

Blockchain-Based Digital Rights Management in Libraries: A Pathway to Secure Digital Content Access

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Abstract: As digital libraries continue to grow their collections of electronic books, journals, and multimedia, the need for effective digital rights management (DRM) systems becomes increasingly important. Traditional DRM methods often face challenges related to copyright compliance, access restrictions, and content security. This article examines the potential of blockchain technology to improve DRM in library systems by providing decentralized, transparent, and immutable solutions. The paper outlines the basic structure of blockchain, its application in DRM, and discusses the benefits and limitations of adopting this technology in library environments. Additionally, it offers a forward-looking perspective on how integrating blockchain with smart contracts could enhance library systems.

Keywords: Digital Library, Digital Rights Management (DRM), Copyright Compliance, Library System, Blockchain, Electronic Books, Journals, Multimedia.

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I. INTRODUCTION

Digital Rights Management (DRM) encompasses a set of technologies and protocols designed to control the access, usage, and distribution of digital content. Its primary function is to protect intellectual property rights by restricting unauthorized copying, sharing, and modification of digital resources. In the context of libraries, DRM plays a critical role in ensuring that access to electronic books, online journals, multimedia resources, and digital archives is both legal and ethical. Libraries are increasingly dependent on licensed digital content from publishers, which comes with specific terms and conditions. To comply with copyright laws and licensing agreements, libraries must implement DRM systems that monitor and restrict how users interact with digital materials. However, traditional DRM models present numerous challenges. These include rigid licensing restrictions that can limit user access, a lack of transparency in content management, difficulties in sharing resources across institutions, and the persistent risk of content duplication and unauthorized distribution. Such issues hinder the mission of libraries to

provide equitable and seamless access to knowledge while protecting the rights of content creators and publishers. As a result, there is a growing need to explore advanced and more adaptable solutions—such as blockchain-based DRM—to address these concerns effectively. (Zyskind, Nathan, & Pentland, 2015).

II. UNDERSTANDING BLOCKCHAIN TECHNOLOGY

Blockchain is a revolutionary distributed ledger technology that enables data to be recorded and stored across multiple nodes in a decentralized network. Unlike traditional centralized databases that rely on a single authority or server, blockchain distributes data across a peer-to-peer network, where each participant maintains a copy of the entire ledger. This structure enhances security, transparency, and resilience against tampering or data breaches. Each block in the blockchain contains a bundle of transaction data, a timestamp, and a cryptographic hash of the previous block, which links all blocks together in a continuous and immutable chain. Any

attempt to alter the information in one block would require changing all subsequent blocks and gaining consensus from the majority of the network—a practically impossible task in well-maintained blockchains.

This immutability, combined with the cryptographic security and decentralized architecture, makes blockchain an ideal solution for digital rights tracking and access control. In a library context, these features can be leveraged to create transparent records of digital content ownership, usage rights, and licensing agreements. Because all transactions are permanently recorded and visible to authorized stakeholders, blockchain ensures accountability and prevents unauthorized access or modification of digital content. As noted by Tapscott and Tapscott (2016), blockchain's inherent security and transparency redefine how trust and control can be established in the digital age, making it especially valuable for managing digital rights in increasingly complex and distributed information environments.

III. TRADITIONAL DRM CHALLENGES IN LIBRARIES

Libraries obtain digital content from multiple sources, each with its own licensing agreements. These licenses may differ in terms of duration, number of simultaneous users, access methods, and allowed functionalities. This lack of standardization creates confusion and complicates the management of digital collections, often requiring separate systems or workflows for different content providers.

➤ *Restricted User Rights*

Traditional DRM systems often impose strict limitations on users. Common restrictions include the inability to print pages, copy and paste text, or download and share materials. Such restrictions can hinder academic work, limit accessibility for users with disabilities, and reduce the overall user experience, conflicting with the library's mission of equitable access to information.

➤ *Vulnerability of Centralized DRM Systems*

Most current DRM technologies rely on centralized control by content providers or DRM software vendors. This centralization creates single points of failure, making systems more vulnerable to hacking, outages, or policy changes by the service provider. Additionally, central authorities may revoke access without notice, even for previously purchased or licensed content.

➤ *High Administrative Overhead*

Managing DRM-protected content requires constant administrative effort. Library staff must monitor content usage, manage license renewals, troubleshoot access issues, and ensure compliance with each vendor's terms. This process is time-consuming and resource-intensive, particularly in institutions with large and diverse digital collections.

These issues collectively point to the need for a more transparent, decentralized, and user-friendly DRM solution, such as blockchain-based DRM systems, which could reduce complexity while enhancing security and access equity (De Filippi & Wright, 2018).

