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# Blockchain For A Greener Digital Media Ecosystem: Securing Content And Supporting Sustainable Royalty Flows

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***Abstract***
*Digital Piracy continues to be at the forefront of issues faced by the artists and creators in the media and music industry. This leads to loss of revenue, lack of proper ownership record of digital content, and a lack of automated royalty management. Blockchain offers a promising solution for this issue by enhancing security, transparency, traceability, and royalty management. This paper studies the role of blockchain in addressing vulnerabilities posing for digital content protection and automated royalty management. The research proposes an Automated Blockchain Royalty Model to assess the effectiveness and feasibility of Blockchain implementations. Results showcase that blockchain technology improves digital rights management and reduces instances of unauthorized distribution. Tracing the true owner of a digital content takes not even a minute. Implementation of blockchain can offer new revenue opportunities for content creators. The potential trade-offs for the stakeholders in the media and entertainment industry are discussed in this paper.*
***Keywords***: *Impact Analysis, Royalty, Digital Rights Management, Blockchain, Digital Media Environment*

## 1. INTRODUCTION

Content creation and distribution has been democratised and this is all because of the rapid advancement of digital technologies. But, these developments have created big challenges in the areas of digital content protection [1]. Digital Content like music, movies, background scores, voiceovers, etc can be easily copied and distributed unethically. This process is called as digital content piracy. This undermines the royalties for content creators, producers and distributors. Blockchain technology has been seen as a potential solution provider for such issues. This is because of the fact that ownership and transfers of digital content can be verified using this technology, provided by the transparency and immutability features. [2]. This research paper aims to identify how blockchain technology can protect digital content, specifically within the media and entertainment sector.

A music artist, a film producer or a voice over artist generates revenue via sales and streaming royalties. Plus, touring has always accounted for most of the musicians' revenue [3]. However, during the pandemic period, their dependency on streaming revenue increased highly, which begs the question of the trustability of these streaming platforms[4]. Music Piracy, unauthorized access, and royalty loss of musicians have been some long-standing problems the music industry faces, be it any era. Non-fungible tokens, enabled by blockchain technology, can provide transparency in royalty payments [5] and safeguard the digital rights of the creators' music and media content [6] [7].

When piracy costs lower than the cost of producing original content, piracy tends to flourish. To mitigate the issue of digital piracy, it is essential to increase the cost of piracy by enforcing regulations and penalties and implementing copy-control mechanisms [8]. With the emergence of the metaverse, it has become crucial to establish appropriate rules and tracking mechanisms to ensure compliance and enhance the consumer experience [9].

In India, streaming platforms such as Spotify and Apple Music report a significant disparity in demand between film and non-film music. This imbalance limits opportunities for independent artists to promote their original creations [10] [11]. Therefore, an alternative approach to music distribution is essential, warranting thorough evaluation and analysis of its impact. Despite being governed by laws and regulations in Indonesia, the protection of songwriters can only partially be implemented[12].

Streaming fraud is yet another global challenge facing the industry. This type of fraud is mainly used to gain undue financial advantage and enhance the popularity of a music artist. Streaming fraud has revealed

a flaw in the whole process of royalties distribution [13]. Hence, there is a need to design and implement automatic royalty distribution systems.

There have been many incidents and cases related to the music and media industry not being very transparent. Blockchain technology presents potential solution to transform the industry into a more sophisticated sector that prioritizes integrity and openness [14]. From royalty distribution to fan engagement, this technology has the capacity to enable music artists to develop interesting and novel ways to market and monetize their artistic content [15].

Since it has a potential to disrupt the industry, blockchain's impact on the digital media and movies industry needs to be evaluated. This impact analysis involves evaluating whether or not blockchain's implementation enhances digital content protection [16], including copyright enforcement [17], digital rights management (DRM) [18], and anti-piracy measures [19]. The benefits, consequences, and challenges of adopting Blockchain in the media and entertainment industry can be understood by the researchers. The Blockchain will reshape the future of content ownership in the coming years as the blockchain provides transparent and decentralized content ownership. There will be decrease in the piracy and will have full ownership on the content which will lead to better royalty distribution.

Several benefits are delivered if an impact analysis in digital content protection is done with the help of Blockchain. The music and movie industry can make data-driven decisions while implementing solutions based on Blockchain. The in-depth analysis ensures that the technology is utilized efficiently for policy development and strategic planning. Risk mitigation is also one of the key benefits, which helps in resolving potential risks proactively.

### 1.1. Organization of the paper

The paper is organized in the following sections. Section 2 focuses on digital content protection in the entertainment and media industry, provided with the help of blockchain technology. The impact of Blockchain on different domains is highlighted in section 3. Section 4 presents the techniques adopted in solving and validating the model. The proposed framework - the Automatic Blockchain Royalty (ABRO) Model, is formulated and discussed in Section 5. The implementation of the model is presented in terms of results and discussion in the Sixth Section. The seventh section summarizes the main conclusions drawn from the study and offers suggestions for future research.

## 2. LITERATURE REVIEW

In the movies and music entertainment industry, digital content protection, digital piracy and copyright management are critical concerns. In recent years, researchers have observed that blockchain offers unique models and features which enable developers to create novel solutions. This section explores existing research literature on blockchain technology's involvement in digital media protection, streaming and royalty distribution, along with emphasizing key findings and gaps in the literature.

