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Industrialisation of Distributed Ledger Technology in Banking and Financial Services

Authors: Rodger Oates, Consulting Partner, Banking and Financial Services
Tata Consultancy Services
Raghavasuresh Samudrala, Industry Advisor, Banking and Financial Services
Tata Consultancy Services

Executive Summary

Blockchain has moved beyond use cases and Proof-of-Concepts (POC) in Financial Services. Many banks have experimented with the technology and tried a number of POCs in areas such as payments, trade finance and securities settlement. But what next? Production deployment of blockchain technology in mainstream banking still seems far away. In order to move to the mainstream a number of key questions clearly still need to be addressed, including:

- What is the transformation potential of the technology in mainstream banking?
- What are the most potentially disruptive use cases and why?
- What are the key business considerations and technology considerations for the industrialisation of this technology?
- What are the pre-requisites for industrialisation of the technology?
- How do I move forward, what is my roadmap/ journey as a Financial Services incumbent?

This paper will provide an overview of the transformation potential of the technology and potential disruptive use cases in financial services. However it will primarily focus on the business considerations that must be addressed before industrialisation of distributed ledger technology can commence.

The adoption of any new technology in Financial Services has to be evaluated in terms of security, scalability and performance. As distributed ledgers bring new challenges, these technology considerations need to be assessed in detail. We also provide some recommendations on the possible next steps, post the initial learning, proof-of-concepts stage in terms of the roadmap for potential widespread adaptation of this technology.

This paper concludes by discussing the key factors financial organisations should consider to measure the success of the initial implementations.

Introduction

Blockchain definitely got the maximum attention and investment from financial services firms as well as technology start-ups in 2015 and it is set to gain more attention and investment going forward. All major global banks have ventured into blockchain or distributed technology in some form or the other. The concept and related technology start-ups have already attracted more than $1 billion in investments. Within the Financial Services, these investments can be broadly classified into the following two categories

- **"Blockchain Driven Banking"**: Led by Technology companies trying to build parallel banking services to the incumbents without the need for the traditional regulated banks or any other trusted intermediaries. These challengers enjoy either less regulation or are unregulated unlike their traditional banking counterparts. They are focusing on solutions in payments, settlement and lending and aim to offer financial products in a trust less manner using cryptographic ledgers. Market acceptability and adaptation of these solutions to a large scale is yet to be achieved. As one would expect, absolute volumes are still small compared to traditional banking. Examples include Bitcoin, Ripple, t0, Circle and the Blockchain Clearing Corporation etc.

- **"Bank Driven Blockchain":** Incumbent banks and financial services organizations have also demonstrated a significant interest in the technology and are exploring how it can help them deliver banking products more cost effectively and efficiently. As a first step, many banks have tried to understand the technology internally or through collaboration with technology partners. However, it has became apparent that the more productive approach is through industry collaboration within and across geographies. "R3cev" with 50 global member banks and the "Post trade Distributed Ledger Working Group" are examples of such collaborative efforts. Unlike technology firms, banks and existing financial services players need to consider regulations, risks, current investments, and business case before being able to implement a new technology. In addition, the unique features and benefits of the technology will need to be articulated before any major investments can be made.

As discussed this document will focus on the "Bank Driven Blockchain" and the distributed ledger solutions being worked upon by regulated banks and financial services organisations.

The following key relevant questions are discussed in more detail

- What is the transformational potential of distributed ledgers?

- What are the most potentially disruptive Use Cases and why?

- What are the key business and technology considerations for industrialisation?

- What are the pre-requisites for industrialisation of the technology?

- How do I move forward, what is the roadmap/ journey for a bank?

Transformation Potential:

Blockchain based distributed ledger systems are considered to be highly disruptive to both the financial services and non-Financial services sector, with use cases across supply chain, real estate, music, entertainment, IoT, manufacturing and cyber security.

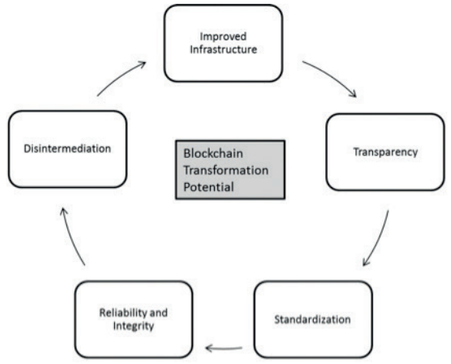


Figure 1. Blockchain Transformation Potential

Distributed Ledger technology in the banking and financial world has the potential to:

- **Disintermediate:** Due to its distributed nature, it inherently promotes disintermediation in banking and financial services. The current transaction processing value chain has evolved over time from paper to electronic, carrying along some intermediary roles that may now be redundant. Blockchain technology provides the opportunity to reimagine the transaction value chain and the role of each intermediary. Those intermediaries that add value to the transaction in the form of risk management, accounting etc. have a place in the reimagined industry, while those that simply maintain the records or provide access will be disintermediated.

