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THE POTENTIAL OF SPACE NFTs

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Abstract

ASTRAX is conducting research on establishing value standards in the era of space travel. The concept of value in space differs from that on Earth, necessitating the creation of entirely new value criteria unique to space environments. In some cases, it may also be necessary to define the value of digital content, for which NFT (Non-Fungible Token) technology could be a viable solution.

This paper explores the necessity of adding value through NFTs in space, the types of assets that could be tokenized, potential use cases, and the challenges associated with implementing NFTs in space environments.

Keywords: Space economy, NFT (Non-Fungible Token), ASTRAX VALUE, ASTRAX U2U, Value Standards, Digital Assets

Acronyms/Abbreviations

NFT : Non-Fungible Token

ASTRAX U2U: ASTRAX Universal User Interface

1. Introduction

As we work to build lunar and solar system economies, ASTRAX has advocated for a different standard of value than that used on Earth. While the possibilities for such a new standard of value in space are limitless, ASTRAX is considering using value information called ASTRAX VALUE as the standard of value required for the private space economy it is building (see reference [96] for details).

We primarily envision digital representation as a way to express value in space, but we believe that this can be broadly divided into numerical value and design value. Here, we will define this and summarize the results of our investigation into the use of NFTs as a way to express value.

2. Space Value Standard Using NFTs

NFTs (non-fungible tokens) excel at guaranteeing "uniqueness" and "irreversible history," so we believe they can be applied to the institutionalization of ASTRAX VALUE.

This will increase the transparency and reliability of value standards and enable fair distribution in the space economy.

2.1 Existence Value Standard

Issuing space stays and life activities as "proof of existence NFTs."

Application scenario:

Proof of a person's "existence itself" in space can be converted into an NFT.

Example:

Issuing a "proof of existence NFT" would be a record of a person's time aboard a specific spacecraft or on the moon.

Smiles, health data, and even carbon dioxide emissions from breathing could also be accumulated as "lifelog NFTs."

Benefits:

Ensuring the uniqueness of space experiences and converting the value of "that person having been there" into an exchangeable form.

2.2 Knowledge and Skill Value Standard

Skills and knowledge acquisition can be authenticated as "skill NFTs" and made tradable.

Application scenario:

Proof of completion of astronaut training, simulation training, and specialized skills (piloting, maintenance, medical care, education, etc.) can be issued as an NFT.

Examples:

- Record an astronaut training program completion certificate as a "Skill NFT."
- Convert a lunar rover operator's license into an NFT.
- Hold and present certifications for space medicine and emergency response skills as NFTs.

Benefits:

- Irreversibly prove acquired skills, facilitating international mutual recognition.
- Capitalize education and training results, improving career development and human resource mobility.
- Streamline role assignment based on expertise, promoting human resource utilization in the space economy.

2.3 Behavioral Value Standards

Capitalize contributions and participation in education and research as "Contribution NFTs."

Application scenario:

Turn individual actions and contributions into NFTs.

Example:

Successful troubleshooting, helping others, sharing knowledge, and other actions can be issued as "Contribution NFTs."

Proof of learning achievement in space education and participation in collaborative research can also be converted into NFTs.

Benefits:

Efforts and actions become "irreversibly proven assets" that can be exchanged for other space services in the future.

2.4 Exchange Value Standard

Resource units are converted into NFTs, and exchange history is recorded.

Application scenario:

"Exchange rates" used in barter are converted into NFTs.

Example:

Each resource unit (oxygen, water, electricity, etc.) is issued as an NFT, and its exchange history is recorded on the blockchain.

This allows for transparent tracking of "which resources have been circulated and how."

Benefits:

Prevents fraud, improves the reliability of resource transactions, and can be used as a common infrastructure that transcends borders and currencies.

2.5 Circulation Value Standard

Contributions to resource reuse and recycling are visualized as "Circulation NFTs."

Application scenario:

Contributions to resource reuse and circulation are visualized as NFTs.

Example:

Waste recycling and the amount of water and oxygen recycled are issued as "Circulation NFTs."

Blockchain can visualize who has contributed to resource circulation and to what extent.

Benefits:

Sustainable behavior is capitalized, making it possible to design incentives.

3. Creating Universal Value with NFTs

ASTRAX's vision for a solar system economy assumes that currency is unnecessary. Instead, a new society based on barter, sharing, and recycling is built. Essential to this is a "value standard" that indicates exchange rates.

