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Triple Entry Accounting Using Blockchain Technology

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1. Introduction

Fintech, as it is more often known, is a term used to describe emerging technology that aims to enhance and automate the provision of financial services. At its foundation, fintech uses specialised software and algorithms that are employed on computers and, increasingly, smartphones to assist businesses, business owners, and individuals in better managing their financial operations, processes, and lives. The term "financial technology" is combined with the word "fintech."

The word "fintech" was first used to describe the technology used in the back-end systems of established financial institutions when it first appeared in the 21st century. However, since that time, there has been a change towards more consumer-focused services and, thus, a more consumer-focused definition. Several areas and industries, including education, retail banking, fundraising. Fintech also includes the development and use of cryptocurrencies, such as Bitcoin. The traditional international banking sector, with its multi-trillion-dollar market capitalization, continues to be where the big money is, despite the fact that that fintech sector may garner the majority of headlines.

The global financial crisis of 2008 acted as a catalyst for the development of the FinTech industry. At that time, a number of factors combined to give industrialised countries the impetus for post 2008 financial crisis Fintech. Around this time, banks' reputations were seriously damaged, especially in the United Kingdom and the United States. A recent survey found that Americans are more likely to trust technology businesses with their money than banks. The same thing seems to be happening in China, where several peer-to-peer (P2P) lending platforms have chosen to operate without the guidance of a specified regulatory framework. Nonetheless, this does not appear to discourage the millions of moneylenders and money-borrowers who choose this option because of the cheaper cost and potential for purportedly larger profits.

2. What is Blockchain Technology?

Before we understand what Blockchain is, we need to understand what centralized network system is. Centralized systems are nothing but single server which handles all the major operations withing that network. Following diagram shows the basic architecture of centralized network system.

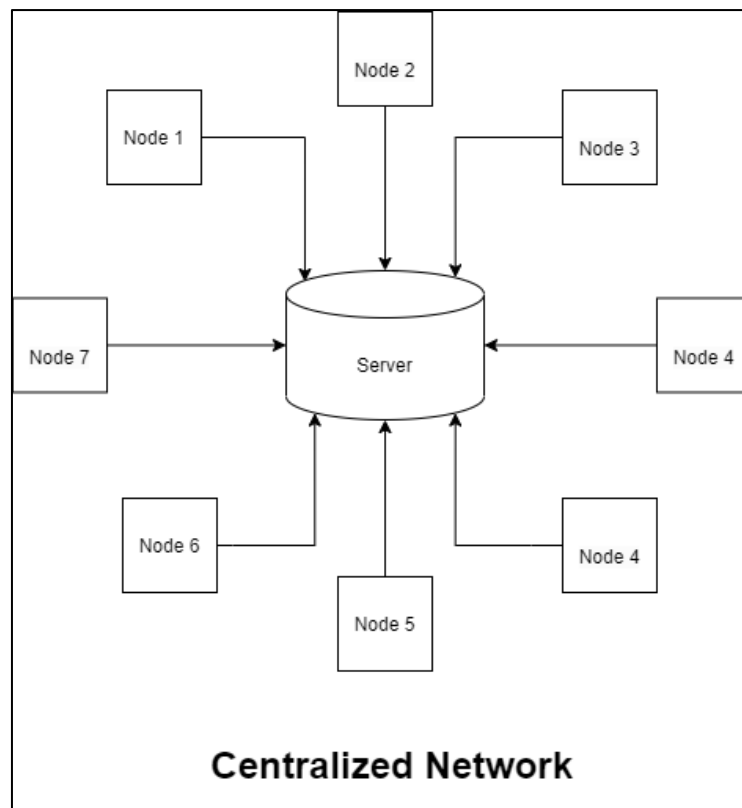


Fig 2.1 Basic Architecture for centralised network system

As we can see from the above diagram all the nodes are connected to one server, if the main server collapse than the entire system will collapse. This is where Blockchain technology is fundamentally different than the centralized system. Blockchain is a decentralized system. Blockchain is a technique for storing data that makes it difficult or impossible for the system to be altered, hacked, or otherwise abused.

