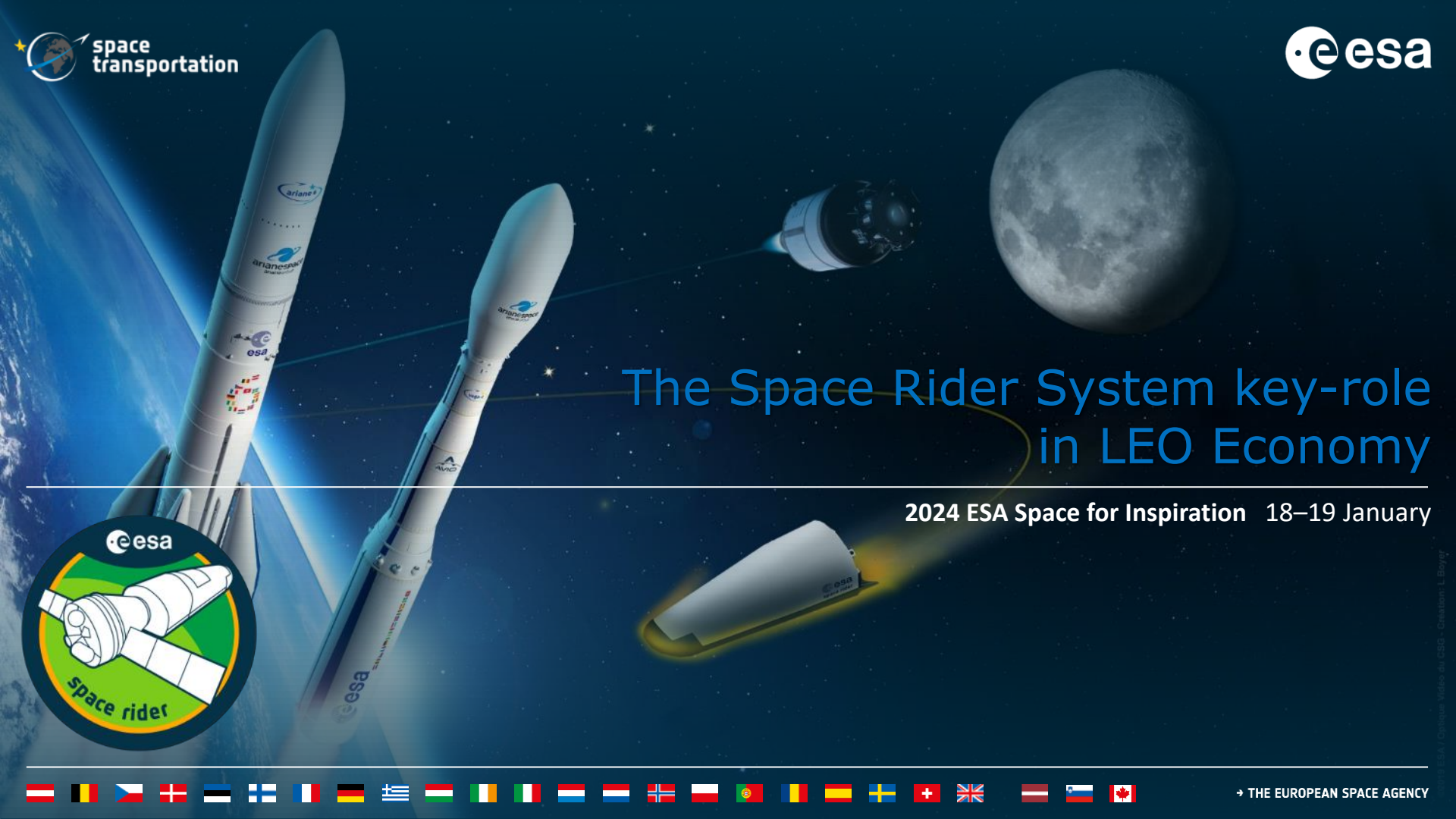
space transportation

esa



The Space Rider System key-role in LEO Economy

2024 ESA Space for Inspiration 18–19 January

TODAY, WE ARE AT AN INFLECTION POINT IN SPACE COMMERCIALIZATION

- Access to Space is No Longer the Issue
- It’s not just the ISS anymore – many more platforms are coming online
- There is record investment into new space transportation systems and space stations
- The new space factories allow for superior R&D and manufacturing for non-traditional space industry
- These New Developments are allowing LEO to become a new “outsourced environment” which allows terrestrial companies to use their own terrestrial outsourcing models to conduct activity in space

SPACE RIDER MISSION

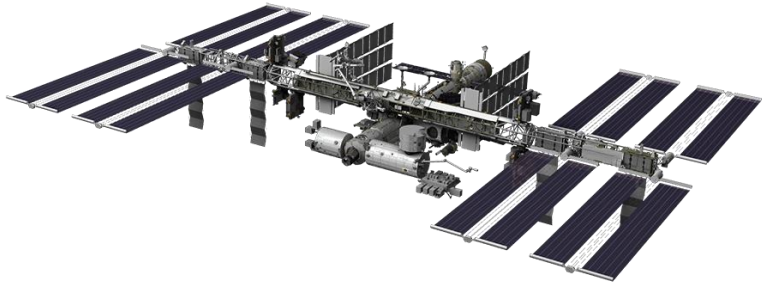
Space Rider is the first commercial European reusable and uncrewed transportation system for routine access to and return from LEO. Its dynamic configuration allows payloads for an array of applications, like in-orbit testing, research and manufacturing, orbit altitudes, inclinations, and mission durations.

- ✓ MAIDEN FLIGHT Q4,2025 ON VEGA C, KOUROU
- ✓ LAUNCHER AGNOSTIC
- ✓ 600 kg CARGO BAY CAPACITY
- ✓ PRESSURIZED & UNPRESSURIZED
- ✓ COMPETITIVE PRICING

RESPONDING TO MARKET TRENDS

As the ISS is planned to be deorbited we will need more real state in Space to allow for testing, superior R&D, and manufacturing for the non-traditional space industry. Space Commerce Matters has calculated a **Total Addressable Market of more than 800M €** for this activity

Space Rider is Europe's space factory. Its unique **uncrewed** configuration sets it apart from new private space stations and cargo vehicles, as it accelerates autonomous manufacturing, in-orbit servicing, high-temperature furnaces, research of more complex pathogens, and many more activities that won't be possible with the presence of humans.



