Why DLT & FMI integration remains stilted

Abstract

Distributed ledger technology (DLT) has been revered as a solution to all the problems that can be found in practically every industry. But over a decade since its creation and enormous effort from large organizations, DLT has yet to prove itself in real-world applications due to several technical challenges, predominantly scale and interoperability across different networks.

The problem is self-evident. Siloed approaches to DLT testing remove the very point of disintermediation. In essence, if a network is reliant on a single blockchain, then it is fairly arguable that the use of the technology is not necessary. Meanwhile, multiple networks are causing complexities in being able to work with other blockchains.

It is of course only reasonable that different financial institutions will aim to test and adopt different blockchains. Whether public or private networks, the industry is moving towards a multi-chain infrastructure.

This report argues that industry participants can begin to showcase the benefits of digital assets and distributed networks should there be a refocus of effort of large-scale ambitions. What can be utilized today with great effect has proven to be the issuance of digital assets, transactions, settlement and custody.

These have been the primary components that have started every blockchain, and with the correct architecture can address many bottlenecks and risks seen in today's Financial Market Infrastructure (FMI).

Trustless ≠ Certainty

Blockchains and DLT have introduced the concept of systems being 'Trustless'. In the simplest of terms, this relies on the notion that parties can interact amongst one another without having to trust the other for a transaction to take place and settle, and has no reliance on a single party for execution.

This breakthrough concept underpins the very core of decentralized technology allowing for peer-to-peer execution that relies on immutable ledgers and smart contracts.

As networks grow, the amount of trust required dissipates further as there are more participants who are economically incentivized to keep all records in order.

But what happens when large network participants decide that it's economically favorable for them to make a change (or not make what is perceived to be a needed change) that would be a negative for others in the network?

When entities are embedded within a Blockchain or DLT network, participants have to accept the fact that parameters can quickly change within an ecosystem where resiliency of a network is closely tethered to how governance of such chains are setup.

On public chains, the mechanism to retain the status quo structure is by retaining the position on the original chain when new paradigms lead to what is known as a "fork".

As such, the reality is that Trustless networks require redundancy plans that would allow participants to continue their business as usual, and accept a degree of disruption in the process.

A very novel point has been made that blockchains are more about confidence rather than trust (De Fillipe et al, 2020). This may be a nuanced linguistic point, but it does warrant attention as global finance looks to establish reliance on distributed networks.

Public blockchains have given us a glimpse of potential shifts that lead to forks be it for technological purposes, or potentially, political. This is where confidence overrides trust.

The most notable forks have come from Bitcoin in 2017 after a community split on the block size that lead to Bitcoin Cash. Ethereum also had to fork after the DAO hack.

However, one of the more interesting and potentially devastating scenarios came after an exchange hack that led to a proposal of reorganizing the Bitcoin blockchain. While this was quickly dismissed, for many reasons, it could have been within the realm of possibilities had the economic incentives been aligned only to shatter the very notion of immutability.

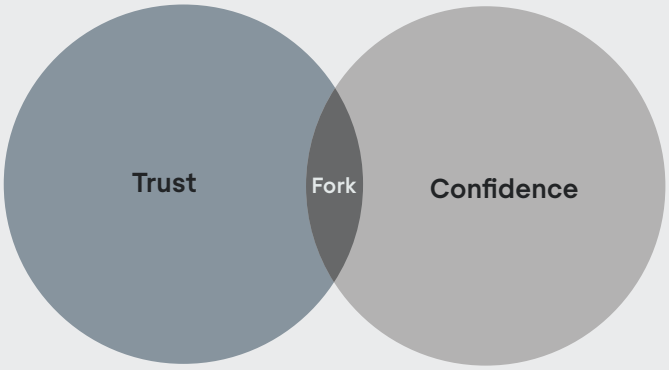
Most recently, Ethereum which moved its consensus mechanism to Proof-of-Stake, saw markets account for a possible failure had 'The Merge' been unsuccessful. Beyond exchanges spinning up new derivative markets for the original Proof-of-Work chain, it was Ethereum's Vitalik Buterin that said he felt "more confident about the merge" as the protocol moved into the stages of testing in 2021. Confidence though means that there was room for error.

