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TUBIX-10 — DESIGN AND FLIGHT EXPERIENCE OF A NANOSATELLITE BUS FOR DISTRIBUTED MISSIONS

Abstract

TUBiX-10 (TU Berlin innovative neXt generation bus) is a satellite bus featuring a cubic form factor of 24 cm side length with a satellite mass till 12 kg (qualified) depending on the bus configuration. It was first used in a cluster of four nanosats successfully launched in 2018 (mission S-Net). As one of the first nanosatellite missions ever, S-Net could successfully demonstrate inter-satellite communication in orbit in S band frequency.

TUBiX-10 is designed as a 3-axis stabilized platform for primary use in experimental M2M communication networks using RF crosslinks. Specific requirements related to the orbital dynamics, onboard autonomy and antenna design (pointing in a meshed network) had to be met; the satellite integration time had to be reduced and the test procedures had to be simplified in order to allow a shorter launch preparation times, usually required for large constellations.

The satellite is designed to be ejected from an electromagnetically triggered deployment container, equipped with a carefully selected spring mechanism as well as a system for minimization of the friction forces and possible angular misalignment during ejection. These design features combined with specific pointing requirements to the launcher regarding the ejection vector, it is possible to achieve a remarkably low initial drift of the relative distances between satellites (0.5 ¡ km/day), helping to reduce the usage of propellant.

The bus architecture is failure-tolerant with very few single points of failure. The approach is characterized through the minimization of the overall system complexity by reducing the number of controllers and, consequently, simplifying the software architecture. So, it was possible to combine the power control, attitude control and data handling functionality in a single controller keeping the software for each of the subsystems independent using multi-threading. The onboard communication architecture could also be optimized by avoiding of bottlenecks. Another advantage of TUBiX-10 is a reduced amount of harness. The structural parts and the electronics are combined to electromechanical components interconnected by board-to-board connectors and a backplane, allowing the system to be quickly assembled and disassembled.

This paper summarizes the most important design aspects of the bus architecture of TUBiX-10 and shows the flight results from the first four satellites based on the TUBiX-10 design. Future work and different bus configurations (Earth Observation, Satellite-to-machine communication) are discussed as well. Satellite missions (for example SALSAT) being currently prepared for launch based on the TUBiX-10 platform and solutions are described.