MARKET EVOLUTION

Developing the market doesn't mean building new technologies, but creating new business models that align with the way terrestrial customers engage. That is why, with the support of ESA Space Rider partners (Space Commerce Matters and STAM) we are creating more demand for Space Rider and Europe's industrial capability in LEO

PAST:

Traditional Focus on supply Side of Space

PRESENT:

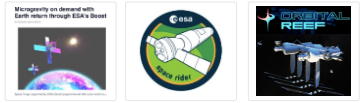
New Space Factories, Transportation Systems & Facilities

Private investment in space companies in 2020 set a new annual record with $8.9 billion, according to Space Capital. "Despite expectations that space Infrastructure would be hardest hit by the pandemic, 2020 turned out to be a record for investment,"
Space Capital managing partner Chad Anderson

NASA Has Picked Private Partners to Build the Next-Gen International Space Station

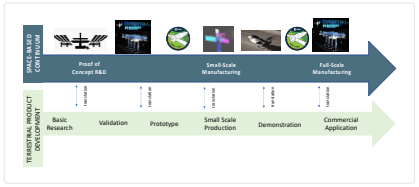
The total estimated award amount for all three funded Space Act Agreements is $415.6 million. The companies that received awards are:

- Blue Origin for $130 million
- Nanoracks for $160 million
- Northrop Grumman Systems for $125.6 million



FUTURE:

Non-traditional space Industries treat space just like ANY OTHER OUTSOURCING they currently do terrestrially



SCM
SPACE COMMERCE MATTERS

SPACE RIDER COMMERCIAL SEGMENTS

SPACE RIDER has multiple offerings geared towards 5 commercial segments

SR Transportation System

- Transportation Vehicle to support Commercial Service Provider Facilities and Capability

SR Qualification System

- Pre-eminent IOV and IOD qualification platform

In-Orbit Servicing

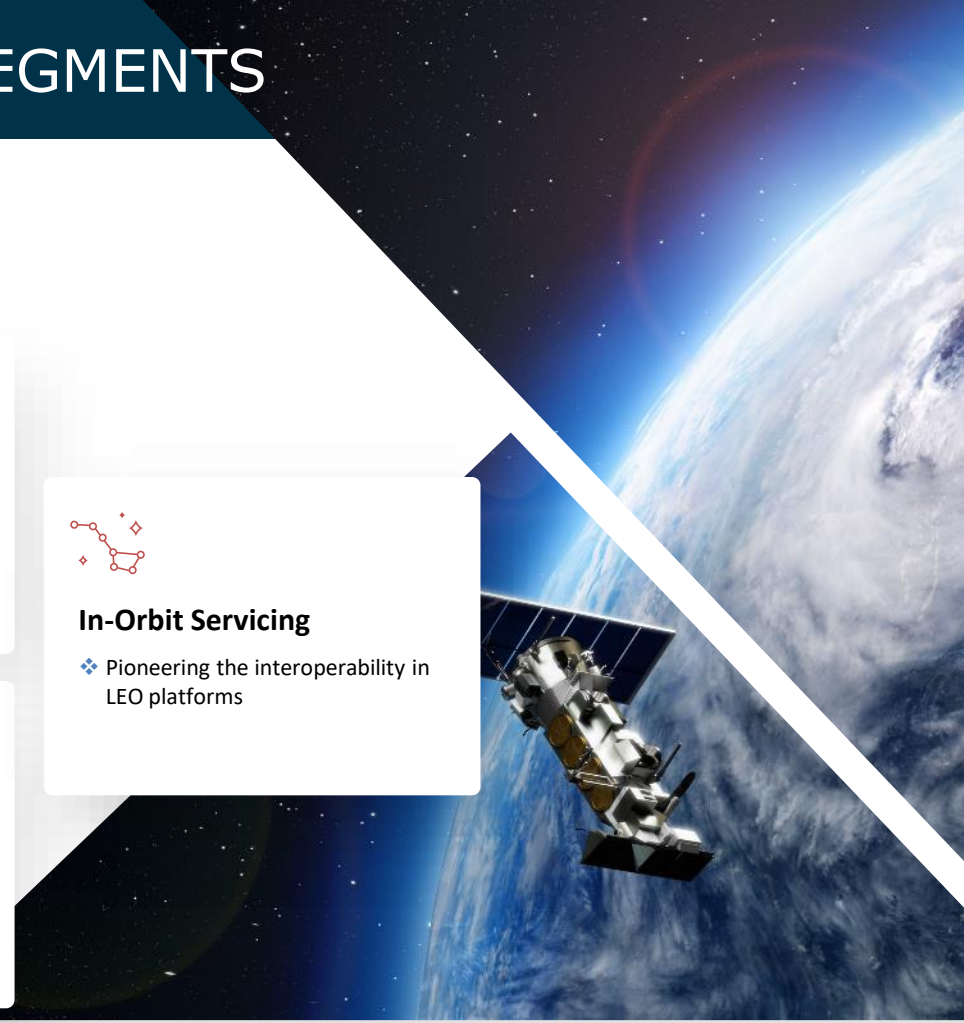
- Pioneering the interoperability in LEO platforms

SR ISS Alternative

- Options for oversubscribed and soon to be de-commissioned ISS

Microgravity as a Service

- Platform that supports a wide range of life and physical science applications

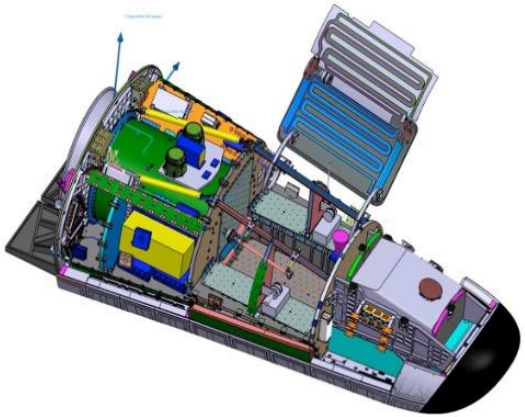


SR Transportation System

- Transportation Vehicle to support Commercial Service Provider Facilities and Capability

SPACE RIDER TRANSPORTATION SYSTEM

SR TRANSPORTATION SYSTEM



POTENTIAL SERVICE PROVIDERS

- SPACE PHARMA
- ICECUBES BY SPACE APPLICATIONS SERVICES
- REDWIRE
- Bartolomeo
- YURI
- KAYSER ITALIA
- Nanoracks
- VOYAGER SPACE

END-USER APPLICATIONS

SHELF-LIFE	OBSERVATION	TECHNOLOGY	IN-ORBIT TECH
BioDegradables Air Purification Food & Beverage Packaging Agritech/ Plant Growth Pharmaceuticals Chemicals Cosmetics	Multi-use Satellites Precious Metal Locals Ecosystem Dynamics Ocean Observation Weather Forecasting Disaster Prediction Migration Patterns Microwave Radiometry	Robotics Transportation Tech Clean Fuels Thermal Processes Water Purification Imaging Tech LEO Cloud Computing	Transport Systems Resupply to Stations Orbital Trash Removal Satellite Access/ Repair Astronaut Training Systems Upgrades Repairs & Maintenance NASA Patent Access
Airlines & Hotels Beverage Companies Plastics Manufacturers Big Agricultural Firms Fast Food Companies Toxic Chemical Manu.	Lockeed Martin, Relativity Space, Telesat,Thinkom, Hiber, Capella Space, Dish, ST Engineering, Ursa Space Systems	Boston Dymanics ABB Ltd, IRobot Siemans, GE Energy, Bosch, Hitachi, Honeywell, IBM, AWS, MS, Salesforce	NASA/ Space Platrorms Trans/Logistics Firms Governments Defense Contractors Northrop, Raytheon General Dynamics

