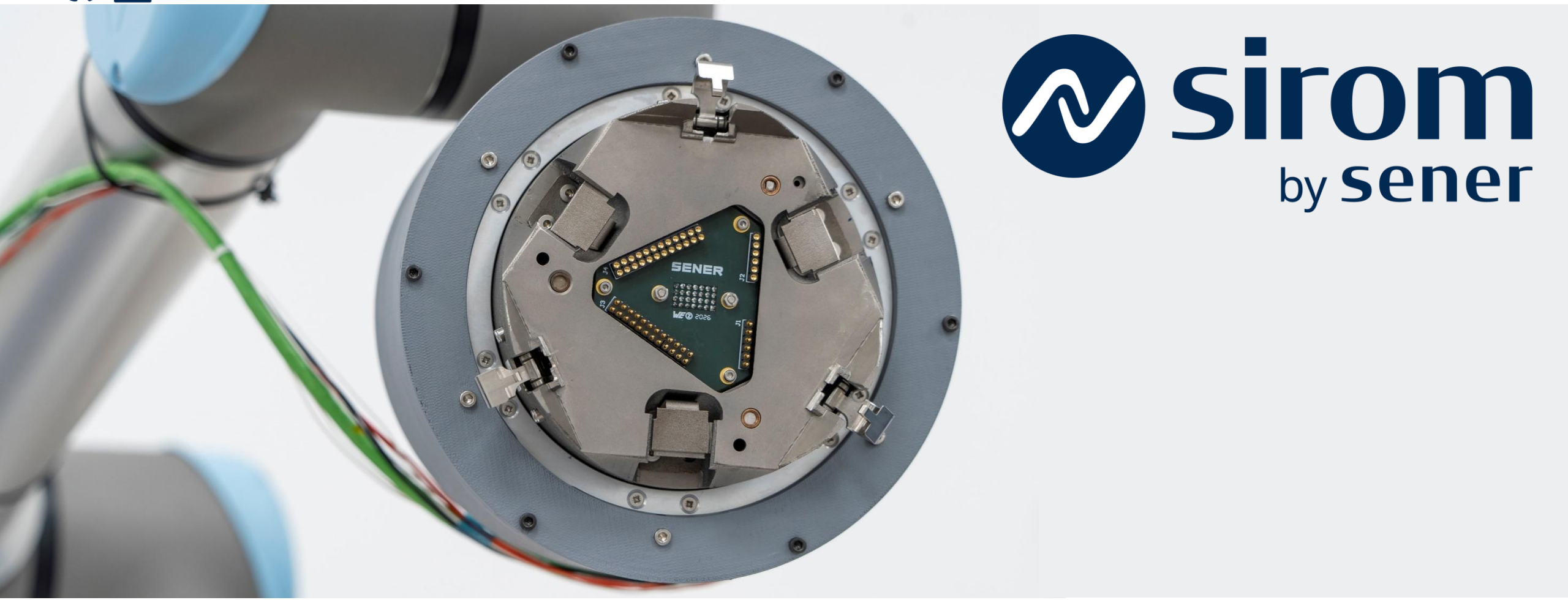
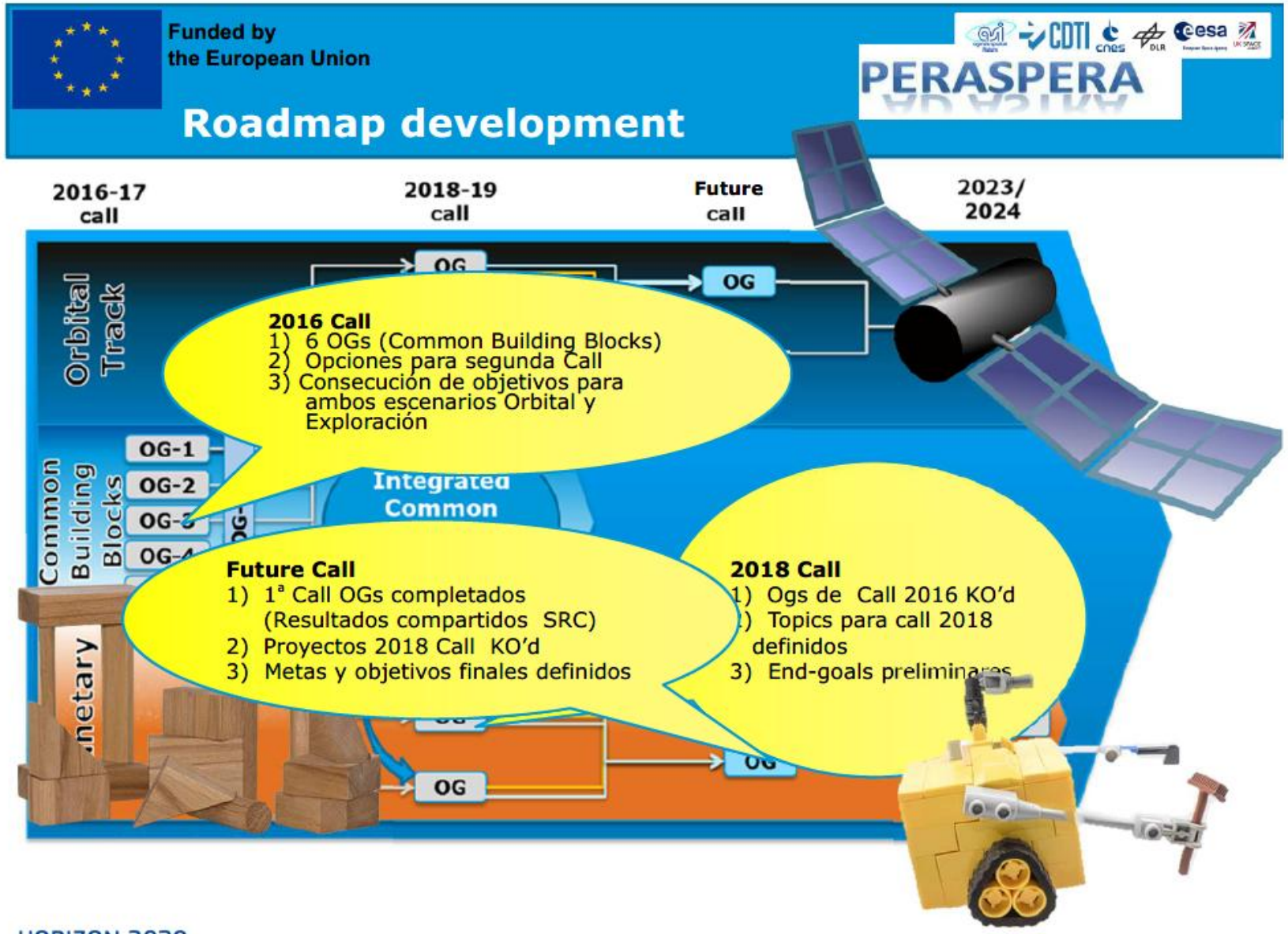
sener

