SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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SERVICABLE SATELLITES - A SOLUTION FOR IMPLEMENTING SUSTAINABILITY IN SPACE

Abstract

Considering the serious situation of space pollution in important Earth orbits, strategies for debris avoidance aspects, such as On-Orbit-Servicing are increasingly discussed among the scientific and engineering community. As the need for long-term sustainability calls for innovative solutions, a team of researchers at Technische Universitaet Berlin and their cooperation partners developed a concept for modular and hence serviceable satellite systems, which will be presented in this paper. The disadvantages of conventional state-of-the-art satellites are obvious: The approach to build an optimized system regarding mass, size and function results in a monolith and unflexible system. In case of an unforeseen malfunction of a single component the entire satellite is lost. Even a fully functional satellite will be discarded as soon as the propellant is used up. A great potential to overcome these issues lies in serviceable space systems composed of single modules, which will be considered as building blocks. This potential ranges from a simple life extension by replacing faulty components, to performance enhancement upgrading old systems and even covers the idea of in-orbit exchange of payloads to fulfill new mission goals. The developed concept for modular satellites will be introduced by a brief presentation of possible levels of modularity and a discussion of their advantages. These levels range from a fully modular and thus highly flexible satellite to an only partially fractionized system, based on failure probabilities of components. The chosen level of modularity has a strong influence not only on the desired serviceability but also on the resulting complexity with respect to the replaceability of modules. Furthermore, it defines the requirements imposed on a possible servicing satellite. Challenges arising out of the building block approach are in particular related to the interfaces, necessary to ensure mechanical connection between blocks as well as the transfer of data, energy and heat throughout the entire satellite. Focusing on the latter three interfaces, possible solutions have been worked out resulting in the development of proof-of-concept prototypes. Standardized interfaces and building blocks would lead to short development times and improved assembly and verification processes and therefore hold a high potential for economic benefits. This paper concludes with a potential mission architecture for a serviceable satellite to outline future opportunities arising from this concept. The proposed concept highlights possible new directions for the development of innovative space systems and thus represents a unique approach to implement sustainability in space.