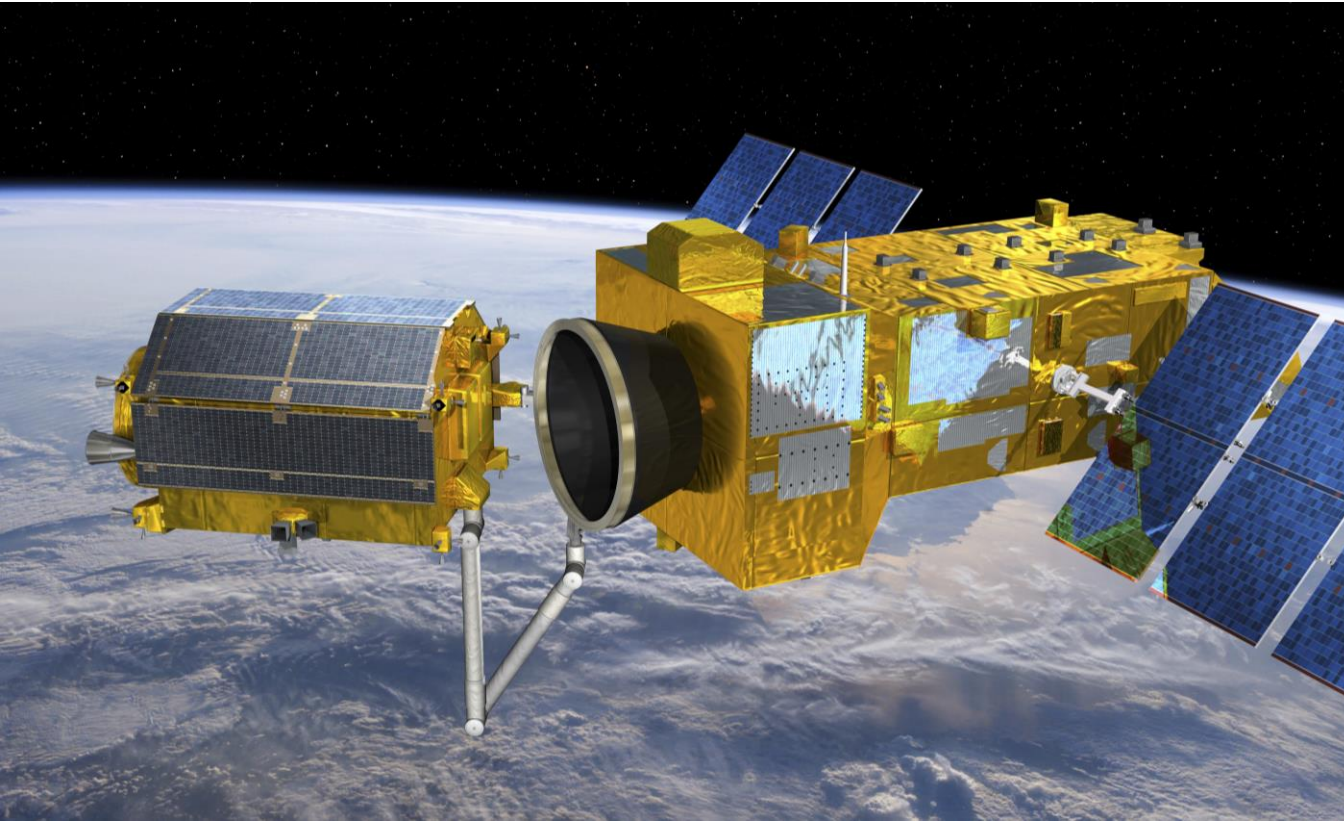


SIROM Roadmap for future In-Orbit Servicing Applications

ASTRA | 18-20 October 2023 | Leiden (The Netherlands)

Context

In-Orbit Servicing and Assembly



Space robotics is one of the key technologies for future European space missions

- In-Orbit Servicing (IOS)
- In-Space Manufacturing & Assembly (ISMA)

