

# Transformation of Capital Market Operations through Block Chain Technology



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*Block chain is a disruptive technology platform to create distributed ledger protocol using cryptography. It is a secure, public record of transactions that participants can inspect, audit, and update. In capital markets, despite technological improvements, middle and back office functions have not kept pace with front office advancements. Block chain technology could enable the front office to interact directly with the back office ledger and simplify the trade process. It can act as a self-clearing system facilitating settlements within seconds. This paper elucidates the potential of Block chain technology to provide a real time, cost effective, and secure settlement model for capital markets.*

**Keywords:** Block Chain, Distributed Ledger, Bitcoin, Cryptography, Trade Process, Real Time Settlement

## 1. Introduction

The ledger system of record keeping is central to the conduct of trade and commerce. A ledger is a tool to track the movement of assets, be they are, land, building, cash or shares in a company. Owing to security reasons, access to the data contained in the ledger is often limited to a set of custodians who manage and maintain the ledger from time to time. In contrast, *Block chain* is a 'distributed ledger' system. It is self-sustaining with no involvement of any central intermediary like a custodian or a clearinghouse, to conduct and record transactions. This ledger holds a list of transactions that can be viewed by all the parties and it is for this reason, also known as a 'public ledger'.

The core of the block chain infrastructure is a managed network of computers resembling the internet. Each connected computer is typically referred to as a 'node'. To ensure reliability, the database of all block chain transactions is replicated across all nodes. Furthermore, each node hosts sophisticated peer-to-peer database technology and software algorithms for conducting, managing, and recording transactions, as a result of which, all authorized participants can access the block chain without the need to go through an intermediary, essentially creating a distributed public digital ledger system.

Block chain technology is most notably employed by the Bitcoin crypto currency. Satoshi Nakamo first established the viability of a decentralized networked currency called 'Bitcoin' [1]. As a networked currency, Bitcoin does not require any central institution like a bank to keep and maintain a record of transactions. Instead, a transaction takes place between two parties within the network and 'Bitcoin' miners use distinct software to verify and validate the transaction. A cluster of recorded transactions taken in quick succession of 10 minutes, called 'blocks', are then linked to one another using a cryptographic signature that is further verified and validated by running complex software algorithms at the bitcoin miner's end requiring extensive computational processing power. As a result, a running stream of carefully validated transactions gets recorded as a chain of linked blocks called a 'Block chain' [2], and the protocol ultimately culminates in the generation of a trusted digital ledger.

### How Block Chain Works?

Figure 1 shows the inner workings of the Block chain technology. The entire ledger is held as a chain of trusted and verified blocks of transactions. The transaction gate guarantees that only valid transactions are added to the block chain. Block chain technology can set rules and business logic for individual transactions, which makes it unique from conventional databases, where rules are normally set for the entire database. Furthermore, it uses public-key encryption. Messages can be unlocked only by linking a public and a private key, which is solely held by the buyer and the seller respectively.

Due to the inherently replicated and trusted nature of block chain, it is considered to be tamperproof against fraud and therefore, minimize the risk of lost and stolen data [3]. Essentially, block chain establishes trust and identity in transactions devoid of any human intervention or dependency. It is, therefore, reckoned as a game changer in sectors, such as, financial markets, health care, insurance, taxation, education, governance, real estate etc., where, information is exchanged with utmost trust.

Depending upon the level of trust in the participants, block chains are classified into two groups [4]

1. **Permission-Less Block Chains:** It allows practically anyone with a computer and a network connection to participate. Prior affiliation to the network is not required. Consensus amongst participants is the key for maintaining the integrity of the ledger.
2. **Permissioned Block Chains:** It allows only known and validated identities to participate. When a new record is added, the authenticity of the ledger is checked by a limited consensus process.

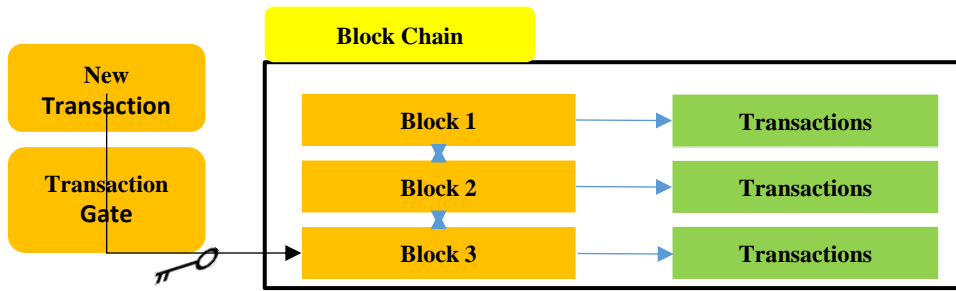


Figure 1 How Block Chain Works?

