B06

アストロスケールが取組む RPO 技術
−低軌道デブリ除去から静止軌道での軌道上サービスまで−
Leading the Development of an On-orbit Servicing Economy

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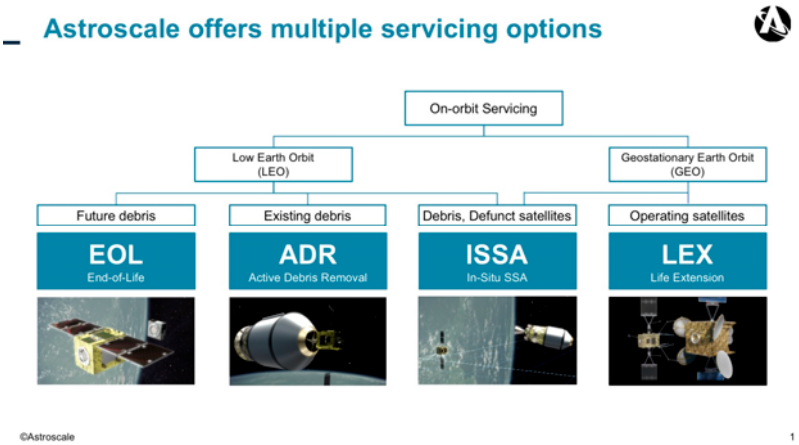
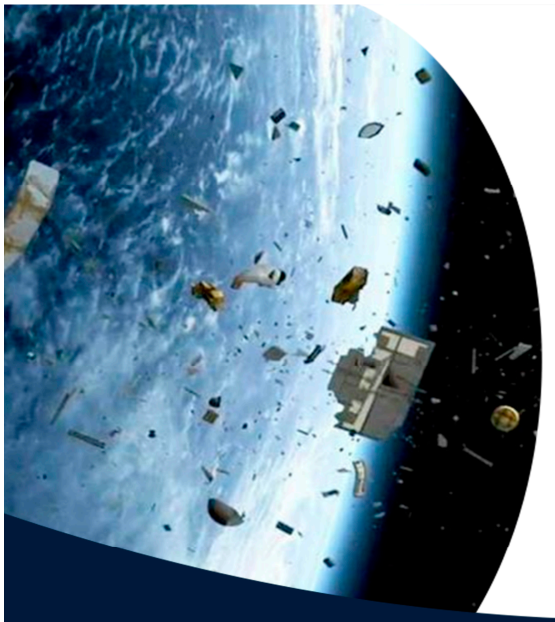
世界5カ国で 140 名以上を擁する、アストロスケールグループは、コアとなる「宇宙空間の非協力物体に対する RPO 技術」を用い、衛星オペレーターやロケット事業者へ安全で持続可能な事業継続に貢献することをミッションに、低軌道から静止軌道で以下4つの軌道上サービスを提供します。
①衛星運用終了時の除去サービス（End-of-Life Service：EOL）低軌道
②既存デブリの除去サービス（Active Debris Removal：ADR）低軌道
③軌道上観測サービス（In-situ Space Situational Awareness：ISSA）低軌道/ 静止軌道向け
④衛星寿命延長サービス(Life Extension Service：LEX) 静止軌道
セッションでは、当社提供の上記のサービスの内容とビジネスモデル、複数の関係企業・団体・機関と協働する、宇宙政策に関わる法規制への取り組みもご紹介します。

Astroscale has a growing team of over 140 people in five countries and is contributing to the safe and sustainable business continuity of satellite operators and launch service providers by using its core "RPO technology for non-cooperative objects in outer space". Astroscale is developing innovative solutions across the spectrum of on-orbit servicing missions and across all orbits including (1) End-of-Life services (2) Active Debris Removal (3) In-situ Space Situational Awareness and (4) Life Extension. In the presentation, we will provide an overview of our technical solutions, as well as discuss how we are working to define the business cases and working with government and commercial stakeholders to develop norms, regulations and incentives for the responsible use of space.





Astroscale

Leading the Development of an On-orbit Servicing Economy

9th JAXA Space Debris Workshop

Astroscale Holdings Inc.
February 25, 2020

On-orbit Servicing (OOS)

Space is not Sustainable

More than 25,000 objects larger than 10cm. Only 3,200 of them are active satellites*.
Both accidents and intentional breakup events can produce large quantities of orbital debris that remain as threats for years or centuries.
Because all objects travel at extremely high speeds, even very small ones can destroy active satellites or endanger astronauts.