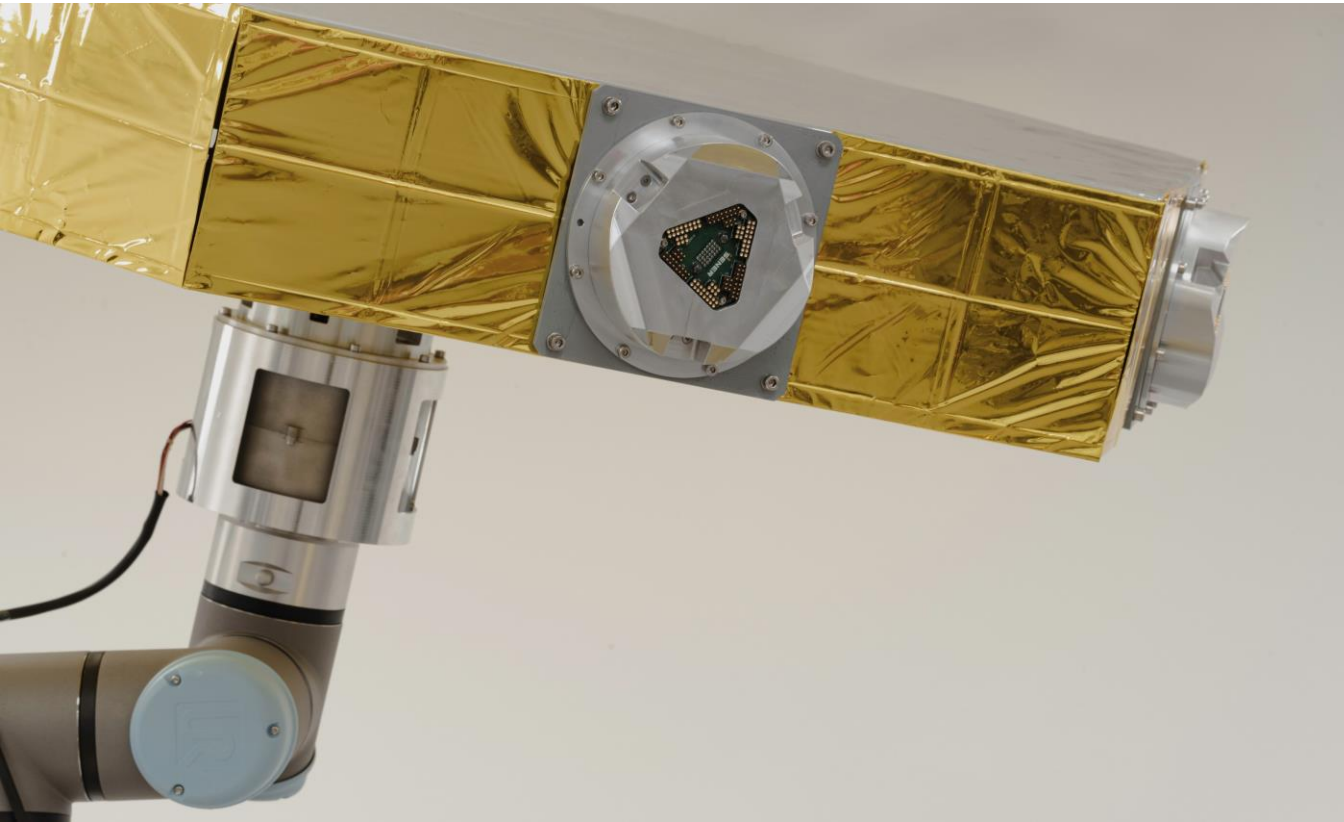
Modular designs: exchangeable modules, cost-effective



Standard Interfaces to connect modules

Context

SIROM development



SIROM developed in the frame of EU's H2020 (OG5) for space robotics missions.

