



## ACCOUNTING AND TAXATION

### ОБЛІК І ОПОДАТКУВАННЯ

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#### INTEGRATION OF BLOCKCHAIN TECHNOLOGY INTO ACCOUNTING AND AUDITING PROCESSES OF DIGITAL ASSETS

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**Summary.** *The article explores the theoretical and practical aspects of integrating blockchain technology into the accounting and auditing system of digital assets within the context of the global digital transformation and the transition to the Web 3.0 economy. It reveals the essence of blockchain as a multi-level information technology capable of ensuring transparency, immutability, and reliability of financial data without intermediaries. The purpose of the study is to substantiate the theoretical foundations and practical approaches to integrating blockchain technology into the accounting and auditing system of digital assets, determine its impact on the reliability, transparency, and efficiency of financial reporting, and identify the advantages and challenges associated with the implementation of decentralized registries in modern accounting and auditing practice. The key barriers to implementation are identified, such as the lack of unified legal regulation, integration difficulties with traditional accounting systems, and issues of confidentiality and technological dependence. The article proposes a conceptual model of an innovative blockchain-based accounting and auditing structure that includes technological, informational, functional, methodological, analytical, organizational-managerial, and legal subsystems. It substantiates that blockchain implementation enables automation of accounting processes, continuous auditing, and unification of financial data in real time. The use of smart contracts is shown to allow automatic recording and verification of business transactions, enhancing control efficiency and reducing the risk of errors or fraud. Special attention is given to the confidentiality of accounting data and the development of hybrid blockchain models that combine public and private segments to balance openness and data protection. The research results demonstrate that blockchain integration in accounting and auditing contributes to the formation of a new paradigm of financial reporting, in which the reliability of information is guaranteed algorithmically rather than administratively. This model creates the foundation for continuous control, increased trust among economic actors, and improved decision-making efficiency. The study concludes that blockchain is not only a technological innovation but also a strategic tool for transforming accounting and auditing systems in the era of the digital economy.*

**Key words:** *blockchain, accounting, auditing, digital assets, smart contracts, transparency, decentralized ledger, financial reporting, Web 3.0.*

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#### ІНТЕГРАЦІЯ ТЕХНОЛОГІЇ БЛОКЧЕЙН У ПРОЦЕСИ ОБЛІКУ Й АУДИТУ ЦИФРОВИХ АКТИВІВ

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**Резюме.** *Досліджено теоретичні та практичні аспекти інтеграції технології блокчейн у систему бухгалтерського обліку та аудиту цифрових активів у контексті цифрової трансформації економіки та переходу до моделі Web 3.0. Метою дослідження є обґрунтування теоретичних засад і практичних*

підходів до інтеграції технології блокчейн у систему бухгалтерського обліку та аудиту цифрових активів, визначення її впливу на достовірність, прозорість і ефективність фінансової звітності, а також виявлення переваг і викликів, пов'язаних із впровадженням децентралізованих реєстрів у сучасну облікову та аудиторську практики. Розкрито сутність блокчейну як багаторівневої інформаційної технології, здатної забезпечити прозорість, незмінність і достовірність фінансових даних без залучення посередників. Визначено ключові проблеми, що стримують широке впровадження технології, серед яких – відсутність єдиної нормативної бази, складність інтеграції з традиційними обліковими системами, ризики конфіденційності та технологічної залежності. Запропоновано концептуальну модель інноваційної структури обліку й аудиту на основі блокчейну, що включає технологічну, інформаційну, функціональну, методологічну, аналітичну, організаційно-управлінську підсистеми. Обґрунтовано, що впровадження блокчейну забезпечує автоматизацію бухгалтерських процесів, можливість безперервного аудиту та уніфікацію фінансових даних у режимі реального часу. Окрему увагу приділено питанню конфіденційності облікових даних і розвитку гібридних моделей блокчейну, які поєднують публічні та приватні сегменти з метою забезпечення балансу між відкритістю і захистом комерційної інформації. Результати дослідження свідчать, що інтеграція блокчейну в бухгалтерський облік і аудит сприяє формуванню нової парадигми фінансової звітності, у якій достовірність інформації гарантується алгоритмічно, а не адміністративно. Така модель створює передумови для розвитку безперервного контролю, зміцнення довіри між суб'єктами економічних відносин та підвищення ефективності управлінських рішень. Зроблено висновок, що блокчейн є не лише технологічною інновацією, а й стратегічним інструментом трансформації системи обліку та аудиту в умовах цифрової економіки.