For example, a system is needed to clearly indicate whether a cup of coffee can be exchanged for one daikon radish, or whether two daikon radishes are required. However, this standard is not absolute; it depends on the context and situation.

- The value of a cup of water varies greatly between an environment with abundant water and one with extreme water scarcity.

- A person's smile or a work of art possesses subjective value that cannot be quantified.

NFTs are effective for proving and circulating such relative and subjective value. NFTs directly record "incomparable value" and convert it into an exchangeable form, enabling the creation of universal value.

4. Future Potential

4.1 Potential Applications of Space NFTs

Possible services that utilize (can be used with) space NFTs include the following:

(1) Space Travel & Experiences

- Space Travel Experience NFTs
- NFTing video, audio, and vital data from space travel
- Turning your personal space experience records into unique digital assets
- Spaceflight Experience Proof NFTs (NFTing records, certificates, and boarding passes)
- Selling photos and videos from spaceflight as NFT art

(2) Arts & Culture

- Space Art NFTs (art and music created in a zero-gravity environment)
- Creative content that can only be created in space
- Space Art NFTs (digital art and works themed around space phenomena)

(3) Land, Resources, and Facilities

- Space Land and Facility NFTs (land rights on the Moon or Mars, space hotel accommodations, etc.)
- Use as proof of digital ownership
- Space Resource Rights NFTs (asteroid mining rights, lunar base land rights)
- NFTs representing ownership of specific locations in space (e.g., orbit overlooking Earth)

(4) Education & Career

- Space Education NFTs (space training program completion certificates, qualifications)
- Use as a means of verifying education and career achievements

(5) Economic & Social Systems

- Space Economy Infrastructure NFTs (service access rights, memberships, mission participation rights)
- Linkage with Space DAOs and crowdfunding
- Space Mission-Related NFTs (NFTization of astronaut activities and research data), etc.

4.2 Future Plans

ASTRAX is considering the following future plans (schedule and methodology are yet to be determined):

(1) Integrate and link Space NFTs with the "Space Value Standard (ASTRAX VALUE)" and make them available on ASTRAX U2U.

(2) Future Vision of Digital Asset Distribution in the Space Economy

(3) Creation of a New Space Economy through Collaboration with Space DAOs and the Metaverse

(4) Reimporting "Space NFT Certificates" to Terrestrial Sectors such as Education, Tourism, and Medicine

5. Conclusion

This study highlighted the need for a new currency-independent value standard in the space economy and proposed ASTRAX VALUE as a framework for achieving this. This model, based on multidimensional value—including existence, action, knowledge, exchange, and circulation—recognizes human existence itself as the source of value creation.

Furthermore, by incorporating NFT technology, we demonstrated that a system for verifying and circulating these values as unique digital assets is possible. NFTs will increase transparency and trust in the space economy and contribute to the creation of a fair and sustainable social infrastructure.

Furthermore, going forward, it will be essential for companies and research institutions to collaborate and conduct comparative experiments while virtually building different types of space economies. Combining space NFTs with the metaverse could demonstrate a prototype of an ideal future society and pave the way for the sustainable development of all humanity.

ASTRAX will continue to demonstrate and promote space NFTs and ASTRAX VALUE, working toward a brighter, more sustainable future for humanity, beyond war and environmental destruction on Earth.

In conclusion, the integration of space NFTs and ASTRAX VALUE will shift our thinking from ownership to sharing, and from scarcity to circulation, and will be the key to realizing a sustainable and fair space economy. This research demonstrates this possibility, and we look forward to concrete demonstrations and institutional design in the future.

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宇宙 NFT の可能性

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Abstract

ASTRAX is conducting research on establishing value standards in the era of space travel. The concept of value in space differs from that on Earth, necessitating the creation of entirely new value criteria unique to space environments. In some cases, it may also be necessary to define the value of digital content, for which NFT (Non-Fungible Token) technology could be a viable solution.

This paper explores the necessity of adding value through NFTs in space, the types of assets that could be tokenized, potential use cases, and the challenges associated with implementing NFTs in space environments.

