Token Economy and Technical Specification

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1 Current landscape and evaluation of Web3 Digitalisation potential

1.1 Introduction

The digitalisation of space-related industries through Web3 technologies presents an opportunity to address critical challenges in manufacturing, testing, tracking, and lifecycle management. This chapter examines four major challenges outlined in Lecture 8, explores existing solutions in greater detail (including their strengths and weaknesses), and discusses cases where space companies have chosen to circumvent these issues entirely, along with the consequences and acceptable thresholds. Additionally, two Web3 digital solutions are proposed to enhance current practices, evaluated in terms of feasibility, cost, and impact.

1.2 Challenge 1: Lack of Control Over Manufacturing Process and Documentation

Traditional space agencies struggle with acquiring reliable manufacturing data for Commercial Off-the-Shelf (COTS) components. Since COTS components for space constitute only 0.1% of the semiconductor market, manufacturers are reluctant to engage in specialized testing or reveal production details. This leads to issues in reliability and sourcing.

1.2.1 Consequences of Avoiding the Challenge

If a space company chooses not to address this challenge, it must rely on whatever minimal documentation is available from COTS component manufacturers. This increases the risks of component failure, counterfeiting, and inability to trace defects back to the source. The acceptable limit is determined by the mission type: for disposable LEO satellites, the risk may be tolerable, but for deep-space or manned missions, uncontrolled sourcing is unacceptable.

1.2.2 Existing Solutions

Solution 1: Domestic Semiconductor Supply Chains (China's Space Agencies Approach) China has increased investment in domestic semiconductor production to reduce dependence on foreign suppliers. The goal is to establish full control over manufacturing and ensure documentation availability.

Strengths:

- Reduces exposure to foreign trade restrictions (e.g., US ITAR/EAR).
- Ensures long-term supply chain stability.
- Improves component traceability.

Weaknesses:

- Expensive and time-consuming to develop a self-sufficient ecosystem.
- Still lacks diversity in high-end semiconductor manufacturing.

Solution 2: NASA's Upscreening Process NASA performs extensive radiation and stress testing on automotive-grade and consumer-grade COTS components, qualifying them for space use.

Strengths:

- Expands the range of available components while ensuring reliability.
- Can be more cost-effective than developing space-grade components from scratch.

Weaknesses:

- Adds significant time delays to projects.
- Some components still fail, leading to increased mission costs.

Solution 3: Third-Party Certification Inspired by the Medical Device Industry In the medical device industry, third-party regulators conduct audits and issue certifications (e.g., FDA 510(k) for US devices, CE marking in Europe). Similarly, an independent certification body for space COTS could develop standardized documentation and audits to improve reliability.

Strengths:

- Manufacturers do not need to disclose proprietary data directly to space agencies.
- Standardized certification increases supplier willingness to engage.

Weaknesses:

- Requires global industry cooperation.
- Adds an extra layer of bureaucracy.

1.3 Challenge 2: High Cost of Testing

Testing for space applications is costly due to rigorous requirements, including radiation and environmental resilience tests. Some agencies and companies attempt to bypass these costs through redundancy.

1.3.1 Consequences of Avoiding the Challenge

If companies avoid testing to cut costs, they must rely on system redundancy to handle component failures in orbit. The consequence is increased waste and operational inefficiencies, as failed satellites or modules may need complete replacement. The acceptable limit depends on the mission: LEO CubeSats can be sacrificed, but high-value payloads require reliability.

1.3.2 Existing Solutions

Solution 1: Redundant System Deployment (SpaceX Approach)
SpaceX and other companies use multiple identical components, allowing systems to switch to a backup upon failure.

Strengths:

- Reduces upfront testing costs.
- Works well in low-radiation environments like LEO.

Weaknesses:

- Leads to higher mass and increased launch costs.
- Not suitable for deep-space missions.

Solution 2: Radiation-Tolerant COTS (Infineon's Hybrid Approach)
Infineon and other manufacturers now offer COTS parts with moderate radiation tolerance, balancing cost and performance.

Strengths:

- Provides a middle ground between high-cost space-grade components and unreliable consumer COTS.
- Reduces testing requirements.

