

INTERREG SUDOE SOE1/P4/E0437

Wildfire Picosatellite Constellation & UAVs Remote Sensing: Active fire mapping and management



FIRE-RS PROJECT

LUME-1 satellite as part of the Fire- RS System

Toulouse, 06 June 2019

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1. UVIGO Background

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- Tailoring of Quality Standards →
- Small Satellites
- System Design: End → End



- Technological Demonstrator <-> New Technology




- International Cooperation
- Application (Amazonia)



System of Systems

- FIRE –RS Fire Detection and Mapping



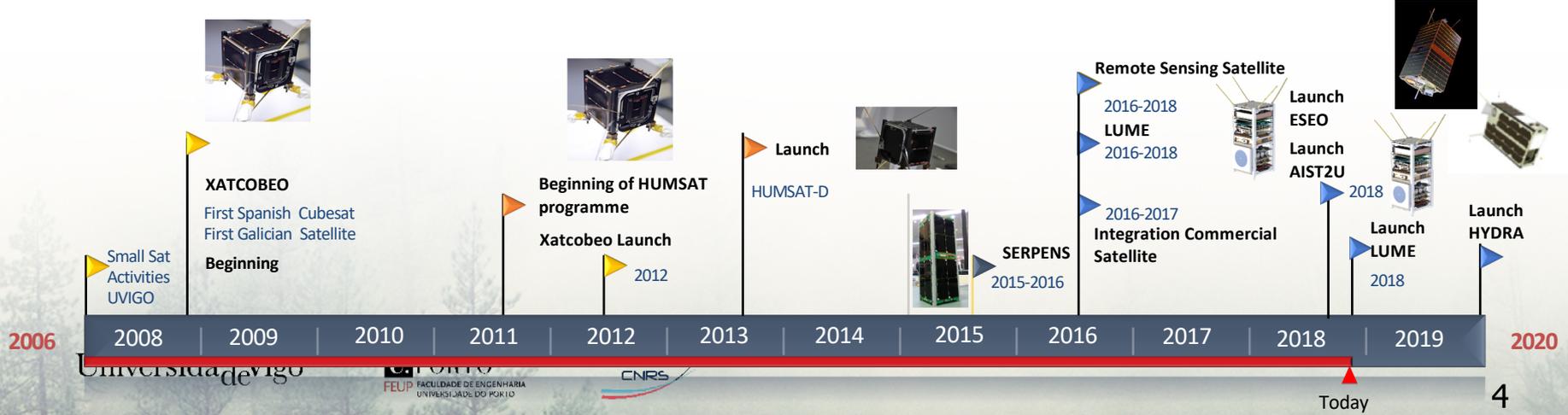
- Mixed Research Unit: Industry 4.0
- HYDRA Remote Sensing Satellites

Research–Industry 4.0 UVIGO/ CINAE



- Commercial AIV
- Constellations

December 2018 - Start-up Alén

2006

2020

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2. FIRE-RS Architecture

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FIRE- RS Project

2.1M€

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LUME-1

- Alarm message:**
- GPS coordinates
 - Time
 - Speed and wind direction
 - Fire extension

- 1**
Infrared camera

- First alarm**
- Autonomous fire detection
 - Initial characterization

2

3

Real time alarm download

Estación Terrena

LAAS CNRS

C>entro de Control



4

- Wildfire SW assessment
- UAV flight plan

UAV

U.PORTO

5

- In-situ data:**
- Detail information
 - Images
 - Nearby population



UAV control center

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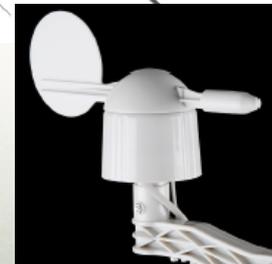
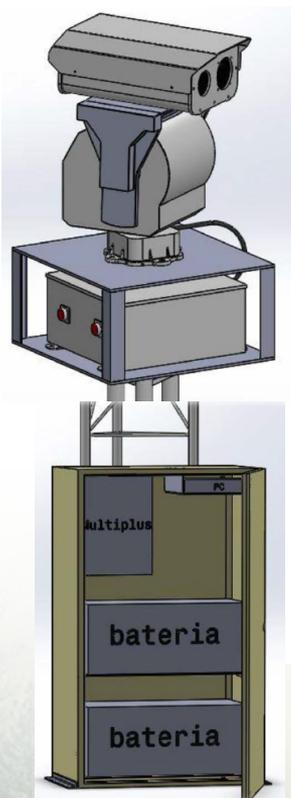
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3. Land Sensors

