Autonomous Fault-Tolerant Avionics for Small COTS Satellites: From Concept to Prototype

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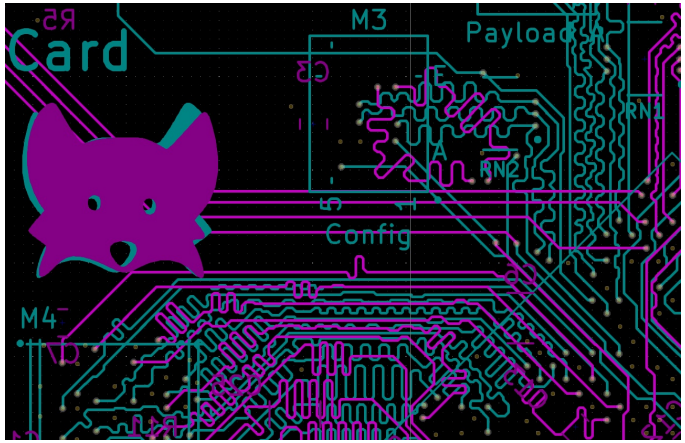
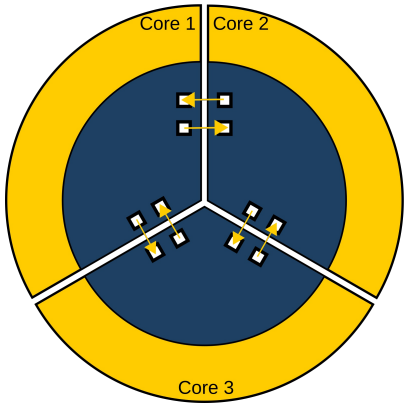
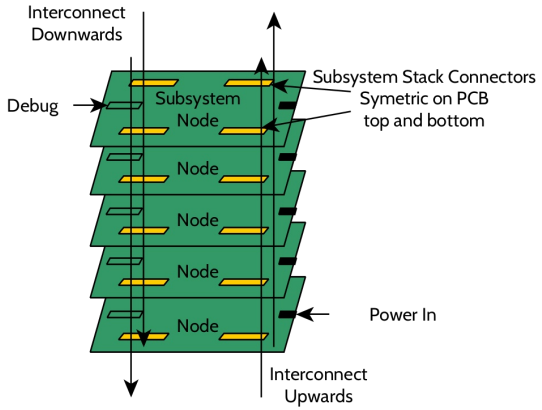
We developed the first truly fault-tolerant and autonomously operating, decentralized satellite backbone and avionics suite for miniaturized satellites down to the size of 2U CubeSats. We developed this technology from the ground up: the idea for this technolgy emerged, when the first CubeSat we worked on as students failed on-orbit. This idea is depicted to the right. We started with a first concept, implemented software and hardware designed, constructed proof-of-concepts, and conducted thorough testing.



Our current prototype can act as central on-board computer or as flexible controller for any given subsystem. In practice, this yields satellite bus architecture consisting of highly adaptable satellite compute notes. Each node is fully replaceable by two or more neighboring subsystem-nodes. This yields a distributed, fault-tolerant, interconnected satellite setup that can survive even multiple subsystem-wide failures without any proprietary TMRed components.



By mid-2020, we achieved our first fully functional system-level demonstrator setup, which we gradually improved and expanded. After four iterations of PCB development and manufacturing, we have condensed our demonstrator into a fully integrated custom PCB-based prototype. Our prototype is stackable and designed to fit on an 80x80mm PCB. It can fulfill nearly any subssytem role, and scale to offer high performance, take over tasks from other subsytem controllers to handle failures, or operate to minimize power consumption.



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https://smallsat2021paper.dependable.space

Contact us: smallsat2021@dependable.space

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