

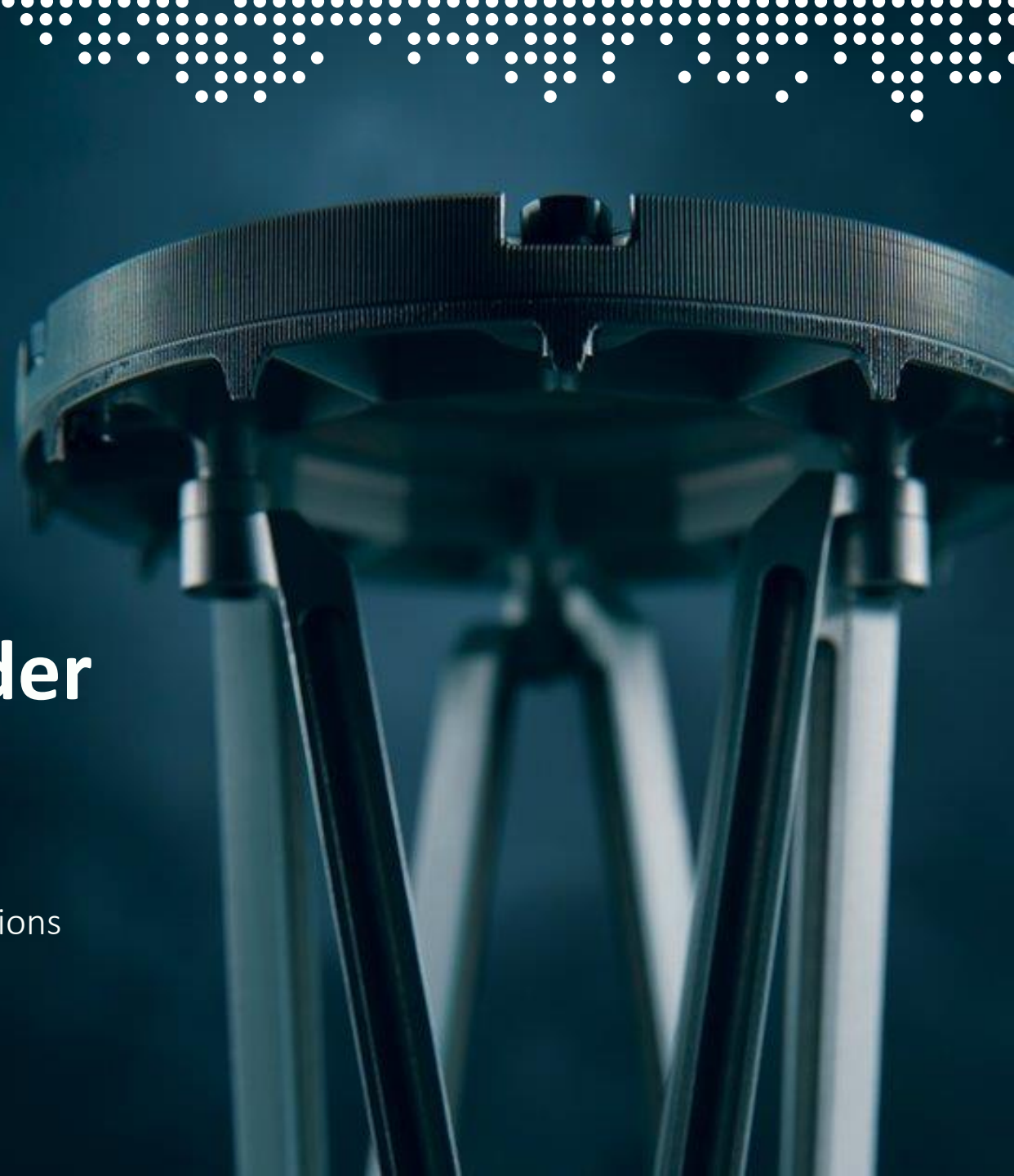


Design for Removal

Astroscale's Service Provider Perspective

Zoé Tenacci, Senior Engineer – Strategy & Engineering Solutions

ESA Clean Space Days, ESTEC 2024



Astroscale – Multiple Capabilities, Multiple Orbits

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



Life Extension + Fleet Management

LEX (GEO)

