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Incorporating Triple Entry Accounting as an Audit Tool—Enhancing Modern Accounting Systems

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Abstract: Despite the advancements in modern accounting systems, fraud remains a prevalent issue, necessitating extensive time and financial resources for audits. Integrating modern accounting ledgers with a public blockchain could facilitate easily verifiable accounting records, streamlining the audit evidence gathering and analytics process. Continuous audits could become feasible through readily available audit evidence from the public blockchain. The proposed audit solution aims to establish verifiable "Financial Fingerprints" (signed indexes) for each accounting entry, subsequently publishing them to specific addresses on the public blockchain. This initiative seeks to structure accounting ledgers in a Triple Entry Accounting format, where the third entry involves notarizing an index of each accounting entry on the public blockchain. The essence of Triple Entry Accounting lies in its atomicity, ensuring a single authoritative set of books. Any attempt to present an alternative set of books would be automatically detected. The approach to achieving this objective can be articulated through two value propositions. Firstly, Triple Entry Accounting offers a means to establish a provable official set of books, providing market access independent of network effects. Secondly, it aims to dismantle data silos by leveraging the blockchain as a shared ledger, thereby assisting auditors in efficiently gathering adequate audit evidence. With its standalone value proposition, Triple Entry Accounting offers benefits even before the network effect comes into play, leading to the development of an open standardized protocol for implementing it as an extension to modern accounting systems.

Keywords: triple entry accounting; continuous audit; public blockchain; shared ledger; financial fingerprint

1.Introduction

Initially, this paper elucidates how triple entry accounting (TEA) can offer intrinsic value independently of the need for concurrent adoption by others. The primary value proposition of TEA is to establish an incontrovertible official set of books, which serves as a gateway for TEA to penetrate the market. The paper contributes by delineating a protocol for the first value proposition ("Financial Fingerprint Type 1"), outlining its practical implementation and compatibility with existing modern accounting systems. The technical mechanisms required to achieve this are referenced throughout the

paper, primarily focusing on a two-party approach involving the user and a public ledger (blockchain) attestation of a ledger root. Secondly, as the network effect of triple entry accounting expands, it becomes easier for companies to reconcile their sub-ledgers against each other using the blockchain as a shared ledger. The second value proposition of triple entry accounting aims to dismantle data silos, thereby assisting auditors in gathering sufficient audit evidence. This paper further contributes by outlining a protocol ("Financial Fingerprint Type 2") compatible with modern accounting systems, employing a three-party approach between two users and a public attestation, a concept pioneered by Ian Grigg. Todd Boyle's notion of shared repositories from 2001 also influenced this approach. Thirdly, a central objective is to facilitate straightforward integration of triple-entry accounting solutions with existing double-entry systems by linking them to API endpoints. This facilitates practical and widespread adoption by allowing different users to onboard at various times while maintaining the ability to reconcile their accounting records. Fourth, the paper aims to introduce developers and accounting professionals to Triple Entry Accounting and outline practical implementation methods for businesses. Accounting, being one of the oldest forms of information technology, plays a crucial role in decision-making. However, traditional accounting systems have inherent shortcomings, including difficulties in reconciling accounting data between trading parties. This paper explores how indexing all general ledger entries on a public ledger can address these challenges, ensuring data integrity and facilitating reconciliation. To address these limitations, the paper proposes extending modern accounting systems to utilize a shared public ledger, preferably implemented on a blockchain. A blockchain, with its timestamping and immutability features, serves as an effective shared ledger, essential for implementing triple-entry accounting. The genesis of the practical implementation of triple-entry accounting can be traced back to Ian Grigg's paper on triple-entry accounting and the Bitcoin Whitepaper. Todd Boyle's concept of a shared transaction repository and Juan Ignacio Ibañez's research on triple entry accounting also influenced this endeavor. Utilizing a public blockchain offers enhanced security and sustainability due to its inherent characteristics of timestamping and immutability. However, confidentiality concerns arise due to the public nature of blockchains. To address this, the paper proposes writing indexes of general ledger entries to a public blockchain without disclosing the content, thereby preserving privacy while ensuring public verification of ledger integrity. Section 3.3 of the paper proposes an audit solution based on triple-entry accounting, with practical suggestions for linking traditional double-entry accounting software to a triple-entry accounting protocol. Section 2 discusses the concept of triple-entry accounting, while Section 3 focuses on a practical audit solution compatible with modern accounting systems. The paper concludes with a discussion of the regulatory environment for implementing the proposed solution and its implications for auditors. This paper draws heavily on the foundational work of Dr. Craig S. Wright, Ian Grigg, Todd Boyle, and Professor Yuji Ijiri. From Single-Entry Accounting to Double-Entry Accounting: Professor Yuji Ijiri explains the evolution of accounting from single entry to double entry, where the same entry is classified twice to capture both what happened and why it happened. In single-entry accounting, transactions are recorded once, reflecting only what happened. In contrast, double-entry accounting records transactions twice, with one entry describing what happened and the other explaining why it happened. This dual classification provides greater insight into financial transactions and ensures accuracy in accounting records. Terms: The term "double entry" signifies the practice of posting the same entry twice, once to describe what happened and once to explain why it happened. This ensures a comprehensive classification of financial transactions. "Posting" or "entry" refers to adding an item to an accounting ledger or book, which represents a collection of entries related to a specific topic or entity. The term "set of books" encompasses all accounting records associated with a particular entity, traditionally recorded in books but now often stored in digital databases.