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3. LUME-1 Satellite

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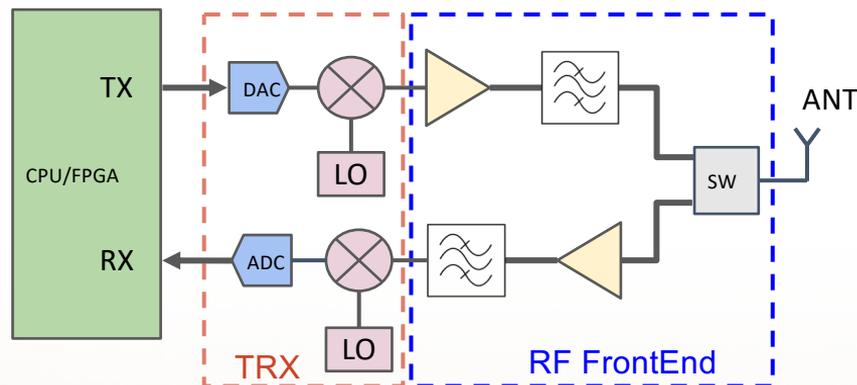
LAAS
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Cubesat Limited resources



Software Defined Radio

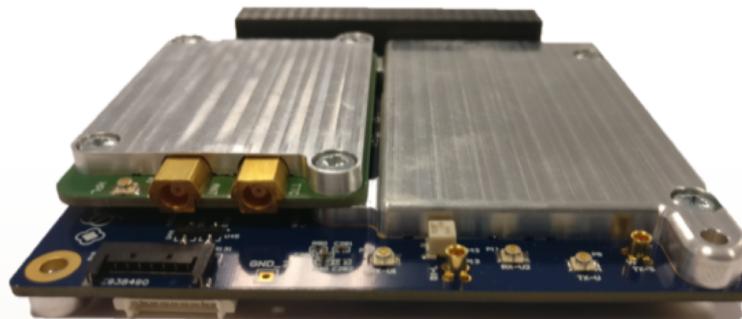
- Radio parameters changed by **SOFTWARE**
- **FLEXIBLE** hardware
- Multi-application platform
- **RECONFIGURABLE**
 - Unexpected conditions
 - Secondary objectives update
 - Last minute bugs...
- Long term design
- Perfect for large scale nanosatellites constellations



TOTEM

High-Performance SDR for nanosatellites

- SoC + WideBand transceiver
- 70 MHz - 6 GHz
 - 2TX & 3RX channels
 - 56 MHz of bandwidth
- 8Gb NAND Flash
- 2x4Gb DDR3L
- 4 Mb MRAM
- Multiple interfaces
 - CAN, I2C, UART, Ethernet, JTAG
- FrontEnd as piggyback
 - 5W @ 30 dBm



OBSW

Features

- TMTC Based on ECSS PUS standard: ECSS-E-ST-70-41C-April 2016.
- Network layers: CSP
- Physical Layers: I2C, SPI, CAN, ...
- Microprocessor architectures: AVR, ARM
- File systems: UFFS, YAFFS, ...
- Operating systems: Linux, FreeRTOS
- Support for critical telecommands
- FDIR

Standard Services	
Request verification	Test
Housekeeping	Parameter management
Event reporting	Request Sequencing
Memory management	
Time management	
Time-based scheduling	
Real-time forwarding control	
On-board storage and retrieval	

Custom Services	
Operations management	
Segmentation protocol	
Payloads and subsystem clients	Integration
	TTC
	EPS
	AOCS
	ADS-B