- **Promote global growth:** Corporate and retail payments may be run on re-laid infrastructure that makes it simple, faster and more efficient to move money across the globe.

- **Increase Transparency:** Today, assets are traded and held in multiple locations. This provides an information arbitrage opportunity for intermediaries and processing bottlenecks for investors. Distributed ledgers can provide transparency and eliminate such arbitrage. Transaction settlement can also be simplified as it can occur within a distributed ledger without the need for realignment. Global ledgers also makes it easier to service the assets due to the consolidated nature of global asset holdings.

- **Encourage Standardization and Utility models:** Distributed ledgers promote the standardisation and consolidation of the financial services industry. In distributed ledger implementations, banks and financial services can outsource part of their ledgers. This may encourage them to outsource the relevant non-core functions to utility providers. Thus potentially reducing the overall transaction costs for customers/investors. Examples include trade finance utility and KYC.

- **Improve Reliability and Integrity:** Distributed ledgers are also used to record events, along with timestamp and owner information that help to validate the existence of a particular transaction / document at a particular time. These ledgers can be used to track audit logs, verify the source and authenticity of the information. Thus helping improving the reliability and integrity of the data that is consumed.

At its simple form, a distributed ledger is

- A source of truth maintained at multiple servers
- An algorithm that involves communication between servers to protect its integrity
- A digital signature that provide identity, authorization and authentication

As a result, distributed ledgers can result in inefficiencies compared to a centralized ledger stored in a single server. It is important therefore to understand the unique benefits of the blockchain based distributed ledger, to identify appropriate use cases that give business benefits despite the technical overheads. Blockchain based industry solutions bring the following unique features

Shared Access: Traditionally, market participants have operated isolated ledgers that use secure financial messaging for transaction processing. Blockchain technology enables the design of a shared distributed flat ledger that can process transactions between multiple participants simultaneously. Financial institutions can post transactions directly to the shared ledger using digital signatures, thereby replacing traditionally used, secure financial messaging.

Open Access: Parties involved in the value chain can post the transactions directly to the ledger. Processing nodes validate the transactions and maintain the integrity of the ledger. A Blockchain can be used to transfer the value and metadata securely to the recipient in near-real time achieving transaction finality.

"Append only" data storage mechanism: In blockchain technology, blocks comprising several transactions get appended to an existing chain. An 'append-only' data storage mechanism like this is ideal for a shared ledger since it allows market participants to synchronize their ledgers with internal books by requesting incremental updates.

Open Source: Many of the current implementations of virtual currency and blockchain are open source. These open source software pieces can be further customized as per business needs, reducing the development costs.

Use Cases:

One of the key components of the distributed ledger is the information that is stored within the ledger. Business use cases can be broadly classified based on the type of information stored in the distributed ledger (illustrated below).

Value Ledger	Information Ledger	Time Stamp Ledger
• Storing and Transfer of value assets • E.g. Payments, Settlements	• Information Orchestration • E.g. Trade Finance, Proxy Voting	• Immutable audit of who, what, when • E.g. Digital contracts, reference data

Figure 2. Distributed ledger categorization

Value Ledger:

A distributed ledger used to store and transfer value across its members can be referred to as a "value ledger". Bitcoin, is a value ledger. Storing and transferring of financial assets like regulated currencies and financial assets is one of the key focus area for banks. Today financial assets are recorded in the siloed ledgers of various banks, intermediaries, service providers and infrastructure providers. Transferring securities or cash requires secured exchange of messages, liquidity management (ensuring cash in the right place at right time) and multiple steps in completing the transaction. This can take 2 to 3 business days despite the fact that these assets are held in a digital form and data can move instantaneously.

Elimination of the barriers caused by siloed ledgers will enable movement of financial assets across the globe instantaneously. This has a significant transformation potential and is the key reason for its consideration as the next big innovation after the internet.

Information Ledgers: Another important use case for distributed ledgers is the orchestration of information between multiple market players. Unlike value ledgers, the information ledger will have details about a particular business process or transaction. Examples include trade finance and proxy voting. An entry is created by the entity that is initiating the business process/transaction. Information is then accessed and enriched by parties in the value chain until the business process is successfully completed. Information ledgers offer a number of benefits. First they promote the concept of utilities, as distributed ledgers support multiple service providers catering to multiple customers, with shared infrastructure and utility models reducing the cost of processing. The second benefit is the drive towards automation. Information flows for business processes such as trade finance and proxy voting typically involves the handling of paper and wet signatures. Distributed ledgers support digital signatures and immutable contracts which could eliminate the regulatory requirements for physical documents over a period of time.

