

# THE 5<sup>th</sup> SYMPOSIUM ON DISTRIBUTED LEDGER TECHNOLOGY

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## Experiences Building and Operating a Blockchain- Based Tasking Market for IoT Devices

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# Abstract

- It is possible to provide tasking information to remote devices over a computer network in such a way as to minimize technical details as to how tasks are to be accomplished.
- By allowing autonomous or semi-autonomous remote devices to respond directly to such tasking requests, a tasking market may be created in which devices cooperate to complete human-provided tasks without requiring them to use strong AI to coordinate their actions.
- An enterprise blockchain forms the technical basis for a solutions architecture that implements this concept.

# Tasking Satellites

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Today's satellites tend to be organised into constellations based upon their ownership and the means by which they are controlled (e.g. by a controlling authority, and communication via designated ground stations).

However, planners still wrestle with space assets being in the wrong location at the wrong time for a given mission.



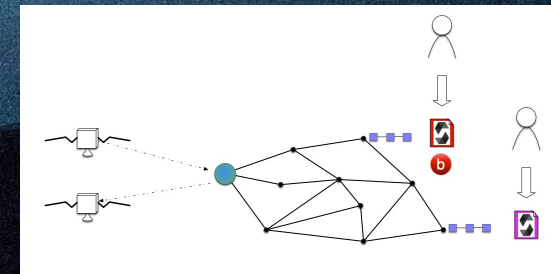
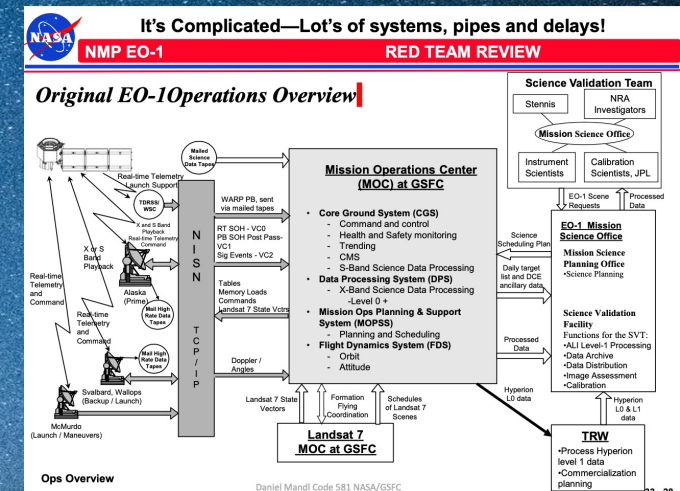


# Approach

Dan Mandl at NASA GSFC proposed an efficient means of distributed spacecraft mission control using blockchain technologies in 2017.

We designed and implemented a **virtual Mandl market for satellite tasking across organisations** mediated via a private blockchain.

The system is intended to allow ground stations, satellites and users to understand the efficiency of that market in optimally allocating resources to satisfying smart contracts in addition to pre-existing taskings.







- A smart contract is issued to the constellation or “market” defining conditions lat, long, lighting, spectrum etc
- Satellites “bid” for and complete contract segments via Ground Station network
- Immutable log of actions taken used to validate contract completion
- Whole of constellation can be addressed with tasking dynamically allocated and completed by un-tasked assets leading to higher utilisation



- Operational control of assets remains with their owners while tasking of assets become available across authorised domains.
- Autonomous agents (at network edge) choose to participate based on constraints.
- Assets share tasking across multiple domains (ownership & control) facilitating system-wide efficiencies.
- Drive utilisation and efficient coordination of scarce assets across a wider user base to reduce underutilised capacities.



