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ODALISS

SMALLSAT Platform: Applications in Scientific and Technology Research Missions.

ASFAE Workshop

March, 2024

THE COMPANY

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EMXYS is an R&D company which develops and produces embedded instrumentation, data acquisition and control systems for space applications.

R&D laboratory and Administrative premises in UMH Science and Business Park (Elche, Spain)

Alumni of ESA European Space Incubation Initiative (ESTEC, The Netherlands).

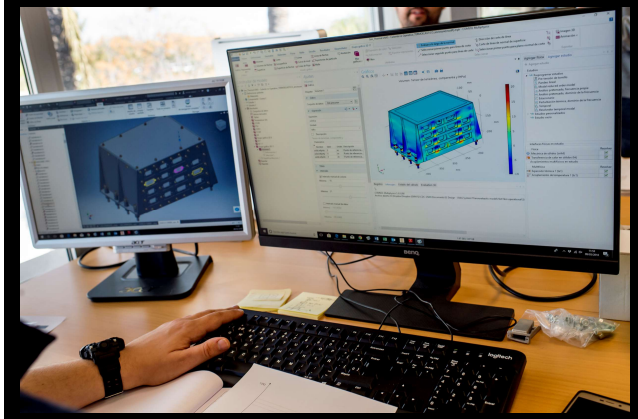
17 Years Experience

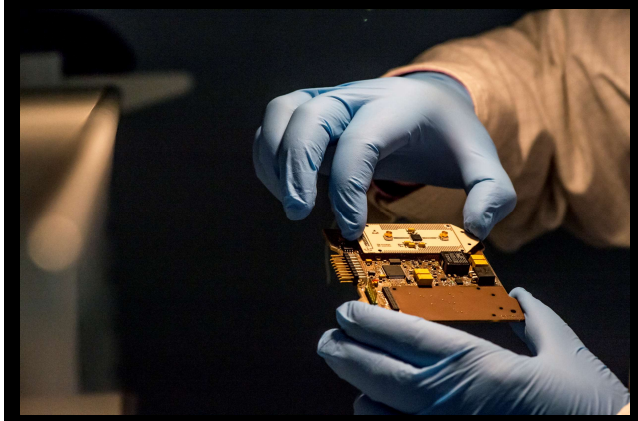
1 Guinness World Record

4 Missions

>30 space projects closed

PRODUCTS AND SERVICES





EMXYS originates technological IP that the company markets under different formulas :

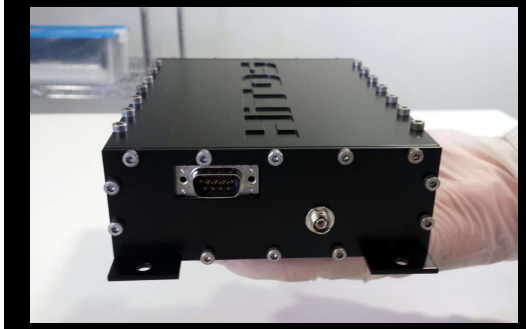
- R&D and ENGINEERING SERVICES.

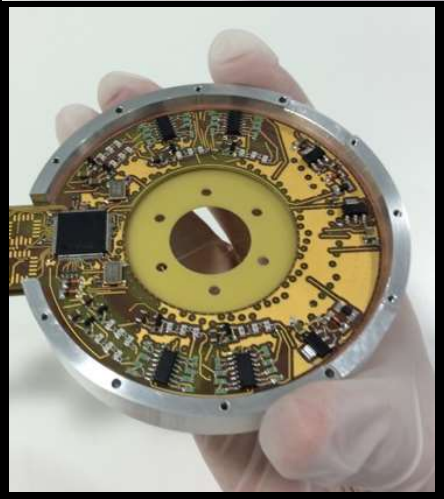
- SYSTEMS AND PRODUCT ENGINEERING
  Design of new customers' products
  Re-engineering of products
  Technology transfer engineering
  Space-like versions of scientific instruments

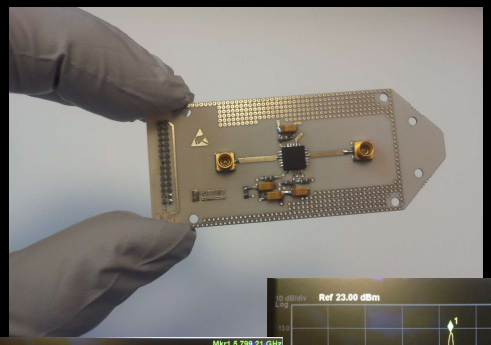
- PROPIETARY PRODUCT LINES.

