IOSHEX And SpaceRider Interoperability Towards Active Debris Removal And Recycling

Clean Space Industry Days 2023

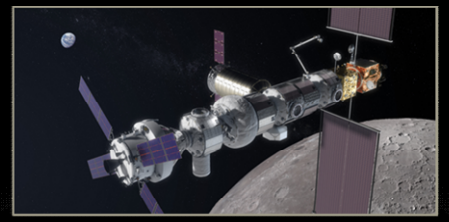
SUMMARY

- Introduction
- IOSHEX, SAB's orbital module for LEO
- Cooperation IOSHEX + Space Rider
- In-Orbit Servicing Infrastructure
- Active Debris Removal and Recycling
- Streamlined Refurbishment of orbital hardware
- The Future IOS Ecosystem

Introduction

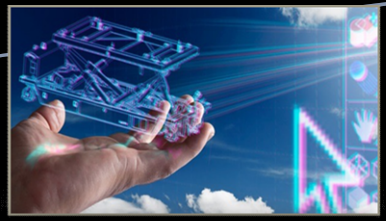
Satellites Mechanical S/S, Equipment and Payloads

Micro-Gravity Payloads



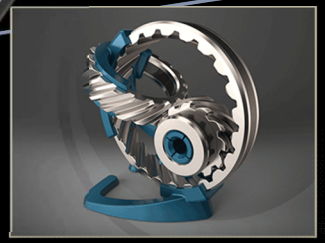
Structures for Pressurized items

Launch Services



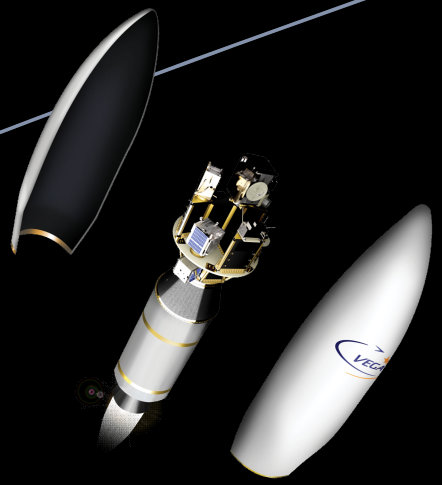
Ground Support Equipment

Launchers Adapters, Dispensers and I/F System



Mechanisms

Introduction



SAB Launch Services S.r.l. (SAB-LS) is a company part of **SAB group offering launch services on European Launchers** for all kind of **Small Satellites**. SAB-LS offers **"end to end" services** including launch procurement, integration activities of the satellite on the launch vehicle structure, pre and post launch support and full insurance at very competitive prices.

SAB-LS offer includes:

- **Launch services including pre and post-launch activities**
- **Support to customer for documentation preparation**
- **Integration into deployer**
- **Microsat Fit Check at Customer Premises**
- **Satellite integration on launch vehicle**
- **Packaging and shipment to launch site**
- **Launch Insurance**

Heritage & Customers

VV16

SSMS PoC flight: It was in Flexi-3 configuration and among the 53 customer on boards SAB provided the launch service to No.6 Institutional CubeSat and to SPIRE (No. 8 Satellite on board). In addition SAB-LS performed integration in Brno.

VV18

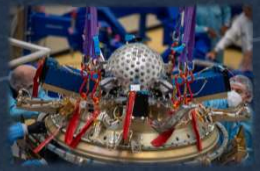
The second SSMS Missions was a Piggy Back and SAB offered the service to Nanoavionics and SPIRE.

VV19

Has been the first missions with CubeSat deployer accommodated on the PLA. All the auxiliary passenger on board were SAB LS Customer:

- LEDSAT
- SUNSTORM
- RADCUBE
- UNSEENLABS

VV21



SAB was the Launch Service provider for TRISAT-R Mission on the VEGA C Maiden flight.

