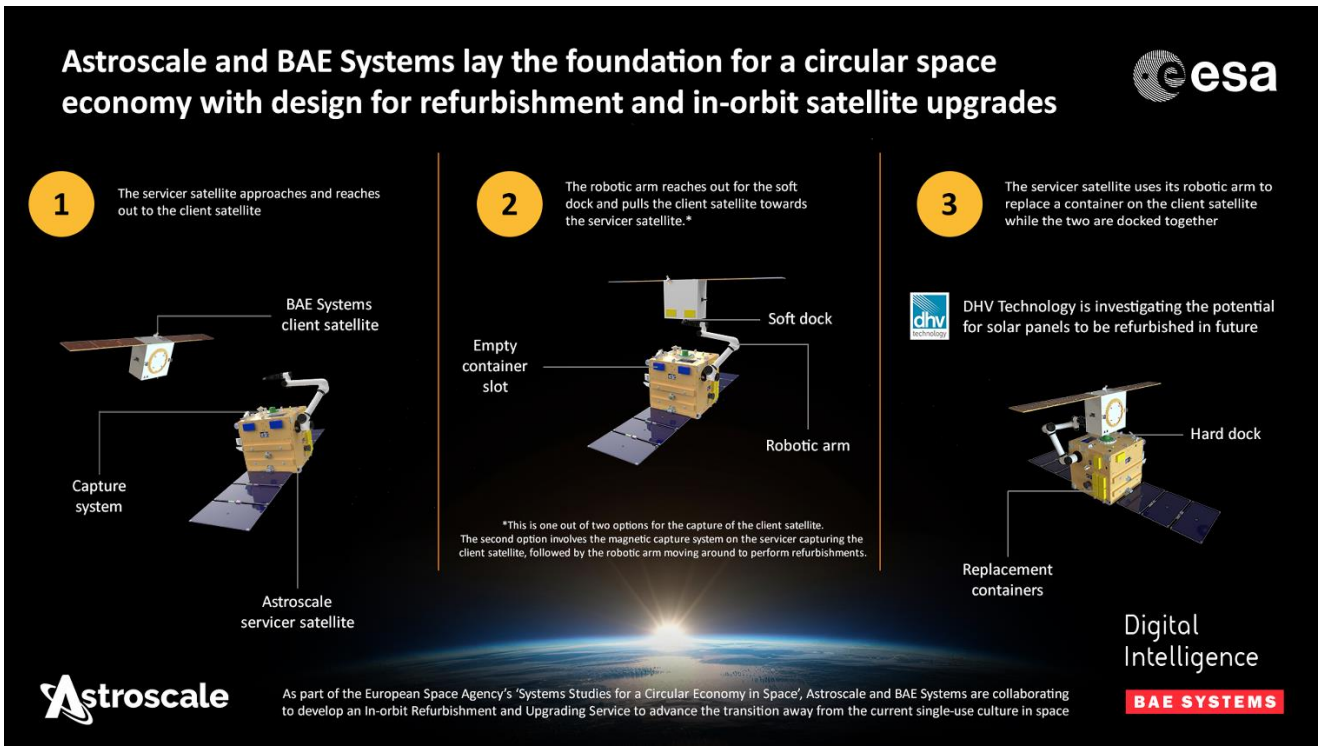
→ PREPARATION



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Towards a Circular Space Economy: Satellite Refurbishment and Upgrading Services for Orbital Sustainability

Executive Summary

Activity type: Systems Study

OSIP Campaign: System Studies for the Circular Economy in Space
Strategic Innovation Area: Preparation

Affiliation(s): Astroscale Ltd (Prime), BAE Systems (Sub 1), DHV Technology (Sub 2)

Activity summary:
The In-Orbit Refurbishment and Upgrading Service (IRUS) is a first-of-its-kind refurbishment and upgrading mission concept, proposed by Astroscale and BAE Systems, aligned with ESA's Circular Economy strategy. The outcome of the systems study was a servicer design, taking elements of Astroscale's ELSA-M and COSMIC platforms, and a modified, prepared BAE Systems client platform. DHV Technology assessed the potential to refurbish and upgrade solar cells and solar arrays. This service will be the next step towards an in-orbit economy, underpinning future in-orbit servicing goals, such as in-orbit assembly, manufacturing, and recycling, and adding significant value to other services such as refuelling.