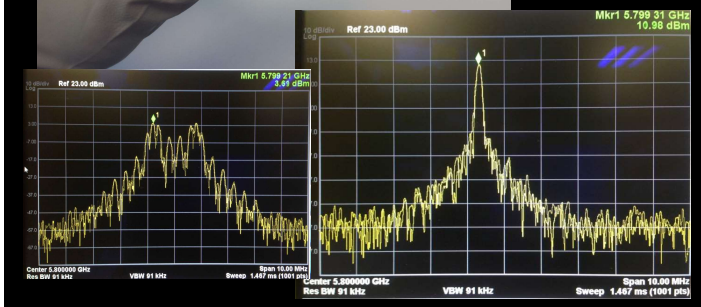
EMXYS markets its own products lines derivated from proprietary technology either directly (Aerospace and Hi-Rel) or under spin-off brands (consumer and industry segments).

CAPABILITIES AND RESOURCES









- In-House Lab for electronics design, assembly and test.
(ESD protected ISO 7 (Class 10.000) 30m^2 integration Clean Room + 80m^2 non-clean research laboratory)

- High speed Digital Sampling station (12Ghz, 5 Ts/s eq.).
- Hardware-in-the-Loop co-simulation workstation.
- CAD design station, physical modelling and Simulation
- ESD protected assembly workstation.
- Programmable logic (FPGA) and microprocessors/MCU development tools (+10 families).

MARKETS

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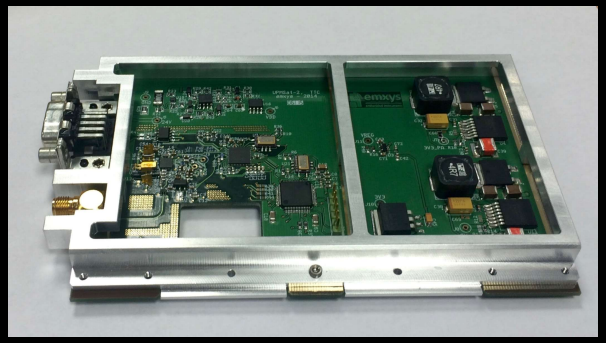


Concerning SPACE ELECTRONICS, EMXYS has expertise in :

- Science and instrumentation payload design.
- ADCS sub-systems.
- PCU/PDU and interface systems.
- MPU and FPGA based systems.
- Bus communication.
- Telemetry (UHF/VHF, S snd C Bands).

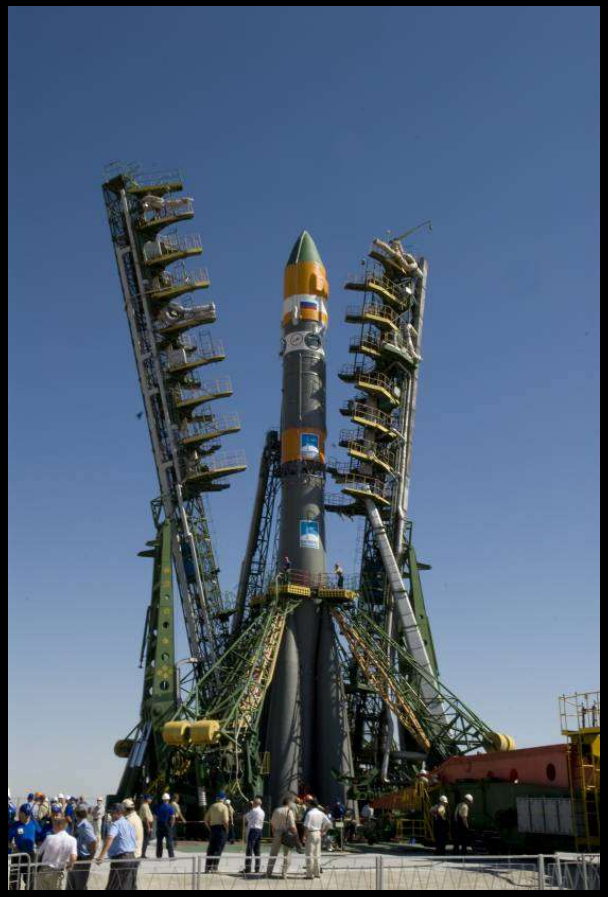
ECSS compliant electronic engineering, Test plans, FMECA, PSA, WCA ...

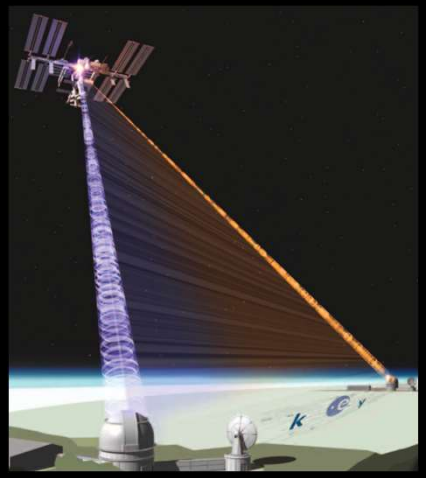
Systems analysis for small missions feasibility studies.

