



Leading insights on the space sector

# Blockchain

## What are the Applications for the Space Industry?

Digital tokens created on the blockchain network enable easier fundraising for space start-ups and facilitation of space assets.

### Concepts and Definitions

#### Blockchain

A Blockchain is a shared, trusted, public database of all transactions in a network. The network stores all transactions in cryptographically secured fragments of data called “blocks” that are “chained” together to form a digital ledger of transactions. Every user in the network has a copy of this digital ledger and hence, is able to see and monitor all transactions in a network, and as such, every user also validates all updates to the digital ledger. The ledger is decentralised as it removes the need for a central entity since the cryptographic, economic incentive mechanisms eliminates the need for third party trust.

Since, this whitepaper is based on the concept of applying blockchain technology to use cases such as initial coin offering and asset tokenization, a detailed review of blockchain is not presented in this paper. However, it is crucial to understand that blockchain is the fundamental platform that allows for the development of products such as smart contracts, initial coin offerings and tokenization.

#### Smart Contracts

Smart contracts are self-executing contracts between a buyer and a seller, with the terms of agreement to be executed being directly written into the code that exists on the blockchain network. As a result, smart contracts allow trusted transactions between parties without the need for a central body or a legal mechanism, as all transactions are transparent and irreversible.

By decoupling the blockchain layer, smart contracts offer a more platform-based approach with a wider variety of applications than those offered by the blockchain layer.

#### Initial Coin Offering

An Initial Coin Offering (ICO) is a fundraising mechanism for cryptocurrencies, combining the concepts of an Initial Public Offering (IPO) and Crowdfunding, in which an entity such as a start-up can raise funds for its new project by offering a digital token to the investors. It eliminates the structural regulations of an IPO such as stake ownership and the potential for returns. Although an ICO does not provide an equity stake in the entity for the investor like an IPO would, the token is directly related to the product or service that the entity is developing, and is thus expected to appreciate in value, thereby leading to a profit for the investor. In general, an ICO works with a type of digital token called “utility token” that provides the investors with permission to have access to a product or service.

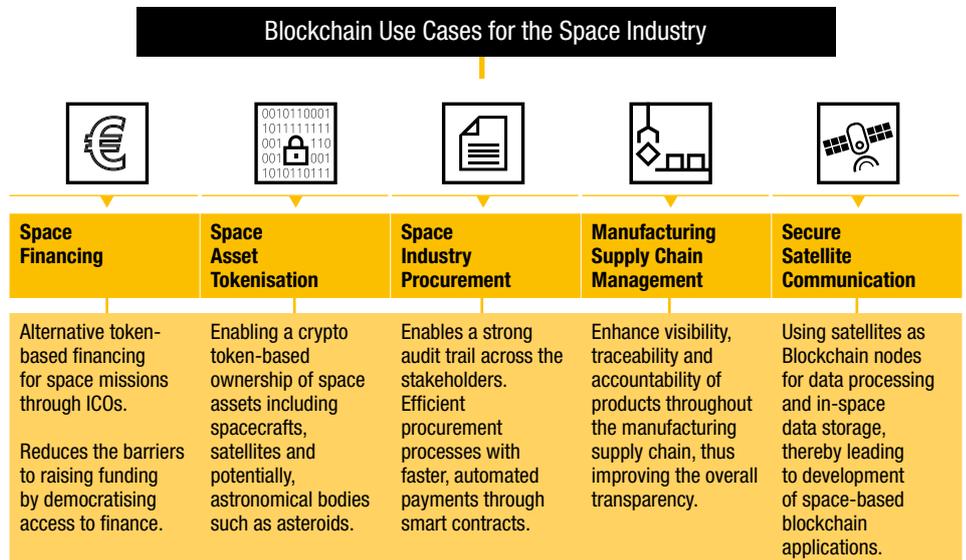
#### Asset Tokenization

Asset Tokenization is the process of converting some form of an asset into a digital token that can be moved, recorded or stored on a blockchain system, where the asset can be manipulated as a digital token. Tokenizing an asset would enable one to manage its value exchange based on the contract written into the blockchain network. Tokens issued through the Asset Tokenization process are a special type called “asset-backed tokens” or “security tokens”, which act as claims to the underlying assets.

These tokens might represent any asset, including a song, a kilowatt-hour of solar energy, a square metre of real estate or a square kilometre of an asteroid. As an example, tokenization allows one to tokenize a property, thus enabling one to purchase only two square metres of a fifty square metre house.

Figure 1 presents five potential use cases for the space industry: Space Financing, Space Asset Tokenisation, Space Industry Procurement, Manufacturing Supply Chain Management and Satellite Communication. For the purposes of relevance in space exploration and brevity, this whitepaper focuses on some potential applications of blockchain in the space industry particularly on the first two use cases regarding financing for the space industry and space asset tokenisation. The use cases discussed here are proposed by the team at PwC and should therefore not be assumed to be an exhaustive list of all applications of blockchain.

