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MEGA-CONSTELLATIONS, SMALL SATELLITES AND THEIR IMPACT ON THE SPACE DEBRIS ENVIRONMENT

Abstract

The number of artificial objects in orbit continues to increase and, with it, a key threat to space sustainability. In response, space agencies have identified a set of mitigation guidelines aimed at enabling space users to reduce the generation of space debris by, for example, limiting the orbital lifetime of their spacecraft and launcher stages after the end of their mission to at most 25 years in low Earth Orbit (LEO). In recent years there has been a considerable increase in space traffic due to the use of small satellites by non-traditional space operators, and due to a significant change of mission scopes and mission orbits in LEO. Many indications point to a further increase in the space traffic in LEO in the near future, including proposals for large constellations in LEO to provide broadband internet services.

Several recent studies have shown that, nowadays, the guidelines for the LEO protected region are insufficiently applied by space systems of all sizes. Therefore, a step increase in the launch rate, whether through the large-scale release of small satellites or through the construction and maintenance of large constellations, is a potential concern for the environment and particularly if the current End of Life (EOL) behaviour prevails in the future. Even with perfect behaviour with respect to the 25 year lifetime "rule", the new traffic might lead to unrecoverable environment trends. Furthermore, a 90

In this study, we report the results of a European effort to analyse in detail the effects that such an increase in the launch rate and number of objects in LEO would have on the sustainability of the space debris environment. With the use of long-term environment simulation tools, the main parameters driving the evolution of the environment under the presence of a large number of small satellites and with the mega-constellation being deployed have been identified. Further analyses have been performed to identify the sensitivity of the environment to different stress parameters.