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INTEGRATING ORBITAL CARRYING CAPACITY INTO INTERNATIONAL POLICY CONSTRUCTS: LEVERAGING BEST PRACTICES FROM AVIATION'S RISK-BASED NORMS.

Abstract

This paper proposes modeling an orbital altitude-based "LEO Class" on aviation's Airspace Class approach that considers traffic volume and complexity in establishing entry requirements for particular airspace volumes. Orbitial capacity, like airspace capacity, must consider the characteristics, behavior, and capabilities of objects operating at particular altitudes coupled with the precision and accuracy of space situational awareness. Carrying capacity at its core is a safety metric, improvements in collision avoidance capability, including SSA and maneuverability, can increase the carrying capacity of a specific orbit, but may be constrained by the least capable actors.

For aviation the requirement to accommodate various airframe types, from experimental home-built aircraft to advanced airliners, operating in airspace ranging from low density to highly congested, led to the existing international framework for aviation safety, using a well-organized set of airspace classes. The aviation framework of Airspace Class establishes performance standards for entry into a specific airspace volume by considering the complexity, congestion, and risk in airspace volume itself. Higher airspace classes have higher entry requirements to mitigate collision risks while airspace volumes with lower collision risk remain accessible to lessor equipped operators through lower entry requirements. Airspace Class is clearly defined and transparently disseminated, allowing operators to self-select operating zones according to their willingness and ability to fulfill entrance criteria. Orbital altitude based approachs, defining LEO Classes using Airspace Class as a model, complement ongoing efforts, like the Space Sustainability Rating (SSR), and provide a necessary incentive structure to accelerate acceptance. This proposal suggests implementing higher safety requirements for altitudes where resident missions are paramount and mishaps have more significant consequences.

In this scenario, "consequence" encompasses the immediate capacity to generate debris, the potential for collision with operational missions, and the long-lasting nature of this collision threat. Debris persistence is a distinctive aspect of space safety compared to aviation. A combined LEO "Airspace" protocol and SSR may contribute to better defining the essential safety requirements that the SSR seeks to uphold by promoting responsible behavior. Modeling an existing globally harmonized approach can provide a path to achieve safe space sustainability goals.

While norms of responsible behavior must encompass equitable access for established and nascent space actors, adopting a uniform framework for all orbital paths may result in the establishment of inadequately low performance thresholds in congested orbits which affects risk, or excessively stringent criteria in sparsely utilized orbits which inhibit experimental endeavors and innovation.