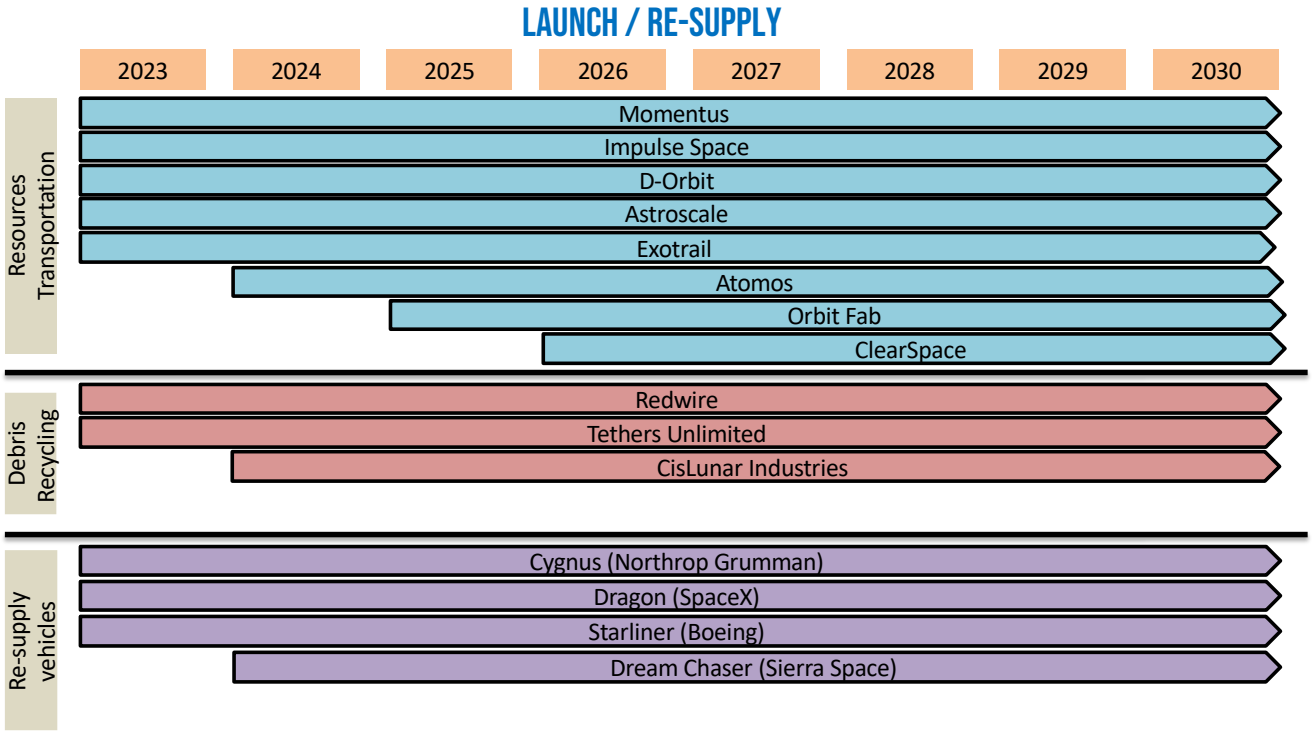
BIOTECH	MEDICAL	MATERIALS	R&D
Protein Crystalization Vaccines & Antibiotics Biomarker Discovery Regenerative Medicine Stem Cell Therapy Tissue Generation Cold Plasma Anti-Aging	Bone Adhesives Stents Telemedicine Tech Wearable Diagnostics Exoskeleton Tech Robotics Thermal Sensors 3D Scanning	Semi Conductors Polymer and Films Multilayered Barriers Industrial Casting Functional Fabrics 3D Printing Frictionless Coatings Precious Metals	Oil & Gas Water Conservation Infectious Disease Cardiovascular System Cerebrovascular Flow Capillary Flow Cellular Biology Pharmaceuticals
Pfizer, Novartis, Merck J & J, Sanofi, Roche Glaxo Smith Kline, Bayer, Eli Lilly, Amgen Gilead Sciences, Abbott Biogen, Moderna	Medtronic, Stryker, Phillips, GE, Siemens, Boston Scientific, Becton Dickenson, Baxter, Danaher, Zimmer Biomet, 3M	Intel, Nvidia, AMD, Texas Instruments, Qualcomm, Micron Precision Castparts 3D Systems, Proto Labs, Rio Tinto	Chevron, ExxonMobil, Saudi Aramco, Shell, BP Dow Chemical Anheuser-Busch, Coca-Cola, Nestle, Pepsico, Starbucks

SR Qualification System

- Pre-eminent IOV and IOD qualification platform

SPACE RIDER QUALIFICATION SYSTEM

SR as a support of the entire roadmap of new space facilities for efficient IOV/IOD and TRL raising



