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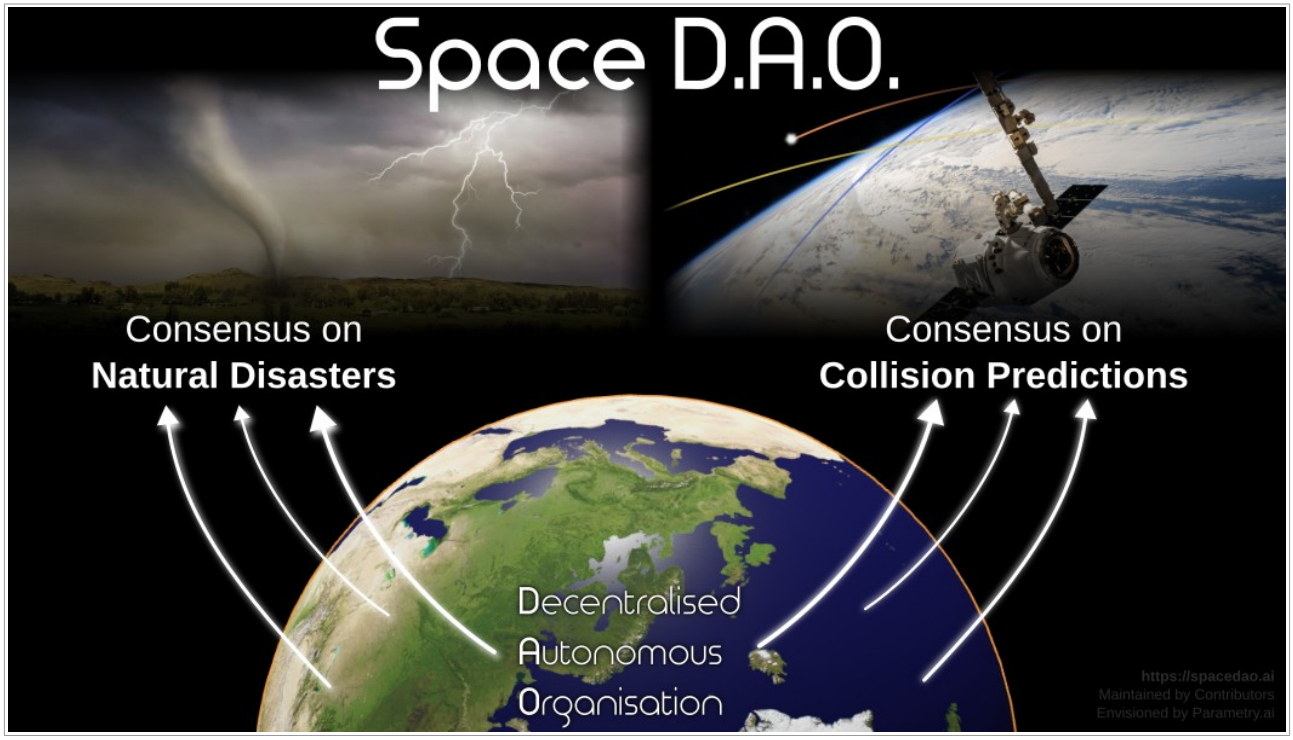

Blockchain ecosystem for an autonomous consensus mechanism of federated satellite networks – Space DAO

Executive Summary

Study

OSIP Campaign: ***Cognitive Cloud Computing***

Affiliation(s): Parametry.ai (Prime), University of Strathclyde (Sub 1), VisionSpace Technology Gmbh (Sub 2)

Activity summary:
In applications such as space traffic and disaster response management, there are growing public and private capabilities. Multiple different stakeholders can detect and identify events (space collision predictions, natural disaster definitions). Augmentation of events definitions lead to confusion for local authorities, operators or any users of these information for costly decisions. This project, Space DAO, sets the base infrastructure to agree on consensus mechanisms to reduce confusion and augment trust in key decision making information. Space DAO acts as a market place for space insights offering full governance power to users as well as data and services providers.

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In order to provide a neutral, fair and effective exchange of trustable data insights, a decentralised autonomous organisation of space insights has been prototyped; **Space DAO**.

Space DAO stands for a Decentralised Autonomous Orbit Organisation and provides autonomy in decision processes output by the ecosystem. Automation of the decision process via a neutral and scalable system has strong gains in decision making. Current applications for the Space DAO are Space Traffic Management (STM) and Disaster Response Management (DRM).

Space Traffic Management

The increase in satellites and space debris in orbit makes space operations increasingly complex, since the risk of conjunctions is increasing exponentially. This has motivated investment and public budget distribution for a reinforced growth of public and private capabilities in the last ten years.
The growth of Space Situation Awareness (SSA) data sources poses the question of trust; if several entities can provide insights on space traffic and predict space objects collisions, which sources is the most accurate when there are important discrepancies. Discrepancies across such insights providers also bring the question of trust; despite non malicious behaviour, users have to decide how to evaluate trust in raw data sources, sensoring capabilities and processing methods of these providers. Trust is also impacted by the lack of transparency on processing pipelines and eventual agreements between providers.

There is yet no common ways to find a consensus on what is really happening in orbit although decision based on these divergent pieces of information have very important impact on continuity of services from space, and on the immediate cost of operations.

Disaster Response Management

The current principle of disaster response is to provide decision making elements for rescue teams and local authorities to act accordingly upon an disaster event. Time is a critical aspect of such process. Several capabilities are emerging in the New Space industry that shows great protential for from-space insights on disaster, thus shifting paradigm of disaster response from reactive to proactive response.

With projection to a future with many satellites and constellations being able to provide disaster predictions, the need for making consensus on a more precise and confident disaster definition is arising.

Space DAO, via its consensus mechanism, offers the capability to present disaster information with an enriched level of confidence. For each insight provider, it uses probabilistic models of confidence managed on the network. This helps building consensus while at the same time updating confidence in performance of each of the stakeholders.

Upon consensus, a distributed planning mechanism is set to help operators or directly connected space asset to redefine their perception actions in orbit to augment observability of a given event. Increasing the capacity to act accordingly and proactively against a natural disaster.

A decentralised collaborative network

Space DAO sets the necessary decentralised infrastructure to incentivise insights providers to work towards rationale consensus, and offers users with first decision making information.

For space traffic as for disaster response management, the process goes via two phases:

- Phase 1: consensus on risk descriptions
- Phase 2: agreement on risk remediation

To increase and ensure the trust and smooth interactions within the whole ecosystem, Space DAO is designed to be transparent and open source. Stakeholders have the capability to democratily change the mechanisms of the system, if seen unfair, by proposing changes and casting votes upon them.

First prototypes for STM and DRM demonstrates the underlying functionality and opportunities of consensus mechanisms in situation of uncertainty of information. The ecosystem can be assimilated to a market place of space insights where trust, neutrality and transparency are ensured by design.