



## Towards Global Space Sustainability – Astroscale’s Vision for Active Debris Removal Services

Speaker

**Dr Jason Forshaw**

MEng MS (Stanford) PhD CEng MIEEE SMAIAA

European R&D Manager, Astroscale Holdings

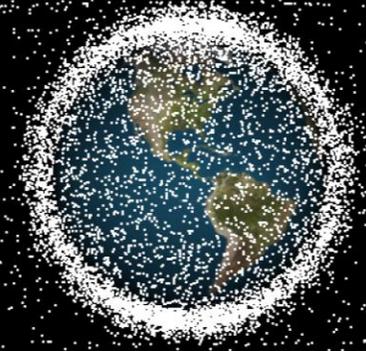
United Nations  
World Space Forum  
Vienna, Austria  
20<sup>th</sup> November 2019



# Space Debris Threatens Space Sustainability



1950

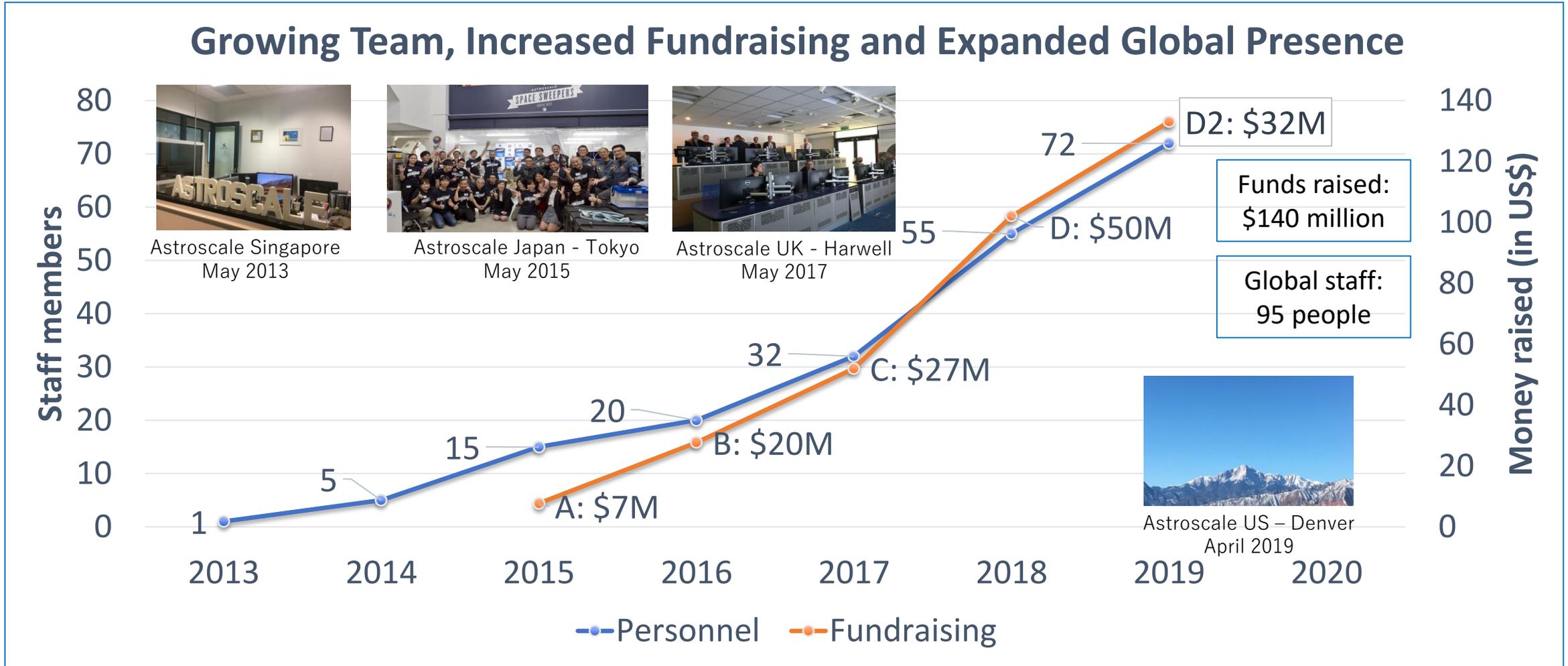


2018

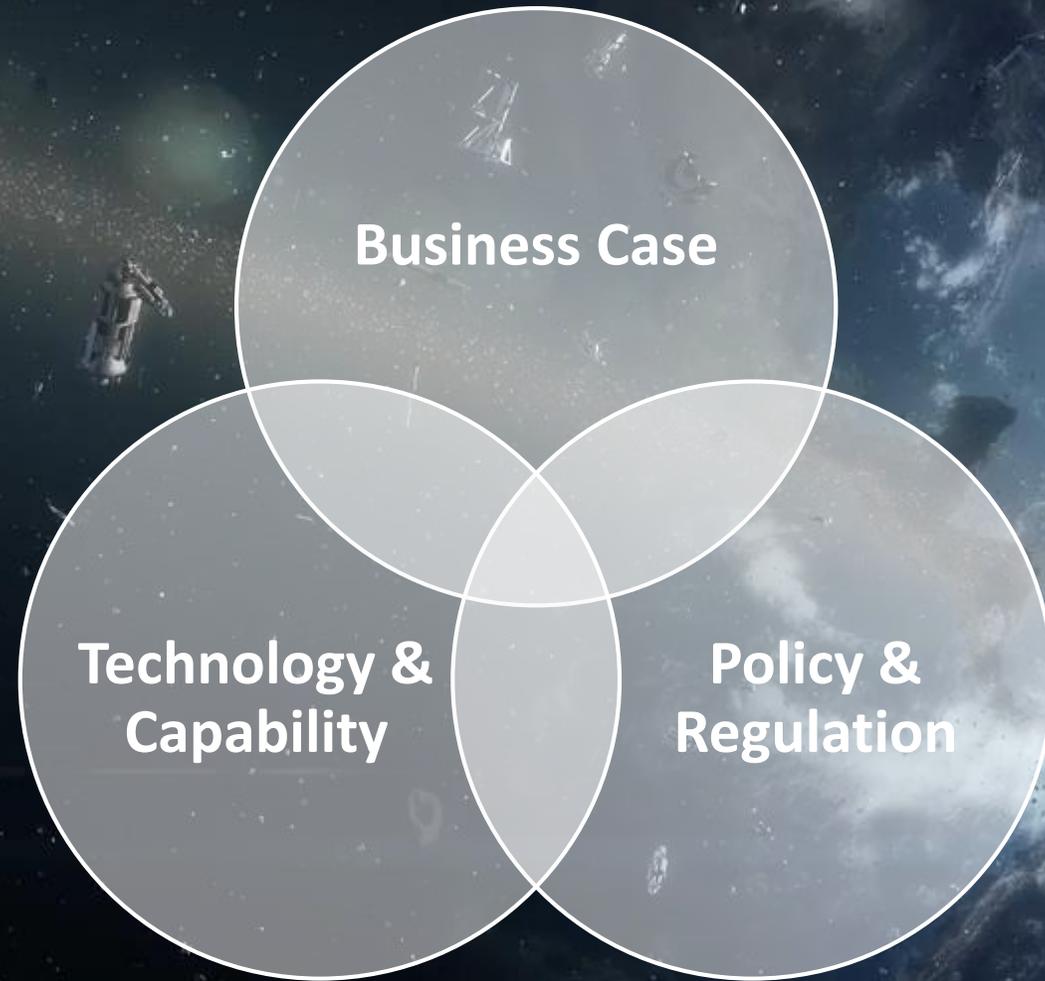


# Astroscale: An International Company Solving a Global Problem

- Astroscale's mission is to secure long-term spaceflight safety and orbital sustainability for the benefit of future generations
- Our services include End of Life (including large constellations) and Active Debris Removal