Weaknesses:

- Not all components are available in radiation-tolerant variants.
- Limited performance in extreme conditions.

Solution 3: Adaptation of Stress Testing from the Food Supply Chain The food industry applies stress testing for shelf-life prediction (e.g., simulating temperature variations for perishable goods). Similarly, space companies could develop accelerated environmental simulations to predict component failure early, reducing the need for redundant deployments.

Strengths:

- Faster than traditional space-grade component testing.
- Reduces reliance on redundancy.

Weaknesses:

- Accelerated aging may not fully replicate space radiation effects.

1.4 Challenge 3: Lack of Detailed Tracking in Automotive Components

The space industry lacks granular traceability for COTS components. Automotive tracking systems use batch numbers but lack individual traceability, making it difficult to detect failures at the wafer level.

1.4.1 Consequences of Avoiding the Challenge

If companies continue using batch-level tracking, identifying faulty wafers or production anomalies will be difficult, leading to more failures in orbit. The acceptable limit is whether component failure rates remain low enough to justify the risk.

1.4.2 Existing Solutions

Solution 1: Authorized Distributors & Procurement Restrictions Space agencies enforce strict procurement policies, only sourcing from certified distributors to prevent component mixing.

Strengths:

- Reduces counterfeit risks.

Weaknesses:

- Does not provide unique tracking per component.

Solution 2: Increased Testing Sample Size Some agencies conduct statistical quality control (like in pharmaceuticals), increasing the number of components tested to detect outliers.

Strengths:

- Helps identify faulty lots early.

Weaknesses:

- Increases per-unit cost.

Solution 3: RFID Tracking from the Luxury Goods Industry Luxury brands use RFID chips to track high-value goods. Similar technology could enable component-level traceability in space supply chains.

Strengths:

- Provides individual tracking per component.

Weaknesses:

- Adds cost and complexity.

1.5 Challenge 4: Mismatched Life Cycles & Change Documentation

COTS components are updated every 2-3 years, while space missions have 10-15 year lifespans. This leads to obsolescence problems and excessive documentation burdens.

1.5.1 Consequences of Avoiding the Challenge

Not addressing this challenge leads to unavailable parts mid-mission, requiring costly redesigns. The acceptable limit is how frequently replacements can be integrated without affecting the mission schedule.

1.5.2 Existing Solutions

Solution 1: Component Reuse & Recycling Some companies explore refurbishing old satellites, similar to how automobile manufacturers remanufacture parts.

Strengths:

- Reduces waste and costs.

Weaknesses:

- Limited feasibility due to extreme space conditions.

Solution 2: Automated Change Management Systems Space agencies use digital documentation tools to streamline component change approvals.

Strengths:

- Reduces human error.

Weaknesses:

- High upfront software costs.

1.6 Web3 Digital Solutions and Evaluation

To address these challenges, two Web3-based solutions are proposed: one emphasizing high feasibility at a higher cost and another that is more affordable but technologically challenging.

1.6.1 Solution 1: Blockchain-Based Component Certification System (High-Cost, Feasible Solution)

Concept Overview

The Blockchain-Based Component Certification System (BCCS) is a permissioned blockchain ledger designed to record COTS component history, including manufacturing details, testing results, supplier information, and deployment history. The system ensures immutability, traceability, and transparency across the supply chain while allowing space agencies, component manufacturers, and suppliers to verify the authenticity and quality of parts used in critical missions.

Implementation Plan

Step 1: System Architecture Design

- **Blockchain Type:** The system will use a permissioned blockchain (e.g., Hyperledger Fabric or Quorum) to control access and maintain confidentiality.
- **Data Structure:**
  - Unique identifier (UID) for each component (linked to its wafer, batch, and test results).
  - Manufacturing logs (date, foundry, radiation tests, environmental resilience tests).
  - Certification records (third-party lab verification, government compliance).
  - Deployment records (satellite or mission usage, failure tracking).
- **Encryption and Access Control:** Space agencies and regulatory bodies will have read/write access, while manufacturers will have write-only access to submit records.

Step 2: Stakeholder Participation and Onboarding

Who is involved?