Timestamp Ledgers: Timestamp ledgers are used to capture an event, timestamp and identity in an immutable ledger. These are typically used to prove that an event/ document/contract was present at a given time and signed by a particular entity. Digitally signed contracts, corporate action announcements, reference data, KYC, standing settlement instructions are some of the examples of timestamp ledgers. Timestamp ledgers enables market participants to trust and validate the information irrespective of the mode of distribution. For example, an issuer signed corporate action announcement can be validated and trusted by members even if the message is not directly received from their custodian. These ledgers typically capture the hash of the source document / contract / message, sender and timestamp in an immutable ledger.

Despite the hype, distributed ledgers are not the answer to all existing problems and there is a need to define a set of criteria that will identify the most promising use cases. Distributed ledgers are most effective when used in the context of simplifying transaction or information flows across multiple organizations through a distributed and anonymous shared flat ledger. Potential use cases include global payments, securities processing

and trade finance. Distributed ledgers may also be considered for intra-group transactions in large global institutions. Note however, there may be traditional technologies that are equally suitable. In addition distributed ledgers may not be the optimal solution for data quality problems or data backup considerations.

In our opinion the initial focus of distributed ledger applications will be on low volume, less automated and less regulated business areas. Such early implementations will need to continue with some of the manual /paper based procedures (e .g. bill of lading in trade finance) until changes can be implemented in the regulatory requirements around these to accept digitally signed documents.

Key Business Considerations

The implementation of distributed ledger technology will need to consider the following factors in order to deliver substantial business benefits.

Reimagined business models:

Existing business processes, intermediaries and transaction processing value chains have evolved over a period of time from paper based processing to limited digitisation and advanced automation. While distributed ledger technology can enable the next evolution, significant benefits will only be realised when the business models of various market entities and the value added by them to the transaction process is redesigned.

Market structure and transaction value chains need to be reimagined to take advantage of distributed ledger technology. The role of service providers or intermediaries who only provide access, or maintain registries needs to be critically reviewed as these functions can be well supported by distributed ledger technology.

Another area where business models can be reimagined is the issuance and custody of assets. Today, securities can be issued, held and traded at multiple locations. This adds to the complexity of processing and gives arbitrage opportunities for market intermediaries with superior computing power and proximity. A single global ledger for a given asset can significantly reduce the complexity and transaction processing costs. Distributed ledgers can capture hierarchical relationships between asset owners, without having to have siloed ledgers within each entity.

Operating Models for an industry solution:

As the most effective use cases for distributed ledgers involve multiple market players that are most likely competitors, it is important to understand how these industry solutions are run and by whom. Distributed ledger based industry solutions need to be built, maintained and operated in the most efficient way possible to ensure secured and uninterrupted services to market participants. Therefore a significant amount of infrastructure, needs to be built e.g. legal, contractual arrangements, processing rules, operational procedures, software and hardware to enable the market's smooth functioning.

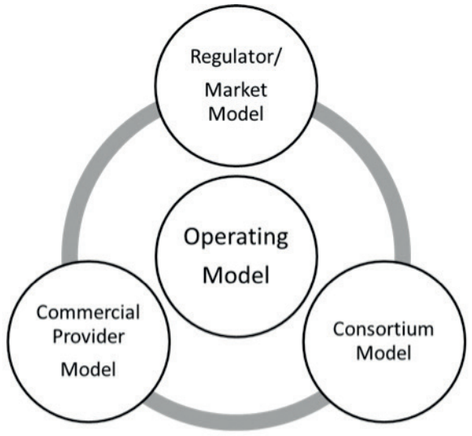


Figure 3: Operating models for distributed ledger solutions

Possible operating models for industry solutions are given below.

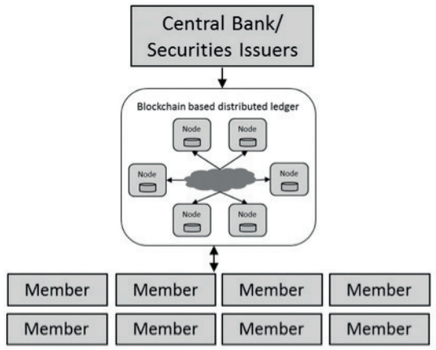
Regulator/Market driven: Central banks or industry regulators take the lead in developing and maintaining a market solution based on distributed ledgers. For example, the Bank of England is looking at its suitability for domestic RTGS payments and ASX for Australian equities. In our opinion a regulatory driven approach is the most efficient way to explore and implement. As market participant commitment, evolution of standards and market acceptability will be relatively higher, however today's solutions are typically being driven by a single country or region and not on a global basis.