**Ключові слова:** блокчейн, бухгалтерський облік, аудит, цифрові активи, смартконтракти, прозорість, децентралізовані реєстри, фінансова звітність, Web 3.0.

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**Problem statement.** The modern financial system is undergoing profound transformations under the influence of the digitalization of the economy. One of the most significant innovations of recent decades has been blockchain – a distributed data registry that ensures transparency, immutability, and authenticity of information without the need for intermediaries. Research shows that 77% of company executives worldwide are convinced that blockchain technology will become a «driving force for revolutionary change» in their industries over the next five years. This indicates a growing awareness of its potential to transform various sectors of the economy. In addition, analytical forecasts indicate that the use of blockchain could significantly increase global GDP – by an estimated \$1.76 trillion by 2030, underscoring its significant economic impact [1]. The potential of blockchain has gone far beyond cryptocurrencies and is gradually being integrated into the fields of accounting, auditing, financial reporting, and digital asset management. In the context of the global economy's transition to the Web 3.0 model, where data and digital resources are becoming new objects of ownership, the question of the role of blockchain in digital asset accounting is becoming particularly relevant [2]. Digital assets such as cryptocurrencies, tokens, non-fungible tokens (NFTs), digital rights, or assets based on smart contracts create new challenges for traditional accounting systems. They require a review of approaches to the recognition, measurement, storage, and control of such assets. In this context, blockchain is not only a technological innovation but also a methodological basis for building a new architecture of accounting processes, where transparency and automation can provide a new level of trust in financial interactions.

**Analysis of recent research and publications.** The issue of implementing blockchain technology in the field of accounting has attracted increasing attention in academic circles in recent years. The growing interest is driven by the development of the digital economy and decentralized financial systems, which require a reconsideration of traditional accounting methods. A review of scholarly literature shows that research in this area covers both theoretical and applied aspects, ranging from defining the essence of blockchain technology to analyzing the possibilities of its integration into existing accounting systems, as well as the formation of new financial reporting standards.

The studies conducted by D. Tapscott and A. Tapscott define blockchain as a fundamental tool of the digital era, capable of transforming the ways information is stored, transmitted, and verified [3]. They consider blockchain not only as a financial technology, but also as a new architecture of trust that can be applied in accounting, auditing, logistics, and public administration. M. Swan notes that blockchain is a multifunctional and multi-layered information technology designed to ensure reliable accounting of various assets. According to her, this technology has the potential to encompass all areas of economic activity and find application across numerous industries [4].

Among contemporary international scholars who study blockchain in the context of accounting, the works of M. Attaran and A. Gunasekaran deserve particular attention [5]. Their research highlights the potential of blockchain technology to enable continuous auditing, automate financial reporting, and enhance the level of trust between counterparties. In particular, E. Bonsón and M. Bednárová emphasize that blockchain can function not only as a tool for recording transactions, but also as an independent control mechanism that ensures the reliability and immutability of accounting data without the need for external auditing [6].

A significant contribution to the development of theoretical approaches to the application of blockchain technology has been made by domestic scholars, including H. V. Nashkerska [7], O. Yaroshchuk and I. Belova [8], as well as A. P. Shot, V. M. Andrusyak, and M. V. Yatsko [9]. In their studies, Ukrainian researchers consider blockchain technology as a promising direction in the evolution of accounting. They emphasize that decentralized accounting systems may form the basis for the development of new reporting models capable of presenting financial information in real time.

A common trend can be observed in scholarly research, namely the recognition that blockchain technology has the potential to fundamentally transform the methodological foundations of accounting. The majority of authors emphasize three key characteristics: the immutability of records, the transparency of transactions, and the possibility of automating accounting procedures through smart contracts. These features make it possible to consider blockchain as a foundation for building a “smart accounting” system, in which information is created, verified, and stored automatically, without the involvement of intermediaries.