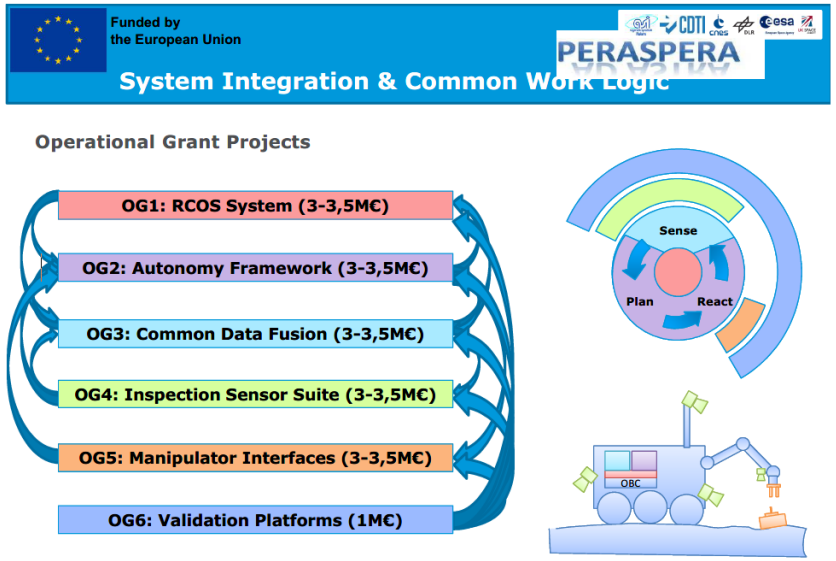


sirom by sener

Casos de Éxito Participación HE - SENER

Space Robotics SRC Operational Grants





SIROM (OG5)

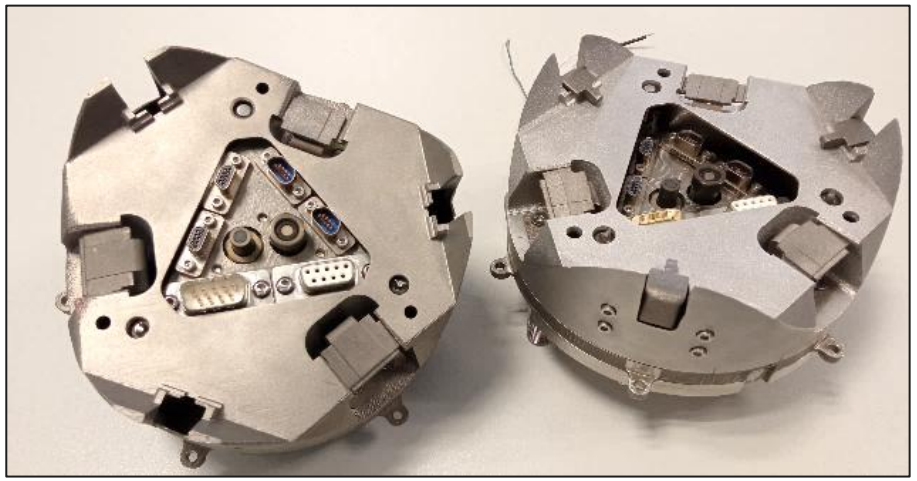
2016-2019

Standard Interface for Robotic Manipulation

SIROM project (OG5) focused on the design, prototyping and testing of a robotic interface for operation in space environments (orbital and planetary):

- Multi-functional coupling of payloads-to-robot manipulators & payloads-to-payloads
- Demonstrate autonomous robotic systems for on-orbit satellite servicing and planetary exploration
- Production of 5 active SIROMs (family A)

Participant No	Participant organisation name	Abbrev.	Country
1 (Coordinator)	SENER Ingeniería y Sistemas S.A.	SEN	SPAIN
2	AIRBUS Defence & Space	ADS-UK	UNITED KINGDOM
3	AIRBUS DS GmbH	ADS-D	GERMANY
4	Thales Alenia Space	TAS	ITALY
5	Finmeccanica S.p.A.	FNM	ITALY
6	University of Strathclyde	US	UNITED KINGDOM
7	Deutsches Forschungszentrum für Künstliche Intelligenz	DFKI	GERMANY
8	TELETEL	TEL	GREECE
9	Space Applications Services	SAS	BELGIUM
10	MAG SOAR SL	MS	SPAIN