Blockchain is the most widely used example of decentralized ledger technology which was first introduced as the technology running behind a lot of cryptocurrencies like Bitcoin and Ethereum etc. Digital content protection, digital piracy, and copyright management are critical concerns in movies and music entertainment. Researchers have recently observed that Blockchain offers unique models and features that enable developers to create novel solutions. This section explores existing research literature on blockchain technology's involvement in digital media protection, streaming, and royalty distribution, emphasizing key findings and gaps in the literature.

Blockchain is the most widely used example of decentralized ledger technology. It was first introduced as the technology behind many cryptocurrencies, such as Bitcoin and Ethereum. This is done by ensuring that all the transactions and transfers of digital media are recorded on the immutable blockchain ledger. Their research demonstrates that Blockchain-based DRM systems have the potential to provide content creators greater control over their art and intellectual property.

The bitsong platform was conceived in 2017. [23] concluded that this platform can enhance organizational communication and create high-value content by creators. In addition to DRM, Blockchain's utilization in digital media monetization has also been explored. [24] Blockchain can enable new revenue models by facilitating micropayments and direct transactions between consumers and content creators, thus reducing reliance on intermediaries. This enhances revenue streams and fosters a more equitable distribution of profits within the streaming ecosystem.

While the theoretical benefits of Blockchain for digital content protection are well-documented, empirical studies are relatively scarce. [25] argue that despite the promise of Blockchain, its adoption in the media

and entertainment sector faces significant challenges, including technological, regulatory, and market barriers. Their study calls for more empirical research to evaluate the practical feasibility and impact of Blockchain implementations in real-world settings.

Table1. Overview of Blockchain Applications and Challenges in Digital Content Protection

| PAPER | PROBLEM ADDRESSED | DESCRIPTION |
|---|---|---|
| [20], [21] | Copyright infringement and piracy | Discusses how Blockchain enhances DRM by providing a secure, tamper-proof record of ownership and usage rights. |
| [22] | Digital piracy and unauthorized distribution | Highlights Blockchain as a decentralized solution, ensuring all transactions are recorded on an immutable ledger. |
| [23], [24] | Monetization challenges in digital content | Emphasizes how Blockchain enables micropayments and direct transactions, reducing reliance on intermediaries. |
| [25], [26] | Practical adoption of Blockchain in media and entertainment | Identifies technological, regulatory, and market barriers, calling for more empirical research to assess feasibility. |

According to the findings, only some blockchain projects directly involve the music industry stakeholders in design or development, and most of them are merely research, proof of concept, or pilot projects rather than extensive commercial phases. The music industry's digital transformation needs to prioritize blockchain implementation[26]. The primary obstacles to Blockchain's acceptance as a worldwide solution are the poor quality of the data at the source and possible governance problems among various music industry stakeholders. The benefits of blockchain adoption in the media sector are given in the table 2.

Table2. Benefits of Blockchain Adoption in the Media Sector

| S. No | Advantages | Explanation |
|---|---|---|
| 1. | Immutable Records | Blockchain protects against unauthorized alterations by ensuring that ownership and distribution rights are permanently recorded. |
| 2. | Smart Contracts | Copyright protection and royalties can be supported by automated smart contracts. |
| 3. | Direct Payments | No Middlemen required |
| 4. | Cost Saving | Third party not required |
| 5. | Less Transaction Fee | Processing fee is not required as parties interact directly |
| 6. | Increased Trust | Tamper proof |

In summary, the existing literature underscores the transformative potential of Blockchain technology for enhancing digital content protection in the media and entertainment sector. It highlights the technology's ability to improve DRM, reduce piracy, and enable new monetization models.
The challenges in digital content protection are:

- Insufficient international enforcement mechanisms
- Digital Rights Management (DRM) System Weaknesses
- Pervasive Digital Piracy & Unauthorized Distribution
- growing risks from artificial intelligence and deepfake technologies
- Content Protection Challenges with Blockchain and Web3
- Issues with Revenue and Equitable Recompense
- Insider Leaks and Pre-Release Content Theft
- Consumer Opposition to Content Protection Measures
- Technical Restrictions in Content Protection Technologies

However, there is a clear need for more empirical research to assess the practical implications and address the challenges associated with Blockchain adoption. This study aims to contribute to this growing body of knowledge by conducting a comprehensive impact analysis of Blockchain technology on digital content

protection, utilizing qualitative and quantitative methodologies to provide a holistic understanding of its effects.

## 3. Blockchain Applications and Their Impact on Various Domains

### 3.1. Financial Services

Bitcoin is the first ever application based on blockchain technology in the financial services industry. Financial transactions have been revolutionized with the help of Blockchain; transactional data is transparent and stored in immutable ledgers, which has further helped improve the speed and reduce the hidden cost of traditional banking. Before the invention of Blockchain, transactions between the two countries took several days, and the conversion fee was also very high. Decentralized finance (DeFi) applications [27] can be created using Blockchain technology, which can work without the involvement of intermediaries.

The blockchain network is impenetrable and impervious to tampering, it does not require any middlemen. Blockchain lowers transaction prices between consumers and creators by doing away with the need for publishers, third-party aggregators, and legal middlemen. It also does away with banking and financial processing fees. By enabling decentralized content distribution, peer-to-peer (P2P) blockchain networks can lessen reliance on large streaming services.