2. Triple Entry Accounting

Double-entry bookkeeping not only revolutionized financial data management but also introduced a robust system of checks and balances to uncover errors and deceit. This system, which reconciles the what and why of transactions, acted as a crucial internal control, especially as businesses grew in complexity. By enhancing internal controls, it encouraged honesty by making it easier to spot mistakes and fraudulent activities. However, despite these strides, double-entry accounting still grapples with significant challenges.

One pressing issue is the potential for maintaining multiple sets of books, a practice historically linked with fraudulent activities. Some traders and accountants maintained clandestine records alongside public ones to obscure financial information from authorities or competitors. This practice undermines the credibility of financial data, providing opportunities for manipulation.

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Another notable drawback is the limited accessibility of double-entry accounting records, often confined within isolated data silos. This isolation poses hurdles in verifying the existence of a single, authentic set of books and complicates transaction reconciliations between trading partners.

To tackle these drawbacks, Triple Entry Accounting (TEA) extends the principles of double-entry by introducing a third entry, documented and shared on a public ledger. This additional entry, known as the "Financial Fingerprint," acts as a certified index of double-entry transactions on the blockchain. Through public indexing, enabled by innovative protocols such as Financial Fingerprint Type 1, entities can validate the presence of a singular, authoritative set of records, minimizing the risks associated with maintaining multiple sets.

Furthermore, TEA facilitates the simultaneous publication of transaction entries by multiple parties, leveraging protocols like Financial Fingerprint Type 2. This enables the exchange of pertinent subledger details among trading partners, simplifying agreement verification and assisting auditors in collecting audit evidence.

In addition to upholding the integrity of financial records, Triple Entry Accounting on the public blockchain unlocks a host of novel functionalities. These include seamless inter-ledger reconciliations for audits, optimized data flow for accounting tasks, secure distribution of shared secrets, bolstered data integrity and availability for cybersecurity, and heightened data reliability for machine learning applications. [10].

