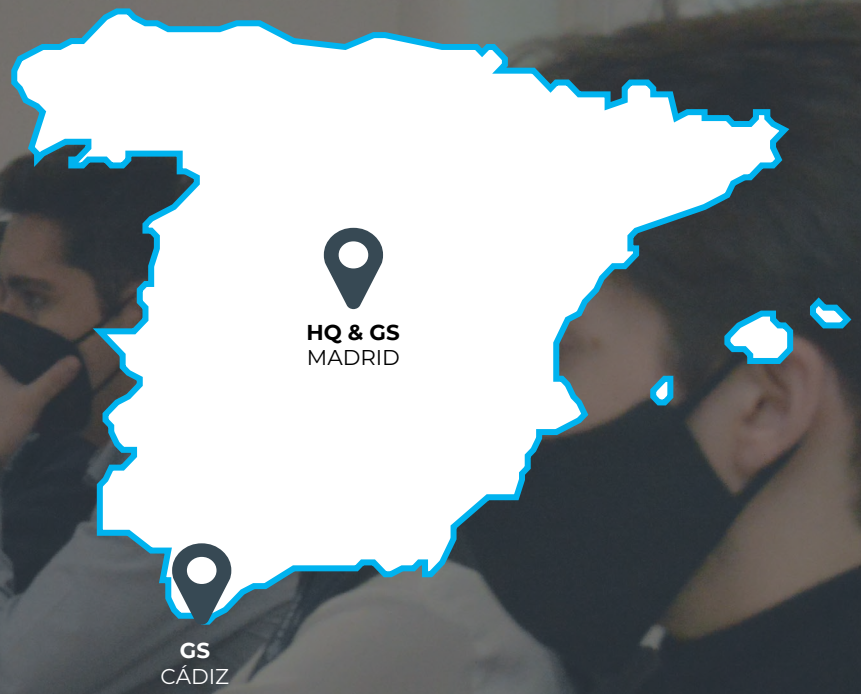


- ESA Galileo Science Office GNSS Experiment
- TLE Generation and GPS Reception Demonstrated

About FOSSA

FOSSA in numbers

- Commercial Establishment in July 2020
- +20 employees
- 13 S/C in orbit (80 by 2024) & 2 Ground Stations
- +15 international customers



- Madrid Offices & Production Centre (ISO7 Cleanroom)
- Madrid Ground Station
- La Línea Ground Station

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References

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Join us in Revolutionizing Global IoT Connectivity!

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