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TOWARDS THE DESIGN OF AN END-OF-LIFE ADR SOLUTION FOR LARGE CONSTELLATIONS

Abstract

Since the beginning of the space era, the amount of debris generated in low Earth orbit has been steadily increasing. Recently, the rise of plans for large satellite constellations in low-Earth orbit (LEO) means that the number of satellites in key orbits will increase at a much higher rate than today.

OneWeb, for example, will be launching a constellation of over 600 satellites to provide global commercial broadband service from an altitude of 1,200 km. In addition to designing their satellites to be deorbited under their own power at EOL, OneWeb is working with industry to develop and standardise Active Debris Removal (ADR) technologies and capabilities for the benefit of the entire industry. For example, recently OneWeb committed to adding docking plates (DPs), also known as grappling fixtures, to their future constellation satellites to ease their future removal in case of failure.

This paper considers the design of an ELSA-OW (End of Life Services by Astroscale – OneWeb) mission up to PDR, working jointly with OneWeb and ESA, and funded under ESA’s Project Sunrise. ELSA-OW will rely on heritage from ELSA-d, Astroscale’s first end-of-life servicing mission due to launch in 2020. ELSA-d will demonstrate technologies for rendezvous and proximity operations (RPO) by launching a servicer satellite attached to a small client satellite, which will then repeatedly separate and dock in orbit, to mature a range of capabilities.

The ELSA-OW servicer is equipped with rendezvous guidance, navigation, and control (GNC) technologies and a magnetic docking mechanism, specifically designed to be compatible with the DP on future OneWeb satellites. The chaser has both chemical propulsion for RPO and electric propulsion for orbital manoeuvring – in fact, the vehicle is designed with a multi-client ADR capability to remove multiple clients with a single servicer. A substantial amount of business analysis has also been undertaken and the vehicle is designed not just for OneWeb, but a range of future constellation customers.

This paper will broadly provide an overview of the concept of operations (CONOPS) and key aspects of the initial mission design. The ELSA-OW concept presents a solution which can be used for the first time commercially to undertake ADR, in LEO, specifically with a representative constellation customer.