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NFT's With ICP Blockchain

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Abstract: Almost a century ago, the philosopher, cultural critic, and essayist Walter Benjamin grappled with the evolution of "The Work of Art in the Age of Mechanical Reproduction." Although art had experienced imperfect imitations and reproductions throughout history, advancements like photography and film in Benjamin's time drastically heightened the efficiency and fidelity of replication. This shift raised profound questions about the notions of "originality" and "authenticity," distancing reproduced works from the unique "aura" of their originals. Fast forward to our present digital age, where a few clicks or lines of code can effortlessly generate flawless replicas, improved duplicates, or even entirely fabricated "deep fakes."

However, the advent of immutable blockchain ledgers, pioneered by Bitcoin, Ethereum, and other cryptocurrencies, and harnessed by non-fungible tokens (NFTs), is ushering in a new era of originality. Crucially, this new era encompasses provable originality and authenticity, paired with indisputable ownership and robust programming capabilities. Similar to how Bitcoin resolved the "double spending" predicament in our digital age, NFTs are now initiating a transformative shift in conventional notions of ownership and provenance while introducing novel forms of originality. Despite existing solely in digital form, crafted through programmable code, smart contracts, and technological protocols, an NFT can maintain its distinctive aura and original essence.

Keywords: Non Fungible Tokens (NTF), Blockchain, Internet Computer Protocol(ICP), ReactJS, Motoko.

I. INTRODUCTION

An NFT stands out as a distinctive form of digital asset or token, establishing its uniqueness and non-interchangeability, hence earning the label "non-fungible token" (NFT). Its individuality is verifiable through a cryptographic record stored on a blockchain or distributed ledger, accessible to anyone interested. NFTs transcend mere digitized representations of assets; they embody digital assets, aligning with the blockchain's role in forming the internet of value.

To grasp this concept better, it's essential to contrast NFTs with fungible tokens or assets. Fungible tokens, prevalent in the blockchain space, share identical characteristics, allowing easy replacement. Cash, exemplified by a 10 Euro note interchangeable with another, serves as a familiar illustration of a fungible asset. On the flip side, non-fungible assets in the real world include event tickets, legal records like property titles, and unique artworks or collectibles.

NFTs adhere to specific frameworks or standards and are deployed on-chain. Currently, Ethereum stands as the leading blockchain for NFTs, with Ethereum's ERC-721 emerging as the standard determining key features for NFTs. Consequently, NFTs can be effectively managed, traded, and owned in accordance with the defined properties of the underlying framework or protocol, shaping their issuance characteristics.

A. Characteristics of NFTs

1) *Distinctiveness:* NFTs offer the ability to generate a limited set of tokens, each uniquely identifiable. A notable illustration is the issuance of 10,000 distinct NFTs by CryptoPunks. While some NFTs may share similarities, such as numbered series from an artist, envision the analogy of 1:1:X – one, out of one, out of X.
2) *Rarity:* Rarity within NFTs takes various forms, encompassing artificial, numerical, and historical elements.

a) Artificial rarity stems from the code or issuance specifics, exemplified by CryptoPunks where only 1.75% possess a Medical Mask feature, creating a distinct rarity compared to the 24.59% chance of having an Earring.

b) Numerical rarity, closely linked to artificial rarity, is intuitively understood. Consider a popular artist releasing 100 digital copies of their music album as NFTs – these signed copies become scarcer and rarer than streaming on platforms like Spotify, akin to owning a physically signed album.

c) Historical rarity pertains to the significance of an NFT's history. For instance, Cryptopunks, as pioneering generative NFTs, hold a special status. Blockchain's immutable ownership history also adds significance, similar to owning items associated with iconic figures like Stevie Ray Vaughan's Fender Telecaster or Paul Newman's Rolex Daytona.

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3) *Ownership:* NFTs bring relevance to proof of ownership, potential fractional ownership, and asset provenance tracking, especially when linked to tangible real-world assets.
4) *Immutability:* Inherent to blockchain-based tokens, immutability ensures resistance to tampering, fostering substantial trust and transparency, unless the underlying blockchain protocol is compromised.
5) *Programmability:* A key differentiator for NFTs lies in their programmability, setting them apart from real-world assets. Beyond artistic expression, NFTs can be programmed akin to software, ensuring ongoing artist residuals or moral rights. Experimental applications also showcase NFTs serving as collateral in diverse DeFi scenarios, resembling a mortgage.