VV23

SSMS commercial mission where SAB aggregated a total of n.7 cubesats.
N. 5 cubesats where Arianespace customers to whom SAB provided deployer and integration services.
The n.2 SAB LS customers:

- MACSAT
- PRETTY

IOSHEX

IOSHEX (In Orbit Servicing HEXagonal module)

- competitive pricing leveraging on its dual function:
  - payload adapter for rideshare and piggyback missions
  - separate from the last stage and perform independent mission activities as a fully independent spacecraft
- modularity
- interoperability with Space Rider
- dedicated to LEO and microgravity services

IOSHEX + Space Rider

SAB vision for commercially successful IOS providing is to have it integrated in the service already provided by the launcher. This is possible thanks to the unique concept of IOSHEX.

To best leverage the potentialities, SAB looked into an infrastructure which exploits the synergies between different systems to establish an IOS ecosystem capable to satisfy customers needs. The choice on the partner vehicle for this mission was on Space Rider, the re-entry vehicle in development under ESA, because of its unique capabilities.

A demonstration mission for the cooperation between the two systems is being studied under a Proof of Concept project under the ESA FLPP program.


SAB
Launch Services
Refuelling
Active Debris Removal
Co-operative AOCS
Takeover
Refurbishment
In-Space Assembly and
Disassembly
Recycling

IOS Infrastructure

This IOSHEX + Space Rider infrastructure opens to new possibilities in the field of IOS and orbit sustainability. This concept allows to enable a streamlined provision of ADR, recycling and in-space hardware refurbishment. This grants a cleaner orbital environment by reducing the current disposability of orbital hardware while allowing the salvage of obsolete items in orbit.

The infrastructure is designed with:

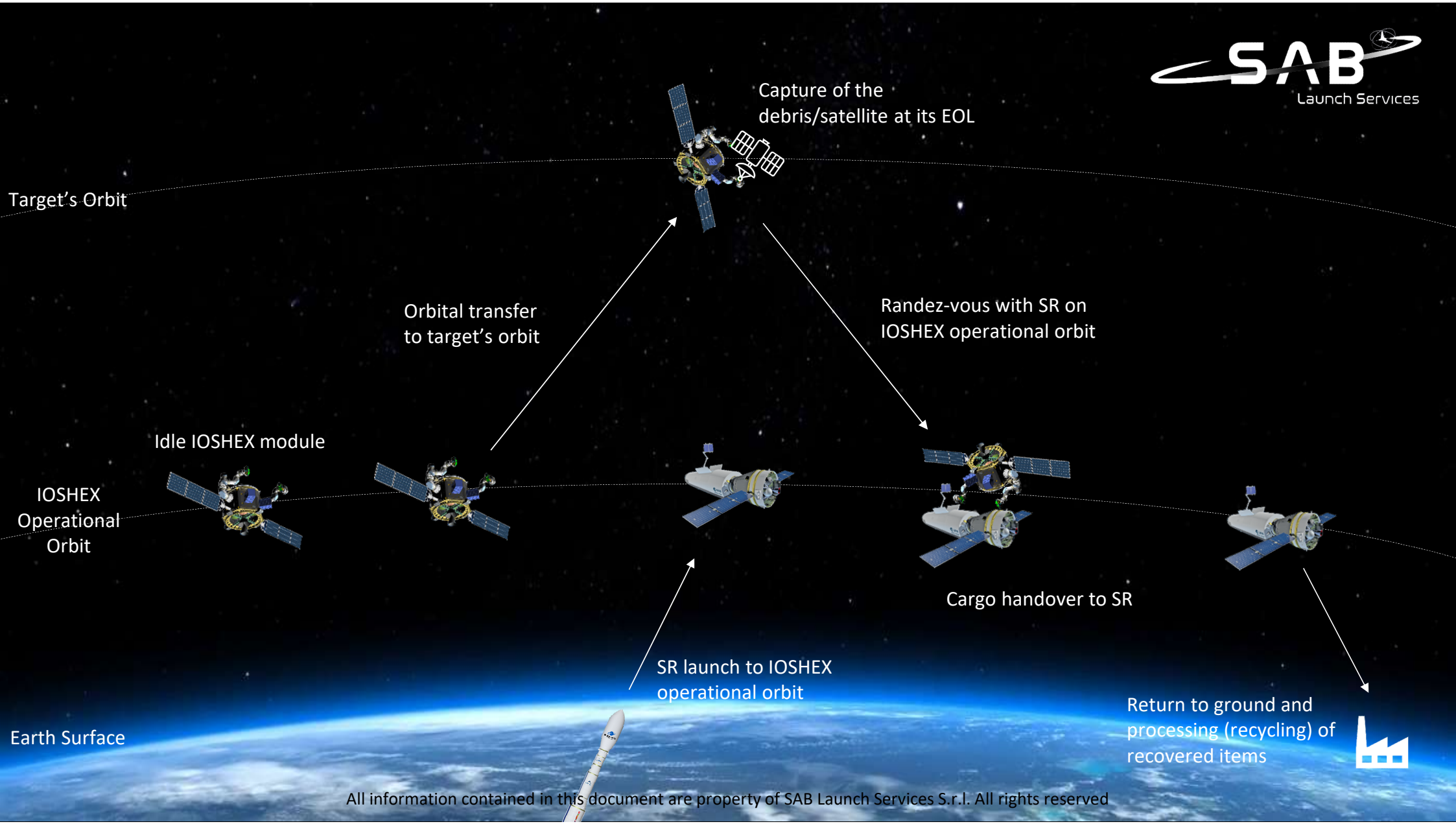
- IOSHEX acts as an orbital module
- IOSHEX stays in orbit in its operational orbit ~600 Km for ~5 years
- Space Rider acts as cargo transporter, delivering refurbishment items from ground to IOSHEX and returning salvaged items back to ground.