- **Component Manufacturers:** Must agree to register new components on the blockchain.
- **Space Agencies (NASA, ESA, CNSA, JAXA):** Can verify authenticity before procurement.

- **Suppliers and Distributors:** Allowed access to validate component origin before resale.
- **Testing and Certification Bodies:** Provide third-party verification, ensuring compliance.

To incentivize participation, manufacturers that comply will receive certification credits that boost their credibility in the space industry.

Step 3: Integration with Existing Systems

- **SAP and ERP Systems:** The blockchain will be integrated into existing supply chain management software used by manufacturers and suppliers.
- **Smart Contracts:** Used to enforce automated compliance checks before components are shipped.
- **IoT and QR Code Integration:** Every component will have a scannable QR/NFC tag to retrieve its blockchain record instantly.

Step 4: Pilot Testing and Deployment

- **Phase 1:** Initial prototype tested with one major supplier and a small batch of components.
- **Phase 2:** Expansion to multiple manufacturers, integrating more datasets.
- **Phase 3:** Full-scale deployment across the space industry.

Feasibility and Impact

Evaluation Criteria	**Assessment**
Current Practice	Component documentation is fragmented, making traceability difficult.
Ease of Implementation	Requires industry cooperation but is technologically feasible.
Need for Web3	High; only blockchain can ensure an immutable, decentralized record.
Security	Strong; private blockchain ensures confidentiality while enabling transparency.
Adoption Challenges	Requires buy-in from manufacturers, who may be reluctant due to costs.

Table 1: Feasibility and Impact Analysis

Strengths

- Enhances supply chain transparency, reducing counterfeiting risks.
- Reduces documentation errors by enforcing standardized records.
- Increases trust between space agencies and suppliers.

Weaknesses

- High initial costs for blockchain integration and onboarding.
- Manufacturers may resist sharing proprietary manufacturing data.
- Requires global standardization efforts to be effective.

1.6.2 Solution 2: Decentralized Order Aggregation and Smart Contracts (Low-Cost, High-Tech Challenge)

Concept Overview

The Decentralized Order Aggregation System (DOAS) is a blockchain-based procurement platform that enables space agencies and companies to anonymously aggregate orders for COTS components. This increases order size, making procurement more attractive to suppliers while maintaining data privacy and supply chain efficiency.

Implementation Plan

Step 1: Smart Contract-Based Order Management

- **Order Pooling:** Organizations submit purchase orders (POs) onto the blockchain, which are automatically grouped by smart contracts into bulk orders.
- **Anonymity Protection:** Buyers can mask their identities while still verifying supplier authenticity through zero-knowledge proofs (ZKPs).
- **Real-Time Pricing Adjustments:** If multiple buyers are interested in the same component, the smart contract dynamically adjusts pricing for bulk discounts.

Step 2: Stakeholder Participation and Incentives

Who is involved?

- **Space Agencies and Startups:** Benefit from cost reductions through collective purchasing power.
- **Component Manufacturers:** Gain access to larger, more predictable bulk orders.
- **Authorized Distributors:** Ensure authenticity and fulfillment of orders.

To incentivize suppliers to participate, the system includes smart contract-based escrow payments, ensuring guaranteed payment upon fulfillment.

Step 3: Integration with Existing Procurement Systems

- **SAP and Supplier Portals:** The platform will be linked to existing enterprise procurement tools.
- **Decentralized ID (DID) System:** Buyers and suppliers use blockchain-based identities to ensure compliance without revealing sensitive business information.

Step 4: Pilot Testing and Deployment

- **Phase 1:** Single space agency pilot with a trusted supplier.
- **Phase 2:** Expansion to a multi-agency procurement network.
- **Phase 3:** Global adoption by both government and private sector players.

Feasibility and Impact

Evaluation Criteria	**Assessment**
Current Practice	Orders are manually consolidated by intermediaries, causing inefficiencies.
Ease of Implementation	Requires smart contract development but is cheaper than traditional procurement reform.
Need for Web3	Moderate; traditional order aggregation exists, but blockchain enhances security automation.
Security	Strong; blockchain ensures supplier verification and automated fulfillment tracking.
Adoption Challenges	Resistance from traditional suppliers, who may not be comfortable with blockchain.