### 3.2. Supply Chain Management

Logistics and supply chain operations require a high level of traceability and transparency. A tamper-proof audit trail is noted for each transaction or movement of the goods on the Blockchain, which helps the parties involved to track their goods transparently. Walmart and Maersk [28] have collaborated with IBM to track their food products during the supply chain so that the challenges of fraud and contamination can be identified early. The overall efficiency of the supply chain can be improved, which will lead to enhanced accountability and visibility while reducing the risk of counterfeiting. The efficiency of the supply chain can be improved by using Blockchain. With the help of blockchain the transparency of the entire supply chain network is improved. The parties involved in the transaction are authenticated and there is no scope of tampering. In the recent years the blockchain has provided many advantages in the supply chain.

### 3.3. Healthcare

The use of blockchain technology also improves data management and security. Authorized healthcare professionals can readily share patient records on a blockchain, making them safe and unchangeable. This enhances service delivery and coordination even more [29]. Clinical studies also benefit significantly from Blockchain, guaranteeing data integrity and openness to study findings. Blockchain, for instance, can ensure that all parties can access correct and validated information and stop trial data from being tampered with [30], boosting confidence in the trial's results.

### 3.4. Intellectual Property and Digital Rights Management

Blockchain technology can create reliable digital content management and protection systems. This encourages the development of stronger protections for digital rights and intellectual property (IP). The inventors can use the blockchain ledger to register their intellectual property, which can be confirmed as an unchangeable ownership record [31]. This aids in (a) establishing authorship and rights and (b) making it easier to manage and license the IP effectively. Blockchain-based platforms, for example, can be used by musicians and filmmakers to distribute their work and get paid directly by customers. Guaranteeing they receive just compensation for their intellectual property can lessen reliance on mediators.

### 3.5. Real Estate

Blockchain makes purchasing, selling, and maintaining properties easier, revolutionizing the real estate sector. Real estate transactions are sometimes quite costly and time-consuming due to the large number of parties involved and the amount of documentation involved [32]. Blockchain offers a transparent and safe way to record transfer deeds and property titles. By guaranteeing that all parties complete their responsibilities before the transfer of ownership, smart contracts—which automatically execute when specific conditions are met—can further streamline real estate transactions [33].

### 3.6. Energy Sector

Blockchain establishes decentralized energy markets in the energy industry to enable peer-to-peer energy trading, allowing customers to buy and sell energy directly. Additionally, Blockchain facilitates the growth of microgrids [34], helping local groups to produce, distribute, and exchange energy [35]. These developments boost energy systems' resilience and efficiency while encouraging the use of renewable

energy sources. Like financial technology, now available to a wide range of new channels and customers, energy production can be made more accessible to the general public.

**3.7. Impact Analysis**

Digital technological advancements are driving a substantial revolution in the media and entertainment industry, with the Blockchain at the vanguard of this evolution. Numerous uses of blockchain-based systems are available to address problems such as revenue distribution, intellectual property management, transparency, and digital theft of data. Dhingra et al. has proposed a block. Dhingra et al. have proposed a blockchain-based architecture for medical data based on smart contract technology for the healthcare sector [36]. The report has enumerated the connections and possible obstacles to adopting mobile health in the healthcare supply chain [37]. Muduli et al. have thoroughly reviewed how blockchain technology might address the difficulties in reverse logistics [38].

Blockchain technology has been proposed to improve supply chain performance and lessen the threat posed by the COVID-19 pandemic [39]. A brief description of the numerous uses of blockchain technology in the world of entertainment and media, as well as the corresponding effects, is given in Table 2.

Table 2. The Effect of Blockchain on the Entertainment and Media Industry

| Application | Description | Impact |
|---|---|---|
| Digital Rights Management (Drm) | Registration Of Creative Works On Blockchain To Establish Ownership And Manage Digital Rights. | Reduction Of Piracy, Simplification Of Licensing And Direct Payments To Creators. |
| Revenue Distribution | Smart Contracts To Automatically Distribute Revenue Among The Contributors. | Transparent And Fair Revenue Sharing For The Contributors. |
| Anti-Piracy Measures | Tracking And Verifying Digital Content To Prevent Unauthorized Distribution And Access. | Reduces Piracy, Ensures Authenticity Of Content, And Protect Content Counterfeiting. |
| Content Monetization | Blockchain-Based Platforms For Direct-To-Consumer Payments And Microtransactions. | New Monetization Opportunities For Creators Coupled With Fan Engagement |
| Fan Engagement And Loyalty | Tokenization Based Rewards Systems To Increase Fan Interaction And Loyalty Programs. | Promotes Fan Engagement, Token Sales Drive New Revenue Streams, And Builds Community. |
| Transparent Royalty Tracking | Immutable Records Of Content Usage And Royalty Payments. | Ensures Accurate And Transparent Royalty Distribution. |
| Decentralized Content Distribution | Peer-To-Peer Networks For Distributing Digital Content. | Lowers Distribution Costs, Increases Reach, And Enhances Content Availability. |
| Secure Transactions | Use Blockchain For Secure And Transparent Financial Transactions Related To Content Sales And Licensing. | Increases Security, Reduces Fraud, And Ensures Transaction Integrity. |

Artists and creators can register their works on a blockchain to create verifiable and unchangeable ownership records. This facilitates digital content management and licensing while establishing authorship. Blockchain-based platforms allow musicians, movie makers, and other content producers to distribute their work and get paid directly by customers, eliminating the need for middlemen and increasing revenue sources.

In order to automate the transaction smart contacts are used and are activated depending on the predefined conditions. Smart contract ensures the fairness and transparency involved in the transaction. Multimedia and entertainment sector has benefitted a lot by using the smart contracts to automate the loyalty distribution.

