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INTEGRATED STACK: REVOLUTIONIZING COMMERCIAL SPACE STATIONS THROUGH A
SINGLE-LAUNCH STARLAB CONFIGURATION ONBOARD STARSHIP

Abstract

The shift from government-owned space assets to commercial ones has brought forth the need for innovative solutions that enhance efficiency and reduce costs. This paper explores the advantages of a groundbreaking commercial space station, named Starlab, designed to be deployed to orbit in a single launch. This streamlined approach seeks to overcome the challenges associated with multiple launches and in-space assembly, heralding a new era in space infrastructure development while delivering hundreds of cubic meters of livable volume and payload capacity using a SpaceX Starship launch.

Funded under NASA's Commercial LEO Destinations Program, one of Starlab's primary advantages lies in its ability to be launched in a single mission, eliminating the logistical complexities and risks associated with multiple launches. Traditional space station assembly requires intricate planning and coordination, with each module launched separately and assembled meticulously in orbit. In contrast, Starlab's single integrated stack approach optimizes launch efficiency, reducing launch costs and minimizing the potential for assembly errors.

The single-launch strategy not only enhances cost-effectiveness but also accelerates the deployment timeline of Starlab. Traditional space station projects often span several years, subjecting the mission to changing political, economic, and technological landscapes. Starlab's rapid deployment mitigates these uncertainties, allowing for quicker utilization of the station for research, commercial activities, and international collaborations and avoiding a "Space Station Gap" after the decommissioning of the ISS.

Moreover, the single-launch concept significantly reduces the environmental impact associated with space exploration. By minimizing the number of rocket launches for assembly, Starlab contributes to a more sustainable space industry. The reduction in launches translates to fewer greenhouse gas emissions, propellant residuals, and the overall ecological footprint associated with station deployment.

This paper will outline the technical philosophy and characteristics of Starlab's innovative approach to space station deployment. The single-launch strategy offers unprecedented advantages in terms of cost-effectiveness, rapid deployment, and environmental sustainability. As humanity looks toward the stars for the next commercial frontier, Starlab stands as a beacon of progress, showcasing the potential for a more efficient and sustainable approach to building and operating commercial space infrastructure.