A Scalable, Universal Architecture for the Management of Collaborative Content

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Abstract

Creating content in the digital era has never been so easy. However, the ownership of this content has often been loosely defined leading to illegal use of content. NFTs are digital certificates of physical or digital items. These certificates stored with the blockchain technology allow to provide certified ownership for the mentioned items. However, current Blockchain technologies are not scalable. For instance, it would not be ready to handle the transition of the entire music industry toward the management of digital certificates. The proposed architecture based on Trustchain will allow digital content to be shared, attributions to be mantained and royalties to be payed.

1 Introduction

Blockchain is defined as a technological protocol enabling data to be exchanged between different parties within a network without the need for intermediaries [3]. In the case of cryptocurrencies, the decentralisation removes the need of central banks. Currently, the creation and trading of non-fungible tokens (NFTs) is one of the largest use-cases of blockchain technology. NFTs are unique digital certificates representing any physical or digital content such as: artwork, songs, algorithms, pictures, ... At the moment, the most trending examples of NFTs are digital artpieces. These are showcased in marketplaces achieving trading volumes of millions of dollars daily. The most known transaction of this field was the artpiece sold by digital artist Beeple for 69$ Million. [REF] Nevertheless, these marketplaces are based on the Ethereum blockchain which suffers from scalability issues and whose high transactions fees [2], derive in the management and exchange of NFTs using Ethereum being prohibitively expensive for mass usage.

At the same time, the ever-growing amount of digital content would benefit from a scalable ecosystem where artists, and their respective digital identities, enjoy the freedom of sharing their work while ensuring entitled attribution and royalty payments. In this work, we devise a fully decentralized system architecture for the management, transfer, and attribution of any digital content. Our programming interface enables any artist to quickly link their work to their verified identity and to share the content with others using the BitTorrent protocol. The enabling element of our system is a scalable and lightweight distributed ledger that is based on fraud detection instead of fraud prevention called TrustChain [REF].

Another use case of the Blockchain technology is Digital Identities. The internet was born without an identity layer which lead to users having no control over their website-focused identities. Self-Sovereign Identity (SSI) proposes a new type of identity in which the control is returned to the user by leveraging the Blockchain technology. SSI allows for the user to decide when and what type of information to reveal to specific parties.

The combination of all the above mentioned aspects: digital certificates, digital coins, the accountability-based TrustChain and the digital identity, form the core of the proposed architecture. By describing and prototyping the core elements of the architecture the following question will tried to be answered:

How can we enhance content sharing by verified identities while maintaining attribution in a scalable and generic architecture?

In order to answer this question, the following sections will be detailed. In the first place, in Section 2, the problem with the current architectures used in the NFT marketplaces will be exposed. In the second place, the main architecture will be presented and described. In section 4, the music industry will be used to show the need for a scalable architecture and a comparison will be done between the capabilities of current architectures compared to the proposed architecture. In section **??**, the ethical aspects of the architecture will be discussed. Finally, Section **??** will conclude whether the aforementioned sections have answered the main research question and the necessary Future Work to bring this architecture into reality will be elicited.

2 The need for a new architecture

Currently, the largest NFT marketplaces are mainly built on top of the Ethereum blockchain. These architectures have some drawbacks described in this section.

Firstly, the Ethereum network has a fraud prevention rather than a fraud detection approach which limits the scalability of the network. Although this is not a problem for small marketplaces, the goal of the proposed architecture is to provide a framework for all collaborative content to be shared and transfered. This includes for instance, the music industry, the art industry, ... In these scenarios, the scalability becomes a major issue which makes of current architectures unfit for the purpose. In numbers, the Ethereum network, it is only able to process around 20 transactions per second. This numbers are dangerously small compared to electronic payment giants like Paypal and Visa, which are able to verify around 193 and 1670 transactions per second respectively [1]. It is therefore clear that a challenge for the architecture proposed is to increase the number of transaction per second of that of the Ethereum-based architectures. Secondly, the high transactions fees add hurdle in the transformation of current NFT marketplaces towards frameworks to share and transfer all types of collaborative content.

