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IMPLICATIONS OF PROPOSED SMALL SATELLITE CONSTELLATIONS ON SPACE TRAFFIC
MANAGEMENT AND LONG-TERM DEBRIS GROWTH IN NEAR-EARTH ENVIRONMENT

Abstract

Several constellations involving large numbers of satellites are being proposed for the near future. For example, SpaceX is considering deployment of a 4000 satellite constellation to provide Internet service worldwide. However, while SpaceX is the largest of the proposed constellations, it is not the only one, and a common feature of these constellations is their concentration of satellites into small altitude regions of Low Earth Orbit (LEO). They can therefore pose a risk to other satellites residing either nearby or passing through such altitudes. As a result, the number of both collisions and collision alerts that both the constellation owners and other LEO operators will have to deal with will increase. Decay and/or disposal of these satellites will also pose an issue to satellites operating below the constellations' original altitude. An examination was performed regarding the number of collisions and collision alerts that could be expected from various proposed future constellations. SpaceX, OneWeb, LeoSat, Spire, Skybox, Iridium Next, Globalstar 2, and Orbcomm 2 were examined. It was found that in the near future these constellations can be expected to generate 1 collision per year in the aggregate for the operational satellites and another 2 collisions per year for the disposed satellites. Similarly, the number of collision alert warnings was found to be large, with 54,000 and 116,000 per day for the operational and disposed satellites respectively when using a 20-km keep-out sphere as the warning criteria. If probability thresholds are used as the warning criteria, it was found that the number of warnings could be reduced by over an order of magnitude. It was also shown that the International Space Station could experience approximately 6.3 times as many collision warnings as they currently face due to the constellation satellites re-entering during the disposal phase. The final paper will discuss both the current operational impact of the proposed satellite constellations and the expected growth in the debris environment caused by collisions involving these vehicles. The collision issues raised by the presence of the constellations may require changes to general policy requirements and specific changes to the design of the constellations and their satellites.