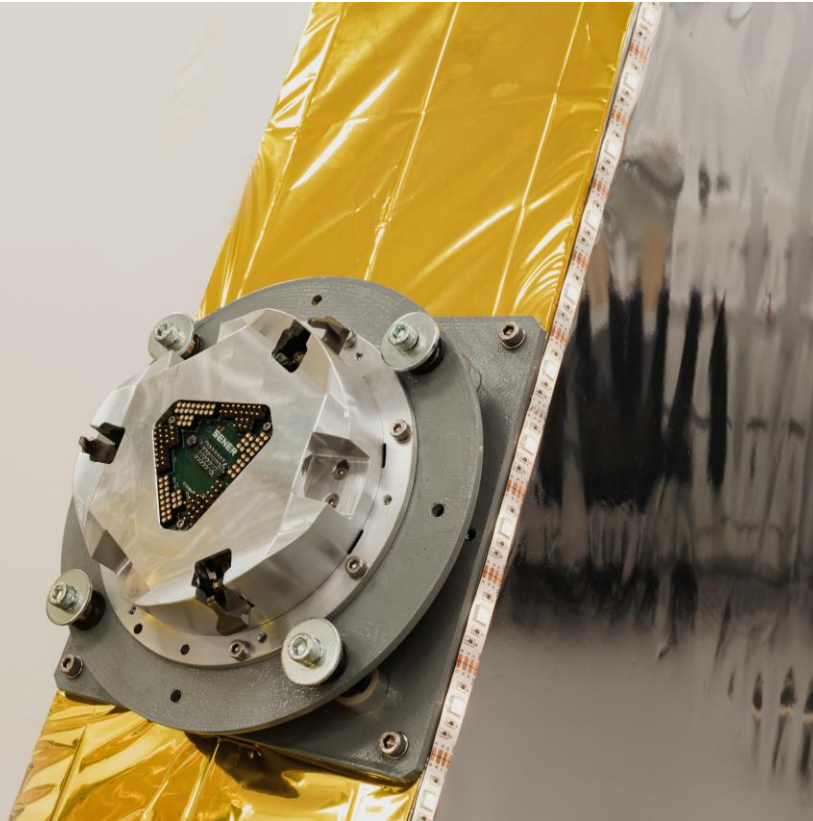
Involvement in European projects:

- EROSS (led by Thales Alenia)
- PERIOD (led by Airbus)
- MIRROR (led by GMV)

Feedback from stakeholders for improvements in the design → New SIROM family of products

Context

Content



- » **SIROM Design Upgrades**
 - Mechanism upgrades
 - Electronics upgrades

- » **Family-oriented product**
 - Family E
 - Family F
 - Family G

- » **Flight adaptation**
- » **Refuelling IF validation**
- » **On-going projects & timeline**

SIROM Design

New families

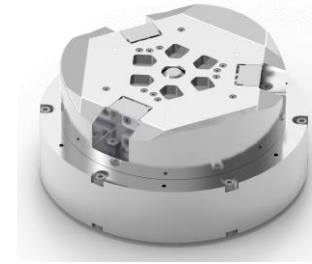
Redesign of SIROM into 3 families:

- Family E: data & power transfer
- Family F: fluidic transfer
- Family G: fluid, data, and power transfer

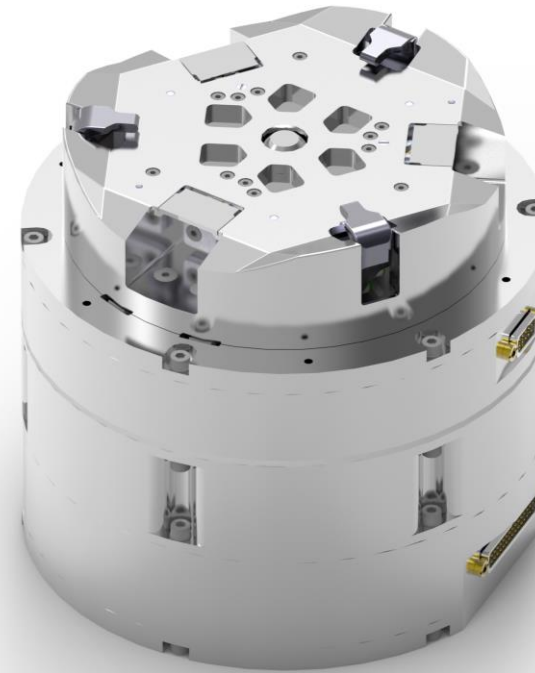
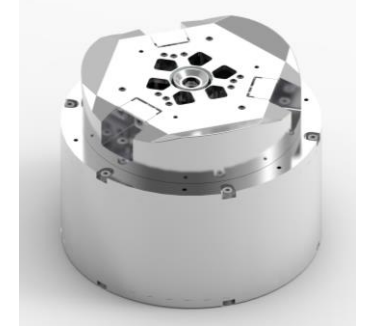
Aspects for improvement:

- Family-oriented design → Less cost, lead time
- Refuelling interface → New applications
- Design for flight → IOD foreseen for 2026

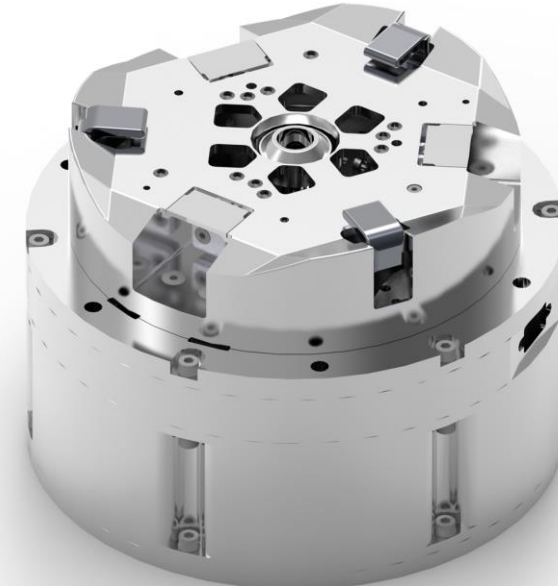
SIROM E (Passive)



SIROM G (Passive)



SIROM E (Active)



SIROM G (Active)

SIROM Design

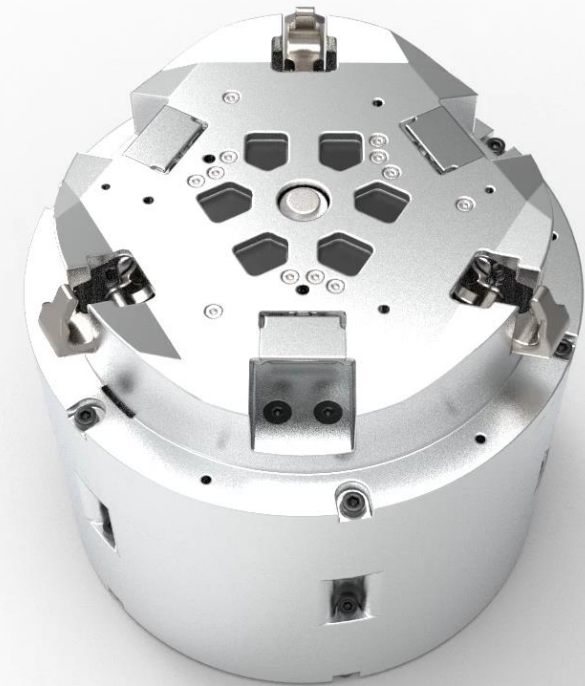
Mechanism upgrades

Mechanism

- ESD Cover to protect the POGO pins
- Second actuator (BLDC) to pull the cover
- Pushing rod in SIROM E to pull passive covers
- Fluid connector deployment in SIROM F/G
- Latches upgrade to allow higher forces