ADR with ground recycling

Recycling of space hardware is key in the sustainability of space environment, but on-orbit recycling is still outside the reach of current technology. With the IOSHEX + SR infrastructure, thanks to the ability of Space Rider to safely transfer items from orbit to ground, the recycle of salvaged debris or spacecraft parts can be done on the ground.

Some key elements and potentiality of the infrastructure:

- Thanks to specific fixtures on the IOSHEX module, multiple targets can be captured and brought to SR in one mission
- Aside of recovering precious parts and materials, valuable science can be collected from items which were subject to orbital environment for long time



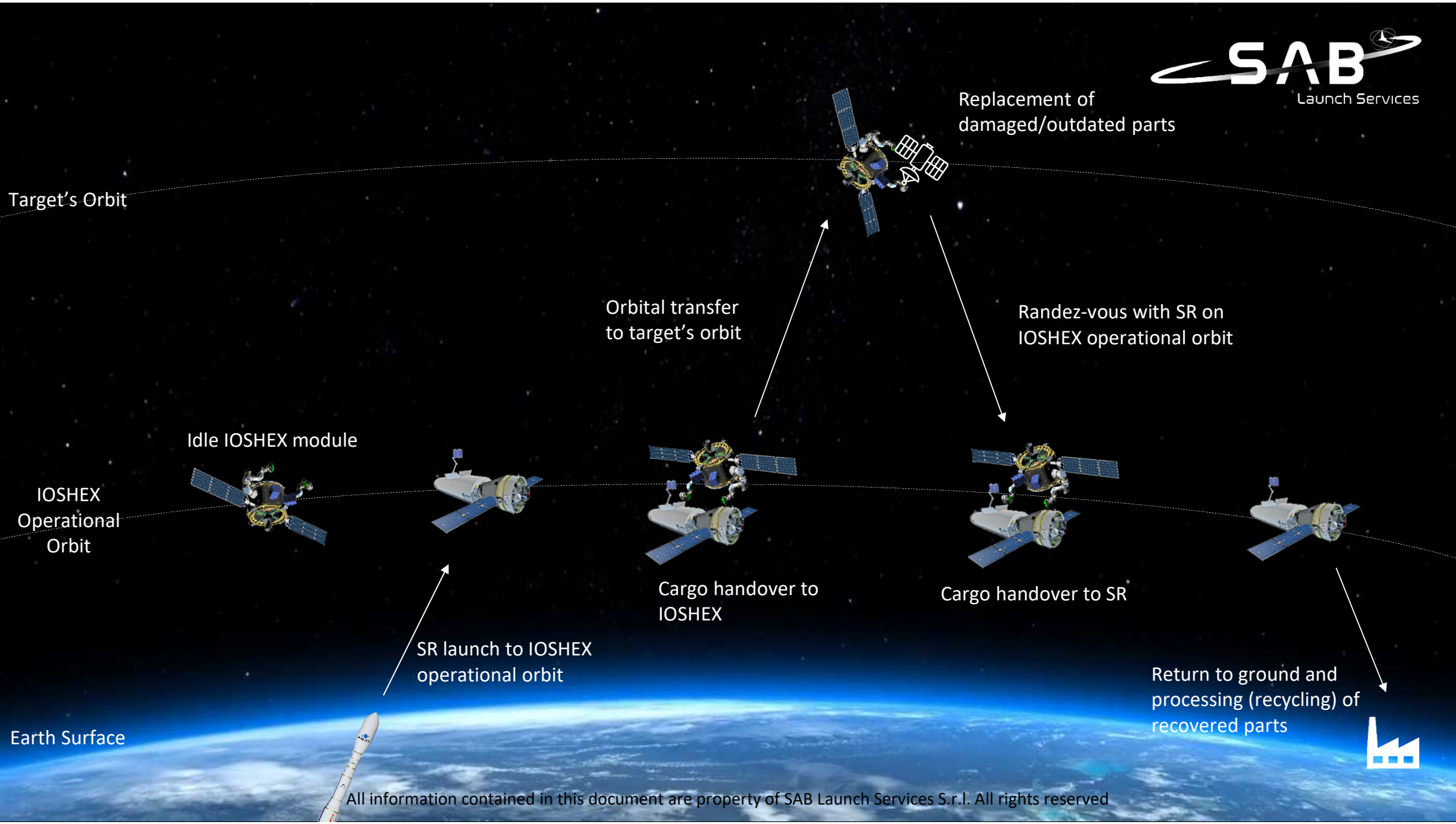
In-Orbit Refurbishment

The key capabilityes of the two vehicles, can enable in-orbit refurbishment with ground recycling. The ADR concept can be streamlined as refurbishment by providing to the IOSHEX module the reconditioning parts through the SR vessel.