A blockchain is a distributed ledger that copies and distributes transactions throughout the blockchain's network of computers. Blockchain technology is a framework for storing public transactional records (sometimes referred to as "blocks") across multiple databases in a network connected by peer-to-peer nodes. This type of storage is commonly referred to as a 'digital ledger'. 'Every transaction in this ledger is validated and protected against fraud by the owner's digital signature, which also serves to authenticate the transaction. As a result, the data in the digital ledger is quite safe. Please refer basic architecture of peer-to-peer blockchain diagram.

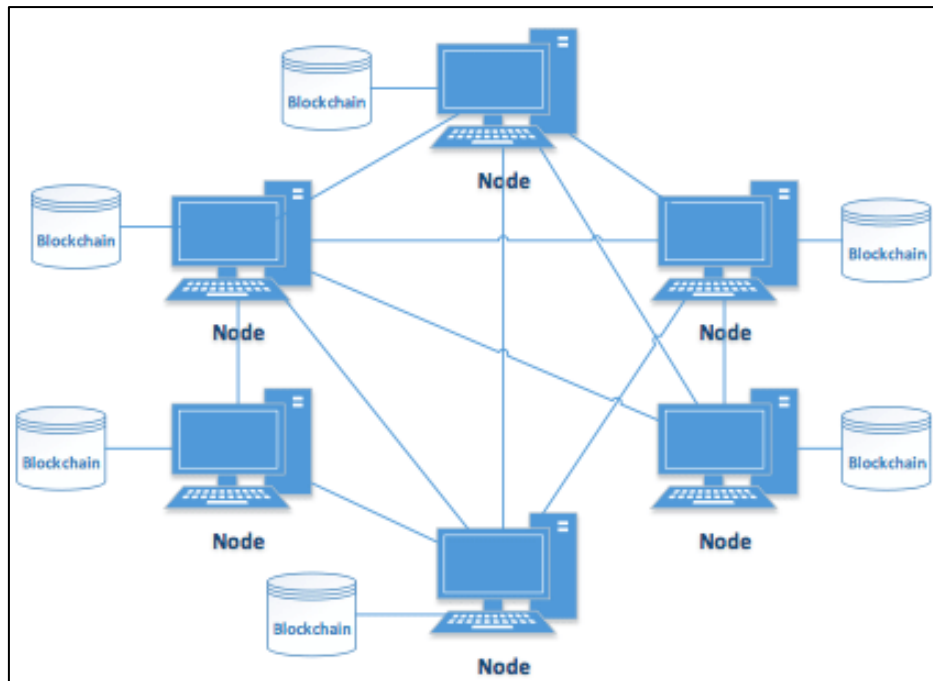
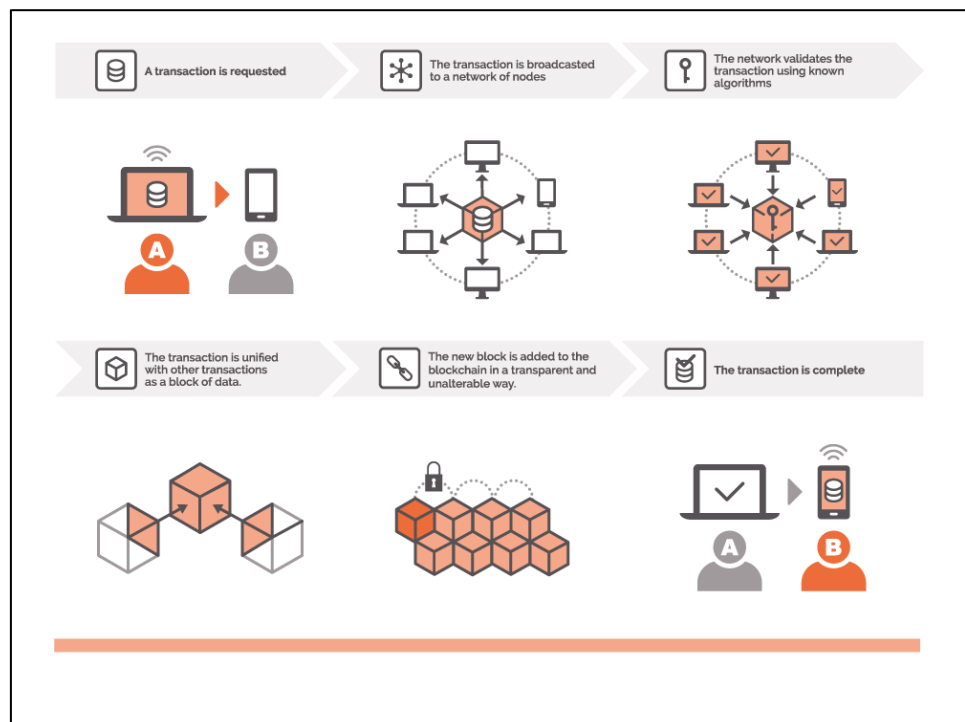


