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Space Systems and Architectures Featuring Cross-Platform Compatibility (7A)

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SCALABLE PLUG AND PLAY TILES FOR MODULAR NANOSATELLITES

Abstract

A typical satellite involves many different components that vary in bandwidth demand. Sensors that require a very low data rate may reside on simple two or three wire interface such as I2C, SPI etc.Complex sensors that require high data rate and bandwidth demands may reside on optical interface. The AraMiS architecture being developed at Politecnico di Torino is enhanced capability architecture, thus alternative to CubeSats for more demanding missions. Although keeping the low-cost and COTS approach of CubeSats, it extends the modularity concept as it also targets different satellite shapes and sizes. The proposed architecture is scalable since it is based on smart tiles which can be connected together at different angles to fit specific mission requirements, making it an extremely modular system. But modularity moves beyond the mechanical structure: the tiles also have thermo-mechanical, harness, and signal processing functionalities. Each tile incorporates solar panels on the external side and basic signal processing,power and data routing capabilities on the internal side. Multiple tiles interface through a proprietary self-configuring, dual-redundant, distributed power and data distribution bus. Further modularizing the system, every tile can also host a variable number of small sensors, actuators or payloads (up to 16 for each tile), connected using a plug-and-play approach. Every sub-system is housed in small daughter board and is supplied, by the main tile, with power and data distribution functions, power and data harness, mechanical support,& is attached and interconnected with space-grade spring-loaded connectors. Connections are electrically and mechanically modular, so they can handle from simple systems with a single analog channel up to larger systems with 8 analog channels, 16 digital I/Os and CPUs with standard serial communication. Each sensor, including analog ones, hosts a serial memory for storing its own calibration and configuration data which is read automatically by the CPU to provide calibrated housekeeping.Each tile embeds a dual CPU with A/D converters embedded with the harness, for handling from sensors, storage, signal processing, and housekeeping functions. Tiles are currently designed with two different mechanical subsystems:

- Single-size: 165x165 cm2 tile, a 1.6mm thick monolithic Aluminum structure, for cheaper and smaller structures.
- Double-size: 165x330 cm2 tile, with 10mm thick honeycomb structure for more rigid and larger structures.

The tile software is also modular and allows a quick adaptation to specific subsystems. The basic software for the CPU is properly hardened to guarantee high level of radiation tolerance at very low cost.