ESA certified PCB assembly & inspection.
AS-9100 ISO-9001 Quality accreditations

ISO 9001:2008 SAE AS9100C:2009
Certificate 45903

PROJECTS





- YES2. (ESA Human Spaceflight & Ed. Office).
- FIBOS payload. (Fiber Bragg Gratings as Optical Sensor Devices) OPTOS Picosatellite scientific payload (INTA).
- HiTOS. High Temperature monitoring system based on Optical Fiber sensors (ESA ITI).
- CLASS. Contactless Angular Sensor for Telecom Satellites long life Mechanisms (ESA ARTES 5).
- **Photonic transceiver for secure space communications (Quantum optics ARTES 5 ESA project).**
- T-REX SS520 Sounding Rocket experiment (JAXA/ISAS-NASA Mission)

PROJECTS

HiTOS
High Temperature Optical Sensors

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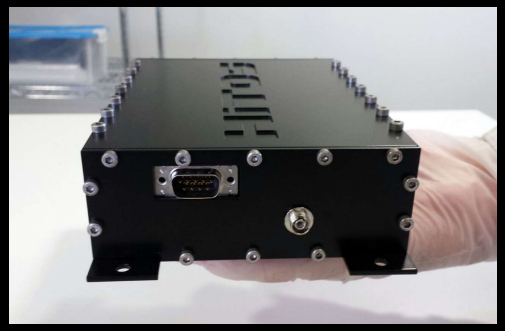

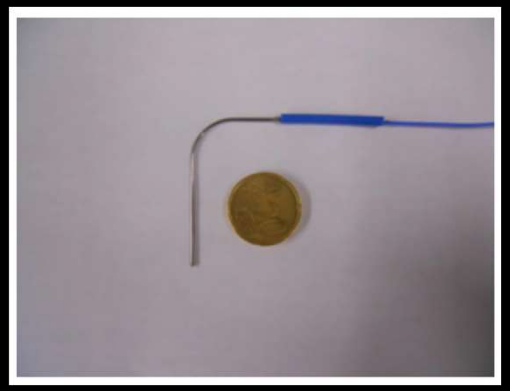

High Temperature Optical Fibre sensors

High temperature monitoring system based on Chemically-Regenerated FBG sensors on optical fibre enabling :

- Serial multiplex.
- Up to 1000 ºC nominal
- Resolution : >1ºC (12pm) at 50ºC/sec
- The project approaches the complete system from interrogation system to packaging/interface technologies.

ESA programs:
ITI Phases A and B completed successfully.
ECI Contract (Pre-Q Model)

MISSIONS

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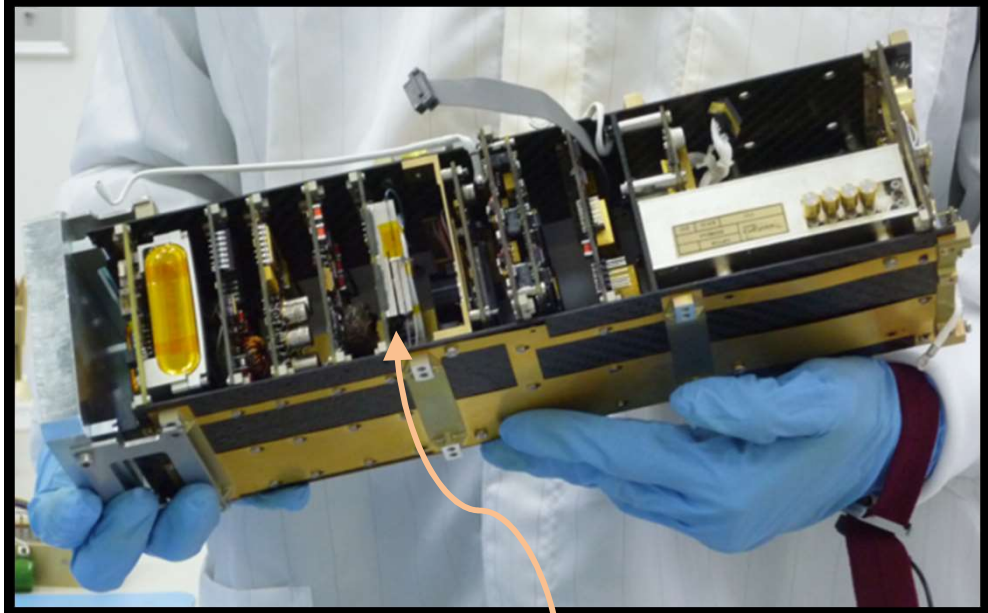
YES2 was successfully launched on September 14th 2007 on FOTON M3 platform.
YES2 experiment was succesfully deployed on September 25th 2007.

MISSIONS



FIBOS Payload integrated in OPTOS satellite inner configuration structure.

FIBOS Fiber Bragg Gratings as Optical Sensor Devices

OPTOS Nanosatellite Experiment
INTA (National Institute of Aerospace Technology)

The objective of FIBOS experimental payload was to demonstrate the performance of a FBG (Fiber Bragg Grating) Optical Fiber-based sensor to measure the internal satellite temperature.

EMXYS developed the FBG sensor readout optoelectronics (interrogation unit) based in a tunable laser source including the active thermal control stage.