## 2. Block Chain Technology for Capital Markets

Specific to financial markets, block chain protocol has the potential to offer the same digital ledger to multiple users to perform financial transactions in a real-time data environment, and to do the back-office operations that make data available on a real-time basis. This collectively managed data environment is a departure from the conventional system, where the data flows from a central database, maintained and monitored by a central authority.

It is for these reasons; financial institutions have started deploying block chain technologies to address payment systems, custodial functions, clearing, and settlement systems. Capital markets are the most conducive sector to adopt block chain technologies. Many stock exchanges across the world are exploring block chain technology to maintain records of asset ownership. NASDAQ successfully launched a block chain based prototype called ‘Linq’, in late 2015, to conduct a share transfer to a private investor [5]. The UK’s Financial Conduct Authority revealed, in August 2016, that it was considering approving a “small but significant number of firms” using the process behind bitcoin, the crypto currency [6]. Bank consortium R3, a private consortium of more than 45 institutions that includes many financial institutions like JPMorgan Chase and Barclays, is working toward a goal of standardized and shared ledger to develop block chain applications [7].

### Range of Block chain Applications

Solutions using block chain technology are already prevalent in the domain of crypto currencies including digital wallets. Moreover, a wide range of solutions are being evaluated in the area of parallel currency applications that comply with both

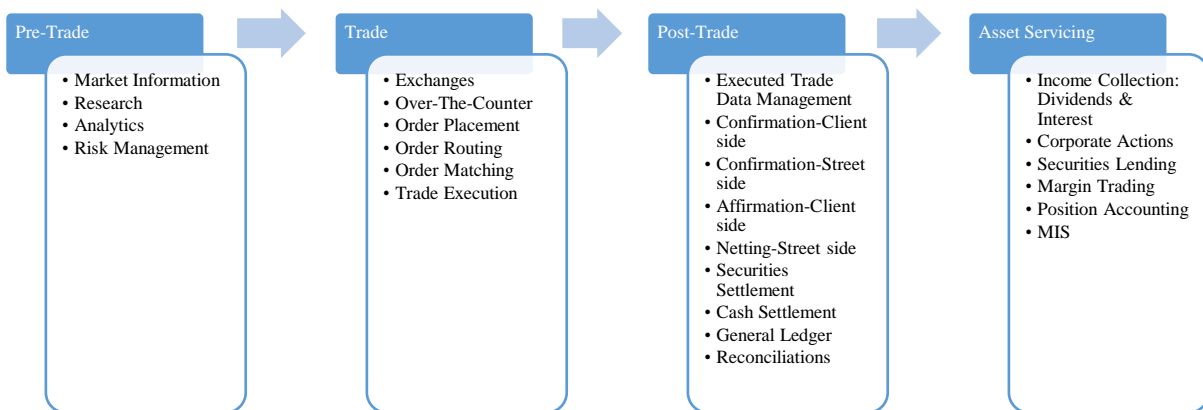


Figure 2 Traditional Securities Life Cycle

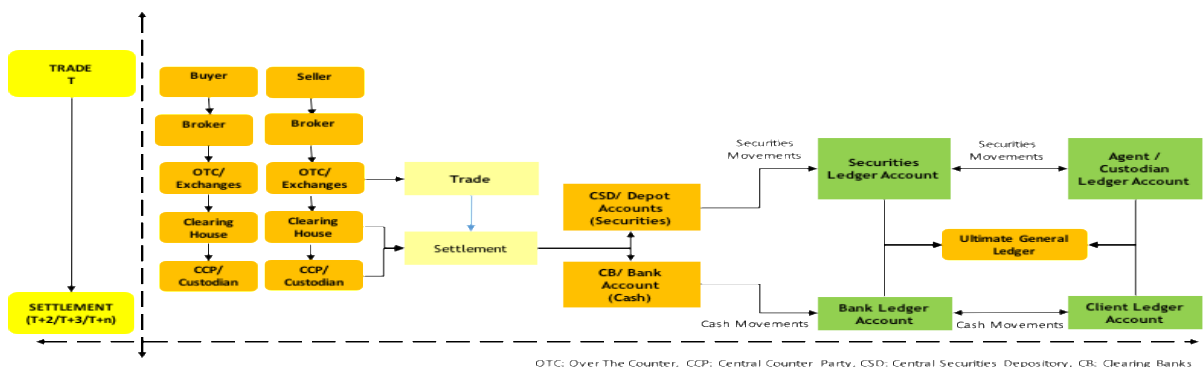


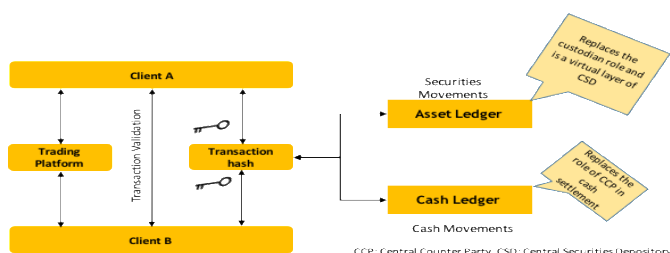
Figure 3 Capital Markets Today

traditional and crypto currencies, correspondent banking network for cross-border payments, supply chain finance and securities settlements, and asset servicing. The focus of this paper is on applications in capital markets, allied with post-trade settlements, and asset servicing.