At face value, the concept of 'Trustless' is true. Mathematical algorithms and economic incentives align so that networks function as intended and increase the cost of any attack on a blockchain network. However, there are many considerations that need to be accounted for that shift the dynamic, if even slightly.

There must be some level of confidence, for example, that the developers are doing their jobs correctly and the network continues to function as intended during development and upgrades. There must be some level of confidence that validators of a network do not collude together against the interest of one or more parties. There must be a level of confidence that the wallets developed, the user interface that custody's assets, does not have a bug.

This inevitably means that blockchains are not fully 'Trustless' but in fact more about confidence in the network's resilience. This is reverted back to 'Trust' by participants should the network ecosystem have the mechanics to realign against malfunctions or bad actors.

The concept of trust and confidence go well beyond just blockchains. Even hard cash has similar traits in this regard. There must be confidence that monetary policy makers will do their utmost in good faith to retain the currency's purchasing power. We must also have the confidence in ourselves that we don't lose the cash when under our custody.



Trust: Duress if without contingencies

The point made on confidence is a key parameter to establishing sound governance structures that would give participants a contingency plan in the form of a fork.

While some points of distrust can be addressed within the architecture of DLT networks, governance frameworks can only be established to pressure points that could come internally, such as other participants. However, it will be much more difficult to establish sound governance frameworks based on external factors, such as new regulatory directives and geopolitics.

Key DLT Network Governance considerations

Economic	Allocation of incentives
	Cost incurred
Technological	Interoperability and scalbility
	Compatibility of smart contracts
	Implemented consensus algorithms
Political	Regulatory accountability
	Undistributed control structures
	Absense of main control
Social	Specifying decision rights
	Openness issue

This means that not only aligning incentives across multiple and diverse participants in any blockchain system is going to be a challenging feat as members will have different requirements, but any lack of ability to address future deviations will hinder network attractiveness (and hence, growth).

'Trustless' systems then need contingency plans should participants wish to avoid being imprisoned into a non-compliant and inefficient network that would no longer serve their purposes.

And with no particular standards in place for governance, uncertainty will remain within DLT networks (Beck et al, 2018).

There are plenty of parameters that need consideration with participating organizations having to all be in line with the technological, economic, political and social rulesets (Bokolo, 2022, see table above).

With governance designs still being under heavy research, the potential for outfits to opt into building their own blockchains or DLT networks isn't implausible. The potential for many networks as of today is then high due to such uncertainty as organizations will aim to retain flexibility. But with this comes the problems of scale and interoperability, the technological capacity of which remains low and high-risk.

This added complexity has left many researchers questioning the very use of DLT in Financial Market Infrastructure (FMI).

Yet a competitive landscape is a net ecosystem positive as it serves to better develop strong and sustainable networks. One chain is unlikely to simply be the outright winner, because, as previously mentioned, it would defeat the purpose of disintermediation and result in a 'vender lock-in' scenario.

Which begs an important question: what can be achieved to address FMI risks and bottlenecks that have stifled the progress of DLT networks with its current capacity and governance state?

DLT: Endless possibilities, odd approach

It's very easy to get caught up in what is possible with Blockchain. Everything can be programmed. Although valid, this approach, attempting to solve for everything, only leads to more of the same problems the industry is attempting to solve.

First and foremost, it is imperative to understand what have become the most established concepts with Blockchains utilized today that can serve as the starting point for any integration of FMI, before moving onto more complex financial services dynamics.

Whilst the technology and development behind blockchains are extremely complex, the end results have solved for the issuance of representations of value (be it a token, certificate or otherwise), the ability to transact with no counterparties, settlement finality within minutes, if not seconds, and the ability to custody and take ownership of assets.

These aspects of issuance, settlement and custody are extremely well established and have the potential to add a great deal of value within FMI today.