Project Information

SIROM

Grant agreement ID: 730035

DOI

10.3030/730035

Closed project

EC signature date

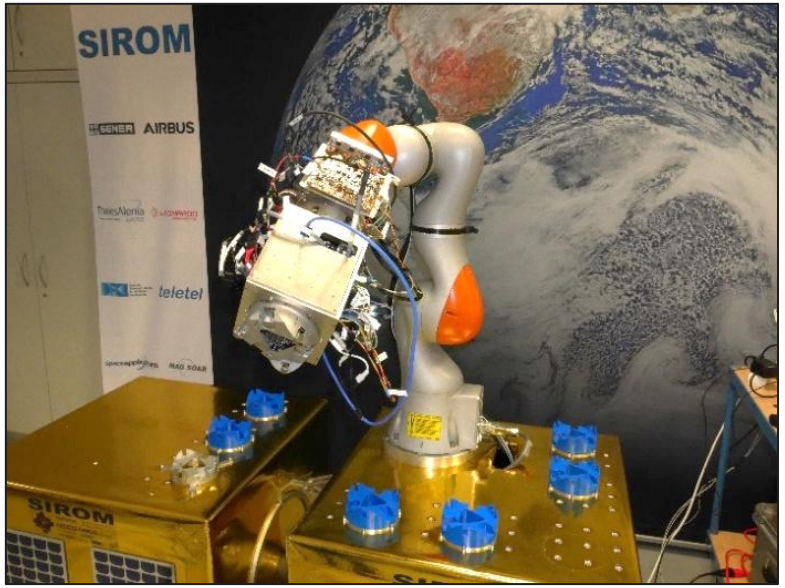
21 October 2016

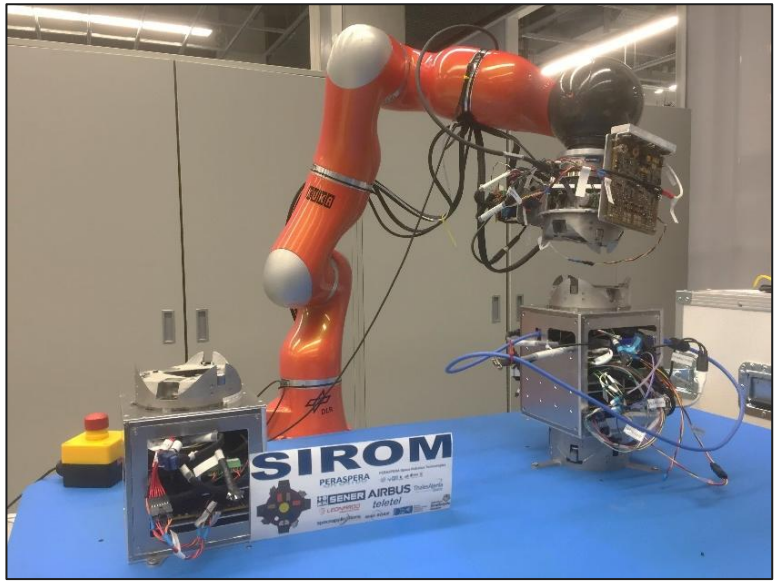
Start date

1 November 2016

End date

28 February 2019





Ground demo (TRL4) at AIRBUS and DLR (2019)

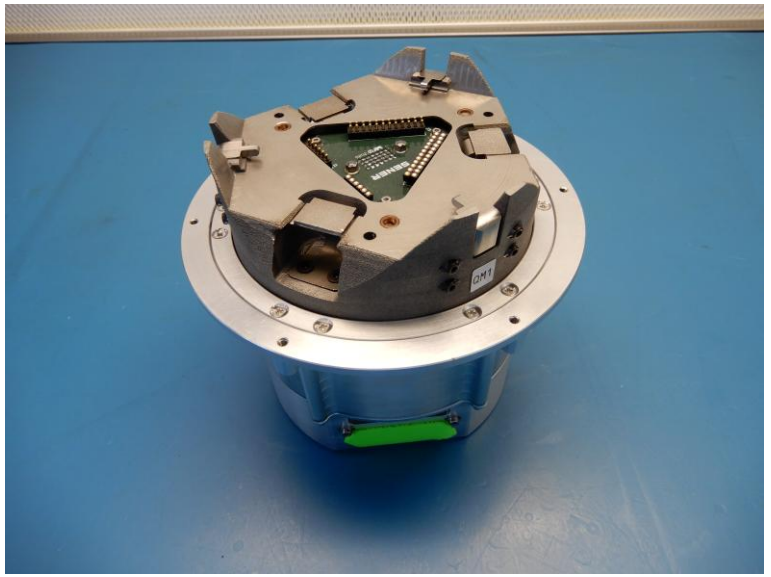
EROSS (OG7)

2019-2021

European Robotic Orbital Support Services

EROSS project (OG7) focused on a ground demo for rendezvous and docking operations involving the common building blocks developed in the previous call, including SIROM (OG5)

- First integrated SIROM version developed for EROSS (SIROM B)
- EROSS servicing operation demo at SENER with UR10
- Final EROSS integration done by GMV with two robotic arms simulating client and servicer satellites
- Internal qualification campaign in parallel (TRL 6)
- Production of 2 androgynous and 3 passive SIROMs (family B)



Project Information

EROSS

Grant agreement ID: 821904

DOI

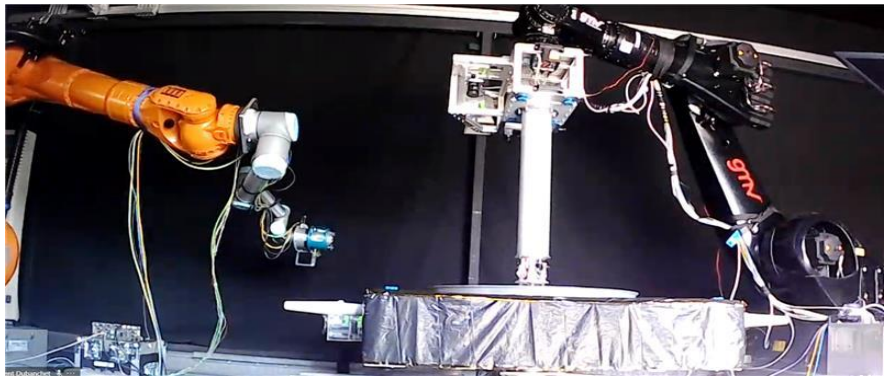
10.3030/821904

Closed project

EC signature date

24 October 2018

Start date	End date
1 February 2019	30 June 2021



Final EROSS demo at GMV (2021)

THALES ALENIA SPACE FRANCE SAS

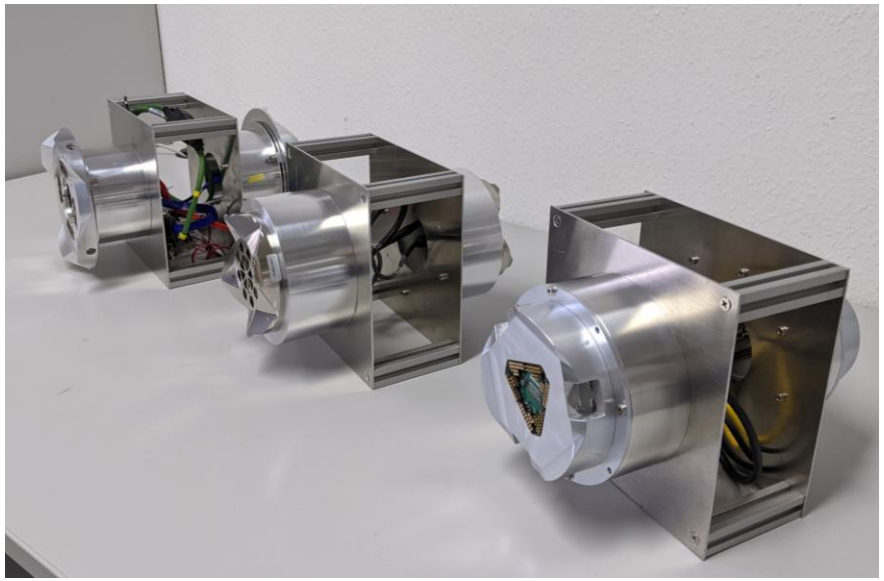
GMV AEROSPACE AND DEFENCE SA
ETHNICON METSOVION POLYTECHNION
PIAP SPACE SP ZOO
SINTEF AS
SODERN SA
SPACE APPLICATIONS SERVICES NV
THALES ALENIA SPACE ITALIA SPA
THALES ALENIA SPACE UK LTD
CRANFIELD UNIVERSITY
SENER AEROESPACIAL SOCIEDAD ANONIMA

PERIOD (OG13) 2021-2022

PERASPERA In-Orbit Demonstration

PERIOD project (OG13) was Phase A/B1 for ISMA and OOS applications, setting the mission and system concepts for an IOD to test and validate the technologies.

