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TOWARD A BLOCKCHAIN-SPACE NEXUS: CHALLENGES AND OPPORTUNITIES TO SECURITY, STABILITY, AND SUSTAINABILITY ON THE FINAL FRONTIER

Abstract

Blockchain technology concerns the decentralized distribution of information over a network via a shared immutable database. This paper explores present and future applications of Blockchain for Space (BfS) and Space for Blockchain (SfB), providing deep examination and review of substantive technical content. We propose new opportunities including: space-based data feeds for decentralized oracle networks and the trustless execution of smart contracts by and for space, the distributed ledger as a next generation of Transparency and Confidence Building Measures (TCBMs) and for the enhancement of global cybersecurity, and their integration into existing legal, insurance, and economic frameworks.

The first successful blockchain, machine learning, and non-fungible token demonstration on the ISS was conducted on December 17th, 2021, heralding a new dawn of economic opportunity in space. The marriage of blockchain and space, two exponential technologies in their own right, is creating a bidirectional accelerating feedback loop of tremendous proportions. This symbiotic nexus goes both ways: blockchain is disrupting space just as space is upending the status quo in the blockchain ecosystem on Earth. Blockchain will play a key role in the continued democratization of space, a cornerstone for TCBMs in an industry that strives to represent a guiding light of trust and cooperation in an otherwise turbulent geopolitical environment.

Blockchain applications are facilitating new space developments while actively making space a safer, more secure, and more trusted commercial environment for all actors:

With space data, algorithmically maintained smart contracts and oracles, "incontrovertible-truth-as-a-service", can serve an increasingly diverse array of critical domains including orbital debris and space situational awareness.

A concentration of data and communications management in the hands of the few has made space more vulnerable to cybersecurity threats. Satellites are bringing decentralization to new heights, spawning blockchain networks' first "nodes in the sky", providing a secure environment for space actors.

Blockchain applications have the potential to enhance governing legal and economic regimes, empowering transparency while securing space commerce and operations.

If the past is prologue, inflexible institutions and legal systems will fail to adapt to the combination of exponential developments in both space and blockchain. This lack of requisite regulation has either hampered progress or fostered misuse, damaging public welfare and their reputation. This paper spurs

discourse regarding this emerging, unified blockchain-space frontier that will require new, next-generation leadership and cooperation to foster, rather than inhibit, a secure and sustainable future of innovation and growth in the space industry.