Thus, the analysis of scholarly sources indicates that the application of blockchain technology in the accounting of digital assets is an interdisciplinary issue that requires a comprehensive approach. Despite the substantial body of research, a unified concept for integrating blockchain into accounting systems has not yet been established. Most scholars agree that blockchain technology represents a powerful tool for ensuring transparency and trust in financial relationships; however, its effective implementation requires further improvement of the legal, organizational, and methodological foundations of accounting.

**Purpose of the study.** The purpose of this study is to substantiate the theoretical foundations and practical approaches to integrating blockchain technology into the system of accounting and auditing of digital assets, to determine its impact on the reliability, transparency, and efficiency of financial reporting, as well as to identify the advantages and challenges associated with the implementation of decentralized ledgers in contemporary accounting and auditing practice.

**Task Statement.** To achieve the purpose of the study, it is necessary to accomplish the following objectives: to examine the possibilities of integrating blockchain technology into traditional accounting systems, in particular the methods of interaction between decentralized ledgers and existing accounting software platforms; to identify the risks and challenges associated with the implementation of blockchain in financial and accounting processes, including issues related to data confidentiality.

The achievement of these objectives will make it possible to develop a comprehensive scientific framework for the implementation of blockchain technologies in accounting and

auditing, contribute to enhancing the transparency of financial reporting, strengthening trust among market participants, and forming an efficient system for managing digital assets in the context of the development of the Web 3.0 economy.

**Presentation of the main research material.** Digital assets are understood as objects that exist exclusively in digital form and possess economic value. These include cryptocurrencies, tokens, non-fungible tokens (NFTs), tokenized securities, digital rights, and other similar assets. Unlike traditional financial assets, digital assets lack a physical form, and their value is determined by market demand, limited supply, utility within a digital ecosystem, and users' trust.

The key challenge in accounting for digital assets lies in the absence of a clearly defined regulatory framework. International Financial Reporting Standards do not provide an unambiguous definition of crypto-assets. In most cases, they are treated as intangible assets in accordance with IAS 38; however, in certain circumstances, tokens may exhibit characteristics of financial instruments or inventories. This creates reporting inconsistencies and highlights the need to harmonize accounting approaches with emerging forms of economic activity [10].

The use of blockchain technology enables the automation of accounting for digital assets: each transaction can function as an accounting entry, while smart contracts may serve as a mechanism for the double recognition of changes in the balance sheet. In this way, blockchain facilitates the formation of a new type of accounting system – so-called smart accounting.

The integration of blockchain into accounting systems implies a radical transformation of the methodology for working with financial data, as it alters the very logic of generating, processing, and storing accounting information. Traditional accounting systems are based on centralized databases, where each business transaction is recorded in the accounting registers of a specific economic entity. Such architecture presupposes the existence of a system administrator authorized to modify, verify, and store information. In contrast, blockchain establishes a decentralized structure in which the authority to validate transactions belongs not to a single participant but to the entire network. Each transaction undergoes a verification process using cryptographic algorithms, and its results are recorded in a distributed ledger, ensuring the immutability and authenticity of accounting data.

Such a model makes it possible to replace centralized databases with distributed ledgers in which all business transactions are stored as network-validated records confirmed through consensus mechanisms. This ensures full traceability of financial flows and assets, making the falsification of reports or concealment of transactional information virtually impossible. At any given moment, all system participants have access to the same version of data, while any changes are immediately reflected in the shared blockchain. As a result, an environment of absolute trust is created, where the reliability of information is ensured not by the authority of a supervisory body but by mathematical and cryptographic principles.

In the accounting context, blockchain can perform the function of a «digital accounting ledger», where each block represents an analogue of a page in an accounting journal, and each transaction serves as an accounting entry validated by all parties involved. This enables accounting data to be generated at the very moment a transaction occurs, thereby eliminating the time lag between an economic event and its reflection in financial statements. Such an approach significantly enhances the timeliness of managerial decision-making, as managers gain access to up-to-date financial information in real time.

Blockchain also guarantees the principle of record immutability, which is of particular importance for auditing purposes. Once a transaction is added to the blockchain, it cannot be altered or deleted without the consent of the majority of network participants. This makes the audit process not only faster but also more objective, as verification can be carried out directly

on the basis of an open and transparent transaction ledger. Consequently, the role of the auditor is gradually transformed: instead of acting as a controller who verifies past transactions, the auditor becomes an analyst who assesses risks, behavioral patterns, and the efficiency of financial processes in real time.

