



“Royalty-Friendly Management Digital Asset Exchange On Blockchain”

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Abstract: The equitable distribution of royalties linked to the trade of digital assets, particularly Non-Fungible Tokens (NFTs), has become a significant point of contention. Amidst differing viewpoints and technological challenges, various stakeholders have devised tailored solutions to address this issue. Consequently, creators and buyers have encountered obstacles in achieving transparent, secure, and interoperable exchanges of these assets, often needing to make compromises to engage with the broader community. This research focuses on automating royalty payments. Initially, we explore the existing limitations and articulate their fundamental requirements before introducing a marketplace-agnostic trading framework that prioritizes royalty considerations for NFTs. This innovative approach, known as the RM-TLSC (Royalty Management Token-Level Smart Contract), harmonizes token and Smart Contract principles to ensure seamless royalty management throughout the asset's lifecycle. A comprehensive, open-source software implementation is provided for the Ethereum blockchain, while the generality of the approach is cross-checked by an open-source proof of concept for the Tezos blockchain.

IndexTerms - Blockchain, Non-Fungible Tokens, Royalty, Smart Contracts, Ethereum.

I. INTRODUCTION

Over the past few years, the fusion of blockchain technology and digital assets has revolutionized the administration of royalties, particularly in the domain of Non-Fungible Tokens (NFTs) [1]. NFTs represent a significant advancement in the digital art and collectibles industry, providing distinctive ownership rights and verifiable origins through smart contracts on blockchain platforms. This research paper explores the complex terrain of royalty administration utilizing blockchain technology, with a specific emphasis on how smart contracts facilitate NFT royalty management.

The rise of blockchain technology has introduced unparalleled transparency, security, and automation to the distribution of royalties. Smart contracts, autonomous contracts with predetermined rules recorded on the blockchain, are pivotal in facilitating seamless and trustless management of royalties within the NFT ecosystem [2]. Through the utilization of smart contracts, creators can establish unchangeable agreements that automatically trigger royalty payments according to preset conditions, thereby simplifying the distribution process and removing intermediaries.

The decentralized structure of blockchain networks enables creators and rights holders to engage directly with their audience and profit from their creations without depending on conventional intermediaries. This transition to decentralized royalty management not only improves efficiency but also promotes a fairer distribution of earnings among all parties involved. Smart contracts integrated into NFTs allow for immediate monitoring of ownership changes and guarantee that creators receive their rightful royalties whenever their digital assets are bought or exchanged on NFT exchange like Opeansea [4] and Coinbase [4].

As the global NFT market continues its rapid expansion, now that the global NFT market can be counted in tens of billions of USD [5] and the need for dependable and flexible royalty management solutions has become increasingly urgent. This paper aims to explore the intricate technicalities, challenges, and potential advantages associated with the integration of smart contract-based royalty management systems for NFTs on blockchain platforms. By critically examining existing methodologies, identifying key obstacles, and proposing innovative solutions, this study seeks to enhance the efficiency and transparency of royalty management mechanisms in the evolving landscape of digital asset exchanges. Furthermore, it aims to provide valuable insights for industry professionals, policymakers, and researchers navigating the dynamic realm of blockchain-based digital assets. Through this exploration of the intersection between blockchain technology and royalty management, the research endeavors to stimulate innovation and accelerate the adoption of decentralized solutions within the digital asset management sector. Beyond regulatory issues, this paper focusses on the technical issues related to automatic royalty distribution. It prospects current day approaches to royalty friendly NFT exchanges before advancing an interoperable solution whose applicative perimeter is discussed.

II. LITERATURE SURVEY

The creative industry is currently undergoing a significant transformation driven by blockchain technology. Royalty management, traditionally characterized by complexity and a lack of transparency, is poised for substantial improvements through the inherent transparency and efficiency offered by blockchain. This comprehensive literature review delves into the potential of blockchain to revolutionize [6] royalty management, highlighting its key benefits, ongoing research initiatives, and potential challenges on the horizon.

The existing royalty management system, while functional, faces inherent limitations due to its reliance on multiple intermediaries such as collection societies, distributors, and publishers. This intricate structure results in various shortcomings, including artists lacking clear visibility into how their royalties are calculated and distributed. Disputes over ownership and payment accuracy are common due to this lack of transparency, leading to delays in payments and significant administrative burdens for all involved parties, from creators to distributors.

Numerous ongoing research projects and startups are actively exploring the application of blockchain in royalty management. For instance, the BASIS Platform utilizes blockchain to monitor ownership and distribute royalties for music creators, while Audius, a decentralized music streaming service, leverages blockchain for transparent royalty distribution to artists. Blockchain technology has the potential to transform royalty management by enhancing transparency, efficiency, and security. Ongoing research endeavors like BASIS's work in music rights management demonstrate significant potential in empowering creators and optimizing royalty distribution across diverse creative sectors.

