



Block Chain Approach to Space Industry and Applications

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Abstract: Blockchain technology has gained significant awareness in current days through improved curiosity inside numerous various fields, including the Space Industry. Blockchain offers a secure, distributed database that can operate without a central authority or administrator. Blockchain uses a distributed, peer-to-peer network to make a continuous, growing list of ordered records called blocks to form a digital ledger with smart contracts.

Each transaction, represented in a cryptographically signed block, is then automatically validated by the network itself. Blockchain has also garnered interest as a platform to improve the authenticity and transparency of space communications data through many use cases, from maintaining permissions in space communication records to streamlining claims processing. In this paper, we describe the basics of blockchain and illustrate current and future applications of this technology within the space industry.

Keywords: Block Chain, Artificial Intelligence, Space Communications, Deep Space Network, Satellites, NASA, ISRO

1. INTRODUCTION

Blockchain Technology, as its name suggests, is a chain of blocks. Every one of these blocks contains a lot of exchanges that have been cryptographically verified to be exact, and these blocks are associated in a chain that regards the sequential request of the exchanges contained in each block – thus the name blockchain. A blockchain speaks to a conveyed record those stores the occasions that happen in the framework. This record is unchanging, and its substance is confirmed by every one of the hubs in the framework – network checked. This straightforward thought gives the premise to a shockingly wide assortment of utilizations. The remainder of this paper audits the innovation behind blockchain and after that reviews its employments [1].

As of late, cryptographic money has pulled in broad considerations from both the industry and the scholarly community. Bitcoin that is frequently called the main crypto money has delighted in an immense accomplishment with the capital market arriving at 10 billion dollars in 2016 (coin work area, 2016). The blockchain is the central instrument for the Bitcoin. Blockchain was first proposed in 2008 and executed in 2009 (Nakamoto, 2008).

Blockchain could be viewed as an open record, wherein every single submitted exchange are put away in a chain of blocks. This chain ceaselessly develops when new blocks are attached to it. The blockchain innovation has the key attributes, for example, decentralization, constancy, secrecy, and discernability. Blockchain can work in a decentralized domain, which is empowered by coordinating a few center advancements, for example, cryptographic hash, computerized signature (in light of halter kilter cryptography) and circulated accord instrument. With blockchain innovation, an exchange can occur in a decentralized manner. Therefore, blockchain can significantly spare the expense and improve the productivity [2-4].

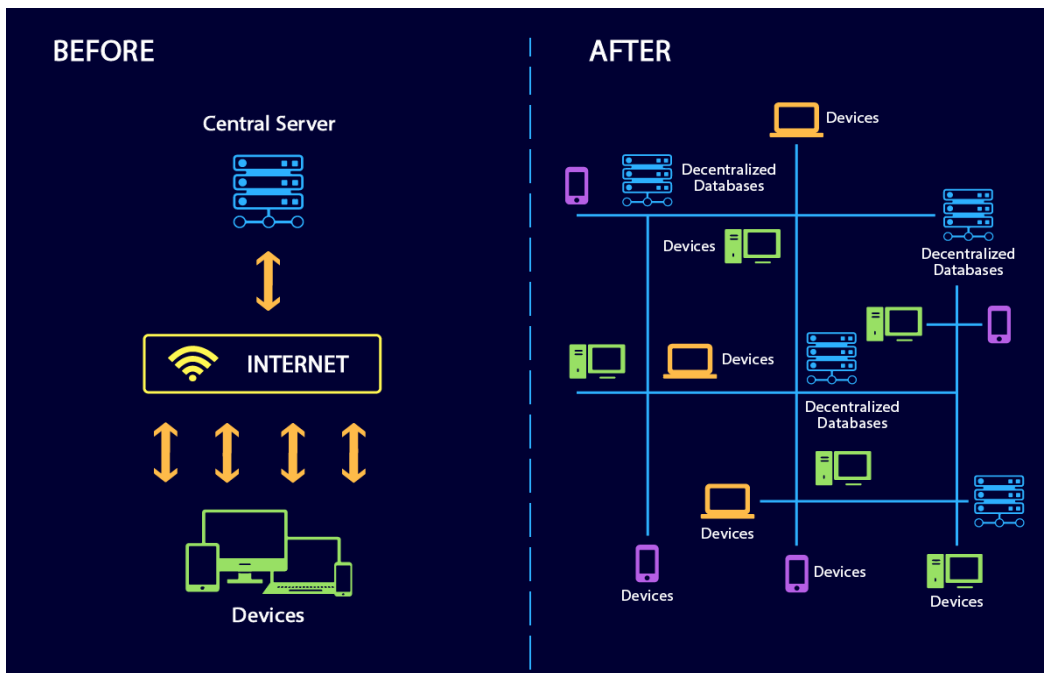
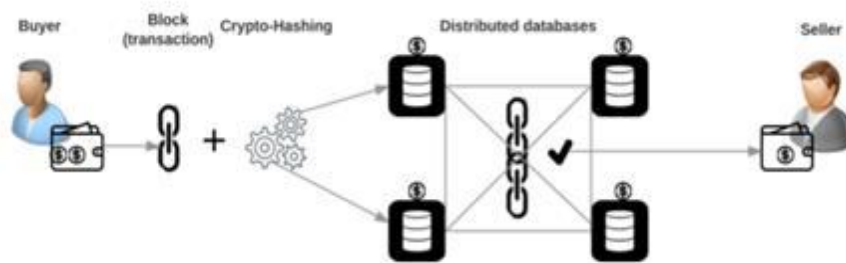