MISSIONS

T-REX (Tether-Rocket Experiment was a sounding rocket mission on board a S-520 JAXA sounding rocket, participated by NASA MSFC.
T-REX aimed to demonstrate the operation of an Electrodynamic tether probe in upper atmosphere.
Emxys contributed in the design of the Power system stage and Battery system.

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GRASS Gravimeter for JUVENTAS Cubesat

EMXYS is the prime contractor of the gravimetry instrument GRASS onboard JUVENTAS cubesat, one of the two European cubesats that will visit Dydimos binary asteroid in HERA mission.

EMXYS is responsible of system engineering, mechanical and electronical design of the gravimeter, involving very low noise mixed-signal electronics.

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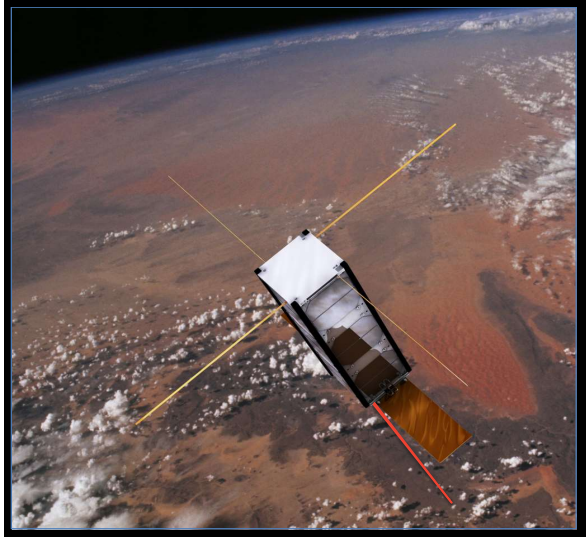

THE SCENARIO :

- Coming satellites and megaconstellations in LEO are facing a critical situation due to the scarcity of RF channels available and demand of computational resources onboard.
- The situation is exacerbated by the data volume demanded by current applications (Big Data based models, IA analysis applications, etc.).
- Optical links are a potential candidate, but existing optical systems are bulky and power consuming

THE SOLUTION :

ODALISS is a Smallsat platform specifically designed for Data-Intensive payloads and to accommodate high Data-Rate communication Payloads (RF and Optical).

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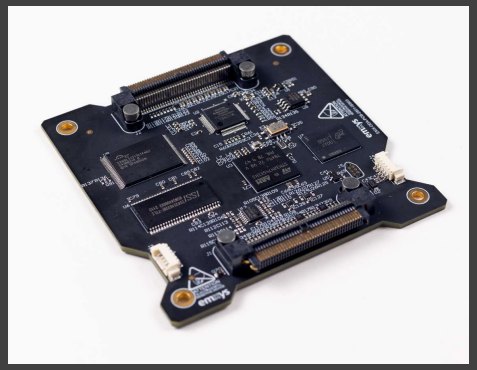
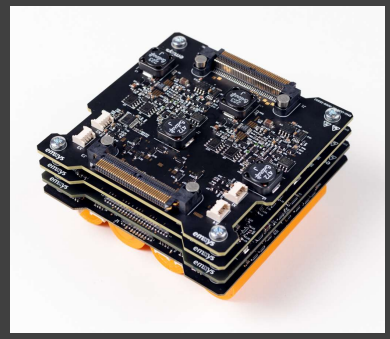


ODALISS On-Board Computer

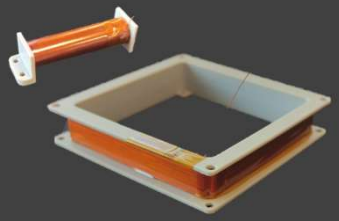
ODALISS
3U cubesat
structure

ODALISS DIPP
Data Intensive Payload
Computer (ICU)