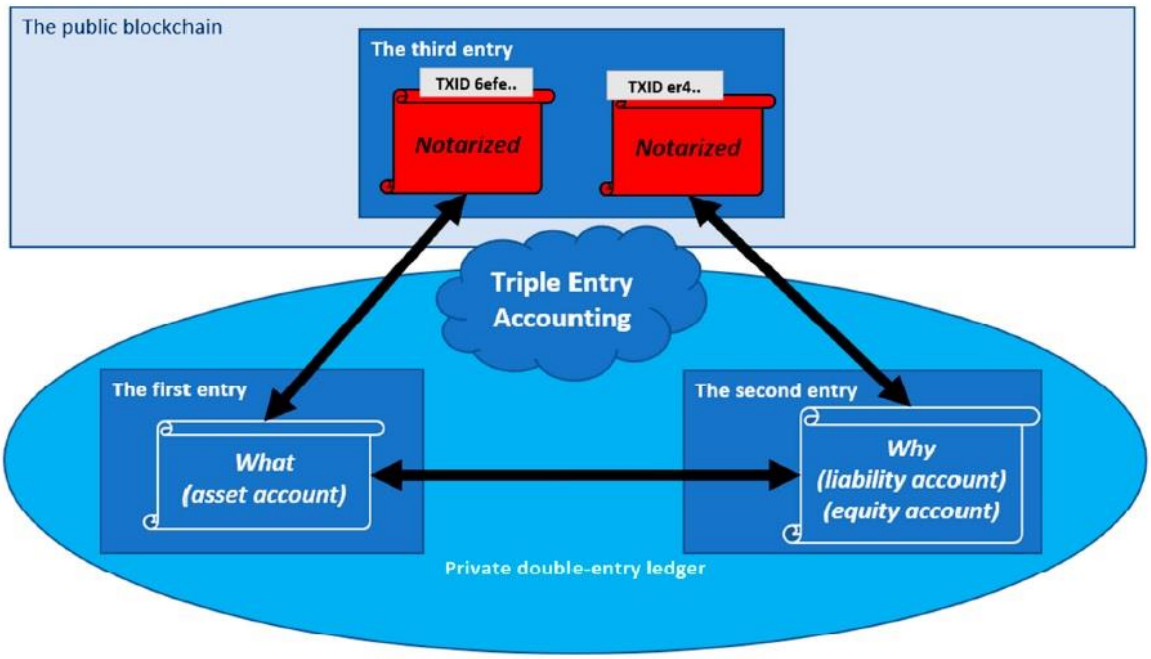

Figure 1. Triple Entry Accounting

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3. Third Dimension

The isolation of double-entry accounting can be addressed by Triple Entry Accounting, which introduces two key features:

1. Verification of a single set of books.

2. Enhanced verifiability through indexed entries on a shared public ledger.

This paper aims to outline how a Triple Entry Accounting protocol can be implemented within existing accounting platforms and explore its potential use for verifiable accounting records and inter-ledger reconciliations as an audit tool.

While previous approaches by Grigg and Boyle suggested Triple Entry Accounting involved shared entries among three parties, our proposal suggests starting with only two parties: a user and a notary, as proving a single set of books offers value. However, as more participants adopt this approach, shared entries between trading partners become reconcilable, evolving Triple Entry Accounting to involve three parties: two trading partners and a notary. This hybrid approach provides value even before widespread adoption, making it a viable entry point for the market and adoption of Triple Entry Accounting. This hybrid dynamic represents a significant contribution to the practical implementation of Triple Entry Accounting from a business perspective, rather than solely a technical one.

The proposed solution aids auditors in gathering sufficient evidence efficiently, speeding up the audit process and enhancing its quality. To facilitate practical and widespread adoption, the solution must accommodate the onboarding of different users (trading partners) at varying times while still enabling reconciliation of accounting records.

In this method, the third entry is generated by (a) creating a unique fingerprint of a double-entry accounting posting, (b) recording it on a shared ledger (the public blockchain), and (c) notifying interested parties accordingly. This process is illustrated in Scheme 1.

4.Proposed TEA Protocol

The isolation inherent in double-entry accounting can be addressed by Triple Entry Accounting, which introduces two key features:

1. Verification of a single set of books.

2. Enhanced verifiability through indexed entries on a shared public ledger.

This paper aims to outline how a Triple Entry Accounting protocol can be implemented within current accounting platforms and explore its application for verifiable accounting records or inter-ledger reconciliations as an audit tool.

A three-party approach involving two users and a public attestation on a public ledger (blockchain) is utilized, employing Financial Fingerprint Type 2. Transactions containing Type 2 Financial Fingerprints can be exchanged between relevant trading parties for reconciliation, forming a tamper-proof, verifiable shared ledger.

Type 2 Financial Fingerprints can be exchanged in various ways, depending on whether a hybrid or full implementation of Triple Entry Accounting is used. In a hybrid implementation, where only one party adopts Triple Entry Accounting initially, a shared "Message" is used instead of a shared secret, facilitating easier onboarding and providing immediate value.

The Type 2 Financial Fingerprint includes a shared message with a trading party, such as an invoice number, to enhance the verifiability of accounting entries indexed on the shared public ledger.

As more actors adopt Triple Entry Accounting, shared entries between trading parties become reconcilable, evolving the concept to involve three parties: two trading partners and a notary. This approach ensures compatibility for future communications capabilities and facilitates a seamless transition to a fully implemented Triple Entry Accounting system..