# bitscore<sup>®</sup> Implementation

Information storage → Information access → Efficient usage



Ransomware resistant online file storage

Multi-party authorisation in contested environments

Multi-device tasking market to optimise expensive assets



EVNTS\*

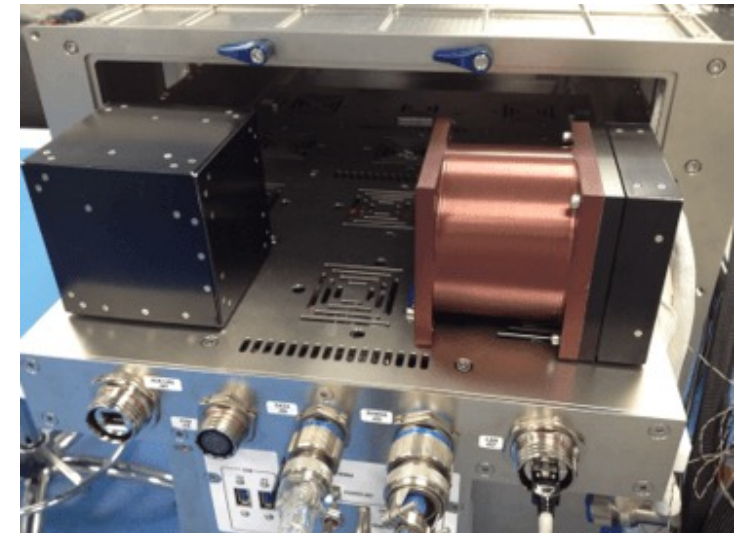
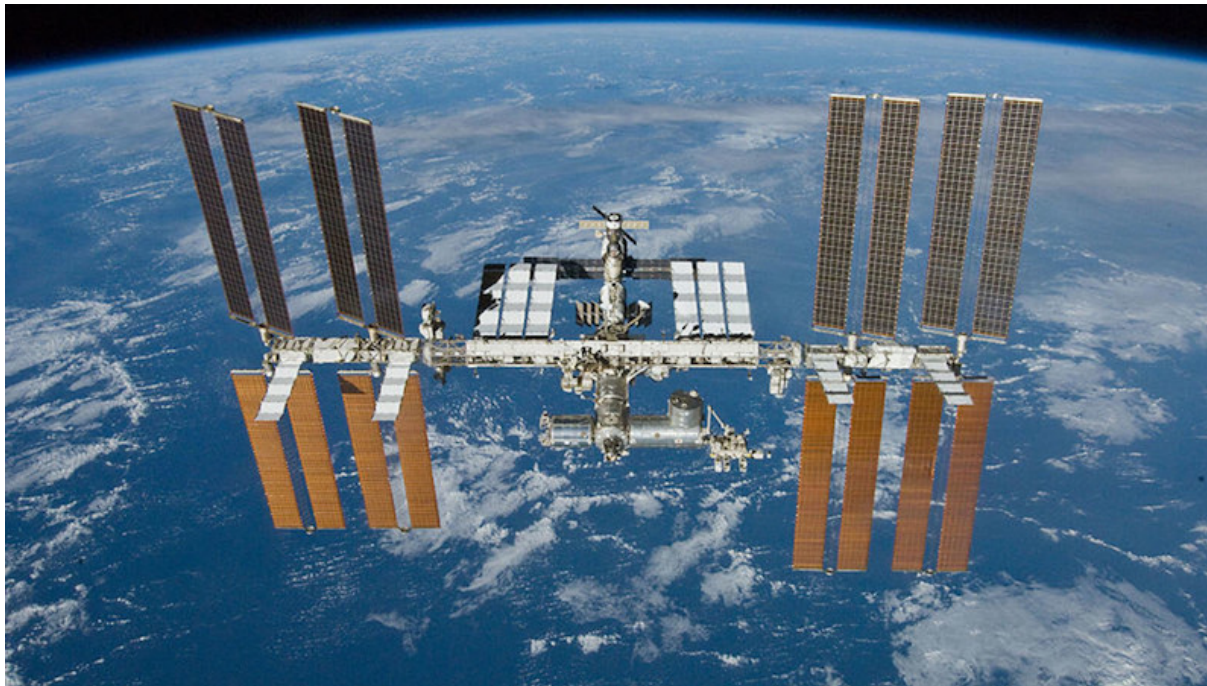


\*Enhanced Virtual Network of Tasking Systems



# Implementation Experience

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Software deployed on the Hydra3/PULSE experiment onboard the International Space Station, Oct 2021





# Implementation Experience

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Hardware/software deployed as a payload onboard a Black Sky Aerospace Sighter 150 rocket launched from Queensland, Nov 2021





# Implementation Experience

Software integrated with two robot boats from Australian Droid+Robot for an invitation-only demo to RAN, Nov 2021







## Our Work

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- **Issued patent:** Blockchain IT Solutions Pty Ltd, 2019. A System and Method for Implementing a Computer Network. WO/2019/119034.
- **Provisional patent:** BITSCore Pty Ltd, 2021. A System and Method for Implementing an Asset Tasking Market over a Computer Network. Australian Provisional Patent Application No. 2021902389.
- **Academic paper:** Hyland-Wood, D., Robinson, P., Saltini, R., Johnson, S., Hare, C. (31 October 2019) Methods for Securing Spacecraft Tasking and Control via an Enterprise Ethereum Blockchain. 37th ICSSC, Okinawa, Japan.
- **Academic paper:** Hyland-Wood, David, Peter Robinson, Sandra Johnson, Christopher Hare, Brett Henderson, Chris Lewicki, and Roberto Saltini. "Blockchain Properties for Near-Planetary, Interplanetary, and Metaplanetary Space Domains." *Journal of Aerospace Information Systems* (2020): 1-8. <https://doi.org/10.2514/1.I010833>

## Related Work

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- Mandl, Dan. "Bitcoin, Blockchains and Efficient Distributed Spacecraft Mission Control." (2017), <https://ntrs.nasa.gov/citations/20170009470>.