## 4. RESEARCH METHODOLOGY

This study examines decentralized apps' possible distinctions and effects on the media and music sectors. The researchers' methodology thoroughly evaluates peer-reviewed literature on rights management for

digital content, copyright mitigation techniques, music, digital royalty, and blockchain-based traceable applications across many industries. This procedure creates functional gaps for additional study in this field.

After determining the research gaps, the researchers suggest the Automated Blockchain Royalty (ABRo) mechanism, a blockchain-based automatic royalty distribution mechanism. Ethereum testing nets and test case data are then used to implement this model on a locally established blockchain.

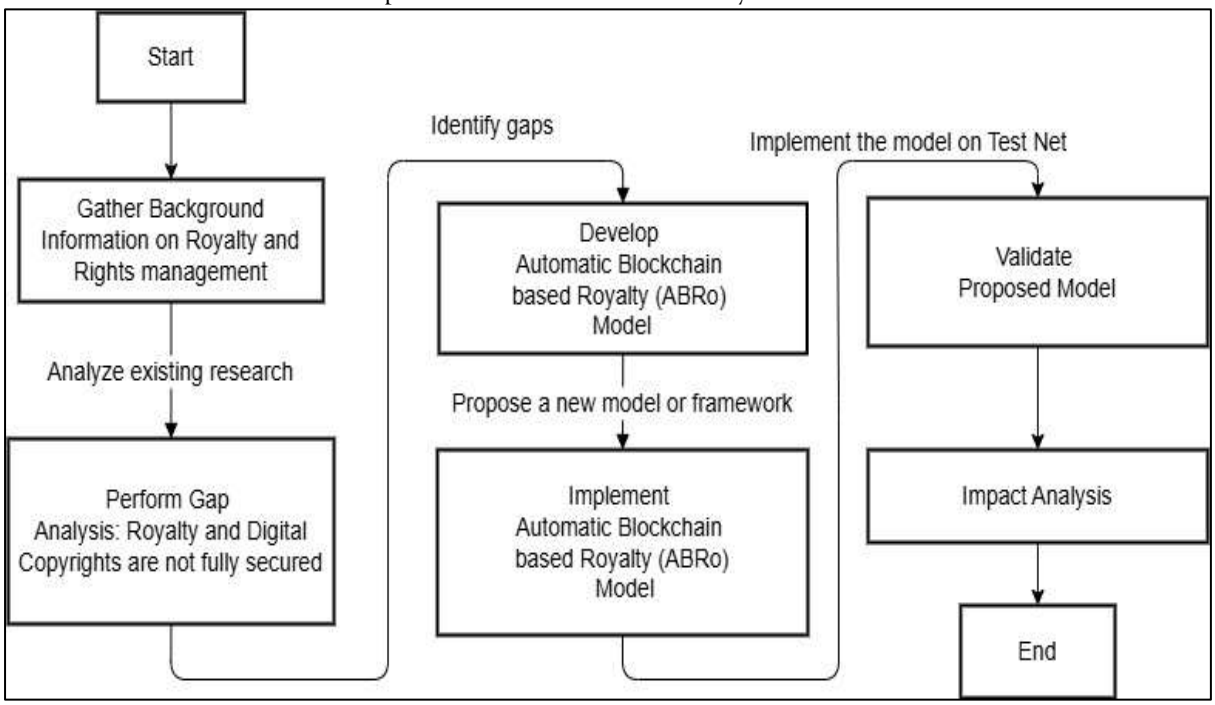


Figure 1. Research Methodology

Sequence diagrams visualize a system's data flow and transactions because they are self-explanatory. The suggested model's influence on digital rights management and automatic royalties' distribution is then examined. The methodology is visualized as a flow diagram in Figure 1.

## 5. Royalty Distribution Based on Blockchain

Royalty distribution is another area where Blockchain offers significant benefits. Smart contracts can automate the distribution of revenues among stakeholders, ensuring transparent and fair revenue sharing. This reduces disputes and ensures that payments are made promptly. Similarly, Blockchain's ability to track and trace for the purpose of verification of digital content helps combat piracy. Therefore, authenticity of content is ensured and protection of revenue streams is maintained by preventing unauthorized distribution and access.

By removing middlemen, blockchain technology enables transparent and automated royalty distribution by direct payments to creators, enabling immediate payment to authors, artists, and producers. Additionally, it results in Fair Revenue Sharing. Smart contracts allow to guarantee clear and real-time royalties, preventing disagreements between distributors and content producers. Content Tokenization: Non-Fungible Tokens, or NFTs, open up new revenue streams that allow artists to directly profit from their creations.

The revenue is in the form of royalties, calculated by fetching the streaming or sales data from streaming partners like Spotify or Apple Music for audio music and Netflix or Amazon Prime Video for video content. The distributor comes into the picture to calculate the royalty to be disbursed to the production house and the creator of the digital asset. This royalty calculation flow is represented visually by the sequence diagram in Figures 2(a) and (b).