An essential component of blockchain integration is the use of smart contracts. These are programmable codes that automatically execute contractual terms once predefined conditions are met. Within accounting systems, smart contracts can enable the automatic posting of transactions, calculation of tax liabilities, and recognition of revenues or expenses without direct human intervention. For example, when a digital asset is sold, the system can automatically update accounting records, generate primary documentation, and reflect changes in the balance sheet. In this way, blockchain facilitates the transition from ex post accounting to real-time accounting, where the system itself becomes an integrated element of financial management [11].

Equally significant is the impact of blockchain on internal control and corporate governance. The decentralized nature of the system ensures transparency of interactions among all participants in the business process, from suppliers to investors. Each transaction can be traced back to its source, which reduces the risks of fraud, manipulation, and unauthorized changes to financial reports. In the event of disputes, blockchain enables precise identification of the sequence of events and the parties responsible for specific actions.

Furthermore, blockchain integration contributes to the standardization of accounting procedures. In traditional accounting systems, different organizations may use proprietary data formats, which complicate the consolidation of financial statements. The use of blockchain protocols allows for the unification of record structures, making data exchange among companies, auditors, and regulatory authorities significantly more efficient. In the long term, this may lead to the formation of a global financial reporting network in which information is available in a standardized format, thereby simplifying regulation and macroeconomic analysis.

From a technical perspective, blockchain integration requires the development of new accounting platforms capable of operating with distributed ledgers. This involves not only changes in software solutions but also a fundamental rethinking of accounting system architecture. Such platforms must ensure interoperability between different types of blockchain networks, support smart contracts, and comply with requirements for the protection of commercial and personal data. One promising direction is the development of private (permissioned) blockchains, where access to data is restricted to authorized users, allowing transparency to be combined with confidentiality requirements.

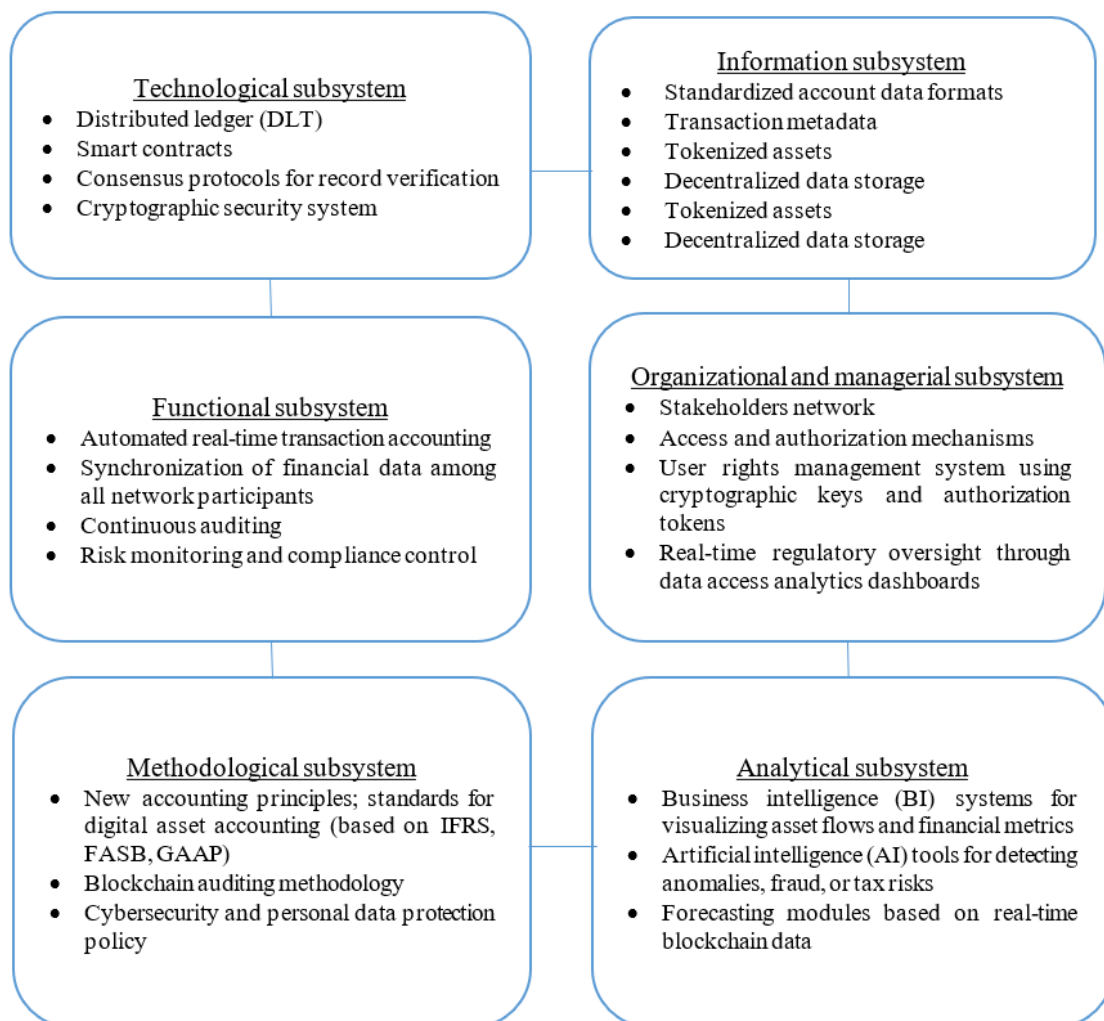
In terms of economic efficiency, the integration of blockchain into accounting systems can significantly reduce costs associated with processing and verifying financial data. The reduction of intermediaries, automation of processes, and elimination of duplicated accounting records lead to resource optimization and increased productivity of accounting personnel. Moreover, blockchain helps minimize the risk of human error, as information processing is performed automatically based on algorithms that are not subject to emotional or subjective influence.