Sensors

- Redundancy for position hall sensors
- Proximity sensors as navigation aid

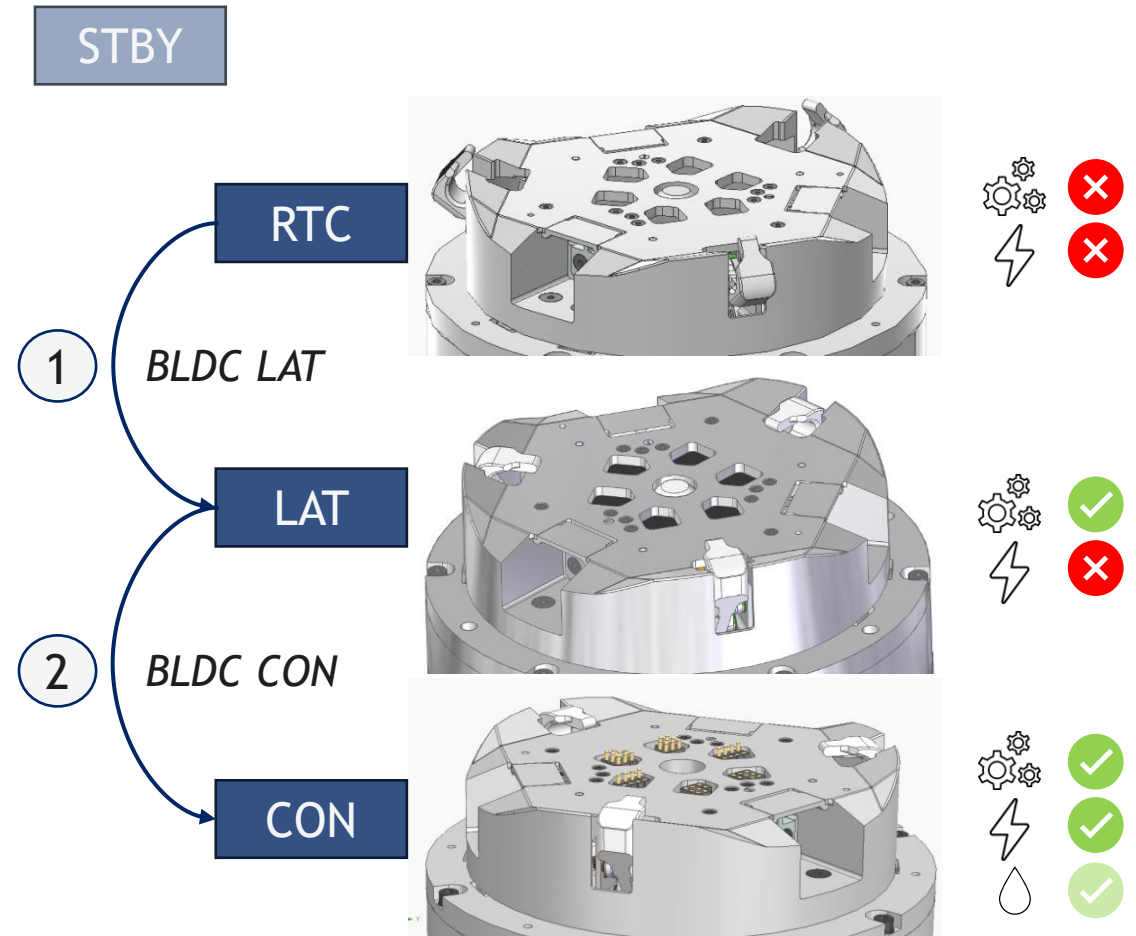


SIROM Design

Electronics upgrades

- New state diagram for SIROM operation, common for all families
- Modified circuits for additional motor driver and sensors
- Single PCA for reduced volume
- Integrated or external unit for SIROM E
- New power block to add configurable power supply rails
- More powerful microcontroller

Breadboard model of electronics already tested at functional block level



SIROM Design

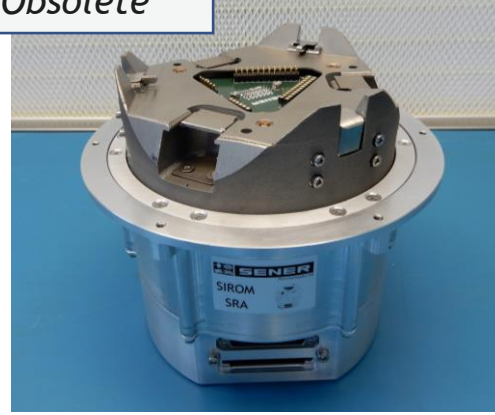
Family oriented product

Manufacturing process → High lead times and costs → New families with shared elements to minimize problem

- SIROM E: “evolution” of SIROM C
- SIROM F: concept for refuelling
- SIROM G: SIROM E+F

Fluid connector forces external electronics unit.