IV. BLOCKCHAIN AS A SOLUTION FOR DRM

Blockchain technology presents a transformative approach to overcoming many of the limitations inherent in traditional DRM systems. By leveraging its decentralized and tamper-resistant architecture, blockchain offers a more secure, transparent, and efficient method for managing digital rights in library environments.

➤ *Decentralization*

Unlike conventional DRM systems that rely on centralized control—typically managed by publishers or third-party vendors—blockchain distributes authority across a peer-to-peer network of nodes. This decentralization eliminates the dependence on a single controlling entity, thereby reducing the risk of system failures, data breaches, or unilateral policy changes. In a decentralized DRM framework, no single party has overarching control, which ensures fairer access and greater resilience.

➤ *Smart Contracts*

One of the most powerful features of blockchain is the use of smart contracts—self-executing code embedded within the blockchain that automatically enforces the terms of an agreement. In a library context, smart contracts can govern access conditions for digital materials, such as setting time-bound licenses, limiting the number of simultaneous users, or restricting certain user actions. This automation significantly reduces the administrative burden on library staff while ensuring compliance with licensing terms.

➤ *Immutable Records*

Every transaction or action involving a digital asset—such as its creation, access, licensing, or transfer—is permanently recorded on the blockchain. These records cannot be altered or deleted, ensuring a complete and trustworthy audit trail. For libraries, this means secure, verifiable tracking of how digital content is accessed and used, which can be critical for usage analysis, reporting, and resolving disputes over content ownership or usage rights.

➤ *Transparency*

Blockchain's open ledger system allows both libraries and users to view relevant information about digital assets, including ownership history, license terms, and usage data. This transparency fosters trust between content providers, libraries, and end users, while also making it easier to identify and correct errors or inconsistencies in content licensing. As Jirgensons and Kapenieks (2018) highlight, such transparency is especially valuable in educational and academic contexts, where equitable

and reliable access to information is paramount.(Jirgensons & Kapenieks, 2018).

V. USE CASES IN LIBRARY DRM

The integration of blockchain into Digital Rights Management (DRM) systems is no longer a theoretical concept—it is being actively explored through various real-world initiatives and pilot projects. These use cases demonstrate how blockchain's decentralized and tamper-proof architecture can be effectively applied to manage digital rights and enhance transparency, especially in libraries and educational institutions.

➤ *Po.et*

Po.et is a blockchain-based platform specifically designed to help authors, publishers, and digital content creators register ownership and track usage rights of their works. By timestamping content on the blockchain, Po.et creates an immutable and verifiable record of authorship. This is particularly beneficial in the library context, where managing copyright and proving content provenance is crucial. Libraries can use platforms like Po.et to ensure that the digital materials they provide to users are accurately attributed and legally licensed. Furthermore, Po.et allows for real-time updates to licensing terms, helping libraries maintain compliance and streamline digital acquisitions.

➤ *San José State University Blockchain Report*

The School of Information at San José State University has conducted extensive research into the role of blockchain in library and archival science. Their 2019 report outlines various potential applications, including secure digital preservation, transparent metadata tracking, and decentralized access control systems for academic libraries. The report highlights how blockchain can help libraries authenticate digital records, ensure long-term access to born-digital content, and create traceable user interactions without compromising privacy. This institutional exploration marks an important step toward real-world blockchain adoption in the academic sector and provides a model for other universities and library systems to follow.

➤ *Ascribe*

Ascribe is another innovative blockchain platform aimed at empowering digital content creators to protect and manage their intellectual property rights. For libraries, Ascribe offers tools to register and track the licensing of digital materials, ensuring that proper attribution is maintained and unauthorized use is minimized. It allows for the creation of smart contracts that govern how and under what conditions digital content can be accessed or reused. This is particularly valuable in environments where digital artworks, multimedia resources, and research outputs need clear ownership and usage guidelines. Ascribe's approach aligns closely with the goals of modern libraries to foster ethical and legal access to information.

These initiatives represent meaningful strides toward a future where libraries can use blockchain to create more secure, transparent, and efficient DRM systems. By adopting these technologies, libraries can protect digital assets while continuing to support open access, academic integrity, and knowledge dissemination (San José State University, 2019).

VI. BENEFITS OF BLOCKCHAIN-BASED DRM IN LIBRARIES

The implementation of block chain technology in Digital Rights Management (DRM) offers numerous advantages that address longstanding challenges in digital content management within libraries. These benefits go beyond simple technological improvements—they support a more equitable, efficient, and secure information ecosystem.