Table 2: Feasibility and Impact Analysis

Strengths

- Reduces procurement costs by leveraging bulk order aggregation.
- Enhances supply chain efficiency by automating purchase agreements.
- Improves security and trust in COTS component sourcing.

Weaknesses

- Supplier resistance due to unfamiliarity with smart contracts.
- Smart contract bugs or attacks could lead to procurement failures.
- Requires space agencies to trust decentralized order execution.

1.7 Conclusion

The space industry faces numerous challenges, particularly regarding COTS component reliability, testing costs, tracking, and lifecycle mismatches. While traditional solutions provide partial mitigation, Web3 technologies offer promising alternatives.

The Blockchain-Based Component Certification System (BCCS) is a high-cost, high-feasibility solution that ensures full traceability in space supply chains. Meanwhile, the Decentralized Order Aggregation System (DOAS) is a lower-cost but technically challenging solution that automates procurement while reducing inefficiencies.

While Web3 technology offers unique advantages in security, automation, and decentralization, adoption barriers—such as manufacturer resistance, infrastructure costs, and regulatory uncertainty—must be addressed for these solutions to be practical in real-world aerospace applications.

Both solutions provide a foundation for future blockchain adoption in space logistics, offering transparency, cost savings, and security that traditional supply chain methods struggle to match.

2 Designing an incentivized token economy

We aim to design a completely new system to tackle supply chain challenges.To create a more engaging and effective token economy, we have drawn inspiration from online games such as Genshin Impact and designed a blind box game to facilitate the smooth operation of the rocket supply chain. Users are incentivized not only by token rewards but also by the excitement of the game itself. More importantly, the anticipation of potential gains significantly enhances user participation.

To ensure that these incentive mechanisms work effectively, the game rules must be intuitive and straightforward. While the complexity of rules can be increased, they must follow a clear logic and be built upon a stable framework. Additionally, the game should feature strong positive feedback loops (such as providing a psychological expectation of "getting rich overnight") to enhance player engagement. At the same time, players should be able to accept failure without suspicion. Unlike gambling in a casino, which may lead to accusations of fraud, we want the game to resemble quantitative trading—when players lose, they reflect on their strategy rather than suspecting external manipulation.

Based on this concept, we propose adjusting the proof mechanism, abandoning traditional Proof of Work (PoW) and Proof of Stake (PoS), and introducing a new Proof of Virtual + Reality (PoVR). In this system, players earn tokens not only by winning in the virtual blockchain game but also by completing verifiable, traceable, and beneficial real-world actions. This design aims to transform speculative trading into a tool for social progress, while also breaking the barrier between blockchain and reality—similar to "breaking the fourth wall"—creating real interactions between the virtual and real worlds, fostering positive value circulation.

The specific steps are as follows:

2.1 Objective

This chapter aims to design a long-term sustainable supply chain blind box economic system, ensuring:

1. Sustainable Token Economy for Supply Chain Blind Boxes – NFT trading should not be just a speculative tool but an economic support system for optimizing aerospace COTS (Commercial Off-The-Shelf) component procurement, traceability, and certification costs.

2. PoVR Mechanism (Virtual + Reality Proof) Implementation – Players should be rewarded for both virtual world achievements (e.g., completing supply chain tasks) and real-world contributions (e.g., providing supply chain data, optimizing procurement chains).

3. Economic Incentives for Aerospace Supply Chain Enterprises – Through NFT transactions, smart contract procurement, and supply chain DAO governance, enterprises should benefit from real-world profits while reducing certification and procurement costs.
4. Mitigating High-Frequency Speculation – Implementing a 0.5% PoVR contribution tax on transactions to prevent excessive speculation while ensuring a stable and functional supply chain economy

2.2 Supply Chain Blind Box Economic Model

2.2.1 Token System

The token system consists of three main tokens, each serving a specific function in the supply chain blind box economy:

- **SCT (SpaceComponentToken, ERC20)**
  - **Type**: Supply chain payment & blind box currency
  - **Main Utility**:
    * Used for purchasing blind boxes
    * Facilitates trading of NFT components
    * Serves as the primary payment method for aerospace supply chain transactions and procurement
- **SCNFT (SpaceComponentNFT, ERC721)**
  - **Type**: Complete Supply Chain Components
  - **Main Utility**:
    * Represents real aerospace COTS components
    * Can be traded within the supply chain
    * Used for procurement by aerospace enterprises
    * Can be locked into supply chain contracts for traceability
- **FragmentNFT (ERC1155)**
  - **Type**: Component Fragments
  - **Main Utility**:
    * Obtained from blind box draws
    * Can be traded in the marketplace
    * Can be combined to form a full SCNFT
    * Provides supply chain credibility verification

2.2.2 Economic Cycle

The blind box economy and aerospace supply chain form an integrated Web3 supply chain financial ecosystem.

1. Players purchase blind boxes with SCT, obtaining Fragment NFTs.
2. Fragment NFTs can be traded or combined into SCNFT(ERC721) .
3. Complete SCNFTs can be sold to aerospace agencies or supply chain enterprises, generating SCT while completing real-world procurement processes.
4. PoVR Mechanism: Every NFT transaction incurs a 0.5% SCT contribution tax, distributed as follows:
    - 50% - supports the Aerospace Supply Chain COTS Certification Fund (assisting companies in COTS certification tests).
    - 30% - donated to The Giving Block (supporting global charities).
    - 20% - allocated to Gitcoin Grants (supporting open-source supply chain optimization projects).

2.2.3 Token Supply: Fixed Supply with DAO-Governed Development

In designing the long-term economic model for SCT, we consider a hybrid approach combining an initial fixed supply with later controlled inflation presents itself to reach the balanced. Under this model, SCT would begin with a fixed total supply—for instance, 100 million tokens—ensuring scarcity and early market stability.

During the first five years, the supply would remain unchanged, relying on market-driven mechanisms such as staking, burning through failed combinations, and PoVR tax redistribution to regulate circulation. This phase would provide time to observe the natural demand and utility of SCT in the ecosystem, preventing excessive inflation from the outset.

However, as the ecosystem evolves, a rigid fixed supply might introduce liquidity challenges. If too many tokens are staked, lost, or locked within long-term contracts, the lack of circulating SCT could hinder market efficiency and slow down the adoption of NFT-based supply chain transactions. To counteract this, we propose a DAO-governed adaptive inflation model, where after five years, the community can decide whether to introduce an annual inflation mechanism—such as a 2-3%controlled issuance rate—to sustain market activity. Any increase in supply would be directly tied to verifiable PoVR contributions, meaning only users who actively engage in the ecosystem (e.g., providing real-world procurement data or contributing to supply chain optimization) would receive newly minted tokens.

This approach would balance long-term value preservation and sustained participation incentives, preventing supply stagnation while avoiding excessive inflation. Importantly, the model is purely a theoretical experiment for long-term economic sustainability and will not be used in the current testing phase. During testing, SCT will maintain a strictly fixed supply to simplify economic modeling and avoid external market variables. The results of the initial test phase will help determine whether transitioning to a controlled inflation model would be beneficial for the ecosystem's real-world implementation in the future.

2.3 Supply Chain Blind Box System

2.3.1 Blind Box Purchasing

Blind Box Type	SCT Price	SSR Component Probability
Standard Blind Box	50 SCT	1%
Advanced Blind Box	200 SCT	5%
Legendary Blind Box	500 SCT	10%

Table 3: Blind Box Pricing and Drop Rates

Special Features:

- Component fragment NFTs can be traded, creating market liquidity.
- Aerospace enterprises can pre-book purchases through NFTs, accelerating supply chain funding cycles.
- Players can use Catalyst NFTs (special blind box items) to increase combination success rates.

2.3.2 Component Combination

1. Collect 3-5 fragments to combine into a full SCNFT (ERC721).
2. Combination success rate:
   - Standard combination: 60% success rate, 40% failure (failed transactions burn SCT).
   - Using Catalyst NFT: Success rate increases to 90%.
3. Complete SCNFTs can be traded or delivered to aerospace enterprises for procurement.

