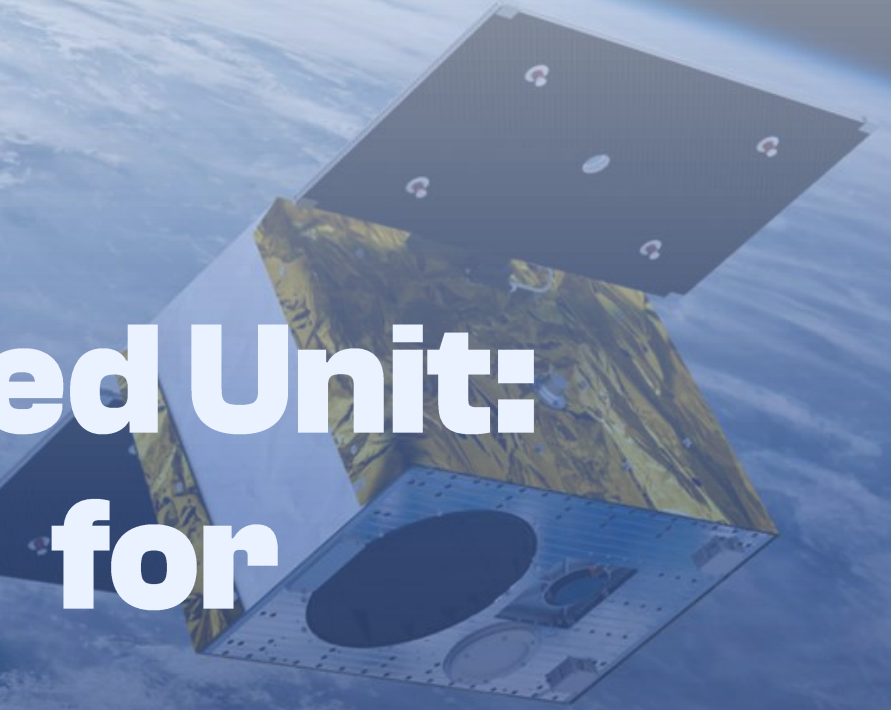




Avionics Centralized Unit: All-in-one solution for satellite platform



EDHPC
OCTOBER 16TH, 2025
JULES WACQUEZ



- 1 **Company presentation**
- 2 **Avionics centralized unit**
- 3 **Redundancy management**
- 4 **Development status**
- 5 **Modular on-board processor**



COMPANY PRESENTATION

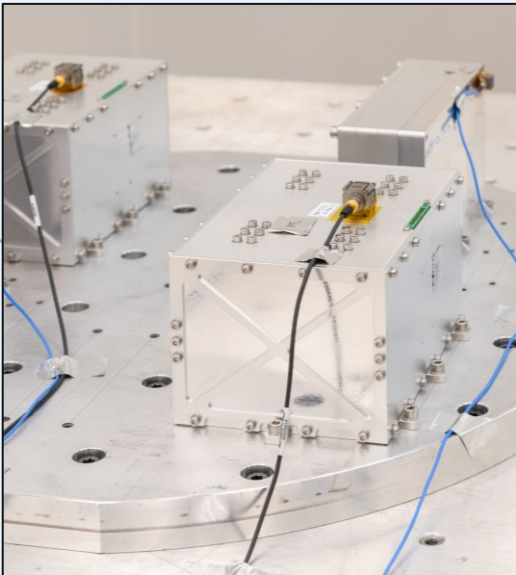
What we do



AEROSPACE LAB ACTS VERTICALLY INTEGRATED SATELLITE SOLUTIONS PROVIDER.