Thus, the integration of blockchain into accounting systems represents not merely a technological innovation but a systemic transformation that reshapes the very philosophy of accounting. Instead of centralized data management, a decentralized ecosystem emerges in which the reliability, transparency, and timeliness of information are ensured algorithmically rather than administratively. This not only enhances trust among financial market participants but also creates a foundation for the development of a new model of corporate governance, where information becomes a strategic asset available for analysis, forecasting, and informed managerial decision-making.

In addition, blockchain supports the development of the concept of continuous auditing, whereby auditors gain access to up-to-date data in real time. This enables the timely detection of anomalies, assessment of companies' financial conditions, and strengthening of trust between investors and businesses.

An innovative model of accounting and auditing for digital assets based on blockchain technology is presented in Figure 1.

This model represents an integrated system that combines technological, informational, analytical, methodological, and legal subsystems to ensure the transparency and reliability of financial data. It involves the use of smart contracts, distributed ledgers, and automated audit processes to perform real-time control. Such a structure contributes to enhancing the efficiency of digital asset management, reducing risks, and fostering trust among all participants in the economic system.



**Figure 1.** Innovative Structure of Accounting and Auditing of Digital Assets Based on Blockchain Technology

Developed by the author.

Despite its obvious advantages, the implementation of blockchain in accounting faces a number of challenges. The most significant is the legal aspect. In most countries, legislation does not provide clear provisions regarding the legal status of blockchain and digital assets. The

absence of unified standards complicates the harmonization of accounting approaches and creates risks of double interpretation of transactions. Another challenge is the complexity of integrating blockchain into existing accounting systems. Most accounting software is built on a centralized architecture, and transitioning to distributed solutions requires substantial financial and organizational resources. Additionally, compatibility with existing reporting and auditing standards must be ensured.

The issue of confidentiality also remains relevant. Although blockchain provides a high level of transaction transparency, excessive openness may be undesirable for corporate accounting [12]. In public blockchain networks such as Bitcoin or Ethereum, information about all transactions is available for viewing by any network participant. While the data is encrypted and participants are identified only via cryptographic addresses, the transaction structure itself allows tracing relationships between wallets and transaction volumes. For businesses seeking to maintain commercial and financial secrecy, such transparency presents certain risks, as analytical reverse engineering can reveal business relationships between companies even in the absence of direct identification.