B. NFTs and ownership

NFTs and ownership intertwine within the framework of "code is law" in blockchain operations. According to the blockchain perspective, the initial creator of the token, linked to an asset, is considered the owner of that token. Upon purchase, the buyer becomes the owner of the associated hash, signifying ownership of the token. This establishes a transactional nature to NFT ownership, encompassing straightforward possession or additional ownership details encoded in the underlying smart contract.

Blockchain and distributed ledger technology facilitate the tracking, verification, and recording of NFT sales and movements on an immutable ledger. Consequently, the creation, unique identifiers, and ownership of NFTs become not only traceable but also verifiable. This robust traceability extends protection to digital collectibles, artworks, and intellectual property, allowing for authentication and verification of each item's origin. NFTs serve as a safeguard against scams and counterfeits, offering proof of ownership for both creators and owners. This proof is encapsulated in the token, providing an immutable and verifiable record of ownership that can be transferred at the owner's discretion.

In diverse scenarios, ownership assumes varying interpretations. For instance, a digital photo copy minted on one platform can be accessible on another, yet ownership of the image remains vested in the NFT token holder. In the music industry, possessing an NFT of an album equates to ownership of that album, with the proceeds directed to the NFT owner.

C. NFT Use Cases

The application of NFTs in the realm of gaming collectibles has become a notable sector, potentially causing disruption within the gaming industry. Digital games, akin to physical counterparts such as board games and collectibles, have gained popularity through their digitalization, offering opportunities to surpass constraints imposed by the physical world, like material degradation and the need for a shared physical space. NFTs present a means to enhance the characteristics of digital games and unlock new possibilities.

In the context of digital games, in-game items serve as valuable collectibles for players, symbolizing invested resources or showcasing skills. The intrinsic value of these items often surpasses that of physical collectibles, facilitated by the ease of liquidity associated with digital assets. NFTs empower artists to explore creative expression, resulting in more diverse and artistically captivating collectibles.

Traditionally, items in games share identical uses and characteristics for all players, with a unique identifier stored on a central server. NFTs introduce a paradigm shift by representing these unique identifiers on the blockchain, enabling decentralization and immutable ownership tracking. While gamers amass in-game items, ownership and value are conventionally centralized within the game provider's environment. Blockchain technology addresses ownership concerns by utilizing a distributed ledger to track ownership through transparent transactions.

The tokenization of items in digital games, coupled with ownership tracking on the blockchain, is poised to revolutionize the gaming industry. Historically, players invested in games solely for the experience, but now, a paradigm shift is occurring. The "play-to-earn" concept incentivizes gamers to monetize their time by selling tokenized items in a marketplace, fundamentally altering the gaming landscape.

Several NFT-based games have gained popularity, including Cryptokitties, Splinterlands, Axie Infinity, Aavegotchi, and LiteBringer. Cryptokitties, developed in 2017 on the Ethereum blockchain, allowed players to breed and trade digital kitties through NFTs. Axie Infinity, a Pokemon-inspired digital pet community on the Ethereum chain, achieved significant success with 1 million daily active players in August 2021. Aavegotchi blends DeFi and NFTs by featuring pixelated ghosts on the Ethereum blockchain, allowing NFT staking and integration with the AAVE protocol. Splinterlands, founded in 2018, is a card gaming platform on the Hive blockchain, utilizing blockchain technology for trading actions. In July 2021, the game raised 3.6 million dollars through private token sales.

II. THE TECHNOLOGY BEHIND NFT'S

Between 2016 and 2018, a surge of new blockchain platforms emerged, reminiscent of a Cambrian explosion, largely fueled by the abundance of capital available for financing core blockchain infrastructures. The platforms supporting Turing complete programming languages inherently possess the capability to support NFT tokens. Despite widespread support for NFT token standards, the development focus around these standards is influenced by several factors. On one hand, many blockchain platforms have not reached critical mass adoption, either in a general sense or in terms of tokenization, making them primarily suitable for niche applications. On the other hand, the vibrancy of the NFT ecosystem relies on the presence of developers, IT professionals, and entrepreneurs, which tends to be platform-specific.