WE DESIGN AND
MANUFACTURE IN-HOUSE

SUBSYSTEMS



USED TO DEVELOP

SATELLITE PLATFORMS



INTEGRATING
PAYLOAD TO DELIVER

TURNKEY SATELLITES



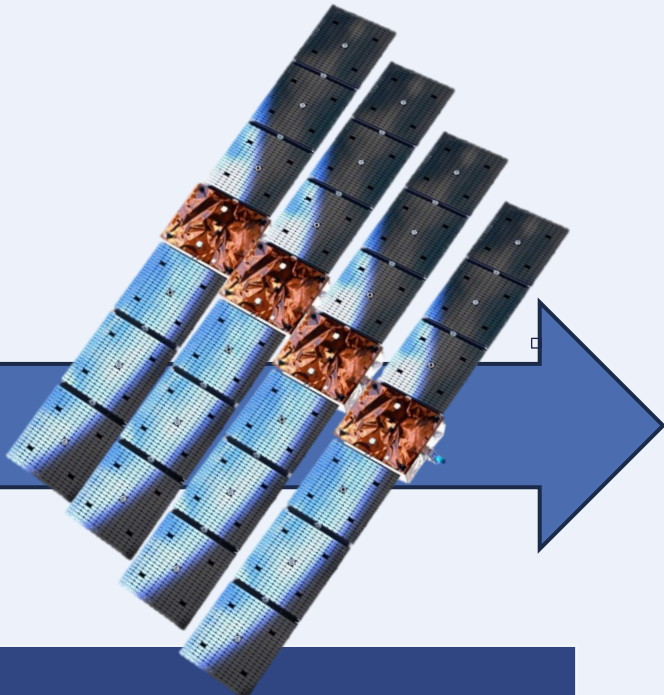
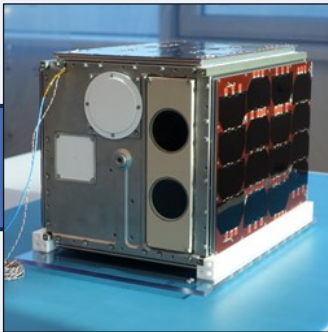
GENERATING
VALUE THROUGH

IN-ORBIT OPERATIONS



Missions & heritage

9 SATELLITES IN ORBIT, AND COUNTING



	GEN 0	GEN 1	GEN 2
Platform	CubeSats 20 - 50kg	VSP platforms 50 – 300kg	VSP next gen 150 – 1000kg
Payload	Optical	Optical VHR Multispectral RF sensing	Earth Observation Telecom
Numbers	2 in flight	7 in flight 14 in production for 2026-2027	+++
Launch Date	2021, 2023	2023, 2024, 2025	2027 +

MEGAFACTORY (Charleroi)

- 500 satellites/year
- Building operational mid-2026



Subsystems portfolio



Flight-proven

POWER



PCDU



BM

AOCS



GNSS

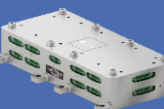


MTM

DATA HANDLING



OBC

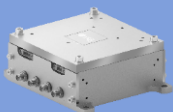


GBES



ROE

COMMS



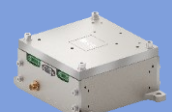
SSDR



SBA TX



SBA RX

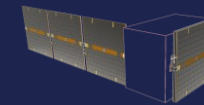


XSDR

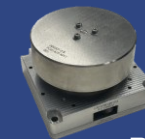


XBA

In development



SAA



RW



EP



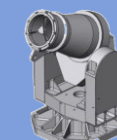
ST



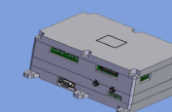
MPC



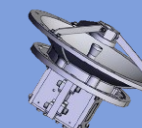
ACU



OCT



KSDR



KBA



ACU: AVIONIC CENTRALIZED UNIT

AN ALL-IN-ONE MODULAR ON-BOARD COMPUTER

ON-BOARD COMPUTER EVOLUTION

GEN 0: Cubesat OBC



GEN 1: OBC-VSP



GEN 2: ACU



> 15 years of cumulated flight heritage

SEE: $62.5 \text{ MeV} \frac{\text{cm}^2}{\text{mg}}$

Linux + Real-time OS

Zynq SoC + Rad-hard uC

TID: 10krad

Cold redundancy

SEE: $62.5 \text{ MeV} \frac{\text{cm}^2}{\text{mg}}$

Linux + Real-time OS

Zynq SoC + Rad-hard uC

Optimized for mass manufacturing

TID: 38krad

Cold & Hot redundancy

SEE: $62.5 \text{ MeV} \frac{\text{cm}^2}{\text{mg}}$

Linux + Real-time OS

Zynq SoC + Rad-hard uC

ACU: An all-in-one modular subsystem

All-in-one subsystem:

- Avionics functions similar across wide variety of satellites
- Ease manufacturing, testing and integration
- Simplification and reduction of the satellite harness
- Greater compatibility and easier utilization for the customer

Modular architecture:

- Mass manufacturing of standard modules
- Reduced development time and NRE
- Easily adapt to the mission needs by swapping and adding modules
- Module definition based on Aerospacelab return of experience and needs for EO and Telecom applications

OBC

On-Board Computer



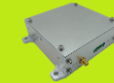
S-SDR

S-Band Software Defined Radio



GNSS

Global Navigation Satellite System



GBES

Gigabit ethernet switch



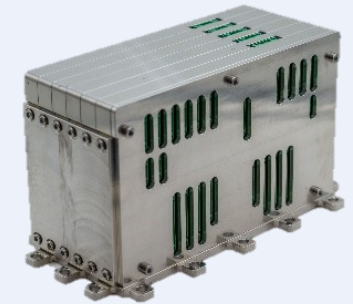
X-SDR

X-band Software Defined Radio



Others

Additional functions TBD



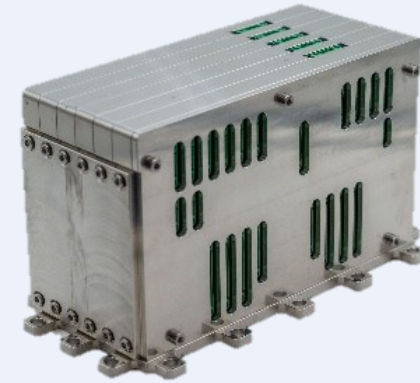
Modules and configurations

Baseline modules:

- On-board computer module:
 - Up to 40x digital interfaces: RS485, RS422, CAN Ethernet, Spacewire, etc
- TT&C transceiver module:
 - S-band (CCSDS + AES256-GCM)
- GNSS module:
 - Galileo E1+E5 & GPS L1+L2+L5
- Thermal management:
 - 64x heaters and temperature sensors per module
- Platform drivers:
 - MTQ drivers, HDRM drivers, Analog interfaces, ...

Future extension modules:

- On-board payload processor with mass memory
- Additional & custom interfaces & IOs
- Custom drivers
- Ethernet switch
- High-rate X-band transmitter
- Other frequencies TT&C transceiver (e.g. X or Ku-/Ka- band)
- High-accuracy timing module
- ...