Figure 1: General Use Cases of Blockchain for the Space Industry



Source: PwC Analysis

**Employing Initial Coin Offerings as a Means of Financing**

**How does an Initial Coin Offering work?**

Essentially, an Initial Coin Offering (ICO) is a token generation and distribution event for buyers who are directly investing in the product or the service provided by the company, by means of individualised tokens generated by the company. Initially, the company publishes a whitepaper detailing its products and services along with how investors could benefit from buying its tokens, along with what type of currency would be accepted in the ICO.

Buyers who invest usually tend to benefit from access to the product or the service that is determined by the token, and also benefit by the appreciation of the token's price.

In essence, this provides the company with a mechanism to incentivise the adoption of its products and services without giving up equity. This is one of the key aspects of an ICO and also one of the significant differences with an Initial Public Offering (IPO).

Buyers participating in an ICO tend to get what is called a "utility token", which allows them to use the product or the service once it is launched. The financial incentive for the buyers is the hope for the demand for the product or the service will skyrocket once it is launched, leading to an increase in the price of the token, by means of which the investor profits. Until 2018, over \$22 billion has been raised in total through ICOs, for a majority of companies in industries including financial services, blockchain platforms, and messaging services<sup>1</sup>.

**Applying ICOs for the Space Industry**

Although investments in the space industry are on the rise in the recent years, access to finance is still considered one of the biggest challenges for entrepreneurs. As such, blockchain technology, and in particular ICOs, might find itself as an attractive proposition to help tackle this challenge. Another aspect of space that might be an exciting prospect for ICOs is funding space exploration missions, especially in the age of "New Space". Monetising data from outer space exploration missions, in particular from missions to asteroids, moon and Mars are particularly interesting from a commercial standpoint.

### Funding Space Start-ups

Apart from debt funding and equity funding, encouraging ICOs as a means of funding could break barriers of entry in the space industry, which has been known to be capital intensive and highly risky. Traditional crowdfunding mechanisms, which are quite popular in the space industry, act mostly as donations to projects from enthusiasts, while ICOs could serve as an alternative funding mechanism for projects that have a utility for its customers.

A start-up that is involved in manufacturing a new propulsion for microsatellites need not have to wait on funding from a venture capitalist. Instead, it can conduct an ICO to provide tokens to its potential customers – for instance, a satellite integrator company – who could be potentially interested in trying out the new technology. This entity might make a strategic decision to invest in the propulsion start-up, which might help reduce its satellite manufacturing costs.

Additionally, the investing entity has an opportunity to reap its rewards for backing the start-up from an early stage by enjoying the benefits of token price appreciation. The entity also has the choice to sell its tokens back, if the start-up is not successful in doing what it set out to do, according to the whitepaper. The “utility tokens” involved might even be part of a smart contract, which means that the start-up is encouraged to achieve its milestones, failing which it could lose its investing entities. National and regional space agencies such as CNES and ESA could serve as a platform to match entities such that there are strategic advantages for both the incumbents and the start-up.

They could be involved in creating an ICO-based funding ecosystem to enable interested entities to contribute to funding mechanisms for start-ups.

### Monetising Space Exploration Missions

Moving away from the traditional approach to space exploration, in which only the national space agencies planned space missions, in the recent era of “NewSpace” a number of private space companies are planning missions to asteroids, the Moon and Mars. Sparked by the development of companies such as SpaceX and Planetary Resources, and the rise in private investments and space competitions such as XPrize, space exploration is increasingly becoming a competitive affair.

At the time of writing (February 2019), Spacell, an Israeli organization, is expected to become the first privately funded lander on the surface of the Moon<sup>2</sup>. A number of other companies, including PTScientists, Astrobotic, Moon Express and Team Indus, are in preparations for their private space missions to the Moon, while others such as SpaceX have a roadmap for Mars exploration. Although space exploration is about to become a more competitive affair, there is room for collaboration between the different parties including the space agencies.