Consortium Driven: A group of large banks or financial institutions can come together to establish an entity to build and operate a market service. Governance and future strategy for the solution will have to be well defined, for the competing institutions to come together and establish a common ledger for a particular business process. A consortium model can deliver global services e.g. "distributed ledger platform for cross border remittances". However such a solution may not encompass the whole industry / global market coverage depending on the size of the consortium.

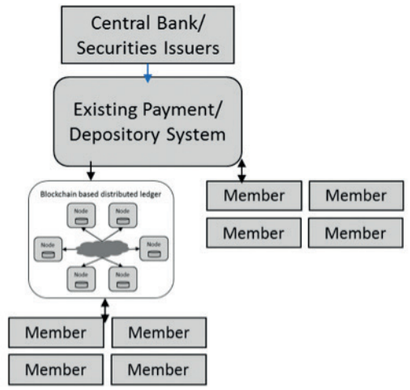
Commercial provider model: A commercial entity like a technology start-up or a market infrastructure company may launch a new and efficient market service leveraging the distributed ledger technology. The commercial entity will perform the necessary due diligence on the market potential, acceptability of the service, competition and initial commitment from pilot customers before making investments. The commercial entity will define the business rules, membership criteria, service standards and fee schedule. Participating banks and financial services organisations will follow the messaging standards to interact with the market services. The commercial entity may need to procure necessary regulatory licences (for example trustee licence) to launch the product. However, such a model may result in proliferation of solutions by competing commercial entities.

Transitioning existing assets into a distributed ledger

A frequently asked question is how to extend distributed ledgers beyond virtual assets into the existing asset classes that occur today.
There are two possible ways. Direct issue of money by central banks or of securities by issuers into a distributed ledger. Alternatively, already issued assets held in a trusted regulated entity can be tokenized and held in a distributed ledger to enable faster and easier transfers.



Option 1: Direct issues of assets on to the ledger
(Market adaptation of distributed ledger)



Option 2: Tokenized issue of assets on to the ledger
(Partial adaptation of distributed ledger)

Figure 4: Issue of financial assets in distribute ledger

Defining Standards

Distributed ledger solutions are most effective when replacing legacy systems designed for a large number of market participants interacting with each other to add value to a transaction. Transactions may be initiated by an authorised entity and enriched through its life cycle by various members. For this to happen participants need to agree on the messaging standards to interact with the distributed ledger using standard structures that can cater to the entire industry.

It is also possible that multiple distributed ledger solutions may emerge across countries, asset classes etc. Standards will be required to ensure that these are interoperable and ensure secure transfer between the ledgers either within the industry solution or even across the industry solutions. There are a number of standards developed for financial services in payment, securities trading and settlement, trade finance e.g. ISO15022, ISO20022 and TSU. Therefore, the industry can use the existing standards to interface with distributed ledgers and eliminate significant amount of integration required with existing systems landscape.

Potential Customer Participation:

The "Bank Driven Blockchain" in our definition is focused on how regulated financial services can leverage distributed ledger technology to offer cheaper and better services to customers. Financial Services can do this by using the distributed ledger solution as their backbone infrastructure, masking the nuances and complexity of digital signatures from their customers. Customer accounts can continue to be maintained in traditional bank ledgers, whereas the distributed ledger backbone is used to transfer those assets. In this approach, financial services will still be in control and can continue to perform their existing KYC, AML and any other checks before accepting any customer transactions. Customers also benefit from the superior service offered without noticing the change in the underlying infrastructure.

An alternative approach may include, customers being directly on-boarded to the distributed ledger by their financial services provider. Banks may still be able to do initial on-boarding in a controlled manner but will not have control on further transfers of value. In such a scenario, the role of the bank changes from processing transactions to facilitating transactions. Once assets are held in a distributed ledger, customers will be able to transfer the assets anywhere without any intervention from the facilitating bank. For the facilitating bank, there is a significant loss of control and the ability to track the transactions for any regulatory compliance. In order for this to occur at scale, the regulatory environment will need to change.

As a result of this second approach, banks would no longer control the assets of their customers as they will be protected by digital signatures. Only customers with the appropriate digital signature will be able to perform a transaction. However, as there is no current equivalent of "Forgot Password" functionality with the blockchain – to replace a private key when a customer loses it. This functional requirement will need to be addressed, before a wider direct customer participation occurs.