Figure.1: Blockchain Centralized process

2. RELATED WORK

Case-1: Several tech specialists have recommended utilizing developing and contemporary advances in EVMs as opposed to the one that is utilizing as of now. One of the most generally proposed innovation by tech specialists in India that can comprehend the EVM altering discusses at the same time is blockchain.

Case-2: Blockchain is utilized for land dealings t into the bigger command of e-administration in India. Numerous other state governments are investigating the use of the innovation; Andhra Pradesh is driving the state to utilize blockchain by leading preliminaries inside its areas of expertise.

The state is working with new businesses, for example, Snapper Technologies and Simplify to execute blockchain crosswise over regulatory procedures.



Figure.2: Blockchain for Industrial Automation

Storing criminal records using Blockchain technology:

Police headquarters and exploring department can utilize blockchain innovation to keep up criminal records. When the record is put away can't be controlled. Store once and can be gotten to by anybody in the system. It is open, straightforward simple to follow the record of the criminal by the exploring official. It gives clients the capacity to control the record in a protected manner without looking for the help of an outsider. Block chain's calculation lessens the reliance on individuals to check the exchanges [5].

Because of the open system, any police headquarters over the system can get to the wrongdoing subtleties effectively. The hub that is straightforward in putting away and confirming the record ought to be compensated by score [8]. Score sheets can be considered for advancements, etc. Regular man additionally ought to be allowed the chance to get to the system on the off chance that if any he/she knowing some substantial data about the wrongdoing which must be checked and can be considered as proof.

2.1. Applications of Blockchain

Space Industry:

Space industry refers to economic activities related to manufacturing components that go into Earth's orbit or beyond, delivering them to those regions, and related services. Owing to the prominence of the satellite-related activities, some sources use the term satellite industry interchangeably with the term space industry [7]. The term space business has also been used. A narrow definition encompasses only hardware providers (primarily related to launch vehicles and satellites). This definition does not exclude certain activities, such as space tourism.

Thus more broadly, space industry can be described as the companies involved in the space economy, and providing goods and services related to space. Space economy has been defined as "all public and private actors involved in developing and providing space-enabled products and services. It comprises a long value-added chaining, starting with research and development actors and manufacturers of space hardware and ending with the providers of space-enabled products and services to final users [3].