Supply Chain Balancing Mechanism:

- Component NFTs represent real COTS supply chain assets, used in aerospace procurement.
- Failure rates control NFT supply, ensuring market scarcity.
- Aerospace enterprises can trace every NFT to verify its manufacturing and test history.

2.4 PoVR Mechanism (Proof of Virtual + Reality)

The PoVR mechanism ensures:

1. **Virtual Contributions (Proof of Virtual)** – Players gain PoVR Certification Points through NFT trading and supply chain optimization tasks.
2. **Real-World Contributions (Proof of Reality)** – Enterprises provide real COTS procurement and certification data to unlock additional rewards.

2.4.1 Virtual Contributions (Proof of Virtual)

Players can complete the following tasks to obtain PoVR certification:

- Optimizing aerospace supply chain NFT trading and liquidity.
- Purchasing aerospace component NFTs and delivering them to aerospace enterprises.
- Enhancing COTS supply chain transparency by submitting test data.

After completion, players earn PoVR Certification Points, unlocking advanced NFT components and supply chain governance rights.

2.4.2 Real-World Contributions (Proof of Reality)

Aerospace enterprises can contribute PoVR data through:

1. Providing COTS component quality certification reports.
2. Contributing supply chain traceability data (e.g., manufacturer details, batch history, test data).
3. Executing COTS procurement transactions via smart contracts, ensuring transparency.

PoVR Contribution Rewards:

- Enterprises with higher PoVR certification get priority in aerospace procurement contracts.
- Supply chain enterprises providing real data can reduce SCT transaction fees, lowering procurement costs.

2.4.3 Simulating PoVR Mechanism for Testing

Since real-world contributions require external verification, the PoVR mechanism will be simulated in the testing environment to bypass real data validation while preserving the intended functionality. The simulation process follows these steps:

1. Deploy the PoVR-enabled smart contract in a test environment.
2. Simulate virtual contributions by executing NFT trades and supply chain-related transactions.
3. Manually invoke the PoVR certification function to mark NFTs or transactions as verified.
4. Replace real-world data submission with predefined mock data to mimic supply chain traceability.
5. Ensure smart contracts correctly process PoVR points and trigger appropriate incentives.

This simulated PoVR mechanism allows for comprehensive testing of the incentive structure without requiring real-world verification, ensuring the system functions as intended in a controlled test setting.

3 Technical Specification of Tokens

This chapter provides the technical specifications for each of the proposed tokens in accordance with the Ethereum Improvement Proposal (EIP) format. The specifications define the interfaces, data structures, and behaviors required for implementing these tokens.

3.1 SCT (SpaceComponentToken, ERC20)

EIP: ERC-20 Standard
Title: Space Component Token
Author: [Brian Joakim Xuanzheng]
Status: Draft
Type: Standard
Created: [2025-02-28]

Abstract:
SCT (SpaceComponentToken) is an ERC20-compliant token used as the primary currency for purchasing blind boxes, trading NFT components, and facilitating supply chain payments within the aerospace industry. A 0.5% PoVR tax is applied to all transactions, with funds allocated to various initiatives.

Specification

Functions:

```
function totalSupply() external view returns (uint256);
function balanceOf(address account) external view returns (uint256);
function transfer(address recipient, uint256 amount) external returns (bool);
function allowance(address owner, address spender) external view returns (uint256);
function approve(address spender, uint256 amount) external returns (bool);
function transferFrom(address sender, address recipient, uint256 amount)
external returns (bool);
function PoVR_donation(uint256 amount) external;
```

Events:

```
event Transfer(address indexed from, address indexed to, uint256 value);
event Approval(address indexed owner, address indexed spender, uint256 value);
event PoVR_Donation(address indexed donor, uint256 amount);
```

PoVR Tax Mechanism:
Whenever a transaction occurs, 0.5% of the SCT amount is deducted and automatically distributed as follows:

- 50% to the Aerospace Supply Chain Certification Fund

- 30% to The Giving Block
- 20% to Gitcoin Grants

3.2 SCNFT (SpaceComponentNFT, ERC721)

EIP: ERC-721 Standard
Title: Space Component NFT
Author: [Brian Joakim Xuanzheng]
Status: Draft
Type: Standard
Created: [2025-02-28]

Abstract:
SCNFT is an ERC721-compliant NFT that represents a complete aerospace component in the supply chain. It is minted by combining ERC1155 fragment NFTs. The NFT includes a PoVR certification mechanism, which allows supply chain enterprises to validate component authenticity.