➤ *Enhanced Content Security Through Immutable Transaction Records*

One of the core strengths of blockchain is its ability to create an unalterable record of every transaction related to a digital asset. This immutability ensures that all activities—such as content creation, licensing, access, and modification—are permanently recorded and cannot be retroactively changed or deleted. For libraries, this feature provides a secure audit trail that safeguards intellectual property and prevents unauthorized alterations, access, or duplication of digital materials. It also builds trust among content creators and users by preserving the integrity of digital resources.

➤ *Reduced Administrative Burden via Smart Contract Automation*

Traditional DRM systems often require extensive manual oversight, including license tracking, usage monitoring, and renewal management. Blockchain-based DRM systems address this issue through smart contracts—self-executing agreements that automatically enforce licensing conditions. Libraries can program smart contracts to manage access rights, expiration dates, and user permissions without continuous staff intervention. This automation reduces the administrative workload significantly, allowing librarians to focus more on user support and content curation.

➤ *Fair Revenue Models for Authors in Open-Access Frameworks*

Blockchain offers a transparent and programmable environment where fair compensation for content creators can be ensured—even in open-access or decentralized publishing models. Smart contracts can be designed to distribute royalties or usage fees directly to authors and rights holders whenever their work is accessed or used. This system eliminates intermediaries, improves payment efficiency, and ensures that creators are fairly rewarded for their contributions, aligning with the ethical goals of academic institutions and libraries.

➤ *Inter-Institutional Collaboration for Secure Resource Sharing*

Blockchain facilitates secure and traceable collaboration between libraries and institutions through shared decentralized ledgers. Libraries within a consortium or network can use blockchain to share digital resources—such as e-books, academic journals, and archives—while maintaining strict access controls and accurate usage records. This enables seamless resource sharing across geographic and administrative boundaries, enhances content availability for users, and fosters a more connected academic ecosystem.

VII. CHALLENGES AND CONSIDERATIONS

While blockchain technology offers numerous advantages for digital rights management, its implementation in library systems is not without significant challenges. These obstacles must be carefully considered when evaluating the feasibility and sustainability of blockchain-based DRM solutions.

➤ *Scalability Issues*

Public blockchains, such as Ethereum or Bitcoin, often face performance limitations due to their consensus mechanisms, which can slow down transaction speeds. For libraries dealing with large volumes of digital content and frequent user access—such as downloading, borrowing, or streaming—these delays can become a major bottleneck. Slow transaction processing may affect user experience and limit the scalability of blockchain-based systems for high-demand library environments.

➤ *Legal Uncertainties Around Smart Contracts*

Smart contracts, while technically reliable and enforceable within blockchain networks, exist in a legal gray area in many jurisdictions. Not all countries recognize smart contracts as legally binding, especially in cases of contract disputes or intellectual property rights enforcement. Libraries that rely on smart contracts to manage access and licensing may face challenges if local laws do not provide clear legal frameworks for resolving conflicts or upholding automated agreements (Lemieux, 2016).

➤ *Cost and Technical Complexity*

Implementing a blockchain solution requires significant technical infrastructure, specialized expertise, and ongoing maintenance. Many libraries, particularly those in public or underfunded academic institutions, may lack the financial resources or trained personnel needed to develop, deploy, and manage blockchain-based DRM systems. This barrier to entry can limit the adoption of blockchain to only well-resourced institutions, potentially widening the digital divide within the library sector.

➤ *Environmental and Energy Concerns*

Certain blockchain platforms, especially those that use Proof-of-Work (PoW) consensus mechanisms, consume vast amounts of computational power and energy. This high energy

consumption raises environmental sustainability concerns, particularly for libraries committed to eco-friendly practices. As digital sustainability becomes a growing priority, the energy footprint of blockchain technology could become a deterrent to its widespread adoption in library systems.

VIII. FUTURE DIRECTIONS

To successfully integrate blockchain into Digital Rights Management (DRM) systems, libraries must approach implementation with a strategic, collaborative, and forward-thinking mindset. The following recommendations outline key actions that can guide libraries in adopting blockchain effectively and sustainably.

➤ *Develop Industry-Wide Standards for Blockchain Licensing*

A major barrier to blockchain adoption is the absence of universally accepted standards for how digital content should be licensed and managed on a blockchain. To ensure interoperability, fairness, and legal compliance, library consortia, academic institutions, and technology experts must work together to create standardized licensing models that can be implemented across platforms. These standards should define terms for content access, user rights, attribution, and usage tracking in a way that aligns with both legal frameworks and the mission of equitable information access.