Keywords: Space economy, NFT (Non-Fungible Token), ASTRAX VALUE, ASTRAX U2U, Value Standards, Digital Assets

アブストラクト

ASTRAXでは、宇宙旅行時代における宇宙での価値基準の設定についての研究を行っている。宇宙での価値基準は、地上とは異なり、「宇宙ならではの」価値基準を作らなくてはならない。場合によってはデジタルコンテンツの価値も設定しなくてはならず、その場合はNFTの技術が利用できると考えている。

本論文では、宇宙におけるNFTによる価値の付加の必要性や種類、考えられる利用方法や課題などについて発表を行う。

キーワード: 宇宙経済圏、NFT(Non-Fungible Token)、ASTRAX VALUE、ASTRAX U2U、価値基準 (Value Standards)、デジタル資産 (Digital Assets)

1. はじめに

ASTRAX では、月面経済圏構築や太陽系経済圏構築を行う中で、地球上とは違う価値基準の必要性を訴えてきた。そのような新たに構築する宇宙価値基準の可能性は無限にあるが、ASTRAX では、ASTRAX が構築する民間宇宙経済圏で必要となる価値基準として、ASTRAX VALUE という価値情報を利用することを考えている(詳細は参考文献【96】を参照)。

宇宙での価値の表現方法については、基本的にデジタルによる表現を想定しているが、その中でも数値的な価値とデザインの価値などに大別できると考えている。ここではその定義と、価値の表現の仕方として、NFT の利用についての検討結果をまとめることとする。

2. NFT を利用した宇宙価値基準

NFT(非代替性トークン)は「唯一性」と「不可逆的履歴」の保証に優れるため、ASTRAX VALUE の制度化に適用できだろうと考えている。

これにより、価値基準の透明性・信頼性が高まり、宇宙経済圏における公正な分配が可能となる。

2.1 存在価値基準

宇宙滞在や生命活動を「存在証明 NFT」として発行。

適用イメージ:

人が宇宙に「存在すること自体」の証明を NFT 化

例:

ある人が特定の宇宙船に搭乗した記録や、月面に滞在した記録を「存在証明 NFT」として発行。
笑顔や健康データ、呼吸による二酸化炭素排出量なども「ライフログ NFT」として蓄積していく

メリット:

宇宙体験の唯一性を担保し、「その人がそこにいた」という存在価値を交換可能な形に変換できる。

2.2 知識・技術価値基準

技能や知識習得を「スキル NFT」として認証し、流通可能にする。

適用イメージ:

宇宙飛行士訓練やシミュレーション訓練、専門的な技能（操縦、メンテナンス、医療、教育など）を修了した証明を NFT として発行。

例:

- ・宇宙飛行士訓練プログラム修了証を「スキル NFT」として記録
- ・月面探査ローバーの操作資格を NFT 化
- ・宇宙医療や緊急対応スキルの認証を NFT として保有・提示

メリット:

- ・習得したスキルを不可逆的に証明でき、国際的な相互承認を容易にする
- ・教育・訓練成果を資産化し、キャリア形成や人材流動性を高める
- ・専門性に基づく役割分担を効率化し、宇宙経済圏における人材活用を促進する

2.3 行動価値基準

貢献や教育・研究参加を「貢献 NFT」として資産化。

適用イメージ:

個人の行動や貢献を NFT 化

例:

トラブルシューティングを成功させた、他者を助けた、知識を共有した、といった行動を「貢献 NFT」として発行。また宇宙教育における学習達成証明や、共同研究への参加履歴も NFT 化できる。

メリット:

努力や行動が「不可逆的に証明される資産」となり、将来的に他の宇宙サービスと交換可能。

2.4 交換価値基準

資源単位を NFT 化し、交換履歴を記録。

適用イメージ:

物々交換で用いる「交換レート」を NFT 化

例:

各資源（酸素、水、電力など）の単位を NFT として発行し、その交換履歴をブロックチェーン上に記録。これにより「どの資源がどのように流通したか」が透明に追跡可能。

メリット:

不正防止、資源取引の信頼性向上、国境や通貨を超えた共通インフラとして活用できる。

2.5 循環価値基準

資源再利用やリサイクルへの貢献を「循環 NFT」として可視化。

適用イメージ:

資源の再利用・循環への貢献度を NFT 化

例:

廃棄物のリサイクルや水・酸素の再生利用量を「循環 NFT」として発行。誰がどの程度、資源の循環に貢献したかをブロックチェーンで可視化。

メリット:

サステナブルな行動が資産化され、インセンティブ設計が可能。

3. NFT による普遍的価値の創造

ASTRAX が描く太陽系経済圏構想では、貨幣は不要と想定している。その代わりに、**物々交換・シェアリング・リサイクリング**の仕組みに基づいた新しい社会が構築される。その際に不可欠なのが、交換比率を示す「価値基準」である。

