ESA Clean Space Industry Days

11th October 2022

D-ORBIT'S DEORBITING KIT
A SOLUTION FOR THE END-OF-LIFE MANAGEMENT OF LAUNCHER AND SPACECRAFT

D-ORBIT'S BUSINESS

LEADER IN SPACE TRANSPORTATION MARKET – MOVING TOWARDS IN-ORBIT SERVICING

2022 TODAY

LAST-MILE DELIVERY SOLUTION FOR SATELLITES

- World's first in-space last mile delivery service, proven in space with paying customers
- Provides correctly spaced satellite delivery; orbital plane changing; and orbit raising
- Building block to enable future in-orbit services tomorrow

2022 TODAY

ADDITIONAL SERVICES: IN-ORBIT SERVICES

- The second life of ION: there are a range of Advanced Services D-ORBIT can provide with IONs in-orbit:

➢ In-orbit validation & demonstration
➢ Backup satellite service to a constellation
➢ Payload hosting and satellite as-a-service
➢ Satellite communication hub services

2022-2026 TOMORROW

IN-ORBIT SERVICING

- The combination of existing technology, the scalability of the ION platform and advanced robotics will enable D-ORBIT to provide in-orbit servicing to satellite operators
- In–orbit Servicing includes: Extending the life of satellites; moving satellites to new orbits; and end of life disposal of satellites

D-ORBIT'S in A GLANCE

D-ORBIT UK

ION Advanced Services
Harwell, UK

D-ORBIT

Headquarters
Production venue, mission control
(2,500m²)

D-ORBIT USA

Commercial subsidiary,
Washington DC

D-ORBIT PT

Critical software and AURORA mission control software,
Lisbon, Portugal

235 people (and growing)

IN-ORBIT SERVICING

THE NEXT MARKET

We believe the combination of **existing D-Orbit technology**, the scalability of the **ION platform** and **advanced robotics** will enable D-Orbit to provide in-orbit servicing to satellite operators

TRANSPORTATION

REFUELING

PHASING

Scalable and modular

In-orbit servicing
active debris removal

MAINTENANCE

EMERGENCY

DISPOSAL

01

Move existing satellites from one orbit to another new orbit

02

Extend the life of satellites

03

Rescue satellites launched or drifting to the wrong orbit

04

Dispose of satellites properly at the end of their life (active debris removal)

D-Orbit has already won a contract with a major satellite operator for studying and delivering in-orbit servicing (active debris removal)

PROGRAM INTRODUCTION

CLEANSPACE DEORBITING KIT DEVELOPMENT AND IN-ORBIT DEMONSTRATION

D-Orbit is contracted by ESA to carry out the design and in-orbit demonstration of a ground-installed deorbit kit for the controlled re-entry of a dual launch adaptor.

PART OF THE SPACE SAFETY PROGRAMME (S2P)

The objective S2P is to contribute to the protection of our planet, humanity, and assets in space and on Earth from threats originating in space, including In-orbit servicing/debris removal missions to address debris and at the same time support the market of in-orbit servicing.

SAFEGUARDING EARTH'S ORBITAL ENVIRONMENT

As reflected by the number of relevant regulations that are being proposed and put in place to address these important issues. The deorbit kit has been identified as a potential strategy for achieving compliance with ESA space debris mitigation policy