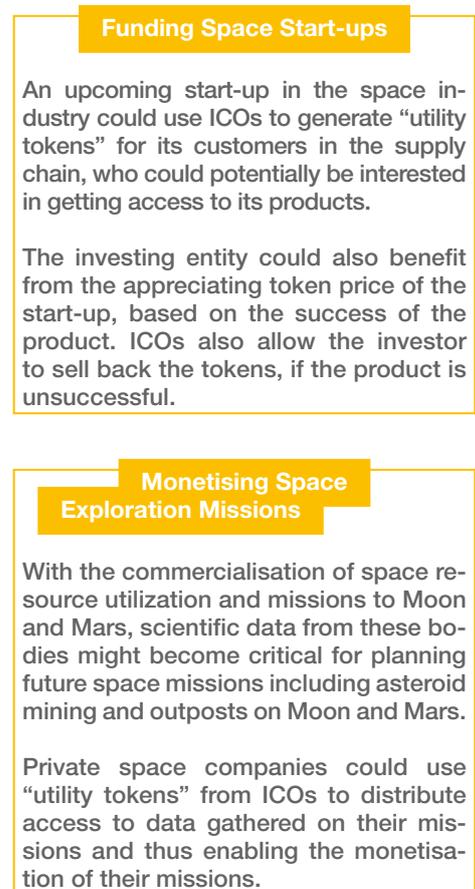
ICOs provide a way for such collaboration, keeping in mind the competition between the parties. With the sale of “utility tokens” in the ICO, a private company could provide access to valuable data for the interested entities, which also includes national space agencies, who are planning future missions to asteroids, the Moon and Mars. A lander on the Moon could generate new scientific data, which could then be monetised by using tokens, thanks to blockchain technology. Further, this approach enables a collaborative ecosystem of private companies, while also financially benefitting the parties in the process.

A company like Spacell will generate useful scientific data that might be useful for other private companies and perhaps even national space agencies for planning future missions. ICOs provide a way for space agencies around the world to invest in private companies for getting exclusive access to data, if the mission proves successful.

Even in the case where the lander mission fails, there is still useful data for the investing entities. ICOs offer the opportunity for private companies to benefit from their exploration activities. Similar to the first use case, blockchain technology allows for the entire token creation and investing process to be managed autonomously, thanks to smart contracts, which could enable a milestone-based investing approach, just as it is currently being done in various publicly funded commercial demonstration space programmes.

Figure 2 summarises the two applications discussed here.

**Figure 2: Use Cases for Initial Coin Offerings in the Space Industry**



Source: PwC Analysis

**Tokenizing Space Assets and Technologies**

**How does tokenizing an asset work?**

Through the process of generating security tokens for digital assets, a physical asset such as a painting could be converted into digital shares of ownership. As such, multiple owners could own the asset and buy or sell digital shares taking advantage of rising or falling prices. This enables a variety of benefits, including liquidity for asset owners, low transaction costs, increased transparency and a digital, 24/7 market.

The most crucial application of asset tokenization is the fact that there are no territorial barriers to investing in assets, and hence any potential interested entity from anywhere in the world can invest into an asset without complicated procedures, with high security models and the speed of transfer offered by the blockchain network, due to the absence of middlemen.

As discussed, any asset can be tokenized into the blockchain network, including venture capital funds, metals, real estate, commodities and art forms (paintings, songs or movies). As shown in Figure 3, this opens up a variety of applications for the space industry, namely 1) in the case of tokenizing astronomical assets, which is a fundamental use case for the commercial space resource utilisation industry and 2) for tokenizing geospatial information and insights in order to store it on the blockchain network.

**Tokenizing Space Resources**

Potential space resource utilisation approaches including asteroid mining and regolith extraction on the Moon could be facilitated by the tokenization of assets. Tokenizing space resources has a huge range of applications in the space mining industry, since blockchain provides a mechanism to register the physical location of space resources as digital tokens, and track their transactions, thus enabling for a transparent identification and management process.

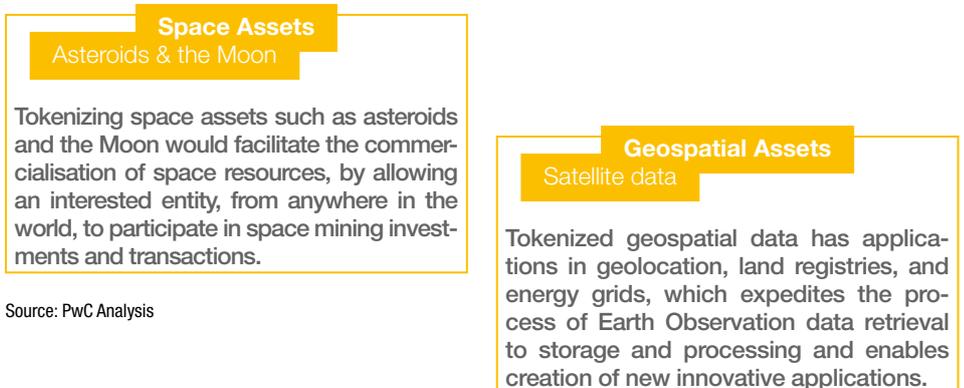
ConsenSys, a blockchain firm, recently acquired Planetary Resources, an asteroid mining company, in order potentially to initiate the application of this use case<sup>3</sup>. It is possible that, in a few years, ConsenSys could manage the transactions of Planetary Resources using its Ethereum-based blockchain network, thus enabling a new wave of investment for space resource utilization by an entity, irrespective of its geographical location.