- Use of Bartolomeo as demonstration platform
- Involvement of Hotdock, iSSI and SIROM as SI manufacturers. Benchmark done by DFKI comparing the three interfaces, with inconclusive results.
- Final demo by Airbus GmbH using commercial robotic arms
- Production of 1 androgynous and 1 passive SIROMs (family C)



Project Information

PERIOD

Grant agreement ID: 101004151

DOI

10.3030/101004151

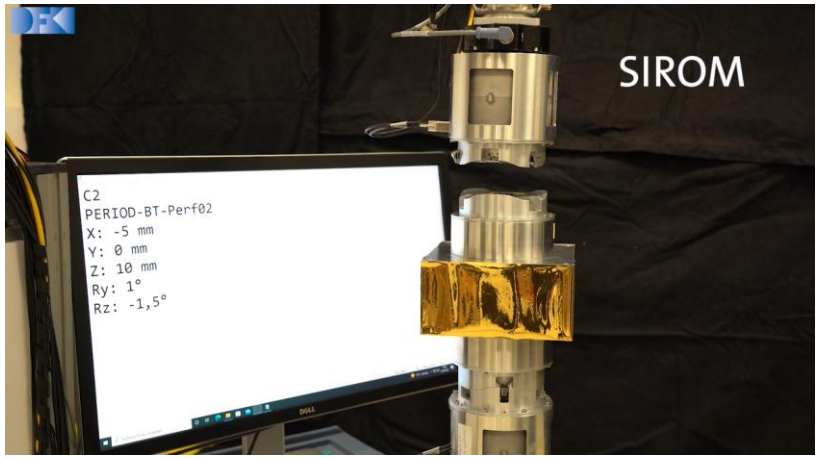
Closed project

EC signature date

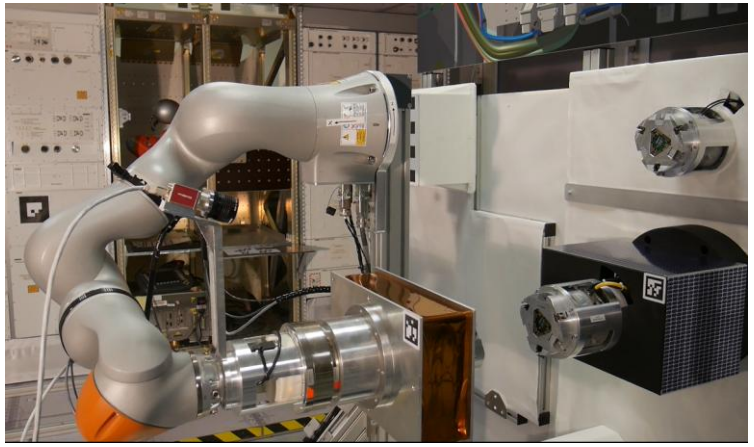
28 October 2020

Start date 1 January 2021

End date 31 December 2022



PERIOD benchmark at DFKI (2022)

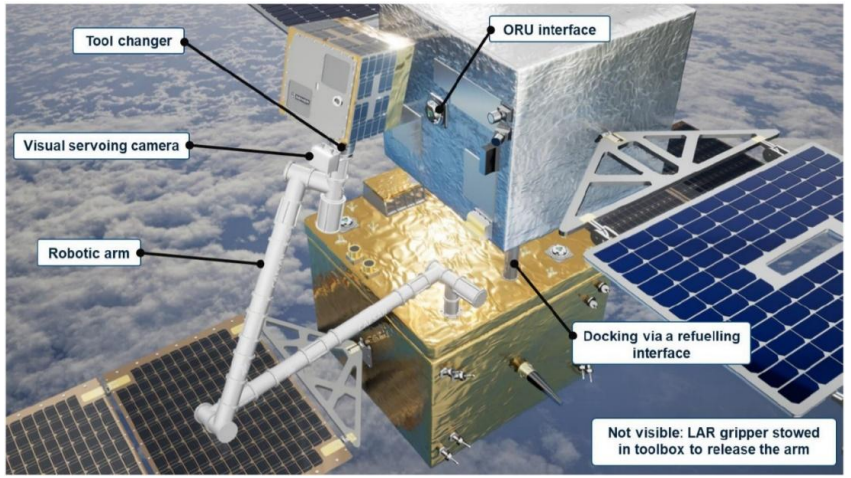


PERIOD demo at Airbus GmbH (2022)

EROSS IOD 2023-2025 *European Robotic Orbital Support Services In-Orbit Demonstration*

EROSS IOD project aims at an in-orbit demonstration of key capabilities of rendezvous between two free flying spacecrafts, and autonomous robotic operations such as capture, refuelling and payload exchange.

- Initial approach as demo mission based on New Space ecosystem → Shift in concept to pre-operational phase
- SIROM flight redesign → SIROM E and G with associated analysis and documentation performed for PDR
- Production of 1 androgynous and 1 passive SIROMs (family E) + 1 active and 1 passive SIROMs (family G)