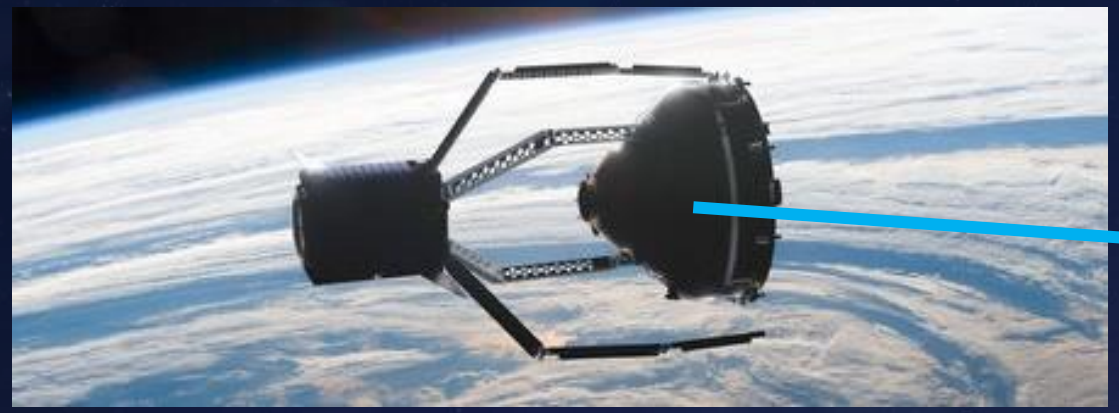
AUTONOMOUS DEORBITING SYSTEMS FOR FUTURE LEO MISSIONS

The deorbit kit, which is a suite of equipment that is installed on the ground before the launch of the satellite, is intended to carry out the necessary functions to perform controlled re-entry of the satellite at end-of-life or after failure.

PROGRAM OBJECTIVES

CLEANSPACE DEORBITING KIT DEVELOPMENT AND IN-ORBIT DEMONSTRATION

- ClearSpace-1 will rendezvous, capture and de-orbit for re-entry the upper part of a VESPA (Vega Secondary Payload Adapter) used with Europe's Vega launcher.

