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Author: Mr. Marcelo Boldt
Space Generation Advisory Council (SGAC), Argentina

Mr. Asmamaw Esayas
Space Generation Advisory Council (SGAC), Austria
Mr. Mikayel Grigoryan
American University of Armenia, Armenia
Mr. Jesse Mikelberg
Reaction Dynamics, Canada
Mr. Chad English
Reaction Dynamics, Canada

OPTIMIZING AND ENHANCING COMMERCIAL CONSTELLATIONS: COST-EFFECTIVE DEPLOYMENT, CONFIGURATION, AND LIFECYCLE MANAGEMENT WITH RESPONSIVE LAUNCH TECHNOLOGIES

Abstract

The last decade saw a significant rise in demand for commercial constellations, and with it has come a transition in the space transport business and an increased requirement for affordable, flexible, and geographically diverse launch services. The significant increase in defense budgets over the past three years has stimulated huge investments in sectors such as earth observation, hypersonics, and missile warning systems. In this situation, launch infrastructure is the essential foundation for human access to space. Yet current offerings, specifically rideshare arrangements with SpaceX and Blue Origin, do not have sufficient flexibility and responsiveness to aid in the fast deployment, resupply, and advancement of commercial satellite constellations. Such shortcomings prevent the industry from achieving quicker time-to-orbit and being responsive to changing market needs.

First, the paper will analyze the business potential of hybrid propulsion technology, which combines the reliability of solid rockets with the efficiency of liquid propulsion in a cost-effective and scalable alternative to heritage systems. Particular attention will be given to Reaction Dynamics' storable, stockpile-able, and sustainable launch vehicle system (Aurora), a novel hybrid launch vehicle providing accurate, on-demand orbital insertion, reducing operational delays and allowing satellite operators to manage deployment schedules more effectively.

Next, it explores the role and significance of responsive launch technologies in the evolving global launch market. By enabling a non-toxic solution, and the long-term stockpiling of pre-fueled launch vehicles, these technologies present a real opportunity for the deployment of both dedicated (single-mission) and versatile (multi-purpose) satellite constellations. Furthermore, the former examines how a low-footprint and mobile launch system could provide satellite operators with unprecedented scheduling flexibility, optimized constellation configurations, real-time system upgrades, and a reduction in redundant satellite systems.

Finally, the paper will leverage market research, constellation operator feedback, and international spaceport interviews - i.e. ELA Australia, combined with intimate knowledge of the Aurora launch vehicle systems as well as its hybrid propulsion technology and responsive capabilities. As a result, it will showcase how this integrated solution could improve satellite operator autonomy, enabling a more robust and regionally diverse space economy outside of the conventional US-centric paradigm.

Keywords: Responsive Space, Constellation, Hybrid Propulsion, Australia, Near-Equatorial Launch Site