Astroscale is actively addressing the orbital debris problem



# Business – Business Lines

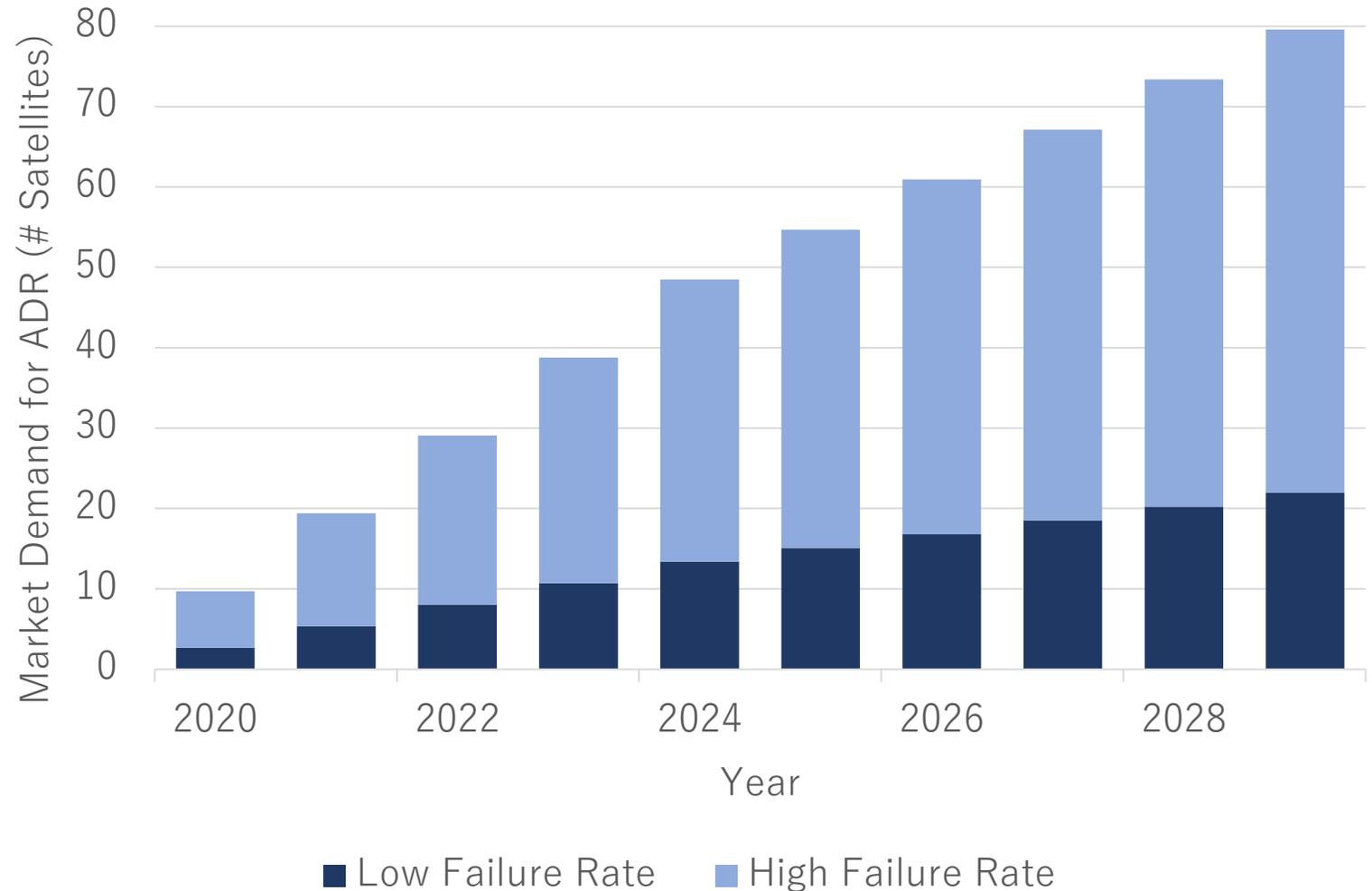


Services	<b>End of Life (EOL)</b> <b>“Don’t add any more debris”</b>	<b>Active Debris Removal (ADR)</b> <b>“Remove debris that is already there”</b>
<b>Potential customers</b>	Constellations, Private Satellite Operators	Governments, International framework
<b>Target Objects</b>	<ul style="list-style-type: none"> <li>- Satellites that have failed in orbit or reached end of operational lifetime</li> <li>- 50~500kg</li> </ul>	<ul style="list-style-type: none"> <li>- Environment Critical Objects</li> <li>- Existing debris</li> <li>- 500kg+</li> </ul>
<b>Rationale</b>	<ul style="list-style-type: none"> <li>- Business continuity and maximize revenue</li> <li>- Adhere to best practices and public demands</li> </ul>	<ul style="list-style-type: none"> <li>- Demonstrate commitment to orbital sustainability</li> <li>- Assure spaceflight safety for all operators</li> </ul>
<b>Global Responsibility</b>		
<b>Technical concept</b>	Semi-cooperative approach and capture	Non-cooperative approach and capture