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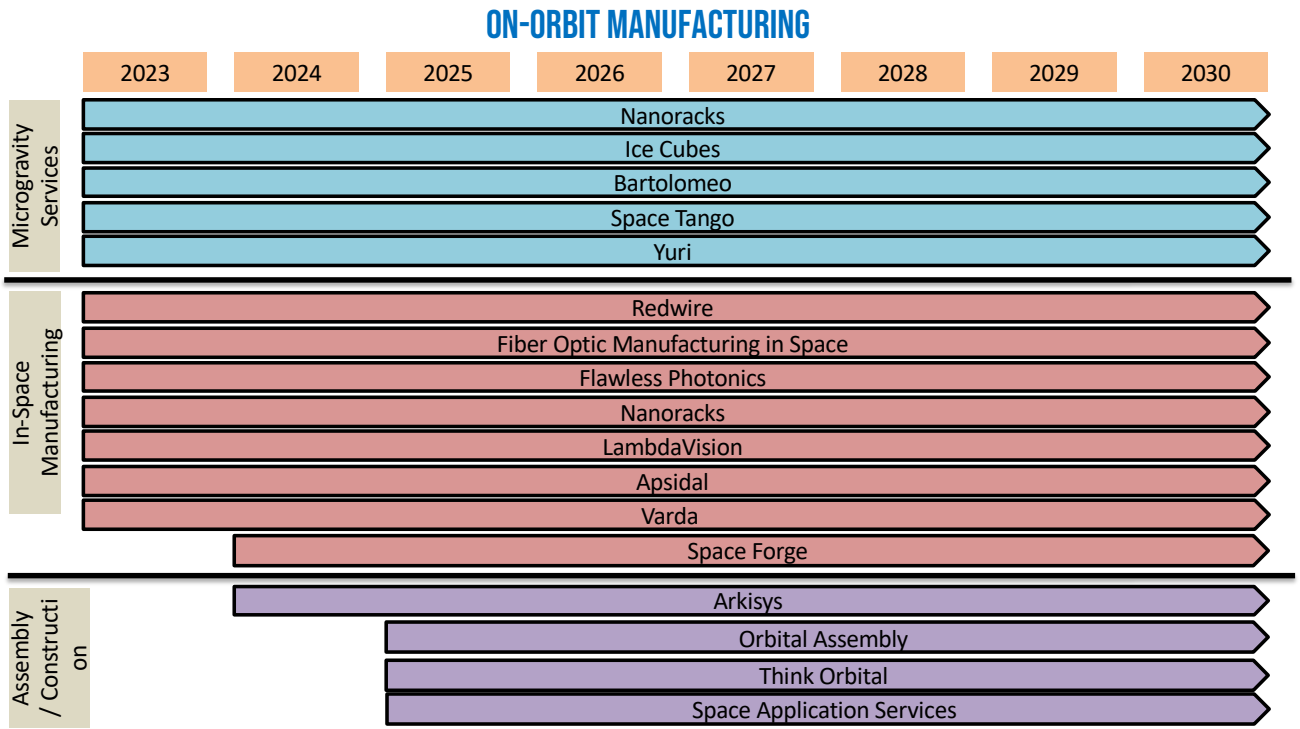
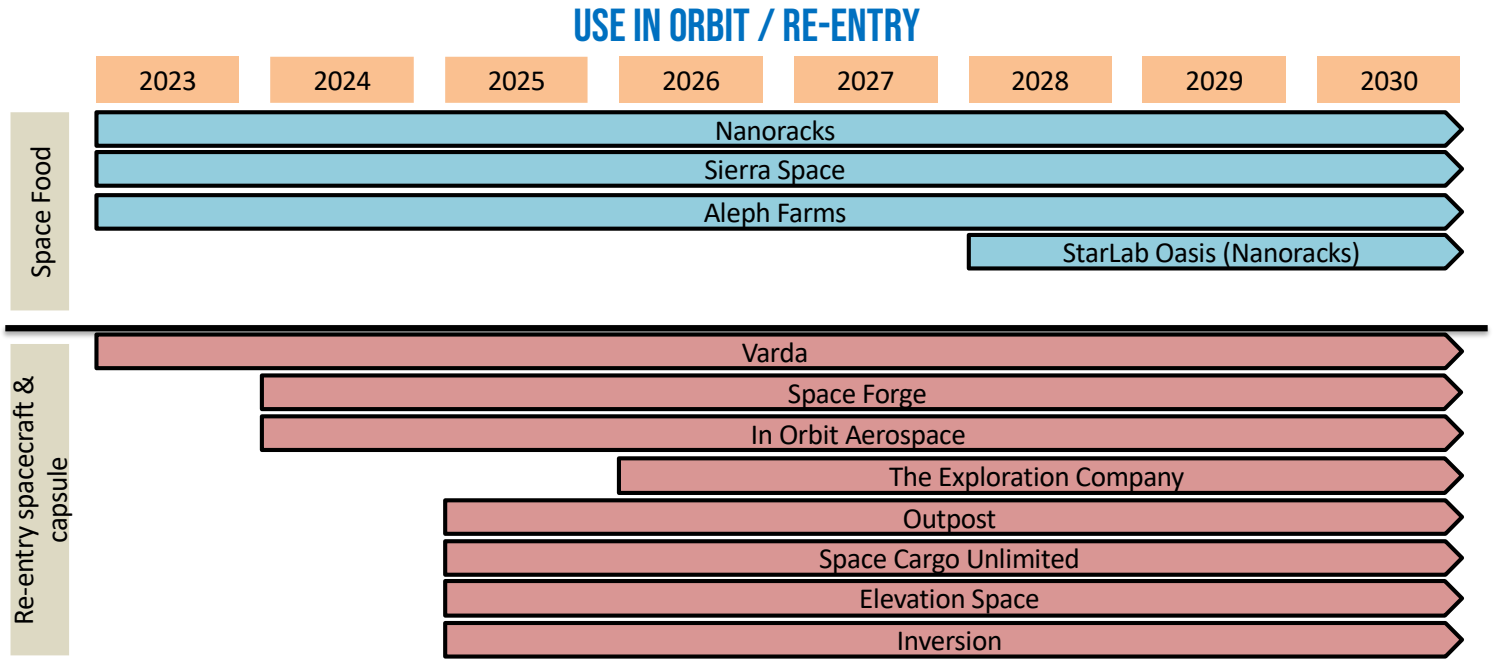


SPACE RIDER QUALIFICATION SYSTEM

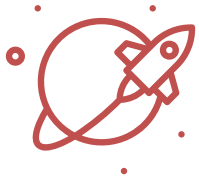
SR as a support of the entire roadmap of new space facilities for efficient IOV/IOD and TRL raising



SPACE RIDER QUALIFICATION SYSTEM

Accelerates and supports testing, operations, and go-to-market strategies for other European platforms like:

- **ForgeStar,** Space Forge
- **Nyx,** The Exploration Company
- **EVA**, Atmos Space Cargo, YURI, RFA
- **REV1**, Space Cargo Unlimited



SR ISS Complement

- Options for oversubscribed and soon to be de-commissioned ISS

SPACE RIDER COULD SUPPORT EXISTING ISS AND INTERNATIONAL PROGRAMMES

POWERING SPACE INNOVATION

esa SPACE SOLUTIONS

ISS NATIONAL LABORATORY®
CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE

BSGN Industry Accelerators

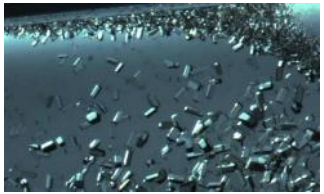
Microgravity as a Service

- Platform that supports a wide range of life and physical science applications

ACCESSIBLE TRADITIONAL AND NEW MARKET AREAS

Crystallization

Larger more ordered structures can be obtained in microgravity



Cell Biology

Microgravity effects cell's behavior, gene expression, and allows 3D structures to form without the use of a scaffolding or matrix

Microorganisms

The diffusion driven environment of space induces changes in the behavior and virulence of microorganisms

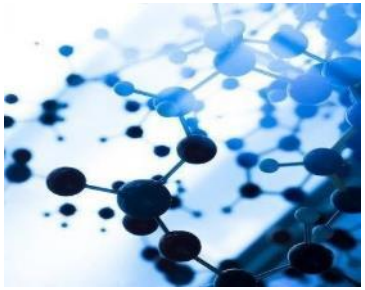
Fluid Dynamics & Transport Phenomena

Unique fluid behavior in microgravity can allow for easier studies of Multiphase Flows, Capillary Flow, Diffusion, Surface Tension, Separation and Agglomeration,