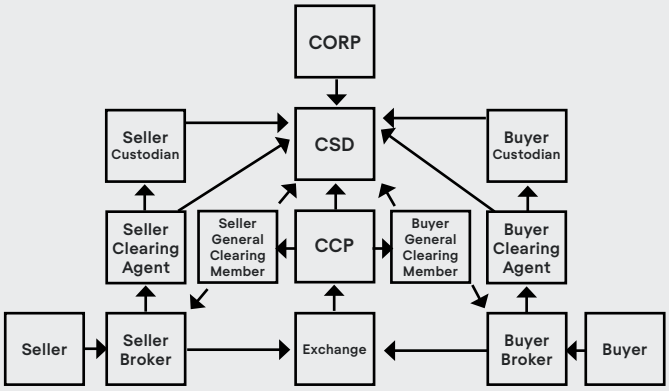
Secondly, part of the reason for the slow progress is the attempt to implement complex data platforms that aim to solve complex issues with what is ultimately, at its very core, a shared and validated accounting record for transactions and ownership.

The basic shared and validated ledger is one of the largest benefits of using a blockchain and seems to be taken for granted. With a clean accounting record of transactions that is integrated with financial markets, industry participants will have increased transparency on how healthy the financial system is and how exposed Systemically Important Financial Institutions (SIFI) are in relation to market participants who take on perhaps more risk than thresholds would really allow for.

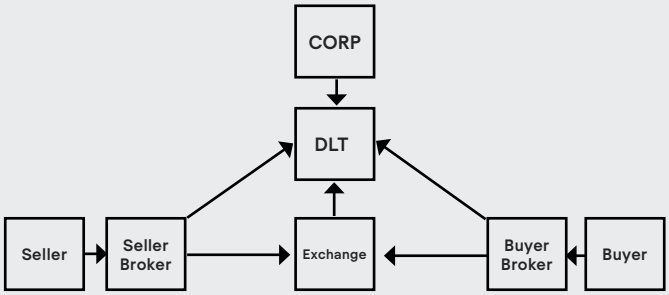
While the current financial market infrastructure still relies on T+2 settlement, digital assets are settled almost immediately. This removes a great deal of counterparty risk on the structural level and alleviates the need for multiple institutions that slow down the settlement and ownership process that include but are not limited to Central Securities Depository (CSD), Central Counterparty Clearing (CCP), Custodians, and Sub-custodians (Feenan et al, 2020).

The removal of such entities is possible with DLT. The problem, however, is that DLT industry participants are aiming to establish complex systems without the need for such organizations from the very start. Such an effort seems a tad unrealistic.

1: Securities clearing and settlement (Feenan et al, 2020)



2: DLT replacement for several entities



DLT network providers are attempting to solve extremely large problems from governance, scale, interoperability, asset servicing, custody, settlement finality, systemic monitoring, identity, KYC, AML - the list goes on and is no small matter by any means.

While this is certainly a good thing from the prospect of development of underlying infrastructure that aims to provide benefits to all network participants, the scope, time and lack of regulatory clarity will take years if not decades to establish on a global scale should the defacto approach be to replace current technology in a single swoop.

Integration first, replacement later

There are aspects of Blockchains and DLT networks, as previously noted, that can be utilized today. It's arguable that development of DLT networks has taken on an agenda to completely replace the use of current technology, rather than looking at possible avenues with an integration approach in mind.

With a focus on issuance, settlement and custody using DLT, and current technology servicing other aspects of financial services, scale and interoperability can be achieved. This would set up the cornerstones for the evolution of FMI. In turn, time would be granted for future developments to be integrated with clarity.

Pause for the cause

With a level-headed understanding of what is actually possible, and what benefits we can derive from the use of DLT in financial services today, industry participants and regulators will be able to build out an evolutionary road map for core functions.

The first problem to solve is interoperability. On a blockchain level, this is extremely complex and public networks have proven this to be dangerous by deploying the use of what is known as cross-chain swaps. Although a great deal of progress has been made in this regard, the use bridging technology has yet to be thoroughly tested at scale.