Minimal configuration
5x modules – 3.5kg

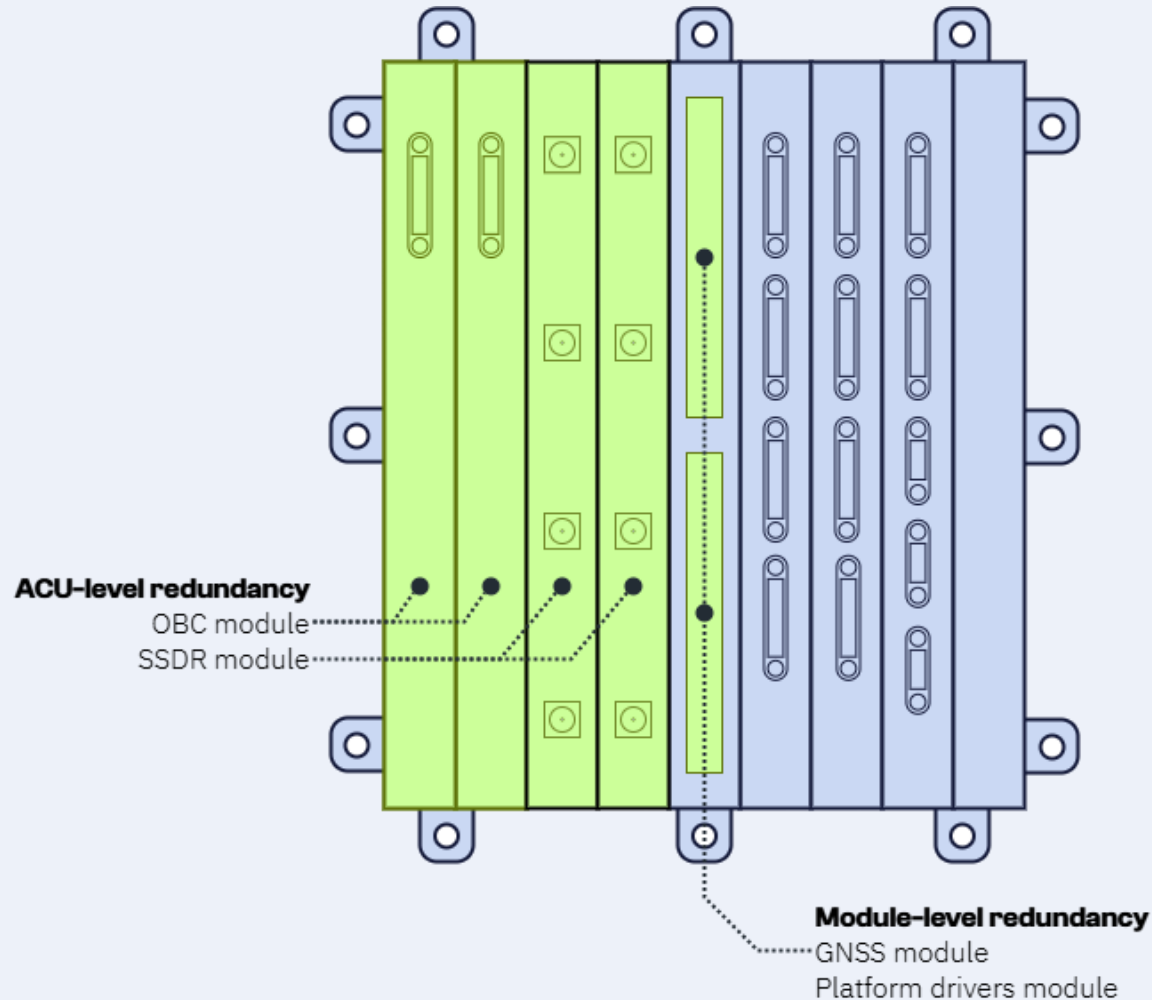


Maximal configuration
14x modules – 8kg



REDUNDANCY MANAGEMENT

REDUNDANCY



Why redundancy?

- Critical for reliability and availability requirements
- Eliminating SPF
 - Protection to prevent failure propagation
 - Thorough FMECA analysis performed to validate robustness to single-failure

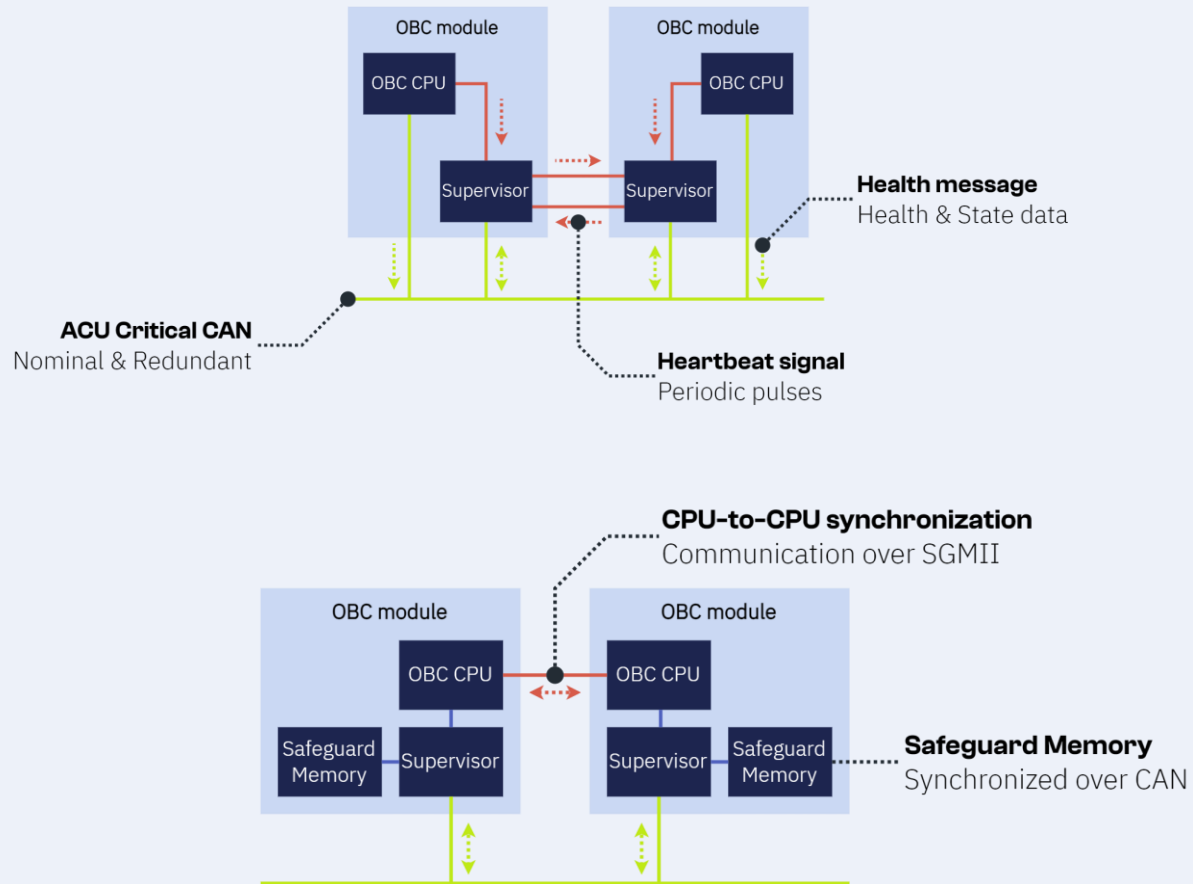
Types of redundancy:

- **Module-level:** Function is duplicated within a module (e.g., GNSS module, Drivers module, Thermal management module)
- **ACU-level:** Complete module is instantiated several times in the ACU (e.g., OBC module)

Modes of redundancy:

- All modules can be used in both hot and cold redundancy based on mission needs
- **Cold redundancy:** reduce wear and maximize reliability
- **Hot redundancy:** reduce down-time and maximize availability

REDUNDANCY MANAGEMENT



Supervisor:

- Rad-hard microcontrollers responsible of:
 - Monitoring CPU health
 - Redundancy management
- Combination of heartbeat pulses and health message

Data synchronization:

- Safeguard memory:
 - Cold and hot redundancy
 - Critical data to safely transition
 - Ex: subsystems health, FDIR configs, etc.
- CPU-to-CPU synchronization:
 - Hot redundancy only
 - Data to enable mission continuity and fast transition
 - Ex: AOCS state, mission timeline, etc.



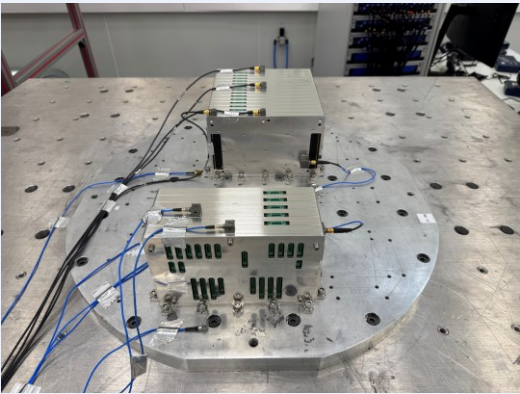
DEVELOPMENT STATUS

DEVELOPMENT STATUS

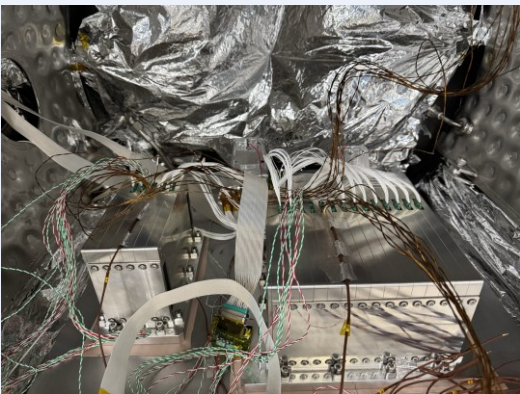
Objective: Reach TRL8 by October 2026

Qualification campaign in June 2026:

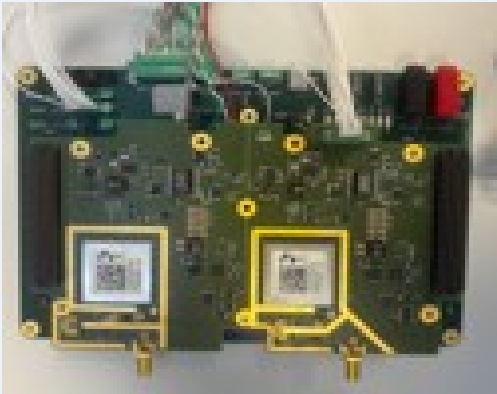
- Electrical, Thermal, TVAC Cycling, Vibration, Shock, EMC
- Qualification of minimal and maximal configurations