Interfacial Behavior

Reaction Chemistry

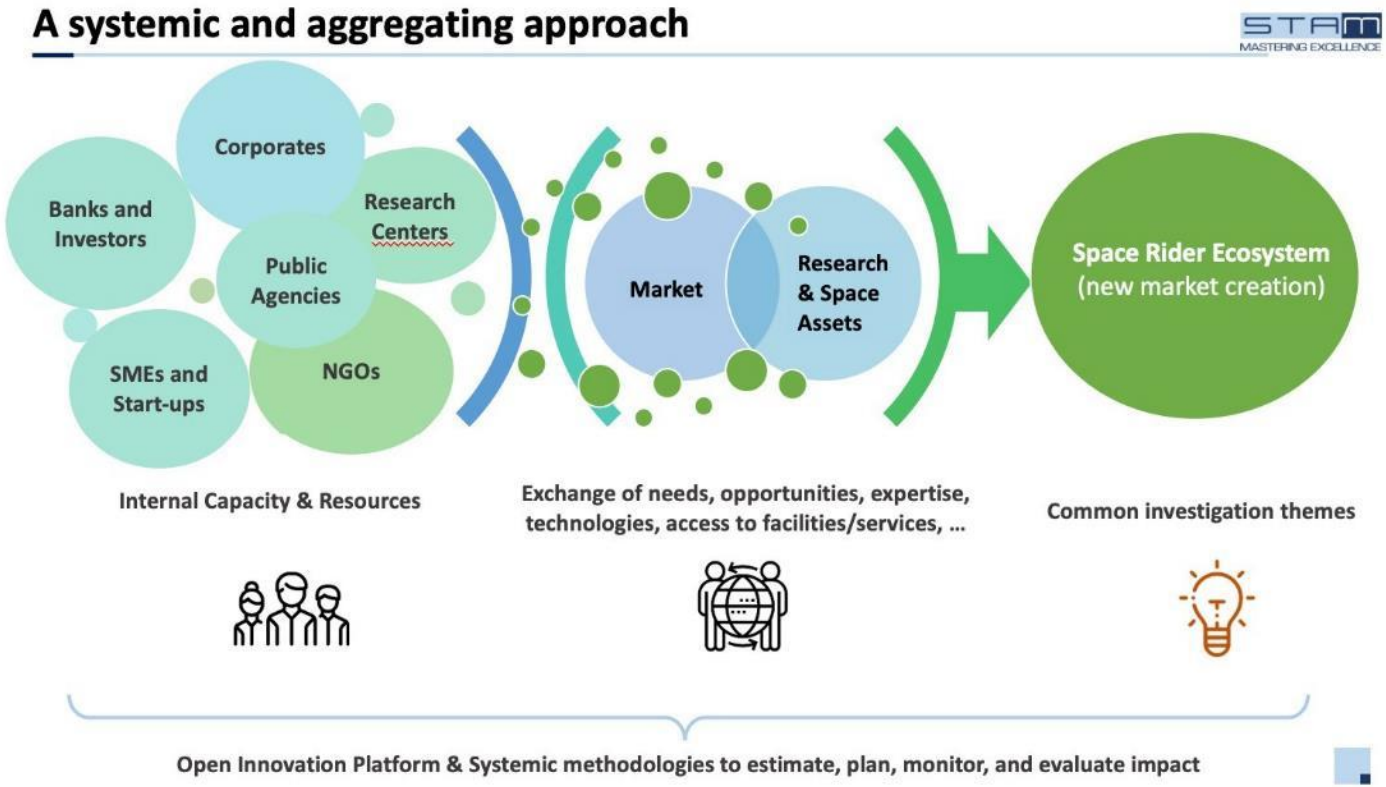
Lack of gravitational forces can influence Chemical Product Formulation, Flow, Batch, Mixing Behavior, Combustion



MERGING WITH RESEARCH

Collaboration, partnership, merging of different expertise and knowledge

Leveraging on research funding opportunities to foster boil up of space rider ecosystem



MERGING WITH RESEARCH

Support Space Rider ecosystem preparation through identification and growth of lean industrial organisation concept

Focusing on centralised hub for a distributed CRO network addressing EU institutions at the first place

Space Rider Single Entry Point and Ecosystem

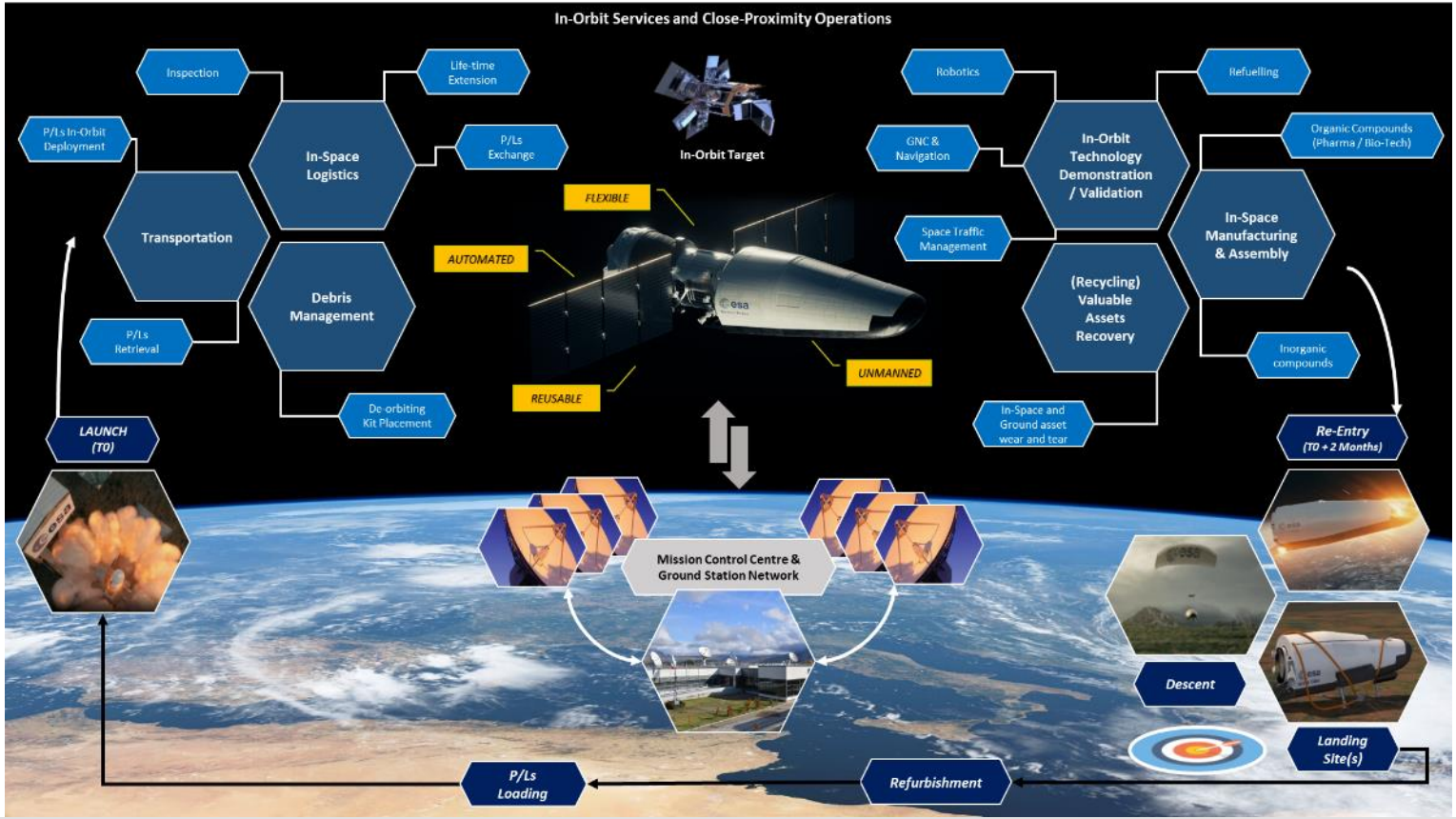
- **Single Entry Point (SEP) for ventures building (e.g. central hub and transnational spokes).**
- **"Distributed" CRO** operational model with a commercial and delivery network
- **Space Rider Ecosystem (SRE)** to foster a win-win approach between clients and clusters of space HW and service providers.
- **EU institutional support initiatives:**