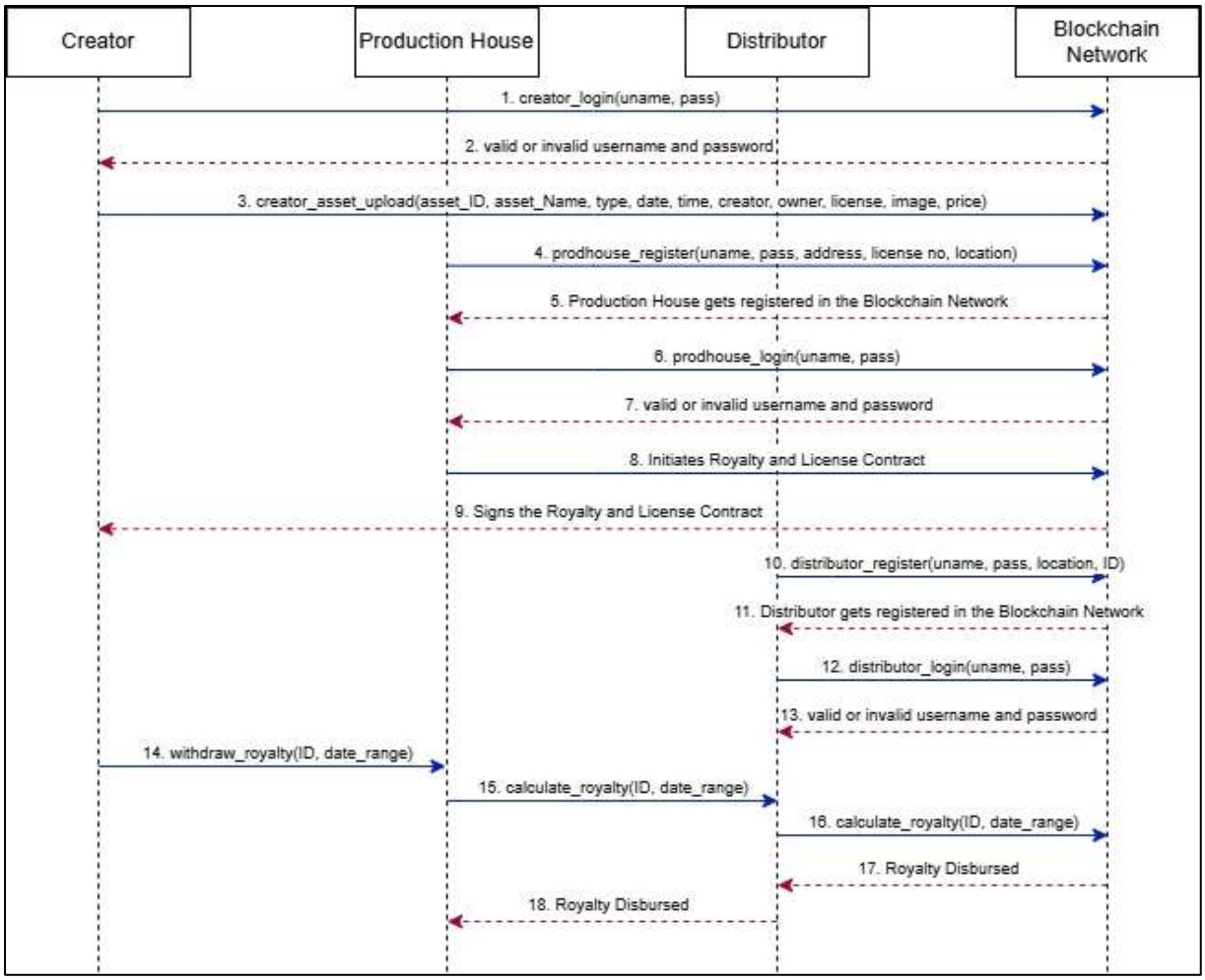


Figure 2 (a). Communication between the Creator, Production House, and Distributor

