SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (1) (4A)

Author: Mr. Andre Kupetz
Germany

Dr. Michael Schluse
RWTH Aachen University, Germany
Prof. Juergen Rossmann
Germany

NOVEL DEVELOPMENT METHODOLOGIES USING A HOLISTIC VIRTUAL TESTBED FOR MODULAR SATELLITES

Abstract

The iBOSS approach (intelligent Building blocks for On-orbit Satellite Servicing and assembly) replaces the classic satellite design with a standardized and modular system and thereby achieves sustainability, cost efficiency as well as rapid development on demand. The classic spacecraft subsystems are converted into task specific and standardized building blocks, the iBLOCKs, forming a modular spacecraft, the iSAT, ready for on-orbit assembly, maintenance, servicing and reconfiguration. Doing so, the classical development approach mainly carried out on satellite level is shifted to the use of prequalified iBLOCKs delivered by specialized companies. These iBLOCKs are assembled and integrated into the final iSAT before this iSAT would be finally tested on satellite level.

To cope with the (compared to classical satellites) increasing complexity and distributed development of iSATs, the iBOSS development methodology heavily uses simulation-technology to provide simulations on system level. These simulations are the basis for a simulation-based systems engineering approach. The simulation tool enabling this is the Virtual Testbed iBOSS (VTi). Throughout the development of the satellite, the VTi can be used right from the beginning to let a digital twin of an iSAT fly in the virtual space. This closes the gap between design, production and test and allows for first tests already in the first design phases. To do so, new development stages (models, prototypes or final components) are integrated into the virtual iSAT as early as possible. Simulations are used to test and verify new developments on component as well as on system level against component/satellite design and requirements using the most up-to-date digital twins of all parts involved in different scenarios. On the other side, each part of the satellite can be developed against the digital twin of iSAT. Physical and virtual iBLOCKs can be integrated into hybrid iSATs to perform functional tests while providing external test stimuli. Basis for all this is a central model database extending the current document-centric modelling approach. All relevant engineering results are reflected by the digital twins in this model database which this way becomes more detailed during the development work.

The final paper will outline the key aspects of this Virtual Testbed infrastructure and its use throughout the development process spanning distributed development teams. The feasibility and practicability of this approach will be demonstrated via a set of virtual reference iSATs realized so far.