LEO
(Low-Earth Orbit)

Takes 90 minutes to circle Earth.
Travelling at 7-8km/sec and takes at altitude of 200-2,000km

Image: © NASA Goddard Space Flight Center

GEO
(Geostationary Orbit)

Travelling at exactly the same rate as Earth (24 hours/day).
The speed is 3km/sec at an altitude of 36,000km

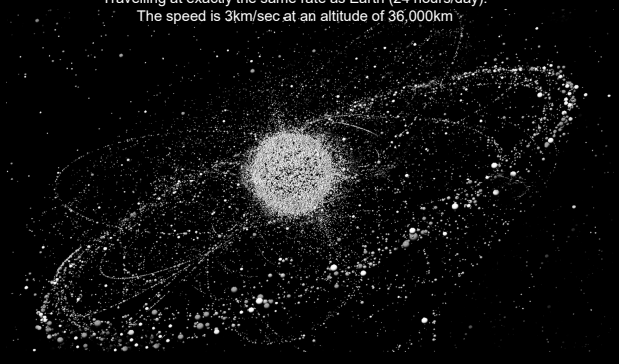


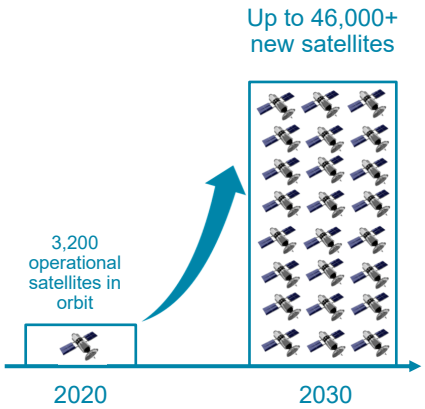
Image:: ESA
(https://www.esa.int/Safety_Security/ESA_and_the_United_Nations_team_up_for_space_debris)