The challenge of confidentiality in blockchain accounting lies in balancing openness, which ensures trust, with data protection, which guarantees organizational security and competitiveness. For this reason, current research and practice increasingly discuss the development of hybrid models combining public and private blockchains. In such systems, core transaction information may be stored on a public blockchain to confirm the authenticity of operations, while detailed data remains in a private segment of the network accessible only to authorized users.

A hybrid model preserves the key advantages of blockchain – immutability and verifiability of data – while controlling access to sensitive information. For example, in corporate accounting, only the transaction hash (cryptographic fingerprint) may be recorded on the public ledger, while its content, counterparties, and financial metrics are stored in a secure corporate database. This ensures the verification of business transactions without disclosing commercial secrets [13]. Such an approach combines the principle of «transparent reliability» with the need to maintain the confidentiality of financial data.

In addition to hybrid blockchains, encryption technologies and zero-knowledge proof (ZKP) protocols are actively applied to protect information. These protocols allow a participant to prove the validity of a fact (e.g., the correctness of an accounting entry or the existence of an asset) without revealing the underlying information. This enables the creation of decentralized accounting systems that guarantee both verification transparency and complete confidentiality of financial data. Similar solutions are already being implemented in corporate blockchain platforms such as Hyperledger Fabric, Quorum, and Corda, which are specifically designed for the financial sector and corporate governance.

Special attention in the context of confidentiality concerns the protection of personal data. In compliance with international legislation, including the European Union's General Data Protection Regulation (GDPR), companies are required to ensure the ability to delete or modify personal user data. However, the immutability of blockchain complicates this principle, as information recorded in the blockchain cannot be altered or deleted. To address this conflict, the concept of the «right to be forgotten via reference» is applied, whereby only a cryptographic key to the data is stored on the blockchain, while the actual data can be deleted or modified in external storage. This approach maintains a balance between the immutability of accounting records and legal compliance requirements.

Another aspect of confidentiality concerns controlling access to information. In traditional accounting systems, access rights are determined administratively through user accounts. In blockchain-based accounting, this process is implemented using cryptographic mechanisms – digital signatures and authorization tokens. Each participant possesses a unique cryptographic key, which not only identifies them within the system but also specifies the data to which they have

access. This creates a flexible yet strictly controlled information management model, in which any unauthorized intervention is immediately recorded in the ledger.

It is also important to understand that confidentiality is closely linked to trust in the data source. In public blockchains, trust is established algorithmically through consensus mechanisms, whereas in corporate systems, trust is generated through internal security policies, audits, and participant certification. For this reason, the concept of a permissioned blockchain – a blockchain with restricted access – is increasingly adopted in business environments. In such systems, only verified users can participate in transaction verification and block creation. This approach allows maintaining confidentiality while preserving blockchain's technological advantages: data integrity, immutability, and reliability.

Beyond technical considerations, confidentiality has a strategic dimension. For companies, it is crucial not only to store data but also to control who, when, and for what purpose can access it. Blockchain technologies enable the implementation of the audit trail principle – a continuous digital record that logs every interaction with the data. This ensures full transparency of the access process and enhances user accountability. Such an approach is especially important for auditors and regulators, who can verify the accuracy of accounting operations without directly interfering with confidential corporate databases.

**Conclusions.** Blockchain opens a new era in the development of accounting, providing a technological basis for transparency, reliability and automation of accounting processes. Its implementation allows you to create systems in which financial data is recorded automatically, and reporting is generated in real time. For digital assets, this means the emergence of a reliable mechanism for their recognition, evaluation and control. However, effective integration of blockchain requires resolving regulatory, methodological and technical issues. It is necessary to develop unified standards for accounting for digital assets, harmonize them with international requirements and ensure a balance between transparency and data confidentiality. In the future, blockchain will become an integral part of the global financial infrastructure, and accounting will be transformed into an open, automated and trusted system that meets the challenges of the development of the Web 3.0 economy. Solving the problem of confidentiality in blockchain accounting requires a combination of technical, legal and organizational mechanisms. The development of hybrid models and private blockchains, the implementation of zero-disclosure protocols, and the use of tokenized access rights are key directions for the formation of a secure digital accounting environment. In the future, these solutions will become the basis for building a new generation of corporate financial reporting systems that combine transparency, reliability, and data protection at a level unattainable for traditional centralized systems.

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