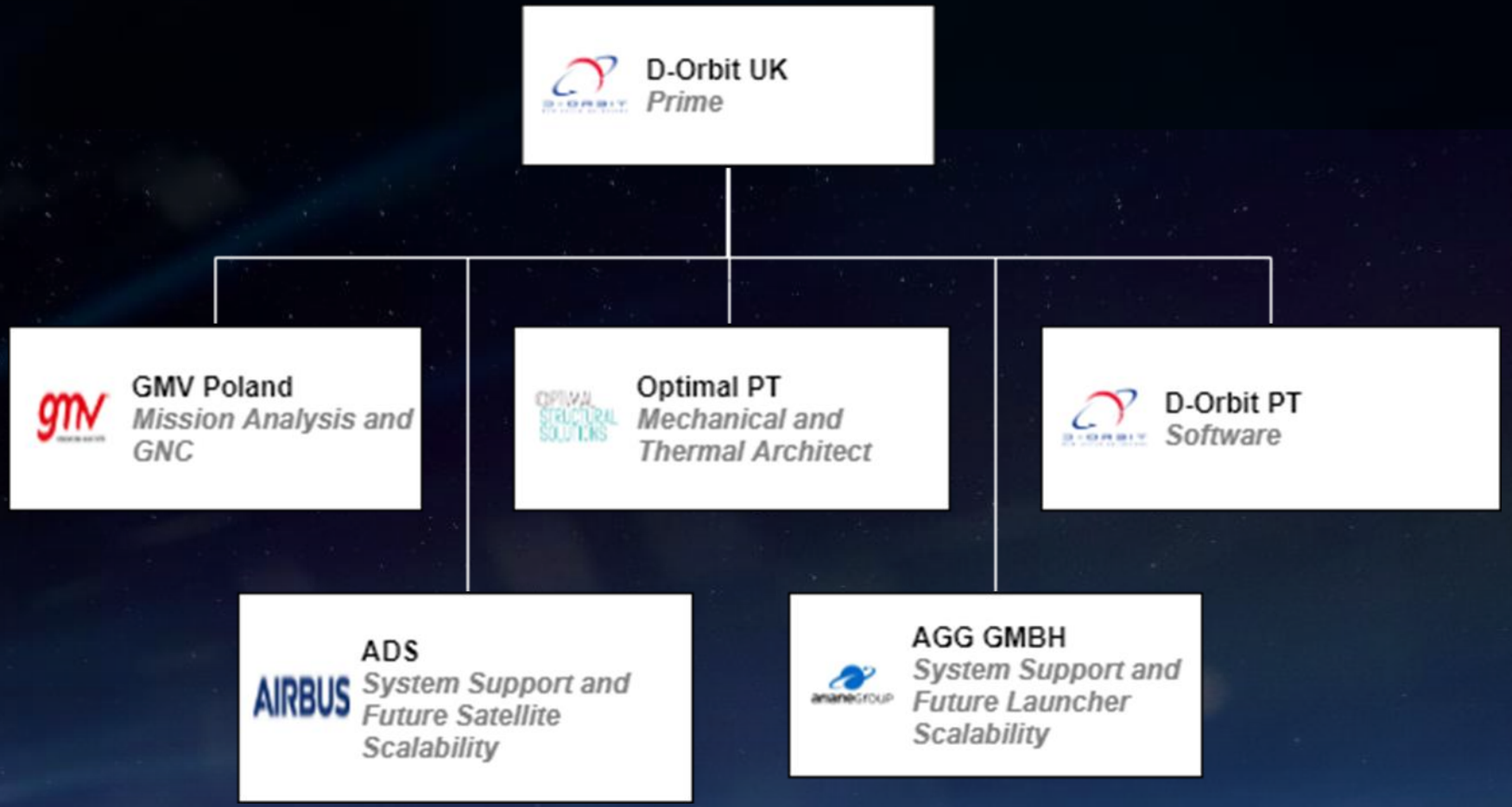


- The Deorbiting Kit is preliminarily foreseen to be launched on the same VEGA launcher, attached on ground to the upper part of the VESPA that will deploy Cleaspace-1 (subject to confirmation).

VESPA is the preliminary target of the deorbit kit

PROGRAM TEAM

CLEANSPACE DEORBITING KIT DEVELOPMENT AND IN-ORBIT DEMONSTRATION



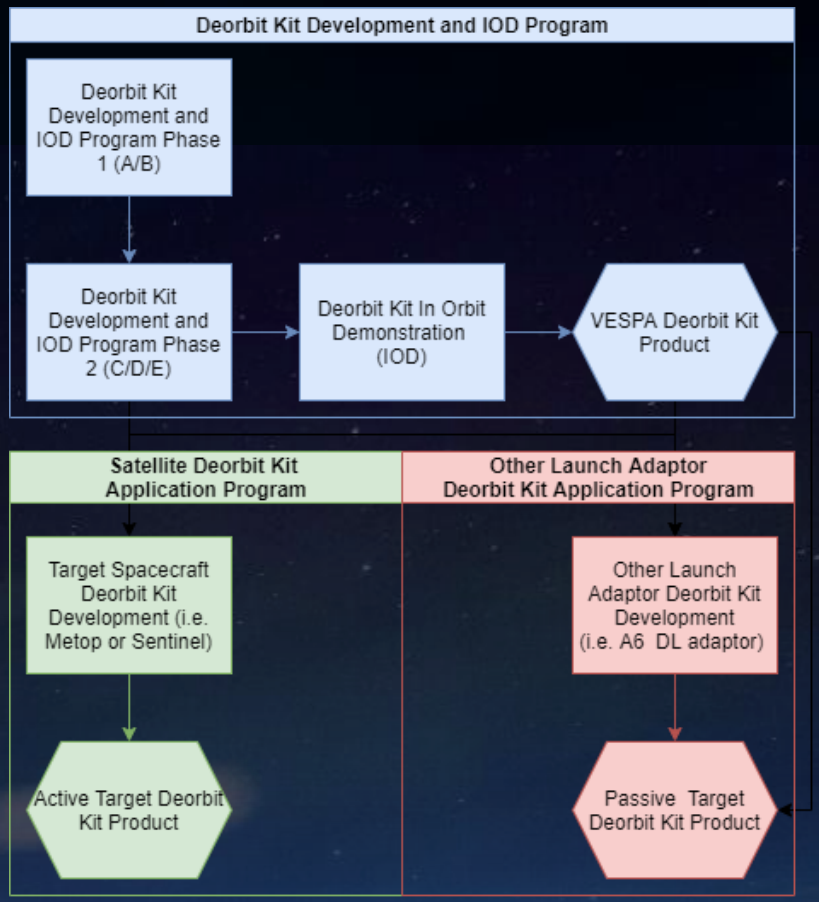
VISION

DEORBIT KIT PRODUCT LINE

The ultimate goal is to develop a modular and scalable concept that would allow the deorbit kit to be accommodated on other hosts (other launch adaptors and satellites).