Specification

Functions:

```
function mintComponent(address to, uint256 tokenId) external;
function submitProof(uint256 tokenId) external;
function isPoVR_Certified(uint256 tokenId) external view returns (bool);
```

Events:

```
event ComponentMinted(address indexed owner, uint256 tokenId);
event PoVR_Certified(uint256 indexed tokenId, address indexed certifier);
```

PoVR Certification Mechanism:
The 'submitProof()' function allows an NFT owner to manually mark the NFT as PoVR certified. This function is used to simulate real-world validation without requiring external data inputs.

3.3 FragmentNFT (ERC1155)

EIP: ERC-1155 Standard
Title: Space Component Fragment NFT
Author: [Brian Joakim Xuanzheng]
Status: Draft
Type: Standard
Created: [2025-02-28]

Abstract:
FragmentNFTs are ERC1155-compliant NFTs representing component fragments obtained from blind boxes. These fragments can be traded or combined to form a full SCNFT.

Specification

Functions:

```
function mintFragments(address to, uint256 id, uint256 amount) external;
function combineNFT(uint256[] memory fragmentIds) external;
function burn(address account, uint256 id, uint256 amount) external;
```

Events:

```
event FragmentMinted(address indexed owner, uint256 fragmentId, uint256 amount);
event ComponentCombined(address indexed owner, uint256 newComponentId);
event FragmentBurned(address indexed owner, uint256 fragmentId, uint256 amount);
```

Blind Box and Combination Mechanism:

- Players acquire FragmentNFTs from blind boxes.
- At least 3-5 fragments must be collected to mint a full SCNFT.
- ‘combineNFT()‘ burns the fragments and mints a new SCNFT.

3.4 Conclusion

This technical specification outlines the required ERC20, ERC721, and ERC1155 standards for the SpaceComponentToken (SCT), SpaceComponentNFT (SCNFT), and FragmentNFT. These tokens integrate seamlessly into the blind box system and simulate PoVR contributions without requiring real-world validation data.

4 Appendix: Token Economy Incentive Model

(A) Role	(B) Desired Behaviors	(C) Frictions to Desired Behaviors	(D) Incentive Mechanisms	(E) Supply Effect	(F) Unintended Incentives	(G) Prevention Mechanics
Players (General Participants)	Participate in blind box purchases, trade NFTs, stake tokens, engage in PoVR activities.	High entry costs, lack of immediate rewards, uncertainty of NFT value.	Staking rewards, airdrops for early participants, increased drop rates for engaged players.	Tokens are staked or burned in failed combinations, reducing circulating supply.	Players may try to game the system by farming airdrops or artificially inflating PoVR participation.	Implement anti-farming rules, require proof of real-world actions for higher-tier rewards.
Aerospace Enterprises	Purchase SCNFTs for real-world procurement, contribute PoVR-certified data, use smart contracts for transparent transactions.	Hesitancy to adopt blockchain, difficulty verifying component authenticity.	Discounts on procurement costs, lower transaction fees for high PoVR contributors.	Increased token circulation through B2B transactions, some tokens locked in long-term contracts.	Enterprises may fabricate PoVR data for benefits.	Require third-party validation, integrate external audit mechanisms.
Supply Chain DAO Governance Participants	Vote on supply chain policies, regulate blind box drop rates, manage incentives.	Governance may be dominated by large token holders, discouraging small participants.	Voting power linked to PoVR contributions rather than token holdings alone.	Some tokens are locked in governance staking.	Risk of centralization if a few entities control governance.	Weighted voting system favoring contribution quality over token amount.

Table 4: Token Economy Incentive Model