EROSS IOD Concept

Project Information

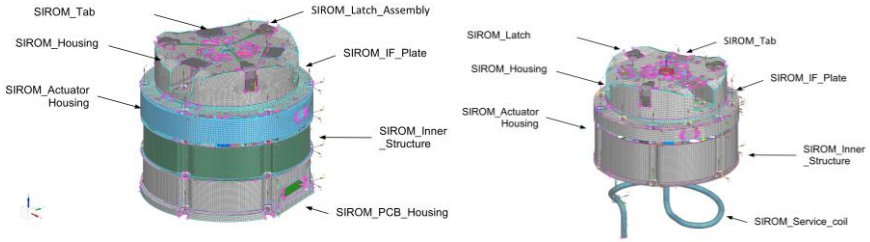
EROSS IOD
Grant agreement ID: 101082464

DOI
10.3030/101082464

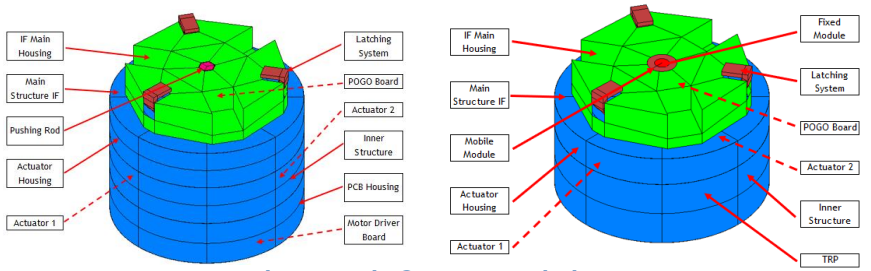
EC signature date
18 October 2022

Start date 1 January 2023

End date 31 March 2025



FEM Models



Thermal GMM Models

THALES ALENIA SPACE FRANCE SAS

SENER AEROESPACIAL SOCIEDAD ANONIMA
SPACE APPLICATIONS SERVICES NV
DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV
PIAP SPACE SP ZOO
TIPIK COMMUNICATION AGENCY SA
GMV AEROSPACE AND DEFENCE SA
SINTEF AS
EXOTRAIL
KONGSBERG DEFENCE & AEROSPACE AS
NETWORK RESEARCH BELGIUM SA
THALES ALENIA SPACE ITALIA SPA
THALES ALENIA SPACE ESPANA SA
GMVIS SKYSOFT SA
KINETIK SPACE GMBH
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA
FUNDACION CANARIA PARQUE CIENTIFICO TECNOLOGICO DE LA UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA
THALES ALENIA SPACE SWITZERLAND AG
ALMATECH SA
CSEM CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA - RECHERCHE ET DEVELOPPEMENT

ORU-BOAS 2023-2024

ORU Based On Building Blocks For Advanced Assembly Of Space Systems

ORU-BOAS focuses on the development and demonstration of an ORU concept based on the Building Blocks in previous calls

- Development of ORU modular concept compatible with different SI, payloads and services
- ORU models to be used in EROSS IOD as plug&play modules for payload exchange
- Production of 1 androgynous and 2 passive SIROMs (family E) for EROSS IOD + breadboard ORU model for concept demonstration at Sener

Project Information

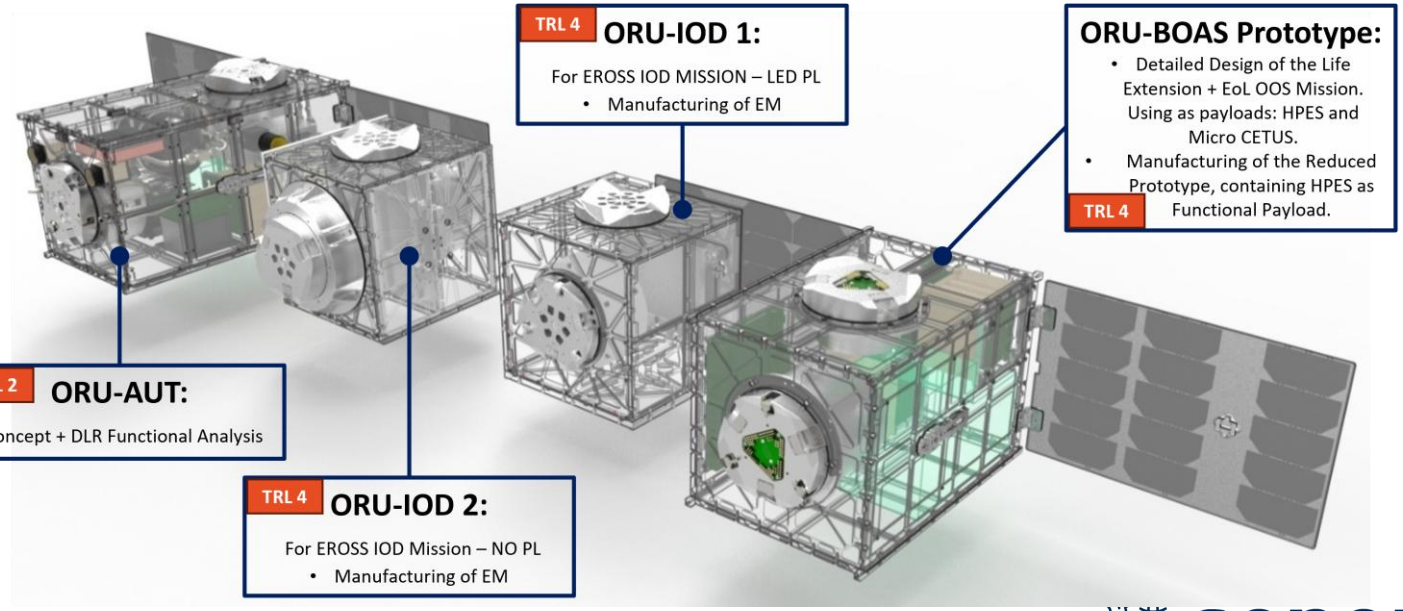
ORU-BOAS
Grant agreement ID: 101082078

DOI
10.3030/101082078

EC signature date
4 October 2022

Start date
1 January 2023

End date
31 December 2024



SPACE USB

2024-202

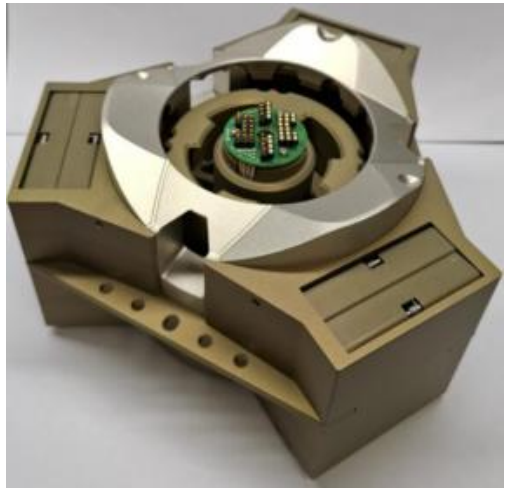
Space Universal Serial Bus

Sponsor:	European Union
Grant number:	HORIZON-CL4-2023-SPACE-01-12 101135215
Website:	https://www.linkedin.com/company/space-usb/
Partner:	THALES ALENIA SPACE France SAS, Sener Aeroespacia Sociedad Anonima, iBOSS GmbH, Space Applications Services NV, In Extenso Innovation Croissance
Application Field:	Space Robotics
Related Projects:	PERIOD (OG12) PERASPERA In-Orbit Demonstration (Operational Grant 12) (01.2021- 12.2022) SIROM (OG5) Standard Interface for Robotic Manipulation of Payloads in Future Space Missions (11.2016-02.2019)

SPACE USB aims to develop a standardized multifunctional interconnects for future orbital space missions.