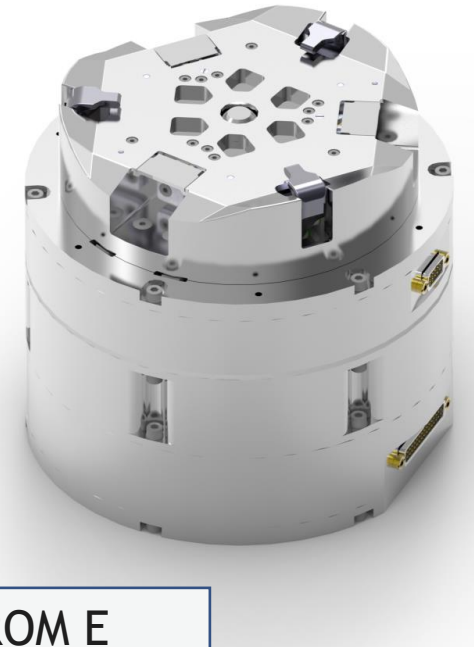
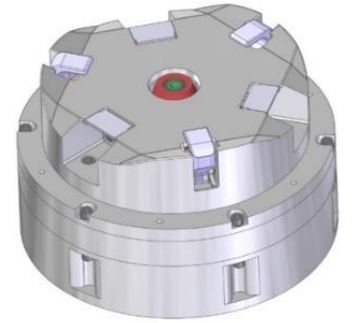
SIROM B
Obsolete