Regulatory Perspective:

In distributed ledger circles, the general view is that regulators are holding back their development. However in our opinion, regulators across the globe have taken a very positive stance with positive encouragement to the banks to experiment and explore. However "Blockchain Driven Banking" solutions will increasingly come under the scrutiny and supervision of regulators with comparable regulations to the existing environment. This will happen as companies or solutions start to develop scale. As in reality regulators cannot have two yardsticks to measure KYC, investor protection, credit risk etc. for regulated banks and unregulated technology firms offering similar services.

However, regulators have a much more proactive role to play when it comes to "Bank Driven Blockchain". Many regulators have acknowledged the benefits of distributed ledger technology and the potential usage of the technology to improve services and reduce costs. Regulators do not seem to have any issues in accepting the technology, as long it is a replacement for legacy technology with enhanced functionality which does not compromise the current regulations or their underlying principles.

Regulators however can help accelerate the industrialisation of the technology by:

- Removing hurdles in the deployment of reimagined business process for deriving maximum benefit out of distributed ledgers e.g. acceptance of electronic bill of lading and digitally signed contracts, instead of wet signatures.

- Supporting / driving the adaptation within a particular industry, to setup the distributed ledger solutions for wider acceptance.

- Approving new technology solutions and enforcing standards

Banking and financial services firms need to work together and educate the regulatory community on the potential opportunities so that the promised benefits can be delivered.

Value Date

This area has in our opinion not yet received the attention it should, with most of the initial solutions not seeming to have addressed this effectively. Blockchain based distributed ledger solutions claim be to operational 24x7x365. However, in the financial world all transactions happen as on a particular value date. Value date is an important attribute in computing interest payments, finding out eligibility of a corporate action, establishing if there is a settlement delay etc. It is a very important attribute without which a significant amount of financial transactions processing will not happen. Hence managing the value date across such diverse time zones is a key issue that needs to be addressed

However, in a distributed ledger environment, there may be multiple nodes across geographies processing transactions. There is no beginning of day and end-of-day processing as in traditional applications.

This problem can be addressed by adding additional logic to populate the value date based on the asset (currency, security), time zone of the asset home market, time zone of the participants involved in the transactions, if available. In other words, value date may have to be synchronized with local market time zones and any deadlines in the market for financial transactions.

In summary, the value date in distributed ledger solutions cannot be populated based on the system date of the server instead it needs to be populated based on the business context of the transaction and the corresponding market timelines.

Co-existence

It is obvious that distributed ledger applications need to co-exist along with legacy platforms. Such a co-existence can occur where

- An asset class in a certain geography has been migrated to a distributed ledger but in other geographies remain in the legacy technology landscape.

- An individual asset class is migrated to a distributed ledger but other asset classes remain on legacy technologies.

- Only new issues in a particular asset class are migrated to a distributed ledger technology, leaving existing assets on legacy technology

- The co-existence of multiple distributed ledger solutions across asset classes or geographies.

Co-existence adds significant complexity in the short term until all assets involved in a transaction are moved to a distributed ledger. As a result a compromise between the cost and risk of big-bang migration of the existing assets (back book) to a distributed ledger versus the complexity associated with co-existence will need to be addressed

Key Technology Considerations

Scalable, reliable, secure and proven distributed ledger technology is one of the most important factors in the potential large scale adaptation. Currently distributed ledger platforms are still being developed, or are in the early stages of launch. "Blockchain Driven Banking" is at a slightly more advanced stage than the "Bank Driven Blockchain" category. Many existing technologies and their integrity algorithms may be suitable for virtual currencies. However, they are unlikely to be suitable, if they needed to scale and handle currencies and financial assets worth trillions of dollars.

Key aspects to be considered in selection or development of the distributed ledger technology include.

Architecture Guidelines: "Bank Driven Blockchain"

Virtual/native currency: Virtual currencies are at the heart of distributed ledgers and are used to store and transfer value to another participant in a distributed ledger (for example bitcoin). It is apparent that banks and financial services cannot work at scale with virtual currencies due to regulatory considerations. Banks will not be able to acquire and hold virtual currencies. Also, as virtual currencies are predominantly designed to be peer-to-peer transactions banks may not have a value adding role to play in their customer transactions.

Native currencies are used by some distributed ledger technology solutions, to collect fees and control network spam. Examples of native currencies are XRP (from Ripple) and Ether (from Ethereum) which offer platforms for payments and smart contracts respectively. A native currency represents a unit of compensation for the hardware and software infrastructure provided by the distributed ledger solution. However a compensation unit for which a price is not decided based on transparent cost plus but on speculative third party behaviour.