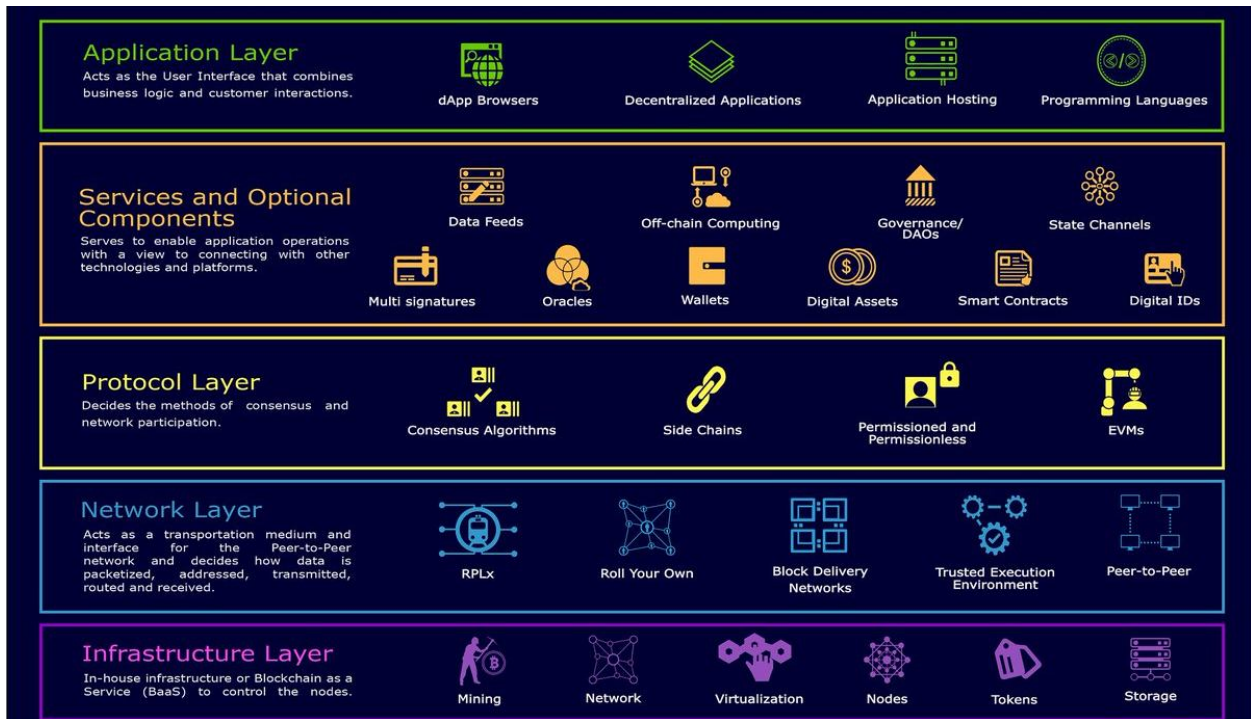


Figure.3: Blockchain enhanced Internal Stack Operations

Blockchain for space systems may offer compelling advantages by reducing complexity across a range of business, operational, and security applications, including:

- a) Fund raising and venture financing
- b) Smart contracts

- c) Supply chain management
- d) Intellectual property rights management
- e) Networking and space community resourcing
- f) Identification management and data access

Space Challenges and Solutions: Blockchain Framework Recently, the space industry isn't far from blockchain benefits and its contributions. In 2017, NASA announced a \$420.00 grant for developing a blockchain-based spacecraft system. The grant is provided to Dr. Jin Wei Kocsis for her project Resilient Networking and Computing Paradigm (RNCP). RNCP represents the first step by NASA toward blockchain adoption in space applications. Space assets such as satellites, spacecraft, space debris, orbits, and asteroids, can be tokenized as digital tokens and manipulated by blockchain technology.

Converting space assets into digital tokens and handling it using blockchain protocols and smart contracts will add more transactions with space resources from any place in the world. Moreover, blockchain will add more intelligence to spacecraft, where it will be able to 'think' and take crucial decisions without connections with the ground stations. This motivation leads us to propose blockchain framework for providing new conceptual models that explain the strengths of using blockchain in the space industry [5].