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IRUS Executive Summary

In-orbit Servicing, Assembly, and Manufacturing (ISAM) is a rapidly growing field and is key to ensuring the long-term safety and sustainability of our orbital environment. Services such as Life-Extension, De-Orbiting, Active Debris Removal (ADR), Space and Situational Awareness (SSA), and Relocation are critical to the proliferation of ISAM. In this context, the In-Orbit Refurbishment and Upgrading Service (IRUS) mission concept is the solution proposed by Astroscale UK together with In Space Missions (ISM), now part of BAE Systems, and DHV Technology (DHV) for a first-of-its-kind refurbishment mission aligned with ESA's Circular Economy strategy.

The mission concept is well rooted in the platform heritage of both Astroscale and ISM and is aiming for a mission launch and operation within the next 5 years. The servicer featured in Figure 1 will take elements of both ELSA-M, Astroscale's commercial multi servicing platform, and COSMIC, Astroscale's UK Active Debris Removal (ADR) solution. The initial client for the in-orbit demonstration (IOD) mission will be a modified version of ISM's Faraday P30 platform that will feature refurbishable batteries and an upgradeable On-Board Computer (OBC). DHV is further strengthening the business case with an assessment of the potential to refurbish and upgrade solar cells and solar arrays.

The outcome of the study is a 700 kg servicer that can fit in the footprint of its ELSA-M and COSMIC predecessors by using very similar hardware for critical systems and that can perform 4 to 6 refurbishments and upgrades in a single mission in LEO. A well-established platform design coupled with a clear path towards integrating any required novelties lead to a feasible roadmap for the IOD.

The IOD mission is meant to derisk the critical phases of a full service including the rendezvous approach, docking, the refurbishing of two client components and the occurrence of an abort while docked to the client. This mission is expected to take less than a year in orbit.

The full service would follow after the IOD and will target large satellite fleets with relatively high component failure rates. IRUS is designed to service clients anywhere between 400 km and 1200 km and it has the capability to travel across any altitudes in this range, thus not constraining the client selection. The mission duration for servicing 5 clients will be less than 2 years depending on their relative locations, and the time taken from the first refurbishment to the last is likely to be less than one year, thus ensuring the technological relevance of the new component.

Refurbishment and upgrading would not be possible without a prepared client designed with modularisation in mind. As a spacecraft manufacturer BAE Systems are well-placed to drive forward the development of service-compatible spacecraft and contribute to the formulation of regulations and standards. Two spacecraft components have been selected as test cases for the IOD on the basis of their potential for being integrated into a new modular container, a Spacecraft Replaceable Unit (SRU). To complement the component analysis performed by ISM, DHV Technology have investigated the potential of enhancing the power raising capabilities and thus extending the operational lifetime of satellite platforms through refurbishing and upgrading. Their conclusions show that extending the life of the client by replacing modular solar array strings can be achieved with for a fraction of the cost of a full array.

The key value of refurbishment lies in being able to maximise ROI through Life Extension and service continuity, cost effectiveness, and sustainability. While upgrading provides the same benefits as refurbishment, the advantage of enhancing the satellite to perform beyond its original design and function can lead to increased revenue generation.

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The project consortium sees refurbishment and upgrading as a promising next step towards an in-orbit economy, with aspects of these services underpinning future in-orbit servicing goals, such as in-orbit assembly, manufacturing, and recycling, and adding significant value to other services such as refuelling, all crucial steps to enabling a circular economy.