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In Code We Trust: A Software-First Framework for Satellite Operations

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Thousands of satellites now orbit the Earth, forming an increasingly interconnected ecosystem of space-based services. Yet the infrastructure to coordinate these systems remains largely centralised and outdated. This research explores how software, not hardware, can transform satellite operations to enable safe, sustainable operations in orbit.

Space is a zero-trust environment, where spacecraft are managed by a wide range of organisations, nations, and commercial actors who do not inherently trust one another, and may actively distrust each other. Enabling meaningful collaboration across trust boundaries requires a new operational model where coordination is not dependent on centralised authorities, which can create single points of failure, and governance bottlenecks.

Distributed Ledger Technologies (DLTs) underpin this proposed solution, providing a software-based foundation for decentralised coordination between spacecraft. Unlike hardware-first operational approaches, DLTs offer a programmable infrastructure that supports resilience, autonomy, and interoperability. In this system, trust is reframed as a software-defined property, verified through consensus mechanisms, rather than presumed based on ownership or affiliation.
Building on prior analysis of DLTs suitable for orbital use, this research is now focused on developing a novel consensus mechanism that incorporates orbit determination data to enable physical tasking. This mechanism is critical for ensuring reliable collaboration between all spacecraft and supports the creation of a Decentralised Autonomous Community in Space, where governance is distributed and coordination is achieved through inter-satellite tasking.

As satellite constellations continue to grow in scale and complexity, software won't just support their autonomy and resilience: it will define the future of sustainable space operations.

Confirm eligibility

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