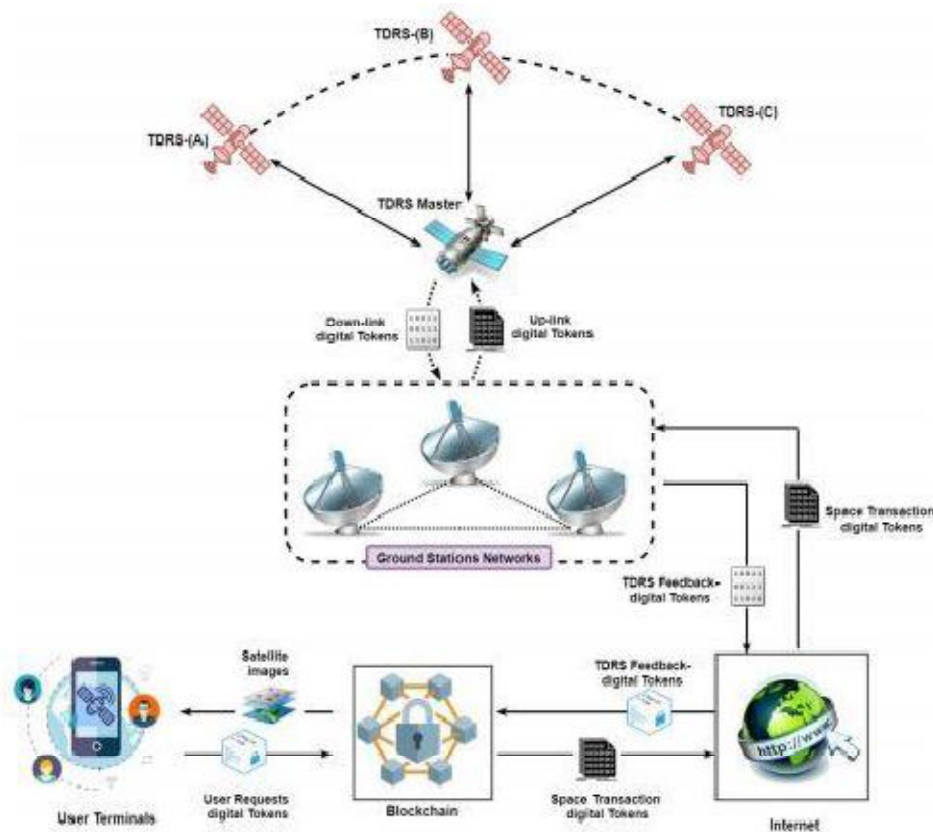


Figure.4: Blockchain enabled security operations space web

Networking and Space Community Resourcing

Space research Communities presents many opportunities for the space sector to coordinate space based data across sensors and missions. NASA and the commercial sector are exploring how to combine artificial intelligence, DLT, spacecraft, and sensors to efficiently manage space-based infrastructure and missions [6]. A few examples are discussed below:

Deep Space Networking and Computing – Basic Research

NASA recently provided \$300,000 grant funding for a research project, named the “Resilient Networking and Computing Paradigm”, led by Dr. Jin Wei-Kocsis of University of Akron’s Department of Electrical and Computer Engineering. Dr. Wei-Kocsis indicated that the long-term goal is to “achieve scalable decentralized cognitive networks in deep space” [4].

Network of Blockchain Nodes in Space – “SpaceChain”

SpaceChain describes itself as a “decentralized space agency that partners with other organizations”. SpaceChain has created smart hardware that can be installed onto satellites with SpaceChain OS [8]. The first satellite blockchain node was launched into space on February 2, 2018. On March 2018, Spacechain completed and integrated Qtum, an open sourced blockchain application platform on the SpaceChain OS. By September 2018, Spacechain completed partnerships with over 10 space and blockchain companies.

The universal space OS “converts single-operator satellites into multi-tenant ones, while the blockchain provides a highly secure sandbox between multiple space applications. That way, users will be able to develop different types of space-based applications on a single satellite, maximizing the efficiency from this expensive resource”. Spacechain aims to establish a community incentive model using tokens which act like tickets to upload and execute space-based apps, and store data onto the Spacechain network.

Thomas Kacpura, Advanced Communications Program Manager at NASA Glenn Research Center16, noted that “Blockchain is one possible engine that can drive cognitive outcomes for autonomous operations. We are currently examining enabling technologies for trusted autonomous operations in space and looking to develop a simple representative distributed system which will emulate how far apart nodes in deep space can work as a distributed blockchain to ensure trusted autonomous operations.

” The idea is to decentralize NASA’s future network of nodes in deep space – to allow for a more resilient and responsive network. This research project could lead to decentralized processing among NASA’s space network nodes [7].