Overcoming challenges related to scalability, standardization, regulatory compliance, and adoption barriers is crucial for the seamless integration of blockchain into conventional royalty management processes. Embracing blockchain on a larger scale holds the promise of reshaping the creative industry by empowering emerging creators, fostering innovation, and potentially redefining existing revenue structures. As stakeholders collaborate to address these challenges, the music industry can harness blockchain's potential to create a more transparent, fair, and artist-centric ecosystem for all involved parties.

III. METHODOLOGY

The management of royalties within the NFT (Non-Fungible Token) ecosystem presents a unique set of challenges and opportunities, particularly as the global NFT market experiences rapid growth. In response to this burgeoning market demand, it becomes increasingly essential to develop robust and scalable solutions for royalty distribution. In this context, blockchain technology emerges as a pivotal enabler, offering unprecedented levels of transparency, security, and automation.

Royalty distribution solutions within the NFT ecosystem typically fall into two broad categories: token-centric and Smart Contract-centric approaches. Both approaches aim to facilitate multiple sub-transactions (royalty payments) upon NFT purchases while balancing key factors such as reliability, transparency, and efficiency. However, these solutions must also consider past and future considerations, ensuring backward compatibility and flexibility to accommodate evolving industry standards and practices.

Token-centric solutions, while straightforward in their implementation, often lack the flexibility required to address the diverse needs of creators and rights holders. Additionally, these solutions may compromise decentralization, undermining the core principles of blockchain technology. Conversely, Smart Contract-centric solutions offer greater flexibility and automation, making them the de facto choice for many within the NFT ecosystem. However, Smart Contracts alone may not fully address the lifecycle management of tokens, presenting challenges in achieving comprehensive royalty management.

To circumvent the limitations of both token-centric and Smart Contract-centric approaches, we propose a synergetic solution: the Royalty Management Token-Level Smart Contract (RM-TLSC)[7]. This innovative approach combines the benefits of token-centric simplicity with the flexibility and automation of Smart Contracts, thereby offering a comprehensive solution for royalty management within the NFT ecosystem.

The RM-TLSC is designed to accompany tokens throughout their entire lifecycle, ensuring that royalty payments are executed as intended by the creator. Unlike traditional token-centric solutions, which may only address specific aspects of royalty distribution, the RM-TLSC provides a holistic approach, integrating seamlessly with existing blockchain infrastructure.

2.1 Initialization Phase:

During the initialization phase of the Royalty Management Token-Level Smart Contract (RM-TLSC), a crucial process unfolds wherein the contract is instantiated with a pre-established set of rules meticulously governing the distribution of royalties. These rules encompass a wide array of parameters, ranging from predetermined percentages dictating the allocation of royalties to designated addresses, to intricate conditions stipulating when royalty payments are triggered. Ensuring adherence to these rules is paramount for maintaining transparency, fairness, and efficiency within the royalty management system. Notably, the RM-TLSC operates within the confines of established token standards [8]. This adherence to standardized protocols not only streamlines the integration process but also mitigates the risk of potential discrepancies or inconsistencies arising during royalty distribution. Furthermore, the RM-TLSC prudently restricts acceptance solely to tokens explicitly approved by their respective owners, a strategic measure aimed at safeguarding against unauthorized or erroneous transactions. By meticulously controlling token compatibility and adherence to established standards, the RM-TLSC sets the foundation for a robust and reliable royalty management framework poised to optimize efficiency and promote trust within the ecosystem.