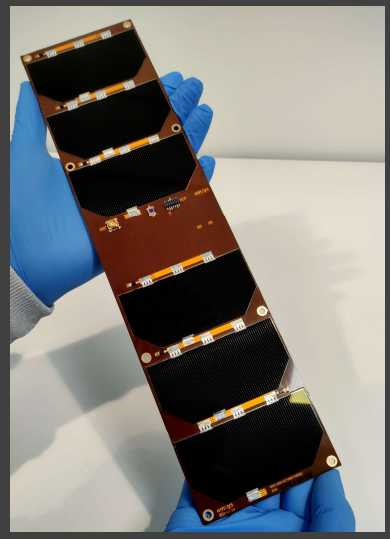
ODALISS PDCU

ODALISS RF Transceiver



ODALISS Magnetorquers

ODALISS Ground Station



ODALISS Solar Panel

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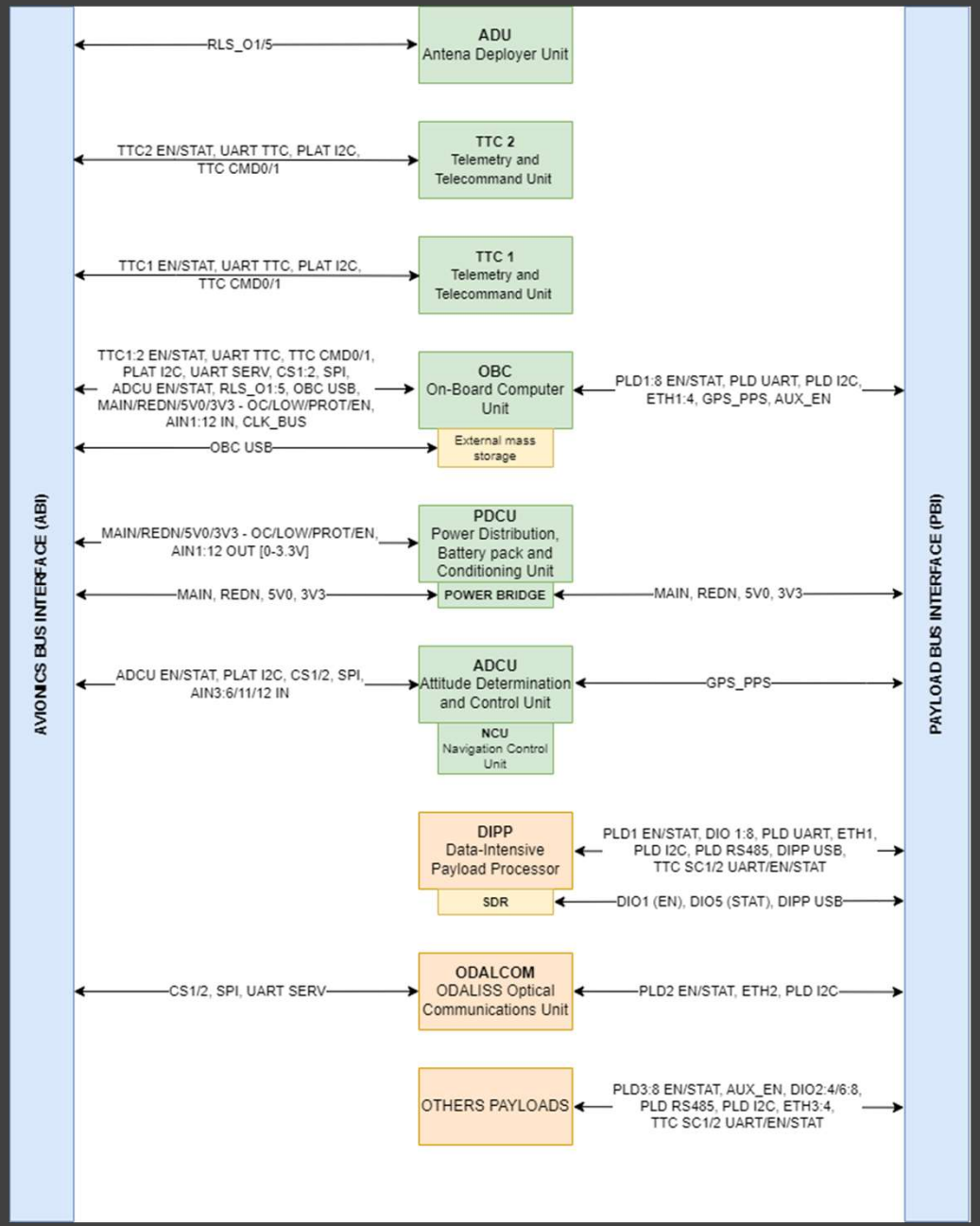

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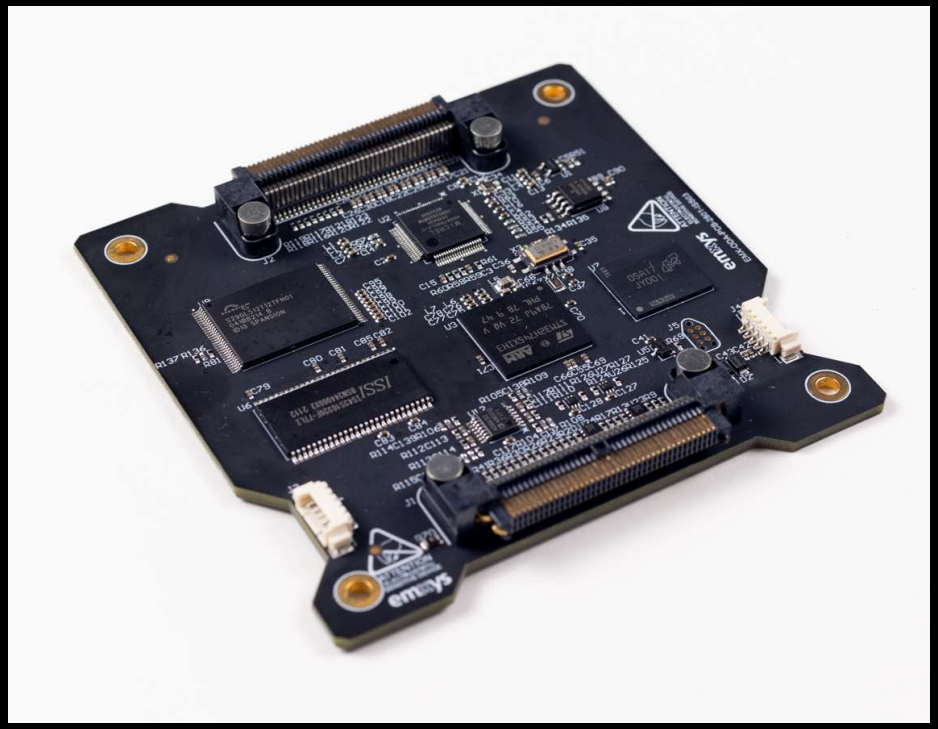