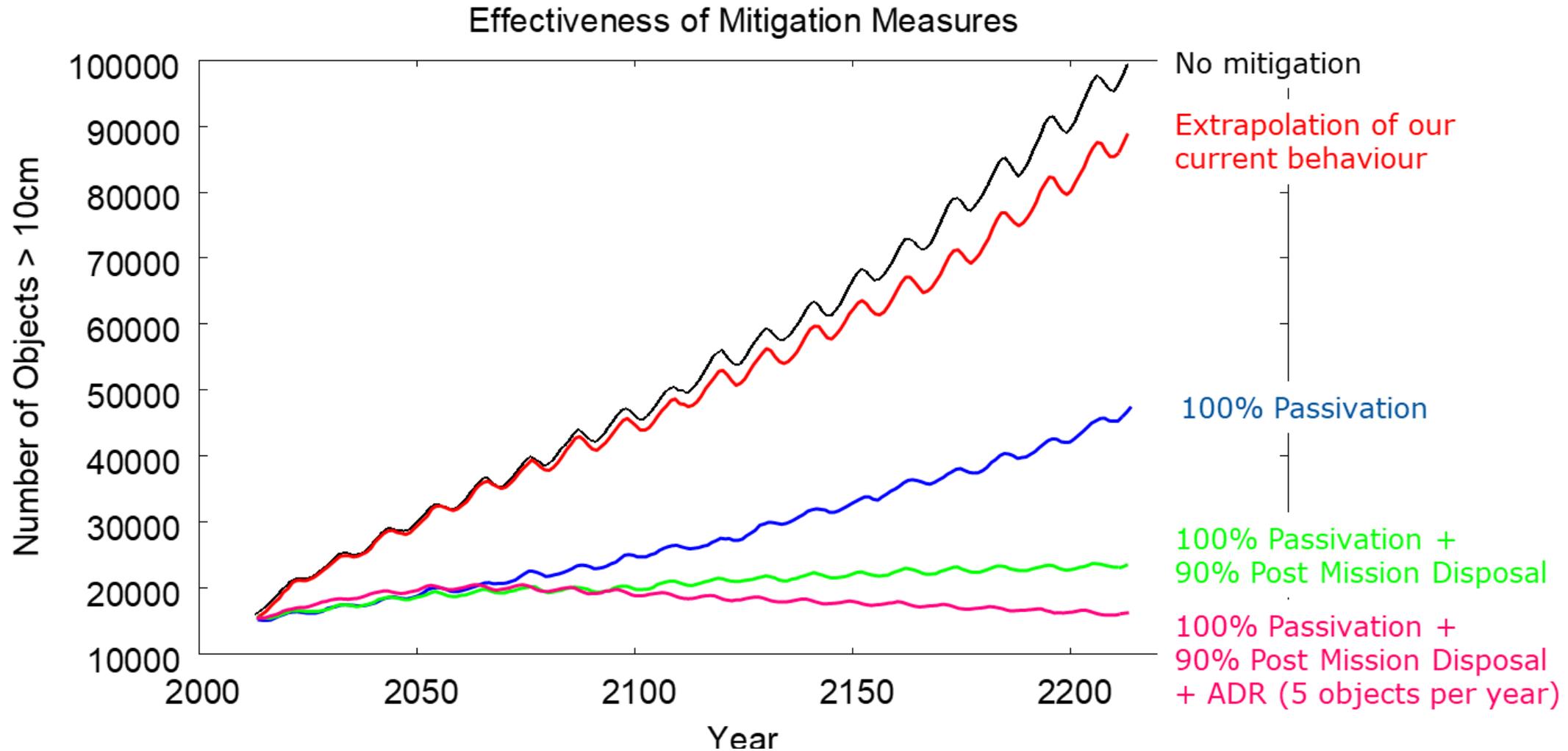


# Business – Market Demand

- Astroscale is tracking 120+ satellite constellations.
- The number of satellites in LEO is expected to increase to over 10,000 satellites within the next 10 years.
- The number of satellites that need to be removed depends highly on satellite failure rate.
- Demand = SOM (service obtainable market) \* failure rate
- ~10-50 satellites per year could be removed from orbit by Astroscale's end-of-life service.



# Business – Actions for Space Sustainability

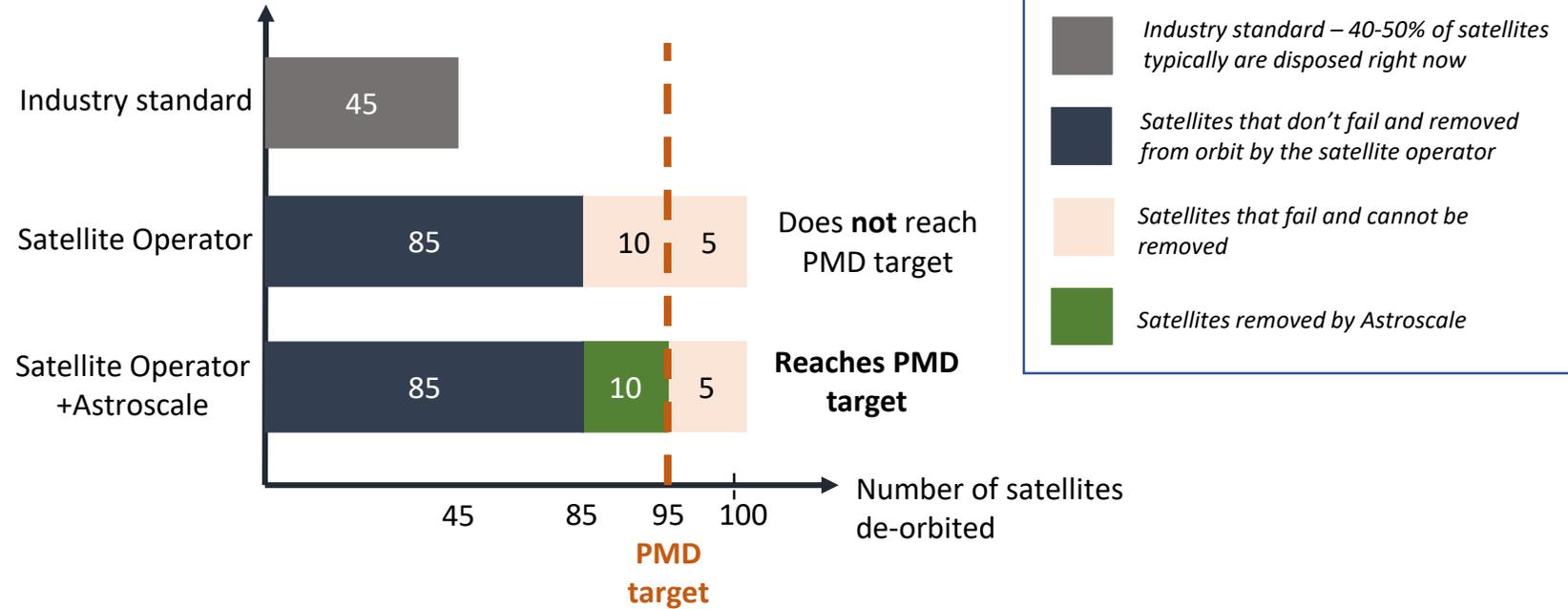


Source: European Space Agency, presentation of H. Krag, Head of ESA's Space Debris Office at SWF Summit for Space Sustainability, June 26, 2019



# Business – PMD Rate Guarantee

- Research shows that future PMD rates of 90 to 95% (ESA, NASA), in addition to removal of several key debris assets per year, are required to maintain space sustainability.
- Many different service options are possible.
- Proposed service: Astroscale removes failed satellites such that an operator reaches a pre-determined PMD rate.
- Example: An operator has a constellation with 100 satellites and a 95% PMD target, assuming 15% satellite failure rate.