Fig 2.2 Basic architecture of peer-to-peer Blockchain

2.1 Working of Blockchain



Followings are the steps for Blockchain transactions

Step 1: - Assume A and B are two nodes on a blockchain network. Currently, Person A wishes to send 50 Bitcoins (BTC) to Person B using a secure method. This transaction will take place on the blockchain network. Initially, we use public and private key encryption methods to double encrypt the data we want to exchange. There will be a public key and a private key for both A and B.

Step 2: - Once the transaction is requested, it is get broadcasted to all over to the network, and all the users or the node involved in that network will come to know that Person A has requested for the transaction to person B.

Step 3: - Once the transaction is broadcasted the users within that network validates the transaction whether the user has the required amount to send it to the receiver. It is not required for all the user within that network to validate the transaction, little over 50% users approving the transaction is fine for transaction to go ahead. Normally consensus algorithm is used for transaction approval. Proof of Work, Proof of stake are some of them used normally.

Step 4: - Once the transaction is approved it is than added to other transaction as a block of the data.

Step 5: - Once the validated transaction is added as block of the data the transaction is complete and the entire network is auto updated with all the latest transaction added into it.

2.2 Main components of blockchain.

Blockchain technology has lately attracted a lot of interest from the general public and private investors. Global company owners and investors are becoming more aware of the blockchain's greater potential to transform a number of global economic sectors. Following are the key components of blockchain network.

- Nodes
- Ledger
- Wallet
- Nonce
- Hash

Node

Node is nothing but a device which is a part of blockchain network, normally computers or mobile phones are used as a device in order to be a part of blockchain network. Following are the type of nodes.

- Full Node: -
 - Full nodes are the one who has the complete copy of the block chain ledger
 - The full nodes can initiate the transaction and can broadcast the transaction message to all the nodes.
 - Full node has an authority to validate the transaction.
 - A system should have large capacity of memory if it wants to be full node, as full node has entire copy of blockchain data.
- Partial Node

- Partial nodes cannot initiate the transaction and cannot broadcast the transaction message either
- They cannot validate the transaction
- A system doesn't require large capacity of memory as it doesn't contain full copy of blockchain ledger. It only possesses the headers.
- Although light nodes only have a partial blockchain history or copy, they are usually connected to full nodes in some fashion. This makes it easier to maintain their accuracy and ensure their usefulness.

➤ **Ledger**

- A ledger is a physical or digital log that keeps track of financial system transactions. Blockchain networks are a particular kind of decentralised ledger system created for the safe storage of data.
- It is a distributed ledger, which means it is a digital system which can store the transactional data in a multiple node at a same time. Unlike traditional ledger the distributed ledger has no centralized system or administration
- It is public in nature as anyone who is in part of blockchain network can read it and access it.
- Lastly it has a property of immutability which means, any data which are registered cannot be deleted or modified. It will stay within the system forever.

➤ **Wallet**

- A user may store their cryptocurrency in this digital wallet. The blockchain network's nodes each have a wallet. Using public and private key pairs, a blockchain network may maintain the privacy of a wallet.
- Wallet are basically of two types Hot wallet or Cold wallet.
- Hot wallet are online wallets, it is mainly used to do day-to-day transaction, since it is an online wallet it is connected to internet and does it is vulnerable to hacking
- Cold wallet are offline wallets, as they are not connected to internet they are consider as safe options as it will be hard for hacker to hack offline wallet. They are need to be purchased.

➤ **Nonce**

- Nonce stands for "Number only used once". It is basically a number which are added on the hashed of the block in blockchain.
- It is the 32-bit number created at random once that aids in the creation of a new block or the validation of a transaction.
- Finding a number that may be used as a nonce is difficult. A significant degree of trial and error is necessary. A miner first guesses a nonce. Then, it appends the guessed nonce to the hash of the current header. The value is then hashed again, and this hash is compared to the target hash.
- If the appended Nonce value is smaller than the Difficulty level of the block than it satisfies the cryptographic puzzle requirement and the block is added to the network.