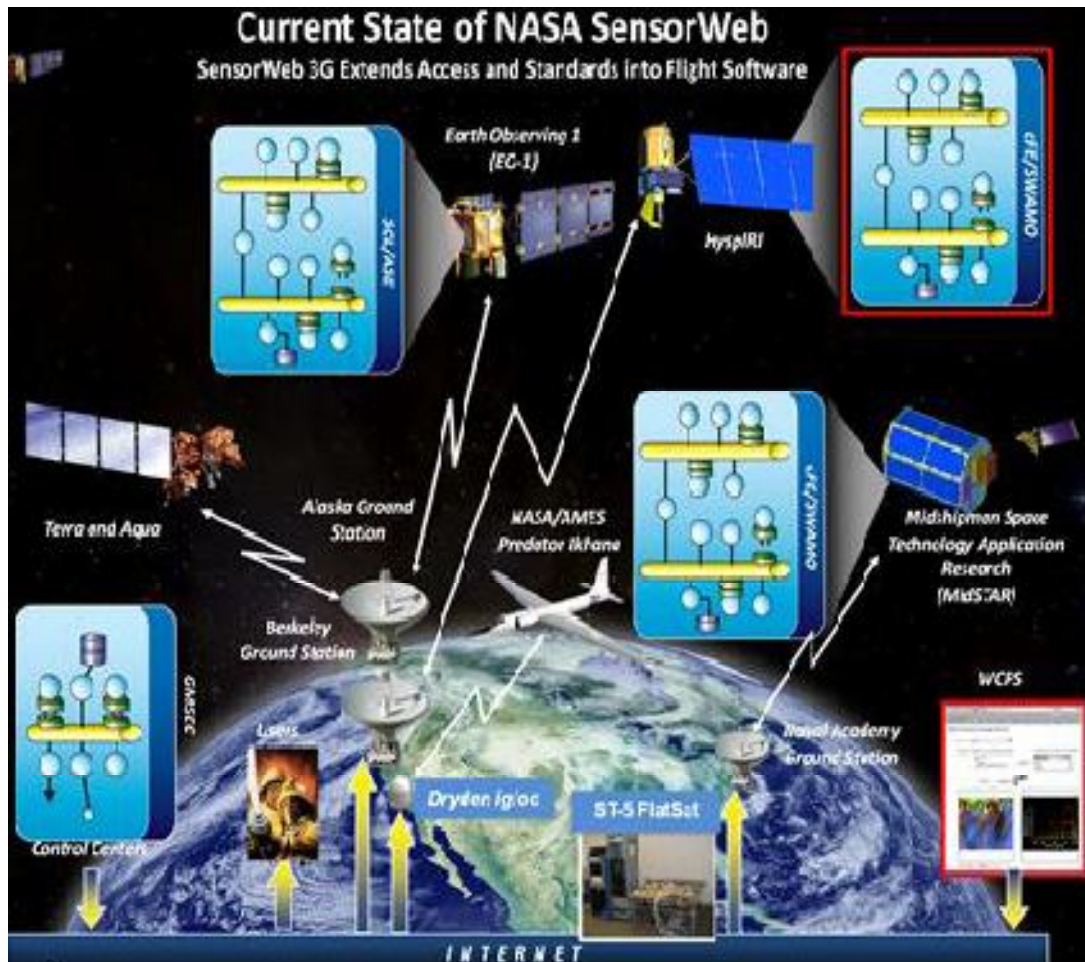


Figure.5: NASA Space Sensor Web

Blockchain Tracking Data Relay Satellite (TDRS) Connections

In Tracking and Data Relay Satellite (TDRS) system, blockchain can be used to sync and manage many connection patterns between the TDRS and its follower satellites or between the follower satellites and ground stations network for optimizing user queries from TDRS.

For example, users can send a specific image request pattern to TDRS system by entering his request information (e.g, locations, and timeframes) into the blockchain which stored as user request digital tokens. Moreover, additional digital tokens such as the transaction session information and uplink data from the ground station to TDRS are also created and recorded in the blockchain as transaction digital tokens, which then sent to the ground station network system.

After that, the ground station network forwards the coming data to TDRS in the form of uplink digital tokens. Based on specific machine learning techniques, the TDRS can smartly reallocate its follower swarm of satellites based on learning methods to optimize image output and minimize the time and the cost to users' queries [6].

The image output, downlink time to the ground station, process start/completion time, satellite feedbacks to the user are sent to the ground stations network in the form downlink digital tokens, which then recorded in the blockchain system as TDRS Feedback digital tokens [1]. Then, user terminals can get the required satellite images after updating the blockchain status with TDRS Feedback digital tokens as a new block.