In capital markets, despite technological improvements, middle and back office functions have not kept pace with front office advancements. Some of the main contributing factors for this are complex processes involving multiple counterparties, manual tasks, and prevalence of many third-party service providers. This creates process duplication besides the need for a continuous data reconciliation, leading to higher cost of transaction settlement.

### How does Block Chain Environment for Capital Markets Look Like?

A business transaction is considered complete after financial messages are successfully exchanged and all necessary ledgers are updated in the books of every participating institution. Figure 2 shows the key processes in the life cycle of a trade in Capital Markets and Figure 3 depicts an outline of the process in capital markets for the transfer of assets from the ledger of one institution to another.



**Figure 4** Capital Markets Block chain-Based Distributed Ledger

There are several intermediaries like exchanges, Central Counter Parties (CCPs), Central Securities Depositories (CSDs), brokers and custodians, who assist the customer to complete a transaction. As a result, the number of messages to be exchanged and ledgers to be updated increases proportionally with the number of intermediaries in the transaction. Sometimes, it is necessary to have additional ledgers for securities lending and borrowing, and for cash management. These introduce a delay in transaction settlement called ‘settlement cycle’ in capital markets, represented as ‘T+n’ in Figure 3, where ‘T’ indicates transaction date and ‘n’ represents the number of days required to complete the settlement of the transaction. In the current system, assets that trade electronically in the blink of an eye often take days to settle. It is an open question if block chain technology can bring in a structural change to capital market operations.

Figure 4 illustrates a simple example to describe the concept of a distributed ledger. Client A owns the security on the asset ledger, while Client B owns cash on the cash ledger and enters into a transaction with Client A. They complete the transaction and jointly sign off by applying their private keys to unlock their asset or cash ledger. Thereafter, they transfer the ownership to the recipient through their public key. The signed transaction is validated and gets recorded in the distributed ledger. In such a system, multiple layers of traditional ledger records are compressed into a single function reflecting the final beneficial owner [8].

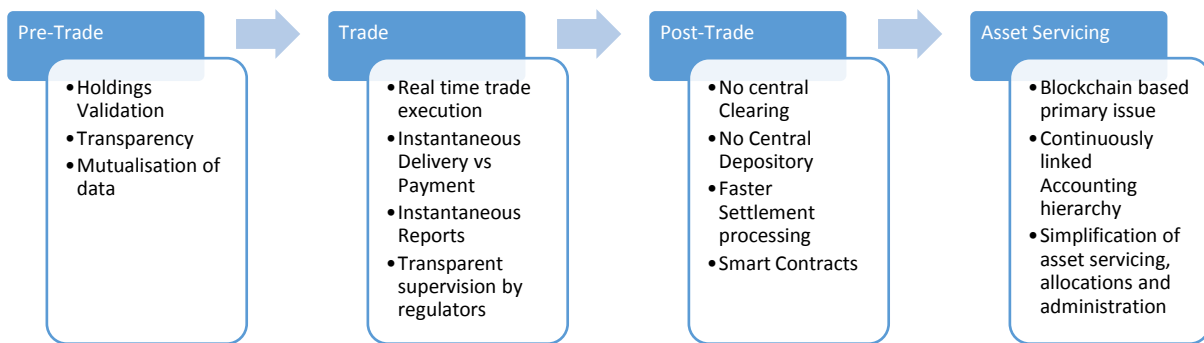
Importantly, interfaces defined in the block chain network allow the front office to interact directly with the ledger, thus simplifying reconciliations. The distributed ledger will have a view of the trade capture process that makes the block chain a self-clearing-cum-settlement system. In other words, it will function as a central clearing house, recording and tracking the obligations of the counter parties, reducing the counterparty risk, besides speeding up the settlement cycle.

Asset servicing like corporate actions can be managed through ‘smart contract’, which is a potential area of application of block chain technology. Smart contract applications carry logic and procedure on how the transaction is required to be carried out, using the stored information and data. For example, a ‘smart contract’ for Interest Rate Swaps (IRS) could automate the business process over the swap life cycle, when certain defined conditions are met. By doing so, even derivative contracts can be created through a ‘smart contract’ that captures both swap conditions and obligations of the counter parties.