However, as this report discussed, multiple blockchains are a net good for ecosystems to grow as they decrease the single-points-of-trust across financial infrastructure networks. What is the solution?

As of today, custodians are the final point of settlement as this is the intrinsic design of digital assets that move across networks.

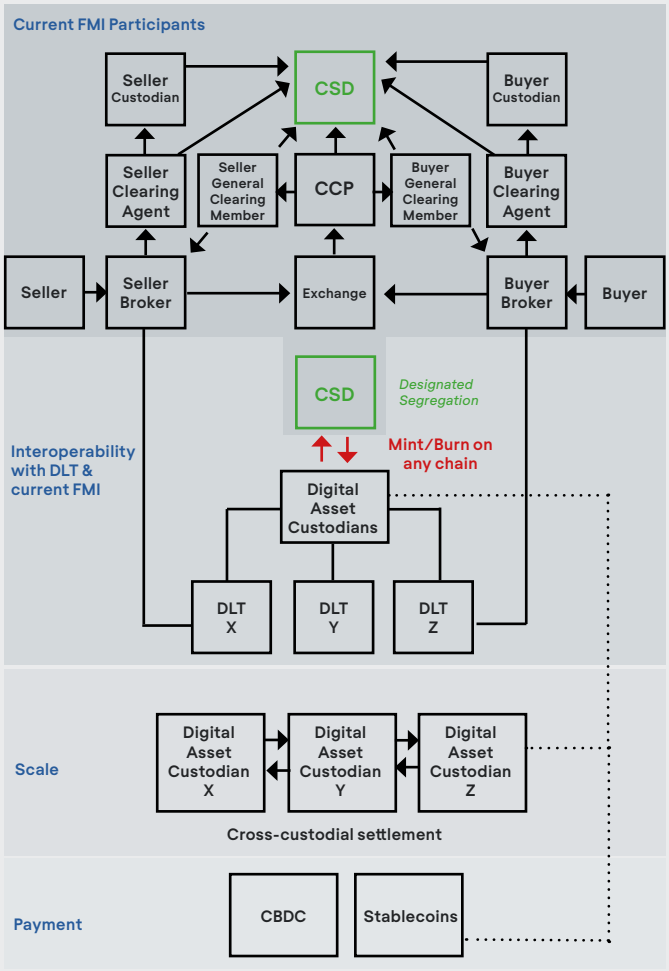
As such, with the custody of assets also meaning settlement finality, the starting point of any digital FMI will be at the custodial level. Cross-custodial settlement in digital assets is likely to be the most powerful tool that can be used to uplift development and integration of FMI without having to wait for breakthrough technology.

The simple reason behind this assertion is that digital asset custody providers are the only market participants who are tech neutral AND are economically incentivized to support as many blockchains and DLT networks as possible.

This means that as far as issuance/minting of assets, custody and settlement, industry participants already have the appropriate tools for financial markets to take advantage of, that can be interoperable, increase scale capacity and integrate access into current FMI (see diagram).

Market participants from both ends of the spectrum – digital assets and traditional finance – may find it a simpler task to tackle primary markets first and foremost. However, the key consideration and hurdle here is that liquidity and price discovery will be throttled and may not work as intended due to a closed environment.

This approach also doesn't highlight the benefits of integrating DLT into FMI as it would continue down a siloed path and would hinder the fast, safe and cost-efficient clearing and settlement arrangements that comes from using tokenized assets.



One approach that industry participants may opt to take is to accept the limitations of blockchains by focusing on issuance, clearing, settlement, custody and transparency before tackling the immense demands needed to have fully-fledged DLT-only FMI.

In conjunction with integrating into current financial infrastructure based on the technology used today, plugging into the ecosystem of global markets would be a much more focused path that would highlight the established benefits of digital assets by removing great deal of counterparty risk and increasing transparency. It also means tokenized assets aren't bound to any DLT network and flows can freely move between blockchains, FMI and digital FMI.

