SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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FLEXIBLE SPACE EXPLORATION ARCHITECTURE BASED ON HIGH POWER AND ELECTRIC PROPULSION

Abstract

Following the key guidelines of the flexible path approach, the increased capability in space operations, gained with the ISS programme, and the advances in efficient in-space transportation systems represent the fundamental aspects to conceive the next class of platforms and mission scenarios for exploration programmes. An affordable architecture, indented to be the steppingstone to the next generation space missions, is outlined in this study. The concept proposed exploits some innovative approaches to increase the platform flexibility that can operate as technology demonstrator, as ISS service module, as multi-purpose space laboratory, as cargo or even as building blocks for future space ports. The time horizon envisaged is the next few decades and to cope with this timeframe, solar electric propulsion and inflatable modules are chosen as the two key building blocks of the architecture proposed. Tens of kW class Hall Effect Thrusters are conceived together with an ATV-derived chemical system for a 100 kW class platform. The whole system is sketched, designed and sized in this paper. The architecture presented might represent the way to extend the human presence beyond LEO and in this context a number of concepts of operations are identified and presented. In particular refuelling, re-boosting or management operations at the ISS are envisaged as the first step for all scenarios after launch. After this phase, where even additional payload, crew, experiments can be boarded, the platform moves toward a number of destinations aiming at reaching, in a longer run, a Mars-based station. This step by step process is composed by a set of intermediate targets. The flexible architecture proposed, indeed, can serve orbiting space laboratories on MEOs, Lunar missions, NEO operations and EML1 space ports. The platform is conceived as a modular structure where multiple components can be interchanged to assembly, for instance via multiple launches and in-orbit docking operations, the more appropriate platform for the specific mission. The complete architecture is conceived also by considering actual constraints of heavy class launchers nowadays available as the focus of future developments is given to in-space operations rather than to space launchers. Top level mass and power breakdown and a detailed mission analysis of some of scenarios identified are presented in the paper to support the concepts of operations and the system design solutions envisaged.