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EXAMINATION OF CONSTELLATION DEPLOYMENTS RELATIVE TO DEBRIS MITIGATION: THE REST OF THE STORY...

Abstract

Many large constellations are in the process of or being considered for deployment over the next ten years into low earth orbit (LEO). This includes proposed large communications constellations in the fixed satellite service (FSS Constellations), large numbers of small satellites (Small Sats), and second generation deployments of existing LEO systems, such as Orbcomm OG2, and Iridium NEXT (Second Generation LEO Systems). On the surface, the introduction of the potential thousands of new satellites has been generally characterized as having a major impact on the future state of the orbital debris population. This paper seeks to quantify the actual future contribution of these constellations to the debris environment, along with existing debris such as derelict rocket bodies and inoperative or destroyed satellites. The paper finds that impact on the future state of the orbital debris population is driven by (1) system reliability including end of life maneuver capability; (2) adherence to existing debris mitigation guidelines; and (3) actual aggregate mass and surface area of objects on orbit at any one time. Analysis shows that by considering available data objectively smallsat constellations pose a smaller contribution to space flight safety or triggering of a cascading effect (i.e., the Kessler Syndrome) than currently advertised and much less than the risk from the existing population of abandoned derelict hardware in low Earth orbit. Finally, the paper evaluates a number of scenarios for regulatory requirements and quantifies their impact (assuming adoption) on the debris environment, ranking such regulatory requirements from most effective to least effective solely from the perspective of orbital debris mitigation.