Keeping GEO satellites in operation after fuel depletion



In-Space Situational Awareness/Inspection

ADRAS-J

Surveying client objects and orbital environments at a variety of ranges



End-of-Life Services

ELSA-d, ELSA-M

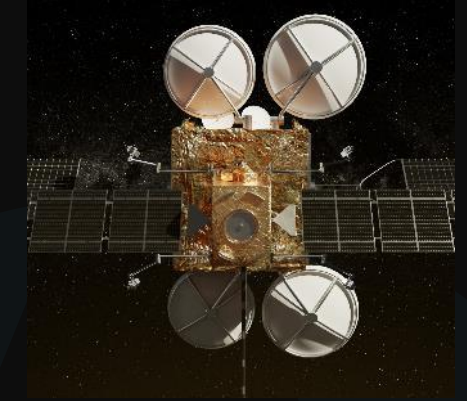
In-orbit maneuvers, last mile delivery, and de-orbiting prepared client spacecraft (docking plates)



Active Debris Removal

ADRASJ2, COSMIC (UK ADR)

Reducing current debris by de-orbiting objects unprepared for servicing



Refueling + Maintenance

ADRAS-J2, LEX, ELSA-M/ COSMIC variants

Upgrading, refurbishment, refueling, repair, or assembly in-orbit

Design for Removal – Why should we prepare now?



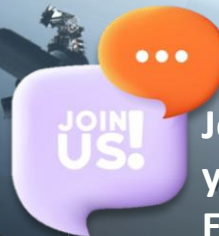
★ Regulation is already encouraging and/or imposing design for removal requirements.

Over 50% of regulations include design for removal requirements.



Adopting measures now will help standardise your fleet now and save future non-recurring cost.

Standardising your spacecraft will enable cheaper options for removal when needed.



Joining before the market is matured ensures you a seat at the table.

Ensure the technologies developed today benefit you now and in the future by interacting with service providers.



Design for Removal – Docking features



Ensures passive access to spacecraft

Docking features ensures that there is a specific and defined way to dock to a spacecraft, without the need to be active in the docking process.



Adaptability to client needs

Different docking features available for different class of spacecraft.

Docking features compatible with multiple capture technologies.



Further standardisation required

Further need to increase cross-compatibility between docking features and capture technologies.



Use cases beyond EOL services

Having a docking feature is crucial for any in-orbit servicing activity aside from End-of-Life disposal.

Design for Removal – Astroscale’s Docking Plate



Capture flexibility

DP is compatible with an array of docking techniques including magnetic and robotic → no vendor lock-in.



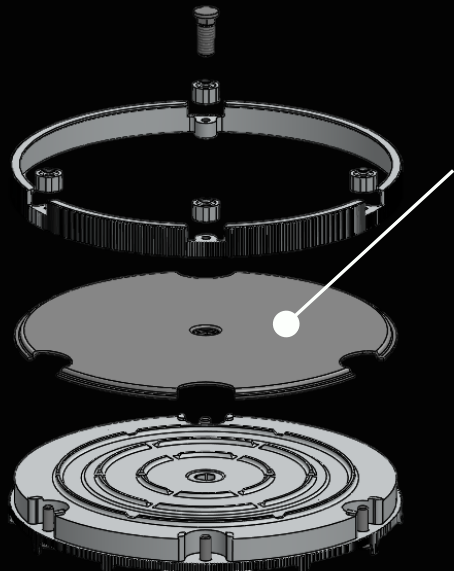
Astroscale optimisation

DP is fully compatible with and optimised for the Astroscale service, reducing future cost of servicing.



Design flexibility

Truss legs in three heights (total assembly heights of 69.5, 119.5 and 163.0 mm).



High performance soft ferromagnetic material with low coercivity, low remanent dipole and high magnetic saturation enabling secure magnetic capture.

Docking aids through **embedded fiducials** on the top magnetic plate to support navigation and enable accurate position and attitude estimation of satellite.

Failsafe mechanically secured components – no structural adhesive degradation issues.

Knurled reinforced rim optimised for strength, and for increased friction to enable grappling by robotic technology.





Design for Removal - Going Further

Beyond mechanical interfaces, spacecraft can be optimised for future removal in other ways, before and after launch, benefitting both EOL and ADR services.



Increase spacecraft position knowledge



Make the spacecraft easier to track

Retroreflectors, GPS beacon, increased SSA performance



Increase spacecraft state knowledge



Stabilise or reduce spacecraft tumble

Detumbler, drag/gravity-gradient stabilisation, single spin



Leave spacecraft in a known state

Fixed-orientation safe/EOL modes



Design for Removal – Benefits for Operators

By designing or adapting your spacecraft for design for removal



You align yourself with current and upcoming regulations.



