



Beyond ELSA-M

Developing Sustainable In-Orbit Commercial Services

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OCTOBER 2023, ESTEC, ESA CLEAN SPACE INDUSTRY DAYS



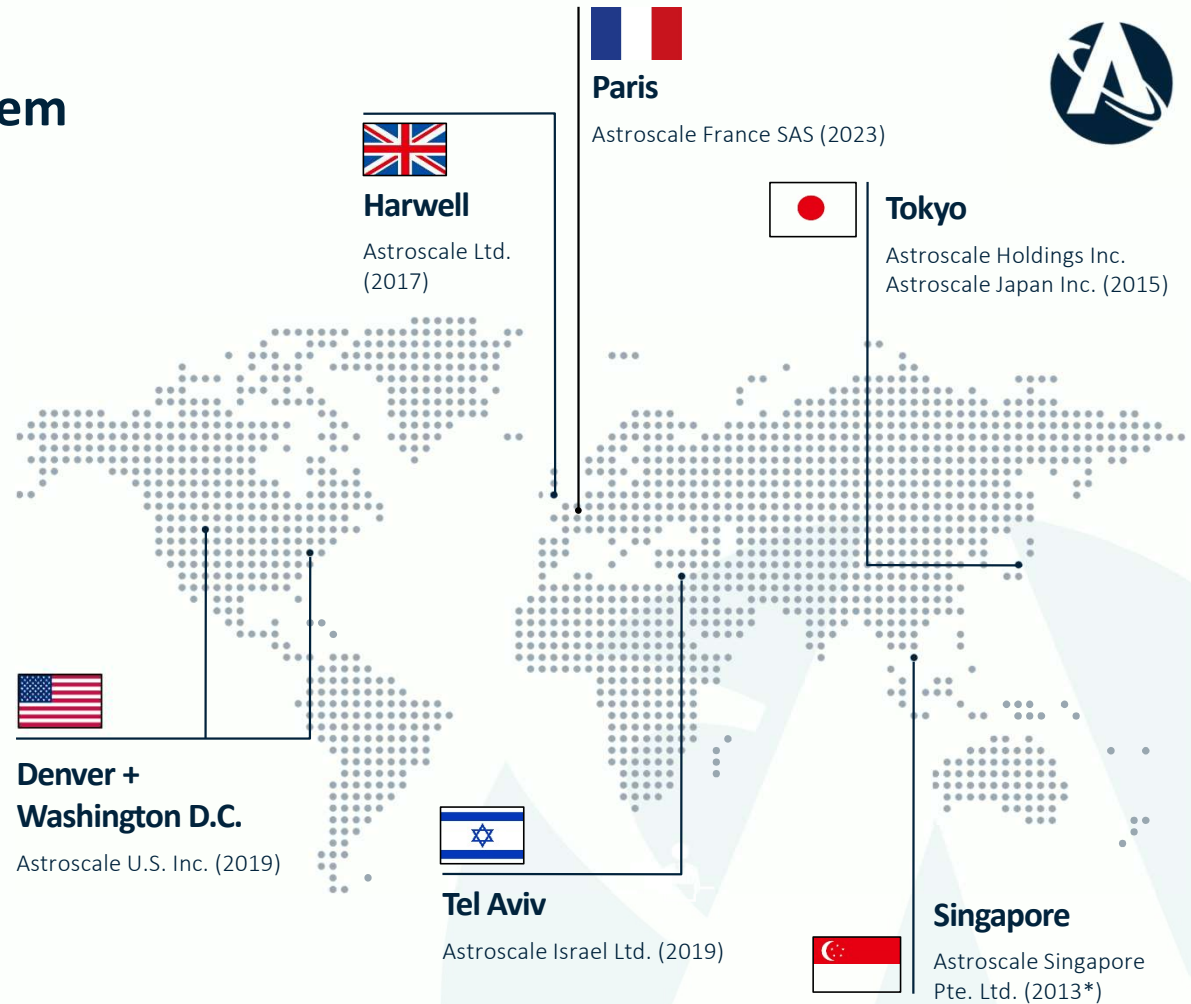
Astroscale: Solving a Global Problem

VISION

Safe and sustainable development of space for the benefit of future generations.

MISSION

Develop innovative technologies, advance business cases, and inform international policies that reduce orbital debris and support long term, sustainable use of space.