- Thales as coordinator with support from DFKI to define a common specification
- SIROM, Hotdock and iSSI as main interfaces in the European market
- Definition and verification of models through industrial collaboration
- Advisory Board defined with common stakeholders (ESA, Airbus, DLR, DFKI, …)

3in1 design: Active SIROM adaptation



3in1 design: Common Passive Interface (CPI)

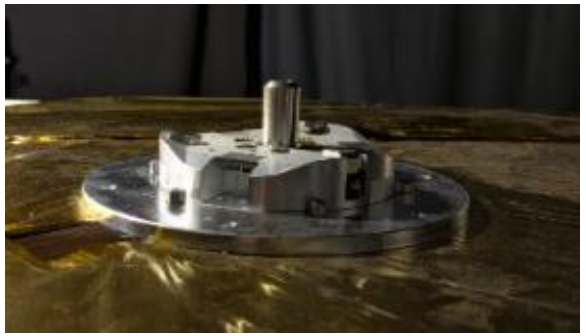
ROBY Test Bench (TAS-F, Cannes)

EU-RISE 2024-2025

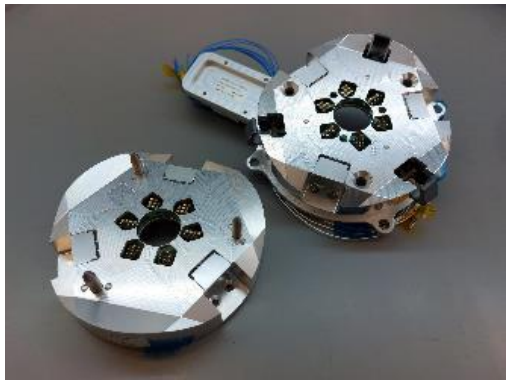
European Robotics for Space Ecosystems

EU-RISE focuses on the definition of the future space ecosystem, including robotic providing services systems, transportation and logistics, modularity in software and receiving services hardware.

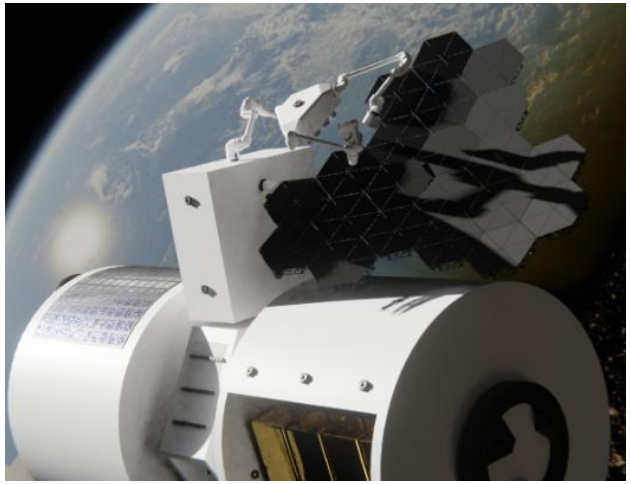
- The final goal is the integration of PERASPERA building blocks into a single ISAM demonstrator (on ground)
- Building blocks including Airbus VISPA & MPT, SIROM, TASTE framework, perception and ground SW by Magellium