Although the above diagram shows a reliance on CSDs, the growth and use of tokenized assets would likely diminish their role in time as suggested by many DLT participants. A direct link between exchanges and custodians would remove this requirement in the future and perhaps why major stock exchanges have made a push into digital asset custodial services.

Integration of DLT and FMI is going to be a process and working under the assumption that one day all of FMI will simply press the switch into DLT infrastructure is an unrealistic notion.

Current FMI: Who owns what, exactly?

Prudential regulations and standards have had to adapt to plenty of unforeseen circumstances to protect investors and mitigate systemic risks.

While the US Securities and Exchange Commission (SEC) Custody Rule has planted emphasis on advisor requirements to segregate client accounts with 'Qualified custodians', little attention has been given to the actual custody chain (i.e. what are these qualified custodians actually holding on behalf of investors?).

The typical custody lifecycle for securities involves the client, several brokers, an exchange, a central counterparty (CCP), International CSD (ICSD), sub-custodians, global custodians, bank correspondence, and central banks.

The result is ultimately a large extension of assets being held with different entities that not only incur costs at every transaction point, but also increases the level of counterparty risks in the event of insolvency, fraudulent misappropriation and erroneous delivery due to opaque operational standards (see table above).

Due to this custody chain, a short fall scenario with any entity within the custody chain reduces the equitable and legal rights of investors.

Perhaps, this is why the first highlighted risk by the International Securities Services Association (ISSA) is in fact "How assets are held" (See table below).

The longer the chain, the higher the risk (Michler, 2014)

Before	Today	Soon..
Investor	Investor	Investor
Issuer	Custodian 1	Private Keys
	Custodian 2	Issuer
	Custodian 3	
	CSD Issuer	

Tokenized assets change the custody chain paradigm completely and return ownership of assets (and legal rights) back into the hands of investors.

Of course, digital assets bring in other considerations. With the transfer of assets into other entities, from a custodian to an exchange for example, private keys are now held with the latter. By default, then they are outside of custody – qualified or otherwise.

With landmark legislation coming out of the EU with the Markets in Crypto Assets regulations (MiCA), Crypto Asset Service Providers (CASP) will be able to lay the correct foundations that will ultimately highlight the key benefits and risk mitigation that could come from financial markets using tokenized assets.

With the correct architecture, the digital asset industry can begin to integrate into FMI and actually prove what has been so far, for the most part, academic and theoretical.

When push comes to shove, the onus will be on digital asset service providers to prove the advantages of tokenized assets regardless of today's blockchain and DLT network limitations.

Top 5 Risks of the global custody chain according to ISSA

How assets are held	Different accounts structures for on-andoff book and on-and-off balance sheet holdings of cash, and the holding of securities in omnibus, nominee and segregated accounts
Asset safety and protection	There are a range of threats (fraud, insolvency, operational error, embargos, regulation, legal, political, counterparty, title transfer and market) to asset safety at every stage of the custody chain
Client on-boarding	Requires a complex set of due diligence checks that custodians and their clients must complete at the start of their business relationship to ensure legal and regulatory compliance
Service-related risks	Failure to capture trade details, match or settle trades, notify or execute corporate actions, etc, due to operational mishaps or shortcomings
Credit risks	Potential for loss when advancing intra-day or overnight credit to clients for fund settlements
Liquidity risks	Potential for loss when clients are not able to deliver the cash or securities required to settle their obligations at a CSD, central bank or sub-custodian bank
Information security risks	Potential loss of confidential information belonging to clients whether it is lost storage or transit, misplaced by employees, stolen from bank systems by intruders or lost to a cyber-attack
Information technology risks	Failure to document system upgrades, maintain up-to-date inventories of technologies, test additions to existing systems, etc, can lead to market, reputational and litigation issues
Vendor and outsourcing risk	Reliance on third parties, such as correspondent banks, providers of transaction processing services, vendors to which custodians have outsourced activities and the potential lack of clear documentation, governance and SLAs
Regulatory risk and compliance risk	Failure to keep up with changes in law and regulation in the jurisdictions where they operate, leading to penalties, fines and sanctions, licence withdrawals and reputational damage

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