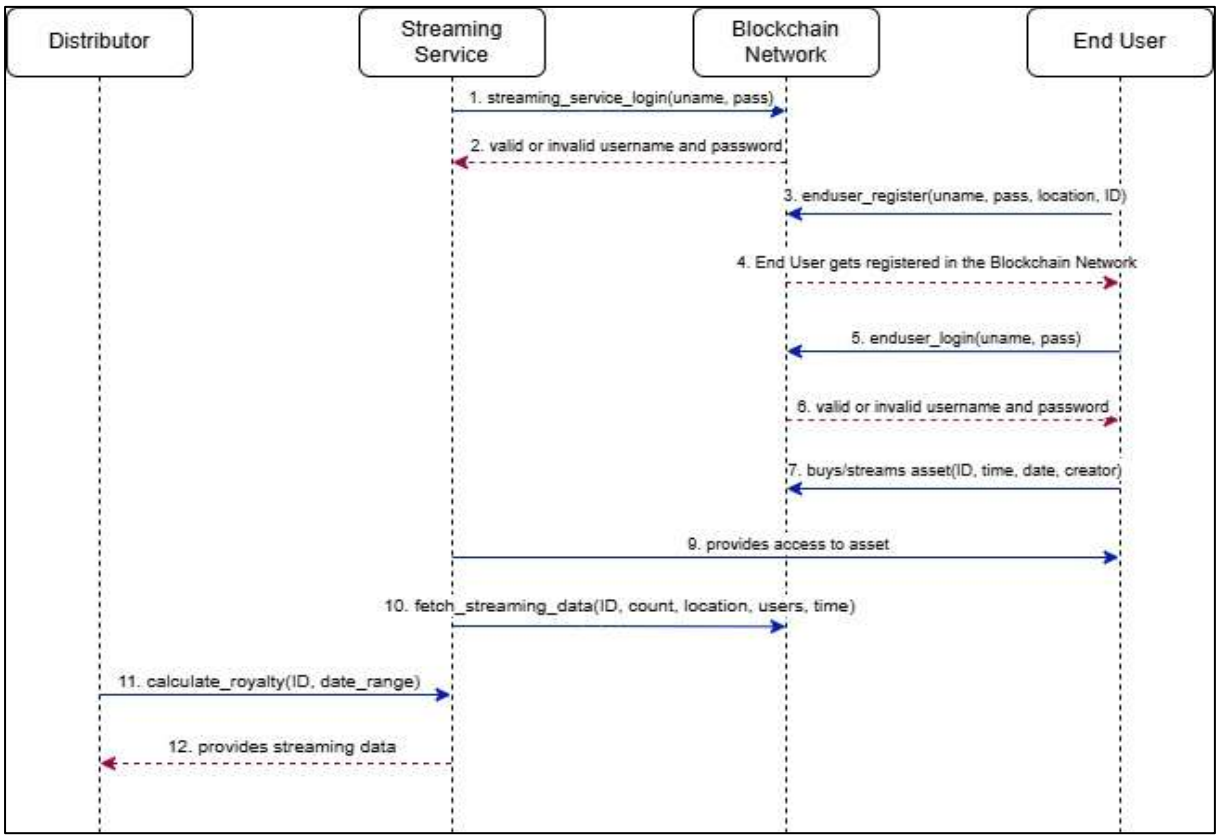


Figure 2 (b). Communication between the Distributor, Streaming Service, and End User

Content monetization is further fortified through the Blockchain-based platform for enabling direct consumer payment, and microtransactions to the artists. As per this, it leads to more point of sale for creators to generate revenue and cuts down reliance on third parties. also, tokenization of the content and Rewards for fans through the usage of Blockchain help in increasing the fan base. These innovations improve fans' engagement, establish new token sales revenue sources, and make consumers more loyal.
It also guarantees that royalty payout is tracked and recorded as data on the blockchain ledger through record of utilization of content and royalty. This ensures proper and clear calculation of royalties and also lessens what producers considers as overhead. In addition, the decentralized distribution of contents through peer-to-peer systems reduces distribution costs, improves dissemination coverage, and content reliability. Last, the application of Blockchain ensures security and transparency in the financial transactions concerning content sales and licensing to get rid of fraud and owning to results, transactions contain complete integrities.

### 5.1. Blockchain Modules

From node creation to the entry of a validated block to the blockchain ledger, the diagram in Figure 3 highlights the essential processes in the blockchain process. Each phase is broken down as follows:
**Blockchain Node Setup:** Initializing and configuring blockchain nodes is known as "setting up" nodes. Nodes are systems or devices that participate in the blockchain network by keeping a copy of the Blockchain and verifying transactions.
**Blockchain Node Synchronization:** After they are configured, nodes synchronize with the blockchain network, guaranteeing that every node has an identical and up-to-date copy of the blockchain ledger.

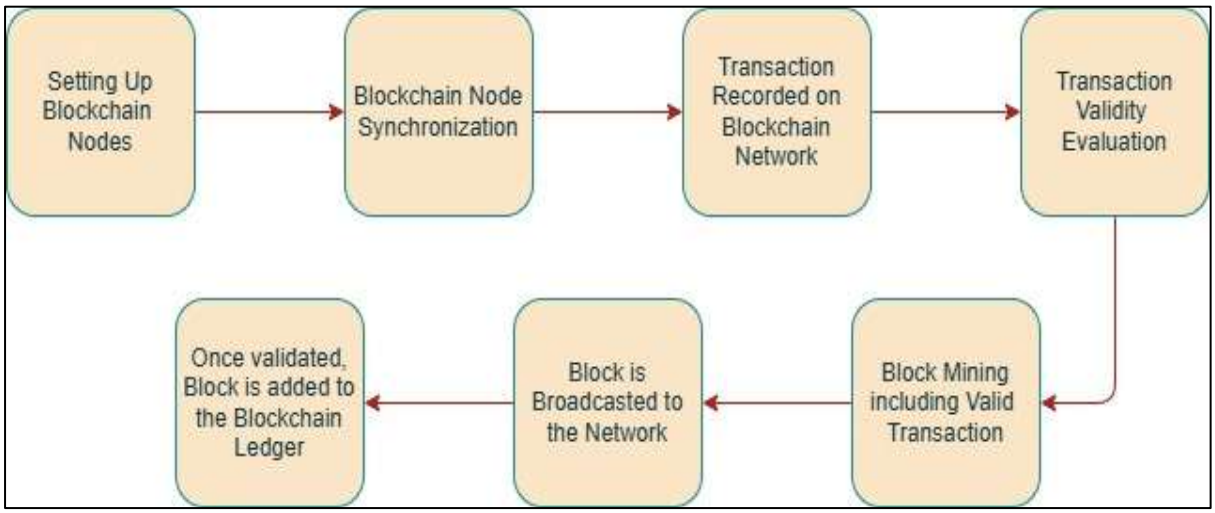


Figure 3. Blockchain modules

**Blockchain Network Transaction:** A user initiates a transaction, which is then broadcast to the blockchain network. This transaction includes information about the sender, recipient, and value being traded.
**Assessment of Transaction Validity:** The network verifies the transaction's legitimacy by examining account balances, digital signatures, and other blockchain-specific regulations.
**Block mining with valid transactions:** A block comprises all valid transactions. To add a block to the Blockchain, miners or validators must either solve a cryptographic problem (proof of work) or adhere to another consensus process (proof of stake, for example).
**Block is Broadcast to the Network:** Following mining, a block is broadcast to every node in the network. This guarantees that the updated Blockchain is distributed to all participants. The block is added to the blockchain ledger when it has been validated. Nodes confirm the validity of the mined block based on proof of work (or other consensus requirements). After verification, the block is permanently added to the blockchain ledger.