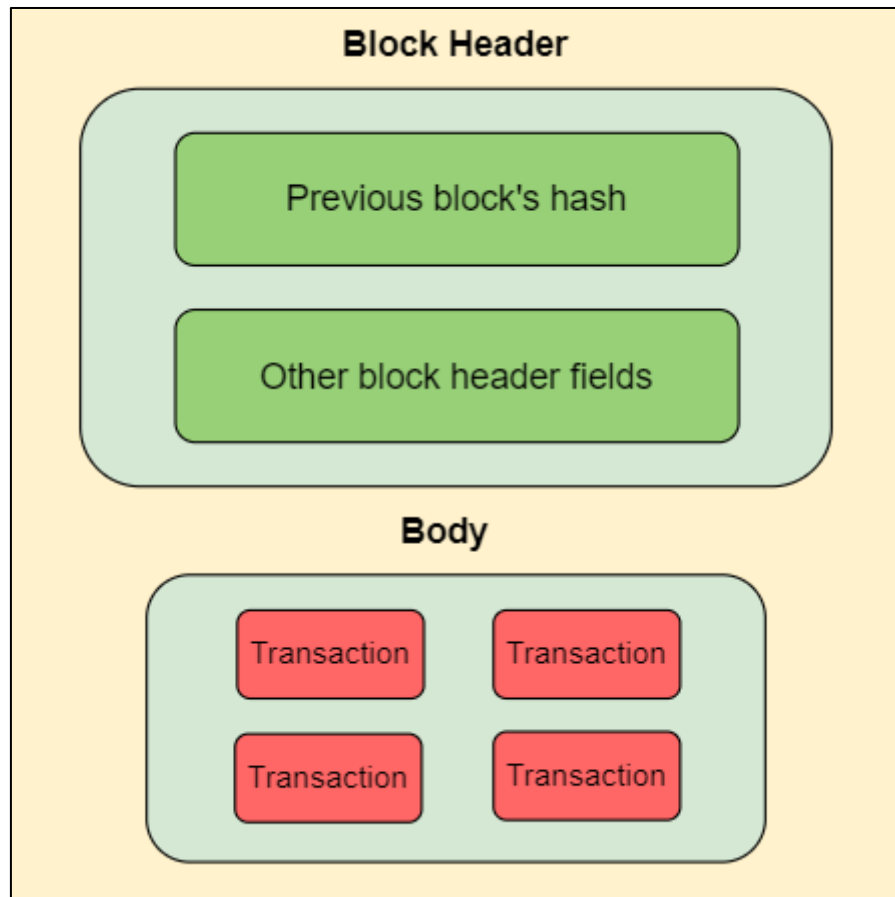
➤ **Hash**

- A hash is a mathematical function that turns an arbitrary length input into a fixed length encrypted output. Hence, its unique hash will always be the same size, regardless of the original quantity of data or file size involved.
- Since hash functions are "one-way," it is impossible to "reverse-engineer" the input from the hashed output.

- Famous SHA-256 technique is used in Blockchain.

2.3 What is inside Block?

Every blockchain has a different block structure. Nonetheless, a block's general structure is as follows



The Block is mainly having two main components.

1. Header
2. Body

➤ Header

Headers are very important in blockchain, as it contains lot of information about the block and the miner. The headers are further subdivided into following components.

Previous Block Hash

In this as the name suggest, contains the hash value for previous blocks. It connects the blocks and makes the data in the previous blocks immutable. The blockchain will unchain if data in earlier blocks is altered, as the hash of that block will also change.

Another Block's header

These fields can change based on the requirements of various blockchains. The following are some of the typical fields:

Nonce: - This is an integer value which the miners try to append in order to solve cryptographic puzzle

Time Stamp: - In this the information related to when the block is created by the miner

Difficulty: It represents the blockchain's current level of difficulty. Each blockchain stores it in a distinct format.

Merkel root hash: Hashes pair off transactions until only one hash remains, called a root hash or a Merkel root hash.

Block height: The number of blocks mined between the genesis block and the current block.

➤ **Body**

It includes all of the data recorded in the block, such as transactions. The format used by each blockchain to store transactions varies. The body of the block contains an array of transactions.