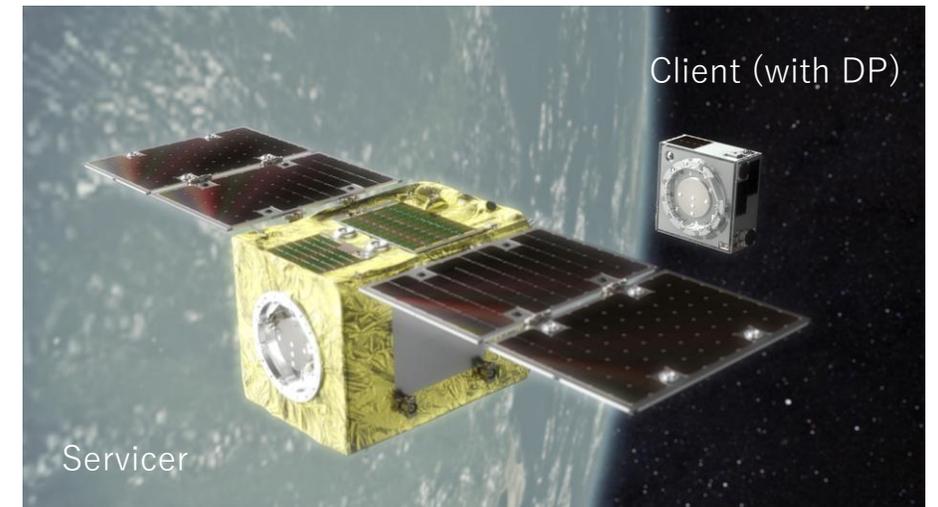
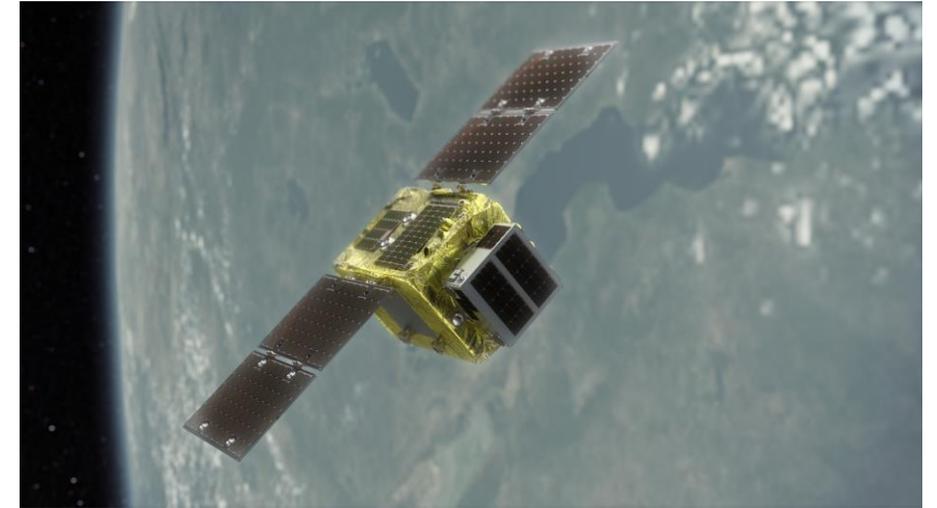