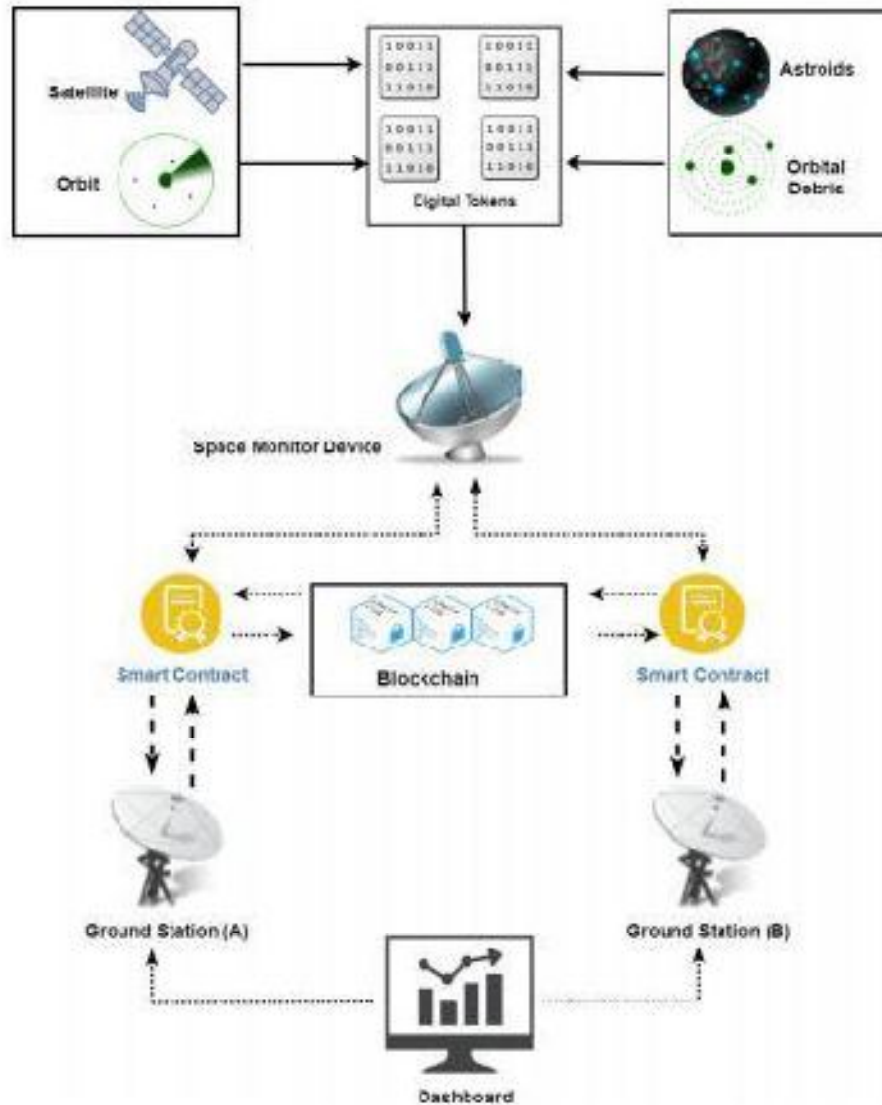


Figure.6: Orbital assets token management using blockchain process

Block Chain in Education Sector:

Cloud storage eliminates the need for electronic record managers to physically install physical storage devices, paying only for the actually used storage. The Blockchain is the core support technology of digital cryptographic currency system represented by Bitcoin. The core advantage of blockchain technology is its decentralization.

It can implement point-to-point transactions based on decentralized credit in distributed systems where nodes do not trust each other by means of data encryption, time-stamping, distributed consensus and economic incentives, coordination and collaboration, so as to provide solutions to the prevalent issues of centralized agencies such as high cost, low efficiency and data storage unsafely [6-8].