The DOK is being developed in two versions:

- **passive target DOK:** a “fully autonomous” DOK meant to be mounted on passive or non-operational satellites such as launch adaptors, with a short lifespan,
- **active target DOK:** a “connected” DOK, which connects to the host to detect satellite failure before turning ON and establishing communications with ground, with an extended lifespan to envelope longer applications.



DEORBIT KIT HERITAGE

LEADER IN SPACE TRANSPORTATION MARKET – MOVING TOWARDS IN-ORBIT SERVICING

D3 DECOMMISSIONING DEVICE

independent, smart propulsive device available for all satellite platforms operating in LEO, MEO, GEO,

SIMBA ON BOARD COMPUTER

A lightweight, cost-effective, and versatile onboard computer for platform management or general-purpose applications

SimON Electro-Explosive System

Used for the remote safe ignition of pyrotechnical chains. The system is particularly indicated for solid rocket motor ignition.

KEY TECHNOLOGIES TESTED IN ORBIT IN 2013 (ALICE 2) AND 2017 (D-SAT)

MECHANICAL CONCEPT

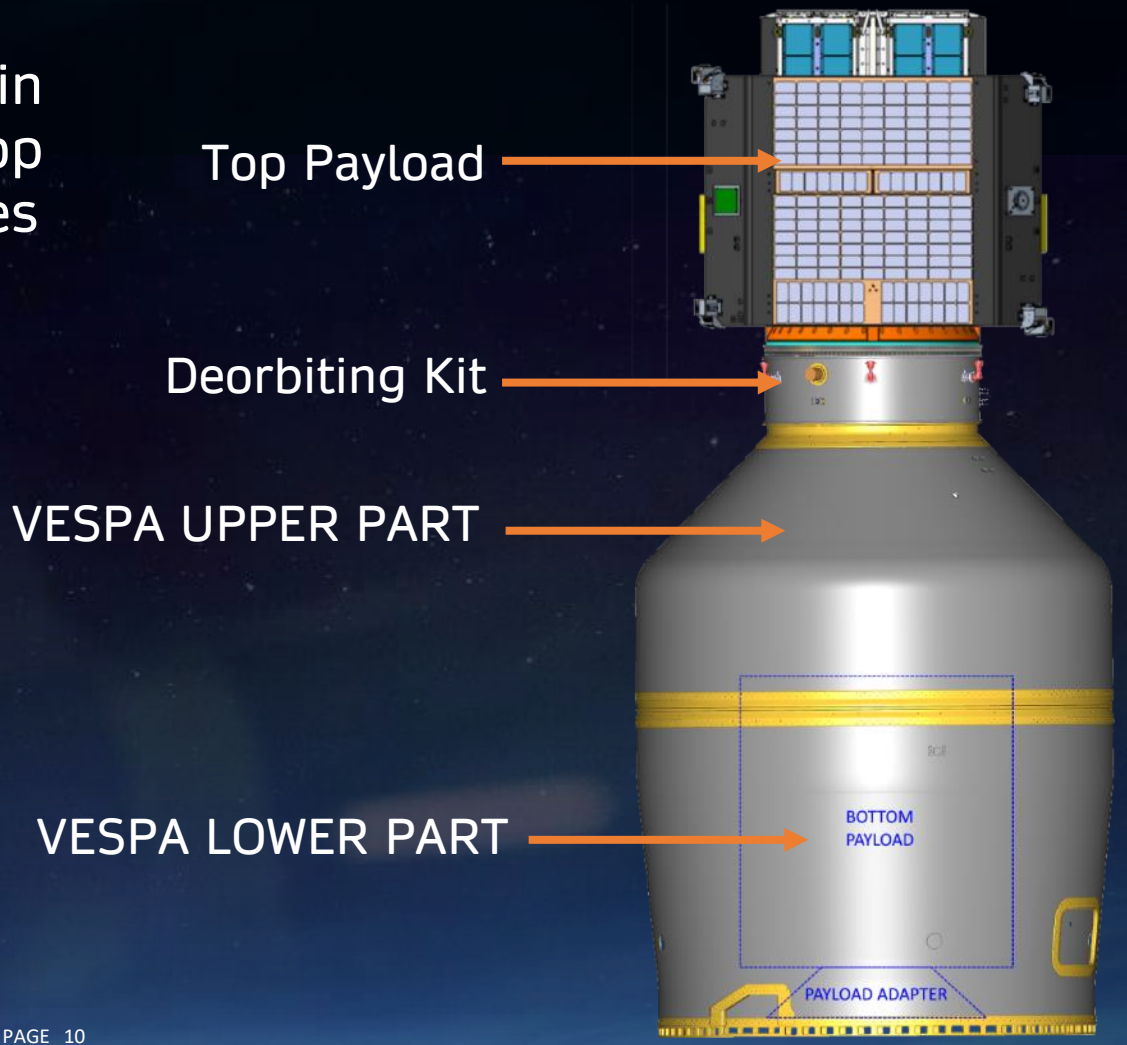
DEORBIT KIT PRODUCT LINE

The Deorbiting Kit IOD will be bolted in between the launch adapter and the top payload's clampband with identical interfaces

It can also sit in between the clampband and the spacecraft enabling the deorbit kit to deorbit the spacecraft rather than the launch adapter.
This guarantees a standard interface for both the passive and active target deorbiting kit.

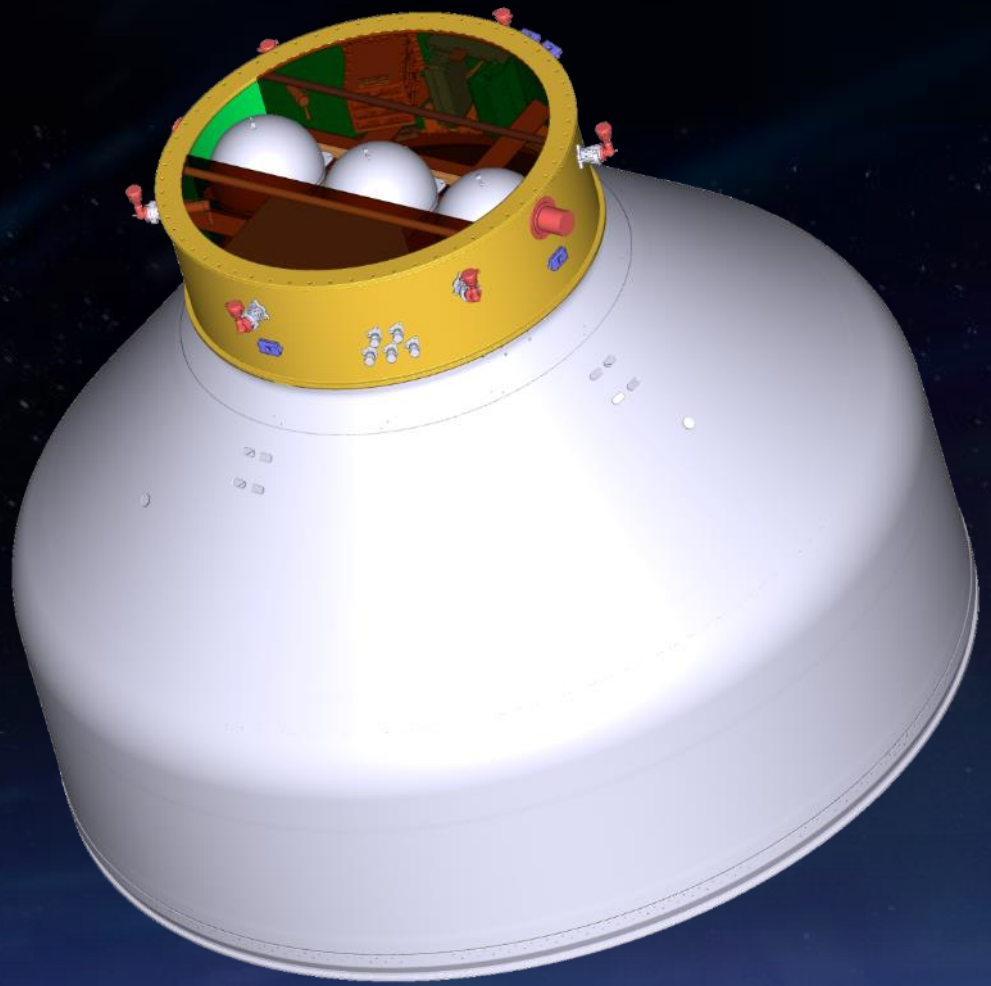
A circular interface is:

- Structurally robust, as evidence by its use on all spacecraft-launcher interfaces
- Suited to accommodate chemical propulsion thrusters in a hexagon to allow for 3-axis control.
- Flexible in the attachment location and easily scalable if needed



DESIGN CONCEPT

DEORBIT KIT PRODUCT LINE



The deorbiting kit is a cylinder of customizable diameter and height. The IOD is 1100mm diameter by 300mm diameter, and only includes:

- Avionics (OBC, RTU)
- Battery (not recharged during life)
- Communications (RXTX, Antenna)
- Propulsion System (Chemical)
- Attitude and Inertial Sensors
- Thermal Control System

A simple deorbiting kit is essential to limit wet mass and cost to enable its commercialization

MISSION PROFILE

DEORBIT KIT DESIGN

SELF CONTAINED

DEORBIT KIT DESIGN

Active host monitoring equipment (host watchdog, host power and data interfaces, etc) do not make sense to have on a passive target deorbiting kit.

Hence:

- Baseline is the configuration to deorbit a passive target (Passive target DOK)
- Hardware needed to make it an Active target DOK is designed as add-ons to ensure future use compatibility.

The DOK is meant to be as self-contained as possible, with the notable exception of:

- The mechanical interface with its host
- A potential power and data interface with its host, to enable a watchdog function

POWER AND DATA INTERFACE

DEORBIT KIT DESIGN

The power and data interfaces are only present on the active target version of the deorbit kit.
Both of these are handled on the OBC, which features a watchdog board.

The following data interfaces are foreseen:

- Data connections to nominal and redounded host platform buses, **MIL-STD-1553B standard or CAN Bus (configurable during manufacturing phase);**
- **A low-level Low-Power Command (LPC)** line to issue on/off commands from the host to the kit,
- **A low-level High-Power Command (HPC)** line to issue the batteries arm/disarm status to the Power Distribution Unit

The DOK accepts a 28V DC connection to power the watchdog function (~2.5W) during the operational life of the spacecraft, greatly limiting the impact on the host's power budget.

CONCLUSION

DEORBIT KIT

D-orbiting Kit's plug-in solution is special in its potential to become a self-sustaining product. While the aim of the initial activity addressed within Clean Space is to deorbit a passive launch adaptor (such as a VESPA upper part) as an in-orbit demonstration, the ultimate goal is to develop a modular and scalable concept that would allow the deorbit kit to be accommodated on other hosts (other launch adaptors and satellites).

This constraint is fully integrated into the mechanical and electrical architecture of the deorbiting kit.

This standardisation effort is essential to the success of the deorbiting kit as a viable IOS solution in the coming years.

Future developments to make the system suitable for being installed in space on existing space assets to provide services such as:

- Orbital Relocation
- Life Extension

D-ORBIT

NEW SPACE SOLUTIONS