例えば、コーヒー 1 杯と大根 1 本を交換できるのか、あるいは大根 2 本が必要なのかを明示する仕組みが必要である。しかし、この基準は絶対的ではなく、文脈や状況に依存する。

- 大量の水がある環境と、水が極端に不足している環境では、1 杯の水の価値は大きく異なる。
- 人の笑顔や芸術作品などは、数値で比較できない主観的価値を持つ。

このような相対的かつ主観的な価値を証明・流通させるために NFT が有効である。NFT は「比較できない価値」をそのまま記録し、交換可能な形式に変換することで、普遍的価値の創造を可能にする。

4. 今後の可能性

4.1 宇宙 NFT の応用可能性

宇宙 NFT を利用した(利用できる)サービスとしては以下のようなものが考えられる。

(1) 宇宙旅行・体験系

- 宇宙旅行体験 NFT
- 宇宙旅行中の映像・音声・バイタルデータを NFT 化
- 「自分だけの宇宙体験記録」を唯一無二のデジタル資産に
- 宇宙飛行の体験証明 NFT (記録、証明書、搭乗券の NFT 化)
- 宇宙飛行中の写真や映像を NFT アートとして販売

(2) 芸術・文化系

- 宇宙芸術 NFT (無重力環境で制作されたアートや音楽作品)
- 宇宙でしか作れないクリエイティブコンテンツ
- 宇宙アート NFT (デジタルアートや宇宙現象をテーマにした作品)

(3) 土地・資源・施設系

- 宇宙土地・施設 NFT (月・火星の土地権益、宇宙ホテル宿泊権など)
- デジタル所有権の証明としての活用
- 宇宙資源の権利 NFT (小惑星採掘権、月面基地土地権)
- 宇宙空間の特定の場所 (例: 地球を望む軌道上) の所有権 NFT

(4) 教育・キャリア系

- 宇宙教育 NFT (宇宙訓練プログラム修了証、資格)

- 教育・キャリアの証明手段としての利用

(5) 経済・社会システム系

- 宇宙経済インフラ NFT (サービス利用権、会員権、ミッション参加権)
- 宇宙 DAO やクラウドファンディングとの連動
- 宇宙ミッション関連 NFT (宇宙飛行士の活動や研究データの NFT 化) など

4.2 今後の計画

ASTRAX では今後の計画として、以下のようなことを考えている(スケジュールや手法などは未確定)。

- (1) 宇宙 NFT を「宇宙価値基準 (ASTRAX VALUE)」と統合し、連携させ、ASTRAX U2U で利用できるようにする。
- (2) 宇宙経済圏におけるデジタル資産流通の未来像
- (3) 宇宙 DAO・メタパースとの連携による新しい宇宙経済の創造
- (4) 「宇宙 NFT 証明書」による教育・観光・医療など地上分野への逆輸入

5. 結論

本研究は、宇宙経済圏において貨幣に依存しない新しい価値基準の必要性を明らかにし、その枠組みとして ASTRAX VALUE を提案した。存在・行動・知識・交換・循環といった多次元的価値を基盤とするこのモデルは、人間の存在そのものを価値創造の源とするものである。

また、NFT 技術を組み合わせることで、これらの価値を唯一性を持つデジタル資産として証明・流通させる仕組みが可能となることを示した。NFT は宇宙経済圏における透明性と信頼性を高め、公正で持続可能な社会基盤の構築に寄与する。

さらに、今後は、企業や研究機関が協力し、異なるタイプの宇宙経済圏を仮想的に構築しながら比較実験を進めることが不可欠である。宇宙 NFT とメタパースを組み合わせることで、理想的な未来社会のプロトタイプを示すことができ、人類全体の持続可能な発展に資する道を切り拓くと考えられる。

ASTRAX は、地球上の戦争や環境破壊を超えて、人類の明るく持続可能な未来のために、宇宙 NFT と ASTRAX VALUE の実証と普及を進めていく。

結論として、宇宙 NFT と ASTRAX VALUE の統合は、所有から共有へ、欠乏から循環へと発想を転換し、持続可能で公平な宇宙経済社会を実現する鍵となる。本研究はその可能性を提示するものであり、今後の具体的な実証と制度設計が期待される。

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