➤ *Foster Collaborations Between Libraries, Publishers, and Blockchain Developers*

Implementing blockchain-based DRM is not task libraries can undertake alone. Successful adoption will require strong partnerships with content providers, technology vendors, and blockchain developers. These collaborations can help align technical capabilities with the specific needs of libraries, such as metadata management, long-term digital preservation, and ethical content use. By involving publishers early in the process, libraries can also help shape more flexible licensing models that prioritize access over profit, particularly in educational contexts.

➤ *Provide Training for Library Staff on Emerging Technologies*

A shift to blockchain-based systems demands new skill sets, especially in areas like smart contracts, distributed ledger management, and data security. Libraries should invest in professional development programs to equip their staff with the necessary knowledge and competencies. Training can take the form of workshops, online courses, certifications, or collaborative learning projects. Empowering staff with technological fluency will not only ease the transition to blockchain-based DRM but also foster innovation and leadership in digital transformation initiatives.

➤ *Implement Pilot Projects to Evaluate Feasibility and Cost-Effectiveness*

Before scaling blockchain across entire collections, libraries should begin with small-scale pilot projects focused on

specific use cases—such as licensing e-books, managing digital archives, or tracking open-access journal usage. These pilots can help institutions test the practicality, user experience, and return on investment of blockchain systems. Evaluating results from these experiments will provide valuable insights into cost, performance, integration challenges, and user adoption, guiding more informed and strategic decision-making for broader implementation.

These proactive steps will enable libraries to harness the transformative potential of blockchain while mitigating risks. With thoughtful planning and collaboration, blockchain can evolve from a promising technology to a practical solution for securing and managing digital content in the 21st-century library.

IX. CONCLUSION

Blockchain technology holds significant promise for revolutionizing Digital Rights Management (DRM) in libraries by introducing a system of decentralized control, transparent licensing practices, and automated governance of digital access. Unlike traditional DRM systems, which often rely on centralized servers and proprietary software, blockchain offers an open and tamper-proof infrastructure where every transaction—from content acquisition to user access—is securely recorded and verifiable. This transparency not only enhances trust between libraries, content creators, and users but also reduces the administrative burden of manually managing licenses and user permissions.

By leveraging smart contracts, libraries can enforce licensing terms automatically, ensuring compliance with minimal human oversight. This creates opportunities for more flexible and user-friendly access to digital collections, especially in academic and research settings where timely and equitable access to information is essential. Additionally, blockchain's immutable nature provides a strong foundation for intellectual property protection, which is particularly relevant in an era of rapid digital content proliferation and concerns over plagiarism, piracy, and misuse.

However, despite these advantages, several challenges must be addressed before blockchain can be widely adopted in the library sector. Issues such as scalability limitations on public blockchain networks, unclear legal recognition of smart contracts, high implementation costs, and environmental concerns related to energy consumption remain significant barriers. These concerns underscore the importance of careful planning, infrastructure investment, and regulatory awareness when considering blockchain integration.

As such, ongoing research, pilot projects, and cross-sector collaboration will be crucial in evaluating the long-term feasibility and effectiveness of blockchain-based DRM solutions. Libraries, in partnership with publishers, developers, and policymakers, must continue exploring how this

technology can be tailored to meet the unique demands of digital information stewardship. If these challenges are met with innovative solutions and cooperative strategies, blockchain has the potential to become a transformative force in how libraries manage, share, and protect digital content in the future.

REFERENCES

- [1]. De Filippi, P., & Wright, A. (2018). *Blockchain and the law: The rule of code*. Harvard University Press.
- [2]. Jirgensons, M., & Kapenieks, J. (2018). Blockchain and the future of digital learning credentialing. In *Proceedings of the International Scientific Conference on Society, Integration, Education* (Vol. 5, pp. 44–52). Rēzeknes Tehnoloģiju akadēmija.
- [3]. Lemieux, V. L. (2016). Trusting records: Is Blockchain technology the answer? *Records Management Journal*, 26(2), 110–139. <https://doi.org/10.1108/RMJ-12-2015-0042>
- [4]. San José State University School of Information. (2019). *Blockchain Technology: A New Era of Archival and Library Records Management*. Retrieved from <https://ischool.sjsu.edu/blockchain>
- [5]. Tapscott, D., & Tapscott, A. (2016). *Blockchain revolution: How the technology behind bitcoin is changing money, business, and the world*, Penguin.
- [6]. Zyskind, G., Nathan, O., & Pentland, A. (2015). Decentralizing privacy: Using blockchain to protect personal data. In *2015 IEEE Security and Privacy Workshops* (pp. 180–184). IEEE. <https://doi.org/10.1109/SPW.2015.27>