3.0 Accounting in Blockchain

The term accounting is nothing new in fact accounting has been practice since last 6000 years, The single entry accounting was one of very earlier technique the organisations use to use and it is still very much practised in small scale business, Single Entry accounting (SEA) is nothing but maintaining a record of every transaction that an entity or organisation made in a given day, week, month, or year. The cash-based accounting system used by SEA maintains track of all incoming and outgoing funds. In 1400 the Italian mathematician introduced Double Entry Accounting (DEA) system for more transparency and efficiency

3.1 Traditional Double Entry System (DEA)

A double-entry accounting system is used in modern financial accounting. Double-entry accounting enables businesses to retain records that represent what they own and owe, as well as what they earned and spent over a certain time period. The goal is to reduce errors in your bookkeeping such that you only need to make two entries for every transaction you make.

Contrary to the SEA system, the DEA system uses accrual-based accounting. Compared to cash-based accounting, accrual basis accounting offers clearer information on income and expenses over a period of time. For example:- as mention above the DEA system has two accounts debit and credit, if the organisation injects £7000 initially that will be consider as an equity and will enter into credit account, if the organisation took the loan of some £44,000 it becomes liability and will be again entered into credit account, whatever the organisation is buys or receives like cash, inventory, accounts receivable, property and equipment will be entered into debit or asset account, irrespective what and how much the transaction take place, in the end total in the balances sheet between debit account and credit account should be equal. [Please refer fig 3.1]

Double Entry Accounting Equation					
Account	Debit	=	Credit		
	Assets		Liabilities	+	Equity
Cash	£500				
Inventory	£1,000				
Accounts receivable	£4,000				
Property	£54,000				
Plant and Equipment	£7,000				
Account payable			£2,750		
Loan			£44,000		
Capital					£7,000
Retained earning					£12,750
Total	£66,500	=	£66,500		

Fig 3.1 Example of Double entry account system

The problem with the above example is that the several sets of books don't actually relate to one another. Each company has its own copy of the records. Hence it can be easily manipulated with the entries. Also, there is no check on when one particular transaction happens whether that account has that money or was the amount deposited that time or not.

3.2 Drawbacks of Double Entry System

- **Complexity:** - As the system requires two accounts to maintain, it is important for business to match the total from both the end and this need lots of verification and validation of each and every entry which are present in the balance sheet.
- **Time Consuming:** - As you can see in above example the auditor has to validate and verify each and every transaction as it has shown in the balance sheet and it takes huge amount of time and resources
- **No Real Time update:** - Since the balance sheets are further verified by the external auditor it is generally done at the end of the month or quarterly, so it is not possible to have real time update of all the latest transaction.
- **Human Error:** - It is highly possible that some transaction can be misplace or some calculation error can occur.

3.3 Triple Entry Accounting (TEA)

The classic double-entry approach can be improved with triple-entry accounting, in which order counting entries involving external parties are cryptographically sealed by a third party and then placed next to the bookkeeping entries of both parties. The fundamental principle of TEA is that a unilateral transaction entry is made by one party, approved by another party, and confirmed by the operator of the shared transaction repository. Each transaction thus results in a receipt that has been approved by three parties. Regarding single, double, and triple entry systems, respectively, the definition of "entry" varies. A record of a financial transaction is referred to as a "entry" in single entry and double entry systems but in TEA 'entry' means digital signature.

3.4 Working concept of Triple Entry System

Step 1: - Continuing with the previous example as shown in fig 3.1, organisation taking loan amount of £44,000, for the company this will be entered into debit account and the loan provider will enter it into credit entry.

Step 2: - Once the transaction is registered in both debit and credit account from respective party, third entry will then be triggered by generating cryptographic proof digital signature.

Step 3: - This digital signature is a unique code which nothing but create third entry of the transaction

Step 4: - Once the third entry is created, it is then shared to decentralized network, where independent user (miner) will try to validate this transaction by solving cryptographic puzzle.

Step 5: - Once the miner validates the given transaction record, it is then added to the distributed ledger along with all the other transaction which are already validated.

Step 6: - Lastly the copy of public ledger is updated with all the latest transaction.