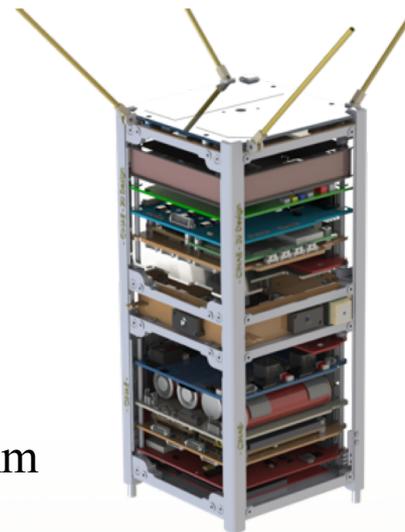
LUME Architecture

Satellite LUME-1 :

- Communication with remote devices M2M-IoT
- Communication with UAVs
- Onboard processing unit

LUME configuration

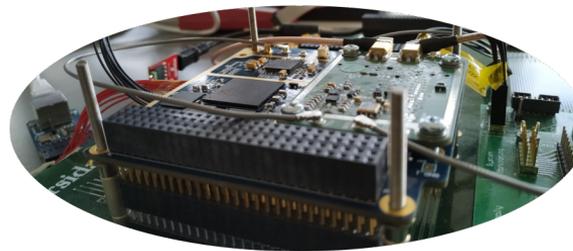
Type: 2U Cubesat
Orbit: SSO Ap: 520 Km Pe: 485 Km
Orbital Period: 94.5 Min
Coms Band: UHF/S-Band/L-Band
Launch: 27-12-2018. Soyuz
Payload: M2M - SDR TOTEM + HUMSAT
Test Area: SUDOE (Galicia + North of Portugal).



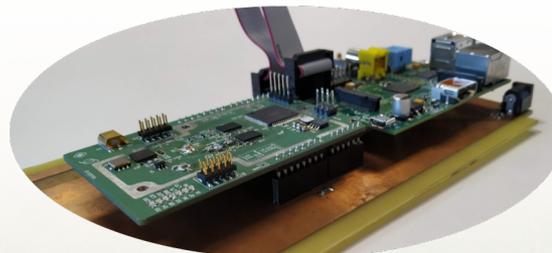
IoT/M2M

- At first, it did not work as expected
- Strong interference in the UHF channel
- Needed to characterize the channel
 - Measure real conditions on ground
 - Build a set up to simulate the same conditions in the laboratory
- Adjust radio parameters and test
- Upload new configuration files to TOTEM
- Current state: **WORKING**
 - 30 dBm in both sides
 - 5 Watts Amplifier for improving link
 - No directive antennas
 - Turnstile in the satellite
 - Dipole on ground

