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TUBIX20 – A GENERIC SYSTEM ARCHITECTURE FOR A SINGLE-FAILURE TOLERANT NANOSATELLITE PLATFORM

Abstract

Technische Universität Berlin is developing the TUBiX platform series to provide an innovative nanosatellite bus for future missions. TUBiX10 is a platform for 10 kg satellites, while TUBiX20 supports 20 kg missions, respectively. TU Berlin is currently working on three TUBiX based missions, which entail the launch of six satellites by 2016.

Reusability, adaptivity and robustness have been identified as the primary requirements for the TUBiX20 platform. Its design to meet these requirements is based on modularity, single-failure tolerance and extensive reuse of hard- and software on various system levels.

The resulting system architecture is based on the allocation of required functionality onto a number of distributed, redundantly implemented computational nodes with uniform interfaces, each connected to a redundant data bus. Hardware and software designs are well-matched, as the generic hardware approach combines with a building block based software design. The generic hardware concept is applied on a scalable level; different computational nodes share a common subset of electronic components, but may also include equal circuit elements or even be physically identical. In the same manner, all nodes share a common set of software modules structured in building blocks. This software library already provides all the basic functionality required to use the node's hardware infrastructure, and furthermore implements all software interfaces defined on satellite level. In this way, synergy effects in hard- and software development are maximized, while still allowing for easy integration of third-party components.

TechnoSat will be the first satellite to be based on the TUBiX20 platform. This technology demonstration mission carries eight different nanosatellite components for on-orbit verification. TechnoSat will be launched with Soyuz Fregat in the second half of 2015. The TU Berlin Infrared Nanosatellite (TUBIN) is the second mission to implement the TUBiX20 bus. It carries two uncooled infrared bolometers as payload and is scheduled for launch in 2016.

This paper describes the system architecture of the TUBiX20 platform, emphasising the capability of its modular approach regarding hard- and software development, testing and adaptability of the platform to different missions. Furthermore, design choices to achieve single-failure tolerance are discussed. The TechnoSat and the TUBIN mission are used as real life examples to demonstrate how the platform supports very diverse missions while only requiring minimal modifications.