8Bln€ (Horizon Europe) **High %** → Rare diseases

In-Orbit Servicing

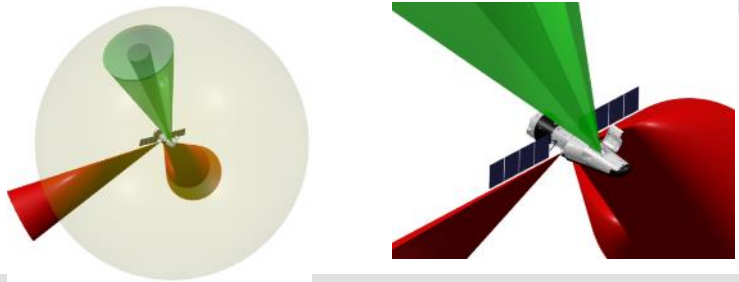
- Pioneering the interoperability in LEO platforms

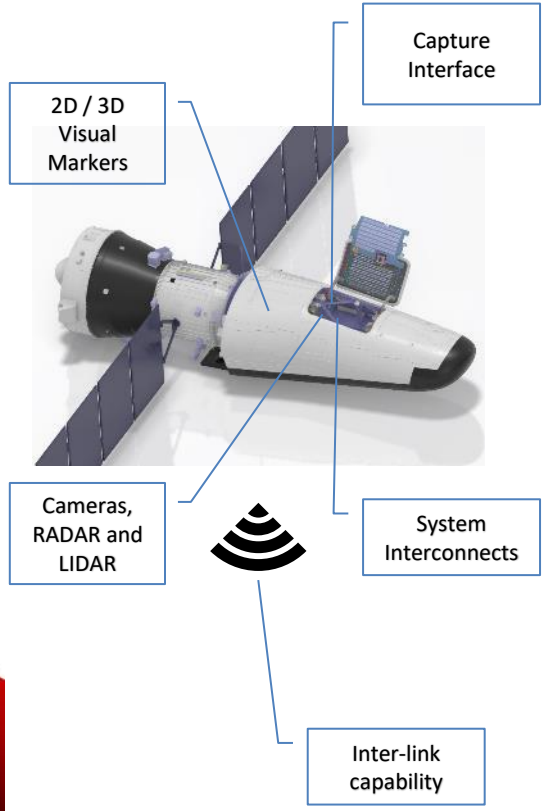
INTEROPERABILITY AND IOS



INTERFACES

- **Visual Markers**: 2D/3D visual markers
- **Cameras, RADAR, LIDAR**: high-resolution, low latency camera and/or RADAR/LIDAR sub-systems.
- **Mechanical Capture / Grappling Interfaces**: mechanical fixture
- **System Interconnects**: advanced interface for exchanging power, data, and other services (e.g., fuels)
- **Standard-based Data and T&C Inter-link**: chaser / target inter-link for communication of vital T&C for CPO in a cooperative scenario and GNC co-ordination.
- Vehicle **parameters** for a **reference CPO configuration**
  - ***Approach Zone***
  - ***Keep-out Zone***
  - ***Approach Corridor(s)***
  - ***forbidden zones***





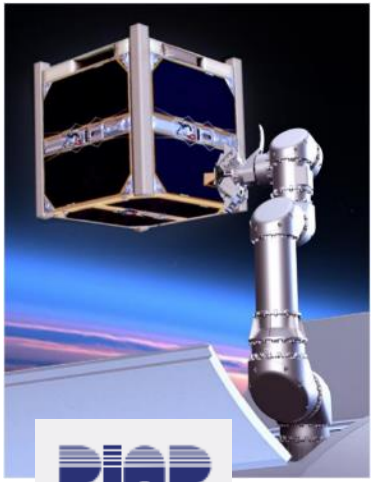
INTEROPERABILITY AND IOS

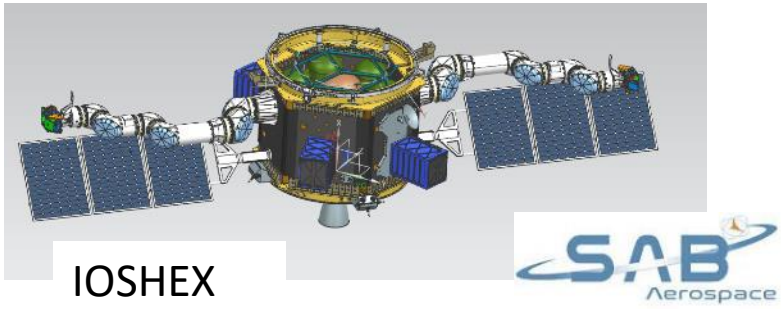
Space Rider as **IOS / CPO**

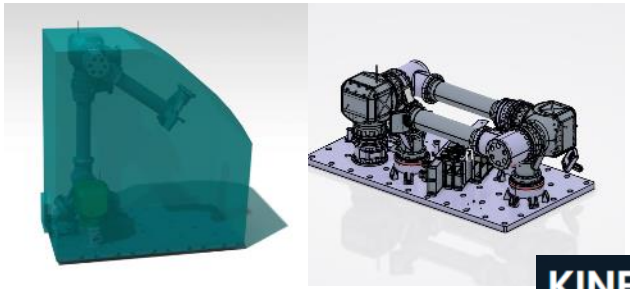
Space Rider can enable interactions with other platforms, acting as:

- A **cooperative** & **prepared target** to be optionally **captured** by other S/C(s)
- A **chaser** able to **manoeuvre**, **reach** and **inspect / capture** a target S/C(s)