ODALISS On-Board Computer

- Powerful dual-core architecture: Cortex®-M7 for high-performance processing unit, and Cortex®-M4 for mission-critical systems control (480 MHz)
- 10/100Mbps Ethernet switch to seamlessly implement standard TCP/IP backplane LAN with up to 5 nodes.
- Safety-centric architecture including RTC, voltage monitoring, and watchdog.
- Flexible logic interface (UART, RS-485, I2C, etc.).
- Up to 256GB eMMC NAND flash for long-term data storage.
- 64MB SDRAM provides fast access to data.
- 256KB FRAM for critical information.
- 128MB NOR flash

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ODALISS DIPP
Data Intensive Payload
Computer (ICU)

- Versatile architecture based on Xilinx® Zynq®-7000 SoC supports flexible software configuration.
- Ethernet connectivity capable of meeting the highest data processing requirements for data intensive payloads, such as Earth observation cameras, Software-Defined Radios (SDR), scientific instruments, etc.
- FPGA fabric can be reconfigured in Run-Time by processor to increase the digital processing capability of the system.
- Rich set of communications peripherals, including Ethernet, UARTs, RS-485, I2C, USB ports along with GPIOs.
- Memory: eMMC NAND flash or microSD card configurable from 4GB up to 256GB, 1GB or 512MB DDR3L RAM.
- Processor: Dual 667MHz 32-bit ARM® Cortex®-A9.

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ODALISS PDCU

- Four solar array input power channels.
- Modular Li-Ion battery packs.
- 8W nominal power, 36W peak power (per pack for 3U).
- Fully configurable power profile.
- Both unregulated and regulated buses.
- Safety regulated bus for critical power application.
- Battery overvoltage and undervoltage protections.
- Main and redundant independent unregulated buses +7.6V nominal (+8.2V Max.).
- Bus operation in independent or parallel configurations.
- Safety dual battery-powered regulated +3.3V bus (1.5A max.).
- Regulated +5.0V and +3.3V buses (1.5A max. each).

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ODALISS RF Transceiver

- Powered by Cortex®M4 CPU, with a wide set of commands providing configuration flexibility.
- Selectable frequency bands VHF and UHF
- Fully remote configuration capability.
- RX sensibility: -110dBm (BER <10^{-5}).
- Redundant configuration possibility for increased reliability.
- Nominal mode: non-proprietary protocol based on packet radio as AX.25.
- Beacon mode: periodic beacons using 2FSK Radioteletype (RTTY).

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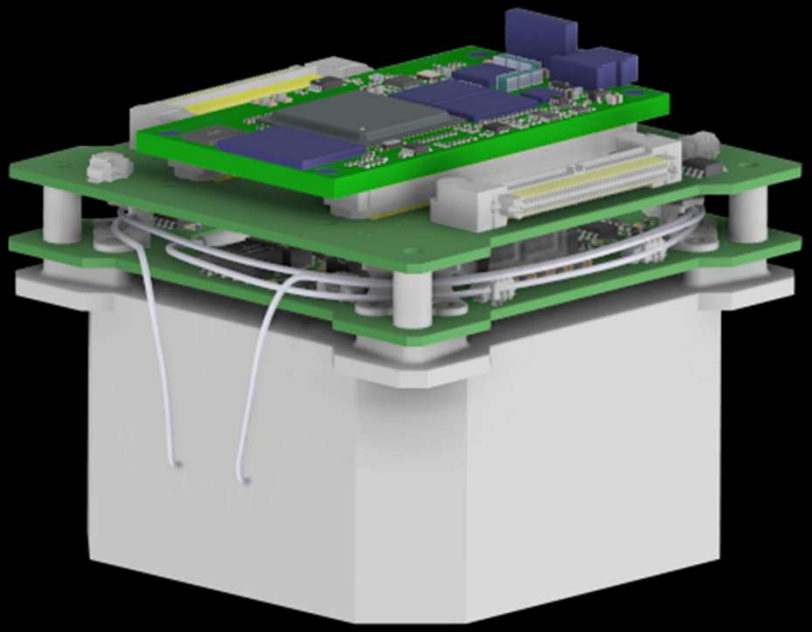