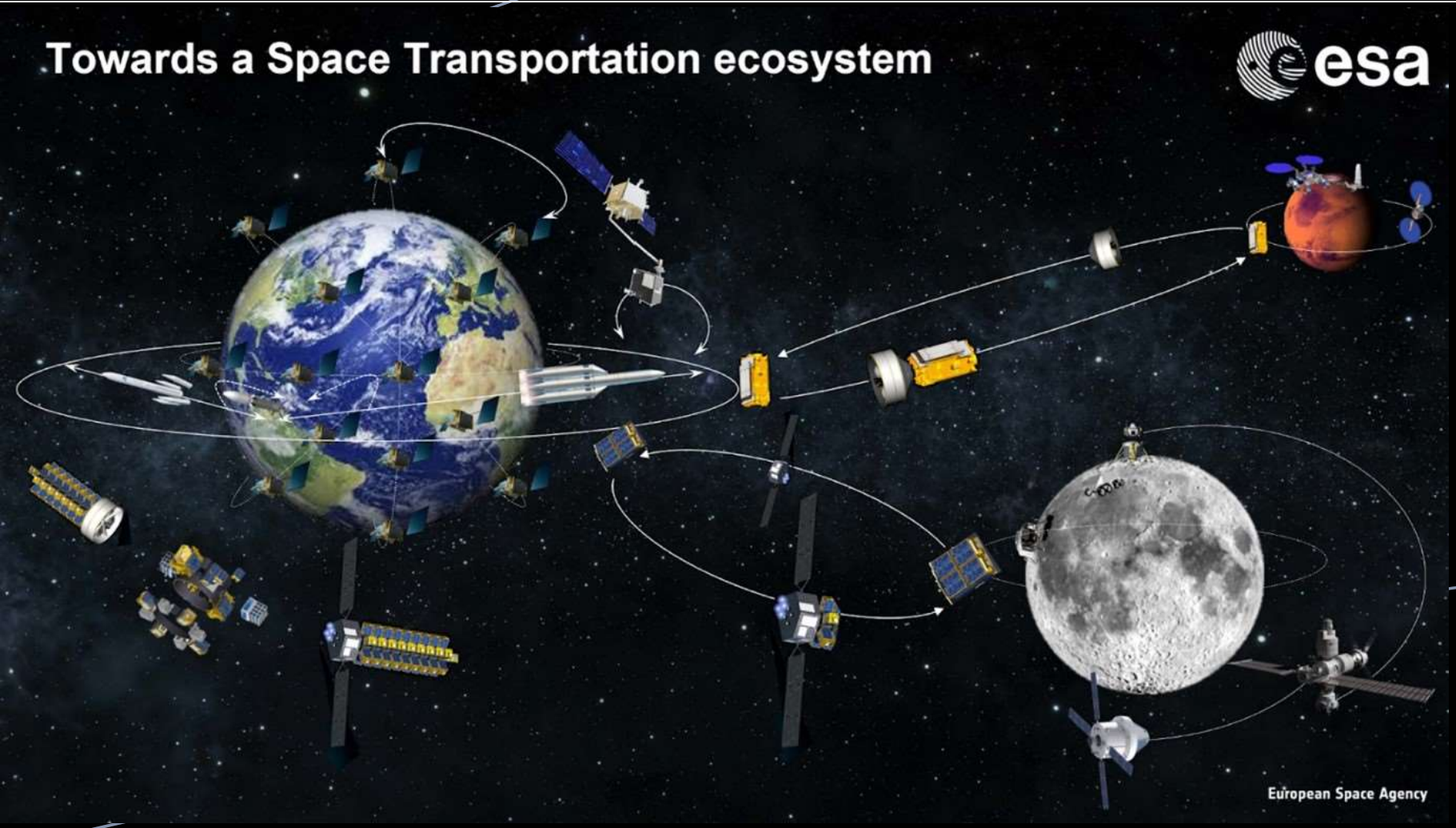
- IOSHEX is equipped with end effectors capable of mounting/dimounting specific parts in orbit.
- SR is the cargo transporter providing IOSHEX with refurbishment material from ground and returning obsolete parts back to Earth's surface.

Some key features of the infrastructure:

- With IOSHEX idle in orbit, a service activity can be quickly set up and delivered.
- Towards sustainability, refurbishment can service both damaged spacecraft to continue their nominal mission and EOL spacecraft to be upgraded and avoid disposal.



The future of In-Orbit Servicing



This ecosystem shall provide logistics and transportation to, among others, the following use-cases and service providers:

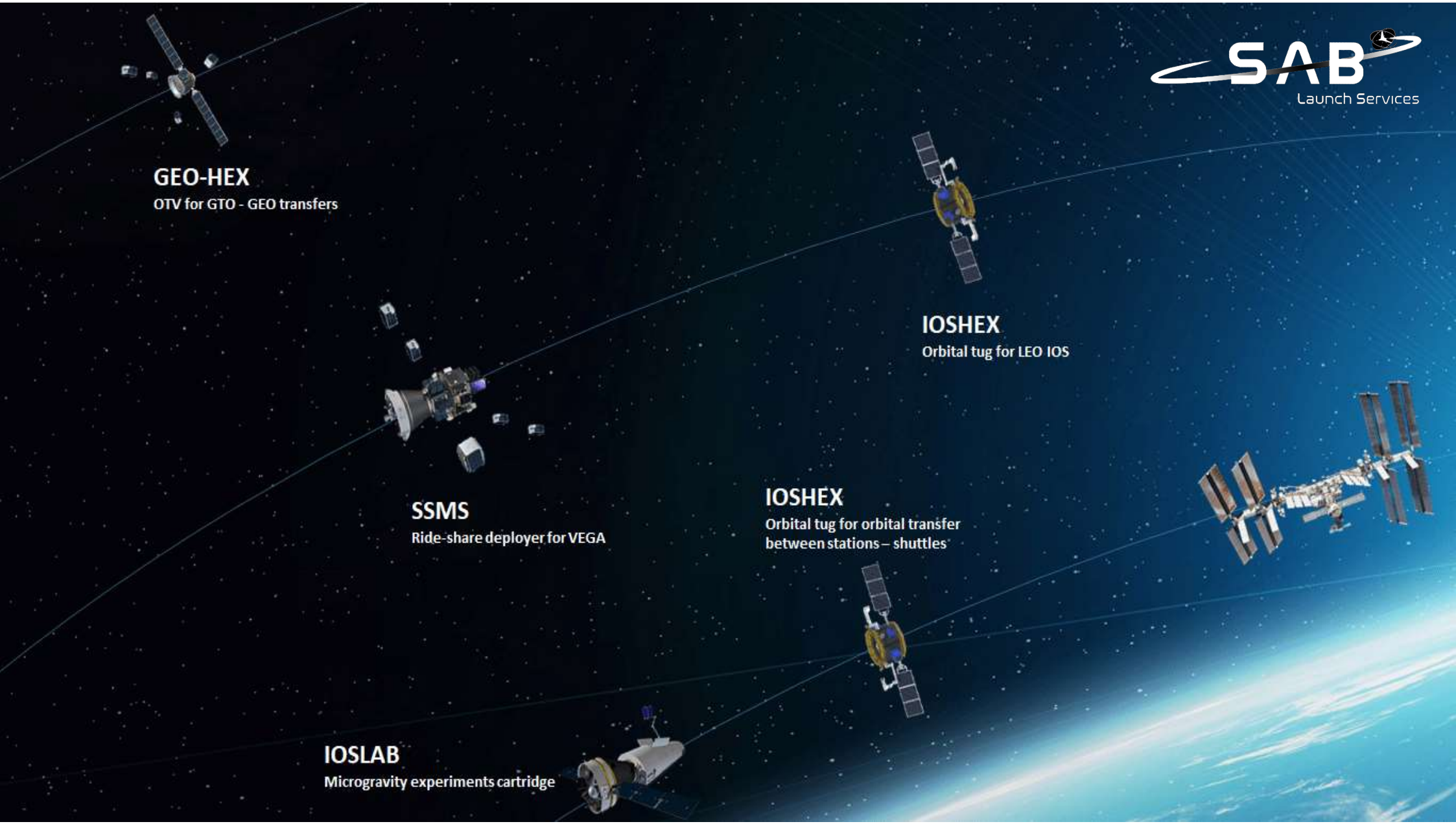
In-orbit servicing:
- refueling,
- maintenance,
- life-extension,
- storage,
- propellant depot;

In-space manufacturing and assembly;

End-of-life management and active debris removal;

In-orbit infrastructures for energy and/or data exchanges;

Return to Earth.


SAB
Launch Services
GEO-HEX
OTV for GTO - GEO transfers
IOSHEX
Orbital tug for LEO IOS
SSMS
Ride-share deployer for VEGA
IOSHEX
Orbital tug for orbital transfer
between stations – shuttles
IOSLAB
Microgravity experiments cartridge