* As of September 2020

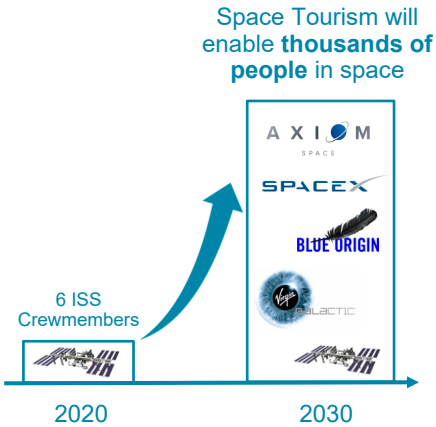
3

As space becomes more congested, safety is essential

Uncrewed Spacecraft

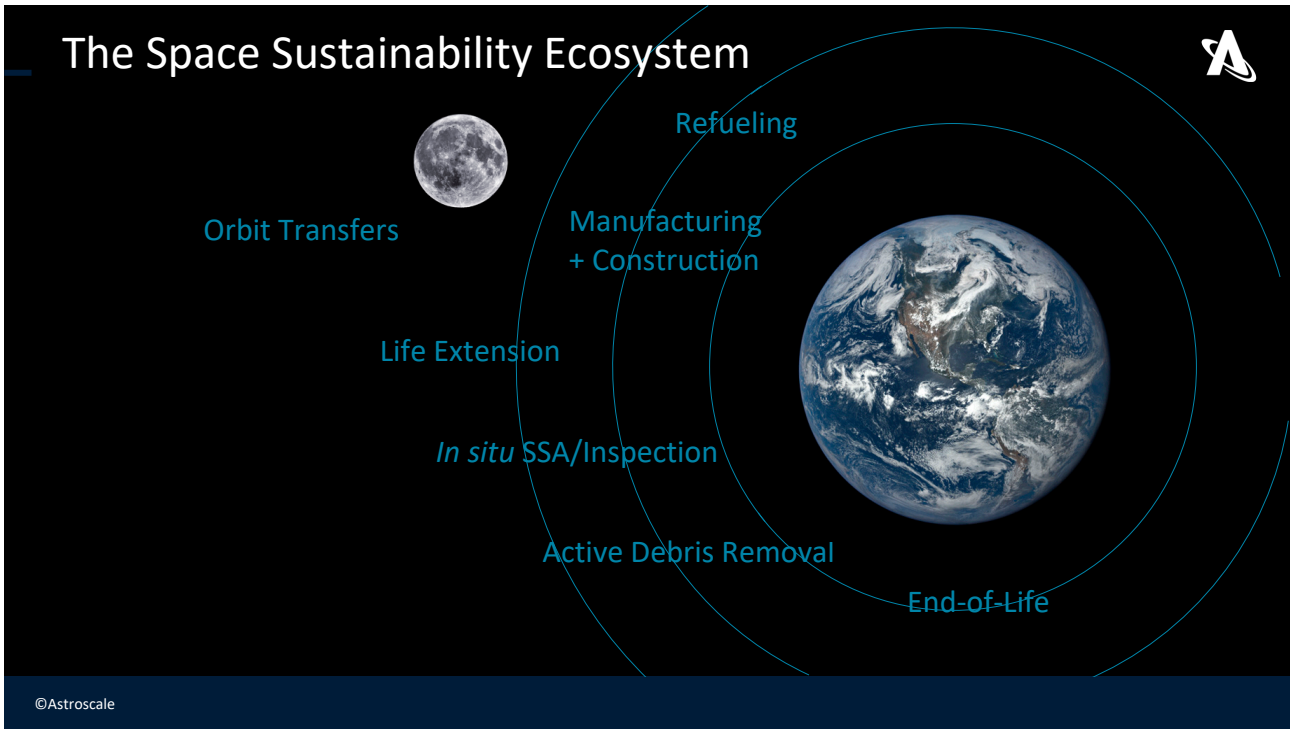


Crewed Spacecraft

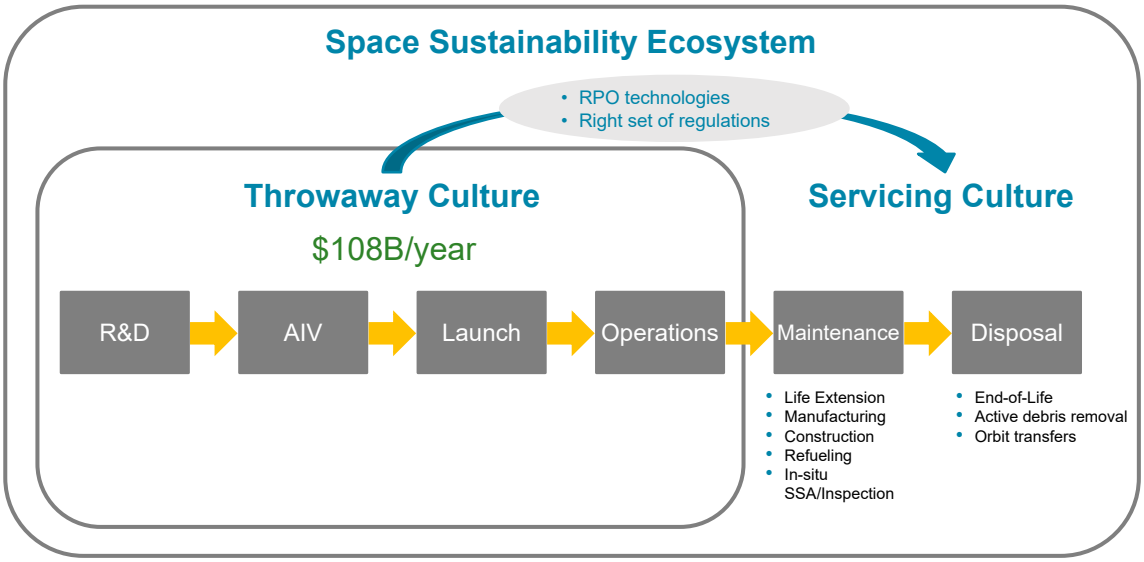


Source: Aerospace Corporation
©Astroscale

4



On-orbit servicing expands the value chain



 7

So.. what does space sustainability really mean?

A Net Positive.

Company Overview

We are a global company solving a global problem

5 offices

170 members

$191M

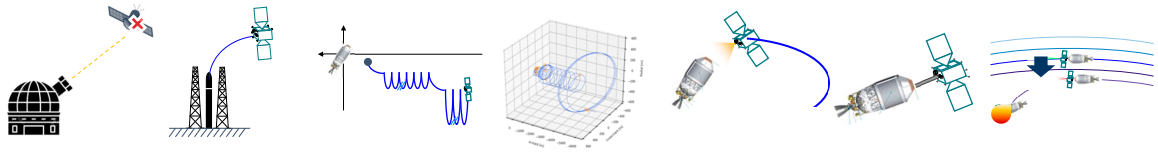
>20 awards

Key roles

Multiple business lines for OOS

Core Technologies – RPO Technologies

①Observe client → ②Launch → ③Far-range approach → ④Short-range approach → ⑤Diagnosis and Fly-around → ⑥Capture → ⑦De-orbit



①Observe client	②Launch	③Far-range approach	④Short-range approach	⑤Diagnosis and Fly-around	⑥Capture	⑦De-orbit
Observe and determine the client orbit.	Define the injection orbit and launch epoch/window.	Absolute navigation approach from a distance. Match the phase, altitude, and orbital plane of the client.	Relative navigation approach with the client as a point using the on-board sensors.	Client fixed point and orbital observation. Fly-around the client and match the momentum (tumbling).	Capture with servicer's capture system. Stabilize attitude assuming a center of gravity when docked.	Performs a de-orbit maneuver to reduce the client altitude and re-entry. Put on target sea area when necessary.

