SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

Author: Ms. Jana Weise
Technische Universität Berlin, Germany

FRACTIONATED SATELLITE ARCHITECTURES AS KEY TO SUSTAINABILITY IN SPACE

Abstract

Considering the current situation of space pollution of important Earth orbits, strategies for debris avoidance such as On-Orbit-Servicing are intensively discussed among the space community. As the need for long-term sustainability calls for innovative solutions, a team of researchers at Technische Universität Berlin and their cooperation partners developed a concept for fractionated and hence serviceable satellite systems, which will be presented in this paper. The drawbacks of conventional state-of-the-art satellites are obvious: The approach to build an optimized satellite system tailored to a dedicated payload results in a monolith, expandable and inflexible system. In case of an unforeseen malfunction of a single component the entire satellite is lost. Even the increasingly popular use of modular platform designs cannot respond to the need for reusability. Great potential to overcome those issues lies in the development of serviceable space systems composed of single modules. The spectrum of opportunities ranges from simple life extension by replacing faulty components, to performance enhancement upgrading outdated components and even includes the idea of an exchange of payloads on orbit to adapt to new mission objectives. The developed concept for fractionated satellite architectures will be introduced by a comparison of different approaches, which differ in the level of fractionation. The different architectures range from a complete fractionation, resulting in a highly flexible satellite, to an only partially fractionated system, accounting for failure probabilities or the design lifetime of the integrated components. The chosen level of modularity has a strong influence not only on the serviceability but also on the resulting complexity with respect to assembly, integration and testing on Earth. Furthermore, it defines the requirements imposed on a possible servicing satellite. One of the challenges arising out of the fractionation approach is 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. The developed technical solutions will be introduced briefly. This paper concludes with a description of a potential mission architecture for a serviceable satellite to outline future opportunities arising from this concept. The proposed presentation gives attention to a unique approach to implement sustainability in space.