- Deploy and Retrieval: S-ROC
- Joint Operations: SAB IOSHEX, Kinetik, PIAP robotic arms

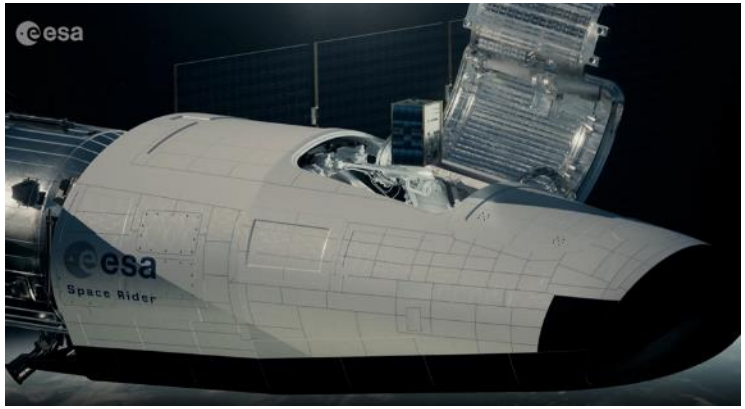






SROC

- The **Space Rider Observation Cube** (**SROC**), an ESA technology demonstration mission.
- Based on a CubeSat deployed from Space Rider, to perform **inspection**, **rendezvous** and **dock** with **dedicated retrieval mechanism** hosted in the SR cargo-bay
- SROC will allow the development of **in-orbit demonstration** technologies and capabilities for **small-satellite proximity operations**, with a particular focus on **propulsion**, **GNC**, and **docking/retrieval mechanisms**

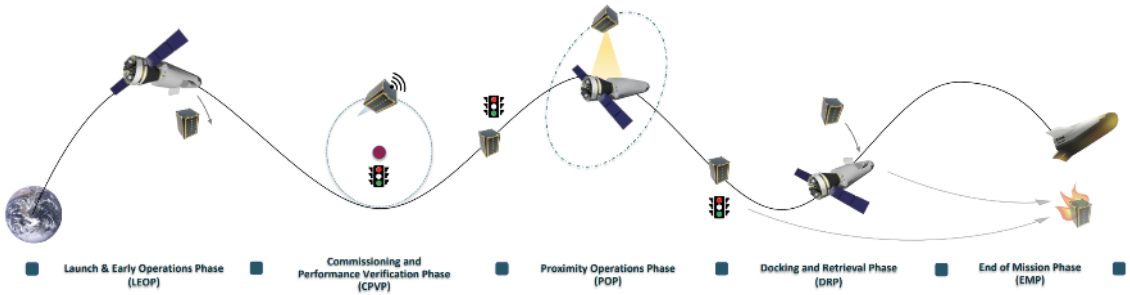


Tyvak International
A Terran Orbital Corporation

Politecnico di Torino

Università degli Studi di Padova

STELLAR PROJECT



FACTS FILE

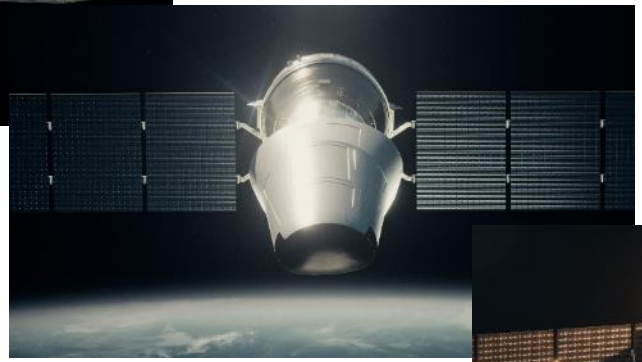
ThalesAlenia Space
a Thales / Leonardo company

AVIO

ALTEC

TELESPAZIO
a LEONARDO and THALES company

SPACE RIDER MISSION

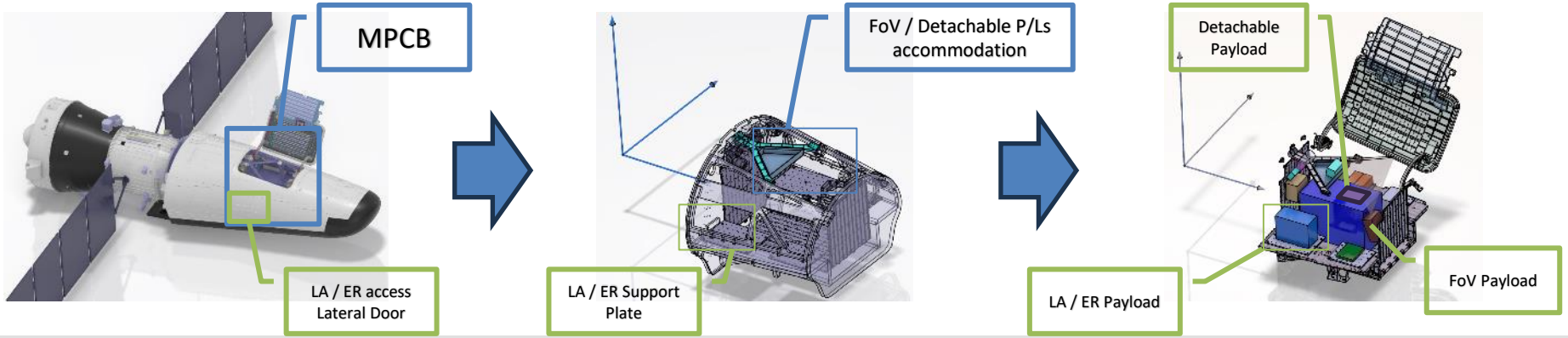


- ✓ ORBITAL CONFIGURATIONS ACCORDING TO USER'S NEEDS
- ✓ DEDICATED ORBITAL TIMELINE **UP TO TWO MONTHS**

- ✓ DATA DOWNLOAD AND TELECOMMANDS FOR USER'S FLIGHT PLANS UPDATE
- ✓ SEGREGATED DATA LINKS FOR PRIVACY
- ✓ UNPRECEDENTED MICRO-g level (1E-6 g)

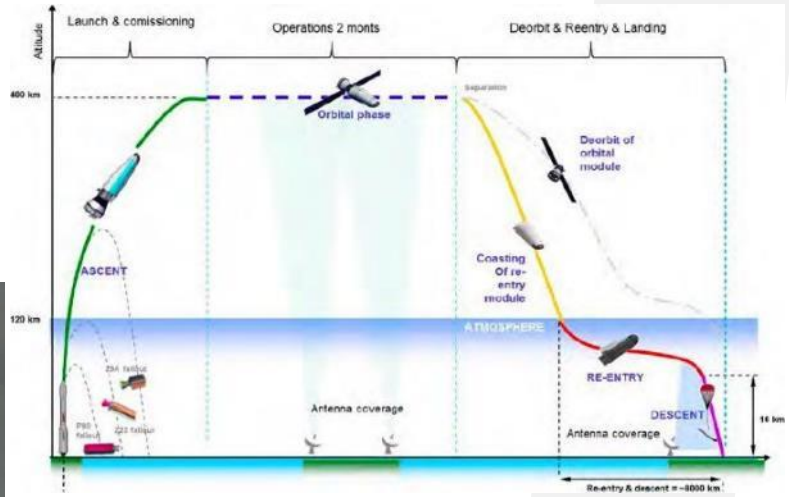
Multi Purpose Cargo Bay (MPCB)