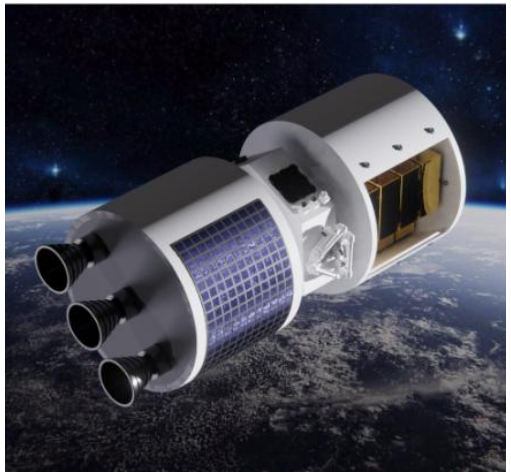
Fluidic demo testbench



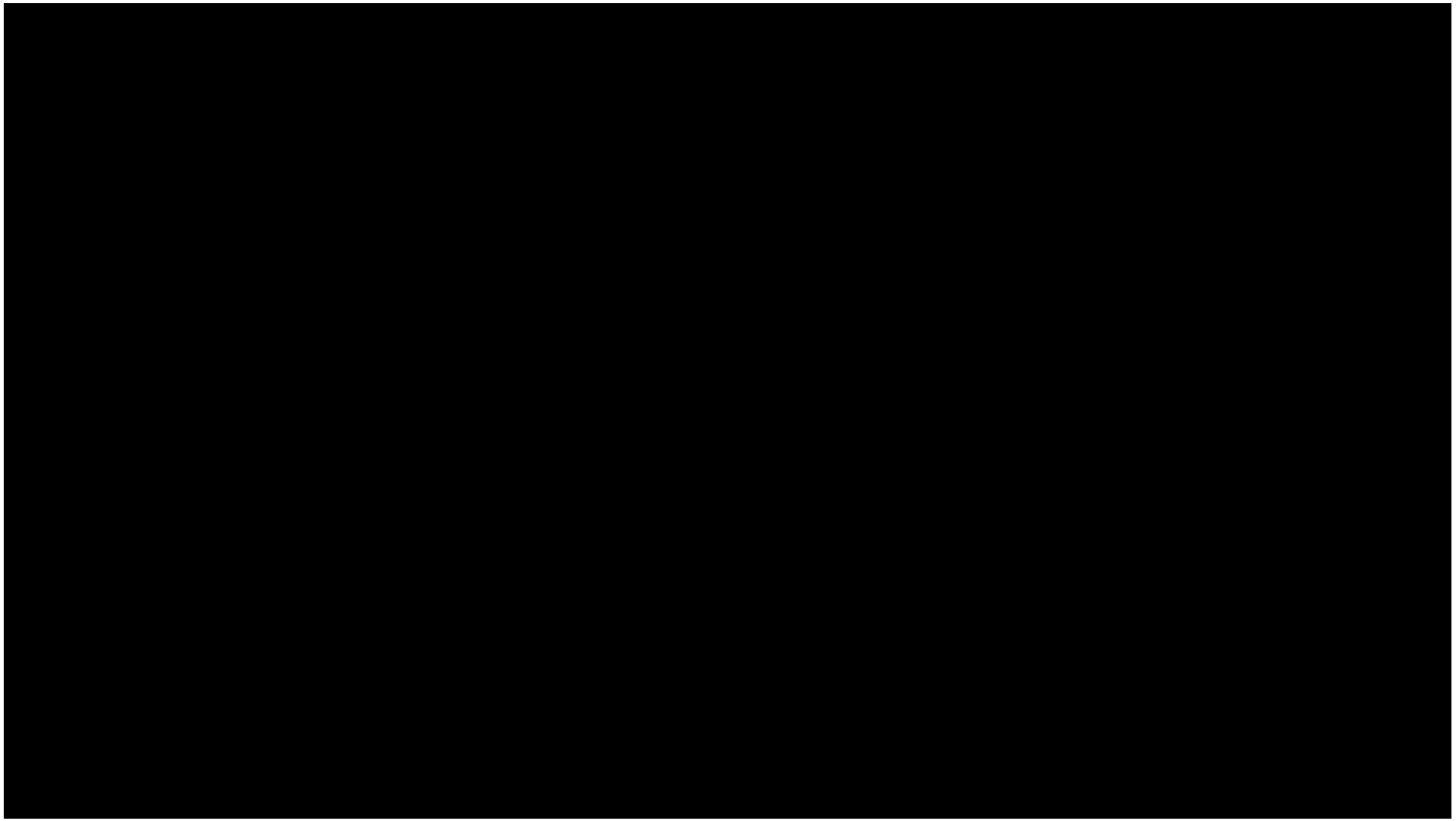
SIROM for tool exchange



Sponsor:	European Union
Grant number:	This project has received funding from the European Union's Horizon Research and Innovation Programme under grant agreement No 101134934.
Partner:	Airbus Defence and Space GmbH Magellium SAS Airbus Defence and Space SAS SENER Aeroespecial The Exploration Company OIKOPLUS GmbH Libre Space Foundation
Application Field:	Space Robotics
Related Projects:	PERIOD (OG12) PERASPERA In-Orbit Demonstration (Operational Grant 12) (01.2021- 12.2022) ESROCOS (OG1) European Space Robot Control Operating System (11.2016- 01.2019) STARLIT Smart automation and robotic tools as modular solutions in the industrial space sector TBC (10.2021- 03.2023)

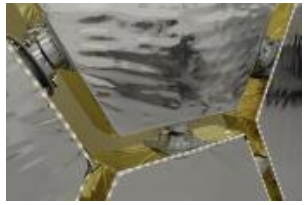


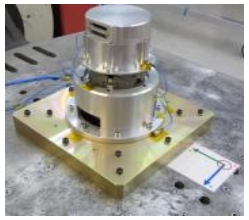
EROSS IOD

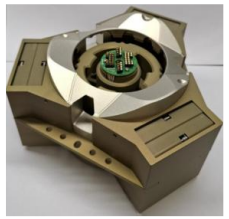


sener

Timeline (2016 - 2028)







SIROM
H2020-OG5 (EC)

MIRROR
ESA

TRL 6
SIROM B

InSPoC-1
ESA

SPACE USB
HORIZON EUROPE (EC)

EROSS-SC
ISOS Servicer (EC)

EROSS LAUNCH
2030 (TBC)

SDILEO
ESA

TRL 8
SIROM E

ORU-BOAS
HORIZON EUROPE (EC)

InSPoC-2
ESA

2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | Future

EROSS
H2020-OG7 (EC)

PERIOD
H2020-OG12 (EC)

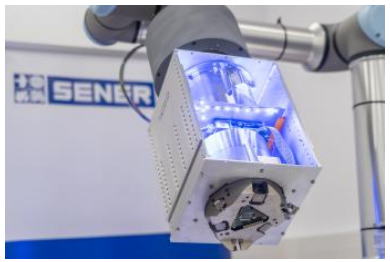
ISAAC
ESA

HAZITEK
UMOR

IRUS
ESA Circular Economy

ASTRALIS
ISOS Logistics (EC)

InSPoC-1 LAUNCH
2030 (TBC)

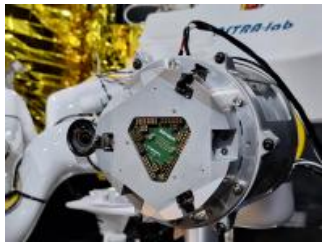


EROSS IOD
HORIZON EUROPE (EC)

EU-RISE
HORIZON EUROPE (EC)

SIROM G GSTP
ESA

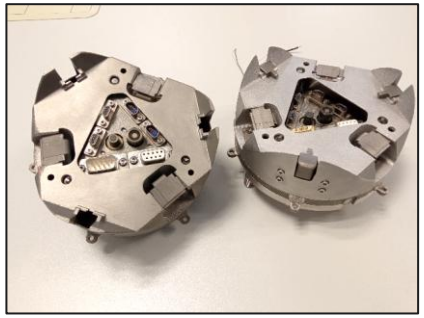
DEXTER
EIC Pathfinder (EC)