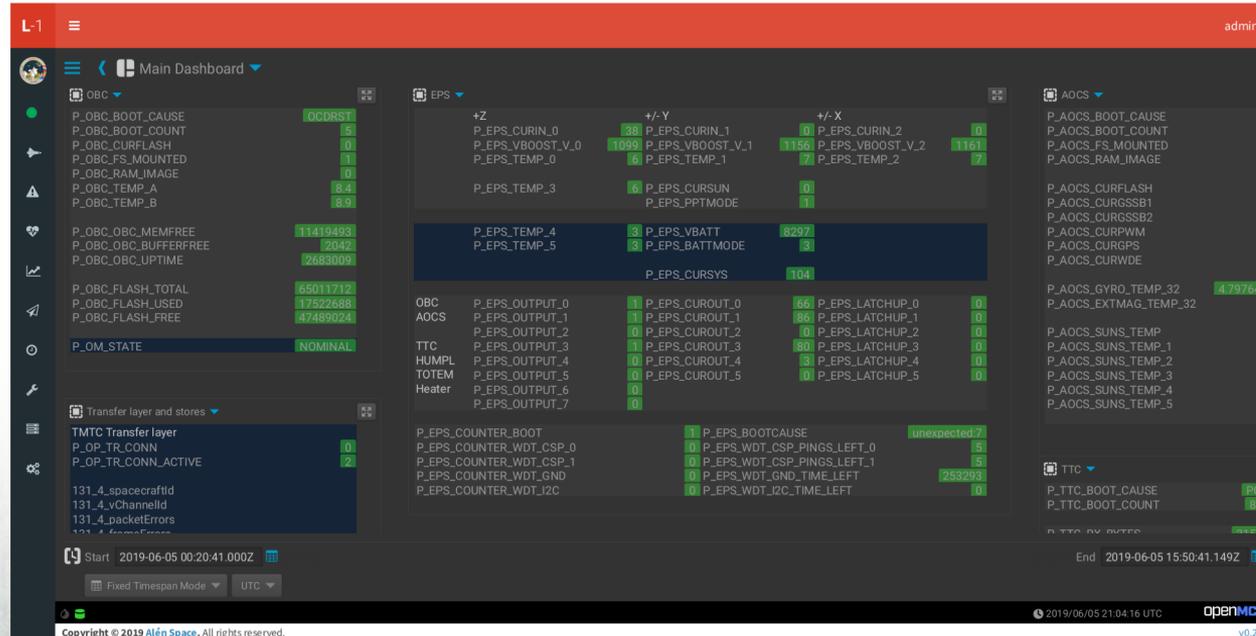
TOTEM-EM



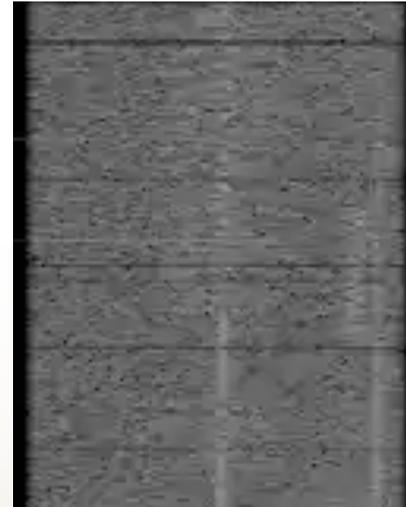
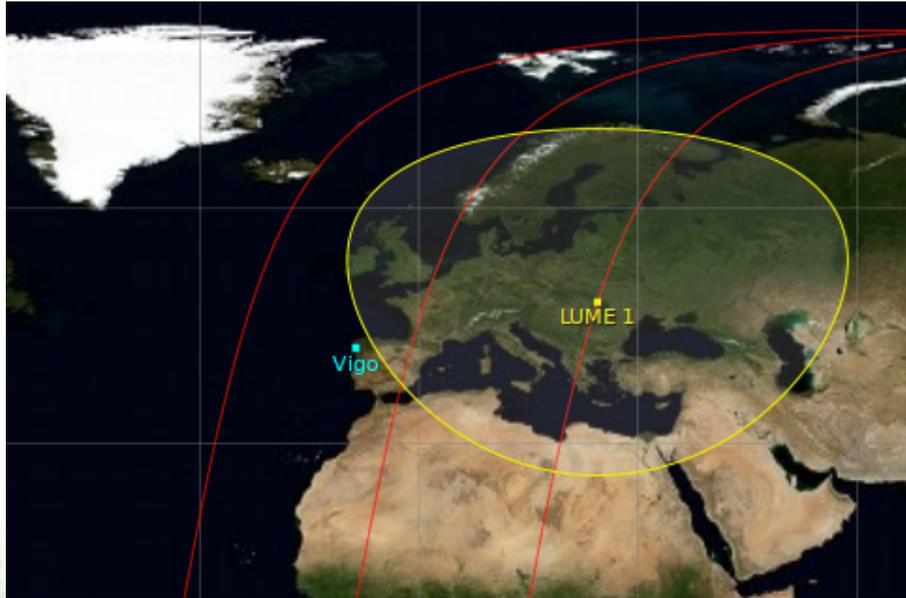
H2O-Terminal EGSE

