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

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FRACTIONATED SATELLITES: A STEP TOWARDS FLEXIBILITY AND RESPONSIVENESS

Abstract

The current approach for designing a satellite relies on the mass and cost minimisation. The mission is defined and the technology selected several years before the satellite is operational. Once launched, the flexibility will stay in the design margin, on-board redundancies and software uploading. The responsiveness capability aims to give a better answer to various sources of uncertainty. Non-traditional parameter of the current satellite design, it gathers maintainability, flexibility and scalability. In particular, it allows the space system to be more flexible with respect to the market evolution. To provide this capability, one solution is the fractionated satellite. The fractionated satellite concept has been studied by EADS Astrium in the frame of an ESA GSP contract. It is a space system that shares its functionalities over multiple spacecraft modules. Each module is a free flyer that fulfils one or several functions of the space system, such as mission communications, computing capability, data storage, power generation, etc. Each module carries either a unique payload (or a set of payloads) or a resource (like data processor, recorder, high bandwidth downlink, solar power collectors, etc) to be shared with other modules. The spacecraft modules fly in a cluster and communicate with each other through a shared wireless network. The architecture of the fractionated satellite depends on several parameters. At first, what could be fractionated in terms of payload and resources, and to what level. The level of fractionation and the redundancy strategy will drive the number of modules constituting the cluster. The wireless data transmission between modules is and the networking (central router, point-to-point) are the basic technologies supporting the fractionation. They will depend on the data rate and the distance between modules that will be a compromise between selected orbits and safety aspects, and transmission technology. Based on that, several types of architectures have been identified. An assessment of the applicability and interest of the fractionated satellite to four reference missions representing various types of applications: LEO mission, GEO communications, scientific satellite at Lagrange point and a planetary mission. This assessment has allowed to define a fractionated architecture for the mission and to compare it with the relevant monolithic concept with respect to traditional and non traditional criteria. The paper describes the possible fractionated architectures, their applicability and added value to the four reference missions and identifies the type of missions for which the fractionated concept is the most attractive.