### 3. The Key Benefits to Capital Markets

The Capital Market industry is facing tremendous pressure to reduce its operational costs and Block chain technology has the potential to offer a solution to this problem. It presents an advantage of speed, reduced cost, improved efficiency, increased reliability of the transaction process, lowered counter party risk, authenticated audit trail for financial accounting, increased data security, better access control, and a seamless regulatory reporting, and is thereby expected to provide a better overall customer experience.

Figure 5 presents a closer look of the potential benefits of Block chain over the securities trade life cycle.



**Figure 5** Potential Benefits of Blockchain Technology over the Securities Trade Life Cycle

#### 4. Implementation Challenges

Block chain is still a nascent technology in the very early phases of the software maturity lifecycle. Very few people understand how this technology works. Currently, we simply do not have sufficient knowledge of block chain technology to comprehend its implications and today, we may not even know all likely questions that this technology may give rise to, leave alone the answers. In this section, we discuss some of the key challenges that are currently being deliberated upon.

Although the industry has offered proof-of-concept implementations of the technology that have shown promising outcomes, there could be substantial risks associated with its adoption. First, scalability of the block chain technology-based capital market solutions remains uncertain especially for high-volume low-latency applications as block chain validation processes could be slow. Second, block chain technology is software-based and is therefore, prone to coding errors. Integrity of the software and the network are basic parameters to be considered while evaluating block chain as an alternative infrastructure technology. Besides, this technology is decentralised and therefore, injecting malicious code to any connected block could potentially result in a major denial-of-service. Simply, the impact of a glitch or hack could be devastating. Third, compatibility of new block chain infrastructure with existing non-block chain based applications is non-trivial. There are apprehensions regarding who would own the compatibility within the block chain network. Fourth, collaboration is key to the development of industry-wide block chains and while doing so, companies may not be willing to share confidential information on the network of competitors. This could pose a hurdle for developing industry standard for block chain.

Furthermore, there are some important practical considerations that the industry should make for a smoother transition to block chain. There is considerable uncertainty regarding operational issues such as asset transfer between traditional and block chain enabled ledgers and effective cost management of the ever growing distributed ledger. Moreover, there are several issues on the legal front such as consensus on a framework that accommodates both smart and traditional contracts, legitimate transfer of non-crypto currency financial assets using the distributed ledger, acceptance of smart contracts by courts, and most importantly, the ownership of digitised data. Finally, there are regulatory concerns around standards and best practices for using blockchain-enabled distributed ledgers and its effect on regulatory reporting requirements.

In summary, a cost benefit analysis weighing the potential benefits against the requisite investments and implementation challenges is required, especially in a post-recession capital markets industry that is focused on cost cutting.

#### Initial Use Cases

While there are not many use cases available, case studies related to capital markets are emerging. Initial aim is to have use cases from demos and prototyping to launching live pilots, to solve cluttered processes in the post-trade settlement period where a change in title happens.

According to a business insider report [9], Santander Inno Ventures, the venture capital arm of the megabank Santander, claimed to have internally identified 20 to 25 use cases of block chain technology, including international money transfers, trade finance, syndicated lending, and collateral management. Furthermore, Euro clear identified a few initial use cases specifically apt to capital markets, categorizing them into (a) first order adoption that would work on a standalone basis, and (b) second order adoption that works subject to critical mass of assets on block chain [8]. Despite its inherent implementation challenges, these efforts clearly motivate major players toward the adoption of block chain technology.

#### 5. Conclusion

The Capital Markets industry is under huge pressure to lower its operational costs and the expectation is that Block chain technology could reduce costs, improve efficiency, and provide superior customer experience. Block chain-based distributed ledger environment could complete clearing and settlement within seconds and support retail investors who desire to access money immediately after a stock sale. There are many other key benefits like lower collateral requirement, greater transparency, and importantly, reduced counter party risk. A recent Santander report estimates that block chain technology could save the industry between \$15-20 billion annually by 2022 [10]. These potential benefits are driving the investments in this technology area, resulting in as much as \$930 million venture capital investments for blockchain technology [2]. A Los

Angeles-based investment bank has estimated that tens of billions of dollars a year, could be saved in trading securities and other assets, by using block chain technology [11].

Besides bringing in a cost-effective securities settlement cycle, block chain technology is all set to redefine the roles of market players like exchanges, Central Securities Depository (CSD), Central Counter party (CCP), and custodians. Attention and focus is required to create use cases that could be actioned in niche applications relevant to smaller markets. As the innovation moves forward, policy maker intervention would be required to implement the change. The Australian Securities Exchange (ASX) is seriously considering replacing its current clearing and settlement system with block chain technology [12]. While block chain-based technology innovations are still in the nascent stage and the adoption line may take between 5 and 10 years, it is up to major established players in the market to work with innovators, visionaries, and trend-setters to develop block chain based capital market environment, and at the same time, preserve and protect the existing strengths of the current ecosystem.

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