Practically, Layer 1 infrastructure for NFT applications should consider the following properties:

- General platform characteristics, fitting into the blockchain trilemma (Security, Decentralization, Scalability). Existing Layer 1 technologies often find themselves balancing between centralization and performance, emphasizing that different platforms suit various NFT use cases. Interoperability is a crucial non-technical feature, gauging a platform's ability to cooperate with other smart contracts, blockchain platforms, wallets, and custodial or non-custodial asset solutions. Well-established token standards facilitate interoperability.
- Network effects' size plays a vital role, encompassing competencies, open-source tools, developers, and knowledge-sharing events focused on the platform. Platforms with diminishing or minimal communities are prone to long-term extinction.

The report does not delve into evaluating the differentiation between Layer 1 protocols, but it references the supported Token Standards in each protocol in Session 2.2 NFT Token Standards. Presently, Ethereum, Binance Smart Chain, Solana, Flow, Algorand, Tezos, and Wax are prominent blockchains for NFT activity, while other protocols continue expanding their NFT-focused infrastructure. Among the Layer 1 NFT-related initiatives is Efinity, developed by Enjin, designed as a purpose-built blockchain for NFTs with fees engineered to remain inconspicuous. Another noteworthy initiative is Flow, developed by Dapper Labs, a fast, decentralized, and developer-friendly blockchain, envisioned as the foundation for a new era of games, apps, and the digital assets driving them.

A. What is ICP

The Internet Computer Protocol (ICP) stands out as a blockchain network designed to enhance the speed, efficiency, and decentralization of data storage and computation. Its core objective is to address prevalent issues in the traditional internet landscape, including system security vulnerabilities, privacy concerns with personal data, and the monopolistic nature of services.

Launched by the Swiss-based cryptography foundation DFINITY, ICP has gained prominence as a web 3.0 project, providing users with the ability to create websites, applications, and various web-based services without reliance on a centralized authority. This decentralized network operates as a protocol facilitating the connection of computers and the sharing of information without the necessity of a central server. Instead, ICP utilizes independent data centers, which are autonomous computers storing data and facilitating communication among themselves.

ICP introduces a set of protocols enabling independent data centers worldwide to collaborate, offering a decentralized alternative to the current centralized internet cloud providers. In contrast to Ethereum, where apps often run partially "on-chain," Internet Computer apps operate entirely "on-chain," distinguishing the two platforms in their approach to handling transaction data.

B. About ICP's Network Infrastructure

The architecture of the Internet Computer Protocol network is structured into four cohesive layers, forming a hierarchical arrangement to optimize functionality. These layers include:

1) *Layer 1:* At the foundational layer are the independent global data centers hosting participating nodes. For a node to be eligible, it must meet specific technical requirements, ensuring exclusivity for selected network nodes and preventing other computers from running the node. This distinctive feature sets ICP apart from Bitcoin and Ethereum.
2) *Layer 2:* Moving up, there are subnets representing an exclusive blockchain structure connectable to other blockchain networks. Subnets, collectively hosted by network nodes, utilize chain key technology instead of Proof-of-Work or Proof-of-Stake consensus algorithms. This technology facilitates swift processing of transactions altering the state of smart contracts within seconds. The chain key technology divides smart contract functions into query calls and update calls, enhancing the efficiency and speed of the crypto network.
3) *Layer 3:* Within the subnets, there reside software canisters, which are smart contracts designed to inject scalability into the system.

4) *Layer 4:* Software canisters utilize a mechanism called cycles, akin to Ethereum's gas. Cycles serve the purpose of supporting computations and managing memory. Built from ICP tokens, cycles maintain a relatively constant value to mitigate computation cost fluctuations. They represent operational costs like hardware, storage, bandwidth, and energy, and are consumed upon usage. This structure ensures a stable and predictable framework for managing the network's computational resources.

III. CONCLUSION

In conclusion, the research journey into the realms of NFTs (Non-Fungible Tokens) and ICP (Internet Computer Protocol) technology has illuminated the transformative potential of blockchain in reshaping various sectors. NFTs, as a unique form of digital asset, have emerged as a powerful tool, revolutionizing ownership, provenance, and monetization in the digital realm. The ability to authenticate and verify digital collectibles, artworks, and intellectual property through blockchain has not only safeguarded creators and owners but also ushered in new possibilities for creative expression.

On the other hand, the Internet Computer Protocol represents a paradigm shift in decentralized computing. The hierarchical structure of the ICP network, with its independent data centers, subnets, and software canisters, showcases a forward-looking approach to addressing the limitations of the traditional internet. By introducing innovative consensus algorithms like chain key technology and incorporating elements such as cycles, ICP strives for efficiency, scalability, and stability in the computation and storage processes.