## 6. RESULTS AND DISCUSSION

The potential effectiveness and performance enhancement of the blockchain-based royalty management system are evaluated by deploying and testing the Automated Blockchain Royalty (ABRo) Model, a test framework explicitly designed for this purpose. The runtime settings that specify the testing environment are shown in Table 2.

**6.1. Configuration and Execution Framework**

1. **Blockchain Interaction with Node.js:** Node.js is a background environment for setting up blockchain contracts. This entails writing scripts for smart contract deployment, monitoring, and interaction. Contract logic can be seamlessly integrated with other system components, and connection with the Ethereum network's infrastructure is ensured by using Node.js.
2. **Solidity Smart Contracts:** Solidity programming language smart contracts control the system's essential operations. Solidity was selected because of its dependability, durability, and Ethereum blockchain interoperability. These agreements contain the guidelines and reasoning to track ownership rights and automate royalties.
3. **Remix IDE for Development:** The Remix IDE is used to create and run Solidity contracts. Remix is an online fully integrated development platform that makes creating, debugging, and deploying smart contracts on Ethereum easier. It guarantees that contract documents are free of logical and syntactic mistakes before deployment and provides real-time testing.
4. Deployment to Ethereum Blockchain: The generated smart contracts are deployed to the Ethereum blockchain, where they remain indefinitely. Royalty payment transactions are permanently documented, guaranteeing openness and reliability.

Table 2. Run Time Parameters

| **Parameter** | **Values** |
|---|---|
| Node Count | 8 |
| Port Numbers | localhost:5001 ~ 5008 |
| Number of Contracts | 5 |
| Contract Address | 0xd9145CCE52D386f254917e481eB44e9943F39138 |
| Miner Node | localhost:5001 |
| Transaction Hash | 0x855d9c570c9a5fd0138ff34bdaf4d9e13758b603ea628ce20288f3e9bad8c04b |
| Transaction Cost | 344022 gas |
| Execution Cost | 261654 gas |

**Explanation of Parameters:**

1. **Node count**: The blockchain network has eight nodes. Every node acts as a model for a producer, distributor, or artist involved in the royalties distribution system.
2. **Port Numbers**: Every node in the network is given a distinct port, which ranges from localhost: 5001 to localhost: 5008, facilitating effective peer-to-peer communication.
3. **Number of Contracts**: Five active smart contracts represent several system modules, including ownership validation, distribution, and royalty computation.
4. **Contract Address**: The smart contract implemented on the Ethereum network is given a distinct address (0xd914...38). This address identifies the contract and enables users to communicate with it.
5. **Miner Node**: Node localhost:5001 is designated as the miner node, responsible for validating transactions and creating new blocks in the Blockchain.
6. **Transaction Hash**: Every transaction executed within the Blockchain is identified by a unique transaction hash (0x855d...04b). This hash provides proof of transaction and ensures traceability.
7. **Transaction Cost**: The transaction cost of 344022 gas represents the computational resources required to execute a transaction. It includes the cost of contract deployment and associated operations.
8. **Execution Cost**: The execution cost of 261654 gas indicates the specific resources consumed to execute the smart contract logic during the transaction.

**6.2. System Evaluation and Performance**

The ABRo model helps keep the system intact by testing the practical side of it, for example the distribution of royalties among various participants. With the use of Nodejs, Solidity, and Ethereum, the system shows its potential for streamlining all processes relating to royalties with less efforts and greater

efficiency. The gas fees prove to be the easy way out at the same time ensuring that the contracts employed are actually workable and making the system viable for wider purposes in an economically sensible manner.

This configuration therefore confirms the feasibility of the Royalty management systems built on blockchain technology that have been devised to improve efficiency and the confidence in the processes of managing royalties.

**6.3. Performance Analysis**

If the time taken to execute a transaction increases, the throughput of the network, also known as transactions per second (tps) decreases. The reason is quite simple the nodes in the network do not change but there are more blocks and more transactions that are initiated. While tps is diminished by sustained network bandwidth. Figure 4 depicts the connection between transaction duration per transaction and throughput in regard to transaction annually, specifically tps.

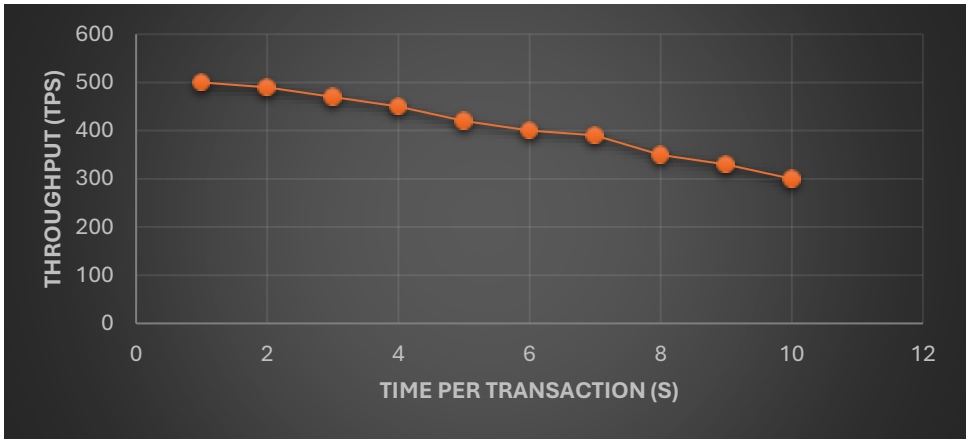


Figure 4. Time per transaction vs throughput

In looking at the finality of transactions on the blockchain, it is important to take into consideration the time taken for individual transactions to get processed and approved, the time taken to mine a block, and usually all mining latency involved in a mining process. When a new block is created, it has to be added to the preceding chain of blocks in a chronological order on a network known as blockchain, and that can take time. This is an important measure, because it determines the practical upper limit of the number of transactions per second.