SIROM C
Ground demos



SIROM F
Fluidic



SIROM E
Electrical



SIROM G
Electrical / fluidic

SIROM Design

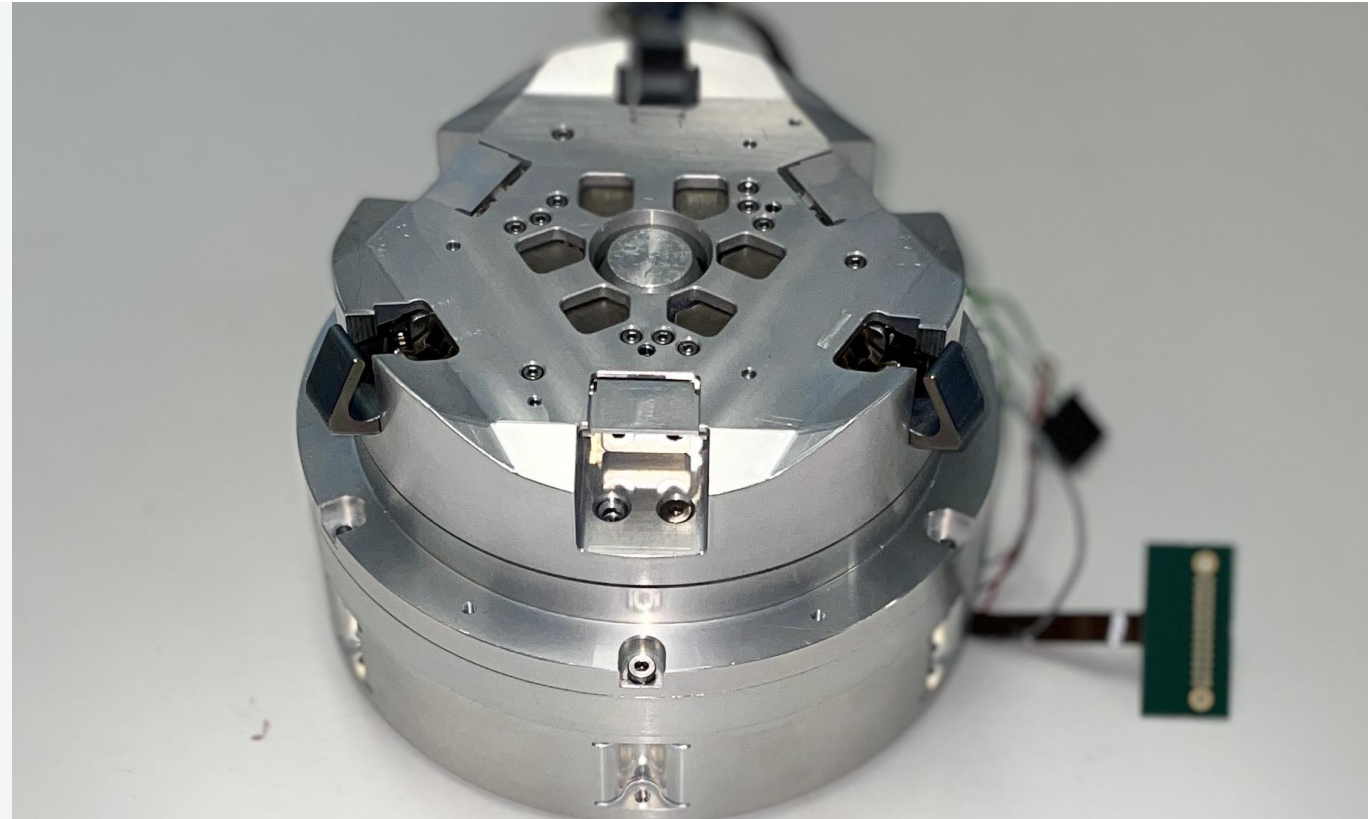
Refuelling validation

Design & Prototype

- Fluid connector from SENER's RIDER
- Prototype for SIROM E with pushing rod
- Assembly in 2023 → Decision to split operation in two stages

Remaining tests for 2023

- Seal selection and leakage tests
- Misalignment test
- SIROM G included in EROSS IOD



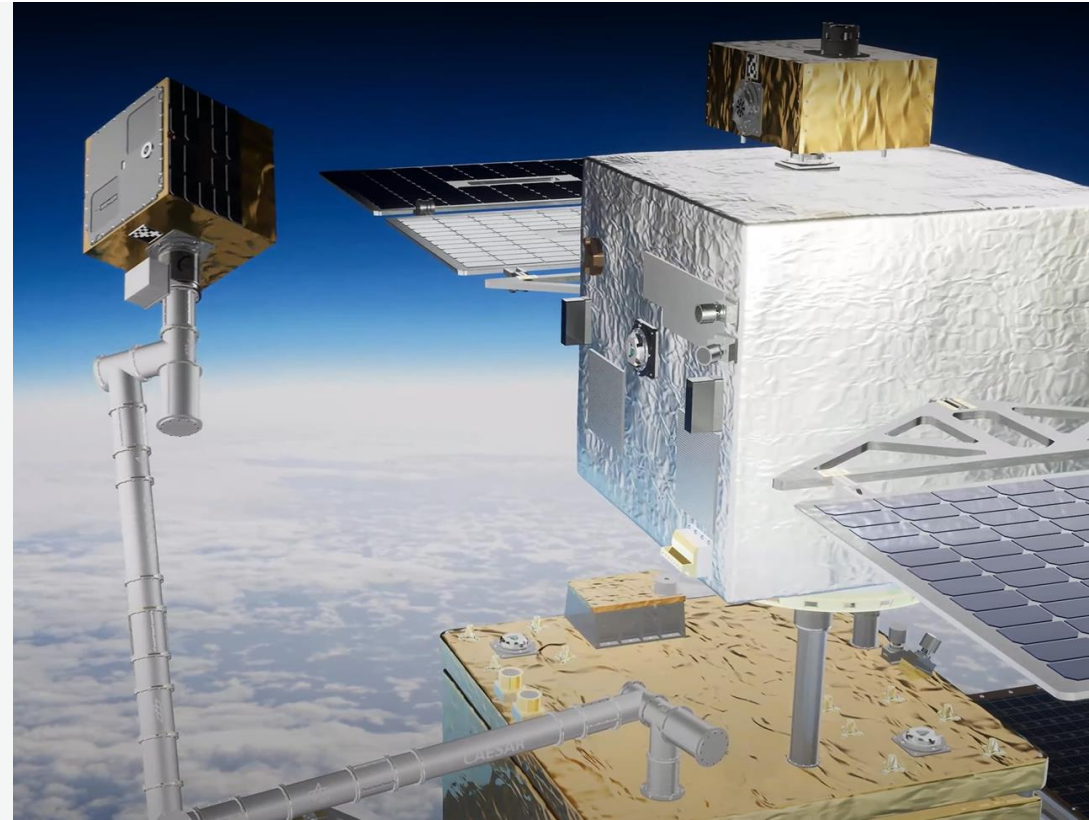
Development of a robotic Fluid Transfer interface based on RIDER connector (Gonzalo Guerra, ASTRA 2022)