On another note, current architectures have non-verified identities. This means a user could pretend to be an author and sell stolen content. Any piece of content can be currently sold without verifying the identity of the seller nor buyer. This provides a getaway for illegal activities which is a major flaw for an architecture aiming to become the universal framework of collaborative content sharing. Along with verifying the identity, we foresee important to to maintain the ownership attribution and the payment of royalties to the original content creators when its work is used as the base for other content. This enhances the content sharing and the developments of collaborative projects. For instance, in the case of an author releasing a song, a remix can be done using the original song as the main raw material and it is therefore clear that the original author should be rewarded for any income the remix author obtains. The enhancement of collaborative content is one of the main contributions of this research project.

Furthermore, as stated earlier, the largest NFT marketplaces are based on the Ethereum blokchain creating a big dependency with the Ether cryptocurrency. This dependency brings two major problems. First of all, the value of content is highly volatile due to the inherited volatility of the Ether coin. Secondly, in the case of the coin Ether losing the trust from investors all marketplaces using this coin will be worthless. Instead, our generic solution allows for the transfer of ownership of any digital content irrespective of the digital coin.

In conclusion, the main problems the proposed architecture will try to tackle are the lack of scalability, the lack of verified identities and the dependency to the volatile Ether.

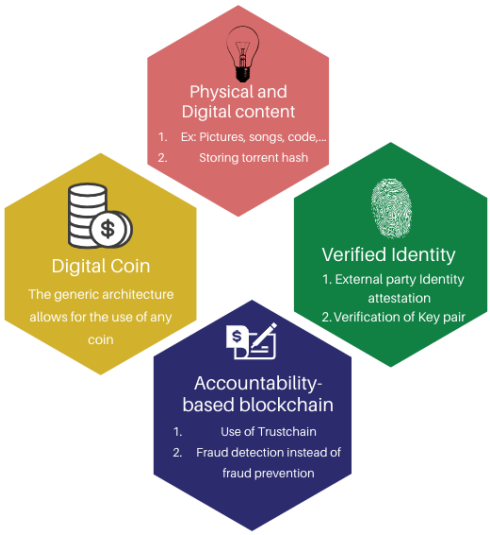

Figure 1: Main pilars of the architecture

3 Your contribution

The contribution has four main pilars: collaborative content, TrustChain, digital coin and digital identities. The main contribution of the proposed solution is that it provides a framework never seen before enhancing the sharing, distribution and cooperation of all type of content by artists in distinct fields while maintaining attribution and royalties payment.

Furthermore, the architecture leverages the scalable nature of TrustChain in order to satisfy the increasing demand for a framework with the above mentioned characteristics. In section 4, a study over the scalability requirements such a framework would need and the limited possibilities the current architectures have in order to satisfy these requirements will be provided. Moreover, the generic architecture allows for the transfer of this digital content by any coin. This proves to be a big advantage compare to existing architectures which rely on volatile cryptocurrencies. For instance, the plummeting of the coin Ether would undermine the NFT market based on the Ethereum network. Lastly, the addition of third-party verified identities adds a layer of impermeability towards illegal activities increasing trust and accountability.

All the above mentioned elements compose the core elements of the proposed architecture. The system architecture shown in Figure 2 provides one more level of granularity and depicts how the different individual components of the proposed solution work together. The architecture is mainly structured in three big layers: the client wallet, the market and the distributed storage.

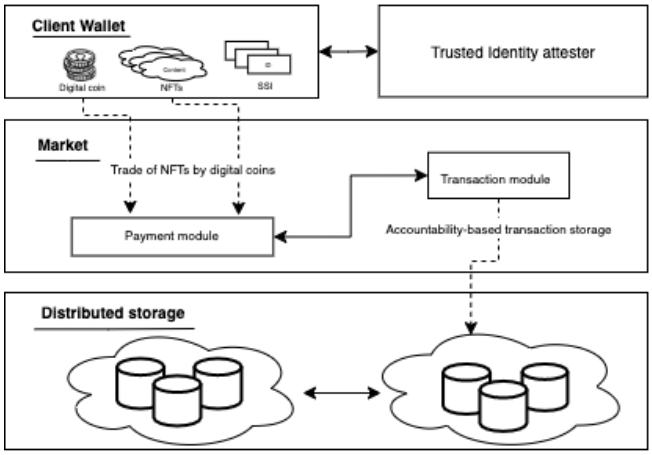

Figure 2: System architecture

I. Client wallet

The first main layer of the proposed architecture is that concerning the user, the client wallet. This wallet contains three elements: digital coins, digital certificates (NFTs) and verified identities.