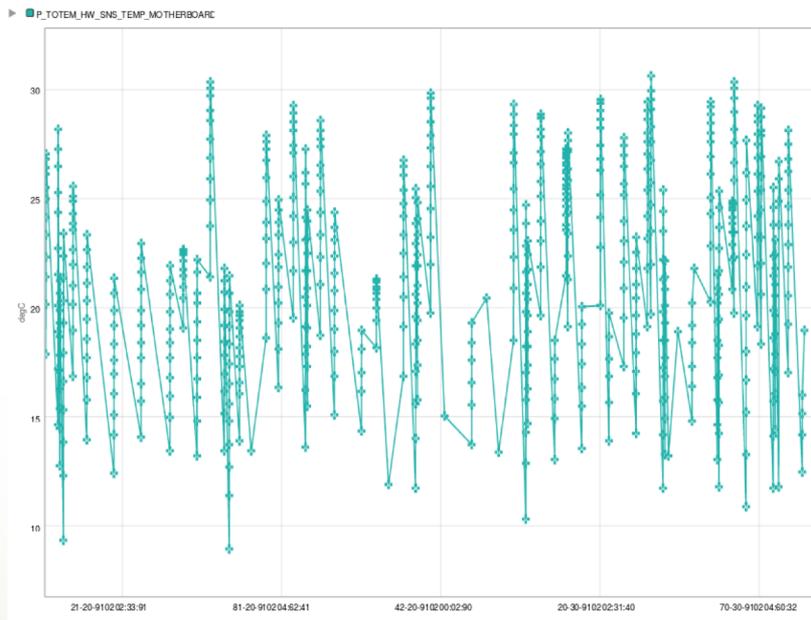
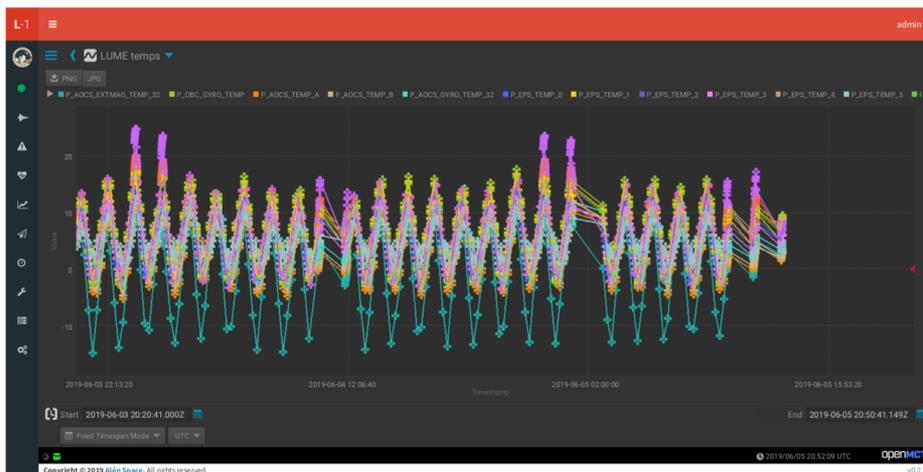


Dashboard: GSSW Features



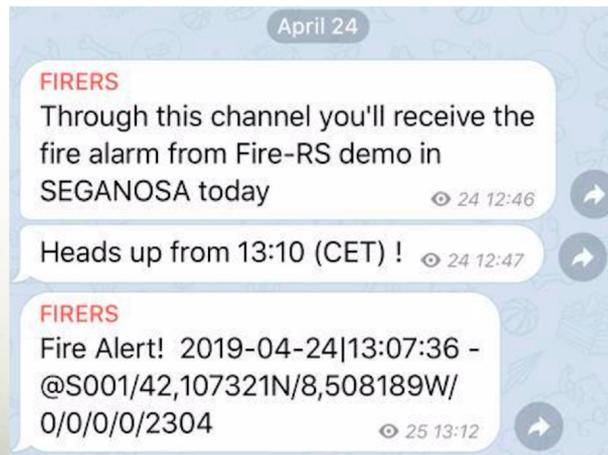
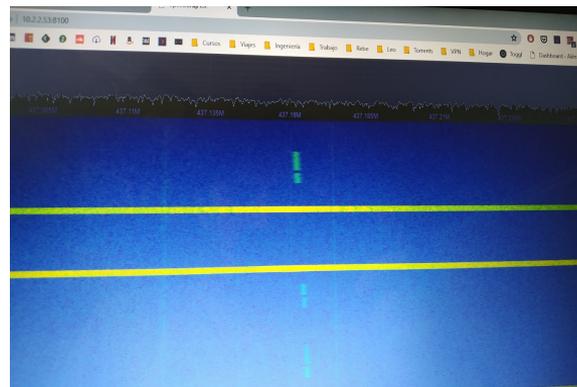
SDR Results





6. Demo Results





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