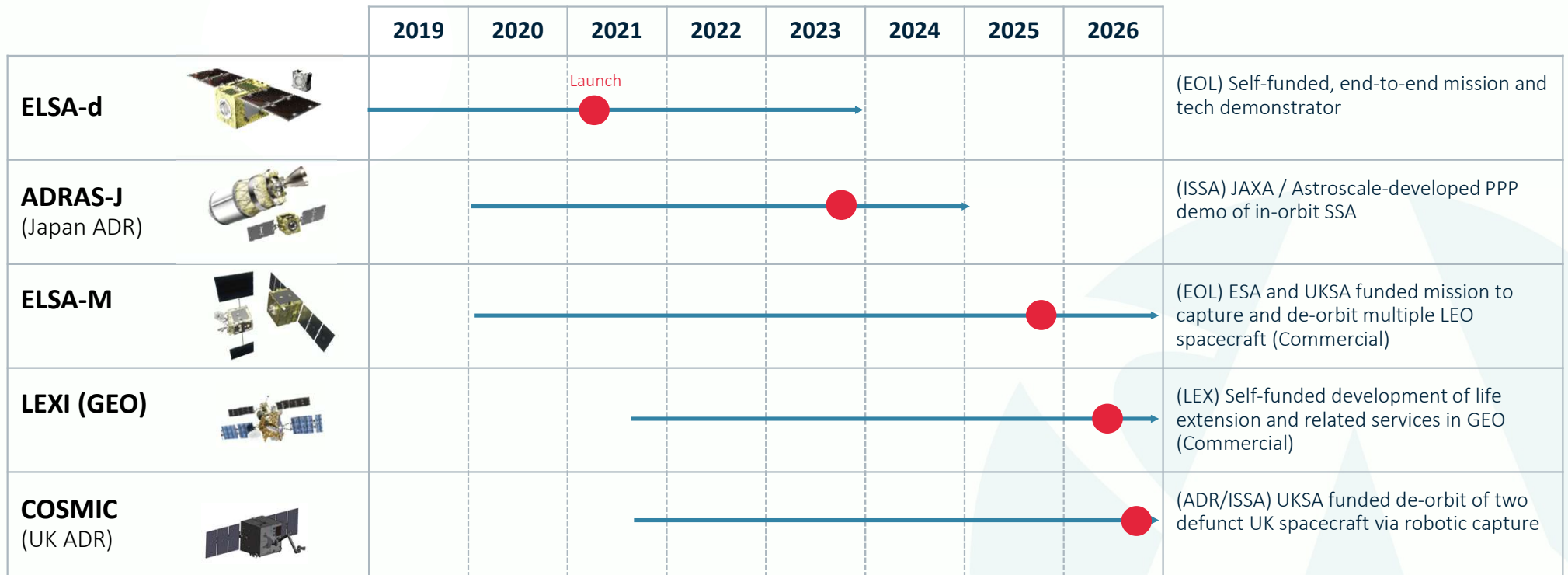


** Astroscale Singapore was founded in 2018. In 2019, Astroscale Singapore merged with Astroscale PTE. LTD., which was formed in 2013. Accordingly, 2013 is shown as the formation date of Astroscale Singapore.*



Astroscale Mission Set

Sample Servicer Timelines



World Leading Commercial Technology



COSMIC

Cleaning up the Past

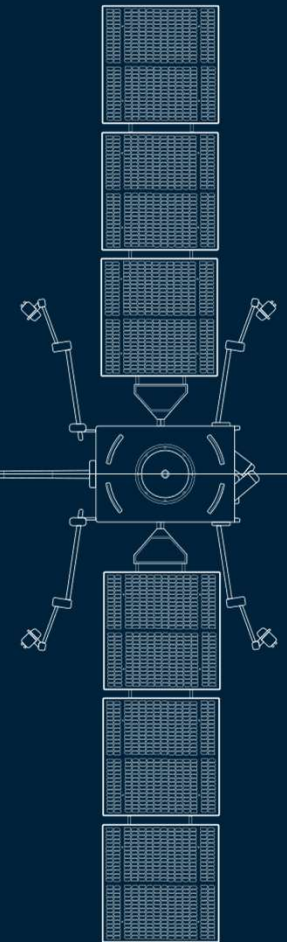
- World's first institutional multi-removal, Active Debris Removal (ADR) mission of unprepared objects
- Robotic technology to remove legacy unprepared objects
- Refuellable for future servicing

ELSA-M

Preparing for the Future

- World's first End-of-Life (EOL) service of a full-sized commercial end customer
- Magnetic removal of prepared satellites
- Multi-client removal to achieve strong business case