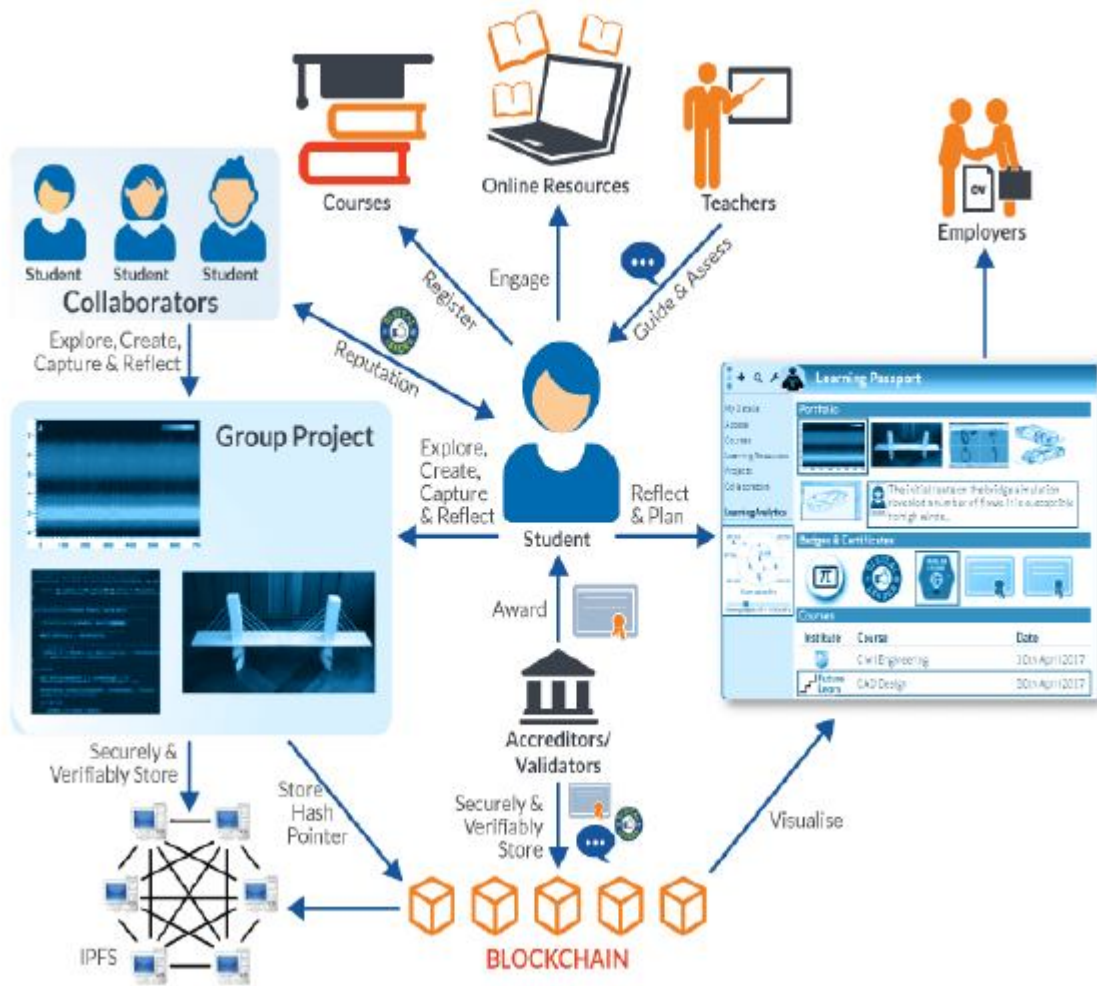


Figure.7: Block Chain based Education sector applications

Trusted record the concept of trusted electronic records originated earlier; representative ideas are: Professor Jiazhen Liu from Wuhan University pointed out: Trusted electronic record described the facts and events refer to the content of the electronic record is reliable, dependable and accurate. Moreover, the accuracy and truth of the content depending on the completeness of the record, the procedural control over the record formation, and the author's reliability. His primary concern is the content's credibility [6].

Trusted electronic records are trustworthy and evidence-based. To realize the historical mission entrusted to the preservation of human memory, we need to manage and protect electronic

records in the right way as emphasized in UNESCO’s Joint declaration on archives. The correct way is to build management technology of trusted electronic record that is based on the standard practice of humanity and in conformity with the objective laws governing the management of records so that the evidence value of the electronic record can be maintained permanently [7]. The system project is complicated and arduous and bound to become a historical research topic in the field of international records. Therefore, it is vital to pay full attention to explore and study the management of trusted electronic records.