sener

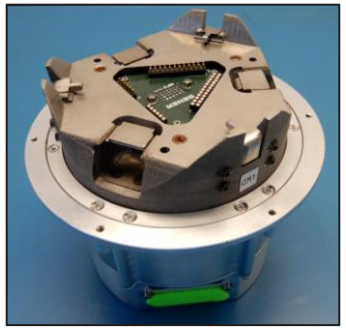
SIROM Brochure

SIROM A



OBSOLETE

SIROM B

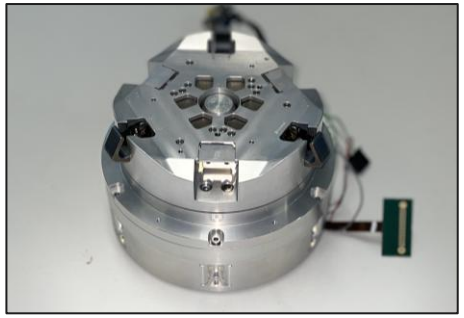


OBSOLETE

SIROM C

GROUND PURPOSES

SIROM D

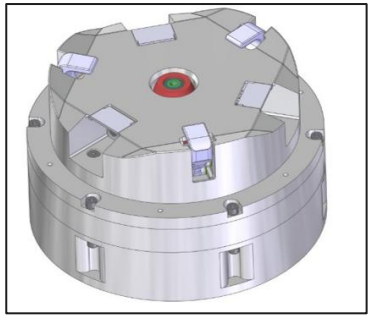


OBSOLETE

SIROM E

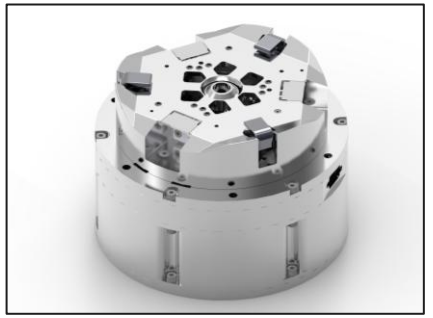
ACTIVE

SIROM F



CONCEPT

SIROM G



ACTIVE

	SIROM A	SIROM B	SIROM C	SIROM E	SIROM F	SIROM G
Size (diam. x height)	X:135 x 77 mm	X: 160 x 138 mm	X: 145 x 132 mm P: 145 x 73 mm	X: 145 x 132.5 mm (TBC) P: 145 x 69.5 mm (TBC)	A: 145 x 85 mm (TBC) P: 145 x 65 mm (TBC)	A: 145 x 100 mm (TBC) P: 145 x 105 mm (TBC)
Mass	1.5 kg	1.5 kg	X: 1.1 kg P: 0.4 kg	X: 1.4 kg (TBC) P: 0.5 kg (TBC)	A: 1.4 kg (TBC) P: 0.65 kg (TBC)	A: 1.6 kg (TBC) P: 0.7 kg (TBC)
Capture range before contact	Axial: +15 mm Radial: +/-5 mm	Axial: +15 mm Radial: +/-5 mm	Axial: +15 mm Radial: +/-5 mm	Axial: +15 mm Radial: +/-5 mm	Axial: +15 mm Radial: +/-5 mm	Axial: +15 mm Radial: +/-5 mm
Radial capture range after contact*	Not assessed	Not assessed	Small vehicles: +/-10 mm Large vehicles: +/-8 mm	Small vehicles: +/-10 mm Large vehicles: +/-8 mm	Small vehicles: +/-10 mm Large vehicles: +/-8 mm	Small vehicles: +/-10 mm Large vehicles: +/-8 mm
Docking time	60 s	30 s	5 s	1-7 s	1-7 s	1-7 s
Traction load	1,3 kN	1,3 kN	1,3 kN	3 kN | 4.8 kN*	3 kN	3 kN
Compression load	5 kN	5 kN	5 kN	5 kN	5 kN	5 kN
Radial load	5 kN	5 kN	5 kN	5 kN	5 kN	5 kN
Torque	420 Nm	420 Nm	420 Nm	480 Nm | 770 Nm	770 Nm	480 Nm
Bending moment	150 Nm	150 Nm	150 Nm	150 Nm | 300 Nm	150 Nm	150 Nm
Integrated electronics	No	Yes	Yes	Optional	No	No
Power consumption	20W	Active mode: 10W	Active mode: 10W	Active mode: 10W	Active mode: 10W	Active mode: 10W
Radiation tolerance	-	-	-	TID: 10 krad(Si) LET: 43 MeV.cm2 /mg @125°C (TBC)	TID: 10 krad(Si) LET: 43 MeV.cm2 /mg @125°C (TBC)	TID: 10 krad(Si) LET: 43 MeV.cm2 /mg @125°C (TBC)

	SIROM A	SIROM B	SIROM C	SIROM E	SIROM F	SIROM G
Temperature range	-	TOmin= -40°C / TOmax=+100°C	TOmin= -40°C / TOmax=+100°C	TOmin= -40°C / TOmax=+100°C	TOmin= -40°C / TOmax=+100°C	TOmin= -40°C / TOmax=+100°C
Power input	24V	20-34V (nominal 28V) DC/DC isolation	20-34V (nominal 28V) DC/DC isolation	Nominal 28V 5, 15, 30V optional	Nominal 28V 5, 15, 30V optional	Nominal 28V 5, 15, 30V optional
Power Transfer: a) regulated b) by-pass	a) 1.2A @100V (120W) & 1.25A @28V(30W) b) No by-pass	a) 1.5A @ 28V (42W) b) No by-pass	a) 3.5A @ 28V (98W) b) 20A @ 150V (3kW)	a) 3.5A @ 28V (98W) b) 10A @ 150V (1.5 kW)	-	-
Data Transfer	Spacewire	Gigabit Ethernet	Gigabit Ethernet or similar	Gigabit Ethernet or similar	-	Gigabit Ethernet or similar
Data rate	200 Mbit/s	1 Gbit/s	1 Gbit/s	1 Gbit/s	-	1 Gbit/s
Control	CAN	CAN	CAN	CAN	CAN	CAN
Resupply	2x COTS connectors	-	-	-	Fluid transfer connector (coolant/propellant compatible)	Fluid transfer connector (coolant/propellant compatible)
MEOP	-	-	-	-	150bar	150bar
Flow rate	-	-	-	-	Gas (He): 3g/s @ 1bar Δp Liq (Water): 5g/s @ 1bar Δp	Gas (He): 3g/s @ 1bar Δp Liq (Water): 5g/s @ 1 bar Δp
Connectors plate	2x subD-9pin 4x microD-9pin	60 POGO pins/pads	132 POGO pins/pads	48 POGO pins/pads	-	48 POGO pins/pads
ESD cover	No	No	No	Yes	-	Yes
Actuators	1	1	1	2	2	2
Proximity sensor	No	No	Yes	Yes	Yes	Yes
TRL	4	6	6	3	3	3
Applications	Laboratory on-orbit servicing	On-orbit Servicing	On-orbit servicing with higher power&data capabilities	On-orbit servicing. Includes dust cover with higher power&data capabilities	On-orbit servicing. Includes dust cover and fluid transfer capabilities	On-orbit servicing. Includes fluid transfer capabilities
Availability	Obsolete. Replaced by SIROM C	Obsolete. Replaced by SIROM C	Available	Available	Available	Available
Projects	OOS SIROM (Horizon 2020)	OG7 EROSS (Horizon 2020)	MIRROR / PERIOD ISAAC	EROSS IOD ORU-BOAS	-	EROSS IOD

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