ODALCOM Transceiver

- Mechanisms-Free beam steering and forming.
- 500 Mbps Tx rate.
- Power consumption <3W.
- Volume 1,5 U and mass <1.5Kg.
- Rich and seamless logic interface (SPI, Ethernet, I2C).
- Nominal Optical power transmission: 200mW (23dBm).
- Maximum Optical Transmission Power: 1W (30dBm). 100mW nominal
- Coarse pointing angular beam steering range: 15º (±7.5º), soft and torque satellite actuators.
- Fine pointing angular range: 5.93º (±2.97º) by software optical modulation

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ODALISS RF
Ground Station

- 19-inch rack standard enclosure.
- SDR over Ethernet new state-of-the-art technology will allow to connect to a local Network through a 16-port switch.
- Open-source software for TTC and satellite tracking.
- Connection system implemented by TCP/IP protocol with Ethernet gigabit switch.

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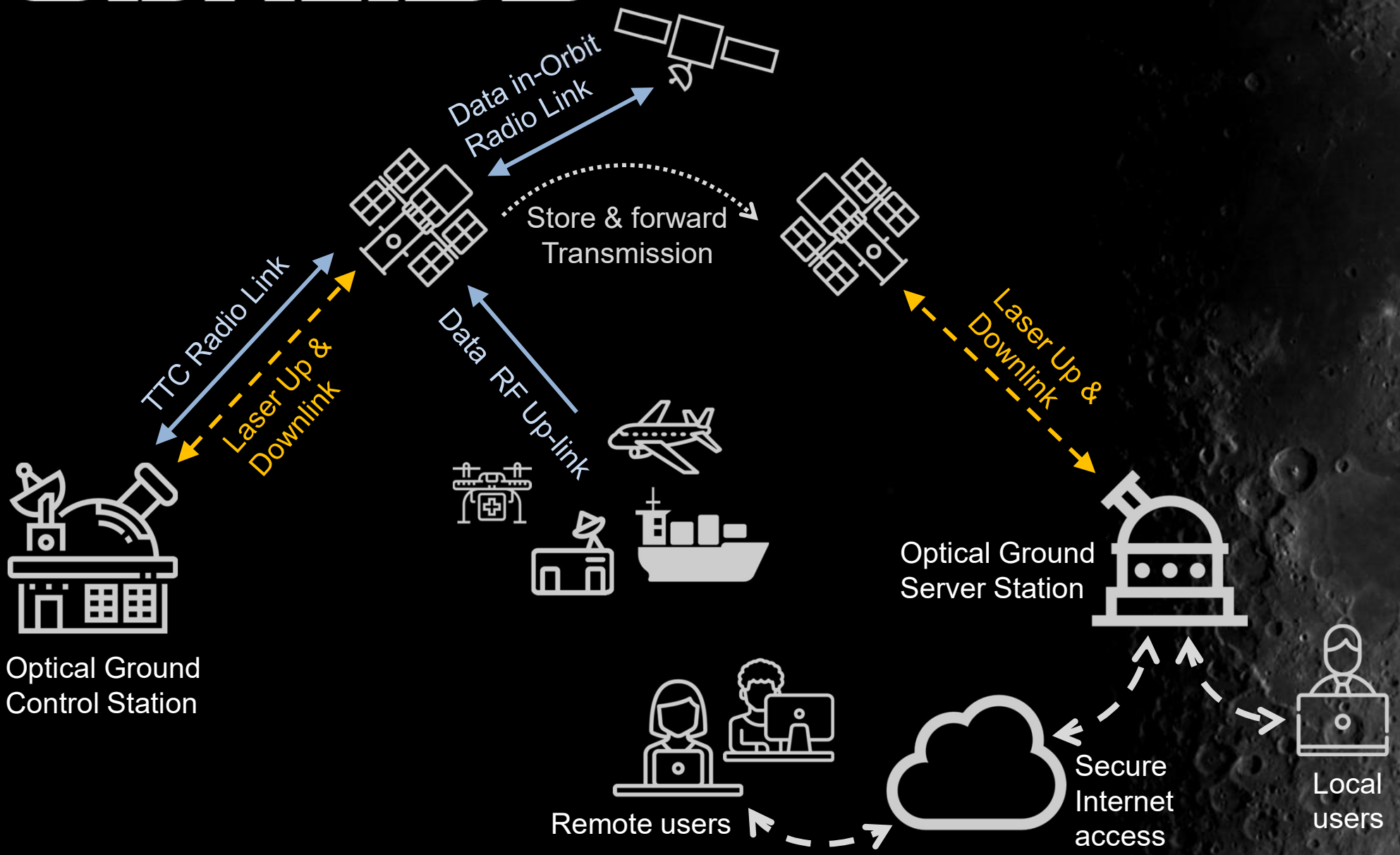