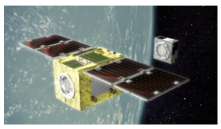
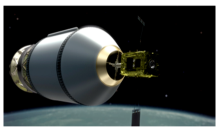
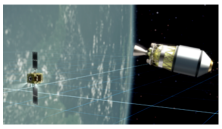
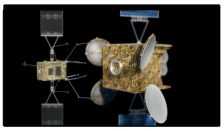
RPO Technology (Rendezvous and Proximity Operations)

Astroscale Offers Multiple Servicing Options

Securing sustainability across orbits by leveraging rendezvous and proximity operations technologies

On-orbit Servicing

- Low Earth Orbit (LEO)
  - Future debris
  - Existing debris
- Geostationary Earth Orbit (GEO)
  - Defunct objects
  - Operating satellites

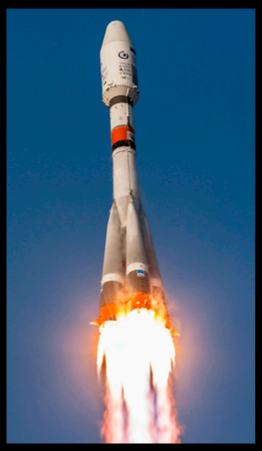
	Future debris	Existing debris	Defunct objects	Operating satellites
Segment	**EOL** End-of-Life Service	**ADR** Active Debris Removal	**ISSA** In-Situ SSA	**LEX** Life Extension Service
Servicer				
Client	Commercial and Government Defunct satellites from constellations	**Government** Existing debris (used rocket bodies, defunct satellites)	**Commercial and Government** Defunct satellites and unknown objects	**Commercial and Government** GEO satellites reaching end of life

ELSA-d

World's first end-to-end debris removal demonstration

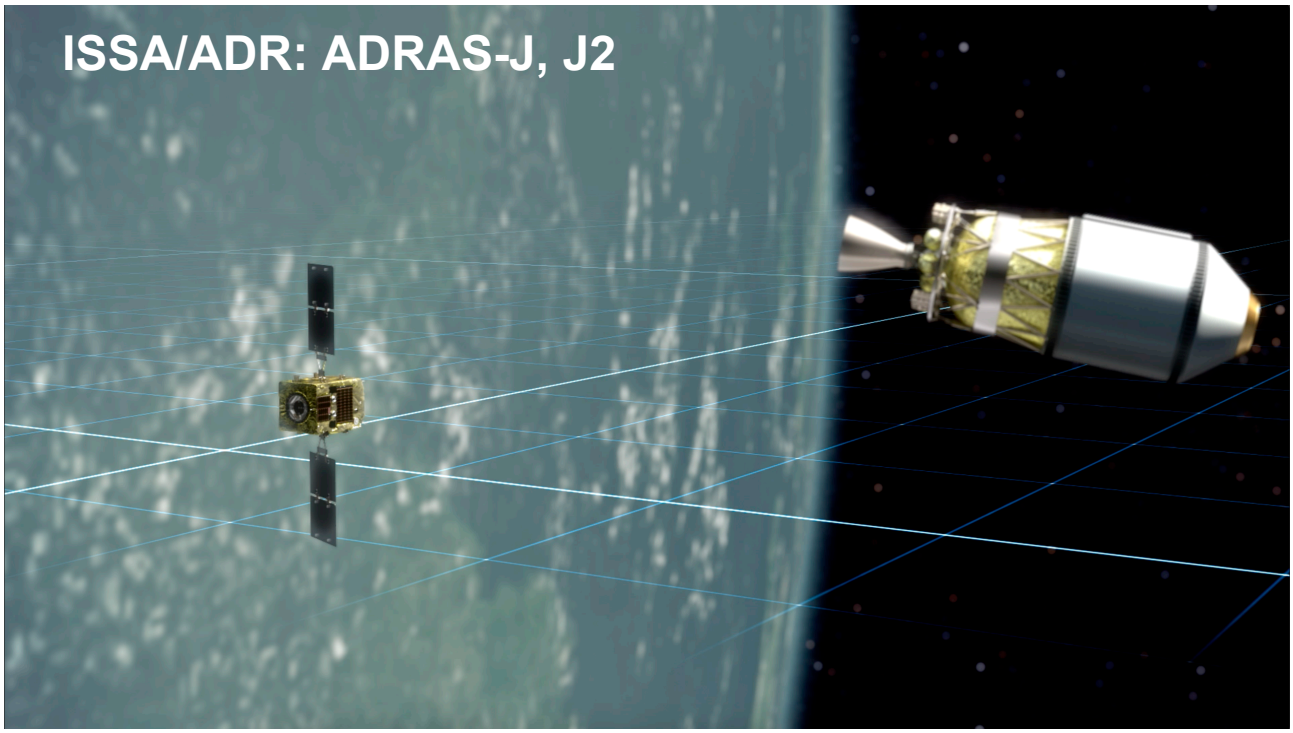
Test
(Early 2020)