There are several variables which affect the block mining time and one of them is how many transactions are physically contained in one block. In blockchain systems, transactions are not processed individually; they are aggregated into blocks and mined (validated and added to the Blockchain). The more transactions included in a block, the longer it may take to mine that block due to the additional computational effort required to validate all transactions and solve the cryptographic puzzle (in proof-of-work systems) or reach consensus (in other mechanisms like proof-of-stake). To better understand this relationship, the plot graph in Figure 5 illustrates how block mining time increases with the number of transactions in a block.

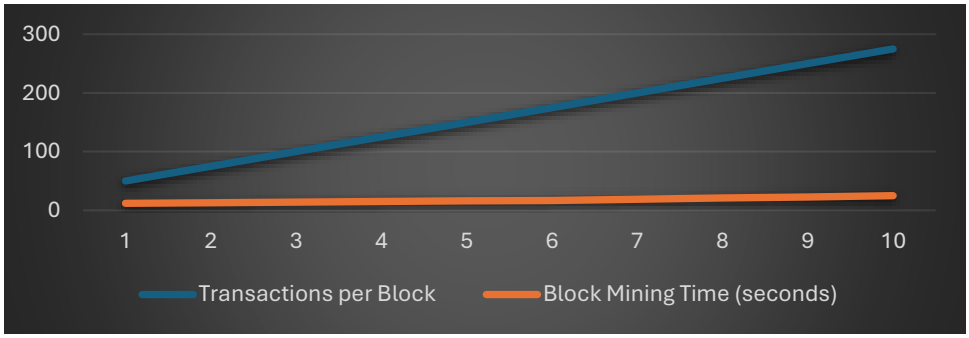


Figure 5. Plot Graph: Transactions per Block vs. Block Mining Time

In the context of Ethereum, the block mining time is relatively consistent due to its consensus protocol and network parameters. Under ideal conditions, Ethereum aims to add a new block approximately every

12 to 14 seconds, depending on the transaction volume and network congestion. However, as the number of transactions in a block increases, block mining time may vary, as shown in the graph below.

The graph displays clear growth, which shows that the number of transactions per a block and the time necessary to mine that block is related to each other, that is, as one increases so does the other. This is due to the fact that greater number of transactions requires greater number of computations to validate all of them.

The faster a block is mined, then the transactions contained in that block can attain finality sooner thereby shortening waiting times for the end users. The responsiveness of the DApps is being enhanced by lower latency in the block mining process, which In turn improves the experience of users. As expected, block mining time allows developers to improve the DApp performance and make plans for future growth based on the anticipated transaction volume.

## 7. CONCLUSION

This research has demonstrated the disruptive potential of advanced systems, such as digital cash systems, specifically blockchain technology, to address and alleviate significant concerns within the film and music entertainment industry, namely, digital piracy, content protection, and royalty management. It seeks to assess how existing vulnerabilities can be tackled or mitigated so that specific blockchain models or systems can have better protection of assets, enhance security automation, and increase transparency and traceability in the royalty distribution processes and procedures.

The Automated Blockchain Royalty Model (ABRo) has shown higher efficiency in battling content piracy and boosting the security of digital assets. This research has shown that the Blockchain technology not only helps in strengthening the protection of the digital rights but also provides the means of bringing in additional sources of income.

The paper shows that these individual players, including regulatory bodies, need to come together to create a wide-range systems that would consider issues of scalability, cost and even inter-operability and more effectively implement the particular blockchain system. It is essential for stakeholders in the music and movies entertainment business to join forces in creating strong systems that will enable full utilization of the Blockchain based systems. Interestingly enough, these stakeholders also include the regulatory bodies in addition to artists and producers.

The author has proposed the below mentioned points for government and regulatory bodies regarding adoption of blockchain in the media industry.

- Create a blockchain task force headed by the government to unite IT specialists, regulators, and media firms.
- Encourage industry-wide cooperation for interoperability, standardization, and moral blockchain behaviour.
- Support scholarly research and innovation centres that concentrate on digital licensing and content security enabled by blockchain.
- Provide tax breaks to media organizations that use blockchain technology for payments and content verification.
- Start blockchain-related training and certification programs for media workers that are supported by the government.
- Establish a blockchain-based register supported by the government to track distribution, ownership, and licensing of content.
- Give journalists, filmmakers, and artists the ability to register their work using tamper-proof timestamps.
- Teach filmmakers, musicians, and journalists how to use blockchain technology for safe content delivery.

In order to fully utilize blockchain technology in the media sector, government organizations must set precise rules for copyright, DRM, and smart contract-based royalties. Encourage media licensing structures and anti-piracy measures based on blockchain technology. Encourage direct creator monetization and decentralized media platforms. There should be more funding allocated to research, infrastructure, and public-private blockchain partnerships. Inform content producers and shield users against scams involving blockchain technology

Finally, the content sharing business in the future may encompass sophisticated techniques such as AI analytics and hybrid forms of blockchain that are more suitable for scaling content databases and providing users with easy access to desired blockchains.

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