Applications: Atmospheric Physics, Astrophysics, Remote Sensing, …

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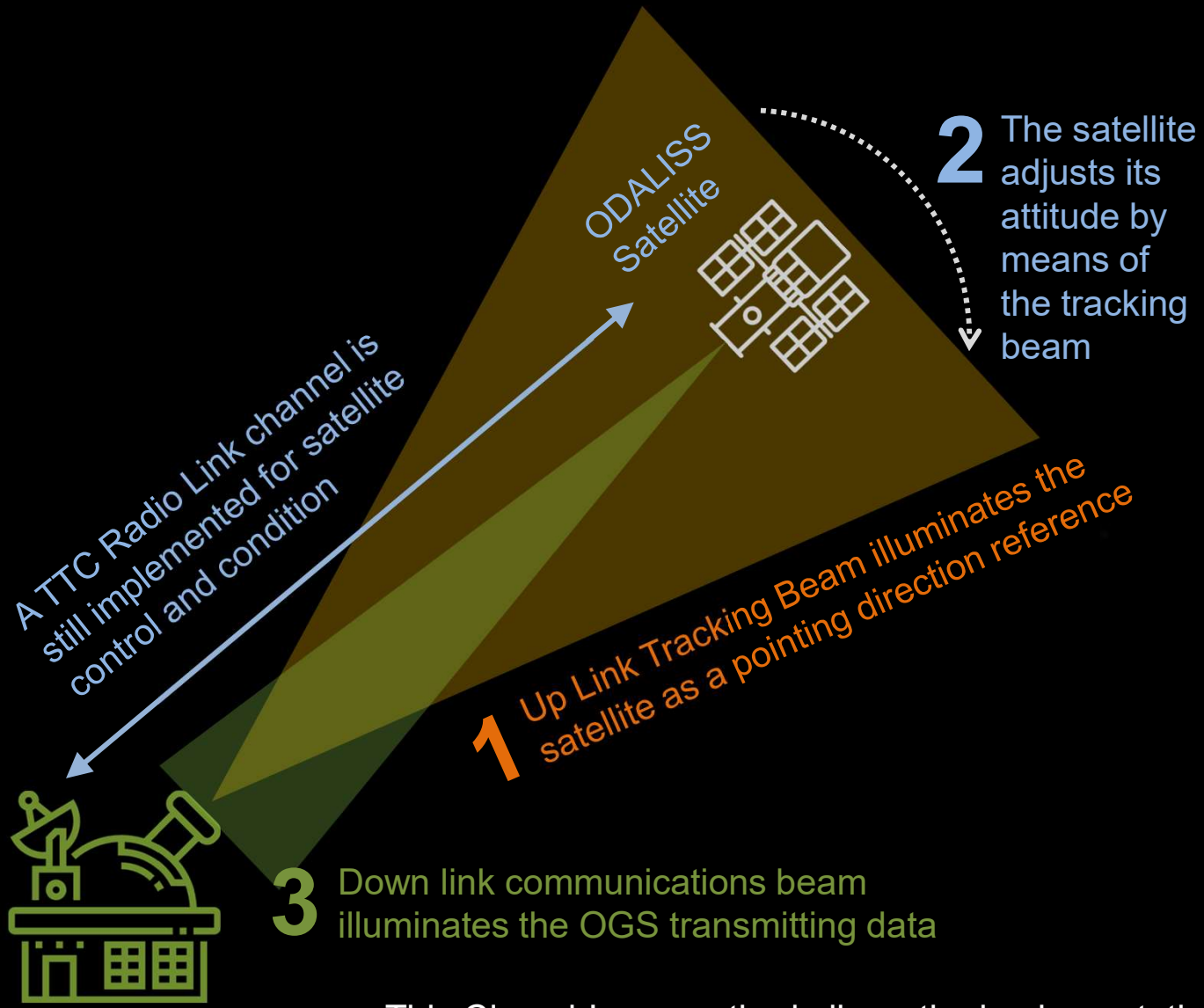

- Mechanisms-Free beam pointing.
- 500 Mbps Tx rate.
- Volume <1U
- Mass <1.5Kg
- Power: 3W
- Optical Power: up to 1W (100 mw nominal)
- Seamless logic interface (SPI, ETH, I2C).

This Closed-Loop method allows the implementation of a precise pointing mechanism without high precision in the attitude control of the satellite, meaning that it can be deployed in small platforms.

Politech.1

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POLITECH.1 is conceived as an enabling mission for Universidad Politécnica de Valencia (UPV) to build up cooperative missions. It is the first ODALISS nanosatellite platform-based scientific mission.

CURRENT UPV PAYLOADS:

- SCHOOL OF GEODESY+ TELECOM ENGINEERING.

Earth Observation telescope camera.
Ritchey-Crètien 3' F5 CMOS APS sensor resolution: 100m

- COMMUNICATIONS DEPT.

Hi-DAC: C-band Down-link deployable patch-antenna

- IFIC Corpuscular Physics Institute (CSIC)

LEON Low Orbit Neutron Detector.

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Thanks for your attention