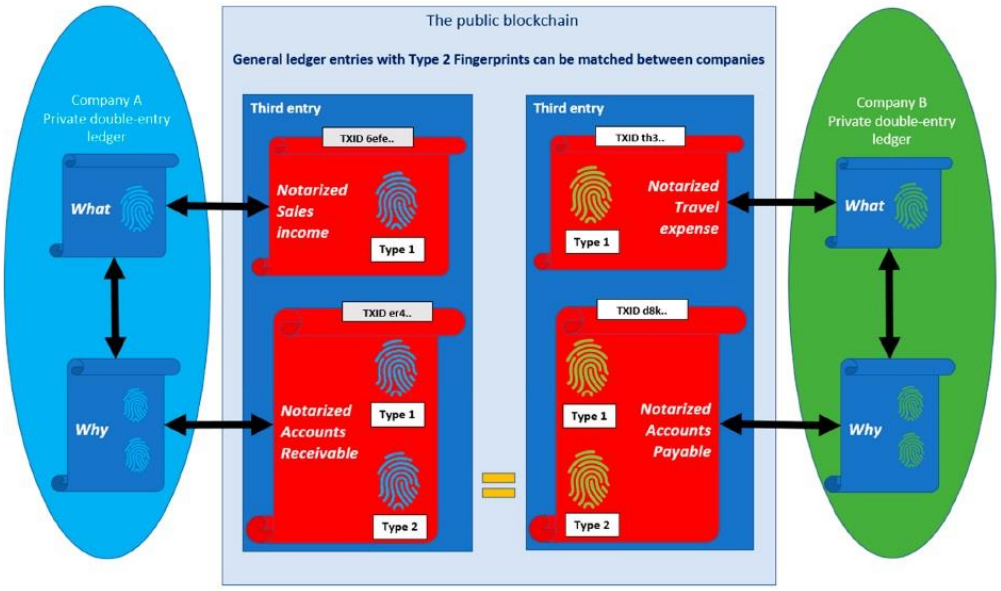

Figure 2. Financial Fingerprints

5. Financial Fingerprints

To streamline the process, the sender of an invoice can include a signed Type 2 Fingerprint along with the invoice itself. The recipient will then generate their Type 2 Fingerprint upon receiving the invoice. For the exchange to be completed, the sender must either (1) be aware of a repository to monitor, (2) receive it through a peer-to-peer method using SPV (Simplified Payment Verification), or (3) request the signed Fingerprint Type 2 from the recipient.

Utilizing SPV and Merkle paths, transactions containing Financial Fingerprints can be easily verified against the block header without the need for extensive blockchain searches. Only the hash needs to be published to the blockchain, minimizing transaction fees and maintaining privacy while still leaving a public record of the event or Fingerprint.

By employing OP_Pushdata and exchanging transaction data in a peer-to-peer manner, businesses can avoid dependency on a single service provider or oracle for fingerprint exchange. They also eliminate the need to scour the blockchain for information or locate matching counterpart fingerprints. While these terms describe advanced blockchain techniques, they are beyond the scope of this paper.

In addition to the Financial Fingerprint, each blockchain transaction will include a signature and PKI (Public Key Infrastructure) certificates. This allows for identity verification without relying on a single intermediary.

In essence, trading partners continually exchange notarized indexes of their supplier and customer sub-ledgers. These indexes, containing Type 2 Financial Fingerprints, can be automatically reconciled against a trading partner's Type 2 Fingerprint. The Type 1 Fingerprint, trusted to belong to the official set of books, derives from the trading partner's publicly announced and attested ledger root through a verifiable derivation path. This path must be confirmed to be legitimate for the posting to be included in their ledger.

6.Customer Shift to Organized Retail

To establish the uniqueness of accounting records, it's essential to imbue them with the attribute of uniqueness. Rooting the ledger is crucial for creating evidence that there exists only one true set of accounting records. Any deviation from the pre-announced root and procedure would indicate the presence of multiple sets of books. Our proposed method of "rooting the ledger" involves the following components:

(a) Publicly posting the root master key in a designated location.

(b) Ensuring this location serves as a "commitment" to the accuracy of the ledger.

(c) Obtaining an attestation confirming that fingerprints will be published according to a publicly pre-announced schema.

(d) Maintaining a ledger of ledgers to track all accounting records.

(e) Performing the aforementioned steps before posting any entries.

(f) Repeating these steps upon onboarding and at the beginning of each new accounting year.

It's important to refer to Appendix A at the end of this paper for further details on this procedure. Rooting the accounting ledger involves a public attestation and the posting of a master key as the "ledger root." This process requires a commitment, which can be validated through a public attestation performed at a government company's registrar or a suitable authority. This attestation notarizes the root key and includes predefined procedures outlining the true set of books. By notarizing the commitment to follow these procedures, each accounting entry indirectly confirms its status as belonging to the official set of books.

7. Conclusion

The proposed solution facilitates the generation of identical Type 2 Fingerprints by two trading parties independently, regardless of time or location. This is possible because the necessary data points are already exchanged between trading partners and logged in modern accounting systems. This streamlined onboarding process enhances the attractiveness of Triple Entry Accounting for reconciliation even before widespread adoption occurs.

There is clear regulatory guidance regarding the use of Triple Entry Accounting. Auditors have the freedom to encourage entities to adopt Triple Entry Accounting and auditing tools without compromising their independence.

Crucially, a primary objective of practical implementation is to ensure seamless onboarding and integration with existing double-entry systems. This is accomplished by integrating the Triple Entry Accounting solution with the API endpoints of current double-entry accounting systems.

It's essential to highlight that the proposed solution allows for flexible onboarding, enabling different users or trading partners to join at various times while still being able to reconcile their accounting records effectively.

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