Preparing for the future

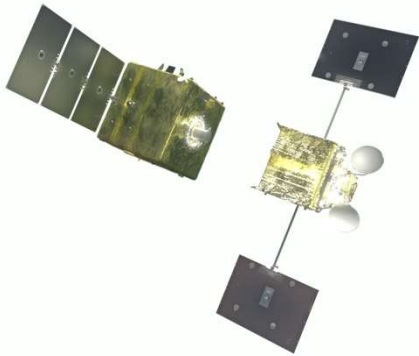
ELSA-M



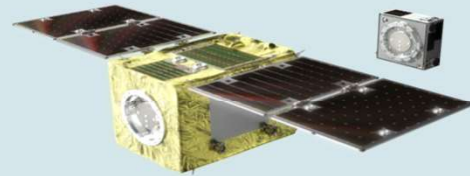


ELSA-M | Leveraging ELSA-d to Launch Commercial Service

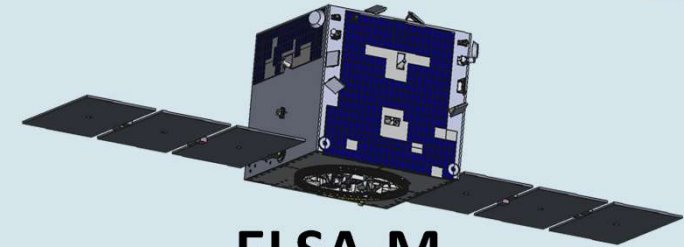
- ELSA-M: Public-Private Partnership (Sunrise) with UKSA, ESA and OneWeb to mature debris removal technology and capability towards an in-orbit demonstration launched by 2025, followed by a commercial service offering.
- Leverages ELSA-d heritage; designed to capture 3-4 pieces of LEO debris during a single mission.
- Capable of servicing a diverse range of LEO clients across a wide range of operating altitudes, satellite masses etc.
- Phase 3 development underway, with Phase 4 (planned for AIT / launch / operations) and CDR approaching soon.



ELSA-M – Advancements from ELSA-d



ELSA-d



ELSA-M



Client	Single 20kg demonstration CubeSat	Multiple clients per servicing mission (multiple client types, up to 800 kg in mass, equipped with DPs)
Funding	Internally funded	Over 5 years development under PPP with ESA and OneWeb, supported by UKSA (Phase 4 starting soon)
Mission Altitude	Low-LEO (~550km) for demonstration mission safety	Moving across altitudes from low-LEO drop-off altitudes to high-LEO (1200km+) – designed for higher radiation exposure and longer mission time
Supply Chain	Mixed global suppliers, including SSTL, Catapult, RHEA, GMV	Strong UK & European supply chain
Mission	Demonstrations of magnetic capture, station keeping, long range approach, absolute to relative handover	Designed to safely and robustly capture and dispose of client; targeting 2025 to service a OneWeb satellite and on-going commercial missions planned 2026+



Business Offering & Value Proposition

Astroscale will provide debris removal services for satellites constellations to **protect, manage, and optimise** satellite services in an increasingly congested environment, achieved through:

- Demonstrating the **value of EOL services** throughout the life cycle
- Considering **EOL services in the context of the fleet**, rather than on a 'per removal' basis
 - Alternative measures will result in additional costs for each and every satellite in the constellation; Astroscale's service is only required for the small proportion of failed satellites
- Recognising the **regulatory benefit** for customers in committing to pay for EOL/ADR services



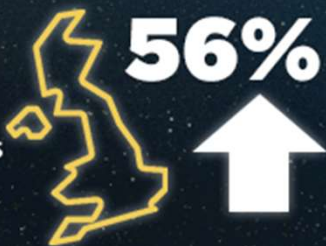
ELSA-M SQM in the Cleanroom, Harwell

ELSA-M : SCALE UP

Astroscale's end-of-life service for satellite operators, contributing to a more sustainable space environment by removing inactive satellites and reducing collision risk for all users of space.

DRIVING REGIONAL DEVELOPMENT

Locating an impressive 56% of expenditure outside the South East and London, boosting investment opportunities across the whole of the UK.



EMPOWERING ECONOMIC GROWTH

Delivering a £23 per £1 return on public investment, showcasing Astroscale's ability to maximise value for the UK economy.



FUELLING JOB CREATION AND INNOVATION

Supporting over 12,000 high-skilled, high-paid jobs across the UK, fostering innovation and expertise in the rapidly growing space industry.



