Design for Removal (D4R) technologies to ease the removal of future LEO platforms

Sébastien Perrault [a], Tiago Soares [b], Luisa Innocenti [c], Jessica Delaval [d]

[a] European Space Agency (ESA), Germany, Sebastien.Perrault@ESA.int
[b] European Space Agency (ESA), The Netherlands, Tiago.Soares@ESA.int
[c] European Space Agency (ESA), France, Luisa.Innocenti@ESA.int
[d] European Space Agency (ESA), France, Jessica.Delaval@ESA.int

ABSTRACT

Complying with the Space Debris Mitigations guidelines is constraining due to the harsh environment to which the spacecraft is exposed for potentially more than a decade during its operational lifetime. Despite the high reliability required to comply with the guidelines, the risk that satellites fail before performing re-entry maneuvers remains. Space-fair nations must therefore also be prepared for this contingency, and adapt their platforms to be manually removed should this event happens.

Indeed, Active Debris Removal is not a straightforward operation, especially in case the targeted satellites to be removed are to some extend un-cooperative. For this purpose, ESA, through the Clean Space Office, has supervised a series of activities, called Design for Removal, aiming to ease the capture of its future LEO platforms in case of failure.

Supported by previous e.Inspector and e.Deorbit missions, as well as other numerous close proximity operation related activities, ESA has identified key technologies which could efficiently help the navigation of a chaser meant to perform Active Debris Removal and On-Orbit Servicing in the future. Among the current on-going activities, ESA has undertaken the design, manufacture and tests of:

- infrared and phosphorescent markers to help the chaser's navigation in the visual and/or infrared spectrum;
- fully passive, robust, and highly reliable radio-frequency tags, supporting pose and range estimation;
- a combined system with a grasping mechanism on a chaser, coupled with a passive interface on future LEO platforms to be captured;
- and magnetotorquers to be autonomously, as well as manually from ground if needed, short-circuited at the end of life of the satellite, to efficiently and passively reduce tumbling rate and, thus, ease its removal by a chaser

First outcomes of this activities show promising results and will likely push to pursue their development, while studying other solutions which would make Active Debris Removal, On-Orbit Servicing, or any other kind of Close Proximity Operations easier and feasible in a near future.

Keywords: Space Debris Mitigation, ESA, Clean Space, Design for Removal, Active Debris Removal, On-Orbit Servicing, Close Proximity Operations