# Technology & Capability – I

## ELSA-d Mission

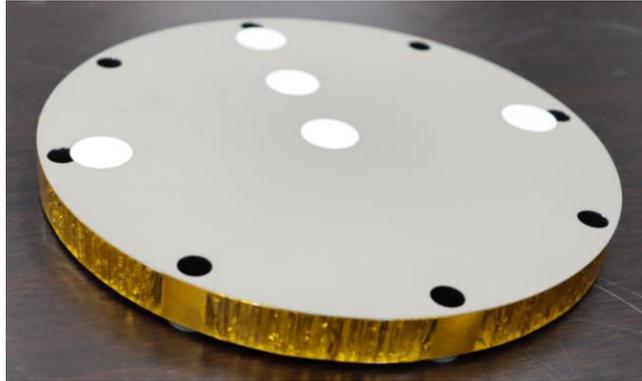
- Servicer: 180 kg
- Client: 20 kg with docking plate (DP)
- DP allows prepared servicing of client using proprietary magnetic capture system.
- Launch in 2020
  - Signed with Glavkosmos/GK Launch Services, Soyuz 2
  - SSO (500-600 km), LTAN 10.30-11.00.
- Full phases of operations that would be necessary for a full EOL service, including client search, inspection, capture, re-orbit and de-orbit.



ELSA-d Mission Concept



# Technology & Capability – II

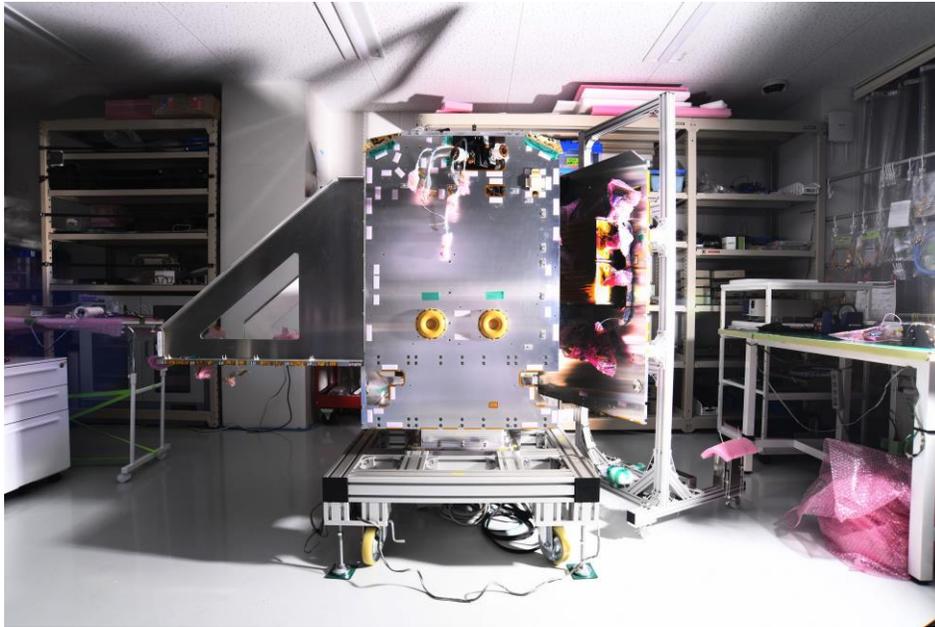


**Docking Plate (DP)**

Towards sustainable space:  
DP enables constellation providers to “future-proof” their satellites