Dealing in native currencies is less problematic for banks compared to virtual currencies but it still may prove to be a problem. The cost of processing transactions may increase with the increase in the rate of adaptation which is counter-productive. Banks will certainly prefer to pay linear fixed compensation in proportion to the cost of services used. It is most likely that banks may experiment with the technologies involving native currencies but may choose the ones where charging is more transparent.

Trusted Processing Nodes: This is also usually referred to as "Permissioned Ledger" which means an owner / sponsor of the industry solution will have the ability to control which nodes can receive, validate transactions and process updates to the ledger. In a Permissioned ledger, it is not possible for simply any party to download the software and start processing the transactions. Banking and financial services are more likely to adapt trusted processing nodes ("Permissioned Ledgers") for the following reasons

- Banks and financial institutions are not comfortable having the transaction information distributed to unknown servers in undisclosed locations for processing and validations.

- Currencies and financial assets in trillions of dollars can only be moved to distributed ledgers when the environment is 100% reliable. Therefore the current 51% rule (at least 51% processing nodes are honest) which is required in "permission less" ledgers is likely to be considered a significant risk to traditional financial services providers and their regulators

- In the case of "Permissionless" ledgers, large number of nodes from diverse geographies are required to provide enough trust on the integrity of the ledger. Therefore trusted processing nodes requires less processing capacity per transaction and are cheaper on the overall ecosystem.

- Due to the secured on-boarding of processing nodes, "Permissioned Ledgers" are more secure to store and transfer financial assets.

Public or Private Ledger?: A public ledger is accessible to everyone to query and post transactions whereas private ledgers are accessible to only authorized entities or people depending on their public/private key. In financial services, the nature of access to the ledger has to be defined at a more granular level than simple public/private. Distributed ledgers will typically need to support multiple functions e.g. ability to create new ledgers, new assets, accounts, new transactions, new contracts, query etc. according to the business use case. Distributed ledger technology for banks should have the capability to specify the access for each API depending on the public key or role. For example, it should be possible to control who can create assets, accounts and transactions. Such functionality needs to allow for flexible design of eco-systems, their roles and access in an industry solution. In some use cases, access may need to be provided to the general public. For example timestamp ledgers may have to be opened for the public to query the validity and source of a particular document or announcement. However, it is unlikely that account creation will be opened to general public due to KYC and other regulatory considerations.

Distributed Ledger Infrastructure Requirements:

Distributed ledger infrastructure will play a key role in the consolidation of industry efforts in this space.

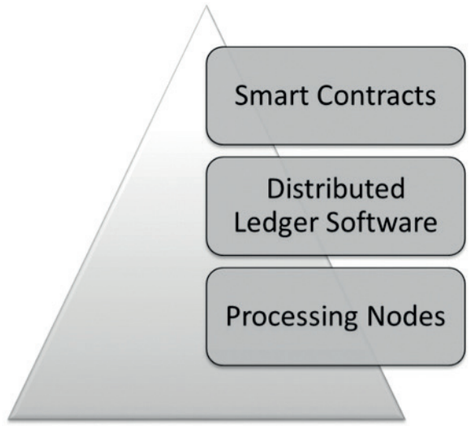


Figure 5: Key elements of distributed ledger infrastructure

Processing nodes: "Permissioned ledgers" are the most likely way forward for banks. In a "permissioned ledger" only trusted and authorized nodes will be able to receive and process the transactions. Processing nodes are nothing but large servers that provide capacity and storage required for running distributed ledger software. To provide true global infrastructure it is necessary to have standards defined around the set-up of processing nodes. Processing nodes have to be run on enterprise class data centres with specified server and storage capacity with agreed levels of availability. From a business model perspective, it should be possible to have independent vendors setup processing nodes on top of which several ledgers can be deployed. Processing nodes should be compensated transparently in mainstream currencies and not based on units of native currency.

Distributed Ledger software: This component contains the software related to ledger maintenance. Data model, APIs are dependent on the nature of the use case. We have discussed three types of distributed ledgers: value ledger; information ledger; and timestamp ledger. There is a need to agree on generic data models and APIs for each of these ledgers separately to be able to cater to the current and extendable business use cases and features. For example, a generic data model and APIs can be defined for a value ledger that can be used for payments as well as securities.

Smart Contracts: The term "smart contract" is used in the industry to represent a wide variety of things. In the context of "Bank Driven Blockchain" Distributed ledger transactions are inherently unitary i.e. assets flow from one party to other. However, financial transactions are rarely simple. Financial transactions involve multiple asset movements in an orchestrated manner within a single logical unit of work like DVP settlement, Forex Settlement, Repo transactions, bonus issues and Interest payments. Smart contracts can be seen as executable software that sits on top of a distributed ledger that can process complex financial transactions. Smart contracts process the complex transactions, convert them into unitary transactions and post them on to the distributed ledger in an orchestrated manner. While the distributed ledger software can be generic for all use cases within value, information and timestamp ledgers, smart contracts add the needed functional richness to the distributed ledger infrastructure.