- **Multiple P/L configurations**, **sealed** or **vented, directly** or **partially exposed** to space environment, **movable** or **detachable**
- **Power** and **data lines, 7 P/L Support Plates** (**SP**) with standardized fixing interface
- Thermal Control through support plates and radiators
- **Late-Access** (**LA**) and **Early-Retrieval** (**ER**) for environmentally sensitive P/Ls, integration and retrieval through RM lateral doors dedicated access to the outer face of P/Ls mounted on support plates.

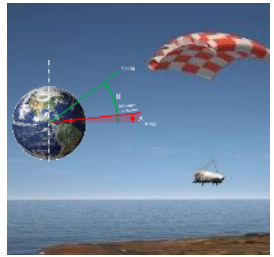


MISSION

✓ **LAUNCH AND LANDING IN KOUROU EUROPE SPACE PORT**



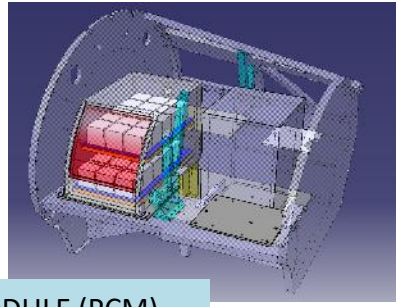
✓ **ALTERNATIVE LANDING IN SANTA MARIA OF AZORRES, FOR MID-INCLINATION MISSIONS**



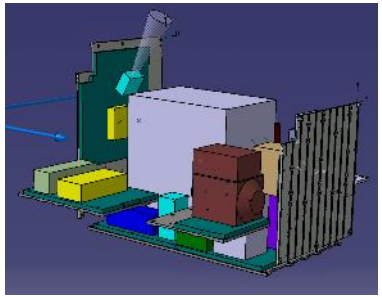
Cargo bay for maiden flight 2025

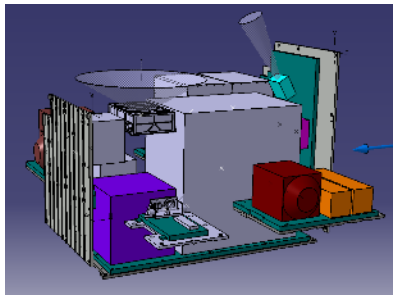
Space Rider **Payloads Aggregate** design for the **Maiden Flight** is currently **on going:**

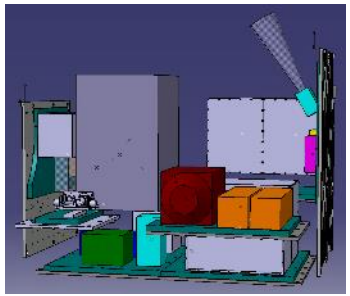
- **18 Payloads** from both **commercial** and **institutional** customers are on board, representing various typologies of experiments:
  - ✓ **Pharma/biotech micro-g R&D**
  - ✓ **Technology IOV/IOD**
  - ✓ **Physical science, remote sensing**
  - ✓ **In-orbit operation technologies and processes**

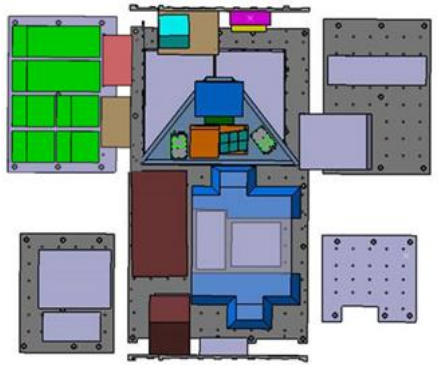


PRESSURISED CARGO MODULE (PCM)









WHY SPACE RIDER

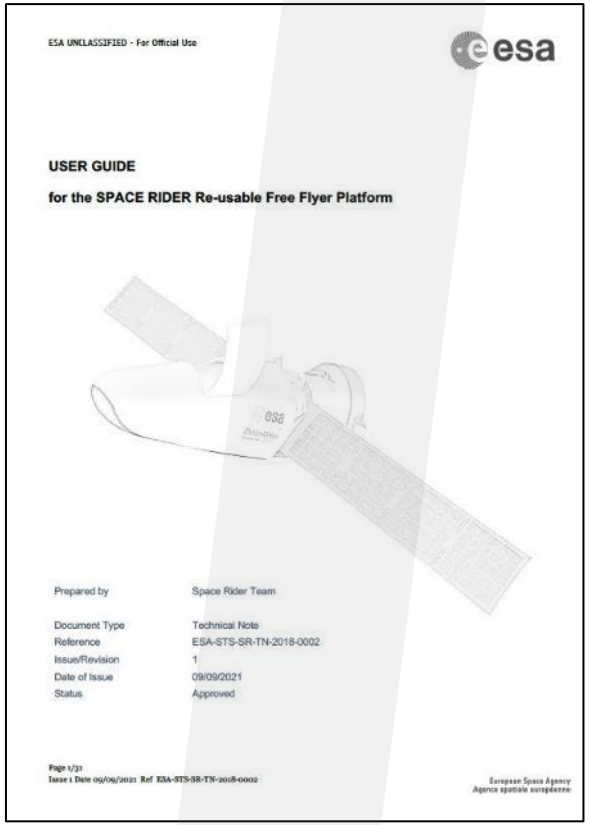
- Vehicle design based on flight proven ESA IXV vehicle
- Unmanned safety standard
- Low G-forces & jitter during flight;
- High quality microgravity (1E-6 g max.)
- Return capability with high downmass/upmass ratio
- Fast access to the experiment back on the airfield
- Payload Service Providers network
- Commercial space manufacturing
- Standard and/or dedicated Payload services
- Launch rate 2/Y and flexible orbital lifetime
- Vehicle concept design for wide range of Payload typologies
- Users Privacy

CONTENTS

- Project highlights
- Cargo Bay Payload environment
- Payload Services
- Payload Operational cycle

ISSUES

- Issue 1 dated 09/09/2021 available
- Issue 2 dated 12/12/2023 released soon to the public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USER GUIDE

for the SPACE RIDER Re-usable Free Flyer Platform

Prepared by	Space Rider Team
Document Type	Technical Note
Reference	ESA-STS-SR-TN-2018-0002
Issue/Revision	1
Date of Issue	09/09/2021
Status	Approved

THANK YOU

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