GENERATING SALES FOR THE UK SPACE INDUSTRY

Projected to contribute £2bn in sales for the UK space industry, accelerating economic growth and prosperity.

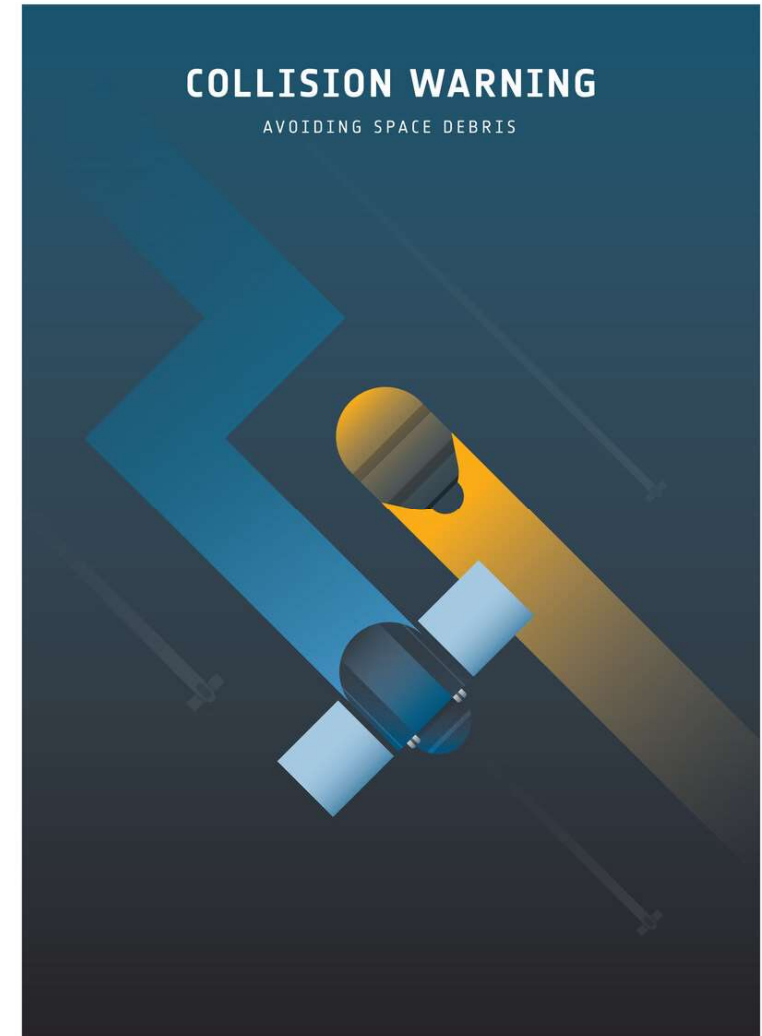


ESA Support Mechanisms

Astroscale has a strategic agreement with ESA, since both parties have mutual strategic interest in pursuing collaboration on ELSA-d and future missions by **exchanging data and expertise** related to mission operations, the environmental monitoring of debris and active debris removal.

We will build on this relationship moving forward for with ELSA-M.

Additionally, Astroscale has been involved in other programmes, such as **CREAM** (Collision Risk Estimation and Automated Mitigation), and future ELSA-M servicers could serve as an optimal testbed for these technologies.





Docking Plate



Astroscale Docking Plate – Key Features

ELSA-d mission has flight proven the 1st generation

- Used during ELSA-d Test Capture, August 2021

2nd Generation plate now available

- Robust, lightweight, compact and minimally intrusive solution utilizing high performance magnetic material
- Mechanical and magnetically compatible
- Simple interface
- No servicer lock-in (servicer agnostic)

Three height variants

- Increasing accommodation options



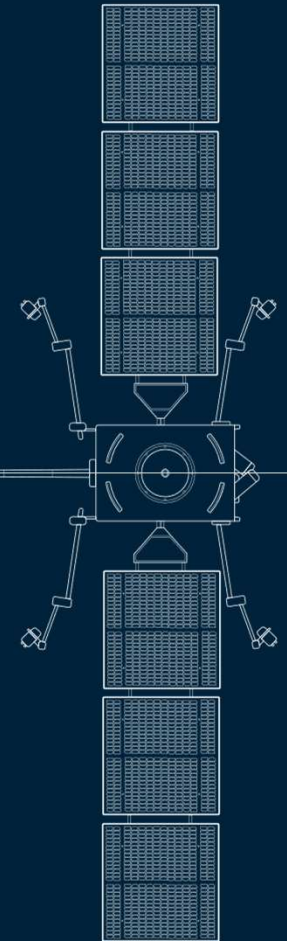
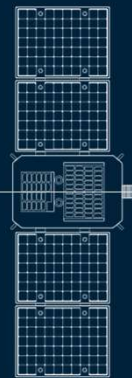
Ferromagnetic Plate