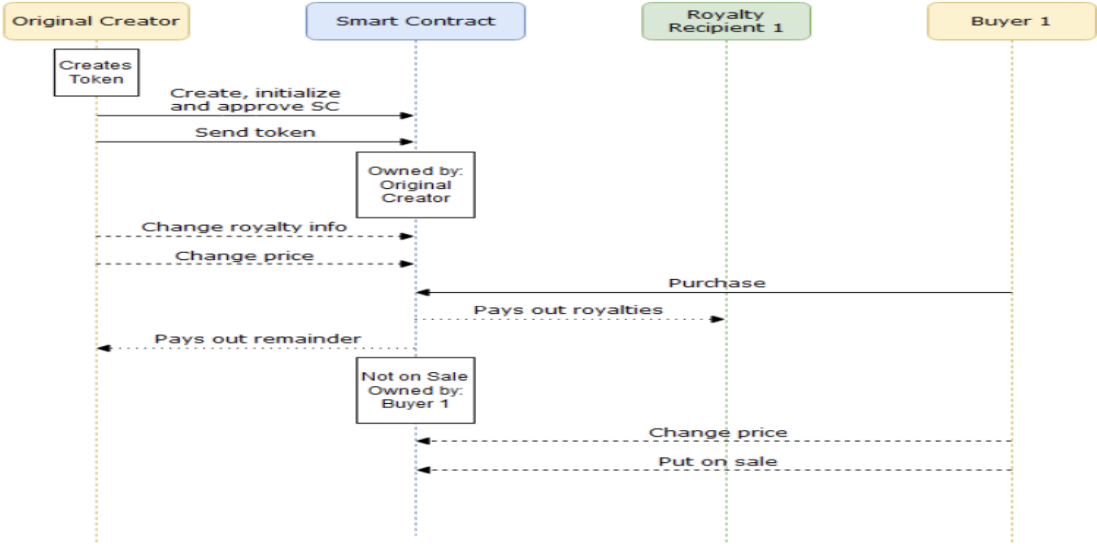


Figure 1: Initialization phase of the RM-TLSC, from instantiation to first purchase.

2.2 Trading Phase

Once initialized, the RM-TLSC enters the trading phase, during which tokens are exchanged alongside the RM-TLSC. As tokens change hands, the RM-TLSC ensures that royalty payments are automatically distributed according to the predefined ruleset. This phase emphasizes the importance of transparency and reliability in royalty distribution, fostering trust among all stakeholders.

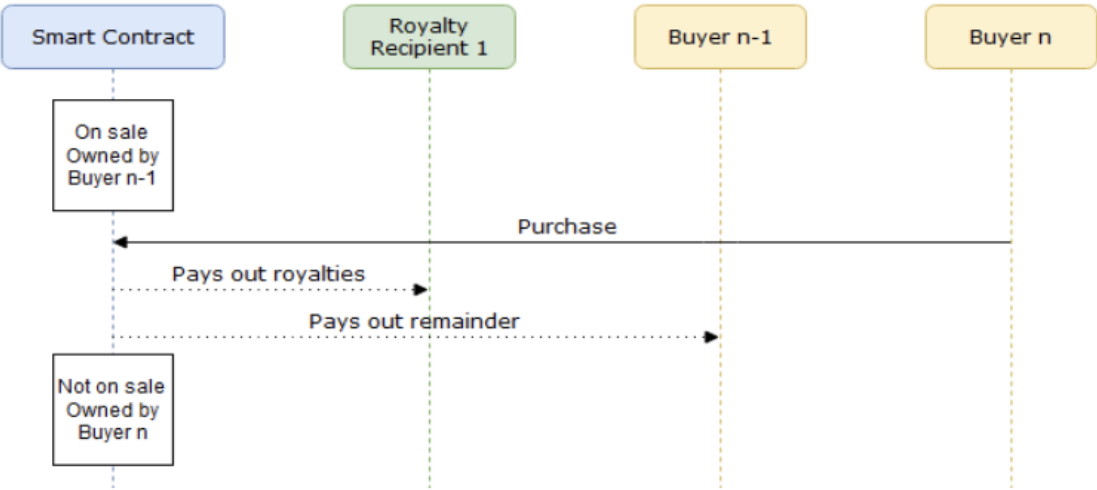


Figure 2: Trading phase of the RM-TLSC, showing automatic royalty payment.

2.3 Termination Phase

In the event that a token owner wishes to retract the token from the RM-TLSC, the termination phase provides a mechanism for orderly dissolution. Royalty holders must express their acceptance through transactions to the retraction function, ensuring compliance with the rules set during the initialization phase. Once successfully terminated, the RM-TLSC relinquishes control of the token, rendering itself unusable.