SIROM Design

Flight adaptation

Main objective: prepare design for flight applications

- ESD cover for protection
- Flight actuator (New space)
- Rad-tol EEE selection (New space)
- External electronics (Cubesat)
- Docking simulations for free-flying capture



Courtesy of Thales Alenia Space

 *Mathematic modelling, simulation, test and correlation of a capture before contact docking mechanism (Alejandro Lázaro, ESMATS 2023)*

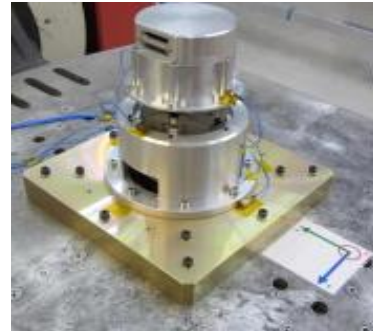


SIROM Roadmap

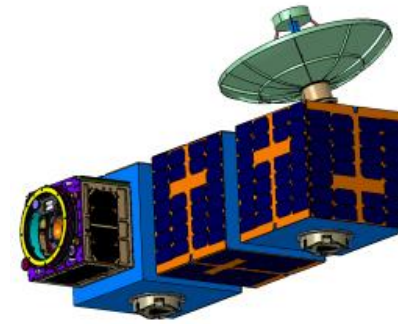
Past & future projects



SIROM TRL 4
SIROM Family A



SIROM TRL 6
SIROM Family B



New scalable satellites
HORIZON EUROPE ORU-BOAS



2016

2017

2018

2019

2020

2021

2022

2023

Future

Common Building Block
H2020-OG5 SIROM

IOS Demo Application
H2020-OG7 EROSS

Large reflector assembly
ESA - MIRROR

ISMA Demo Application
H2020-OG12 PERIOD

In-Orbit Demonstration
HORIZON EUROPE
EROSS IOD

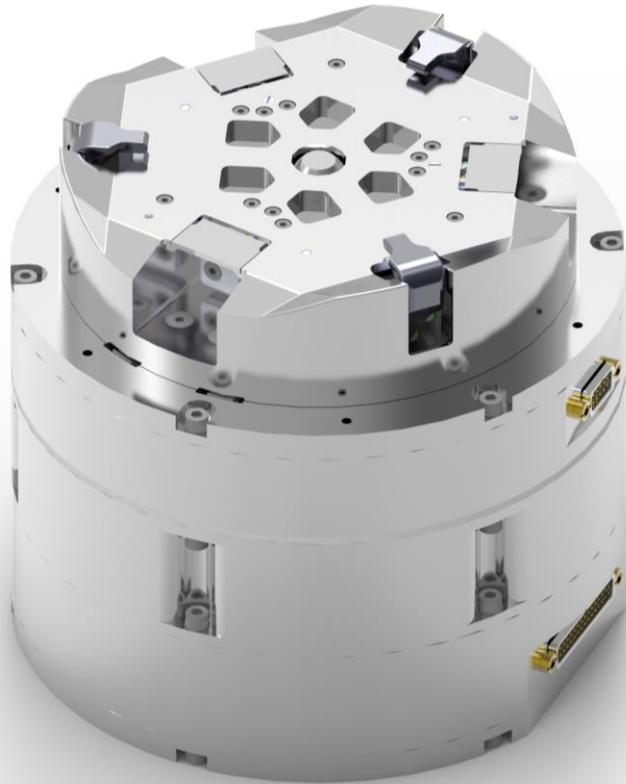
ISMA Demo Application
ESA - ISAAC

EROSS IOD
Orbital RDV and servicing
(IOD foreseen in 2026)

ORU-BOAS
Development by SENER for modular satellites

ISAAC
Demonstration of ISMA of large structures

Conclusions



In the past two years, several improvements have been made towards future in-orbit applications

SIROM is present in different European IOS and ISMA projects that will help to gain valuable insight from stakeholders

Standard Interfaces is a necessary building blok for the future of space robotics



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THANK YOU

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