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Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development (1)

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ARCHITECTURE OF A MODULAR, IN-SPACE ASSEMBLED MEGASTRUCTURE FOR COMMERCIAL PAYLOAD HOSTING

Abstract

Historically, it has been common for many mission definition teams to design the scientific payloads of a spacecraft in conjunction with other critical systems, such as power generation, on-board data handling, attitude and orbit control, and telecommunication link. This approach limited space access to larger institutions which had the economic and human resources to design a mission in all of its aspects. Additionally, this constricted the types of missions that could be selected for development as smaller scope missions might have resulted too taxing for the expected scientific return. This paradigm was challenged by ridesharing, a process through which a number of payloads from different entities are carried together to reduce the cost of the individual mission. Additionally, the payloads can take advantage of centralized systems like telecommunication and power generation for the time that they are stored on board, further reducing the total complexity of the individual missions. Ridesharing has been successfully used primarily in the commercial launcher industry, with many companies providing a default service to a primary payload accompanied by a number of smaller secondary ones. At the same time, this concept has also been implemented for in-space hosting in limited cases like the Japanese Experiment Module (JEM) on the International Space Station (ISS). The work conducted by the Hestia team focused on the application of the ridesharing concept to in-space hosting of commercial payloads, by outlining the architecture for a space-bound platform. The proposed design is that of a modular structure which is gradually assembled in orbit and provides centralized utilities to up to a total of 20 payloads of differing size. This paper analyzes the architecture of the Hestia Hub. The centralized services that are provided to the payloads (power management, thermal control, data handling, etc.) are studied by establishing the requirements and providing a preliminary concept design of the relative systems. The platform concept is analyzed by defining its shape, the composing module, and the assembly/disassembly schedules. Finally, the proposed design for an ad hoc robotic tool to be used during the assembly and docking procedures of the payloads is presented.