- a) Losses of paper certificates
- b) Frauds in education certificates
- c) Difficulty in verifying authenticity
- d) Disconnected lifelong learning records

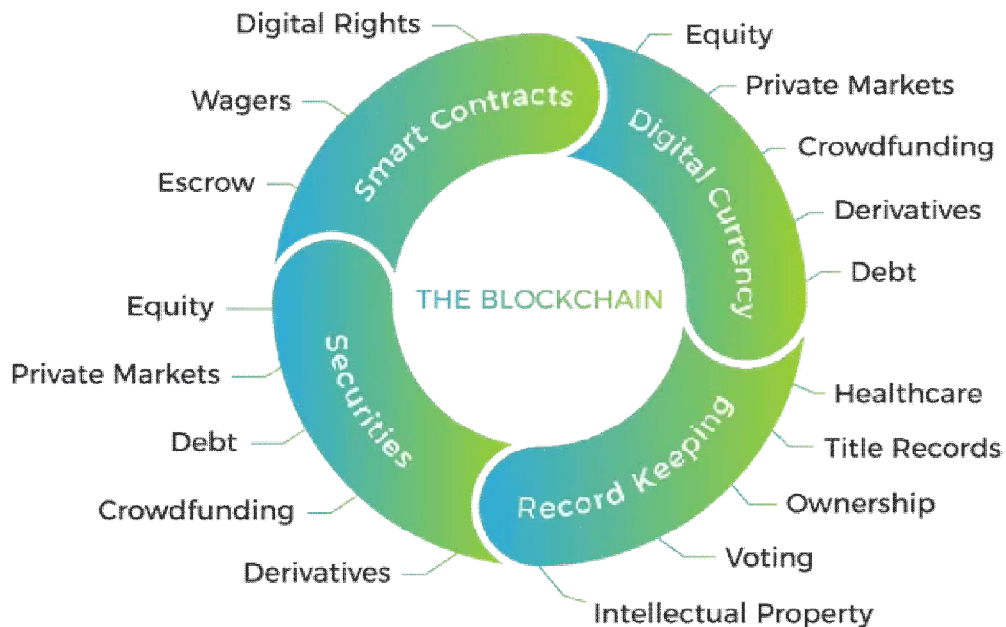


Figure. 8: Block chain Applications in different areas

3. CONCLUSION

Blockchain technology offers a platform that could be used for many potential applications in Space Industry. While in the early stages of design and development, many organizations have proposed solutions that have the potential to increase communicate data transparency and functional operating efficiency. However, the scalability, security, and cost-effectiveness of blockchain technology will require further research prior to very Large-Scale production deployments. The future of this technology in Space research and universal communications and other industries is still being adapted and the applications in research and are not yet established. Nevertheless, a distributed decentralized system with the aim of eliminates intermediaries have extensive possible to disorder numerous in progress process in space research.

References

- [1]. Y. Fu, "Meta-key: A secure data-sharing protocol under blockchain-based decentralized storage architecture," *arXiv preprint arXiv:1710.07898*, October 2017.
- [2]. P. Gordon, M. Hood, and H. Materne-Smith, "Crypto-contracts: The coming of the blockchain revolution," *Bulletin (Law Society of South Australia)*, vol. 39, no. 3, p. 34, April 2017.
- [3]. Richard Gendal Brown, James Carlyle, Ian Grigg, and Mike Hearn. Corda: An introduction. R3 CEV, August, 2016.
- [4]. Nakamoto S. Bitcoin: A Peer-to-Peer Electronic Cash System.2008. <http://www.cryptovest.co.uk/resources/Bitcoin%20paper%20Original.pdf>. Accessed January 15, 2017
- [5]. Baum S. Health IT startups working to secure pharma supply chains?Medcity News. <http://medcitynews.com/2017/01/drug-supply-chain-security-and-technology/>. Accessed March 1, 2017.
- [6]. Witchey NJ. Healthcare transaction validation via blockchain proof-of-work, systems and methods.US patent US20150332283 A1. 2015.
- [7]. Decker, Wattenhofer. 2013. Information Propagation in the Bitcoin Network, 2013 IEEE Thirteenth International Conference on Peer-to-Peer Computing (P2P). [Online] <http://dx.doi.org/10.1109/P2P.2013.6688704>
- [8]. Fanning, K et.al. 2016. Blockchain and Its Coming Impact on Financial Services, The Journal of Corporate Accounting and Finance, Wiley Periodicals, Inc. [Online].<http://onlinelibrary.wiley.com/doi/10.1002/jcaf.22179/pdf>