Integration Requirements (APIs):

A distributed ledger is nothing but a ledger that is maintained in multiple servers. Distributed ledgers do not have any business logic, but allow the development of business functionalities around the distributed ledger. Distributed ledger software should be flexible, open and offer necessary integration options like APIs for various business applications to interface. Generic ledger structure need to support the development of multiple business applications and interoperability. We discussed three types of ledgers from a business perspective: value; information; and timestamp ledgers. Integration options (APIs) offered by these ledgers and business services that can be deployed on these ledgers are different.

Value Ledgers: These ledgers support storing and transferring of financial assets. APIs may potentially include the creation of assets, creation of accounts, transfer of assets etc.

Information Ledger: These ledgers support the information orchestration between financial institutions and possibly their customers. APIs may potentially include the creation of a record or transaction or contact, status updates, comparison of meta-data etc.

Timestamp Ledgers: These ledgers are used to

record the occurrence of an event/document/ contract along with the source and timestamp. APIs may potentially include registering a timestamp event by source and validation of timestamp events by general consumers.

These ledgers should be open, interoperable and be built on standards so as to ensure industry cooperation and the non-proliferation of ledgers.

Reference Data Requirements:

Reference data is a key component of any industry solution. Reference data setup and access needs to be addressed in the context of a distributed ledger for a productive deployment. The following key identities need to be maintained within the reference data.

Asset identification: This is used to uniquely recognise the asset that is being stored or transferred. In our opinion it is best to use industry standard identifications like ISO currency code or ISIN to store the asset identification. As industry participants currently source and maintain the data association between the asset ID and asset attributes, it is not necessary to store all the asset attributes within the value ledger.

Party / Account Identification: Party / account identification on a distributed ledger is critical for industry participants to instruct the distributed ledger. Currently, party identification is done using existing industry standard code e.g. BIC code or LEI, however in distributed ledgers primary party/ account identification is done using public keys. It is therefore necessary to have the mapping of party/account identification as it is practiced today and the public key to be able to instruct and process transactions correctly.

Mapping can occur under the following mechanisms.

In mapping outside the ledger it will be necessary for each participant to maintain the mapping between their counter party information and their public keys in the distributed ledger.

Alternatively, distributed ledgers can support alternate identification apart from the public key. It should be possible to instruct and query using such an alternate identification. This approach however is not suitable in certain use cases where information privacy is of utmost importance.

Issuer Identification: Issuers may not have a standard identification mechanism across the globe given the various assets on the ledger. This may lead to proprietary identification for Issuers. However, Issuers need to be on-boarded on the distributed ledger and need to be given the authorization to issue specific assets only after the necessary due diligence and regulatory compliance. Participants in a distributed ledger need to be aware of the real world identity behind the issuer of assets.

User identification: Distributed ledger are based on digital signatures. Identification of individual users and their authentication will have to happen within the business applications before the transaction is posted to the distributed ledger with the necessary signatures. Identification within the distributed legers will always be via the public key. Also alternate identification to access the accounts will be with industry standard names, as a result it will not be necessary to maintain user identification within the ledger.

Pre-requisites for industrialisation:

The distributed ledger discussion has definitely moved beyond use cases and Proof-of-Concepts (POC) in financial services. Many banks have experimented with the technology and a number have tried proof-of-concepts in payments, trade finance and securities settlement.

But what next? Production deployment of distributed ledger technology in mainstream banking seems still far away.

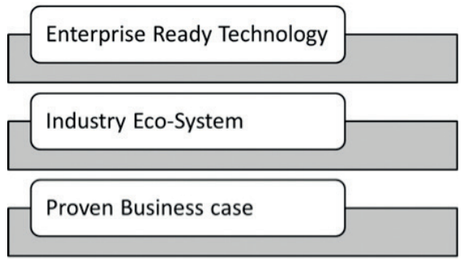


Figure 6: Pre-requisites for industrialisation of distributed ledger solutions

We have identified the following prerequisites for mainstream implementation

Enterprise Ready Technology: There is currently no commercially available proven technology platform tested for enterprise class volume, security, reliability and regulations yet. This is one of the key factors holding back the productive implementation of the use cases. To date for conducting POCs, banks have used available open source or vendor technologies. Several compromises or assumptions can be made at POC stage but these cannot be carried on to production systems.