Fiducial Pattern Coating
(example pattern)

Reinforced, Knurled Rim
for Mechanical capture

Truss Legs





Beyond ELSA-M

Sustainable In-Orbit Commercial Services



Multiple Capabilities, Multiple Orbits

Astroscale is the only company solely dedicated to providing on-orbit services across all orbital regimes



Life Extension + Fleet Management

LEX (GEO)
Keep GEO satellites in operation after fuel depletion



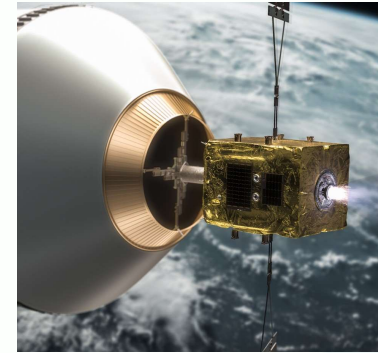
In-Space Situational Awareness/Inspection

ADRAS-J, LEX
Diagnose and characterize objects



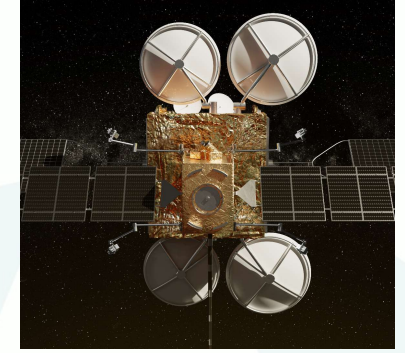
Orbital Transfer

ELSA-d, ELSA-M, LEX
On-orbit maneuver, last mile delivery, and deorbit services



Active Debris Removal

CRD2, COSMIC (UK ADR)
Remove large, non-prepared debris currently in orbit



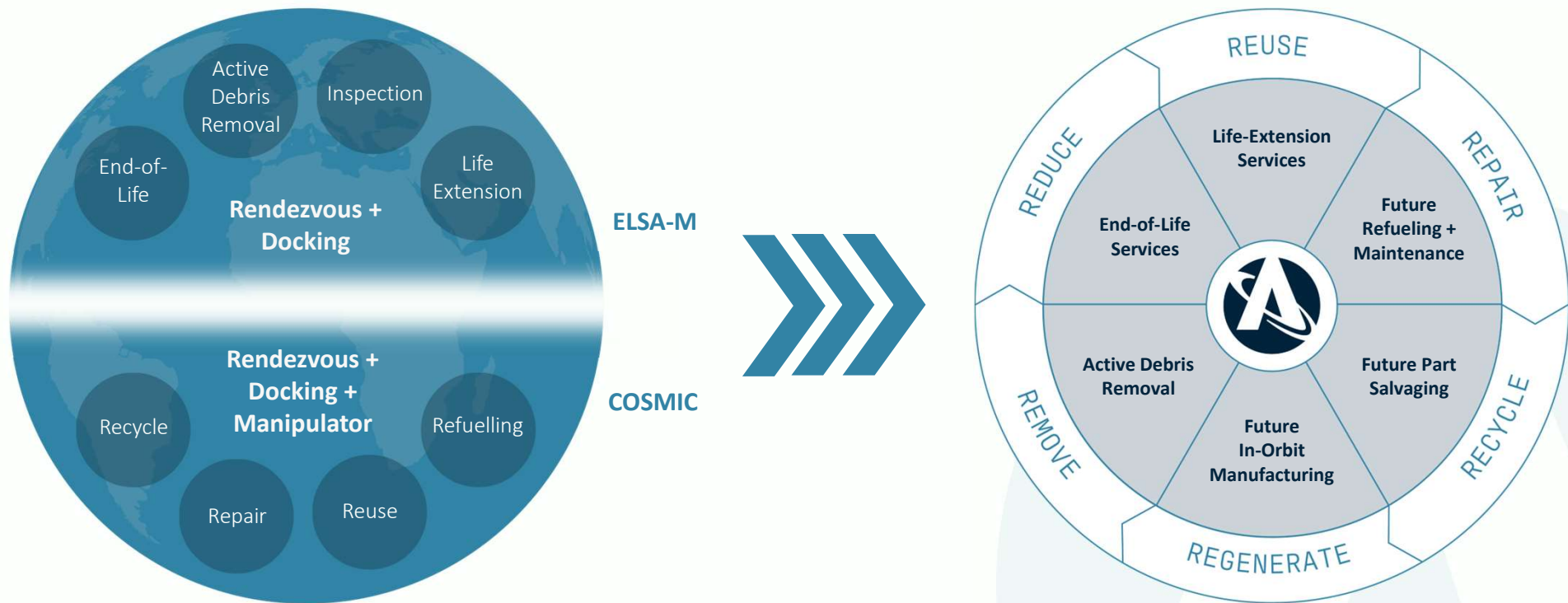
Refueling + Maintenance

CRD2, LEX, ELSA-M/
COSMIC variants
Upgrade, refuel, repair, or assemble on-orbit



Sustainable Space

Astroscale's services enable a circular economy in space, all while mitigating risk and maximizing value





Action from Governments is Growing

Nations are racing to address debris problem, and Astroscale is involved at every step



UK Plan for Space Sustainability

- UKSA and the New Zealand Space Agency are working together on a framework for joint ADR/IOS missions.
- UK Government is working with industry to improve regulations and insurance structures and the UKSA is carrying out a consultation on Orbital Liabilities and Insurance.
- His Majesty's Government is preparing guidance on ADR missions and large constellations, following on from initiatives such as the Astra Carta and the Earth Space Sustainability Initiative.



