Building Blocks to Space: How Blockchain Can Advance Space Exploration

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On July 20, 1969, the United States' Apollo 11 mission became the first manned vessel to land on the moon. In the time since, the US government, and a select number of private companies, have prioritized space exploration. Still, just six moon landings occurred in the last 50 years. The reason

is simple: space exploration is costly, fraught with logistical challenges, and riddled with process inefficiencies. Blockchain has been seen world-wide as the answer to address many of these issues.

Until recently, every business in the world kept their own records of relevant transactions and data. Those records lived in many different ledgers across both individual businesses and groups of businesses that represent different parts of a transaction. Reconciling those records has proven to be time-consuming and prone to error. Discrepancies, lack of transparency, and the possibility of corruption has led to many costly disputes. Blockchain provides businesses the ability to eliminate those challenges because it facilitates a single source of truth. It is a shared, tamper-proof database for recording the history of transactions. A blockchain system registers the chronological order of transactions with all participants agreeing to the validity of those transactions using a chosen consensus model. The result is a ledger of irreversible transactions visible only to members in the network. Rather than relying on centralized, trust-based systems, blockchain network participants have equal access to up-to-date information. Further, no central intermediaries means there is no central point of failure. Given their architecture and functionality, blockchain-based systems provide increased transparency, enhanced security, improved traceability, greater efficiency, and reduced costs. Those very traits make blockchain an attractive solution to various problems in the space exploration industry.

The first attractive trait is cost. Costs to participate in space exploration are so high that only government owned or sponsored entities, and a few billion-dollar companies, populate the market. Consequently, the creativity and out-of-the-box thinking that the Internet introduced to almost every other industry has not made its way to space exploration. SpaceChain seeks to change that dynamic by providing easier access to satellites and allowing unrelated parties to share access. SpaceChain provides hardware that allows its users to access satellite technology through nodes placed on a satellite. The nodes will be installed with the SpaceChain operating system (OS), which is based on blockchain technology and allows multiple companies or individuals to access the satellite's functions and data without impacting each other's work. Through the SpaceChain OS's open source platform, users will be able to develop different types of space-based applications on a single satellite.

The concept appears to be working. In February 2018, SpaceChain launched its first SpaceChain OS blockchain node into space. Since then, developers, who otherwise may have been priced out of space-related research and development, have begun to craft projects using the SpaceChain OS.

One venture involves using SpaceChain OS to advance climate change research through a platform that allows users to communicate with and collect data from sensors in the ocean. The SpaceChain OS has been discussed as a solution to the security risks (e.g., hacking centralized servers) inherent in cryptocurrency exchanges. To avoid that risk, the SpaceChain OS can be used to create an exchange on a decentralized satellite network.

Blockchain will improve supply-chain management for space exploration. A supply-chain is the sequence of processes and inputs between a company and suppliers that are necessary to produce and distribute a specific product. For a spacecraft, the supply-chain begins with the sourcing of raw materials to build the vehicle. Once gathered, raw materials need to be sent to manufacturers, who will build the spacecraft's parts. After being built, they are sent to a facility for assembly. After the spacecraft has been assembled, it must be fitted with the proper hardware and software necessary for a launch. Although simplified in this article, the entire process is extremely complicated, expensive, and time-consuming. In almost every industry, supply-chain management presents record keeping challenges, and the logistical burden of coordinating with the numerous vendors along the chain.

Blockchain-based supply-chain management systems could neutralize some of the inefficiencies in supply-chain management by providing permanent, audit-able, real-time records on a secure platform accessible to all participants in the chain. Consequently, companies in the space exploration industry have been exploring ways to integrate blockchain in their supply-chain management. For example, Moog, a US manufacturer of flight control systems, created VeriPart, a blockchain-based platform for supply-chain management. VeriPart can (1) execute secure digital transactions for aircraft parts using smart contracts, and, (2) verify manufactured parts' quality through proper establishment of qualification and certification standards. Additionally, GSC Aviation has been working on a blockchain application to allow aerospace manufacturers to have tamper-free and transparent records of each single element of their supply chain, including origin of parts, specifications, date of shipping, and maintenance needs. This blockchain platform will simplify record-keeping and streamline processes by tracing every part from manufacturer or supplier to installation. Further, stakeholders can upload documentation essential to the aircraft's lifecycle, which will improve maintenance and regulatory oversight. Through the SpaceChain OS, companies can develop applications to track their shipments from air to sea globally, which currently is difficult to do because of network coverage issues in various countries.

Finally, blockchain may improve space exploration efficiency by removing the human element (think of the many spacecraft functions that exist just to keep people alive and comfortable). In

March 2017, the US Congress approved legislation, which directed the US National Aeronautics and Space Administration (NASA) to prepare a plan for deep space exploration, including sending humans to Mars. NASA awarded a $330,000 grant to scientists at the University of Akron to develop autonomous spacecraft that could make decisions without human intervention. The software that will power the autonomous spacecraft is called the Resilient Networking and Computing Paradigm (RNCP). Based on Ethereum technology, the RNCP automatically runs certain transactions or executes code when conditions are met. Theoretically, an RNCP-powered spaceship will be able to recognize environmental threats, respond to them appropriately, and perform several necessary tasks automatically. The frequency of substantive space exploration missions likely will increase with such technology.

As in other industries, blockchain presents a myriad of solutions including for space exploration challenges. It would not be a stretch to expect that blockchain advancements will propel space exploration developments.

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