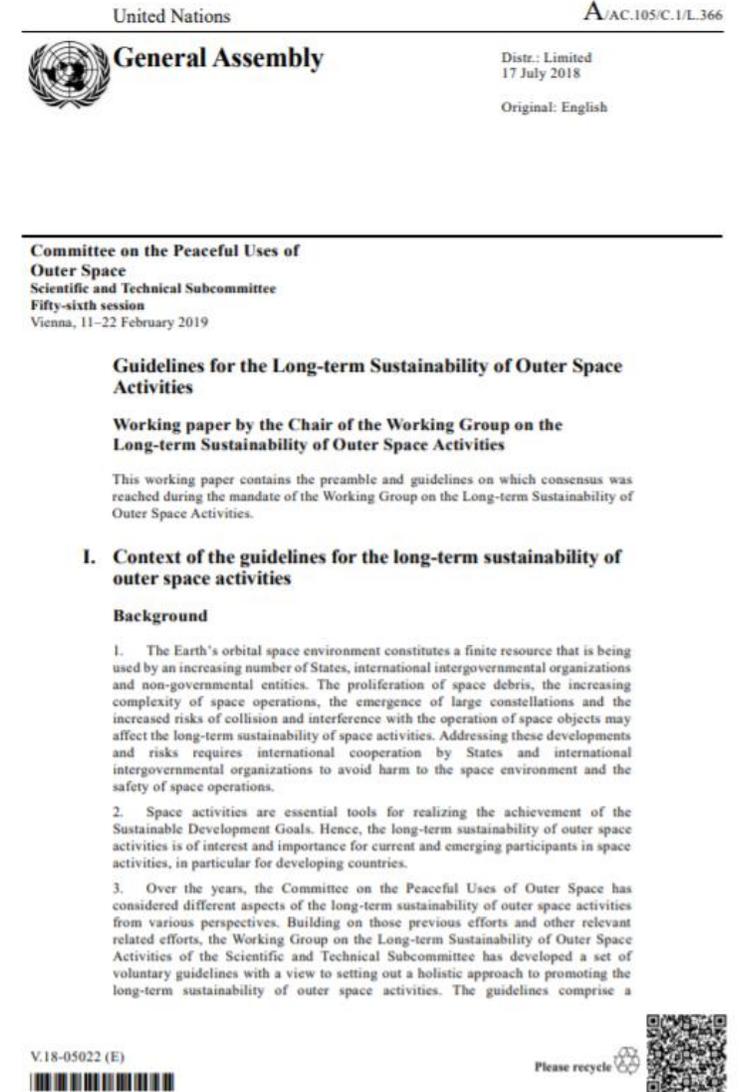
**ELSA-d AIT**  
presently on-going  
in Tokyo



# Policy & Regulation – I



- Sample objectives that align with Astroscale’s mission to “secure long-term spaceflight safety and orbital sustainability for the benefit of future generations”:
  - Ensure and enhance the long-term sustainability of outer space activities
  - Promote international cooperation and understanding to address natural and man-made hazards that could compromise operations
  - Developing national and international practices and safety frameworks service.
- It is incumbent upon private space operators to be good stewards of the space environment. Industry must play a role in implementing 21 LTS Guidelines.



# Policy & Regulation – II



- Astroscale is involved in a variety of ways for a generating best practices for the sustainability of space operations.
  - Astroscale is on the executive committee for an industry-led initiative seeking to establish best practices and operations standards for rendezvous proximity operations (RPO) and on-orbit servicing (OOS).
  - Our CEO is a member of the WEF Global Future Council on Space Technology who helped develop the mandate for a WEF SSR.
- Astroscale is mid-way through licensing ELSA-d:
  - Obtaining a mission license for a debris removal mission is unique and will open a path for future services that will support the long-term sustainability of space.
  - Key considerations: in-flight safety, spectrum, insurance.



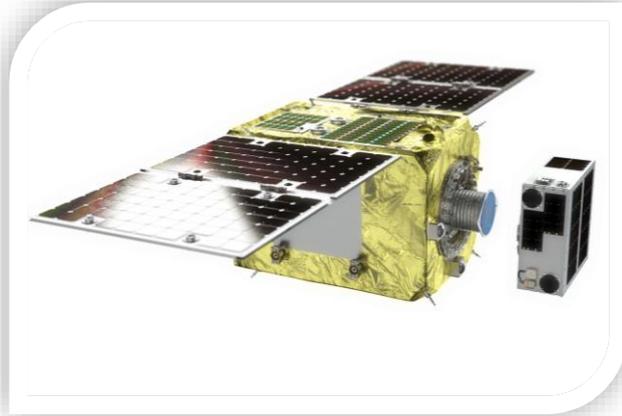
June 2018, UNISPACE+50 (UNCOPOUS)



June 2018, Astroscale presentation to IADC (Inter-Agency Space Debris Coordination Committee)



# The Path Forward



ELSA-d Mission  
The world's first commercial demonstration of ADR



Working on ESA Sunrise Programme with OneWeb towards a future large constellation EOL service



Worked on past JAXA ADR studies and presently exploring future work options with JAXA



New Totsuka Ground Station, Yokohama, Japan



Prime developer for UK National IOS Facility, Catapult, Harwell



Driving Global ADR Policy & Regulation



[www.astroscale.com](http://www.astroscale.com)