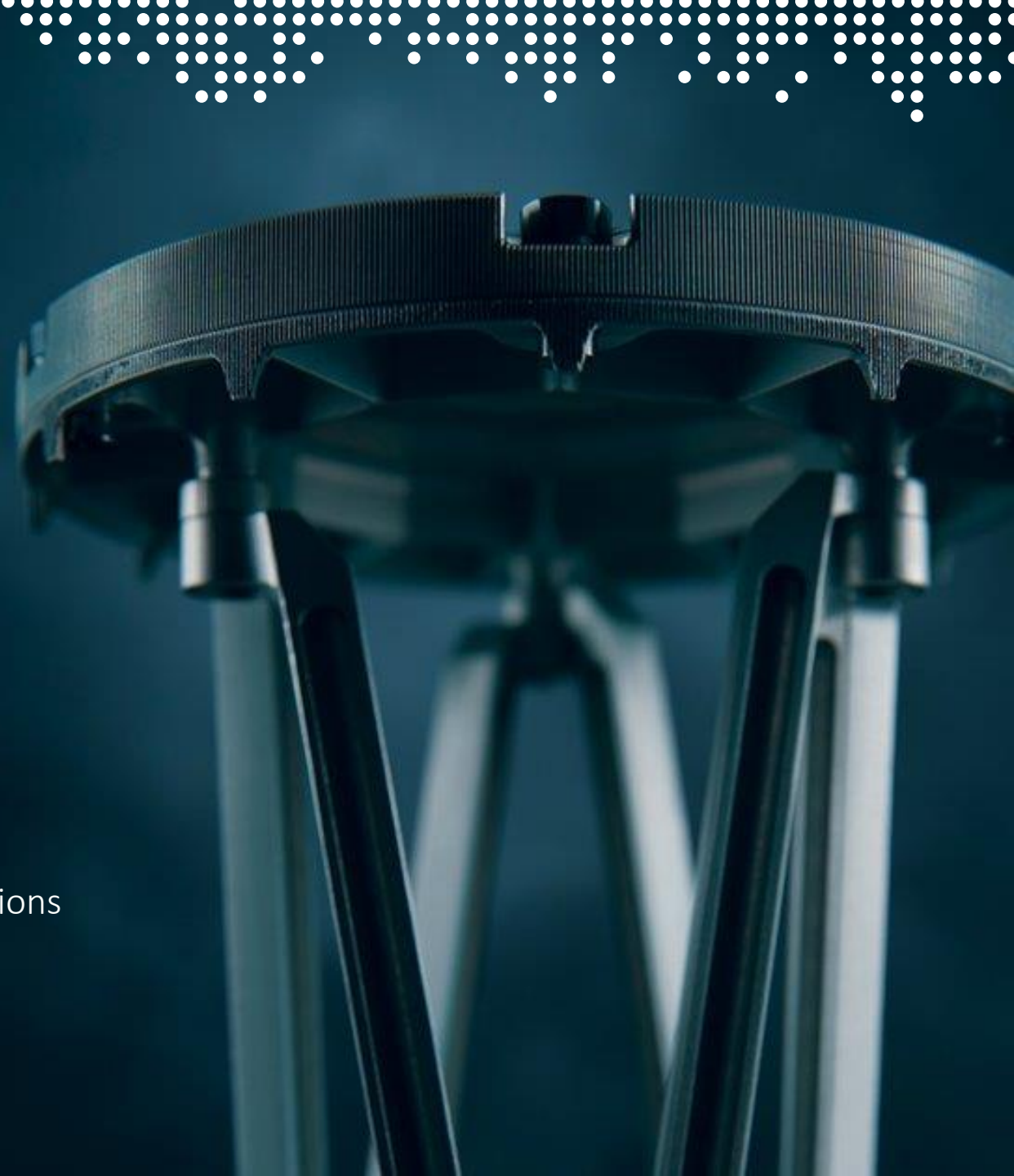
You increase the flexibility and resilience of your fleet or mission.



You open yourself to other in-orbit servicing markets which could benefit your business.

Beyond design for removal, think how can these new technologies and services benefit your business case and increase your revenue?





Any questions?

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