Firstly, the generic architecture allows to use any digital coin, including stablecoins, and thus, reducing the dependencies on single volatile coins current architectures suffer from. In order to provide this generality, an API has been added containing the following methods : *addMoney(), retrieveMoney()* to be implemented with the adequate payment method of the chosen coin. Secondly, the NFTs are digital unique certificates representing digital or physical content such as artwork, photos, songs, algorithms,... These are created using the BitTorrent protocol and the infoHash of the Torrrent file is stored in a block in the distributed storage together with its value and the ownership chain of the item. Lastly, the verified identities are obtained by verifying the identity of public keys. Once an external trusted party has verified the public key of a user, any transaction involving the user will be traceable and therefore accountable.

II. Market

The second layer of the proposed architecture is that concerning the market. In this layer, we discern two main modules: the payment module and the transaction module. These two modules work together to provide the core functionality to the architecture, the creation and transfer of collaborative content.

In the first place, the payment module is concerned with the transfer of NFTs by the stipulated value in the chosen digital coin and the payment of royalties to original creators of content. In order to transfer an NFT, its block needs to be retrieved. This block contains the value which needs to be transferred as well as the ownership chain needed to pay royalties to previous authors. In the second place, the transaction module is responsible for the accountability of transactions. The main types of transactions are: the creation of content and the transfer of content. The creation of content allows for many shapes, it can be either individual or collaborative ; and it can be either building upon an existing content or not. The transactions related to the transfer of content also play a key role in the proposed architecture since they are responsible for the transfer of the unique certificate to the right public key in exchange for the stipulated value in the stipulated coin. Furthermore, they need to crawl the ownership chain and cooperate with the payment module to pay the proportional royalties to each of the previous author should receive. Both of these transaction rely on Trustchain to store and maintain accountability.

III. Decentralized storage

The last layer of the proposed architecture is the decentralized storage. This architecture leverages the scalability of IPv8 and Trustchain to have decentralized storage with a shift from safety to accountability. TrustChain relies on guaranteed eventual consistency to solve the double spending problem [REF]. However, since time is not a critical factor in our solution, this problem does not poses a major drawback.

4 Experimental Setup and Results

5 Responsible Research

Reflect on the ethical aspects of your research and discuss the reproducibility of your methods.

6 Discussion

Results can be compared to known results and placed in a broader context. Provide a reflection on what has been concluded and how this was done. Then give a further possible explanation of results.

You may give this section another name, or merge it with the one before or the one hereafter.

7 Conclusions and Future Work

Summarize the research question(s) and the answers to the research question(s). Make statements. Highlight interesting elements.

Discuss open issues, possible improvements, and new questions that arise from this work; formulate recommendations for further research.

ideally, this section can stand on its own: it should be readable without having read the earlier sections.

References

[1] Om; Singh Mor Tejinder; Singh Mor Tejinder Chauhan, Anamika; Malviya. Blockchain and scalability, 2018.

[2] Jordan Lyanchev. High ethereum transaction fees, 2021.

[3] Nils; Regner, Ferdinand; Urbach and André Schweizer. Nfts in practice: Non-fungible tokens as core component of a blockchain-based event ticketing application, 2019.

A The obvious

A.1 Reference use

- use a system for generating the bibliographic information automatically from your database, e.g., use BibTex and/or Mendeley, EndNote, Papers, or ...
- all ideas, fragments, figures and data that have been quoted from other work have correct references
- literal quotations have quotation marks and page numbers
- paraphrases are not too close to the original
- the references and bibliography meet the requirements
- every reference in the text corresponds to an item in the bibliography and vice versa

A.2 Structure

Paragraphs

- are well-constructed
- are not too long: each paragraph discusses one topic
- start with clear topic sentences
- are divided into a clear paragraph structure
- there is a clear line of argumentation from research question to conclusions
- scientific literature is reviewed critically

A.3 Style

- correct use of English: understandable, no spelling errors, acceptable grammar, no lexical mistakes
- the style used is objective
- clarity: sentences are not too complicated (not too long), there is no ambiguity
- attractiveness: sentence length is varied, active voice and passive voice are mixed

A.4 Tables and figures

- all have a number and a caption
- all are referred to at least once in the text
- if copied, they contain a reference
- can be interpreted on their own (e.g. by means of a legend)