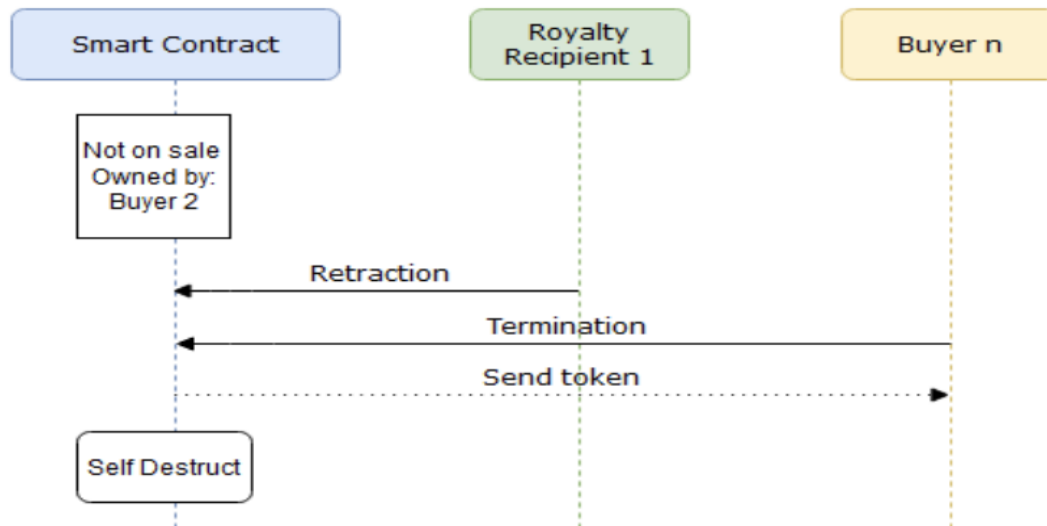


Figure 3: Termination phase and end of life cycle of the RM-TLSC

The RM-TLSC concept leverages the tools and standards available on most application-enabled blockchains, with specific implementations tailored to the programming language and application-level standards of the environment. By providing a flexible and transparent solution for royalty management, the RM-TLSC contributes to the advancement of efficient and equitable practices within the evolving landscape of digital asset exchanges.

In summary, the methodological workflow outlined above demonstrates a comprehensive approach to royalty management using blockchain technology. By addressing the technical intricacies, challenges, and opportunities associated with implementing smart contract-based royalty management systems for NFTs, this research aims to contribute to the advancement of efficient and transparent royalty management mechanisms within the NFT ecosystem.

IV. LIMITATIONS

While the RM-TLSC offers beneficial features and allows for further extensions, it also presents certain limitations inherent to the blockchain environment. Ten aspects are discussed, covering various dimensions of digital assets, token usage, user perspectives, and broader implications for royalty solutions in blockchain environments.

4.1 Notion of Ownership

The RM-TLSC framework relates to token ownership, where users own a Smart Contract that, in turn, owns the token. This nuanced ownership structure may impact user acceptance, reflecting ongoing debates surrounding token ownership in digital art[11].

4.2 NFT Advertisement

The RM-TLSC does not inherently advertise tokens; this responsibility falls on authors or third-party platforms. However, community-driven websites could enhance token visibility, similar to existing practices within the space.

4.3 Royalties Over Tokens

The question of royalties' applicability to digital assets is discussed, emphasizing the creator's role in determining asset value. The RM-TLSC accommodates complex features without compromising its fundamental principles.

4.4 Transfer/Purchase Loophole

The loophole in certain use cases does not affect the RM-TLSC's systematic royalty enforcement. The introduction of cordial retraction enhances flexibility while maintaining systematic royalty distribution.

4.5 Technical Knowledge Requirement

The RM-TLSC initialization may require Smart Contract development familiarity, but the evolving blockchain space offers user-friendly solutions for token creation [12].

4.6 Integration with Existing Solutions

While designed for backward compatibility, integrating the RM-TLSC with user wallets presents challenges. Overcoming this obstacle parallels previous innovations in token standards and wallet solutions.

4.7 Third-Party Exploitation

The RM-TLSC mitigates exploitation risks by restricting Smart Contract ownership to token creators. Existing token standards offer further protection against malicious behavior.

4.8 Security/Zero Trust

RM-TLSC security relies on blockchain mechanisms, with ongoing testing and standardization efforts to address emerging threats. User control over private keys ensures decentralization and mitigates security risks.

4.9 Gas Cost

Gas costs associated with RM-TLSC initialization and transactions are acknowledged, with considerations for optimizing costs and expanding interoperability in future developments.

V. CONCLUSION

This research paper has extensively explored the Royalty Management Token-Level Smart Contract (RM-TLSC) system to facilitate efficient and transparent royalty management within the Non-Fungible Token (NFT) ecosystem. Through a detailed analysis of the Smart Contract architecture, deployment environment, testing methodologies, and experimental results, several key insights have been uncovered.

The deployment of the RM-TLSC system has demonstrated its effectiveness in managing royalty distribution seamlessly from initialization to termination. By leveraging the ERC721 NFT standard and incorporating a comprehensive set of variables and functions, the Smart Contract framework ensures resilience and adaptability to diverse token standards and operational scenarios.

Deployment on both private blockchains and public testnets, along with rigorous testing using tools like the Remix IDE and web3py library, has validated the system's functionality and robustness. Test scenarios have showcased successful transactions while emphasizing the system's capability to prevent unauthorized activities, affirming its reliability for real-world applications.

In essence, the RM-TLSC system emerges as a promising solution to address the complexities of royalty management in the dynamic landscape of NFTs and blockchain technology. Further enhancements, optimization efforts, wider adoption, and integration into blockchain ecosystems will enhance transparency, efficiency, and trust within the digital asset realm.

With the continuous evolution and expansion of the NFT market, the RM-TLSC system is poised to play a pivotal role in shaping the future of royalty management by promoting fair distribution of earnings among creators, rights holders, and stakeholders. Ongoing research endeavours and development initiatives position the RM-TLSC system as a transformative force in revolutionizing royalty management practices and empowering creators in the digital era.

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