Together, NFTs and ICP technology epitomize the evolving landscape of blockchain applications. As NFTs reshape how we perceive and interact with digital assets, ICP extends this transformation into the fabric of decentralized computation, offering a glimpse into a future where digital ownership and computing power are distributed, secure, and accessible. The synergy of these technologies has the potential to redefine industries, empower creators, and enhance the overall user experience in the digital age. As we navigate this ever-evolving technological landscape, it becomes imperative to monitor how NFTs and ICP contribute to the ongoing narrative of blockchain innovation and adoption.

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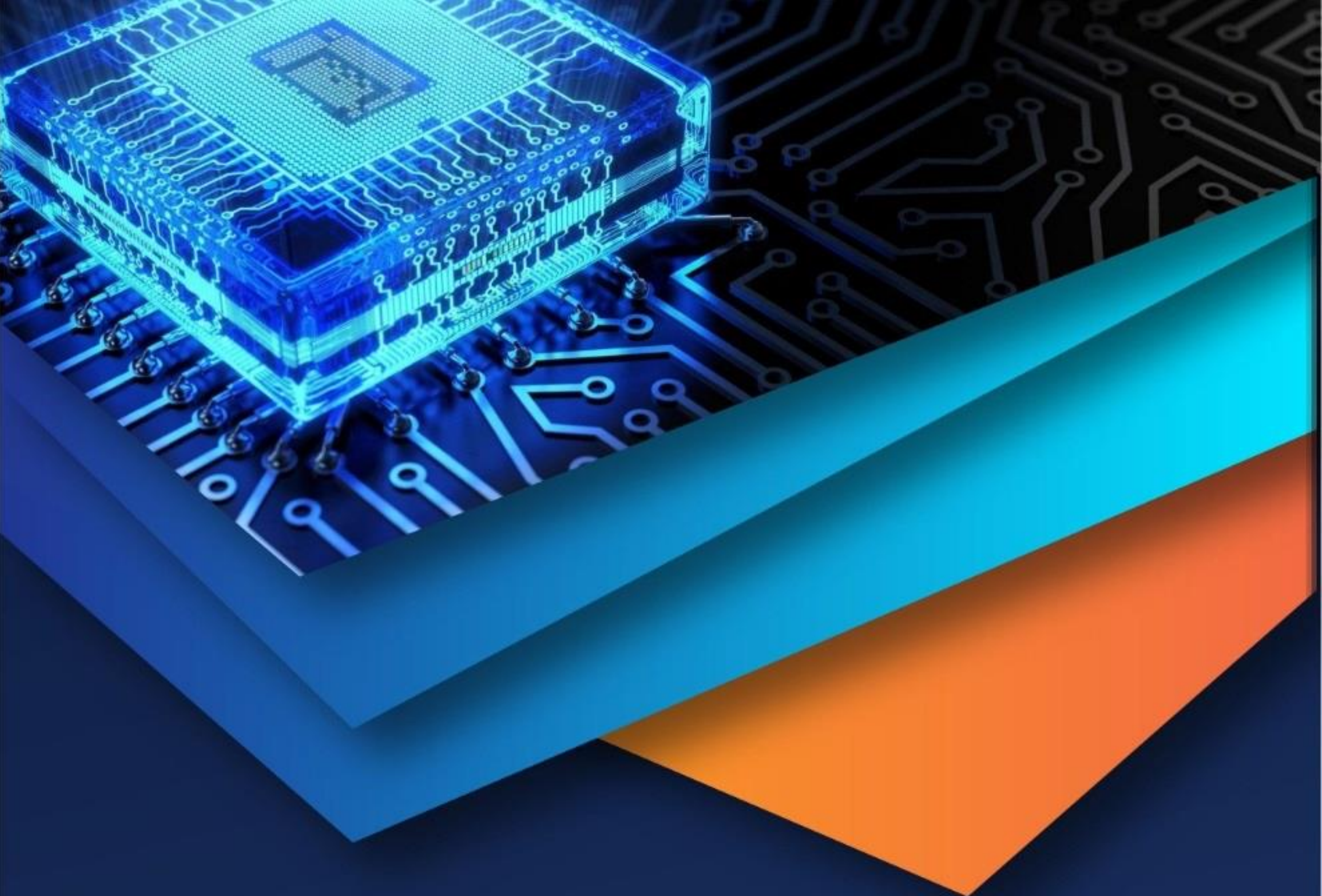

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