3.5 What is Digital Signature in Triple Entry System

In TEA, each transaction record's digital signature carries a unique code that certifies the transaction's legitimacy and integrity. Advanced encryption techniques, such as public-key cryptography or blockchain technology, are used to generate the digital signature. It contains following information

- Public key
- Private key
- Hash code
- Timestamp

The miners use consensus algorithms to check the authenticity and integrity of the digital signature when the transaction record with the signature is shared among them. In order to accomplish this, miners verify that the hash in the signature matches the transaction data as well as the public key in the signature and the public key of the sender. Ideally the digital signature is generated by the sender but in example discussed in step 1 in this case both the company and the loan provider will be involved in making a digital signature.

3.6 Advantage of Triple Entry Accounting

- **Transparency:** - It is simple for stakeholders to confirm the correctness of financial information thanks to the use of blockchain technology in triple entry accounting, which guarantees that all transactions are recorded and maintained in a secure and transparent manner.
- **Security:** -The use of TEA will give a massive boost to organisation in order to help maintain all the transaction entries up to date, with no chance of manipulation as the block chain has a property of immutability means once the data is entered into block chain it cannot be alter, manipulate or deleted from the public ledger, thus it will be difficult for hacker to hack or manipulate any data from the public ledger

- **Real Time update:** - With the help of TEA, all the transaction will be updated on real time bases as soon as the data is added in the distributed ledger. This will give stakeholders and the investor more options and time to improve or analyse company's performance.
- **Trust:** - As the information is more secure and transparent, it helps to gain trust from the stakeholders and the investor on company's financial report.

3.7 Limitation of Triple Entry Accounting

While enhanced openness and less fraud are few potential advantages of triple-entry accounting, it also has significant drawbacks.

- **Lack of Standardization:** - Since TEA is a concept, it has no standardized framework and thus it is hard to implement and interpreted
- **Privacy Concerns:** - Since the data will be stored on public ledger where all the users will have a copy of entire public ledger, this can also be an issue with many organisations who might not want to reveal their internal data to third users.
- **Implementation Challenge:** - As TEA is still a concept, implementation stage is already considered as a big obstacle in any future move for accounting to move from DEA to TEA. As cost of moving entire accounting operation will be more especially for small firm.
- **Regulatory clearance:** - As we know accounting is very heavily regulated sectors, there is no clarity on if the government will allow such an important financial data to be put on distributed public ledger.

4.0 Integration of other technology in Triple Entry Accounting

After understanding the working of TEA and its pros & cons, I believe there are lot of questions which still need to be answered like how much financial data should the company needs to put on blockchain, can TEA handle every transaction to be post on blockchain? What if there is some genuine error in the transaction, what if the organisation wants to undo some transaction from their books how it can be done?

Well not all the questions can be answered but I believe Integration of some technology along with TEA Blockchain can help us to give more clarity on it.

4.1 Edge Computing in TEA

Edge computing is sub part of cloud computing technology, it is basically a distributed data storage technique where it performs computation task on local device like computers, phones etc., where the data is stored and only send important or required amount of data to main cloud computing infrastructure. The main purpose of the edge computing reduces the network latency and improve the performance of the eco system.

Edge computing can co-exist with blockchain in fact they even complement each other and can enhance Triple Entry Accounting.

Following are the ways where edge computing can make an impact

- **Decentralised:** - As both blockchain and edge computing are decentralised based technology the organisation doesn't have to send all the accounting data into the

blockchain network rather they can store maximum data into the local system and send only relevant data into blockchain. This will improve the efficiency of the TEA system.

- **Smart Contract:** - Smart contracts, which are self-executing contracts with the details of the agreement between the buyer and seller being directly encoded into code, are made possible by blockchain technology, with the help of edge computing the smart contract can be created with the help of local processor power and can be done in real time. This will increase TEA's speed.
- **Distributed data sharing:** - Blockchain nodes can benefit from edge computing's distributed computing architecture, which enables quicker transaction propagation and verification. This could improve the efficiency and scalability of blockchain networks.

5.0 Conclusion

To accomplish the numerous accounting responsibilities, including Accounts Payable, Accounts Receivable, Billing & Invoicing, Bank Reconciliation, Billing & Invoicing, and Built-in financial and business reporting, today's accounting practises heavily rely on technology. TEA can be the next big thing in accounting and auditing sector but certainly it has lot of questions which is yet to answers, Even with collaborating with other technology might not be enough for TEA to convince everyone within its sector to make huge digital transformation from DEA to TEA.