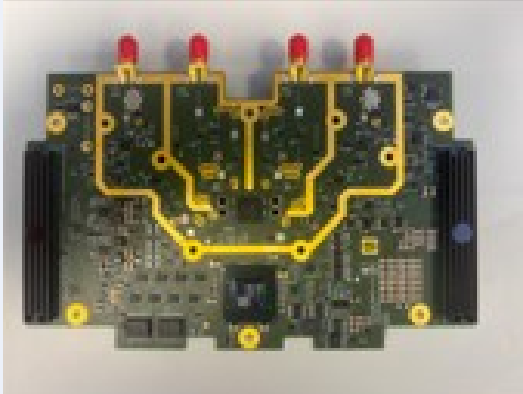
STM test: vibration



STM test: thermal vacuum



GNSS module



SSDR module



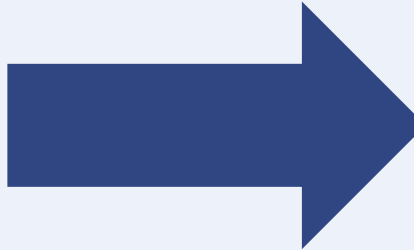
ON-BOARD PROCESSOR

DATA HANDLING UNITS

**COMMAND &
DATA HANDLING**



OBC

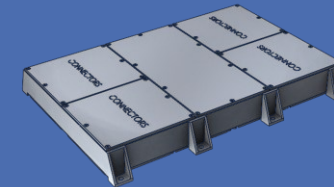
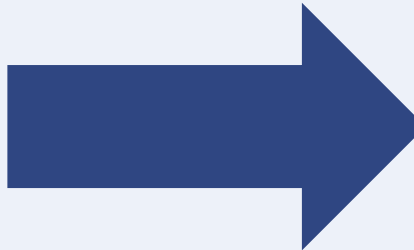


ACU

**PAYLOAD DATA
HANDLING**

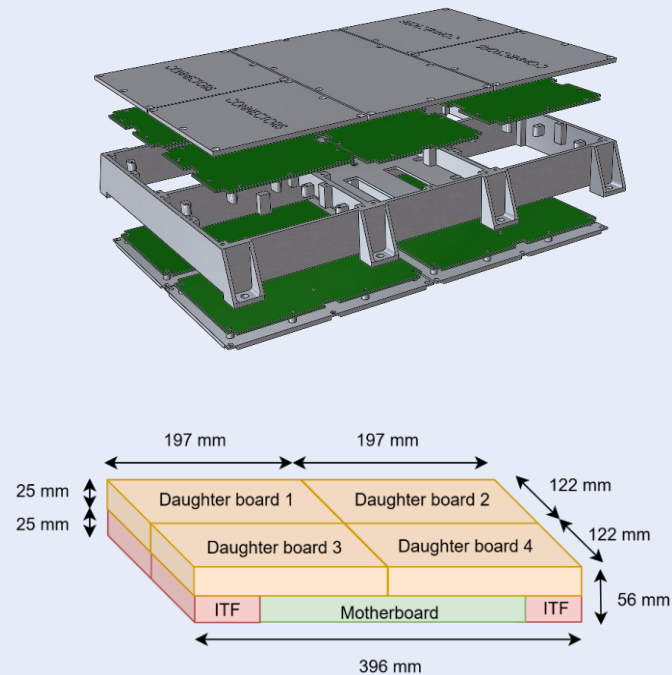


ROE



MPC

ON-BOARD PROCESSOR



Modular hardware

Each *Modular Payload Computer* (MPC) unit is a combination of standard building blocks: Versal FPGA/AI, CPU, GPU, Ethernet 100G+, RFSoc

Optimal thermal design

Designed to be thermally efficient to accommodate state-of-the-art resources, up to 500W

EO and Telecom applications

Computation intensive functions such as regenerative/transparent telecom payload, routing and switching, on-board data processing, change detection, etc.

Scalable

Multiple MPC units combined to implement a complete payload OBP system

ESA funded

Hardware design and qualification part of an ESA ARTES program (2025-2027)



THANK YOU

Thank you to ESA and Belgian delegation for supporting us through GSTP contract