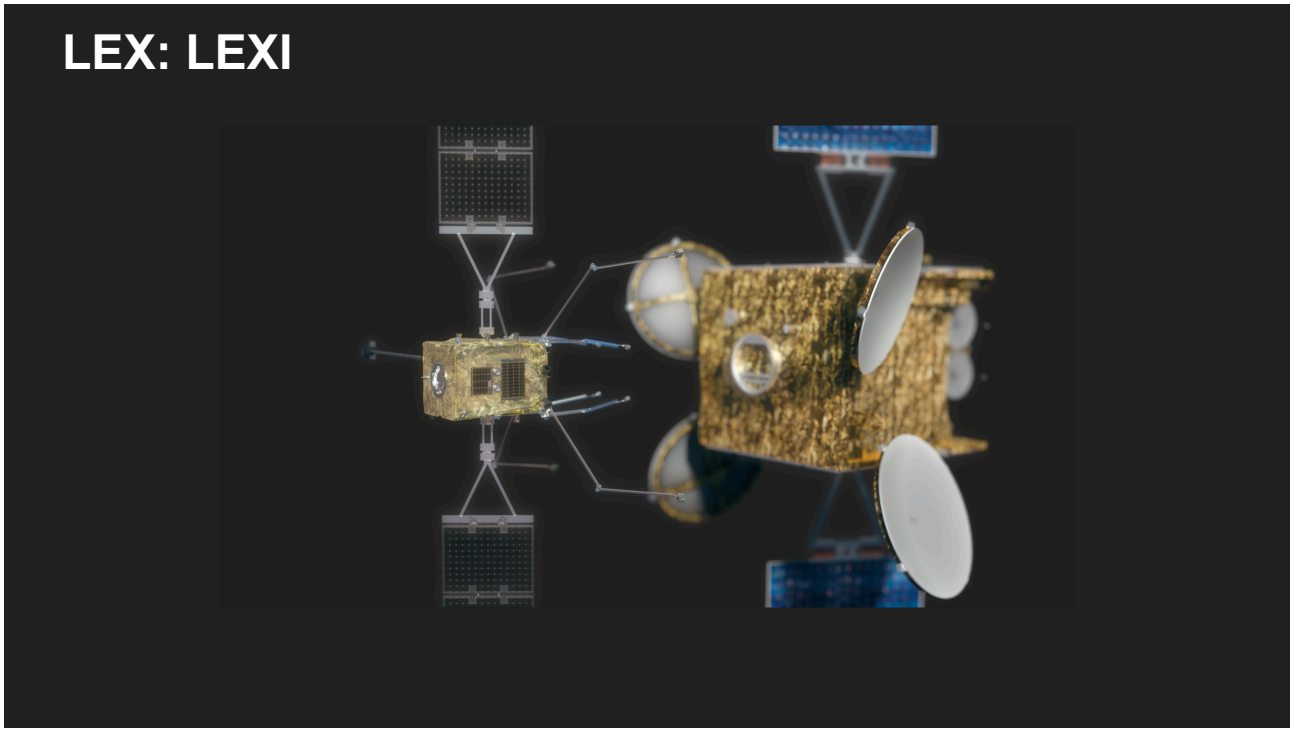
Shipment
(Dec 2020)



Launch
(Mar 20, 2021)

ISSA/ADR: ADRAS-J, J2





– We contribute to developing norms, regulations and incentives for the responsible use of space

17