**Tokenizing Geospatial Data**

Geospatial data gathered using satellites could be tokenized into “utility tokens”, thus enabling a digital storage mechanism on the blockchain network. Land transactions and land data repositories are two powerful applications of tokenized geospatial data. Blockchain-based land registry systems provide an innovative way to eliminate the bureaucratic paperwork involved in registration and verification of land transactions, by eliminating the need for an intermediary and reducing transaction-processing time. Countries such as India, the Netherlands and Sweden are already testing out pilot projects to identify how using tokenized geospatial data would enhance their repository maintenance<sup>4</sup>.

Further, crypto-spatial protocols could be developed that could serve as “location tokens.” In an Internet of Things enabled world, a traveller using a public transport might be recognized using the geolocation token data available extracted from satellite data, which in turn, could be used to calculate the travel fares and automatically deducted from the crypto wallet<sup>5</sup>. Tokenizing geospatial data might have a number of such far-reaching advantages across industries.

**Figure 3: Use Cases for Asset Tokenization in the Space Industry**



Source: PwC Analysis

## Blockchain Adoption in the Space Industry

### Recent Trends

Although there are plenty of applications of blockchain technologies across the space value chain, adoption rates have rather been low. With respect to adoption by the public bodies, space agencies have been sceptical about the potential of blockchain and are pursuing a “wait-and-watch” approach as the industry aims to apply blockchain to their products and services. The European Space Agency conducted a study in 2018 to identify its applications in Procurement, Voting and Information Management<sup>6</sup>.

Spacebit Capital was launched in 2018 as the first crypto fund for the space sector, in collaboration with the Moon Village Association and angel investors from Luxembourg and European Space Angels<sup>7</sup>. Private companies have rather been more ambitious in trying to apply blockchain technologies to the space industry. SpaceChain is currently focused on developing a satellite-based blockchain network to create an open source operating system to develop blockchain applications. Recently, the company completed its first blockchain transaction in space enabling energy savings while taking advantage of the recent trends in low-earth orbit based satellite constellation<sup>8</sup>.

### Challenges in Adoption

Regulatory challenges, uncertainty with legal frameworks along with the prevalence of scams in bitcoin and ICO has slowed down the adoption rates for blockchain technology<sup>9</sup>. There is a country dependent regulatory framework for ICOs and as such, it is one of the biggest hurdles. With respect to tokenization, lack of clarity of legal rights of a token holder discourages companies from tokenizing their assets. However, although adoption has been slow, the potential of blockchain technology is increasingly being investigated in the space sector, particularly in the areas of supply chain management. ICOs and asset tokenization presents some interesting challenges and opportunities for the space industry particularly with respect to its feasibilities and capabilities. Thus, the private industry and the space agencies need to conduct feasibility studies to identify areas where blockchain adoption could help enhance the space ecosystem.

## Sources

- [1] Based on the definition provided by Coin desk
- [2] Israel becomes the first country to put a private lander on the Moon
- [3] Blockchain studio ConsenSys acquires Planetary Resources
- [4] How Blockchain be applied to Geospatial data
- [5] FOAM Protocol to enable crypto wallets
- [6] ESA Study on Leveraging Blockchain
- [7] Spacebit Capital launches the 1st crypto fund for space
- [8] Qtum launches cubesat based cryptocurrency blockchain platform
- [9] 80 percent of ICOs conducted in 2017 were scams

## Contact

---

If you have any questions or wish to discuss the space sector and the challenges it faces, please contact our team:

### **Luigi Scatteia**

Space Practice Leader  
+33 (0) 7 63 06 10 24  
[scatteia.luigi@pwc.com](mailto:scatteia.luigi@pwc.com)

### **Aravind Ravichandran**

Senior Associate, PwC Space Practice  
+33 (0) 6 42 00 71 67  
[aravind.ravichandran@pwc.com](mailto:aravind.ravichandran@pwc.com)

## About PwC and the space sector

---

### **Data**

The information presented in this document provides some ideas of applying blockchain technology to the space sector. They are based on available data as of February 2019, and are subject to change over time.

### **About the PwC network**

At PwC, our purpose is to build trust in society and solve important problems. We are a network of firms in 157 countries with more than 208,000 people who are committed to delivering the highest quality solutions in advisory, assurance and tax services.

### **About the PwC space sector**

The PwC space team is part of the PwC Advisory practice, which includes strategy and consulting. The PwC space team is fully dedicated to the space sector. Our team includes specialists from all space sectors who are supported by consultants from the global PwC network. Our expertise covers the entire space sector and spans the value chain, from upstream to downstream. We help entities, public and private, to face their business, technological and governance challenges in a constantly changing environment.