Market ecosystem: The use cases that appear to have significant positive impact on the industry (like global payments, trade finance, securities settlement etc.) involve participation from multiple market players. Successful deployment of these solutions requires bringing together these different players and agreeing on the communication and data standards. This is quite challenging as one can see from the typical timelines to implement new standards in the industry like ISO20022. Some of the early distributed ledger solutions launched will be effective only when there is a large scale industry participation. Banks are doing their bit for competitive co-operation by forming alliances, joint workgroups and investments in start-ups. But a clear idea on how an industry solution based on distributed ledger will evolve is yet to emerge. Adding to the complexity, distributed ledger capability to disintermediate some industry players, will increase friction among them as the technology gets closer to implementation.

Business Case: The superiority of the distributed ledger in processing complex hierarchical transactions has been demonstrated on paper. But the real cost of establishing the technology, migration of data and services to new platforms, cost of changes to core systems, user training, operational process changes, ongoing system maintenance have not been clearly estimated and compared with baseline costs. Logically, this area should gather focus once there is more clarity on technology and ecosystem related issues. There is no shortcut for the mainstream implementation of distributed ledger technology with the above mentioned challenges needing to be addressed in order for it to become a reality.

Roadmap/journey for a bank

It is unlikely that large scale implementation of distributed ledger is going to happen in the short term due to the reasons identified. After understanding the technology potential and experimenting with few use cases, what is the journey and roadmap to industrialisation?

Banks as well as industry consortiums can explore the following options to move from POC stage to enterprise deployment.

Learn from early experiences: A number of initial solutions from start-ups and mainstream firms are currently in the pre-production stage and are expected to go live in near future. It is apparent that these are not the only and final solutions using distributed ledgers. It is important to learn from these initiatives the business and technology considerations discussed in this paper.

Explore market specific opportunities: It is easier for banks and financial services to launch a service within a particular country instead of looking for global solutions. Consortium of top major banks in a country can come together to improve the payment or security infrastructure possibly for an asset class not currently fully automated. Such initiatives can be taken up together with the involvement of regulators and market infrastructure firms. Country specific technology modernization programs for infrastructure are a perfect opportunity to implement distributed ledger technology. For example, modernization of the equity settlement platform in Australia.

Explore Intra group transactions: Large banking and financial services firms that have multiple subsidiaries across the globe can look at the distributed ledger as a mechanism to transfer tokenized assets between the group companies in near real time.

Continue Industry Collaboration for global standards and interoperability: Banks and financial services firms need to continue to collaborate not only within the geography but across the globe to ensure that implementation of distributed ledgers do not lead to new inefficiencies. Regulators, experienced market intermediaries and infrastructure firms have a key role to play in this and coordinate the efforts across the industry.

Target high impact use cases: Collaborate on high impact use cases that have the potential to prove the benefits of distributed ledger technology without disrupting the current processing. For example developing a trusted corporate action information hub, using distributed ledger.
The journey to a distributed ledger in the future is certain but the industry will need to start with a clear identification of use case(s) that does not require the entire market to participate. Once an appropriate use case has been agreed development of a clear business and architecture vision for delivery will provide the roadmap. Organisations will then need to define their partner(s) and think about the interactive ecosystem that they will need to build.

Conclusion

Distributed ledger based industry solutions will move into production within financial services in the next 12-18 months. Initial implementations will be small and adaptation is expected to increase over time. However, the final word is not yet out on whether distributed ledgers will be able to disrupt major parts of the financial services world rapidly and whether existing high volume applications can be migrated to distributed ledger platforms through transformational programs. A lot depends on the experiences from initial implementations being rolled out by mainstream financial services.

Banks and financial services will be keenly watching the business aspects of the early implementations e.g. potential benefits, cost of operation, usability, regulatory compliance etc. as well as technology considerations like scalability, security, performance. The comparison between early implementation of distributed ledger solutions with the existing traditional systems is unavoidable. Distributed ledger solutions need to demonstrate a step change in the business and technical parameters to be able to justify huge investments for transformation programs. Banks also will be keenly watching "Blockchain driven banking" initiatives by technology start-ups for any signs of loss of market share and also determine what the regulatory response to their adaptation will be.

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If you would like to find out any more information about techUK's work in Distributed Ledger Technology, please contact:

Ruth Milligan, Head of Financial Services and Payments
ruth.milligan@techuk.org

James Lee, Programme Manager, Financial Services and Payments
james.lee@techuk.org

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Contact

Kerry Chapman
Regional Director - Industry Marketing UK & Europe
Tata Consultancy Services
kerry.chapman@tcs.com

Rodger Oates, Consulting Partner, Banking and Financial Services
Tata Consultancy Services
r.oates@tcs.com