**An Investigation Into Transecting Satellites in Future Space Traffic Management Scenarios**

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The number of satellites expected to populate the near-Earth space environment is set to dramatically increase in the coming decade as new large constellations are approved and deployed. Current strategies for placing new batches of these satellites on orbit often involve launching into an initial orbit, and then performing apogee raising maneuvers to reach a target altitude. Similarly, end-of-life planning for these constellation satellites can consist of de-orbit burns that lower perigee to permit disposal via re-entry. Both the raising and de-orbiting maneuvers can result in the individual satellites traveling in high-eccentricity orbits that have the potential to transect other spacecraft trajectories. While individual large constellations may be able to coexist in separate altitude and inclination bands, having thousands of satellites moving between these bands as new satellites are replaced and old ones are removed could pose additional collision risks. Similar concerns have been raised regarding the impact that large numbers of university-class CubeSats might have in terms of their overall collision risk, especially as these satellites typically do not have propulsion systems for active maneuvering.

To assess the impact that transecting satellites might have to future space traffic management strategies, this study explored a variety of future realistic scenarios using a high-fidelity simulation tool. The model can simulate the orbit of tens of thousands of resident space objects (RSOs) simultaneously, to include active satellites, debris, rocket bodies, or even future hypothetical scenarios, using a realistic force model that incorporates non-spherical gravity, atmospheric drag, solar radiation pressure, and more. As the model is run forward in time, various statistics and meta-data are gathered on any predicted conjunction event, providing insight into the nature and frequency of potential collisions, e.g., what size are the two satellites, who operates the satellites, are they active or passive objects, etc. Additional customization is available in terms of how probability of collision is computed, and how the probability ellipsoids and screening volumes are determined. The simulation tool also allows for rule-based maneuvers for active satellites, e.g, given an advance conjunction “warning,” one or both of the satellites can maneuver to a safe distance. A wide range of maneuvers can be implemented using impulsive or low-thrust methods, and the latencies can also be varied, e.g., using maneuver lead times of 48 hours, 24 hours, or 12 hours.

Validation of the simulation results is performed against current and historical datasets available, to include comparisons to prior conjunction data messages (CDMs), object properties (mass, volume, etc.), and two-line-element records from both public and internal sources. Using the simulation environment, an assessment on the general risks that transecting satellites might pose for hypothetical future space object environments will be presented. This will involve the simulation of approximately 50,000 new large constellation satellites, in addition to the existing catalog of approximately 20,000 known resident space objects (RSOs), over propagation periods of one month to one year. A description of the simulation methodologies, scenarios evaluated, and validation methods will also be presented, as well as a preliminary assessment of the effectiveness of several candidate maneuver strategies that have the potential to reduce collision risk between active satellites.