Astroscale France and EU Efforts

- The French Space Operations Act is currently in review, with a focus on space sustainability.
- With offices recently opened in Paris, Astroscale are actively involved in the review.
- Astroscale France is also involved in the development of EU Space Law.



ESA Zero Debris Approach

- Engage the space sector in a collaborative effort to consolidate the zero debris approach into a comprehensive and actionable roadmap for 2030.
- Astroscale continues to be involved in the operations workshops, defining requirements and standards, and in the drafting of the Zero Debris Charter.



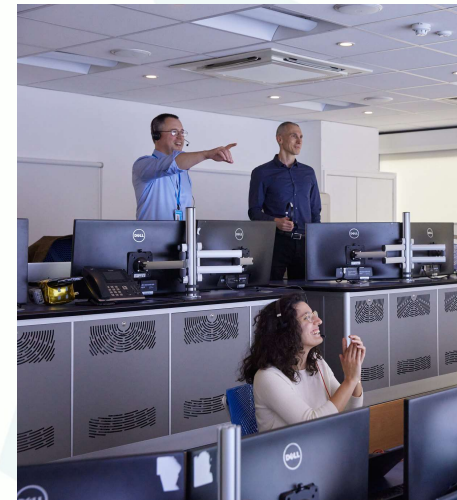
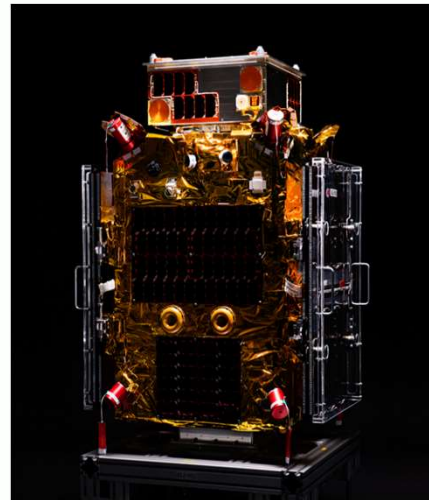
Japanese and US Initiatives

- FCC regulation calls for LEO operators to dispose of objects as soon as practicable, and no more than 5 years from the previous 25 years after end of mission.
- Japan Government has been working with industry for several years to develop guidelines for on-orbit servicing missions.



Conclusions

- Astroscale UK's key missions, ELSA-M and COSMIC, will provide EOL and ADR services in LEO
- ELSA-M (launched by 2025) is being developed with UKSA, ESA and OneWeb, and will be able to remove 3-4 pieces of LEO debris during a single mission
- The Astroscale docking plate is a key product in enabling satellites to prepare for future servicing
- ELSA-M will be followed by a commercial service offering and will lead to other in-orbit commercial services
- Support globally for these services is growing





Questions?

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